

Water Operations and Maintenance Bulletin

Active Maintenance



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subject index is available at:
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On the Cover:

*The spillway at Choke Canyon
Dam in Texas.*

Message from the Office of Policy

Effective maintenance of water storage and conveyance systems helps ensure reliable water deliveries, avoid property and facility damage, increase asset lifespans, and protect the safety of employees and the public. Maintaining complex systems is challenging and requires good planning—but pays dividends in reliability and safety of the system. Several key items to focus on:

- Repeat problems. Do the same problems keep occurring? Take time to note the pattern and see if there are ways to fix the underlying problem to avoid spending time addressing it again and again. In the Winter 2016 Bulletin, we highlighted the Klamath Project's work with using a system-wide approach to handling weeds to avoid repeated daily cleaning of equipment.
- Shared problems. Reliability-centered maintenance focused water conveyance systems will likely be operated and maintained the same as other systems in your local area. We encourage you to reach out and form relationships with nearby systems to share tips and lessons learned. The Fall 2017 Bulletin tells some stories about districts using simple deflectors to avoid stones in intake pipes, dive teams, rubber dams, void filling techniques, and more.
- New ideas. Reclamation has one of the best research programs in the world. The Summer 2018 Bulletin highlights recent research ideas, and you can contact the Research Office with concerns that Reclamation research might help address. Partner with local universities, other districts, state and local agencies to find out what new ideas might work for you.
- Training opportunities. Training can help empower your staff to gather new insights and improve operation and maintenance at your facility. Did you know Reclamation offers free onsite canal training to our transferred works partners? The Fall 2018 Bulletin lists Reclamation's training opportunities.
- Potential problem areas. The earlier a problem is spotted, the easier and less expensive it is to fix. The Winter 2018 Bulletin explains how to effectively work with Reclamation to identify and address potential problems.
- Budgets and partnerships. The Winter 2017 Bulletin covers ways to develop O&M budgets and develop partnerships to help maximize value of limited O&M budgets.

Communicating, learning, and applying effective ways to maintain your system is a constant task. We hope these bulletins have helped you improve O&M of your water conveyance facilities. This bulletin covers maintenance issues such as communication, major rehabilitation and replacement databases, capacity constraints, and coatings. Also, please join us in the next Water Management Workshop from February 10 to 13, 2020, in Denver, Colorado (see details in this bulletin). Let us know what works for you, and we can help pass along your insights and findings in future O&M bulletins.

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Open Channels of Communication

Just as open channels in a canal system are vital for water delivery, open channels of communication are vital to your planning, operations, maintenance, and emergency response. Just having a number to call isn't enough—you need to have ongoing relationships with partners and your stakeholders so that everyone understands how the water conveyance system works and how it is managed.

Who to Call

Operating districts that maintain Reclamation facilities should be talking to their Area Office Managers and should know who to notify and consult when completing operation and maintenance recommendations on their facility. Area Offices can call on Reclamation experts in Regional Offices and in the Technical Service Center for additional advice and assistance when planning for and completing recommendations.

What to Discuss

Communicate is key.

- Schedule coordination meetings or include partners in monthly board meetings. Consider working with the Area Office Manager to identify a Reclamation Area Office employee to serve as a point of contact for the district. This helps to have a person who is familiar with on-going activities and participate in relevant periodic meetings.
- Coordinate emergency plans. In an emergency, you don't want to guess who to call. So plan early and keep in contact regularly.
- Periodic inspections let Reclamation inspectors and operating staff point out potential changes in the field, discuss how to handle changing conditions—and help everyone keep an eye out for problems as well as to plan improvements.
- Districts with an active relationship with a Reclamation Area Office typically tend to have more operation and maintenance recommendations planned and completed.

Call Early. Call Often.

Talk through inspections, from the earliest idea stage to the final sign offs on completion of recommendations. Reclamation can help define expectations and processes. Understanding timelines for permitting, compliance, specifications and other requirements up front can help streamline the planning process and save time and costs overall.

Reclamation can also identify the resources that can help with the process, from funding sources to expertise. As Reclamation works with many irrigation districts throughout the Western U.S., Reclamation can share stories about similar issues and plans, explain lessons learned through similar processes, and even provide design drawings and other documents so that you do not have to start from scratch.

