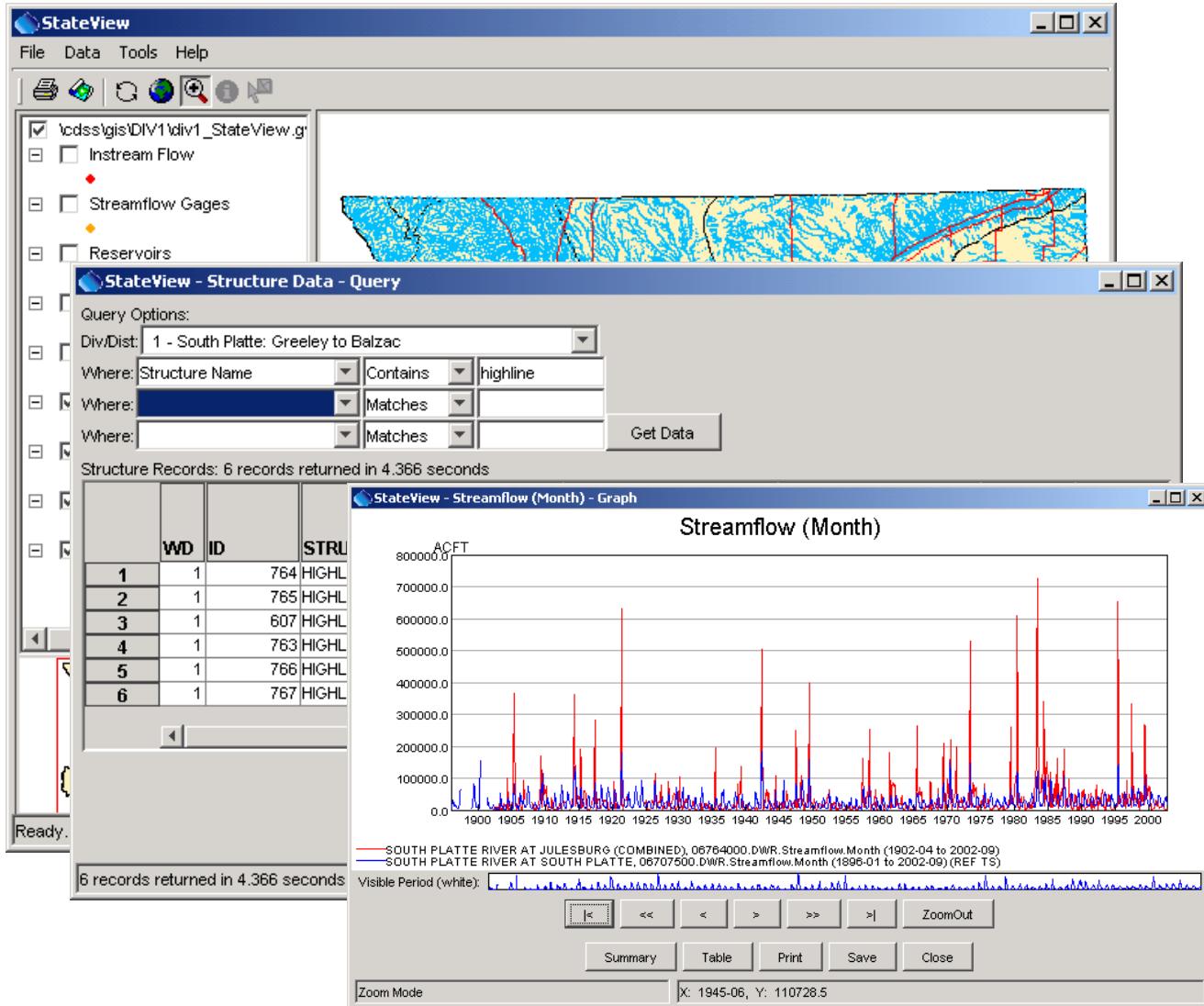


Colorado's Decision Support Systems

Colorado Water Rights Administration Tool (CWRAT)



Colorado Department of Natural Resources
Colorado Water Conservation Board
Division of Water Resources

Developed by:
 RIVERSIDE
global science solutions

Version 04.02.02, 2013-04-16

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This document is formatted for double-sided printing.

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DISCLAIMER for CDSS Products

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CDSS products and associated access are under development at this time. Access is provided solely to test and demonstrate CDSS capabilities. In the future, this access may be restricted or offered for a fee. The State assumes no legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed herein. It is the user's responsibility to determine the fitness of the data for a particular purpose.

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1 Acknowledgements

2011-07-15

StateView/CWRAT has been developed by Riverside Technology, inc. (Riverside). Initial CWRAT development work was funded by the State of Colorado, Water Conservation Board, under the Colorado River Decision Support System (CRDSS). Later StateView and CWRAT development occurred as part of CRDSS maintenance, the State of Colorado's Rio Grande Decision Support System (RGDSS), and South Platte Decision Support System (SPDSS), under the umbrella CDSS effort (Colorado's Decision Support Systems).

Users are encouraged to provide general feedback using the email address: cdss@state.co.us. The CDSS web site is <http://cdss.state.co.us>

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2 Introduction

Version 4.02.00, 2011-07-15

StateView and the Colorado Water Rights Administration Tool (CWRAT) are interactive data-viewing tools for the State of Colorado's HydroBase database. Both tools offer the same data viewing features; however, CWRAT additionally provides water administration tools, for use by State of Colorado water commissioners and others who play a role in daily water delivery. CWRAT differs in functionality from StateView only in that CWRAT provides an **Administration** menu.

Because most of the features of StateView and CWRAT are the same, much of the documentation for the two programs is shared. Where documentation is shared, the software is referred to as StateView/CWRAT. As much as possible, discussion of CWRAT-specific features is confined to **Chapter 5 – Administration Tools**.

StateView/CWRAT include the following useful features:

- Displays for real-time data from the State of Colorado's Satellite Monitoring System
- Displays for administrative data including water rights, structure information, and call chronology
- Displays for historical data including flow and diversion time series
- Tools to create, edit, and use WIS (water information sheets) to perform water accounting within a water district (CWRAT only)

The following chapters are available in this document:

Chapter 2 - Introduction provides background information about StateView, HydroBase, and other CDSS tools.

Chapter 3 – Getting Started provides an overview of the StateView/CWRAT interface features.

Chapter 4 – Viewing Data provides information about the primary data viewing features.

Chapter 5 – Administration Tools provides information about the administration features.

Chapter 6 – Tools Menu provides information about additional tools for data analysis and viewing.

Chapter 7 – Help Menu provides information about displaying StateView/CWRAT version information and viewing on-line documentation.

Chapter 8 - Examples of Use provides examples of how StateView/CWRAT is commonly used, including use of the map interface.

Chapter 9 - Troubleshooting provides information to resolve run-time problems.

The **Installation and Configuration Appendix** provides information about installing and configuring StateView/CWRAT.

The **Query Guidelines Appendix** provides information about using the query by example HydroBase views.

The **TSView Time Series Viewing Tools Appendix** provides a general reference for time series viewing features. These features are used throughout StateView/CWRAT.

The **GeoView Mapping Tools Appendix** provides a general reference for the GeoView map interface.

See also the self-paced training materials, which can be accessed using the **Help...View Training Materials** menu and are located in the *doc\Training* folder under the software installation.

2.1 The HydroBase Database

The State of Colorado's HydroBase database contains extensive data that are important for the management of water within Colorado, including:

- Station data and related time series, including climate and streamflow data
- Structure data, including headgates, reservoirs, well, and dams
- Diversion, well, and reservoir time series data
- Instream flow locations
- Irrigated lands, corresponding to spatial data layers that are also available in CDSS
- Water rights and well permits
- Administrative and real-time streamflow data used by State of Colorado staff
- Data to support models

StateView's primary purpose is to provide display features for HydroBase data, allowing users to query, view, export, and print data.

HydroBase, spatial data, and StateView can be obtained from the State of Colorado on a DVD and can be installed on a single computer or network. Spatial data layers enhance the query and display capabilities of StateView/CWRAT and if installed from the DVD will be available in the C:\CDSS\GIS folder. The data layers also are available from the CDSS website (<http://cdss.state.co.us>).

Whereas previously it may have been necessary to receive water-related data on diskette or review printed data records, most data can now be retrieved from HydroBase, using StateView. Because data are updated over time, HydroBase is updated one or more times per year. Data products (e.g., reports and graphs) will also change over time – a water rights tabulation report printed in 1997 is appropriate for a study done at that time; however, the report if printed today would be slightly different, reflecting new water rights and corrections to data in the database. To help account for changes over time, HydroBase is distributed with a date stamp. When comparing HydroBase contents and StateView/CWRAT output, it is important to take into consideration the database version.

Although efforts have been made to present data in understandable terms, some terminology is inherently technical and has historic basis. Refer to the **State of Colorado's Water Commissioner Manual**, HydroBase documentation, and other information for background information. Where appropriate, explanations are provided in this document. Many displays also contain “tool tips”, which will display helpful information when the mouse is stationary over a component.

2.2 Using StateView/CWRAT with other CDSS Tools

StateView/CWRAT serves well as a general data-viewing tool and may therefore be the only CDSS tool that some users will ever need. It is designed for:

- HydroBase queries (i.e., finding data based on criteria)
- Selective viewing of data in tabular and detail views
- Export of data for other tools

However, StateView/CWRAT is not well suited for batch processing and analysis of data or preparing data for models such as the State of Colorado's consumptive use model (StateCU) or basin planning model (StateMod). StateView/CWRAT can support these efforts by helping users find specific information; however, other tools such as TSTool and StateDMI should be used to prepare data for models. In many cases, users will start with StateView/CWRAT to gain an understanding of the data in a basin and will then transition to other tools for modeling.

Additionally, the State of Colorado's Division of Water Resources (DWR) has developed a number of online data applications that are available at the CDSS website: <http://cdss.state.co.us>.

To facilitate the exchange of information between tools, a number of standards have been adopted in StateView/CWRAT:

- The general menu organization and software features are similar to other CDSS tools.
- The mapping tools and data formats used in StateView/CWRAT are the same as those used in other CDSS tools. Mapping tools are described in the **GeoView Mapping Tools Appendix**.
- The graphing tools and data formats used in StateView/CWRAT are the same as those used in other CDSS tools. Graphing tools are described in the **TSView Time Series Viewing Tools Appendix**.
- Tabular data display tools and formats used in StateView/CWRAT are the same as those used in other CDSS tools. Display tools are described further in **Chapter 3 – Getting Started**.
- The nomenclature specific to the State of Colorado's data has been implemented consistently, as much as possible, in various CDSS tools.

Consequently, it is possible to start using CDSS with only StateView/CWRAT and then transition to other tools.

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3 Getting Started

Version 4.02.00, 2011-07-15

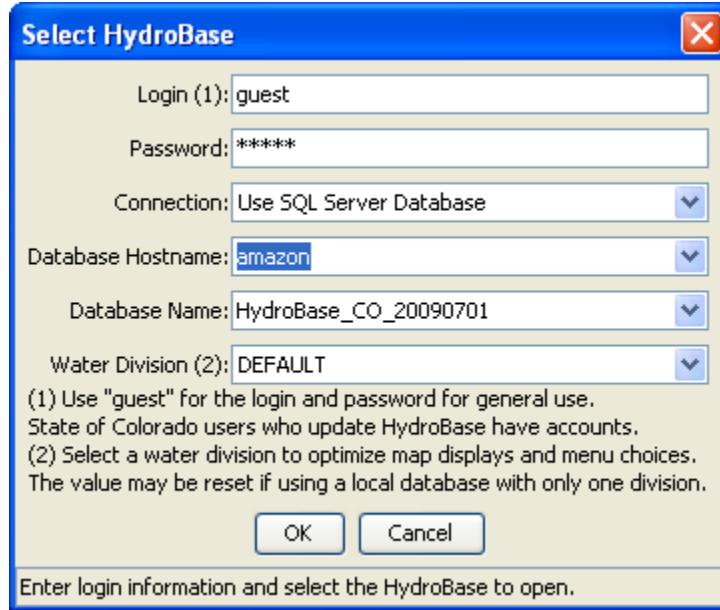
This chapter provides an overview of the StateView/CWRAT graphical user interface (GUI). The main interface components are described below, with specific chapters devoted to the main features.

3.1 Starting StateView/CWRAT

StateView/CWRAT can be started using the **Start...Programs...CDSS...StateView-Version** and **Start...Programs...CDSS...CWRAT-Version** menus. Newer systems may use the **Start...All Programs...CDSS...** menus. Software updates install in a separate versioned location so that old and new versions can be run independently.

3.2 Select HydroBase Dialog

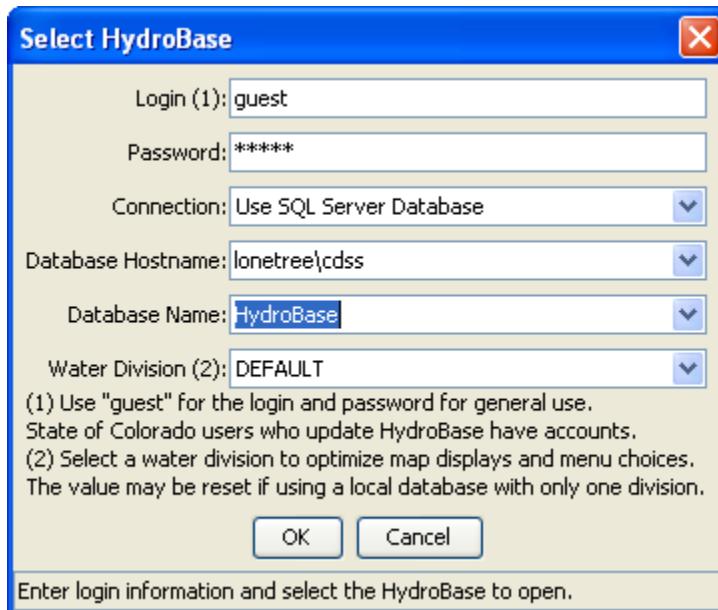
At startup you are requested to select a HydroBase database. A HydroBase database can also be selected from the **File...Open...** menu. The dialog shown in the following figure will be displayed (in this case illustrating the use of HydroBase running on a local desktop computer):



Select HydroBase Database Dialog for Local Computer

HydroBaseLogin_Local

The following figure illustrates the HydroBase login when a shared (remote) database server is used:



HydroBaseLogin

Select HydroBase Database Dialog for Shared Database Server

You can also cancel the login, in which case HydroBase features will be disabled. If a previous HydroBase connection has been made, then **Cancel** reverts to the previous connection.

The main items displayed in the login dialog are described below. Footnotes in the login dialog provide information about some of the data fields.

Login

The login identifies the user to the system. Many users can use the default guest login for viewing data. CWRAT **Administration** features require a valid login and password in order to edit data.

Password

The password is associated with the login and is required to edit data. The default guest login and password are suitable for most users.

Connection

The connection indicates the database that will be used for data viewing and editing. If **Use SQL Server Database** is selected, then the main Denver SQL Server database or a SQL Server Express server will be used. If **Use Access Database** is selected, then a Microsoft Access version of HydroBase will be used (Access is being phased out and is not discussed further below).

Database Hostname

The database host name choices are defaulted to available servers. If necessary, enter an alternate name or Internet address.

Database Names

A list of databases is listed for the selected **Database Hostname** (any databases that include HydroBase in the name).

Water Division

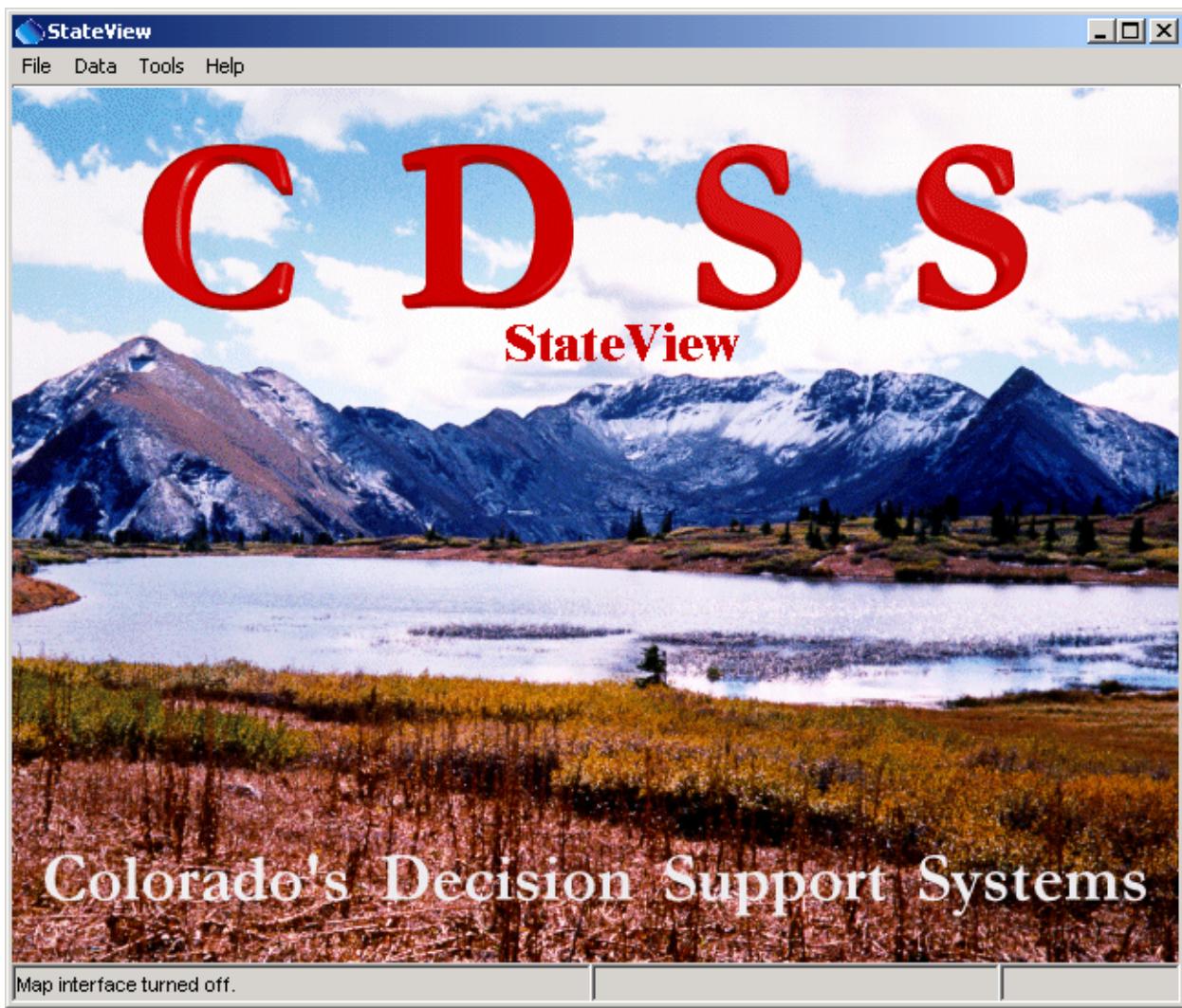
The **Water Division** choice is used to determine user preferences for the session. For example, a user who always works with Division 3 data can select DIV3. The **Tools...Options...Water District Filter** and **Tools...Options...Map** settings, when changed, will then be applied to a Division 3 login session. The settings in the SQL Server databases for State of Colorado staff may be pre-configured to typical settings. Using the DEFAULT Water Division setting will typically result in no map display and Water Division/District lists that include all divisions and districts.

3.3 Main Interface

The StateView/CWRAT application provides two main interface options:

1. **No map interface.** In this configuration, all interface features are accessed using the main menus.
2. **With map interface.** In this configuration, an interactive map is displayed that shows background layers (e.g., rivers and water districts) and data associated with other display windows (e.g., diversion locations), allowing some queries to be performed from the map interface. Spatial data to support the map interface are available from the State of Colorado and generally are installed in the *C:\CDSS\GIS* folder (this is the default location when installed from the HydroBase DVD).

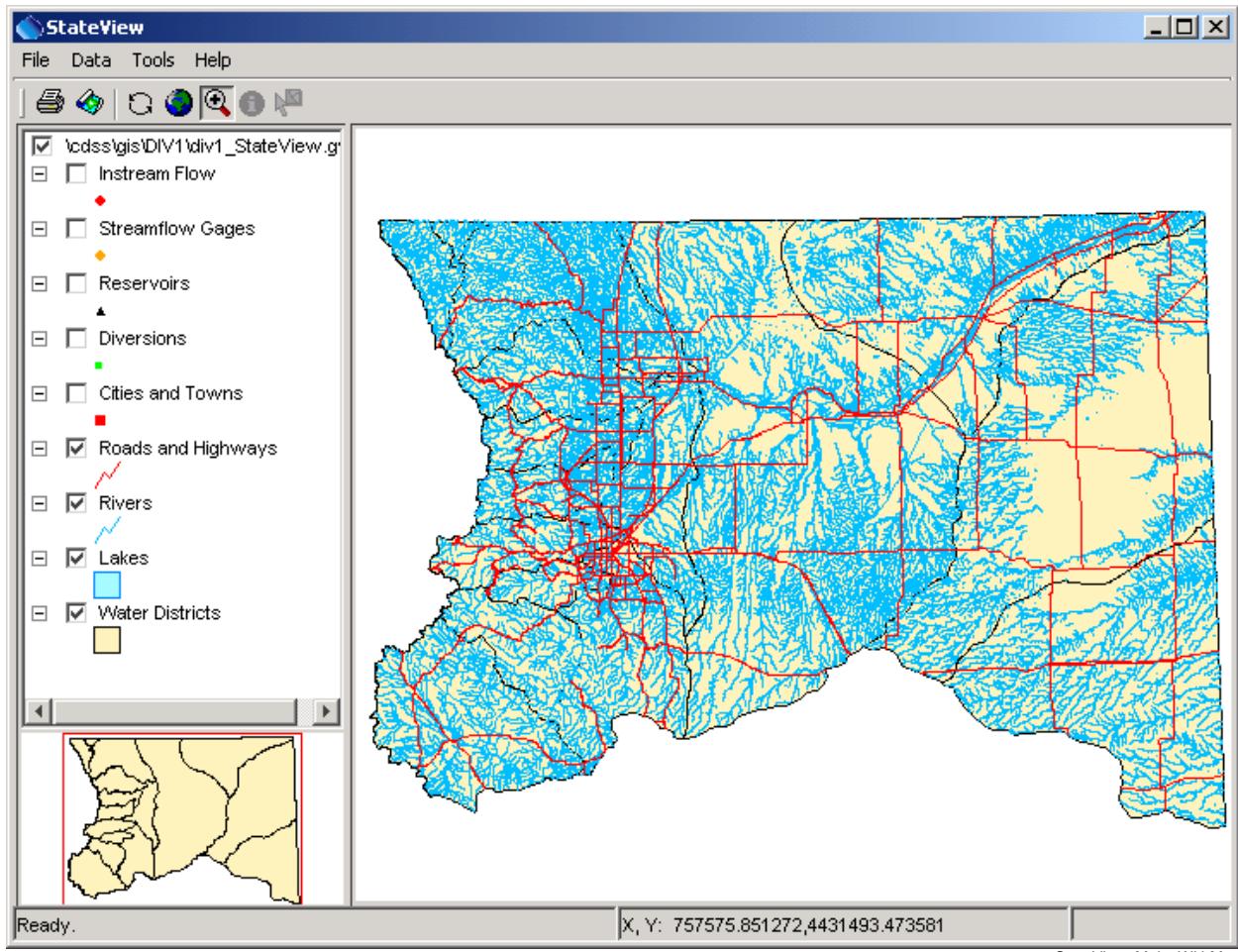
The following figure illustrates the StateView interface after startup, with no map. The interface will appear as follows until you have completed the login procedure. (Note that the CWRAT interface is the same except that it includes an **Administration** menu.)



StateView Main Interface - No Map

3.3.1 Map Interface

StateView/CWRAT will display a map interface if, for your login, the **Tools...Options...Map** settings indicate a valid GeoView project file. Supporting GIS (Geographic Information Systems) files are typically distributed with the HydroBase DVD and are made available to State of Colorado staff on a file server. The following figure illustrates the main StateView interface when a map is displayed.



StateView Main Interface - With Map

The mapping tool used by StateView/CWRAT is a general tool and is described in the **GeoView Mapping Tools Appendix**. The map interface is similar to other common map interfaces; however, it has been implemented to specifically provide features to view HydroBase data and related spatial data. The mapping tools can be used interactively (e.g., you can zoom in to an area or turn layers on and off). To streamline the specific StateView/CWRAT functionality, the following actions are taken by StateView/CWRAT:

1. The GeoView project file, which describes the layers that are initially shown in the map, identifies layers as Baselayer or specific data types (e.g., Diversion). StateView/CWRAT is then able to automatically turn layers on and off during operation. For example, if the **Data...Structures** menu item is selected, only the structure layer types (Diversion, Reservoir, Well) will be enabled on the map (indicated by the check-box in the map table of contents). This automatic enabling/disabling of layers is meant to streamline data viewing. You can turn on other layers if

necessary by enabling them in the table of contents. Automatically displaying some map layers will cause StateView/CWRAT to pause temporarily if spatial data layers are large. Loading the spatial data at startup will also temporarily slow down the software.

2. Several **Data** menu displays include **Select on Map** buttons that allow data from those displays to be selected on the map (e.g., station or diversion locations). The default behavior in this case is to zoom in to the selected structures. Again, this behavior has been implemented to help streamline data viewing.

Chapter 7 - Examples of Use provides step-by-step examples of how to use the map interface to simplify spatial queries of the database (e.g., finding diversions in an area). Additional information is discussed for each **Data** display that supports map interaction (see **Chapter 4 – Viewing Data**).

3.3.2 Time Series Viewing Tools

Many StateView/CWRAT data views allow time series data to be displayed. In most cases, regardless of how time series data are initially displayed, time series can be displayed in the following ways:

1. Graph
2. Table
3. Summary (i.e., text report)

The **TSView Time Series Viewing Tools Appendix** describes the features of the time series viewing package, which is used by several CDSS programs.

3.3.3 Tabular Lists (Worksheets)

Tabular lists are used for record-based output, such as lists of structures or water rights. Because the size of such output may be large, both vertical and horizontal scrollbars may be used. The following figure illustrates a tabular list.

Structure Records: 6247 records returned in 59.155 seconds							
	WD	ID	STRUCTURE NAME	LOCATION	WATER SOURCE	STREAM MILE	OWNER
1	1	500	HOOVER DITCH	S 5N 64W 15 NE NW	SOUTH PLATTE RIVER	147.00	HOOVER DITCH ▲
2	1	501	EMPIRE DITCH	S 5N 63W 19 SW SW SE	SOUTH PLATTE RIVER	0.00	BIJOU DITCH CO
3	1	502	HARDIN DITCH	S 5N 63W 25 NE NW SE	SOUTH PLATTE RIVER	0.00	ABANDON
4	1	503	RIVERSIDE CANAL	S 5N 63W 20 SW	SOUTH PLATTE RIVER	144.00	RIVERSIDE IRRI
5	1	504	ILLINOIS DITCH	S 5N 63W 34 NE SW NW	SOUTH PLATTE RIVER	0.00	FARR, W. D.
6	1	505	BIJOU & PUTNAM D	S	SOUTH PLATTE RIVER	0.00	NO INFORMATI
7	1	506	PUTNAM DITCH	S 4N 62W 13 NE	SOUTH PLATTE RIVER	0.00	PUTNAM DITCH
8	1	507	BIJOU CANAL	S 4N 63W 13 NE	SOUTH PLATTE RIVER	139.00	BIJOU IRRIGATI
9	1	508	RIVERSIDE RES OUT D	S 5N 63W 20 SW	SOUTH PLATTE RIVER	133.00	WOODWARD, I
10	1	509	CORONA RANCH DITCH	S 4N 62W 17 SE NW NW	SOUTH PLATTE RIVER	136.00	CORONA RANC
11	1	510	SCHULTZ DITCH	S 4N 62W 15 SE SE NW	SOUTH PLATTE RIVER	133.00	.
12	1	511	WELDON VALLEY DITCH	S 4N 61W 13 SW	SOUTH PLATTE RIVER	126.00	WELDON VALL
13	1	512	JACKSON LAKE OUT	S	SOUTH PLATTE RIVER	121.00	FT MORGAN RE
▼							

Example Tabular List

TabularList

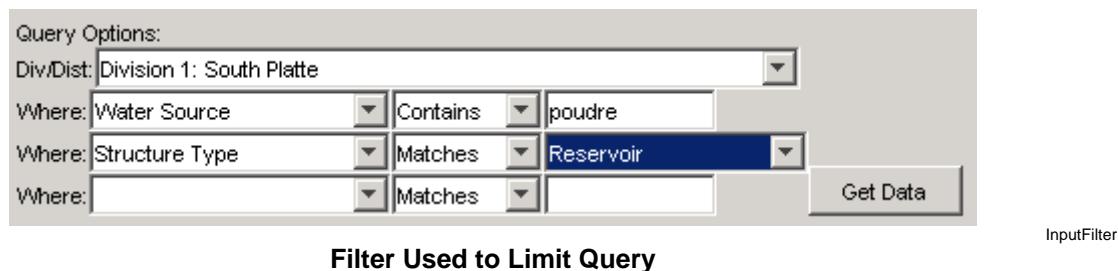
Features of tabular lists are summarized below:

- Default widths for columns are set based on the contents of the column; however, the column widths can be changed by dragging the boundary between two columns.

- The contents of a column can be sorted by right clicking on the column header and selecting **Sort Ascending**, **Sort Descending**, or **Original Order**. The sorts are performed alphabetically and numeric sorts are also performed based on alphabetic ordering of the number's digits. This limitation at times causes some columns to not sort properly because of the output format (e.g., blanks occurring at the beginning of a line).
- Long tabular lists typically are shown with a label indicating the total number of records. Most tabular lists include a column with the record number, to facilitate scrolling.
- To facilitate interaction with other software, most tabular lists allow copy and paste. To select all cells, press **Ctrl-A**. To select a single cell, use **Ctrl-left-click**. To select groups of cells, select one cell and then use **Shift-left-click**, or drag over several cells. To copy selected cells, use **Ctrl-C** or right-click on the worksheet and select **Copy** from the popup menu. The selected cells' contents can then be pasted into other applications like Microsoft Excel. Currently, copy and paste is performed using text only and the resulting copy may need to be formatted in the receiving application.

3.3.4 Filters for Queries

Many queries provide choice-based input filters, as shown in the following figure:

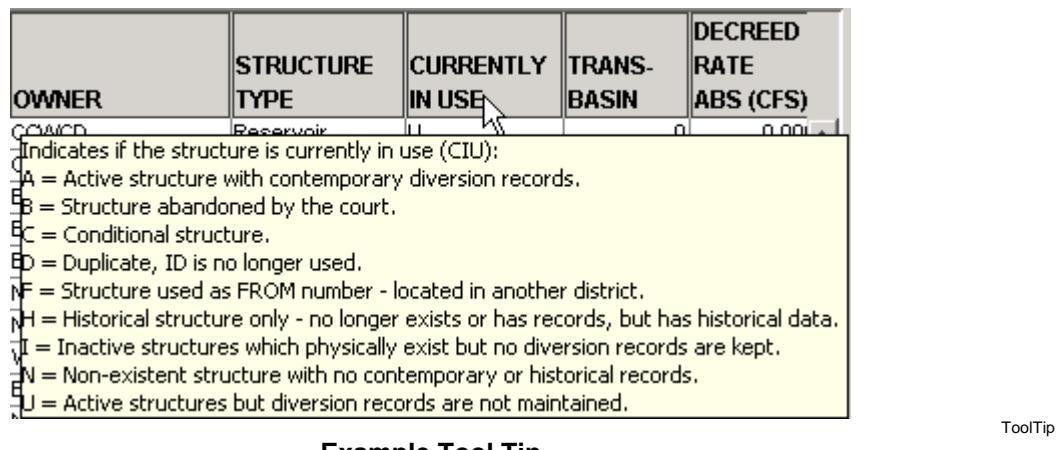


Filter Used to Limit Query

By default, all data will be returned. However, the filters can be used to restrict the query. Depending on the data being evaluated, a choice may be provided, or a value may need to be typed. If more than one filter is used, the query will be further restricted.

3.3.5 Tool Tips

In many cases, holding the mouse stationary over a graphical interface component for a few seconds will display useful information, as shown in the following example:



Example Tool Tip

3.4 File Menu – Open HydroBase, Display HydroBase Properties, Exit

The **File** menu provides standard input and output features as described below.

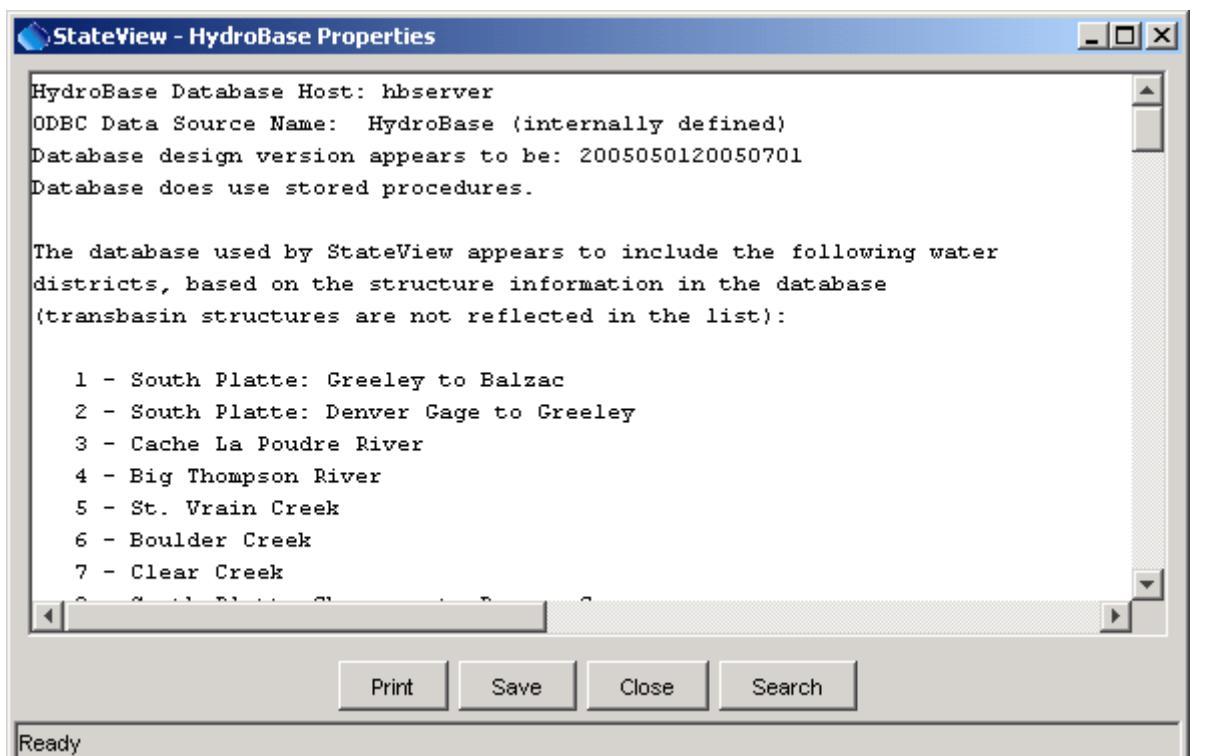


3.4.1 Open HydroBase

The **File...Open** menu displays the **Select HydroBase** dialog, as previously discussed in **Section 3.2 – Select HydroBase Dialog**.

3.4.2 HydroBase Properties

The **File...Properties** menu displays properties for the HydroBase database, as shown in the following figure. The properties indicate the database server that is being used and the version of the database. This information is useful when diagnosing database problems or comparing differences between database contents.

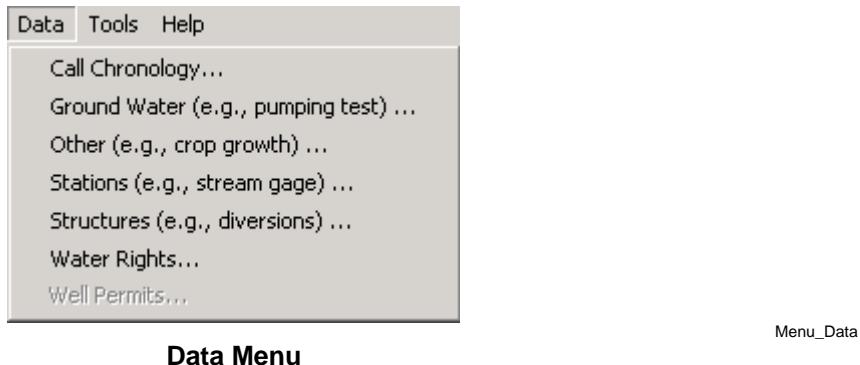


3.4.3 Exit

The **File...Exit** menu exits StateView/CWRAT. You are given the option to cancel the exit. If you have changed display options and are logged in as someone other than guest, the settings will be saved in HydroBase for use in the next session.

3.5 Data Menu

The **Data** menu provides displays for most of the data in HydroBase, and is summarized below. See **Chapter 4 – Viewing Data** for more information.



Data Menu

3.5.1 Call Chronology

The **Data...Call Chronology** menu item displays river call data for active and previously set/released calls. The interface is similar to that available from the **Administration...Edit Calls** interface except that calls cannot be modified. Call data may only be available in the central databases (not on HydroBase DVD).

3.5.2 Ground Water

The **Data...Ground Water** menu item displays data related to ground water, including well levels and pumping tests. Ground water data are only available for basins where a CDSS ground water modeling effort has occurred.

3.5.3 Other

The **Data...Other** menu item displays data that do not fit into the other menus, primarily crop statistics and consumptive use information.

3.5.4 Stations

The **Data...Stations** menu item displays data for climate and streamflow stations, including time series data.

3.5.5 Structures

The **Data...Structures** menu item displays data for administered structures (diversions, reservoirs, instream flow locations, dams, and wells). All structures except dams have water rights. Multiple data

views are available for structures, reflecting the variety of data available in HydroBase for structures. The water rights view can be accessed from structure displays.

3.5.6 Water Rights

The **Data...Water Rights** menu item displays water right transactions and net amounts. Water rights data can be viewed in raw form or can be formatted in standard reports.

3.5.7 Well Permits

The **Data...Well Permits** menu item displays well permit data. Because well permit data have traditionally only been available for a fee, the menu is only enabled when using a SQL Server database with a non-guest login.

3.6 Administration Menu

The **Administration** menu is available only in CWRAT, and provides water administration tools, as summarized below. The data editing features of administration tools allow saving data to HydroBase only when logged in as someone that has permission in a water district, as configured by the HydroBase database administrator. See **Chapter 5 – Administration Tools** for more information.



3.6.1 Edit Calls Menu

The **Administration...Edit Calls** menu item displays the interface for setting and releasing river call information. After call information is saved to HydroBase, it can be viewed by other system users, including web site users.

3.6.2 Water Information Sheet Menu

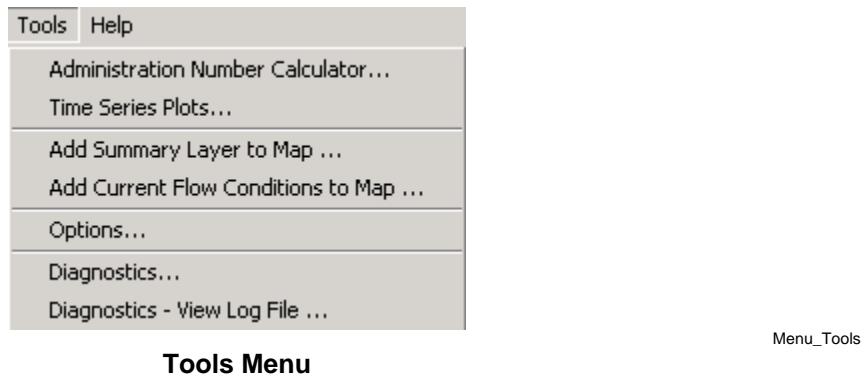
The **Administration...Water Information Sheet** menu item displays the Water Information Sheet (WIS) interface, which provides a daily water administration worksheet. Water commissioners and others who administer data use WIS.

3.6.3 Water Information Sheet Builder

The **Administration...Water Information Sheet Builder** menu item displays the WIS builder tool, which allows WIS formats to be adjusted. This tool is used infrequently to adjust a WIS. It can also be used to edit the WIS diagram.

3.7 Tools Menu

The **Tools** menu provides useful tools, as summarized below. See **Chapter 6 – Tools** for more information



3.7.1 Administration Number Calculator

The **Tools...Administration Number Calculator** menu item displays a dialog that converts between administration number and appropriation date.

3.7.2 Time Series Plots

The **Tools...Time Series Plots** menu item provides a general time series plotting tool that allows time series from other displays (e.g., stations and structures) to be dragged onto a configuration window to produce complex plots. Time series products can be saved in HydroBase for reuse at a later time. The TSTool software is also useful for displaying time series of different type and interval.

3.7.3 Add Summary Layer to Map

The **Tools...Add Summary Layer to Map** menu item provides a general tool that allows a delimited file to be used to create a summary map layer. For example, average historical flow conditions at stream gages can be displayed as bars on the map.

3.7.4 Add Current Flow Conditions to Map

The **Tools...Add Current Flow Conditions to Map** menu item displays current flow conditions on the map, using the streamflow gage layer for locations. This feature requires that HydroBase include real-time streamflow data.

3.7.5 Options

The **Tools...Options** menu item displays options for configuring StateView/CWRAT.

3.7.6 Diagnostics

The **Tools...Diagnostics** menu item displays a dialog that controls diagnostics settings, which are used in troubleshooting. The **Tools...Diagnostics – View Log File** menu item displays the log file, allowing scrolling and searches.

3.8 Help Menu

The help menu displays the software version and support information.



The **Help...About StateView** menu (and **Help...About CWRAT** menu for CWRAT) displays the program version number, as shown in the following figure. Indicate the version number when reporting problems or suggestions. StateView and CWRAT share most features and the software versions will be consistent. The **Show Software/System Details** button displays technical information that is useful in troubleshooting.



The **Help** menu also provides access to the this documentation and to training materials.

4 Viewing Data

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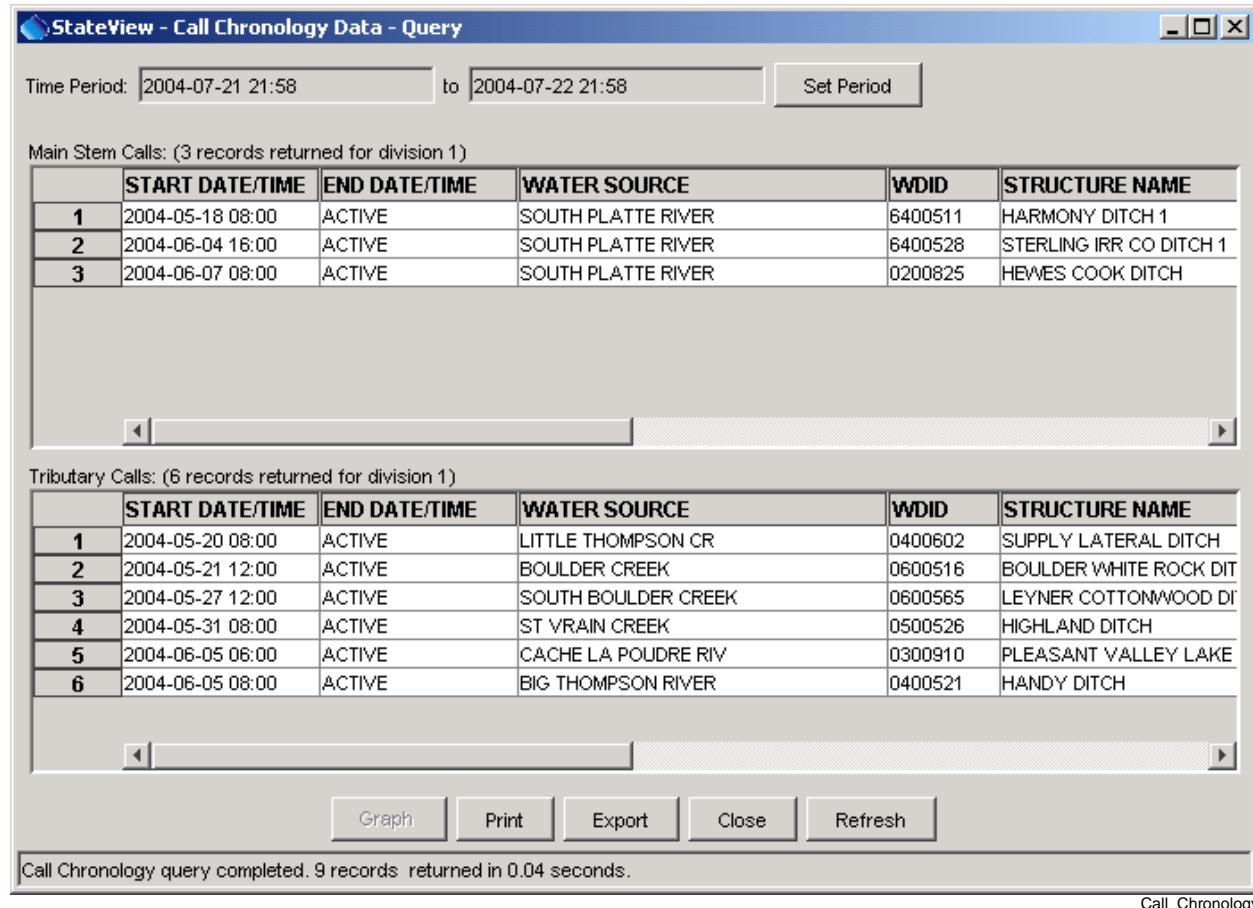
The **Data** menu provides displays for major categories of data, including nearly all of the data in the HydroBase database. In each case, a main display window is available, which provides access to additional display windows as appropriate. The following sections describe the various data types that can be displayed.



The **Well Permits** menu will only be enabled if you have logged in as someone other than “guest” using a SQL Server database that includes well permit data. Well permit data access is meant primarily for State of Colorado personnel.

4.1 Call Chronology

The **Data...Call Chronology** menu displays a view-only history of calls affecting a water district or entire division during a particular period, as shown in the following figure.

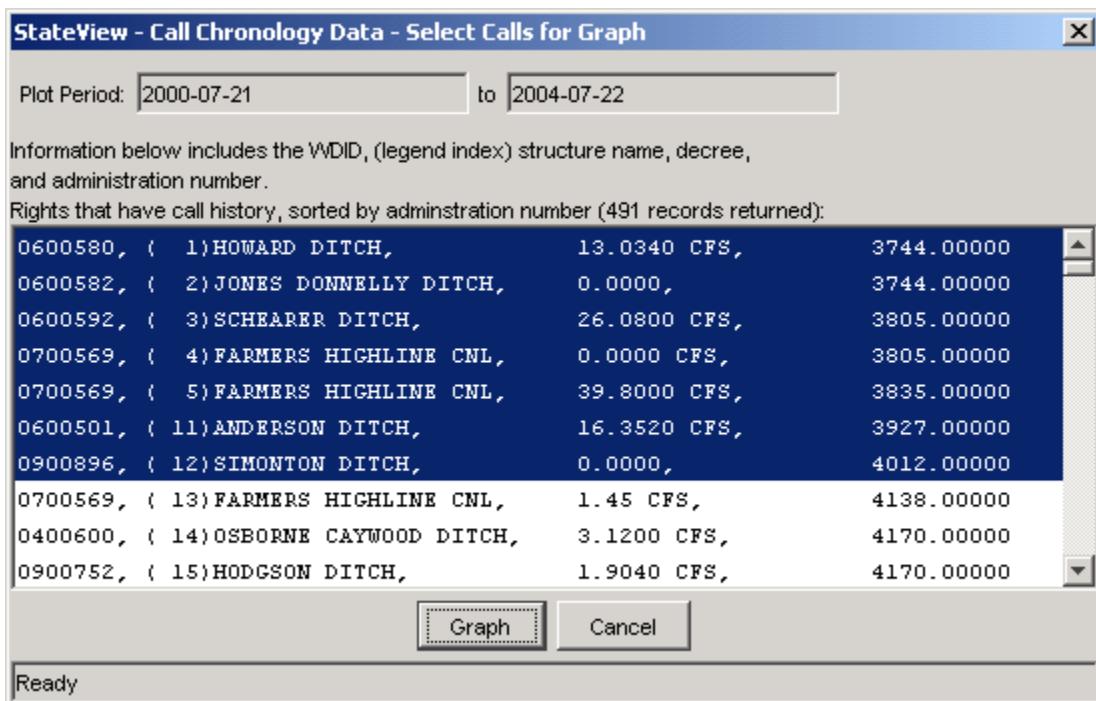


The initial display uses the time period set with **Tools...Options...Time Period**, which is typically set to display a recent period of time. To obtain results for a different period, specify the new period using the **Set Period** button, which will automatically re-query HydroBase. Calls that were active at any time in the specified period are displayed, with active calls being listed first. Calls are listed separately for main stem and tributary calls (main stem calls are on streams that do not flow into other streams). Use the **Refresh** button to refresh the display (e.g., to monitor changing conditions during the day).

Calls are set with the **Administration...Edit Calls** menu in the CWRAT program. Call data cannot be modified using the **Data...Call Chronology** menu.

Selecting one or more calls and pressing the **Graph** button allows calls to be graphed. This feature, described below, is more useful when a long period is specified because it shows when calls are on/off over the period. The call data that are displayed can be printed or exported for use by other tools.

After the **Graph** button is selected, the following dialog will be displayed:

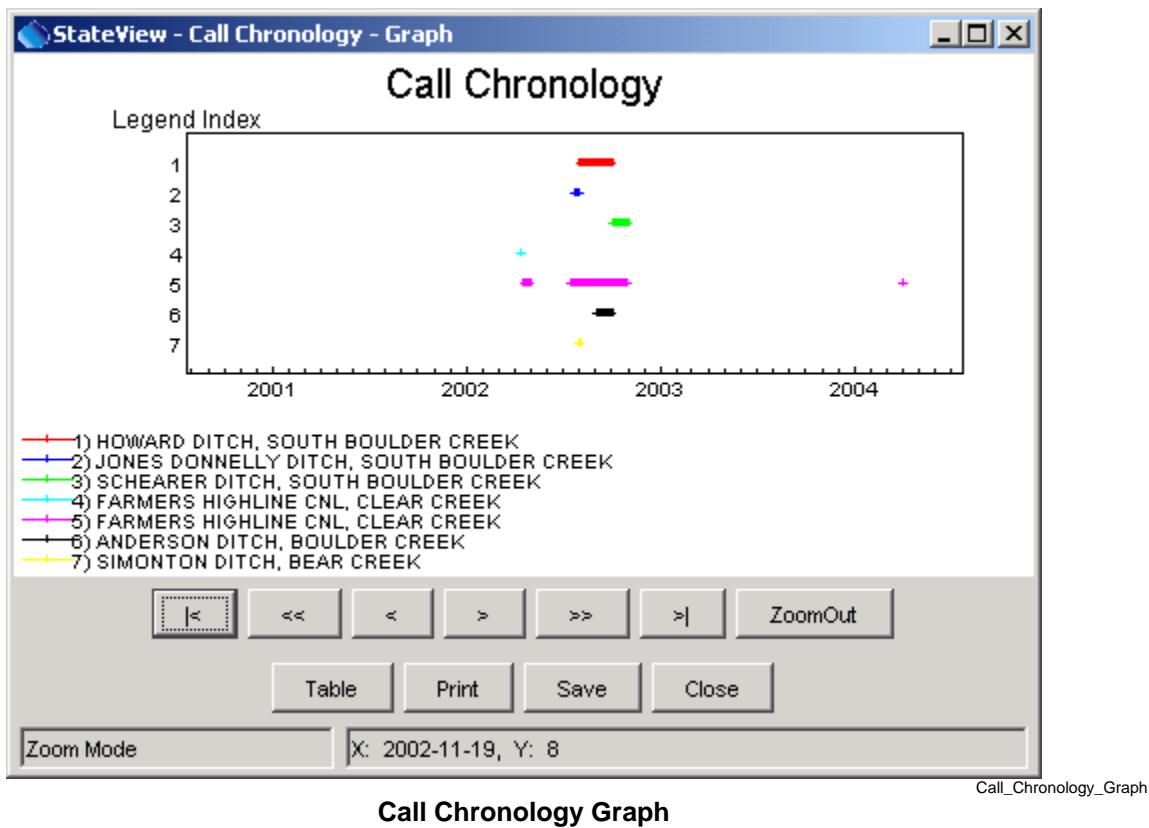


Call_Chronology_Graph_Select

Call Chronology Graph Selection Dialog

In the above example, for the specified period, there are 491 available calls, which are uniquely identified by the structure identifier and the water right administration number. The calls are listed with the most senior water right first. A gap in the counter that is shown indicates that the first right before the gap has had multiple calls during the period. A graph cannot normally display a very large number of calls, so a subset is typically selected. In the above example, multiple calls have been selected by clicking on the first call and then using shift-click on the seventh call. After selecting calls to graph, press **Graph**.

The following figure provides an example of a call chronology graph.

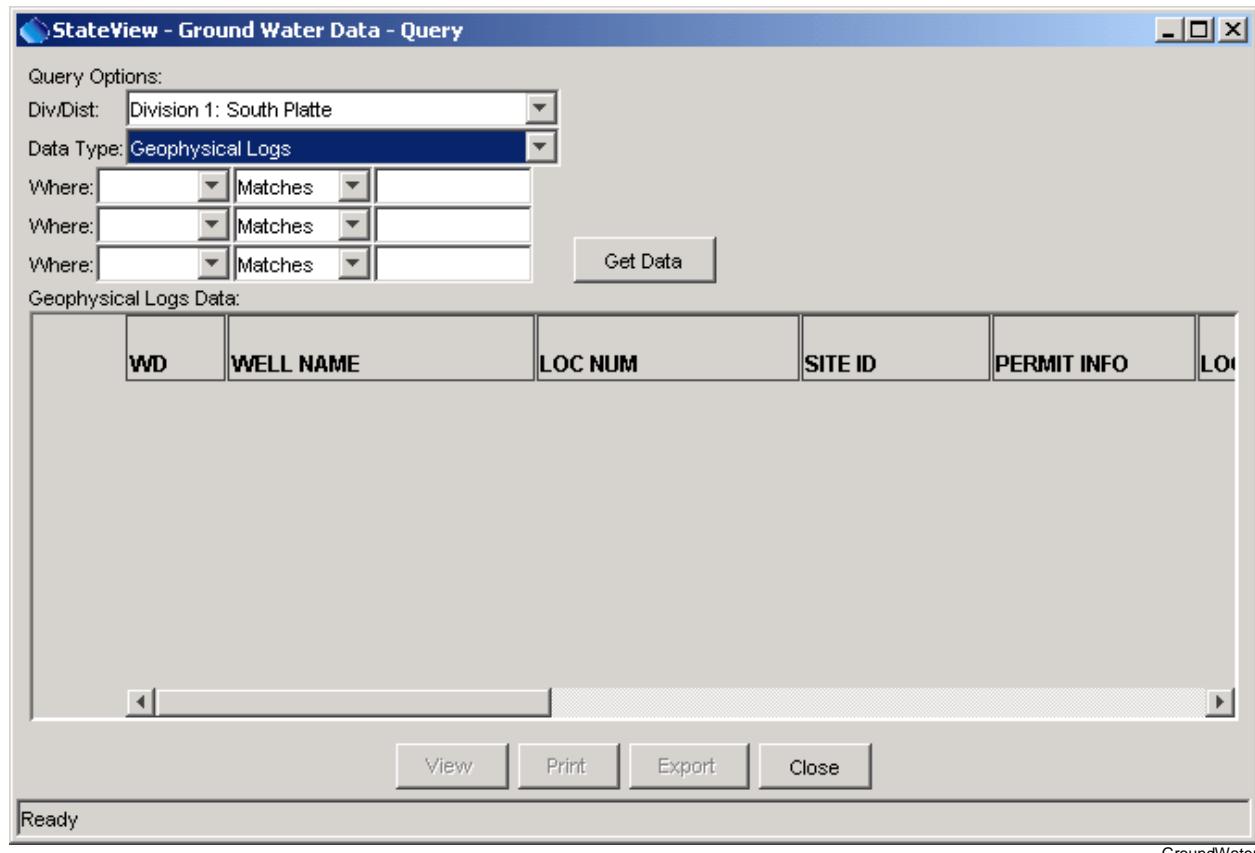


Each call that was selected for graphing is shown as a horizontal line on the graph. The vertical order of the graph is consistent between the legend and the numbered indexes on the vertical axis. A small plus sign is drawn at each day on which a call was active; consequently, if a call was only active for one day, there will only be a plus symbol and no line.

The general features of the graphing tool are described in the [TSView Time Series Viewing Tools Appendix](#).

4.2 Ground Water Data

The **Data...Ground Water** menu provides views for ground water data, which include driller's K sum, geophysical logs, pumping tests, pumping time series, volcanics, and well level data. Ground water data are available only for some divisions where a ground water modeling effort has occurred (e.g., Divisions 1 and 3). Well permits are available using the **Data...Well Permits** menu item. The **Data...Structures** menu displays well data for structures that have water rights. Data may only be available for certain water divisions (select **Div/Dist** as **Entire State** to see all available data).

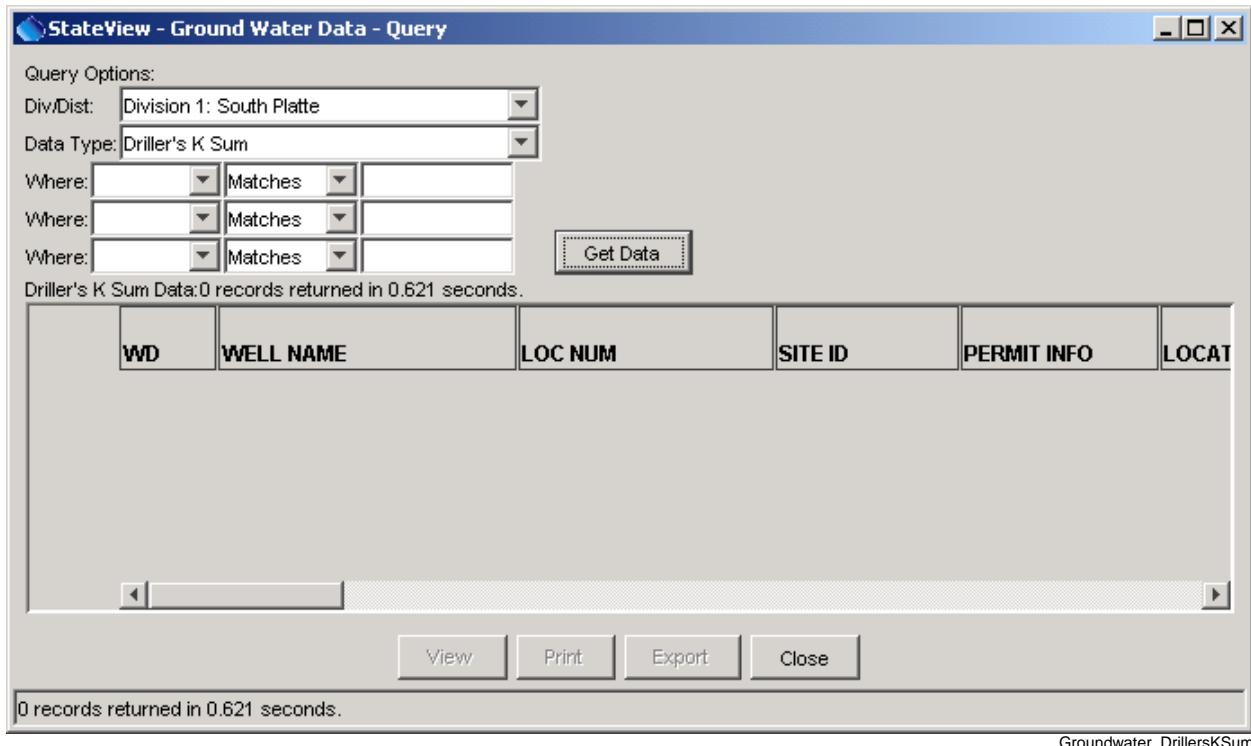


Ground Water Query Window as Initially Displayed

Similar to other views, you must first select a data type and then press the **Get Data** button to display data. The following sections describe the ground water views that are available. Each display typically displays available identifier and location information for the wells, in addition to the specific data. Some wells have identifiers from multiple sources.

4.2.1 Driller's K Sum

To list driller's K sum data, first select **Driller's K Sum** as the **Data Type**. If desired, filter the query by specifying **Where** information. Press **Get Data** to query the database.



Driller's K Sum Data

4.2.2 Geophysical Logs

To list geophysical log data, first select **Geophysical Logs** as the **Data Type**. If desired, filter the query by specifying **Where** information. Press **Get Data** to query the database. The corresponding list of geophysical log data will be shown, as in the following figure:

The screenshot shows the 'StateView - Ground Water Data - Query' window. In the 'Query Options' section, 'Div/Dist' is set to 'Division 1: South Platte' and 'Data Type' is set to 'Geophysical Logs'. There are three 'Where' dropdown menus, each with a 'Matches' button. A 'Get Data' button is located to the right of the 'Where' fields. Below this, a message states 'Geophysical Logs Data: 3970 records returned in 7.712 seconds.' A data grid follows, with columns labeled WELL ELEVATION, WELL DEPTH, LOG TYPE, LOG SWL, LOG DEPTH, LOG DATE, UTM X, and UTM Y. Four rows of data are visible, corresponding to entries 1 through 4. At the bottom of the window are 'View', 'Print', 'Export', and 'Close' buttons. A status bar at the bottom left says '3970 records returned in 7.712 seconds.' and the status bar at the bottom right says 'Groundwater_GeophysicalLogs'.

Geophysical Logs Data

To see a text view of the data, select a record and press the **View** button:

The screenshot shows the 'StateView - Geophysical Log Records' window. The title bar reads 'Geophysical Log data for Well'. The main area displays the following text:
 WD: 2
 Well Name:
 Loc Num: SB00106623DB
 Site ID:
 Permit Info: 20213-F-
 AQUIFER TOP BASE NET ORIG. 1986
 UPPER ARAPAHOE 4815 No
 Below this is a toolbar with 'Print', 'Save', 'Close', and 'Search' buttons. A status bar at the bottom left says 'Ready' and the status bar at the bottom right says 'Groundwater_GeophysicalLogs2'.

Geophysical Logs Data – Report View

4.2.3 Pumping Tests

To list pumping test data, first select **Pumping Tests** as the **Data Type**. Optionally, also enter **Where** information to limit the query. Then press **Get Data**. The corresponding list of pumping test data will be shown, as in the following figure:

The screenshot shows the 'StateView - Ground Water Data - Query' window. In the 'Query Options' section, 'Div/Dist' is set to 'Division 1: South Platte' and 'Data Type' is set to 'Pumping Tests'. There are three 'Where:' dropdown menus, each with a 'Matches' button. A 'Get Data' button is located to the right of the third 'Where:' field. Below the query options, a message states 'Pumping Tests Data: 1332 records returned in 2.864 seconds.' The main area displays a table titled 'Pumping Test List' with columns: WD, WELL NAME, LOC NUM, SITE ID, and PERMIT INFO. The table contains 1332 rows of data. The row for WD 190 and WELL NAME 1111895 has a dark blue background, indicating it is selected. At the bottom of the window are buttons for 'View', 'Print', 'Export', and 'Close'. A status bar at the bottom left says '1332 records returned in 2.864 seconds.'

WD	WELL NAME	LOC NUM	SITE ID	PERMIT INFO
183	6410601R	SB01004801BC		10601-R-
184	641066R	SB01004915BB		1066-R-
185	811	SC00506735 HILLIER1		--
186	111030R	SB00506423CA		11030-R-
187	6411126R	SB01005013DB DWR1		11126-R-
188	2111298	SB00306607		111298--
189	6411173R	SB01104608AC		11173-R-
190	1111895	SB00405928BB		111895--
191	111212R	SB00406126BC		11212-R-
---		SB00406126BC		11212-R-

Pumping Test List

GroundWater_PumpingTestMain

The above example illustrates the results of the query, which lists pumping tests and parameters determined from the tests. To see a single pumping test in an expanded view, select the pumping test from the list (left click) and then press the **View** button.

The following figure illustrates the resulting pumping test view.

StateView - Ground Water Data - Pumping Test -

WD:	ID:	Loc Num:	Site ID	Permit Info					
1		SB00405928BB		111895--					
Name: _____									
PM:	TWN:	RNG:	SEC:	1/4:	1/4 1/4:	1/4 1/4 1/4:			
S	4	N	59	W	28		NW	NW	
Test Type:	Data Source:	Test Date:	Test Duration (hrs):						
Specific Capacity	SEO Well Permit Database	1974-04-09	5.00						
Static Level (ft):	Final Level (ft):	Water Level Change (ft):	Average Flow (gpm):						
66.00	68.00	2.00	1200.0						
Top of Test Interval (ft):		Base of Test Interval (ft):							
Transmissivity (gpd/ft):	Hydraulic Conductivity (ft/d):	Storativity:	Leakance:						
1693958									
<input type="checkbox"/> Includes Monitor Well <input type="checkbox"/> Includes Observed Well <input type="checkbox"/> Multiple Tests Available									
<input type="button" value="Print"/> <input type="button" value="Export"/> <input type="button" value="Close"/>									

GroundWater_PumpingTestSingle

Pumping Test Data

4.2.4 Pumping Time Series

Currently, pumping time series are not available in HydroBase, other than as part of the diversion coding data. To view pumping time series, use the **Data...Structures** menu and select the **Diversion Coding/Reservoir Releases** view (see **Section 4.5 - Structures**).

4.2.5 Volcanics

To volcanics data, first select **Volcanics** as the **Data Type**. If desired, filter the query by specifying **Where** information. Press **Get Data** to query the database.

StateView - Ground Water Data - Query

Query Options:

Div/Dist: Division 3: Rio Grande
Data Type: Volcanics

Where: [dropdown] Matches [dropdown]
Where: [dropdown] Matches [dropdown]
Where: [dropdown] Matches [dropdown]

Get Data

Volcanics Data: 30 records returned in 0.942 seconds.

WD	WELL NAME	LOC NUM	SITE ID	PERMIT INFO	LOCA
1	22 ARROW RANCH	NA03501105CA		246-R-	N 35N ▲
2	35 CASTRO JOSEPH J & COLLEEN M	SC03007433AB		47035-F-	S 30S
3	35 DAVIS JAMES G	SC03007426DD		47447-F-	S 30S
4	35 FIELDS ERNIE & DEBORAH	SC02907325AB		46564-F-	S 29S
5	27 GEYER DONALD J	NA04100720CD		44606-F-	N 41N
6	27 GEYER DONALD J	NA04100720CD		44606-F-	N 41N
7	27 GEYER DONALD J	NA04100720CD		44606-F-	N 41N
8	21 GONZALES LEO	NA03500815AD		5571-F-	N 35N
9	22 GUADALUPE WATER ASSN	NA03300918DC		12905-F-	N 33N
10	22 GUADALUPE WATER ASSN	NA03300918DC		12905-F-	N 33N
11	22 GYLING O VW & SOWARDS DO...	NA03401005CD		11721-R-	N 34N
12	20 MCNEIL RANCH	NA03800725CD		206700--	N 38N
13	20 MCNEIL RANCH	NA03800725CD		206700--	N 38N ▼

View Print Export Close

30 records returned in 0.942 seconds.

Volcanics Data

Groundwater_VolcanicsMain

4.2.6 Well Level Measurements

To list information about well level time series, select **Well Level Measurements** as the **Data Type**. Optionally, also enter **Where** information to limit the query. Then press **Get Data**. The following figure illustrates the resulting list:

The screenshot shows the 'StateView - Ground Water Data - Query' window. In the 'Query Options' section, 'Div/Dist' is set to 'Division 3: Rio Grande' and 'Data Type' is set to 'Well Level Measurements'. There are three 'Where:' dropdown menus followed by 'Matches' dropdowns and empty text fields. A 'Get Data' button is located to the right of the third 'Where:' field. Below the query options, a message states 'Well Level Measurements Data: 957 records returned in 3.174 seconds.' The main area displays a table with 12 rows of data. The columns are labeled 'WD', 'WELL NAME', 'LOC NUM', 'SITE ID', 'PERMIT INFO', and 'LOCATION'. The 'WELL NAME' column contains entries like 'CB 107512AAA', 'CB00107320DCC', etc. The 'LOC NUM' column contains entries like 'CB01007512AAA', 'CB00107320DCC', etc. The 'SITE ID' column contains entries like '370345105434501', '370120105351501', etc. The 'PERMIT INFO' column contains entries like '--', '--', etc. The 'LOCATION' column contains entries like 'C 1N', 'C 1N', etc. At the bottom of the table are navigation buttons for 'View', 'Print', 'Export', and 'Close'. A status bar at the bottom of the window also displays '957 records returned in 3.174 seconds.'

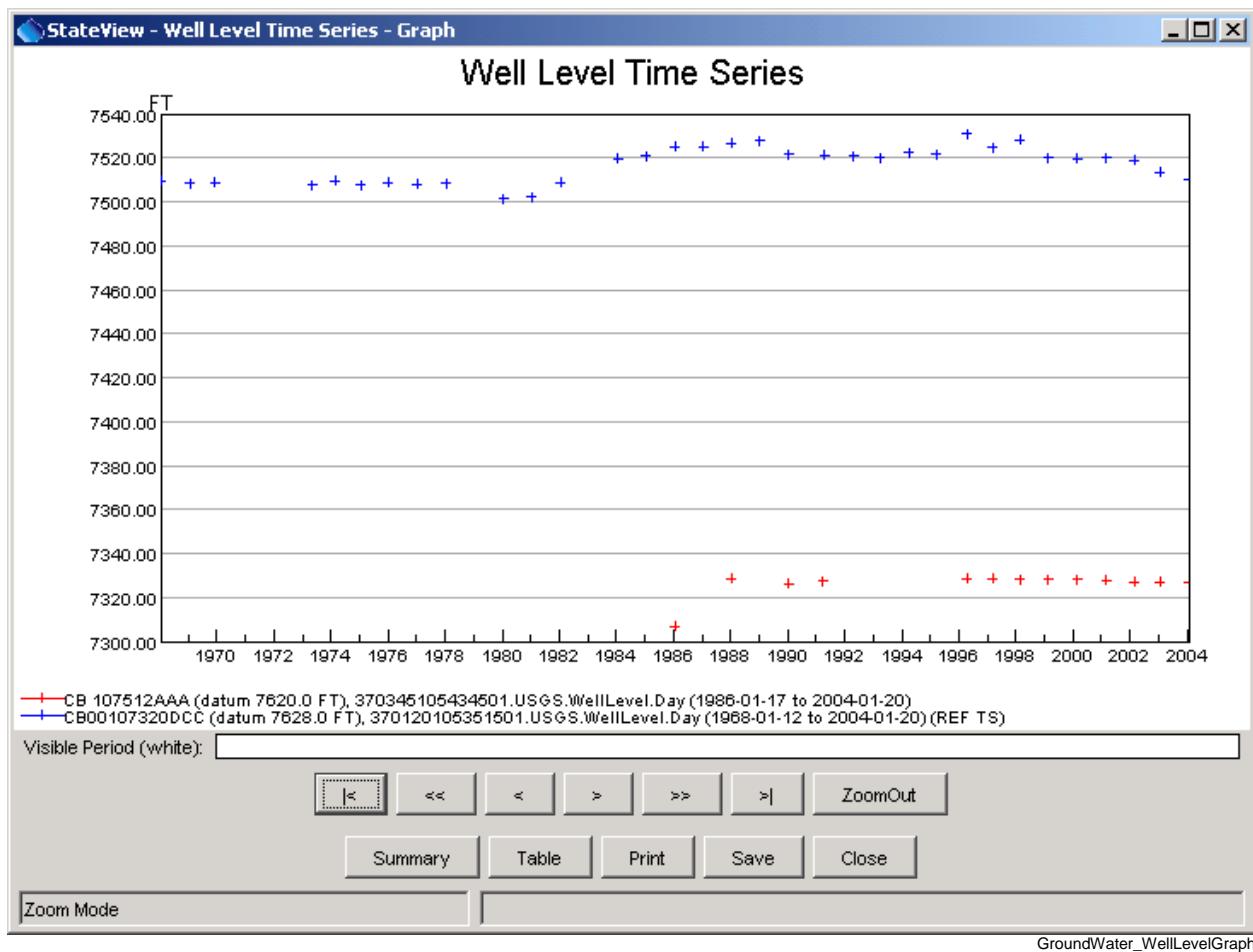
WD	WELL NAME	LOC NUM	SITE ID	PERMIT INFO	LOCATION
1	24 CB 107512AAA	CB01007512AAA	370345105434501	--	C 1N
2	24 CB00107320DCC	CB00107320DCC	370120105351501	--	C 1N
3	24 CB00107335BAB	CB00107335BAB	370030105320501	--	C 1N
4	24 CB00107415DBD	CB00107415DBD	370225105393501	--	C 1N
5	24 CB00107425AAA DUP2	CB00107425AAA DUP2	370115105370501	--	C 1N
6	24 CB00107427DCD	CB00107427DCD	370028105393501	--	C 1N
7	24 CB00107433DAA	CB00107433DAA	365958105403001	--	C 1N
8	24 CB00107524CCA	CB00107524CCA	370130105442501	--	C 1N
9	24 CB00207119ACC	CB00207119ACC	370728105223001	--	C 2N
10	24 CB00207212ADC	CB00207212ADC	370845105235401	--	C 2N
11	24 CB00207303BAA	CB00207303BAA	370958105332001	--	C 2N
12	24 CB00207305DDA	CB00207305DDA	370945105343501	--	C 2N

Well Level Measurement List

GroundWater_WellLevelMain

To graph well level measurement time series, select one or more items from the list and then press the **View** button. In HydroBase, wells with well level measurements may or may not correspond to a structure with water rights. For example, wells may have a USGS or USBR identifier. For time series identifiers, the location is determined from the agency that is the data source for the time series data. If available, the datum is used to adjust well levels to elevation (as opposed to depth).

The following figure illustrates the resulting graph for well level measurements.



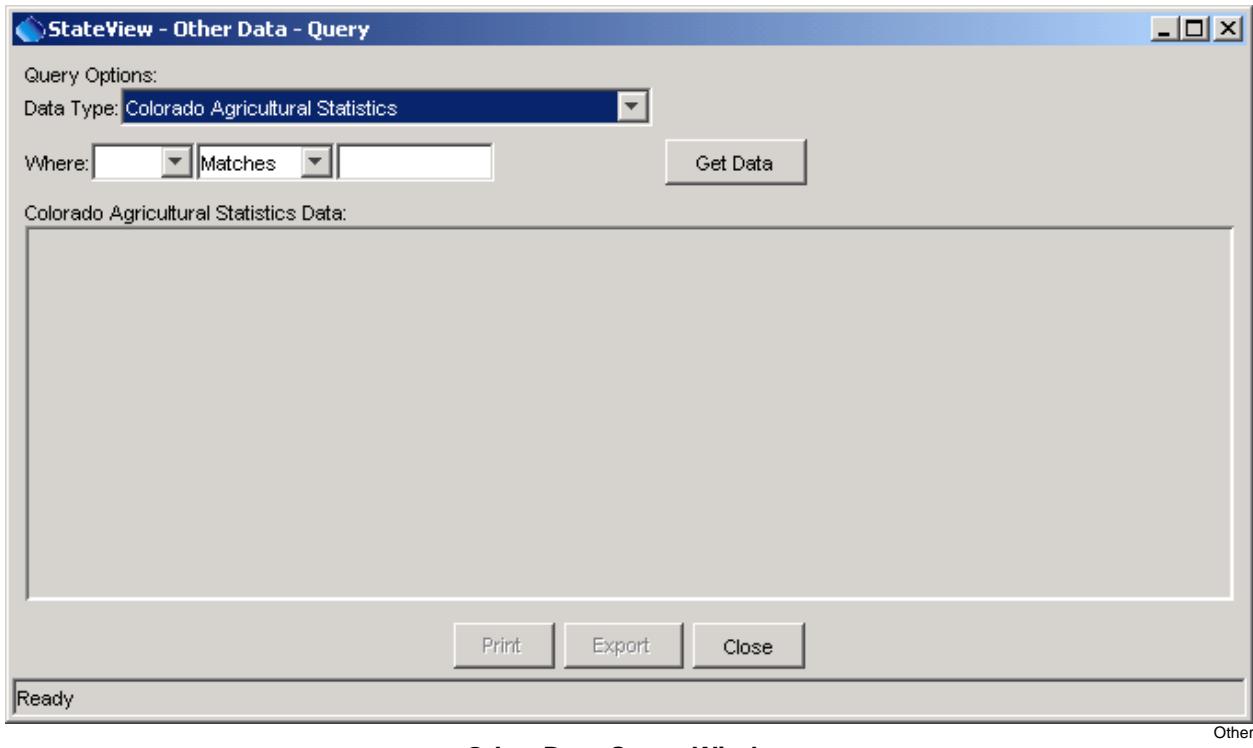
In order to display the data as a graph, daily well level measurements are treated as a daily time series, although not every day may have a measurement. Because well measurements are often measured in absolute units (e.g., elevation from sea level), the y-axis for the graph does not start at zero. If zero were used, the well level graph would be difficult to distinguish from a horizontal line. The datum is shown so that it can be evaluated for accuracy.

The features of the graphing tool are described in the **TSView Time Series Viewing Tools Appendix**.

Well level data also can be viewed and processed using the CDSS TSTool software.

4.3 Other Data

The **Data...Other** menu displays miscellaneous data that are not directly associated with the other data types in the **Data** menu. Many of these data are static information (rather than time series or administrative data). The main query dialog is shown in the following figure.



Other Data Query Window

To view data, select a data type and then press the **Get Data** button. You can filter the amount of output by selecting using the **Where** information. In some cases, all data are displayed and cannot be filtered. Each data type is explained in subsequent sections.

4.3.1 Colorado Agricultural Statistics

Colorado agricultural statistics are available by county. Agricultural statistics are time series of crops sorted by county, crop (commodity), irrigation practice, and year. Familiarity with the Colorado Agricultural Statistics Service (CASS) data is helpful when using the data.

The screenshot shows a Windows application window titled "StateView - Other Data - Query". In the top left, it says "Query Options: Data Type: Colorado Agricultural Statistics". Below that is a search bar with "Where: County" dropdown set to "LARIMER" and a "Get Data" button. A message below the search bar says "Other Data Records: 1683 records returned in 0.651 seconds.". The main area is a table with 8 rows of data. The columns are labeled: STATE, COUNTY, COMMODITY, PRACTICE, CALENDAR YEAR, PLANTED (ACRE), PLANTED HARVESTED (ACRE), and HARVESTED (ACRE). The data shows Barley All being irrigated from 1956 to 1963 in Larimer County. At the bottom of the table are navigation arrows. Below the table are three buttons: Print, Export, and Close. A status bar at the bottom of the window says "1683 records returned in 0.651 seconds." and "Other_ColoradoAgStats".

