

## Knowledge Stream Research and Development Office Magazine

## Year in Review



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### Message from the Chief

Greetings and welcome to the Winter 2017 issue of the *Knowledge Stream* magazine! In this issue, the Research and Development Office (R&D) is pleased to highlight fiscal year (FY) 2016 accomplishments toward addressing the many technical challenges facing Reclamation as it manages, develops, and protects water and related resources in an environmentally and economically sound manner. These accomplishments were the result of funding support from two R&D programs (Science and Technology Program and Desalination and Water Purification Research Program), and through the many project-level collaborations involving Reclamation's Denver and Regional Offices, other Federal agencies, and non-Federal organizations. Some FY16 accomplishments you will learn about include:

- Demonstrating a new snowmelt model to improve reservoir operators' awareness of snowpack and snowmelt conditions in the Boise River Basin (Idaho), relevant to both water supply management and flood risk reduction.
- Developing an improved model to assess groundwater pumping relations to land subsidence near the Delta-Mendota Canal (California), which poses risks to water deliveries.
- Investigating gas insulated transformers and their potential use at Reclamation's hydropower facilities to improve safety and address environmental hazards.
- Developing a new Reclamation Water Information System that will make Reclamation's reservoir water data more easily accessed by public/private sectors.
- Using unmanned aircraft systems to help assess and manage rockfall hazards near Hoover Dam (Nevada) and other Lower Colorado Region infrastructure, which pose risks to water and power deliveries, infrastructure, and public safety.
- Evaluating effectiveness of innovative weir at the Hogback Canal on the San Juan River (New Mexico) to prevent entrainment of endangered fish during irrigation.
- Releasing a new data resource offering better depictions of future daily weather under climate change, which is critical for long-term water management/planning.
- Improving aeration/oxygenation to address Colorado State water clarity standards and support operational decisions at the Colorado-Big Thompson Project.

In addition, you will also learn about planned FY17 activities for technology transfer, technology prize competitions, and a variety of other R&D research areas. Coordinators and contacts are provided herein if you would like to follow up and learn more about these activities. We hope you enjoy!

Levi Brekke Chief of R&D

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# Contents

#### **RONDA DORSEY**

in Reclamation's **Research and Development Office** served as topic editor for this issue

#### **NEXT IN FISCAL YEAR 2017**

**Open Water Data** (spring)

From the Regions (summer)

**Renewable Energy** and Hydropower (fall)

### 02 Message from the Chief

### **1** Program Highlights

Science and Technology Program Desalination and Water Purification Research Program

### **18** Research Area Highlights

Advanced Water Treatment Climate Change and Variability Sustainable Infrastructure and Safety **Renewable Energy Open Water Data Initiative** Invasive Zebra and Quagga Mussels

### 20 Region Highlights

Pacific Northwest Region **Mid-Pacific Region** Lower Colorado Region Upper Colorado Region **Great Plains Region** 

- **Technology Transfer**
- **Technology Prize Competitions**
- Featured Faces
- 35 About the *Knowledge Stream*

## Program Highlights Science and Technology Program One of the ways Reclamation is working to ensure a sustainable water

and power supply in the Western United States is its investment in science and technology. Reclamation's Science and Technology (S&T) Program is an applied Research and Development Office (R&D) program that addresses the full range of technical issues confronting Reclamation water and power managers and their project stakeholders.

S&T projects are awarded in four general areas: Conserving or Expanding Water Supplies, Water and Power Infrastructure Reliability, Environmental Issues in Water Delivery and Management, and Water Operations Decision Support. Within these areas, research priorities vary through time, and in fiscal year 2016 (FY16) included Advanced Water Treatment, Climate Change and Variability, Invasive Zebra and Quagga Mussels, Renewable Energy, Sustainable Infrastructure and Safety, Regional Director Needs, and the Open Water Data Initiative. These research priorities continue in FY17. In addition to projects funded through research solicitation, the S&T Program also funds a variety of innovation efforts, including technology prize competitions and technology transfer partnerships with non-Federal organizations.

FY16 was an exciting year as the S&T Program provided funding to 220 projects totaling \$13.5 million. Over 70 projects were scheduled for completion at the end of the fiscal year, and the final reports for these projects will be posted on the R&D website in the near future. Although not promoted or formally announced, 45 FY15 projects were completed and these final reports were posted on the R&D website in FY16 (see "more information"). Additionally, the S&T Program announced the FY17 Call for Proposals in May, and included some changes from previous years. This fiscal year, the "Regional Director Needs" were described in the call and solicited proposals were sought to address these needs. Solicited and brokered projects were also included in the S&T Program's independent technical and program panel review processes. This supported a consistent evaluation of all research projects funded by the S&T Program.

FY17 proposals were due in June and went through an independent technical review, program panel review, and bureau-wide red flag review before recommending them to the Commissioner for funding in September. Internal and external announcements about the new awards were provided in early October. The S&T Program is funding 84 new projects, summing to \$5.13 million. An additional 91 projects are continuing in FY17 (from FY16), summing to \$5.88 million. With over \$10 million in active research in FY17, these projects should yield results to support positive impacts to Reclamation's mission of delivering water and power in an environmentally and economically sustainable manner in the West.



Reclamation employees from multiple regions and directorates were represented on the program panel for FY17 proposals: Research and Development Office; Information Resources Office; Dam Safety Office; Policy and Administration; Technical Service Center; and the Pacific Northwest, Mid-Pacific, Lower Colorado, Upper Colorado, and Great Plains Regions.

The S&T Program is also focusing efforts in two additional areas in FY17 to improve program administration. First, the S&T Program is preparing to release a Reclamation Manual Directive and Standard to provide a more consistent and clear overview of requirements for the research solicitation aspect of the program. Second, the S&T Program is engaged in a bureau-wide process to update the priorities that are highlighted in each fiscal year's Call for Proposals. Through internal interactions and an external review, the S&T Program intends to provide more transparency to the priority setting process and for the priorities to reflect the most critical research needs and areas where there is the most room for innovation. The updated priorities will be ready for the FY18 Call for Proposals, which will be announced in late spring.

### **More Information**

"S&T Results" on R&D website: www.usbr.gov/research/publications/science-technology.cfm

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### **Desalination and Water Purification Research Program**

Keclamation's Desalination and Water Purification Research (DWPR) Program is a nationwide competitive, merit-based program that funds research at three major levels: laboratory-scale, pilot-scale, and full-scale projects. While the need for water for irrigated agriculture is greatest in the arid West, the need for high quality water for drinking and for industry is nationwide. The DWPR Program works with Reclamation researchers and partners to develop innovative, costeffective, and technologically efficient ways to treat impaired waters to augment useable water supplies. The program has aligned its objectives with the strategic desalination research agenda and needs identified in the last two publications from the National Research Council of the National Academies, from 2008 and 2012, *Desalination: A National Perspective* and *Water Reuse: Potential for Expanding the Nation's Water Supply Through Reuse of Municipal Wastewater*, respectively.



Program. In fiscal year 2016 (FY16), the DWPR Program awarded 12 new projects for a total of \$1.8 million in funding. It received 82 total research project submissions—63 laboratory studies and 19 pilot projects. Of the 82 total research project submissions, 68 made it past the first review by acquisitions—56 laboratory studies and 12 pilot projects. There was a total Reclamation request of \$7,524,150 with a non-Federal cost share of \$3,200,193 for the 68 proposals moving forward for review by the Application Review Committee.

It has been an exciting year for the DWPR

DWPR focuses on the experimentation, development, and maturation steps of this general model.

