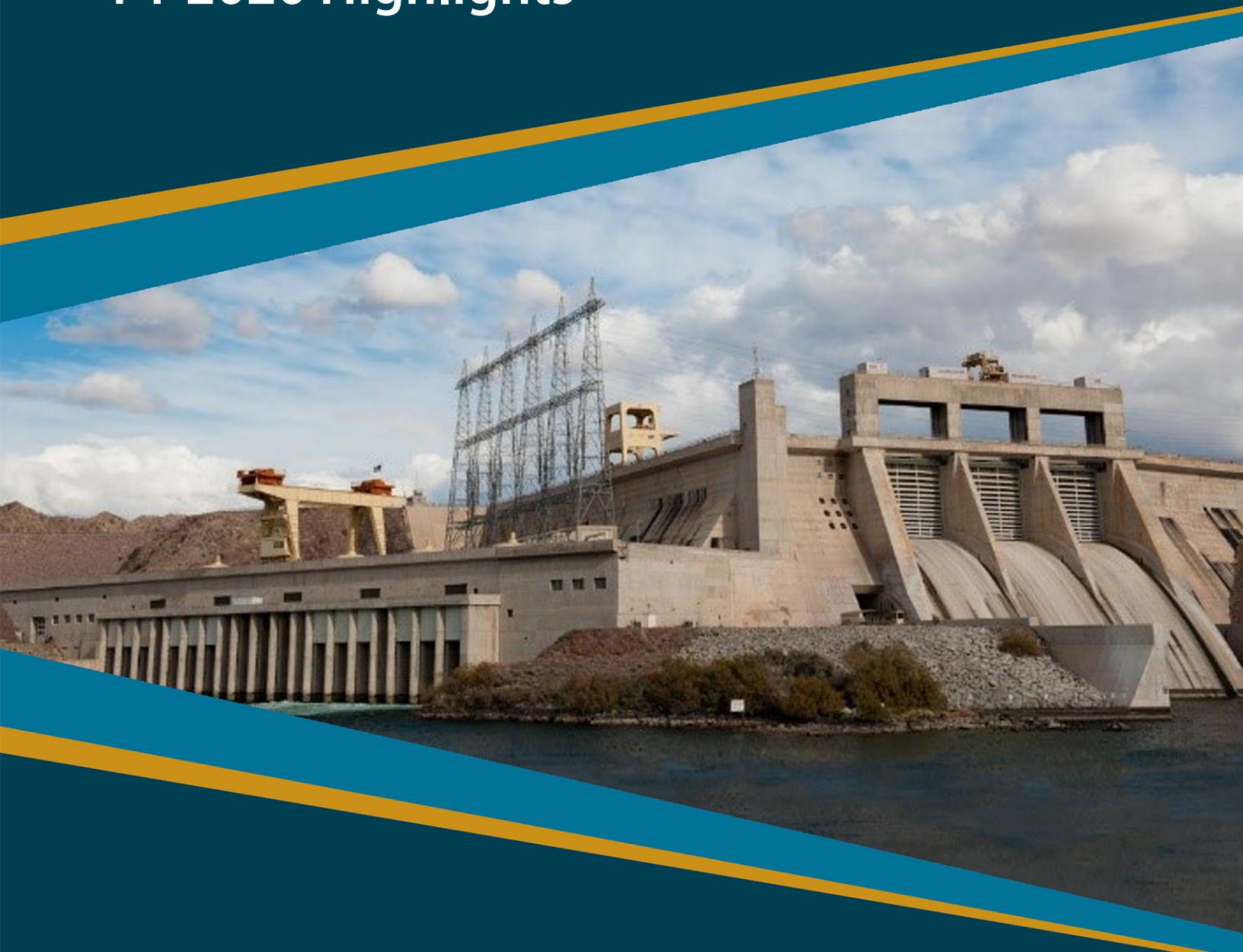




— BUREAU OF —  
**RECLAMATION**

# **Research and Development Office**

## **FY 2020 Highlights**



# Reclamation's Research and Development Office

The Research and Development Office (R&D) administers innovation programs to advance the agency's mission to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public. R&D's two appropriated programs, Desalination and Water Purification Research and Science and Technology address the technical obstacles related to our mission. R&D also administers the Open Water Data program to provide bureau-wide water data publishing and enhance science and products dissemination from R&D programs. Learn more at: <https://www.usbr.gov/research>.

