IMPROVING THE OPERATIONAL EFFICIENCIES OF 19TH CENTURY IRRIGATION CANALS IN THE 21ST CENTURY — EXAMPLES IN IDAHO

Brian W. Sauer ¹
Lloyd Hicks ²

ABSTRACT

The Great Feeder Canal is a 26-mile long natural channel developed in the late 1800’s by Mormon settlers in Eastern Idaho to deliver Snake River water to 120,000 acres of farm land near the town of Rigby. The Great Feeder, with a capacity of over 5,000 cfs, delivers water to 14 major canals and 26 smaller canals. Several of the canal companies embarked on an effort to rehabilitate and modernize their 100-year old irrigation distribution systems with current technologies. Updates have included the rehabilitating and automating of water control structures, improved water measurement, and the installation of a shared radio telemetry system.

Overall water management in this large tract has been greatly improved. System improvements have resulted in significant conveyance efficiency improvements, reducing losses from spills and seepage and provided more constant and reliable deliveries to farms. Improved conveyance efficiencies have enabled irrigators to extend limited water supplies later into the irrigation season. With more reliable late-season supplies, even during recent drought periods, farmers have been able to reduce the risk of crop loss. This enabled growers to plant a wider variety of crops. The improvements have also helped improve the ability of water users to carry reservoir storage into the next year and provide a measure of future reliability.

The Burgess Canal and Irrigating Company (BCIC), the largest canal supplied by the Feeder, was established in 1886 and provides irrigation water to 22,000 acres of farmland. The Burgess Canal shareholders are finishing a 10-year program to improve system operations through improved water control and measurement. Major control structures are being rehabilitated and automated using durable, low-cost components and radio telemetry. Ramp flumes and other measurement devices were installed at the head of the main canal and other laterals. Steel trash diverters have been installed to protect automated gates from accumulation of debris and pass it though the distribution system.

The initial success of the BCIC prompted 10 other canal companies on the Great Feeder to start similar enhancements of their older systems. Currently there are approximately 40 automated control sites along the Feeder. BCIC and other canals have pooled resources to construct a network of 11 spread spectrum radio towers to connect most of the automated structures.

¹ Hydraulic Engineer, U.S. Bureau of Reclamation, Snake River Area Office, 230 Collins Road, Boise, ID 83702.
² President, Burgess Canal & Irrigating Co., 225 North 3600 East, Rigby, ID 83442
BACKGROUND

History

Few European settlers inhabited the lands along the Snake River in what is now Eastern Idaho until the late 1860’s when the U.S. military defeated the Shoshone and Bannock Indians and forced them onto reservations through the Fort Bridger Treaty in 1868. Beginning in 1871, the Utah and Northern Railroad was built north from the Union Pacific transcontinental line from Utah through the Idaho to connect the Salt Lake Valley with the copper mines near Butte in the Montana Territory. Settlers began homesteading in the Upper Snake River Valley as soon at the railroad came. Most of the new settlers were from Utah, encouraged by the Mormon Church to homestead in the region and large scale settlement ensued. By 1890, the Mormon settlers had built roads, bridges, dams, and irrigation canals that turned tens of thousands of acres of desert the Upper Snake River Valley into productive agricultural lands. Farms in the region grew sugar beets, potatoes, peas, grains and alfalfa.

Settlers in an area northeast of Idaho Falls, the largest city in the area, tapped into a side channel of the Snake River, known as the Dry Bed. This channel flows westward, through a broad alluvial plain know as the Rigby Fan, parallel to the south bank of the river for approximately 30 miles. Numerous distribution canals were constructed from the Dry Bed to new farms in the area, eventually supplying water to 120,000 acres. During the summer of 1894, low flows in the Snake caused the Dry Bed to run dry. In January, 1895, the Dry Bed canal companies pooled their resources to form the Great Feeder Canal Company to construct a large canal half a mile upstream to divert water from the river into the Dry Bed and improve the original Dry Bed channel. The canal, know as the Great Feeder Canal was opened with a gala celebration in June, 1895.