There was a significant increase in university submittals this year in response to the

laboratory studies Funding Opportunity Announcement (FOA). Overall, the DWPR Program received many first-time applicants (comprised mainly of small businesses and academic institutions) with innovative new technologies or processes that had never applied to the program before. In addition, there were a couple of submittals from nonprofit organizations and nearly half of the states in the United States were represented in the submittals, proving this fiscal year's most diverse group of proposals ever seen in the DWPR Program.

For the upcoming year, the DWPR Program announced three opportunities providing funding for the full spectrum of technology development and testing to support the commercialization of new desalination and water purification technologies. The funding opportunities relate to research and laboratory-, pilot-, and full-scale testing projects. The program priorities for FY17 are focused on



Lake Cachuma, California, works to find solutions in augmenting water supplies as reservoir water levels are low during drought periods.



Reclamation's Brackish Groundwater National Desalination Research Facility (BGNDRF) in Alamogordo, New Mexico.

novel water treatment technologies, novel processes and/or materials to treat impaired waters, and innovative new smart systems to improve the efficiency, longevity, and reliability of water treatment systems for real-time monitoring and automation. Applications were due in mid-January 2017, with the goal to issue awards by mid-summer 2017.

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The reverse osmosis (RO) unit at North Cape Coral RO Plant, Florida.

## **Research Area Highlights** Advanced Water Treatment

he Advanced Water Treatment (AWT) priority area of Reclamation's Science and Technology Program, which was the theme for the fiscal year 2016 summer issue of the *Knowledge Stream*, supported several water research technology innovations this year.

Reclamation selected three projects to receive nearly \$300,000 for innovative water treatment research at Reclamation's first annual "Pitch to Pilot: Bridging Reclamation's Clean Water Technologies for Today and Tomorrow" event in October 2016. The selected projects will receive funding through cooperative agreements and will include a period of pilot testing at Reclamation's Brackish Groundwater National Desalination Research Facility in Alamogordo, New Mexico. The selected projects for funding were:



Lehigh University (Pennsylvania), one of three awardees of Reclamation's Pitch to Pilot Event, was selected for their project, "Enhanced Recovery From Impaired Water Resources: Field-Scale Validation of Hybrid Ion Exchange Membrane Desalination Process." Mike German accepts the Crowd Favorite Award from the Research and Development Office's Advanced Water Treatment Research Coordinator, Yuliana Porras-Mendoza.

- Enhanced Recovery From Impaired Water Resources: Field-Scale Validation of Hybrid Ion Exchange Membrane Desalination Process from Lehigh University (Pennsylvania)
- Development of Novel Photobiological Process to Improve Water Recovery in Brackish Groundwater Desalination from Pacific Advanced Civil Engineering, Inc.
- Pilot Evaluation of a Sustainable Autonomous Brackish Groundwater Desalination System from the University of North Texas and New Mexico State University

Reclamation has also been collaborating this year with researchers at California State Polytechnic University–Pomona, to commercialize a portable, automated, off-grid system to treat brackish water to drinking standards at an economical cost. The innovation focus is removing constituents that pose health

concerns, such as hexavalent chromium, to improve the treatment process and support small communities to seek less costly solutions.

Lowering desalination costs remains a high priority research topic for Reclamation's Advanced Water Treatment efforts. Reclamation is funding research studies to gain a better understanding of how to best manage concentrate streams and has funded four different approaches to find solutions:

- Concentrate management toolbox research study that focuses on the assessment of existing technologies
- Concentrate contaminants of emerging concern research study that focuses on contaminants in concentrate streams of water reuse desalination facilities
- Eastern Municipal Water District's pilot-scale demonstration of General Electric's AquaSel technology at its Menifee Desalter, California
- Prize competitions to seek solutions from the broader solver community to capture more water and reduce concentrate



Miguel Acevedo of the University of North Texas, in collaboration with New Mexico State University, pitches their joint project, "Pilot Evaluation of a Sustainable Autonomous Brackish Groundwater Desalination System" at Reclamation's Pitch to Pilot Event.

For the coming year, Reclamation and the American Membrane Technology Association, the leading association in the United States (U.S.) in the area of membrane research and technology, partnered to provide funding for four graduate student fellowships.

These competed awards were given to graduate students pursuing a full-time master's or doctor's degree at a university or college in the U.S. conducting research in innovations for advancing membrane technologies. The selected research projects are:

- Fabrication and Characterization of Patterned Thin-Film Composite Membranes With Well Controlled Surface Patterns to Reduce Concentration Polarization, Fouling, and Scaling by Masoud Aghajani, University of Colorado–Boulder
- Tailoring Thin-Film Nanocomposite Membranes for Water Reuse by Kasia Grzebyk , University of North Carolina at Chapel Hill
- Modeling of Mass Transfer and Endocrine Disrupting Compound Removal in a Nanofiltration Membrane Process Modified for Acid Pretreatment Conditions by Carlyn Higgins, University of Central Florida
- Osmotic Membrane Bioreactors Coupled to Membrane Distillation for Low-Energy Potable Reuse by Christopher Morrow, University of Southern California–Los Angeles

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### **Climate Change and Variability R**esearch pertaining to the availability of natural water supplies includes topics such as the onset and persistence of drought, wet weather extremes, and long-term changes in basin yields. These types of projects have been consistent priorities for the Research and Development Office (R&D). In addition to the physical and environmental sciences supporting such investigations, R&D also engages in decision science and planning tools related to water availability and management. For this year in review *Knowledge Stream* issue, two water availability efforts are

highlighted—1) a new addition of state-of-the-art climate projections to a decadelong running resource and 2) a new project on decisionmaking in the face of

considerable uncertainty. REC Managing Water in the West CLIMATE Southwest Climate Santa Clara Science Center **US Army Corps** University **Climate Analytics Group** of Engineers CENTRAL School of Engineering LAWRENCE LIVERMORE SCRIPPS INSTITUTION OF IONAL LIBRARY OCEANOGRAPHY

Collaborators on the release of the LOCA downscaled climate projections.

Since 2007, Reclamation and collaborators have been hosting and serving climate projections, downscaled products from those projections, and associated projections of streamflow. These datasets are housed and maintained in partnership with the Lawrence Livermore National Laboratory through their website portal. Over the past decade, the portal has served approximately 40,000 data requests from more than 2,000 users. In fiscal year 2016, a new dataset was added to the portal archive, based on the Coupled Model Intercomparison Project Phase 5 (CMIP5) ensemble, and downscaled using the Localized Constructed Analogs (LOCA) technique developed by researchers at the Scripps Institution of Oceanography. Downscaling is a critical part of the climate projection development process; the spatial resolution of climate models does not sufficiently resolve areas of complex topography. Downscaling methods address this by taking model output for a given area and resolving it to a finer scale. The LOCA method aims to better preserve extreme hot days and heavy rain events, regional patterns of precipitation, and the future climate. Furthermore, the LOCA data are two times finer spatial resolution as compared with other datasets available on the portal archive, which is consistent with the objective of better representing extreme events. This dataset reflects a commitment by Reclamation and collaborators to advance climate science and make resulting products available to the broader community (see more information).

