



Chapter 5:
*Other Research
Around Reclamation*

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Science and research underlie everything Reclamation does—from relying on state-of-the-art technology to managing water systems to understanding our environment, species, and habitat to understand and address impacts. Reclamation is engaged in a variety of science and research-related activities that address issues including:

- ◆ Water quality
- ◆ Dam safety
- ◆ Impact assessments
- ◆ River and wetland restoration
- ◆ Endangered species

Many of these research efforts have no, or minor, Science and Technology funding and are funded through projects and other programs as they are designed to provide information for a specific location and activity.

Much of the field work conducted by Reclamation's field offices is associated with understanding how endangered and otherwise sensitive species interact with Reclamation projects. This understanding helps Reclamation find appropriate balances among competing demands for water to minimize unacceptable impacts to the environment and ensure reliable water delivery.

However, the challenges, lessons learned, results, and accomplishments are often useful for other Reclamation areas grappling with similar questions. As part of our overall technology transfer effort, this section of the report provides highlights of some of these activities. We invited all Reclamation regions, area offices, and programs to share their experiences. These highlights are drawn from those that responded—so this is not a complete Reclamation-wide summary. We want to share this information so others can benefit from and help support these projects.

Regional Research

Great Plains Region

Bull Trout.—From 1996 through 2000, Reclamation's Montana Area Office has collected information on bull trout, an endangered species, and westslope cutthroat trout in the St. Mary River Basin, Montana. A temporary experimental electronic fish barrier will be installed during the fall of 2001 and will be studied for effectiveness in 2002. This research will help develop solutions to several issues surrounding project operations. The information collected through these studies is the only comprehensive work on this distinct population segment and will be instrumental in writing the recovery plan. Contact Sue Camp, (406) 247-7668 (scamp@gp.usbr.gov).

Contract Renewals.—Reclamation is conducting several water quality studies at our reservoirs to support contract renewal activities. We are cooperating on a project to use radiotelemetry to track fish habitat associations in relation to low dissolved oxygen at Reclamation's Canyon Ferry Reservoir, Montana. Nitrogen supersaturation below Reclamation's Yellowtail Dam is being studied, as high levels of nitrogen cause gas bubbles to form in fish. In 2001, Reclamation initiated general water quality investigations at Reclamation's Clark Canyon Reservoir, Montana. Contact Sue Camp, (406) 247-7668 (scamp@gp.usbr.gov).

Facilities Paints and Coatings.—The Montana Area Office is currently monitoring a variety of experimental paints and coatings for metals and concrete. This research will provide information on the most effective products to maintain steel and concrete structures in Montana's climate. Contact Jerry Moore, (406) 247-7308 (jmoore@gp.usbr.gov).

Fish Entrainment.—Reclamation's Montana Area Office conducted studies from 1996 through 1999 to estimate numbers and species of fish being entrained into the Main Canal of the Lower Yellowstone Project at Intake Diversion Dam near Glendive, Montana. The study also provided baseline fishery data on the Lower Yellowstone River. Reclamation found extremely high numbers of fish entrained—between 383,000 to 809,000 fish per irrigation season. Thirty-four species (25 native and 9 non-native) of fish were sampled. As a result of an Endangered Species Act consultation with the U.S. Fish and Wildlife Service, Reclamation plans to implement fish screens within the canal so fish travel back to the river. To determine the effectiveness of louver-style fish entrainment prevention structures, the Montana Area Office is partnering with Tongue and Yellowstone Irrigation District. This research focuses on new structures on the Tongue and Yellowstone Diversion Dam on the Tongue River near Miles City, Montana. Preliminary results indicated a very high success rate for fish over 100 millimeters total length and an approximately 65-percent success rate in preventing entrainment of all fish. Contact Sue Camp, (406) 247-7668 (scamp@gp.usbr.gov).

Fish Passage.—Reclamation built a rock fishway to provide fish passage at Reclamation's Huntley Diversion Dam near Huntley, Montana, in the fall of 1999. In 2000, the Montana Area Office began a monitoring effort in conjunction with Montana Fish, Wildlife and Parks to determine if fish were able to use the fishway

to pass the dam. Some minor problems have been identified in the grade of the fishway, and plans are to fix these when water conditions are low this summer. Fish sampling also is providing baseline data on fisheries in the Yellowstone River in this area. Contact Sue Camp, (406) 247-7668 (scamp@gp.usbr.gov).

