

IRIS: AN INFORMATIONAL RIVER AND RESERVOIR SIMULATION DISPLAY

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ABSTRACT

Water District #1 has developed computer software displaying statewide water supply conditions for all major river basins in Idaho. This scaleable software visually simulates reservoir contents, river discharges, major diversions, and snow water equivalents. USBR Hydromet data and NRCS SNOTEL data are transmitted through an automated FTP transfer process to Water District #1's server and database, and linked to the R*TIME near real-time software created by SCIENTECH INC. This software allows water managers to quickly display current water supply conditions and graphically compare the data to previous historical years. The computer simulation is a time-scaled replay feature that has pause, rewind, and fast forward buttons; enabling users to animate reservoir, river and snow displays at variable speeds. It is a valuable tool that can be used for water management purposes and will increase understanding of both professionals and the general public concerning water supply and water distribution.

INTRODUCTION

Water is a renewable resource, but also a highly variable supply both within the water year, and from year-to-year. This is especially true for rivers whose headwaters originate in the Rocky Mountains. Most of the western water supply varies predominately with the snowpack rather than from summer precipitation. During past drought years, numerous major reservoirs have been built to store water during the surplus time of the year in order to supply supplemental storage water during the summer low flow, high demand period. Historically, the major demands for water were for irrigation, power generation and flood control. Now, demands for water have increased including recreation, minimum fish flows, Indian tribal water rights, endangered species and managed groundwater recharge projects. Because of these competing demands for water, the need to communicate with multiple special interest groups is also increasing, and having the tools and ability to create the appropriate displays and water supply information for both current conditions as well as provide a historical perspective are needed. Better water management tools to help illustrate and explain the complex hydrologic processes and the interrelationship of the snowpack with the operation of the reservoirs and river system are needed.

DEVELOPMENT

Water District #1 built upon a basin-wide Upper Snake River Reservoir Simulation system and created an expanded reservoir, river and snow display system named the Idaho Reservoir and River Information System (IRIS). Because all of the SNOTEL (SNOW TELemetry) stations in the Columbia River System are available from the same Natural Resources Conservation Service (NRCS) computer in Portland, Oregon, expanding and processing the automated SNOTEL information was a relatively straightforward process, but greatly expanded the amount of data processing.

Expansion of the US Bureau of Reclamation (USBR) Hydro Meteorologic (Hydromet) data being transmitted was also possible for other basins within the state that had existing Hydromet data. Obtaining data for major rivers and reservoirs that did not have automated data available or stations maintained and collected by private companies such as Idaho Power, Avista or others were more difficult to collect and merge into a common format. Ultimately, the success of a statewide display system might be dependent on obtaining partners or agencies that have sufficient interest to review and maintain quality data for their particular area of interest.

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TECHNOLOGY

At the heart of the IRIS project are several software applications from a Human-Machine-Interface (HMI) class of software called R*TIME. This type of software is frequently used by process and control industries, and similar to many power plant operator interface software available to the power plant industry. The R*TIME software is capable of running on Microsoft Windows NT 5.0 and Windows XP computer operating systems.

The dynamic linking of the near real-time data and historical database with the display screens and graphics is what creates a lot of the value to the water managers to quickly review and present current water supply conditions. By simply updating a portable notebook's database, a ready-made presentation can be put together quickly with graphics and the ability to view more detailed reservoir, river or SNOTEL data with comparisons to similar recent water years.

Probably the most acclaimed and innovative feature for many water and snow professionals is the ability to "animate" or simulate a recent water year. Creating the visual display to show how the reservoirs are used to store water during the peak runoff, and storage water is used to supplement the existing discharges when water is in short supply will quickly improve understanding of flood control and irrigation contribution of reservoirs to the local economy. This animation is a very valuable feature of the IRIS project. It is being used to help a wide range of people from public policy makers to interested residents visualize how the reservoirs and rivers are operated as a system.

