

# Water Operation and Maintenance Bulletin



*"Everyone one I spoke to said that they really got a lot out of the training. It's great the way you guys recognize the long-term employees. I will continue to send our guys."*

John Chappellear, Superintendent,  
General Water Operations & Maintenance, North Division Imperial Irrigation District



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**RECLAMATION**  
Managing Water in the West

Keep Your Home Safe by Keeping Embankments Clear



## About this Bulletin

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*Thank you.*

## *On the Covers:*

*Front: Canal Maintenance Training*

*Back: Job Hazard Analysis*

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# Learning to Be the Best

## Recent Canal Operators and Maintenance training

Reclamation held Canal Operator Training and Canal Maintenance Training classes in five locations from December through February 2017, training almost 400 canal operators from irrigation districts ranging from small to large. Reclamation's Office of Policy and Administration funded the courses, which members of the Technical Service Center (TSC) Water Conveyance Group developed and taught.

The classes were interactive and provided real-world examples of improper/proper operations and maintenance practices, failures, and lessons learned. Participants shared their knowledge and experience, providing insights that TSC staff captured and passed on to further training sessions. The diverse range of experience among the participants was impressive; some were new in the field (one hired that morning) and some had over 40 years of experience. In one session, three canal operators represented over 120 years of experience. Staff with over 40 years of experience were recognized for their dedication and were also encouraged to pass on their experiences and knowledge to the next generation of staff. Newer staff members were also encouraged to ask questions and learn from those with experience so that they can be better equipped to ensure proper care of the nation's critical water conveyance infrastructure.

Feedback from these courses showed that participants gained a great deal of knowledge, with consistently high ratings for the ease of understanding, the right amount of time, helpful discussions, and usable advice. Other positive comments on the course included:

- Good instructions. Time very well spent. Very helpful and fun.
- Well presented, good interaction and getting the audience involved.
- Enjoyed the way safety was incorporated.
- Very informative.

Participants also provided feedback to improve future training opportunities. Participants requested: more case studies and real experiences on projects with pictures; more information on moss control and removal, rodent control, repairing leaks and seeps, controlling livestock (sheep and goats) on canals, handling lower recharge rates with more efficient canals, and more specific applications of products that have worked for canal maintenance; for Reclamation to work more closely with irrigation district's in the future to identify their needs.

These training classes are updated regularly. Classes for Winter 2018 are planned for southwest Oregon, northern California, central California, and Nevada. Please submit issues, activities, and successes that you want to share with other districts to [drowateroandm@usbr.gov](mailto:drowateroandm@usbr.gov).

### For more information contact:

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303-445-2941, [cvick@usbr.gov](mailto:cvick@usbr.gov)

*Chris Duke and Rolf Swainston did a great job of engaging with our stakeholders and in teaching these classes. We were fortunate to have their support/expertise and are grateful for that. We look forward to their future support as there is a definite interest in having this again.*

Alexander Belous P.E.  
Manager, Construction  
Services Group  
Bureau of Reclamation  
Yuma Area Office



*TSC's Chris Duke engaging with class participants during the Canal Operator Training. Photo by Julian Higuera, January 18, 2017.*

Canal Maintenance:  
Vegetation



Canal Maintenance:  
Burrowing Animals



Canal Maintenance:  
Concrete Lining and Structures



Canal Maintenance:  
Embankments



Canal Mechanical and Electrical  
Equipment  
Maintenance, Inspection, and Testing:



# Operations, Maintenance, and Repair Manuals

## Animal, Vegetation, and Concrete Manuals Debut

Reclamation will soon release a series of Operation, Maintenance, and Repair/Replacement manuals for water districts who operate Reclamation canals: Vegetation Control, Burrowing Animal Control, Concrete, and Mechanical Equipment. These manuals are based on Reclamation and districts' experience and expertise, and research into successful strategies. These manuals can help irrigation and water districts identify issues within their respective systems, and to plan, budget, and prioritize actions to address these issues. The manuals contain pictures identifying problems, helpful techniques to prevent these problems, and guidance on solving problems.

The **Vegetation Control** manual covers recommendations for vegetation management and control—from preventing vegetation on overtaking canal systems to what to do when vegetation gets out of hand. The manual covers regular maintenance, such as mowing, and periodic maintenance, such as tree removal and repair.

The **Burrowing Animal** manual explains when animals can threaten the canal system and how to discourage incursions and address problems. The manual also covers repairs after the animals are eradicated.

The **Concrete** manual provides a background on common concrete issues and how to identify problem areas. This guidance on repairing concrete will help your structures stay ship-shape and ready to serve.

