



— BUREAU OF —  
RECLAMATION

## Fiscal Year 2021 WaterSMART Applied Science Grants

### Arizona

**Salt River Project Agricultural Improvement and Power District, Continuous Predictive Hydrologic Model to Inform Salt River Project's Reservoir Operations within the Salt and Verde Watersheds**

**Reclamation Funding: \$155,015**

**Total Project Cost: \$310,030**

The Salt River Project Agricultural Improvement and Power District in Arizona will develop a real-time reservoir operations model for the Salt and Verde rivers. The model will be used to predict changes to lake levels based on a continuous runoff simulation, enhancing the Salt River Project's ability to analyze and react to forecasted hydrological events in the watersheds that impact operations and infrastructure. The model will forecast streamflow at specified locations that directly impact reservoir operations, informing operations decisions and facilitating early responses to flooding caused by storm events or landscape changes created by wildfire. The Salt River Project is carrying out the project with the support of the Arizona Municipal Water Users Association and the cities of Tempe, Chandler, and Scottsdale.

### California

**California Water Data Consortium, Advancing an Open-Source Water Accounting and Scenario Planning Platform to Support the Successful Implementation of California's Sustainable Groundwater Management Act**

**Reclamation Funding: \$200,000**

**Total Project Cost: \$544,031**

California Water Data Consortium, located in Sacramento, California, will partner with the California Natural Resources Agency, Environmental Defense Fund, California Department of Water Resources, State Water Resources Control Board, Sonoma County Water Agency, Pajaro Valley Water Management Agency, and multiple local water authorities and districts, to enhance and expand an open-source Water Accounting Platform to serve as a baseline groundwater accounting and tracking tool available to Groundwater Sustainability Agencies across California. Because California groundwater resources remained largely unregulated until the Sustainable Groundwater Management Act was passed in 2014, most local groundwater management agencies have limited data management infrastructure. This project will facilitate effective accounting and management of available water resources by integrating two established, open-source software tools to improve access to water elevation and extraction data, water

accounting systems, and scenario planning and visualization tools critical for effective groundwater management.

### **Lawrence Livermore National Security, Improved Recharge Monitoring for Enhanced Conjunctive Management of Ground and Surface Water**

**Reclamation Funding: \$200,000**

**Total Project Cost: \$400,000**

Lawrence Livermore National Laboratory, located east of Oakland, California, will partner with the Omoichumne-Hartnell Water District (OHWD) to improve monitoring of infiltration and groundwater recharge and provide real-time data accessibility to inform water management decisions at OHWD recharge project sites. The District will use conjunctive use of ground and surface water on agricultural lands to help address reduced summer flows that have limited the use of surface water diversions. The project partners will develop a model to simulate groundwater conditions, perform geophysical surveys, install new monitoring wells, incorporate electrical conductivity and soil moisture sensors into an online dashboard for data sharing, and improve estimates for river recharge potential. This new information will directly aid OHWD in the coordinated management of both surface and groundwater systems and guide the expansion of on-farm recharge infrastructure projects.

### **Social and Environmental Entrepreneurs, Inc., A Data Platform for Urban Water Efficiency in California**

**Reclamation Funding: \$199,977**

**Total Project Cost: \$399,977**

Social and Environmental Entrepreneurs, a nonprofit organization that sponsors the California Data Collaborative, will develop the California Urban Water Efficiency Data Platform in collaboration with its member agencies, which include local and regional municipal water suppliers. The project location spans across California, with a primary focus on areas served by Urban Retail Water Suppliers, entities providing potable municipal water to more than 3,000 end users, or that supply more than 3,000 acre-feet of water per year. The 2012-2016 drought in California highlighted the need for a single data system to provide timely, accurate information about water production and demand to enable informed water demand management. The data platform will assist local water suppliers with tracking, quality controlling, and analyzing their water production and demand data. The platform will help agencies evaluate their current efficiency levels, identify opportunities for improvement, share data for regional collaboration, and report their data for compliance with California's water efficiency legislation. The software will be made accessible online using technologies common in modern consumer software.

