ARROWROCK DAM, SPILLWAY
Boise River, 22 miles upstream east of Boise
Twin Springs vicinity
Boise County
Idaho

HAER ID-27-A
HAER ID-27-A

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
PACIFIC WEST REGIONAL OFFICE
National Park Service
U.S. Department of the Interior
1111 Jackson Street, Suite 700
Oakland, CA 94607

HISTORIC AMERICAN ENGINEERING RECORD

ARROWROCK DAM, SPILLWAY

HAER No. ID-27-A

Location: Boise River, 22 miles upstream east of Boise
Twin Springs vicinity
Boise County
Idaho

UTM: 11:587110:4827470 (Northeast point)
11:586870:4827520 (Northwest point)
Quad: Arrowrock Dam, Idaho, 1:24,000

Dates of Construction: 1911-1915, 1935-1937

Builder: United States Reclamation Service (USRS)

Project Engineer: A.P. Davis

Present Owner: United States Bureau of Reclamation

Present Use: Reservoir spillway

Significance: Arrowrock Dam is a key component of the Boise Project, an irrigation project designed by the USRS to irrigate roughly 390,000 acres in the Boise and Payette Valleys in southwestern Idaho. This Project helped to make the Boise and Payette Valleys the most agriculturally productive region in Idaho. In large measure this was due to Arrowrock Dam on the Boise River, a dam that created a reservoir of more than 272,200 acre-feet of water for irrigation. Arrowrock Dam was the highest dam in the world when it was completed in 1915, measuring 350.5 feet high from bedrock. Experimental elements of its gravity-arch design would be applied to later dams that were even higher. It was only one of two Reclamation dams built with sand cement for the concrete. It was the first USRS dam built whose design required Ensign valves for its outlets to release water. Ensign valves were an important step in the rapid evolution of water regulating valves triggered by construction of ever higher dams at the beginning of the twentieth century. The reinforced-concrete spillway at the Arrowrock site is a key appendage of Arrowrock Dam. The spillway serves as an overflow during periods of high water, directing flow around the dam and thus preventing reservoir spillage over the dam's crest.

Moreover, the spillway operates in conjunction with the needle valves, helping to regulate the amount of water moving from the reservoir into the Boise River below the dam. The spillway's weir is equipped with moveable drum gates, a unique feature that allows operators to impound water within the reservoir. When the drum gates are raised the capacity of the reservoir increases by about 15,000 acre-feet.

Description: Arrowrock Dam's spillway is located within a rock cut at the north end of the dam. It is vital to the dam's operation. The spillway serves as an overflow during periods of high water, directing flow around the dam and thus preventing reservoir spillage over the dam's crest. Moreover, the spillway operates in conjunction with the needle valves, helping to regulate the amount of water moving from the reservoir into the Boise River below the dam. The boomerang-shaped structure comprises two main components: a concrete weir and a channel. The crest of the weir is 10 feet below the crest of the dam. The weir rests at roughly a right angle to the end of the dam, and runs slightly northeast upstream 402 feet. A concrete-lined channel parallels the weir, although the channel angles slightly to the northwest for 402 feet where the weir intersects with the north end of the dam. The sides of the channel are sloped in a trapezoidal shape. The slope is greater in that part of the channel adjacent the weir. The channel floor is about 30 feet wide throughout most of its length, although it narrows considerably near the channel's northeast end. Water flowing over the weir falls into the channel and is directed to the northwest end of the spillway, falling over the rock face at this point and into Deer Creek. Deer Creek guides the flow into the Boise River below the dam.

The weir is divided into six parts by concrete piers with pipe railings top each pier. Each section is 62 feet long and 10 feet wide. Both sides have a taper. Each section of the weir holds a drum gate that is 62 feet long, 6 feet high and 8 feet 7 inches wide. The drum gates are hydraulically operated, by filling or draining a float chamber beneath the gates can be floated into position or lowered. When the drumgate is raised, the height of the weir's crest is elevated about 6 feet, thus more water is impounded within the reservoir. An operating gallery is located within the weir and runs almost its entire length. The gallery is just over 6 feet high and about 4 feet wide.