Find your Area Office Manager

<https://www.usbr.gov/main/offices.html>

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Wild West Works Together

While Yuma, Arizona, may sound more like the wild West than a center for interesting water issues, Reclamation has arguably the hottest and one of the most varied area offices there. As the last delivery point of Colorado River water before entering Mexico, Reclamation's Yuma Area Office (YAO) deals with over ten water users' associations, several Indian Tribes, and a shared use diversion dam that serves nearly all of the area's water users as the last diversion structure on the U.S. side of the river. Yuma is nestled on the border between Arizona and California and is bordered by Mexico to the south and the west. Geographically and politically, it is one of the most complex places for water delivery in all of Reclamation.

YAO's 175 personnel have been working since the early 1900s to develop, operate, and maintain complex water distribution systems that turned a once barren desert into the nation's winter vegetable capital, producing over 90% of the nation's vegetables when the rest of the country is in the off season. As a result of the numerous competing interests collocated at the "end of the line" on the Colorado River, YAO is often faced with complicated and unique challenges with our water districts, particularly as shared use facilities are all approaching or over 70, 80, or even 100 years old.



Yuma Construction Office, 1906

For example, YAO works with a water distribution facility that is Reclamation-owned, operated by Bard Water District, and serves both Bard water users as well as the Quechan Indian Tribe. Like many of Reclamation's facilities, the entire distribution was showing its age. However, there was not a consensus between the Tribe and the district for planning the repairs and capital improvement projects that the system needed. Several years ago, to bring a set of fresh eyes to the problem, YAO worked with Reclamation's Technical Service Center (TSC) in Denver to join them in the sunniest part of America, assess the system, identify projects, and validate the distribution of water between the joint users of the system.

The TSC got right to work to take a wholistic look at the system and to develop a first draft Capital Improvement Plan (CIP) to suggest to the district and the Tribe. The team spent two weeks in Yuma to really understand how water is delivered through the entire system, measure volumes of water, review RO&M recommendations, and make suggestions on improving the system. They then returned to Denver and worked on a report of their findings, and to suggest a CIP. TSC worked very closely with YAO staff and the water users in this iterative process, to foster buy in to the final project.

Eventually, the TSC came and presented their findings and plan to the YAO, District Board, Bureau of Indian Affairs (BIA), and Quechan Tribe. We finalized a plan based on this TSC report. Since then, YAO has dedicated a number of resources to work with the Tribe and the district to assess the CIP, help to make it "their own", and monitor progress in completing tasks. YAO, the district, and the Tribe meet quarterly to track progress and update the plan. The district and the Tribe work with an agricultural engineer to assist them in developing grant applications to supplement the CIP fund. This fund has been building concurrently since the plan was established.

YAO found this "third party" approach to developing long-term, large-scale plans much more effective in making meaningful modifications and repairs to water distribution



Yuma Area Office, 2011

systems that are still under our ownership, even though O&M has been transferred. The office has used this approach in assessing the needs at other facilities, including dams, which has been helpful in looking past the normal smaller scale RO&M recommendations, and has facilitated buy-in from our water users. The users have found this approach particularly marketable in working with boards to establish CIP funds which may not have been previously established or to set existing CIP funds at appropriate assessment rates. This approach has encouraged full engagement and support from both area office personnel and water districts.

After 37 years at the water district, the district manager retired in August—a sad moment for those that knew him well and cherished our professional relationships. YAO feels that a solid relationship and plan has been developed among all parties, including the District Board, which will facilitate the continuity of the CIP plan and continue improving this shared system for years to come.

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Major Rehabilitation and Replacement

On March 12, 2019, the President signed into law the John D. Dingell, Jr. Conservation, Management and Recreation Act (P.L. 116-9). Title VIII of this Act Subtitle G identified requirements for Bureau of Reclamation Transparency on repair needs.

Reclamation has been collecting and analyzing data on Major Rehabilitation and Replacement (MR&R) activities as part of its annual asset management planning and reporting processes since 2008. The MR&R data is a snapshot estimate of the major non-recurring facility maintenance activities, deferred maintenance, and safety of dams modification activities that support the continued safe, dependable, and reliable delivery of authorized project benefits. This estimate of MR&R activities has been used in various reports, testimonies, and responses to inquiries. The new legislation identifies interest in the MR&R activities conducted at Reclamation facilities, both transferred and reserved, including estimates of the funding required to address those activities and categorizations of the importance of addressing each activity.