The **Mechanical Equipment** manual covers general issues such as corrosion, coatings, and lubrication as well as specific guidance for operating, inspecting, testing, and maintaining gates and valves, pumps, and electrical issues.

The **Embankment and Seepage** manual explains the three most common causes of seepage and canal breaches: seepage through the embankment and foundation, slope instability, and surface erosion. It also provides pictures of each type of issue and ways to detect, identify, and prevent problems from reaching catastrophic levels.

### For more information contact:

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# Canal Automation

## Smooth Operators Use SCADA

"Technology does not take away the need for operations, It just helps you operate better," Justin Harter, Naches-Selah Irrigation District (NSID) Manager explained in a recent interview. His district manages a 120-year old system serving 11,000 acres in Yakima County, northern Washington. Large canal water level fluctuations and spills were common as there was no formal water ordering system and steep canal and conduits were incorporated in the main canal.

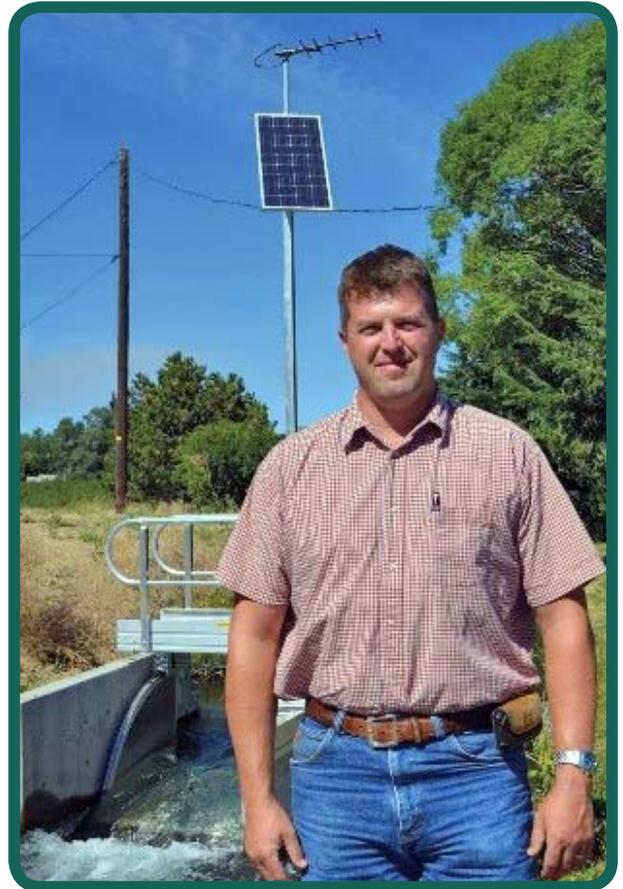
Physical improvements to the system (a gravity flow waste pipeline and reregulating reservoir) were too costly. So NSID identified the areas that could benefit most from an automated system and worked closely with a Supervisory Control and Data Acquisition (SCADA) manufacturer to install gates at the flumes along the main canal and use a SCADA system to operate the canals. As large, unplanned changes in delivery flows required operator attention 24 hours a day, NSID developed automated operations for 8 miles of the main canal. Now NSID has 20 sites that use control software to automatically coordinate with each other and adjust continually.

Benefits include:

- Simplifying the management of a complex system
- Immediately improving service
- Maintaining canal water levels generally within an inch
- Improving operators' safety and lifestyle as they no longer need to make manual gate adjustments 24 hours a day.

Justin shares these insights from the NSID journey into the automated age:

- Do not reinvent the wheel when planning your system. Know how you operate now and program the canal operations to reflect your needs.
- Take it slowly and start small. We phased this in, starting in 2007 and took five years until 2012 to go to full automation.
- Do not be intimidated by the technology.
- Partner with a reliable firm. Use their solutions.
- Build on success. Identify what works and build on that.
- Money is the easiest deciding factor. Determine what you can afford and prioritize what would provide the best help in your overall system.



*Justin Harter, NSID Manager.  
Photo courtesy of Rubicon,  
all rights reserved.*

### For more information contact:

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509-697-4177, [justinh@n-sid.org](mailto:justinh@n-sid.org)

## Strategies for Successful SCADA Systems

**H**ave you ever looked at a neighboring district and envied their healthy, successful SCADA system? What a great setup, where you can lean back, push a button, and everything is done for you! How wonderful it would be to know everything about the canal system immediately and accurately. What a life, and you wish you had exactly that. Well. . . not so fast. What works for one district works for that one district—because every district is unique and has a specific way of running things, particularly addressing their little trouble spots.



