

RECLAMATION

Managing Water in the West

Safe Then; Safe Now

A Summary of Pueblo Dam's History



**U.S. Department of the Interior
Bureau of Reclamation
Great Plains Region
Eastern Colorado Area Office**

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Introduction

Pueblo Dam, a 10,230 foot-long earthen and concrete structure impounding one of the largest reservoirs in the state, is located six miles west of Pueblo, Colo. Built, owned and operated by the Bureau of Reclamation, Pueblo Dam and Reservoir are an integral part of the Fryingpan-Arkansas Project and provide a supplemental water supply for southeastern Colorado.

Consequently, many people are interested in the dam and reservoir and the various programs that affect them. We at the Bureau of Reclamation believe the public should understand the purpose of these programs and associated activities. To help promote that understanding, we have prepared this summary report to explain the continuing effectiveness of the Safety of Dams Program at Pueblo Dam. Pueblo Dam is safe and this report helps illustrate Reclamation's efforts to assure it remains so.

The Fryingpan-Arkansas Project and Pueblo Dam

Pueblo Dam was constructed between 1970 and 1975 as part of the Fryingpan-Arkansas Project. The project was authorized in 1962 for the purpose of supplying water for irrigation, municipal, domestic and industrial uses and for generating and transmitting hydro-electric power.

By diverting water from the upper Fryingpan River basin on Colorado's west slope and tunneling it under the

Continental Divide, the "Fry-Ark" project delivers an average of 48,500 acre-feet of water a year to southeastern Colorado. Pueblo is the last of five reservoirs on the project and stores water before it is delivered north along the Front Range and east to the plains.



The concrete spillway section on the upstream side of Pueblo Dam.

Pueblo is an earthen embankment dam, with a center concrete section that supports a large spillway. The spillway is designed to *safely* pass floodwaters that would otherwise overflow the dam. If filled to the spillway crest, Pueblo Reservoir can hold about 357,678 acre-feet of water.

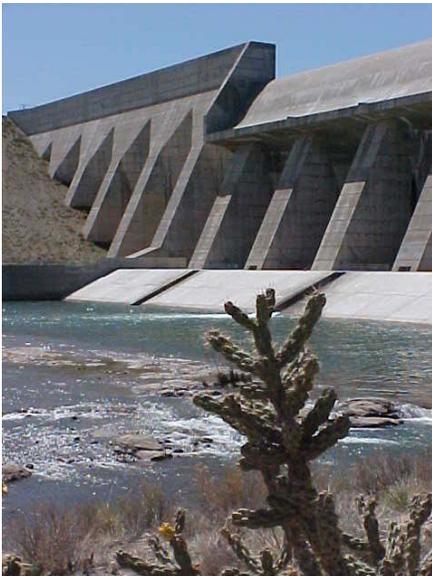
Pueblo Reservoir is one of the few Reclamation reservoirs in Colorado constructed for flood control purposes. That means Pueblo fills to its full capacity only in a flood event. By keeping approximately 19 vertical feet, or 93,000 acre-feet, vacant, the dam helps prevent flood water from raging

down the Arkansas River, into Pueblo, and east through the plains.

The area around Pueblo Reservoir is managed by Colorado State Parks and is one of the most visited State parks in Colorado. Pueblo State Park hosts over one million visitors a year. The fish hatchery and Rock Canyon Swim Beach area were also built by Reclamation and are equally popular recreation areas.

The Safety of Dams Program

One of the most important programs developed and managed by Reclamation is its Safety of Dams Program. The program is a direct reflection of Reclamation's commitment to ensure the continuing safety of more than 350 storage dams and dikes the agency constructed throughout the western United States.



The concrete spillway at Pueblo Dam

The Safety of Dams Program was officially implemented in 1978 with passage of the Reclamation Safety of Dams Act (Public Law 95-578). This act was amended in 1984 under Public Law

98-404 and again in 2004 under Public Law 108-439. The mission of the program is simple: Maintain Reclamation dams to ensure the safety of the public. This mission is accomplished through three primary elements:

- Monitoring instrumentation on all dams;
- Regular inspections and analysis of dams based on current technology and safety standards;
- Implementation of safety improvements and new technology, as needed.

The Safety of Dams Program also has areas of specific focus. One such area is earthquakes and seismic loading. Continuing advances in earthquake engineering technology trigger a more in-depth look at all of Reclamation's dams, particularly in mountainous areas and along fault zones. Through such studies, Reclamation engineers can evaluate how dams will perform during seismic loading.