## DWPR Projects

### FY 2020 by the Numbers

- ◆ 113 Applications
- ◆ 30 Awarded Grants
- ◆ \$7.0M Federal Funding
- ◆ \$9.8M non-Federal Match

## Desalination and Water Purification Research (DWPR)

Reclamation's DWPR Program seeks to reduce the cost, energy consumption, and environmental impacts of using desalination and other water purification technologies to develop water supplies from otherwise unusable sources (e.g., brackish groundwater, sea water, produced water from oil and gas extraction, municipal wastewater).

These are the challenges and solutions proposed by FY 2020 funded projects:

Challenges being addressed:

- per-and-polyfluoroalkyl substances (PFAS) removal
- water reuse for potable and indirect potable reuse
- innovative membranes
- concentrate management
- optimization via machine learning



Discovering Desal at BGNDRF.



Features at BGNDRF - Top photo: Well 1 Cooling Tower; Bottom photo: Evaporation pond.

## Brackish Groundwater National Desalination Research Facility

The DWPR program funds the operation and maintenance of BGNDRF, located in Alamogordo, New Mexico, a focal point for developing technologies for the desalination of brackish and impaired groundwater found in the inland states. The facility supports piloting to full-scale testing of desalination and water purification technologies.

BGNDRF brings together researchers from Federal government agencies, universities, the private sector, research organizations, and state and local agencies to work collaboratively and in partnership. In FY2020, the facility hosted their first Virtual Water Innovations and Networking (WIN) Workshop with over 150 registrants.

## Science and Technology Program (S&T) Research Projects

The S&T program funds innovative development, applied and demonstration research addressing the full range of technical issues confronting Reclamation water and power managers, customers, and stakeholders. Program research is funded in five areas:



### Water Infrastructure (WI)

Dams, Canals, Pipelines, and Miscellaneous Water Infrastructure



### Power and Energy (PE)

Hydro Powerplants, Energy Efficiency, Pumping Plants, and Non-Hydropower Renewable



### Developing Water Supplies (WS)

Advanced Water Treatment, Groundwater Supplies, Agricultural and Municipal Water Supplies, and System Water Losses



*Water quality will be analyzed at Salt River Project Reservoirs to investigate why invasive quagga mussel populations establish at some sites but not others.*



*Example of the impact of sand abrasion on a turbine.*

### S&T Projects

#### FY 2020 by the Numbers

- ◆ 211 Active Projects
- ◆ 36 Completed Projects
- ◆ \$10.1M Federal Funding
- ◆ \$13.1M non-Federal Match