Pallid Sturgeon.—Existing data shows pallid sturgeon need better fish passage at Reclamation's Intake Diversion Dam to reach historical spawning habitat in the Yellowstone River. Reclamation's Montana Area Office has developed concepts for improving fish passage. However, researchers need to better understand the swimming abilities of pallid sturgeon to design the most effective passage structure. Working with the U.S. Army Corps of Engineers, Reclamation will study how well the pallid sturgeon swim in various flow conditions under laboratory and field conditions. Contact Sue Camp, (406) 247-7668 (scamp@gp.usbr.gov).

Wetlands.—The Montana Area Office funds an annual piping plover survey at Nelson Reservoir, Montana, to study how piping plovers use gravel islands. Two islands were recently raised by adding gravel to provide safer nesting habitat in fluctuating water conditions. This work is done in compliance with a Section 7 Endangered Species Act consultation. Reclamation is also sponsoring work to develop hydrogeomorphic slope wetland criteria and digitizing aerial maps of the Lower Marias River, Montana. This research will be used for analyzing the effects of contract renewal action and potential water operations on the river. Contact Sue Camp, (406) 247-7668 (scamp@gp.usbr.gov).

Lower Colorado Region

Endangered Gila Topminnow.—Reclamation's Phoenix Area Office has been doing field and lab work over the past 2 years to determine whether the endangered Gila topminnow can control mosquitoes in constructed wetlands. Preliminary results suggest that the native Gila topminnow has similar water quality tolerances and diet preferences as the non-native mosquitofish, but a relatively low ability or willingness to penetrate dense vegetation in search of mosquito larvae. However, establishing new refugia populations of Gila topminnow and not stocking non-native mosquitofish may help recover this native species. Contact Henry Messing, (602) 216-3856 (hmessing@lc.usbr.gov).

Flat-tailed Horned Lizard.—Reclamation has worked closely with the flat-tailed horned lizard Interagency Coordination Committee to develop a rangewide management strategy plan for this lizard. Reclamation is partnering with Utah State University and the U.S. Navy to continue research on sampling techniques, population densities, and behavior patterns to conserve habitat and maintain viable populations of flat-tailed horned lizards. Contact Julian DeSantiago, (928) 343-8259 (jdesantiago@lc.usbr.gov).

Endangered Razorback Sucker.—Reclamation's Yuma Area Office is implanting razorback suckers with ultrasonic transmitters and releasing these tagged suckers into a stretch of the Colorado River in the Imperial Division. This will show how razorback suckers use the habitat before, during, and after the Imperial Division Backwater and Channel Restoration Project Number One. This information will help Reclamation determine which habitats and backwaters would be best suited for future restoration and enhancement projects along the Lower Colorado River. Contact Julian DeSantiago, (928) 343-8259 (jdesantiago@lc.usbr.gov).

Mountain Lion.—The Tucson Aqueduct, as well as urbanization around the Tucson Mountains, could isolate and eventually eliminate mountain lions from the local ecosystem. As mitigation, Reclamation's Phoenix Area Office constructed siphons under several washes and bridges over the canal to facilitate wildlife movements. Reclamation also purchased a 4¼-square-mile section of Sonoran Desert habitat as a wildlife corridor. The mountain lion study will attempt to identify significant corridors that could be integrated into the Sonoran Desert Habitat Conservation Plan. Phase I has been completed and consisted of a survey of public attitudes to lions and lion management, as well as a GIS-based inventory of mountain lion sightings. Phase II in 2001 captured several lions and outfitted them with radio collars with global positioning system transmitters. Contact Henry Messing, (602) 216-3856 (hmessing@lc.usbr.gov).

Threatened Loach Minnow and Spikedace.—Reclamation's Phoenix Area Office initiated field work in the spring of 2000 to describe the patterns of larval fish drift in Aravaipa Creek and quantify potential losses over the Reclamation-constructed fish barriers. Data analysis and mathematical modeling are ongoing. Preliminary results suggest that impacts of the barriers to native fish population dynamics will be minimal. Contact Henry Messing, (602) 216-3856 (hmessing@lc.usbr.gov).

Willow Flycatcher.—Reclamation's Phoenix Area Office is working with several groups to identify willow flycatchers and their habitat. With the Arizona Game and Fish Department, the area office developed a model to predict suitable habitat based on satellite imagery and digital elevation models. We are applying this model to Roosevelt Lake to detect a change in the amount of suitable habitat from 1981 through 2006, in 5-year intervals. This model was expanded statewide in 2001. A willow flycatcher wintering ecology study in Central America found willow flycatchers singing and defending territory throughout the winter. With the Colorado Plateau Field Station, U.S. Geological Survey—Biological Resources Division, we are documenting where willow flycatchers travel. With the Arizona Game and Fish Department, we are studying willow flycatcher nests in central Arizona to document productivity, causes of nest failure, and habitat use. Contact Henry Messing, (602) 216-3856 (hmessing@lc.usbr.gov).