The results of these studies and their recommendations are often published in Reclamation reports. Some reports used to be available to the public. Since September 11, 2001, however, security protocol has required us to safeguard all dam safety reports.

Pueblo and the Safety of Dams Program

In the case of Pueblo Dam, reports regarding earlier improvements to the dam are still publicly discussed in and around Pueblo. Unfortunately, two technical terms have been taken from these reports and widely misused and misunderstood.

“High hazard dam” is a classification term used in reference to dams located above populated areas, like the City of Pueblo, and does not indicate anything about a dam’s overall performance.

“Seepage” describes the water that moves through all dams. Pueblo Dam has features to control and collect the seepage in a safe manner and equipment that monitors seepage through the structure.

In fact, there are over 150 monitoring instruments on and around Pueblo Dam measuring water pressure, seepage, and movement of any portion of the dam. The equipment is checked daily, weekly, or monthly, as indicated by a prescribed schedule.

Inspections and analysis of Reclamation’s dams, like Pueblo, using current technology and safety standards also occur on a regular schedule: general reviews annually; periodic reviews (more in-depth than annuals) every six years; and comprehensive (the most thorough review) every six years (alternating with periodic reviews). A Comprehensive Facility Review was completed in 2006. A Periodic Facility Review was completed in 2009. The next Comprehensive Facility Review will be in 2012. As can be seen, dam safety reviews are an ongoing part of Pueblo Dam’s life. We are constantly monitoring the dam and inspecting it to ensure its continuing safe operation.

As part of this program, it is necessary to physically work on the dam, from time to time. For example, as a result of past inspections and analysis, Pueblo Dam has undergone several technological updates. In 1981, a stability berm was

added to the base of the northern earth embankment. In 1997, Reclamation initiated a foundation drain cleaning program. In 1998, drain pipes were installed downstream of the north embankment to collect and monitor seepage that occurs at high water elevations.

In 1997, a review of Pueblo Dam identified a slight possibility that the concrete spillway section of the dam could slide under high loading conditions—a lot of pressure behind the dam. Actions were taken to prevent the possibility of sliding. Those actions included:

- Filling a portion of the stilling basin with roller-compacted concrete (RCC)
- Installing rock bolts through the toe block and the foundation layers to further anchor the concrete section.

As anticipated, the modification work successfully addressed the sliding potential.



Full releases from Pueblo Dam to the Arkansas River following the completion of SOD work in 2000.

Pueblo Dam's future

As mentioned earlier, earthquake analyses are a focus of the Safety of Dams Program across Reclamation. In 2003, Reclamation finished modernizing all four dams at Horsetooth Reservoir, above Fort Collins, CO with seismic stability berms. In 2005, Reclamation evaluated Olympus Dam in Estes Park for seismic loading. And in the next few years, similar drill-sampling programs for seismic loading data will be completed at Pueblo Dam.



The long earthen embankment at Pueblo Dam

To assess seismic loading, Reclamation must evaluate “core samples” of the material in the dam’s earth fill embankments and foundation. In 2005, samples were obtained from the downstream slope of Pueblo Dam, in the soils below the downstream slope and just downstream of the dam.

Reclamation intends to collect more samples to analyze how the dam reacts to seismic loading. This time, samples

will be taken from the upstream slope and foundation.

Material samples from the holes will be taken to Reclamation’s labs in Denver for full analysis. The samples will help Reclamation determine if anything needs to be done to Pueblo’s southern earth fill embankment to assure safe performance during the rare event of an earthquake.

A road will be cut into to the upstream face of the southern earth fill section in the fall of 2009. Reclamation will notify customers and partners of the Fryingpan-Arkansas Project, as well as the general public, before work at Pueblo Dam begins. Drill programs such as this do not impact operations of the dam or the Fryingpan-Arkansas Project.

Conclusion

Today, one of Reclamation’s largest responsibilities is the continuing maintenance of its massive infrastructure throughout the 17 western United States. The Safety of Dams program is a very important part of our continued dedication to maintaining safe structures and fulfilling our agency’s mission for water resource management. Because of this high level of dedication, Pueblo Dam has operated safely and effectively for 30 years. With proper review and maintenance as provided by Reclamation under its Safety of Dams Program, Pueblo Dam will continue its safe operations well into the future.

For additional information on Pueblo Dam and its Safety of Dams Program, please contact Kara Lamb with Reclamation’s eastern Colorado office at (970) 962-4326 or klamb@usbr.gov.