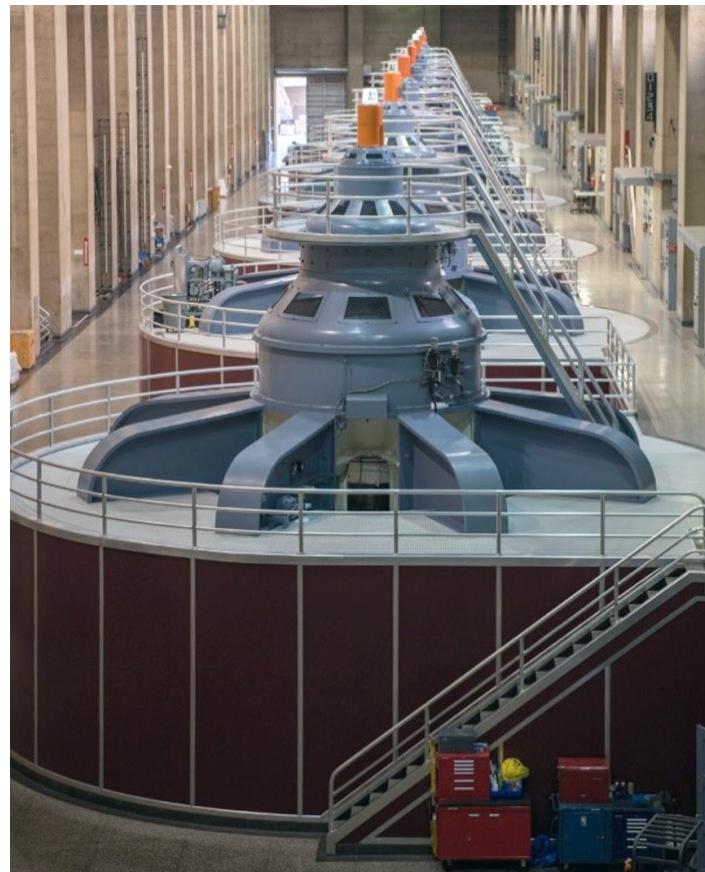
### Environmental Issues in Water Delivery and Management (EN)

Water Delivery Reliability, Invasive Species, Water Quality, Sediment Management, and River Habitat Restoration



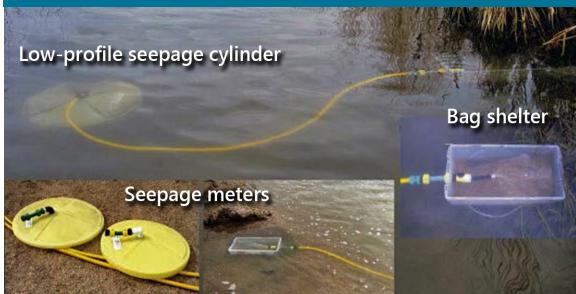
### Water Operations (WP)

Water Supply and Streamflow Forecasting, Water Operations Models and Decision Support Systems, Open Data, and Climate Change and Variability



*Carbon dioxide is being investigated as a method to prevent invasive mussel fouling in generator cooling systems.*

## Science and Technology Program (S&T) Highlighted Research Projects



### (WI) Select Techniques for Detecting and Quantifying Seepage from Unlined Canals

**Problem:** No single approach for canal seepage investigations and canal health evaluations.

**Solution:** Canal Seepage Framework identifies appropriate investigation tools based on specific issues and risks for a canal.

**Impact:** Streamlined decision process for investigations.

Total Federal Cost: \$41,216

Benefit Cost Ratio: 24

### (PE) Feasibility of Utilizing Optical Instrument Transformers

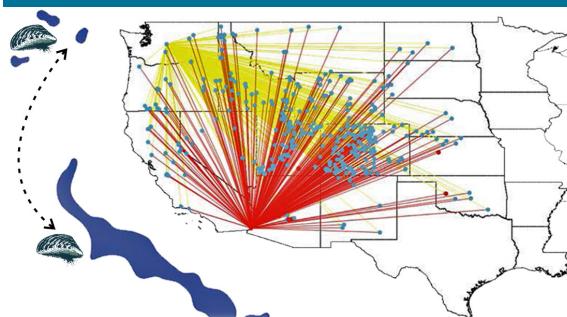
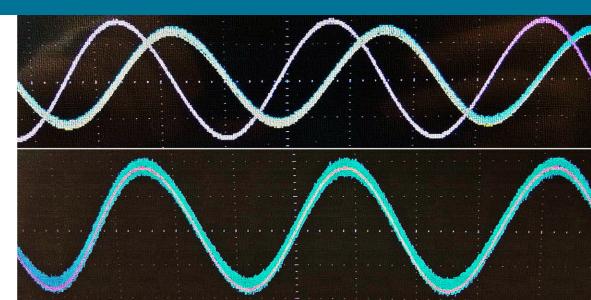
**Problem:** Conventional instrument transformer safety and performance.