Reclamation has an established bureau-wide Facility Operation and Maintenance Team to provide a forum to address Reclamation-wide O&M-related priorities, issues, policies, activities, budget formulation, and to facilitate program accomplishment. In 2019 to facilitate this data collection, the Facilities Operation and Maintenance Team identified the need to improve the process for collecting MR&R information particularly for transferred works. Improvements to Reclamation's data collection and reporting processes were necessary because Reclamation's maintenance programs have developed different approaches for determining the amount and priority of funding necessary to support expenditures by Reclamation on reserved works. Reclamation's project staff also employ different approaches to the oversight of maintenance, including extraordinary maintenance, on transferred works. As a result, it is challenging to combine the information from these various processes in a single document that clearly communicates the basis of Reclamation's maintenance funding requests to Congress, water and power partners, and other stakeholders.

An internal database application was developed to streamline reporting and improve consistency and completeness of the MR&R data. Reclamation is developing an external outreach plan to improve the data collection process on transferred works assets. Reclamation is planning outreach session to describe the requirements and collaborate on developing the data collection process to fit existing district procedures. Outreach is planned for fall and winter. Please contact your regional Facilities Operation and Maintenance Team member if you have additional questions.

- Great Plains Region – Tim Flanagan (406-247-7775, tflanagan@usbr.gov) , Scott Boelman (406-247-7652, sboelman@usbr.gov)
- Pacific Northwest Region – Jim Dean (208-378-5398, jdean@usbr.gov)
- Mid-Pacific Region – Paul Caruso (916-978-5224, pcaruso@usbr.gov)
- Lower Colorado Region – Carrie Scott (928-343-8317 , cmscott@usbr.gov)
- Upper Colorado Region – Art Valverde (505-462-3544, avalverde@usbr.gov), Chad Savage (801-379-1169, jsavage@usbr.gov)

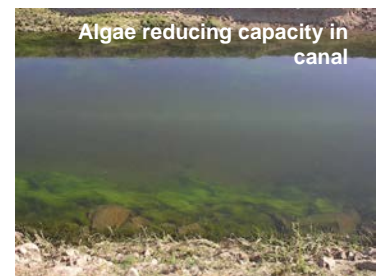
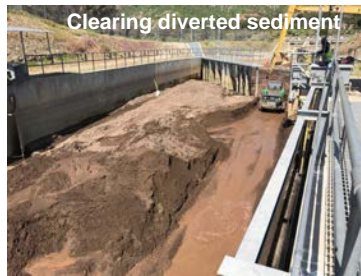
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Capacity Culprits

Regular maintenance is not only essential to keeping your equipment running for as long as possible, it vital to keeping systems as effective as possible in delivering water. Ensuring capacity involves every aspect of your system.

- Maintain equipment. Gates and valves in good working order/well maintained do not leak precious water past the seals.
- Clear sediment. Increased sedimentation can gradually reduce capacity. Sedimentation from wind and water gradually can fill in a canal over time. Vegetation can grow on sediment bars. Sedimentation and vegetation tend to restrict the canal prism and increase the hydraulic roughness. Both the reduced canal prism and increased roughness reduce the hydraulic conveyance capacity of the canal. Monitoring canal discharge and selected cross sections can detect this problem and periodically removing sediment and vegetation can restore the canal conveyance capacity.
- Remove rocks and other debris. Large rocks, cars, or other debris can fall into the canals. These can choke the system at checkpoints and block deliveries. Maintain good communication and regular ditchriding to note and extract these as soon as possible.
- Root out vegetation. Saturated ground with vegetation sloughs off and restricts flow, as well as causes bank erosion and alignment issues over time. Remove vegetation as early as possible to stay on top of this growing problem.
- Keep wasteways clear. Ensure that wasteways are functioning well. Keep trash, vegetation, and other debris out of the wasteways. Ask staff to imagine the wasteways full of water each time they visit the sites—are there any obstructions? Where will the water go?
- Get accurate feedback. Measurements are only accurate if the measurement tools are aligned and functioning properly. Check and calibrate physical measurement tools like gages and flumes, and confirm that your SCADA systems are reporting accurate measurements and operating as designed.
- Track water. Keep an eye out for any water loss or use alerts in the system to warn of water loss. Water loss can indicate seepage (through cracks in concrete lining or potential voids in the embankment). It can also indicate water theft via unauthorized extraction from the system.



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Encroachment and Trespass

Regular maintenance inspections can identify and prevent trespass and encroachment issues on your project facilities and the underlying project land. Common unauthorized uses may include constructing buildings, docks, or other facilities on Reclamation land, unauthorized entry, and the subsequent impacts to Reclamation's land, facilities and water bodies from activities not permitted. Trespasses and encroachments may happen at any time and can lead to serious consequences. It's the operating entity's responsibility to perform regular and periodic inspections to identify trespass and encroachment issues.