See “Advanced Water Treatment Research—Water Quality Improvement Center” for more Lower Colorado research.

Mid-Pacific Region

Endangered Species Research.—Reclamation is working with the U.S. Fish and Wildlife Service and the California State University to research endangered species in California's San Joaquin Valley. Techniques to monitor wildlife and understand their habitat and needs include: wildlife tagging and radiotelemetry, molecular genetic analyses, population modeling, bat detection and identification, remote and digital photography, burrow viewing devices, trained wildlife dogs, habitat restoration methodologies, and global positioning system and geographic information system. Contact Kathy Wood, (559) 487-5103 (kwood@mp.usbr.gov) or visit the web site <<http://arnica.csustan.edu/esrpp/>>.

Land Retirement.—Thousands of acres of irrigated cropland in the western San Joaquin Valley are affected by poor drainage conditions. High selenium concentrations in the drainage effluent preclude using subsurface agricultural drains. Land retirement is one management strategy being considered to mitigate the drainage problem. A 5-year, 15,000-acre Land Retirement Demonstration Project has been established to study the effects of large-scale retirement of agricultural lands with high selenium levels in soils and shallow ground water. In addition to these physical effects, the demonstration project is researching and developing cost-effective techniques for dryland wildlife habitat restoration. Contact Kathy Wood, (559) 487-5103 (kwood@mp.usbr.gov).

Tracy Fish Collection Facility.—The Mid-Pacific Region is constructing the Tracy Fish Test Facility at the Tracy Fish Collection Facility, near Tracy, California. The facility will develop new technologies to divert and collect fish before they reach the pumps—without threatening contracted water deliveries through the Tracy Pumping Plant. Reclamation is also conducting model studies and experiments at the Technical Service Center and working with the University of California, Davis, to develop and fund laboratory studies to refine the design of the Tracy Fish Test Facility. Contact Ronald Brockman, (916) 978-5206 (rbrockman@mp.usbr.gov).

Pacific Northwest Region

Endangered Anadromous Fish Restoration.—The Yakima River Basin Water Enhancement Project, Title XII of Public Law 103-434, authorizes Reclamation to help restore anadromous fish in the Yakima River and its tributaries. To base anadromous fish recovery in the Yakima River Basin on the best available science, Reclamation's Acquisition Program initiated and funded the "Critical River Reaches Study" with the University of Montana and Central Washington University. The 3-year study is assessing surface and ground water interactions in key flood plain reaches of the Yakima River. Results will help us understand how these critical reaches have been degraded by flow regulation, pollution, and other manmade effects in the Yakima River. The study provides recommendations for actions needed to maintain or restore the environmental integrity of the most sensitive areas of the river basin. It also is providing a basis to determine water conservation projects by relating flows to critical salmon habitat in the most sensitive reaches. Contact Tracey Yerxa, (509) 575-5848, ext. 264 (tyerxa@pn.usbr.gov).

Wickiup Oregon Spotted Frog Conservation Research Program.—Reclamation has embarked on a unique research project to evaluate and monitor the results of a mitigation effort to relocate an Oregon spotted frog (*Rana pretiosa*) population. The frog is currently protected by state regulations and is under consideration for listing under the federal Endangered Species Act. Reclamation's Wickiup Safety of Dams action in 2001 may adversely impact a small population of these frogs that live in a drainage channel immediately below the dam. Reclamation's Pacific Northwest Region Safety of Dams program is currently providing funds to conduct short-term research monitoring activities. Recent reviews of projects that move species to non-natal habitat sites reiterate the need for intensive monitoring and publishing of both successful and unsuccessful results. The need for information on translocating these frogs is particularly acute, as very few studies have been thoroughly documented for this group. Contact Chuck Korson, (541) 312-9323 (ckorson@pn.usbr.gov).

Upper Colorado Region

Columbia Spotted Frog.—The spotted frog is a conservation species that was once petitioned for listing but was later withdrawn due to the conservation efforts of state and federal agencies. These frogs are highly aquatic and are found in isolated springs in Utah's west desert and in wetlands and spring complexes along the Wasatch Front. Major threats to the species are habitat loss, degradation, and predation. Reclamation's Upper Colorado Region is supporting research and monitoring efforts to understand and conserve this frog. Reclamation has funded and participated in numerous monitoring and survey efforts throughout Utah. Reclamation is also funding a Utah State University study that will provide needed information on habitat requirements, especially on overwintering habitat. Future conservation efforts, including translocation efforts and reintroductions, depend on these research efforts. Contact Russ Finding, (801) 379-1084 (rfinding@uc.usbr.gov).

