

History and Significance of the Low-Flow Conveyance Channel: What is its Future?

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Introduction

The Low-Flow Conveyance Channel, also known simply as the low-flow channel or conveyance channel, is an artificial channel that runs alongside the Rio Grande between San Acacia, New Mexico and Elephant Butte Reservoir. The Bureau of Reclamation built the low-flow channel as part of the Middle Rio Grande Project's river channelization program for the purpose of reducing consumption of water, providing more effective sediment transport, and improving valley drainage. Operation and maintenance of the low-flow channel are continuing Reclamation responsibilities.

The basic concept behind the low-flow channel is that depletion of water can be reduced by diverting some or all of the river's flow into a narrower, deeper, and more hydraulically efficient channel. The low-flow channel exposes relatively

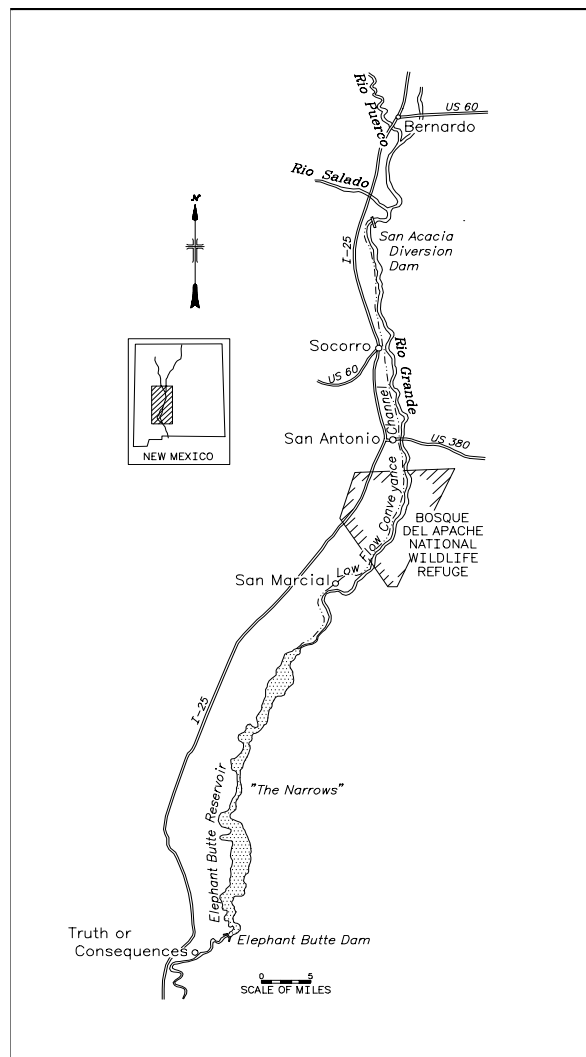


Figure 1. Location Map

less water surface area to evaporation and is less prone to loss of water by seepage than the natural river channel. The higher flow velocities in the low-flow channel can also move more sediment than the river, especially at lower discharges. The low-flow channel has a nominal capacity of 2,000 cfs but, in practice, diversions greater than 1,800 cfs have rarely occurred. The maximum recorded mean daily discharge of the low-flow channel at San Acacia is 1,950 cfs.

Historical Context

During the first half of this century the habitability and agricultural productivity of the Middle Rio Grande Valley declined because of inefficient water delivery, poor drainage, and frequent floods. The first attempt to address these problems in a comprehensive manner was the organization of the Middle Rio Grande Conservancy District (MRGCD) in the 1920s. At about the same time the states of New Mexico, Texas, and Colorado began negotiating the Rio Grande Compact to apportion the flow of the river among themselves. The final Compact, which took effect in 1939, requires the State of New Mexico to deliver at Elephant Butte Dam, a scheduled portion of the Rio Grande flow that passes the river gauging station at Otowi. In effect, the Compact allocates a limited share of the river's flow for depletion in the Middle Valley.