The finished headgates, 116 ft in total length, with a capacity of 5,000 cfs, were touted as the largest in the world. The company replaced the headgates in 1906 and again in 1915. The headgates were renovated in 1967 and are still in use today. Periodic work to the gates and the concrete structure maintain the integrity of the Great Feeder headworks. Small temporary dams, at first made of pole cribs and later replaced by cement overflows, have been built and rebuilt to direct the flow of the river into the head of the Great Feeder at various times.

With the construction of dams on the Snake River at Jackson Lake, Wyoming, in 1911 and American Falls and Palisades in Idaho in 1927 and 1957, respectively, many of the Great Feeder companies signed contracts with the U.S. Bureau of Reclamation for stored water to supplement their natural river flows. There are currently 40 irrigation diversions from the Great Feeder, with capacities ranging from less than 1 cfs to over 1,100 cfs.

---

Canal Systems

Most of the distribution canal systems share a similar history with the Great Feeder. Originally, most of the water control structures were constructed from wood. As structures deteriorated over the years, wooden structures were gradually replaced with concrete and steel, although many still use wooden check boards to regulate canal levels at bifurcations and deliveries. Each canal has its own board of directors and a water master who manage and operate the facilities. The directors determine the canal’s maintenance needs and set the assessments to charge users for these needs. None of the companies have their own maintenance crew so they contract out maintenance work to local contractors. Generally, the water master is only hired for the irrigation season which runs from May through October.

The water master’s job is to operate the canal to assure that all of the canal’s patrons receive their share of the water. The water master’s responsibilities include taking daily water orders from his irrigators and placing a water order with the Great Feeder water master 24 hours in advance. He also adjusts control structures in his own canal to assure that individual irrigators on his canal receive the water they order.

Daily water orders from each canal’s water master are sent to Water District 01 who compiles these orders and, in turn, places orders with the Bureau of Reclamation for releases from the several storage reservoirs in the Upper Snake River Basin. The Water District is the entity sanctioned by the Idaho Department of Water Resources to oversee water distribution within the Upper Snake Basin. The District encompasses over 1 million irrigated acres and more than 120 measured diversions. District 01 is headed by a watermaster who is considered a state employee but is elected and compensated directly by district water users. Proper water distribution under Idaho’s prior appropriation system is the primary goal and responsibility of the District. Daily monitoring of natural stream flows, reservoir storage, and irrigation diversions are the primary duties of the watermaster and staff. All of these elements must be taken into account to assure proper water use accounting under the complex system of priority dates and decreed water rights for natural flow and reservoir storage.

Canal System Challenges

Canal companies along the Great Feeder face several operational challenges. By virtue of the Feeder’s location just 30 miles downstream of Palisades Dam, flows in the Snake River at the Great Feeder headworks can vary substantially with changes in water releases. These flow adjustments at the dam and diversion changes at any of several large canals upstream of the Feeder can cause significant fluctuation in the river level and subsequent changes in the rate of diversion into the Feeder. Additionally, flow changes at any of the larger diversions along the 30-mile Great Feeder can impact downstream diversions.

The headgates on the Great Feeder are also subject to large accumulations of woody debris, particularly when the Snake River flows run high. These accumulations can
partially block portions of the headworks and impact diversions. High flows, often greater than 20,000 cfs, occur during flood control releases from Palisades Dam and generally occur during the irrigation season in May and June. During high flow periods, Feeder operators occasionally station an excavator at the headworks to remove debris. High conveyance losses are another challenge faced by most Great Feeder canals. Because most of the area served by the Feeder is made of alluvial material, seepage losses are high. Some high-value crops, such as corn and potatoes are difficult to grow in this area because of the porous, rocky soils. Due to high conveyance losses, large flows are necessary at the head of the canal systems to assure adequate flow at the end. Historic annual diversions of many canals in the area are as high as 12 acre-ft per acre, with less than half of the diverted water reaching the farms. Seepage accounts for 30-40% of the conveyance losses. Seepage from area canals supports local shallow aquifers as well as the 10,800 square-mile Eastern Snake Plain aquifer that covers much of south-east Idaho.