Electrofishing.—This long-term project is expected to help researchers identify the effects of this ubiquitous sampling technique on target and non-target populations and provide recommendations to minimize harmful effects. Reclamation's Upper Colorado Region is in the final stages of completing a multiyear review of the effects of electrofishing on adult fish, eggs, larvae, and juveniles. In addition, we have conducted one of the most comprehensive literature reviews ever attempted on the subject. The report will be published under the U.S. Geological Survey Biological Report Series. Contact Tom Chart, (801) 524-3863 (tchart@uc.usbr.gov).

Endangered Fish.—Reclamation was co-lead with the U.S. Fish and Wildlife Service on the recently completed report that provided flow and temperature recommendations for the Green River below Flaming Gorge Dam. This comprehensive study involved an integration of information on hydrology, temperature, riverine geomorphology, and biological requirements of endangered fishes to identify flow and temperature needs of the endangered fishes in the Green River below Flaming Gorge Dam. Contact Tom Chart, (801) 524-3863 (tchart@uc.usbr.gov).

Hydrologic Analysis: Developing Hydrologic Models to Predict Flows.—These predictions compare projected flows under existing conditions and alternative scenarios to determine potential impacts. The Upper Colorado Region researches and develops sophisticated hydrologic models using RiverWare to predict flow changes associated with implementing flow recommendations. These analyses are used primarily in ongoing National Environmental Policy Act compliance processes. These include operational environmental impact statements at Navajo and Flaming Gorge Dams and the Aspinall Unit. Contact Tom Chart, (801) 524-3863 (tchart@uc.usbr.gov).

Kokanee.—Kokanee salmon are an important sport fishery in Blue Mesa Reservoir, Colorado. Reclamation's Upper Colorado Region has been sponsoring research on the distribution, life history, and population dynamics of kokanee. This will help us better understand the ways water releases from Blue Mesa Reservoir for downstream endangered fishes in the Gunnison and Colorado Rivers affect the kokanee and identify management options that will improve this valued game fishery. Contact Tom Chart, (801) 524-3863 (tchart@uc.usbr.gov).

Macroinvertebrate Monitoring.—The aquatic invertebrates below Flaming Gorge Dam form the food base for nationally recognized trout fisheries. Since the early 1990s, Reclamation has monitored this community to determine how flow releases for endangered fish affect them. Initial findings provide convincing evidence that overall flow releases between 1992 and 2000 have had a neutral or beneficial effect on the invertebrates. Additional funding is being sought to continue monitoring and trend analyses as flows and temperature releases from Flaming Gorge Dam continue to be modified to meet recovery needs of the downstream endangered fishes, including the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail chub. Contact Tom Chart, (801) 524-3863 (tchart@uc.usbr.gov).

Native Fishes in the Colorado River.—Reclamation is reviewing the status of the native flannelmouth sucker, bluehead sucker, and roundtail chub in the Colorado River system. We are coordinating with other federal and state agencies to identify long-term population trends in these species so appropriate early action can be taken to preclude the need for future listing under the Endangered Species Act. Contact Tom Chart, (801) 524-3863 (tchart@uc.usbr.gov).

Riparian Vegetation.—This study compared cottonwood survival and regeneration on the largely unregulated Yampa River with the nearby regulated Green River below Flaming Gorge Dam. Results indicate that few cottonwoods are establishing on the Green River in the Brown's Park area, the area most directly affected by river regulation. The lack of overbank flooding, lack of fine sediment to hold moisture, and moisture competition from other vegetation prevent seedlings from establishing. Reclamation established test plots for various management actions that could help regenerate cottonwoods. Results indicate that, in addition to high flows, management activities such as lowering banks, clearing vegetation, and limiting vegetation will be needed to maintain cottonwood forests along many sections of the Green River. Research is also underway to determine the causes of premature dieoff of mature cottonwoods. Preliminary results indicate that as floods occur less frequently on the regulated Green River, the root zone saturation needed to maintain mature cottonwoods may not be adequate. This may be a factor in these dieoffs. The 2001 phase of research will focus on determining the effects of flow regulation on cottonwoods further downstream than Brown's Park. Contact Tom Chart, (801) 524-3863 (tchart@uc.usbr.gov).