	STATE	COUNTY	COMMODITY	PRACTICE	CALENDAR YEAR	PLANTED (ACRE)	PLANTED HARVESTED (ACRE)	HARVESTED (ACRE)
1	CO	Larimer	Barley All	Irrigated	1956	18110		17570
2	CO	Larimer	Barley All	Irrigated	1957	17150		16770
3	CO	Larimer	Barley All	Irrigated	1958	17400		17200
4	CO	Larimer	Barley All	Irrigated	1959	14140		14010
5	CO	Larimer	Barley All	Irrigated	1960	15310		15000
6	CO	Larimer	Barley All	Irrigated	1961	15220		14520
7	CO	Larimer	Barley All	Irrigated	1962	15000		14000
8	CO	Larimer	Barley All	Irrigated	1963	14020		12200

Colorado Agricultural Statistics

Colorado agricultural statistics data also can be viewed and processed using the CDSS TSTool software.

4.3.2 National Agricultural Statistics

National agricultural statistics are available by county. Agricultural statistics are time series of crops (commodities), sorted by county, crop, irrigation practice, and year. Familiarity with the National Agricultural Statistics Service (NASS) data is helpful when using the data.

The screenshot shows the 'StateView - Other Data - Query' interface. In the 'Query Options' section, 'Data Type' is set to 'National Agricultural Statistics'. Under 'Where', 'County' is selected and 'Matches' 'LARIMER'. A 'Get Data' button is present. Below this, a message states 'Other Data Records: 28 records returned in 0.08 seconds.' A data grid displays 10 rows of statistics for Larimer County, Colorado, from 1945 to 1987. The columns are labeled: STATE, COUNTY, COMMODITY, CALENDAR YEAR, AMOUNT (ACRE), and FLAG. The data shows a general decline in orchard acreage over the period. At the bottom of the window are 'Print', 'Export', and 'Close' buttons, and a note '28 records returned in 0.08 seconds.'

	STATE	COUNTY	COMMODITY	CALENDAR YEAR	AMOUNT (ACRE)	FLAG
1	CO	LARIMER	Orchards, Irrigated	1945	2671	
2	CO	LARIMER	Orchards, Irrigated	1950	2152	
3	CO	LARIMER	Orchards, Irrigated	1954	962	
4	CO	LARIMER	Orchards, Irrigated	1959	838	
5	CO	LARIMER	Orchards, Irrigated	1964	566	
6	CO	LARIMER	Orchards, Irrigated	1969	245	
7	CO	LARIMER	Orchards, Irrigated	1974	71	
8	CO	LARIMER	Orchards, Irrigated	1978	130	
9	CO	LARIMER	Orchards, Irrigated	1982	1680	
10	CO	LARIMER	Orchards, Irrigated	1987	129	

National Agricultural Statistics

Other_NationalAgStats

National agricultural statistics data also can be viewed and processed using the CDSS TSTool software.

4.3.3 Crop Characteristics

Crop characteristics are parameters associated with crops and are used by the consumptive use model. Refer to the StateCU model documentation for more information about how these data are used.

The screenshot shows the 'StateView - Other Data - Query' window. The 'Data Type' dropdown is set to 'Crop Characteristics'. A message at the top says 'Other Data Records: 27 records returned in 0.211 seconds.' Below is a table with 11 rows of data:

	CROP TYPE	METHOD	TEMP EARLY MOIST (DEG F)	TEMP LATE MOIST (DEG F)	INIT ROOT (IN)	MAX ROOT (IN)	MAX SOIL DEF. (%)	MAX APP DEP (IN)
5	CORN_GRAIN	TR-21	55.00	32.00	3.30	3.30	50.00	3.1 ▲
6	CORN_SILAGE	TR-21	55.00	32.00	3.90	3.90	60.00	3.1
7	COTTON	TR-21	62.00	32.00	3.50	3.50	55.00	3.1
8	DRY_BEANS	TR-21	60.00	32.00	2.50	2.50	60.00	3.1
9	GRAPES	TR-21	55.00	50.00	4.10	4.10	50.00	3.1
10	GRASS_PASTURE	TR-21	45.00	45.00	3.30	3.30	50.00	3.1
11	GREEN_BEANS	TR-21	60.00	32.00	2.50	2.50	45.00	3.1 ▼

At the bottom are 'Print', 'Export', and 'Close' buttons. A note at the bottom says '27 records returned in 0.211 seconds.'

Crop Characteristics

Other_CropCharacteristics

Crop characteristics data also can be viewed and processed using the CDSS StateDMI software.

4.3.4 Crop Growth Characteristics

Crop growth characteristics are used by the StateCU consumptive use model. Refer to the StateCU model documentation for more information about how these data are used. The output for these data is shown in a report because of the variability in the data for different methods.

The screenshot shows a Windows application window titled "StateView - Crop Growth Characteristics Report". The main title bar says "Crop Growth Characteristics by Consumptive Use (CU) Method". Below this, it says "BLANEY-CRIDDLE". The data is presented in a table:

Crop	Curve Type	Curve Value	Crop Growth Coefficient
ALFALFA	Day	1	0.60
ALFALFA	Day	15	0.63
ALFALFA	Day	32	0.68
ALFALFA	Day	46	0.73
ALFALFA	Day	60	0.79
ALFALFA	Day	74	0.85
ALFALFA	Day	91	0.92
ALFALFA	Day	105	0.99
ALFALFA	Day	121	1.04
ALFALFA	Day	135	1.09
ALFALFA	Day	152	1.12
ALFALFA	Day	166	1.13
ALFALFA	Day	182	1.13
ALFALFA	Day	196	1.12
ALFALFA	Day	213	1.09
ALFALFA	Day	227	1.07
ALFALFA	Day	244	1.03
ALFALFA	Day	258	0.99
DT.FDT.WD	Day	274	0.95

At the bottom of the window are buttons for Print, Save, Close, and Search. A status bar at the bottom left says "Ready".

Crop Growth Characteristics

Other_CropGrowthCharacteristics

Crop growth characteristics data also can be viewed and processed using the CDSS StateDMI software.

4.3.5 Human and Livestock Consumptive Use Characteristics

Human and livestock consumptive use characteristics are used by the consumptive use estimates. Refer to the StateCU model documentation for more information about how these data are used.

StateView - Other Data - Query

Query Options:

Data Type: Human and Livestock Consumptive Use Characteristics

Get Data

Other Data Records: 7 records returned in 0.661 seconds.

	CONSUMPTIVE USE NAME	USE/DAY GALLONS	CONSUMPTIVE USE EFFICIENCY
1	SHEEP	2.00	1.00
2	HOG	3.00	1.00
3	HUM_PUBLIC	7.00	0.35
4	CATTLE	10.00	1.00
5	HUM_COMMERCIAL	28.00	0.35
6	HUM_RESID_URBAN	120.00	0.36
7	HUM_RESID_RURAL	120.00	0.36

Print Export Close

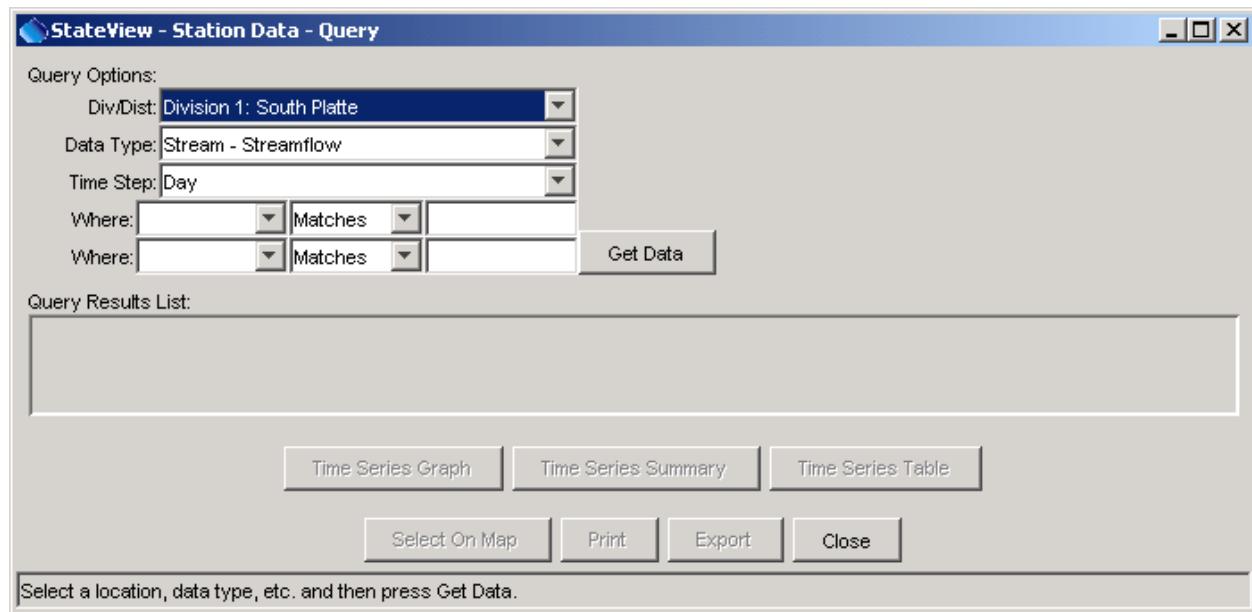
7 records returned in 0.661 seconds.

Human and Livestock Consumptive Use Characteristics View

Population data also can be viewed and processed using the CDSS TSTool software.

4.4 Stations

The **Data...Stations** menu displays station information, primarily as a way to access real-time and historical time series data. The following figure illustrates the Station Data interface, which displays basic information including identifier, name, and location. The CDSS TSTool software also can be used to view and process station time series data.



Stations Query Interface

Stations

Each station may be associated with one or more time series. For example, a streamflow station may have daily and monthly time series as averages, totals, minimum, maximum, etc. To display station data, first select query options, as described below:

Water Division/District The water division and district are used to limit queries to a region. The available options are typically constrained using the **Tools...Options...Water District Filter** settings.

Data Type Station queries are based on knowing the data type of interest. Consequently, you cannot ask “what are the data types available at a station”. The available data types correspond to time series data stored in HydroBase. Data types are listed in logical groupings. Real-time data may only be available when using a State server HydroBase.

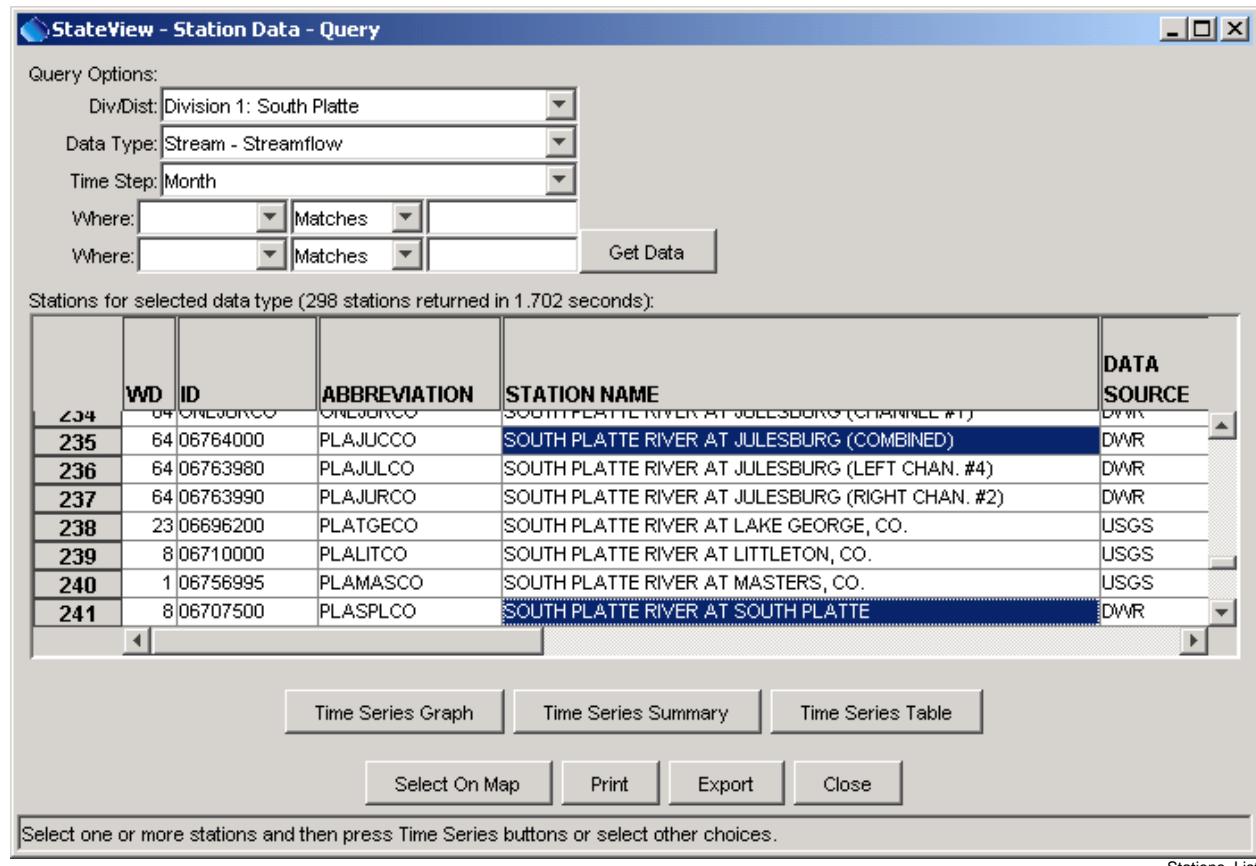
To mix time series data types and intervals, use the **Tools...Time Series Plot** feature or the TSTool software.

Time Step The time step indicates the data interval and provides an additional level of detail when selecting time series for stations.

Where Use the **Where** lists to choose additional criteria for limiting a query.

After selecting query options, press the **Get Data** button (or press the **Enter** key in **Where** text fields).

The following figure illustrates the results of a station query.



Station Query showing Monthly Streamflow Stations

The results of the query are displayed in the list area and consist of stations that have time series data of the requested type. Select one or more stations from the list. The following buttons can be pressed to act on the list:

Time Series Graph Display the selected time series in a graph. See below for an example.

Time Series Summary Display the selected time series in a text report form.

Time Series Table Display the selected time series in a tabular form.

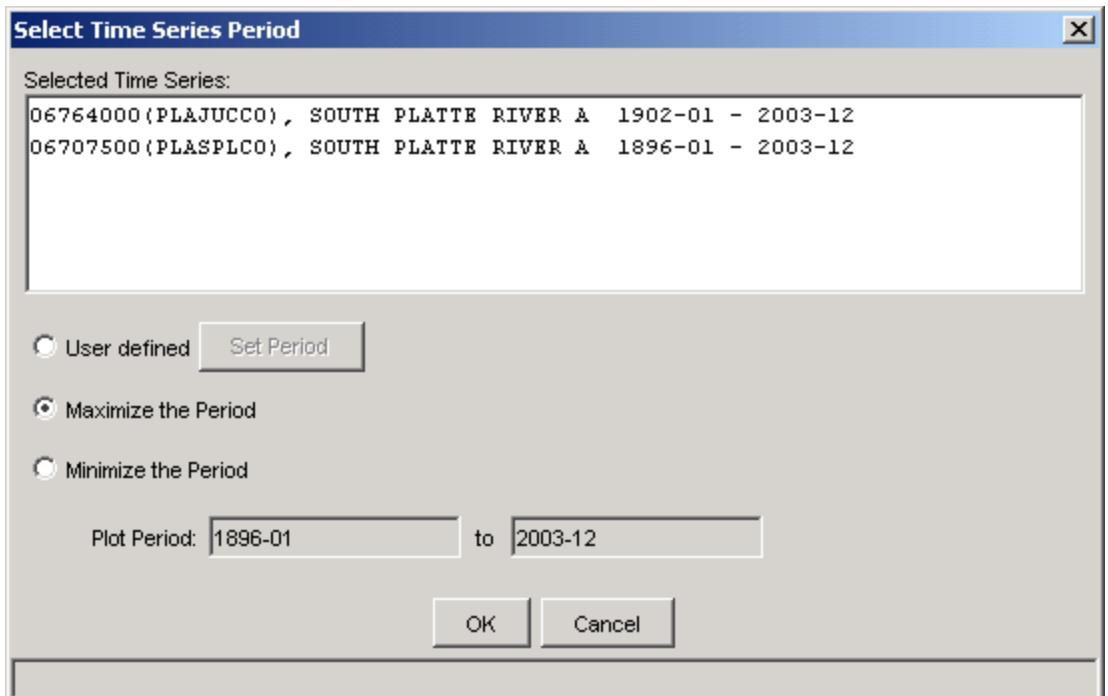
Select On Map If the map interface is enabled and station data are available on the map, select the stations on the map. **Warning: only streamflow stations and general climate station data are typically available for maps. Not all data types may have corresponding map layers.** See **Chapter 7 - Examples of Use** for information about interacting with the map interface.

Print Print the contents of the list.

Export Export the contents of the list to a file.

Close Close the **Station Data** window.

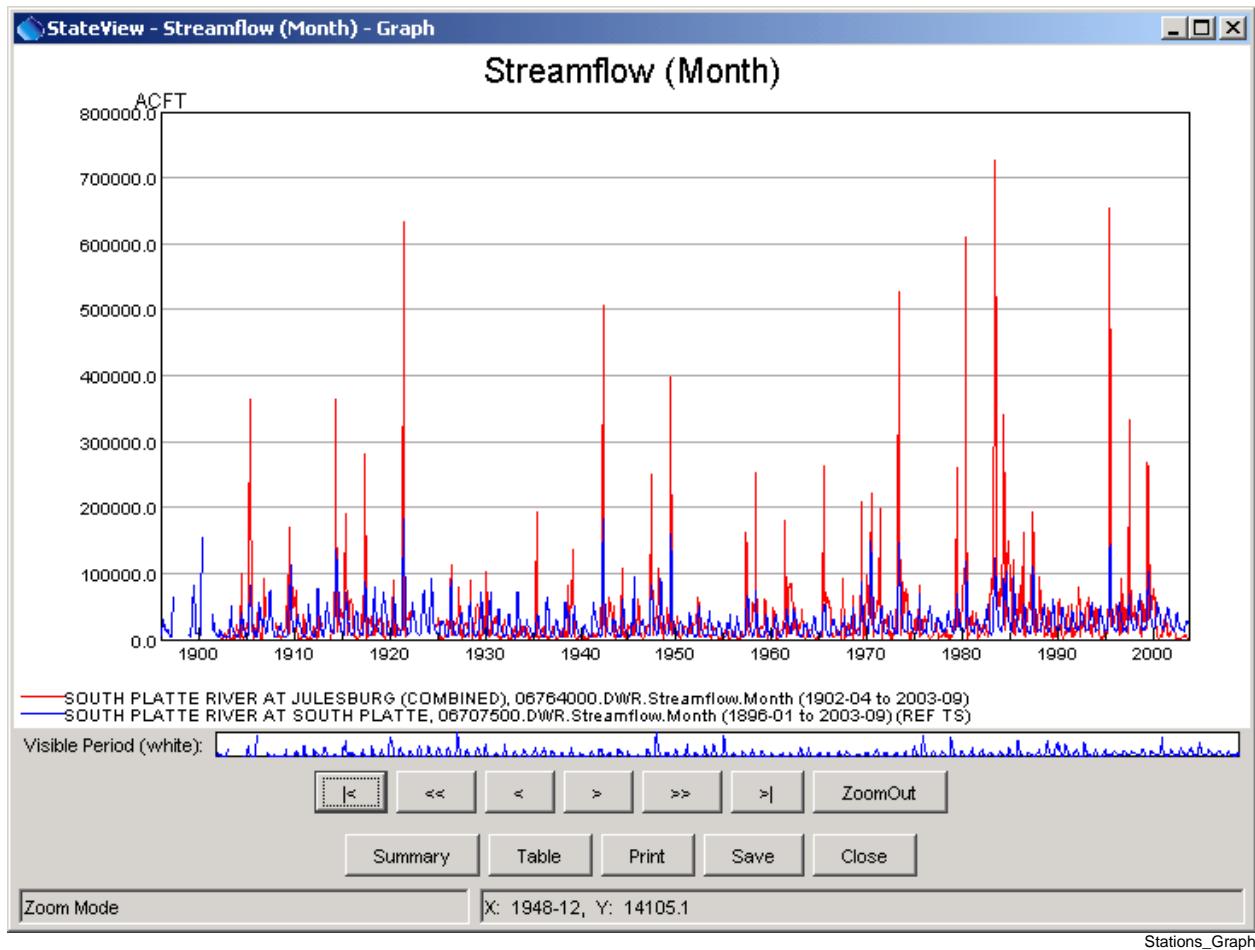
When the **Time Series Graph**, **Time Series Summary**, or **Time Series Table** buttons are pressed, the period that is used to query the time series data can be limited. Specifying a shorter period can increase performance. The following figure illustrates the period selector dialog.



Stations_Period

The period can be specified as the maximum period, the minimum overlapping period, or a user-defined period. Pressing **OK** will display the appropriate view (graph, summary, or table).

The following figure illustrates a graph view.

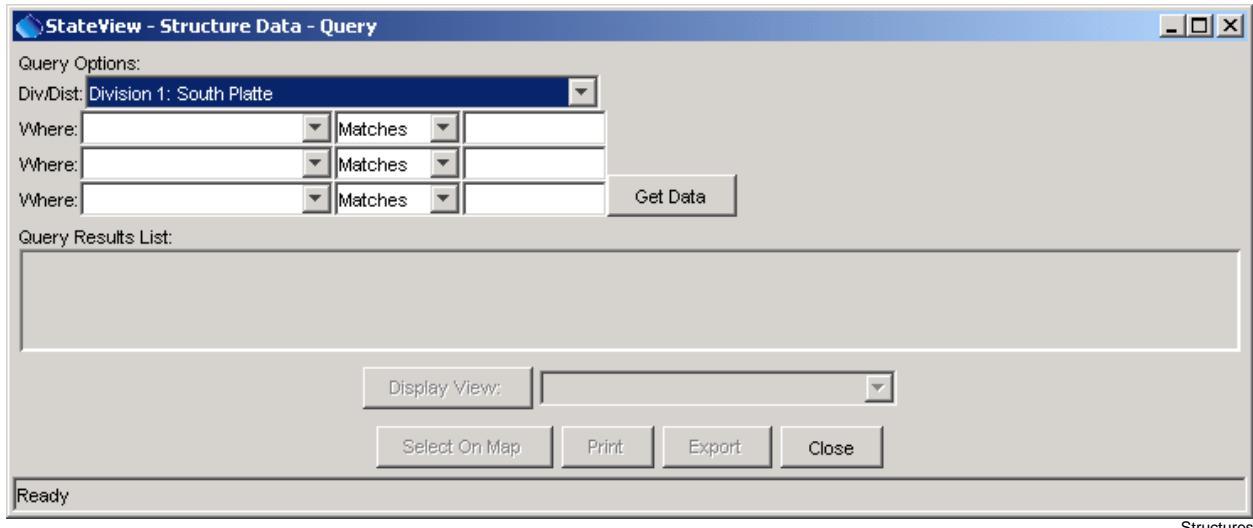


The **TSView Time Series Viewing Tools Appendix** describes the features of the graph and also provides examples of the summary and table views. Note that the graph, summary, and table views can be displayed from each of the individual views by pressing the appropriate buttons.

For example, use the arrow buttons to scroll through the graph or use the mouse to draw a box on the main graph or the overview graph above the buttons. Right-click on the graph to edit graph properties.

4.5 Structures

The **Data...Structures** menu displays information associated with structures (e.g., diversions, reservoirs) that have administrative data. The following figure illustrates the **Structure Data** display.



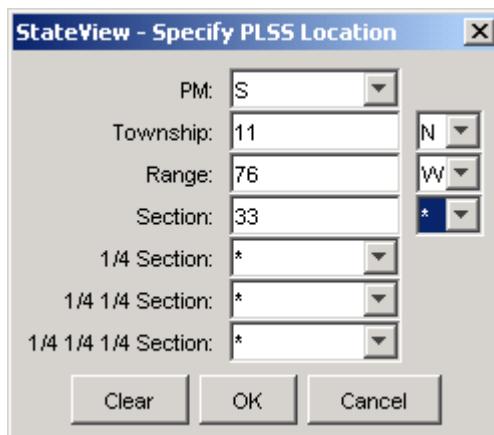
Structure Data Window

To display structure data, first select query options, as described below:

Div/Dist The water division and district are used to limit queries to a region. The available options are typically constrained using the **Tools...Options...Water District Filter** settings.

Where Use the **Where** list to choose additional criteria for limiting a query. To see an explanation of the choices, do a simple query, and then use the tool tips for each column heading.

Use the **Location** choice to query by legal location. To input the location, click in the entry field, which will cause the following dialog to be displayed:



Location_Dialog

Wildcard characters (*) can be used to make the search as broad as desired.

Initiate a query by pressing the **Get Data** button or press **Enter** while the mouse cursor is in a text entry field. Queries of entire districts or divisions may require a few minutes to return results but typically only a few seconds are required. The results from the query are displayed in list format, as illustrated in the following figure:

The screenshot shows the 'StateView - Structure Data - Query' window. At the top, there are 'Query Options' fields: 'Div/Dist: 1 - South Platte: Greeley to Balzac', 'Where: Structure Name Contains highline', and two additional 'Where' dropdowns. A 'Get Data' button is located to the right of these fields. Below the query options, a message states 'Structure Records: 6 records returned in 4.366 seconds'. The main area displays a table with the following data:

	WD	ID	STRUCTURE NAME	LOCATION	WATER SOURCE	STREAM MILE	OWNER
1	1	764	HIGHLINE DITCH 1	S 3N 62W 10 SW SW NW	LOST CREEK	0.00	NO INFORMATION
2	1	765	HIGHLINE DITCH 2	S 3N 62W 10 SW SW NW	LOST CREEK	0.00	NO INFORMATION
3	1	607	HIGHLINE DITCH 3	S 3N 62W 10 NE NE NW	LOST CREEK	0.00	NO INFORMATION
4	1	763	HIGHLINE DITCH 4	S 3N 62W 10 SW SW SE	LOST CREEK	0.00	NO INFORMATION
5	1	766	HIGHLINE DITCH 5	S 3N 62W 10 SW SE SW	LOST CREEK	0.00	NO INFORMATION
6	1	767	HIGHLINE DITCH 6	S 3N 62W 10 SE NW NW	LOST CREEK	0.00	NO INFORMATION

At the bottom of the window, there are buttons for 'Display View', 'Print', 'Export', and 'Close'. A note at the bottom left says '6 records returned in 4.366 seconds.' and the title 'Structure Data Query Showing Results List' is centered at the bottom.

Structures_Diversion

Information displayed in the tabular list includes water district, identifier, name, legal location, water source (stream, lake, etc.), stream mile (from the state line), owner, structure type, currently in use (see below), whether a trans-basin structure, sum of decreed rights, and location coordinates. These data fields are available for all structure types in HydroBase. The currently in use flag can change from year to year and has the following possible values (from **State of Colorado Water Commissioner Manual**):

- A Active structure with contemporary diversion records
- B Structure abandoned by the court
- C Conditional structure
- D Duplicate, ID is no longer used
- F Structure used as FROM number – located in another District
- H Historical structure only – no longer exists or has records, but has historical data
- I Inactive structures which physically exist but no diversion records are kept
- N Non-existent structure with no contemporary or historical records
- U Active structures but diversion records are not maintained

Unlike the **Data...Stations** display, where multiple stations can be selected and viewed together, structure views are displayed by first selecting a single structure (click on the list) and then selecting a view from a list of available views. This approach is taken because available structure views depend on the structure type and structures have several related views. The following buttons can be pressed to act on the structure list:

Display View

Display the selected view for the selected structure. See below for a list of views.

Select On Map

If the map interface is enabled and structure data are available on the map, select the stations on the map. **Warning: only diversion, reservoir, and well data (for some divisions) are typically available for maps. Not all data types may have corresponding map layers.**

See **Chapter 7 - Examples of Use** for information about interacting with the map interface.

Print

Print the contents of the list.

Export

Export the contents of the list to a file.

Close

Close the **Structure Data** window.

Once a structure is selected from the list, the list of available views next to the **Display View** button is updated, based on the structure type. The following views are available:

Available Structure Display Views

View Type	Structure Type	Description
Detail	Any	Detailed information specific to the structure type; the view choice will be specific to the structure type (Jurisdictional Dam - Detail , Minimum Flow Reach - Detail , Non-Jurisdictional Dam - Detail , Reservoir - Detail). Headgates and wells do not have additional detail data.
Diversion Coding/ Reservoir Releases	Headgate, Reservoir	Historic diversion coding (diversion time series), which may include reservoir releases.
Historical Reservoir Measurements	Reservoir	Time series associated with reservoirs (e.g., elevations, storage)
Irrigated Acres by Parcel	Any	Irrigated acreage information associated with the structure.
Location	Any	Location information
More Structure Information	Any	More structure information that is available for any structure but which does not fit on the main Structure Data screen
Owner/Contact Information	Any	Owner and contact information
Structure Summary	Any	A summary of several data values for the structure, including water rights, irrigated acreage, and diversion coding, if available.
Water Rights - Transaction, Water Rights - Net Amounts	Headgate, Minimum Flow Reach, Reservoir, Well	Water rights associated with the structure. Note that wells with water rights may or may not also be represented in the Data...Well Permits displays.

Examples of each view are provided in the following sections.

4.5.1 Detail - Jurisdictional Dam

The structure **Jurisdictional Dam - Detail** view shows information for jurisdictional (non-exempt) dams, as shown in the following figure.

StateView - Structure Data - Jurisdictional Dam Detail - 5190510108 (GRANBY)

Structure Name:	DIV:	WD:	ID:																																				
GRANBY	5	51	90510108																																				
Dam AKA:		State Dam ID: 510108																																					
Hazard Class: 1		National Inventory ID: 01656																																					
Nearest Downstream																																							
Town Name: HOT SULPHUR SPRINGS		Distance: 15.0	Federal Land: N																																				
		Stream Code: N	Federal Regulations: N																																				
		Crest: Elevation: 8280.0	Dam Heights:																																				
Spillway Capacity: 12000.0		Length: 861.0	Jurisdictional: 232.0																																				
Outlet Capacity: 435.0		Width: 40.0	Hydraulic: 231.0																																				
Dam Type: RE		Purpose: IR	Structural: 298.0																																				
Remarks: _____																																							
<input checked="" type="button"/> Spillway <input type="button"/> Inspection <input type="button"/> Outlet <input type="button"/> Emergency Plan																																							
<table border="1"> <thead> <tr> <th></th> <th>SPILLWAY NAME</th> <th>SPILLWAY CAPACITY</th> <th>FREEBOARD</th> <th>FLOW CODE</th> <th>SPILLWAY TYPE</th> <th>WALL SS</th> <th>WIDTH</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> <td>12000.0</td> <td>25.0</td> <td>CONC</td> <td>GCHAN</td> <td>0.0</td> <td>40.0</td> </tr> <tr> <td>2</td> <td></td> <td>0.0</td> <td>0.0</td> <td></td> <td></td> <td>0.0</td> <td>0.0</td> </tr> <tr> <td>3</td> <td></td> <td>0.0</td> <td>0.0</td> <td></td> <td></td> <td>0.0</td> <td>0.0</td> </tr> </tbody> </table>									SPILLWAY NAME	SPILLWAY CAPACITY	FREEBOARD	FLOW CODE	SPILLWAY TYPE	WALL SS	WIDTH	1		12000.0	25.0	CONC	GCHAN	0.0	40.0	2		0.0	0.0			0.0	0.0	3		0.0	0.0			0.0	0.0
	SPILLWAY NAME	SPILLWAY CAPACITY	FREEBOARD	FLOW CODE	SPILLWAY TYPE	WALL SS	WIDTH																																
1		12000.0	25.0	CONC	GCHAN	0.0	40.0																																
2		0.0	0.0			0.0	0.0																																
3		0.0	0.0			0.0	0.0																																
<input type="button"/> Print <input type="button"/> Export <input type="button"/> Close																																							

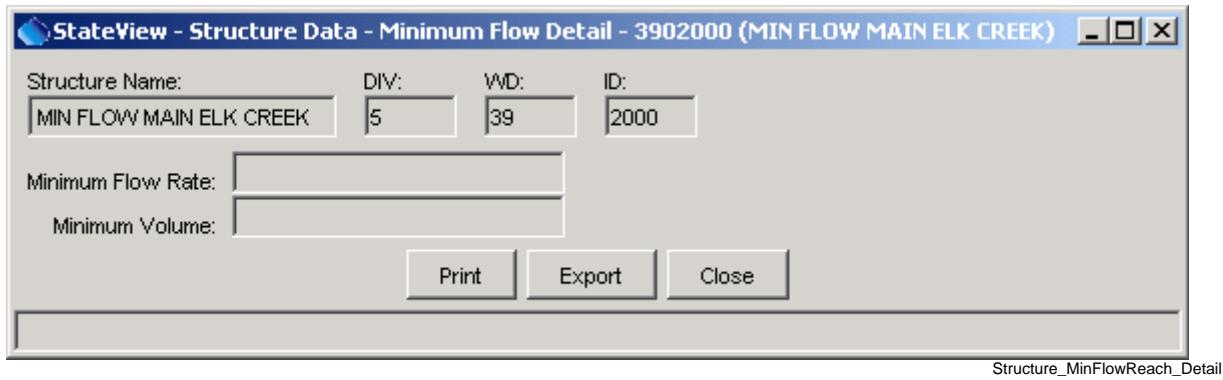
Jurisdictional Dam Detail View

Structure_JurDam_Detail

Note that several tabbed displays can be viewed at the bottom of the view for **Spillway**, **Inspection**, **Outlet**, and **Emergency Plan** data.

4.5.2 Detail - Minimum Flow Reach

The structure **Minimum Flow Reach - Detail** view shows information for minimum flow reaches, as shown in the following figure.



Minimum Flow Reach Detail View

Currently, HydroBase does not include the CWC's instream flow database (it mainly includes information related to water rights). The CWC database is being linked to HydroBase and may be available in the future.

4.5.3 Detail - Non-Jurisdictional Dam

The structure **Non-Jurisdictional Dam - Detail** view shows information for non-jurisdictional (exempt) dams, as shown in the following figure.

The screenshot shows a Windows application window titled "StateView - Structure Data - Nonjurisdictional Dam Detail - 5191009679 (HAR...)" with a blue header bar and standard window controls (minimize, maximize, close).

The main area contains the following data entries:

Structure Name:	DIV:	WD:	ID:
HARBERT	5	51	91009679
Receipt:	9679		
Date Application Approved:	1963-06-27		
Date Construction Completed:			
Drainage Area:	2000.0		
Dam Type:	T		
Height of Dam:	11.00		
Height of Spillway:	6.00		
Width of Spillway:	200.00		
Tank Capacity:	1.0		
Size of Outlet:			
Type of Outlet:			
Title Number:	1-1963		

At the bottom of the window are three buttons: "Print", "Export", and "Close".

Non-Jurisdictional Dam Detail View

Structure_NonJurDam_Detail

4.5.4 Detail - Reservoir

The structure **Reservoir - Detail** view shows information for reservoirs, as shown in the following figure.

StateView - Structure Data - Reservoir Data - 5103695 (CBT SHADOW MTN GRAND L) [Minimize] [Maximize] [Close]

Structure Name:	DIV:	WD:	ID:	
CBT SHADOW MTN GRAND L	5	51	3695	
Normal Storage	Maximum Storage	Surface Area	Drainage Area	
18400.0	24109.0	1852.0	121600.0	
Reservoir EOM Record Period		[] to []		
Capacity Table				
	ELEVATION (FT)	GAGE HEIGHT (FT)	SURFACE AREA (ACRES)	VOLUME (AF)
1				2 4
2				27 76
3				145 506
4				190 750
5				480 2069
6				929 5591
7				1096 8628
8				1208 10932
9				1808 14708
10				1830 16530
11				1852 18369

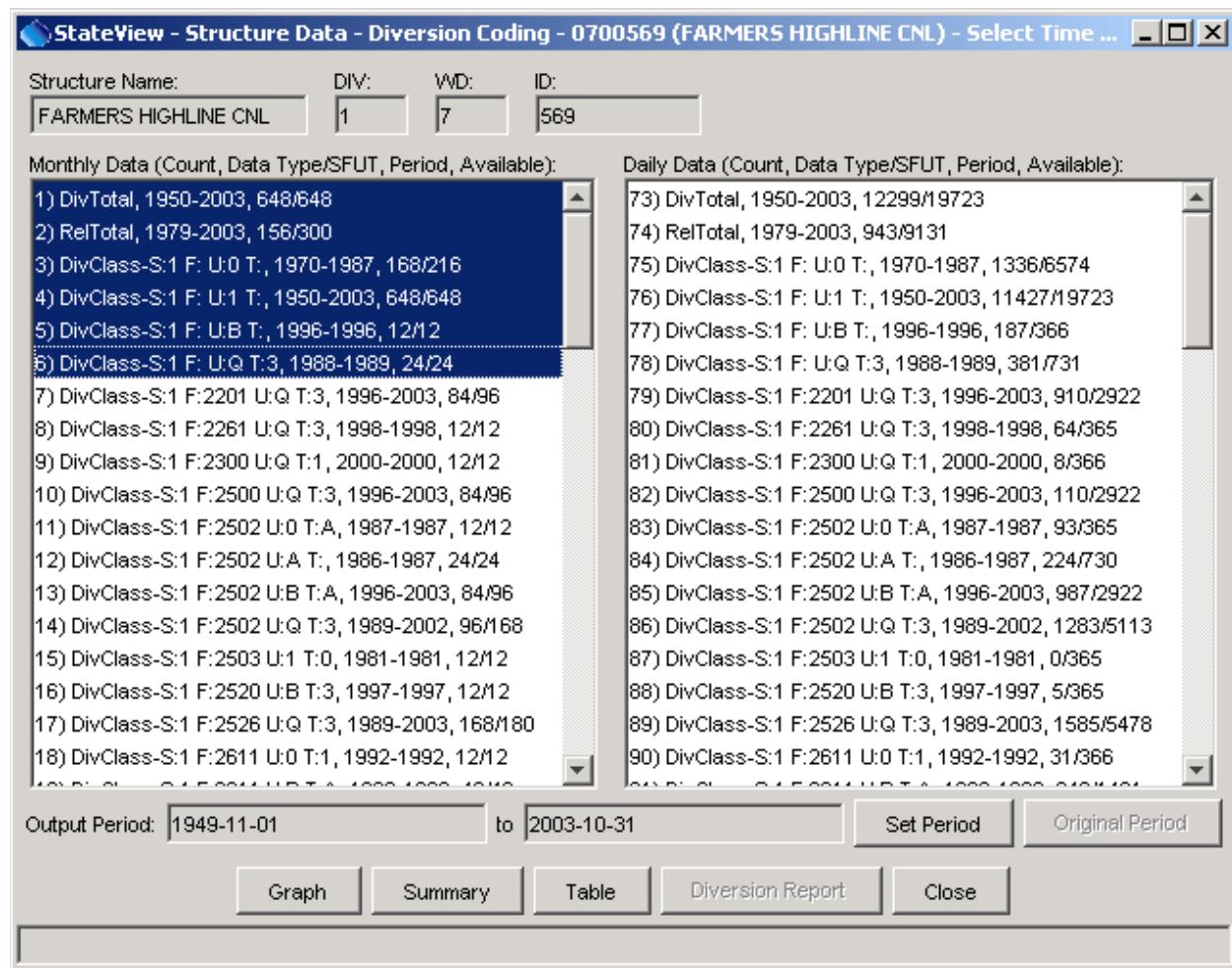
Print Export Close

Structure_Reservoir_Detail

Reservoir Detail View

4.5.5 Diversion Coding/Reservoir Releases

The **Diversion Coding/Reservoir Releases** view provides access to historic diversion coding and reservoir release (time series) records in graphical, report, and tabular formats. Diversion coding applies to diversion and reservoir administrative data. When this view is initially selected, the following dialog is displayed, which lists the available diversion coding combinations.



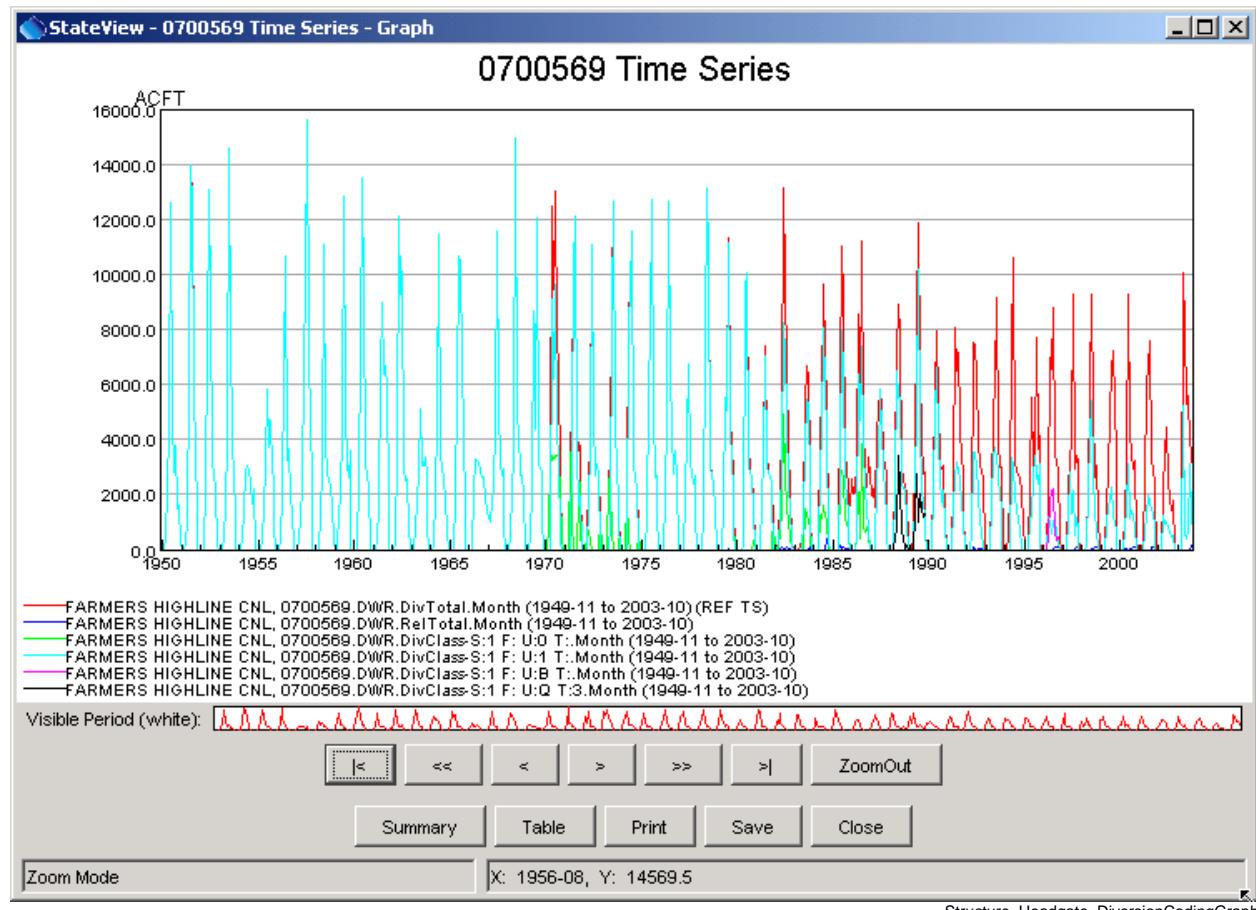
Diversion Coding Time Series List Dialog

Structure_Headgate_DiversionCodingList

As shown in the above example, time series that are available for a structure are categorized by diversion total, release total, and SFUT (source, from, use, type) water classes. The SFUT values are explained in the **State of Colorado Water Commissioner Manual**. One or more time series can be selected from the list and can consequently be viewed by pressing the **Graph**, **Summary**, or **Table** buttons. The **Output Period** that is shown is adjusted automatically as time series are selected but can also be manually set with the **Set Period** button.

This display does not currently list infrequent diversion or diversion comments. These time series can be viewed in the **Structure Summary** display and TSTool software.

An example of a graph for the above time series is shown in the following figure. See the **TSView Time Series Viewing Tools Appendix** for more information about time series viewing tools.



Example Diversion Coding Graph

Diversion/reservoir coding data also can be viewed and processed using the CDSS TSTool software.

4.5.6 Historical Reservoir Measurements

The structure ***Historical Reservoir Measurements*** view is only available for reservoirs. It lists in tabular form the reservoir measurements that are recorded on a day.

The screenshot shows a Windows application window titled "StateView - Structure Data - Historical Reservoir Measurements - 2003536 (CONTINENTAL RES)". At the top, there are input fields for "Structure Name" (CONTINENTAL RES), "DIV" (3), "WD" (20), and "ID" (3536). Below these fields is a message: "See also Diversion Coding and Reservoir Release data." A sub-header "Query Results List: (439 records returned)" is followed by a table with 11 rows of data. The table has columns: DATE, GAGE HT. (FT), STORAGE (ACFT), INFLOW (ACFT), RELEASE (ACFT), and EVAP LOSS (ACFT). The data is as follows:

	DATE	GAGE HT. (FT)	STORAGE (ACFT)	INFLOW (ACFT)	RELEASE (ACFT)	EVAP LOSS (ACFT)
1	1974-11-01	25.1	1066.0			
2	1974-12-01	26.8	1314.0			
3	1975-01-01	29.1	1706.0			
4	1975-02-01	31.6	2213.0			
5	1975-03-01	33.7	2697.0			
6	1975-04-01	35.6	3189.0			
7	1975-05-01	37.6	3733.0			
8	1975-06-01	39.5	4303.0			
9	1975-07-01	46.3	6604.0			
10	1975-08-01	36.6	3461.0			
11	1975-09-01	32.4	2377.0			

At the bottom of the window, there are buttons for "Print", "Export", and "Close". A status bar at the bottom left says "Reservoir Measurement Query completed." and the file name "Structure_ReasMeas" is visible on the right side.

Historical Reservoir Measurements View

Records are typically not continuous and all data types may not be available for a reservoir.

Reservoir measurement data also can be viewed and processed using the CDSS TSTool software.

4.5.7 Irrigated Acres by Parcel

The structure **Irrigated Acres by Parcel** view shows the irrigated acres associated with a structure.

Structure Name: RIO GRANDE CNL **DIV:** 3 **WD:** 20 **ID:** 812

Irrigated Acres Summary

GIS Total (Acres):	84513.883	Most Recent Report Year:	1998
Diversion Comments Total (Acres):	57420.000	Most Recent Report Year:	2004
Structure Total (Acres):	80347.000	Most Recent Report Year:	2002

Parcel Details

YEAR	DIV	ID	PARCEL	PERIMETER (M)	PARCEL AREA (ACRE)	CROP TYPE	IRRIGATION TYPE	PARCEL PERCENT IRRIGATED BY STRUCTURE	PARCEL AREA IRRIGATED BY STRUCTURE (ACRE)	PARCEL AREA IRRIGATED BY STRUCTURE, SUM (ACRE)
1	1998	3	10101	2610.943	131.832	ALFALFA	SPRINKLER	100.000	131.832	84513.882
2	1998	3	10102	2650.783	135.253	ALFALFA	SPRINKLER	100.000	135.253	84513.882
3	1998	3	10103	3103.069	124.643	ALFALFA	SPRINKLER	100.000	124.643	84513.882
4	1998	3	10104	2532.175	123.794	ALFALFA	SPRINKLER	100.000	123.794	84513.882
5	1998	3	10105	2619.833	133.197	ALFALFA	SPRINKLER	100.000	133.197	84513.882

Irrigated Acres by Parcel View

Structure_IrrigatedAcres

Irrigated acres are shown by year, parcel identifier, crop type, and irrigation method. The percent of the parcel irrigated by the structure is also shown, which allows calculation of the acres irrigated. The total acres irrigated by the structure for a year are also shown, repeated in each row. The parcel data are typically determined during the irrigated lands assessment that is performed to support consumptive use modeling for CDSS projects. The spatial data and attributes are loaded into HydroBase to facilitate queries.

Irrigated parcel data also can be viewed and processed using the CDSS TSTool software.

4.5.8 Location

The structure **Location** view provides location-related information about a structure.

StateView - Structure Data - Location Data - 2000812 (RIO GRANDE CNL)

Structure Name:	DIV:	WD:	ID:			
RIO GRANDE CNL	3	20	812			
State:	County:	Location Type:	Stream Name:	Stream Mile:		
CO	RIO GRANDE	Manmade Structure	RIO GRANDE	0.00		
COORDINATES:						
PM:	TWN:	RNG:	SEC:	1/4:	1/4 1/4:	1/4 1/4 1/4:
N	40	N 6 E	30	NW	NW	SW
Latitude:	Longitude:	UTM X:	UTM Y:	Topographic Map:	Hydrologic Unit Code:	
37.687651	-106.367453	379430.800000	4172039.900000		13010002	
Print Export Close						
Ready						

Location View

Structure_Location

4.5.9 More Structure Information

The structure **More Structure Information** view provides additional information common to all structure types that will not fit on the main structure display. Use available **Detail** views described previously to see information specific to a structure type.

StateView - Structure Data - More Structure Information - 2000812 (RIO GRANDE CNL)

Structure Name:	DIV:	WD:	ID:																			
RIO GRANDE CNL	3	20	812																			
Structure Type:	CIU Code:	Estimated Capacity:	Decreed Capacity:																			
Headgate	A	1900.00	1648.50 CFS																			
Structure AKA:	Equipment:																					
<table border="1"><thead><tr><th></th><th>DATE INSTALLED</th><th>MEAS DEVICE</th></tr></thead><tbody><tr><td>1</td><td></td><td>80 FT RATED SECT</td></tr></tbody></table>				DATE INSTALLED	MEAS DEVICE	1		80 FT RATED SECT														
	DATE INSTALLED	MEAS DEVICE																				
1		80 FT RATED SECT																				
Mapfile Information:	Court Case Information:																					
<table border="1"><thead><tr><th>FILING DATE</th><th>FILING NUMBER 1</th><th>FILING NUMBER 2</th><th>TITLE</th><th>SUF ST#</th></tr></thead><tbody><tr><td></td><td></td><td></td><td></td><td></td></tr></tbody></table>		FILING DATE	FILING NUMBER 1	FILING NUMBER 2	TITLE	SUF ST#						<table border="1"><thead><tr><th>CASE NO</th><th>BOOK NO</th><th>PAGE NO</th><th>COMMENTS</th></tr></thead><tbody><tr><td></td><td></td><td></td><td></td></tr></tbody></table>			CASE NO	BOOK NO	PAGE NO	COMMENTS				
FILING DATE	FILING NUMBER 1	FILING NUMBER 2	TITLE	SUF ST#																		
CASE NO	BOOK NO	PAGE NO	COMMENTS																			
Notes:																						
<input type="button" value="Print"/> <input type="button" value="Export"/> <input type="button" value="Close"/>																						
Finished retrieving data.																						

More Structure Information View

Structure_MoreStructure

4.5.10 Owner/Contact Information

The structure **Owner/Contact Information** view provides information about the owner of the structure.

StateView - Structure Data - Owner/Contact Data - 2000812 (RIO GRANDE CNL)

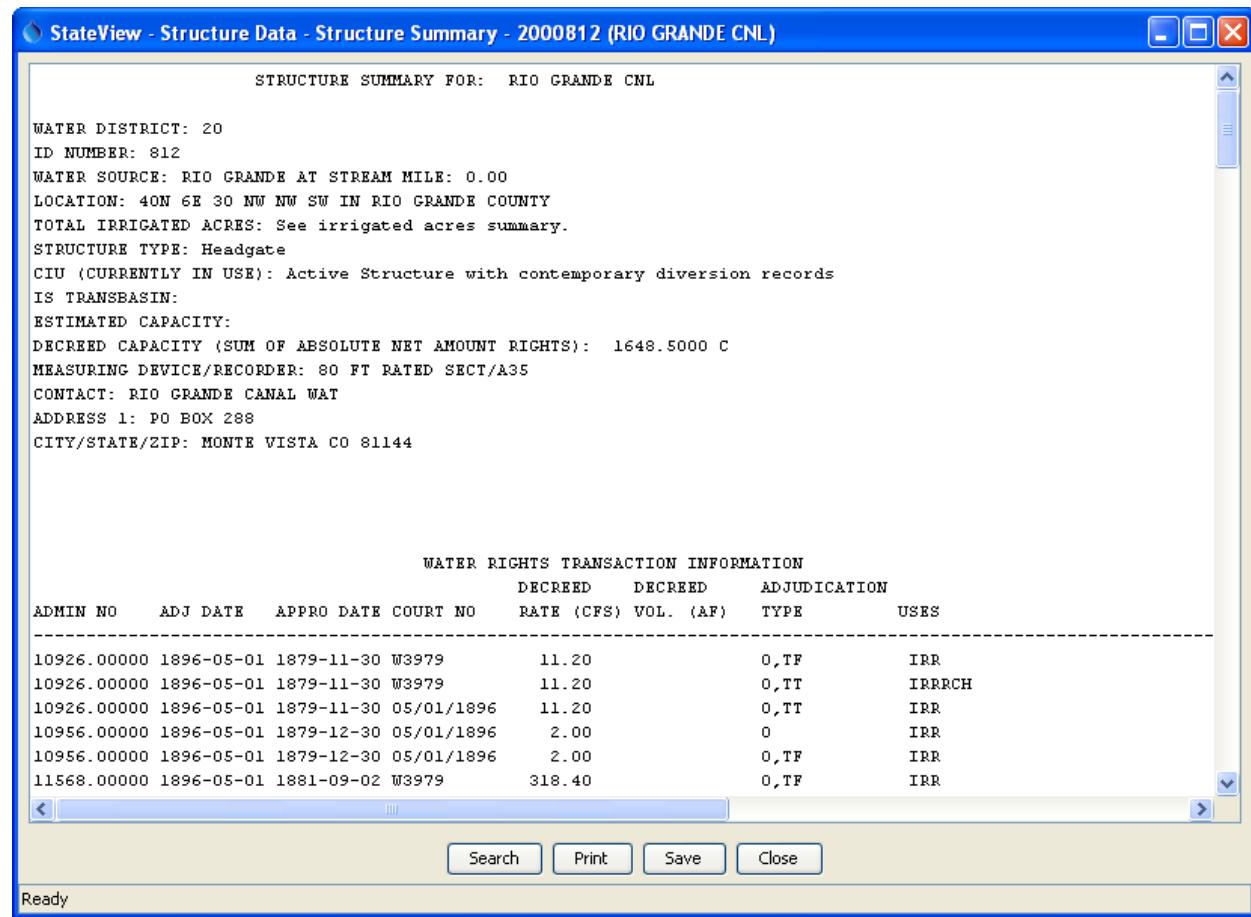
Structure Name:	DIV:	WD:	ID:
RIO GRANDE CNL	3	20	812
Fullscreen:			
Name:	RIO GRANDE CANAL WAT		
Title:	OWNER		
Organization:			
Bonding Co.:			
Address:	BOX 288		
City:	MONTE VISTA		
State:	CO		
ZIP:	81144		
CONTACT MEANS TRY FIRST PHONE NUMBERS			
Print Export Close			

Structure_Owner

Structure Owner/Contact Information View

4.5.11 Structure Summary

The **Structure Summary** view displays summary information for a structure.



Structure Summary View for a Headgate

This report summarizes structure information from several database tables, including:

- Structure identifier, name, location, and physical characteristics
- Water rights
- Irrigated acreage
- Diversion and reservoir release records

The report is useful when one or a few structures are of interest.

4.5.12 Water Rights - Net Amounts

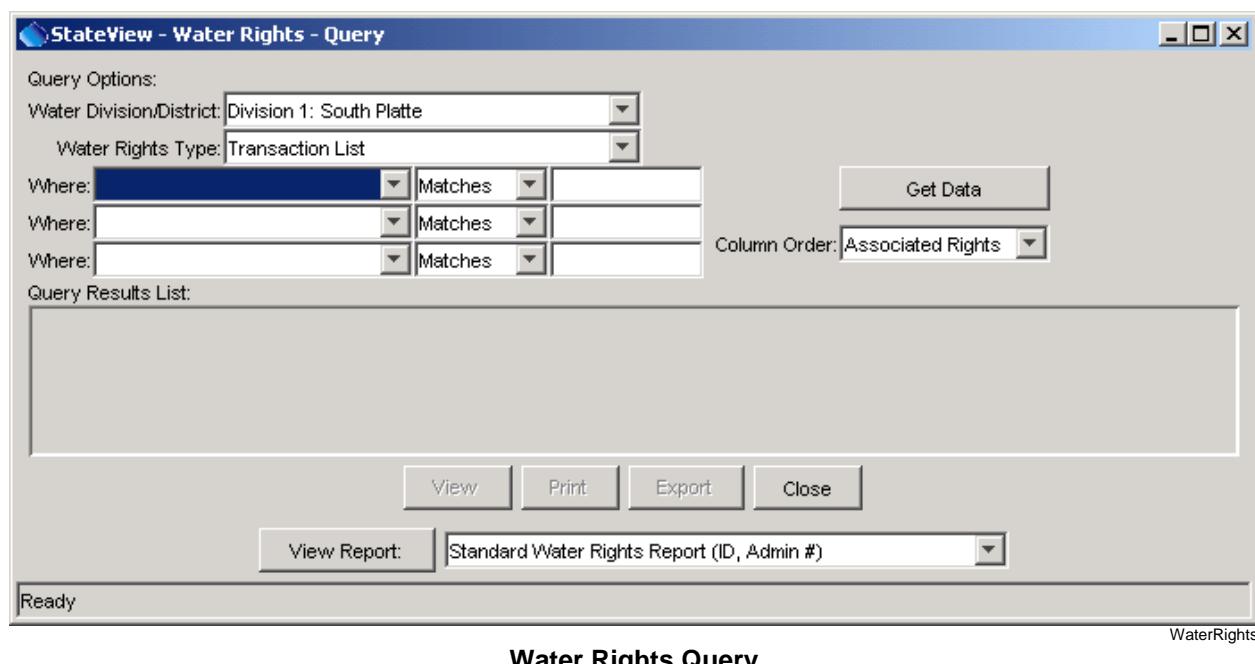
The structure **Water Rights - Net Amounts** view for a structure is the same as the general **Data...Water Rights** view, constrained to show only the structure of interest. See **Section 4.6 - Water Rights** for more information.

4.5.13 Water Rights - Transaction

The structure **Water Rights - Transaction** view for a structure is the same as the general **Data...Water Rights** view, constrained to show only the structure of interest. See **Section 4.6 - Water Rights** for more information.

4.6 Water Rights

The **Data...Water Rights** menu displays transaction and net amount water rights as raw data and reports. The following figure illustrates the **Water Rights Query** display.

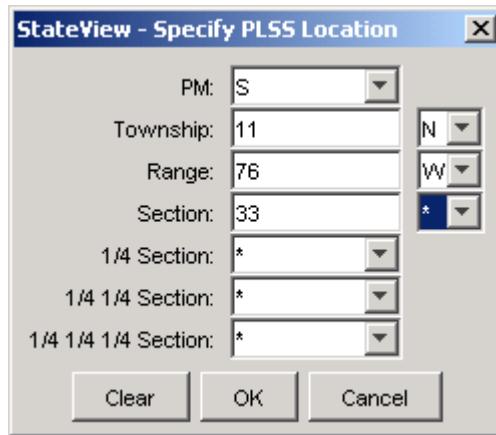


Water Rights Query

To display water rights data, first select query options, as described below:

- Water Division/District** The water division and district are used to limit queries to a region. The available options are typically constrained using the **Tools...Options...Water District Filter** settings.
- Water Rights Type** The water rights type can be either **Transaction List** (the individual transactions that have occurred over time) or **Net Amounts** (the resulting sum of the transactions). The available output formats depend on the water right type.
- Where** Use the **Where** list to choose additional criteria for limiting a query. To see an explanation of the choices, do a simple query, and then use the tool tips for each column heading.

Use the **Location** choice to query by legal location. To input the location, click in the entry field, which will cause the following dialog to be displayed:



Location_Dialog

Wildcard characters (*) can be used to make the search as broad as desired.

- Column Order** If the **Legal** column order is selected, then the legal location is shown before other information. If the **Summary** column order is selected, the legal location information is shown at the right end of the table. The column order is changed after data are queried.
- Output Format** After water rights are displayed to the screen as raw data, the results can be formatted and displayed in a report window. The format of the report, including sort order, is predefined for reports; therefore, the data may be requeried if the displayed order is not consistent with the report. Displaying the raw data is useful because it can be exported to a delimited format (e.g., for use with a spreadsheet) and the query options can be used to narrow the query. Printing some of the reports may require landscape and/or oversized paper (this is not automatically selected).

Initiate a query by pressing the **Get Data** button or press **Enter** while the mouse cursor is in the **Is** field. Queries for an entire district or division can take several minutes but typically require only a few seconds. The results from the query are displayed in list format, as illustrated in the following sections.

4.6.1 Net Amount Water Rights

The following figure illustrates a net amounts water rights data view.

The screenshot shows the 'StateView - Water Rights - Query' application window. At the top, there are 'Query Options' for 'Water Division/District' (set to 'Division 1: South Platte') and 'Water Rights Type' (set to 'Net Amounts'). Below these are three 'Where' clauses: 'Water Right Name Contains highline cnl', 'Where' (empty), and 'Where' (empty). A 'Get Data' button is located to the right of the second 'Where' clause. To the right of the third 'Where' clause is a 'Column Order' dropdown set to 'Legal'. Below the query options, a message states 'Water Rights Records: 155 records returned in 21.823 seconds'. The main area displays a table with 155 records. The columns are labeled 'WD', 'ID', 'WATER RIGHT NAME', 'WATER SOURCE', 'LOCATION', and 'COUNTY'. The first five rows of the table are as follows:

WD	ID	WATER RIGHT NAME	WATER SOURCE	LOCATION	COUNTY
27	7	FARMERS HIGHLINE CNL	CLEAR CREEK	S 3S 70W 27 SW NW SE	JEFFERS
28	7	FARMERS HIGHLINE CNL	CLEAR CREEK	S 3S 70W 27 SW NW SE	JEFFERS
29	7	FARMERS HIGHLINE CNL	CLEAR CREEK	S 3S 70W 27 SW NW SE	JEFFERS
30	7	FARMERS HIGHLINE CNL	CLEAR CREEK	S 3S 70W 27 SW NW SE	JEFFERS
31	8	HIGHLINE CNL	SOUTH PLATTE RIVER	S 6S 69W 33 SE NW SE	JEFFERS

At the bottom of the window, there are buttons for 'View', 'Print', 'Export', and 'Close'. A dropdown menu below these buttons shows 'View Report' and 'Tabulation Report (Admin #, ID)'. A status bar at the bottom left says '155 records returned in 21.823 seconds.' and the status bar at the bottom right says 'WaterRights_Net_List'.

Water Rights View Showing Net Amounts List

The water rights data display includes a large number of columns. This format is useful for finding specific data items. However, standard reports are also available that organize data in useful formats. To view the water rights in a report format, select the appropriate format from the **View Report** choices. If necessary, the database will be queried in order to sort data as needed for the report. Available net amounts reports are as follows and adhere to existing report formats, as much as possible.

Available Net Amounts Water Right Reports

Net Amounts Output Format	Sort Order
Administrative Summary List	Admin #, ID
Administrative Summary List by Stream	Stream, Admin #, ID
Priority List	Admin #, ID
Priority List by Stream	Stream, Admin #, ID
Stream Alphabetical List	Stream, Name, Admin #
Tabulation Report	Admin #, ID

The following figure illustrates a net amounts tabulation report.

StateView - Tabulation Report (Admin #, ID)

Tabulation Report							
Name of Structure	Type	Name of Source	WD	-- L O C A T I O N --	Use	Net Abs	Net C
FARMERS HIGHLINE CNL		CLEAR CREEK	7	SE NW SW 27 3 S	70 W S IMC	0.276	
FARMERS HIGHLINE CNL		CLEAR CREEK	7	SE NW SW 27 3 S	70 W S IMC	1.000	
FARMERS HIGHLINE CNL		CLEAR CREEK	7	SE NW SW 27 3 S	70 W S IMC	3.281	
FARMERS HIGHLINE CNL		CLEAR CREEK	7	SE NW SW 27 3 S	70 W S IMC		
FARMERS HIGHLINE CNL		CLEAR CREEK	7	SE NW SW 27 3 S	70 W S IMC	39.800	
FARMERS HIGHLINE CNL		CLEAR CREEK	7	SE NW SW 27 3 S	70 W S IMC		
FARMERS HIGHLINE CNL		CLEAR CREEK	7	SE NW SW 27 3 S	70 W S IMC		
FARMERS HIGHLINE CNL		CLEAR CREEK	7	SE NW SW 27 3 S	70 W S IMC		
FARMERS HIGHLINE CNL		CLEAR CREEK	7	SE NW SW 27 3 S	70 W S IMC		
HIGHLINE CNL		SOUTH PLATTE RIVER	8	SE NW SE 33 6 S	69 W S M		
HIGHLINE CNL		SOUTH PLATTE RIVER	8	SE NW SE 33 6 S	69 W S IMC		
FARMERS HIGHLINE CNL		CLEAR CREEK	7	SE NW SW 27 3 S	70 W S IMC		
FARMERS HIGHLINE CNL		CLEAR CREEK	7	SE NW SW 27 3 S	70 W S IMC		
FARMERS HIGHLINE CNL		CLEAR CREEK	7	SE NW SW 27 3 S	70 W S IMC		
FARMERS HIGHLINE CNL		CLEAR CREEK	7	SE NW SW 27 3 S	70 W S IMC		
HIGHLINE CNL		SOUTH PLATTE RIVER	8	SE NW SE 33 6 S	69 W S IMC		
FARMERS HIGHLINE CNL		CLEAR CREEK	7	SE NW SW 27 3 S	70 W S IMC	1.610	
FARMERS HIGHLINE CNL		CLEAR CREEK	7	SE NW SW 27 3 S	70 W S IMC	2.750	
FARMERS HIGHLINE CNL		CLEAR CREEK	7	SE NW SW 27 3 S	70 W S IMC		
HIGHLINE CNL		SOUTH PLATTE RIVER	8	SE NW SE 33 6 S	69 W S IMC		
FARMERS HIGHLINE CNL		CLEAR CREEK	7	SE NW SW 27 3 S	70 W S IMC		

Ready

Net Amounts Water Rights Tabulation Report

WaterRights_Net_Tabulation

In addition to the water rights data list and reports, a single net amount water right can be viewed in expanded form by selecting the water right in the list in the **Water Rights Query** window and then pressing the **View** button. The following figure illustrates the resulting view.

StateView - Water Right - Net Amounts

Water Right Name:	DIV:	WD:	ID:	Water Source:			
FARMERS HIGHLINE CNL	1	7	569	CLEAR CREEK			
County:	PM:	TWN:	RNG:	SEC:	1/4:	1/4 1/4: 1/4 1/4 1/4:	
JEFFERSON	S	3	S	70	W	27	SW NW SE
Adjudication Date:	Prior Adjudication Date:					Appropriation Date:	
1884-10-04						1865-04-23	
Administration No:	Order No:					Prior/Case No:	
5592.00000	0					94CW0291	
Adjudication Type:	Use Type:					Struct Type:	
	STOIRRMMUNCOMINDRECFISFIRDOMSTK					1	
Rate Abs (cfs):	Vol Abs (acft):	Rate Cond (cfs):	Vol Cond (acft):	Rate Apex (cfs):	Vol Apex (acft):		
2.8900	0.0000	0.0000	0.0000	0.0070	0.0000		
Action Comment:	30/1981 ARVADA CHNG USE W-8762; THORNTON CHNG USE 12/06/1990 86CW401/						
<input type="button" value="Print"/>		<input type="button" value="Export"/>		<input type="button" value="Close"/>			

WaterRights_Net_View

Example Net Water Right View

4.6.2 Water Rights Transaction List

The following figure illustrates a water rights transaction list data view.

The screenshot shows the 'StateView - Water Rights - Query' application window. At the top, there are 'Query Options' including 'Water Division/District' (set to 'Division 1: South Platte') and 'Water Rights Type' (set to 'Transaction List'). Below these are three 'Where:' clauses: 'Water Right Name' containing 'highline cnl', 'Matches' (empty), and 'Matches' (empty). To the right of these are 'Get Data' and 'Column Order' buttons (set to 'Associated Rights'). A message at the top states 'Water Rights Records: 531 records returned in 35.123 seconds'. The main area is a grid table with columns: WD, ID, WATER RIGHT NAME, WATER SOURCE, and LOCATION. The data shows 5 rows for 'FARMERS HIGHLINE CNL' from 'CLEAR CREEK' at 'S 3S 70W 27 SW NW SE'. At the bottom are 'View', 'Print', 'Export', and 'Close' buttons, and a 'View Report' dropdown set to 'Standard Water Rights Report (ID, Admin #)'. A status bar at the bottom says '531 records returned in 35.123 seconds.' and the window title is 'WaterRights_Transaction_List'.

Water Rights Transaction List View

The transaction list view includes a large number of columns. This format is useful for finding specific data items. However, standard reports are also available that organize data in useful formats. To view the water rights in a report format, select the appropriate format from the **View Report** choices. Available transaction list reports are as follows and adhere to existing report formats, as much as possible. The standard and extended reports are very similar, with the extended report having comments.

Available Water Right Transaction List Reports

Transaction List Output Format	Sort Order
Standard Water Rights Report	ID, Admin #
Standard Water Rights Report	Stream #, ID, Admin #
Standard Water Rights Report	Name, Admin #
Standard Water Rights Report	Location
Standard Water Rights Report	Admin #, Name
Standard Water Rights Report	Stream #, Admin #, ID
Extended Water Rights Report	ID, Admin #
Extended Water Rights Report	Stream #, ID, Admin #
Extended Water Rights Report	Name, Admin #
Extended Water Rights Report	Location
Extended Water Rights Report	Admin #, Name
Extended Water Rights Report	Stream #, Admin #, ID

In addition to the water rights data list and reports, a single water right transaction can be viewed in expanded form by selecting the water right in the list in the **Water Rights Query** window and then pressing the **View** button. The following figure illustrates the resulting view.

StateView - Water Right - Transaction

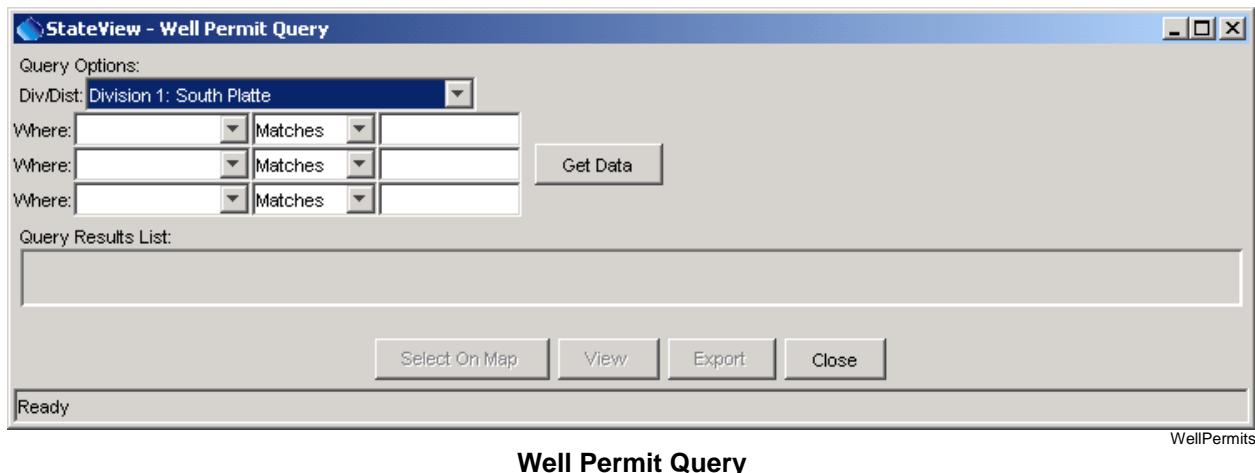
Water Right Name:	DIV:	WD:	ID:	Water Source:					
FARMERS HIGHLINE CNL	1	7	569	CLEAR CREEK					
County:	PM:	TWN:	RNG:	SEC:	1/4:	1/4 1/4: 1/4 1/4 1/4:			
JEFFERSON	S	3	S	70	W	27	SW	NW	SE
Adjudication Date:	Prior Adjudication Date:	Appropriation Date:							
1884-10-04		1860-02-25							
Administration No:	Order No:	Prior/Case No:							
3708.00000	0								
Adjudication Type:	Use Type:	Struct Type:							
O	RRMUNCOMINDRECFISAUGWLD	1							
Rate Amt (cfs):	Vol Amt (acft):	Aband:	Status:	Case No:					
0.0074			A	88CW0105					
Assoc Type:	Assoc WD:	Assoc ID:	Aug Role:	Plan WD:	Plan ID:				
Trans Type:	Tran WD:	Tran ID:	Last Due Dil:	Action Update:					
TT	7	569		1997-08-07					
Action Comment:									
ARVADA CHNG USE 02/13/1992									
<input type="button" value="Print"/>		<input type="button" value="Export"/>		<input type="button" value="Close"/>					

WaterRights_Transaction_View

Water Right Transaction View

4.7 Well Permits

The **Data...Well Permits** menu displays information associated with well permits. Because these data are not typically distributed to the public with HydroBase, the **Data...Well Permits** menu is only enabled if at login the SQL Server database is selected for a non-guest login. The following figure illustrates the **Well Permit Query** display.

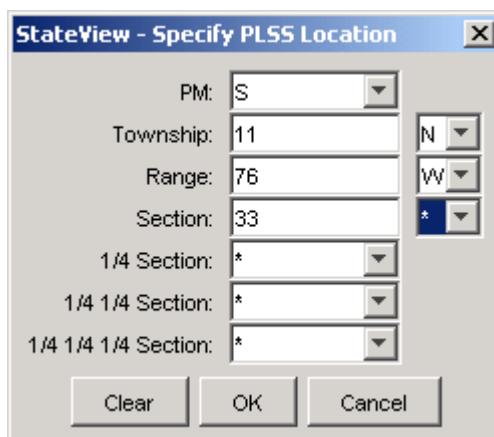


To display well permit data, first select query options, as described below:

Div/Dist The water division and district are used to limit queries to a region. The available options are typically constrained using the **Tools...Options...Water District Filter** settings.

Where Use the **Where** list to choose additional criteria for limiting a query. To see an explanation of the choices, do a simple query, and then use the tool tips for each column heading.

Use the **Location** choice to query by legal location. To input the location, click in the entry field, which will cause the following dialog to be displayed:



Location_Dialog

Wildcard characters (*) can be used to make the search as broad as desired.

Initiate a query by pressing the **Get Data** button or press **Enter** while the mouse cursor is in a **Where** text field. Queries of entire districts or divisions may require a few minutes to return results, but typically only a few seconds are required. Because some districts have many thousands of wells, it may be necessary to use the location **Where** selector to limit the query.

The results from the query are displayed in list format, as illustrated in the following figure:

The screenshot shows the 'StateView - Well Permit Query' dialog box. At the top, there are 'Query Options' settings: 'Div/Dist: Division 8: Designated Basin', 'Where: Depth, feet Greater than 3000', and two additional 'Where' fields. A 'Get Data' button is located next to the second 'Where' field. Below the query options, a message states '3 records returned in 0.22 seconds.' A table displays the results with columns: DIV, WD, PERMIT #, SFX, REP, LOCATION, RECEIPT, WELL NAME, STRUC #, and SUBD. The results are:

DIV	WD	PERMIT #	SFX	REP	LOCATION	RECEIPT	WELL NAME	STRUC #	SUBD
1	8	66	7968		S 34S 44W 31 NE SE	9071961			
2	8	49	12060	F	S 9S 42W 33 NW SW	9036108			
3	8	65	19379	F	S 8N 48W 24 NW SW	9044010			

At the bottom of the dialog box are buttons for 'Select On Map', 'View', 'Export', and 'Close'. The status bar at the bottom left says 'Ready' and the bottom right says 'WellPermits_List'.

Well Permit Query List

Information displayed in the tabular list includes water district, permit number, suffix and replacement code, legal location, receipt, name, and many other data fields. Currently, well permits cannot be displayed on the map. The list of permits can be exported to a file.

Selecting a well permit from the list and pressing the **View** button displays a detailed view of the specific well permit, as shown below. This interface illustrates the meaning of the different fields in the list view shown previously.

StateView - Well Permit

Case No.: XRef#:				Receipt: 9036108
Well Name: Statute:				Permit: 12060 F
Subdivision:				Div: 8 WD: 49
Lot:Block:Filing:				Bas: 1 MD: 1
Parcel ID: Acres in Tract:				Eng: User: RAB
Use 1:	1			Act:
Use 2:				Stat: RC 1994-09-13
Use 3:				Tran: YY 1996-12-05
Area Irrigated:				NP:
Proposed:	Pump Rate:	Acre Feet:	Depth (ft):	EX:
Actual:	1150.00		3130	Notice:
Elevation:	Top:	Bottom:	Water Level:	WA:
Aquifers:				WC:
GW				NWC:
Driller:	Pump:			Pl:
Flow Meter:	Geo.	Log:	Qual:	PC:
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SA: 1968-06-10
Comment:				SBU:
				NBU:
				ABR:
				ABCO:
<input type="button" value="Print"/> <input type="button" value="Export"/> <input type="button" value="Close"/>				

WellPermits_View

Well Permit Data

5 Administration Tools

Version 03.06.05, 2005-08-05, Color, Acrobat Distiller

The CWRAT **Administration** menu provides access to water administration tools. This menu is not available in StateView.



The following sections describe the features available for each menu item:

5.1 Edit Calls

Set and release calls and edit data for existing calls.

5.2 Water Information Sheets

Use existing Water Information Sheets for administration, and display stream network diagrams.

5.3 Water Information Sheet Builder

Create and modify Water Information Sheets and associated diagrams.

Earlier versions of CWRAT relied on local Microsoft Access databases to store real-time streamflow and administrative data. This information could then be synchronized with the central SQL Server database. Due to advances in network communications, administration performed with CWRAT should now occur using the central SQL Server database. The overall performance of this approach is better and simplifies the software tools.