Due to age of the canals, severe winter weather, and partially due to the local farm economy, many canal structures in the area have deteriorated and are in need of rehabilitation. This problem has been exacerbated by recent low commodity prices and a number of drought years, starting in the early 1990’s. It is difficult to adequately manage canal flows with the existing aging infrastructure. Additionally, few of the canals were constructed with accurate water measurement. The original measurement stations tend to “shift” or lose accuracy as vegetation increases in and along canals as the irrigation season progresses. The lack of accurate water measurement limits how precisely canal operators can regulate their distribution systems.

The Burgess Canal is the largest canal diverting from the Great Feeder, with a capacity of 1100 cfs at its head. The 22-mile long Burgess distributes water to 22,000 acres of farmland through a system of 15 large lateral canals and 12 smaller laterals. Because of the Burgess Canal’s large capacity and its location near the upper end of the Feeder, diversions from the Feeder were difficult to regulate. The Burgess typically took the brunt of planned or unplanned flow changes on the Feeder. Additionally, the Burgess headgates, located on an outside bend of the Feeder were subject to accumulations of debris which would partially block one or more of the 4 radial gates.

**CANAL SYSTEM IMPROVEMENTS**

In 2000, the board of the Burgess Canal & Irrigating Company (BCIC) started what became a 9-year program to improve the operations of the company’s distribution system by improving water control and measurement. The board hoped to address problems with variable canal flows, water shortages at the tail end of the system, and aging control structures. This process began at the head of the canal and worked downstream.

Prior to the 2001 irrigation season, the BCIC made significant concrete repairs and upgrades to the existing headgate structure, originally constructed in 1929. The four radial control gates at the structure were replaced by new steel slide gates. Two of the new gates were operated by AC-powered actuators, the other two with manual operators.
To help eliminate the problem with accumulation of floating debris on the upstream side of the gates, BCIC installed a 48-ft trash diverter across the entrance of the headworks structure.

The trash diverter has a reinforced steel plate that extends approximately 2 ft down from the upstream water surface. The diverter is angled slightly toward the center of the Feeder to deflect debris away from the Burgess headworks. This serves to reduce debris accumulation and to protect the automated gates from being damaged. The Great Feeder Canal carries water most of the year, so much of the construction was planned for the 2-week period when the Feeder is shut off for maintenance every March.

During the 2001 season, a Sutron 8200 programmable logic controller (PLC) was connected to the 240VAC Limitorque motorized actuators. The PLC was programmed to automatically adjust the gates to maintain a preset water level at the rated measurement section in the canal just downstream of the headgates. After some initial calibration problems, the automated gates did an excellent job of maintaining the desired diversion rates and the trash diverter kept most of the debris away from the headgates. Unfortunately, 2001 was an extremely dry year and the Burgess Canal irrigators used up their entire allotment of reservoir storage by September 8 and were forced to end the irrigation season.

Following the 2001 irrigation season, the Island Irrigation Company, with technical assistance from the Bureau of Reclamation, automated one of three existing gates on the Company’s diversion structure downstream from the Burgess Canal on the Feeder. This project utilized a 12-volt solar-powered gear motor and a Campbell Scientific CR10 data logger for a gate controller. The system was designed to adjust diversions to compensate for water level fluctuations in the Feeder as well as flow changes in the smaller Dilts Canal that splits from the Island Canal just below the headgate structure. This structure was operated without telemetry during the 2002 irrigation season. A laptop PC was used to make adjustments on-site. Prior to the 2003 season, the irrigation company added analog cell phone communications to incorporate remote operations and monitoring.