A Watershed Approach to Endangered Fish.—The Upper Colorado Region is involved in several large-scale programs that use a watershed basin approach to research and water management. Reclamation cooperates with many federal, state, and local governments; tribes; environmental groups; water districts; stakeholders; universities; and private sector organizations to determine fish needs and habitat throughout a watershed. Reclamation also funds moderate to large research projects to understand the life history and habitat of endangered fish to implement management strategies for their recovery. These research efforts will help Reclamation develop flow and water management strategies for river basins, including the Green, Yampa, Gunnison, Colorado, White, and San Juan Rivers. Contact Tom Chart, (801) 524-3863 (tchart@uc.usbr.gov).

Operations West

National Irrigation Water Quality Program

Reclamation is researching ways to effectively address high selenium levels aggravated by irrigation projects. To try to lower selenium levels in bottom sediment of Stewart Lake (Middle Green Project and Jensen Unit, Central Utah Project, Utah), Reclamation is applying lime to lakebed sediments and harvesting cattails and bull rushes. Reclamation is also planning to analyze cottonwood tree cores for baseline data on historic levels of pre-irrigation selenium concentrations. To reduce selenium infiltration of ground water from irrigation water in unlined irrigation canals (Gunnison/Grand Valley Project, and Uncompahgre Project, Colorado), Reclamation is applying polyacrylamide to irrigation laterals. Contact Joy Nelson, (303) 445-2929 (jnelson@do.usbr.gov).

Dam Safety Research Program

Reclamation's Dam Safety Research Program began in 1997 for research in a wide variety of program areas. Contact Bruce Muller, (303) 445-3238 (bmuller@do.usbr.gov) for information on this program, or see the Dam Safety web site at <http://www.usbr.gov/research/dam_safety/>.

Some of the many research activities are:

Case Histories of Piping and Non-piping.—This study is examining case histories of embankment dams to identify factors that contributed to accidents and failure related to piping and erosion. Professor Robin Fell, from the University of New South Wales, Australia, collected a large data base of case histories. Reclamation is developing “key words” to search this data base for case histories of dams that are similar to Reclamation dams that can be used in risk assessment studies. Contact David Miedema, (303) 445-3034 (dmiedema@do.usbr.gov).

Compilation and Review of Stochastic Models.—Some form of stochastic rainfall-runoff model is needed to develop volume estimates for extreme floods. Reclamation has little experience with these types of models for dam safety analyses. A review of existing rainfall-runoff models is an important component of incorporating these models into flood hazard analyses. This project is performing a detailed analysis and review of the stochastic rainfall/runoff models and evaluating the models' applicability to the Reclamation Dam Safety Program objectives. Contact Marijo Camrud, (303) 445-2568 (mcamrud@do.usbr.gov).

Development of a Paleoflood Database for Rivers in the Western United States.—Paleoflood data requirements are needed to develop hydrologic loads for input into risk assessment and flood hazard studies. This research is collecting reconnaissance-level data to be used in flood frequency analyses and evaluating extreme flood events for Comprehensive Facility Reviews. This year, we are developing a repository for this information that could be used to support estimates for probabilistic flood loads for Reclamation dams in the Western United States. Contact Ralph Klinger, (303) 445-3173 (rklinger@do.usbr.gov).

Failure Modes of Arched Dams—Large Shake Table and Nonlinear Analysis.—Field data is scarce for negative performance of arch dams under earthquake loading, as no arch dam has been seriously damaged. In addition, the field cases have several parameters that are difficult to model. This research study is designing models of arch dams on a shake table. These results can be confirmed with nonlinear analysis. The procedures and material modeling needs can be established in the numerical models for use in full-scale field analyses. Contact Terry Payne, (303) 445-3232 (tpayne@do.usbr.gov).

Identifying the Conditions that Cause Natural and Manmade Slopes to Fail.—Knowing how to predict how these slopes may slide is crucial to identifying potential dam safety problems. This study identifies slope conditions that may result in slow or rapid sliding, predicts how slopes may deform, and estimates the travel distances and velocities for landslides. The study is also developing a database of settlements and displacement of earthfill embankments to help assess “abnormalities” of specific embankment movements. Contact Jeanne Major, (303) 445-297 (jmajor@do.usbr.gov).

Investigation of the Ability of Filters to Stop Erosion in Cracks Through Dams.—To stop erosion through cracks in the core of a dam, a filter must be graded so that it will restrain movement of particles from the core, and the filter must be truly cohesionless, so that it will not crack even when subjected to the same types of deformations that cause cracks in the core. This experimental research is investigating the filter’s abilities to prevent and stop cracks. The research is also developing criteria that can be relied upon to ensure that the filter will perform its essential functions, even when subjected to deformations of the type that cause cracks in the adjacent core. Contact Jeff Farrar, (303) 445-2333 (farrar@do.usbr.gov).