Long-term planning, particularly in the water management field, is inherently uncertain. The addition of climate variability and change to these efforts in recent years often increases uncertainties with respect to future supply availability and, similarly, projections of demands. In many cases, this has led to an ensemble-based approach to characterize potential future hydrologic conditions. When faced with expanding uncertainty, the task of responsible planning and resource management can be quite challenging. In response, Reclamation is partnering with the Rand Corporation to explore Decision Making Under Deep Uncertainty (DMDU) methods for use in water management and planning (see more information). The Rand Corporation is recognized as a leader in this field and the project will have close coordination with Reclamation's Policy and Administration Office through the West-Wide Climate Risk Assessments. The goal is to evaluate the applicability of DMDU methods in a water planning and management context. From those methods with strong potential for use by Reclamation and other agencies or stakeholders with similar missions, tools will be developed. This effort compliments much of R&D's past and currently funded water availability research through increased utility and applicability.



LOCA ensemble median of maximum daily precipitation for the historical period (1970-1999, first column) and the future period (2040-2069, second column).

### **More Information**

Downscaled CMIP3 and CMIP5 Climate and Hydrology Projections website: http://gdo-dcp.ucllnl.org/downscaled\_cmip\_projections/ dcpInterface.html#Welcome

Refer to Reclamation's Science and Technology Program research project, "Building Capacity for Addressing Climate Change Uncertainty in Reclamation's Long-Term Planning and Decisionmaking Process," Project ID 1771.

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Unified intelligent model project at Glen Canyon Dam (Arizona)—approximately 700 scans were collected during the 2-week site visit, including scanning on the powerplant roof (top) and of reservoir upstream of dam face (bottom). Screenshot created from collected Sonar data. The depth is portrayed by the color ramp. The crest in the foreground is assumed to be the upstream construction cofferdam.

# Sustainable Infrastructure and Safety

n fiscal year 2016 (FY16), Reclamation's Science and Technology (S&T) Program funded 34 new and continuing research projects aimed at improving Reclamation's infrastructure sustainability and safety. Projects investigate many aspects of infrastructure, including hydraulic structure and equipment evaluations, geotechnical studies, new materials evaluations, condition assessment techniques, and engineering controls.

Several FY16 projects focused on demonstrating photogrammetric methods to advance Reclamation condition assessments. Matthew Klein, a Principal Investigator (PI) for awarded S&T research who is from Reclamation's Technical Service Center (TSC), completed the Elephant Butte Dam (New Mexico) photogrammetric survey processing and evaluated virtual reality headsets and software as a platform for conducting safe inspections of inaccessible features. PI David Winslow (Reclamation's Upper Colorado Region) completed data collection on the unified intelligent model project using updated survey control, laser scanning, photography, and Sonar scanning at Glen Canyon Dam (Arizona) and is creating a facility-wide, three-dimensional model in collaboration with Autodesk, Inc. PI Erin Bell (Reclamation's Pacific Northwest [PN] Region) tested two types of global positioning system (GPS)-enabled mobile devices for field data collection, finding the Apple iPad Air 2 Tablet to be preferable. Advantages of the tablet over a Trimble unit were the large touch screen, photography features, and a much lower price tag. An external GPS receiver, such as the Bad Elf GNSS Surveyor, provided

increased accuracy. PI Theresa Gallagher (Reclamation's Security, Safety, and Law Enforcement) worked in collaboration with the Office of Naval Research to complete a noise survey at Hoover Dam Powerplant (Nevada/Arizona), and will soon be installing noise controls at Shasta Dam Powerplant (California) to demonstrate the technique at a large facility. PI Tyler Chatfield (TSC) evaluated drill parameter recorders for installation on drill rigs to provide real-time monitoring of fugitive parameters, such as penetration rate, holdback force, torque, thrust, rotational speed, and pressures. Incorporation with geologist real data allows for spatial correlation of strata between borings and other valuable calculations. The U.S. Army Corps of Engineers and Reclamation held its 2nd Annual USACE-USBR Research Team Meeting in December 2016. The event provided a full day of in-person, co-PI presentations and a tour of the laboratories in Reclamation's TSC. It featured eleven infrastructure collaborations in which co-PIs coordinate a joint effort to attain mutually beneficial goals. The meeting discussions helped to determine agency benefits, including faster and broader implementation of research results and higher-quality research.

The FY17 funding cycle produced 30 new infrastructure research projects. Most notably is a concerted effort to improve evaluation and maintenance of aging canal infrastructure, addressing needs identified in the Canal Infrastructure Research Roadmap. These eight funded projects include continued efforts on cracked embankment erosion testing and rapid health assessment and seepage detection using an instrumented cart, as well as new efforts in evaluating fiberreinforced concrete and ultra-high performance concrete for canal lining. The respective PIs (TSC) for these projects are: Peter Irey, Justin Rittgers, Jeffery Keim, and Catherine Lucero. Additional new canal projects will:

- Evaluate airborne red, near-infrared, and thermal-infrared multispectral remote sensing for detecting canal seepage (PI Audrey Rager, TSC)
- Evaluate canal seepage at Truckee Canal (Nevada) (PI Evan Lindenbach, TSC)
- Demonstrate synthetic sheet piles to improve canal safety (PI Christopher Ellis, TSC)
- Evaluate linings for seepage reduction (PI Michael Walsh, TSC)
- Review secondary effects of canal lining to ecosystems and water supply (PI Leah Meeks, PN Region)

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### **Renewable Energy**

n fiscal year 2016 (FY16), Reclamation's Science and Technology (S&T) Program funded 17 new and continuing research projects aimed at improving operation and maintenance (O&M), efficiency, and safety for Reclamation's hydropower fleet. These projects examined several areas of hydropower, including modeling, design, testing, diagnostics, and new technologies.



Finite element analysis project—finite element model of a generator stator.

Two projects focused on improving hydropower modeling capabilities. Reclamation worked with the National Renewable Energy Laboratory (NREL) to improve the hydropower models informing studies on renewable energy integration, especially within Reclamation's service area. Moshe Redmon, a Principal Investigator (PI) for awarded S&T research who is from Reclamation's Technical Service Center (TSC), used finite element analysis to improve diagnostic tools available for examining generator stator faults.

Four more projects examined new technologies for use in the hydropower

industry. PI Jeremiah Bradshaw (TSC) examined the use of gas insulated transformers at Reclamation's hydropower facilities, with site visits to the Osage Powerplant/Bagnell Dam (Missouri) and Toshiba Manufacturing Facility and Ojiya Powerplant (Japan), determining that these transformers can improve safety and environmental hazards. Morrow Point Powerplant (Colorado) requested specifications in FY16 to demonstrate this technology. PI Benjamin Few (TSC) researched ester oil transformers for improved safety and environmental impacts, including review of toxicology test results that inform how the fluid breaks down in water and its effects. PI Josh Mortensen (TSC) completed the phase 1 hydrokinetic energy demonstration in the Roza Canal (Washington), in partnership with Instream Energy Systems Corporation, to assess and model the impacts on Reclamation's canal systems through testing and developing a one-dimensional hydraulic model. PI Benjamin Few (TSC) performed testing on metal fiber brushes and concluded they are not suitable for use in the excitation system of Reclamation units.

In FY17, the S&T Program funded seven new and continuing research projects aimed at improving O&M, efficiency, and safety for Reclamation's hydropower fleet.

Reclamation will partner with Denver Water on a hydrokinetic installation and testing program in a canal near Denver, Colorado. Reclamation will be performing canal testing, improving on the body of knowledge gained in the Roza Canal on the impacts of hydrokinetics to Reclamation's canal infrastructure.

Reclamation will also potentially be working with the General Electric Company on a cavitation and residual stress project on a facility in the Pacific Northwest Region.

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Gas insulated transformers project—gas insulated transformers at Osage Powerplant/Bagnell Dam (Missouri) (top) and Ojiya Powerplant (Japan) (bottom).