Diversions into the Burgess Canal were automatically regulated throughout the 2003 irrigation season. Diversions were maintained within 5 cfs or less of the desired level, despite normal fluctuations of flows in the Great Feeder. Prior to automating the gates, flows at the head of the Burgess Canal could vary as much as +/- 40-50 cfs with Feeder flow variations. While this improved the Burgess operations, this also caused greater water level fluctuations in canals diverting from the Great Feeder Canal downstream of the Burgess. By virtue of its large size and position near the head of the Great Feeder, the Burgess Canal dampened many of the impacts of flow changes in the Feeder for downstream diverters. With continuously regulated Burgess diversions, downstream diverters experienced greater impacts.

In 2003, the Burgess Canal began automation water control sites further down the canal system. The first canal site automated was the Midway structure, where four delivery canals, ranging from 20 to 160 cfs capacity, bifurcate from the main Burgess Canal,
located approximately 16 miles from the head of the canal. The original concrete structure included manually operated wooden slide gates to regulate flows into each of the distribution canals. Water levels upstream of the structure were regulated with wooden check boards and a 15-ft steel slide gate. Because of the relatively shallow canal depths at the site, small water level fluctuations upstream of the check tended to cause significant fluctuations in delivery canal flows. As with the Burgess headworks, the Midway structure tended to accumulate woody debris, impacting canal operations.

The Midway structure was rehabilitated prior to the 2003 irrigation season. Damaged concrete piers were repaired and wooden slide gates were replaced with new steel slide gates. A steel overshot gate replaced the wooden stoplogs in the main check. All of the gates were motorized using 12V DC actuators made by the C.I. Automation Company. These actuators, which include integral limit switches and position indicators, are similar to devices originally used to move early satellite dishes and slide outs in recreational vehicles. The structure is controlled by a Campbell Scientific CR10X data logger. Pressure transducers measure water levels upstream of the structure. This water level data and data from position sensors on the delivery canal headgates are used in an orifice formula to estimate flows below the gates.

The Burgess Canal Company has continued to rehabilitate and automate all of the major control structures along the canal and is planning on completing the project in early 2010. When completed, the BCC will have automated 31 gates at 17 sites on their distribution system. Beginning in 2004, the BCIC began the installing spread-spectrum radio (SSR) communications at all of their automated structures, enabling the company’s water master to monitor the sites and make any adjustments remotely. The radio link also provides the operator with instant notification of any unusual circumstances at any of the sites. Additionally, the BCC constructed a broad-crested weir or ramp flume at the head of the main canal to obtain more accurate water accounting.

Other canal companies along the Great Feeder have also upgraded their distribution systems in the past 10 years by automating control gates, installing telemetry and building new ramp flumes. Much of this work has utilized financial assistance from the Bureau of Reclamation’s Water Conservation Field Services Program. The recipients of the federal assistance matched at least 50% of the total project costs with their own cash and in-kind services. Table 1 lists the entity and their related projects.
Table 1. Summary of Irrigation System Improvements Along the Great Feeder From 2000-2009

<table>
<thead>
<tr>
<th>Entity</th>
<th>Acreage served</th>
<th>System improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burgess Canal &amp; Irrigation Company</td>
<td>22,000 ac</td>
<td>17 automated control sites, ramp flume, radio telemetry, debris diverter at canal headworks</td>
</tr>
<tr>
<td>Harrison Canal Company</td>
<td>13,000 ac</td>
<td>Automated canal headworks with diverter, radio telemetry, ramp flume</td>
</tr>
<tr>
<td>Island Canal Company &amp; Dilts Irrigation Company</td>
<td>4,400 ac</td>
<td>Automated headworks, debris diverter telemetry, ramp flume</td>
</tr>
<tr>
<td>Lowder Slough Canal Co</td>
<td>1,200 ac</td>
<td>Automated canal headworks, ramp flume</td>
</tr>
<tr>
<td>Parks &amp; Lewisville Irrigation Company</td>
<td>11,500 ac</td>
<td>Automated canal headworks with diverter, ramp flume</td>
</tr>
<tr>
<td>North Rigby Canal Company</td>
<td>1,200 ac</td>
<td>Automated canal headworks with diverter, ramp flume</td>
</tr>
<tr>
<td>Clark &amp; Edwards Canal Co.</td>
<td>1,700 ac</td>
<td>Automated canal headworks with diverter</td>
</tr>
<tr>
<td>Labelle Irrigation Company</td>
<td>2,900 ac</td>
<td>Ramp flume</td>
</tr>
<tr>
<td>Long Island Irrigation Co. &amp; West Labelle Irrigation Co.</td>
<td>12,000 ac</td>
<td>Automated canal headworks with diverter</td>
</tr>
<tr>
<td>Great Feeder Canal Company</td>
<td>81,000 ac</td>
<td>Two automated diversion gates, telephone/radio telemetry, floating debris diverter on Snake River</td>
</tr>
</tbody>
</table>