*Water flow rate is measured at a newly installed long-throated flume in the Pima Canal on the Indian Unit of the Reservation Division of the Yuma Project, Arizona. Water depths are measured upstream from the flume and in its throat, and flow rate is calculated before being logged on-site and transmitted by radio to the office base unit.*

But you can develop a SCADA system that works for you. First, figure out your **objectives**. A successful system should work for you and meet your needs. Ask what you want the SCADA system to do for you—where are you wasting many staff hours traveling, fixing, going back, changing operations, and on and on and on? Where are the risky areas that keep you awake at night—if that gate failed again, if that check broke, or if that vandal came back again. Wouldn't it be nice to have eyes on that spot 24/7? Or, do you struggle to document the diversions and deliveries that were made and really need help with logging and recording those flows?

Understanding the **hydraulic behavior** of your water delivery system is also important from the outset. The most crucial points affecting water delivery will often depend on how the original delivery system (canals and pipelines) was designed and constructed and how canal pools behave from a hydraulic standpoint. Training offered by Reclamation's hydraulics laboratory can help identify the pinch points in your system and provide ideas for better ways to move water through the system, some of which are much more feasible with a good SCADA system.

Next, look at **your existing infrastructure and other resources**. If you already have a SCADA system that needs upgrading, consider the value of maintaining compatibility with existing software or hardware. The communications component of the system is especially important, as it is the backbone of your SCADA operation. A good system must reliably transmit data and possibly operational commands. So, what type of communication system already exists or would work well for your needs? Is there good radio or cell phone coverage? Do you need hard-wired communications in some areas? Could a satellite-based system that provides periodic data updates rather than continual coverage meet your needs? What security concerns need to be addressed to ensure your system's safety?

Think about **the people** who will build, use, and maintain your system. Once you have a successful small system, start to think of new ways to expand it and increase its usefulness for your operations. A healthy

system continues to change to meet your needs and should be worked with to ensure it stays healthy. Don't just set up a system and walk away, thinking your troubles are over forever. Someone needs to be there to fix problems or address new issues when they develop, and if your SCADA expert lives three states away, your system will stay broken until they can come fix it. Find someone who can be on the spot quickly when something breaks or when new requirements crop up. This could be someone on your staff: an internal champion willing to dig in and understand the system, and unafraid to tinker with it when needed. Or it could be an external integrator: a contractor who can both create the system and continue to fix and adjust it to meet these changing needs. In any case, be sure to plan to have people who know how the system works.

Consider how fast you will build this new system. Successful SCADA systems usually start out small—covering the most pressing needs first. Make sure that early efforts provide **maximum bang for the buck**, and then other improvements can be added incrementally. This also encourages perseverance when problems crop up; if the system is providing big benefits you and your staff will be motivated to maintain it, rather than abandoning and returning to old ways when a problem occurs. This phased, start-small-and-grow approach also helps canal operators and other staff get used to the system and test out what it can do. Once SCADA is established in one area, it is easier to think of ways it could be used to help out in other areas.

If a new SCADA system is in your future, or if you'd just like to do more with the system you already have, Reclamation staff are available to help you—now and well into the future. The Water Conservation Coordinator in your local or regional office, or the Hydraulics Lab and Water Conveyance groups in the Technical Service Center in Denver are great places to start.

**For more information on SCADA systems, contact:**

Tony Wahl, Hydraulic Engineer,  
Reclamation's Technical Service Center,  
303-445-2155, [twahl@usbr.gov](mailto:twahl@usbr.gov)



*Ainsworth Irrigation District office base radio/control unit: Programming installed in this unit enables target flow rates at both the Airport lateral and the Sand Draw lateral to be remotely adjusted from the ditch rider's room at the district office. Target adjustments may also be made on-site at each of the laterals.*