5.1 Edit Calls

The **Administration...Edit Calls** menu allows river call data to be viewed and edited. The interface serves as a record-keeping mechanism for calls but currently does no analysis to help determine when calls should be placed. The viewing features are similar to those available from the **Data...Call Chronology** menu (the latter being non-editable). Users with a valid login and permissions for the water district of the call can edit the call data (guest users are not allowed to edit calls).

The following figure illustrates the **Edit Calls** interface.

Main Stem Calls: (5 records returned for division 1):

	START DATE/TIME	END DATE/TIME	WATER SOURCE	WDID	STRUCTURE NAME
1	2005-07-10 08:00	ACTIVE	SOUTH PLATTE RIVER	6499999	SOUTH PLATTE RIVER COM
2	2005-07-15 08:00	ACTIVE	SOUTH PLATTE RIVER	6400511	HARMONY DITCH 1
3	2005-07-30 08:00	ACTIVE	SOUTH PLATTE RIVER	0100518	LOWER PLATTE BEAVER C
4	2005-07-30 08:00	ACTIVE	SOUTH PLATTE RIVER	6400528	STERLING IRR CO DITCH 1
5	2005-07-31 08:00	ACTIVE	SOUTH PLATTE RIVER	0200826	JAY THOMAS DITCH

Tributary Calls: (9 records returned for division 1):

	START DATE/TIME	END DATE/TIME	WATER SOURCE	WDID	STRUCTURE NAME
1	2005-07-04 08:00	ACTIVE	LITTLE THOMPSON CR	0400602	SUPPLY LATERAL DITCH
2	2005-07-29 06:00	ACTIVE	CACHE LA POUDRE RIV	0300915	CACHE LA POUDRE DITCH
3	2005-07-29 08:00	ACTIVE	CLEAR CREEK	0700549	COLO AGRICULTURAL I
4	2005-07-31 08:00	ACTIVE	ST VRAIN CREEK	0500527	ROUGH READY DITCH
5	2005-07-31 08:00	ACTIVE	BIG THOMPSON RIVER	0400530	LOUDEN DITCH
6	2005-07-31 08:00	ACTIVE	Boulder Creek	0600529	WCU AND S SIDE DITCH
7	2005-07-31 08:00	ACTIVE			
8	2005-07-31 08:00	ACTIVE			
9	2005-07-31 08:00	ACTIVE			

Call Chronology query completed. 14 records returned in 0.371 seconds.

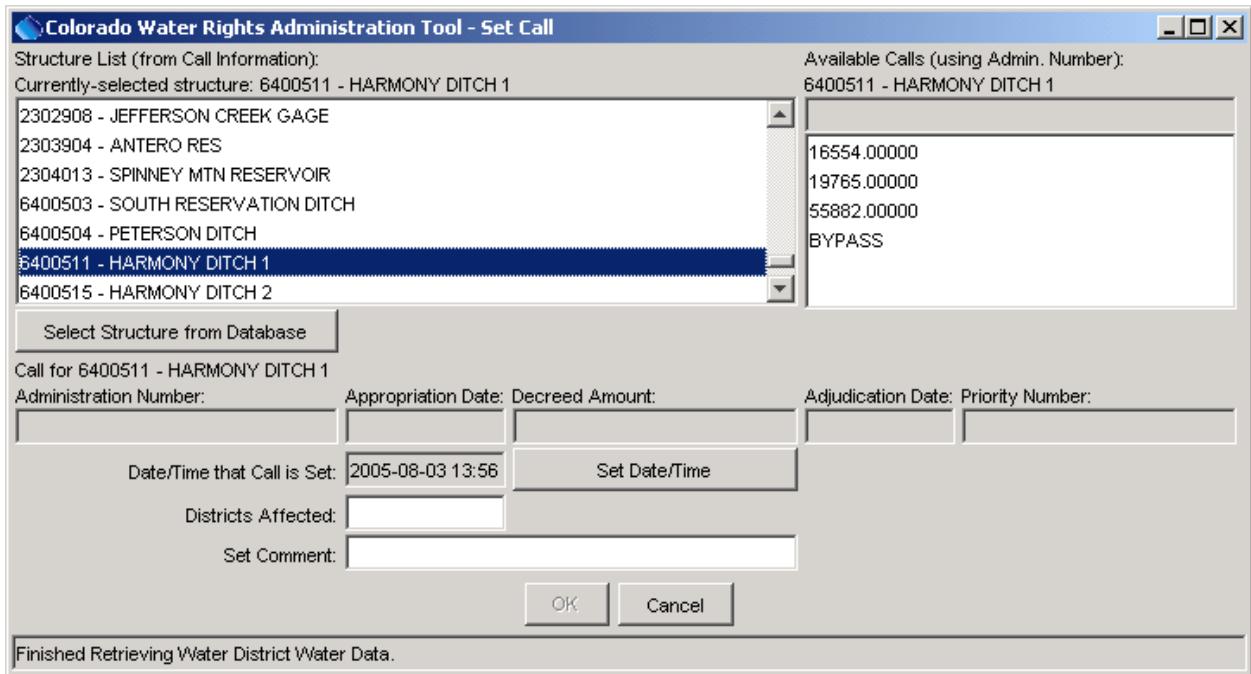
Edit Calls Interface

Admin_EditCalls

The calls that are initially displayed have been active during the display period listed at the top of the window. The period shown defaults to the period set in the **Tools...Options...Time Period** settings. The calls are divided into **Main Stem Calls** (those occurring on streams that are not a tributary) and **Tributary Calls**. Recent calls are listed at the top of each list. The following sections describe how to set and release calls. Use the **Refresh** button to requery the database without setting the period (e.g., use this feature when others may have set calls after the current session has started).

5.1.1 Setting a Call

To set a new call, first press the **Set Call** button on the bottom of the **Edit Calls** interface, which will display a view as illustrated in the following figure.

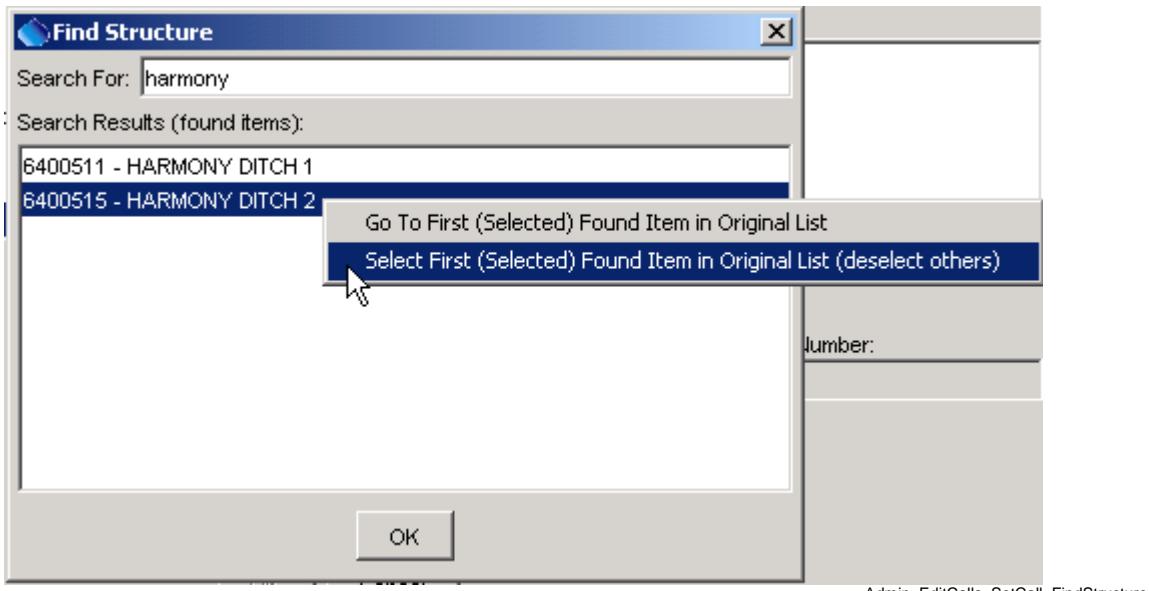


Set Call Dialog - Before Entering Call

Calls are set by first selecting a structure using its water district identifier (WDID) and then selecting a net amount water right for the structure. The first structure in the list will be selected by default. Because there are a large number of structures in the HydroBase database, it is difficult to provide a selectable list containing all structures. Additionally, only structures that are actually administered need to be listed. Consequently, the list of structures that is initially displayed is generated either from available Water Information Sheets or previous calls (see the **Tools...Options...Administration** settings to control which method is used by default). If the desired structure is not in the list, press the **Select Structure from Database** button to make a general database query, which will display the **Structure Data** view as described in **Section 4.5** – when done selecting a single structure, press **OK** and the structure will be added to the **Structure List** as shown in the above figure.

To set a call for a structure using the **Set Call** interface:

1. Select the calling structure's name from the **Structure List**. As discussed above, the list of structures can be listed from available WIS, previous calls, or from a HydroBase query. The structures are sorted by water district identifier. You can also right-click on the list and select **Find Structure** to display a search dialog for the list, as shown in the following figure.



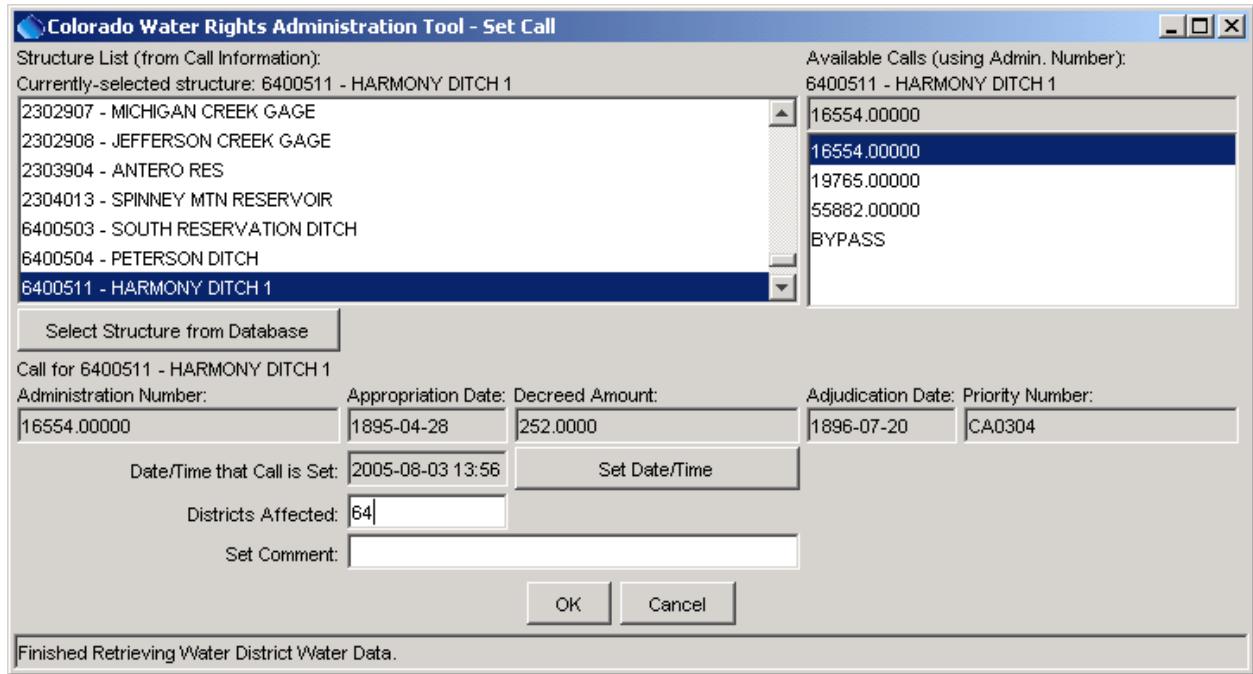
Find Structure Dialog

Admin_EditCalls_SetCall_FindStructure

To use the search dialog, enter a string in the **Search For** text field and press the **Enter** key. All matching structures in the structure list will be listed in the search dialog. To select a structure in the original list, select the structure in the **Find Structure** dialog, then right-click on the list and indicate to select the first found item in the original list. The item will be selected in the original list as if you had selected it directly. Press **OK** to close the **Find Structure** dialog. The currently selected structure will be indicated with a label above the **Structure List**.

2. Based on the structure that is selected, a list of all the available water rights for the structure will be displayed (see **Available Calls** in the **Set Call** interface). The list is sorted in ascending order. The content of the list is set by the **Tools...Options...General** settings and can be the administration number, appropriation date, decree amount, adjudication date, or priority number. When a calling right is selected, all of the values related to the call are displayed in the center of the **Set Call** interface.
3. Set the **Date/Time that Call is Set** for the call to start (defaults to the current time) using the **Set Date/Time** button.
4. List the **Districts Affected**, separated by commas. You must enter these manually (the list is not automatically generated).

5. Enter a **Set Comment**, if desired. The completed call information in the **Set Call** window will look similar to that shown in the following figure.



Completed Call Data

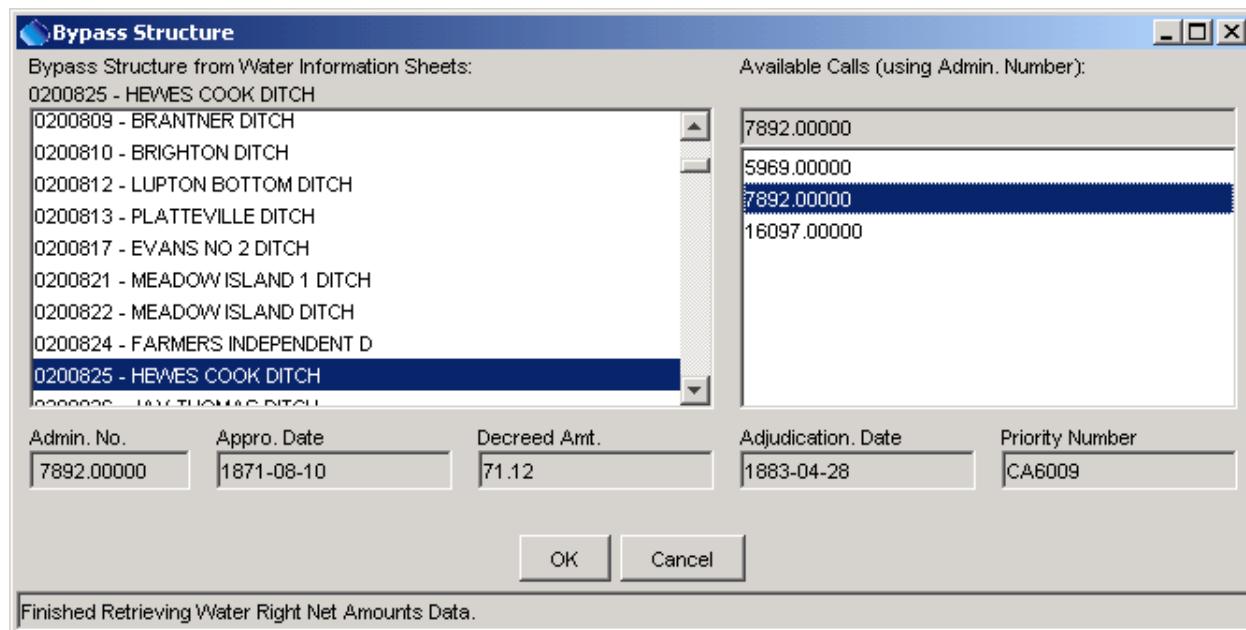
Admin_EditCalls_SetCall_Complete

6. Press the **OK** button to set the call. The call will then be listed in the **Edit Calls** screen. The call will be available for viewing by other system users.

5.1.1.1 Setting a Bypass Call

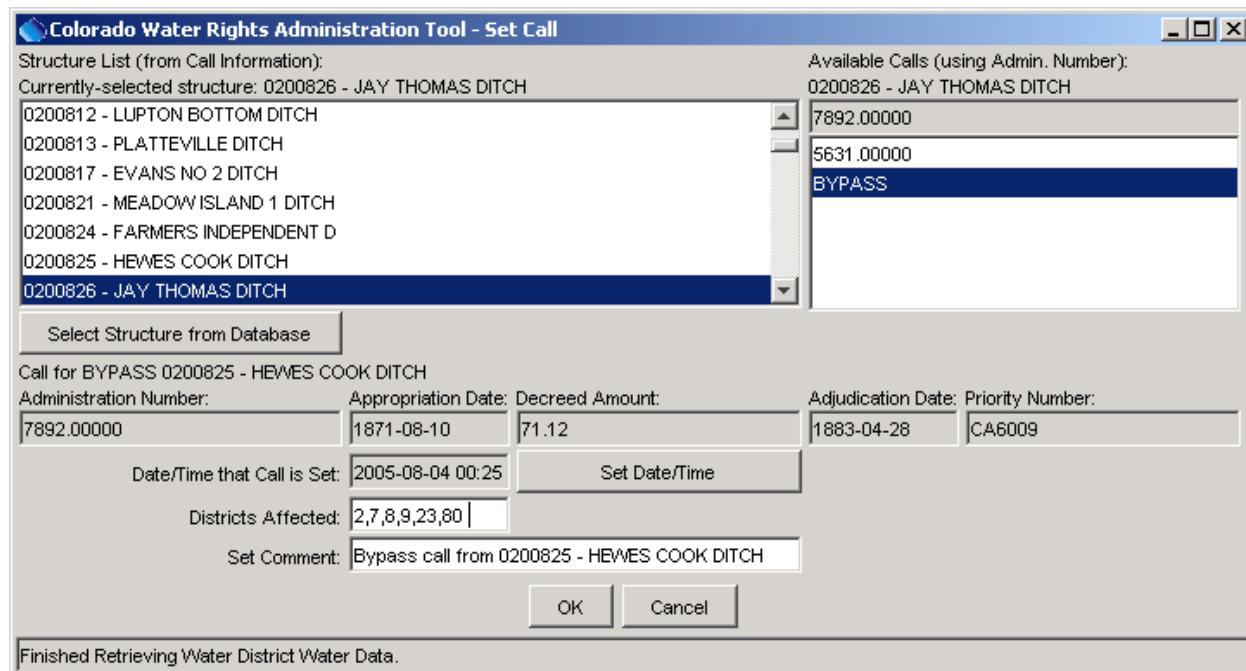
Bypass calls are used in Division 1 and involve using water rights for a secondary structure. The procedure for setting a bypass call is as follows:

1. Select the calling structure's name from the **Structure List**, as described above. This will display the available rights for the structure in the **Available Calls** list.
2. Rather than selecting a water right for the structure, select BYPASS under the **Available Calls**. This will display a window similar to the following:



Selecting the Bypass Structure and Associated Calling Right

3. The list of bypass structures is determined by listing structures in water information sheets. Select the bypass structure and the water right to use for the call and then press **OK**. The bypass structure will be indicated in the **Set Comment** for the call, as shown in the following figure. The **Set Comment** is used later when copying calls; therefore, any additional comments should be added at the end of the default comment. Note that the information in the lower part of the **Set Call** window is labeled as being related to the bypass structure.



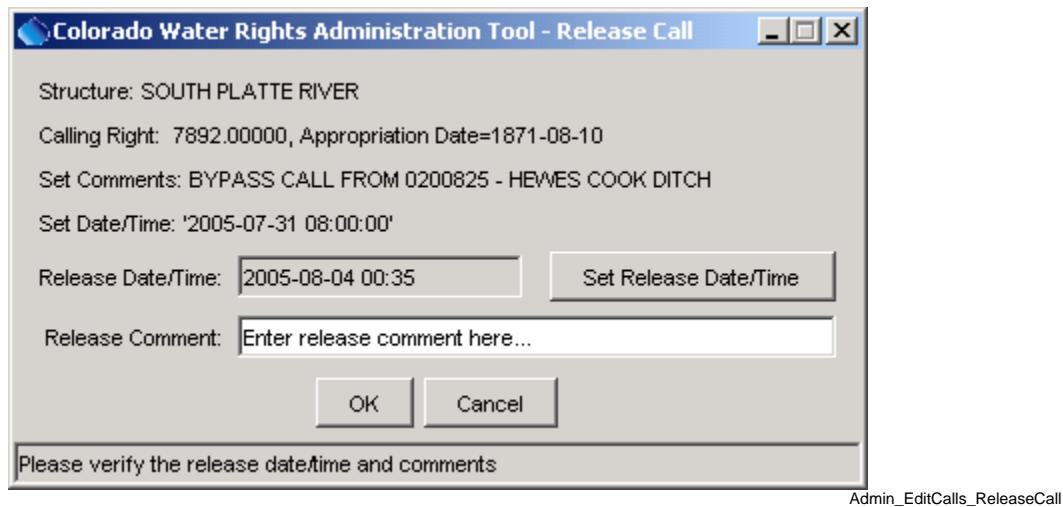
Final Bypass Call Information

4. Press **OK** to set the bypass call.

5.1.2 Releasing a Call

A call is released when the conditions for the call no longer apply and therefore the call is no longer needed. Releasing a call releases the call in the database but does not delete it from the database. A call that has been released can be reactivated (discussed in subsequent section). To release a call:

1. Select the desired call from the **Main Stem Calls** or **Tributary Calls** list in the **Edit Calls** interface and press the **Release Call** button. This displays the dialog similar to the following:



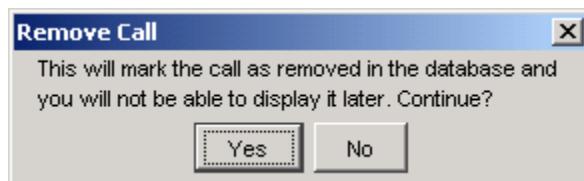
Release Call Dialog

Admin_EditCalls_ReleaseCall

2. If appropriate, edit the **Release Date/Time**.
3. If appropriate, enter a **Release Comment**.
4. Press the **OK** button. The main **Edit Calls** display will be updated to reflect the release.

5.1.3 Removing a Call

In cases where a call was set by mistake, it can be removed by selecting the call in the **Edit Calls** window and pressing the **Remove Call** button. The following figure shows the warning that is issued before the call is removed.



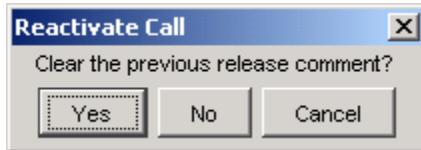
Warning Issued when Removing a Call

Admin_EditCalls_RemoveCall

To confirm the delete, press the **OK** button. The main **Edit Calls** display will be updated to reflect the removal of the call.

5.1.4 Reactivating a Released Call

To reactivate a released call, select the call in the **Edit Calls** window and press the **Reactivate Released Call** button, which will display the following dialog:



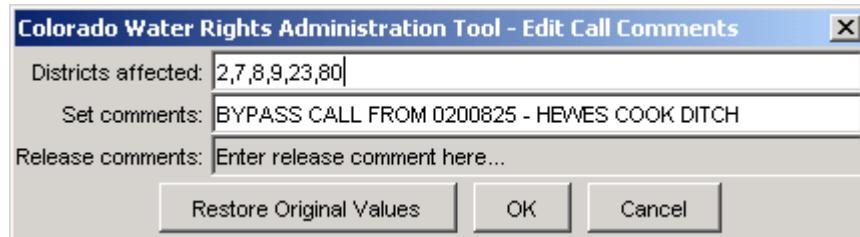
Admin_EditCalls_ReactivateCall

Reactivating a Released Call

This dialog provides the choice of retaining the original release comment or clearing it so that a new release comment can be added later. You may need to change the time period in the **Edit Calls** window to be able to see the call.

5.1.5 Editing a Call's Comments

Call comments may need to be edited if the information for the call has changed. To edit call comments, select a call in the main **Edit Calls** window and press the **Edit Call Comments** button. A dialog similar to the following will be shown:



Admin_EditCalls_EditComments

Editing Call Comments

Press **OK** to save edits, or **Cancel** to cancel the edit. The **Restore Original Values** button can be used to restore the original comment information, if an error was made in the dialog.

5.1.6 Copying a Call

To streamline setting calls, previous calls can be copied. To copy a call:

1. Select a call in the main **Edit Calls** window and press **Copy Call**. The **Set Call** window will then be displayed with the same information as the original call, with the **Set Date** being the current date/time. If the original call was a bypass call, the labels in the **Set Call** window will display the bypass structure and right.
2. Edit the call information as desired and press **OK** to set the call. The main **Edit Calls** window will be updated to reflect the change.

5.1.7 Graphing Calls

Calls can be graphed to see when calls are on/off over a time period. See **Section 4.1 - Call Chronology** for more information.

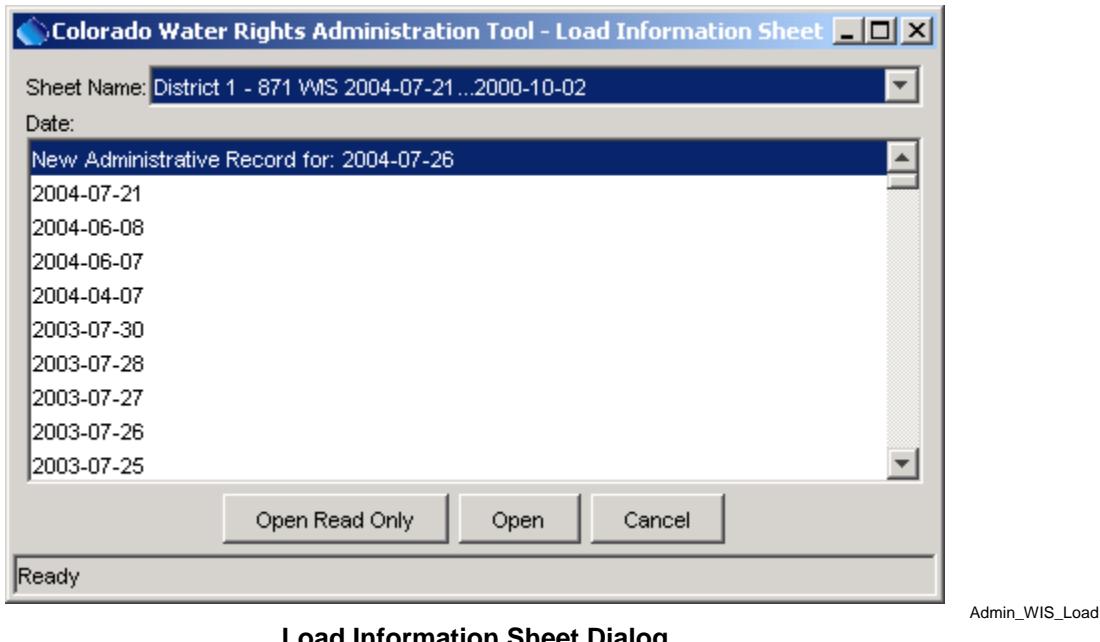
5.1.8 Displaying Calls on the WIS Diagram

Calls that are set can be displayed on a diagram representation of the river system. To do so, use the **Administration...Water Information Sheet** menu, select an appropriate WIS, and then use the **Display Diagram** button – see **Section 5.2.2 – WIS Diagram**. Note that this feature can be used even if daily data in the WIS are not actively being maintained (although the format of the WIS must be reasonably accurate).

5.2 Water Information Sheet

The WIS (Water Information Sheet) is a useful administration tool in CWRAT. Using the WIS, you can submit or view vital information regarding the condition of the river. Before loading a WIS, the format of the WIS must be defined (see **Section 5.3 - Water Information Sheet Builder** for a complete discussion of WIS capabilities). Water information sheets are typically defined by State of Colorado staff familiar with the **WIS Builder**.

Once a WIS has been built, load it using the **Administration...Water Information Sheet** menu, which will display a selection dialog as shown in the following figure.



The **Sheet Name** choice lists available WIS. The first part of each choice is the sheet name. The number of sheets that have been saved and the period for the saves is also shown. This gives an indication of the amount of data that are available for viewing, including graphing of decisions over time.

Typically, water commissioner information in HydroBase is configured to allow a water commissioner to edit administrative data only for districts for which they are responsible. However, WIS can be viewed (not edited) by all CWRAT users.

To load a WIS, select a **Sheet Name** from the drop-down list. The list of administrative dates available for the selected sheet name will be shown. Select an administrative **Date**, which is the date for which the data applies (selecting a new sheet name will refresh the list of administrative dates), and press:

1. **Open Read Only** – to view the WIS but not be able make changes. This is useful when an old sheet needs to be reviewed in order to make current administrative decisions.
2. **Open** – to load the WIS for full functionality.

If a sheet is not saved for the current date, you have the option of loading a sheet that will be treated as a new administrative record (as shown in the above figure). **When a new administrative record date is selected, the sheet will initially be filled with data from the previous sheet, regardless of the amount of time that has passed since a WIS was previously saved.** A sheet for a previous date can be selected and then archived with a new date (e.g., when setting information for weekends). During the week, sheets will normally be edited for a new administration record. **Only one sheet per day can be saved – the last sheet saved for the day will remain in the database.**

Once a sheet and date are selected, the WIS will be displayed as shown in the following figure.

Row Label	Point Flow	Natural Flow	Delivery Flow	Gain Loss	Releases	Priority Diversion	Delivery Diversion	Trib. Natural	Trib. Delivery	Comments
South Platte River										
PLAKERCO	459.0	459.0	0.0							
EMPIRE DITCH	459.0	459.0	0.0							
Crow Creek	464.0	464.0	0.0					5.0		Bypassing 10 cfs f
RIVERSIDE CANAL	336.0	336.0	0.0			128.0				
ILLINOIS DITCH	320.0	320.0	0.0			16.0				
BIJOU CANAL	205.0	205.0	0.0			115.0				
PUTNAM DITCH	205.0	205.0	0.0							
CORONA RANCH DITCH	202.6	202.6	0.0			2.4				
JACKSON LAKE INLET DITCH	202.6	202.6	0.0							
WELDON VALLEY DITCH	79.6	79.6	0.0			123.0				
Jackson Lake Outlet	79.6	79.6	0.0							
FT MORGAN CANAL	-55.4	-55.4	0.0			135.0				
PLAWELCO	457.0	457.0	0.0							
Weldon Valley Return	457.0	457.0	0.0							
Bijou Creek	459.0	459.0	0.0					2.0		
DUEL SNYDER CANAL	459.0	459.0	0.0							
UPPER PLATTE BEAVER CNL	306.0	306.0	0.0			153.0				

Comments:

Status: Sheet has been modified Gain Method: None

Save Clear Dry River Print Export Summary Display Diagram Close Cancel

Finished performing calculations.

Water Information Sheet after Loading

Each tributary (or stream) is represented by rows on the sheet and links between streams can be made. See **Section 5.3 – Water Information Sheet Builder** for more information about configuring sheets.

If the sheet has never been used, it will be blank and/or contain zeros. If a previous archive exists, then the sheet will display the previous data values, with current data imports superimposed in the appropriate cells. During normal operation, the previous sheet's values will be carried forward to the current sheet, minimizing the need for data entry.

WIS cell formats are as follows:

Gray Cell	Contents are view-only and have their values computed automatically.
blue contents	Real-time flow data imported according to the import definition in the WIS builder (some gaged diversions are also imported). Blue cells change to black after initial computations are complete. You can enter values in any of the white cells, and can override imported values if desired (for example, if a real-time stream gage value is inaccurate, a different value can be entered).
red contents	Cell is computed based on a formula, as defined in the WIS builder. You can enter values in any of the white cells.
black contents	When initially loaded, cells with black contents are carried forward from a previous sheet. After the WIS is computed, black contents in gray cells are computed. Values in white cells can be entered.

WIS columns are described in the following table.

WIS Columns (left to right)

WIS Row	Description
Row Label	A (generally) verbose row label. If the row is a structure or station from HydroBase, the label is the station/structure name. Otherwise, the label is defined in the WIS Builder .
Point Flow	The point flow on the river. The point flow is determined by one of the following methods: <ol style="list-style-type: none"> 1. Imported from a stream gage 2. Computed as the upstream point flow + Gain/Loss + Trib. Natural + Trib. Delivery + Releases – Priority Diversions – Delivery Diversions The point flow also is the sum of Natural Flow and Delivery Flow .
Natural Flow	The portion of the point flow that has not been allocated to human use. It is free river water (other than it is can be checked against minimum flow requirements). This is either set with a formula (defined in the WIS Builder) or is computed as Point Flow – Delivery Flow .
Delivery Flow	The portion of the point flow that is allocated to human use. For the most upstream node in a tributary, it is determined as: <ol style="list-style-type: none"> 1. User-supplied (enter a user-supplied value in the releases column), or 2. Define a formula using the WIS Builder For other nodes, it is the upstream point's Delivery Flow + Trib. Delivery + Releases – Delivery Diversion .
Gain Loss	The gain or loss that occurs from the upstream point on the stream. It is computed as the gain/loss between base (gaged) flow locations on the reach, prorated by stream mile or weight, depending on the gain method that is used (selected in the lower right of the Water Information Sheet window).
Releases	A release made at the structure (typically only for reservoirs or to set the initial flow at the top of a tributary).
Priority Diversion	A priority diversion, which subtracts from the natural flow.
Delivery Diversion	A delivery diversion, which subtracts from the delivery flow.
Trib. Natural	For confluence rows (defined in the WIS Builder), this is the natural flow that is contributed from the upstream tributary.
Trib. Delivery	For confluence rows (defined in the WIS Builder), this is the delivery flow that is contributed from the upstream tributary.
Comments	Comments for the row (e.g., to explain an administrative decision).

Flow values shown in rows are immediately downstream of the point for the row. For streamflow gage rows, this is essentially the value at the gage. For rows that have diversions or releases, the flow is that after the diversions and releases have been accounted for.

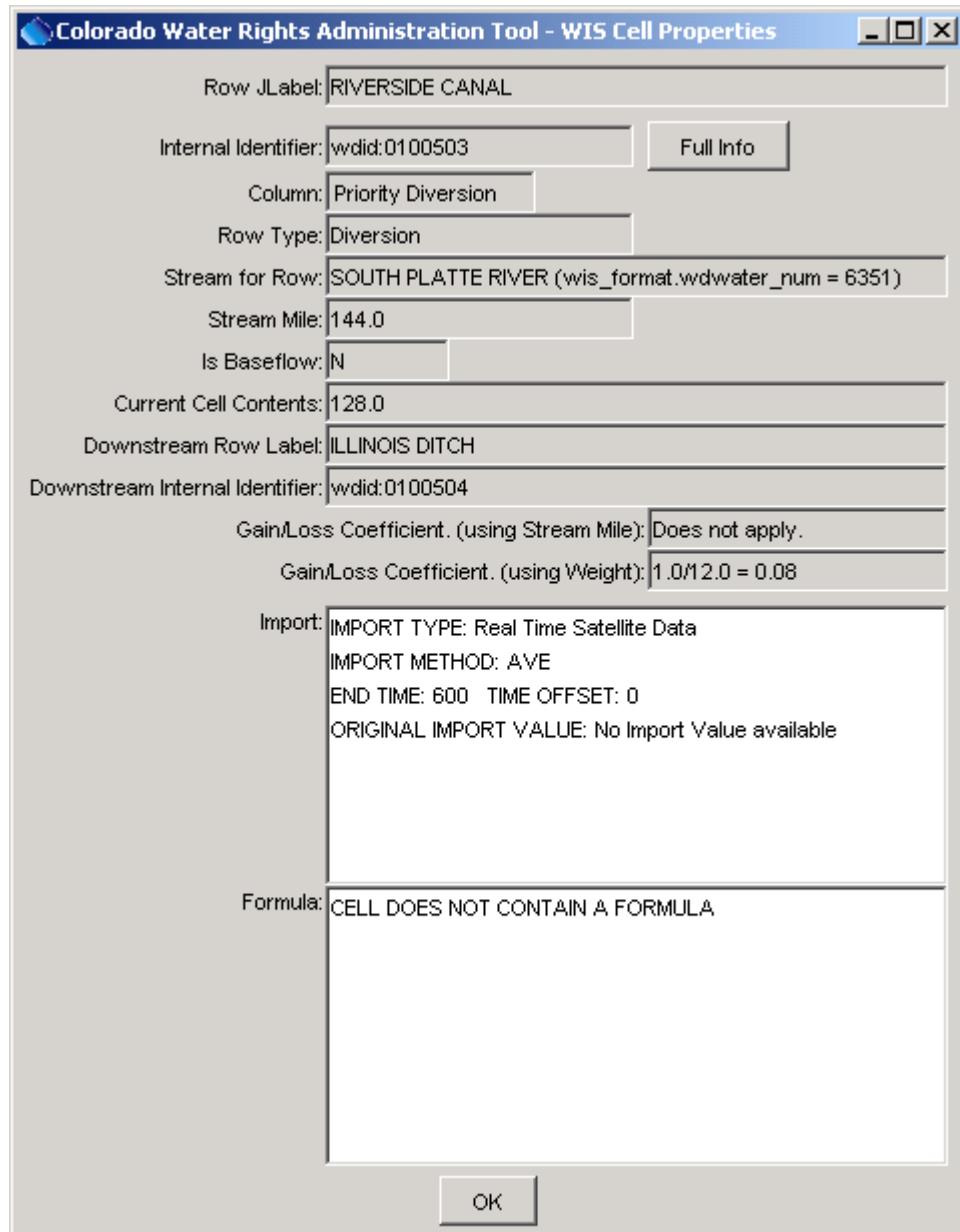
Additional information about the Water Information Sheet interface is listed below, from top to bottom and left to right in the interface:

Administrative data for (top of window)	Sets the date for which the WIS applies. To save sheets for the weekend, load a previous sheet and then save using the date that corresponds to the weekend day.						
Comments (below worksheet)	Comments that apply to the entire sheet (comments can also be set for each row).						
Status (below comments)	Indicates whether the sheet has been modified, which will be the case if editing a new sheet or when an existing sheet is loaded and edited.						
Gain Method (below comments)	Indicates the gain method to be used when calculating the cell contents. The following options are available: <table border="0"> <tr> <td>None</td><td>Flows between points are essentially carried forward with no adjustment for the overall gain/loss between known point flows (stream gages). This method is the simplest.</td></tr> <tr> <td>Stream Mile</td><td>Gain/loss between known point flows (stream gages) is distributed based on the stream mile of the points. This method is not often utilized because the stream mile for all points is not typically known.</td></tr> <tr> <td>Weights</td><td>Gain/loss between known point flows (stream gages) is distributed based on a simple proration factors defined in the WIS Builder. This method allows hydrologic conditions of the basin to be recognized in each stream reach.</td></tr> </table>	None	Flows between points are essentially carried forward with no adjustment for the overall gain/loss between known point flows (stream gages). This method is the simplest.	Stream Mile	Gain/loss between known point flows (stream gages) is distributed based on the stream mile of the points. This method is not often utilized because the stream mile for all points is not typically known.	Weights	Gain/loss between known point flows (stream gages) is distributed based on a simple proration factors defined in the WIS Builder . This method allows hydrologic conditions of the basin to be recognized in each stream reach.
None	Flows between points are essentially carried forward with no adjustment for the overall gain/loss between known point flows (stream gages). This method is the simplest.						
Stream Mile	Gain/loss between known point flows (stream gages) is distributed based on the stream mile of the points. This method is not often utilized because the stream mile for all points is not typically known.						
Weights	Gain/loss between known point flows (stream gages) is distributed based on a simple proration factors defined in the WIS Builder . This method allows hydrologic conditions of the basin to be recognized in each stream reach.						
Save	Save the current sheet contents. The sheet is automatically recomputed before saving. You will be warned if the archive date is in the past or the future. You will also be warned if negative flow values are detected. You should consider correcting negative flow values because they indicate a problem with water balance. Negative flows may be the result of the gain method (see above).						
Clear	Clear all the cell contents. This action is used primarily during development and is typically not used by water commissioners. You will be prompted to verify the clear.						
Dry River	The Dry River button will be highlighted if you have selected a row that is of type Diversion, Reservoir, Minimum Flow, or Other. If you press this button on a selected row, the Point Flow is set to zero and is labeled as "DRY". The row is then treated as a known point flow row (similar to a stream gage) during subsequent computations. If a dry row is selected, the button will change to UN-Dry River and you have the option of restoring the original condition. You can select multiple dry rows in a stream reach in which case the point flow is interpolated between the dry points. The effects of gains and losses in a reach may result in negative flows when dry rows are used. It is your responsibility to adjust for negative flows before archiving the sheet.						

- Print*** Print a text version of the WIS.
- Export*** Export the WIS to a file, in either text or HTML formats.
- Summary*** Similar report as the ***Export*** but includes a diversion coding summary at the bottom.
- Display Diagram*** Display a diagram of the basin (see **Section 5.2.2 – WIS Diagram** for more information)
- Close*** Close the WIS. You will be prompted to determine if you want to save the sheet.
- Cancel*** Close the WIS without saving changes.

5.2.1 Displaying WIS Cell Attributes

To display a WIS cell's attributes, right-click on the cell (if necessary, first select the cell with the left mouse button). This results in a dialog similar to that shown in the following figure.



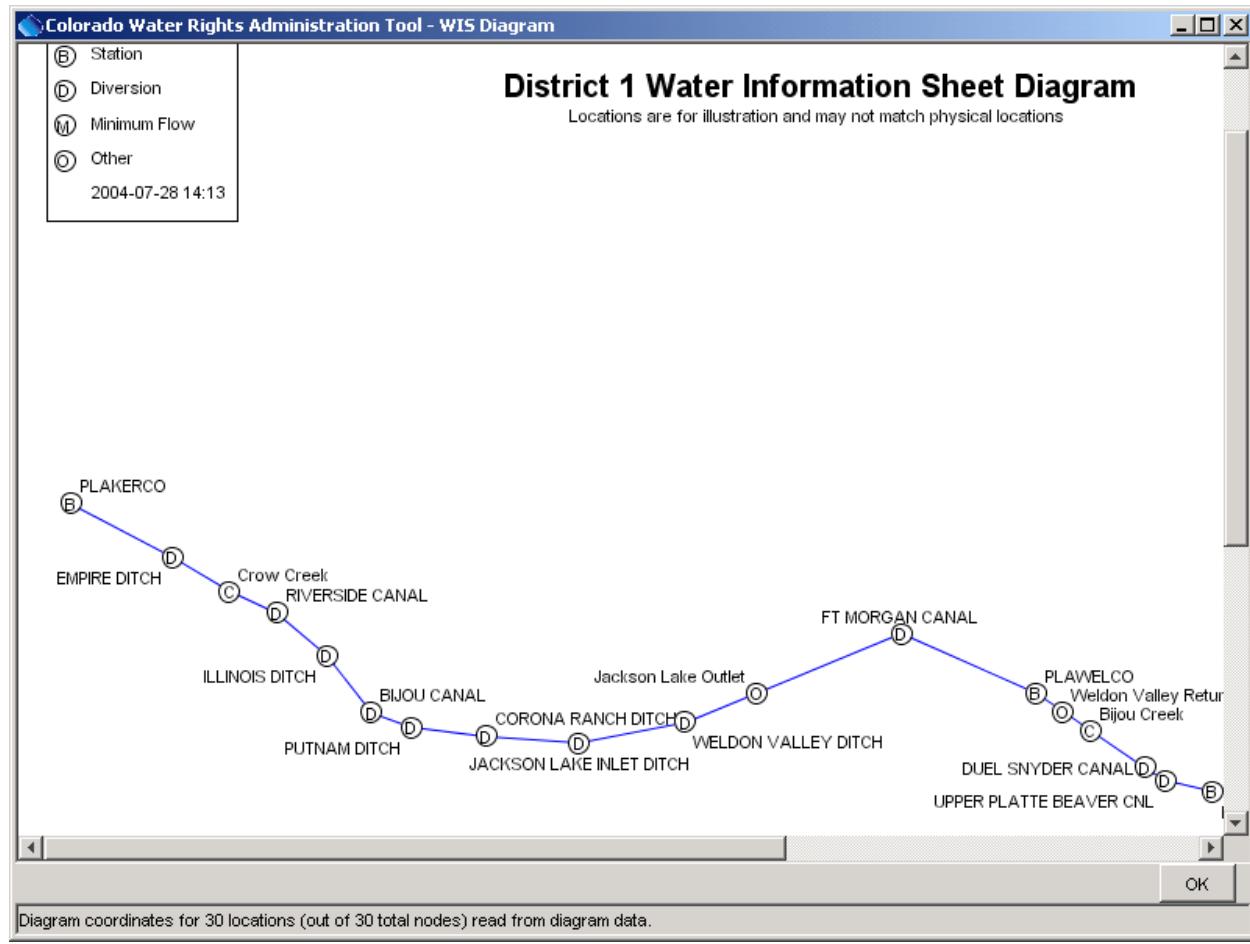
Admin_WIS_CellProps

WIS Cell Properties Dialog

The information that is shown is consistent with the cell properties shown by the WIS Builder.

5.2.2 WIS Diagram

The **WIS Diagram** is a simple schematic representation of the basin that is described by the WIS and is displayed using the **Display Diagram** button on the main WIS window. A sample diagram is shown below:



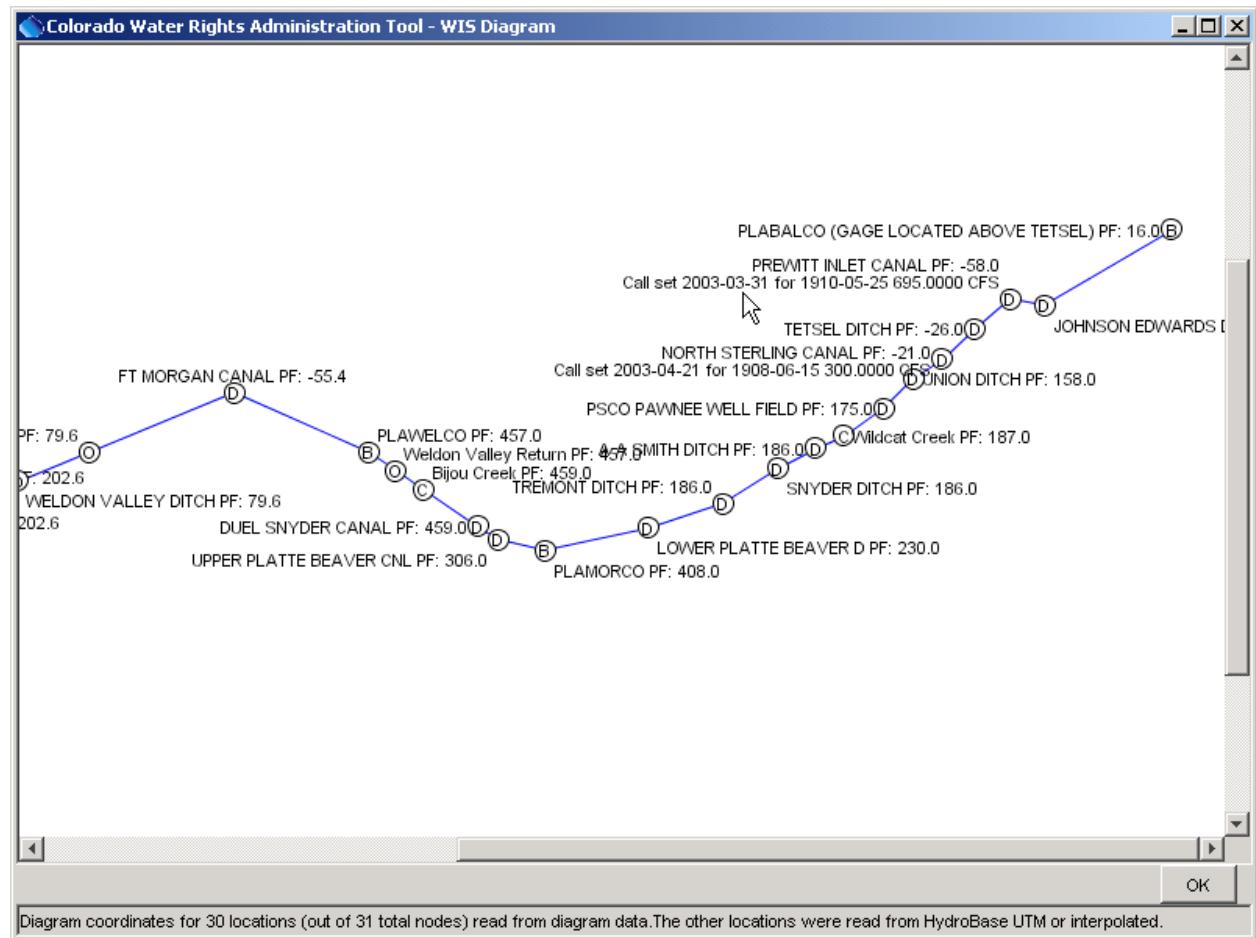
WIS Diagram for District 1

The layout of the river system is not meant to match traditional line diagrams or physical locations. The layout is configured in the **WIS Builder** to allow display of location names and other information, without information overwriting itself. The basic display provides a visual representation of the order of the river, in order to better understand data values shown in the WIS.

Right-clicking on the diagram displays a menu with the following choices:

- | | |
|-------------------------------------|--|
| Show Flow Data | Label the diagram with point flows from the WIS. |
| Show Calls | Label the diagram with calls, as of the time of the WIS. |
| Show Rights | Label the diagram with water rights for structures in the WIS. |
| Print on Letter in Landscape | Print the diagram as shown, on letter-sized paper, in landscape orientation. |

The following figure illustrates an example of the **WIS Diagram** showing point flows and calls:



District 1 WIS Diagram with Point Flows and Calls

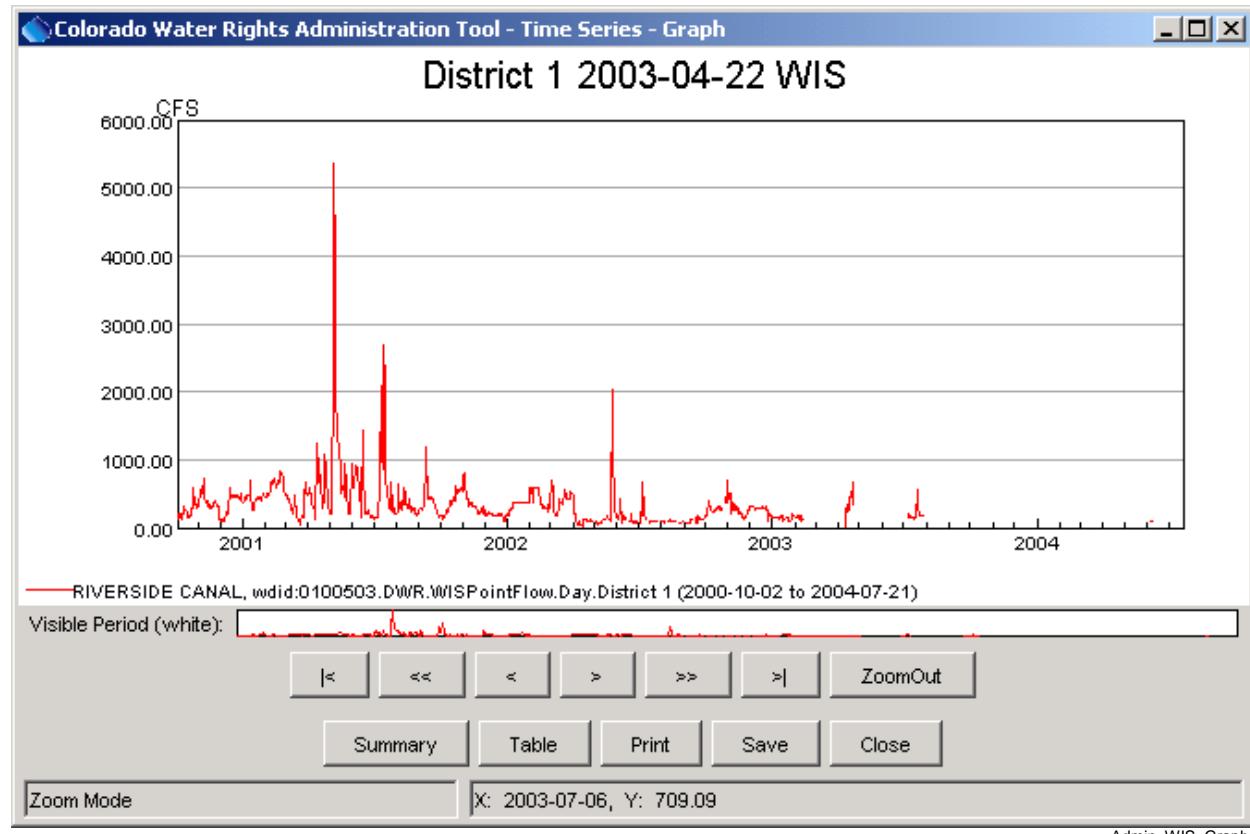
The above figure illustrates that it is difficult to fully control the display of labels so that they do not overwrite (displaying rights adds additional labels to the diagram). The intent of the **WIS Diagram** is not to provide publication-quality graphics but to present data in a concise and reasonable layout. If necessary, the **WIS Builder** can be used to fine-tune the diagram representation.

WIS Diagram data are stored in the HydroBase database. Consequently, any user that is able to display a WIS can also view the diagram. Additionally, it is not a requirement to have actively-maintained WIS to use the diagram. If a WIS is defined for a water district and minimal configuration has been done to import real-time gage values, then a diagram can be shown to display the real-time point flow values. Calls that have been set with the **Administration...Edit Calls** interface will also be shown, even if the WIS is not actively maintained. Consequently, the **WIS Diagram** is a useful tool for viewing administrative data in a spatial representation.

5.2.3 Graphing Cell Contents

Any data cell in a Water Information Sheet can be graphed, as follows:

1. Left-click in the cell to select the cell. Only data cells (cells with numerical information) can be graphed.
2. Right-click in the cell to show the popup menu and select the **Graph** menu item. All of the available data period for the cell will be used to create a graph, similar to the following (graphing from an old WIS may show data after the WIS was saved):



Graph of Natural Flow Column for a WIS

Admin_WIS_Graph1

3. Interact with the graph as described in the **TSView Time Series Viewing Tools Appendix**. For example, use the **Table** and **Summary** buttons to view different data formats. The data can also be saved in DateValue format, for import into a spreadsheet or other tool.

It is also possible to graph all of the data for a row. To do so, select the row by clicking on the **Row Label** column. Then follow steps 2 and 3 above.

Using the above approach, there is currently no way to create a graph with cells from different rows. The TSTool software will allow data from different WIS cells to be graphed on the same page.

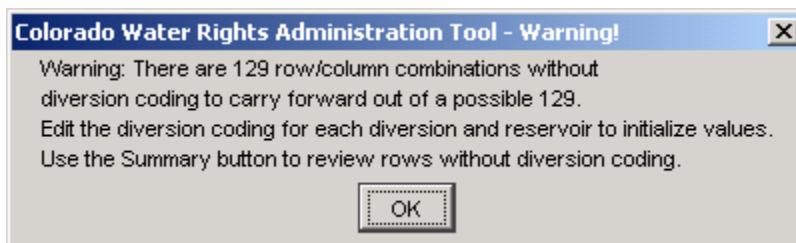
5.2.4 Diversion Coding

Diversion coding indicates the diversion records for a structure, including the water source (e.g., Natural Stream Flow), the structure from which the water is taken (e.g., a reservoir water district identifier), water use (e.g., irrigation), and type (e.g., Released to River), collectively known as SFUT (Source, From, Use, Type). See the **State of Colorado Water Commissioner Manual** for more information. The WIS can be used to perform diversion coding so that electronic diversion records are available for review in the winter off-season (when diversion records are transferred from water commissioners to the Denver offices and are entered in HydroBase as official diversion records). WIS diversion coding data are not saved in HydroBase in the same data tables as official diversion coding records and therefore do not take the place of official records – the WIS diversion coding values are meant as a data entry and verification aid. Because diversion coding is a somewhat laborious process, the WIS tool tries to help by using carry-forward logic, similar to the WIS data values. Diversion coding using the WIS is an optional activity and is turned on using the **Tools...Options...Administration** menu.

WIS diversion coding saves the SFUT information for each appropriate cell, using a convention similar to normal SFUT diversion coding conventions. The specific data that are saved are explained below.

The following steps are executed when using the diversion coding features.

1. When a WIS is loaded, WIS diversion coding records are queried from the database. For each structure, a query is executed to determine the nearest previous date when diversion coding was entered. If data are found on the WIS's date, then the observation flags are left as is. If data are found on an earlier date, then the data values are used but the observation flags are set to C to indicate that the data are being carried forward. The first time that a WIS is loaded with diversion coding turned on, a warning like the following will be displayed:



Admin_WIS_DivCoding_Warning

WIS Load Warning when Diversion Coding is Enabled

The above warning indicates that the carry-forward procedure used by the diversion coding logic cannot be completed because there were no previous diversion coding values to carry forward. Once initial values are entered, the warning should not appear. Use the **Summary** feature of the Water Information Sheet interface to list cells that do not have diversion coding.

2. Edit diversion coding information by first left-clicking on a white cell for **Priority Diversion**, or **Delivery Diversion**. Then select the **Diversion Coding** item in the popup menu. This will display a dialog similar to the following.

The screenshot shows a Windows application window titled "Colorado Water Rights Administration Tool - Diversion Coding for WELDON VALLEY DITCH (2004-07-26 - Priority Diversion)". The window contains a message area with instructions for entering diversion coding values. Below this is a table with columns: STRUCTURE ID, SOURCE, FROM (ID), USE, TYPE, OBS, and AMOUNT (CFS). A single row is present in the table, labeled "1 TOTAL" with a value of "0.00". At the bottom of the dialog are buttons for "Add Row", "Delete Row", "View History", "OK", and "Cancel".

Admin_WIS_DivCoding_Bank

Example Diversion Coding Dialog with No Data

The above example illustrates the case where previous diversion coding data for the structure are not available. In this case, you must enter the diversion coding that will be used until changed. In cases where diversion coding records are available (either because they were previously entered for the date or because they are being carried forward), those records will be displayed. To enter diversion coding values, first add a row using **Add Row** and then left-click in a cell to be edited. Select appropriate values from available choices or type in values where choices are not available (see the **Water Commissioner Manual** for more information). The **Obs** flag indicates whether the diversion value is observed by a water commissioner (*), is user-supplied (U), or is carried forward (C). If any value is changed from its original value and the **Obs** flag is C, then the **Obs** flag is automatically changed to *. If a record is added or deleted, the observation flag is automatically changed from C to *, if necessary. The flag should be verified because U might be the correct flag. See also **Section 5.2.5 – Diversion Coding when Previous Coding Exists** for an explanation of the W flag, which the WIS will use in some cases.

3. Press the **OK** button in the **Diversion Coding** dialog to save the diversion coding information to the Water Information Sheet. This does not save the information to HydroBase (see below for that step). Press the **Cancel** button to ignore changes that you made in the **Diversion Coding** dialog. When diversion coding information is saved with **OK**, the following occurs:
 - The total amount from the **Diversion Coding** dialog is entered in the WIS in the appropriate cell,
 - The diversion coding records from the **Diversion Coding** dialog replace those that were initially read and will consequently be saved if the WIS is saved.
4. When the Water Information Sheet **Save** button is pressed (or **Close** with a confirmation to save), the diversion coding records are saved to HydroBase.

Note that if you re-edit a WIS from a previous date, the changes that are made in that sheet do not automatically propagate to later sheets. Consequently, later values that indicate a carry-forward **Obs** flag of C will not agree with values that are edited (the C flag will not be accurate). However, no feature is

currently in place to propagate a change forward in time as this would likely compromise the validity of decisions made when those sheets were saved.

5.2.5 Diversion Coding when Previous Coding Exists

When diversion coding has been enabled in a WIS, it may be difficult to consistently edit the coding for every cell. Consequently, default behavior has been implemented to streamline diversion coding.

If a cell value in the main sheet is changed, the associated diversion coding records (if available), are changed as follows:

1. If the cell has a single diversion coding SFUT combination, then the total value for the record is immediately updated to the value in the main WIS and the observation flag is set to *. Opening the **Diversion Coding** dialog will display the new total value and observation flag. The **Diversion Coding** dialog must be used if the observation flag should be set to something other than *.
2. If the cell has multiple diversion coding SFUT combinations, no immediate action is taken to adjust the associated diversion coding records. Ideally the **Diversion Coding** dialog should be used for the cell to enter SFUT combinations that add to the total in the main display (note that if the **Diversion Coding** dialog is used, the total is always transferred back to the WIS). However, if the diversion coding is not entered, then when the WIS is saved, a diversion coding record will be saved with empty SFUT values and an observation flag of W, indicating that unknown diversion coding has occurred and the WIS is making an assumption. This case will be carried forward in future WIS (the W flag will be changed to C in future records). A warning is printed before the save to allow you to enter diversion coding for cells where default SFUT has been assumed.

In most cases, diversion coding will consist of a single SFUT record and no assumptions will need to be made by the WIS. In cases where multiple SFUT combinations are used, it will generally be best to edit the diversion amount using the diversion coding interface, rather than by only entering a total in the main WIS.

In summary, using the diversion coding feature allows more detail to be recorded about administrative decisions. However, it also adds additional data entry requirements. The carry-forward logic that has been implemented ideally minimizes the day to day data entry requirements.

5.2.6 Examples of WIS Use

A water commissioner typically uses the WIS as follows:

1. Login to CWRAT using the HydroBase login.
2. Load the WIS for the region of interest (typically a water district) using the **Administration...Water Information Sheet** menu. Typically a new administrative record is used, which carries forward the previously WIS values.
3. Real-time data (e.g., streamflow gage point flows) are reviewed, and if necessary, corrected. This may also involve using the **Data...Stations** interface or previously configured time series plots to view real-time streamflow hydrographs.
4. Administrative data (e.g., release, diversion, delivery flows) are reviewed and are updated as appropriate. If appropriate, use the **Dry River** feature. If enable, use the diversion coding feature to enter detailed diversion record information.
5. Display the **WIS Diagram** to review overall basin flows and calls.
6. When satisfied, save the sheet using the **Save** (or **Close**) buttons.

The use of gain/loss information is the main option that can be exercised when using Water Information Sheets. The following examples illustrate features of the WIS using actual data.

The following example uses no gain method (gain method: **None**), in which the gain or loss between known point flows is not computed.

Colorado Water Rights Administration Tool - Water Information Sheet: District 1

Row Label	Point Flow	Natural Flow	Delivery Flow	Gain Loss	Releases	Priority Diversion	Delivery Diversion	Trib. Natural	Trib. Delivery	Comments
South Platte River										
PLAKERCO	150.0	150.0	0.0							
EMPIRE DITCH	150.0	150.0	0.0							
Crow Creek	155.0	155.0	0.0					5.0		
RIVERSIDE CANAL	99.0	99.0	0.0			56.0				
ILLINOIS DITCH	97.0	97.0	0.0			2.0				exchange w bijou
BIJOU CANAL	DRY	0.0	0.0			69.0				
PUTNAM DITCH	0.0	0.0	0.0							
CORONA RANCH DITCH	0.0	0.0	0.0							Putnam
JACKSON LAKE INLET DITCH	0.0	0.0	0.0							
WELDON VALLEY DITCH	-120.0	-120.0	0.0			120.0				
Jackson Lake Outlet	-120.0	-120.0	0.0							, 28.26, 1.9 UP&B,
FT MORGAN CANAL	-288.0	-288.0	0.0			168.0				
PLAWELCO	150.0	150.0	0.0							
Weldon Valley Return	170.0	150.0	20.0		20.0					
Bijou Creek	172.0	152.0	20.0					2.0		
DUEL SNYDER CANAL	142.0	122.0	20.0			30.0				
UPPER PLATTE BEAVER CNL	114.0	122.0	-8.0				28.0			Jackson 28.26, 1.9

Comments:

Status: Sheet has been modified Gain Method: None

Save Clear Dry River Print Export Summary Display Diagram Close Cancel

Finished performing calculations.

Admin_WIS_Gains_None

Example WIS Using Gain Method "None"

The above figure illustrates a WIS that does not use gains. Consequently, if no diversion, release, or confluence occurs, flows are just carried forward from one row to the next. Note that negative flows may result because losses are not distributed in this approach.

The following example uses the weights gain method, in which the gain or loss between known point flows is distributed using a simple weighting method, as illustrated by the constant value in the **Gain Loss** column.

Colorado Water Rights Administration Tool - Water Information Sheet: District 1

Row Label	Point Flow	Natural Flow	Delivery Flow	Gain Loss	Releases	Priority Diversion	Delivery Diversion	Trib. Natural	Trib. Delivery	Comments
South Platte River										
PLAKERCO	150.0	150.0	0.0	0.0						
EMPIRE DITCH	144.4	144.4	0.0	-5.6						
Crow Creek	143.8	143.8	0.0	-5.6				5.0		
RIVERSIDE CANAL	82.2	82.2	0.0	-5.6		56.0				
ILLINOIS DITCH	74.6	74.6	0.0	-5.6		2.0				exchange w bijou
BIJOU CANAL	DRY	0.0	0.0	-5.6		69.0				
PUTNAM DITCH	62.6	62.6	0.0	62.6						
CORONA RANCH DITCH	125.1	125.1	0.0	62.6						Putnam
JACKSON LAKE INLET DITCH	187.7	187.7	0.0	62.6						
WELDON VALLEY DITCH	130.3	130.3	0.0	62.6		120.0				
Jackson Lake Outlet	192.9	192.9	0.0	62.6						, ,28.26,1.9 UP&B,
FT MORGAN CANAL	87.4	87.4	0.0	62.6		168.0				
PLAWELOCO	150.0	150.0	0.0	62.6						
Weldon Valley Return	190.0	170.0	20.0	20.0	20.0					
Bijou Creek	212.0	192.0	20.0	20.0				2.0		
DUEL SNYDER CANAL	202.0	182.0	20.0	20.0		30.0				
UPPER PLATTE BEAVER CNL	194.0	202.0	-8.0	20.0			28.0			Jackson 28.26, 1.9

Comments:

Status: Sheet has been modified Gain Method: Weights

Save Clear Dry River

Print Export Summary Display Diagram Close Cancel

Finished performing calculations.

Admin_WIS_Gains_Weights

Example WIS Using Gain Method "Weights"

Because a gain or loss can occur between each point in the stream, the point flow values are adjusted at each point, even if no diversions, releases, or confluences occur. Consequently, negative flows shown in the previous example are removed.

The following example illustrates the **Dry River** feature (see the **UNION DITCH** and **TETSEL DITCH** rows), which essentially sets the known point flow to zero at the specified location(s).

Colorado Water Rights Administration Tool - Water Information Sheet: District 1

Row Label	Point Flow	Natural Flow	Delivery Flow	Gain Loss	Releases	Priority Diversion	Delivery Diversion	Trib. Natural	Trib. Delivery	Comments
PLAWELCO	150.0	150.0	0.0	62.6						
Weldon Valley Return	190.0	170.0	20.0	20.0	20.0					
Bijou Creek	212.0	192.0	20.0	20.0				2.0		
DUEL SNYDER CANAL	202.0	182.0	20.0	20.0		30.0				
UPPER PLATTE BEAVER CNL	194.0	202.0	-8.0	20.0			28.0			Jackson 28.26, 1.9
PLAMORCO	214.0	222.0	-8.0	20.0						
LOWER PLATTE BEAVER D	131.1	139.1	-8.0	-18.9		64.0				bypass 10.6 at 2pm
TREMONT DITCH	112.3	120.3	-8.0	-18.9						
SNYDER DITCH	93.4	101.4	-8.0	-18.9						
A A SMITH DITCH	54.6	62.6	-8.0	-18.9		20.0				
Wildcat Creek	37.7	45.7	-8.0	-18.9				2.0		
PSCO PAWNEE WELL FIELD	18.9	26.9	-8.0	-18.9						
UNION DITCH	DRY	8.0	-8.0	-18.9						
NORTH STERLING CANAL	7.5	15.5	-8.0	7.5						
TETSEL DITCH	DRY	8.0	-8.0	7.5		15.0				
PREWITT INLET CANAL	54.7	62.7	-8.0	54.7						
JOHNSON EDWARDS DITCH	109.3	117.3	-8.0	54.7						
PLABALCO (GAGE LOCATED AB...	164.0	172.0	-8.0	54.7						

Comments:

Status: Sheet has been modified Gain Method: Weights

Save Clear UN-Dry River

Print Export Summary Display Diagram Close Cancel

Finished performing calculations.

Admin_WIS_DryRiver

WIS Illustrating Dry River Feature

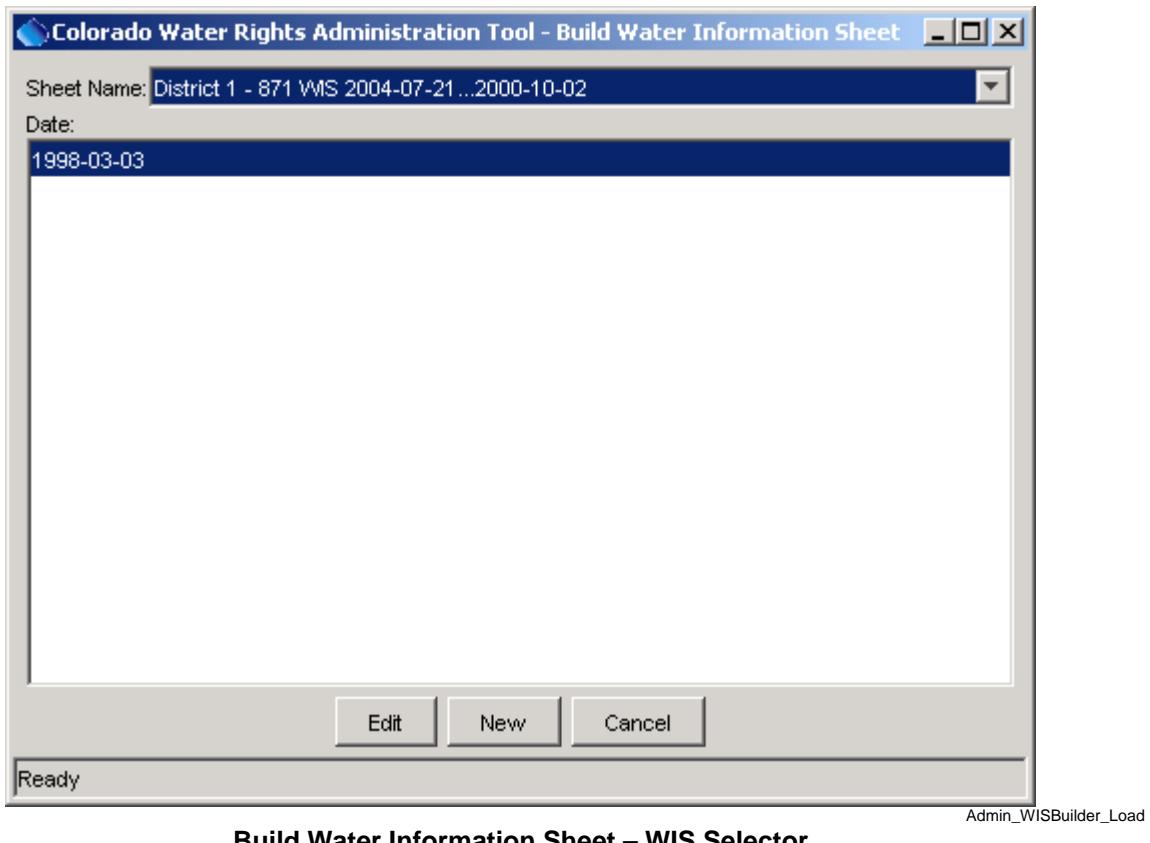
The **Dry River** feature influences how the gain/loss is computed in a reach because it introduces new known point flow locations in a stream. In the above example, the weights gain method is used and therefore negative point flows are minimized.

5.3 Water Information Sheet Builder

The **WIS Builder** provides tools to build or edit a Water Information Sheet and is intended for infrequent use. A WIS must first be built in order to populate the operational WIS with data and allow curtailment, depletion, and point flow analyses to be performed (see **Section 5.2 – Water Information Sheet** for information about the operational WIS).

Important: The **WIS Builder** relies on information in HydroBase in order to build a sheet. In particular, water sources for structures are used to form lists of structures on a stream and stream tributary information is used to help indicate how confluences should be treated. HydroBase data are not always accurate or complete. Consequently, the **WIS Builder** provides several ways to specify some information. Additional quality control of HydroBase location data and enhancements to the **WIS Builder** will improve are occurring to improve overall functionality.

The **WIS Builder** is displayed using the **Administration...Water Information Sheet Builder** menu item. The initial dialog as shown below prompts you to select a WIS sheet name.



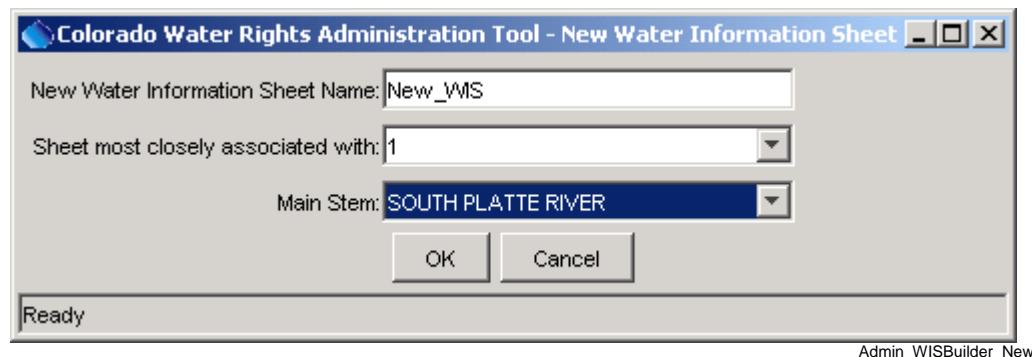
Build Water Information Sheet – WIS Selector

A list of existing sheet names is displayed, and the archive dates for the selected sheet formats are displayed.

The following options are available when loading a sheet:

Edit Select an existing sheet name and date, and **Edit**. The edited sheet can be saved with a new date and optionally a different name. See subsequent sections for information about editing the sheet. **Most water districts have had baseline sheets created and can be modified if necessary.**

New Select **New** to create a new blank sheet. You are first prompted for main sheet information, as shown below.



Enter appropriate information and then press **OK**. Then refer to subsequent sections for how to add information to the sheet. **It is important that the first row added to the sheet is a *Stream* row.**

When creating a new sheet or editing an existing sheet, the **WIS Builder** interface will be displayed, as shown in the following figure (this example is for an existing sheet).

Colorado Water Rights Administration Tool - Water Information Sheet Builder

Sheet Name: District 1 Date: 1998-03-03 Gain Method: None

Row Label	Point Flow	Natural Flow	Delivery Flow	Gain Loss	Releases	Priority Diversion	Delivery Diversion	Trib. Natural	Trib. Delivery	Comments
South Platte River (1, Stream, str...										
PLAKERCO (2, Station, stat:0675...										
EMPIRE DITCH (3, Diversion, wdid...										
Crow Creek (4, Confluence, conf...										
RIVERSIDE CANAL (5, Diversion, ...										
ILLINOIS DITCH (6, Diversion, wdi...										
BIJOU CANAL (7, Diversion, wdid...										
PUTNAM DITCH (8, Diversion, wdi...										
CORONA RANCH DITCH (9, Diver...										
JACKSON LAKE INLET DITCH (10,...										
WELDON VALLEY DITCH (11, Div...										
Jackson Lake Outlet (12, Other, o...										
FT MORGAN CANAL (13, Diversi...										

Add Row Delete Row Add Formula Delete Formula Add Import Delete Import Display Gains

Water Districts: 1 - South Platte: Greeley to Balzac Row Type: Stream Unique Identifier: Stream for Current Row: Stream:6351

Stream (Stream Number): SOUTH PLATTE RIVER (6351) Row Label (Select Stream at left if possible): South Platte River

Show as Text Edit WIS Diagram Save Close

Ready Admin_WISBuilder_Initial

Water Information Sheet Builder after Loading a WIS

When a new row is added, the information on the bottom of the display should be filled out appropriately for the row. In most cases, this consists of making simple selections from choices but in some cases (e.g., when data from HydroBase are incorrect or unavailable), additional information may need to be entered.

The following sections describe the components of a Water Information Sheet and the builder.

5.3.1 WIS Format Description

The **WIS Builder** displays rows and columns similar to a spreadsheet; however, the columns have been pre-selected (and are fixed) and the rows correspond to stations and structures that have data in the HydroBase database. Special rows used for managing the sheet are also available. The WIS is not a full-featured spreadsheet like Microsoft Excel, although it has many features like a spreadsheet. The rows and columns of the sheet (along with formulae and imports, as discussed in subsequent sections) describe the format of the sheet. This format can be reused each day as new data are entered. Changing the WIS format changes the nature of the sheet. Each row has a row label that is typically a structure, stream, or station name. The streams that are entered in the sheet should be entered upstream to downstream, with each tributary's rows grouped together. The WIS row types are as shown in the following table.

WIS Row Types

Row Type	Description
Confluence	A point where tributaries meet.
Diversion	A diversion structure.
MinFlow	A minimum flow point (at this time, minimum flow reaches are not fully implemented – only a minimum flow point is enabled).
Other	A point used as a base flow node for computations.
Reservoir	A reservoir structure.
Station	A streamflow station, possibly with real-time data.
Stream	Indicates the top of a stream reach (used to keep track of streams). A stream must always be present in the sheet.
String	A row that only has a label but which can contain formulas.

The WIS columns are described in the following table.