The MRGCD struggled through the depression years of the 1930s to dig drains, consolidate the irrigation system, and build El Vado Dam on the Rio Chama. Calls for federal assistance increased when a damaging flood occurred on the Rio Grande in 1941. The origins of the Middle Rio Grande Project and the Low-Flow Conveyance Channel lie in the damages caused by this flood, another high-flow year in 1942, and subsequent beginning of a drier period in the mid-'40s.

The floods of the early '40s completely filled Elephant Butte Reservoir. As the reservoir filled, channels into the reservoir were inundated and filled with sediment. Even above the reservoir itself, large quantities of sediment brought with the floods deposited and plugged the river channel. An infestation of salt cedar on the floodplain helped to trap sediment and compounded the problem.

With the onset of drier conditions in the mid- and late '40s, the reservoir dropped, and the distance between San Marcial and the reservoir increased. Because the clogged river could not move sediment, deposits continued to accumulate above the reservoir. Eventually, by the record dry year of 1951, the head of the reservoir had receded to about 40 miles below San Marcial and the river below Bosque del Apache had become a series of disconnected segments separated by sediment plugs and delta deposits.



Figure 2. Aerial view looking downstream from the southern boundary of the Bosque del Apache in January 1952. At this time there was no river channel from this point downstream for about 2½ miles.

Because there was no channel into the reservoir, water spread widely over the floodplain and reservoir delta, even at low flows. Depletions due to evaporation and use by growing vegetation increased. Estimates made at the time put the depletion of water between San Marcial and the reservoir at more than 140,000 acre-feet annually. By comparison, total valley depletions in the 50-mile reach between San Acacia and San Marcial currently average around 100,000 acre-feet per year. Large streamflow depletions below San Marcial were a big factor in the difficulties that New Mexico had in meeting its Compact delivery obligations beginning in the mid-'40s. New Mexico's difficulties in delivering water to Elephant Butte resulted in the application of Compact provisions that limited the storage of water at

El Vado for use in the Middle Valley. Excess depletions also contributed to water shortages for the Rio Grande Project, which provides water to lands below Elephant Butte in New Mexico and Texas as well as in the Republic of Mexico.

In 1947, the Bureau of Reclamation and the Corps of Engineers completed a comprehensive plan for assisting the Middle Rio Grande valley in addressing its water and sediment management problems. This plan included dams for flood and sediment control, rehabilitation of the Middle Valley's irrigation and drainage system, and extensive river channelization works. Congress authorized the recommended plan, with the notable exception of the proposed Chiflo Dam, in the Flood Control Acts of 1948 and 1950.

Opening channels into Elephant Butte Reservoir to increase efficiency of conveying water and sediment was the highest priority when work on the Middle Rio Grande Project began. In 1951, President Truman gave Reclamation special authority to start channel construction immediately. Work on the low-flow channel and clearing a floodway for passage of higher flows began in October of that year.

Construction on the low-flow channel continued throughout the '50s. A first phase, the so-called San Marcial Channel, was completed at the end of 1953. Diversions through a heading near the southern end of the Bosque del Apache began

in November of that year. Extension of the low-flow channel upstream to San Acacia was completed in 1959. When completed, the low-flow channel extended some 70 miles from San Acacia to a point just above the narrows of Elephant Butte Reservoir.

Diversions from the river to the low-flow channel began at San Acacia in 1959. During the '60s and '70s, the entire river flow was carried in the low-flow channel most of the time. In general, flow was routed to the river below San Acacia only during periods of high flow in the spring and occasionally during the summer rainy season.

While the low-flow channel conveyed the great majority of river flow in the '60s and '70s, the average annual depletion of water between San Acacia and San Marcial—as measured by total flow through the respective valley cross sections—was reduced by about 40,000 acre-feet annually. Extrapolating to the Narrows, some estimates of water savings attributed to conveyance of water in the low-flow channel are as high as 60,000 acre-feet a year. The effects of the reduced depletions on deliveries to Elephant Butte Reservoir are reflected in the record of New Mexico's Compact delivery status. As shown in Figure 3, a debit of more than 500,000 acre-feet that had accrued between 1943 and 1956 was entirely eliminated by 1972.