### **Stockton East Water District, Eastside Groundwater Use Measurement Project**

**Reclamation Funding: \$58,000**

**Total Project Cost: \$117,080**

Stockton East Water District, with the support of Eastern San Joaquin Groundwater Authority, North San Joaquin Water Conservation District, and Central San Joaquin Water Conservation District, will develop groundwater pumping and recharge volumes using proven, remote sensing techniques, based on evapotranspiration (ET) estimation from NASA's Landsat satellite imagery.

The agencies involved are part of the Groundwater Sustainability Agency responsible for implementing California's Sustainable Groundwater Management Act in the Eastern San Joaquin Groundwater Sub Basin. The Eastern San Joaquin Groundwater Basin is a high priority, critically over-drafted groundwater basin by the California Department of Water Resources. This project will implement the Geospatial Resources of Water Management for Agricultural Systems, an automated portal that uses Landsat imagery and weather data to produce daily, monthly, and annual ET data. The project will help the groundwater sub-basin account for groundwater demand, manage available surface and groundwater resources, allocate costs and document benefits of proposed groundwater banking, storage and conjunctive use projects.

## Colorado

### Grand Mesa Water Users' Association, Grand Mesa Water Users' Association Efficiency Project

**Reclamation Funding: \$200,000**

**Total Project Cost: \$440,000**

The Grand Mesa Water Users Association, located on the Grand Mesa in Delta County, Colorado, will produce digitized capacity surveys for 50 reservoirs. The reservoirs on the Grand Mesa were built to capture and conserve available water from snowpack for irrigation and municipal use. This project includes conducting reservoir capacity surveys using drone technology, installing water measuring sensors at each reservoir to monitor water level heights, and developing a water distribution control system with multiple functions such as an interactive map of the reservoirs, a database with data on the reservoirs, a dashboard showing water administration activity, and a forecasting tool. These tools will enhance the management of water supplies and reservoir operations.

## Kansas

### University of Kansas Center for Research, Inc., Incorporating Climate Uncertainty into Water Allocations in Kansas

**Reclamation Funding: \$97,822**

**Total Project Cost: \$195,648**

The University of Kansas, located in Lawrence, Kansas, will work with the Kansas Water Office (KWO) to include climate uncertainty in the water supply allocation procedure in the State of Kansas. KWO uses a water balance model across the system based 1950's climate, which was an extreme drought period in the state of Kansas, for determining water allocations. This project will develop a procedure for incorporating climate uncertainty into the water allocation process. The process will include quantifying climate uncertainty using historical climate and climate projections, using a hydrologic modeling framework to estimate the uncertainty in streamflow and evaporation, modifying the existing KWO water allocation model to use an ensemble of streamflow and evaporation inputs, and quantifying the uncertainty in future water allocations due to climate based on a Bayesian probabilistic framework. A more robust system accounting for climate uncertainty will allow the state to conduct long-term water supply planning and better anticipate the range of future resource conditions.

## Montana

### Montana Department of Natural Resources & Conservation, Enhancing Hydrologic Modeling and Water Supply Forecasting in Montana's Upper Yellowstone Basin

Reclamation Funding: \$119,009

Total Project Cost: \$405,135

The Montana Department of Natural Resources and Conservation will develop a water balance, precipitation-runoff hydrologic model, and water supply forecasting tool for the Upper Yellowstone Watershed in south-central Montana. Stakeholders and managers in the watershed are increasingly forced to balance growing demands for water with uncertainty in water supply, driven by climatic shifts towards earlier season snowmelt runoff, warmer temperatures, and persistent drought conditions. This complexity in water management has created tension throughout the community in recent years. This project will develop a modern hydrologic toolset to forecast water supply conditions, enhance water management decision-making, and inform drought planning efforts. Water supply forecasting will be enhanced by incorporating a physical precipitation-runoff technique, which will complement the existing statistical method. Evapotranspiration and crop consumption estimates will also be improved through the use of remote sensing data and existing modeling software. This method has been shown to improve modeling and forecasting accuracy, reduce error, and contribute to a better understanding of watershed hydrology.