Reclamation and operating and managing entities all share an interest in trespasses and encroachments. Operating Plans and Management Agreements should identify procedures and methods to address unauthorized use. Additionally, establishing communication is critical to ensure effective management of risks or threat to the facilities, water deliveries, and/or the Federal interest.

This includes any risk or threat to the facilities, water deliveries and/or the Federal interest.

Know your area. See what uses are permitted or not permitted (whether this is unauthorized water use, trespass on canals or structures). Be on a constant lookout for any signs of trespasses or encroachments. Look for:



Building or growing crops on a canal right-of-way is a common type of encroachment.

- **Unauthorized water uses.** Be aware of what should be on canals and other facilities and what is and is not authorized.
- **Any odd structures or additions.** Note anything out of the ordinary. Staking could be a sign for further development.
- **Any paths or trails.** These can indicate regular trespassing activities like people taking shortcuts or using the land.
- **People or animals where they should not be.** People recreating, hiking, or driving over Reclamation lands may be putting themselves or others in danger and may harm operations.
- **Construction activity.** Residential or commercial construction often encroaches on rights of way, the land parcel, or facility. These actions could endanger embankment stability, pose a liability risk, or threaten Reclamation operations.

A thorough understanding of risks and how to address trespass and encroachment starts with a good relationship between Reclamation and the operating entity. Other stakeholders include partners such as recreation managers, permitted rights and interest holders, concession operators, and members of the public. All user groups can help identify potential issues.

A few tips include:

- **Work closely with all Reclamation staff, including the Land and Realty team.** They know the areas and can help initiate actions identified in regulation (as explained in 43 CFR Part 429 and 43 CFR Part 423, shown in the text box).
- **Coordinate with Reclamation's Area Office Security Officers or Regional Law Enforcement Officers.** They know the procedures and contacts for handling emergencies or security breaches.
- **Know your area.** Understand the boundaries for Reclamation's land or interests—what could affect canal and facility safety and operations. Know what is permitted.
- **Have an action plan.** Be clear on who does what and who is responsible for what. Who works directly with entities? Work with Reclamation and ensure you are on same page, be aware of agreements.

- **Be proactive.** Even if it is not on Reclamation land or interest, Reclamation and districts can work with cities, developers, and property owners to ensure safe and effective water deliveries.

Processes and procedures for addressing trespass and encroachment are found in 43 CFR Part 423, *Public Conduct on Bureau of Reclamation Facilities, Lands, and Waterbodies* (Part 423) and 43 CFR Part 429, *Use of Bureau of Reclamation Land, Facilities, and Waterbodies* (Part 429) define what uses and public conduct are allowed on Bureau of Reclamation land and provide Reclamation and its operating partners with tools on how to address trespass and encroachment.