**Solution:** Optical transformers may be used in niche applications where additional costs and complexities are justified.

**Impact:** Research identified potential uses for optimal transformers that would improve accuracy, safety and space issues.

Total Federal Cost: \$64,547

Benefit Cost Ratio: 25.9



### (EN) Predictive Dreissenid Mussel Monitoring in the Western United States

**Problem:** Predicting future dispersal patterns is difficult.

**Solution:** Ecological modeling can be used to forecast different invasion patterns to determine areas at the highest risk for future colonization.

**Impact:** Improved efficiency of mussel control resources deployment.

Total Federal Cost: \$610,327

Benefit Cost Ratio: 7.7

### (WP) West-wide Evapotranspiration Forecast Network

**Problem:** Irrigators lack skillful forecasts of crop ET.

**Solution:** This project produces a station corrected ET forecast product based on the NOAA GFS weather model across much of the western United States.

**Impact:** With additional information regarding crop water needs over the upcoming week, irrigators can better schedule irrigation and enhance water use, resulting water savings and/or higher yields.

Total Federal Cost: \$377,866

Benefit Cost Ratio: 10.5



### (WS) Measuring Sparingly-Soluble, Aqueous Salt Crystallization Kinetics

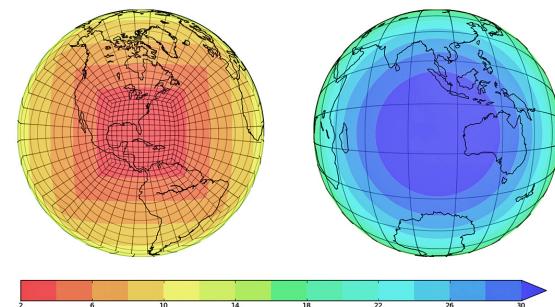
**Problem:** Lack of economical and environmentally satisfying solutions for handling concentrate streams generated from desalination processes.

**Solution:** This project researched a novel process design for a crystallizer to bring supersaturated concentrate streams back to saturation and not allowing for the sparingly soluble salts to deposit (scale) on the membrane and other surfaces.

**Impact:** A reaction engineering approach to study crystallization of sparingly soluble salts using continuous stirred tank reactors in series was developed. The results obtained provides clearer directions for crystallization process improvements but additional work is needed to be able to design a scaled-up crystallizer.

Total Federal Cost: \$361,024

Benefit Cost Ratio: 19.5



## Open Water Data

The Open Water Data Program focuses on making Reclamation's mission-related data available in open formats for broad public use and supports implementation of the OPEN Government Data Act. Program activities include coordinating S&T research projects related to open data, developing and operating an open data publication IT system, and interfacing with internal and external partners to enhance data access and use.

In FY2020, Reclamation hired a full time Open Water Data Coordinator to manage the program and launched its new open data portal, the Reclamation Information Sharing Environment (RISE) at <https://data.usbr.gov>.

RISE provides a platform for Reclamation programs and offices to publish water, hydropower, environmental, and related data for both internal and external data consumers. The site includes a data catalog listing available datasets, a map interface

### OWD Activity

#### FY 2020 By the Numbers

- ◆ Datasets published in RISE: 1677 catalog records
- ◆ RISE Releases: 5 deployments with 118 tasks
- ◆ Total RISE Users: 533

for browsing data by location and interacting with geospatial datasets, a query page for accessing time series data, and an Application Programming Interface (API) for automated data calls. RISE launched for internal access in fall 2019 and for public access in summer 2020. The initial catalog included datasets related to water operations, hydropower generation, bird and small mammal monitoring, and brackish groundwater monitoring, with additional datasets in progress for sediment monitoring, water quality, S&T research projects, invasive mussel monitoring, and more.