WIS Columns (left to right)

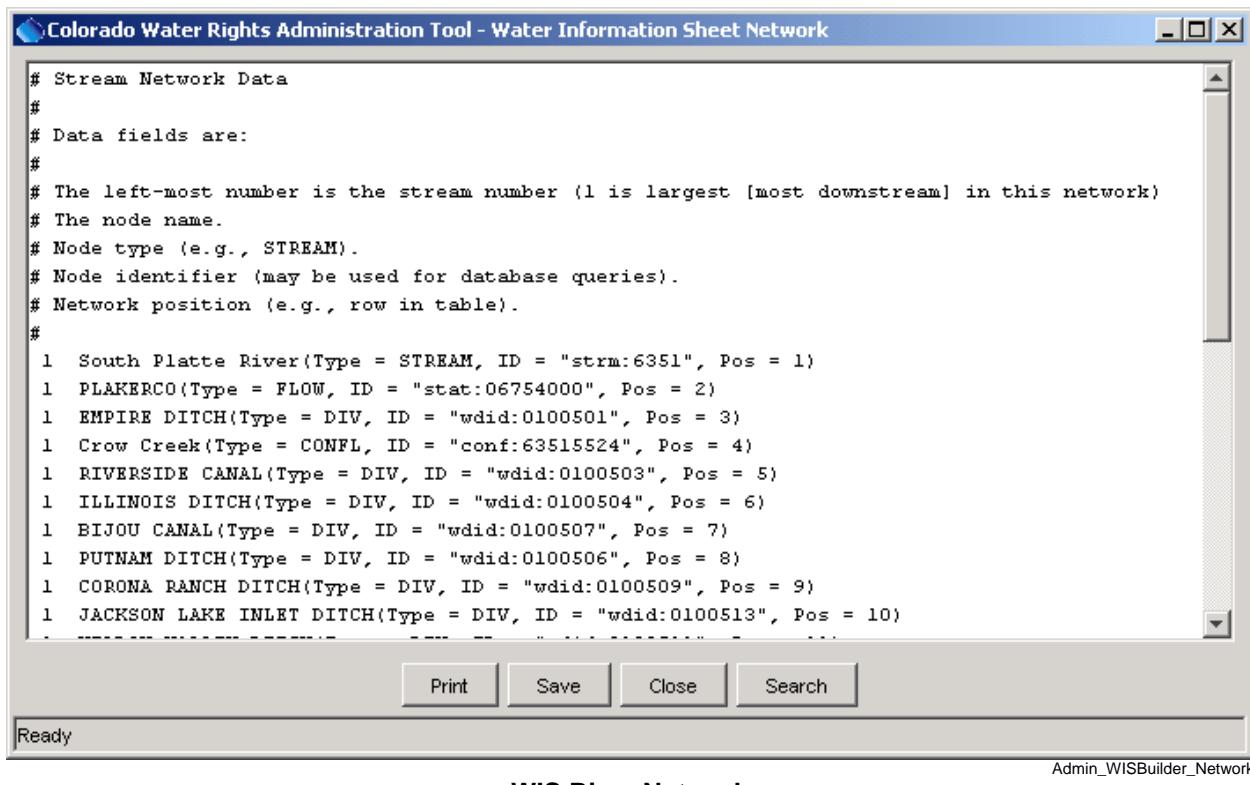
WIS Row	Description
Row Label	A (generally) verbose row label. If the row is a structure or station from HydroBase, the label is the station/structure name. Otherwise, the label is defined in the WIS Builder .
Point Flow	<p>The point flow on the river. The point flow is determined by one of the following methods:</p> <ol style="list-style-type: none"> 1. Imported from a stream gage 2. Computed as the upstream point flow + Gain/Loss + Trib. Natural + Trib. Delivery + Releases – Priority Diversions – Delivery Diversions <p>The point flow also is the sum of Natural Flow and Delivery Flow.</p>
Natural Flow	The portion of the point flow that has not been allocated to human use. It is free river water (other than it is can be checked against minimum flow requirements). This is either set with a formula (defined in the WIS Builder) or is computed as Point Flow – Delivery Flow .
Delivery Flow	<p>The portion of the point flow that is allocated to human use. For the most upstream node in a tributary, it is determined as:</p> <ol style="list-style-type: none"> 1. User-supplied (enter a user-supplied value in the releases column), or 2. Define a formula using the WIS Builder <p>For other nodes, it is the upstream point's Delivery Flow + Trib. Delivery + Releases – Delivery Diversion.</p>
Gain Loss	The gain or loss that occurs from the upstream point on the stream. It is computed as the gain/loss between base flow nodes on the reach, prorated by stream mile or weight, depending on the gain method that is used (selected in the lower right of the Water Information Sheet window).
Releases	A release made at the structure (typically only for reservoirs or to set the initial flow at the top of a tributary).
Priority Diversion	A priority diversion, which subtracts from the natural flow.
Delivery Diversion	A delivery diversion, which subtracts from the delivery flow.
Trib. Natural	For confluence rows (defined in the WIS Builder), this is the natural flow that is contributed from the upstream tributary.
Trib. Delivery	For confluence rows (defined in the WIS Builder), this is the delivery flow that is contributed from the upstream tributary.
Comments	Comments for the row (e.g., to explain an administrative decision).

Flow values shown in rows are immediately downstream of the point for the row. For streamflow gage rows, this is essentially the value at the gage. For rows that have diversions or releases, the flow is that after the diversions and releases have been accounted for.

Once a WIS has been loaded, information about the row can be displayed and edited by selecting the row. The information for the row is displayed at the bottom of the **WIS Builder**.

5.3.2 The Stream Network

The rows of the WIS, along with some behind-the-scenes data, allow rows in the WIS to be represented as nodes in a stream network. Being able to represent the WIS as a stream network allows efficient traversal of the data for computations and output. The **Show as Text** button at the bottom of the **WIS Builder** displays the network in a text fashion, as illustrated in the following figure.



The screenshot shows a window titled "Colorado Water Rights Administration Tool - Water Information Sheet Network". The main content area contains a text representation of a stream network. The text starts with a header "# Stream Network Data" followed by several comments starting with "#". The data is organized into numbered lines, where each line represents a node (e.g., stream, flow, ditch, canal) with its type, ID, and position. Indentation is used to show the hierarchical structure of the network. At the bottom of the window, there are four buttons: "Print", "Save", "Close", and "Search". Below the window, a status bar says "Ready" and "Admin_WISBuilder_Network". The title bar also includes standard window controls (minimize, maximize, close).

```

# Stream Network Data
#
# Data fields are:
#
# The left-most number is the stream number (1 is largest [most downstream] in this network)
# The node name.
# Node type (e.g., STREAM).
# Node identifier (may be used for database queries).
# Network position (e.g., row in table).
#
1 South Platte River(Type = STREAM, ID = "strm:6351", Pos = 1)
1 PLAKERCO(Type = FLOW, ID = "stat:06754000", Pos = 2)
1 EMPIRE DITCH(Type = DIV, ID = "wdid:0100501", Pos = 3)
1 Crow Creek(Type = CONFL, ID = "conf:63515524", Pos = 4)
1 RIVERSIDE CANAL(Type = DIV, ID = "wdid:0100503", Pos = 5)
1 ILLINOIS DITCH(Type = DIV, ID = "wdid:0100504", Pos = 6)
1 BIJOU CANAL(Type = DIV, ID = "wdid:0100507", Pos = 7)
1 PUTNAM DITCH(Type = DIV, ID = "wdid:0100506", Pos = 8)
1 CORONA RANCH DITCH(Type = DIV, ID = "wdid:0100509", Pos = 9)
1 JACKSON LAKE INLET DITCH(Type = DIV, ID = "wdid:0100513", Pos = 10)

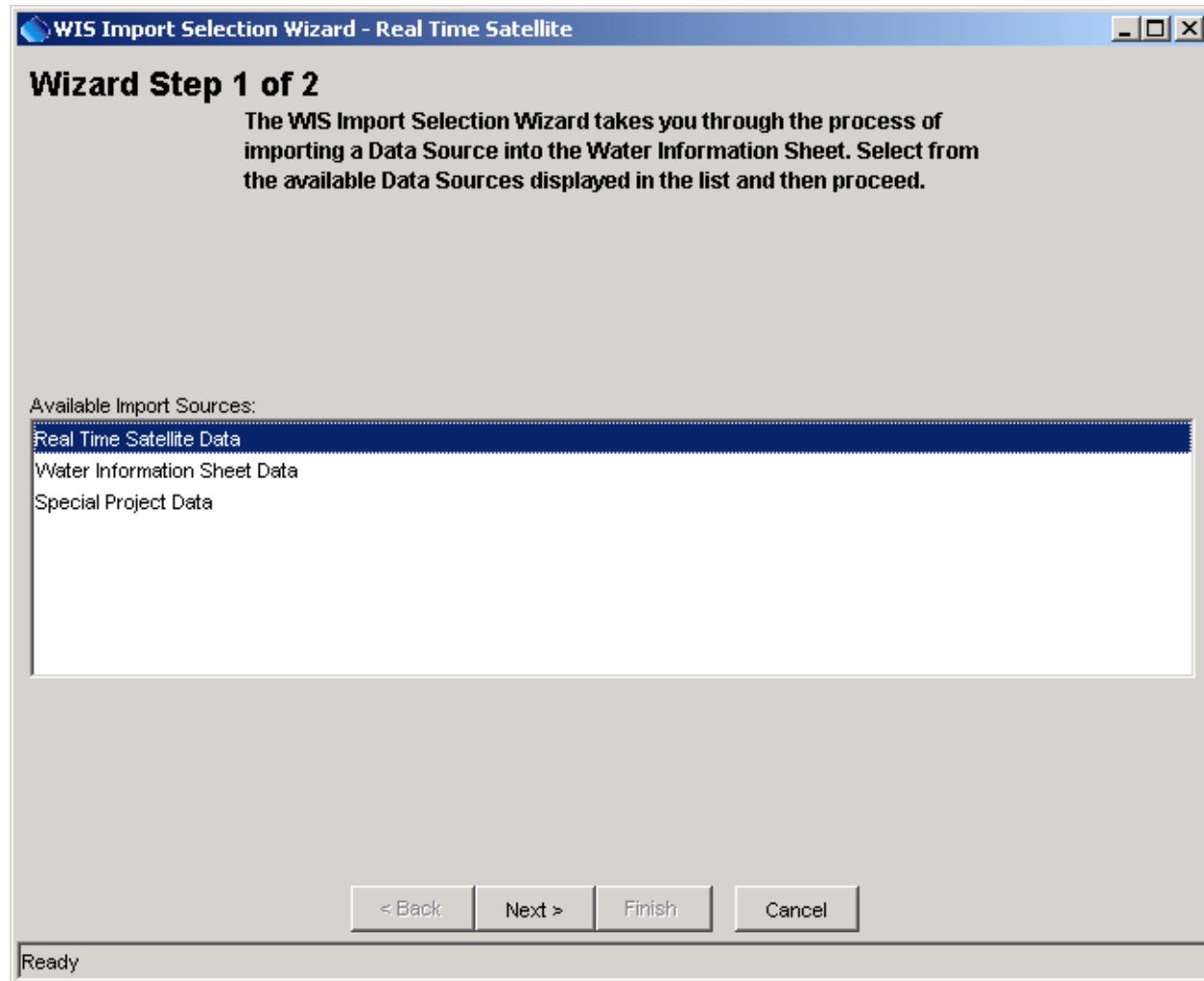
```

The stream network display illustrates how tributaries join each other and eventually meet with the main stem. Some of the information in this interface is for developers. The numbers on the left indicate the tributary level, with one being the most downstream (main stem) and the highest number being the most removed from the main steam. Indentations are used as appropriate to reinforce the stream ordering concept. See also **Section 5.3.7 – WIS Diagram** for information about the graphical network display.

The relationship of the rows (nodes) to each other is currently controlled by a stream table in the database. Base flow nodes are known flow points, rather than being computed from water passed from upstream. In the WIS, base flow nodes are restricted to the Streamflow and Other node types. These nodes provide necessary known data that are used in computations. Currently, baseflow nodes are required at the headwater and mouth of each tributary. **Section 5.2 – Water Information Sheet** describes the concept of drying the river, which allows you to dynamically treat a row as a known point of zero, when appropriate during dry periods.

5.3.3 Data Imports

The WIS has several features that allow data sharing and manipulation. The data import feature can be used to add an import (e.g., gaged streamflow or diversion value) to any editable cell. The **Add Import** button at the bottom of the **WIS Builder** is used to add import information for a selected cell, as illustrated in the following initial import dialog:



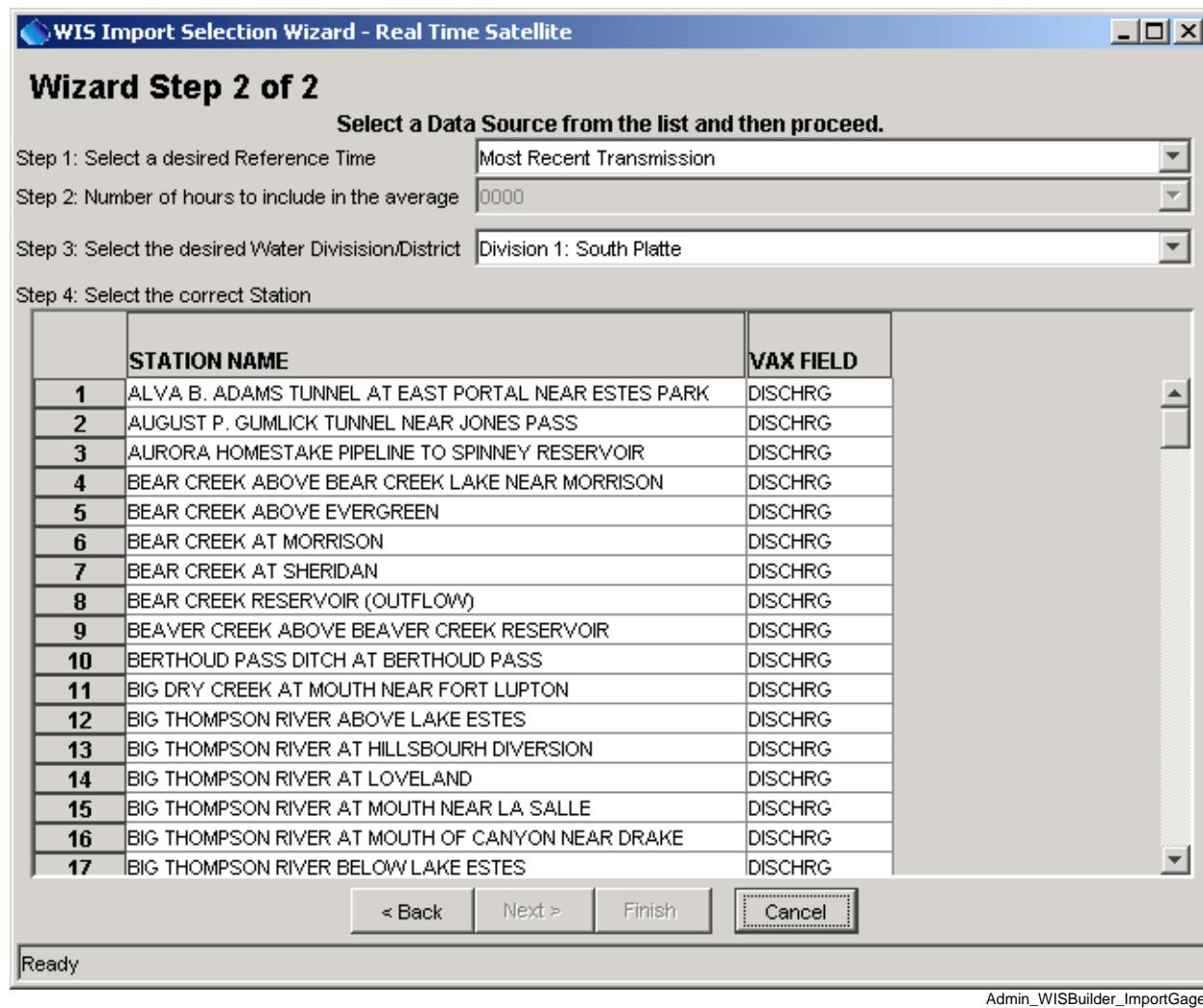
Import Dialog to Select Import Data Type

Admin_WISBuilder_ImportGage1

An import can be applied in any editable cell and transfers data from the specified data source to the WIS. If an import fails during operation, the cell value from the previous archive will be used.

The following figures illustrate imports of different data types.

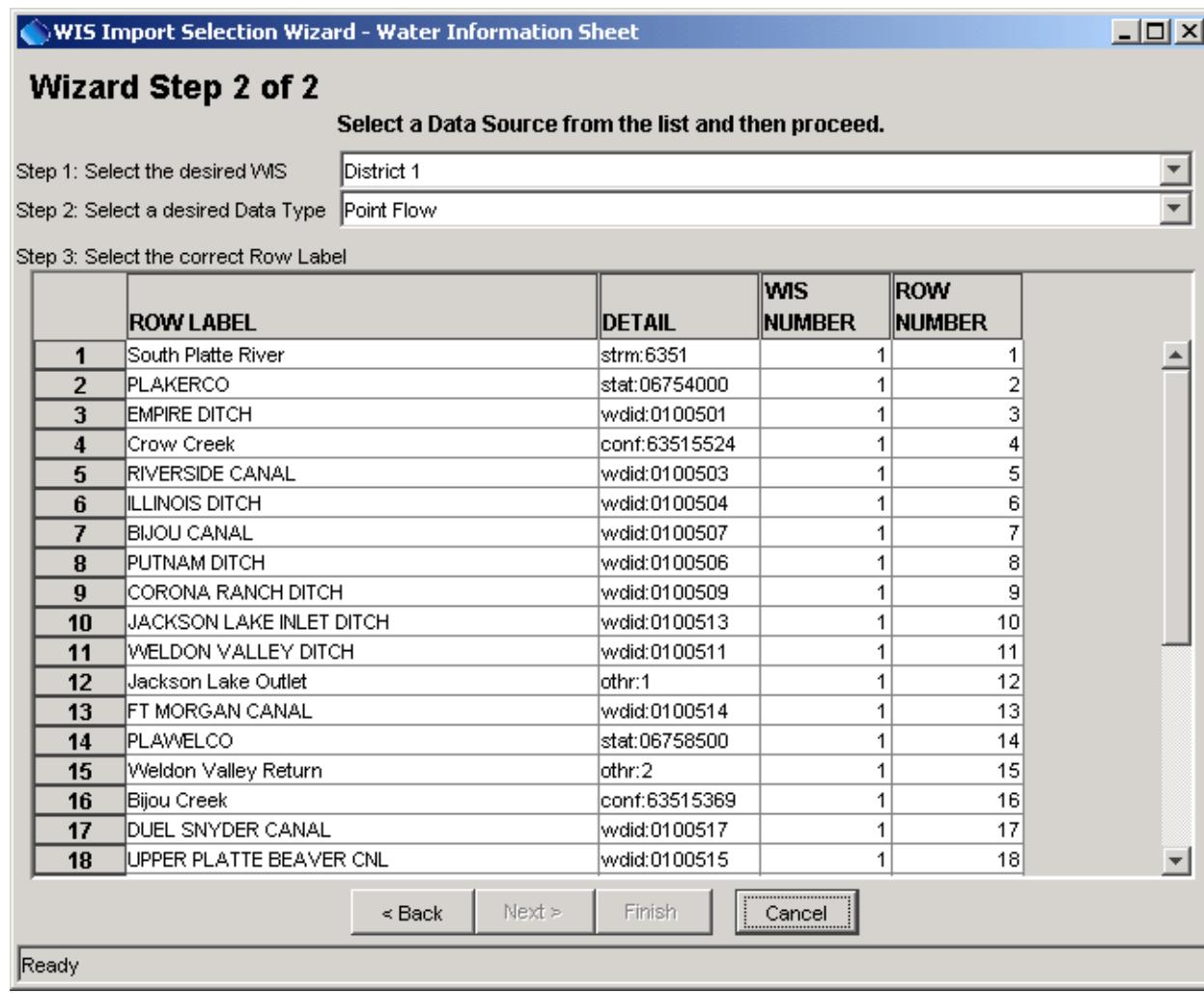
The following figure illustrates the dialog used to import real-time data (streamflow).



WIS Import for Real-time Data

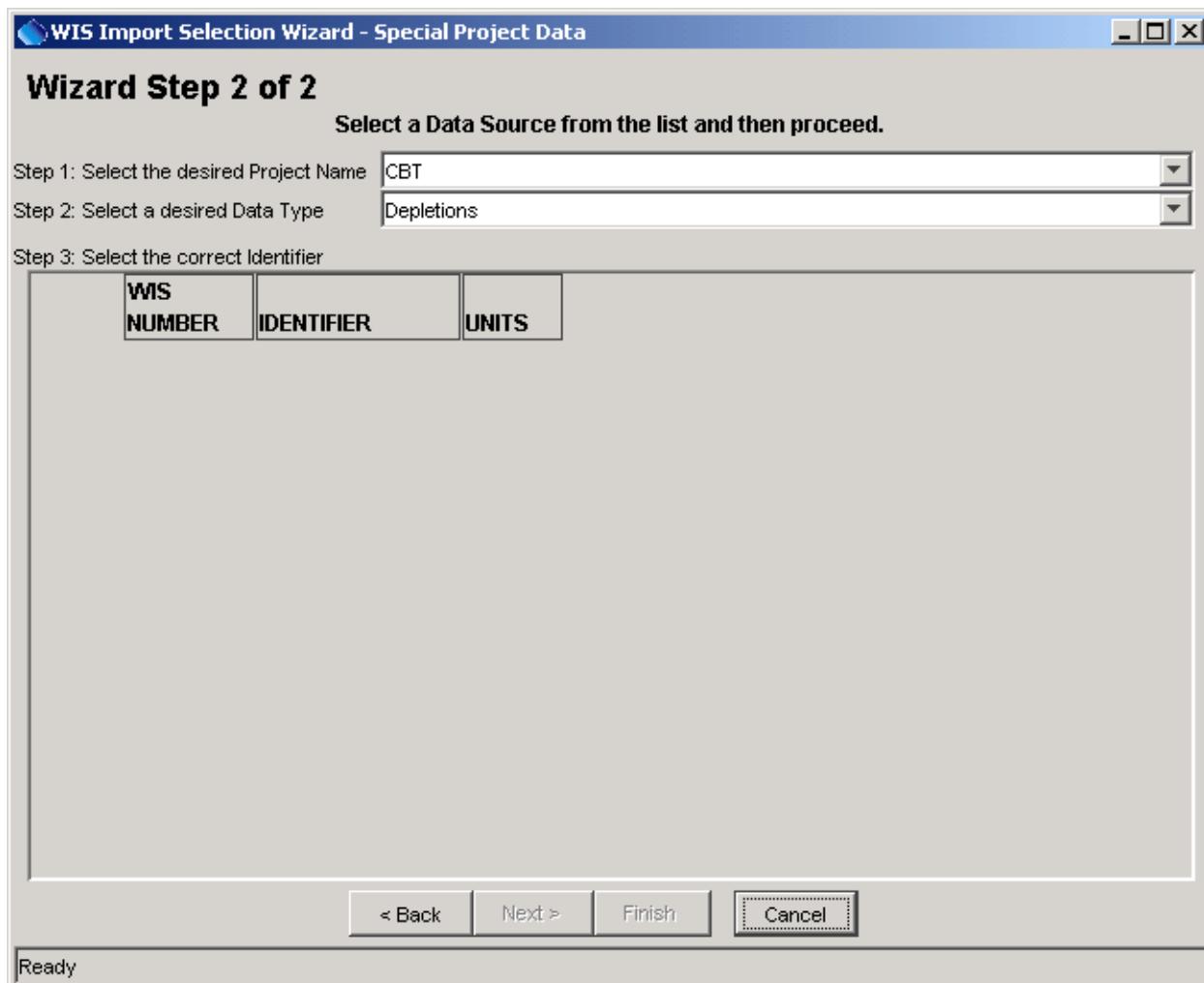
Select a reference time (**Most Recent Transmission**, or a military time for the time of day corresponding to the end of the observation period). If a time is selected, select the number of hours (again, military time) to include in the average prior to the reference time. For example, pick a reference time of 0600 and 2400 hours to return the average flow in day ending at 0600. Also select the real-time measurement to import from the station list. Only data that are available in the central HydroBase can be imported.

The following figure illustrates an import of data from a WIS.



This is used, for example, to import the outflow from an upstream WIS (if used operationally, this requires that WIS data be saved on an appropriate schedule so that downstream WIS can use data from upstream WIS). The value for the administration date will be imported when used operationally. If not available, the cell value from the last archive will be carried forward. To complete the import, select a WIS, column, and row. Note that only WIS that are available in HydroBase can be imported.

The following figure illustrates an import of Special Project data.



WIS Import Dialog for Special Project Data

To import data, select a special project sheet and the data type for the special project. The import value for the administrative date. If not available, the cell value from the last archive will be carried forward.

Special project have been used on a limited basis with the Division 5 Workbook and data may not be available.

5.3.4 Formulas

The formula editor allows formulas to be assigned to an editable cell. Formulas have three primary purposes in the WIS:

1. Transfer tributary mouth flows to a confluence node. For example, select the **Tributary Delivery** cell for a confluence row and then add a formula where the cell value equals that of the tributary mouth delivery flow.
2. Transfer flow to a baseflow point. For example, there may be a gaging station downstream in the basin but not at the headwater. In order to provide some flow at the headwater, either a release has to be made or a known streamflow has to be prorated to the headwater. A formula can be used to set the **Natural Flow** of the headwater node to a fraction of the downstream natural flow.
3. Implement a summary-type formula. For example, summarize all the tributary mouth natural flows.

To add a formula, select a cell and then press the **Add Formula** button at the bottom of the **WIS Builder**. An interface similar that shown in the bottom of the following figure will appear.

Colorado Water Rights Administration Tool - Water Information Sheet Builder

Sheet Name: District 1 Date: 1998-03-03 Gain Method: None

Row Label	Point Flow	Natural Flow	Delivery Flow	Gain Loss	Releases	Priority Diversion	Delivery Diversion	Trib. Natural	Trib. Delivery	Comments
South Platte River (1, Stream, str...										
PLAKERCO (2, Station, stat:0675...										
EMPIRE DITCH (3, Diversion, wdid...										
Crow Creek (4, Confluence, conf...										
RIVERSIDE CANAL (5, Diversion, ...										
ILLINOIS DITCH (6, Diversion, wdi...										
BIJOU CANAL (7, Diversion, wdid...										
PUTNAM DITCH (8, Diversion, wdi...										
CORONA RANCH DITCH (9, Diver ...										
JACKSON LAKE INLET DITCH (10, ...										
WELDON VALLEY DITCH (11, Div ...										
Jackson Lake Outlet (12, Other, o...										

Add Row Delete Row Add Formula Delete Formula Add Import Delete Import Display Gains

Water Districts: Row Type: Unique Identifier: Stream for Current Row:
1 - South Platte: Greeley to Balzac Diversion wdid:0100507 South Platte River (strm:6351)

Formula Editor: Formula for BIJOU CANAL.Point Flow
= 0.5
* PLAKERCO.Point Flow

Delete + - / *

Show as Text Edit WIS Diagram Save Close

Select a cell or specify a constant value...

WIS Builder Formula Editor

The selected cell will be highlighted in red. The formula wizard at the bottom of the interface steps you through building a formula. **Note that at this time, the formula builder does not support complicated formulas, such as those requiring parentheses.** Formulas can occur in the following cells:

1. Known base flows (e.g., real-time station).

2. Releases, Priority Diversion, Delivery Diversion, Tributary Natural, Tributary Delivery, regardless of row type.
3. Any cell of a String row type.

To delete a formula, select a cell with a formula and press the **Delete Formula** button.

To identify cells as they are being added to formulas, a verbose cell location notation is used. This consists of the cell row and column being displayed as the row label and column heading. To enter terms of a formula, either enter a constant (**followed by Return**) or an operator, then select a cell of interest. String row types can have formulas in any cell and are ignored during network computations. Formula cells are displayed in red.

5.3.5 Computations

When building a WIS, data values are not present in the sheet because the WIS format and the WIS data are stored separately. However, it is valuable to discuss here the sequence of events that occur when the WIS is loaded and solved because this sequence must be kept in mind when building the WIS. The flow values and gain/loss information for a row consider the releases, diversions, and tributary contributions for the row. Therefore, the flow values are shown immediately downstream of the structure (essentially at the structure for gages).

The following steps occur in order to calculate the current values in a WIS.

1. The WIS format is loaded to define the relationship of rows and columns.
2. If a previous archive date for the WIS data is available, load the data into the current sheet. Only data from a WIS format matching the current format can be loaded.
3. Next, apply data imports. For example, if valid real-time data exists, import and display in the sheet in a blue font. The data import value can be reset by the user if the field is editable.
4. Solve the network:
 - a) Solve for **Delivery Flow** throughout.
 - b) Compute **Natural Flow** for user-entered **Point Flow** (**Point Flow** is known).
 - c) Compute the base flow node flows. If **Natural Flow** is a formula, then process the formula first and compute the **Point Flow** second. If **Point Flow** is a user-entered formula, process the formula first and compute the **Natural Flow** second.
 - d) Loop over the network nodes, going from upstream to downstream and compute the **Gain/Loss**, then the **Point Flow**, and then the **Natural Flow**.
 - e) Compute the **Gain/Loss** for all base flow nodes.
 - f) Evaluate string formulas.

Turn on gains information in the builder by selecting the **Gain Method** in the upper right corner of the **WIS Builder** interface. Then press the **Display Gains** button in the middle of the interface to recompute gains. The gain weight for a row is editable in the bottom of the interface when a row is selected (the default weight is 1). A similar approach is used for stream mile data (stream mile is from the Colorado border).

Colorado Water Rights Administration Tool - Water Information Sheet Builder

Row Label	Point Flow	Natural Flow	Delivery Flow	Gain Loss	Releases	Priority Diversion	Delivery Diversion	Trib. Natural	Trib. Delivery	Comments
South Platte River (1, Stream, str...										
PLAKERCO (2, Station, stat:0675...										
EMPIRE DITCH (3, Diversion, wdid...				1.0/12.0 = 0.08						
Crow Creek (4, Confluence, conf:...				1.0/12.0 = 0.08						
RIVERSIDE CANAL (5, Diversion, ...				1.0/12.0 = 0.08						
ILLINOIS DITCH (6, Diversion, wdi...				1.0/12.0 = 0.08						
BLUOU CANAL (7, Diversion, wdid...				1.0/12.0 = 0.08						
PUTNAM DITCH (8, Diversion, wdi...				1.0/12.0 = 0.08						
CORONA RANCH DITCH (9, Diver...				1.0/12.0 = 0.08						
JACKSON LAKE INLET DITCH (10, ...				1.0/12.0 = 0.08						
WELDON VALLEY DITCH (11, Div...				1.0/12.0 = 0.08						
Jackson Lake Outlet (12, Other, o...				1.0/12.0 = 0.08						
FT MORGAN CANAL (13, Diversi...				1.0/12.0 = 0.08						

Add Row | Delete Row | Add Formula | Delete Formula | Add Import | Delete Import | Display Gains

Water Districts: 1 - South Platte: Greeley to Balzac | Row Type: Confluence | Unique Identifier: conf:63515524 | Stream for Current Row: South Platte River (strm:6351)

Confluence (Stream Number): On Stream In Water District 1 | Row Label (Select Confluence at left if possible):
 CROW CREEK (5524) | Stream Mile: | Weight: 1.0

Show as Text | Edit WIS Diagram | Save | Close

Ready Admin_WISBuilder_Gains

WIS Builder Illustrating Gain Information

5.3.6 Editing Rows

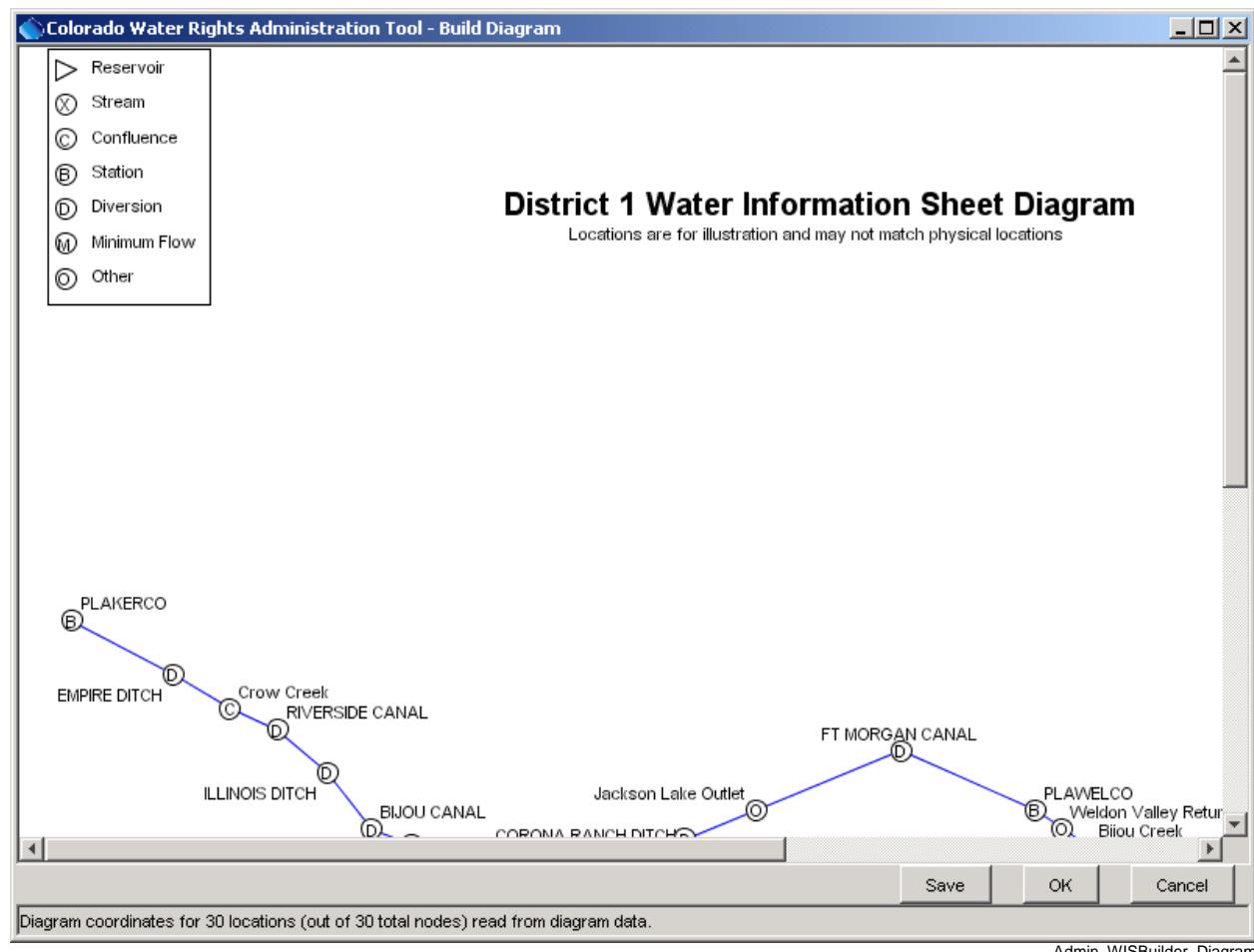
To add a row to a WIS, use the **Add Row** button. The lower part of the screen will then allow data entry for the row. The row will always be inserted above the selected row. If the selected row is the last row in the WIS, you will be prompted to answer whether the insert should be before or after the last row. **It is important that groups of rows in the WIS associated with a stream have a top row that is of type Stream.** Information for the row should adhere to the guidelines specified in earlier sections of this documentation. After adding a row, you can apply imports and formulas as necessary.

To delete a row, select a cell in the row and then press **Delete Row**.

5.3.7 WIS Diagram

The **Edit WIS Diagram** button on the **WIS Builder** displays the **WIS Diagram**, which provides a visual representation of the WIS stream network. The first time that a **WIS Diagram** is opened for a WIS, the software will try to use UTM location information in HydroBase to position the nodes in the network, and will interpolate or extrapolate missing coordinates. After loading the data, the network representation can be edited (as explained below), and saved to HydroBase. Subsequent displays of the network will use the information that was previously saved.

The following figure illustrates the appearance of a **WIS Diagram**, showing an existing diagram.



WIS Diagram Editor

Characteristics of the diagram are as follows:

- The page size for the diagram is pre-selected as letter. Currently this page size cannot be changed. The screen representation of the diagram closely matches the hard copy representation.
- A standard legend is automatically drawn in the upper-left of the diagram and indicates the symbols used for each node type.
- Nodes are labeled with the row label from the WIS and a symbol is drawn for each node.
- Only rows with a physical representation are drawn. String and stream row types are not drawn on the diagram.
- The first time the network diagram builder is opened, node positions are automatically determined, but they can be repositioned interactively (see below). If a node has been added since the last time the nodes were manually positioned in the network diagram, it may be automatically placed inaccurately, and will likely need to be repositioned to fit the rest of the diagram.
- The WIS Builder and WIS Diagram communicate with each other, so that if a node is deleted from the WIS it will be automatically deleted from the diagram (if the diagram editor is open at the same time). Likewise, if a node is added to the WIS, it will automatically be placed into the diagram using default coordinates.

The buttons on the bottom of the **WIS Diagram** are as follows:

- Save** Save the diagram representation to HydroBase, associating the diagram with the WIS that is being edited.
- OK** Save changes and close the **WIS Diagram** editor.
- Cancel** Cancel any edits to the **WIS Diagram** and close the **WIS Diagram** editor.

Additionally, right-clicking on the diagram will display a popup menu with the following menu items:

- Add Annotation** Add an annotation (e.g., title) to the diagram. See the explanation below.
- Delete Diagram Data from Database** Delete the **WIS Diagram** data from HydroBase. A confirmation dialog will be displayed before deleting the data. This action is useful if updates to the spatial data in HydroBase have occurred that allow a better default representation of the diagram to be regenerated (when the diagram is reopened again). However, label positions for each node will likely need to be reset to optimize the display.
- Print on Letter in Landscape** Print the **WIS Diagram** on letter size paper in landscape orientation.

The following sections provide details on using specific features of the diagram editor.

5.3.7.1 Moving Nodes on the Diagram

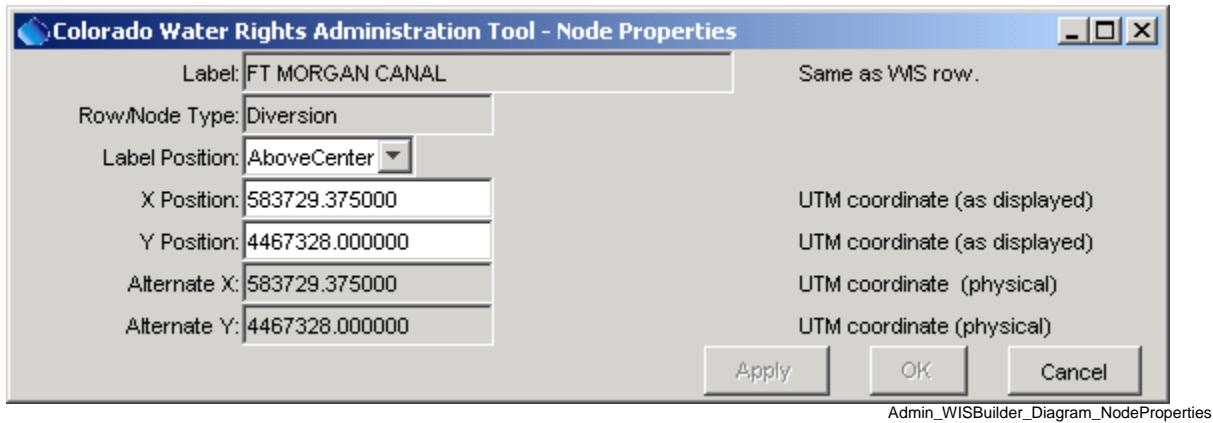
Nodes can be repositioned on the diagram as follows:

1. Click on the node to be moved.
2. While holding the mouse button down, drag the mouse to a new location. When dragging a node, the node will not display any information and the river connection lines will not be redrawn.
3. Release the mouse button. The associated connecting lines on the diagram will redraw.

If for some reason it is difficult to select the proper node (e.g., several nodes have very similar coordinates), it may be necessary to first spread out the nodes and then reposition each node.

5.3.7.2 Editing Node Properties

To edit the properties for a node, right-click on a node symbol and select the **Properties** menu item, which will display a dialog similar to the following:



WIS Diagram Node Properties Dialog

Node properties include only properties that impact the visual representation of the node. All other properties are defined in the main **WIS Builder** tool (including node/row type, whether a baseflow, etc.). Node properties include:

- Label** The label for the node – same as the WIS row label.
- Row/Node Type** The row/node type – same as the WIS row type.
- Label Position** Indicates the position of the node label, relative to the symbol. An appropriate position should be selected to minimize the condition where labels overwrite.
- X, Y Position** The coordinate of the node on the diagram. Initially this will be the same as **Alternate X, Y**, but values will reflect nodes being moved in the diagram editor.
- Alternate X, Y** The alternate coordinate is initially set to the UTM coordinates from HydroBase, or the interpolated coordinates.

5.3.7.3 Adding Annotations

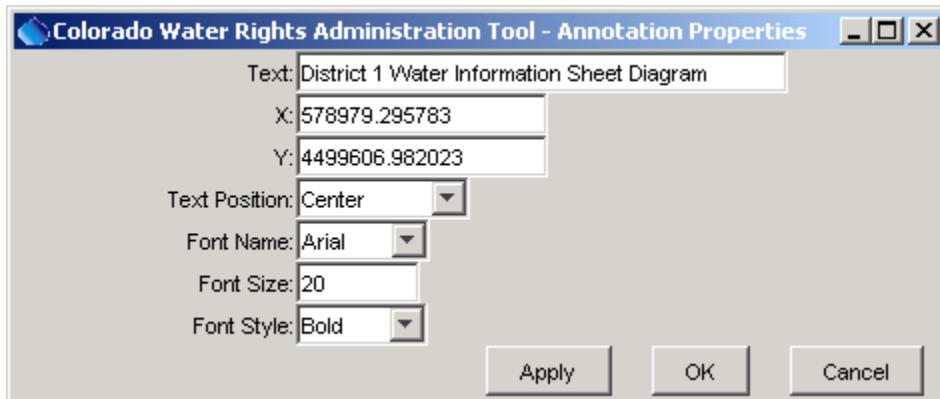
Annotations can be added by right clicking on the **WIS Diagram** and then selecting the **Add Annotation** menu item. Initially, the following dialog will be shown:



Admin_WISBuilder_Diagram_AddAnnotation

After pressing **OK**, the text will be displayed on the diagram centered on the location that the mouse was clicked.

Once the annotation has been added, it can be moved by selecting and dragging the text. Additionally, right-click on the annotation and select **Delete** to delete the annotation, or select **Properties** to change the appearance of the annotation, using the following dialog:



Admin_WISBuilder_Diagram_AnnotationProperties

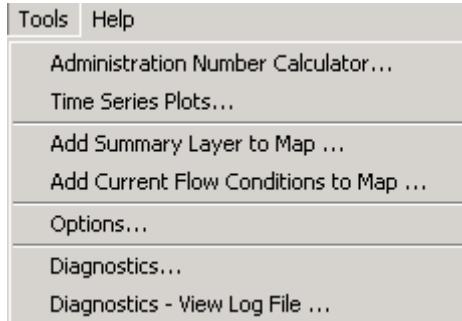
The meaning of the specific properties is as follows:

Text	Text for the annotation.
X, Y	Coordinate for the annotation – not usually hand edited.
Text Position	Indicates the position of the annotation text, relative to the X, Y coordinates.
Font Name	Font to use for the annotation.
Font Size	Font size (points) to use for the annotation.
Font Style	Font style for the annotation.

6 Tools

Version 4.02.00, 2005-08-03, Color, Acrobat Distiller

The **Tools** menu provides access to useful tools and allows program options to be set.

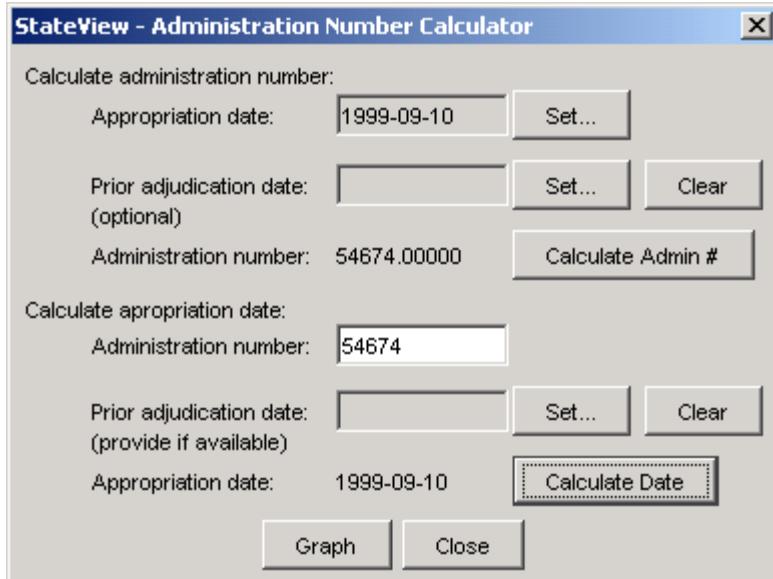


Menu_Tools

Tools Menu

6.1 Administration Number Calculator

The **Tools...Administration Number Calculator** menu displays an interface to convert between appropriation and prior adjudication dates and the administration number, all of which are used by the State of Colorado to indicate the seniority of water rights. The administration number is a useful representation because it allows priorities to be quickly sorted.



Tools_AdminNumCalc

Administration Number Calculator

The administration number depends on the appropriation date and prior adjudication date for a water right and in simple terms is the number of days since 1849. Use the calculator to convert between dates and the administration number. Use the upper part of the dialog to calculate the administration number from dates and the bottom to calculate the dates from the administration number. Use the **Calculate Admin #** and **Calculate Date** buttons to perform the calculations. In the above example the date was entered in the top to compute the administration number. The administration number was then entered in the bottom to

compute the date. The information should be consistent. Use either of these options as needed. Press the **Graph** button to see a graph of whole administration numbers over time (ignoring the prior adjudication date).

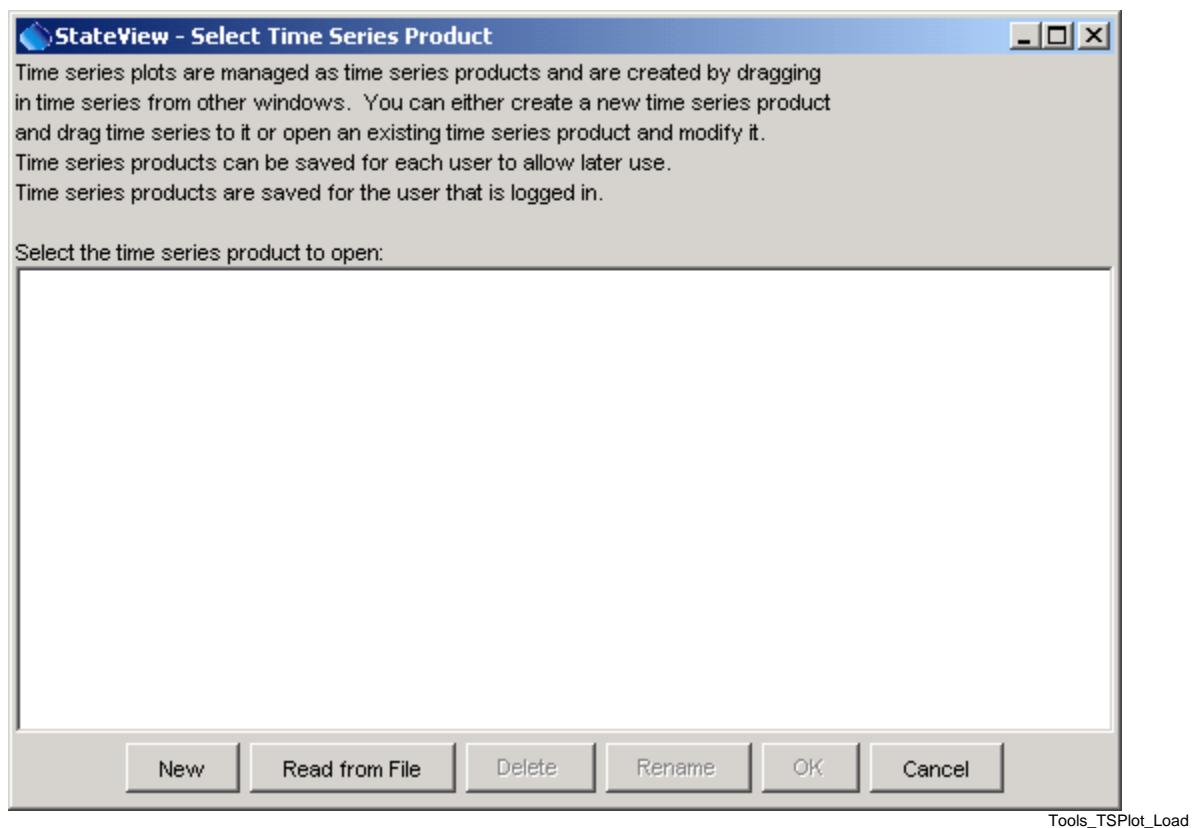
6.2 Time Series Plots

The **Time Series Plot** tool can create plots for time series of different data type and time step and is a generic plotting tool. Whereas older versions of the plotting tool used the term *template* to describe a graph configuration, the current tool uses the term *time series product*. The time series product configuration features are essentially the same that are available in the general plotting tool described in the **TSView Time Series Viewing Tools Appendix**. The main additional feature is that an interface is provided to retrieve time series products from HydroBase and save modified products back to HydroBase. The feature to display real-time data shifted to overlay historical data has been removed because the features were not extensively utilized in StateView/CWRAT and similar features are available in the TSTool software.

A time series product consists of a list of time series identifiers and configuration properties to describe one or more graphs on a “page”. Time series identifiers are determined internally by the software and conform to the conventions described in the TSTool software documentation (see also the **TSView Time Series Viewing Tools Appendix** for background). Properties include titles, graph types, colors, symbols, etc. In order to facilitate reuse of time series products, the definitions of time series products can be saved to HydroBase, for the current login, and can be saved to text files (*.tsp), for later use or to share with other software like TSTool.

The remainder of this section describes how the **Tools...Time Series Plots** features are used to define and retrieve time series products, and how to display the graphs associated with the products.

When the **Tools...Time Series Plots** menu is first selected, you will be prompted to select an existing time series product or create one, as shown in the following figure.



Tools_TSPlot_Load

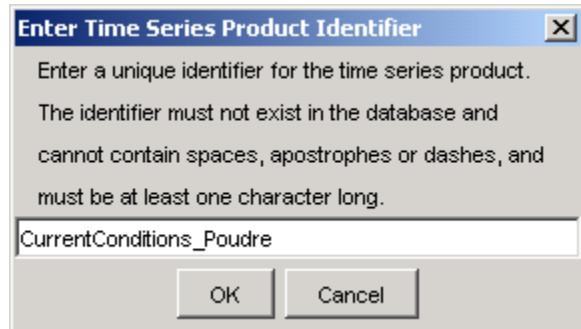
Note that if logged in as guest, you cannot save the plot configuration to HydroBase but you can save as a time series product file (see below). The following buttons are available in the load dialog:

- | | |
|-----------------------|--|
| New | Create a new time series product – see Section 6.2.1 – Create a New Time Series Product below. |
| Read from File | Read an existing time series product from a file (instead of from HydroBase). For example, read a time series product file created with the TSTool software. |
| Delete | Delete the selected time series product from the list. |
| Rename | Rename the selected time series product. |
| OK | Load the selected time series product from HydroBase. |
| Close | Close the time series product load dialog. |

6.2.1 Create a New Time Series Product

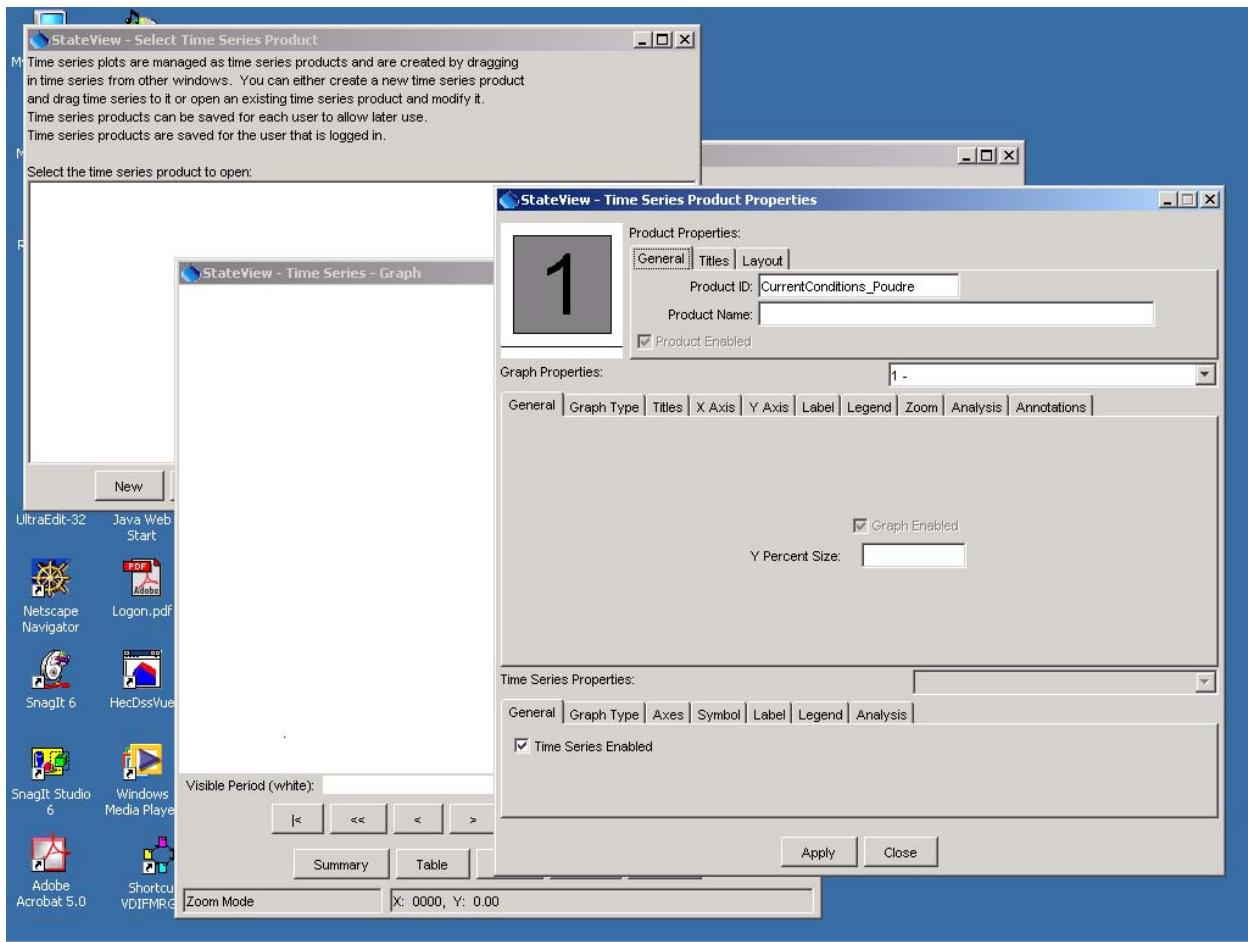
Creating a new time series product involves the following steps. Although the initial configuration will involve using a number of windows in StateView/CWRAT, once the configuration is complete, displaying the resulting time series product is much simpler). It may be simpler to use the TSTool software to create the initial time series product.

- From the **Select Time Series Product** dialog, press **New**. The following dialog will be displayed.



Tools_TSPlot_New

- Enter a unique identifier for the product. The previous **Select Time Series Product** dialog will list existing products; therefore, refer to the list to avoid using the same identifier. After entering an identifier, press **OK**. A blank graph and its related properties window will appear, as shown in the following example (the windows have been arranged to facilitate discussion).

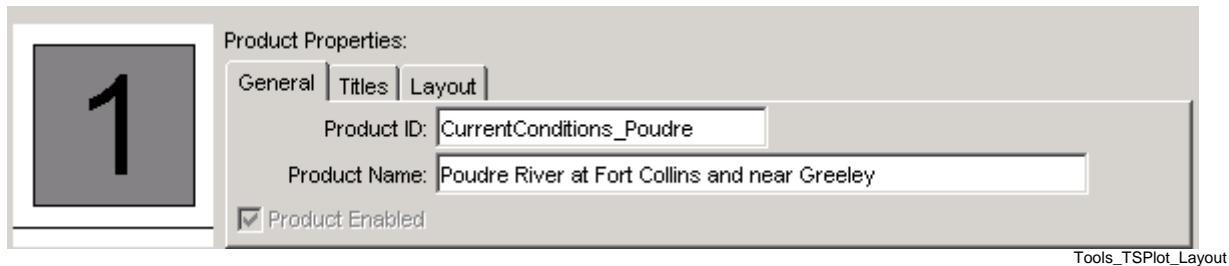


Tools_TSPlot_NewBlank

StateView/CWRAT tries to position the windows appropriately but you may need to move them around. The **Time Series - Graph** window (initially blank) displays the results of processing the

time series product (in this case a graph) and the **Time Series Product Properties** window is used to configure the product (set titles, etc.). The properties window displays the time series product identifier at the top. It is suggested that you also enter a name, which will be used to list time series products during the initial selection/load.

The graph window is blank because no time series have been specified. To add time series, use the properties window layout area (the small graphic in the upper left that displays a large number for each graph on the page). Time series will be dragged from other StateView/CWRAT windows to this area, as described below.

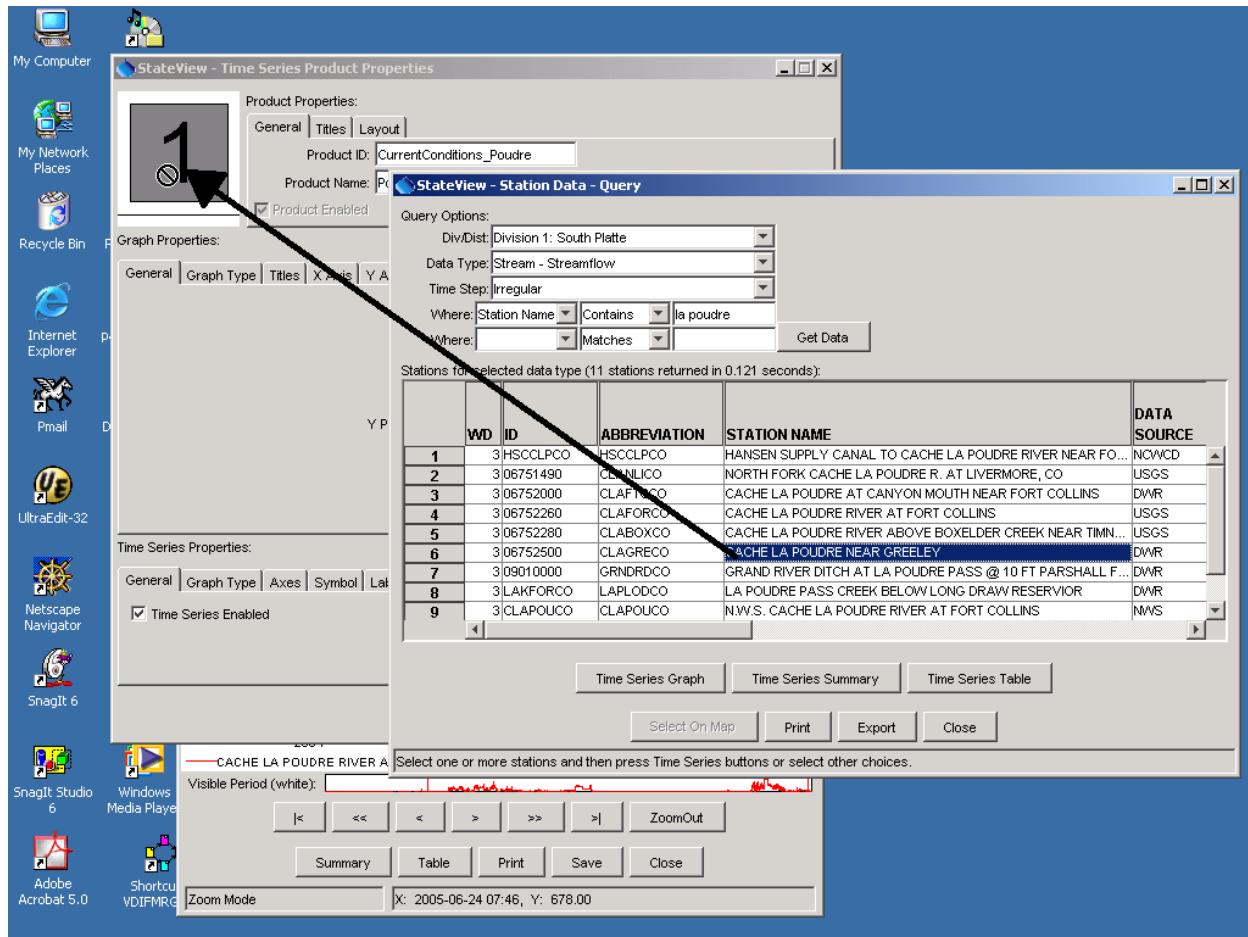


Tools_TSPlot_Layout

3. Add time series to the time series product. The **TSView Time Series Viewing Tools Appendix** describes the functionality of the properties window. Within StateView/CWRAT, time series are added to a time series product by dragging the time series from **Data** menu display windows and dropping them onto the layout area. Time series to be added to the graph can be dragged to the layout window from the windows indicated below. To do so, select the indicated item and hold the mouse down while dragging the item – the cursor will change to a (although there is sometimes a delay). When the cursor is over the layout window (the area with a large 1 in the above figure), release the mouse and the time series will be added to the indicated graph. To display the data in the graph, a query will be performed, resulting in slight delay. The windows from which time series can be dragged are:

- The **Station Data window** – perform a station query and then select and drag one row at a time from the time series list table. This allows all historical and real-time station data to be selected.
- The structure **Diversion Coding/Reservoir Release** window – select and drag one row at a time from the list of available time series. This allows the major time series data for structures to be selected.
- The **Ground Water Data** window for well level data – select and drag one row at a time from the list of available wells.

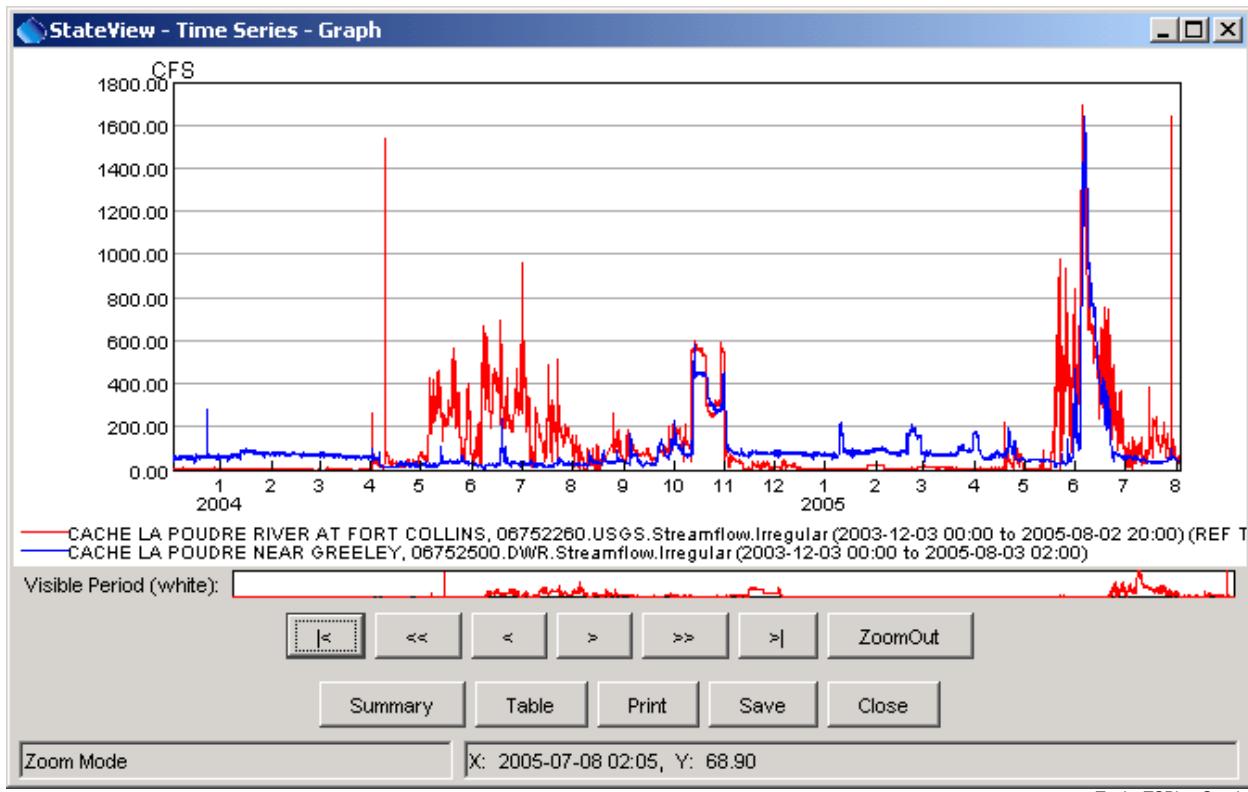
For example, use the **Station Data** window to select real-time data and drag onto the time series product, as follows:



Example of Dragging a Time Series from a Display Window to the Time Series Product Layout

Note that only a single time series can be dragged at one time. Therefore, if multiple time series are to be displayed in the graph, each will need to be dragged separately.

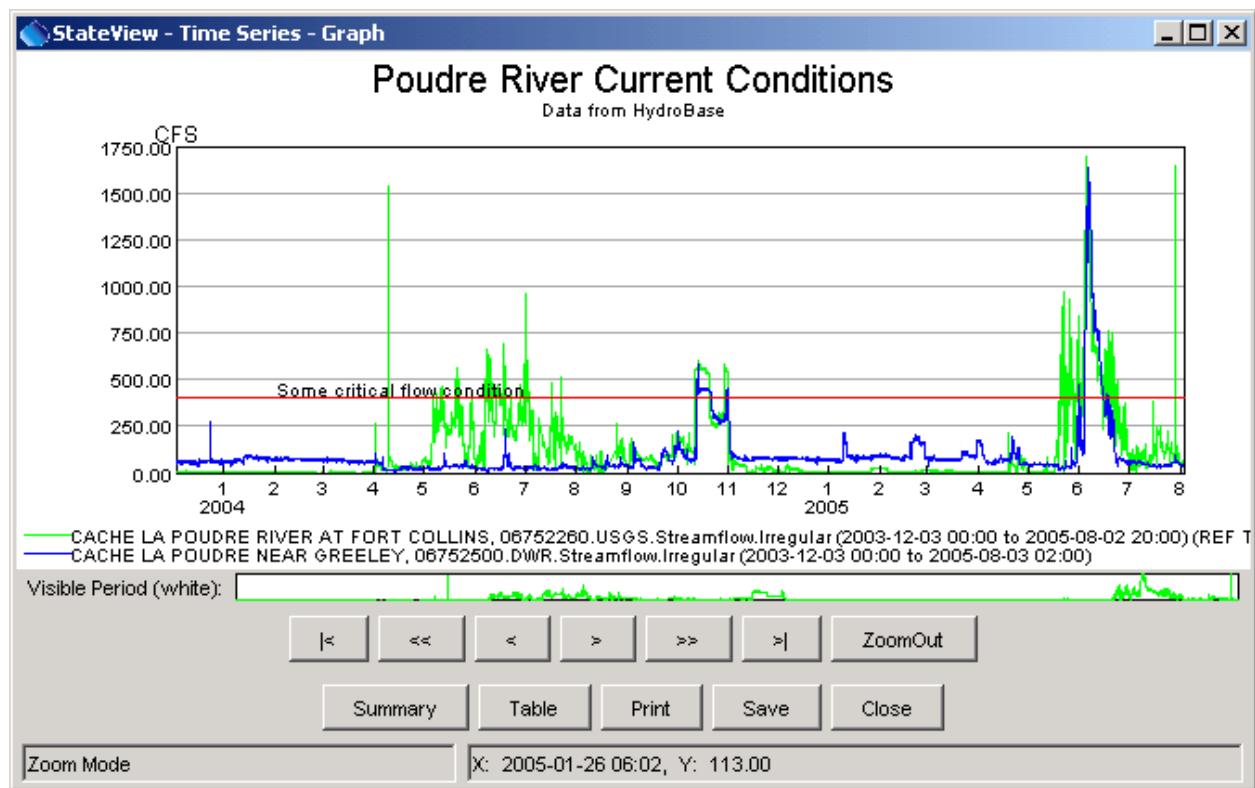
After adding time series to the layout, the graph window will appear similar to the following:



Example Time Series Product Graph after Adding Time Series

Using the drag and drop approach allows the general plotting tools described in the **TSView Time Series Viewing Tools Appendix** to be used throughout StateView/CWRAT, while relying on existing **Data** displays to query data. Consequently, the **Time Series Plots** tool can focus on graphs and avoid duplicating query features.

4. Configure the plot appearance using the **Time Series Product Properties** window. To configure the plot more specifically, set additional properties. The following figure illustrates the graph after setting titles and adding annotations. Press the **Apply** button in the properties window to redraw the graph.



Example Time Series Product Graph after Adding Titles and Annotations

This simple example illustrates the power and flexibility of time series products. If the existing features cannot create a product that is needed, enhancements can be made to add new properties for the graph. Refer to the **TSView Time Series Viewing Tools Appendix** for full details about configuring time series products.

5. Save the time series product. After adding time series and setting graph properties, use the **Save** button on the bottom of the graph window to save the configuration to HydroBase. This will save the time series product identifier and name so that the product can be reused later (see **Section 6.2.2 – Using an Existing Time Series Product** below). Trying to close the graph without saving will display a warning to remind you to save. The time series product can be saved to HydroBase or a text time series product file, which can be used by TSTool. If using the SQL Server database, you will only be able to save a time series product if logged into someone other than guest.

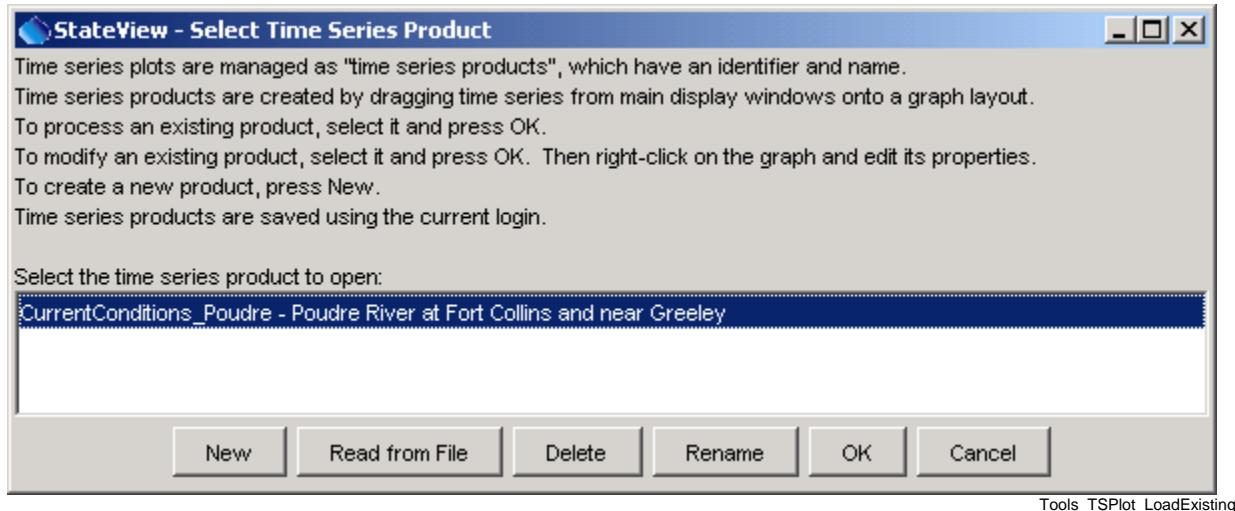
All of the time series can be graphed independently in various display windows. Therefore, time series products should only be used where a complicated graph needs to be composed. It may be more efficient to use TSTool to create the plots and then import the time series products into StateView/CWRAT.

Note that when graphing time series, all available real-time data in the database are shown, which may result in a longer period than desired. This is generally not an issue because the real-time data tables in HydroBase are limited to a relatively short period and because the graphing tools allow zooming in to a shorter period.

6.2.2 Using an Existing Time Series Product

Using an existing time series product to display a graph involves the following steps:

1. Select the **Tools...Time Series Plots** menu item.
2. From the **Select Time Series Product** dialog, select a product that has been stored in HydroBase and, as shown in the following figure:



Tools_TSPlot_LoadExisting

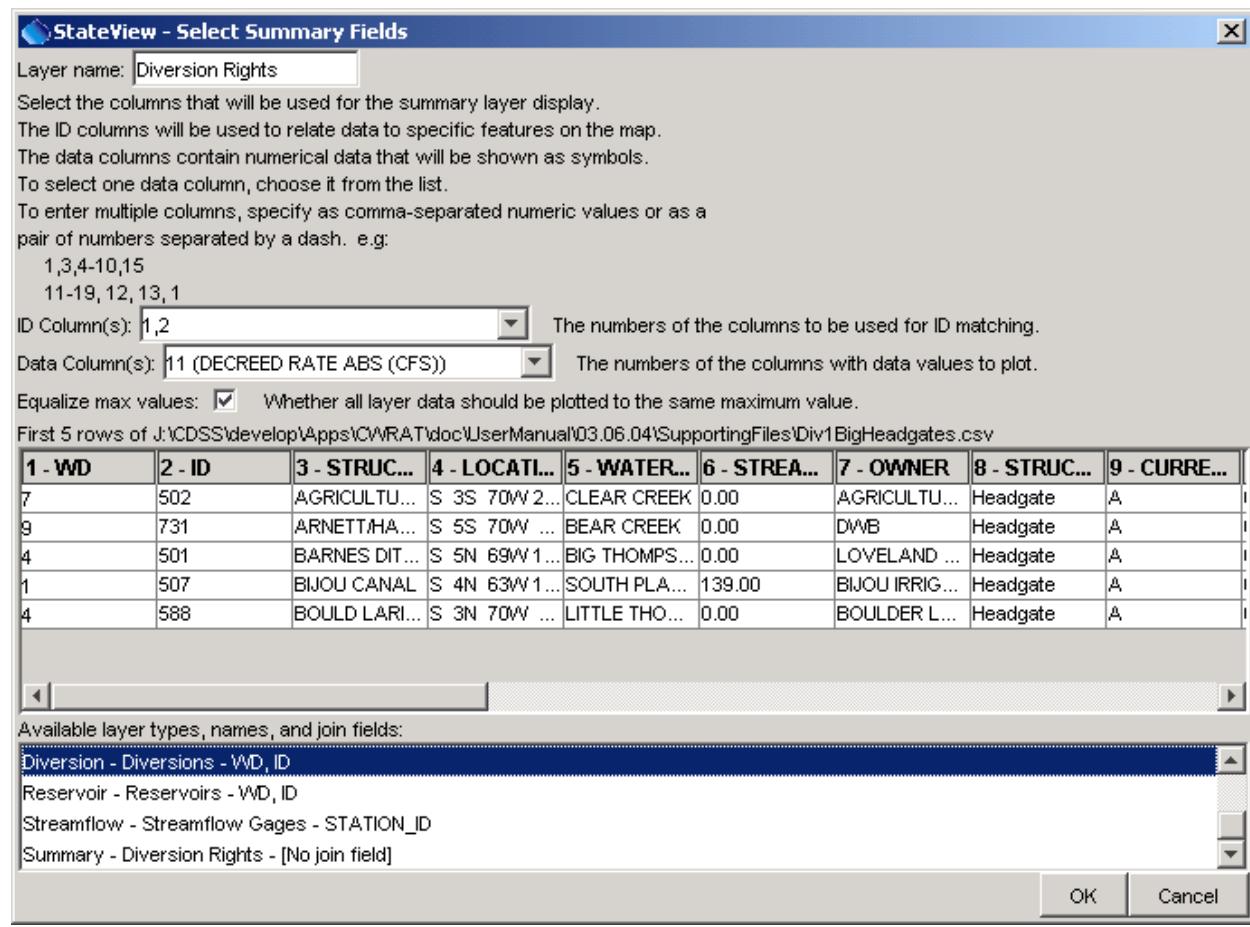
3. Press **OK**, or load a time series product file using **Read from File**. The graph will be displayed, as shown previously. A pause will occur as the database is queried for data. The size of the window will be the default graph size and may need to be changed for optimal viewing.
4. If changes are desired, right-click on the graph and press the **Properties** menu choice. Set properties or drag new time series onto the graph as described in **Section 6.2.1 – Create a New Time Series Product** above. To save the changes over the existing time series product, use the Save button on the graph window.

6.3 Add Summary Layer to Map

The **Tools...Add Summary Layer to Map** menu allows data from a delimited file to be displayed on the map, by joining with spatial data. This tool is only available when the map display is shown and vertical scaled bars are the only symbols that are available. The current flow conditions map (see next section) uses this tool, internally handling all of the data preparation. The general tool is being provided to facilitate data viewing; however, some technical issues remain (e.g., optimizing the performance and performing joins on WDID locations, where one or two identifier fields may be provided for the join. See the **Installation and Configuration Appendix** for more information about configuring map data for use with StateView/CWRAT. **Using this tool with many records (thousands) can be slow.**

To add a summary layer to the map:

1. Prepare a delimited input file. Typically this file should contain station identifiers and numerical data to display. For example, data from the normal structure and station tabular displays can be exported to a comma-delimited file, or a spreadsheet can be saved as a CSV file.
2. Select the **Tools...Add Summary Layer to Map** menu and select the file from step 1.
3. The input file will be read and the following dialog will be displayed, prompting for more information:



Summary Map Layer Tool Interface

Provide the required information about the file, to allow the software to complete the display.

Layer Name	A name to be displayed in the map layer list (table of contents).
ID Column(s)	Indicate the column numbers for identifier information, to be used to match the data records with the spatial data features. The order of the columns should match the join fields shown for available layers at the bottom of the window.
Data Column(s)	One or more column numbers, for the columns to be displayed.
Equalize max values	If more than one column of data are used, selecting the checkbox will cause the maximum values for both data columns to be scaled to match on the map.