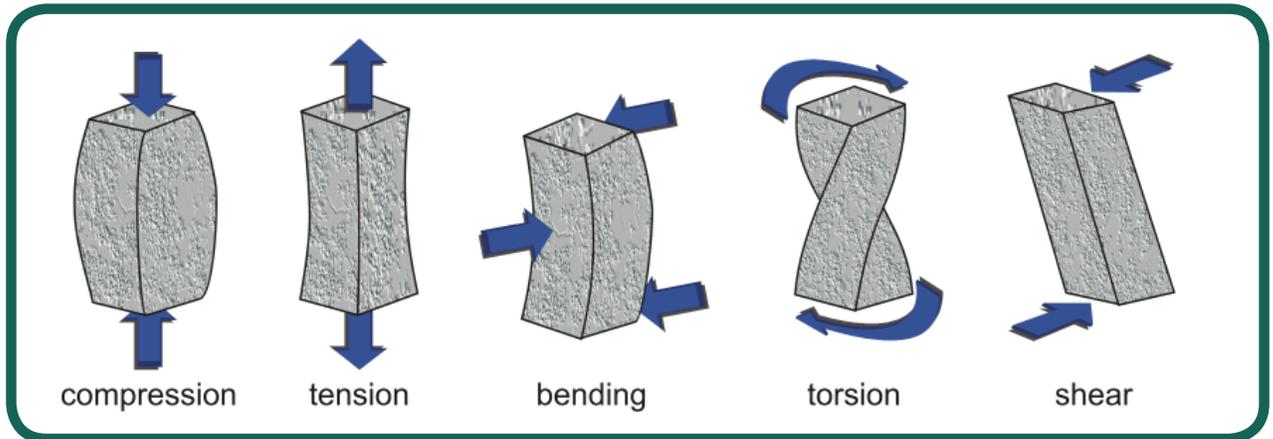


*Total flow is measured as it passes over a Cipoletti weir in the Ypsilanti East Canal Indian Unit of the Reservation Division of the Yuma Project, Arizona.*

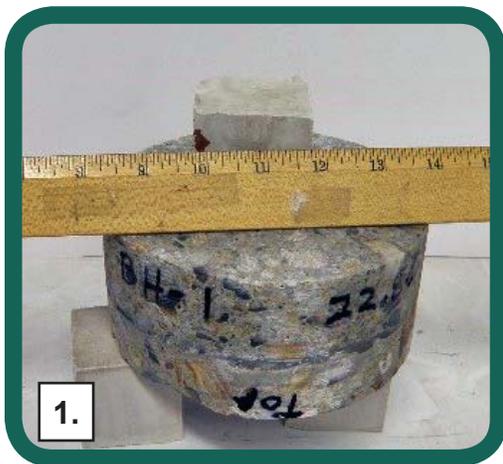
# Reclamation's Concrete Testing Capabilities

## Testing Shear Strength for Concrete

Canal systems with single purpose dams often struggle with issues associated with these aging concrete structures. Dams that were designed to last a hundred years are nearing the end of that life span, and determining the best methods to get these dams through the next century can be daunting.



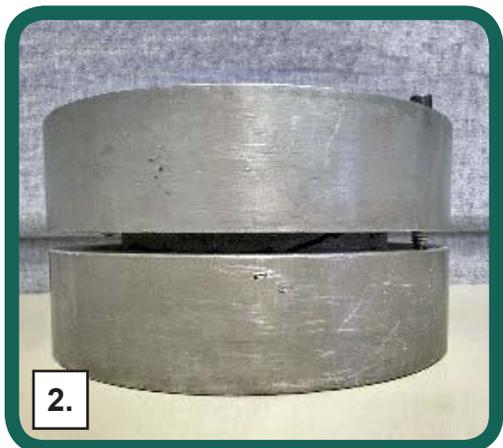
A concrete structure is designed to resist getting squashed (compression forces), being pulled apart (tension), or being pushed in opposite directions (shear forces) to perform properly. We need to understand the strength of concrete in dams and other structures for different loading conditions. Reclamation can perform laboratory testing that properly mimics these forces in concrete structures, which is vital for predicting performance.



1.

Lab testing performed at Reclamation's Concrete, Geotechnical and Structural Laboratory (CGSL) subjects concrete specimens to compression, direct or splitting tension and direct shear testing. Reclamation performs lab direct shear testing by:

