

UTAH'S TRI-COUNTY AUTOMATION PROJECT

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ABSTRACT

This paper discusses an ongoing technology project in the tri-county area of central Utah (Carbon, Emery, and Sanpete Counties; see Figure 1). The three counties share the same watershed (Wasatch Plateau) even though Carbon and Emery are in the Green/Colorado River drainage and Sanpete is in the Sevier River drainage. The county boundaries roughly equate to river basin boundaries: Emery—San Rafael River; Carbon—Price River; and Sanpete—San Pitch River.

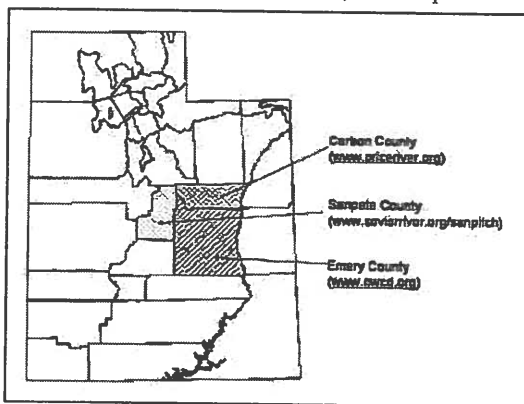


Figure 1. Tri-County Area

There are 13 small trans-basin diversions that export water from Emery and Carbon Counties to Sanpete County. There is a Federal water project in each county and Colorado River salinity projects in Emery and Carbon. And there is a myriad of contentious issues developing including: protecting and quantifying water rights, a leaky reservoir basin which has become an unintentional trans-

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basin diversion, a proposed new trans-basin diversion which is in the final planning stages, quantifying the impacts of the Federal salinity projects, conjunctive use of Federal and non-Federal facilities, and addressing fish and wildlife issues.

Part of the solution to avoiding future conflicts in the tri-county area involves increased real-time monitoring and control, and using this information to operate both Federal and non-Federal facilities in an optimal fashion to the benefit of all. The existing (but still evolving) Emery County real-time monitoring system and real-time web site (www.ewcd.org) are demonstrating what is possible (Emery WCD and Reclamation, 2003). Officials in all three counties are indicating strong support for a multi-county system which would cover the entire area. Emery is so committed to the concept that, several years ago, the county raised its *ad valorem* tax to provide base-level funding for their portion of the project (Hansen and Berger, 2003).

BACKGROUND ON THE FEDERAL WATER PROJECTS

Reclamation's first construction efforts in the tri-county area date back to the Great Depression; its most recent construction activities were in the 1960's. The three Reclamation projects provide supplemental irrigation water, with the Emery County Project providing some water for industrial use and the Scofield Project providing flood protection.

The completion of a railroad through Sanpete County contributed to growth in the Ephraim and Spring City area. When the San Pitch River could no longer provide a dependable full-season irrigation supply, Reclamation began an investigation in 1931 to develop additional water sources. Started in 1935, the Sanpete Project was completed 4 years later. It features two small tunnels that transport water from the San Rafael River (a tributary of the Green River) on the east side of the Wasatch Plateau, to the valley farmland on the west (in the San Pitch/Sevier drainage). Today the project features are operated by the Horseshoe and Ephraim Irrigation Companies.

Started during World War II, the Scofield Project was completed in 1946. Reclamation's Scofield Dam on the Price River (a tributary of the Green River) was initially constructed to protect the Denver and Rio Grande Western Railroad tracks, a state highway, telephone and telegraph lines, and several coal mines from potential flooding. The project now provides seasonal regulation of the Price River for supplemental irrigation to the lands around Price, as well as flood protection. The project is operated by the Carbon Water Conservancy District.

Located just south of the Scofield Project, in the San Rafael River Basin, the Emery County Project provides supplemental irrigation water to the lands around Orangeville, Castle Dale, and Huntington. The project includes two reservoirs, a

diversion dam, two canal delivery systems, and land drainage features. The irrigation facilities were completed in 1970. After construction, the project was altered to provide water for coal-fired power plants in the county. The project is operated by the Emery Water Conservancy District.

The operating entities on all these projects are small compared to other Reclamation projects. Each struggles to operate its project 24/7 in an optimal manner. Technological innovations promise some relief.