## Open Water Data Initiative

hrough support from its Science and Technology (S&T) Program, Reclamation is undertaking activities to improve the management of water and related data by helping to make data more comparable across locations, more easily found, and more readily shared with other agencies, stakeholders, and the public. These activities are addressing the requirements of the President's Executive Order 13642, *Making Open and Machine Readable the New Default for Government Information*, and the Advisory Committee on Water Information's Open Water Data Initiative (OWDI).



Open data have machine-readable output in commonly used formats. Data are freely accessible via the Internet, and programs provide manual and automated ways to retrieve the data.

In fiscal year 2016 (FY16), S&T Program activities included supporting the bureau-wide Open Data Team (ODT), who was delegated with identifying Reclamation OWDI needs and opportunities that may be implemented through a mix of technology, tool development, and demonstration activities. ODT considered goals with respect to multiple water and water-related data domains, including reservoir operations and riverflows, hydropower, species recovery, river restoration, lands, structures, etc. In parallel, several development efforts were initiated, including "Developing a Sustainable Framework to Support Open Data for Reclamation's Colorado River Basin Decision Support Systems" and "Animated Tea-Cup Diagram Tool for Visualization of System-Wide Conditions Over Time," among others.

To further achieve OWDI goals, the S&T Program partnered and worked with Reclamation's WaterSMART Program to develop public-access web visualization

tools—one to accompany the release of the WaterSMART Progress Report and another that mirrors the narrative of the SECURE Water Act Report to Congress (see "more information"). The SECURE Water Act Report Data Visualization Tool displays projected changes in temperature, precipitation, and snowpack as well as bias-corrected and spatially downscaled surface water projections throughout the major river basins in the 17 Western States. The data visualization tool is intended to act as a companion product that allows the public to access and interact with technical assessment reports, underlying climate data, and collaborative planning studies at one central site.

In addition to these development projects, the S&T Program also began supporting a foundational effort to modernize reservoir water data standards and data management systems in support of OWDI goals. This effort, known as the "Reclamation Water Information System (RWIS) – Opening Reclamation Water Data Through a Multi-Region Web Portal," was launched in April 2016. This project is being implemented by a bureau-wide team, including reservoir water data specialists, database administrators, information technology engineers, and information security experts. The pilot will provide a concept-level, Reclamation-wide system for sharing reservoir water budget time series data from each of Reclamation's five regions. The system will include supporting information technology (IT) infrastructure, a public-facing website, a web portal with a web service for machine-to-machine communication, and both map- and

query-based interfaces for data discovery. The overarching goal of the pilot is to demonstrate the consolidation of Reclamation's region-specific sources of time series water data into a machinereadable central resource that can be disseminated to stakeholders and the public under the guiding principles of data stewardship and open-sourced IT standards and data management systems. It is anticipated that the RWIS will be publically launched in 2017, and will serve as a proof of concept for a potential future long-term operational system incorporating the full range of water data types managed by Reclamation.

In FY17, the S&T Program will fund the RWIS team to engage the Reclamation Data Council, ODT, and other staff managing other types of water-related data. Efforts will focus on scoping and initially implementing similar foundational pilots for those data domains (e.g., hydropower, environmental) involving development and demonstration of modernized data resources and tools in order to provide improved resource management decision support.

Other efforts include:

- Web-based stochastic storm transposition toolkit for physically-based rainfall and flood hazard analysis
- Environmental resources data mapping pilot to support reservoir operations planning
- West-wide evapotranspiration forecast network
- Open access web-based database of invasive aquatic research and water quality data
- Quantitative assessment of water and salt balance for cropping systems in Lower Colorado River irrigation districts

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RWIS water monitoring sites map. Source: RWIS test site.

### **More Information**

WaterSMART - Data Visualization Tool website portal:

https://usbr.maps.arcgis.com/ apps/MapJournal/index.html?a ppid=043fe91887ac4ddc92a4c 0f427e38ab0

SECURE Report - Data Visualization Tool website portal:

https://usbr.maps.arcgis.com/ apps/MapJournal/index.html?a ppid=cd222d3af91a4a078a1a8 d73d168a270

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### Reduction of Mussel Fouling on Fish Screens

Evaluating resistance of commonly used fish screens to mussel fouling



Silicone foul-release coatings project—reduction of mussel fouling on fish screens.



Proof-of-concept testing project at San Justo Reservoir (California) zebra mussels are dosed until there is 100 percent mortality for eradication.

### Invasive Zebra and Quagga Mussels

he dreissenid mussel research for detection and control of zebra and quagga mussels is an ongoing effort for researchers at Reclamation. In fiscal year 2016 (FY16), silicone foul-release coatings work continued, which showed promise in facilities and on fish screens (Principal Investigator [PI] Allen Skaja). Turbulence research, which to date has had mixed success, was completed at Davis Dam (Arizona/Nevada) (PIs Mortensen and Pucherelli), along with installing and conducting a laser, pulsed pressure treatment system that had some encouraging initial results (PIs Kubitschek and Pucherelli, and the National Institute of Standards and Technology). (The laser, pulsed pressure treatment system research is continuing in FY17.) Testing ultraviolet effectiveness for biofouling prevention at Parker Dam (California/Arizona) may prove to have applications for biofouling reduction in other facilities (PI Pucherelli). The research collaboration with the U.S. Army Corps of Engineers (USACE) to prepare a manuscript on microsatellite analysis of quagga mussels in the Western United States revealed some interesting genetic similarities, which may provide clues to mussel control in the future (PIs Pucherelli and Keele). The life-cycle study of quagga mussels on the Lower Colorado River demonstrated the size range for all size classes broadens the previously documented literature (PI Denise Hosler).

Reclamation's Mid-Pacific Region, California Department of Fish and Game, San Benito County, and the San Benito County Water District began a mussel eradication project at the San Justo Reservoir (California). In addition, proof-of-concept testing was performed at the same reservoir establishing Muriate of Potash (potassium chloride) dosing concentrations for the final eradication effort in the future (PIs O'Meara and Hosler, and other Reclamation Detection Laboratory for Exotic Species [RDLES] staff in Denver, Colorado).

On the molecular side, past research allowed RDLES staff to develop a Molecular Biology Standard Operating Procedure (SOP) for numerous different DNA extractions and polymerase chain reaction (PCR) methods used to identify invasive, native, and exotic species. Additionally in FY16, a PCR SOP was developed to detect spiny water fleas—an invasive, non-native zooplankton that threatens fisheries. Some of the FY16 research performed included analysis by next generation DNA sequencing samples from Lake Mead (Nevada/Arizona) and the Salton Sea (California). The data will be used in future presentations and reports; however, the technology holds potential for large-scale ecosystem analysis (PIs Keele and Passamaneck).

FY16 significant events included RDLES staff participating in the Colorado Parks and Wildlife Statewide Aquatic Biologist Meeting and Colorado Aquatic Nuisance Species Task Force Meeting, both held in January, with PIs Keele and Passamaneck presenting, "The Added Value of eDNA in Biological Assessment and Management of Native, Endangered, and Invasive Species" at the first meeting.

PI Hosler participated in the U.S. Fish and Wildlife Service Quagga-Zebra Mussel Action Plan Research Meeting in Portland, Oregon, and then the USACE-Engineer Research and Development Center (USACE-ERDC) programmatic research reviews for the Aquatic Plant Control and Aquatic Nuisance Species Research Programs, and will again participate in FY17.