Screenshots from RISE, top left: RISE map interface showing dataset locations; top right: RISE homepage; bottom left: RISE query page showing a plot of reservoir release data; and bottom right: RISE map interface showing user interaction with a geospatial dataset.

## Prize Activity

### FY 2020 by the Numbers

- 4 Competitions Launched
- 4 Completions
  - 3 Competitions
  - 1 Competition Phase
- 112 Solutions Received
- 19 Winning Solutions
- \$800,000 Cash Prizes Awarded

in FY2020 and built upon Reclamation's *Improving Fish Exclusion from Water Diversions and Intakes* theoretical competition that concluded in December 2019. Three winners from the Fish Protection Prize are continuing to advance their solutions through a 1-year agreement with DOE's Pacific Northwest National Laboratory.

Three competitions and one phase of a competition concluded in FY2020. The competitions concluded are:

- *Improving Fish Exclusion from Water Diversions and Intakes*: \$75,000 total awarded; 6 winners for their theoretical solutions
- *Lowering the Cost of Continuous Streamflow Monitoring*: \$75,000 total awarded; 5 winners
- *Fish Protection Prize*: \$400,000 in cash and in-kind voucher support awarded; 3 overall winners continuing solution development
- *Rust Busters – Phase 1*: \$250,000 total awarded; 5 Phase 1 winners developing and submitting prototypes for laboratory and field testing.

In FY 2020, Reclamation advanced in its prize competitions by pivoting to multi-phase competitions. IN the multi-phase competitions, competitors are often provided opportunities to develop, demonstrate, and test their proposed solutions. They may also receive technical input or engagement from subject matter experts as they advance their solutions. Prize competitions complement traditional research by providing another tool to help find breakthroughs or overcome technical obstacles and complexities. Reclamation is continuing to work internally and with prize winners to further develop solutions received from completed competitions including eradication of mussels in open water.

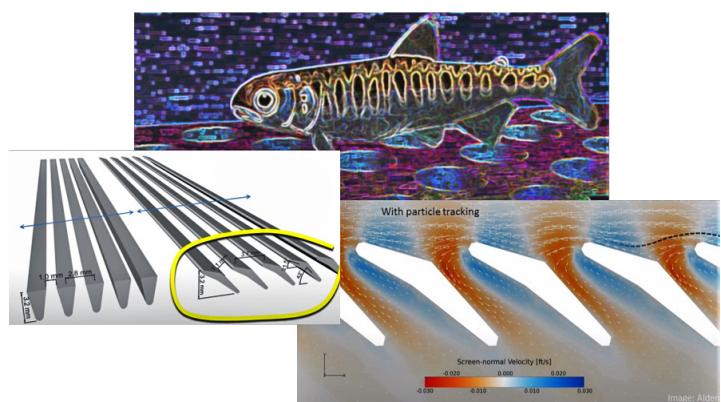


**Guardians of the Reservoir:** Launched July 2020. Five solvers currently developing innovative solutions to manage sediment accumulating in reservoirs.

These competitions are reaching an international community of solvers and include:

- *Guardians of the Reservoir*: Addressing reservoir sediment removal and transport.
- *Sub-Seasonal Climate Forecast Rodeo 2*: Year-long, real-time temperature and precipitation forecasting competition.
- *Streamflow Forecast Rodeo*: Warm-up competition for improving skill of short-term (10 days) streamflow forecasts.

