TRUCKEE-CARSON IRRIGATION DISTRICT TURNOUT WATER MEASUREMENT PROGRAM

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ABSTRACT

The Irrigation Training and Research Center (ITRC) has been working with TCID and USBR as part of the Newlands Project in the Truckee and Carson River basins of California and Nevada. In 1997, ITRC developed a volumetric measurement program to provide documented and reasonably accurate turnout delivery measurements in TCID. This program has involved a series of steps for implementing a volumetric water measurement program, including elements for categorizing, prioritizing, designing, and installing flow measurement devices at turnouts that account for 75% of deliveries (by volume). Since that time, TCID has incorporated ITRC recommendations and has greatly exceeded expectations. As a result of this Water Measurement Program, TCID and USBR have jointly advanced the water measurement program to a point where an accuracy of +/-10% has been achieved on many of the district turnouts.

INTRODUCTION

The Irrigation Training and Research Center (ITRC) of California Polytechnic State University, San Luis Obispo, has been working under a technical assistance contract with the Truckee-Carson Irrigation District (TCID) to provide technical support and training to improve the performance of the Newlands Project in conjunction with other agencies. The Newlands Project has included projects related to water measurement, canal modernization, operational strategy and resource planning, on-farm water management, and SCADA systems.

Background

The Newlands Project is located in the Truckee and Carson River basins of California and Nevada as shown in layout map in Figure 1. Water used for irrigation on approximately 73,700 acres of water-righted land is diverted from both the Truckee and Carson Rivers. There are approximately 391 miles of main canals, laterals, and sub-laterals that deliver irrigation water to an estimated 1,500 farm head gates. Lahontan Valley wetlands, including primary wetland habitat in the Stillwater National Wildlife Refuge and Management Area and the Carson

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Lake Pasture and Marsh, and numerous "secondary" wetlands habitats, are included in the project.