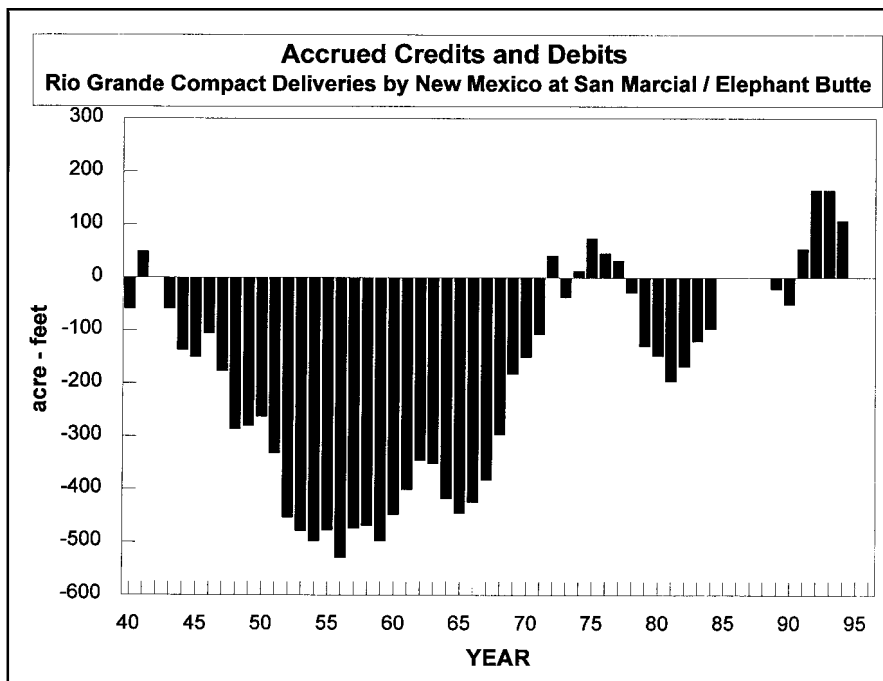


Figure 3. New Mexico's accrued Rio Grande Compact delivery debits and credits, 1939-1996

Current Conditions

The period of low-average streamflow that began in the mid 1940s persisted through the '70s. During this time the average flow of the Rio Grande at San Marcial was only about two-thirds of the average flow for the entire period of record, which goes back before 1900. There was an especially severe drought between 1950 and 1956 when the average flow of the river was only about 40 percent of the long-term average.

Beginning in 1979, the average flow of the Rio Grande increased markedly compared to the low streamflows of the '50s, '60s and '70s. By 1985, the higher flows had filled Elephant Butte Reservoir for the first time since 1942. The spill cancelled all accrued Compact delivery debits, but the high flow and high reservoir created some new management problems.

An episode of heavy sediment deposition began that affected a reach of the river extending for some distance above the reservoir. At the San Marcial railway bridge, which is about 8 miles above the reservoir's high-water pool, some 15 feet of sediment have deposited since 1979. While sedimentation at San Marcial has been quite rapid over the past several years, it must be noted that this is an episode overlaying a continuing long-term sedimentation trend. Records going back to before 1900 indicate that fairly rapid sedimentation has been occurring over at least the past century. Destruction of the town of San Marcial by floods in 1929 can be directly attributed to sedimentation of the river channel.

A brief history of the railway crossing illustrates some of the effects of sedimentation at San Marcial. Before 1920, the railway crossed the river on a steel bridge about a half mile upstream from where the present bridge now stands. During a flood in 1920, the river shifted to a new channel, breaching the railway embankment at the site of the present bridge. A wooden trestle was built to carry trains across the new channel. Because of sediment deposition, the railroad company raised the tracks nine feet when they built the present steel bridge to replace the trestle in 1930. Deposition of sediment from the floods in 1941 and '42 necessitated raising the bridge an additional 12 feet in 1943. So the railroad tracks at San Marcial are now more than 20 feet higher than they were in the 1920s. Continuing sedimentation has again

reduced clearance under the bridge to a degree that flow capacity is significantly reduced. Limited channel capacity under the bridge and through the San Marcial reach have become the main factors controlling flood releases from Cochiti Dam. The lower releases from Cochiti have had significant impacts throughout the Middle Valley.