In April, PIs Hosler, Pucherelli, Keele, and Merton gave presentations at the International Conference on Aquatic Invasive Species in Manitoba, Canada. In collaboration with USACE-ERDC, RDLES staff also hosted the First Annual Environmental DNA Training and Technical Exchange Workshop in August, presenting research on PCR, eDNA, and native amphibian identification. Lastly, RDLES staff wrapped up the fiscal year with PIs Hosler and Pucherelli presenting at the USACE Invasive Species Leadership Meeting held in Denver, Colorado.

Also in FY16, Pucherelli et al. authored a publication on hydroid expansion, which seems to link to mussel presence (see "more information"). Two other articles are also pending publication in FY17—a San Justo Reservoir treatment article authored by O'Meara, and another by Hosler that documents test relationships for positive results.

### **More Information**

Pucherelli, S.F., J. Keele, Y.J. Passamaneck, J.R. Beaver, and R. Renicker. 2016. "Range expansion of the invasive hydroid, *Cordylophera caspia* (Pallas, 1771), in Colorado River reservoirs." *BioInvasions Records* (2016) 5(3): 133-137.

### Contact

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## **Region Highlights** Pacific Northwest Region

hrough Reclamation's Science and Technology Program, Pacific Northwest (PN) Region researchers continue to find innovative solutions to the myriad of challenges the region encounters in day-to-day work. In fiscal year 2016 (FY16), continuing and newly funded projects had the potential to directly benefit the region's ability to manage, develop, and protect water and related resources in an environmentally and economically sound manner.

One such project involved applying the physically based snowmelt model, *iSnobal*, to reservoir operations forecasting in the Boise River Basin (Idaho) for the 2016 water year. Current operational snowmelt-driven streamflow forecasts rely upon statistical relationships and historical observations and have a tendency to become unreliable when unprecedented, or "non-normal," conditions are encountered. Physically based forecast models (like *iSnobal*), on the other hand, numerically estimate all mass and energy fluxes influencing snow cover, require minimal calibration, and thus provide a more robust alternative to their statistically based counterparts when evaluating short-term extreme events and climate warming. This study was successful in providing local area water managers with real-time 3-day snowpack forecast data, including spatially distributed snow water equivalent (SWE), susceptibility to melt, and volume of liquid water delivered to the soil (a.k.a., "snow water input" or "SWI"). Figure 1 illustrates the spatial distribution of SWE and "cold content" simulated by iSnobal. Comparison of forecast results with measurements obtained later on from SNOTEL locations revealed strong agreement, further building confidence that the forecast tool can be relied upon in an operational setting.



Another research project from FY16 focused on developing and applying an agent-based model to simulate future agricultural water needs in the Boise Valley using physical, economic, and sociological factors. The model simulates individual farmers' behaviors and reactions to experiences using a table of probabilities developed from historical information, taking into account limiting factors such as knowledge or equipment to grow a particular crop. "New experiences" that emerge during the simulation are used to update the probability



table for subsequent time steps. The model was tested in the Boise Valley and was able to estimate the volume of water needed within 8 percent of historical values. It was also used to predict potential future conditions using future projected climate data. Figure 2 depicts the model interface.

FY17 is shaping up to be another year of great research in the PN Region. Among this research is an effort being conducted collaboratively with the U.S. Geologic Survey to directly link MODSIM (a water operations model) and MODFLOW (a groundwater model) and apply the linked modeling platform in the Deschutes River Basin (Oregon), a fairly complex system with a variety of competing water operations. Researchers hope to determine whether the new tool can improve calibration quality and more accurately represent the nonlinear feedbacks between surface water operations and the groundwater/surface water interactions resulting from those operations.

Another important research project gearing up in FY17 is an assessment of the relative contributions of hydrologic models to bias corrected future streamflow projections. More specifically, this study will evaluate the tools and methods currently relied upon for the development of future streamflows, and determine whether such tools/methods are sufficient for continued use or if additional time and funding should be invested in the development of more complex or better calibrated tools.

### Contacts

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### **Mid-Pacific Region**

n fiscal year (FY) 2016, Reclamation's Science and Technology Program funded several Mid-Pacific Region new and continuing projects.



The ruptured Delta-Mendota Canal lining due to land subsidence.

One continuing project focused on the issue of how land subsidence near the Delta-Mendota Canal (DMC) can impair the canal's ability to deliver water by reducing freeboard, reversing hydraulic gradients, and causing structural damage. Preventing subsidence in the area of the DMC is thus critical to Reclamation's mission.

In FY15, a total of 27 scenarios were formulated that probe the impacts of different groundwater pumping magnitudes, locations, and timing patterns. The model scenario simulations were run and the results documented. These

results indicated that the dominant factor affecting land subsidence is groundwater pumping magnitudes. In FY16, work was performed towards extending the model simulation. This extension will enhance the ability of the model to represent the groundwater pumping–land subsidence relationship, including the recent dramatic subsidence rates observed by the U.S. Geological Survey.

In FY17, the extended model will be used in a comprehensive sensitivity analysis. The extended model and associated analysis will help guide water management in the area to augment surface water supplies with groundwater pumping in the most effective way possible, while also protecting the DMC from the negative impacts of subsidence. Related projects in the area may also benefit from the results of this project.

Another project funded in FY16 related to a watershed-scale model/tool for simulating the effects of wildfires on mercury (Hg) contamination of land and water. Hg transport to terrestrial waters is associated with suspended sediments and organic matter. Past research suggests that suspended sediment concentration remains a controlling factor in Hg flux in disturbed watersheds, especially those impacted by wildfire.

According to the National Interagency Fire Center, more than 8 million acres have burned in United States (U.S.) wildfires throughout 2015. Ecosystem-based management to control the adverse impacts of large wildfires has become a societal imperative, given the wide-ranging impacts from wildfires on water supply and quality, particularly in the Western U.S.



BLM's Cache Creek Wilderness in Lake County, California, after the Jerusalem and Rocky Fires in 2015. Cache Creek Wilderness contains Harley Gulch, downstream from the abandoned Abbott Turkey Run Mercury Mine, which is known to deposit Hg and MeHg into Cache Creek.

A major impact of large fires is increased soil erosion, which leads to increased sediment, nitrogen, and phosphorus and mercury transport into streams and reservoirs during storm events. Such storm events can severely impact drinking water quality, fish and wildlife, and ecosystem health. In particular, Hg pollution from mining has been a widespread concern in California for many years

Numerous researchers hypothesize that particulate organic matter in post-fire runoff not only transport Hg, but also lead to downstream Hg methylation by providing conducive sediment conditions. The dominant organic-Hg form, methylmercury (MeHg), is globally recognized as a threat to people and wildlife as an agent of neurological damage and toxicity, and oxidized divalent inorganic mercury Hg(II) an important precursor to MeHg. Very few watershed-scale modeling tools simulate wildfire effects on mercury fate and transport to receiving waters.

The goals of the research were to: 1) better understand the impact of wildfire on Hg cycling and transport in the aquatic environment through soil erosion during the immediate post-fire period, as well as the longer-term recovery period; 2) study the relationship between wildfire intensity and inorganic mercury species, including Hg(II) in soils; and 3) develop a user-friendly model/tool for the management of Hg in fire-affected watersheds.

The Mid-Pacific Region led this research effort with contributed in-kind support by Reclamation's Technical Service Center and the Bureau of Land Management's (BLM) California State Office. Additionally, the U.S. Geological Survey agreed to share its data and previous research results, and provide technical review and guidance on the project.