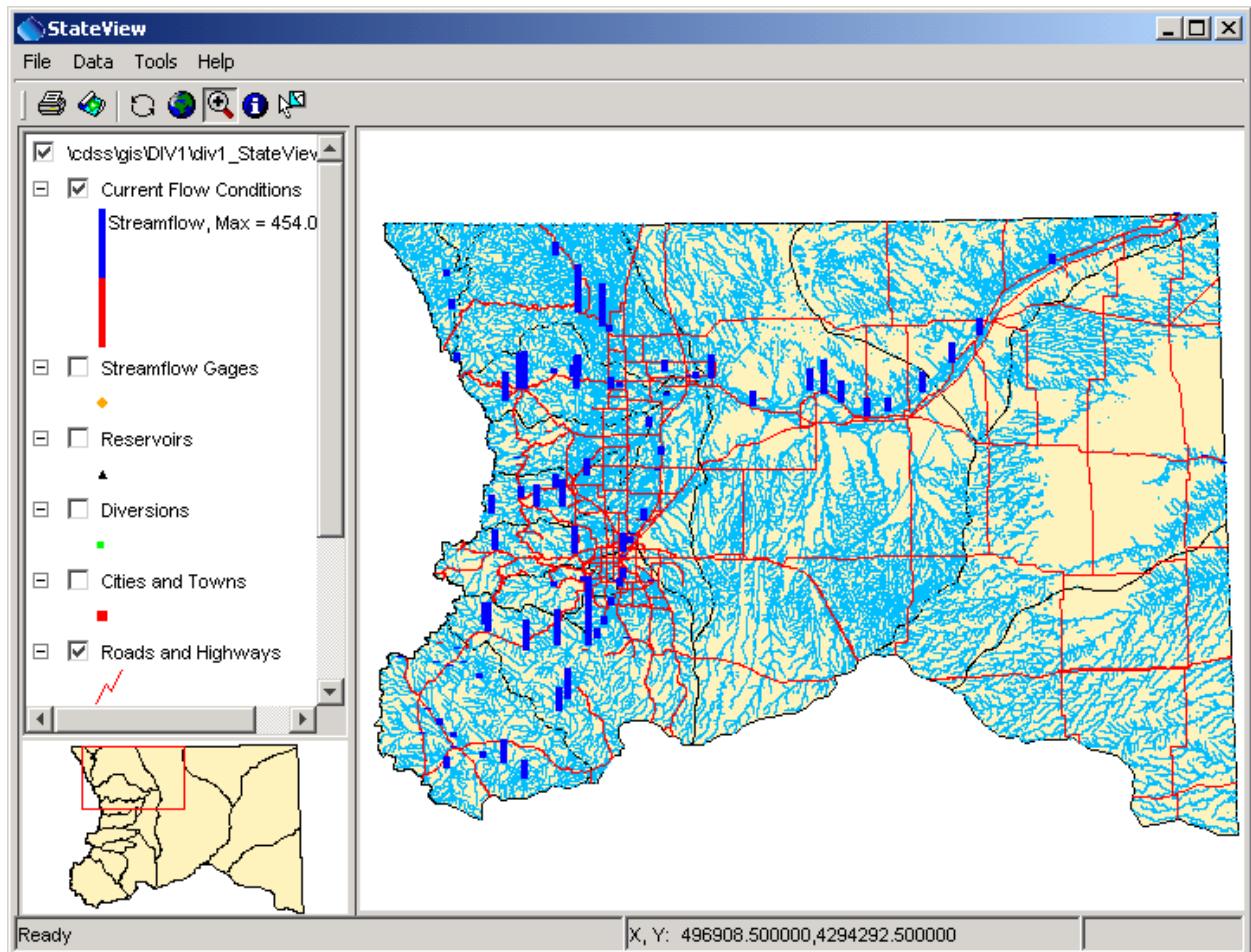
4. Press **OK** to display the layer on the map. Warnings may result if locations on the map cannot be found – this is can usually be ignored. See the next section for an example display and information about labeling data.

6.4 Add Current Flow Conditions to Map

The **Tools...Add Current Flow Conditions to Map** menu will display the current flow conditions on the map. This tool is only available when the map display is shown and real-time data are available in HydroBase. The steps used to produce the map are as follows:

1. HydroBase is queried to determine the real-time streamflow stations for the division that has been selected at login (the division selection controls the map that is displayed). **Warning: the HydroBase design does not distinguish between real-time gages and monitored structures; therefore, some values that are displayed will not be natural stream channels.**
2. HydroBase is queried to read the real-time streamflow time series for DISCHRG data types. This is essentially the same action that is done from the **Stations** query when displaying real-time streamflow data. Data from the current time, minus one day is requested. During this step, it is possible that a warning will be displayed, indicating that time series for some real-time stations are not available. This warning can usually be ignored, especially if the number of stations with missing data is low.
3. The time series data are examined and the most recent value is used to display on the map. The time for the observation is also saved for labeling the map (see below). Because a window of one day is allowed for data, it is possible that flow values across a region will not be for a single point in time. However, the pattern of flows will generally be reasonably accurate. Real-time stations that are not reporting will typically be delayed only by a short time or will not report for the full period being analyzed. See below for instructions for how to view the measurement times.
4. The real-time station identifiers are compared with the identifiers for station layers on the map. It is possible that some stations will not have locations and a warning will be shown. This warning can usually be ignored, especially if the number of stations with missing data is low.
5. A summary map layer is added to the map, using bars to indicate relative flow amounts. The map legend displays the maximum value displayed.

The following figure illustrates current flow conditions, indicated with vertical bars:



Results of Using the Current Flow Conditions Tool (South Platte Basin)

By default, the flow values are not labeled because the display becomes too cluttered. An easy way to view the observation times is:

1. Select the **Current Flow Conditions** layer in the layer list.
2. Right-click, press View Attribute Table, and locate the station(s) of interest.

To label the observation times on the map when **Current Flow Conditions** has been selected:

1. Right-click and press **Properties**, select the **Label** tab.
2. Specify that the label should use the flow date and/or other information. See the **GeoView Mapping Tools Appendix** for more information.
3. Zoom in to a smaller region to make the map labels more readable.

To remove the flow conditions from the map:

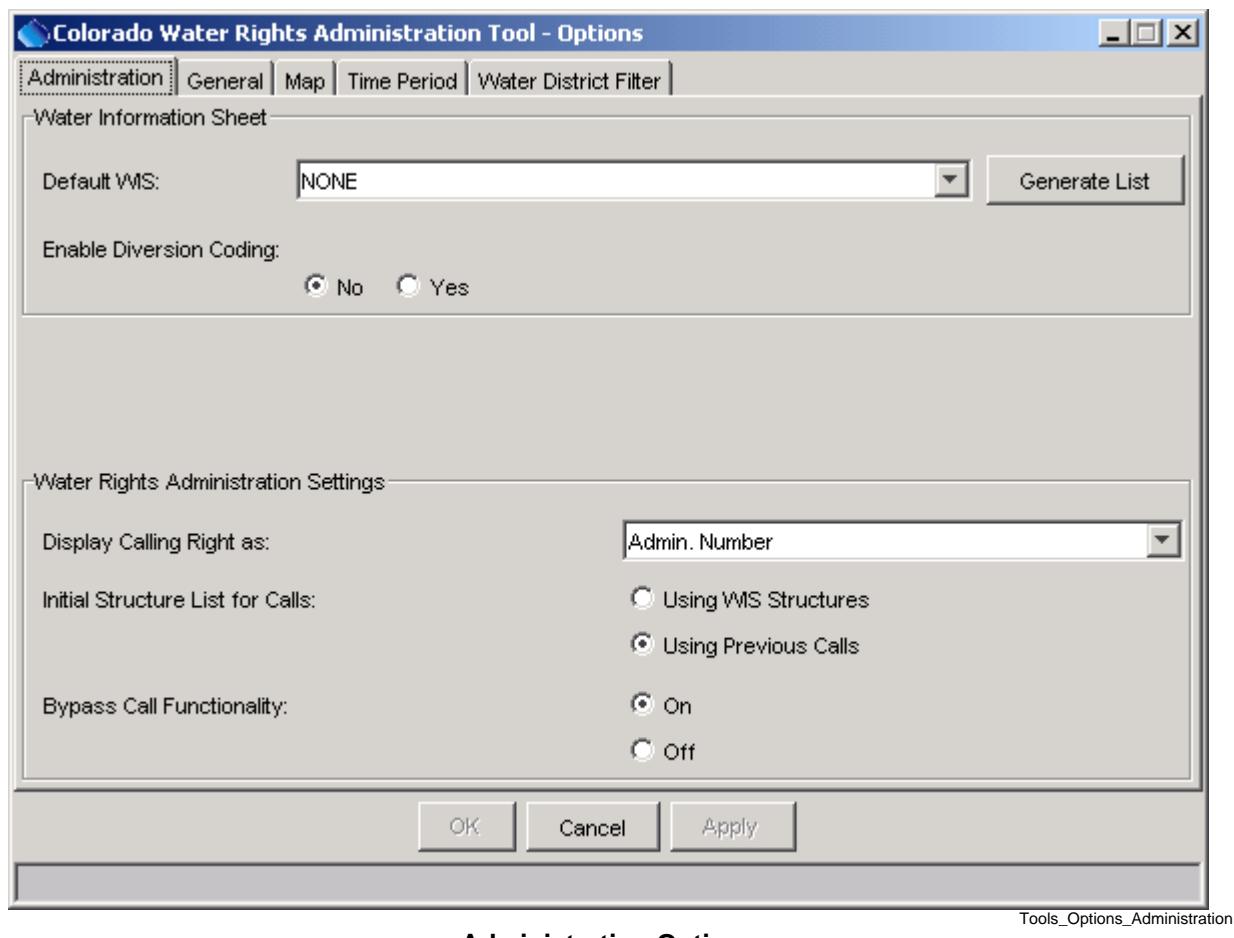
1. Disable the **Current Flow Conditions** layer checkbox – this will cause the layer to not be drawn.
2. Select the **Current Flow Conditions**, right-click, and press **Remove Layer** to remove from the map.

6.5 Options

The **Tools...Options** menu allows viewing and changing StateView/CWRAT configuration settings. Options are displayed in tabbed panels. Options are typically set for a user and are associated with the login that is being used. Guest users may be prevented from changing options, especially if a SQL Server database is used. The various tabs display different settings, as described in the following sections. Some options are independent of the Water Division that was selected at login. However, the **Water District Filter** and **Map** options are saved for each Water Division and for a default case to be used when no Water Division is selected at login.

6.5.1 Administration Options

Administration options are available only when running CWRAT and are used to control settings for the **Edit Calls** and **Water Information Sheet** features.

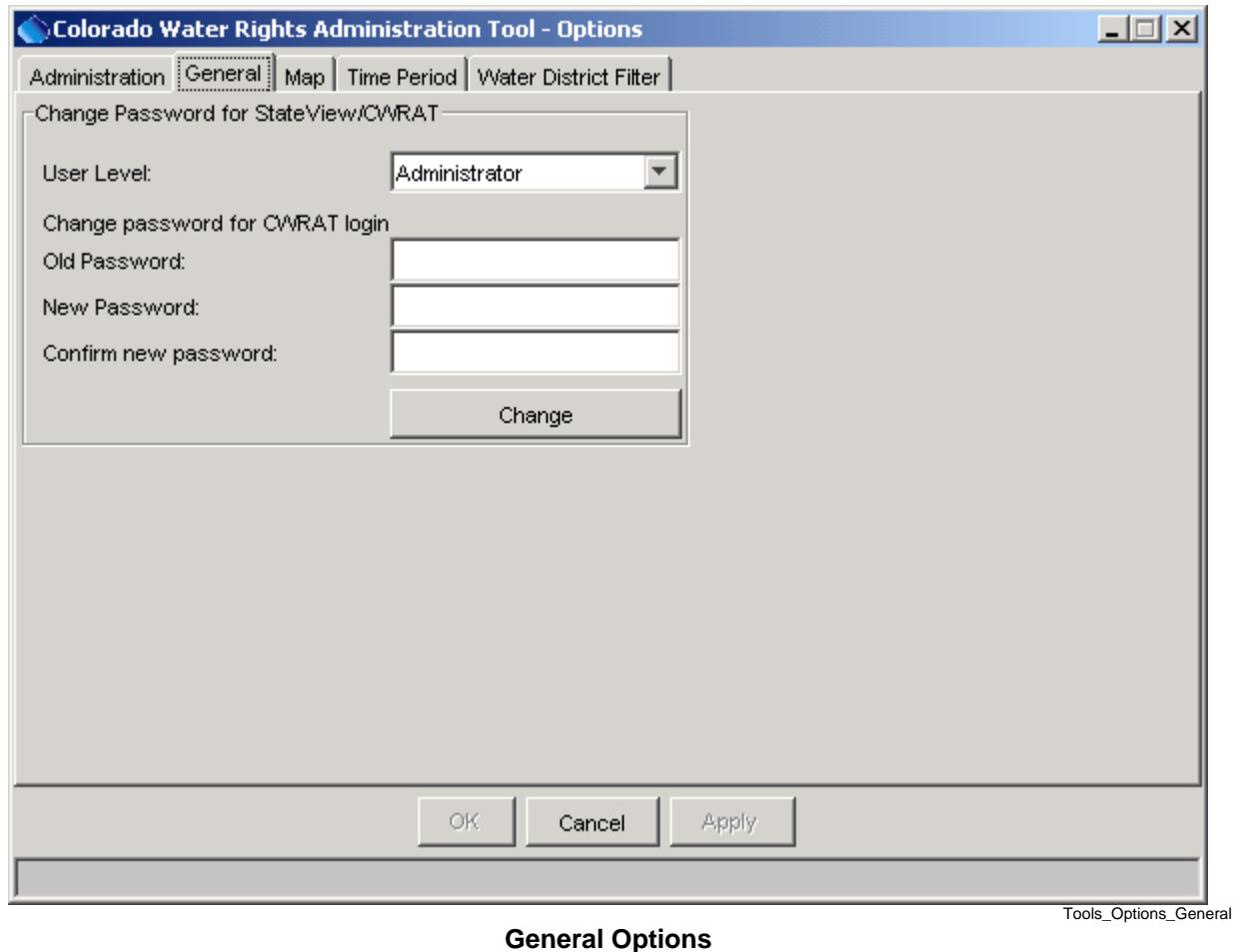


Administration options are as follows:

- Default WIS** Select a default Water Information Sheet to be highlighted for the **Load WIS** dialog, which is displayed when the **Administration...Water Information Sheet** menu item is selected. The sheets that are accessible are listed and the list can be regenerated if a new sheet is added elsewhere in the program.
- Enable Diversion Coding** Enable/disable diversion coding features in the WIS (enabling diversion coding provides more WIS features but may not be desirable for all users). Using diversion coding allows diversion coding details to be stored as values are entered on the main WIS display.
- Display Calling Right as** Sets the defaults for rights information display, in particular for the **Administration...Edit Calls** interface in CWRAT.
- Initial Structure List for Calls** When setting a call with CWRAT, a list of structures is provided. This list, if taken from HydroBase, can be very long. Consequently, the initial list can be taken from available Water Information Sheets or previous calls (i.e., structures that are actually being administered using CWRAT).
- Bypass Call Functionality** Enables or disables the bypass call functionality in the CWRAT **Administration...Edit Calls** interface (used by Division 1).

6.5.2 General Options

General options are used throughout StateView/CWRAT. The export format option that was available in previous versions of StateView/CWRAT is now provided in file choosers when an export occurs.

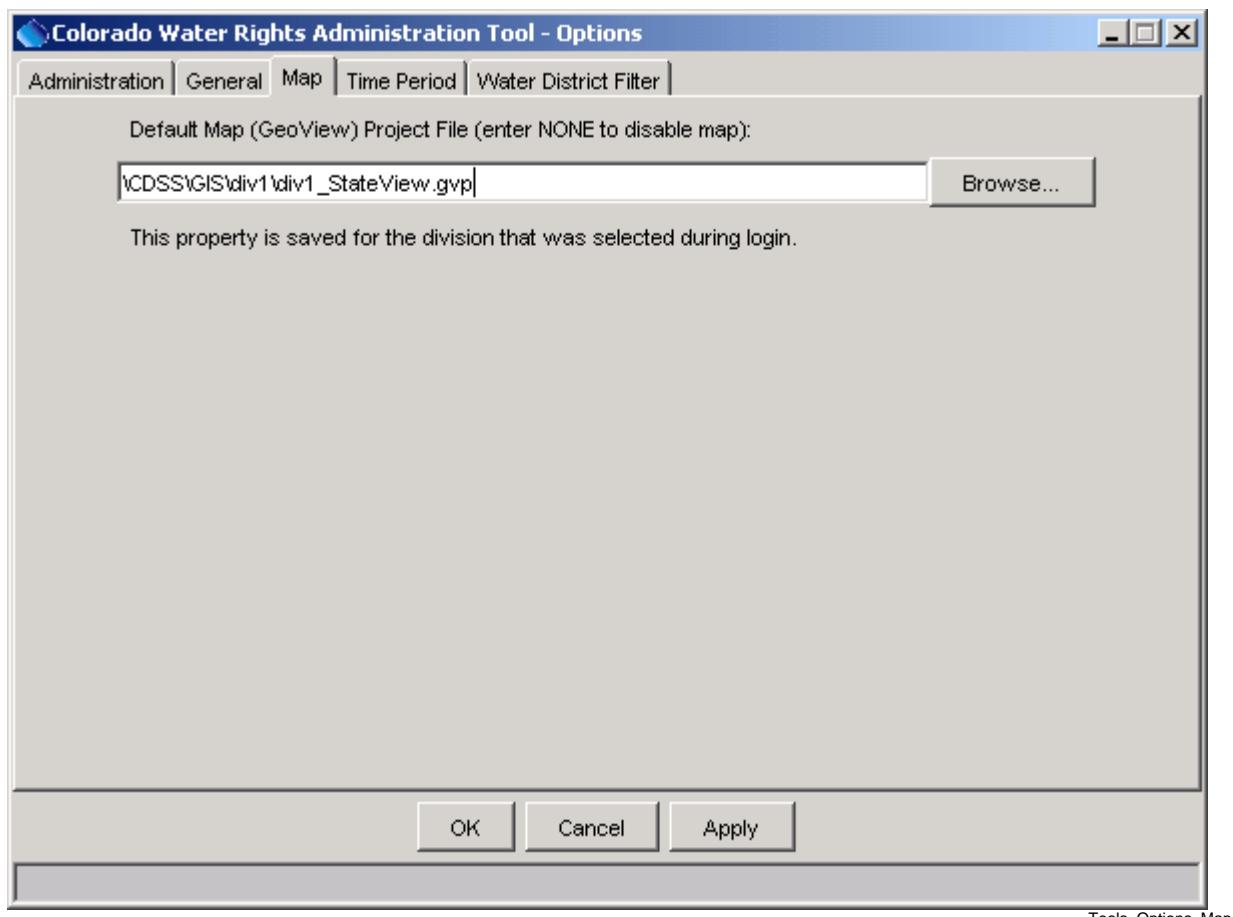


General options are as follows:

- User Level** The user level is used internally by the software to determine which software features to turn on. Choices are **View Only**, **Advanced User**, **Administrator**, and **Other** (used by developers). This feature is being evaluated.
- Change Password** Use these fields to change the SQL Server HydroBase StateView/CWRAT password for the current login.

6.5.3 Map Options

Map options control the use of the map interface.



Tools_Options_Map

Currently the only map option is the name of the GeoView project file (.gvp), which is used to define the map layers displayed in the main interface map. If **NONE** is specified, then no map interface will be used. If a path to a file is specified, an absolute path with or without a drive letter (as shown) can be given. The latter is more general but may not be explicit enough if StateView/CWRAT is run in a network environment from various drives.

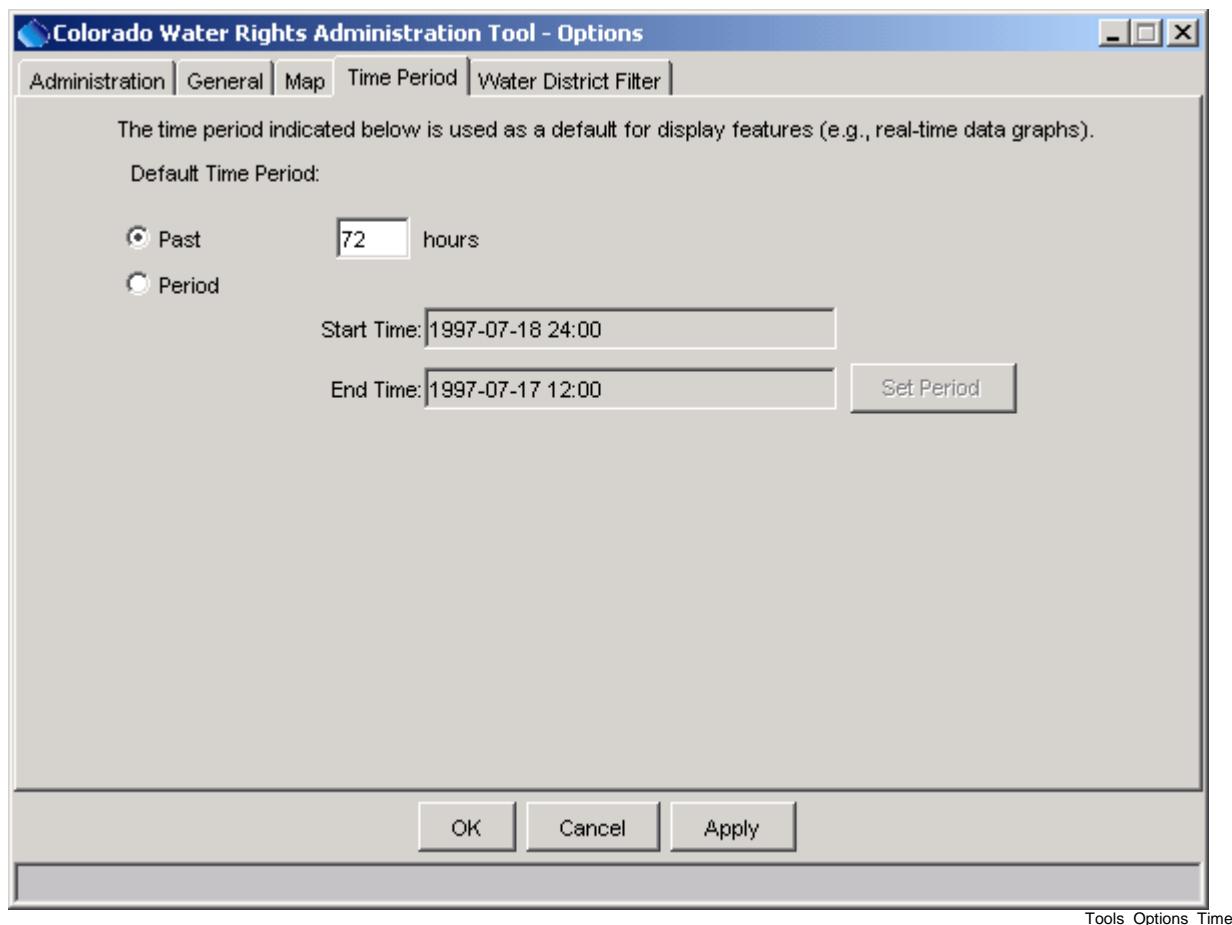
See the **GeoView Mapping Tools Appendix** for information about the map interface. See also **Chapter 7 - Examples of Use** for information about using the map interface.

In many cases, the HydroBase database administrator will have configured the guest login so that the map interface is appropriate for the Water Division that is selected at login.

If CDSS software and data are pre-configured, the path to the .gvp file may not include a drive letter. This requires that the software be started from the same drive as the spatial data, in order to find the data. This is not usually a problem but refer to the **Installation and Configuration Appendix** if problems occur.

6.5.4 Time Period Options

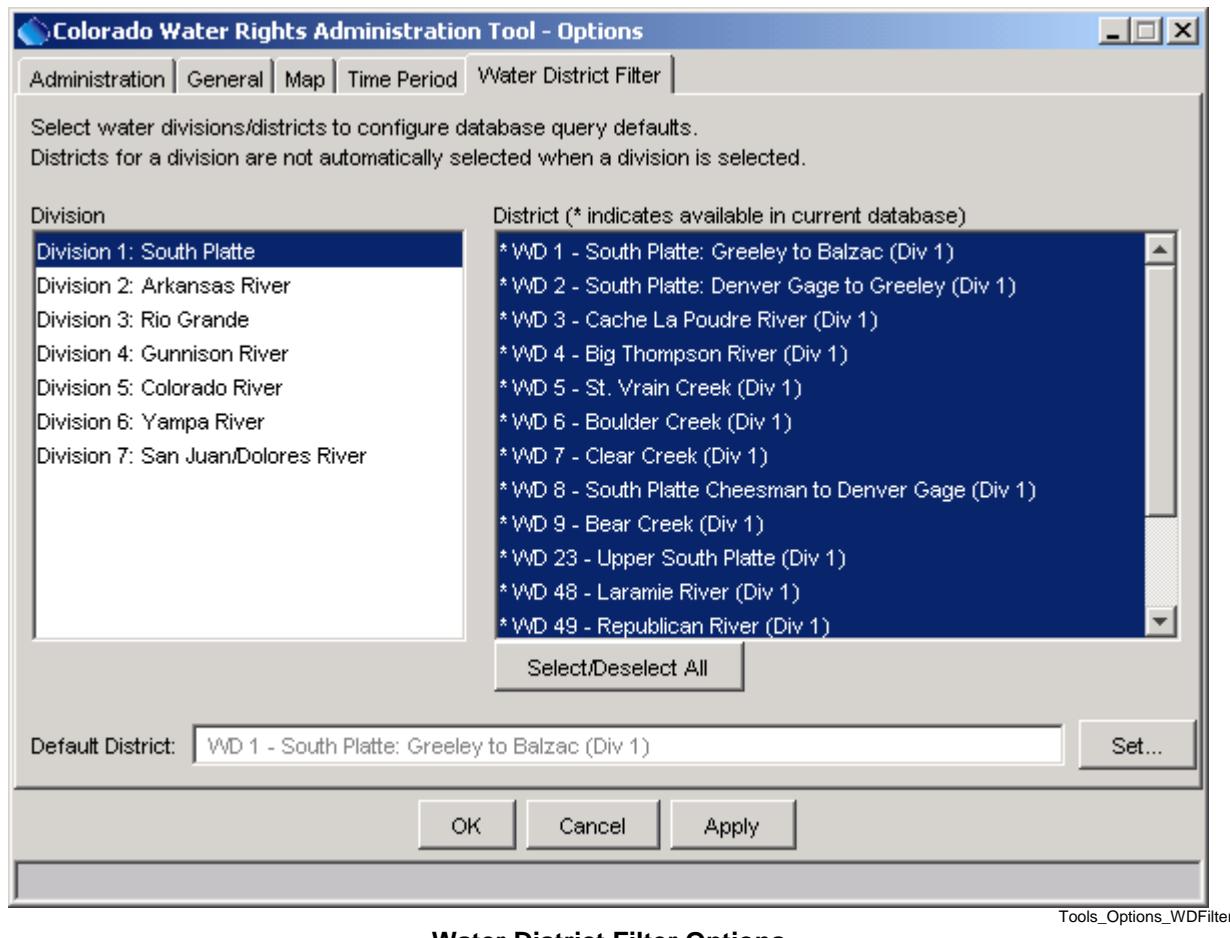
The time period options indicate how to retrieve time-related data from HydroBase.



Time period options indicate the default period for retrieving real-time data from the database (e.g., for **Data...Call Chronology**). The default period can be specified as a period extending back from the current time (**Past**), in which case the number of hours is required, or a fixed period (**Period**), in which case a specific period is required. In most cases, a recent period is desirable.

6.5.5 Water District Filter Options

The water district filter sets the water divisions and districts that are available in query display menus and lists.



Tools_Options_WDFilter

Water District Filter Options

The water district filter is used to set reasonable defaults to limit query results. Highlighted water divisions and districts are displayed in query screens. If changes are made, visible display windows may need to be closed and reopened to activate the new settings. The districts that are available are controlled by the contents of the HydroBase database. In the above figure, the asterisks on the right indicate whether a district is available in the local database (determined by checking districts for structures that are available in HydroBase). You can also select the default district or division to be highlighted in query menus.

For State of Colorado water commissioners, a single water division and/or district may be used for most work. In this case, the filter can be constrained to only the division and/or district of interest. Doing so streamlines the use of the application by eliminating extra choices.

If you selected a Water Division when logging in to StateView/CWRAT, the setting will be saved for that Water Division. Selecting the same Water Division at the next login will then utilize the settings.

6.6 Diagnostics

Diagnostics features are useful for troubleshooting and are consistent among CDSS software, where possible. When an error occurs, a small warning dialog may be displayed, as shown in the following figure:



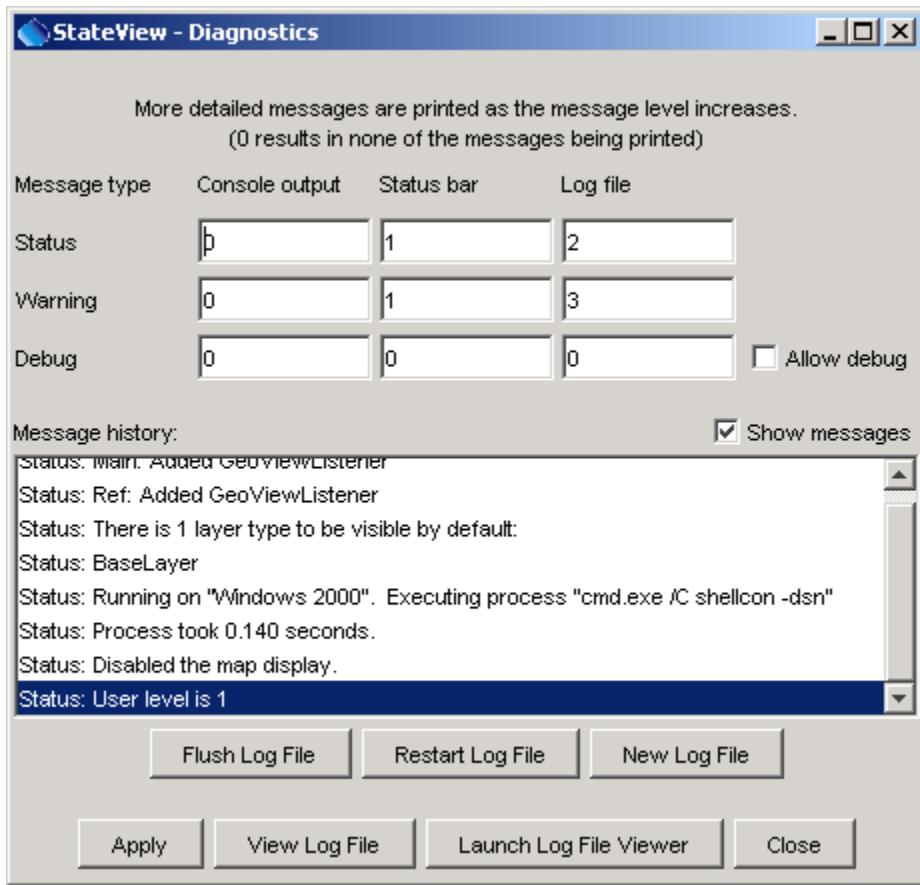
Diagnostics_Warning

Example Warning Message Dialog

If results are not as expected, also review the messages in the status bar at the bottom of the main or secondary windows.

6.6.1 Diagnostics Settings

The **Tools...Diagnostics** menu item displays the **Diagnostics** dialog, which is used to set message levels and view messages as the application runs. The **Diagnostics** dialog (see the following figure) can be used to evaluate a problem.



Diagnostics

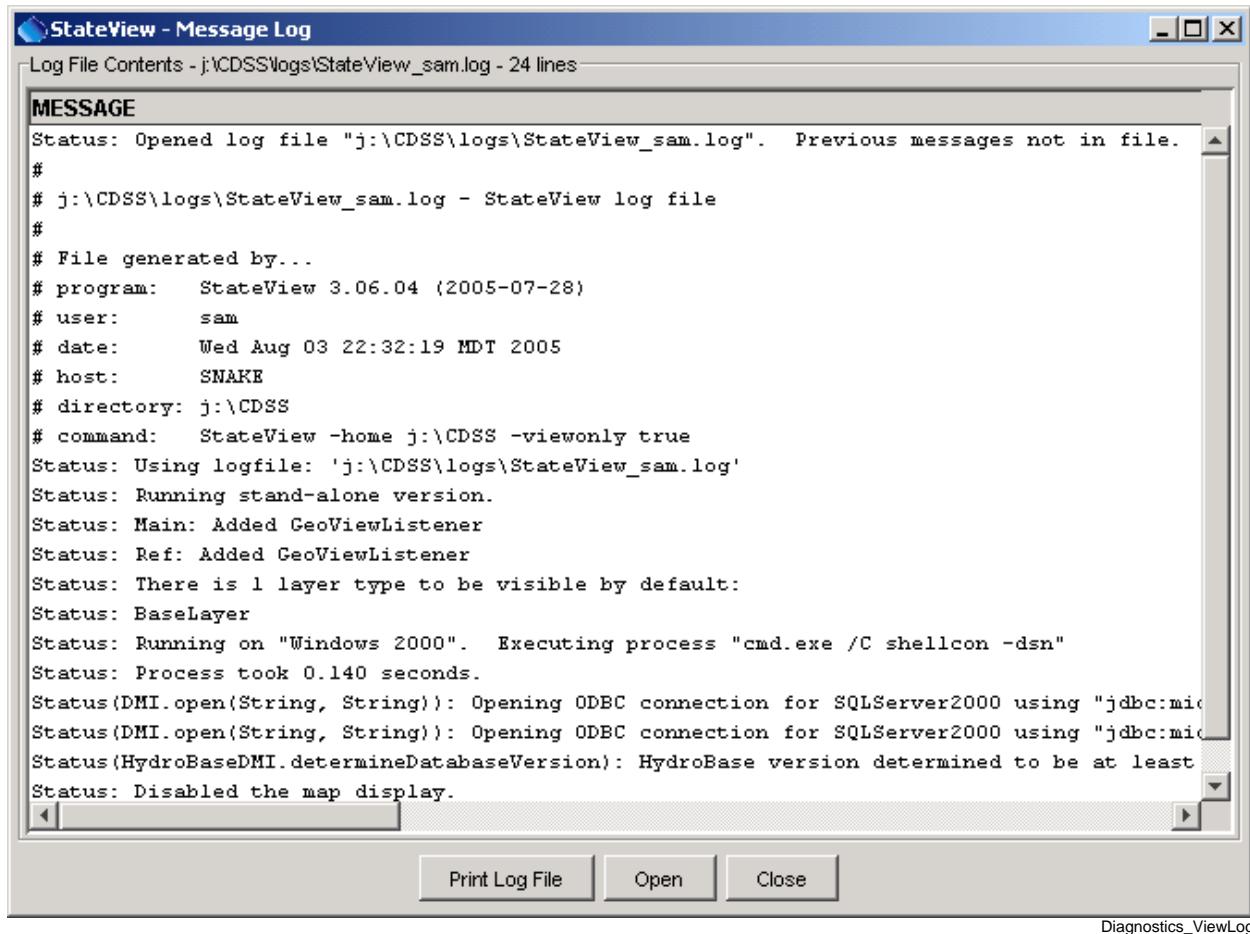
Diagnostics Interface

The settings at the top of the dialog are used to specify the level of detail for messages printed to the console window, the status area at the bottom of the main window (and the **Diagnostics** dialog), and the log file. The log file contains warning, status, and debug messages, many of which are not normally displayed in the main interface. The log file is created in the *logs* directory under the installation directory (e.g., `\cdss\logs\StateView_USER.log`). The **Diagnostics** interface features are as follows:

Status, Warning, Debug	Enter integer values, with larger numbers resulting in more output and slower performance. Zero indicates no output. If troubleshooting, a good guideline is to set the debug level to 10 or 30 (and select the Allow Debug checkbox). The default settings are often enough for normal troubleshooting and result in good software performance.
Allow Debug	Select to enable debug messages. Turning on debug messages will significantly slow down the software.
Show Messages	Select to display messages in the Diagnostics window.
Flush Log File	Force messages to be written to the log file. Messages can be buffered in memory and may not otherwise immediately be written to the log file.
Restart Log File	Restart the log file. This is useful if a long session has occurred and troubleshooting will occur on new actions.
New Log File	Open a new log file, with a new name.
Apply	Apply the settings in the Diagnostics dialog.
View Log File	View the log file in an integrated window. The View Log File button will be enabled if the log file has been opened.
Launch Log File Viewer	View the log file using a viewer from the operating system. On Windows computers, Notepad will be used.
Close	Apply the settings in the Diagnostics dialog and close the window.

6.6.2 Diagnostics – View Log File

The **Tools...Diagnostics – View Log File** menu item displays the integrated log file viewer. Selecting this menu item is equivalent to selecting the **View Log File** button in the **Diagnostics** dialog. The log file viewer will be displayed in a window as shown in the following figure:



Diagnostics_ViewLog

Log File Viewer Window

The log file messages can be scrolled. To find a string in the log file, right-click and select the **Find** menu item. The information in the log file can also be copied and pasted into email, when contacting support.

7 Examples of Use

Version 4.02.00, 2011-07-15

This section summarizes the steps to retrieve and manipulate HydroBase data for a number of common cases. It is assumed that a SQL Server HydroBase database is being used, or, if using a Microsoft Access database, that the **Tools...Options...Water District Filter** settings have been set appropriately for the HydroBase database that is used.

See also the training materials available from the **Help...View Training Materials** menu.

7.1 Viewing Historical Streamflow Data

Perform steps similar to the following to view historical streamflow data (see also **Section 4.4**):

1. Select the **Data...Stations** menu to display the **Stations Data** window.
2. Select the water division/district of interest. Select a division to list more stations.
3. Select **Stream - Streamflow** as the data type.
4. Select the **Time Step** as appropriate.
5. Select appropriate **Where** values. Querying for all data may be acceptable. Often, if some part of the station name is known, use a substring (e.g., specify **Where | Station Name | Contains | platte**).
6. Press the **Get Data** button. If the query criteria are matched, one or more stations will be listed in the **Station Data** window.
7. Select one or more stations from the list.
8. Press the **Time Series Graph**, **Time Series Table**, or **Time Series Summary** button to query and display the time series data in the selected format.

See also the TSTool software for viewing historical streamflow data.

7.2 Viewing Real-time Streamflow Data

Real-time streamflow data can be viewed using the **Station Data** display (described above) or the **Tools...Time Series Plots** tool, as described below. Real-time data are typically only available in the HydroBase on the State of Colorado's servers. Ideally, real-time data would be identified as 5-minute, 30-minute, etc.; however, the HydroBase design does not currently allow this approach and therefore real-time data are treated as irregular time series.

7.2.1 Viewing Real-time Streamflow Data Using the Station Data Window

The steps for viewing real-time streamflow data are very similar to viewing historical data:

1. Select **Data...Stations** to display the **Station Data** window.
2. Select a **Data Type** of **Stream - Streamflow** and a **Time Step** of **Irregular**. Optionally, use the **Where** information query specific real-time stations. Press **Get Data** to query HydroBase. Select one or more stations and press the **Time Series Graph** button. This will query the time series data. In some cases, even though the time series are listed, data are not available, and errors will result – in these cases, remove the offending time series from the list selected for graphing.

7.2.2 Viewing Real-time Streamflow Data Using the Time Series Plots Menu

Time series products allow graphs to be defined once and then be displayed again later (with the current real-time data available at that time). This is useful if the same graph is viewed repeatedly. The following steps illustrate how to use a time series product to display real-time streamflow data:

1. Select the **Tools...Time Series Plots** menu.
2. Select **New** and enter an identifier for the new time series product. A blank graph window and its associated time series product properties window will be shown.
3. From the list of stations listed in the **Station Data** window (e.g., from the steps described in **Section 7.2.1** above), select one or more rows and drag the rows onto the layout window in the **Time Series Product Properties** layout area. A pause may occur as the data are retrieved. The graph window should then refresh to display the graph.
4. Repeat steps 1 and 2 as needed to identify more stations and time series.
5. In the **Time Series Product Properties** window, change graph properties as desired and press **Apply**.
6. In the graph window, press the **Save** button to save the plot definition.

See the **TSView Time Series Viewing Tools Appendix** for more information.

You can also use the TSTool application or the CDSS web site to view real-time data.

Time series products can also be used with historical data and time series from different windows (e.g., diversions, reservoirs) can be combined on the same graph.

7.3 Viewing Streamflow Station Data Using the Map Interface

The following procedure illustrates the use of the map for querying streamflow station information. This description is appropriate only if map data are available and are displayed (see **Tools...Options...Map**). For example, select a division of interest during login.

1. Follow steps 1-7 in **Section 7.1**, which will result in a list of stations being displayed in the **Station Data** window. Note that when the **Data...Stations** menu is initially selected the map layers should automatically adjust so that only station layers are enabled.
2. In the **Station Data** window, press the **Show on Map** button. This causes the stations layer used by the map to be searched. Matching stations are selected (default select color is typically yellow or pink) and the map extents are adjusted to zoom in on the selected stations.
3. To label the stations, select the stations layer in the map layer list (table of contents), right-click on the stations layer, and select the **Properties** menu item. Then select the **Label** tab in the **Properties** dialog. Use the **Label Field(s)** choice to indicate the data that should be used for a label. Specify the **Label Format** if necessary to remove spaces (e.g., use %s to remove spaces from a string field). Select the **Label Selected Features Only** checkbox if desired. Press **Apply** or **OK** to cause the labels to be shown on the map.
4. If the map is in **Zoom Mode**, zoom to station of interest.
5. Making sure that the streamflow layer is still selected in the layer list, change to **Info Mode**  and click near a station (or draw a box around several stations). A dialog will appear showing information about the station, from the geographic data.
6. Change to **Select Mode**  and draw a box around one or more stations. This causes the **Station Data** window to start a query using the box coordinates as additional **Where** information. Note that the original **Where** information in the **Station Data** window are also used and may need to be changed (for example, remove previous constraints). If the geographic data and HydroBase are using the same data, the stations that were selected on the map should be listed in the **Station Data** window. Sometimes differences occur because of differences in the versions of the database and spatial data files.
7. Repeat similar steps for other query criteria.

The above procedure illustrates selecting map features from the tabular displays and displaying results in the tabular display by first selecting on the map. The two activities can be performed independently as appropriate.

See the **GeoView Mapping Tools Appendix** for a full description of map features.

7.4 Viewing Diversion Data

To view diversion (headgate) data:

1. Select the **Data...Structures** menu to display the **Structure Data** window.
2. Select the water division/district of interest. Select a division to list more stations; however, because there are a large number of structures, displaying all structures in a division can be slow (see below for information about limiting the query).
3. Select **Where | Structure Type | Matches | Headgate** as the structure type to query, or query all structures types if desired (do not select **Structure Type** in a **Where**).
4. Select appropriate additional **Where** values. Because there are a large number of structures, querying for all structures may not be acceptable. Often, if some part of the structure name is known, use a substring (e.g., specify **Where | Structure Name | Contains | smith**).
5. Press the **Get Data** button. If the query criteria are matched, one or more structures will be listed in the **Structure Data** window.
6. Select one structure from the list and select a view from the choices next to the **Display View** button. A good overall summary for a structure is provided by the **Structure Summary** view. Use the **Diversion Coding/Reservoir Releases** view for diversion records (time series).
7. Optionally, select additional views to display in the **Structure Data** window.

7.5 Viewing Structure Water Rights

To view water rights data:

1. Select the **Data...Water Rights** menu to display the **Water Rights Query** window.
2. Select the **Water Division/District** of interest. Because there are a large number of water rights, displaying the water rights for an entire division may be very slow. Optionally, limit the query as described below.
3. Select **Net Amounts** as the **Water Rights Type**.
4. Select appropriate **Where** values. Because there are a large number of water rights, querying for all water rights may not be acceptable. Often, if some part of the station name is known, use a substring (e.g., specify **Where | Water Right Name | Contains | smith**).
5. Press the **Get Data** button. If the query criteria are matched, one or more water rights will be listed in the **Water Rights Query** window.
6. Optionally, to format as a text report, press the **View Report** button after selecting a report format from the list of choices. The data will be requeried if necessary because the sort order for the report may not match the sort order for data that are currently displayed.
7. Select one water right from the list and press the **View** button to see the water right in detail.

Water rights can also be viewed using the **Water Rights** display view in the **Structure Data** window.

7.6 Viewing Diversion Structure Data Using the Map Interface

The following procedure illustrates the use of the map for querying diversion information. This description is appropriate only if map data are available and are displayed (see **Tools...Options...Map**). For example, select a division of interest during login.

1. Follow steps 1-5 in **Section 7.4**, which will result in a list of diversions being displayed in the **Structure Data** window.
2. In the **Structure Data** window, press the **Show on Map** button. If the diversions layer is not shown on the map, it will automatically be turned on (a noticeable pause will result, as the map is redrawn). The diversion layer used by the map is then searched. Matching stations are selected and the map extents are adjusted to zoom in on the selected diversions.
3. To label the diversions, select the diversions layer in the map layer list (table of contents) and press the **Properties** button under the legend. Then select the **Label** tab in the **Properties** dialog. Use the **Label Field(s)** choice to indicate the data that should be used for a label. Specify the **Label Format** if necessary to remove spaces (e.g., use %s to remove spaces from a string field). Select the **Label Selected Features Only** checkbox if desired. Press **Apply** or **OK** to cause the labels to be shown on the map.
4. If the map is in **Zoom Mode**, zoom to diversion of interest.
5. Making sure that the diversions layer is still selected in the layer list, change to **Info Mode**  and click near a diversion (or draw a box around several diversions). A dialog will appear showing information about the diversion, from the geographic data.
6. Change to **Select Mode**  and draw a box around one or more diversions. This causes the **Structure Data** window to start a query using the box coordinates as an additional **Where**. Note that the original **Where** information in the **Structure Data** window are also used and may need to be changed (for example, remove previous constraints). If the geographic data and HydroBase are using the same data, the diversions that were selected on the map should be listed in the **Structure Data** window.
7. Repeat similar steps for other query criteria.

The above procedure illustrates selecting map features from the tabular displays and displaying results in the tabular display by first selecting on the map. The two activities can be performed independently as appropriate.

See the **GeoView Mapping Tools Appendix** for a full description of map features.

8 Troubleshooting

Version 4.02.00, 2011-07-15

This section discusses how to troubleshoot StateView/CWRAT problems.

StateView/CWRAT typically is started from the computer's start menu but can be run from the command line with *stateview.exe*. A log file is created in the logs directory under the main installation directory (e.g., *C:\CDSS\StateView-Version\logs\CWRAT_USER.log*). The most common problems are program configuration (see the **Installation and Configuration Appendix**), user input error (see the body of the documentation for information about features), and database errors (more below). Other problems should be reported to the StateView/CWRAT developers (see **Chapter 2 - Acknowledgements** for support contacts). Code has been implemented to detect common errors, but you may need to refer to the log file to determine the nature of a problem.

In general, when running the StateView/CWRAT, you will be warned about major problems using pop-up dialogs. The log file can also be viewed (see **Chapter 6 – Tools** and refer to the **Diagnostics** section). Search for the string **Warning** with the log file editor to find problems. Status messages provide useful information.

User and database errors can occur for a number of reasons. The following table summarizes common errors and their fixes.

StateView/CWRAT Errors and Possible Solutions

Error	Possible Solutions
StateView/CWRAT does not run (error at start-up).	If using the StateView executable on Windows and the following is shown (or a command line message is printed with a similar message):  A screenshot of a Java Virtual Machine Launcher dialog box. The title bar says "Java Virtual Machine Launcher". The main area contains a large red "X" icon and the text "Could not find the main class. Program will exit.". At the bottom is an "OK" button. This error may be shown if software files have been manually moved. Reinstall using the installation program.
StateView/CWRAT starts slowly.	Several software files are loaded when the software starts. If the computer is running virus-checking software, a noticeable pause may occur as the software is checked for viruses. Start-up performance may increase in subsequent sessions.
Data are not returned from the database.	<ol style="list-style-type: none">Verify that the database includes the water districts of interest using the File...Properties menu.Verify that the identifier for data is valid. For example, for station data, a USGS gage identifier may have changed. To verify, try searching for the station using its name rather than the identifier. Also try removing all query filter constraints to get more data.

Error	Possible Solutions
StateView/CWRAT fails on large queries.	StateView/CWRAT may run out of memory on queries. If running on Windows using the StateView.exe program (the default configuration), increase the value of the <code>-XmxNNNm</code> option in the <code>bin\StateView.l4j.ini</code> file under the software installation folder. Report this situation to support and the default value can be increased for future software releases.
Unexpected failure.	If there was an error in input that was serious, StateView/CWRAT may quit processing input. See the log file for details. If the log file does not offer insight, contact the developers. Errors are sometimes due to combinations of operating systems and network environments.

Appendix: StateView/CWRAT Installation and Configuration

Version 04.02.00, 2011-07-15

1. Overview

This appendix describes how to install StateView/CWRAT in the CDSS (Colorado's Decision Support Systems) environment. StateView and CWRAT share the same software files. The main difference between the programs is that StateView does not display the **Administration** menu. Consequently, StateView is suitable for general users and CWRAT can be used by State of Colorado staff.

The StateView/CWRAT software can be installed on individual computers and on servers within the State of Colorado's network for use by State of Colorado personnel.

2. File Locations

CDSS consists of the HydroBase database, modeling, and data viewing/editing software. StateView/CWRAT can be used with this system to view HydroBase data and edit administrative data.

Locations of StateView software files are as shown below (CWRAT files are similar). The *_XXX* notation indicates the JRE [Java Runtime Environment] version number (e.g., *_16*), which may change as upgrades to the system occur:

\CDSS\GIS\	Geographic information system files, installed when software is installed from the HydroBase DVD (otherwise must be installed from the CDSS website).
CDSS\StateView-Version	Top-level install directory.
bin\	Software directory for .exe, and Java JAR files.
StateView.exe	StateView executable program that starts the JRE software.
StateView_XXX.jar	StateView main application package.
StateView.l4j.ini	Run-time configuration file.
HydroBaseDMI_XXX.jar	State of Colorado HydroBase database interface package.
sqljdbc4.jar	Microsoft SQL Server packages.
*jar	Additional Java software packages.
doc\	Main documentation directory for StateView.
UserManual\StateView.pdf	StateView documentation as PDF.
Training\	StateView training materials.
jre_XXX\	Java Runtime Environment.
logs\	Log files (should be writable).
system\	Folder for system files.
CDSS.cfg	Configuration file for CDSS, including HydroBase connection information.
stateview.gif	Startup graphic for StateView.
DATAUNIT	Data units file.

3. Installing StateView/CWRAT

StateView/CWRAT can be installed either as part of the HydroBase Tools DVD installation, or as a separate installation. In both cases, it is recommended that the default CDSS file structure be used.

3.1 Installing StateView from the HydroBase Tools DVD

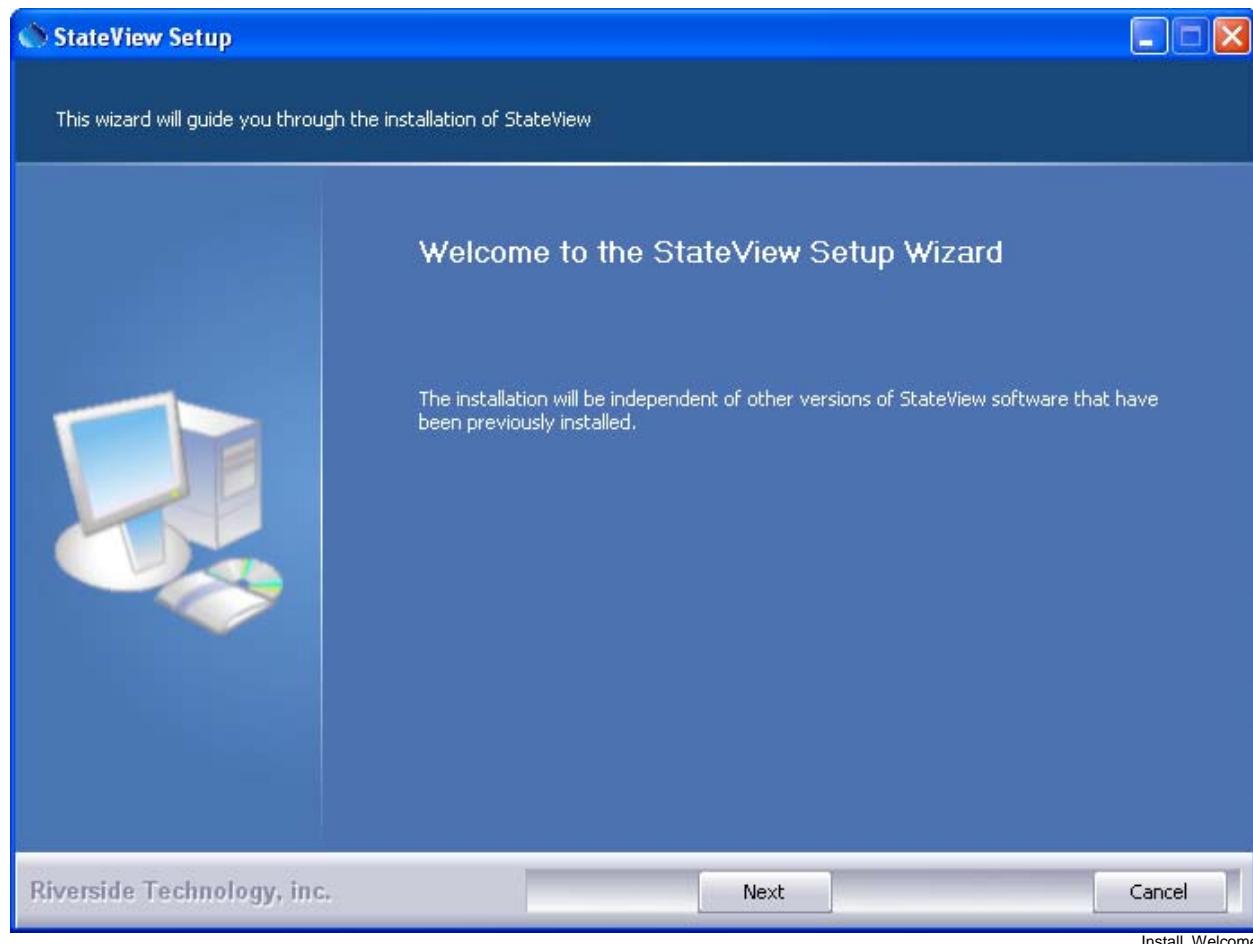
If you have acquired a HydroBase DVD, StateView will be installed during the DVD install process. Refer to the installation instructions for that distribution.

3.2 Installing StateView/CWRAT from the Setup File

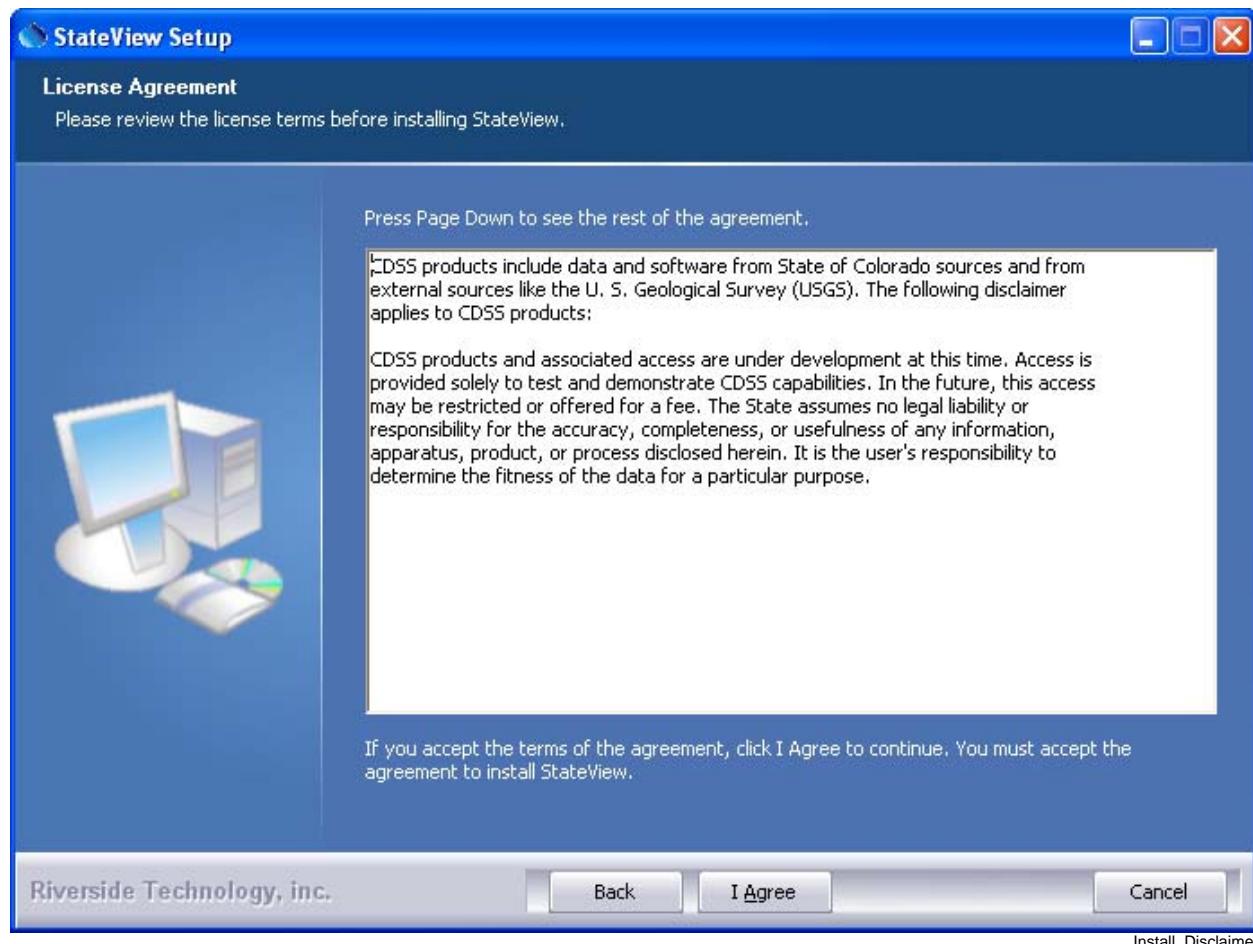
Use the following instructions to install StateView/CWRAT using the *StateView_CDSS_Version_Setup.exe* or *CWRAT_CDSS_Version_Setup.exe* installer program, for example if software was downloaded from the CDSS web site (<http://cdss.state.co.us>). The following example is for StateView, but installation is similar for CWRAT.

1. Run the installer setup file by selecting from Windows Explorer or the run menu. The setup filename will include a version number (e.g., *StateView_CDSS_04.02.00_Setup.exe*).

You must be logged into the computer using an account with administrator privileges. If you have administrative privileges, the following welcome will be displayed, and the installation can continue:

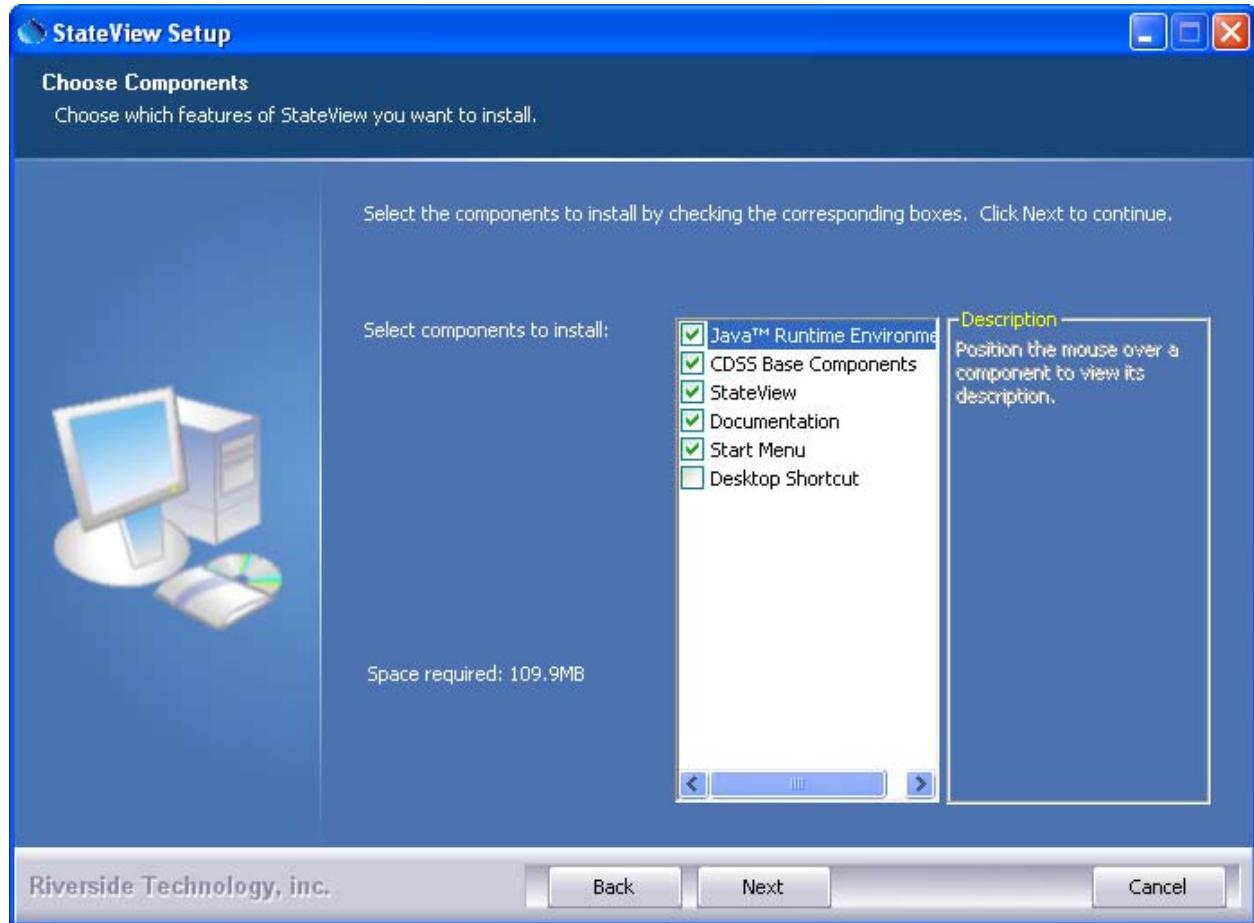


Press **Next** to continue with the installation.



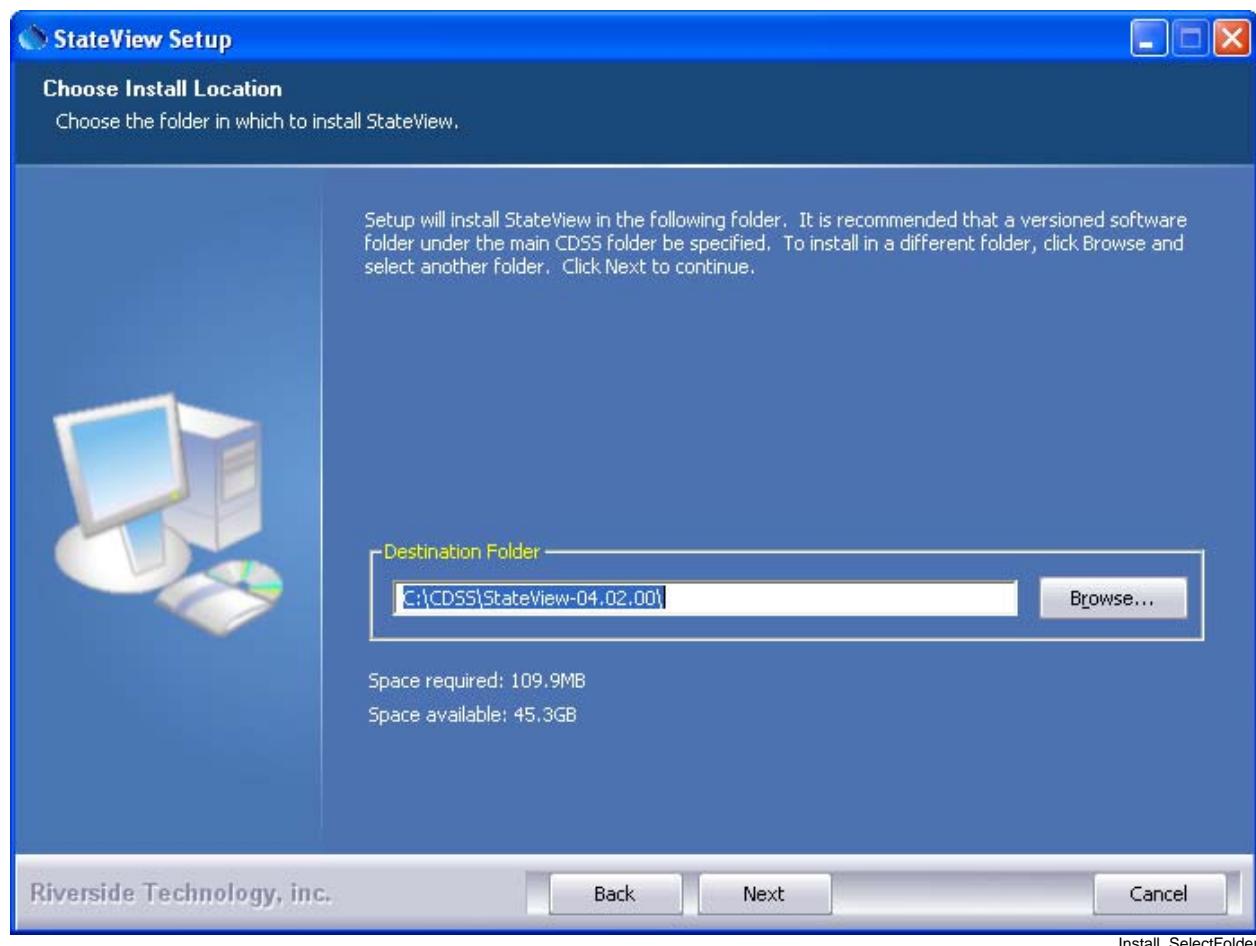
StateView is distributed with CDSS with no license restrictions. However the disclaimer must be acknowledged. Press **I Agree** to continue with the installation.

2. Several components can be selected for the install as shown in the following dialog. Position the mouse over a component to see its description. It is recommended that the defaults are used.



Select the components to install and press **Next**.

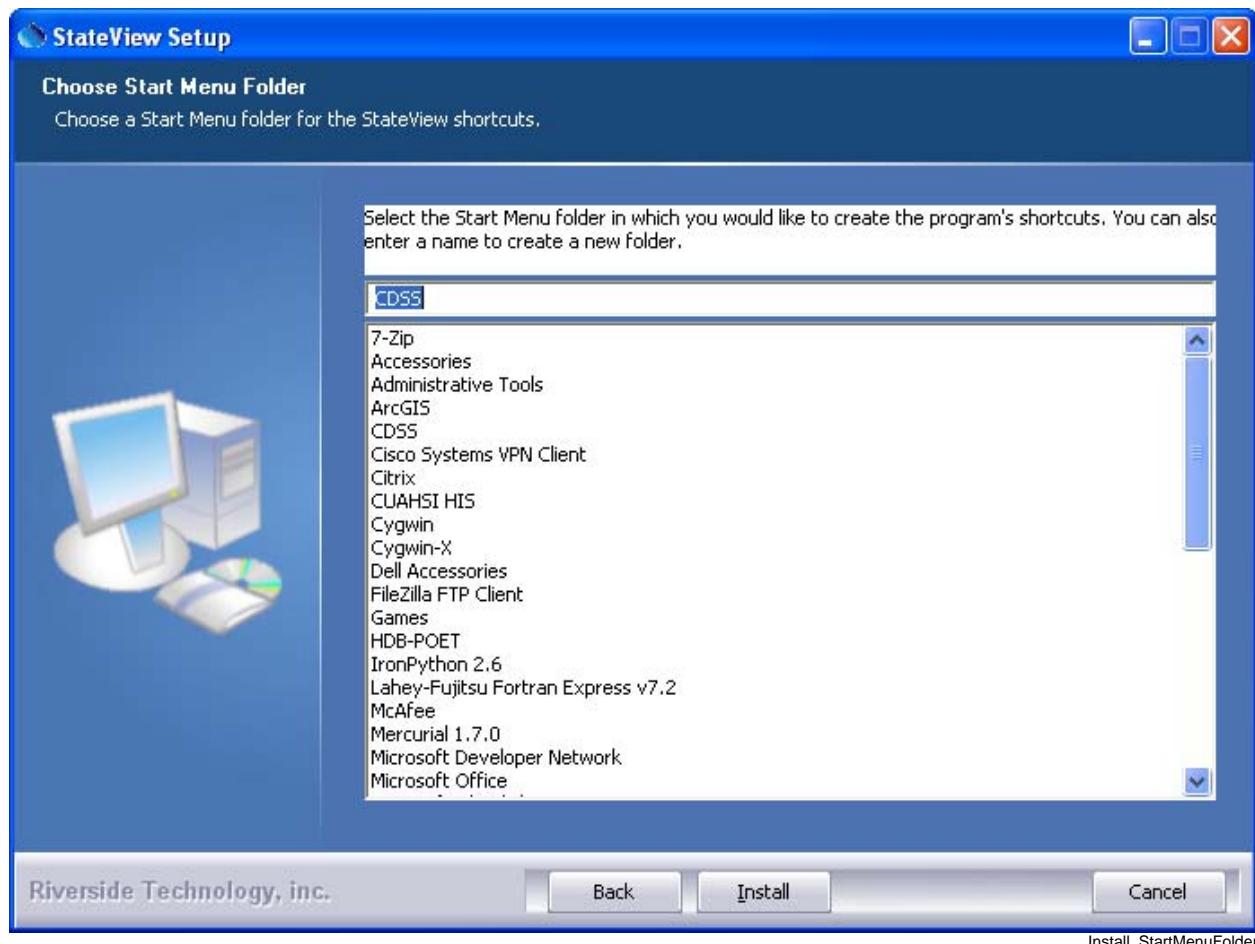
3. The following dialog is then shown and is used to select the installation location for StateView/CWRAT. Multiple versions of StateView/CWRAT can be installed and there are no dependencies between the versions. It is recommended that the default install location shown is used.



After selecting the install location, press **Next**.

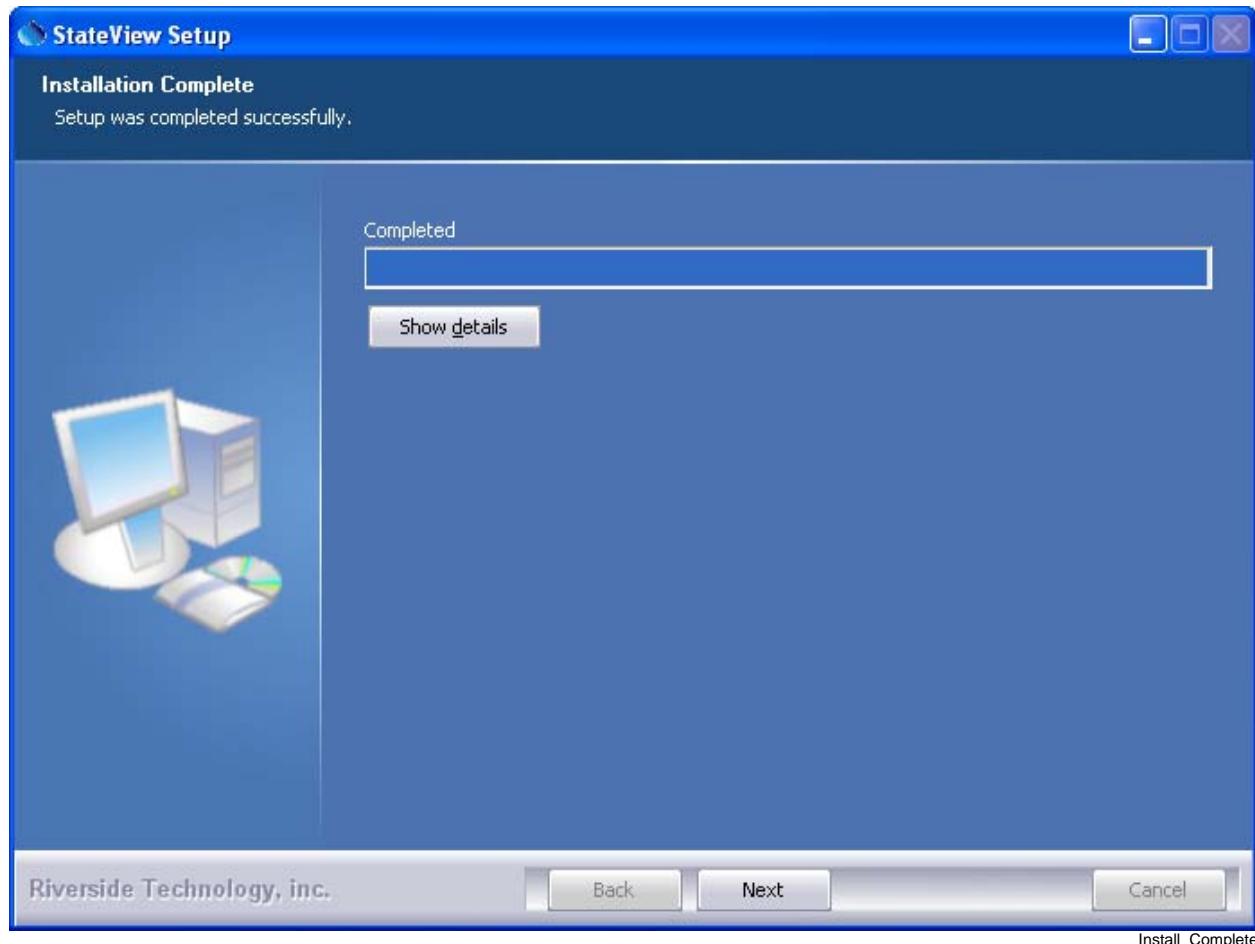
Note that this location will be saved as a Windows registry setting (HKEY_LOCAL_MACHINE\Software\State of Colorado\StateView-Version\Path or HKEY_LOCAL_MACHINE\Software\State of Colorado\CWRAT-Version\Path) to allow future updates to check for and default to the same install location and to allow the standard software uninstall procedure to work correctly.

4. The following dialog will be shown to select the menu for the software:



After selecting the folder, press **Install**.

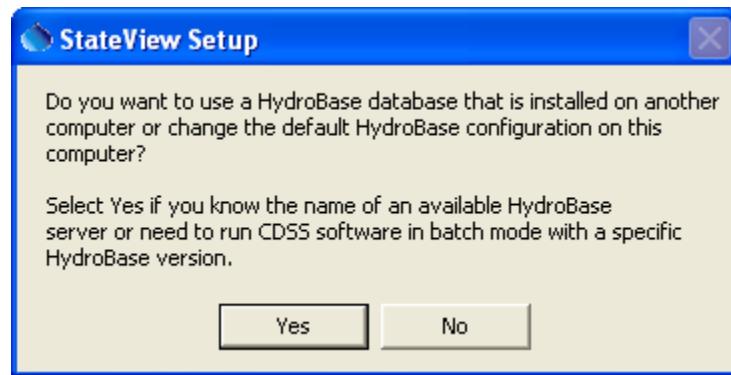
5. The following dialog will show the progress of the installation:



Install_Complete

Press **Show details** to see the files that were installed or press **Next** to continue.

6. If the CDSS Base Components were selected for install, the following dialog will be displayed to allow further HydroBase configuration:

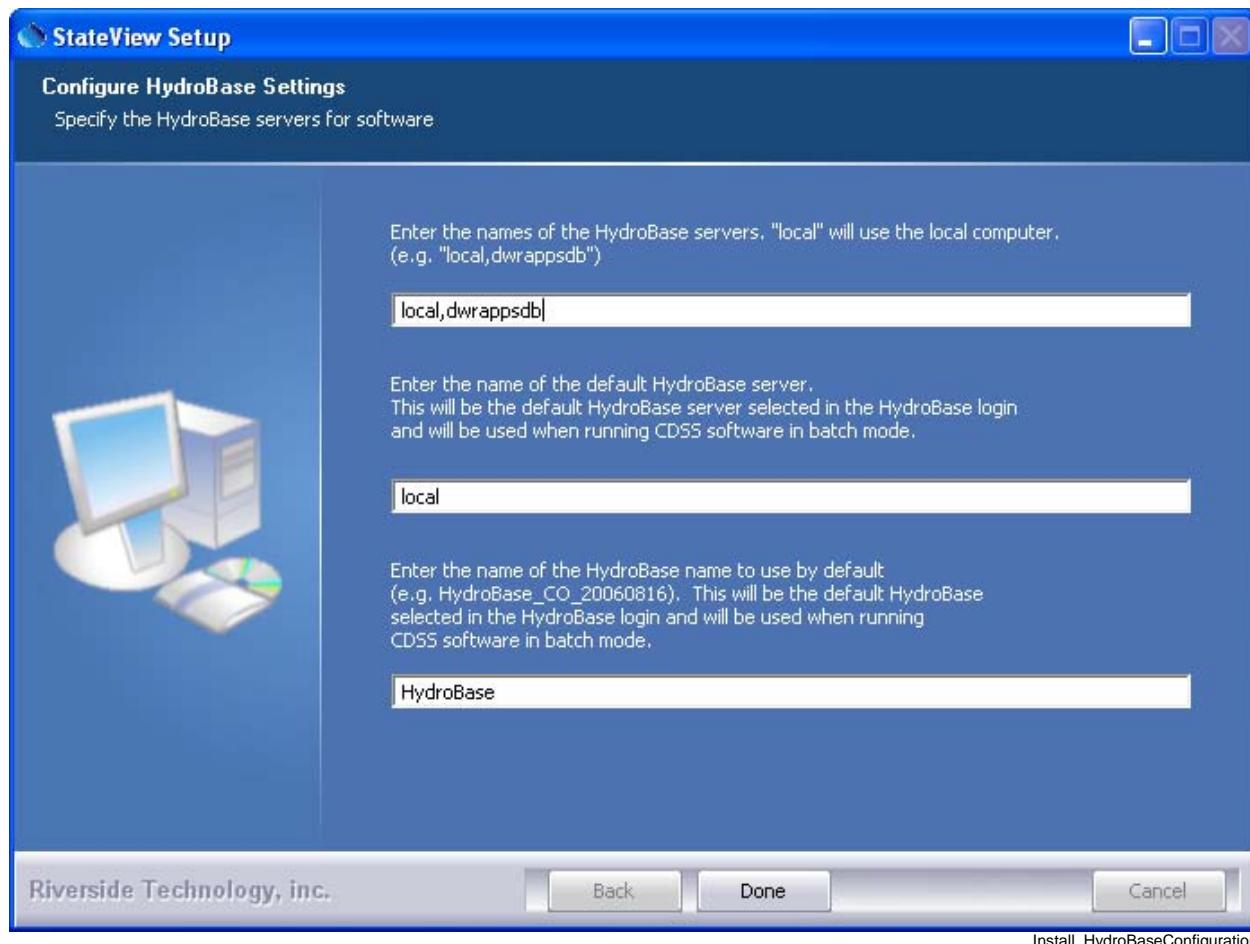


Install_HydroBaseQuestion

StateView/CWRAT and other CDSS software can utilize HydroBase running on the local computer as well as other computers. Press **Yes** if HydroBase has been installed on another

computer in the network environment and may be used by the software (then continue to the next step). Otherwise, press **No** and skip to step 8.

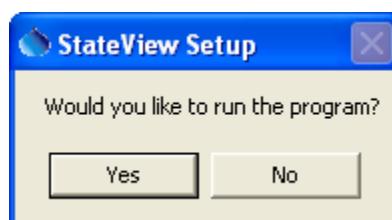
- The following dialog allows additional HydroBase servers to be specified for use by CDSS software (the example below configures CDSS software to list the *dwrappsdb* HydroBase server in choices and defaults to HydroBase on the local computer).



Install_HydroBaseConfiguration

After entering the name of a HydroBase server and the default server to use, press **Done**.