As indicated in the table above, many of the canal companies have improved their water measurement capabilities by constructing ramp flumes, in most cases at the head of their canals. Most of the flumes were designed by Water District 01 staff as part of the District’s efforts to improve water use accounting. Flow information from most of these flumes is transmitted to the District via satellite through the Bureau of Reclamation’s Pacific Northwest Hydromet system.

Initially, many automated sites used telephone telemetry, either via land lines or analog cell phone. As the Burgess Canal expanded their automated system, they moved to spread-spectrum radio communications. Due to the local terrain and many trees, several 20-30 ft towers were needed to provide adequate radio coverage. As analog cell service was eliminated, other companies converted their communications to SSR as well. Since all of the canal companies in the area were using Campbell Scientific controllers and radio equipment, other companies’ sites could be used as repeaters to relay radio transmissions. To date there are 21 SSR sites along the length of the Great Feeder.

**BENEFITS OF SYSTEM IMPROVEMENTS**

All of the Great Feeder irrigation companies have benefited from their recent system improvements, individually and collectively. Automated gates have given the canal operators the tools to better control their distribution systems. Eight of the major canals that divert from the Feeder have automated their headworks, eliminating much of the
problems associated with flow variations in the Feeder. This alone has provided much more stable farm deliveries to their irrigators. Since 2006, when two of the Feeder’s eight gates were automated, diversions into the Great Feeder have been much steadier as well, reducing the impacts of fluctuating flows in the Snake River below Palisades Dam. Benefits have included:

**Reduced Diversions:** Better water control has significantly reduced the conveyance losses in the individual distribution systems. Traditionally, the canal companies diverted extra water into their canals to avoid delivery shortages at the end of the system. Regulated diversions have eliminated the need for most of this extra water, much of which spilled into drains and wasteways. More efficient water distribution has helped to improve the available water supply. By lowering diversion rates early in the season, more reservoir storage is available for use later in the season. In drought years, many canals in the area ran out of water in August.

Prior to the system rehabilitation, operators estimate that daily operational spills from various points within the Burgess Canal distribution system totaled 25,000-30,000 acre-ft of water over the course of the irrigation season. This can be attributed to diverting as much as 100 cfs more than was actually delivered to farms. This extra water was diverted to assure adequate deliveries and to help compensate for the inevitable flow fluctuations caused to the lack of adequate water control at the head of the canal and within the distribution system. Currently, spills from the Burgess system have been reduced to minimal amounts while still providing adequate farm deliveries. This has enabled the company to utilize much of the “saved” water late in the irrigation season to extend the irrigation period and to assure full, late-season deliveries.

Other canals along the Great Feeder have been able to reduce operational losses through improved measurement and control of their distribution systems. While improvements on other canals have not been as extensive as on the Burgess, all have improved the efficiency of their operations and experienced similar benefits. Operational spills have been reduced, diversions into the distribution systems are accurately regulated, and irrigators receive more uniform deliveries at their headgates.