### **R&D** Contacts

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### Contact

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### Lower Colorado Region

iscal year 2016 (FY16) was a thrilling year for science and technology (S&T) in Reclamation's Lower Colorado (LC) Region. There were research projects conducted directly from the region as well as research projects conducted by Reclamation's Technical Service Center (TSC)—seven research projects in total for FY16.

The LC Region completed two scoping research projects that led to the submission of two new 3-year conducting proposals, which were both selected and awarded funding for FY17. These research projects are investigating low-flow streambed canals and exploring the use of unmanned aircraft systems (UAS) to complete missions. Both of these projects were submitted in FY16 under the Regional Director Needs research priority, but were competitively submitted during the S&T Program's FY17 Call for Proposals.

The first research project will investigate low-flow ecosystem features, or lowflow streambed canals, that can be implemented in urban channels without raising the flood stage. The Los Angeles River provides an excellent pilot site for the research because of the extreme urbanization of the channel and watershed, and the interest and momentum that is being generated towards improving the ecosystem and aesthetic qualities of the river.



Los Angeles River—(left) looking downstream from the Verdugo Wash Confluence, showing contrast between the concrete-lined channel bed and native material channel bed and (right) looking downstream from 1st Street Bridge, showing the flow is mostly contained by the low-flow notch, but spills out in a few areas. Photographs taken by Nathan Holste (TSC) (April 21, 2016).

The second research project will explore the feasibility of using UAS for Reclamation mission work, specifically in assessing and managing potential rockfall hazards. Rockfalls can occur at Reclamation facilities, potentially disrupting water and power deliveries, damaging infrastructure and equipment, and causing severe injury or death to the public and/or Reclamation employees. Reclamation inspects rockfall hazard areas using staff deployed on rope teams, which itself introduces risk to personnel. This research project intends to conduct UAS test flights over a rockfall hazard area around Hoover Dam (Nevada) to assess prospective safety, cost, and decision support benefits of using UAS in data gathering. Data gathered through the test flights will be used to build high-resolution two- and three-dimensional facility maps of hazard areas and mitigation features, as well as for change-detection tools to provide some forecasting ability for potential rockfall.

Also a highlight in FY16, the LC Region completed the Las Vegas Wash research project that looked at the time of travel using a dye tracing study on the Wash.

Reclamation's LC Region is looking forward to FY17. In addition to the two new 3-year conducting research projects, Reclamation's S&T Program also awarded funding for some top-notch research projects. Researchers within the region are always looking for new and innovative ways to carry out mission responsibilities while improving received data products. Some of these exciting projects the region will be performing in FY17 are:

**Remotely Operated Vehicle to Collect Water Data.** Instead of manually retrieving water samples from the Colorado River, the LC Region will be scoping a project to research the use of remote controlled or autonomous watercrafts to obtain the water samples. The region is excited about this scoping research project and believes the findings will be of interest to many.

**Project Management Software Testing.** The LC Region is also focusing on improving the efficiency of business practices within the region by researching and applying a commercially available Project Management System Software that can integrate with, and talk to, Reclamation's Financial Business Management Software. It is anticipated that the outcomes of this project will be applicable Reclamation-wide and will improve the way Reclamation operates everyday business.

Alternative Battery Chemistry Solutions. Reclamation still uses leadacid batteries in its powerplants. Thus, the LC Region is conducting a "Regional Director Needs" research project to study the use of alternative battery chemistry solutions as a replacement for those leadacid batteries currently installed within power generation facilities.

### Contacts

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### **Upper Colorado Region**

Reclamation's Upper Colorado (UC) Region was the recipient of funding for two science and technology (S&T) research projects in fiscal year 2016 (FY16). The first S&T research project was at the Hogback Canal on the San Juan River



Figure 1.—Inspecting the installation of a 1 MHz (right) and 2 MHz (left) AquaDopp acoustical probes. These sensors have worked well on other fluvial systems installed by USGS. Reclamation designed the mounting structure to avoid sediment burial and still be submerged for most flow conditions (goal is > 500 cfs). Photograph by J. AuBuchon (UC Region's Albuquerque Area Office) on September 22, 2016.



Figure 2.—Debris and sediment left from storm surge on uncontrolled tributaries upstream of the USGS San Acacia gaging station. This material was subsequently cleared away by USGS's Albuquerque Field Office. Photograph by T. Austring (USGS) on October 13, 2016.

in northwestern New Mexico. Reclamation constructed an innovative weir in this diversion canal to prevent entrainment of endangered fish during irrigation season. A Value Engineering Study, completed in FY07, identified the weir as the most promising option of reducing entrainment, diverting irrigation water, and eliminating debris loads that are common with more traditional fish screens. Weir construction was completed in FY13 for a cost of \$3.5 million. The weir was designed and constructed by the UC Region's Western Colorado Area Office in Grand Junction, Colorado, with support and technical assistance from Reclamation's Technical Service Center in Denver, Colorado.

Subsequent weir testing, using a sample consisting of 1,450 Passive Integrated Transponder (PIT)-tagged fish, showed that 95 percent of the fish were diverted past the canal and not entrained. Larval fish entrainment testing is ongoing; however, some testing was delayed due to the canal being shut down from the Gold King Mine spill near Durango, Colorado. The testing is scheduled for completion in FY17, but several fish weirs with modifications are now being planned for other canals in the Colorado River Basin and there is interest in the design from Reclamation's Pacific Northwest Region.

The Rio Grande River in New Mexico is the site for the second S&T research project. The river often carries large debris and sediment loads that are problematic for engineering systems, such as dams, reservoirs, water diversions, and nearby infrastructure. Too much or too little



Figure 3.—Ole Miss's acoustical instrumentation. On the left is the transducer and casing; on the right is the data acquisition box. Photographs taken by W. Carpenter (U.S. Fish and Wildlife Service) on October 21, 2016.

sediment can also cause problems that affect the riverine ecosystem and influence available habitat for endangered species. A variety of sediment data collection techniques exist, but high suspended sediment concentrations in the Rio Grande River are often beyond the scale of most automated sediment sensors.

In the fall of 2016, Reclamation began a research partnership with the University of Mississippi (Ole Miss) and the U.S. Geological Survey (USGS) to record continuous suspended sediment measurements in the Middle Rio Grande River (MRG) using newly developed active acoustics. Field installation at the USGS San Acacia gaging station on the MRG occurred at the end of September (figures 1 and 2). Ole Miss's acoustical instrument is currently undergoing testing (figure 3), with a deployment planned in FY17. The ultimate goal is to develop equipment that continuously and accurately measures sediment loads in high sediment rivers like the Rio Grande River.

### Contacts

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### **Great Plains Region**

**reatment of Impaired Water Sources.** Reclamation has many missioncritical water supply and operational needs that can be addressed through the treatment of impaired water sources for beneficial use. Reclamation's Science and Technology Program is providing the avenue by which the Great Plains (GP) Region is addressing these needs by investigating several opportunities. For example, the GP Region's Eastern Colorado Area Office is currently investigating options to improve aeration/oxygenation to address state water clarity standards and support operational decisions at the Colorado Big Thompson Project in Colorado; modeling is underway and recommendations are expected in 2017. As well, the GP Region's Dakotas Area Office is investigating methods to identify and mitigate Nitrosamines, a potentially harmful disinfection byproduct known to exist in the Mni Wiconi Rural Water System in South Dakota; a peer review team is being assembled, and testing scheduled to begin in early 2017 with results in 2018.



Treatment of Impaired Water Sources Project— Miguel Arias-Paic (left) and Anthony Kennedy (right), Reclamation's Technical Service Center, commissioning an ion exchange water treatment pilot unit to remove hexavalent chromium from groundwater.