- The following dialog will then be shown asking whether the StateView/CWRAT software should be run:



Install_RunStateViewQuestion

Press **Yes** to run the software or **No** to exit the installation procedure.

3.3 Installing StateView/CWRAT on a File Server

StateView/CWRAT can be installed on a file server, which allows software updates to be made in one location, thereby eliminating the need to install software on individual machines. For this type of installation, all computers that access the software and HydroBase must have similar network configurations so that servers can be found. The standard installer described in this documentation focuses on individual installs on user computers. To make StateView/CWRAT software installed on a server available to other computers, perform the following (this is typically performed by system administrators):

1. Run the installer as described above. During installation specify the CDSS home using a drive letter and path for the server or specify a Universal Naming Convention (UNC) path (e.g., <\\CDSSServer\CDSS>). All computers that will use the software will need to have access to the server in a consistent way because the StateView/CWRAT software will expect the CDSS installation home at runtime to be that specified during the installation.

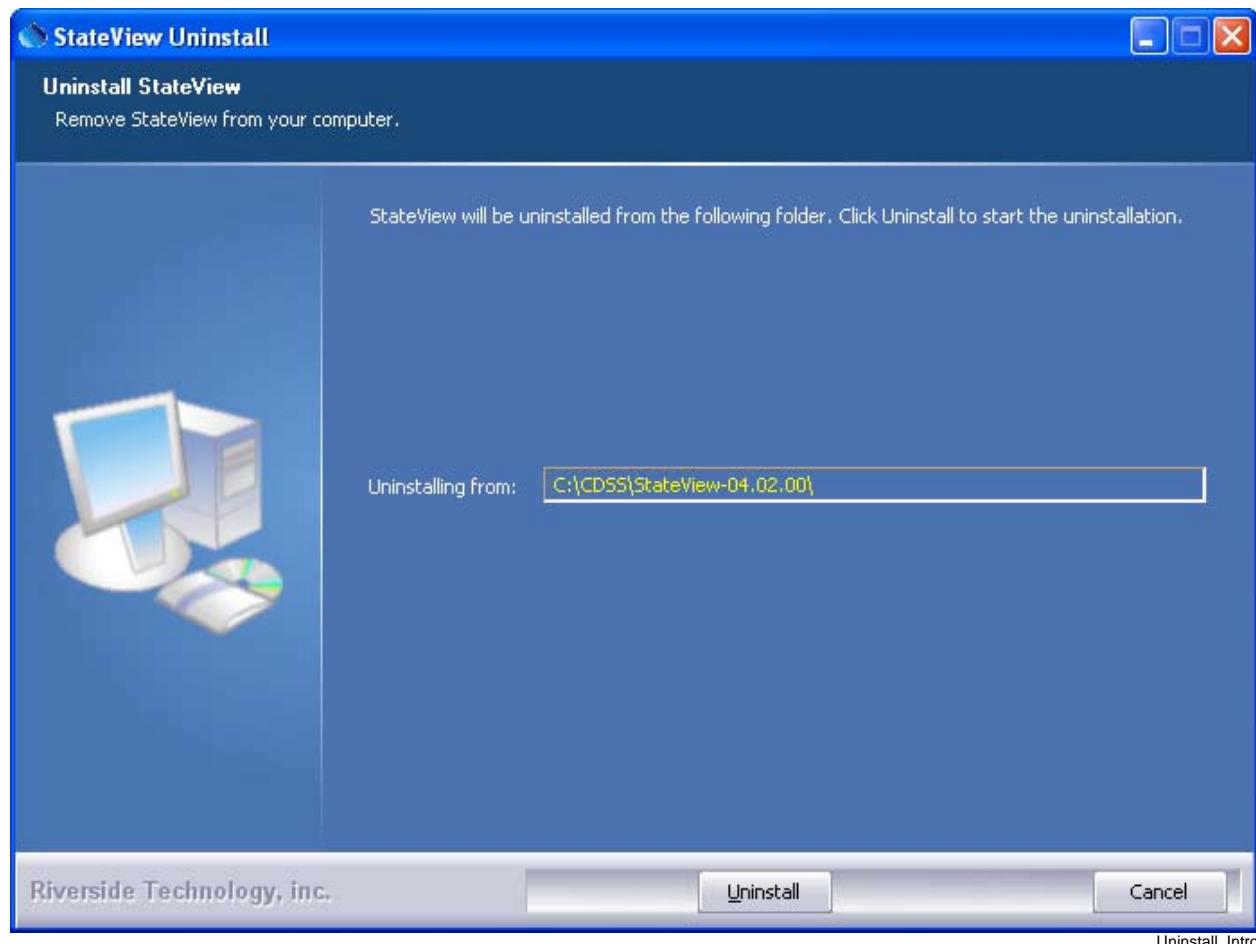
Another option is simply to copy the StateView-Version folder from a local computer to a server and then make a shortcut to the bin\StateView.exe program. The shortcut then can be copied onto local computers. Refer to the properties of the menus that start the applications to see the program that is being run, and the start location.

2. The menus and shortcuts will only be configured for the computer from which the installation was run. Therefore, menus and shortcuts for other computers will need to be manually configured.
3. If appropriate, edit the \system\CDSS.cfg file to include additional information.

If StateView/CWRAT has been installed on a local computer and it is also available on the network, the network version can be run by running the software in the *NetworkStateViewInstallHome\bin* folder. The software will expect that file locations use the same drives as when the software was installed.

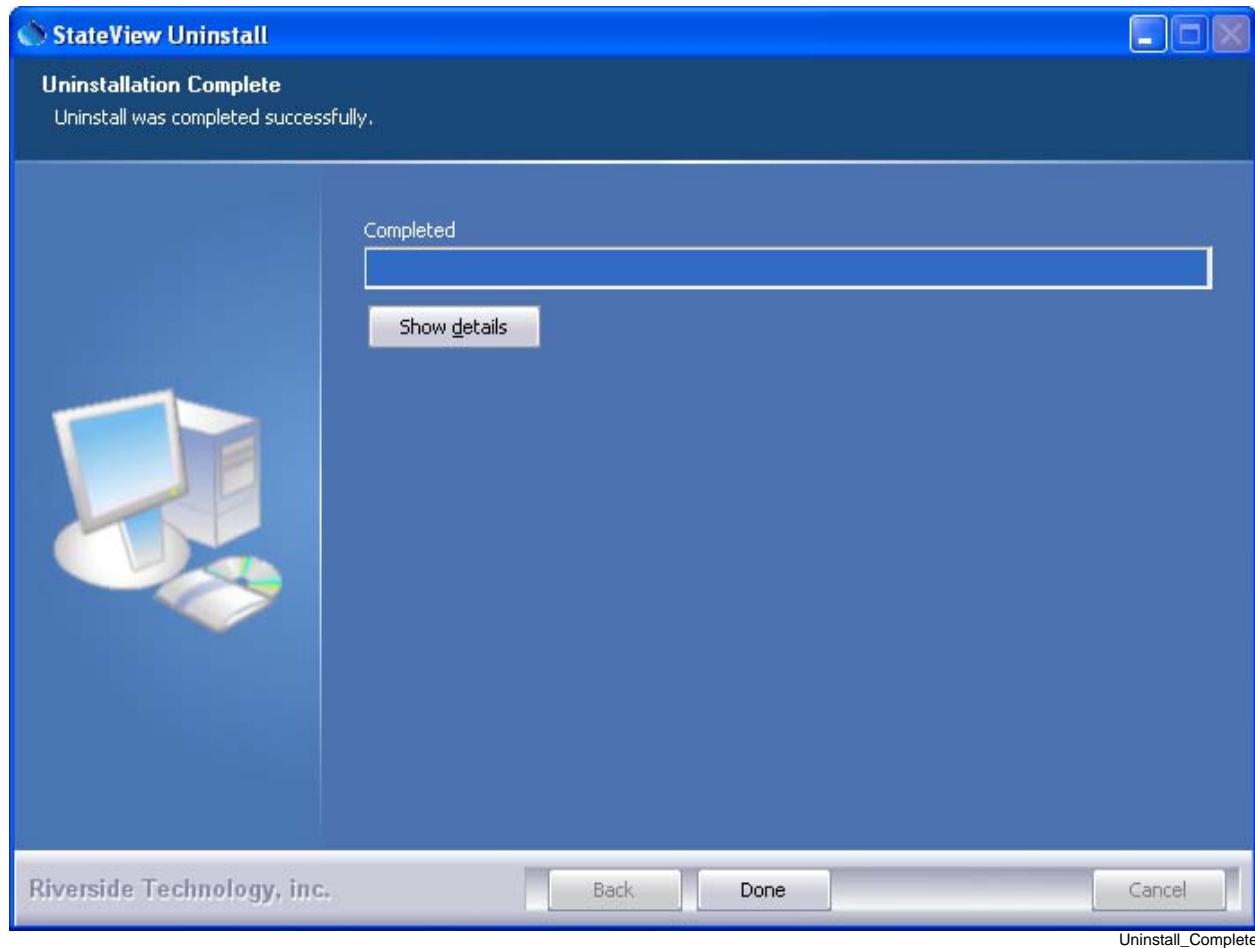
4. Uninstalling StateView/CWRAT Software

To uninstall StateView/CWRAT software, select **Start...Programs...CDSS...Uninstall...StateView-Version** (and similar for CWRAT) and confirm the uninstall.



Press **Uninstall** to uninstall the software.

The following dialog shows the progress of the uninstall.



Press **Show details** to see the list of files that were removed. Press **Done** to exit the uninstall.

5. Running StateView/CWRAT

The **Start...All Programs...CDSS...StateView-Version** (or **Start...Programs...CDSS...StateView-Version**) menu can be used to start the StateView software. CWRAT can be run similarly.

6. StateView/CWRAT Configuration

StateView/CWRAT requires minimal configuration. This section describes the StateView/CWRAT configuration files that can be customized for a system. Installations on a server use one configuration for all users.

6.1 CDSS Configuration File

By default, StateView/CWRAT will automatically look for HydroBase databases on the current (local) machine and the State servers. State server databases are typically only accessible to State of Colorado computers. If SQL Server HydroBase versions have been installed on a different machine, the `\CDSS\StateDMI-Version\system\CDSS.cfg` file can be used to indicate the database servers. An example of the configuration file is as follows:

```
[HydroBase]

ServerNames="ServerName,local"
DefaultServerName="ServerName"
DefaultDatabaseName="HydroBase_CO_20080730"
```

The CDSS configuration properties are described in the following table:

CDSS HydroBase Database Configuration Properties

Property	Description	Default
ServerNames	A comma-separated list of server names to list in the HydroBase login dialog.	The state server is listed.
Default ServerName	The default HydroBase server name to use. This allows the HydroBase login dialog to preselect a default that applies to most users in the system.	greenmtn.state.co.us
Default DatabaseName	The default HydroBase database name to use. This allows the HydroBase login dialog to preselect a default that applies to most users in the system.	
Database Engine	Reserved for internal use.	
DatabaseName	The database name to use for the initial connection. This overrides the default server.	
Database Server	The server name to use for the initial connection. This overrides the default server.	
SystemLogin	Reserved for internal use.	
SystemPassword	Reserved for internal use.	
UserLogin	Reserved for internal use.	

6.2 Data Units File

The *system\DATAUNIT* file under the main installation directory contains data unit information that defines conversions and output precision. In most cases the default file can be used but additional units may need to be added for a user's needs (in this case please notify the developers so the units can be added to the default file distributed with installations). Currently, the data units file is the only source for units information – in the future units may be determined from HydroBase if available.

6.3 Map Configuration

The **GeoView Mapping Tools Appendix** describes mapping tools in detail. The StateView/CWRAT GeoView project files (typically available as *\CDSS\GIS\divX*.gvp*) have been preconfigured and generally can be used without modification. The following table lists the GeoView project file AppLayerType properties, which allow StateView/CWRAT to know the spatial data layers that correspond to display features in the software. The AppLayerType values are reserved for use with StateView/CWRAT, although some data types do not currently have a link with spatial data (instream flow, water right, well permit), either because the data do not support the feature, or because StateView/CWRAT do not have an appropriate display.

AppLayerType Value	How Used in StateView/CWRAT
BaseLayer	Indicate base layers that can be ignored by specific displays.
Diversion	Used when displaying diversion structure information.
InstreamFlow	Used when displaying instream flow structure information.
Precipitation	Used when displaying precipitation station information.
Reservoir	Used when displaying reservoir structure information.
Streamflow	Used when displaying streamflow station information.
Temperature	Used when displaying temperature station information.
WaterRight	Used when displaying water right information.
Well	Used when displaying well structure information.
WellPermit	Used when displaying well permit data.

The AppLayerType values correspond to physical features, which are represented by the spatial data layers. However, some StateView/CWRAT displays focus on time series data types, which may not correspond one-to-one with physical features. For example, streamflow stations can have real-time and/or historical data using a variety of station identifiers and time intervals. Additional enhancements to HydroBase, spatial data, and/or software are needed to allow relating physical features to time series data types for all combinations.

6.4 Additional Configuration

To change the program configuration at run-time, use the **Tools...Options** menu. StateView/CWRAT will save changed configuration information to the HydroBase database so that the settings are active the next time that StateView/CWRAT is run. The guest login settings are only valid during the current session and cannot be saved to the database.

Appendix: StateView/CWRAT Release Notes

Version 4.02.02, 2013-04-16

This appendix provides information about changes that have occurred in StateView/CWRAT versions.

StateView/CWRAT Version History

The following table summarizes the StateView/CWRAT release history. See the following section for more detailed information about each version. Recent release note items are categorized as follows:

- Bug Fix** – A bug has been fixed. Users should evaluate whether their work is impacted.
- Known Limitation** – A known limitation has been documented and may impact the user. The limitation may be addressed in a future release.
- Change** – An existing feature has been changed.
- Remove** – A feature has been removed.
- New Feature** – A new feature has been added, with functionality that was not previously available.

StateView/CWRAT Version History Summary (most current at top)

StateView/ CWRAT Version	Version Information	Release Date
04.02.02	Rebuild with current code libraries. Update to Java 1.6 release 33.	2013-04-16
04.02.01	Update to new version of installer software to support Vista and Windows 7 installs, maintenance updates.	2011-09-19
04.01.00	Update to Java 1.6, maintenance updates.	2010-01-20
04.00.00	Implement new software installer, support new SFUT(G) conventions in HydroBase.	2007-03-02
03.08.01	Carry forward daily diversions according to standard procedure. Fix sort order for WIS.	2006-04-27
03.08.00	Allow structures to be queried for bypass calls in CWRAT.	2006-01-23
03.07.00	Add water division to many tabular displays and allow queries for the entire database (entire state).	2005-11-15
03.06.07	Maintenance release.	2005-09-30
03.06.06	Maintenance release.	2005-08-16
03.06.05	Release that uses stored procedures; includes updates from previous review.	2005-08-04
03.06.04	Development releases for internal review...	2005-07-28
03.06.03		2005-07-20
03.06.02 BETA		2005-07-08
03.06.01 BETA		2005-06-28
03.06.00 BETA		2005-06-02
03.05.01		2004-12-01
03.05.00		2004-08-08
03.04.00		2004-07-28

StateView/ CWRAT Version	Version Information	Release Date
03.03.00	Begin supporting stored procedures.	2004-07-12
03.02.00		2004-06-09
03.01.00		2004-05-17
03.00.00 BETA		2004-01-11
02.09.00	First official release of CWRAT with diversion coding in Water Information Sheets, several other minor changes.	2003-04-17
02.08.00	Several updates to make map interface more intuitive, other corrections.	2002-08-19
02.07.00	Call graph uses now uses new plotting package.	2001-11-01
02.06.00	Implement new map interface.	2001-10-19
02.05.00	Finalize SQL Server support. Correct problem in synchronization to handle different versions of the database. Implement new plotting package.	2001-06-14
02.04.00	Internal release. Add support for SQL Server.	2001-04-05
02.03.00	First official release of the View Data...Ground Water menu displays. Make compatible with the new StateView application.	2000-07-24
02.02.00	Add diversion comments to structure summary. Update date queries to be compatible with INFORMIX update on server. Add preliminary support for well displays and make code compatible with View Data application.	2000-05-15
02.01.00	First major release using the new HydroBase 1999 design and Java 1.1.8. A number of enhancements and maintenance fixes have been implemented.	1999-09-08
02.00.00	Initial version using Java 2 technology.	1999-04-01
01.07.02	Add ability to select ODBC data source if using a local database.	1999-02-15
01.07.01	Add irrigation summary display for structures. Features have been updated to be compatible with recent database changes. Make a number of updates based on user feedback. Next planned release will be for Java 2.	1999-02-09
01.06.00	Minor enhancements to handle database changes for Special Project features. Other minor changes based on user feedback.	1998-10-16
01.05.00	Includes division query, -login option, maintenance fixes, and minor enhancements.	1998-08-31
01.04.00	Update before final training session.	1998-08-17
01.03.00	Internal release.	1998-08-01
01.02.00	Minor update – bug fixes and addition of user registration, View Data...Other Data display.	1998-06-08
01.01.00	Minor update created before first training session.	1998-05-18
01.00.00	First official release on web site.	1998-05-11
00.04.01b	Limited beta release with station and structure views.	1998-04-02
00.02.00b	First beta release to field.	1997-12-14
00.01.00b	Limited beta release.	1997-10-01
-	Start of development.	1997-06-01

Changes in 04.02.02 Release

- Change [4.02.02] Update Java version distributed with software to 1.6 release 33.
- Change [4.02.01] Maintenance update to use current code libraries.

Changes in 04.02.01 Release

- Change [4.02.01] Update installer to support Windows 7.
- Change [4.02.01] Maintenance release to use current code libraries.

Changes in 04.02.00 Release

- Bug Fix [4.02.01] Fixed problem where station view query parameters reset to defaults after each query.
- Change [4.02.00] Update the installer to support Vista and Windows 7. Separate installers are available for CWRAT and StateView.
- Change [4.02.00] A number of enhancements have occurred in other CDSS software that also benefit CWRAT/StateView. For example, performance of software related to irregular time series (e.g., infrequent reservoir and well data) has been improved.
- Remove [4.02.01] Remove Microsoft Access as a database connection choice since HydroBase has not been offered in Access format for years.
- New Feature [4.02.00] System information is now available from the help menu to facilitate troubleshooting.
- New Feature [4.02.00] Self-paced training materials for StateView now are included in the software installer and can be accessed from the help menu.

Changes in 04.01.00 Release

- Bug Fix [4.01.00] Fixed problem where structure irrigated parcels view was not displaying.
- Change [4.01.00] The Java Runtime Environment (JRE) was updated from version 1.4.2 to version 1.6 release 26, providing significant performance increases.
- New Feature [4.01.00] The PDF documentation can be viewed from the help menu.

Changes in 04.00.00 Release

- First release using the new software installer, to facilitate providing software to users.
- Support new HydroBase SFUT convention, where a *G:* field has been added and the *F:* includes the WD and ID (previously just the structure ID within the water district).
- Implemented some performance enhancements in the mapping component.
- Remove **Use Stored Procedures** checkbox from HydroBase login – it is the default.

Changes in 03.08.01 Release

- Enable carry forward logic for daily diversions, to match the results shown in standard reports. The data are still not by default supplemented with diversion comments or infrequent data – use TSTool if this processing is required.
- Fix bug in water information sheets where sheets were not being listed in the correct order by date.
- Other minor maintenance.

Changes in 03.08.00 Release

- Updated CWRAT to allow structure query for bypass calls.

Changes in 03.07.00 Release

- Added the “Div” column to many displays to allow data to be sorted on water division.
- Added the ability to query the entire state for major displays.

Changes in 03.06.07 Release

- Fix bug where daily diversion coding time series would by default be displayed through day 1 of the last month. The day was defaulting to 1 instead of the number of days in the month.
- The adjudication type in the transaction rights section of the structure summary now displays a concatenated list of multiple fields, as per traditional reports. The documentation has been updated to describe this.

Changes in 03.06.06 Release

- Fix minor problem in CWRAT copy call feature.

Changes in 03.06.05 Release

- Fix bug where editing the WIS would cause the subsequent opening to have all zeros for data. The data now carry forward from the previous sheet.
- Edits to time series products were not being saved to HydroBase.

Changes in 03.06.01 BETA through 03.06.04 Releases

- Many changes to support stored procedures and to reflect review comments.

Changes in 03.06.00 Release

- Implement input filters in main screens, with drop-down choices.

Changes in 03.05.01 Release

- Fix problem where HydroBase connections were not closing properly.
- Fix bug in diversion coding display where period was not being computed properly.

Changes in 03.05.00 Release

- Add map display for current streamflow conditions.

- Add summary map layer display.
- Enable selecting temperature and precipitation time series on the map, if the layers are enabled.

Changes in 03.04.00 Release

- Make minor corrections and synchronize documentation with software.

Changes in 03.03.00 Release

- Use stored procedures by default.

Changes in 03.02.00 Release

- Make an official release with updated features.

Changes in 03.02.00 Release

- Add the `-usesp` command line option to enable stored procedures for testing.
- Make an official release.

Changes in 03.01.00 Release

- Internal release to reflect review feedback.

Changes in 03.00.00 BETA Release

- Handle startup errors more gracefully.
- Add application name to title bar of all windows.
- Remove the **Administration** submenus: **Synchronize Data, Register User, HydroBase Administrator.**

Changes in 02.09.00 Release

- The legal location query builder used in some query windows listed Q10, Q40, Q160. This order was reversed and has been corrected.
- Fix so that well permit information, when exported to delimited format, contains location data.
- On-line documentation now refers to the PDF document.
- Fix bug where a well permit with a long comment was causing the well permit detail window to appear very wide.
- The progress bar on threaded queries had been mistakenly disabled in the previous release – it is not active again.

Changes in 02.08.00 Release

- If performing a map select in a query window and the map is not displayed – display it.
- Require that a box is used on the map to perform a select – a point select is not allowed.
- Add the water source for the net amounts water right display.
- Fix bug where the county was not being displayed correctly in the net amounts water right detail.

Changes in 02.07.00 Release

- The call graph now uses the same graphing package as other graphs. Fix a bug where some calls were not being plotted because administration numbers were not whole numbers.
- If the map interface is disabled, the main window size now returns to the original size.

Changes in 02.06.00 Release

- A new map-based interface has been implemented and will be phased in as GIS data are made available. The map interface is activated by selecting a GeoView Project (.gvp) file in the **Map** tab of the preferences window.
- A number of enhancements have been made to increase performance.

Changes in 02.05.00 Release

- Finish adding support for SQL Server for WIS, real-time data synchronization, and calls.
- Fix limitation where local and remote databases needed to be the same version. Synchronization will now work between different database versions (for the versions that are in common use today).
- A new time series plotting tool has been implemented where appropriate. This is the same tool used in **TSTool**. This tool allows graph, tabular, and summary report views of one or more time series, with zoom capabilities. More descriptive legends and plot titles have also been added. The tool has not been implemented for the call chronology but has been implemented for all other plots. Performance should also be faster.
- Features that were not implemented due to technical or budget limitations have been eliminated from the interface rather than remaining as disabled menus and buttons.
- The **File...DataBase Information** dialog has been rearranged to show all database revision information.
- Where lists are used, effort has been made to enable multiple selects using standard Windows conventions (**click** selects one item, **Ctrl-click** selects additional, **Shift-click** selects all since previous selection).
- The **Communications...Synchronize Data...Synchronize Satellite Data** features have been updated to work with SQL Server. Multiple stations can be added to the synchronize preferences in one step and any stations that are duplicates are ignored. Multiple stations can now be deleted from the synchronization list. The list of stations to be synchronized is now shown with station identifier and name.
- The **Communications...Synchronize Data...Synchronize WIS** features have been updated to work with SQL Server.
- The **Communications...Synchronize Data...Synchronize Special Projects** features have been updated to work with SQL Server.
- The **Communications...Synchronize Data...Synchronize Calls** features have been updated to work with SQL Server.
- The **Communications...Synchronize Data...User Preferences** features have been updated to work with SQL Server.
- The **View Data...Ground Water...** well measurement list now includes the datum elevation and the datum is included in graph legends.
- The **View Data...Other Data...** crop characteristics report has been expanded to include new database information.
- The **View Data...Other Data...** crop growth characteristics report has been renamed **Consumptive Use Method Data** and provides output specific to each CU method.

- The **View Data...Stations** display now refreshes the list when a query criteria changes. A number of data types were previously listed with incorrect data types (e.g., daily precipitation was changed from average to total). A warning has been added for the table view for cases where the display may be slow.
- The **View Data...Structures** display has been updated. Previously a **Time Series** view was available for diversions and reservoirs. This has been renamed **Structure Source/From/Use/Type** to recognize that the time series are mainly diversion records. The dialog used to select time series has been changed from check boxes to a list and the limitation of 15 time series displayed has been removed. Time series are displayed using the new tool previously mentioned. There have been some minor changes to the appearance of some displays.
- The **Tools** menu has been enabled for both **CWRAT** and **StateView**, with StateView having the **Administration Number Calculator** and **Time Series Plot** available.
- The **Tools...Administration Number Calculator** tool now has a graph button to graph whole administration numbers versus appropriation date. The minimum (0) and maximum (99999) values are plotted as end points. This is useful as a general reference.
- The **Tools...Time Series Plot** tool now uses the new graphing package previously described. The **Delete** keyboard key has been enabled to delete rows from the template. The **Delete** keyboard key has also been enabled to the template load dialog to delete templates completely. The wizards to add rows now clearly indicate that multiple time series from a list can be selected. The advanced plotting method has been updated to have clearer instructions to help guide the setup of the information.
- The **Preferences...Options...Water District Filter** tab now provides Windows-like shift/ctrl/click capabilities for the district list. The districts are also labeled with the division number.

Changes in 02.04.00 Release

- The majority of the application was updated to be compatible with the new SQL Server central database. Only data synchronization and WIS were not updated.

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Appendix

TSView - Time Series Viewing Tools

Color, 2005-08-05, Original Maintained with TSTool, Acrobat Distiller

Overview

Time Series Terminology

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Changing a Graph Page Layout

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Time Series Product Reference

Overview

The TSView package contains integrated software components that can be used with software applications to enable time series viewing capabilities. The main purpose of the TSView package is to provide simple, consistent, and flexible displays that can be used in a variety of applications with little or no reconfiguration. TSView also provides features to configure and process time series products (e.g., graphs), where the time series data are stored separately from the configuration information.

The TSView package has been developed by Riverside Technology, inc., using Java technology. TSView interfaces can be embedded in Java applications and can be used in web pages either as embedded applets or stand-alone windows. TSView tools operate similarly on Microsoft Windows and UNIX operating systems.

This appendix describes general TSView features and can be used as a reference for how to configure and use TSView components. Software program documentation may include specific information about using TSView features.

Time Series Terminology

The TSView package treats time series as objects that can be read, manipulated, and output in various formats. A time series is defined as having header information (attributes) and data, which usually consists of a series of date/time versus data pairs. Internally, time series are considered to have either regular interval (equal spacing of date/time) or irregular interval (e.g., occasional observations). Regular time series lend themselves to simpler storage and faster processing because date/time information can be stored only for the endpoints. The following basic attributes are stored for each time series:

- data interval as an interval base (e.g., Month, Hour) and multiplier (e.g., 1 for month, or 24 for hour) - in many cases, the multiplier is 1 and is not shown in output (e.g., Month rather than 1Month),
- data type (e.g., Streamflow), which ideally can be checked to determine if a time series contains mean, instantaneous, or accumulated values,
- units (e.g., CFS), which ideally can be used to make units conversions and look up precision for output,
- period of record, using dates that are of an appropriate precision for the interval,
- data limits (the maximum, minimum, etc.),
- description (generally a station, structure, or sensor name),
- missing data value (used internally to mark missing data and trigger data filling, often -999),
- comments (often station comments, if available),
- genesis history (a list of comments about how the time series was created).

In order to uniquely and consistently identify time series, a multi-part *time series identifier* is employed, having the following parts:

- location (or location-sublocation)
- data source
- data type (or datatype-subdatatype)
- data interval (time step)
- scenario

and optionally:

- sequence number (currently being evaluated)
- input type
- input name

These time series attributes are typically concatenated into a time series identifier string. The following example illustrates how the basic identifier parts can be used (without input type and name):

```
12345678.USGS.Streamflow.DAY.HIST
```

The above example identifies a USGS streamflow gage identified as location 12345678, at which historic average daily flow data are available. If possible, data types appropriate for the input type should be used to avoid confusion; however, time series file input types often do not contain a simple data type abbreviation (see the input type appendices in the TSTool documentation for more information). The above example illustrates that the scenario can be used to qualify the data (in this case as historic data, HIST). The scenario is often omitted. When the scenario is used, it often indicates some specific condition (e.g., FLOOD, DROUGHT, HIST, FILLED)

The optional input type and input name are used to specify the time series input format and storage location, especially in cases where the identifier is saved in a file and the input type is needed for later processing. For example:

```
12345678.USGS.Streamflow.DAY.HIST~USGSNWIS~C:\data\12345678.txt  
12345678.USGS.Streamflow.DAY~HydroBase
```

The first example illustrates a time series identifier for a USGS National Water Information System data file. The second example illustrates the identifier for the same time series, in the HydroBase database. Using the input parts of the identifier allows software to transparently locate the data, and for the above examples, would allow the time series to be read from each input source and compared.

The use of the input type and name is being phased into TSView and related components. Input types that have been added to software more recently (e.g., as of version 05.04.00 of the TSTool application) use the new convention and older input types are being updated accordingly. The TSTool appendices that describe each input type identify issues with compatibility.

Using the above time series identifier convention omits use of time series attributes like the period of record and the units, even though these attributes could conceivably be used to distinguish between time series that are otherwise the same. Instead, it is assumed that the period of record and units can be determined from the input and do not need to be part of the identifier. If necessary, different input files can be used to further differentiate time series.

The TSView components use the time series identifiers extensively to locate and manage time series. For example, graph properties for each time series are cross-referenced to time series by using the identifiers. Perhaps most importantly, the time series identifiers as simple strings can be stored in files and can be used by a variety of software to consistently and reliably locate data for processing.

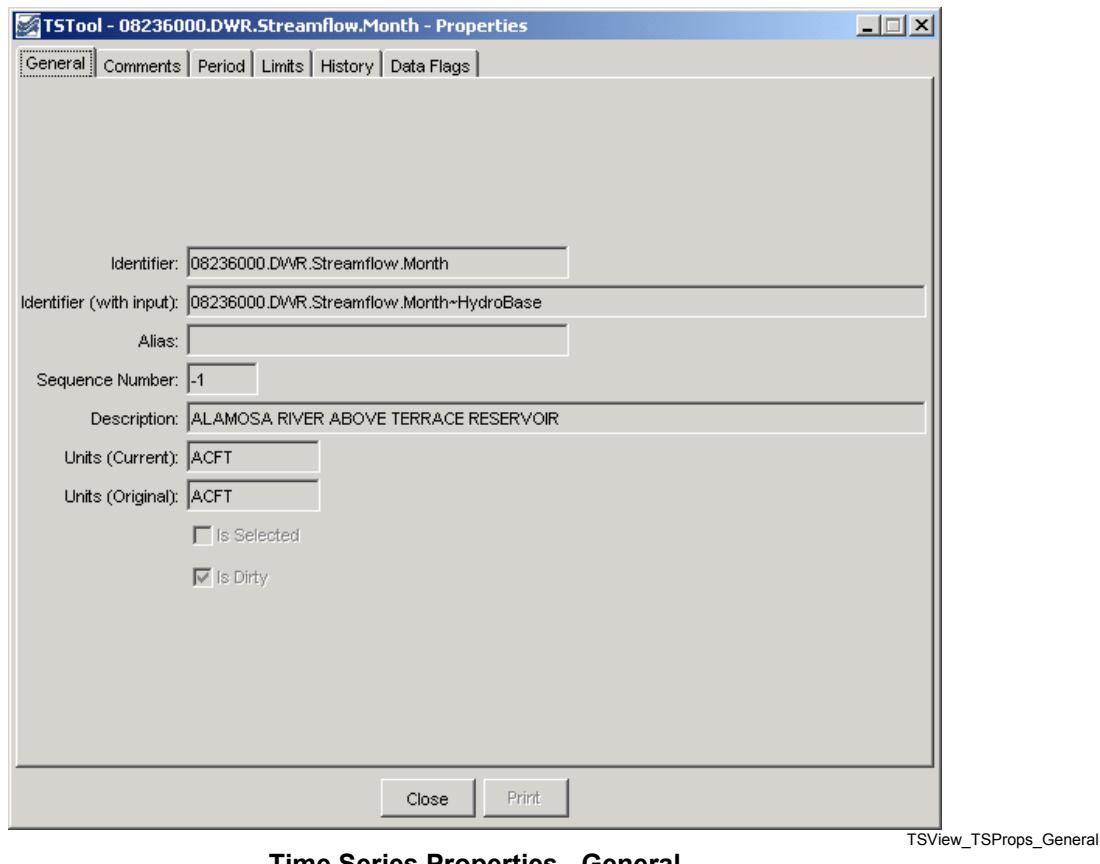
The following table summarizes important time series terminology.

Time Series Terminology (listed alphabetically)

Term	Description
<i>Data Interval</i>	Time interval between time series data values. If a <i>regular</i> time series, the interval is constant. If an <i>irregular</i> time series, the interval can vary. Intervals are represented as an optional multiplier followed by a base interval string (e.g., 1MONTH, 24HOUR) or IRREGULAR for irregular time series.
<i>Data Source</i>	A string abbreviation for a data source, which is part of the time series identifier and typically indicates the origin of the data (e.g., an agency abbreviation, or a model name if the result of a simulation).
<i>Data Type</i>	A string abbreviation for a data type, which is part of the time series identifier (e.g., Streamflow).
<i>Date/Time Precision</i>	Date/time objects used with time series have a precision that corresponds to the time series data interval. The precision is typically handled transparently but it is important that the precision is consistent (e.g., monthly data should not use date/time objects with daily precision). Displaying time series with various precision usually results in the smallest time unit being used for labels.
<i>Input Name</i>	A string input name corresponding to an input type, which is part of a time series identifier. For database input types, the name may be omitted or may be the name of the database connection (e.g., ARCHIVE). For input files, the name is typically the name of the file.
<i>Input Type</i>	A string abbreviation that indicates the input type (persistent format) for a time series, and is part of a time series identifier. This is often the name of a database (e.g., HydroBase, RiversideDB) or a standard data file format type (e.g., StateMod, MODSIM, RiverWare).
<i>Location</i>	A string identifier that is part of a time series identifier and typically identifies a time series as being associated with a location (e.g., a stream gage or sensor identifier). The location may be used with certain input types to determine additional information (e.g., station characteristics may be requested from a database table using the location).
<i>Scenario</i>	A string label that is part of a time series identifier, and serves as a modifier for the identifier (e.g., HIST for historical).
<i>Sequence Number</i>	A number indicating the sequence position of a time series in a series. For example, possible time series traces may be identified with a sequence number matching the historical year for the data. The use of sequence numbers with traces is being evaluated.
<i>Time Series Product</i>	A graph or report that can be defined and reproduced. See the Time Series Product Reference section.
<i>Time Step</i>	See Data Interval.

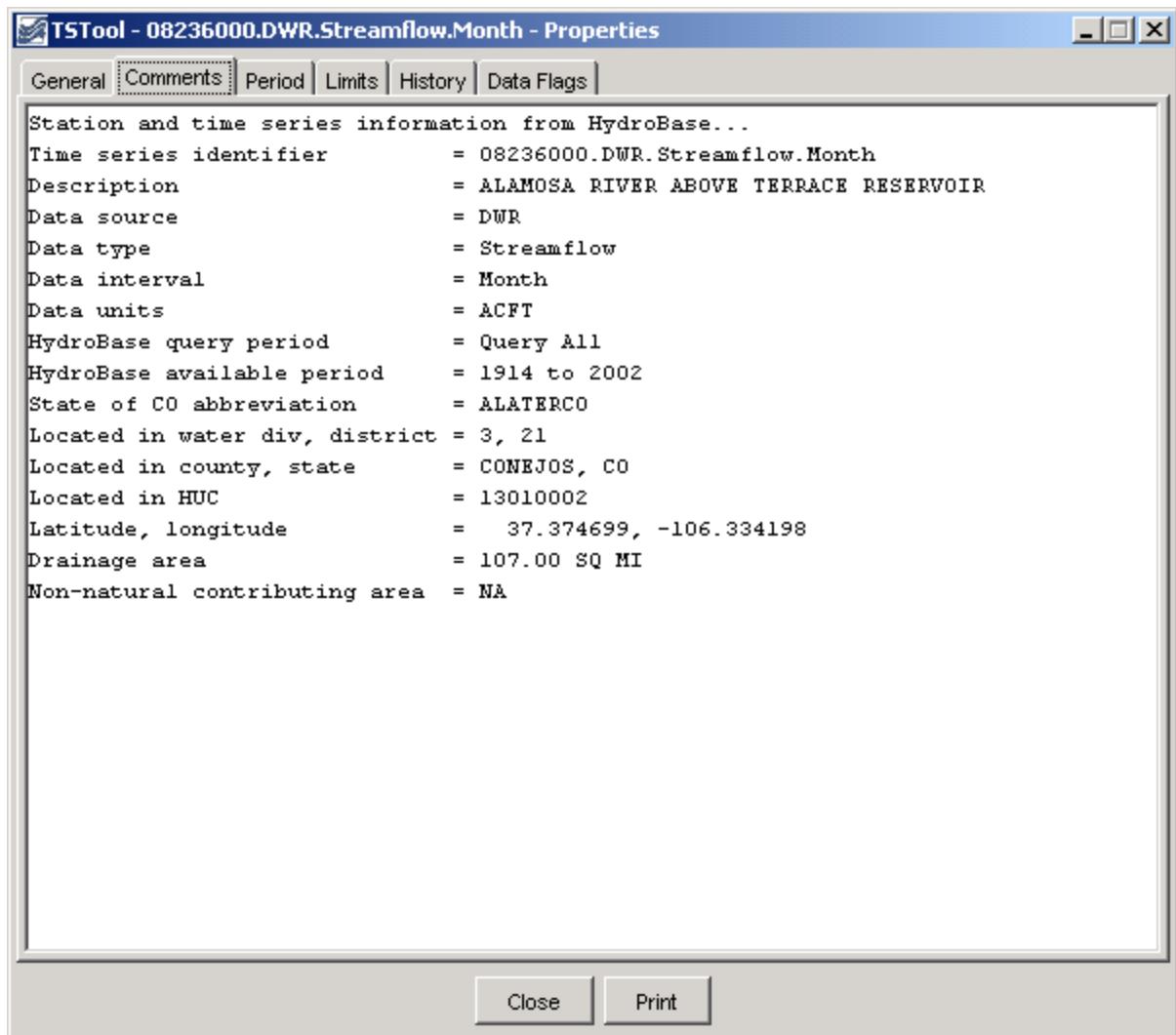
Time Series Properties Interface

Time series properties are displayed in a tabbed panel as appropriate in applications (e.g., the TSTool application can display the properties after time series are read and listed in the TSTool interface). Differences between time series input types may result in variations in the properties (e.g., some input types do not have descriptions for time series). The following figures describe the properties tabs. The size of each tabbed panel is set to the size of the largest tab; therefore, some tabbed panels are not completely filled.

Time Series Properties - General**Time Series Properties - General**

General time series properties are as follows:

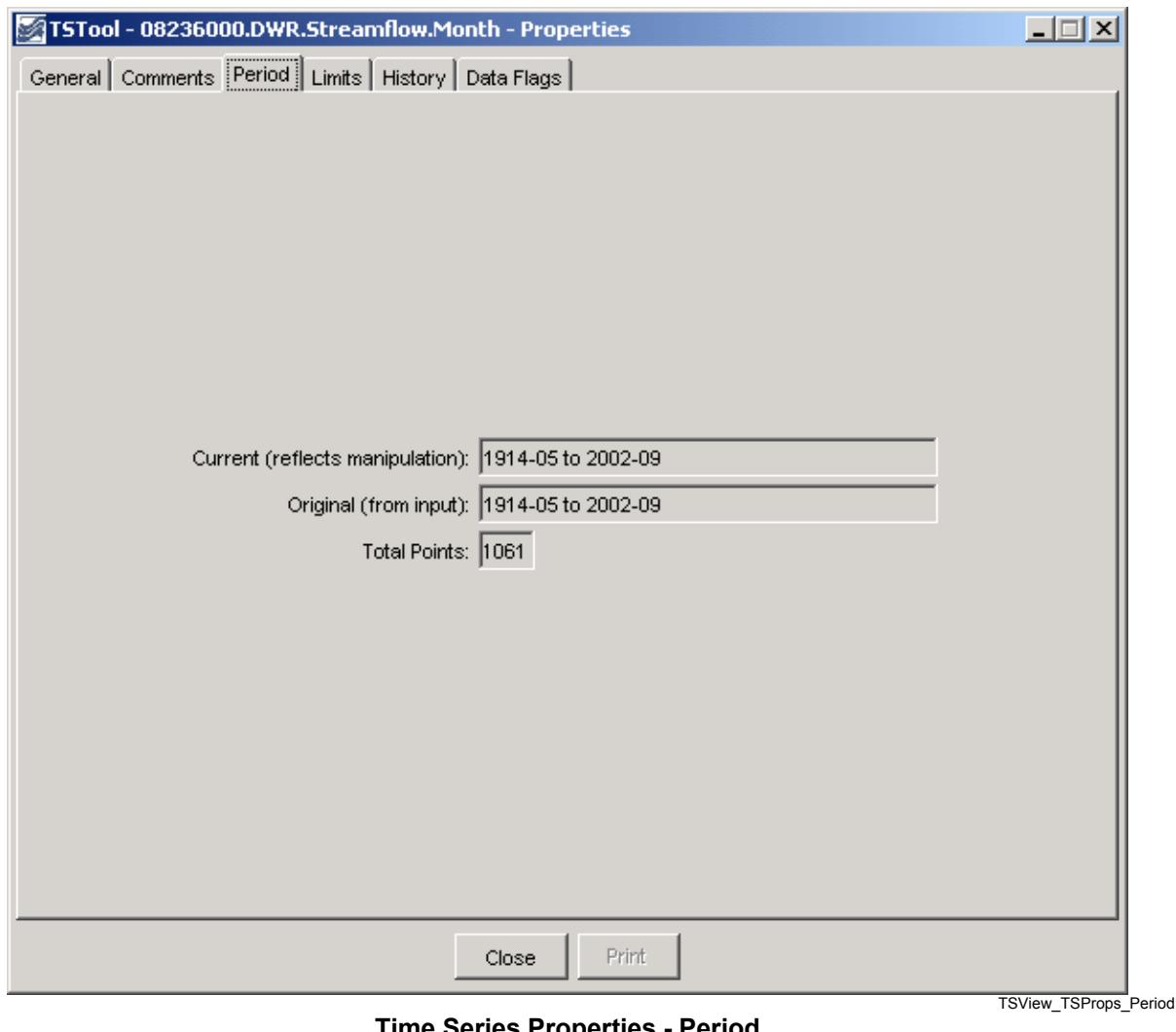
Identifier	The five-part time series identifier without the input type and name. This identifier is often used internally in applications to manage time series. See the Time Series Terminology section for a complete explanation of time series identifiers.
Identifier (with input)	The full identifier, including the input type and name (if available). The input type and name indicate the format and storage of the data.
Alias	A time series may be assigned an alias to facilitate processing (e.g., the alias is used by the TSTool application in time series commands).
Sequence Number	If the time series is part of a series of traces, the sequence number is used to identify the trace. Often it is the year for the start of the trace.
Description	The description is a mid-length phrase (i.e., longer than the location but shorter than comments) describing the time series (e.g., XYZ RIVER AT ABC).
Units (Current)	The units that are currently used for data. The units may have been converted from the original.
Units (Original)	The units in the original data source.

Time Series Properties – Comments**Time Series Properties - Comments**

TSView_TSProps_Comments

Comments for time series can be created a number of ways and may be formatted specifically for an application. Common ways of creating comments are:

- read comments from the original data source - this is ideal; however, electronic comments are often not available (e.g., the USGS previously published comments for data stations in hard copy water reports; however, comments may no longer available electronically),
- format comments from existing data pieces (e.g., the figure illustrates a standard set of comments for State of Colorado data, using the HydroBase input type).

Time Series Properties – Period

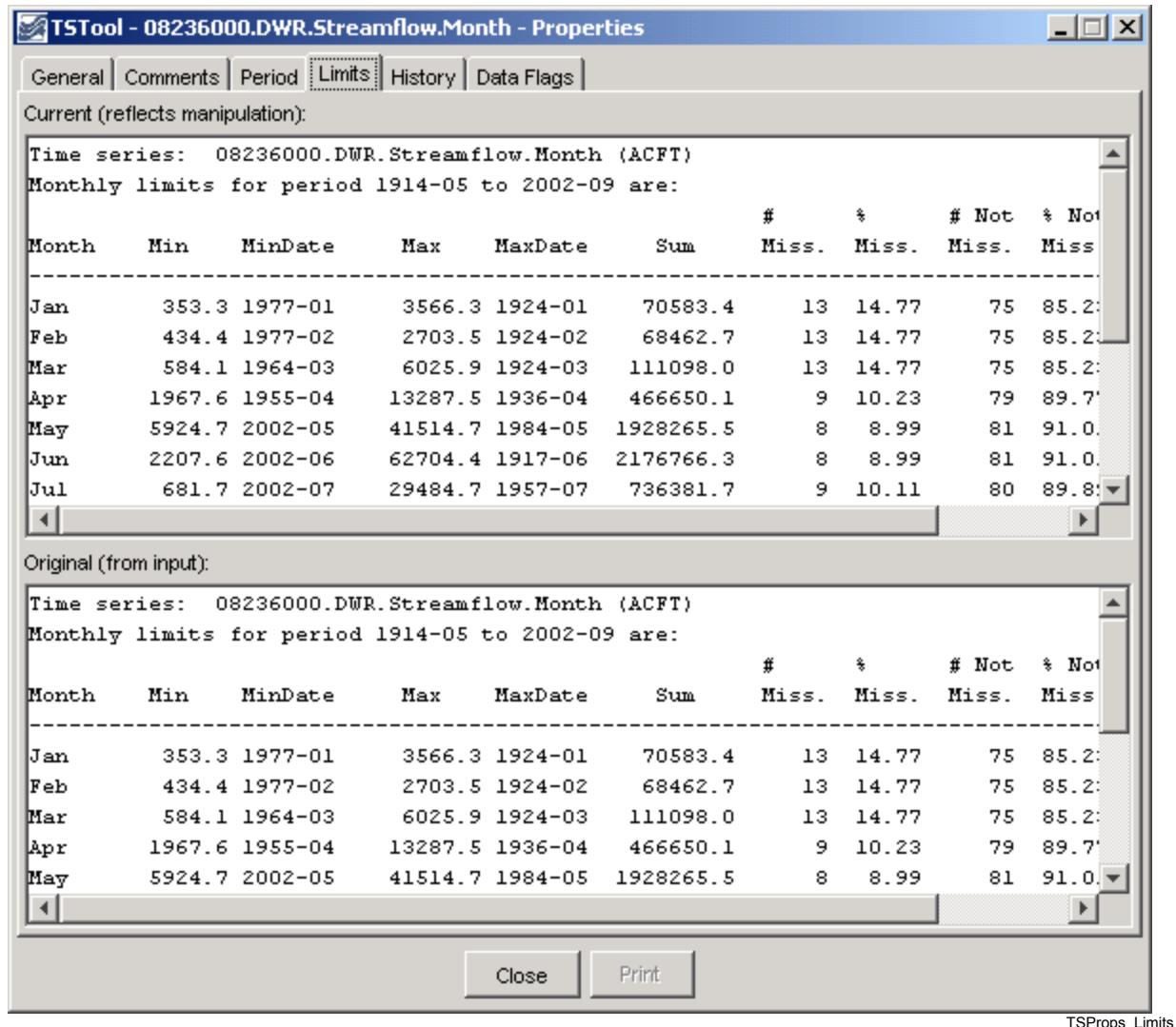
TSView_TSProps_Period

Time Series Properties - Period

Properties related to the period are as follows:

- | | |
|--|--|
| Current
(reflects
manipulation) | The current period is used to allocate computer memory for the time series data. This period may be set by an application (e.g., when creating model input files a specific period may be used). The precision of the date/time objects should generally be consistent with the time series data interval. |
| Original (from
input) | The original period can be used to indicate the full period available from a database. Setting the original period can sometimes be complicated by how missing data are handled (e.g., a database or file may indicate a certain period but a much shorter period is actually available). |
| Total Points | Total number of points in a time series. If a regular time series, this can be computed from the period. If an irregular time series, the number of points is determined from a count of all data values. The data points may include missing data – see the data limits for additional information. |

Time Series Properties – Limits



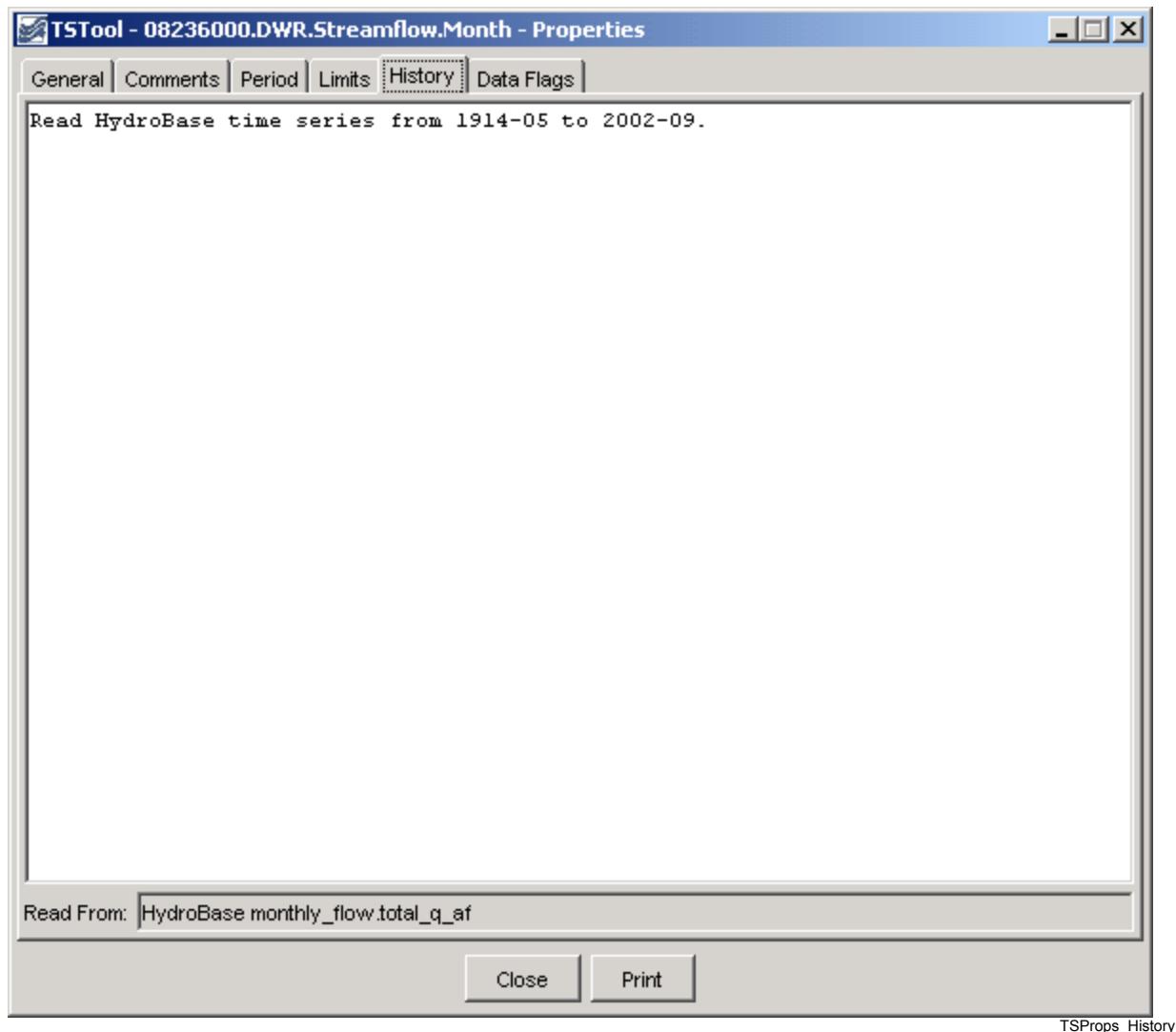
TSProps_Limits

Time Series Properties - Limits

Time series limits are determined for both the current data (top in figure) and the original data (bottom in figure). This is useful because the original data may contain missing data, which are later filled. The data limits are displayed consistent with the data interval. In the example shown, limits are computed for each month. For other time series having other intervals, only overall data limits may be computed.

Theoretically, it is possible that a daily time series could have day limits (e.g., max/min values for each day of the year), month limits (e.g., computed as an average of the daily values by month), and year limits (e.g., computed as an average of all daily values in a year). However, automatically including this level of detail decreases performance and it is difficult to automatically make the right decisions (e.g., about whether to average or total values). Consequently, the limits are currently computed in a basic fashion on the raw data (no interval changes).

Time Series Properties – History



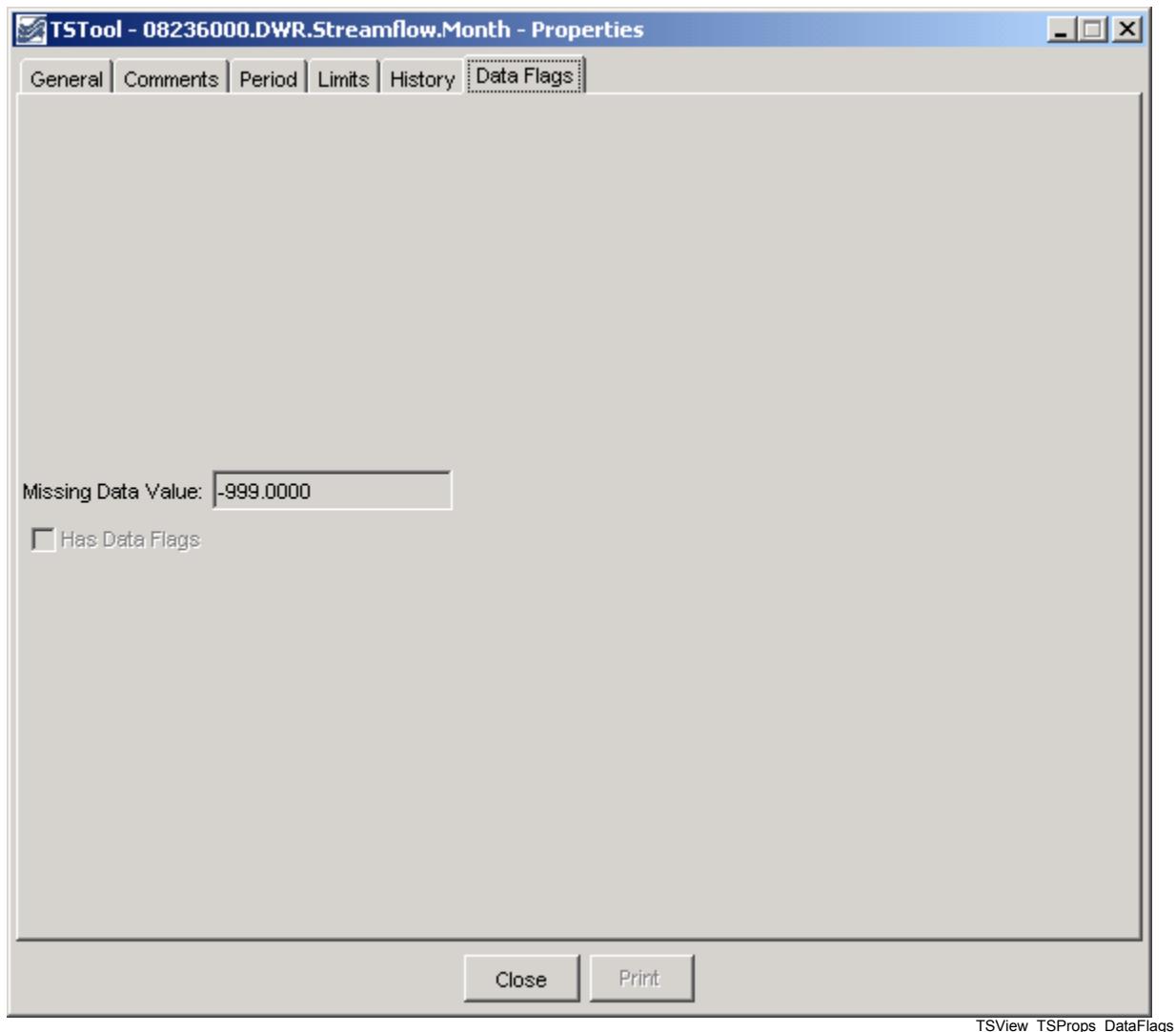
TSProps_History

Time Series Properties - History

The time series history (sometimes called the *genesis history*) is a list of comments indicating how the time series has been processed. The completeness of this history is totally dependent on the time series input/output and manipulation software. Although efforts have been made to add appropriate comments as time series are processed, enhancements to the history comments are always being considered.

At the bottom of the history list (see **Read From**) is the input name that was actually used to read the data. This input name may or may not be exactly the same as the input name in the time series identifier. For example, if reading from a HydroBase database, the time series identifier may specify an input type of HydroBase and no input name (because the software knows from the other parts of the time series identifier which database tables to read). However, it is also useful to know the actual table that is read in order to help users and developers understand the data flow. If reading from a file input type, the **Read From** information will show the full path to the file; however, the input name in the time series identifier may only include a relative path.

Time Series Properties – Data Flags



Time Series Properties - Data Flags

Time series data flags contain information that describe the quality of a data point. The missing data value indicates a special number that is used to indicate that a data value is missing at a point. Currently only floating point values are recognized; however the NaN (not a number) value is generally supported for input types that use the convention. All time series are typically assigned a missing data value.

The **Has Data Flags** checkbox indicates whether the time series has data flags. Full support for data flags is being phased in, based on whether an input type supports data flags. The USGS NWIS file format is an example of an input type that supports data flags (e.g., e is used to indicate estimated data).

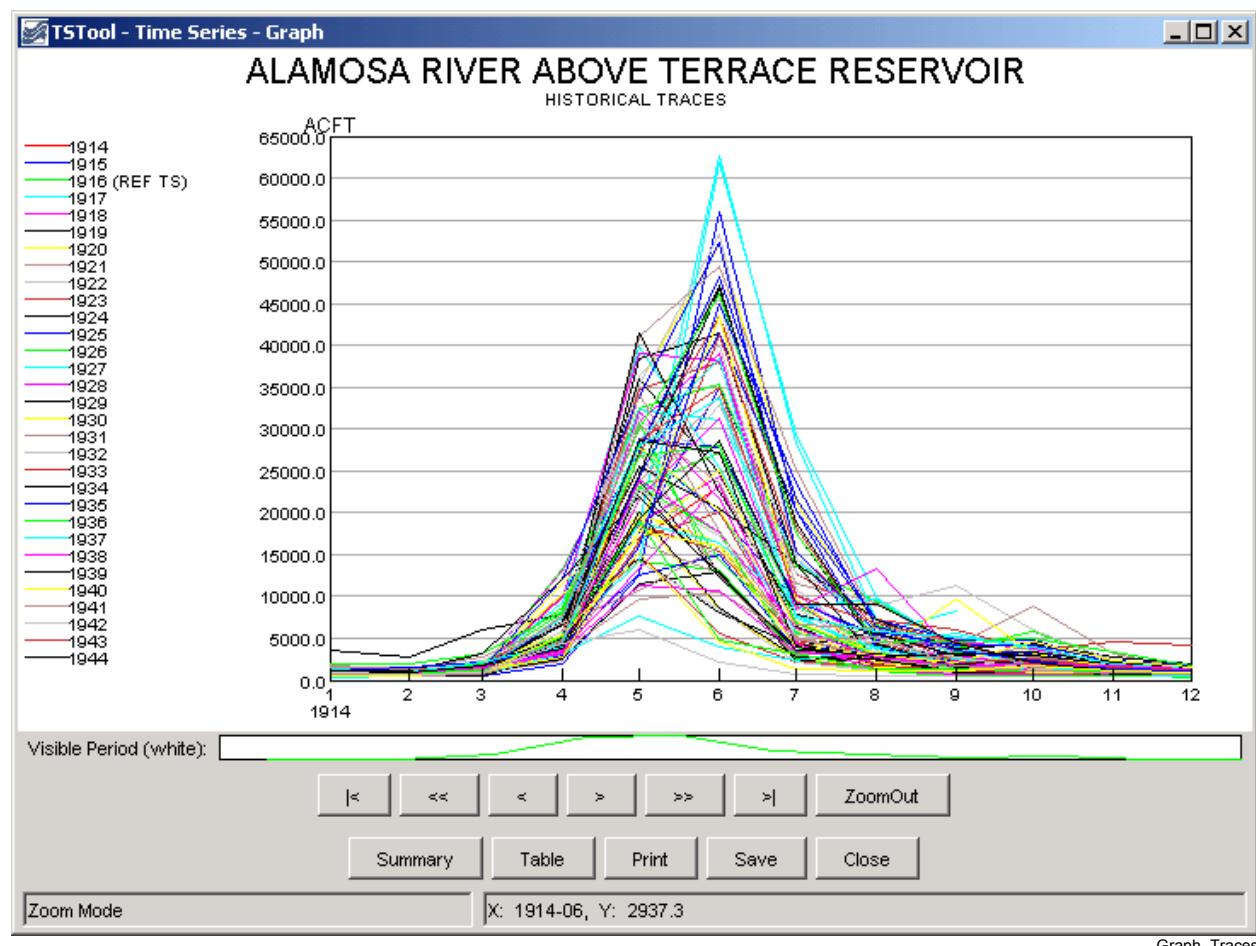
One of the issues with fully supporting data flags is that different input types (and even different data within an input type) treat data flags inconsistently. Therefore, it is easier to add data flags to time series visualization tools (e.g., label points on a graph with the flag) than to integrate data flags in data filling and analysis features. Features related to data flags will continue to be enhanced.

Time Series Traces

The term *time series traces* in general refers to a group of time series, often shown in overlapping fashion. Common uses of time series traces are:

- separate a full time series into annual traces and plot them on top of each other, shifted so that they all start at the same date/time,
- run a model or analytical tool multiple times, with input being a series of input traces, and generating a series of output traces, in order to produce probabilistic simulations.

The power of using traces is that a large amount of data can be used to visualize and study statistical qualities of the data, as shown in the following figure.



Example Graph for Time Series Traces

The TSView package supports time series traces at various levels. Time series properties include a sequence number that can be used to identify a time series as being in a group of traces. However, for data management and viewing, time series identifiers often do not indicate whether a time series is in a group of traces (the sequence number is managed internally). Full support of time series traces is being phased in.

Currently, applications like TSTool include features to create time series traces and TSView tools can be used to view the time series as if they were separate time series. Additional visualization features are being enabled as time allows.

The following sections describe the different time series views that are available in TSView. Although most illustrations use simple time series, most features are also available for use with traces.

Time Series Views

The main components of the TSView package are configured to provide multiple views for time series data. The three main views that are available are:

1. **Graph** - line, bar, or other graph
2. **Summary** - text report suitable for the data type and interval
3. **Table** - spreadsheet-like table with scrolling, suitable for export to other tools

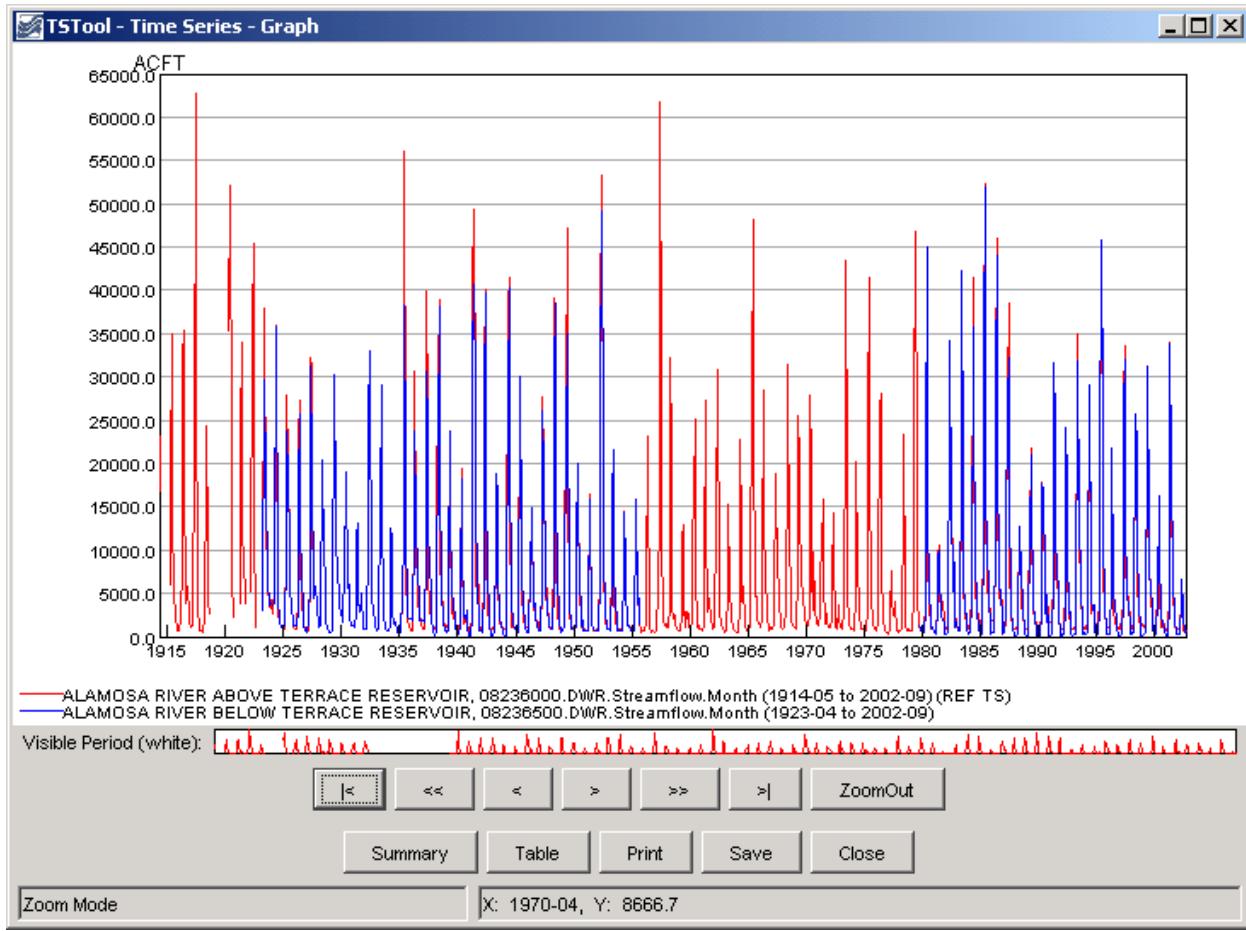
The initial view for a time series list is typically determined from the actions of the software user. For example, a **Graph** button may be displayed on a screen, which when pressed will result in a graph being displayed. The time series that are displayed in the view can typically contain one or more time series (some graph types may have a restriction on the number of graph types). To increase performance and capacity, the TSView package as much as possible uses a single copy of the time series data for visualization. For example, to generate graphs, the data for the time series objects are used directly rather than being copied into a graphing tool's data space. This also allows TSView to more easily display different data intervals on the same view because the data do not need to be forced into a consistent grid data structure.

The following sections describe the three time series views. The graph view type requires more extensive explanation due to the variety of graph properties.

Time Series Graph View

The graph view for time series supports a variety of graph types. The features of the various graph types will be discussed in detail in the following sections, starting with basic graph types, followed by more specific types.

Typically, the graph type is selected in the application (e.g., menus are available in TSTool for selecting the graph type for a list of time series). In many applications, the graph type often defaults to a line graph. The following figure illustrates a line graph for two monthly streamflow time series.



Example Line Graph for Monthly Streamflow

The graph view is divided into the following main areas:

Graph Canvas

The graph canvas is the area where the graph and legend are drawn. This area is used to interact with the graph (e.g., zoom). More than one graph can be drawn in the canvas (see the **Time Series Product Reference** section for additional details). If zooming is supported for the graph, a box can be drawn with the mouse to zoom in to a shorter period. Right-click over a graph of interest to show the popup menu for graph properties and analysis details (e.g., regression results). The canvas area is essentially a preview of a printed graph.

Reference Graph The reference graph below the main graph canvas shows the current view extent (the white area in reference graph in the figure above). The reference graph is only shown for graph types that support zooming. If shown, it can be used for zooming, similar to the main graph. The time series with the longest period of record is drawn in the reference graph to illustrate variations in the data over time (this time series is noted in the main graph legend with REF TS – this label is not shown in printed output).

Scroll/Zoom Buttons Under the graph areas is a layer of buttons used for zooming. The **Zoom Out** button will zoom to the full extent of the data.

The other buttons facilitate scrolling through data as described below. For all scrolling operations, the visible graph extent (or *page*) is maintained during the scroll. Scrolling can use the buttons or keys described below. To use the keyboard, first click in the main graph canvas to shift focus to that area.

<	Home	Scroll the visible window to the start of the period.
<<	Page Down	Scroll the visible window one full page to the left (earlier in time).
<	Left Arrow	Scroll the visible window 1/2 page to the left.
>	Right Arrow	Scroll the visible window 1/2 page to the right (later in time).
>>	Page Up	Scroll the visible window a full page to the right.
>	End	Scroll the visible window to the end of the period.

Main Buttons The bottom row of buttons provides features for displaying other views, printing, and exporting:

Summary	Display the summary view for the time series (see the Time Series Summary View section).
Table	Display the table view for the time series (see the Time Series Table View section).
Print	Print the graph. Because the physical extents of the printed page are different from the visible window, the printed graph may not exactly match the viewed version (e.g., more or less axis labels may be used).

Save	Save the graph as a Portable Network Graphic (PNG) or JPEG graphic, a DateValue file (a useful time series format), or a <i>Time Series Product</i> file (see the Time Series Product Reference section) by selecting from the choices. Depending on the main application, saving to a database as a time series product may also be enabled.
Close	Close the graph window. If related summary or table windows are still visible, the graph view can be quickly re-displayed by pressing the Graph button on the other view windows. If the graph properties have been changed but have not been saved, a warning will be displayed.
Status Message Area	The lower-left status message area is used to provide general user instructions and feedback.
Mouse Tracker Area	The lower-right status message area is used to indicate the position of the mouse on a graph, in data units. The coordinates are typically shown using an appropriate precision as determined from the time series date/time precision and data units.

Within each graph canvas it is possible to draw more than one graph, each with its own titles, legend, etc. The **Time Series Product Properties** section (below) provides an example and discusses how to edit graph properties. The **Time Series Product Reference** section describes in detail the format of *Time Series Product* files. These files, when saved from the graph view, can be used to recreate a graph interactively or in batch mode, at a later time.

Because TSView is a general tool, a number of rules are in place when viewing time series in graphs (see the **Time Series Product Properties** section for information on changing specific graph properties to override the defaults):

1. Time series plotted on the same graph should generally have the same units or have units that can be readily converted. If the units are not consistent, you will be warned and the units will be displayed in the legend rather than on the axis. (A future enhancement may allow multiple axes, each with different units.)
2. Time series can have different data intervals (e.g., daily data can be plotted with monthly data). However, other output options, such as reports, may not allow the same flexibility. It is important to understand the data type characteristics. For example, some data are instantaneous (e.g., real-time streamflow) whereas other data are accumulated (e.g., precipitation) or mean (e.g., mean temperature). Therefore, the representation of the data may need to be selected with care to ensure consistency. For example, some data intervals and types may be better represented as bars and others as lines or points.
3. Data values are plotted at exactly the point that they are recorded. The plot positions are determined using the year as the whole number and months, days, etc. to determine the fractional part of the plot position. The end-user does not typically see these computed positions because labeling uses data units, including dates. The plot positions are determined from the dates associated with data and no

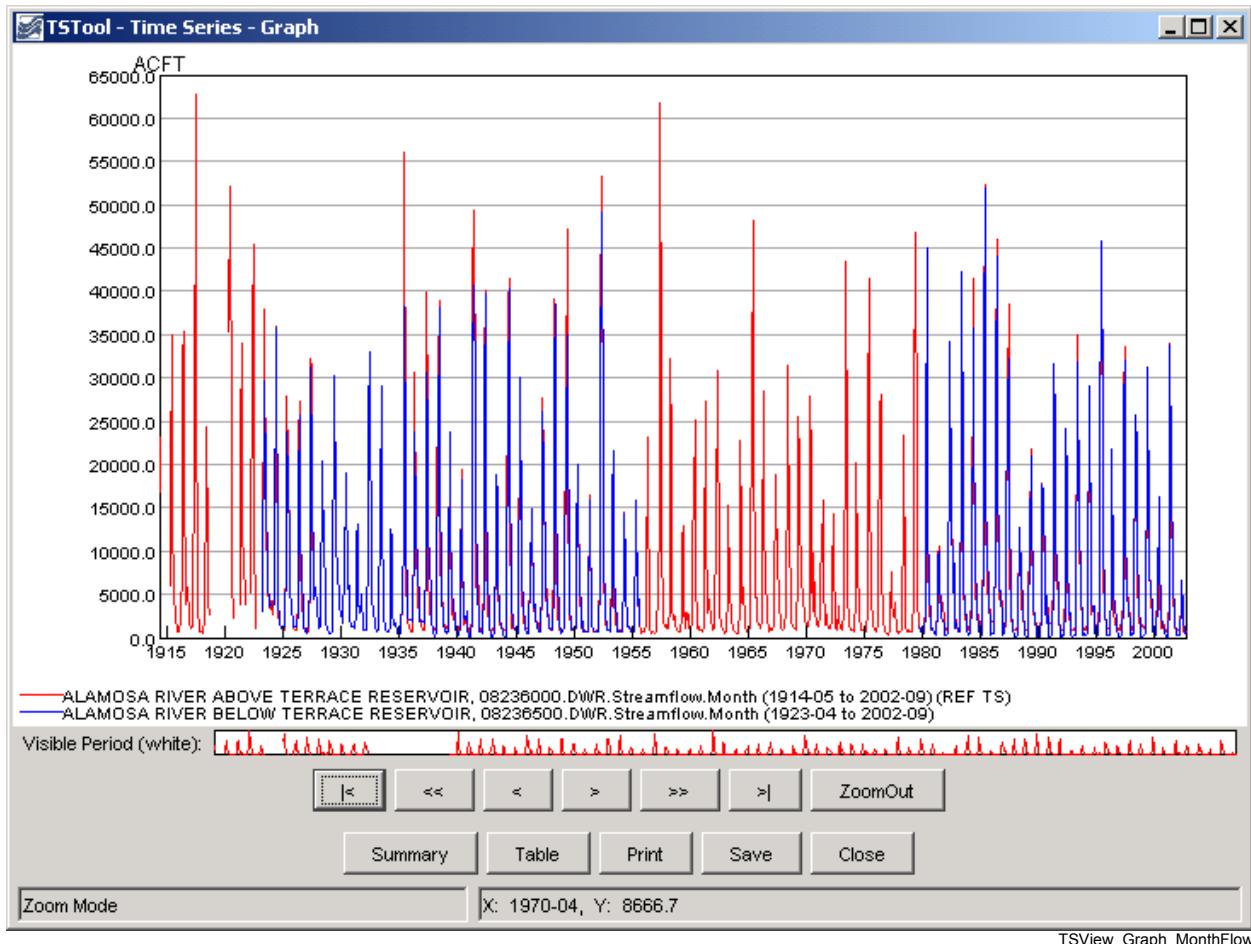
adjustments are made to plot in the middle an interval. For example, monthly data are plotted at the first day of the month (not day 15). Properties to override this convention are being evaluated. Bar graphs allow you to select whether the bars are drawn to the left or right of the date, or centered on the date. This allows flexibility to show a period over which a value was recorded, if appropriate.

4. The mouse coordinates that are displayed by the mouse tracker are computed by interpolating screen pixels back to data coordinates (which involves a conversion of the plot position to date/time notation). Consequently, the values shown may be rounded off (depending on the zoom extent and data precision). The mouse coordinates are displayed based on the precision of the time series data. When moved, the mouse will display the same date until the date changes within the given precision. For example, for monthly data, moving the mouse left to right, the mouse coordinate will display as 1999-01 as soon as the date changes from 1998-12 to 1999-01. The label will remain at 1999-01 until 1999-02 is encountered. Because data values are drawn at points, you should therefore always position the mouse slightly to the right of the point to see the date corresponding to the value. This is very important for bar graphs because the bar may extend over several dates. If specific values need to be determined, use the summary or table views.
5. Labels for axes are determined automatically in most cases based on the font requirements, available display space, and data range. Major and minor tic marks are drawn to help determine the data coordinates. Labels are redrawn as the visible period is changed.
6. Graphs that can be zoomed do not allow the vertical axis to be re-scaled on the fly. This capability is being evaluated.
7. Currently, graph types cannot be mixed for time series on a graph. In other words, a graph cannot contain a bar graph for one time series and a line graph for another time series. This ability may be added in the future. A work-around is to use multiple graphs on a page (see the **Time Series Product Properties** section for an example).
8. The precision used to format graph labels is determined from data unit information provided by the application. This generally produces acceptable graphs. However, in some cases, the range of values being plotted results in inappropriate labels where label values are truncated and/or repeated.
9. Graph types can be changed after the initial display, with limitations. Graphs can be switched between simple types like line and bar graphs; however, simple graphs cannot be changed to more complex types.

The following sections describe various graph types supported by the TSView package. Graph properties are mentioned in some sections. The discussion of how to change graph properties is included in the **Time Series Product Properties** section after the graph type descriptions.