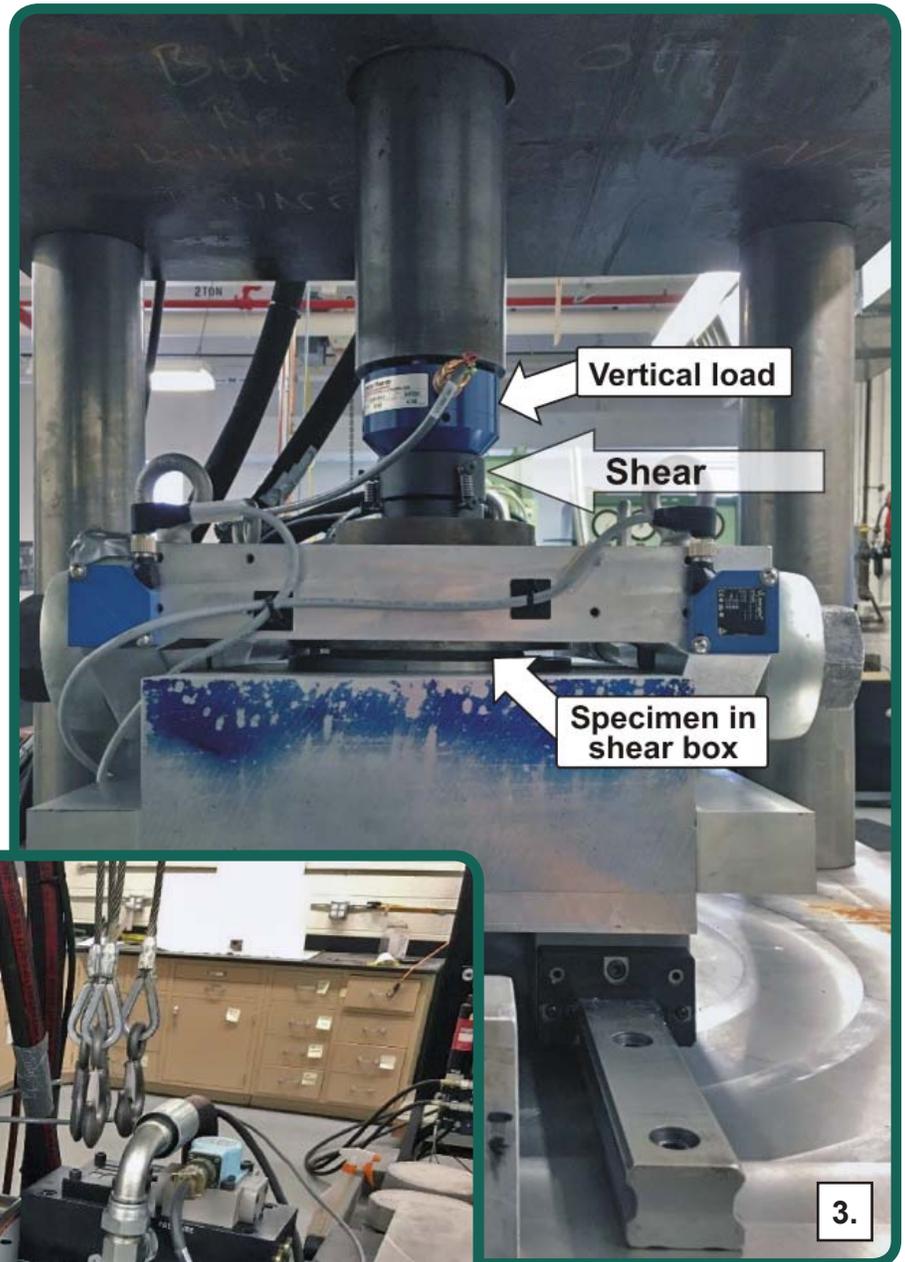
1. Getting a concrete core and isolating a specific section of concrete for testing.
2. Applying a vertical load based on what the structure experiences in actual use. The concrete specimen is cast between two metal confining rings and held in place with hydrostone cement. A vertical load will be applied to the top of the specimen and shear loads will be applied to each half, as shown by the arrows.
3. Putting the specimen in a shear box, shearing the specimen at a constant displacement rate, and recording the load needed to make the two halves of the specimen slide against each other.



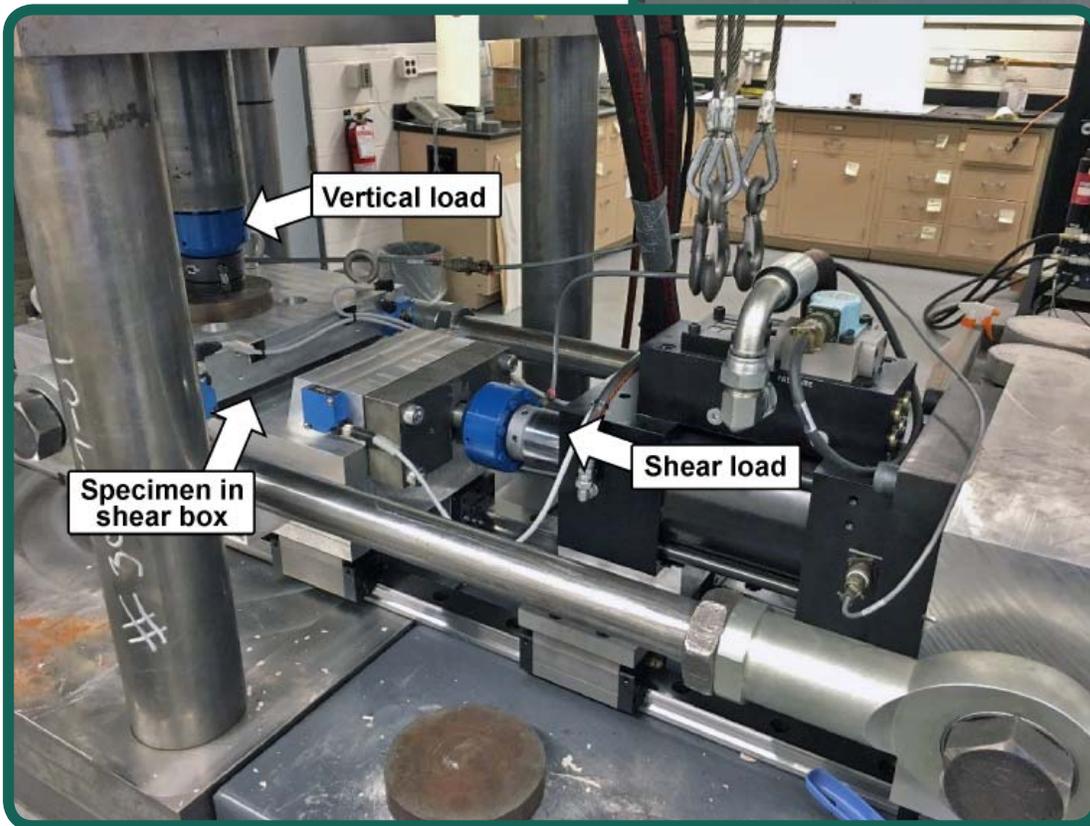
2.