Another valuable result of this project is replaying what-if scenarios and learning from historical operations. This helps decision makers have a greater depth of knowledge and understanding of the lessons learned from historical years to present day operations. The scaleable basin wide or state wide ability to view data is the most recent innovation, and extends usefulness to people in many regions of the state of Idaho.

SOFTWARE PRODUCTS FEATURES AND MENUS

The top menu allows the user to select one of the nine major river basins that covers Idaho on a statewide display. A Trend Displays menu button selects up to four stations from the database allowing the system operator to display combinations of river discharge, reservoirs and snow water equivalents for bar graphs or trends chosen for any database period of record. Additionally, the System Function Displays filters data by using an archive retrieval process for any combination of greater than, less than or equal to sorting of historical conditions.

The Schematics are connected to the latest available data to show current reservoir, river status. The Snow Sites Overview menu button links the color graphic displays to SNOTEL data can then be selected from either a map interface or a SNOTEL name legend. By color coding the SNOTEL sites according to elevation enables a quick selection of the pertinent SNOTEL sites being analyzed or displayed. Similarly, the Reservoir and River Overview also links a map interface and a legend menu of reservoir and river data for automated data stations within the basin. The Tabular Data and Reports menu button connects to the most recent data, or displays data in USGS annual report style formats for the years retrieved.

The River Reservoir Flow Simulation menu button replays a water year with a variable playback rate and uses pseudo-proportional reservoirs and variable river widths in proportion to the discharge to quickly illustrate how snow, reservoir storage and river discharge are interconnected from a water supply perspective.

DATA SOURCES AND COMPLEXITY

Success or failure of a project such as the IRIS project is dependent on quality data. Bringing data together from multiple agencies such as USBR, USGS, NRCS, Water District #1, NWS, USCOE and private companies such as Idaho Power, or Avista Corp. can greatly complicate the process. The visualization of the river basins as a complete system is however, dependent on bringing the snow, reservoir, river, and diversion data together into a common database. The quantity of data collected can be overwhelming unless some automated data handling and transfer methods are created. The time needed to review data quality can also be very time consuming, even with the ability to view the data graphically. Having a large amount of data collected remotely virtually guarantees

some missing data either at the field stations, receive sites, data transmissions or at the computer databases. Developing processes to collect data from backup sources, or fill in missing data are important to creating and maintaining a quality display system.

The USBR Hydromet and NRCS SNOTEL data are collected at the USBR earth station receive site in Boise, Idaho and NRCS receive site in Portland, Oregon, respectively. These two data sources transmit the bulk of the data information. The USGS data is retrieved from their computer database. The data from Idaho Power and others have been transferred at the end of the water year. Some of the long-term daily discharges averages for river gages and SNOTEL data were obtained from the USGS and NRCS respectively. Currently, there are 140 SNOTEL sites, 28 reservoirs and 130 river gaging stations included in its present configuration.

SUMMARY

Data collected from several snow and water agencies including NRCS, USBR, USGS IDWR, Water District #1 and others, was combined with a Human-Machine-Interface (HMI) class software program into a common database linking the data to display modules. This powerful tool for displaying data through a graphical display system enables water managers and users to visualize how the snow, reservoirs, rivers and diversions are managed. The IRIS information can be used to explain, educate or improve the understanding of the reservoir and river system benefits, as well as replaying parallel historical data events within the database.

ACKNOWLEDGMENTS

The USBR, Idaho Department of Water Resources, Ron Abramovich, of the NRCS Snow Survey office and others provided assistance in getting the interagency data transmitted to a common database location. SCIENTECH Inc., used their proprietary R*TIME software product as the primary data linking method to connect the data to the various displays. Lyle Swank was the principle architect and visionary of this display system and how it could be used to improve the understanding of the reservoir and river system.