Aggradation of the Rio Grande channel above Elephant Butte Reservoir in the 1980s resulted in loss of channel capacity and some shifting of the channel alignment. While peak discharges were not remarkably high, unusually long-flow durations compounded problems caused by high-river stages as water stored upstream was delivered to Elephant Butte throughout the year.

The lower 15 miles of the Low-Flow Conveyance Channel were inundated and filled with sediment as the reservoir filled in the early '80s. In 1983, the outlet of the Low-Flow Conveyance Channel was moved to a location near the top of the reservoir pool, but diversion of water and sediment at San Acacia could not be continued because rapid deposition of sediment prevented maintenance of a suitable outfall. Diversions at San Acacia were suspended in March 1985.

During the late 1980s, extensive rehabilitation and improvement work was done on the low-flow channel in anticipation of future operations. With diversions suspended, the low-flow channel continues to serve as the valley's main drainage outlet, carrying seepage flows and irrigation returns to the reservoir. The low-flow channel also serves as the Bosque del Apache National Wildlife Refuge's main water supply and provides supplemental water to the MRGCD. Water flowing out of the low-flow channel also sustains highly productive marshes and wetlands below San Marcial

Because the river has been confined to the eastern side of the floodplain by the levee that protects the low-flow channel, the aggradation of the river bed in the San Marcial area has caused it to become perched in a narrow strip along the eastern side of the floodplain. Head difference between the river on one side of the levee and the low-flow channel on the other is now as much as 10 to 15 feet. Severe stress on the levee has been manifest in cracking and occasional incidents of river water piping through the embankment.

Future of the Low Flow Conveyance Channel

The need for efficient conveyance of water to Elephant Butte Reservoir to meet Rio Grande Compact delivery obligations remains. In the inevitable drought, the need will be even more critical.

Reclamation's Albuquerque Area Office has managed the river and maintained the levee to protect and preserve as much of the low-flow channel as possible so that full operation can be resumed in the future under suitable conditions. Raising and reinforcing the levee in the San Marcial area has prevented further breaching and consequent damage to the low-flow channel. However, as aggradation of the river has continued, it has become increasingly doubtful that containing the river on the east side of the levee is a practical long-term strategy. Consequently, Reclamation is now completing an Environmental Impact Statement to evaluate proposed modifications to the channel system. The proposed modification involves moving the low-flow channel and the river below San Marcial into new alignments westward of their current locations. The realigned river would be on the lower section of the floodplain west of the levee and the low-flow channel would be near the western edge of the floodplain.

Realignment of the river would relieve pressure on the levee and reduce potential for an uncontrolled breach. In addition to damaging the low-flow channel, an uncontrolled breach of the levee would cause substantial loss of high quality riparian wildlife habitat and could result in a disconnected river channel. Realignment would also expand the active floodplain with benefits to wildlife as well as sediment management.

Future options for operation of the low-flow channel will be evaluated as part of the Upper Rio Grande Basin Water Operations Review. The range of possible operating options ranges from continuing a no-diversion operation or resuming diversions when conditions permit or require.

Concerns over the environmental effects of low-flow channel operations have arisen in recent years that are expected to impose limitations on future operations. Most prominent among these are endangered species considerations, particularly associated with habitat needs of the Rio Grande silvery minnow and the southwestern willow flycatcher. Future diversion of the entire river flow, as was typical in the 1960s, will

probably not be possible. It is reasonable to expect that the quantities of water that can be saved by more limited low-flow channel operations may not compare with the 1960s. Studies are continuing to determine the effectiveness of partial diversion strategies.