## Nebraska

### Nebraska Department of Natural Resources, Application for Platte River Decision Support System (DSS) of Excess Flow in Nebraska Phase 4 - Water Management Tools and Stakeholder Outreach

Reclamation Funding: \$200,000

Total Project Cost: \$400,000

The Nebraska Department of Natural Resources (NeDNR), the primary surface water permitting agency in Nebraska, will implement the fourth phase of the Decision Support System (DSS) development for the Platte River to better utilize unappropriated water on the Platte River in the wake of increasing climate variability and its impact on water resources. A systematic approach for water allocation decisions during excess flow events increases efficiency, transparency, and accountability while simplifying the process and reducing the regulatory burden on customers applying for excess water use. The DSS will provide a vital tool to Nebraska's water managers to leverage opportunities to re-time water supplies through storage and groundwater recharge to support planning efforts to maintain a balance between water uses and supplies. NeDNR initiated DSS development in 2018 and will complete the Water Management Tools and Stakeholder Outreach Phase (Phase 4) during this project. This phase of the project will increase water supply reliability through forecasting within the Platte River Basin, support NeDNR water administration to avoid water allocation conflicts, and help support the management of the river, including the administration of water rights in periods of surplus water availability.

## **Nevada**

### **Southern Nevada Water Authority, A Three-Part Modeling Effort to Quantify and Reduce Pathogen Concentration in the Las Vegas Valley Water Supply: Study Case in Las Vegas, Nevada**

**Reclamation Funding: \$199,985**

**Total Project Cost: \$496,650**

The Southern Nevada Water Authority (SNWA), located in Las Vegas, Nevada, will create a Quantitative Microbial Risk Assessment (QMRA) model that characterizes risk from pathogen exposure in municipal drinking water. Some pathogens of concern for drinking water, including norovirus, adenovirus, and Cryptosporidium, are often present in such low concentrations that they are difficult to measure in finished drinking water, yet still pose a significant risk to public health. This project will use mathematical models to quantify and minimize risks from pathogen contamination in the drinking water system maintained by SNWA. The QMRA will be developed using the Monte Carlo model that samples pathogen concentrations and uses operational scenarios to quantify risk. This project will use an existing water quality model developed for Lake Mead to create distributions for travel time (i.e., pathogen die-off) and recycled water contribution (i.e., blending and dilution) as inputs for the QMRA. The output from the coupled Lake Mead Model and QMRA will inform training data for a machine learning model, increasing the model's ability to recognize and address impacts from potential risk events.

## **New Mexico**

### **New Mexico Institute of Mining and Technology, NM Water Data Initiative: Improving Water Data Access for Modeling in The Middle Rio Grande**

**Reclamation Funding: \$195,050**

**Total Project Cost: \$391,710**

The New Mexico Bureau of Geology and Mineral Resources (located at the New Mexico Institute of Mining and Technology), in partnership with the New Mexico Interstate Stream Commission (NMISC), will improve water data access in the middle Rio Grande region of New Mexico. The project will focus data on the area Otowi gage to the Elephant Butte reservoir, particularly related to data associated with Rio Grande flow and irrigation management. Management and operations of water in this region is one of the most challenging endeavors, as it impacts some of the largest population centers of the state, a large irrigation district, several tribal partners, municipalities, and an increasingly fragile river ecosystem. The project will enhance modeling capabilities for the NMISC and provide more reliable and direct access to real-time, near real-time, and historical water data. This project will improve access to and use of water resources data by connecting information from numerous federal, state, and local agencies. The project will produce a robust water data Application Programming Interfaces, with additional descriptive metadata. This project will benefit the 2019 WaterSmart Applied Science Project titled "Developing a Projection Tool for Otowi Index Supply and Elephant Butte Effective Index Supply."

## Oklahoma

### **Norman Utilities Authority, Lake Thunderbird Predictive Lake Level Optimization Tool**

**Reclamation Funding: \$154,781**

**Total Project Cost: \$309,563**

The Norman Utilities Authority, located in Norman, Oklahoma, will collaborate with the National Water Research Institute to develop a Predictive Lake Level Optimization Tool (PLOT) for the Lake Thunderbird watershed in Central Oklahoma. This new water-balance tool help water managers implement the planned lake augmentation system by providing support for the timing and duration of pumping. Effective management of a reservoir’s conservation pool is critical to the survival of any surface water body during prolonged drought periods. The new forecasting tool for lake water-level will play an important role during these periods. The project will seek to establish proof-of-concept for a model that, in subsequent work, can link to real-time data collection, make forecasts of the lake’s water balance and the augmentation needed. The PLOT forecasts will consider both near-term precipitation projections and statistical climatological trends to identify the preferred augmentation flows to optimize lake yield, conjunctive groundwater use, drought risk mitigation, and augmentation volumes. The project will further the regional goal of a sustainable, shared water reservoir by constructing a cloud-based tool to allow for transparent, smart augmentation flow pumping to Lake Thunderbird.