The fourth competition launched, *Fish Protection Prize*, was in partnership with the Department of Energy's (DOE) Water Power Technologies Office. This competition launched and completed



**Fish Protection Grand Prize:** Benjamin Mater of Alden Research Laboratory and Charles Coutant, *Making a Deal with the Devilfish: Biometric-Informed Screening Technology*. (Images\_Alden Research Laboratory Inc.; Salmon fry illustration by Alaska Department Fish and Game)



Debris clogged in the hydrokinetic generator rotors. Tarp transitions were cut to relieve upstream water levels. (Photo\_BOR)

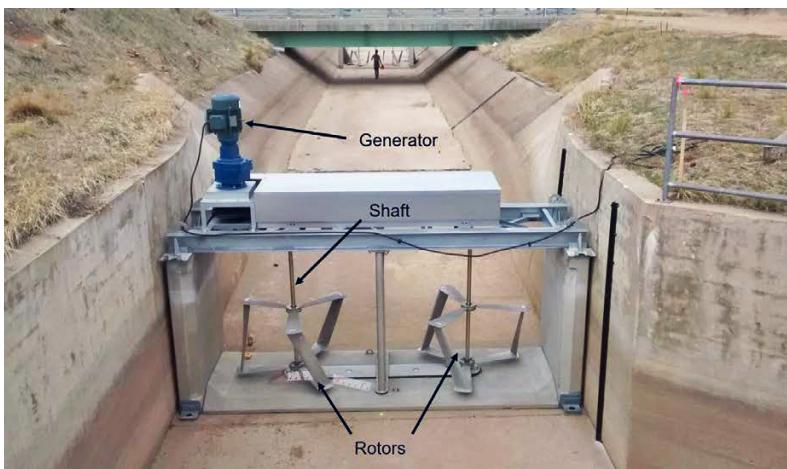
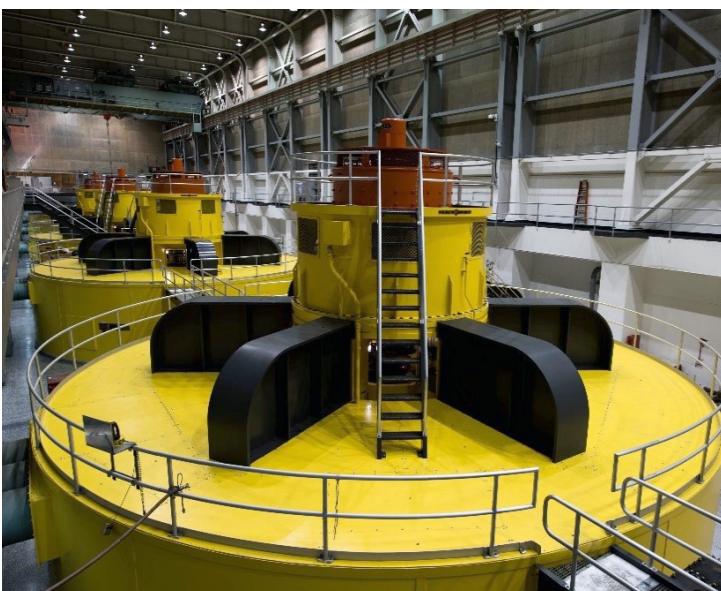


Photo of the dual rotor hydrokinetic unit installed in the downstream of a canal transition zone. (Photo\_BOR)



Hydropower turbines at Glen Canyon Dam on the Colorado River near Page, Arizona. (Photo\_Alexander Stephens)

Conducting residual stress measurements on Grand Coulee turbine runner.

## S&T Technology Transfer

The S&T Program pursues a variety of joint venture research partnership agreements by leveraging Technology Transfer (TT) with the private sector.

This includes Cooperative Research and Development Agreements (CRADA), Materials Transfer Agreements (MTA), and Facility Use Service Agreements (FUSA), among others, where industry plays a role in maturing and transforming research results into usable, manufactured products that can be supplied to Reclamation and the broader water management community.

### TT Activity Summary FY 2020 by the Numbers

- ◆ 2 CRADAS
- ◆ 6 MTAs
- ◆ 12 Active Patents with 4 License Agreements
- ◆ 2 Patents Filed



Researchers are investigating coatings to prevent mussel fouling at hydropower plants. The photo shows how mussels do not adhere to the experimental coating but can attach to the algae on the coated surface.



# STREAMFLOW FORECAST RODEO

## UP TO \$500,000 IN PRIZES