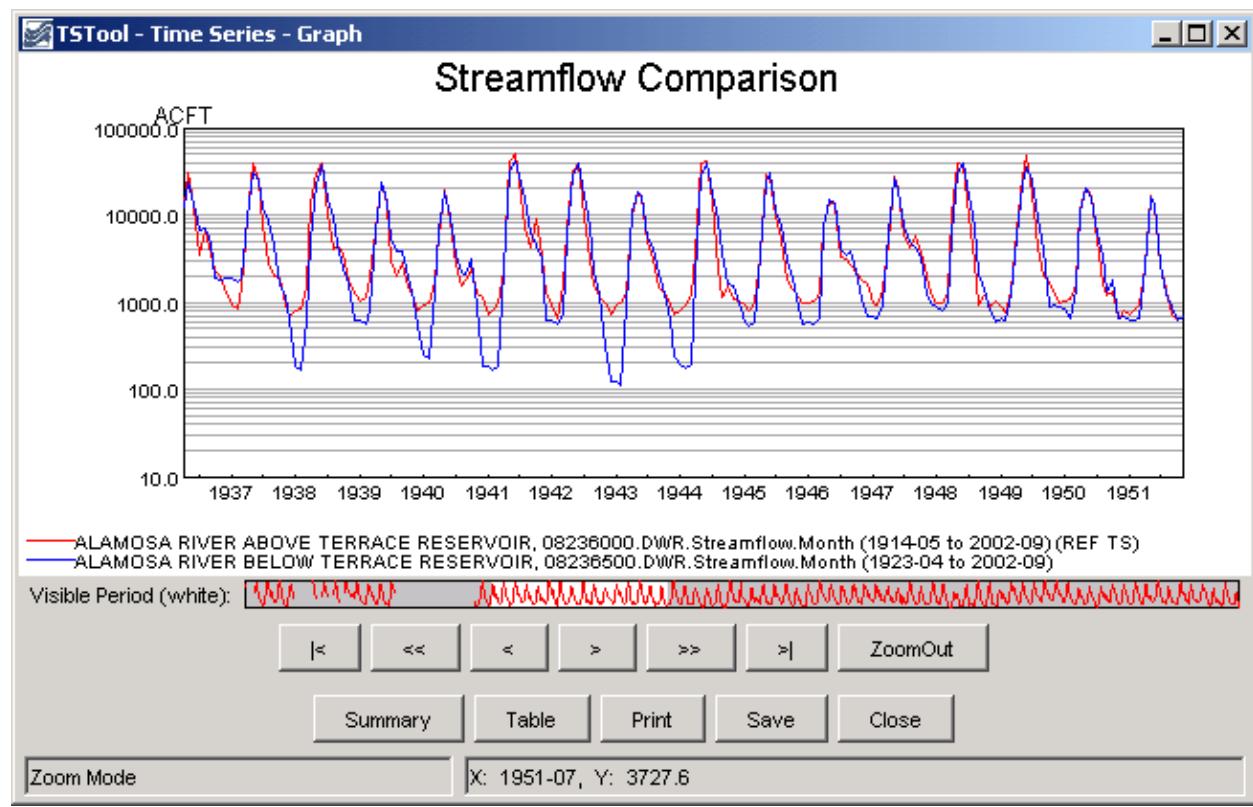
Line Graph

Line graph features have been illustrated in previous discussion. The line graph type is also used to generate graphs with only points by setting the line style to None (for example, software that displays daily data where gaps are expected may default to using symbols and no line).



Line Graph - Log Y Axis

Log-axis line graphs are similar to simple line graphs. The following figure illustrates a typical graph.



Example Log Y Axis Graph showing Monthly Streamflow

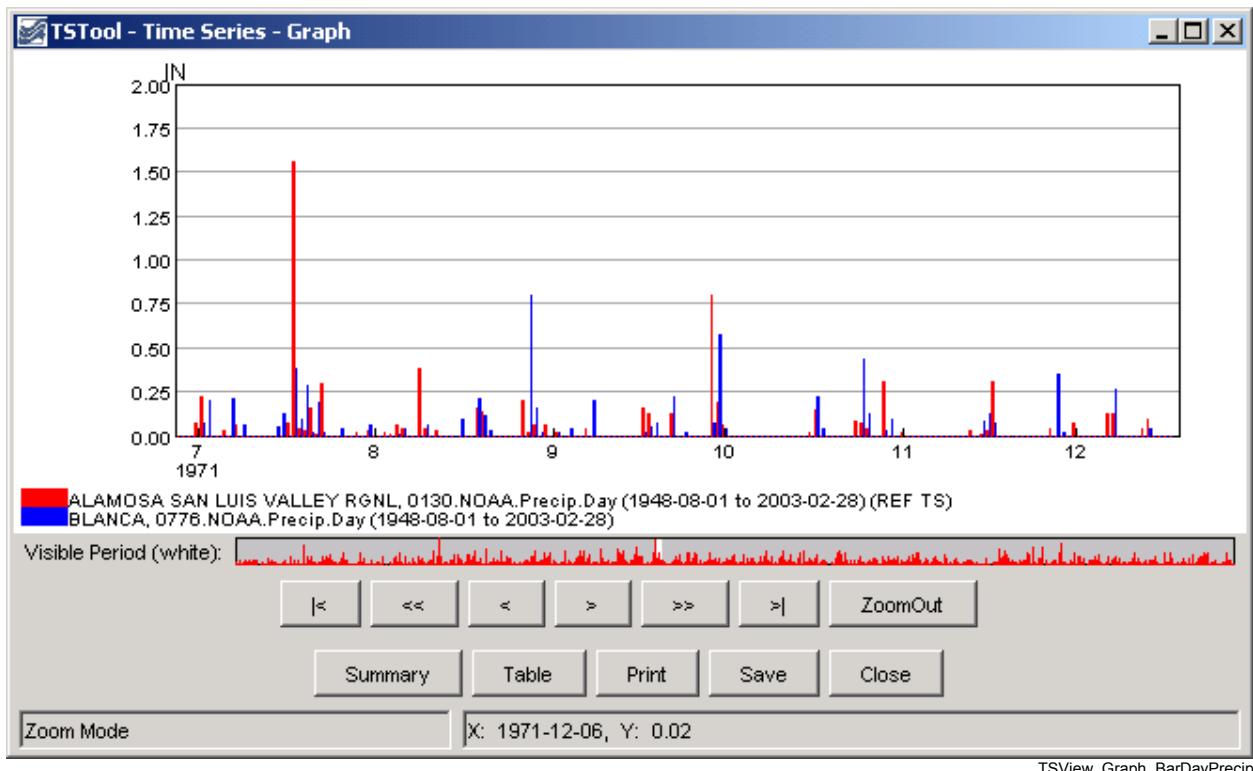
TSView_Graph_LogMonthFlow

Characteristics of the log plot are:

- If the minimum data value is ≤ 0.0 , then .001 is used for the minimum plotting value.

Bar Graph

The bar graph type produces a graph with parallel vertical bars, as shown in the following example:



Example Bar Graph showing Daily Precipitation

The above example illustrates that at the given zoom extent (which is a small part of the full period - see the white area in the reference graph), labels are drawn for months. Zooming in more would display the day in the labels. The mouse tracker in all cases shows days since that is the precision of the data. Characteristics of the bar graph are as follows:

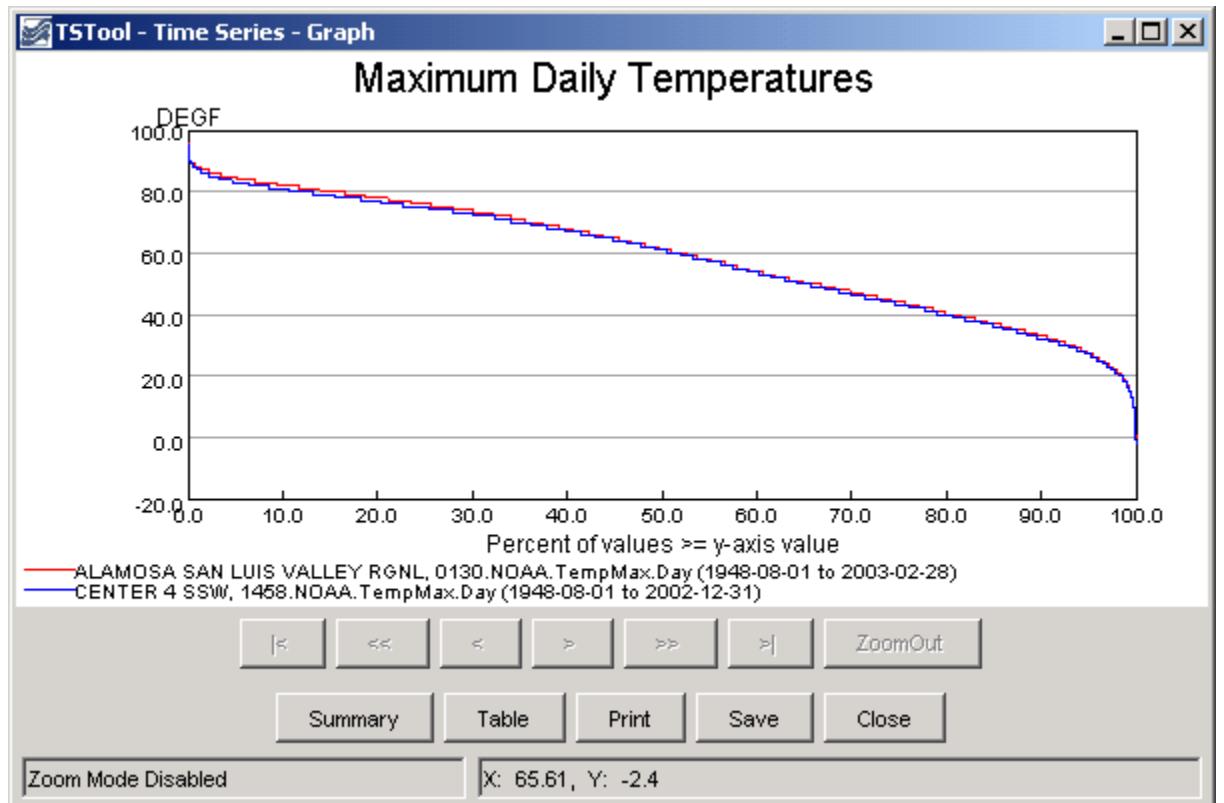
- Bars can be plotted centered on, to the left of, or to the right of the dates. If multiple time series are plotted, the overall total width of the bars will correspond to one data interval. If drawn to the left of the date, the bars for all graphed time series are drawn to the left of the date. If drawn to the right of the date, the bars for all graphed time series are drawn to the right of the date. If centered on the date, half the bars are drawn to the left of the date, and half to the right
- Bar widths are determined based on the number of time series being plotted. Monthly time series use a slightly narrower bar (larger gap between bars) because the number of days in a month varies. To make bars stand out better, a white line may be drawn to separate adjacent bars. If bars are very narrow the line is not drawn. Bars will always be drawn at least one pixel wide, even if this obscures neighboring bars (zoom in to see more detail). Round-off in drawing bars may result in some bars being slightly wider or narrower than other bars.
- Bars always end at the zero value on the Y axis. In other words, bars extend up or down from zero.
- The mouse cursor display dates relative to the axis and does not determine the data value relative to edges of the bars. For example, if bars are plotted centered on dates, 1/2 of the bar will actually be in the previous date, according to the mouse tracker.

Double Mass Curve

Double mass curves are currently disabled. An alternative is to use the TSTool application and generate cumulative time series, which can be viewed in a line graph.

Duration Graph

A duration graph indicates the range of values in a time series and how often they occur, as shown in the following example:



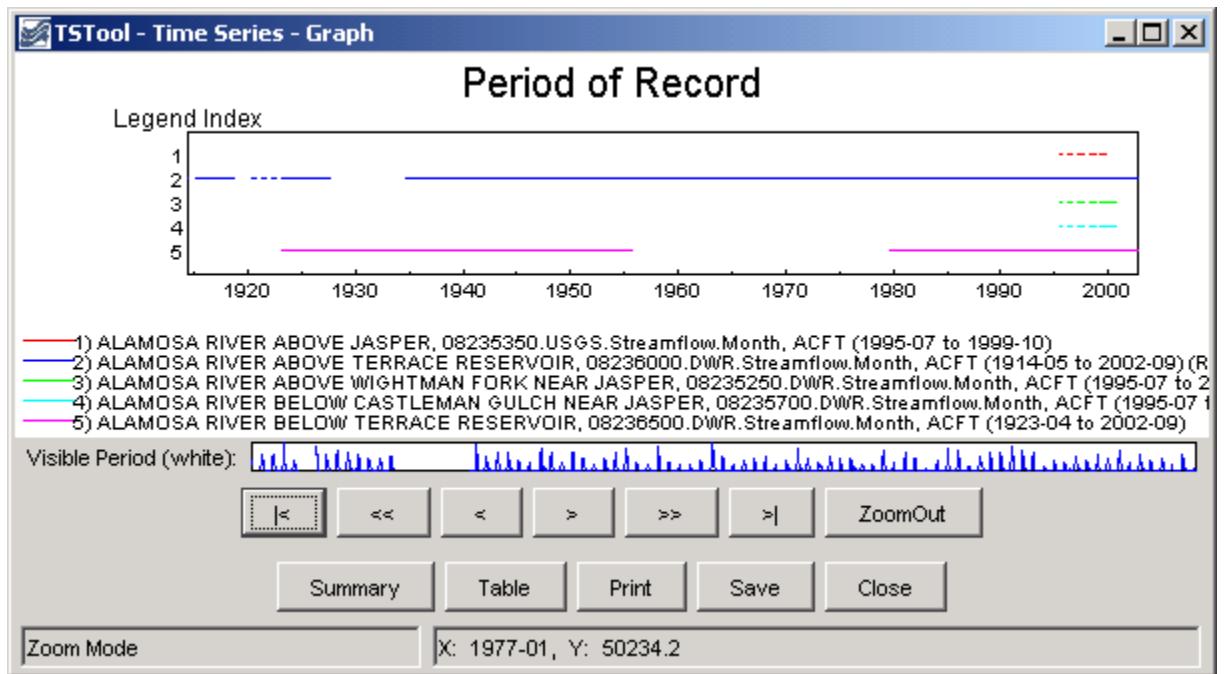
Example Duration Graph showing Maximum Monthly Temperatures

The algorithm for calculating and graphing a duration curve was taken from the book **Handbook of Applied Hydrology** (edited by Ven Te Chow): “*When the values of a hydrologic event are arranged in the order of their descending magnitude, the percent of time for each magnitude to be equaled or exceeded can be computed. A plotting of the magnitudes as ordinates against the corresponding percents of time as abscissas results in a so-called duration curve. If the magnitude to be plotted is the discharge of a stream, the duration curve is known as a flow-duration curve.*” Features of duration graphs are as follows:

- The zoom feature is disabled for this graph type.
- Although duration curves have traditionally been applied to streamflow or reservoir data, duration graphs can be created for any time series data.
- Noticeable breaks in the curve are caused by a limited number of data points and/or values that are measured as rounded values.

Period of Record Graph

The period of record graph is used to display the availability of data over a period, as shown in the following figure:



Example Period of Record Graph showing Monthly Streamflow

Characteristics of the period of record graph type are:

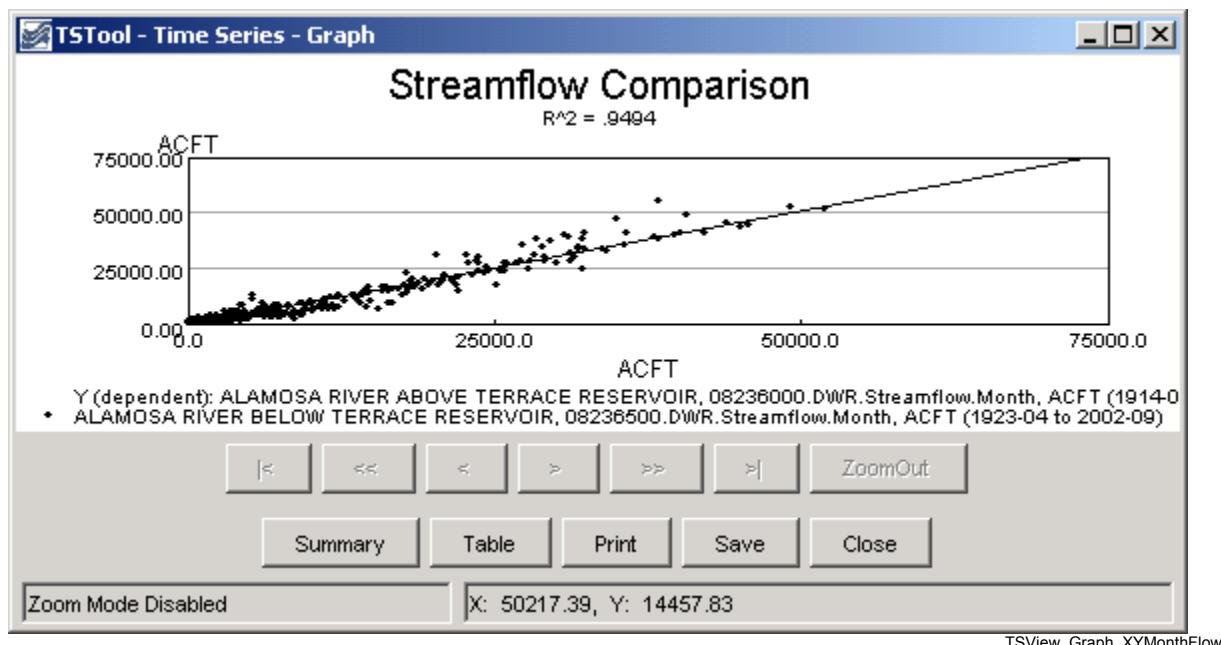
- Horizontal lines are drawn for each time series, with breaks in the line indicating missing data.
- Zooming is fully enabled, however, it may be difficult to see small breaks in the lines – it may be necessary to display symbols at the data points. The data limits properties of each time series can also be used to check for missing data. The TSTool application provides reporting features to summarize data coverage.
- Because data values are not plotted, the y-axis is labeled with a legend index number. This also allows the graph window to be compressed vertically, if desired.

XY-Scatter Graph

The XY-Scatter graph type can be used to compare data having the same data interval (units can be different). This graph type is often used for the following comparisons:

1. The dependent time series (Y) requires filling and multiple independent time series (X) are analyzed to find the best time series to use as the independent time series. One or more independent time series can be plotted on the same graph.
2. The dependent time series (Y) contains observed data and one or more independent simulated time series (X) are analyzed to determine which simulation is closest to actual observations.
3. The independent (X) and dependent (Y) time series are compared to determine whether any type of relationship exists between data points. In this case, a single dependent time series may be compared with multiple independent time series on the same graph.

Currently the XY-Scatter graph can have only a single dependent time series but can have one or more independent time series. The following figure shows a typical graph.

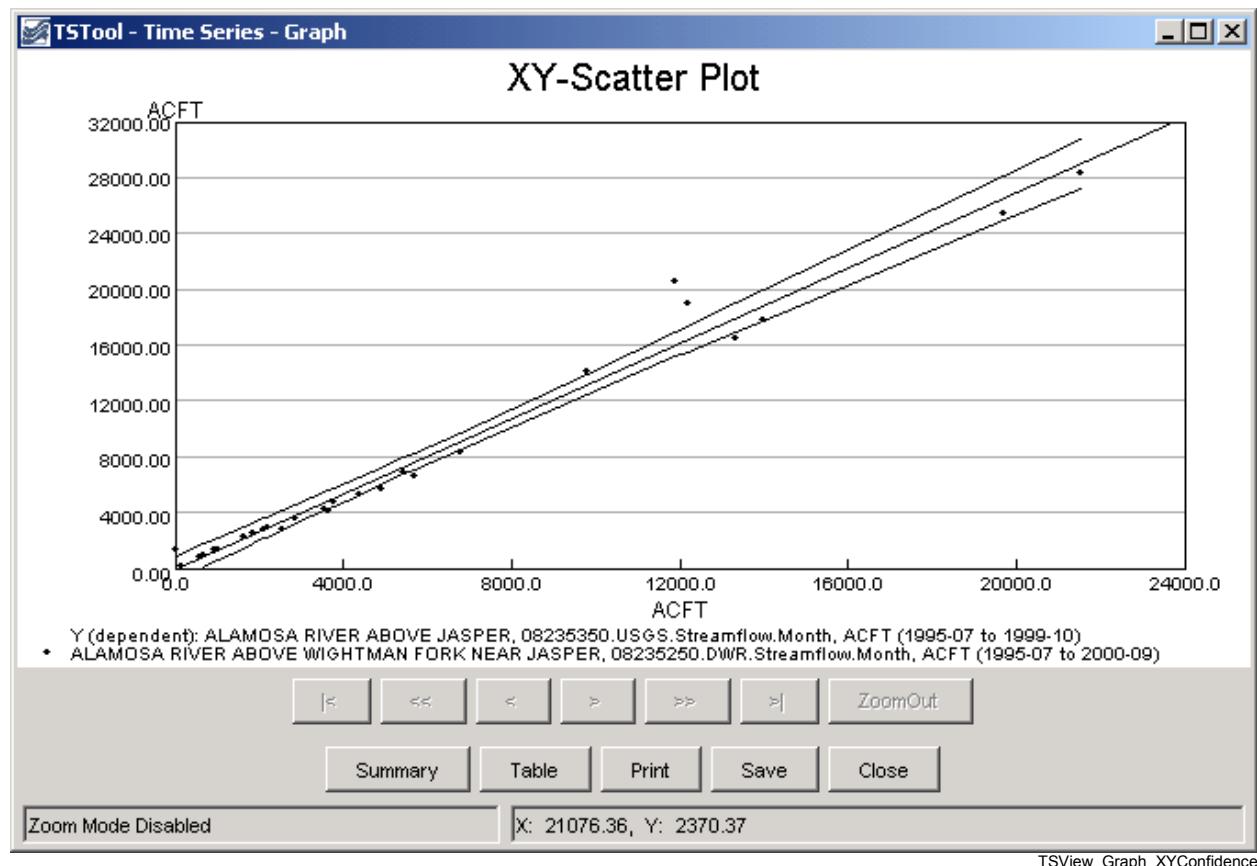


Example XY Scatter Graph showing Monthly Streamflow

Characteristics of the XY Scatter graph are:

- Labels and legend are automatically generated. See the **Time Series Product Properties** section below for information about changing the appearance of the graph.
- Simple linear regression is initially performed to determine a line of best fit. See the **Analysis** tab in the **Time Series Product Properties** section below for information about curve fit methods.
- A 45 degree line is currently **not displayed** because time series of different types and units may be compared. Graph properties do allow the line of best fit to be forced to zero. The limits on the axes are not automatically set to equal values for the same reason; however, a property to force the values to be the same will be added.
- Zooming is disabled.
- Two or more time series must be specified and must have the same interval.

- Confidence intervals can be turned on, as shown in the following figure:



TSView_Graph_XYConfidence

The confidence intervals provide a useful way for assessing the quality of a point estimate. When a regression line is of interest, the confidence interval on the line as a whole permits one to make confidence statements about a number of values of the predictor variables simultaneously. Confidence limits for the line are a function of the level of confidence (e.g., gamma = 95% or 99%), and the F-test statistic (2, n-2 degrees of freedom, and level of significance =1-gamma). The equations used to plot the confidence intervals are shown below (note that because the curves depend on the data points, the shape and smoothness of the curves will depend on the number of points; the points are sorted to generate a continuous line).

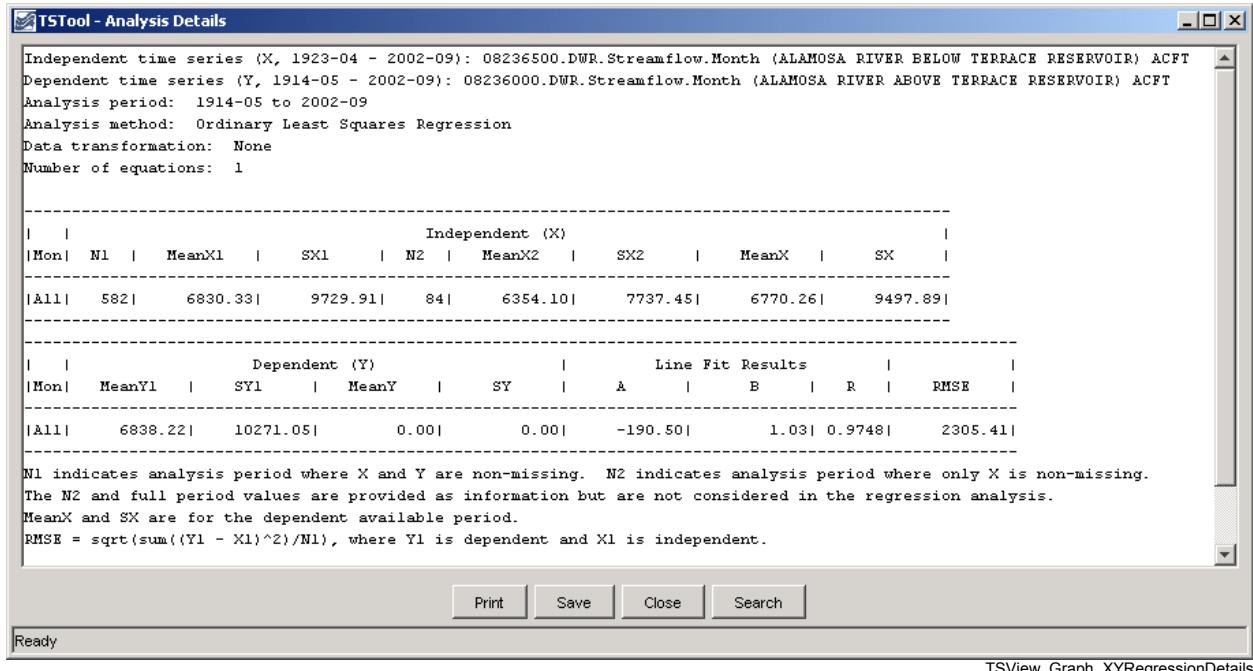
$$\hat{y}_{Cl_i} = [\bar{y} + B(x_i - \bar{x})] \pm \sqrt{2F} \left[\frac{1}{n-2} \sum_{j=1}^n (\hat{y}_j - y_j)^2 \right]^{1/2} \left[\frac{1}{n} + \frac{(x_i - \bar{x})^2}{\sum_{j=1}^n (x_j - \bar{x})^2} \right]^{1/2}$$

where:

- \hat{y}_{Cl_i} = confidence interval y value at x_i
- \bar{y} = mean of y
- B = slope of regression line equation $y = A + Bx_i$
- x_i = x value where Y_{Cl_i} is being computed
- \bar{x} = mean of x

- F = F distribution at $(2, n-2)$ degrees of freedom and gamma significance
 n = number of points with x and y values
 \hat{y}_i = y predicted by the equation $y = A + Bx_i$
 y_i = y value of data point corresponding to x_i

- The best fit line can be turned off.
- Right-clicking on the graph displays the **Analysis Details** menu, that, if selected, displays curve fit information about the time series, as illustrated in the following figure:



Example Analysis Details

The RMS error (or *RMSE*) is calculated in the following way:

$$\begin{aligned} SSE &= \sum(X_i - Y_i)^2 = \text{Sum of Square Errors} \\ MSE &= SSE/N = \text{Mean of Sum of Square Errors} \\ RMSE &= \sqrt{MSE} = \text{Square Root of the MSE} \end{aligned}$$

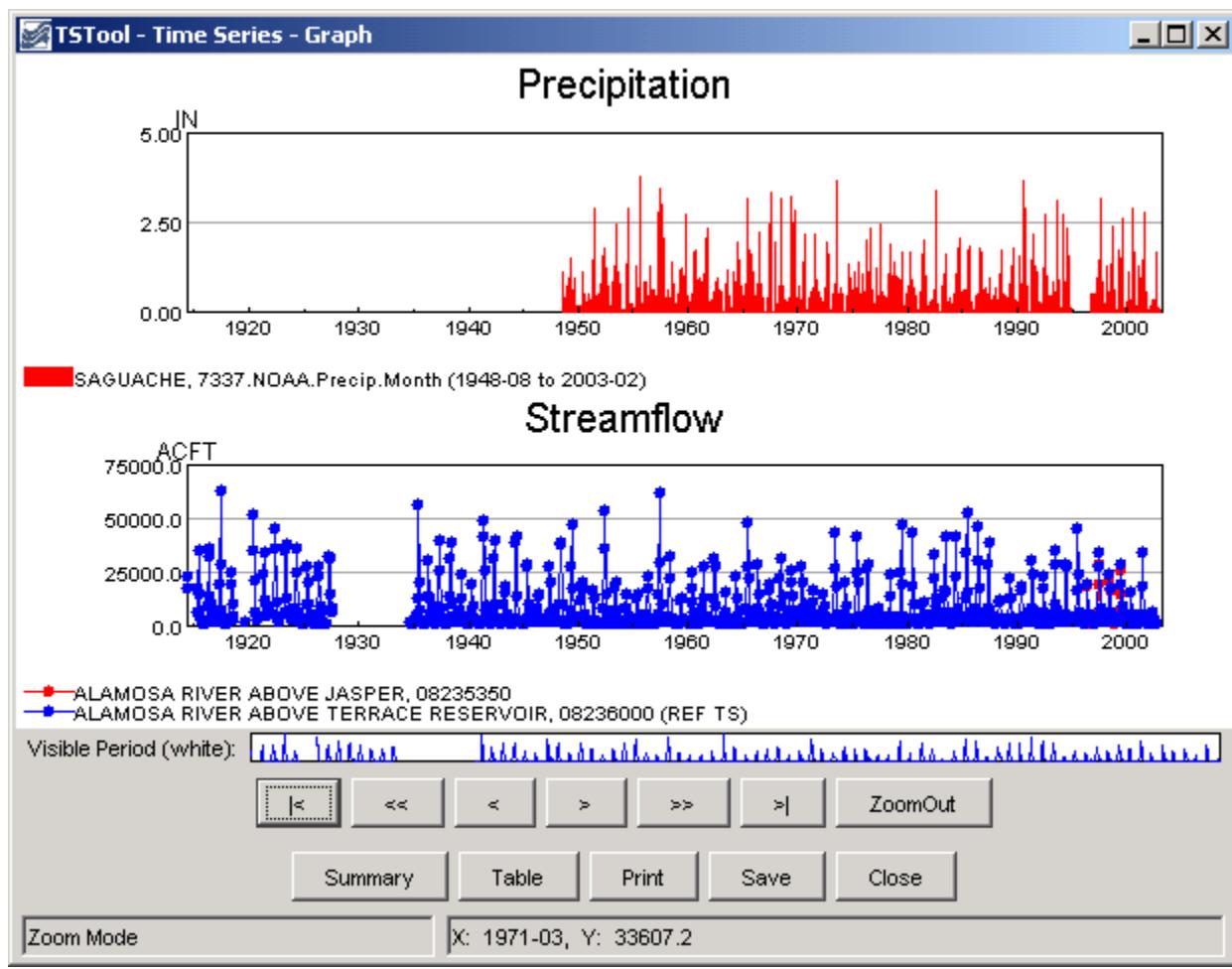
The *RMSE* can have different meanings, depending on how the data are being analyzed:

1. If a measured (X) and a simulated (Y) time series are being compared to determine, for example, to determine how well a model is simulating actual observations, then the *RMSE* indicates the error of a simulation when compared to the actual (comparing the values).
2. If two time series are evaluated to determine if the relationship between the time series can be used to estimate missing values in one of the time series, then the difference between estimated values (Y_{est}) and the line of best fit (e.g., $A + BX$) is used to compute the *RMSE*. For a perfect fit, the *RMSE* would be zero. Values of *RMSE* can be used to evaluate the estimator for data filling.

To provide as much information as possible for multiple uses, the **XY-Scatter Graph Analysis Details** provides both *RMSE* values. The default is to display a line of best fit, which is usually desirable information. The graph properties allow the analysis to be done for data filling, if desired.

Time Series Product Properties

A time series product is one or more time series graphs, tables, or reports on a “page”, although currently TSView focuses on graph products. Time series product properties can be displayed by right-clicking on a graph of interest and selecting the **Properties** menu item from the popup menu. Interactively changing properties allows graphs to be configured as desired. The following figure illustrates a time series product that has two graphs (see the **Time Series Product Reference** section for information about how to define time series product files, which can be used to save a product).



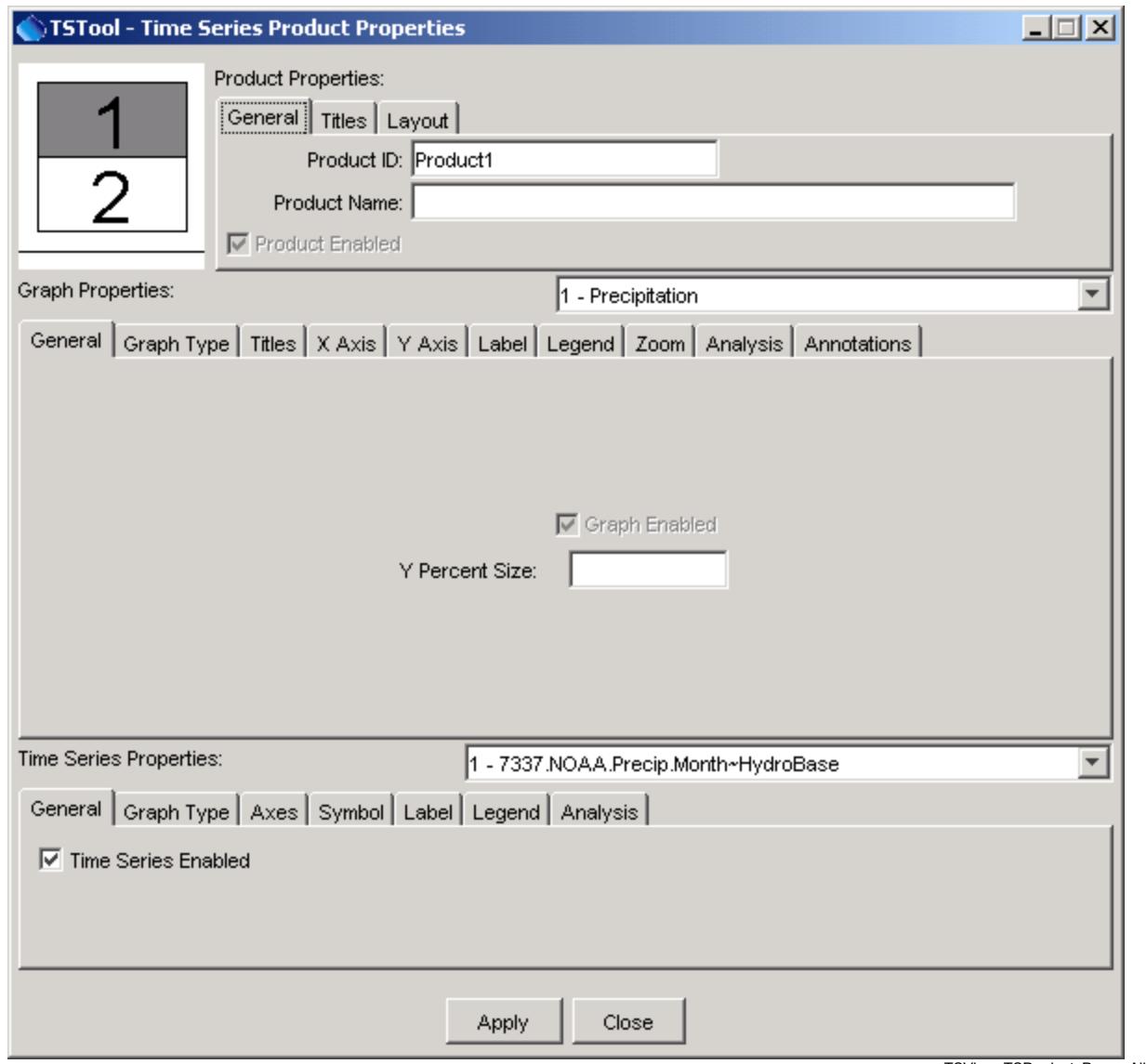
Example Graph Product showing Precipitation and Streamflow

In many cases, a graph product will consist of only a single graph (which may show one or more time series). However, it is also useful to display multi-graph products, especially when related data types are used. The TSView interface includes features to construct multi-graph products interactively, and the product files described in the **Time Series Product Reference** section can be created and processed. The TSTool application, for example, can interactively create or read a product file and display a graph similar to the one shown above. Important considerations for multi-graph products are:

- The product page has its own set of properties (e.g., titles and size).
- Each graph area has its own properties (e.g., titles, labels, graph type, legend). These properties comprise most of the properties for a product.

- Each time series has its own properties (e.g., symbol, color).
- If zooming is enabled, then zooming in one graph causes the same zoom to occur in related graphs. Each graph (and the reference graph) is assigned a *zoom group* number. This is used to indicate which graphs should zoom together. Currently, all graphs are in the same zoom group.

Right-clicking on a graph and pressing the **Properties** item in the popup menu will display the properties for the graph. The following figures illustrate the properties tabbed panel:



Tabbed Panel to Edit Time Series Product Properties

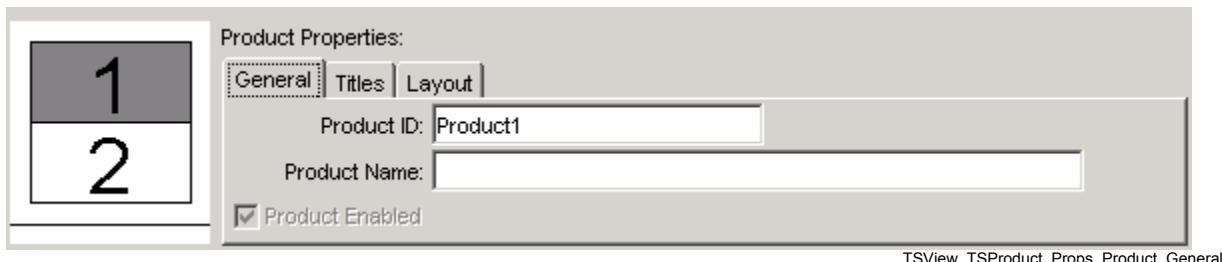
The time series product properties display as three layers of tabbed panels. Characteristics of the properties window are:

- The window is divided into a layout area (top-left) and tabs for different groups of properties. The layout window shows the overall layout of graphs on a page and allows manipulation of the time series product by dropping time series onto the layout.

- The top layer of tabs (**Product Properties**) are associated with product properties (the page).
- The middle layer of tabs (**Graph Properties**) are associated with subproduct properties (graphs on the page). The graph of interest is selected using the drop-down choice that shows the graph number and graph main title. When initially displayed, the selected graph is the one that was clicked on to display the **Properties** menu.
- The bottom layer of tabs (**Time Series Properties**) are associated with data (time series) properties. A time series within a graph is selected using the drop-down choice that shows the time series number within the graph, and the time series identifier. When initially displayed, the first time series for the selected graph is selected.
- The **Apply** button will apply the current properties and update the graph(s). **Warning - when changing between graphs and time series (where multiple graphs and/or time series exist for a product), properties that are changed are applied automatically. This behavior is being evaluated.**
- The **Close** button will apply the current properties, update the graph(s), and close the properties window.
- Only properties read from an original time series product file or that are set by the user will be saved if a time series product is saved. Internal defaults are not saved. This minimizes the size and complexity of product definition files.

The remaining discussion in this section illustrates each of the tabbed panels. The text-based properties that are displayed in the panels are described in the **Time Series Product Reference** section.

Product Properties - General



Example Product General Properties

The above figure illustrates the product **General** properties. The **Product Enabled** checkbox indicates whether the product is enabled (currently view-only). The **Product ID** is used when saving the product definition to a database. The **Product Name** is also used to when displaying lists of products.

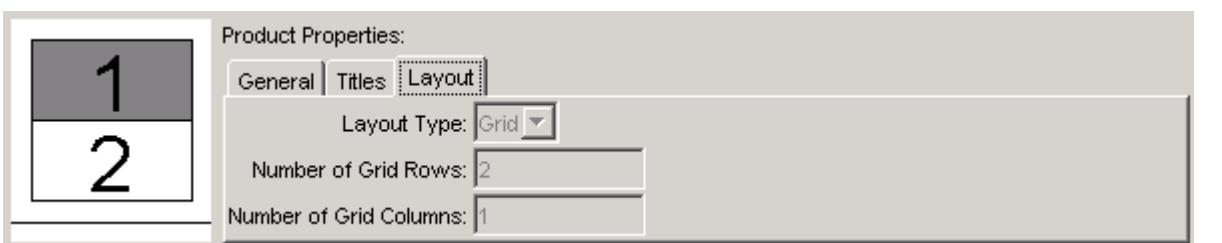
Product Properties - Titles



Example Product Title Properties

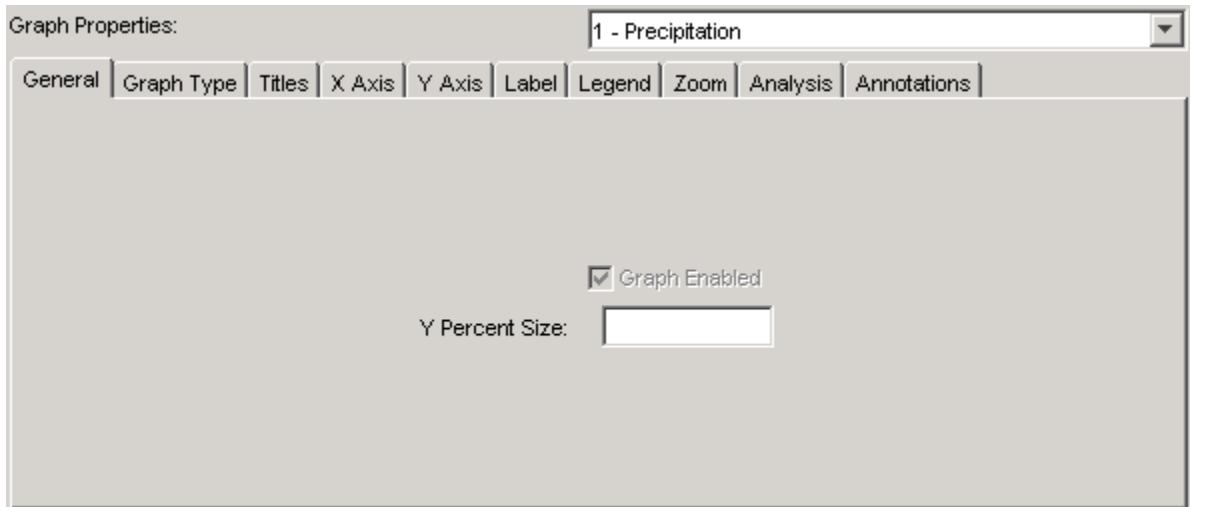
Product **Titles** properties include title and subtitle. If blank, no title will be shown. Because graphs (subproducts) also have a title and subtitle, the product titles are often only used when multiple graphs are included on a page.

Product Properties - Layout



Example Product Layout Properties

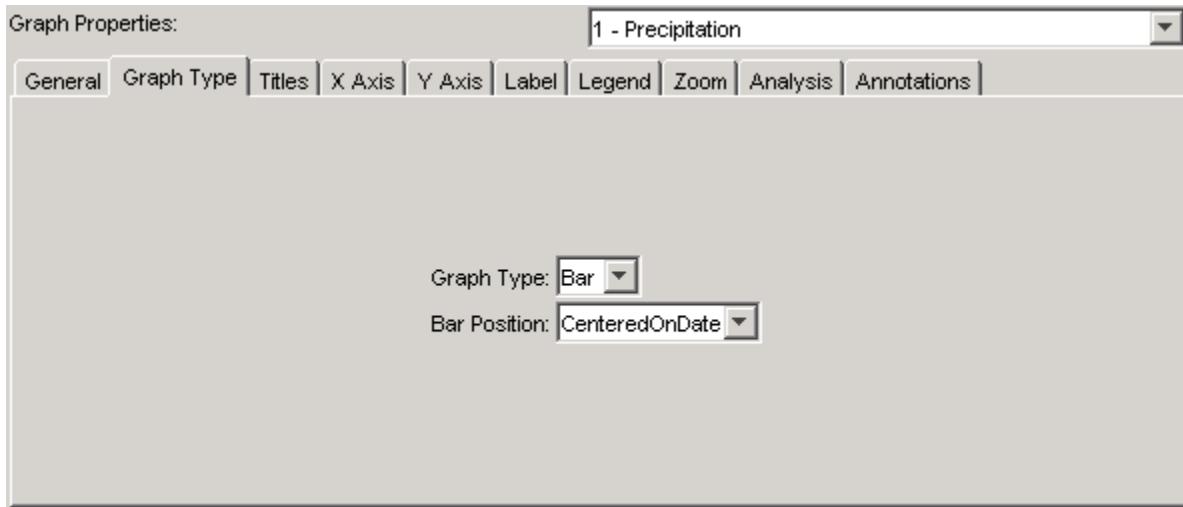
Product **Layout** properties describe how graphs are laid out on the page. Currently, graphs can only be organized in a vertical stack, although the design will support multiple columns. The layout properties are updated automatically as graphs are added to or deleted from the layout window at the left. The relative size of each graph on the page is controlled by using the **LayoutYPercent** general property for each graph on the page (see below).

Graph Properties - General

TSView_TSProduct_Props_Graph_General

Example Graph General Properties

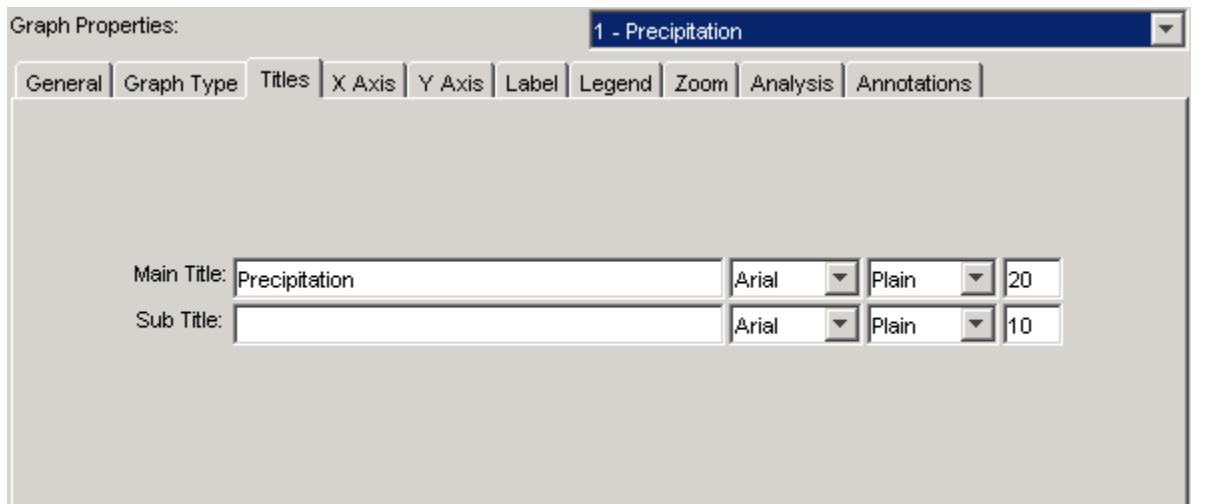
The above figure illustrates graph **General** properties. The **Graph Enabled** checkbox indicates whether the graph is enabled (currently view-only). The vertical size of the graph on the page (percent) can also be specified (the default is to size all the graphs on the page equally).

Graph Properties - Graph Type

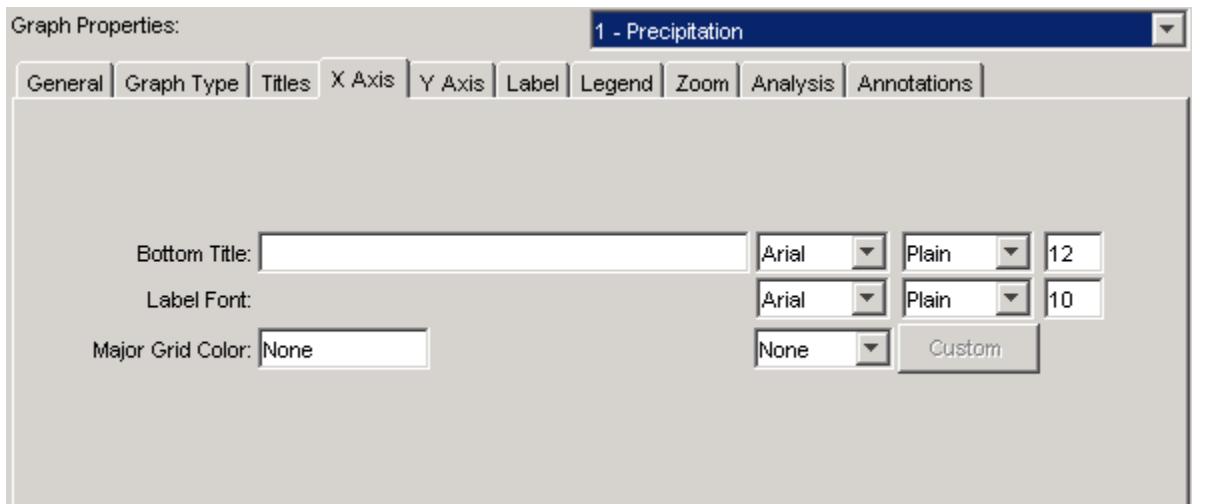
TSView_TSProduct_Props_Graph_GraphType

Example Graph Graph Type Properties

Graph Type properties control the overall display of the data. The graph type can be changed after the initial display only when switching between simple graph types (e.g., line and bar graphs). Some graph types may have specific properties (e.g., bar width for bar graphs). If necessary, to change the graph type, you can usually select the type from a main application, and generate a new graph.

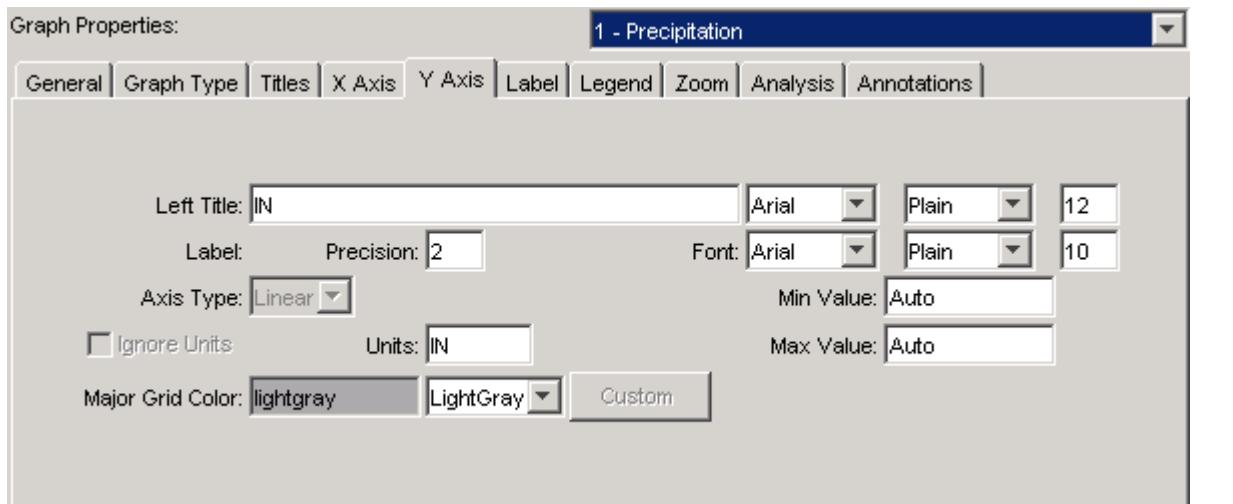
Graph Properties - Titles**Example Graph Title Properties**

Graph **Titles** properties include title and subtitle. If blank, no title will be shown. Font properties can also be specified. After applying the a change to the main title, the title will be added in the list of graphs.

Graph Properties - X Axis**Example Graph X Axis Properties**

Graph **X Axis** properties include title, label, and grid properties. The **Major Grid Color** can be specified by selecting from the available choices, which then fill in the text field with the given color selection.

Graph Properties - Y Axis



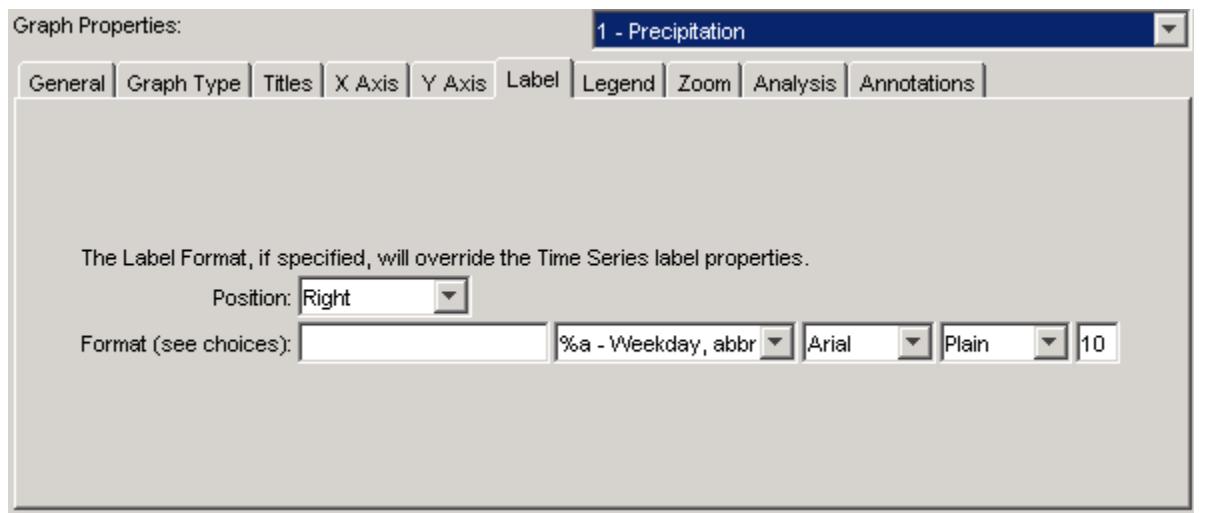
TSView_TSProduct_Props_Graph_YAxis

Example Graph Y Axis Properties

Graph **Y Axis** properties include the following:

- **Left Title** - this may be set to the data units but can be specified (the Y axis title is currently always placed at the top of the Y axis).
- **Label** - the font for labels and precision of numerical labels can be specified.
- **Axis Type** - currently this is view-only.
- **Min Value, Max Value** - currently this is view-only but can be set in time series product definition files (see the **Time Series Product Reference** section).
- **Units, Ignore Units** - currently these are view-only. If time series with incompatible units are graphed, **Ignore Units** will be checked and the units may be shown in the legend.

Graph Properties - Label

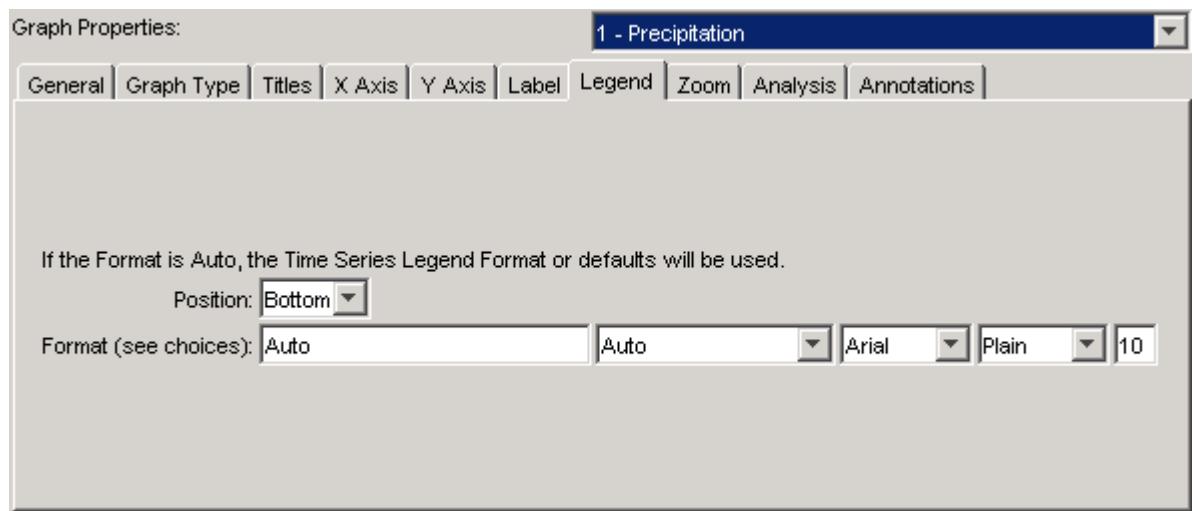


TSView_TSProduct_Props_Graph_Label

Example Label Properties

Data points are not labeled by default because there are usually too many data labels to be legible. However, for plots with limited data, or after zooming in, labels can be useful to identify points without referring to tabular data. The label format can be defined using the choices next to the text field or by entering literal text. For an XY Scatter plot, repeat the %v format (e.g., %v, %v) to show the independent (X) and dependent (Y) data values. See the **DataLabel** properties in the **Time Series Product Reference** section for label options.

Graph Properties - Legend

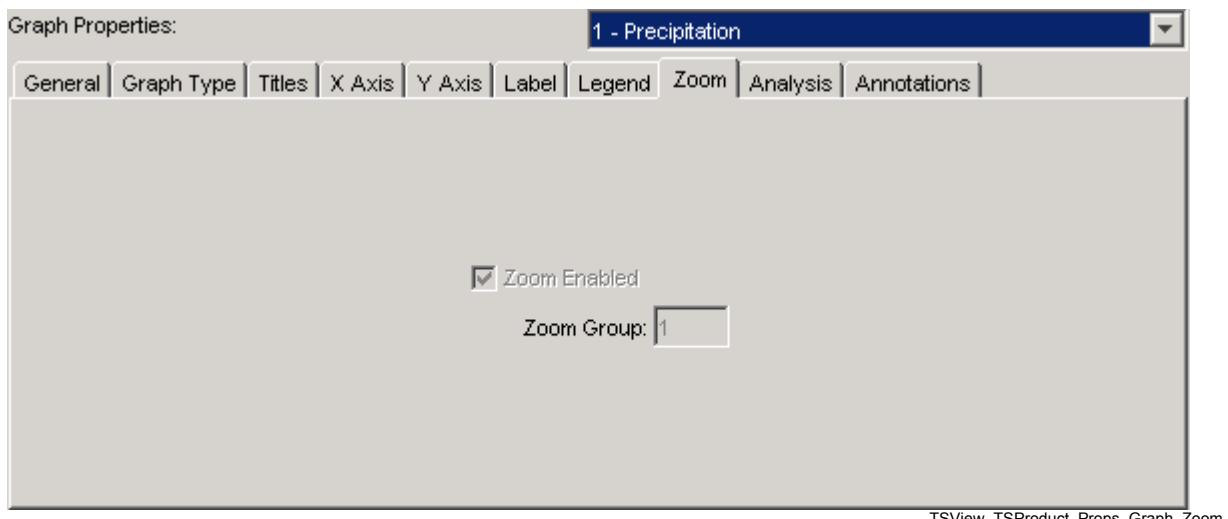


TSView_TSProduct_Props_Graph_Legend

Example Graph Legend Properties

Graph **Legend** properties include format and font properties. If the **Legend Format** is **Auto**, a default legend format will be constructed from the time series description, identifier, and period of record. See the **LegendFormat** property in the **Time Series Product Reference** section for legend formatting options.

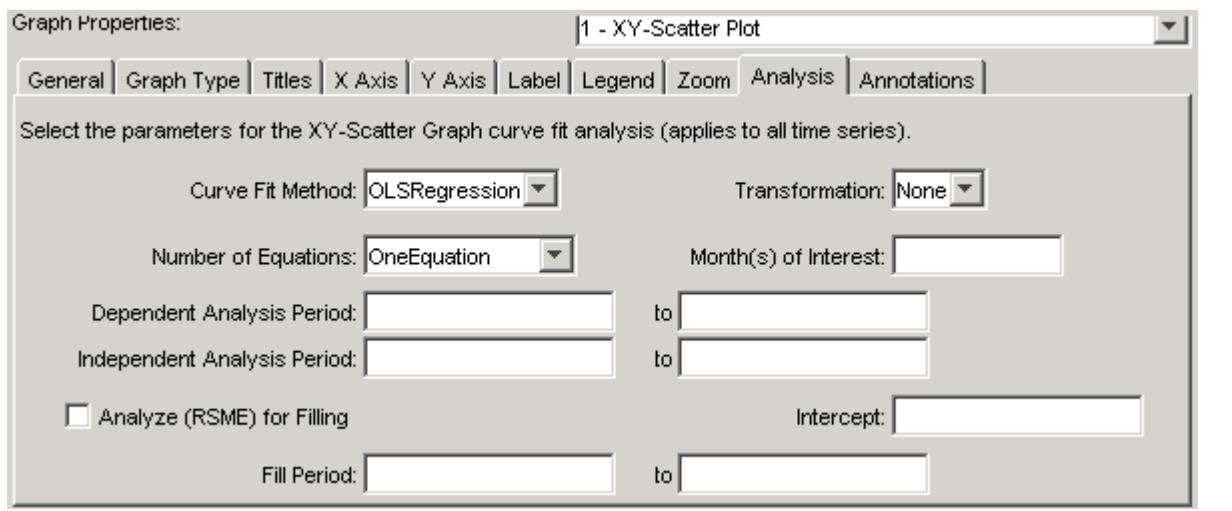
Graph Properties - Zoom



Example Graph Zoom Properties

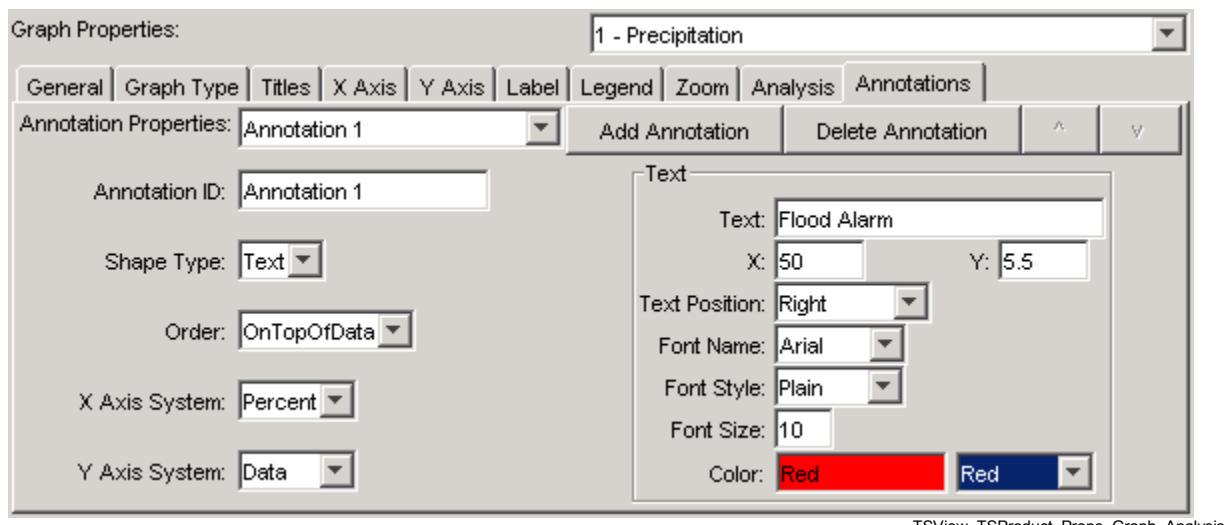
Graph **Zoom** properties are currently view-only. Zoom will be enabled for graph types that support it (e.g., duration graphs do not). The zoom group indicates how graphs should respond when other related graphs on a page are zoomed and currently defaults to 1 for all graphs.

Graph Properties - Analysis



Example Graph Analysis Properties

Graph **Analysis** properties are available if the graph requires some type of analysis to produce the result (e.g., curve fitting). See also the analysis tab for individual time series. For help with input, place the mouse cursor over a field and a tool tip will be shown.

Graph Properties - Annotations

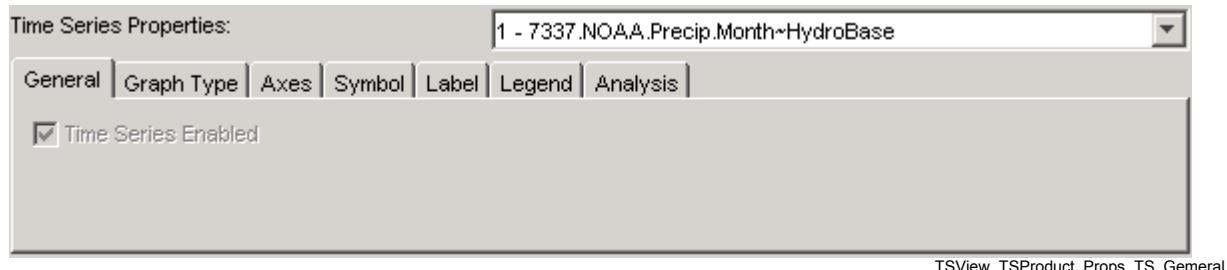
TSView_TSProduct_Props_Graph_Analysis

Example Graph Analysis Properties

Graph **Annotations** properties are used to add annotation objects to a graph. Annotations are text, line, or other simple shapes and are stored as simple text properties in time series products (see the **Time Series Product Reference** section below for more information). Annotations are placed on a graph using data units or a percent of the graph dimension. This allows annotations to move if a graph uses real-time data.

To add an annotation, press the **Add Annotation** button. Then select the **Shape Type** and specify annotation properties, as appropriate. The example shown in the above figure places the string “Flood Alarm” at the horizontal (X) center of the graph at a Y-coordinate of 5.5. A horizontal annotation line could also be drawn using 0 to 100 percent on the X axis at the same Y-coordinate.

Time Series Properties - General

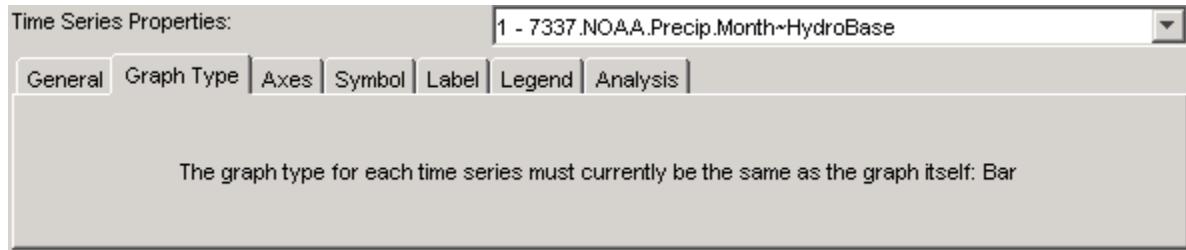


TSView_TSProduct_Props_TS_General

Example Time Series General Properties

Time series **General** properties are currently view-only and indicate whether the time series is enabled for the graph.

Time Series Properties - Graph Type

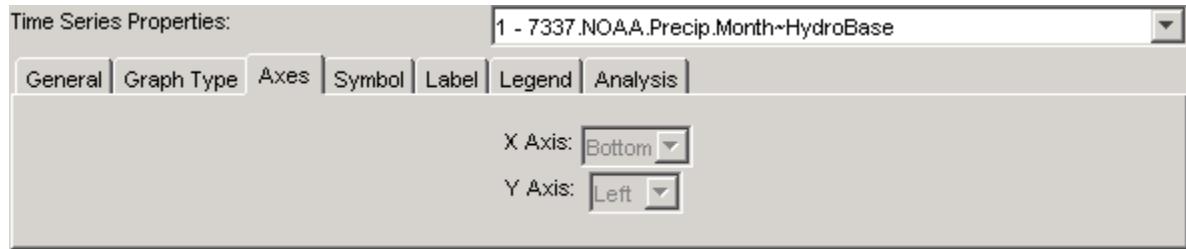


TSView_TSProduct_Props_TS_GraphType

Example Time Series Graph Type Properties

Time series **Graph Type** properties are currently disabled. Currently all time series in a graph must have the same graph type.

Time Series Properties - Axes

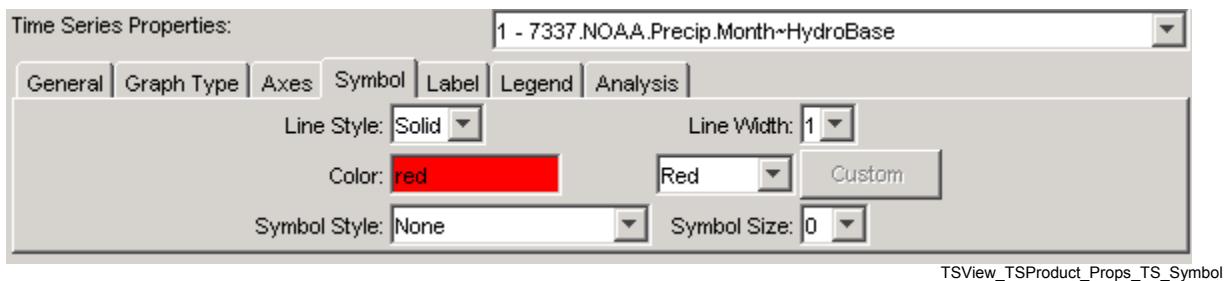


TSView_TSProduct_Props_TS_Axes

Example Time Series Axes Properties

Time series **Axes** properties are currently view-only and show the graph axes to which a time series is associated.

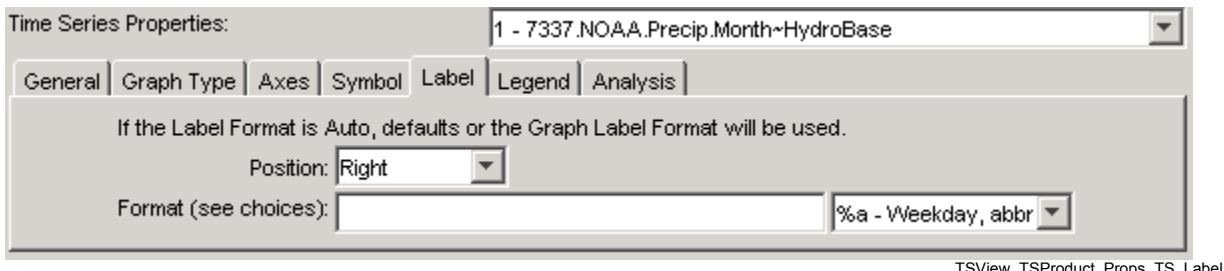
Time Series Properties - Symbol



Example Time Series Symbol Properties

Time series **Symbol** properties define the graphical appearance of time series data. Properties are enabled/disabled based on the graph type (e.g., the **Symbol Style** will be disabled if the graph type is Bar). The symbol properties are consistent with the GeoView tools used for maps.

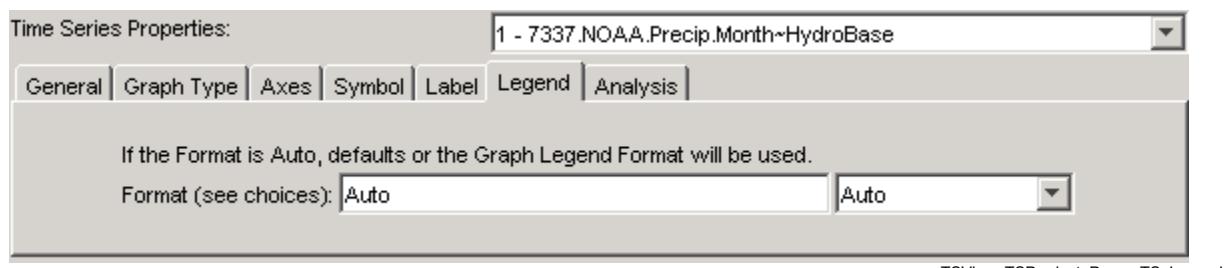
Time Series Properties - Label



Example Time Series Label Properties

Time series **Label** properties allow the data label to be changed. Data points are not labeled by default because there are usually too many data labels to be legible. However, for plots with limited data, or after zooming in, labels can be useful to identify points without referring to tabular data. The label format can be defined using the choices next to the text field or by entering literal text. For an XY Scatter plot, repeat the %v format to show the independent (X) and dependent (Y) data values. See the **DataLabel** properties in the **Time Series Product Reference** section for label options.

Time Series Properties - Legend

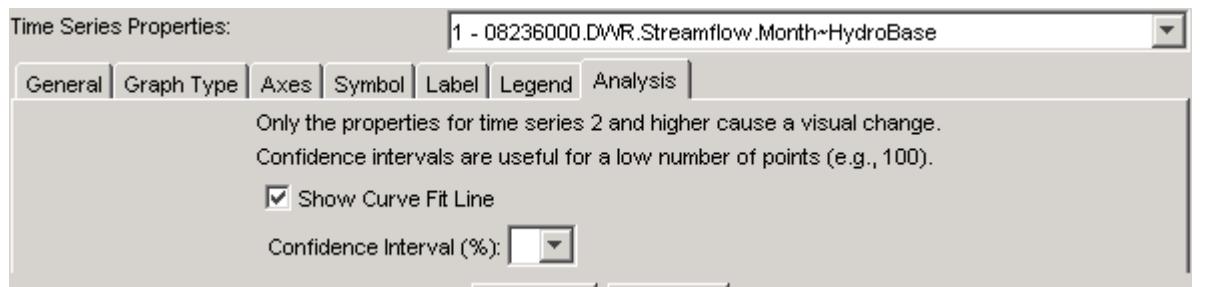


Example Time Series Legend Properties

Time series **Legend** properties allow the legend format to be changed. This is useful if the time series is to have different legend labeling than the other time series in the graph. If the **Legend Format** is Auto, a default legend format will be constructed from the time series description, identifier, and period of record.

See the **LegendFormat** property in the **Time Series Product Reference** section for legend formatting options.

Time Series Properties - Analysis



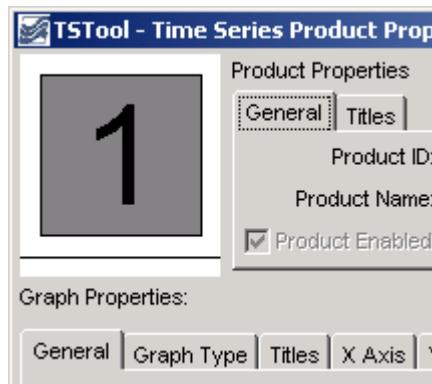
TSView_TSProduct_Props_TS_Analysis

Example Graph Analysis Properties

Time Series **Analysis** properties are available if the graph requires some type of analysis to produce the result (e.g., curve fitting).

Changing a Graph Page Layout

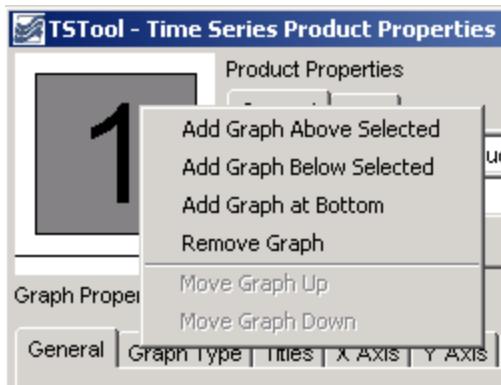
The default page layout for graphs is to display all time series in one graph. In this configuration, the layout area at the top-left corner of the time series product window will display as shown below:



TSView_Layout_1Graph

Layout Window Showing One Graph

The layout area can be used to split the single graph into multiple graphs on the page. For example, two graphs may be needed because of different units, time step, or graph type. Left-clicking on a graph in the layout area will select the graph – the selected graph is shown in gray. Right-clicking on the layout area displays a menu with available options:



TSView_Layout_Menu

Layout Window Menu

The actions taken by the menus are described below:

- | | |
|---------------------------------|---|
| Add Graph Above Selected | Add a new graph above the selected graph, renumbering the graphs as needed. |
| Add Graph | Add a new graph below the selected graph, renumbering the graphs as needed. |
| Add Graph at Bottom | Add a new graph below all existing graphs, giving the new graph the next number in the sequence. |
| Remove Graph | Remove the selected graph, renumbering the graphs as needed. |
| Move Graph Up | Move the graph up one in the sequence, renumbering the graphs as needed. The menu is enabled only when multiple graphs are available. |
| Move Graph Down | Move the graph down one in the sequence, renumbering the graphs as needed. The menu is enabled only when multiple graphs are available. |

When a new graph is added, it will not have any specific properties, time series data, or annotations, other than the default properties that are assigned (e.g., the default graph type is Line), and when drawn it will appear as a blank area. To see the graph, it will be necessary to set the graph's properties and provide it with data (and optionally, annotations). Properties and annotations are defined using the properties tabs as documented in previous sections – use the **Apply** button to apply and view the changes. To set graph properties, the graph to be modified should be selected from the choices at the top of the **Graph Properties** tab panel (or selecting the graph in the layout window).

To add time series data to the new graph (or an existing graph), two approaches can be taken:

1. Find the time series to be moved using the list in the time series properties panel. It may be necessary to select a graph to find the time series – selecting a graph will not impact the ability to move the time series to a different graph. In the list of time series, hold the left mouse button down over a time series choice and drag the time series to a graph on the layout area. During this process, the cursor will change to a new shape, as shown below:



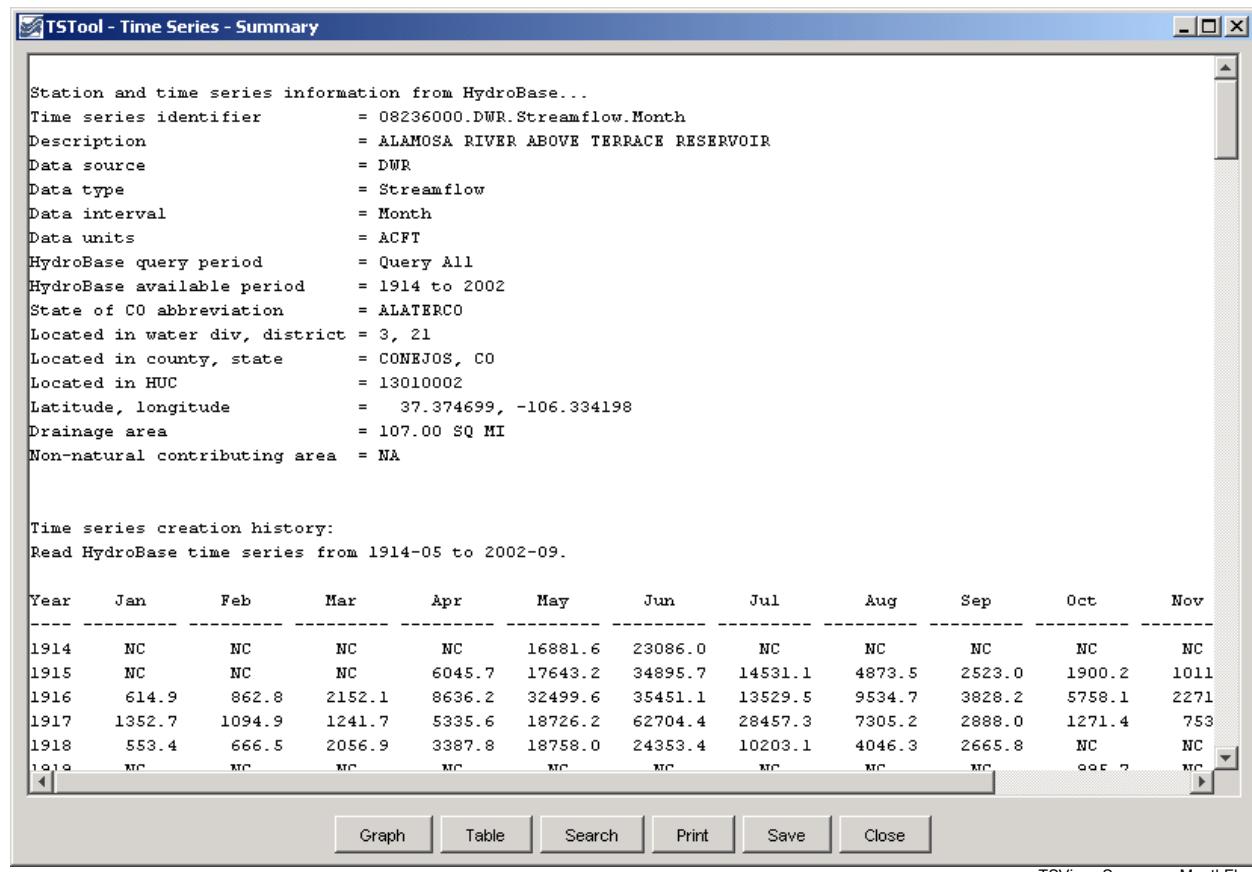
Release the mouse over the graph in the layout area that is to receive the time series. The time series will then be removed from the original graph and will be inserted into the new graph as the last time series in the list.