### **Oklahoma State University, Quantifying the Amount and Impact of Agricultural Water Use in the Upper Red River Basin**

**Reclamation Funding: \$135,469**

**Total Project Cost: \$271,192**

Oklahoma State University, with the support of the Lugert-Altus Irrigation District, will quantify agricultural water use across the Upper Red River Basin, located in southwestern Oklahoma and the Texas panhandle, by combining geospatial analyses, remote sensing techniques, and ground-truthing. This basin has experienced significant drought impacts. During the 2011-2015 drought, water levels in Lake Altus dropped below the intake level of the main canal, halting water deliveries to irrigated farms for several years and devastating the local economy. The University will estimate the acreage of irrigated agricultural lands and identify the types of crops being grown, and apply and evaluate remotely sensed energy balance models to quantify actual crop water use and irrigation application on a distributed basis. This project will benefit water supply reliability by supporting robust water accounting.

## Texas

### **Big Bend Conservation Alliance, Far West Texas Groundwater Districts Adopt Data Management Software and Develop a Data-Sharing Module to See the Bigger Picture of Shared Aquifer Health**

**Reclamation Funding: \$48,000**

**Total Project Cost: \$96,000**

Big Bend Conservation Alliance, in partnership with Presidio County Underground Water Conservation District, Brewster County Groundwater Conservation District, and Culberson County Groundwater Conservation District, located in west Texas, will establish a common data management software platform in the region enabling them to share data on shared aquifers and to provide for better coordination of region-wide water management goals. The proximity of these counties to the Permian Basin, which is experiencing an explosion of growth in unconventional oil exploration, puts this region at substantial risk for groundwater depletion. The adoption of this software and data sharing module will provide an efficient way to monitor the aquifer levels, groundwater management models, and desired future conditions over time at the district and regional level and facilitate sharing this data with state agencies and other stakeholders.

### **Southwest Research Institute, Application of a geochemical framework for water resource management in a semi-arid landscape: Trans Pecos Texas, USA**

**Reclamation Funding: \$200,000**

**Total Project Cost: \$319,998**

Southwest Research Institute, located in San Antonio, Texas, will work with the Middle Pecos Groundwater Conservation District and Reeves County Groundwater Conservation District to conduct a geochemical and statistical analysis to improve understanding of the hydrology of two interconnected spring systems in west Texas, the San Solomon Springs in Balmorhea, and Comanche Springs in Fort Stockton. The analysis and resulting database will be used to identify relative amounts of recharge from different source areas, potential changes in spring hydrochemistry resulting from land use practices, and recharge and discharge rates. Spring systems in arid and semi-arid environments are threatened by changes in land use and development, including irrigation practices and pumping for oil and gas development, as well as changes to recharge from precipitation. This project will help inform several ongoing efforts in the area, including efforts to reduce groundwater extraction to increase spring discharge and restore perennial flows.

## **Texas A&M University-Kingsville, Making Post-wildfire Hydrologic Change Assessments Efficient by Developing A Web-based Remote Sensing-integrated Hydrologic Modeling Tool**

**Reclamation Funding: \$107,497**

**Total Project Cost: \$215,220**

Texas A&M University at Kingsville, Texas, in partnership with the City of Missoula, Missoula Valley Water Quality District, Clark Fork Coalition, the Nature Conservancy of Montana, Oak Ridge National Laboratory, USGS, and the US Army Corp of Engineers, will develop an intuitive web-based tool for efficient simulation of post-wildfire hydrologic changes by integrating remotely sensed data in a hydrologic model. Understanding the compound hydrologic effects of recurring fire, drought, and climate projections and their immediate and long-term implications on water management has become time-sensitive for communities across the western United States. This project will use the Clark Fork Basin in western Montana and northern Idaho as a testbed as wildfire is a major disturbance, making it an ideal study area for this project. This project will equip watershed managers and stakeholders with a user-friendly workflow to quickly post-process variables associated with fire and drought, integrate remotely sensed data into a hydrologic model, simulate and analyze the hydrologic flow and sediment transport across a large river network, and visualize input-output data through an interactive map interface.