For more information contact

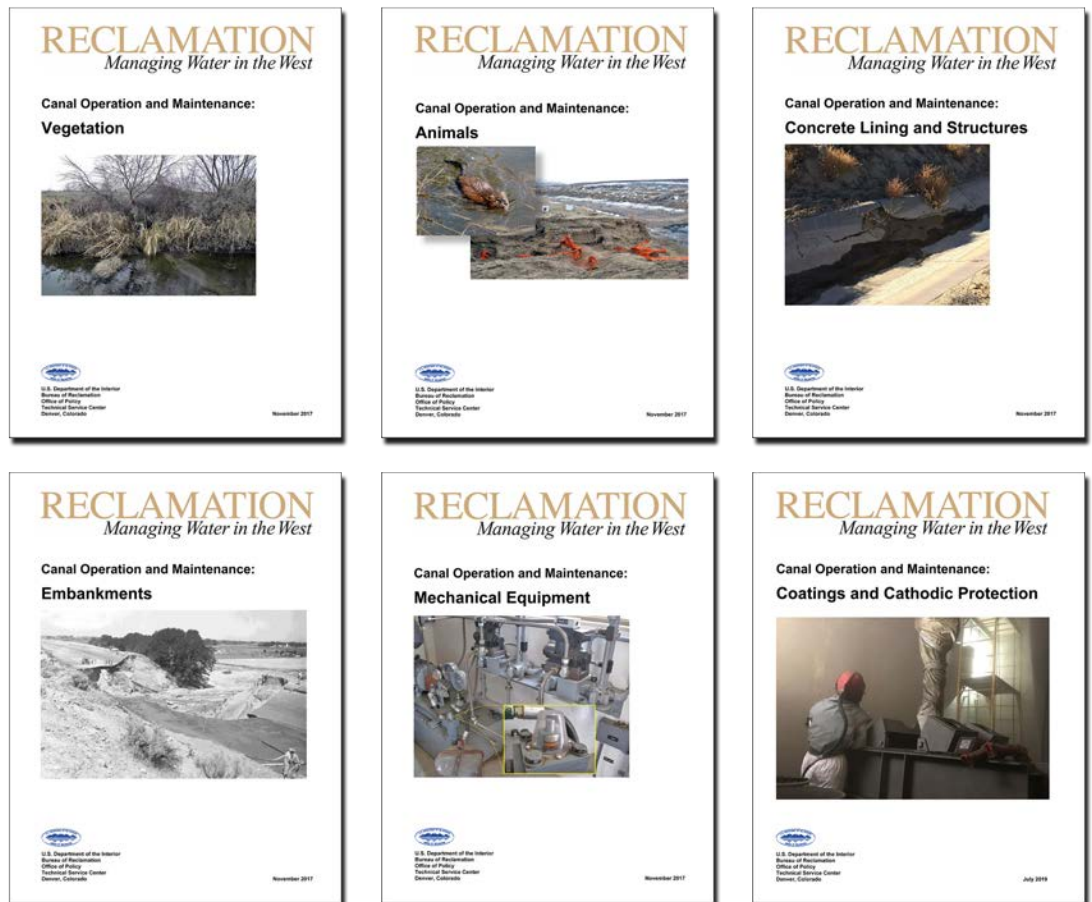
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Coatings and Cathodic Protection Manual

Use coatings and cathodic protection to avoid corrosion

Reclamation’s latest manual in our Canal Operations and Maintenance series describes how to protect infrastructure with coatings and cathodic protection (CP). Preventing infrastructure corrosion requires the right type of protection used the right way. While it is important to consult the experts for particular situations, a general understanding of protective coatings and cathodic protection will help plan actions to prevent and address corrosion.

See the Coatings and Cathodic Protection Manual along with our other manuals for canal operators and water districts at <https://www.usbr.gov/assetmanagement/OMG.html>.



Reclamation’s Canal Operations and Maintenance series are available in one notebook or in separate booklets.

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Using field EIS along with conventional inspection techniques provides a more robust method to segmenting large structures and prioritizing coating maintenance.

Coatings Investigations

Prioritizing coatings maintenance can be daunting, particularly if you have limited resources and need to avoid outages. Traditional inspection techniques like visual inspections, dry film thickness measurements, and ultrasonic/steel thickness testing may not provide enough data to guide confident decision making. To get more information about how a coating system is faring, researchers at the Reclamation’s Technical Service Center (TSC) Materials and Corrosion Laboratory have recently started to use electrochemical impedance spectroscopy (EIS) analyses in the field.

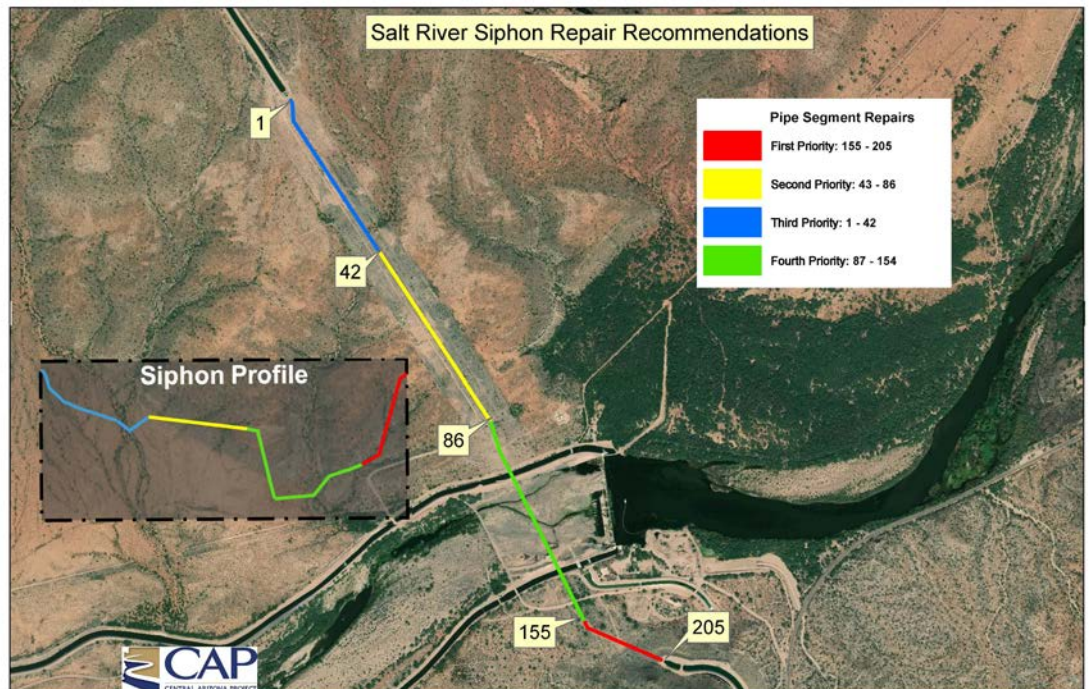
EIS is a non-destructive technique that measures the resistance of electrons flowing through a coating. The resulting value, called impedance magnitude, is derived from voltage and current data. For over a decade, TSC has been regularly performing these tests in our coatings testing lab, and has used the quantitative results to guide coatings selection for structures across Reclamation.