WEB-ENABLED MONITORING NETWORKS

To better manage the three Federal water projects, plus all the pre- and post-projects, a web-enabled real-time monitoring system is developing in the tri-county area. This monitoring system is taking advantage of the rapid changes occurring in the technology arena.

We live in an increasingly interconnected world. Water information is being collected from watersheds and service areas, and being transmitted to water district offices, canal company staff, river commissioners, etc. A water manager can access sensors and gate actuator data in remote locations to see what is happening and make the necessary changes; a technologist can troubleshoot an automation problem at a site distant from his or her PC. The issue has become, how do we make all this information, from different devices and transmitted in different protocols, accessible to all the people who need it?

The Web provides an ideal graphical user interface (GUI) for water resource applications. Because of its standardized and portable nature, the Web's various components allow us direct access to information from a variety of computing platforms, from desktop PCs to cell phones. Web page designers can embed programming and algorithms into the pages themselves. The server (the computer that serves Web pages) can communicate directly with embedded applications. All of these capabilities allow for development of complex data-driven pages to present essential and timely information, without information overload and without having to create custom applications. To understand how this applies to water resource application, view the situation in Emery County.

EMERY'S REAL-TIME MONITORING SYSTEM

In 1993, with funding provided by a drought-program grant from Reclamation, the Emery Water Conservancy District (District) designed and installed the first step in a comprehensive real-time hydrologic and weather monitoring system. This system was designed to improve the responsiveness of the county's delivery systems. Data from the field sites was telemetered back to the District's office by line-of-sight radio. The field monitoring sites fell into four general categories: the San Rafael River and its tributaries, canals (largely at diversions), springs

critical to Emery County's municipal and industrial (M&I) water supply, and weather stations. In this initial effort, 17 water and 3 weather monitoring sites were upgraded to real-time.

The initial effort has expanded in subsequent years. The District now has a monitoring system covering western Emery County that includes 80 field sites (see Table 1), 5 repeaters, and a base station (Humphrey, et al., 2002). The system also includes an early warning system on Joes Valley Reservoir and 3 fully-automated cloud-seeding sites. All these activities have similar equipment to facilitate operation, maintenance, and repairs (OM&R).

Table 1. Real-Time Monitoring Sites Identified by Type and Drainage (2002)

Type of Site	San Rafael River				Total
	Huntington Creek	Cottonwood Creek	Ferron Creek	Muddy Creek	
River/Reservoir	8	8	3	2	21
Canal	12	10	3	0	25
Spring	8	10	3	6	27
Weather	1	4	2	0	7
Total	29	32	11	8	80

The District's real-time monitoring system generates a great deal of information, much of it useful to organizations other than the District. There was a continuing concern about the best and most efficient method to dispense the data. At the recommendation of a local consulting firm, StoneFly Technology, it was decided to dynamically connect the environmental monitoring system to the District's website (www.ewcd.org).

In 1999, a first attempt was made at using the District's website to distribute the county's real-time information. The website was modeled after a successful site that was developed for Utah's Sevier River Basin (www.sevierriver.org) (Berger et al., 2001). The Emery website has been so successful that it is continually expanding. A popular feature of www.ewcd.org is the six webcams (one pan-tilt-zoom or PTZ). The website displays live still images (updated every 10 minutes) from cameras located throughout the county, including 14 views from the PTZ on the Swasey Diversion Dam.

Since 1993 the base station for the District's system has also evolved. The first unit was a PC running DOS and the datalogger vendor's software. The current base station includes: (1) router/firewall which secures the real-time system; (2) a switch which routes network communications; (3) an ADSL modem which connects to the upstream Internet provider; (4) a file server running Windows

2000 Professional which polls the datalogger and stores the real-time data to disk; (5) a mirror data storage system located in an adjacent building; (6) dual web servers running Redhat 7.3 Linux which provide web/e-mail/DNS hosting for www.ewcd.org; (7) a healthy UPS with web-based management; and (8) a diesel-powered backup generator.