Liquefaction and Non-liquefaction Case Histories.—While analytical tools to predict slope stability and/or deformation demonstrate that an embankment is stable, it is difficult to predict how an unstable embankment would behave. This study is researching case histories of actual dams (and other sites) subjected to strong earthquake loading to provide information for risk assessments and modification decisions. Contact Dave Gillette, (303) 445-2994 (dgillette@do.usbr.gov).

New Paleoflood Simulation.—This study is partnering with the University of Arizona to evaluate the value of paleoflood information in flood frequency estimation. The analysis is generating synthetic flood frequency records through a Monte Carlo process and comparing these to paleoflood records from the Southwestern United States. Contact Dan Levis, (303) 445-3175 (dlevish@do.usbr.gov).

Probabilistic Flood Hazard Workshop.—This workshop brought in the world’s leading experts on various aspects of probabilistic flood hazard estimation to assist with the development of the new Reclamation program. We are also compiling, reviewing, and evaluating current state-of-the-art knowledge on probabilistic techniques used in flood hazard assessment. External experts in various aspects of flood hazards presented a Reclamation Technical Update Lecture (1½ hours). The Flood Cadre subsequently met with them to discuss their research in detail and potential technology transfer to Reclamation. Contact John England, (303) 445-2541 (jengland@do.usbr.gov).

Resistance of Soils to Piping.—Most Reclamation embankment dams were not constructed with state-of-the-art designed filter zones to help preclude failure by internal erosion or piping. This study partners with the University of New South Wales, Australia, to evaluate those risks. It examines supplemental criteria that can provide additional information on the downstream zone's potential effectiveness in providing filter protection for the dam's core. Contact: Nathan Snorteland, (303) 445-2395 (nsnorteland@do.usbr.gov).

Advanced Water Treatment Research—Water Quality Improvement Center

See Lower Colorado Region for other research in the Lower Colorado Region.

The Colorado River Basin Salinity Control Act provides measures to meet the salinity requirements for United States' agreements with Mexico. The act authorized constructing the Yuma Desalting Plant and conducting a research program into reducing costs of treating saline water. In 1997, Reclamation teamed up with the National Water Research Institute and the U.S. Army to expand the test plant into the Water Quality Improvement Center, the cornerstone of the National Center for Water Treatment Technology. The Water Quality Improvement Center opened its doors to the public to conduct water treatment research. This makes pilot water research and field testing more cost effective and practical for entities such as the U.S. Government, desalting researchers, universities, water treatment companies, municipalities, private industries, and foreign governments. Contact Mike Norris, (520) 343-8214 (mnorris@lc.usbr.gov) or see the web site <<http://www.yao.lc.usbr.gov>> regarding any activity listed below.

Areas of interest include:

- ◆ Suspended-solid gravity settling
- ◆ Lime softening and coagulation
- ◆ Depth filtration
- ◆ Microfiltration
- ◆ Nanofiltration
- ◆ Ultrafiltration
- ◆ Reverse osmosis
- ◆ Natural organic material precipitation

Chlorine-Resistant Membrane Study (Title I and Science and Technology Funds).—Chlorine and other oxidizing biocides used in the feedwater can result in irreversible damage to polyamide membranes. Reclamation is working with partners to develop and evaluate chlorine-resistant polyamide

reverse osmosis membranes. Separation Systems Technology, Inc., is developing and casting new chlorine-resistant polyamide reverse osmosis membrane compositions and will provide membrane samples to the Water Quality Improvement Center for research evaluation. Chlorine, the most common biocide for water, must be neutralized to safe levels before contacting such membranes. Although we were successful in synthesizing and purifying two batches of high-purity acid chloride to produce membrane test samples, we had difficulties repeating the procedure to obtain consistent results. This project is to develop ways to reproduce acid chloride efficiently and consistently. This is funded through Title I and Science and Technology funds. Partners: Reclamation's Science and Technology Program, University of Denver, and Separation Systems Technology, Inc.

Comparing Treatment Methods for Recycled Water.—An increasing number of municipalities are using recycled water as a new water resource and have developed a wide variety of options to reuse water. For indirect potable reuse, recycled wastewater is either discharged into surface water using the best available treatment technologies or infiltrated into the subsurface using soil-aquifer treatment. This study compares different methods to remove bulk and trace organics in long-term soil-aquifer treatment and best available treatment technologies for reclaimed water used for indirect potable reuse. This is funded through a Cooperative Research and Development Agreement Partnership. Partners: Arizona State University and Stanford University.