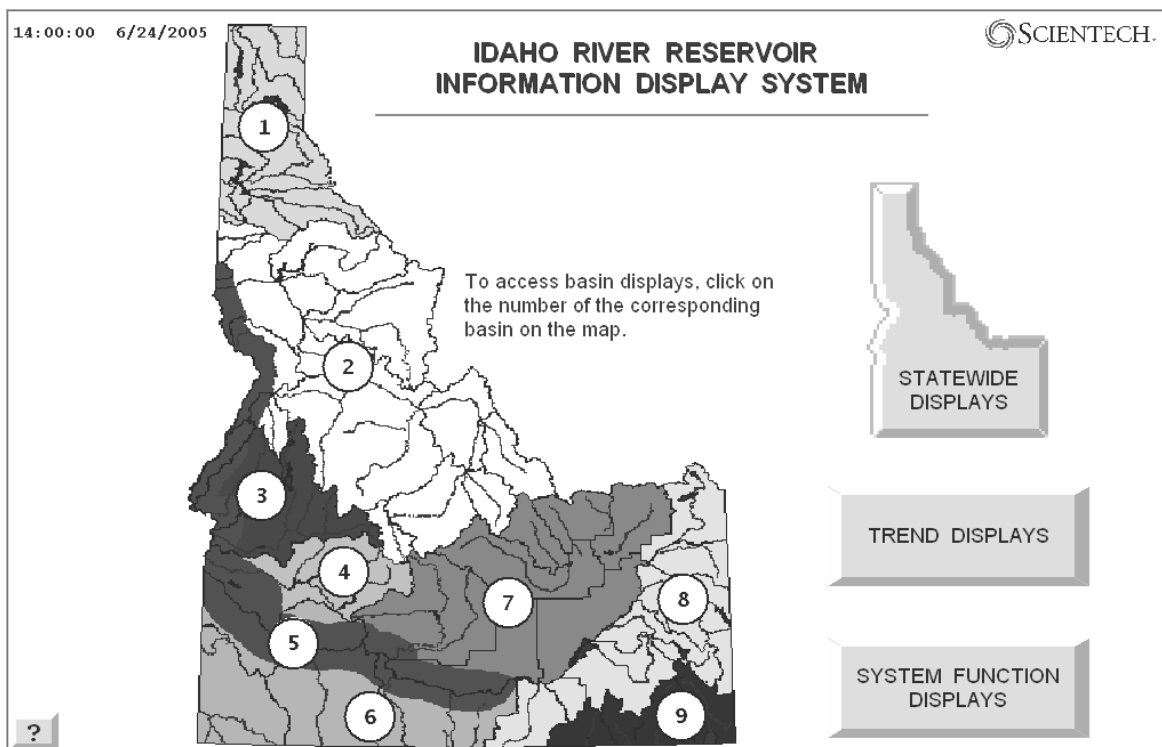


Figure 1. Top menu of Idaho River Reservoir computer simulation display.