**Improved Water Supply:** Additionally, unused reservoir storage can be carried over into the following year, increasing the next year’s water supply reliability. Unused reservoir storage can also be leased to others water users in the basin through the Water District 01 water bank. This allows the water to be leased to other irrigators, but for other uses including hydropower generation and augmenting Snake and Columbia River flows for downstream migration of endangered runs of salmon and steelhead smolts. Revenues from water bank leases can also provide a cash stream for lessors to help fund additional distribution system improvements.

**Improved Facility Operations:** The trash diverters installed at many of the sites have done an excellent job of preventing accumulations of debris at control structures. This has not only eliminated debris-caused flow restrictions, but has also protected the automated gates from damage. Additionally, telemetry at the structures can notify
operators of unusual conditions, such as high water levels or non-functioning gates as soon as the problem occurs.

The automated gates have also reduced the time and travel required to operate the canal systems. In the past, canal operators made several trips a day to the headworks to make manual adjustments and then follow the flow change down the system, making adjustments at downstream control structures. With automated gates, the flows are regulated around the clock and can be kept much more constant. With telemetry, operators can check canal conditions at the site and make adjustments remotely.

**The Burgess Canal Experience**

The Burgess Canal & Irrigating Company began to see efficiency improvements in 2001, the first year of the company’s multi-year improvement program. The trash diverter kept most of the large woody debris away from the canal headgates all season. In past years, it occasionally was necessary to bring in a hydraulic excavator to clear large debris from the canal headgates. One of the two motorized headgates was automated mid-season and was able to greatly reduce the swings in canal flows caused by flow changes in the Feeder. Prior to automation, the BCIC estimates that spills from these Feeder fluctuations resulted in cumulative losses of 6000 to 8000 acre-ft over a typical irrigation season,

As the BCIC began automating other control structures in the distribution system, the company’s water master was able to better regulate flows in the main canal and in smaller distribution laterals. The system was able to automatically respond to flow variations caused by daily irrigation demand changes. Flows could be more closely matched with on-farm demands, virtually eliminating the long-standing practice of supplying (and spilling) extra water to avoid shortages at delivery points. The Company estimates that this added water resulted in nearly 100 cfs being lost to spills and additional seepage, or 25,000 to 30,000 acre-ft per year.

The Burgess water users have received other benefits from the system improvements that are more difficult to quantify, but are nonetheless important. The construction of the ramp flume at the head of the canal significantly improved the accuracy of the Burgess diversion measurement, yielding more accurate water accounting and better regulation of the diversion by the automated gates. Reducing flow fluctuations in the canal system has reduced erosion in the canal banks. The telemetry system enables the canal operators to monitor and adjust control structures remotely, saving time, fuel and mileage. The remote monitoring and control capabilities, coupled with better handling of floating debris, enabled the company to reduce its Watermaster position to part-time in 2009.

The cumulative effect of all of the BCIC’s efficiency improvement efforts has been to improve the water supply reliability for the company’s irrigators. This could be best illustrated during the 5-year drought period from 2001-2005. During these years, the company was able to stretch reduced water supplies through the whole growing season. This is unlike earlier drought years when the company ran out of water as early as July.
For the past four years, water supplies have been better and the BCIC has not used its full allotment of reservoir storage. This has enabled the company to carry this water into the next year. This not only improves the reliability of supplies for Burgess shareholders, but also enables the company to lease water, through the Water District 01 water bank, to other canal companies for irrigation or to utilities and government agencies for hydropower and environmental purposes. Improved water supply reliability has also increased cropping options for irrigators, enabling them to consider longer season crops, such as potatoes and corn, with less risk of water shortages.

While none of the other canal companies on the Great Feeder have rehabilitated and enhanced their distribution systems from top to bottom like the Burgess, all of the companies have experienced the same types of benefits from improved water measurement, improved water control, automation and telemetry. Additional work is still underway by several companies. With multiple canal companies involved with similar and related projects, another unintended benefit has been increased cooperation and interaction between the various irrigation entities along the Feeder.