History: Excavation for the spillway at Arrowrock began in 1912. Engineers estimated that the amount of material pulled from the spillway site would total about 350,000 cubic yards. Since granite material taken from the site would be used in the sand concrete for Arrowrock Dam, the speed of spillway excavation would be regulated by the need for sand and crushed

rock in the concrete for the dam.[1] Excavation at the spillway ended for the season in December 1913 just before the start of the New Year.[2] By spring 1914 excavation for the spillway was mostly finished. Work on the spillway was a little behind schedule because a rockslide had filled part of the structure's channel early in the year. Toward the end of the year, however, the slide material had been removed and workers were preparing the channel for its reinforced-concrete lining.[3] By early 1915, the concrete lining in the spillway channel was about 40 percent complete.[4] On July 26, 1915 the first of the spillway's six drum gates arrived at the site. The remaining gates arrived soon thereafter. All of the gates were installed at the spillway's crest by the end of the year. In October the finishing touches were being made to the spillway including finishing the last part of the channel lining. [5] Also during this year steel bridge was erected over the spillway channel at its northwest end. The bridge connected the roadway atop the dam with a minimum maintenance road just to the north. The Pratt through truss bridge has a span of 96 feet with a 16 foot-wide deck..[6] The through truss design limited the height of vehicles that could pass over it, but the crossing type was probably chosen because of the width of the channel.

In 1928 the drum gates on the spillway received some attention as the interior plate surfaces of the gates were quite rusted. The surfaces were cleaned and a painted with "No-Ox-Id" which was developed by the Dearborn Chemical Company of Chicago, Illinois.[7] Two years later Reclamation realized that it would need to make concrete repairs to the surface of Arrowrock Dam and the lining in the spillway channel. The sand cement was not holding up as well as the agency thought it would. This was due to fractures and pitting on the downstream concrete face due to weather exposure and in the case of the spillway the high volume of turbulent water that frequently coursed through it.[8]

The $600,000 concrete repair work would involve utilizing both poured concrete and gunite. Engineers chose to use gunite on the surfaces of the spillway channel, as well as on the surface of the dam near its crest.

---

[1] Charles H. Paul, "The Arrowrock Dam Boise Irrigation Project, U.S. Reclamation Service." *Engineering News* 67 (June 6, 1912), 1065.
[2] Ibid., 2 & 3.
[3] Paul, "Progress on the Arrowrock Dam," 1286; USRS, *Boise Project, Idaho, Annual History, 1914*, 5-8, 22, 41.
[4] Charles H. Paul, "Progress on Arrowrock Dam," *Engineering News* 73 (February 25, 1915), 371.
[5] USDI, *Fifteenth Annual Report of the Reclamation Service, 1915-1916*, 142 & 143.
[6] USRS, *Boise Project: Storage Unit, Annual Report, 1915,* 27.
[7] USRS, *Boise Project, Idaho, Annual History, 1919,* 11; Reclamation, *Boise Project, Idaho, Annual History, 1927,* 60-62; Reclamation, *Boise Project, Idaho, Annual History, 1928,* 72-75.
[8] Reclamation, *Boise Project, Idaho, Annual History, 1930,* 82; Lyman Marden, "Arrowrock—Veteran Among the Mighty," *(Boise) Idaho Statesman*, June 6, 1937.

Besides adding a new face to the storage facility, the work also called for raising the dam and spillway by 5 feet. Elevating the dam and spillway would increase the reservoir's storage capacity by roughly 15,000 acre-feet, thus less water would be lost during the early part of the irrigation season and the potential for flooding would be slightly reduced. This project was awarded through the Works Progress Administration (WPA). The WPA was one of Franklin Roosevelt's Depression-era initiatives designed to put people to work and help jump-start the ailing economy. Bids for Reclamation Specification No. 661 for work on the dam were received late in 1935. The job was awarded to T. E. Connelly, Incorporated of San Francisco. Case Construction Company of Los Angeles subcontracted for all of the gunite work. The two companies erected a number of structures at the dam site, including bunk houses, dwellings, shops, and a large mess hall.[9]

Surface repair to the dam and spillway channel did not actually begin until early 1936. [10] The steel tubes were being fitted over the outlets, the contractor began chipping off 18 inches of the surface of the dam and spillway. Once the dam and spillway were clean of the old sand concrete, steel anchors were driven into the surfaces of each structure. Steel mesh was then placed over the surfaces, held in place by the steel anchors. Concrete was poured over or in the case of gunite it was then sprayed on the mesh, thus creating a reinforced concrete slab. Wet burlap was then laid over the gunited area to help the mixture cure. Prior to guniting operations, a considerable amount of experimentation was completed to discover the best ratio of sand, cement, and water to be used. Reclamation believed this early testing resulted in rapid completion of the guniting part of the project.[11] Both resurfacing and raising the dam took slightly less than two years to complete. For a while it appeared as if the project would finish well behind schedule, but during 1937 work hours were increased and three shifts employed. The work moved rapidly as a result with the spillway being completed first in October. Work on the remainder of the dam was finished by November 25, 1937.[12]