In the field, EIS provides more information about coatings that look like they are in good condition to help researchers estimate a coating’s remaining service life and prioritize maintenance before the coating shows signs of degradation. If impedance magnitudes are over 108 ohms, then the coating is providing good corrosion protection with a potential for 10 to 20 more years of adequate coating performance. But impedance magnitudes under 107 ohms indicate that the lining is providing poor corrosion protection—and needs maintenance or replacement.

Costs for the EIS are similar to any other type of testing, as the testing charges are for labor and travel for TSC inspectors. Usually tests require two people for three days, depending on the length of pipe to be tested. Costs are thus around \$10,000 for 20,000 linear feet of pipe.

TSC’s surveys of the 22-year-old linings in the Agua Fria River Siphon and Salt River Siphon, both near Phoenix, Arizona, are good examples of using EIS in the field. The 21-foot diameter siphons are nearly 9,900 feet and 8,600 feet long, respectively, and are the largest flexible steel pipes that Reclamation has designed and constructed. The siphons are now operated and maintained by the Central Arizona Project (CAP).

TSC conducted EIS tests at regular intervals throughout the pipe: about one test for every fourth pipe segment. The procedure involved temporarily gluing small test cells to the pipe wall, resaturating the lining within the cells by filling them with tap water, and running the test using a series of electrodes and a portable potentiostat. Some sections of pipe were inaccessible or untestable due to sediment accumulations or steep grades.



Salt River Siphon repair recommendations based on priority.

The systematic inspections provided plots of the impedance magnitude versus pipe segment. The plots clearly depict the condition of the lining throughout the siphons and reveal trends of severe degradation that warrant the highest priority for repair (e.g., pipe segments 155 to 205 of the Salt River Siphon, Figure 1). Over some segments, the resulting curve roughly resembled the siphon's elevation profile—indicating that sediment scouring along steep grades may be causing the lining degradation. These insights helped specify coating systems to mitigate lining degradation.

Thanks to the EIS analyses of the Agua Fria and Salt River siphons, TSC recommended repairs, and based on recommendations from MCL researchers, CAP was able to prioritize lining repair by pipe segment. "The EIS analysis is a useful tool to help determine location and extent of potential repairs, especially when budget and schedules are tight and I would recommend other facility owners consider EIS analyses when they inspect their pipelines," said Jim Geisbush, P.E., CAP Engineering Project Manager.

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Water Management Workshops February 10-13, 2020

The 2020 Water Management Workshop will be held in Colorado at the Denver Federal Center, February 10 - 13, 2020. The Water Management Workshop is a 4-day training seminar for supervisors, managers, water masters, and others responsible for or associated with the operation and maintenance of water systems. The workshop, sponsored by the Bureau of Reclamation, has been held since 1961. The workshop is held when field activities are generally at a minimum for the convenience of operating personnel.

Leaders who are well qualified in their particular field will be in charge of each session. They will present a summary of the material to be covered, with an emphasis on discussion and exchange of information by all participants in the session. Participants will spend their time attending sessions in either a classroom setting or at Reclamation's research laboratories at the Denver Federal Center. The objective of the workshop is the self-improvement of personnel who are directly responsible for the technical details of operation and maintaining water systems.

<https://www.usbr.gov/assetmanagement/training.html>



Participants in a presentation at the 2019 Water Management Workshop.