Developing Portable Desalting Units.—Los Alamos Technical Associates/MIOX and the Defense Advanced Research Projects Agency are partnering with Reclamation to develop water purification systems that one person can carry and use. These reverse osmosis units would weigh less than 2 pounds and produce 1 liter of potable water in 5 minutes. Reclamation is testing the prototypes. We are also developing and evaluating an oxidant that is more compatible with commercial reverse osmosis membranes than chlorine. The Water Quality Improvement Center evaluation results will determine if the oxidant can be incorporated into the process design of this individual water purification system. It is funded through a Cooperative Research and Development Agreement Partnership. Partners: Defense Advanced Research Projects Agency and Los Alamos Technical Associates/MIOX.

High-Purity, High-Rejection Cellulose Acetate Membranes.—This project is developing superior cellulose acetate membranes that can exceed the current salt rejection rates of 99 percent. This product would be commercially viable since this would require only relative minor modifications in the production process of cellulose to cellulose acetate to the final membrane. This is funded through Title I and Science and Technology Funds. Partner: Separation Systems.

Making Brackish Water Sweet in Somerton, Arizona.—The city of Somerton, Arizona's water supply is brackish well water, and the city is concerned about its customers' complaints regarding the taste. Reclamation and the city of Somerton analyzed treated waters to determine and compare their organic and inorganic contents and conducted a taste and odor test. The city of Somerton and Reclamation believe that the Environmental Protection Agency will monitor the drinking qualities and help out to arrive at a superior water quality that will satisfy its consumers. Reclamation's Water

Quality Improvement Center can perform reverse osmosis pilot scale research and help provide the best water treatment alternative for the community. The city of Somerton is planning to blend Colorado River water with Somerton well water. Reclamation is also investigating corrosion issues of the blended water to anticipate possible problem areas. Adding a reverse osmosis facility at the Somerton plant would significantly increase water quality and benefit the community. This is funded through Title I. Partner: City of Somerton.

Mobile Seawater Pilot Research Plant.—Reclamation is designing and producing a 43,000-gallon-per-day mobile seawater pilot research plant with Saudi Arabian funds. This plant is designed to be a practical, onsite research tool complete with pretreatment, chemical, reverse osmosis, and support systems. This study is resolving and preventing problems that may develop in seawater desalination plants. The study is also testing water treatment alternatives. Partner: the Saudi Arabian Saline Water Conversion Corporation under the United States Saudi Joint Economic Commission. Additional contact, Michael Hood, (202) 513-0558 (mhood@usbr.gov).