**SUMMARY**

The Great Feeder Canal and the smaller irrigation canal systems that it serves were developed in the late 1800’s in Eastern Idaho near the town of Rigby. The Great Feeder, with a capacity of over 5000 cfs, delivers water to 14 major canals and 26 smaller canals. Due to age of the canals, severe winter weather, and partially due to the local farm economy, many canal structures in the area deteriorated and were in need of rehabilitation. Canal system operators struggled to deliver water efficiently and meet the needs of their share holders, particularly in drought years.

In the past 9 years, the Burgess Canal and 12 other canals in the area have improved system operations through improved water control and measurement. Major control structures were rehabilitated and automated using durable, low-cost components and radio telemetry. Ramp flumes and other measurement devices were installed at the head of the main canals and other laterals to better manage flows. Steel trash diverters were installed to protect automated gates from accumulation of debris.

These efforts have resulted in improved operational efficiency and better service to their water users. Benefits have included:

1. **Increased water use efficiency** – Prior to these improvement projects, excessive operational losses reduced available water supplies and frequently caused late-season water shortages and reduced crop yields. These recent improvements have provided system operators with effective tools for managing their distribution systems and reducing losses. Also, accurate measurement helps canal operators better match canal flows with on-farm demand.

2. **Improved supply reliability** – Improved efficiency has helped to increase available water, effectively extending the length of the irrigation season in poor water years.
Better late-season water supplies have given farmers more crop choices. This has reduced the risk of planting more long-season crops such as potatoes, corn and alfalfa. Additionally, improved efficiency has increased the likelihood of carryover reservoir storage available for use in the next water year.

3. **Reduced operational costs** – The staff time and travel expenses of distribution system operators have been reduced substantially. Automated control structures have eliminated frequent trips to control structures to make manual adjustments. Telemetry permits operators to see the entire system at a glance, saving travel and spotting potential problems before they become serious.

4. **Improved cooperation between local entities** – The combined effort of the various independent irrigation entities has had the unplanned benefit of instilling more cooperation within the canal companies along the Great Feeder. Many of the canal companies are now working more closely on water operations and maintenance issues. There is a good deal of communication between the companies as they learn how to best use their new technologies.

**DISCLAIMER**

The information contained in this report regarding commercial products or firms may not be used for advertising or promotional purposes and is not to be construed as an endorsement of any product or firm by the U.S. Bureau of Reclamation or the Burgess Canal and Irrigating Company.
Figure 1. Headworks of the Great Feeder Canal along the Snake River, near Ririe, Idaho. Two gates at left were automated prior to 2007 irrigation season.

Figure 2. Upstream side of Burgess Canal headworks, July, 2000. Note deteriorated concrete and accumulation of woody debris. Windlass-style hoist operated four radial gates under concrete deck.
Improving Operational Efficiencies of Irrigation Canals

Figure 3. Rigby Canal headworks prior to rehabilitation and automation.

Figure 4. Rehabilitated Rigby Canal headworks. Project also included upstream trash diverter and downstream ramp flume.
Figure 5. Two automated gates controlling flow at Burgess Canal Midway structure. Overshot gate at right regulates pool height and passes debris. Slide gate at left regulates main canal flows. Smaller gates at left control flow into delivery laterals.

Figure 6. Steel trash diverter to deflect debris in the Great Feeder away from Clark & Edwards Canal headworks. Debris continues downstream over check structure at right.
Figure 7. Automated overshot gate at last control structure on the Burgess Canal. Spills can be measured as flows pass over gate. Debris is diverted over the gate and can be collected in normally dry wasteway below.

Figure 8. Automated headgate for small delivery lateral on the Burgess Canal. Gate position transducer and water level sensors in both upstream pool and on downstream side of the slide gate permit flow calculations.
Figure 9. Ramp flume at the head of the Burgess Canal. Flow data is used for controlling automated headgates. Fifteen-minute average flow measurements are transmitted via satellite to Water District 01 for water accounting every four hours.