---

[9] Lyman Marden, "Arrowrock—Veteran Among the Mighty," *(Boise) Idaho Statesman*, June 6, 1937; Reclamation, *Boise Project, Idaho, Annual History, 1935*,11; Reclamation, *Boise Project, Idaho, Annual History, 1936*, 21; Harry J. Brown, "Work to Begin on Arrowrock Within Month," *(Boise) Idaho Statesman*, January 1936; "Face Lifting Job Complete at Arrowrock," *(Boise) Idaho Statesman*, December 2, 1937; "Arrowrock—Veteran Among the Mighty."
[10] "Arrowrock to Get New Face, Pope Informs," (*Boise) Capital News*, August 5, 1935.
[11] Good discussion and photographs of the concreting operation is located in Reclamation, *Boise Project, Idaho, Annual History, 1937*, 35-47. Photographs "Washington Office No. 1824," "Washington Office No. 1828," "Washington Office No. 1829," "Washington Office No. 1837," and "Washington Office No. 1888," show the steel mesh and anchors being mounted to portions of the dam and spillway. The photographs are available in Album No. 2, file 8NN-115-85-006, Box 44, at NARA, Denver.
[12] "Face Lifting Job Complete"; Reclamation, *Boise Project, Idaho, Annual History, 1937*, 36-41; Reclamation, *Boise Project, Idaho, Annual History, 1938,* 43; Reclamation, *Boise Project, Idaho, Annual History, 1939,* 48-49.

By the late 1980s inspection of the spillway's drum gates revealed spot corrosion. Also, some gate seals were in poor condition. Inspectors recommended completing corrosion repairs, repainting the gates, and replacing the worn seals. By this time the spillway floor was cracked and spalling. The walls of the spillway that had been gunited in the 1930s were still in good shape, though. Portions of the concrete on the upstream face of the spillway's weir were also deteriorating about this time. At least some work on the spillway concrete was completed in the fall of 1994.

Sources:

"Arrowrock to Get New Face, Pope Informs." (*Boise) Capital News*, August 5, 1935.

Brown, Harry J. "Work to Begin on Arrowrock Within Month." *(Boise) Idaho Statesman*, January 1936.

"Face Lifting Job Complete at Arrowrock." *(Boise) Idaho Statesman*, December 2, 1937.

Marden, Lyman. "Arrowrock—Veteran Among the Mighty." *(Boise) Idaho Statesman*, June 6, 1937.

Paul, Charles H. "The Arrowrock Dam, Boise Irrigation Project, U.S. Reclamation Service." *Engineering News* 67 (June 6, 1912): 1061-1065.

Paul, Charles H. "Progress on the Arrowrock Dam." *Engineering Record* 71 (June 11, 1914): 1286-1287.

Paul, Charles H. "Progress on Arrowrock Dam." *Engineering News* 73 (February 25, 1915): 370-371.

U.S. Department of the Interior, *Fifteenth Annual Report of the Reclamation Service, 1915-1916*. Washington D.C.: Government Printing Office, 1916.

U.S. Department of the Interior, Bureau of Reclamation. *Boise Project, Idaho, Annual History*. Various dates. Available at Reclamation's Pacific Northwest Regional Office, Boise.

U. S. Department of the Interior, U.S. Reclamation Service. *Boise Project: Storage Unit, Annual Report*. Various dates. Available at Reclamation's Pacific Northwest Regional Office, Boise.

Historian(s): A rough draft of the historical narrative was done by Denis Gardner of Hess, Roise and Company in Minneapolis, Minnesota in 2002. Kelsey J. Doncaster of Reclamation completed, revised, edited and finalized the document in 2013.

Project Information: By the late 1990s, many of the Ensign valves at Arrowrock Dam were no longer functioning as reliably due to wear from long use. Reclamation decided to replace 10 of the original valves with new clam shell-type gates and retire the other 10 Ensign valves from service. Since Arrowrock Dam has been determined eligible for the National Register of Historic Places, this Historic American Engineering Record (HAER) documentation was undertaken to mitigate the adverse effects of valve replacement and other alterations. Large format photography was done by three different photographers starting in August 1995 with Brent F. Smith and then Clayton B. Fraser of Fraserdesign in Loveland, Colorado in June 1999 prior to modification of the structure and Kirsten Strough of Reclamation on April 5, 2012 after its modification.