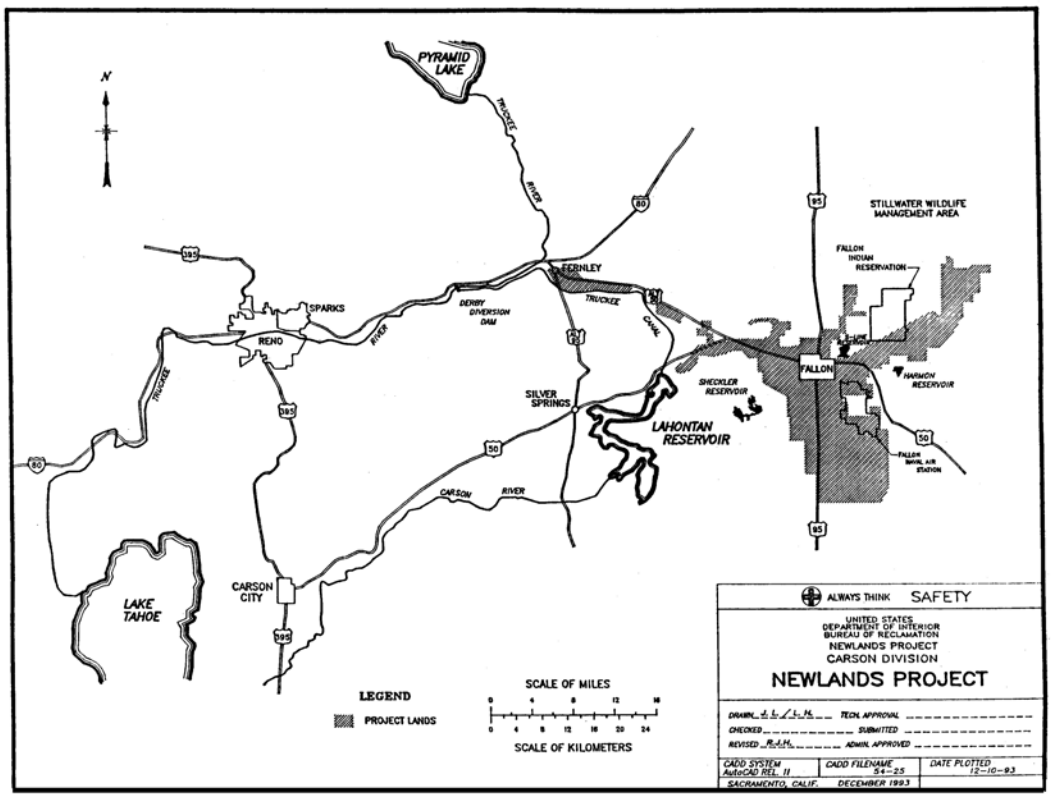

Figure 1. Newlands project layout map.

The Newlands Project is governed by an Operations and Maintenance Contract (no. 7-07-20-X0348) between the United States Bureau of Reclamation (USBR) and TCID, which was signed in 1996 and approved by the Nevada 3rd Judicial District Court in 1997. The O&M Contract contains a Water Management provision that requires the preparation of a Water Conservation Plan, continuation of a water measurement program, and the establishment of a Water Conservation Fund, among other obligations. In addition, the Operating Criteria and Procedures (OCAP) approved in 1998 and incorporated into Public Law 101-618 sets forth provisions for calculating the maximum annual allowable entitlements and implementation of conservation measures to improve project efficiency, including penalties and incentives related to phased efficiency targets. In a full entitlement year, the established target for project efficiency is 68.4% after a phased-in period.

The Volumetric Measurement Program

In 1997, ITRC was asked to develop a volumetric measurement program to provide documented and reasonably accurate turnout delivery measurements in TCID. The resulting ITRC study listed a series of steps for implementing a volumetric water measurement program, including elements for categorizing, prioritizing, designing, and installing flow measurement devices at turnouts that account for 75% of deliveries (by volume). To fund these activities, TCID committed the entire Water Conservation Fund established under the O&M Contract to the water measurement program. The water measurement program requirements as outlined by ITRC in March 1997 are outlined in Table 1.

Table 1. Original water measurement program requirements.

Step 1	Categorize the turnouts	• Location/available head • Delivery life (based on lands that may be sold for water rights) • Probability of errors
Step 2	Develop software and procedures for recording volumes	• Review of electronic measurement devices • Review of potential sites to demonstrate units • Incorporate data into existing water delivery procedures
Step 3	Categorize/prioritize the turnouts	• Ten categories based on criteria
Step 4	Develop timelines and verification procedures	• To be completed after Steps 1-3 are finished
Step 5	Design new structures	• Complete site investigations • Need at least one person to complete this task
Step 6	Install new structures	
Step 7	Train operators	• Includes both field operators and office staff • Modified operation will need to be incorporated into billing
Step 8	Compare results	• Compare historical delivery data to new data • Verify procedures
Step 9	Re-assess the program	• Annual re-assessment required • Evaluate TCID's actions

Evaluation Approach

In order to make appropriate recommendations for district improvement, it was necessary to complete a preliminary water balance and water quality analysis. The water balance analysis was based on USBR water budget guidelines, modified to more appropriately follow what was actually occurring within the district. One of the major recommendations for the district included enhanced monitoring of district inflows and outflows to improve future water budgets.

The water balance was completed for 1994 to 2000. 1993 was the last year of a 7 year drought the plagued the western U.S. During this time the wetland acreage dropped to as low as 2,400 acres in the entire valley. Since the end of the drought, the wetland acreages and depleted lakes and reservoirs have been steadily increasing in size within the water budget boundaries increasing the overall storage within the district boundaries.

During 1999 and 2000, a total of 352 sites were evaluated and categorized. The completed review concluded that while Replogle flumes were a viable option for approximately 42% of the sites evaluated, this method of flow rate measurement could not be used at every turnout.