The Emery County monitoring system has proved to be successful. According to the Utah State Water Plan (Utah Division of Water Resources, 2000, p. 6-10): “The District’s installation of real-time monitoring . . . has helped to make the water supply more efficient. This could be critical, especially during the inevitable dry years. There will be savings in the cost of water management.” Ways the real-time system has helped conserve water and improve crop yields include: (1) faster reaction to changing hydrologic and weather conditions; (2) more frequent fine tuning of gate settings; (3) ease of trouble shooting when water deliveries are reported to be incorrect; and (4) improved ability to get water to the end of delivery systems.

The tri-county area is currently in the 6th year of a difficult drought. Emery’s major storage reservoir was at record lows during the 2003-04 winter. The county’s real-time monitoring system and website have proved to be an invaluable asset for managing the limited water available. But realistically, Emery’s real-time system is still in its infancy.

With funding provided through the Department of Commerce’s Technology Opportunities Program (TOP), the District is pursuing additional uses for its real-time monitoring network. One such use is encouraging tourism. A webpage was developed to report real-time conditions at Huntington Lake State park, located adjacent to an Emery County Project reservoir (see Figure 2). Similar pages are being developed for the area’s other major tourist attractions.

HUNTINGTON CREEK

The possibilities for a real-time monitoring system were recently highlighted by events in the Huntington Creek sub-basin of the San Rafael River (Emery County). In the 1970s, PacifiCorp (formerly Utah Power) constructed a reservoir (Electric Lake) in the upper reaches of Huntington Creek to provide water to one of its coal-fired power plants. Recently the reservoir basin has started to leak; it is hypothesized that the water is being collected in an adjacent coal mine and part of it is unintentionally being exported to Carbon County. This has put pressure on the other Huntington Creek water users and threatened the Federal water right associated with the Emery County Project. At a recent well-attended meeting of all the parties involved, it was agreed that an intensive real-time monitoring and reporting system is needed, and that decision-support models could further enhance river operations. All parties agreed to cooperate and cost-share in the project. The system is being integrated into www.ewcd.org (see Figure 3).

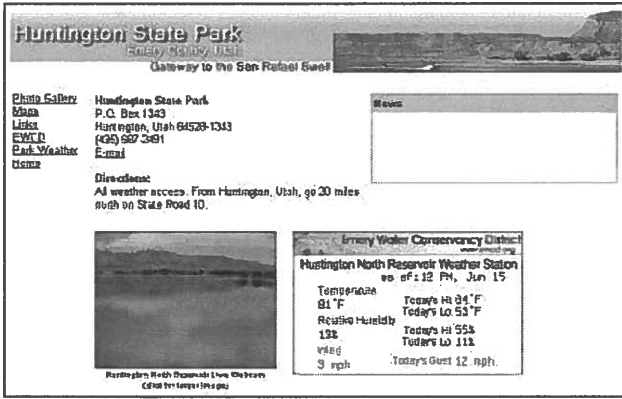


Figure 2. Web page highlighting the real-time environmental conditions (including line image) at Huntington Lake State Park. (www.ewcd.org/huntington_park)

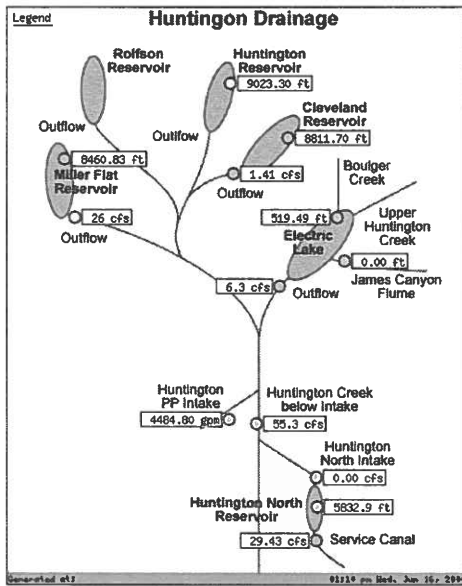


Figure 3. Schematic for reporting real-time hydrologic conditions on Huntington Creek (www.ewcd.org/Huntington_drain)

During the winter of 2003-04 additional monitoring stations were added to the Huntington Creek sub-basin. Software was also developed. A key component of the sub-basin's network will be the use of OpenBasin, a standardized Open Source database and website management software package (Berger and Maxwell, 2004). Also decision-support software is being developed to provide: (1) daily updates on the status of water rights, and (2) assistance with short-term reservoir releases.