The GP Region's Oklahoma-Texas Area Office (OTAO) is partnering with the Texas Water Development Board (TWDB), U.S. Geological Survey (USGS), City of Waco, and Baylor University to design and install an innovative constructed wetland. This wetland is comprised of various treatment cells that can reduce emerging contaminants, such as pharmaceuticals, that are present in wastewater effluent streams and that can be recycled for drinking water. It is anticipated that the wetland will be installed in 2017, and followed by 3 years of monitoring. OTAO is also partnering with TWDB and USGS to develop techniques on how to better utilize existing geophysical well logs to characterize brackish groundwater that can be treated and developed as new drinking water supplies; results are expected in 2017. A separate effort is underway to develop a user-friendly "toolbox" of the latest treatment technologies that can be used to reduce or eliminate the waste concentrate streams emanating from inland brackish desalination plants. Lastly, in Oklahoma, Reclamation researchers are piloting a new ion exchange technology to treat hexavalent chromium from groundwater used by the City of Norman, a recipient of Reclamation project water, as an alternative water supply; results are expected in 2017.

**Evaluating Methods to Apply Cellular Concrete** on Reclamation Projects. The GP Region continues to evaluate grout mix designs and methods for removing air entrained in cellular concrete to increase unit weight, compressive strength, and durability. In partnership with private industry, equipment and materials for the research are being evaluated. Laboratory tests have verified material strength and durability of the current mix design material. Mix designs and transport methods of the cellular concrete have been developed and are ready for testing and monitoring in the field. In FY17, researchers are seeking to test the materials and delivery methods on a transitional zone from a fully lined concrete section to a shotcrete-lined section in a Reclamation tunnel that is subject to damage due to turbulent water eroding the shotcrete invert and undercutting the tunnel walls. This field testing will provide in-situ data and enable researchers to understand the resulting strength and durability of the cellular concrete in a field application and further refine the mix designs for future projects.

Enhancing Database Functionality to Ensure Great Plains Region Conformance With Environmental Compliance Audit Requirements. Design review and planning for enhancing the functionality of the GP Region Environmental Compliance Audit Database is underway. With more than 150 major water storage and delivery structures and 21 hydropower facilities, the GP Region Environmental Compliance Audit Program annually produces and manages a large volume of data,



Evaluating Methods to Apply Cellular Concrete on Reclamation Projects—Data collection during inspection to document extent of concrete erosion in the North Side Collection System, Cunningham Tunnel, Fryingpan-Arkansas Project, Colorado.

reports, and correspondence. Enhancing the existing database design will improve effectiveness of the program across multiple users in the Region and ensure compliance with the Reclamation Manual. The final database and user's manual, anticipated in FY17, will be specifically tailored to meet program requirements and could be adopted by other Regions for use.

### Contacts

Collins Balcombe and Jennifer Beardsley GP Regional Science and Technology Coordinators (see "About the *Knowledge Stream*" on page 35 for contact information)

# **Technology Transfer**

ighlights of activities conducted under the Federal Technology Transfer Act of 1986 during fiscal year 2016 (FY16) include developing Reclamation Technology Transfer Directives and Standards. In March 2016, the Research and Development Office (R&D) released Reclamation Manual Directives and Standards (D&S) RES 01-01 for implementing the U.S. Department of the Interior's new Departmental Manual Chapter for Technology Transfer Policy and Procedures (761 DM 1), which was issued on May 16, 2014. The D&S establishes responsibilities and requirements for Reclamation to maximize the benefits provided by the Federal Technology Transfer Act. The Act authorizes Reclamation to work jointly with non-Federal entities in developing and commercializing new solutions to water and water-related problems.

The purpose of this D&S is to facilitate effective partnerships that can leverage shared capabilities and costs, and more effectively develop and move technologies to stakeholders, the public, and private sectors. Additionally, these partnerships allow Reclamation and non-Federal partners to efficiently and cost-effectively generate userready solutions that can improve the economic, environmental, and social well-being of the United States (see "more information").



Left to right: Samantha Zhang, Technology Transfer Administrator (R&D); Jim DeHaan, Electrical Engineer (TSC), and John "Jack" James, FLC Mid-Continent Regional Coordinator (NASA Johnson Space Center) accepting the Notable Technology Development Award at the FLC Mid-Continent's Regional Meeting



and Award Event in Albuquerque,

comparable to a penny electrical generators.

Also in FY16, Reclamation received a Notable Technology Development Award, which recognizes new technologies serving the common good, from the Federal Laboratory Consortium (FLC) Mid-Continent Region for its Flexible Magnetic Flux Probe.

The Hydropower Diagnostics and SCADA Group in Reclamation's Technical Service Center (TSC) developed and patented (#6,466,009) a flexible magnetic flux probe that detects deteriorating insulation in large-scale spinning electrical generators, preventing failure as well as expensive repairs and replacements. The inexpensive, small, flat, light, and flexible probe accurately measures the magnetic flux and can be mounted in the air gap without rotor removal or shutdown. The probe design is very thin, allowing easy installation into the air gap. If the probe comes loose during generator operation, the flexible substrate will not damage the generator. Reclamation has a nonexclusive license agreement with Iris Power LP, and currently has sold over 200 probes.

The inventors of the flexible magnetic flux probe include Jim DeHaan, Malin Jacobs (retired), and Bert Milano (retired). Jim DeHaan accepted the award at the FLC Mid-Continent's Regional Meeting and Award Event in Albuquerque, New Mexico, in September 2016.

Additionally, the Denver Water Treatment Engineering and Research Laboratory in Reclamation's TSC entered into a Material Transfer Agreement with an environmental consulting company in FY16 to combine their specialized capabilities to test hexavalent chromium (Cr<sup>6+</sup>), or brine waste, using nanofiltration membrane processes. Nanofiltration membrane processes are used to recover regeneration salt (a liquid solution also used in the regeneration process and an important chemical cost) and reduce the volume of waste. This agreement allows both parties to gain insight on treating Cr<sup>6+</sup> from ion exchange potable water treatment plants to levels that would comply with U.S. Environmental Protection Agency and State of California standards. It also allows both parties to better understand the potential for nanofiltration membranes playing a larger role in expanding the Nation's usable water supplies.

Upcoming initiatives proposed for FY17 through FY19 will help R&D carry out technology transfer (T2) activities efficiently and meet the requirements of T2 authorities (see "more information"). In addition, these initiatives will enable R&D to sustain and expand its base of T2 activities across Reclamation, thereby increasing benefits to Reclamation and its partners:

**Provide Bureau-Wide Training.** Knowledge and use of T2 and/or its tools are limited throughout Reclamation thus necessary to improve and expand on. R&D will develop desk references or guides, case studies, training, webinars, and presentations to demonstrate how to use T2 tools and its benefits.

**Improve Regional Coordination.** There is limited Regional Office involvement within T2; therefore, R&D will establish regional T2 support or liaisons to assist in T2 activities. Initial support will include the Regional Science and Technology Coordinators and others who have been involved in T2 activities. Regional T2 support is needed to 1) help identify opportunities where T2 agreements can solve regional technical problems that align with Reclamation's mission and objectives and 2) participate in the T2 agreement process as necessary to gain familiarity with agreements, including Material Transfer, Facility Use, and Cooperative Research and Development Agreements.

#### **Continue Technology Transfer Agreements With Non-Federal Organizations.**

Reclamation will continue to enter into T2 agreements with non-Federal organizations to develop new and improved cost-effective solutions that will be adopted by Reclamation resource managers, stakeholders, and the American public.