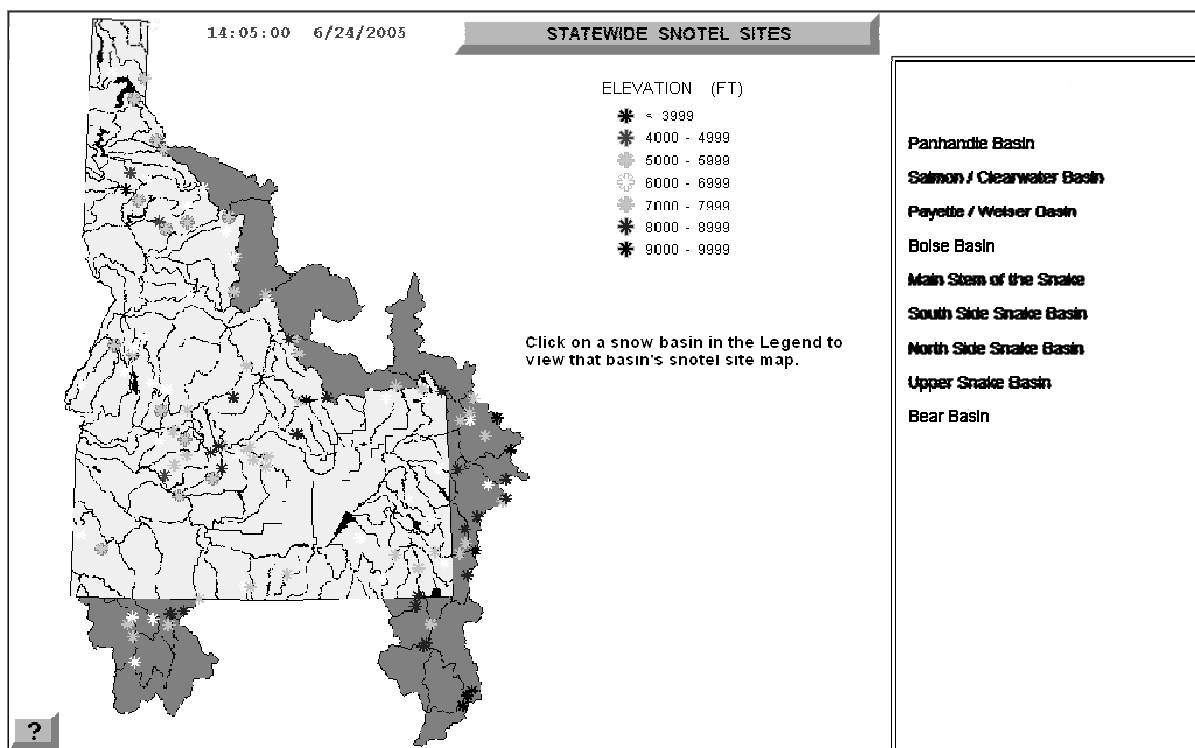


Figure 2. Statewide display of SNOTEL sites colored coded by elevation.