Taking into account the information gained from the water balance and a water quality analysis, as well as the current level of system performance and the cost-effectiveness of installing flow measurement devices, ITRC identified recommendations for TCID as part of an updated operational plan. These recommendations involved several water management and hardware options, including:

- Automated control structures
- Communication systems
- Flow measurement devices (Replogle Flumes and Doppler meters)
- Water level control options
- Recirculation facilities

Figure 2. Flow measurement flume at TCID.

RESULTS

As required in the Water Management provisions of the O&M Contract, the district has implemented the recommended water measurement program and cooperated with annual reassessments of related activities.

TCID is one of the few irrigation districts in the Western US that has taken the extra steps required to measure water accurately to the farm using traditional water measurement structures. The results of their overall efforts can be clearly seen in the reductions of diversions from the Lahonton Reservoir (Figure 3).

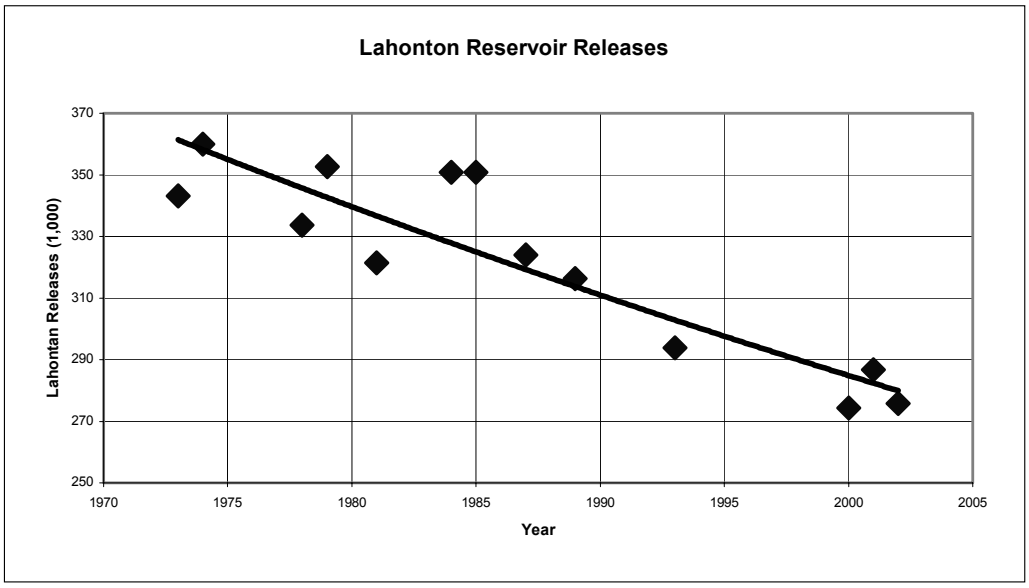

Figure 3. Reduction of annual diversions from Lahontan Reservoir from 1978 through 2004 (USGS).

Following ITRC recommendations through the Turnout Water Measurement Program, TCID has accomplished and continues to achieve the following:

- Prioritization of turnouts for inclusion in the water measurement program and installation of Replogle flumes at high priority locations.

- Investigation of new electronic Doppler flow meters for non-standard turnout sites, as well as laterals and major diversion points in the district.

- Construction of a team of technicians with responsibility for current meter verification and calibration.

- Dedication of the appropriate level of resources for ongoing activities related to the water measurement program, such as flushing stilling wells, removing

moss and debris from stations, changing batteries, collecting data, calibrating stations, and repairing devices.

As a result of this Water Measurement Program, TCID and USBR have jointly advanced the water measurement program to a point where an accuracy of +/-10% has been achieved on many of the district turnouts. In the past several years, TCID has actually surpassed the requirements imposed upon the district, and has implemented each step of the Water Measurement Program quicker than expected (Figure 4).