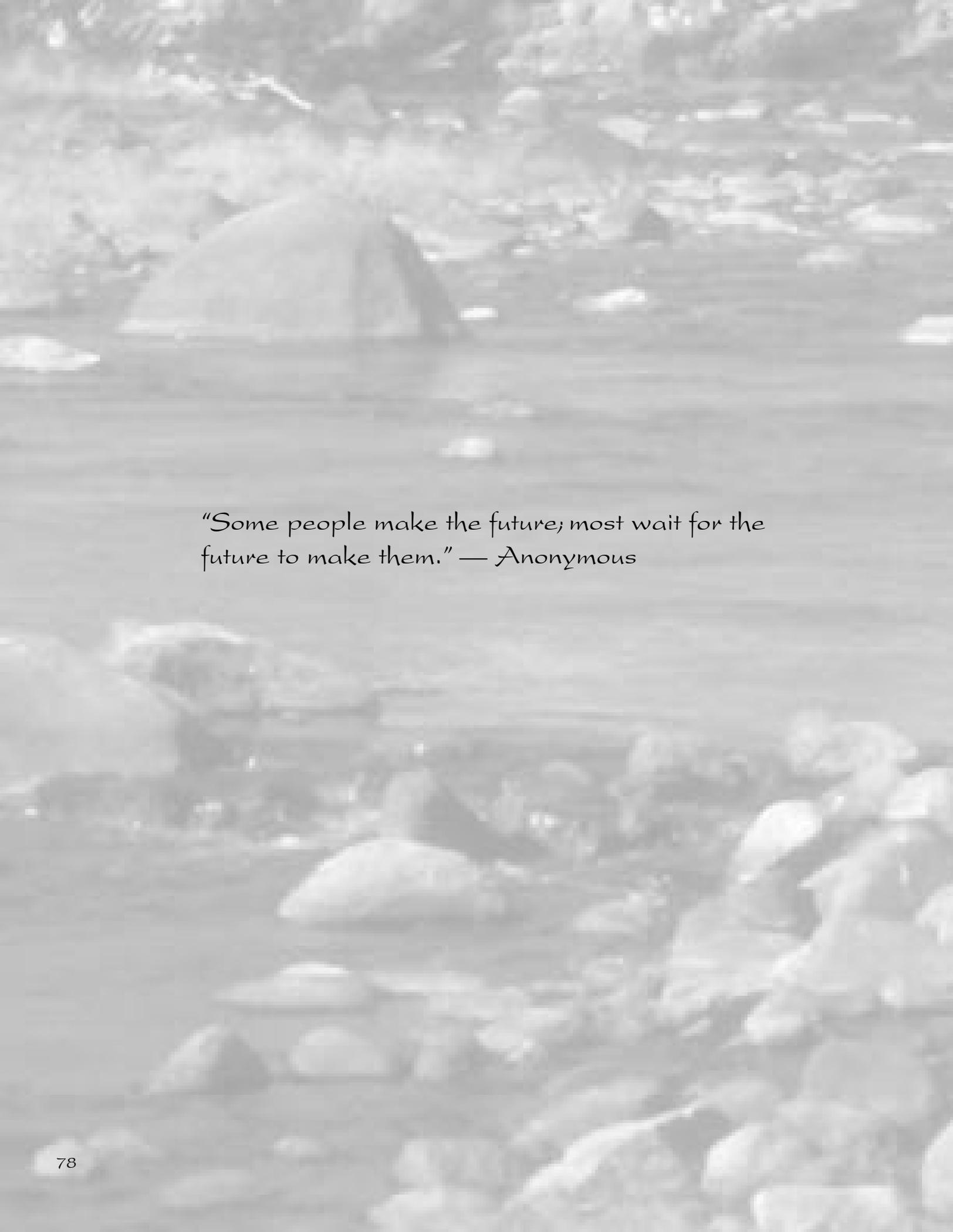
Technical Support to the Central Arizona Salinity Study.—Central Arizona Salinity Study (CASS) builds partnerships between water users in central Arizona and southern California in the Southwest United States and Sonora and Baja California in northern Mexico. Together, we can address salinity issues with Colorado River water in central Arizona in conjunction with Reclamation's Central Arizona Project. Within the framework of these partnerships, the CASS identifies the extent of salinity impacts, estimates when and how long these impacts may occur, and evaluates actions to address these salinity impacts. It is funded through CASS. Additional contact, Tom Poulson, (602) 216-3836 (tpoulson@lc.usbr.gov).

Training New Advanced Water Treatment Operators.—Reclamation is working with David H. Paul, Inc., and Arizona Western College to develop an innovative degree program—a hybrid of traditional classroom learning and real-world, on-the-job style training. This off-campus, self-contained program is designed to meet the very specific needs and requirements for the certification process associated with industrial reverse osmosis water treatment. Students can earn either a traditional Associate Degree or a Certificate in Advanced Water Treatment. Students register with Arizona Western College and sign up for the Advanced Water Treatment Degree Program. The program received the 2001 Nathan Burbank award for environmental education innovation. Partner: David H. Paul, Inc., and Arizona Western College. Additional contact, Angela Adams, (520) 343-8100 (aadams@lc.usbr.gov).

Upgrading Yuma Desalting Plant Pretreatment and Reverse Osmosis Systems (Title I Funds).—When the Yuma Desalting Plant was designed in the 1970s, it was based on the most reliable water treatment and desalting technologies available. The past 30 years have brought an array of advances. This study evaluates these advances as potential improvements to the Yuma Desalting Plant. The study also addresses congressional inquiries, exploring potential use of new advanced water treatment technologies at the Yuma Desalting Plant. This is funded through Title I funds.

Water Quality Information Center High Recovery with Antiscalants.—Antiscalants are generally added to feedwater for desalinating with reverse osmosis membranes. This prevents precipitation and scaling inside the reverse osmosis equipment. Although effective, the maximum concentrations of antiscalants that the equipment can tolerate are difficult to predict. This study evaluates the best use of antiscalants for increasing the water recovery at the Yuma Desalting Plant. It is funded through Title I of Colorado River Basin Salinity Control Act Funds.

Water Quality Information Center Non-toxic Storage of Reverse Osmosis Elements: Irradiation Phase V.—The Yuma Desalting Plant has fungi problems in stored fluid systems cellulose acetate reverse osmosis elements. Using biocides in storage poses severe problems in safely handling and disposing of the toxic biocides. Dry storage with glycerin appears to be a reliable and non-toxic storage method for some membrane types, but not for others. This project is demonstrating the effectiveness of gamma irradiation for non-damaging sterilization of fluid systems. It is funded through Title I funds.



“Some people make the future; most wait for the future to make them.” — Anonymous