Reclamation's shear box is a new state-of-the-art instrument, designed and fabricated in-house at the CGSL to replace the previous machine from the 1970s.

*Reclamation has been testing concrete since the 1960s and is the only lab doing this level of testing in the world. In the last year, about 100-feet of 6-inch diameter concrete core from a concrete dam in New Zealand was sent to CGSL for shear testing. The bottom line is, spending money to test your aging concrete structures up front will save you from spending huge amounts of money on fixes that may not be needed or that may not work. So, spend more upfront and you will save more in the long-term.*



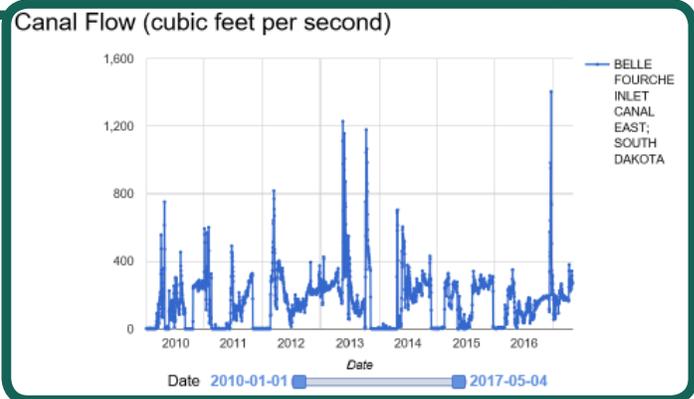
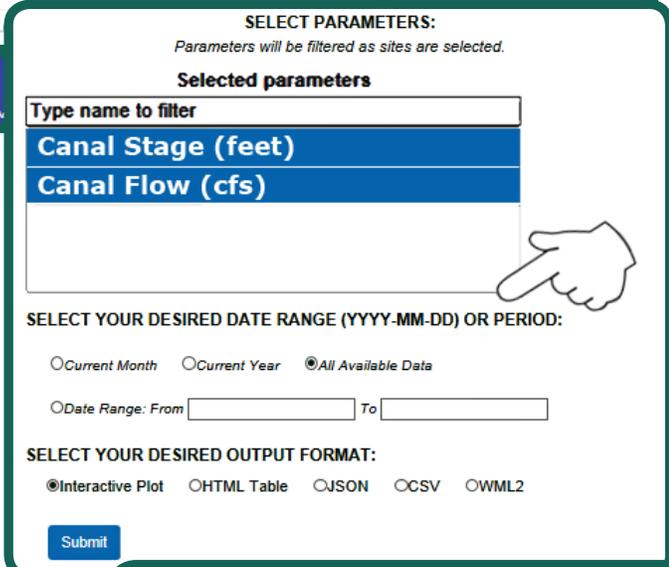
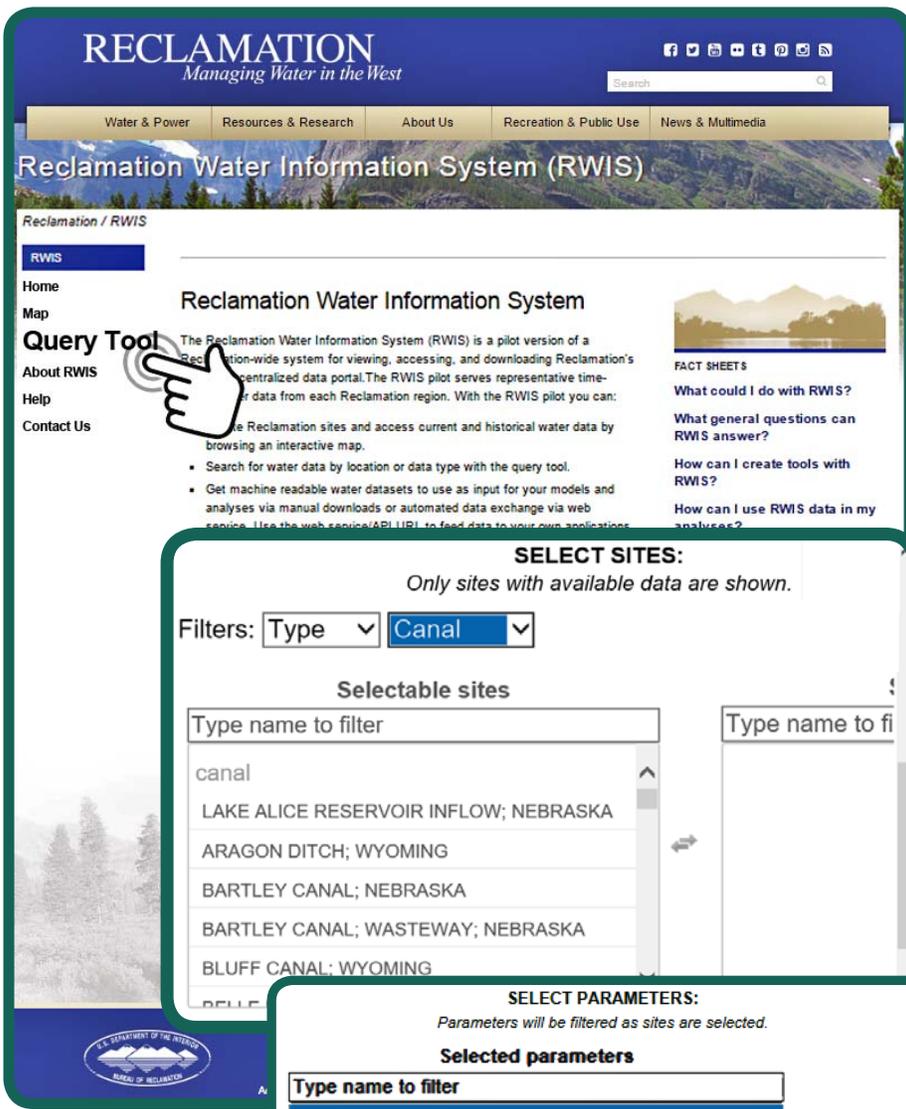
*Concrete direct shear machine with specimen in shear box.*



*Concrete direct shear machine showing vertical and shear load applicators.*

**For more information contact:**

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Concrete, Geotechnical and Structural Laboratory,  
303.445.2336, [elindenbach@usbr.gov](mailto:elindenbach@usbr.gov)



# Connections

## Reclamation's Water Data—coming to you!

Reclamation is starting to make its water data publicly available and easily accessible through a new open data pilot project. The Reclamation Water Information System (RWIS) is a pilot project to consolidate and publish water and related data from throughout Reclamation, which makes it easier to locate and access.

Find out what Reclamation has for your canal system!

1. Go to [water.usbr.gov](http://water.usbr.gov)
2. Open the Query Tool
3. Select Filters: Type: Canal
4. Type in the name of your canal (if your system is not yet available, contact [rwis@usbr.gov](mailto:rwis@usbr.gov))
5. If your canal is available, then select parameters (canal flow and canal stage)
6. Select desired dates
7. Select the format you want. You can get this in machine readable formats such as JSON or CSV, with a static URL that may work with your SCADA systems. Or you can get an interactive plot that can pinpoint data by each day.
8. Click submit

Go to [water.usbr.gov](http://water.usbr.gov) to use RWIS and contact us at [rwis@usbr.gov](mailto:rwis@usbr.gov) with any questions, suggestions, or problems. Thank you.