### **More Information**

D&S RES 01-01: www.usbr.gov/recman/res/res01-01.pdf

Departmental Manual, 761 DM 1: http://elips.doi.gov/elips/0/doc/3999/Page1.aspx

#### Departmental Manual, 207 DM 8: http://elips.doi.gov/ elips/DocView.aspx?id=783&searchid=50b7abf2-a187-4e95-bbd7-3f3cccd60339&dbid=0

### **R&D** Contact

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## **Technology Prize Competitions**

### Reclamation's Water Prize Competition Center Update

**F** or centuries, prize competitions have helped expand frontiers, reach new heights, and address the challenges of every age. With the world now connected through the Internet, many online crowdsourcing platforms now exist to connect those that have problems with those that can help solve problems. Over the past 15 years, using these platforms by the private sector to solve problems has increased dramatically.



Stonefly aquatic invertebrate. Photograph courtesy of California Department of Fish and Wildlife.

Since the America COMPETES Reauthorization Act of 2010 (15 U.S.C. § 3719), Reclamation has the authority to invite the public and private sectors to come and work with Reclamation to solve problems that are important to Reclamation's mission. "Reclamation realizes the world is full of talented people, and one way to collaborate with these individuals or groups is through a prize competition," Reclamation Commissioner Estevan López said. "It's a winwin situation for all involved. We receive innovative ideas that may help us recover threatened and endangered fish species, while prize competition participants are rewarded or recognized for their innovation and hard work."

Reclamation's Water Prize Competition Center allows the agency to seek new and timely solutions from beyond the usual sources of potential solvers and experts. In FY16, the Water Prize Competition Center—in partnership with other Federal agencies, state and local agencies, nonprofits, and private sectors—launched four additional prize competitions:

- Quantifying Drift Invertebrates in River and Estuary Systems
- Downstream Fish Passage at Small Dams
- Detecting the Movement of Soils (Internal Erosion) Within Earthen Dams, Canals, Levees, and Their Foundations
- Preventing Rodent Burrows in Earthen Embankments

Current planning and design work supports the following upcoming prize competitions launching in FY17:

#### Water Availability Theme Area

More Water, Less Concentrate – Stage 1 Arsenic Sensor – Stage 1 Sub-Seasonal Climate Forecast Rodeo

#### **Environmental Compliance Theme Area**

Better, Faster, Cheaper: Estimating Reservoir Water Storage Capacity

#### Infrastructure Sustainability Theme Area

Long-Term Corrosion Protection of Existing Hydraulic Steel Structures – Stage 1 Mobile App Framework for Field Data Capture for Engineering and Science Information

Current Water Prize Competition Center collaborators include:



### **More Information**

To learn more, visit: www.usbr.gov/research/challenges

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**Featured Faces S** lim Baxter and Sheryl Krueger work as volunteers at Reclamation's Brackish Groundwater National Desalination Research Facility (BGNDRF) in Alamogordo, New Mexico. They first came into contact with BGNDRF through their membership in Otero County's Retired and Senior Volunteer Program (RSVP). The RSVP Program is one of the largest volunteer efforts in the United States. The program provides volunteers aged 55 and over with a unique opportunity to help meet critical needs in their community by engaging in a diverse range of volunteer activities. It was through the RSVP Program that Slim and Sheryl became volunteer workers at BGNDRF nearly 2 years ago.



According to Dan Lucero, Facility Operations Assistant at BNGDRF, he first learned of the RSVP Program through his wife, who manages a local senior citizen's center in Alamogordo. Several of the senior citizens were interested in volunteering their time and energy to a worthwhile cause and requested a tour of the BGNDRF facility, which was approved. It was during this tour that Dan first met Slim Baxter. Soon afterward, a Memorandum of Understanding was prepared between BGNDRF and the senior citizen's center, and Slim became the first RSVP volunteer to work at BGNDRF. Soon afterward, he was joined by fellow RSVP volunteer Sheryl Krueger.

Although BGNDRF has been operating for over 10 years as a research facility, local residents often refer to it as a desalination plant. Therefore, Slim and Sheryl work as advocates, educating the public about the various research work taking place at BGNDRF. They often bring in groups of seniors to tour BGNDRF. In addition, Slim and Sheryl served as the welcoming committee during the Desal Prize event held at BGNDRF. When a third-grade elementary school class toured BGNDRF, Slim drove the children around the grounds in a cart, while Sheryl served as timekeeper and operated the intercom.

Slim and Sheryl even assist with minor maintenance activities at BGNDRF, such as touchup painting and detailing. They maintain the alternative energy desalination demonstration (referred to as "the BUIK"), which they revised to make it more user friendly. They even landscaped in the summer heat! "I like to go out and sweat," reports Slim. According to Dan, Slim and Sheryl work so hard they have to be reminded not to overextend themselves. "We have to hold them back," Dan jokes, adding "They are a great asset and complement to the facility team—it's a synergy."

Slim and Sheryl often accompany Dan when he gives traveling demonstrations and presentations at schools, performing setup, takedown, and operation and maintenance of the BUIK. They work an average of 6 hours per week, but work more hours during special events, such as the Pitch to Pilot and Desal Prize.

Slim has been a New Mexico resident for over 55 years. Before he retired, he worked for 38 years on the White Sands Missile Range and Holloman Air Force Base for contractors who were in data reduction systems. He also worked as an electronics technician in research and development. During his retirement, Slim was diagnosed with cancer. After that experience, he decided to get back into the world by volunteering with Meals on Wheels and the New Mexico Space Museum. In addition to volunteering at BGNDRF, Slim also volunteers for Rails-to-Trails and the Center for the Performing Arts.

Sheryl has lived in New Mexico for over 45 years. She spent 38 years performing administrative work, holding down both primary and secondary jobs. After retiring, Sheryl decided to go to the senior center and see what was going on. She states, "I met Slim through volunteering, and he needed some help, and I've been volunteering ever since."

Slim Baxter and Sheryl Krueger are outstanding examples of senior citizens who are committed to making a difference in their communities and in the lives of others. Their volunteer spirit shines as they speak. Slim says, "I'm 83 years old, and I keep trying to prove to people to keep going. That's what I tell the young kids when they ask about how active I am. I told them don't grow up." Sheryl adds, "I'm 68 years old, and volunteering and helping somebody else is really rewarding at this point in time in our lives. The commitment is so different being a volunteer than being an employed person. For me, it's a sense of being needed somewhere and with something to do."

### About the Knowledge Stream

The *Knowledge Stream*, published by the Bureau of Reclamation's Research and Development Office, is a seasonal magazine bringing mission-critical news about the agency's research and science, as well as the many challenges associated with managing water and generating power in the West, including: projects, tools, methods, practices, results, innovation, prize competitions, publications, and more.

### **Regional Science and Technology Coordinators Contact Information**

Whether you are a regional researcher, Reclamation partner or customer, or just have an idea for a project that can help your region, the Regional Science and Technology Coordinators can help you with your research ideas, proposals, and projects.

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On the Covers-

- Front Cover: Autonomous unmanned aerial system testing, one of Reclamation's Science and Technology Program awarded research projects receiving funding for fiscal year 2017.
- Back Cover: Fall 2016 high-flow release of water from Glen Canyon Dam (Arizona) under an innovative science-based experimental plan. The goal is to enhance the environment in Grand Canyon National Park and Glen Canyon National Recreation Area while continuing to meet water and power delivery needs, and also allow for continued scientific experimentation and monitoring on the Colorado River.