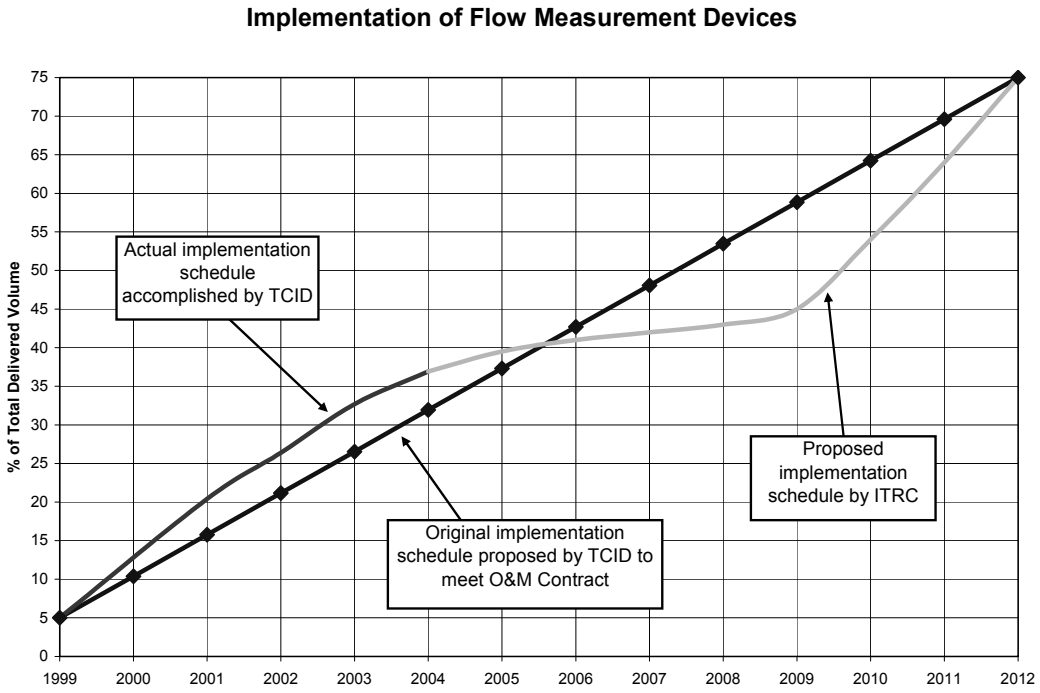

Figure 4. Implementation schedule for water measurement devices since 1997.

CONCLUSION

Both TCID and USBR recognize the critical need to develop new strategies for improving project efficiency. To address this situation, the ITRC has recommended that a comprehensive study be conducted that examines what has been done to date as a result of the Water Conservation Plan and prioritizes future actions as part of an overall strategy to improve project performance.

This type of modernization evaluation requires a holistic approach that takes into account the current level of system performance and the cost-effectiveness of installing additional flow measurement devices at this time. The proposed study will identify modern water management and hardware options (control structures, communication systems, flow measurement devices, recirculation facilities, etc.)

and make recommendations for implementing these options as part of an updated operational plan. It is essential that hardware or automation recommendations be linked to a feasible operation plan if the investment is to provide maximum benefits.

There are two considerations that suggest a fresh look be taken at modernization options:

1) The cost of flow measurement sites (including design, data collection, site surveying, construction, calibration, and maintenance) has exceeded by a significant amount the initial estimates in the Water Conservation Plan, and furthermore, the next level (priority 2) will likely have an even higher cost to measure a relatively smaller volume of delivered water
2) TCID has exceeded the mandated OCAP efficiency with only the priority 1 flow measurement devices installed (55 devices). This re-assessment of priorities would ensure that the best possible use is made of limited resources – funding, staff time, and technical assistance.

By continually re-assessing the water measurement program at TCID, it is ensured that the district will be offered the most up-to-date and accurate recommendations to improve its modernization efforts. The district and USBR's willingness to participate in such a far-reaching program indicates that even far better water conservation successes may be achieved through this combination of cooperation, research, and implementation.