2. Some software programs will allow dragging a time series from a display to the time series product properties window. Similar to above, drag the time series onto the receiving graph in the layout area. Refer to documentation for the specific software program for additional information about whether this feature is available.

After adding a new graph and moving time series, it may be necessary to change the graph type for a graph. For example, the top graph may show precipitation and the bottom graph may show streamflow resulting from the precipitation. Precipitation is normally shown as bars and streamflow as a line. The graph will initially be shown using the graph type that was originally selected. Change the graph type in the new configuration, as appropriate, by selecting the graph to be changed and then use the **Graph Type** tab.

Time Series Summary View

The time series summary view can be selected from the graph or table view using the **Summary** button. Additionally, applications that use the TSView package may allow displaying a summary from a menu or button option. A time series summary view can usually be produced quickly, whereas the table view uses more resources. The following figure illustrates a typical summary view.



Example Summary View showing Monthly Streamflow

The summary view has the following characteristics:

- The graph view can be displayed using the **Graph** button and the table view can be displayed using the **Table** button.
- Each time series interval (e.g., Month, Day, Hour) has a default summary report format suitable for the interval. This format may be made more specific if time series are read from specific data types (e.g., if daily diversion time series are read from the HydroBase input type, the summary report will use the State of Colorado diversion coding report format).
- The contents of the view can be printed.
- The summary can be saved as a text file or DateValue time series file.
- Limited search capabilities are available to search for a string in the text area.

Time Series Table View

The time series table view can be selected from the graph or summary view using the **Table** button. Additionally, applications that use the TSView package may allow displaying a table from a menu or button option. The table view is useful for viewing date and data values in a spreadsheet-like display. A time series table view for a long period or many time series may require extra time to display, but usually only a few seconds are required. The following figure illustrates a typical table view.

The screenshot shows a Windows application window titled "TSTool - Time Series - Table". The main area is a grid table with two columns: "DATE" and "Streamflow, ACFT". The "DATE" column lists months from 1914-05 to 1916-04. The "Streamflow, ACFT" column lists corresponding values. The window has standard Windows controls (minimize, maximize, close) and buttons at the bottom labeled "Graph", "Summary", "Save", and "Close". A status bar at the bottom indicates "Currently-selected worksheet: Interval base: Month x 1".

DATE	08236000, Streamflow, ACFT	08236500, Streamflow, ACFT
1914-05	16881.6	
1914-06	23086.0	
1914-07		
1914-08		
1914-09		
1914-10		
1914-11		
1914-12		
1915-01		
1915-02		
1915-03		
1915-04	6045.7	
1915-05	17643.2	
1915-06	34895.7	
1915-07	14531.1	
1915-08	4873.5	
1915-09	2523.0	
1915-10	1900.2	
1915-11	1011.6	
1915-12	614.9	
1916-01	614.9	
1916-02	862.8	
1916-03	2152.1	
1916-04	8636.7	

Example Table View showing Monthly Streamflow

TSView_Table_MonthFlow

Characteristics of the table view are:

- The summary view can be displayed using the **Summary** button and the graph view can be displayed using the **Graph** button.
- The precision of dates matches the data interval for the time series.
- If time series with different intervals are selected, multiple tables will be displayed in the window.
- The table contents can be saved as a DateValue file, which is a useful delimited format file.

Time Series Product Reference

A *time series product* is a report, table, or graph, although currently TSView focuses on graph products. Examples of time series products and their use are:

- Reports and graphs generated from a database to perform quality checks.
- Reports and graphs generated from model input and output to check a calibration or model results.
- Reports and graphs generated from a database for real-time data products, to monitor current conditions or to create products for a web site.

The TSView package contains features to process time series product files in interactive and batch mode to produce time series products. Currently, only graph products are supported. The time series graph view allows a graph to be saved as a time series product file. This file describes the layout and contents of the product but does not include the time series data itself; therefore, the time series product is relatively small.

Time Series Product File Format

The time series product definition file format consists of comments (lines that start with #), sections (indicated by []), and simple `property=value` pairs. The following example illustrates the parts of a product file:

```
# Example Time Series Product file
# Comments start with #
# Sections are enclosed in [] and must be included

[Product]

# product properties - surround with double quotes if values contain spaces
xxxxx="xxxxxxxxxx"

[SubProduct 1]

# "sub-product", e.g., a graph on a page (page is product and may have
# multiple graphs)

[Data 1.1]

# First data item in the SubProduct (e.g., first time series).
TSID = ...

[Data 1.2]

# Second data item in the SubProduct (e.g., first time series).
TSID = ...

[SubProduct 2]

[Data 2.1]

# Annotations are associated with a SubProduct
[Annotation 2.1]

Annotation properties...
... etc. ...
```

Example Time Series Product File

Most properties, if not specified in the file, will default to reasonable values. The most important property is TSID, which indicates time series identifier to be read for data. The time series identifier follows the conventions described in the **Time Series Terminology** section. Some tools, like TSTool, will match the TSID against time series that have already been read into memory, or, if necessary, read the time series from a file or database if not in memory. The normal convention is to use a *.tsp* extension for time series product file names.

The list of properties that can be used in a time series product definition file is quite extensive and new properties are added as new features are enabled. As shown in the previous section, properties are defined as simple variable=value pairs. These properties are used internally by the graph view (and its properties window) regardless of whether the graph originated from a product file or interactively. The following tables list the properties that are currently supported or envisioned to be enabled in the future. The first set of properties are used to define the overall product (the full page).

Top-level Time Series Product Properties

Product Property	Description	Default
Current DateTime	The current date and time to be drawn as a vertical line on all graphs. If the property is not specified, no current date/time line will be drawn. If specified as Auto, the current system time will be used for the date/time. If specified as a valid date/time string (e.g., 2002-02-05 15), the string will be parsed to obtain the date/time. This property is often specified internally by the application at run time.	Not drawn.
Current DateTime Color	Color to use to draw the current date and time. Colors can be specified as named colors (e.g., red), hexadecimal RGB values (e.g., 0xFF0000), integer triplets (e.g., 255, 0, 0) or floating point triplets (e.g., 1.0, 0.0, 0.0).	Green
Enabled	Indicates whether the product should be processed. Specify as True or False.	True
LayoutNumber OfColumns	The number of columns in the product.	Currently always 1.
LayoutNumber OfRows	The number of rows in the product.	Currently equal to the number of graphs.
LayoutType	Indicates how the graphs in a product are laid out. Only Grid is supported.	Grid
MainTitle FontName	Name of font to use for main title (Arial, Courier, Helvetica, TimesRoman).	Arial
MainTitle FontSize	Size, in points, for main title.	20
MainTitle FontStyle	Font style (Bold, BoldItalic, Plain, PlainItalic).	Plain
MainTitle String	Main title for the product, centered at the top of the page.	No main title.
OutputFile	Output file when graph product is generated in batch mode. This property is often set at run time by the application.	C:\TEMP\tmp.jpg on windows, /tmp/tmp.jpg on UNIX
Owner	An identifier that indicates the owner of the TSProduct, used internally when saving TSProduct definitions to a database that implements permissions.	None – can be blank if permissions are not important.

Top-level Time Series Product Properties (continued)

Product Property	Description	Default
PeriodEnd	Ending date for time series data in the product. The date should be formatted according to common conventions (e.g., YYYY-MM-DD HH:mm), and should ideally be of appropriate precision for the data being queried. This property is often set at run time by the application.	Full period is read.
PeriodStart	Starting date for time series data in the product. The date should be formatted according to common conventions (e.g., YYYY-MM-DD HH:mm), and should ideally be of appropriate precision for the data being queried. This property is often set at run time by the application.	Full period is read.
PreviewOutput	Indicates whether the product should be visually previewed before output. This property is often set at run time by the application and is used to override generation of the outputFile.	false
ProductType	Currently only Graph is supported.	Graph
SubTitleFontName	Name of font to use for subtitle (see MainTitleFontName for font list).	Arial
SubTitleFontSize	Size, in points, for subtitle.	10
SubTitleFontStyle	Font style (see MainTitleFontStyle for style list).	Plain
SubTitleString	Subtitle for the product.	No subtitle.
TotalHeight	Height of the total drawing space, which may include multiple graphs, pixels.	400
TotalWidth	Width of the total drawing space, which may include multiple graphs, pixels.	400

The subproduct properties are associated with the graphs on a page. There can be one or more graphs on a page, each with different properties. It is envisioned that graphs can be grouped into several zoom groups, where zooming in on one graph will cause all graphs to scale similarly. However, at this time, all graphs in a product are placed in a single zoom group. It is also envisioned that graphs will could be placed anywhere on the page; however, at this time, multiple graphs on a page can only be stacked vertically, each using the full width of the page.

The following tables describe the subproduct (graph) properties.

Subproduct (Graph) Properties

Subproduct (Graph) Property	Description	Default
BarPosition	For use with bar graphs. This property controls how bars are positioned relative to the date and can have the values CenteredOnDate, LeftOfDate, or RightOfDate.	CenteredOnDate
BottomXAxisLabelFontName	Name of font for bottom x-axis labels (see Product MainLabelFontName).	Arial
BottomXAxisLabelFontSize	Bottom x-axis labels font size, points.	10
BottomXAxisLabelFontStyle	Bottom x-axis labels font style (see Product MainLabelFontStyle).	Plain
BottomXAxisTitleFontName	Name of font for bottom x-axis title (see Product MainTitleFontName).	Helvetica
BottomXAxisTitleFontSize	Bottom x-axis title font size, points.	12
BottomXAxisTitleFontStyle	Bottom x-axis title font style (see Product MainTitleFontStyle).	Plain
BottomXAxisLabelFormat	Format for X axis labels. Currently this is confined to date/time axes and only MM-DD is recognized.	Determined automatically.
BottomXAxisMajorGridColor	Color to use for the major grid.	Most graph types automatically set to None.
BottomXAxisMinorGridColor	Color to use for the minor grid. This property is not implemented.	None
BottomXAxisTitleString	Bottom X axis title string.	As appropriate for the graph type (often none if dates).
DataLabelFontName	Name of font for data labels (see Product MainLabelFontName).	Arial
DataLabelFontSize	Data label font size, points.	10
DataLabelFontStyle	Data label font style (see Product MainLabelFontStyle).	Plain

Subproduct (Graph) Properties (continued)

Subproduct (Graph) Property	Description	Default
DataLabelFormat	<p>Format specifiers to use for labeling data points. If blank, no labels will be drawn. If specified, labels are drawn for line graphs and XY scatter plots.</p> <p>The following format specifiers are available (all other text in the format is treated literally). The last three specifiers are related to time series data and all others are related to the date for a point. The %v specifier can be specified twice for XY Scatter plots to display the X and Y values. If specified and the time series data property is not specified, the graph property will be used.</p>	Blank (no data point labels).
%%	Literal percent.	
%a	Weekday name abbreviation.	
%A	Weekday name.	
%B	Month name.	
%b	Month name abbreviation.	
%d	Day number.	
%H	Hour (0-23), 2-digit.	
%I	Hour (1-12), 2-digit.	
%J	Day of year.	
%m	Month 2-digit.	
%M	Minute, 2-digit.	
%p	AM, PM.	
%S	Second, 2-digit.	
%Y	Year, 2-digit.	
%Y	Year, 4-digit.	
%Z	Time zone.	
%v	Data value, formatted according to units.	
%U	Data units.	
%q	Data flag (e.g., quality).	

Subproduct (Graph) Properties (continued)

Subproduct (Graph) Property	Description	Default
DataLabelPosition	Indicates the position of data labels, relative to the data point: UpperRight, Right, LowerRight, Below, LowerLeft, Left, UpperLeft, Above, Center. If specified and the time series data property is not specified, the graph property will be used.	Right
Enabled	Indicates whether the sub-product should be processed. Specify as true or false.	true
GraphHeight	Graph height in pixels. Currently this property is ignored (use Product TotalHeight instead).	Product TotalHeight (minus space for titles, etc.) if one graph, or an even fraction of Product TotalHeight (minus space for titles, etc.) if multiple graphs.
GraphType	Indicates the graph type for all data in a graph product. Available options are: Bar, Duration, Line, PeriodOfRecord, Point, XY-Scatter.	Line
GraphWidth	Graph width in pixels. Currently this property is ignored (use Product TotalWidth instead).	Product TotalWidth (minus space for titles, etc.).
LayoutXPercent	For the product grid layout, the width of the graph as a total width of the product, percent.	100 divided by the number of columns in the layout.
LayoutYPercent	For the product grid layout, the height of the graph as a total width of the product, percent.	100 divided by the number of rows in the layout.
LeftYAxisIgnoreUnits	Indicates whether to ignore units for the left Y axis. Normally, units are checked to make sure that data can be plotted consistently. If this property is set, then the user will not be prompted at run-time to make a decision. Specify as true or false.	If not specified, the units will be checked at run-time and, if not compatible, the user will be prompted to indicate whether to ignore units in the graphs. The property will not be reset automatically but will be handled internally using the interactively supplied value.

Subproduct (Graph) Properties (continued)

Subproduct (Graph) Property	Description	Default
LeftYAxisLabelFontName	Name of font for left y-axis labels (see Product MainLabelFontName).	Arial
LeftYAxisLabelFontSize	Left y-axis labels font size, points.	10
LeftYAxisLabelFontStyle	Left y-axis labels font style (see Product MainLabelFontStyle).	Plain
LeftYAxisLabelPrecision	If numeric data, the number of digits after the decimal point in labels.	Automatically determined from graph type and/or data units.
LeftYAxisMajorGridColor	Color to use for the major grid.	Most graph types automatically set to lightgray.
LeftYAxisMax	Maximum value for the left Y Axis.	Auto, automatically determined. If the actual data exceed the value, the property will be ignored.
LeftYAxisMin	Minimum value for the left Y Axis.	Auto, automatically determined. If the actual data exceed the value, the property will be ignored.
LeftYAxisMinorGridColor	Color to use for the minor grid. This property is not implemented.	None
LeftYAxisTitleFontName	Name of font for left y-axis title (see Product MainTitleFontName).	Arial
LeftYAxisTitleFontSize	Left y-axis title font size, points.	12
LeftYAxisTitleFontStyle	Left y-axis title font style (see Product MainTitleFontStyle).	Plain
LeftYAxisTitleString	Left y axis title string. Note that due to limitations in Java graphics, the left y-axis title is placed at the top of the left y-axis so that it takes up roughly the same space as the y-axis labels. The top-most label is shifted down to make room for the title.	As appropriate for the graph type (often the data units).
LeftYAxisType	Left y-axis type (Log, or Linear).	Linear
LeftYAxisUnits	Left y-axis units. This property is currently used internally and full support is being phased in. See also LeftYAxisIgnoreUnits.	Units from first valid time series, or as appropriate for the graph type.
LegendFontName	Name of font for legend (see Product MainTitleFontName).	Arial
LegendFontSize	Legend font size, points.	10
LegendFontStyle	Legend font style (see Product MainTitleFontStyle).	Plain

Subproduct (Graph) Properties (continued)

Subproduct (Graph) Property	Description		Default
LegendFormat	The legend format is composed of literal characters and/or time series data format specifiers, as follows.		Auto, which uses Description, Identifier, Units, Period
	Blank	No legend will be displayed.	
	%%	Literal percent	
	%A	Time series alias	
	%D	Description (e.g., RED RIVER BELOW MY TOWN)	
	%F	Full time series identifier (e.g., XX_FREE.USGS.QME.24HOUR.Trace 1)	
	%I	Full interval part of the identifier (e.g., 24Hour).	
	%b	Base part of the interval (e.g., Hour).	
	%m	Multiplier part of the interval (e.g., 24).	
	%L	Full location part of the identifier (e.g., XX_FREE).	
	%l	Main part of the location (e.g., XX).	
	%w	Sub-location (e.g., FREE).	
	%S	The full source part of the identifier (e.g., USGS).	
	%s	Main data source (e.g., USGS).	
	%x	Sub-source (reserved for future use).	
	%T	Full data type (e.g., QME).	
	%t	Main data type.	
	%k	Sub-data type.	
	%U	Data units (e.g., CFS).	
	%z	Sequence number (used with traces).	
	%Z	Scenario part of identifier (e.g., Trace1).	
LegendPosition	Position of the legend relative to the graph: Bottom, InsideLowerLeft, InsideLowerRight, InsideUpperLeft, InsideUpperRight, Left, None, Right.		Bottom

Subproduct (Graph) Properties (continued)

Subproduct (Graph) Property	Description	Default
MainTitleFontName	Name of font to use for graph main title (see Product MainTitleFontName).	Arial
MainTitleFontSize	Size, in points, for graph main title.	10
MainTitleFontStyle	Graph main title font style (see Product MainTitleFontStyle).	Plain
MainTitleString	Main title for the graph.	None, or appropriate for graph type.
PeriodEnd	Ending date for time series data in the sub-product. The date should be formatted according to common conventions (e.g., YYYY-MM-DD HH:mm), and should ideally be of appropriate precision for the data being queried. This property is often set at run time.	Full period is read.
PeriodStart	Starting date for time series data in the sub-product. The date should be formatted according to common conventions (e.g., YYYY-MM-DD HH:mm), and should ideally be of appropriate precision for the data being queried. This property is often set at run time.	Full period is read.
RightYAxisLabelFontName	Name of font for right y-axis labels (see Product.MainLabelFontName). This property is not enabled.	Arial
RightYAxisLabelFontSize	Right y-axis labels font size, points. This property is not enabled.	10
RightYAxisLabelFontStyle	Right y-axis labels font style (see Product MainLabelFontStyle). This property is not enabled.	Plain
RightYAxisTitleFontName	Name of font for right y-axis title (see Product MainTitleFontName). This property is not enabled.	Arial
RightYAxisTitleFontSize	Right y-axis title font size, points. This property is not enabled.	12
RightYAxisTitleFontStyle	Right y-axis title font style (see Product MainTitleFontStyle). This property is not enabled.	Plain
RightYAxisTitleString	Right y axis title string. This property is not enabled.	

Subproduct (Graph) Properties (continued)

Subproduct (Graph) Property	Description	Default
SubTitleFontName	Name of font to use for graph Sub title (see Product MainTitleFontName).	Arial
SubTitleFontSize	Size, in points, for graph sub title.	10
SubTitleFontStyle	Graph sub title font style (see Product MainTitleFontStyle).	Plain
SubTitleString	Sub title for the graph.	No subtitle.
TopXAxisLabelFontName	Name of font for Top x-axis labels (see Product.MainLabelFontName). This property is not enabled.	Arial
TopXAxisLabelFontSize	Top x-axis labels font size, points. This property is not enabled.	10
TopXAxisLabelFontStyle	Top x-axis labels font style (see Product MainLabelFontStyle). This property is not enabled.	Plain
TopXAxisTitleFontName	Name of font for Top x-axis title (see Product MainTitleFontName). This property is not enabled.	Arial
TopXAxisTitleFontSize	Top x-axis title font size, points. This property is not enabled.	12
TopXAxisTitleFontStyle	Top x-axis title font style (see Product MainTitleFontStyle). This property is not enabled.	Plain
TopXAxisTitleString	Top X axis title string. This property is not enabled.	As appropriate for the graph type.
XYScatterAnalyzeForFilling	Indicate whether the analysis should be used to analyze for filling. If true, then the XYScatterIntercept, XYScatterFillPeriodStart, and XYScatterFillPeriodEnd properties may be specified.	false
XYScatterDependentAnalysisPeriodEnd	Specify the ending date/time for the period to analyze the dependent time series data, to determine the best-fit line.	Blank (analyze full period).
XYScatterDependentAnalysisPeriodStart	Specify the starting date/time for the period to analyze the dependent time series data, to determine the best-fit line.	Blank (analyze full period).
XYScatterFillPeriodEnd	When XYScatterAnalyzeForFilling =true, indicates the ending date/time of the period to fill, using standard date/time string.	Blank (fill full period).

Subproduct (Graph) Properties (continued)

Subproduct (Graph) Property	Description	Default
XYScatterFillPeriodStart	When XYScatterAnalyzeForFilling =true, indicates the starting date/time of the period to fill, using standard date/time string.	Blank (fill full period).
XYScatterIndependentAnalysisPeriodEnd	Specify the ending date/time for the period to analyze the independent time series data, to determine the best-fit line.	Blank (analyze full period).
XYScatterIndependentAnalysisPeriodStart	Specify the starting date/time for the period to analyze the independent time series data, to determine the best-fit line.	Blank (analyze full period).
XYScatterIntercept	The value of A in the best-fit equation A + bx. If specified, the value of B is adjusted accordingly. This property cannot be used with transformed data and if specified must be 0.	Blank (do not force the intercept).
XYScatterMethod	Curve fit method used when analyzing data for the XY Scatter graph (OLSRegression or MOVE2).	OLSRegression
XYScatterMonth	One or more month numbers used when analyzing data for the XY Scatter graph, separated by commas or spaces (1=Jan).	Blank (analyze all)
XYScatterNumberOfEquations	Number of equations used when analyzing data for the XY Scatter graph (OneEquation or MonthlyEquations).	OneEquation
XYScatterTransformation	Data transformation used when analyzing data for the XY Scatter graph (None or Log). This property is not enabled.	None
ZoomEnabled	Indicates whether the graph can be zoomed (true) or not (false).	Graph types are evaluated and the property is automatically set. XY-Scatter and Duration graphs can't zoom.
ZoomGroup	Indicate a group identifier that is used to associate graphs for zooming purposes. For example, there may be more than one distinct group of graphs, each with its own overall period or data limits. The graph types may also be incompatible for zooming. This is an experimental feature and should currently not be specified in product files.	All graphs are assigned to zoom group 1.

Time Series Properties

Each subproduct (graph) includes time series data, and the presentation of each time series can be configured using data (time series) properties. In some cases, properties are layered, allowing a property to be defined for the subproduct (graph) for use by all time series (e.g., legend text).

The following tables list data (time series) properties.

Data (Time Series) Properties

Data (Time Series) Property	Description	Default
Color	Color to use when drawing the data. Examples are named colors (e.g., red), RGB triplets (e.g., 255, 0, 128), and hexadecimal RGB (e.g., 0xFF0088).	Repeating, using common colors.
DataLabelFormat	Data label format specifiers. See the graph DataLabelFormat property. If the graph property is specified and the time series property is not, the graph property will be used.	Blank (no labels).
DataLabelPosition	Data label position. See the graph DataLabelPosition property. If the graph property is specified and the time series property is not, the graph property will be used.	Right
Enabled	Indicates whether the data should be processed. Specify as true or false.	true
GraphType	Indicates the graph type for the data in a graph product. Available options are: Bar, Duration, Line, PeriodOfRecord, Point, XY-Scatter. Currently the sub-product property is used for all data. It is envisioned that this property will be enabled in the future to allow different data representations to be plotted together (e.g., monthly as bars, daily as line).	Property not enabled.
LegendFormat	The legend for the data can be specified and will override the SubProduct LegendFormat property (see that property for details).	Auto
LineStyle	Line style. Currently only None (e.g., for symbols only) and Solid are allowed.	Solid
LineWidth	Line width, pixels. Currently a line width of 1 pixel is always used.	1

Data (Time Series) Properties (continued)

Data (Time Series) Property	Description	Default
PeriodEnd	Ending date for time series data in the data item. The date should be formatted according to common conventions (e.g., YYYY-MM-DD HH:mm), and should ideally be of appropriate precision for the data being queried. This property is often set at run time.	Full period is read.
PeriodStart	Starting date for time series data in the data item. The date should be formatted according to common conventions (e.g., YYYY-MM-DD HH:mm), and should ideally be of appropriate precision for the data being queried. This property is often set at run time.	Full period is read.
RegressionLineEnabled	Indicates whether the regression line should be shown (currently only used with the XY-Scatter graph type). The line is drawn in black (there is currently not a property to set the line color).	true
SymbolSize	Symbol size in pixels.	0 (no symbol)
SymbolStyle	Symbol style. Recognized styles are: <ul style="list-style-type: none"> • None • Arrow-Down, Arrow-Left, Arrow-Right, Arrow-Up • Asterisk • Circle-Hollow, Circle-Filled • Diamond-Hollow, Diamond-Filled • Plus, Plus-Square • Square-Hollow, Square-Filled • Triangle-Down-Hollow, Triangle-Down-Filled, Triangle-Left-Hollow, Triangle-Left-Filled, Triangle-Right-Hollow, Triangle-Right-Filled, Triangle-Up-Hollow, Triangle-Up-Filled • X, X-Cap, X-Diamond, X-Edge, X-Square 	None

Data (Time Series) Properties (continued)

Data (Time Series) Property	Description	Default
TSID	Time series identifier.	Must specify.
XAxis	X-axis to use (Bottom or Top). This currently always defaults to bottom.	Bottom
XYScatterConfidenceInterval	This property is only used with XY scatter plots. If not blank, the value indicates that confidence level lines should be drawn on the XY Scatter plot for the given confidence interval, percent. Currently only 99 and 95 percent confidence intervals are supported. The lines will only be drawn if the curve fit line is drawn (see RegressionLineEnabled).	Blank (do not draw).
YAxis	Y-axis to use (Left or Right). This currently always defaults to left.	Left

Annotation Properties

Annotations are associated with subproducts (graphs) and are implemented as simple shapes that are drawn on normal graphs. It is envisioned that all shapes supported by the drawing package will eventually be supported but currently only text labels and lines can be specified as annotations.

To allow flexibility, annotations can be placed using two coordinate systems. For example, if a product is generated using real-time data, the date/time axis will have a different range over time. Therefore, placing an annotation using a fixed coordinate would cause the annotation to scroll off the graph as time passes. To resolve this issue and still allow absolute positioning of annotations, as appropriate, the following coordinate systems are supported, as specified by the XAxisSystem and YAxisSystem properties:

Data When using the data coordinate system, it is expected that the coordinates used to define the annotation will agree with the data units being drawn. For example, for a normal time series graph, the x-axis coordinate would be specified as a date/time to the necessary precision and the y-axis coordinate would be specified using data values.

It is envisioned that a notation +NNN and -NNN will be implemented in the future to allow offsets from the edges of the graph, in data units.

Percent When using the percent coordinate system, it is expected that the coordinates used to define the annotation are specified as a percent of the graph width or height, with 0 being the lower/left and 100 being the upper/right.

Each axis can have a different coordinate system (e.g., the y-axis value can be set using data units and the x-axis value can be set using percent).

The following tables list annotation properties.

Annotation Properties (All Shapes)

Annotation Property	Description	Default
AnnotationID	A string that identifies the annotation, to be used in software displays. If there are many annotations, this helps identify them when editing.	Annotation + annotation number (1+) (e.g., Annotation1).
Color	Color to use when drawing the annotation. Examples are named colors (e.g., red), RGB triplets (e.g., 255, 0, 128), and hexadecimal RGB (e.g., 0xFF0088).	Black
Order	The drawing order for the annotation, either BehindData to draw behind time series data or OnTopOfData to draw on top of time series data.	OnTopOfData
ShapeType	The type of shape to be drawn for the annotation. Currently accepted values are Text and Line.	None – must be specified.
XAxisSystem	Indicates the system for X coordinates: <ul style="list-style-type: none">• If Data, the X coordinates that are specified will be in data units.• If Percent, the X coordinates are percent of the graph (0% is left and 100% is right).	Data
YAxisSystem	Indicates the system for Y coordinates: <ul style="list-style-type: none">• If Data, the Y coordinates that are specified will be in data units.• If Percent, the Y coordinates are percent of the graph (0% is bottom and 100% is top).	Data

Annotation Properties (Line Shape)

Annotation Property	Description	Default
LineStyle	Line style. Currently only None and Solid are allowed.	Solid
LineWidth	Line width, pixels. Currently a line width of 1 point (pixel) is always used.	1
Points	X and Y coordinates for the line endpoints, as follows: X1 , Y1 , X2 , Y2 or X1 , Y2 X2 , Y2.	None – must be specified.

Annotation Properties (Text Shape)

Annotation Property	Description	Default
FontSize	Annotation text font size, points.	10
FontStyle	Annotation text font style (see Product MainLabelFontStyle).	Plain
FontName	Annotation font name (see Product MainTitleFontName).	Arial
Point	X and Y coordinates for the text position, as follows: X1 , Y1	None – must be specified.
Text	The string to display.	Blank
TextPosition	Indicates the position of text, relative to the point: UpperRight, Right, LowerRight, Below, LowerLeft, Left, UpperLeft, Above, Center.	Right

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Appendix

GeoView Mapping Tools

Color, 2004-05-27, Original Maintained with TSTool, Acrobat Distiller

Overview

GeoView Terminology

The GeoView Panel

Interacting with the GeoView Map

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Viewing a Layer's Attributes

Using GeoView with an Application

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GeoView Project File Examples

Overview

The GeoView package contains integrated software components that can be used with software to enable map-based interfaces. The main purpose of the GeoView package is to provide simple and flexible map displays that can be used in a variety of software applications with little or no reconfiguration.

The GeoView package has been developed by Riverside Technology, inc., using Java technology. GeoView interfaces can be embedded in Java applications (e.g., use GeoView as the main window interface), can be enabled as a separate floating window (e.g., to support an application's features without being embedded in the main window), and can be used in web pages either as embedded map applets or stand-alone map windows. GeoView tools operate similarly on Microsoft Windows and UNIX operating systems.

This appendix describes general GeoView features and can be used as a reference for how to configure and use GeoView components. Specific uses of GeoView in a software program are discussed in the documentation for the specific software. Some of the figures shown in this documentation were generated using GeoView with the TSTool software and consequently title bars include TSTool in the wording.

GeoView Terminology

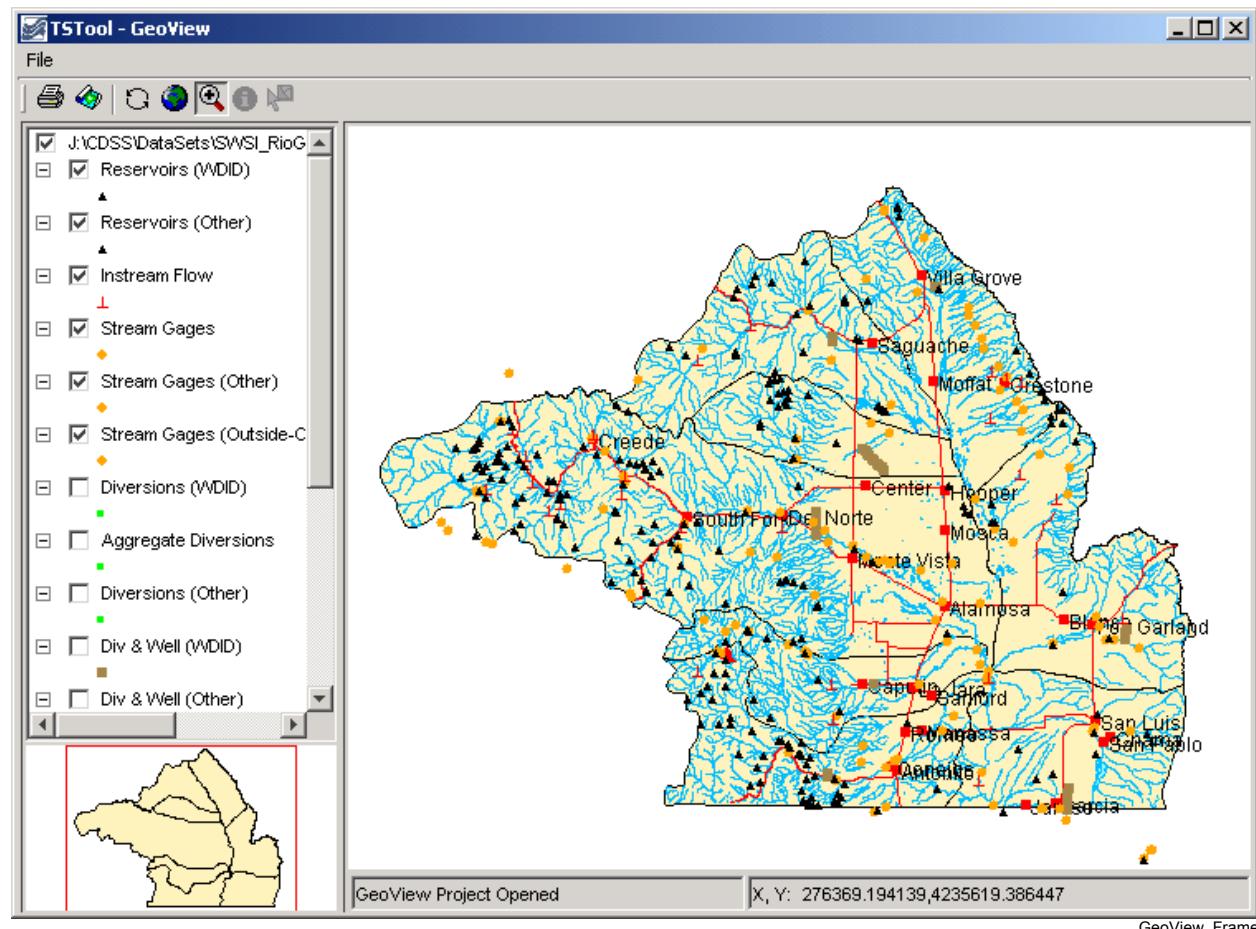
GeoView terminology is similar to other GIS product terminology. Important terms are shown in the following table. These terms are used infrequently in most user interfaces and applications but are visible at times in property dialogs and configuration files.

GeoView Terminology

Term	Description
<i>GeoView</i>	The visible map window where maps are displayed. Currently there can be only one main GeoView. A reference GeoView may be used to show the zoom extents in the main GeoView.
<i>GeoLayer</i>	A data layer, in its "raw" form (e.g., an ESRI Shapefile). The more generic term "layer" is often used.
<i>GeoLayerView</i>	A view of a GeoLayer, with symbol properties for visualization. The more generic term "layer view" is often used. This is equivalent to a "theme" in some software packages.
<i>Feature</i>	A general term describing an item on the map, consisting of shape and attribute data.
<i>Shape</i>	A general term defining the type of feature (e.g., point, polygon). The shape type defines the ways that a feature can be symbolized and used in analysis. Shape types can typically be determined automatically from input data.
<i>Attributes</i>	A general term defining non-shape data that are associated with a feature. Often, attributes are stored in a tabular form, such as a relational database table. Attributes are usually associated with a shape using some type of index number (shape index).
<i>Symbol</i>	The combination of properties used to visualize a layer (e.g., symbol style, color, labeling, classification). The feature shape type controls how the feature can be symbolized.
<i>GeoView Project</i>	A GeoView Project file (.gvp) can be used to define the layers and global viewing properties for a GeoView. The contents of this file are described in more detail in the GeoView Configuration – the GeoView Project File section at the end of this appendix.
<i>Application Layer Type</i>	Because GeoView is a generic tool, it has no implicit understanding of the types of data that are important to an application. The AppLayerType is a property that can be assigned to layers in a GeoView Project file to help an application know that a layer is important to the application. An application layer type of "BaseLayer" indicates that a layer should be used for background information and is not specific to the application. See the Using GeoView with a Software Application section below for more information.

The GeoView Panel

An example GeoView interface is shown in the following figure. This example uses a floating GeoView window. Some programs use a GeoView that is embedded in the main application window, and some rely on secondary map windows (as shown below). If the map is in the main window, the menus at the top of the window will be those specific to the software (whereas below the single GeoView **File** menu is shown).



Example GeoView Interface (from TSTool)

The GeoView Panel is a self-contained component that offers a standard map-based interface that can be used in many applications. In the above figure, the GeoView Panel includes everything shown, except for the top menu bar (with the **File** menu). The general purpose GeoView Frame includes the menu bar and a GeoView Panel. The GeoView Panel contains the following components:

Table of Contents (left edge)	The table of contents displays a list of layer views, showing the top-most layer at the top of the legend. Layers can be enabled/disabled by toggling the check box. A layer can be selected/deselected by clicking on the layer in the table of contents. Layers that are selected can be acted on (e.g., properties can be viewed). The table of contents also indicates the symbol for the layer.
Main GeoView (large map)	The main GeoView displays the enabled layers and allows you to interact with the map using the mouse and keyboard (e.g., zoom, select).

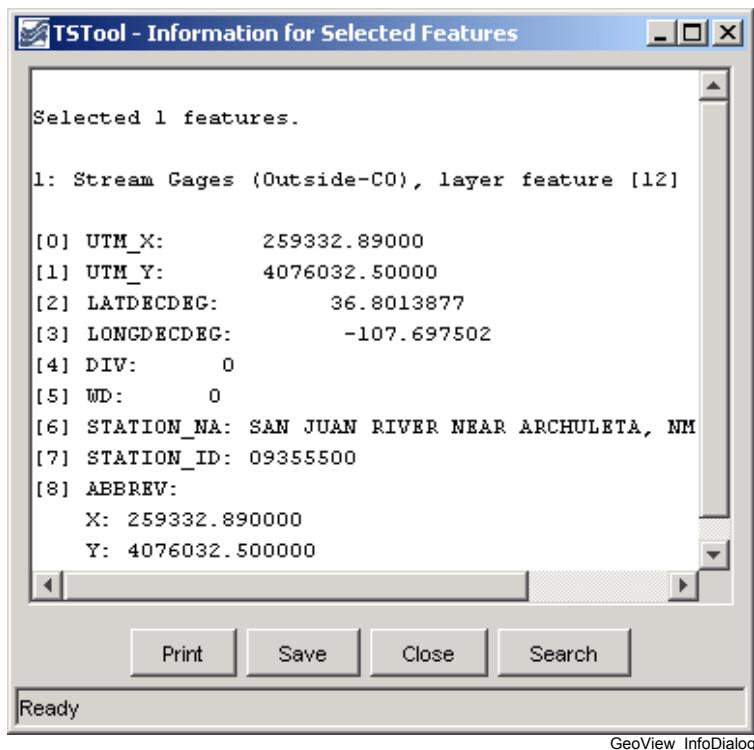
Reference GeoView (lower left)	The reference GeoView displays layers that have the property <code>ReferenceLayer</code> set to <code>true</code> . This view shows the current zoom extent relative to the maximum extent of the data and can also be used to initiate a zoom to a region on the main map (the reference map is always in zoom mode).
Standard Controls (top, below menu bar)	Standard controls perform actions on the visible map as follows:
	Print Print the visible map. You will be able to pick the printer and orientation.
	Save Image Saves the map as a Portable Network Graphics (PNG), JPEG, or other supported graphic file format.
	Refresh Refresh the map display by redrawing features in enabled layers that are in the visible window. This does not re-read the original data. GeoView normally refreshes automatically as needed.
	Zoom Out Zoom to the maximum data extents.
	Select the Mode as Zoom, Info, or Select Select the interaction mode. The Zoom mode allows a rectangle to be drawn on the map to zoom to the specified region and is the default mode if no layer is selected. The Info mode allows features to be selected (by clicking on or drawing a box around), after which geographic information about the features is displayed. The Select mode is similar to Info ; however, its purpose is to select features for an additional action (e.g., exporting data or performing a query). The Info and Select modes are only enabled if one or more layers are selected in the table of contents.
Message Areas (bottom)	See the next section for more information about using these features.

The GeoView Panel components work with each other to provide interaction with the maps, as described below.

Interacting with the GeoView Map

The layers shown on the map are initially displayed according to the GeoView Project settings. Once displayed, you can interact with the map in the following ways:

Disable/Enable a layer view	<p>Layers can be enabled/disabled to make the map more readable or useful:</p> <ol style="list-style-type: none"> 1. Use the check boxes in the table of contents to disable and enable layer views, as appropriate. The map will automatically refresh, resulting in a slight delay as the map is redrawn. 2. If necessary, use the Refresh tool () to cause the map to be updated (automatic refresh may be disabled for some applications, due to performance reasons).
Change layer view order	Currently the layer view order can only be changed by editing the GeoView Project file.
Zoom in/out	<p>Zooming is useful make symbols and labels more readable. To zoom in:</p> <ol style="list-style-type: none"> 1. Set the GeoView interaction mode to "Zoom" by selecting the zoom tool () at the top of the window. 2. Use the mouse to draw a box around an area of interest (left mouse button down to start, move the mouse, and then release). The main GeoView map will zoom to the selected region and the reference map will show the zoom extent. 3. Use the Zoom Out tool () to zoom to the full extent or use the reference GeoView to zoom to a different region.
Change symbols for a layer view	<p>To change the symbols and labels for a layer view:</p> <ol style="list-style-type: none"> 1. Select the layer view in the table of contents 2. Right-click and select the Properties menu. See the Setting GeoView Properties section below for information about the properties.
Display geographic information for features	<p>The GeoView interface can display information about geographic features (shape and attribute data) from the original geographic data. To do so:</p> <ol style="list-style-type: none"> 1. Select layer views in the table of contents that are to be searched for information. 2. Set the GeoView interaction mode to Info () 3. Click near the feature or draw a box around multiple features. The layers will be searched and the following dialog will be shown.



GeoView_InfoDialog

The resulting dialog will show information about the selected features, including basic layer information, and information about the specific shapes and attributes. **The display is for geographic data only.**
Attribute names and values are as they appear in the original data.
Additional application-specific data are typically provided by a separate software interface.

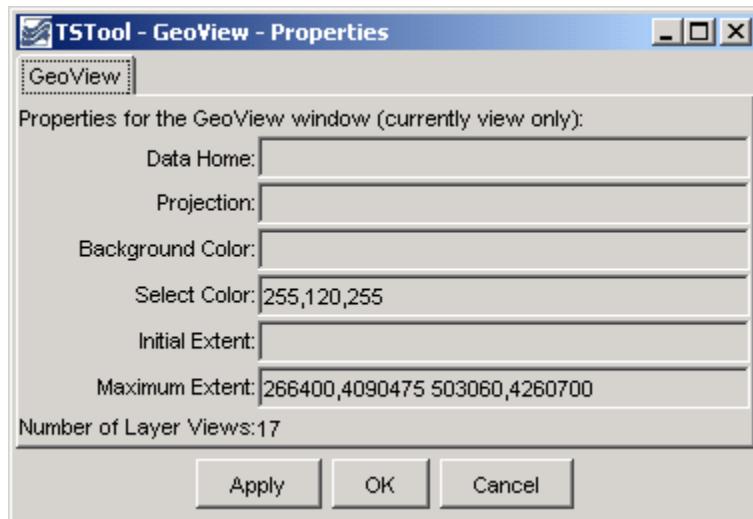
Select features

Features can be selected for a number of reasons. Currently, GeoView has limited select tools, which are mainly used internally when integrated with an application (e.g., an application can select features internally, which are then highlighted on the map). In the future, interfaces to select features from the GeoView interface using query criteria may be added.

Features can be selected () similar to the **Info** mode described above. The selected features are highlighted on the map. In the past, yellow, or cyan have been used to highlight selected features. However, yellow is not clearly visible when earth-tone colors are used for background layers and cyan is not clearly visible when water-tone colors are used for background layers. Therefore, GeoView is phasing in a magenta/pink selection color, which is rarely used for background layers.

Setting GeoView Properties

GeoView properties are initially set in a GeoView Project file or are assigned internally by the software. Most properties control how layers are displayed (colors, labels, etc). To view general GeoView properties, right click on the GeoView map and select the **Properties** menu. Some properties are currently view-only. Refer to the **GeoView Configuration – the GeoView Project File** section below for a complete list of properties that can be defined in a GeoView Project file.



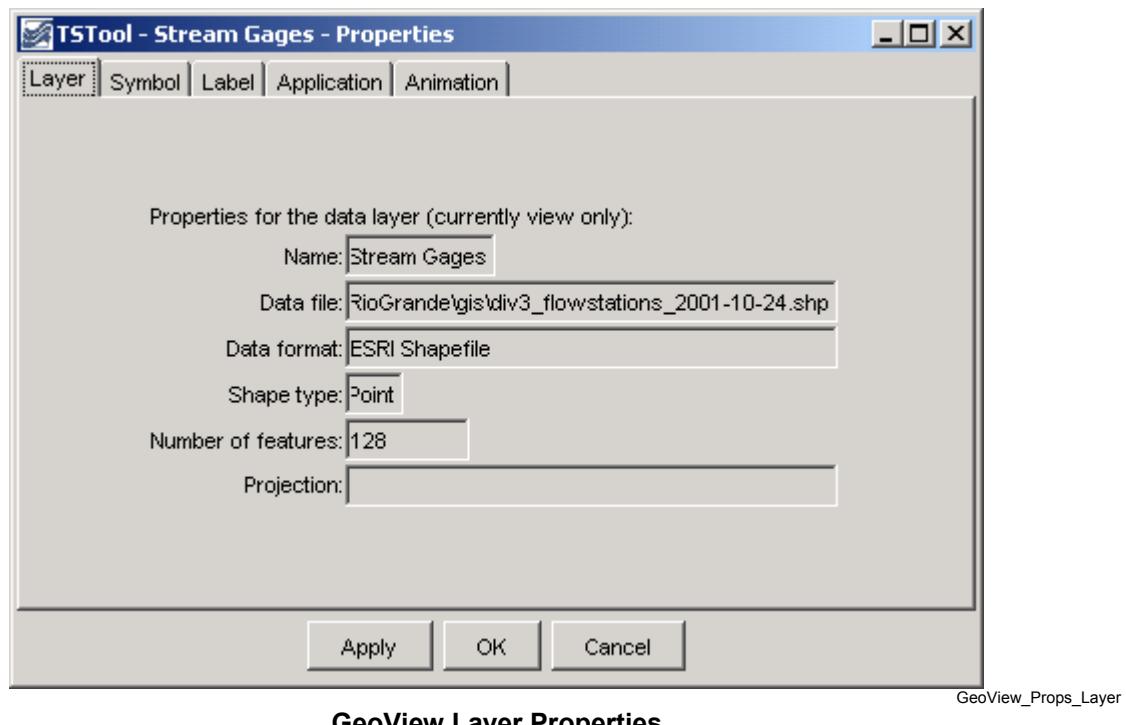
GeoView_Props

Main GeoView Properties

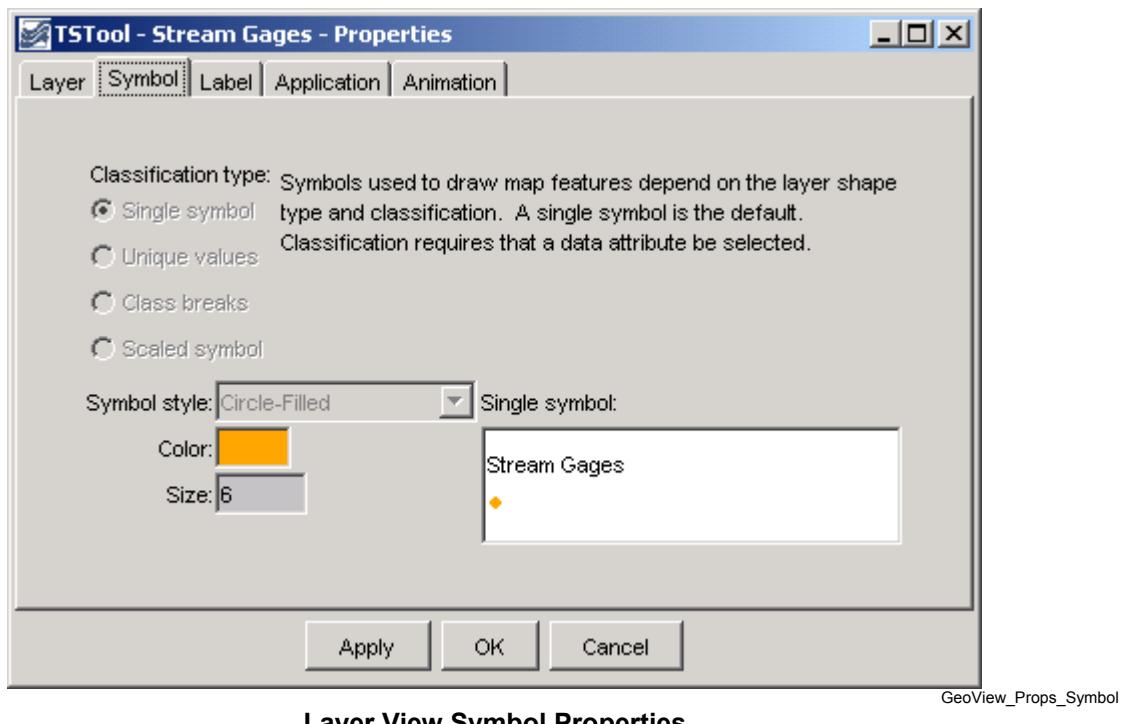
GeoView properties, as shown in the above figure, apply to the main GeoView and are shared between layers. These properties are typically not edited by end users. One important property is the projection property. If all data layers are projected consistently (e.g., for ESRI shapefiles) then a projection does not need to be defined. However, if the layers have different projects, a GeoView projection and projections for each layer can be defined to allow the GeoView to project data consistently for visualization.

If the **OK** or **Apply** buttons are pressed, the GeoView properties will be updated in memory (the GeoView Project file is not updated) and the map will redraw. Pressing **OK** will additionally close the properties dialog. The **Cancel** button causes the dialog to close, without updating the properties.

To view or change properties for a layer, select a layer view in the table of contents, right-click and select the **Properties** menu item. The following tabbed dialog will be displayed for the first selected layer view. The tabbed panels are discussed below the each figure.



GeoView layer properties, as shown in the above figure, apply to the input source. Currently these properties are used for information purposes and cannot be interactively edited.

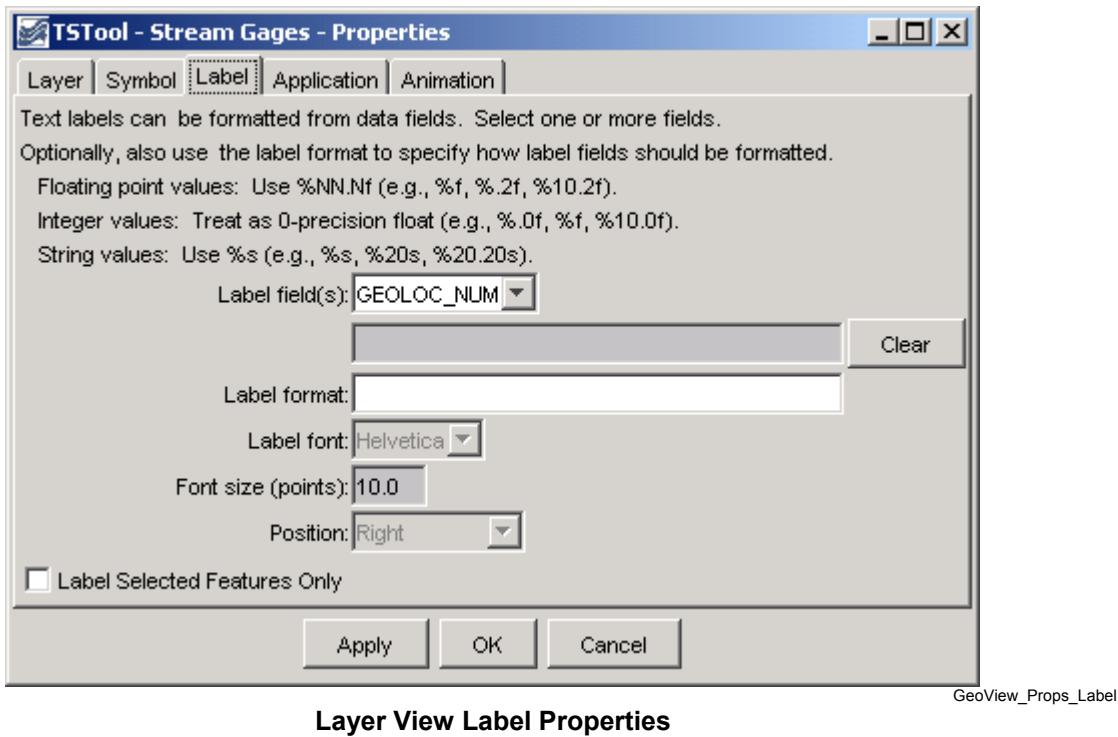


GeoView_Props_Symbol

Layer View Symbol Properties

Symbol properties, as shown in the above figure, indicate how the layer is to be drawn (symbolized) on the map and in the table of contents. A sample of the symbol is shown in the dialog, although it may appear slightly different on the map and table of contents.

Symbol terminology corresponds to standard GIS tools.



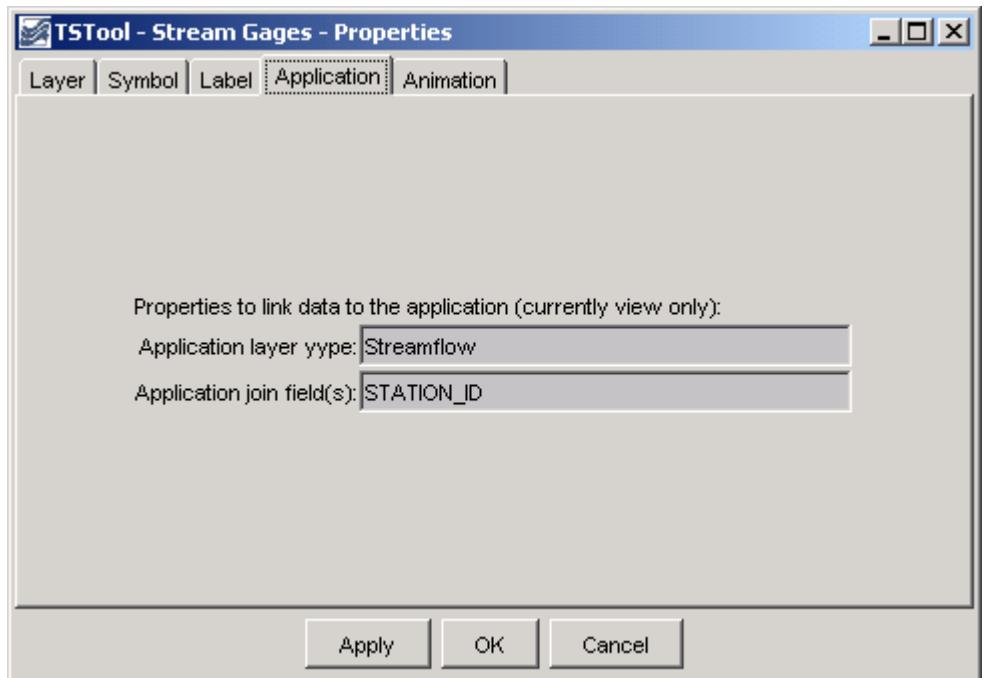
GeoView_Props_Label

Layer View Label Properties

Label properties, as shown in the above figure, can be modified to label features with attribute data or literal strings. Currently, only point features can be labeled. Labels can consist of a combination of attribute values. To label features, select the attribute fields from the available choices, in the order that they should appear in the label.

The label format, if not specified, defaults to the use the full width of the attribute. For example, if an attribute field is defined as being twenty characters wide, the label may be the full width, including leading and trailing spaces. More often, it is desirable to omit the spaces. To do so, or to format numbers using a more appropriate format than the full width default, use the **Label Format** information. The dialog box notes illustrate valid formats. For example, if a string field and an integer field are available, the following label format would show the labels with only a comma and one space between the values:

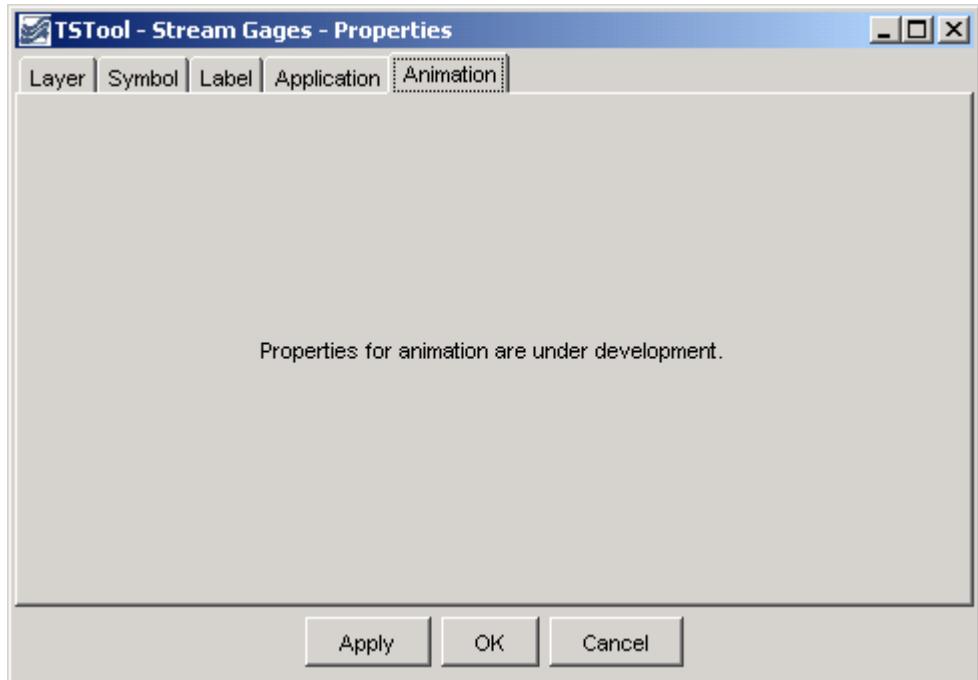
`%s, %d`



GeoView_Props_Application

Application Layer Type

Layer application properties (above) are used to link a layer's data to an application. This process allows general GeoView features to be used more specifically by specific software programs. The **Using GeoView with a Software Application** section (see below) describes this functionality in more detail.



GeoView_Props_Animation

Layer View Animation Properties

Layer view animation properties are currently under development. Animation properties will define, for example, the time series data that are used for symbolization during animation.

Viewing a Layer's Attributes

Each feature in a layer includes geographic shape information (e.g., the coordinates that define a polygon). Each feature also can have attribute data, which are typically represented in a tabular fashion. To view the attributes for a layer, first select the layer in the table of contents, then right-click and press the **View Attribute Table** menu choice. A window similar to the following will be shown:

The screenshot shows a Windows application window titled "TSTool - Attributes of Stream Gages". The window contains a table with the following columns: DNGDECDEG, DIV, WD, STATION_NA, STATION_ID, ABBREV, and STATION_NU. The data in the table is as follows:

DNGDECDEG	DIV	WD	STATION_NA	STATION_ID	ABBREV	STATION_NU
-106.115837	3	25	KERBER C AT ASHLEY RANCH, NR VILLA GROVE...	08224500	KERVILCO	503
-106.218330	3	26	TRACY PIT RESERVOIR INFLOW NEAR SAGUACH...	08227400	TRASAGCO	504
-105.507500	3	35	MOSCA CREEK NEAR MOSCA, CO.	08234200	MOSMOSCO	505
-106.187775	3	21	LA JARA CREEK AT GALLEGOS RANCH, NR CAP...	08238000	LAJCAPCO	506
-105.425278	3	24	CULEBRA CREEK AT SAN LUIS, CO.	08250000	CULSANCO	508
-105.721947	3	24	RIO GRANDE AT COLORADO-NEW MEXICO STATE...	08252000	RIOBORCO	509
-106.830833	3	20	RIO GRANDE AT WAGON WHEEL GAP, CO	08217500	RIOWAGCO	669
-105.879448	3	20	RIO GRANDE AT ALAMOSA, CO.	08223000	RIOALACO	670
-105.943054	3	25	RASPBERRY CREEK NEAR VILLA GROVE, CO.	08224200	RASVILCO	671
-106.334167	3	21	ALAMOSA RIVER ABOVE TERRACE RESERVOIR, ...	08236000	ALATERCO	673
-106.888611	3	20	RIO GRANDE AT WASON, BELOW CREEDE, CO.	08217000	RIOWASCO	780
-106.829445	3	20	GOOSE CREEK AT WAGONWHEEL GAP, CO.	08218500	GOOWAGCO	781
-106.318886	3	27	CARNFRO CRFFK NFAR LA GARITA, CO	08230500	CARI AGCO	782

At the bottom of the window, it says "Displaying 128 records." and "Ready".

Attributes Table for a Layer

GeoView_Attributes

The attributes are displayed in the order and format determined from the input data. Attribute names in ESRI shapefiles are limited to ten characters. Information in the table can be selected (use **Ctrl-A** to select all) and can be copied to other software.

Using GeoView with a Software Application

Software developers integrate the GeoView components with software applications and typically the software user does not need to know how GeoView works with the application. However, this section describes a few important concepts that will help facilitate setting up data for use by an application.

Basic GeoView implementations involve defining a GeoView Project (see the **GeoView Configuration – the GeoView Project File** section below for details on project file properties) and then interacting with the GeoView interface when the map is displayed. In a basic application, a GeoView can be added to show maps for reference purposes only. For example, the application may be an interface to a database containing location information. If a GeoView project file is defined with only base layers, then the zooming and features will allow a user to zoom into a region of interest, but there will be no interaction between the GeoView and the application.

In a more advanced application, layers in the GeoView Project file are assigned an AppLayerType property, which is recognized by the application. For example, a layer may be assigned an application type of "Streamflow" to indicate a streamflow gage. Additionally, the AppJoinField property can be defined to allow the application to join its data to the geographic data. This assignment in and of itself causes no effect in the GeoView. However, the application can now interact with the GeoView by asking for the "Streamflow" layer. This allows features in the GeoView to be selected from the application (e.g., in a database query screen) and allows the GeoView to provide information about the layer to the

application. For this type of implementation, it is important that the application layer types, feature (shape) type, and the required join fields are documented; consequently, new data layers can be used with the application with only a few configuration changes.

Some applications may automatically update the map interface by zooming to selected areas, selecting features, etc. Standard GeoView features are typically still available, as previously described.

Limitations

The GeoView components have been developed not to serve as full-featured GIS components, but to support many common GIS activities like selection, zooming, and symbolization. The components have been developed to integrate with existing applications and use other tool sets, including time series viewing tools. Basic features have been implemented to address important needs for applications; however, additional features are implemented as requirements change. The GeoView components are not envisioned as a replacement for pure GIS tools like ESRI's ArcGIS products. In many cases, ESRI or other tools can be used to develop the data for use with GeoView.

Currently, properties that are changed interactively cannot be saved to the GeoView Project file.

GeoView software currently does not examine projection files optionally distributed with ESRI shapefiles. Projections must be defined in the project file (or, if omitted, the projection is assumed to be consistent for data layers). Only a few projections are recognized, as needed by specific GeoView software implementations.

GeoView Configuration – the GeoView Project File

A GeoView display is configured mainly by using a GeoView Project (*gvp*) file, which is either read at software startup or when selected by the user. The purpose of the file is to persistently store the configuration of a map display so that it can be loaded again without redefining the configuration. The file format is simple text properties and can be read by applications implemented in various technologies running in various environments. An example of the file is shown below.

```
# Main properties global to the GeoView
# The format is:
# [Prefix]
# Prop=value
[GeoView]
GeoDataHome = .

# Properties for each GeoLayerView (data source and
# symbols)...
[GeoLayerView 1]
GeoLayer = xxx.shp

[GeoLayerView 2]
GeoLayer = xxx.shp
```

The GeoLayerViews listed first in the project file are drawn first and are therefore behind other layers on the map. For all properties, the comma is used as an internal delimiter and the semi-colon is used as a second layer of separation, as appropriate. Most properties will default to appropriate values if not specified (see tables below). The most important properties, as shown in the example above, are the `GeoDataHome`, which defines where data can be found, and `GeoLayer`, which defines where the data file is for each layer. Recognized layer file formats are listed in the following table and are described further in separate appendices. Support for additional layer types can be added as necessary.

Layer Type	Description
ESRI shapefile	ESRI shapefiles are commonly used with ESRI software such as ArcView, ArcMap, and ArcExplorer. GeoView determines the type by looking for the <code>.shp</code> file extension and checking the internal file format. No projection is assumed but the <code>Projection</code> property for the <code>GeoView</code> and individual layers can be used to indicate the projection.
NWSRFS GeoData files	The National Weather Service River Forecast System (NWSRFS) uses ASCII and binary files defining various geographic layers. This format is detected by checking the file names, which are predefined for NWSRFS. The <code>Projection</code> property is defined as <code>Geographic</code> if ASCII data and <code>HRAP</code> if binary data.
NWS XMRG Radar Files	XMRG files are gridded radar files produced by the National Weather Service. GeoView treats these files as grid files. This format is detected by looking for an "xmrg" string in the filename. The <code>Projection</code> property is defined as <code>HRAP</code> .

The following main GeoView properties can be defined in the project file. Graphical user interfaces to allow interactive editing of all properties are being implemented.

Main GeoView Property	Description	Default Value
Color	Background color for map. See the discussion after the properties tables for a discussion of how to define colors.	White.
FontName	Name of font to use for GeoView components (e.g., buttons). This property currently can only be set internally with software.	System-specific.
FontSize	Size of font, in points, to use for GeoView components (e.g., buttons). This property currently can only be set internally with software.	System-specific.
FontStyle	Font style to use for GeoView components (e.g., buttons). This property currently can only be set internally with software.	System-specific.
GeoDataHome	Directory where the GIS data exist. This directory will be prepended to layer files if they are not absolute paths already.	If not specified or if specified as ".", the directory will be set as the home of the GeoView Project file.
InitialExtent	Initial extent of the map display, in data coordinates. The coordinates should be specified as "XMIN, YMIN XMAX, YMAX", where the first pair is the lower-left corner of the extents and the second pair is the upper right. This property has not been implemented. See the MaximumExtent property.	No default. The initial extent will be the maximum data extent.
MaximumExtent	Maximum extent of the map display when zoomed out, in data coordinates. The coordinates should be specified as "XMIN, YMIN XMAX, YMAX", where the first pair is the lower-left corner of the extents and the second pair is the upper right.	No default. The maximum extent will be the maximum data extent.
Projection	Projection for the GeoView. The projection definition varies depending on the projection (some projections require more parameters). The following projections are currently supported: Geographic - no projection (decimal degrees) HRAP - used by National Weather Service UTM, Zone[, Datum, FalseEasting [, FalseNorthing][, CentralLongitude [, OriginLatitude][, Scale]] - Universal Transverse Mercator. The Zone is required (e.g., 13 for Colorado). Datum defaults to NAD83. The FalseEasting defaults to 500000. The FalseNorthing defaults to 0. The CentralLongitude is computed from the Zone. The OriginLatitude defaults to zero. The Scale defaults to .9996.	No default. All data are assumed to be the same projection.
ProjectAtRead	Indicates whether layer features are projected at read-time to the GeoView projection. This slows down the application initially but increases performance later during map refreshes.	false (it is usually best to project all data to a common projection rather than relying on GeoView to do projections)
SelectColor	Color to use for selected features. See the discussion after this table for examples of how to specify colors.	Yellow A more unique magenta/pink color with RGB 255,120,255 is being considered.

The following GeoLayerView properties can be defined, corresponding to each data layer/file:

GeoLayer View Property	Description	Default Value
AppJoinField	Specify the field(s) that should be used by an application to join the layer data to application data. If multiple fields are necessary, separate the field names by commas (e.g., "wd, id").	None.
AppLayerType	Indicate a layer type to be handled by an application. For example, a layer may be tagged as "Streamflow". The application can then use this information to treat the layer differently (e.g., to know how to join the data to application data). Valid AppLayerType values must be defined and understood by the application.	None.
Color	Color for features when the SymbolClassification is SingleSymbol. If point data, this is the main color for the symbol. If line data, this is the line color. If polygon data, this is the fill color. See the discussion after this table for examples of how to specify colors.	Random.
ColorTable	<p>Used when the SymbolClassification property is ClassBreaks or UniqueValues and requires more than a single color. The number of colors should be one more than the number of class break values if SymbolClassBreaks is used and equal the number of class values if UniqueValues is used. Color tables can be defined in three ways:</p> <ol style="list-style-type: none"> 1. ColorTableName;NumColors Predefined tables include Gray, BlueToCyan, BlueToMagenta, BlueToRed, CyanToYellow, MagentaToCyan, MagentaToRed, YellowToMagenta, and YellowToRed. These named tables choose primary colors where necessary to provide clean color breaks. 2. Ramp;NumColors;Color1; Color2 3. Custom;NumColors;Color1; ...;ColorN <p>Only the first option is currently enabled. See the discussion after this table for examples of how to specify colors.</p>	Named color table using Gray.
EventLayerView	Indicates if the layer view is an event layer (ESRI Map Object notation). This property is not currently used in the Java tools.	false
GeoLayer	Name of file for the data layer, typically with the file extension. If an ESRI shapefile, specify the .shp file. If a relative path, the GeoView.GeoDataHome property will be prepended to the file name. This property is used to detect a break in the GeoLayerView numbering, indicating the end of layer views.	No default. Should always be specified.
IgnoreDataOutside	Indicate a range of values that should be considered. Currently this applies only to grid layer types. Specifying a range can be used, for example, to draw only cells with positive data values. The range should be specified as two numbers separated by a comma (e.g., .00001,100.0).	Not specified. All cells are considered.
LabelField	Specify one or more fields to be used for the label, separated by commas. If a LabelFormat property is specified, use it to format the label; otherwise, format each field according to the field specifications from the attribute data source.	No default. Specify one or more fields for the label.

GeoLayer View Property	Description	Default Value
LabelFontName	Font to use for labels. This property has not been enabled.	Helvetica
LabelFontSize	Label font height, points. This property has not been enabled.	10
LabelFormat	Specify a C-style format string to format the fields. The format specifications must agree with the data types being formatted. For example, if two floating-point fields are specified with the LabelField property, the corresponding format may be "%10.1f, %5.2f".	If not specified, the label will be formatted using the field width and precision determined from the data table, with values separated by commas.
LabelPosition	Label position. If point data, the position is relative to the point coordinates. If line or polygon data, the position is relative to the centroid coordinates. The position of the text will be offset to not overwrite a symbol and can be UpperRight, Right, LowerRight, Below, LowerLeft, Left, UpperLeft, or Above .	Right
Name	The layer view name that should be displayed in the legend.	No default. If not specified, the file name will be used in the legend.
OutlineColor	Outline color for point or polygon symbols. See the discussion after this table for examples of how to specify colors.	Default to the same as main color).
Projection	Projection for the layer's data. See the main GeoView Projection property for available values.	No default. It is assumed that all data in a project have a consistent projection.
ProjectAtRead	Indicates whether features are projected at read-time to the GeoView projection. This slows down the application initially but increases performance later during map refreshes. This property can be set once in the GeoView main properties.	false (it is usually best to project all data to a common projection rather than relying on GeoView to do projections)
ReadAttributes	Indicates whether attributes should be read when the data are read. If possible, based on the layer data format, attributes will be read on the fly as needed. Reading the attributes (true) takes more memory but will result in faster performance.	false
ReferenceLayer	Indicates whether the layer should be drawn in the reference GeoView. Indicate as true or false. Typically only the most general boundary information should be used in the reference layer.	false
SelectColor	Specify the color to be used when drawing selected features. This property is useful if the default select color does not easily viewed.	Use the GeoView .SelectColor property.
SkipLayerView	Can be set to true to skip the layer altogether when reading the project file (useful for commenting out layers during development). If this property is used, the number sequence for the layer views can be kept the same.	false (the layer view will be displayed)
SymbolClassBreaks	Class breaks that correspond to the ClassBreaks SymbolClassification property. The number of values should be one less than the number of values in the ColorTable property for the classification.	No default, although an application may suggest values.
SymbolClassField	Attribute data field that is used when the SymbolClassification property is ClassBreaks or UniqueValues.	No default, although an application may suggest a value based on the available attributes.

GeoLayer View Property	Description	Default Value
SymbolClassification	Indicates how data are to be classified when displaying the shape symbols. Values can be SingleSymbol (e.g., single point symbol, line style, or polygon fill color), UniqueValues (display a unique symbol style for each value, currently not implemented), or ClassBreaks (display a unique symbol style for groupings of values - requires specification of the SymbolClassField and SymbolClassBreaks properties).	SingleSymbol
SymbolSize	For point data, specify the symbol size in pixels. For line data specify the line width in pixels. Not used for polygon data. This property may need to be expanded to properly handle printed output (might need to use points rather than pixels or allow the units of measure to be set in the property). This property is currently not enabled.	6 pixels for points, 1 pixel for lines.
SymbolStyle	Indicates the symbol style. If point symbols, the style is the symbol identifier (e.g., CircleFilled). If line data, the symbol style is the line style (currently only Solid is supported). If polygon data, the symbol style is the fill pattern (currently only FillSolid is supported). See below for a full discussion of symbol styles.	None for points, Solid for lines, FillSolid for polygons.

Color Specification

Colors are specified for a number of different properties, including the feature color and outline color. In order to allow flexibility in specifying colors, a number of formats are supported:

- Named color. Available colors are: None (transparent), Black, Blue, Cyan, DarkGray, Gray, Green, LightGray, Magenta, Orange, Pink, Red, White, Yellow
- Comma-separated Color Triplets as 0-255 (e.g., 255, 0, 0) or 0.0 -1.0 (e.g., 1.0, 0.0, 0.0).
- Hexadecimal: 0xRRGGBB (e.g., 0xFF0000 for red)

Color Tables

Color tables are simply a list of colors. Typically the symbol maintains a color table if the classification is other than SingleSymbol. The symbol will also keep track of unique values or class breaks and use this information to determine a color to display for a shape. A number of predefined color tables are supported but user-defined tables are supported in the property format.

Symbol Style - Point Data

Symbol styles for point data are the same as for time series viewing tools. The following styles are available:

- None
- Arrow-Down, Arrow-Left
- Asterisk
- Circle-Hollow, Circle-Filled
- Diamond-Hollow, Diamond-Filled
- Plus, Plus-Square
- Square-Hollow, Square-Filled

- Triangle-Down-Hollow, Triangle-Down-Filled, Triangle-Left-Hollow,
Triangle-Left-Filled, Triangle-Right-Hollow, Triangle-Right-Filled,
Triangle-Up-Hollow, Triangle-Up-Filled
- X-Cap, X-Diamond, X-Edge, X-Square

Classification

Classification is used to symbolize data. The following classifications are supported:

Classification Type	Description
SingleSymbol	This is the default for all layers if not specified. For point data, a single symbol is used, centered on the . For line data, a single line width and color is used. For polygon data, single fill and outline colors are used.
UniqueValues	The data values for the field specified with the <code>SymbolClassField</code> property is sorted and checked for unique values. Each value is then assigned a color in the color table.
ClassBreaks	The number of class breaks should be one less than number of colors in the color table for the symbol. Breaks are defined by using a groupings of features based on the values of the field specified with the <code>SymbolClassField</code> property: < first value >= first value < second value ... > last value

GeoView Project File Examples

This section provides several examples, extracted from GeoView Project files.

The following example illustrates how to configure base layers in a GeoView Project file:

```
# GeoView project file for Rio Grande basin.

# Main GeoView properties.

[GeoView]

# Main home for data
# If a directory is not specified, the directory will be determined when the
# GeoView project file is selected.
#GeoDataHome = "C:\cdss\statemod\data\rgtwday\gis"
# ArcView/ArcExplorer Default...
#SelectColor = Yellow
# Arc 8...
#SelectColor = Cyan
# All-purpose (magenta/pink)
SelectColor = "255,120,255"
MaximumExtent = "266400,4090475 503060,4260700"

# Now list the layer views. A layer view consists of specifying a data layer
# (e.g., shapefile) and view information (e.g., symbol). This is equivalent to
# the ESRI "theme" concept. The layers specified first are drawn on the bottom.
# Start with number 1 and increase the layer number sequentially as layers are
# added on top.

[GeoLayerView 1]
GeoLayer = div3_districts.shp
Name = "Water Districts"
# RGB 153 204 50 - green-yellow
#Color = "0x99CC32"
# tan
Color = "255,240,190"
OutlineColor = black
ReferenceLayer = true
AppLayerType = "BaseLayer"

[GeoLayerView 2]
GeoLayer = div3_lakes.shp
#GeoLayer = div3_lakes.shp
Name = "Lakes"
# - blue
Color = "165,250,254"
OutlineColor = "0,130,254"
AppLayerType = "BaseLayer"

[GeoLayerView 3]
Name = "Rivers"
GeoLayer = div3_rivers.shp
#GeoLayer = div3_rivers.shp
# RGB - blue
Color = "0,188,253"
AppLayerType = "BaseLayer"

[GeoLayerView 4]
GeoLayer = div3_highways.shp
Name = "Roads and Highways"
Color = "255,0,0"
AppLayerType = "BaseLayer"

[GeoLayerView 5]
GeoLayer = div3_cities.shp
Name = "Cities and Towns"
SymbolStyle = "Square-Filled"
SymbolSize = 6
Color = "red"
LabelField = "Name"
LabelPosition = RightCenter
AppLayerType = "BaseLayer"
```

The following example illustrates how to display point data layers. These properties should be inserted at the appropriate location in a GeoView Project file.

```
[GeoLayerView 15]
#SkipLayerView = true
GeoLayer = div3_flowstations_2001-10-24.shp
Name = "Stream Gages"
# orange
Color = "254,167,0"
SymbolStyle = "Circle-Filled"
SymbolSize = 6
AppLayerType = "Streamflow"
AppJoinField = "STATION_ID"
#LabelField = "STATION_NA, STATION_NA"
#LabelFormat = "%s, %s"

[GeoLayerView 18]
#SkipLayerView = true
GeoLayer = div3_reservoirs_2001-10-24.shp
Name = "Reservoirs (WDID)"
# black
Color = "black"
SymbolStyle = "Triangle-Up-Filled"
SymbolSize = 6
AppLayerType = "Reservoir"
AppJoinField = "ID_LABEL_6"
```

This page, when printed, can be used as a spine for a binder.

Colorado's Decision Support Systems (CDSS)

Colorado Water Rights Administration Tool (CWRAT)

