

**Staff** - The Water Resources Research Laboratory is presently staffed by 12 full-time engineers and 2 technicians with backgrounds in civil, hydraulic, and mechanical engineering. Eight craftsmen specializing in metal, plastic, and woodwork fabricate custom-designed models and test equipment.

**Facilities and Equipment** - The WRRL has a 6,000 m<sup>2</sup> indoor laboratory space with up to 10 m of vertical clearance, four 100-150 hp pumps, a high-head pump (200 m), 900 m<sup>3</sup> storage reservoir, several portable 10-30 hp pumps, a low ambient pressure chamber (0.1 atm., 2x3x5 m), computational fluid dynamics and computer workstation capability, velocity meters, acoustic flow meters, an adjustable sloping flume (-2% to 8%; 1 m wide by 20 m long), a 20,000 kg weight-based calibration tank, 18 permanent venturi flow meters with measurement uncertainty less than  $\pm 0.25\%$ , state-of-the-art data acquisition and analysis equipment, and a 100-m-long canal automation training and testing facility.



The WRRL's 6000 m<sup>2</sup> (65000 ft<sup>2</sup>) indoor laboratory

**Doing Business with Us** - In addition to serving Reclamation's area and regional offices, the WRRL works with Federal, State and local governments, International clients, Irrigation districts, Native American groups, and other clients. We would appreciate the opportunity to discuss your project. For more information, contact:

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[http://www.usbr.gov/pmts/hydraulics\\_lab/](http://www.usbr.gov/pmts/hydraulics_lab/)

### **Reclamation's Mission**

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

# RECLAMATION

*Managing Water in the West*



## Water Resources Research Laboratory

Celebrating 75 years of hydraulic modeling  
1930-2005



U.S. Department of the Interior  
Bureau of Reclamation  
Technical Service Center  
Denver, Colorado

## 75 Years of Hydraulic Modeling

Since 1930, the Bureau of Reclamation's hydraulic laboratory has conducted research and tested scale models of hydraulic structures and equipment critical to the development of western water projects. From the first small lab in Fort Collins, Colorado to field labs at Montrose, Colorado, Hoover Dam, and Grand Coulee Dam, to today's modern Water Resources Research Laboratory (WRRL) in Denver, Reclamation's hydraulic laboratory has been a pioneer in development of hydraulic equipment, structures, instrumentation, and design guidance and analysis tools for hydraulic engineering. We have produced world renowned manuals on Energy Dissipation in Hydraulic Structures, Cavitation in Chutes and Spillways, Air-Water Flow in Hydraulic Structures, Water Measurement, and Canal Automation.

## What We Do Today

Today as always, the WRRL applies hydraulic modeling, hydraulic analysis, and field testing expertise to the solution of water resources, hydraulics, and fluid mechanics problems. We address site-specific issues and pursue applied research that develops new water resource management tools for Reclamation. We perform work for Reclamation and other organizations, including international clients, federal, state, and local government agencies, and private entities. We are part of Reclamation's Technical Service Center, which provides engineering, research, scientific, and laboratory services to all of Reclamation. We have active programs in **environmental hydraulics, water conservation, dam safety, and hydraulic structures and equipment**. Our services include physical modeling, numerical modeling, field testing, hydraulic analysis, research and development, and training.

## Environmental Hydraulics

Applied research in this area improves the environmental compatibility of man's use of water, so that project operations and the beneficial use of water can continue. Major areas of emphasis include:

**Fish Protection and Screening** - The WRRL performs laboratory and field evaluations of fish screen performance. We are developing new screen designs and improving existing structures to meet evolving fish engineering standards. A new Fisheries Engineering Manual will be published soon.

**Fish Passage** - WRRL research is improving fish passage methods for warm and coldwater native and sport fisheries. Laboratory and field-based research is conducted on fish ladders, fish locks for small diversion dams, and fish pumps for screen bypasses.

### **Reservoir Release Water Quality** -

Maintaining the quality of reservoir releases is important on many Reclamation projects. Our research has led to new methods for controlling release water temperature, turbidity, dissolved oxygen, and total dissolved gas.

## Water Conservation

The WRRL's water conservation program includes research, development, and implementation of new technologies that allow water users to "measure every drop and make every drop count". Areas of emphasis include:

- ◆ Canal operation methods
- ◆ Canal modernization and automation
- ◆ Flow measurement structures & equipment
- ◆ Water data collection and telemetry
- ◆ Software development
- ◆ Specialized training and workshops
- ◆ Consulting on water management issues

## Dam Safety

The WRRL performs dam safety research for the Reclamation Dam Safety Program and other partners. Areas of emphasis include:

**New Spillway Technologies** – Research on fuse plug spillways and labyrinth weirs has produced new, cost-effective, emergency spillway alternatives.

**Emergency Gate Closures** – We have created and implemented new methods for verifying safe operation of emergency outlet gates.

**Dam Overtopping Protection Alternatives** - Laboratory models and near-prototype tests have been used to develop new, patented technology for protecting embankment dams from overtopping flows.

**Embankment Dam Breach Prediction** – The WRRL leads Reclamation's involvement in worldwide efforts to develop improved numerical models for simulating embankment dam breach processes.

## Structures and Equipment

We have a long tradition of solving flow problems related to operation and maintenance of hydraulic structures and equipment. Work in this area has focused on

- ◆ Spillways and outlet works
- ◆ Gates and valves
- ◆ Turbines and pumps
- ◆ Energy dissipators

Our experience, combined with modern laboratory facilities and sophisticated instrumentation and data acquisition equipment, provide for cost effective and timely solutions to a variety of operational and maintenance problems.