**Keep Your Home Safe by Keeping Embankments Clear**



**Contact Information**

Call us for more info or to report a problem:

**Your Contact Info Here**



U.S. Department of the Interior  
Bureau of Reclamation

Fall 2016

**Saving Canals—one neighborhood at a time!**

As you are riding along the O&M road, you see yet another garden, swimming pool, retaining wall. And you wonder—don't these people understand that they live by a canal? What part of *don't mess with our embankments or there could be trouble* are they not getting? Ahhh, but talking to your neighbors may be difficult. Reclamation has developed a brochure that carefully explains what not to do (plant trees, irrigate canal embankments, build structures that compromise the embankment integrity). It is designed for you to pass out to the property owners next to canals.

**We can print your contact information on this brochure—for your copies or to find out more, contact:**

Chris Vick, Office of Policy, Asset Management Division, 303-445-2941, [cvick@usbr.gov](mailto:cvick@usbr.gov)

**KEEP CLEAR!**



**Keep canal embankments clear of dense landscaping so it is easy to identify problems such as rodent burrows or seepage.**

**NO Trees or Gardens**



- Vegetation and shrubs invite rodents to burrow in the embankment.
- Cutting down a tree leaves roots that shrink and create paths for seepage through canal embankments.
- Planting and irrigation on the embankment can make embankments unstable.
- Planting dense vegetation and shrubs on the canal embankment makes it difficult to see rodent burrows or seepage.

**NO Structures**



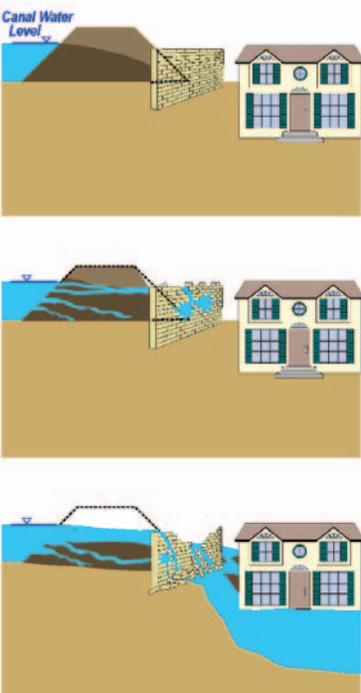
Building retaining walls that cut off the embankment toe allows water that normally stays below the ground to come to the surface as seepage, which makes the embankment unstable.

**NO Blocked Access**

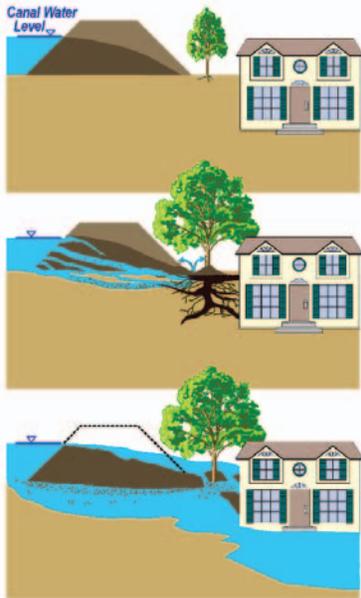


Fences on the embankment make it difficult for the irrigation district to inspect and access the canal embankment to perform maintenance.

**Don't Let Your Retaining Walls Undermine Canals!**



**Don't Let Your Landscaping Undermine Canals!**



Embankments hold the water in the canal. Canal water naturally seeps through the ground (the darker areas in the illustration). Tree roots can create seepage paths for water to flow out to the surface. This could lead to an embankment breach and cause flooding.

**Let's Work Together**



**Planting trees and building retaining walls on embankments could lead to:**



**Thinking of constructing or landscaping???**  
**CALL US FIRST!!!**

**Provide instructions and procedures to carry out tasks!**

**Lower the chances of damage to staff, equipment, systems, and more!**

**Use a Job Hazard Analysis to:**

- Think through possible hazards
- Identify what could happen
- Determine what jobs pose the highest risks
- Plan how to address any problems
- Identify resources for emergencies (medical, emergency, equipment)

**Job Hazard Analyses are needed for ANY FIELD ACTIVITY and are required for Reclamation staff.**

**To create a JHA:**

**Step through all tasks and ask:**

- What are the actions involved in each task (getting to the task, doing the work, cleaning up)
- What are the risks?

**Get everyone involved to share different perspectives. Review your company's accident/injury/illness/near miss history to determine which jobs pose the highest risk to employees and to get lessons learned. You are studying the task—not judging performance.**

See Reclamation Safety and Health Standards, with a Job Hazard Analysis form in Appendix A (<https://www.usbr.gov/ssle/safety/RSHS-all.pdf>)

## Charging out can leave YOU all charged up!



### Prepare your staff!

- Know the equipment
- Know the Standing Operating Procedures (SOP)
- Know the equipment and operating limitations
- Have the right tools to respond to various operational failures