## **The University of Texas at Arlington, Adapting Ensemble Inflow Forecasts to Inform Operations of a System of Reservoirs along the Brazos River in Central Texas**

**Reclamation Funding: \$199,656**

**Total Project Cost: \$399,316**

The University of Texas at Arlington will partner with the Texas Water Development Board and the Brazos River Authority (BRA) to adapt and assess ensemble forecast products from the National Weather Service to support operational decisions at a system of reservoirs in the Brazos River Basin. The project will produce adapted forecasts that can be immediately implemented at National Weather Service (NWS) West Gulf River Forecast Center and climate index-constrained inflow traces to be delivered to BRA to assist with operational planning. The project will also yield operation-specific decision support tools for partnering agencies, including a forecast-based guide on periodic use of a portion of the flood pools for water supply storage and associated changes in flooding risk, a forecast-based planning tool for BRA's planning and operations, and a forecast-driven scenario tool for drought contingency planning. This project is being implemented in coordination with the US Army Corps of Engineers and the NWS West Gulf River Forecast Center.

## Utah

### Utah Geological Survey, Supplementing Estimates of Evapotranspiration - The Utah Flux Network

**Reclamation Funding: \$134,518**

**Total Project Cost: \$280,035**

Utah Geological Survey, located in Salt Lake City, Utah, with support from the Utah Division of Water Rights, the Utah Division of Water Resources, and the Central Utah Water Conservancy District, will establish a network of high-quality eddy covariance flux stations in Utah, including new and existing stations to provide ground-based evapotranspiration estimates. Water scarcity in Utah and the western United States requires effective management of this resource, which in turn requires reliable information describing and quantifying water availability, diversions, returns, and consumptive use. Allocations under the Upper Colorado River Compact are based on consumptive use, the portion of a water diversion that does not return to any surface stream or groundwater aquifer, including evapotranspiration. The evapotranspiration measurements and resulting model grids will be applied to measure consumptive water use by crops to facilitate water conservation efforts and depletion-based water rights management. Improved consumptive use measurements will also support water banking strategies for more efficient irrigation practices and preservation of instream flows, and will can be used in the development of watershed water budgets to improve watershed management.

### Utah State University, WaterSMART: A platform for drought forecast in Intermountain West with the optimized multi-model ensemble approach

**Reclamation Funding: \$129,675**

**Total Project Cost: \$259,370**

Utah State University, located in Logan, Utah, will work with Bear River Association of Governments, the Salt Lake City Department of Public Utilities, and the Utah Division of Water Resources to develop an improved seasonal forecast that will be disseminated via a web interface supported by the Utah Climate Center. Reliable forecasts of drought conditions allow water resource managers, planners, and decision-makers to take proactive actions in mitigating drought impacts. The improved forecast will build on the North American Multi-Model Ensemble (NAMME) outputs, which provides climate forecasts up to 12 months ahead, but at a coarse spatial resolution. The project team will downscale the spatial resolution of the NAMME forecasts to a more useful geographic scale, and create a user-friendly web-based platform for disseminating drought forecast products through the Utah Climate Center for water resources managers and planners across the intermountain west. This project builds on several previous Reclamation WaterSMART grants that focus on predicting droughts and water shortages.

### Western States Water Council, Western Water Rights and Aggregate Water Use Data Access and Analysis Tool

**Reclamation Funding: \$200,000**

**Total Project Cost: \$836,581**

The Western States Water Council, whose members include 17 western States and Alaska, will continue developing Western Water Rights and Aggregate Water Use Data Access and Analysis

Tool (WestDAAT), moving it from prototype to full functionality. WestDAAT will enable users to obtain consistent water rights data within its member states to support water resources planning and management. The WestDAAT Team will also work closely with Reclamation to coordinate and enhance its existing water rights database. Making water rights and aggregate water use information easily available will lead to more innovative applications that stretch scarce water supplies, improve drought management, facilitate state water rights administration, raise recognition of federal water right reservations, promote conservation and water marketing, highlight conjunctive ground and surface water use opportunities, and focus initiatives for watersheds, fish and wildlife habitat, and endangered aquatic species protection.