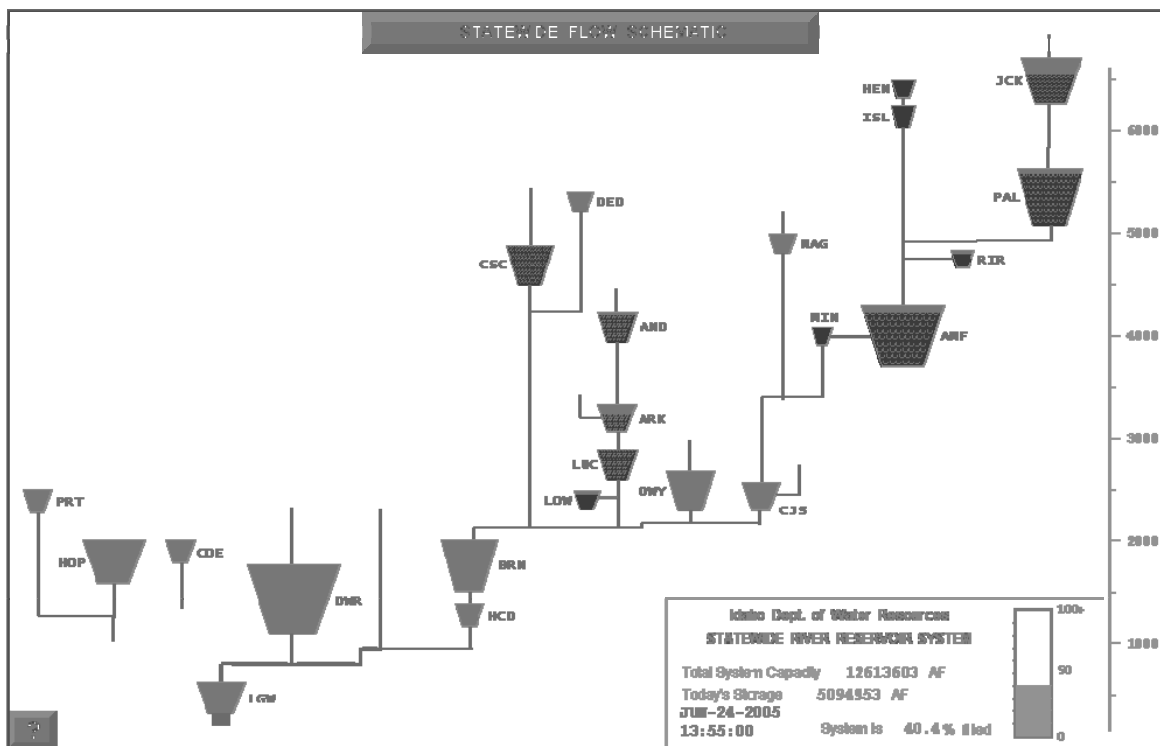


Figure 3. Statewide display of Snake River reservoirs from Jackson Lake (JCK) in Wyoming to Lower Granite Reservoir in Washington (LGW).

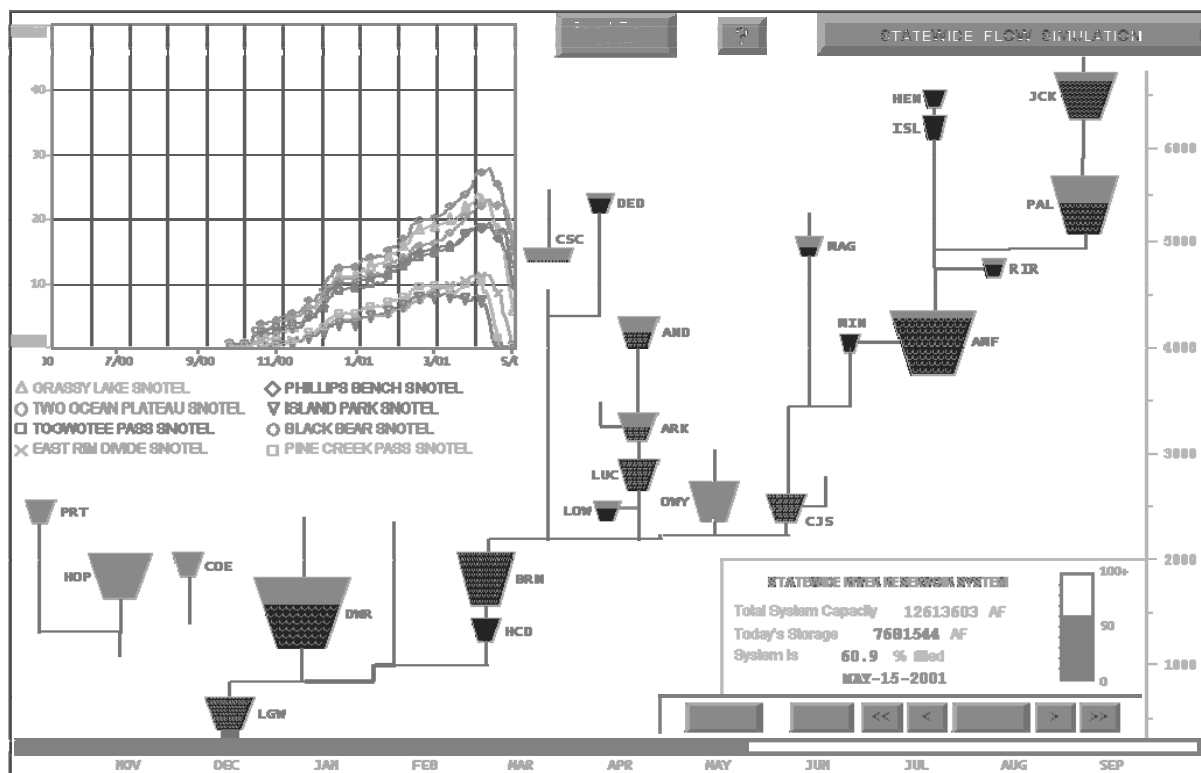


Figure 4. Computer simulation display of reservoir, streamflow and selected snow sites.

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