An outgrowth of the ongoing efforts in Huntington Creek is a developing interest in automating key water control structures. The District has installed remote control on its small off-stream reservoir. Now the canal companies are looking to automate their high-mountain reservoirs and canal diversions. These interventions and others are being partially funded with a "Water 2025" grant from the Bureau of Reclamation.

TRANS-BASIN DIVERSIONS

There are 13 small trans-basin diversions from the upper San Rafael and Price River drainages to the San Pitch River Basin (see Table 2). It has recently been proposed that an additional, and substantially larger, trans-basin diversion be constructed. This controversial project has highlighted the existing 13 diversions. This has encouraged the counties to improve the measurement and management on some of the existing trans-basin diversions.

A first effort was made by the Horseshoe Irrigation Company when they installed a real-time monitoring station on their outlet works on the Spring City tunnel. At the same time, the Emery Water Conservancy District improved the monitoring system on the tunnel inlet. By sharing information, both groups have improved water management, and the level of trust between the two groups.

This year it is anticipated that a similar activity will occur on the Fairview Tunnel. Carbon County officials have contacted the Emery District about sharing the costs of a monitoring system on the tunnel inlet.

Table 2. Transbasin Diversions: San Rafael Drainage to the San Pitch Basin

Diversion	Average (1941-1990) (acre-feet/year)
<i>Price River to San Pitch River Basin</i>	
Fairview (Narrows) Tunnel (Gaged)	2,240
<i>Subtotal</i>	<i>2,240</i>
<i>San Rafael to San Pitch River Basin</i>	
Candland Ditch (Estimated)	200
Coal Fork Ditch (Estimated)	260
Twin Creek Tunnel (Estimated)	200
Cedar Creek Tunnel (Estimated)	340
Black Canyon Ditch (Estimated)	290
Spring City Tunnel (Gaged)	1,900
Reeder Ditch (Estimated)	250
Horseshoe Tunnel (Estimated)	600
Larsen Tunnel (Estimated)	690
Ephraim Tunnel (Gaged)	1,900
Madsen Ditch (Estimated)	40
John August Ditch (Estimated)	200
<i>Subtotal</i>	<i>6,870</i>
TOTAL	9,110

OTHER DEVELOPMENTS

In Carbon County, the water users are evaluating the feasibility of automating Scofield Reservoir, their principal water storage facility, which is located in the mountains, a 1-hour drive from the District office. The Carbon Canal Company has installed a real-time monitor at the head of its canal and will be installing two real-time monitors near the canal terminus this summer. The later will provide more reliable flows to irrigators at the end of the canal.

In Sanpete County, the Manti Irrigation Company is converting from an open ditch delivery system to a pressurized sprinkler system. Critical components of this new system are four small storage ponds. The irrigation company has installed a real-time monitoring and control system on each of the four ponds (see Figure 4) to help manage water deliveries.

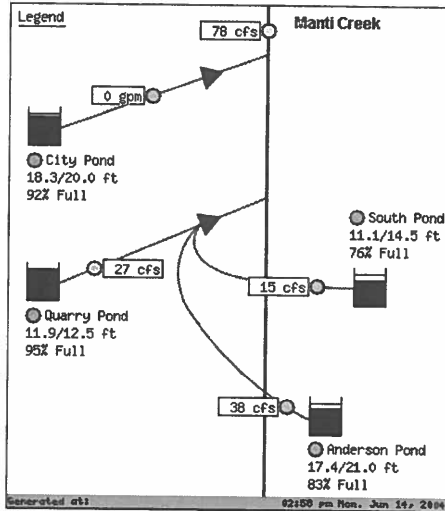


Figure 4. Schematic for reporting the status of the Manti pressure irrigation system (www.sevierriver.org/sanpitch/sf_index.php3)

CONCLUSIONS

While the automation activities in Emery County are considerably more advanced than in the other two counties, significant progress is being made in all three counties in the development of a comprehensive real-time monitoring network with accompanying websites. Not only are the counties looking at river basin management (rather than just individual projects), but they are also examining their inter-county issues. By providing information in an open fashion they are not only improving water management, but they are developing trust between all water users in the tri-county area.

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