Pima-Maricopa Irrigation Project
Education Initiative
2002-2003

Restoring water to ensure the continuity of the Akimel O'otham and Pee Posh tradition of agriculture

The San Carlos Dam Study

Part 24

On August 24, 1912, Congress approved the 1913 Indian Appropriation Act. In section 2, the Secretary of War was directed to "convene a board of not less than three engineers of … wide reputation and … experience" to undertake the necessary studies as to the "reasonability and practicality" of constructing a dam at the Box Canyon site on the San Carlos Apache Reservation. On September 19, 1912, Secretary of War Lindley M. Garrison appointed three engineers from the Army Corps of Engineers (ACE) to evaluate the site for the purpose of providing irrigation for "Indian, private and public lands" in the Gila River Valley.

The first action by the ACE was to reject the original 1898 dam site because of its inferior quality of rock (limestone, which with local warm springs suggested there could be cavities in the rock wall), its depth to bedrock (74 feet) and a geologic fault that cut across the canyon. A site 1,000 feet upstream was proposed. At the new site, the rock (quartzite and quartzitic sandstone) was of a better quality, the depth to bedrock was considerably less and the dam itself was above the fault. Here a 180-foot tall dam could impound 709,626 acre-feet of water at a cost of $2,104,000.

In arriving at this decision, the ACE evaluated more than a dozen aspects of reclamation, foremost of which was determining if an adequate water supply existed. The annual water supply based on water flow records maintained between 1890 and 1912 averaged 346,568 acre-feet. A low volume of 99,936 acre-feet occurred in 1902 with a high mark of 1,011,082 acre-feet in 1905. The low average runoff and the extremes between high and low runoff concerned the ACE. But of a far greater concern was the length time during which the annual run-offs were "continuously below" the average. The years between 1898 and 1904 and between 1908 and 1910 were all below average flow. While a 180-foot tall dam could store more than 310,000 acre-feet, the ACE believed it would be unwise to plan more than that amount being stored on any given year. Based on data from similar reservoirs, it was believed no more than five feet of water would evaporate from the reservoir each year.

It was widely known that the Gila River carried a large volume of silt each year. This posed two challenges. First, how could the amount of silt be controlled so as not to fill the reservoir with sediment too quickly (and thereby lessen the life expectancy of the dam)? Secondly, what means of allowing silt to pass through the dam so as to not deprive Pima farmers of the beneficial fertilizing aspects of the silt could be devised? The ACE adopted a liberal annual percentage of silt of 1.3% of the total volume of water. With an average flow of 346,568 acre-feet of water, the annual volume of silt would be around 4,500 acre-feet, or 7,200,000 cubic yards. Of this, 3,750 acre-feet, or 6,000,000 cubic yards, would remain behind the dam; the remainder would pass through in suspension. As to removal of the silt in the reservoir, dredging was the only feasible means. The cost was calculated at $3.33 per acre served by the project. While the potential for generating hydroelectric power existed, it was not recommended due to the limited "amount of power which can be counted on continuously."

The ACE placed great importance on the long-term sustainability of the reservoir. While the dam might impound 709,626 acre-feet of water, this did not mean that all of it should be used each year and that more land than could be conservatively served by the average supply of water be brought under the project. More than half a dozen tests were conducted to find the most beneficial way of ensuring an adequate supply of water during times of drought. These studies indicated the largest volume of water that could be safely assured "year in and year out," was 200,000 acre-feet. To ensure

this amount was available every year, the storage capacity of the dam needed to be at least 500,000 acre-feet.

While the ACE considered a dam 220 feet high (with a capacity of 1,335,926 acre-feet), it was not considered feasible because of the high costs that would be borne by the landowners who would have mortgaged their lands to pay for the project. It would also retain more of the fertilizing silt of the river. By so doing, farmers downstream would be forced to supplement the natural fertilizing agents of the river. Based on these considerations, the maximum height of the dam could not exceed 180 feet. Using no more than 200,000 acre-feet for irrigation purposes each year, the dam could store more than 500,000 acre-feet of water for use in times of drought. Even if another drought as bad as that of 1898-1904 should occur, stored water would be available in all but the most extreme conditions.

The proposed dam would create a reservoir 16 miles long and, on average, about 1.25 miles wide. It would inundate five miles of track belonging to the Eastern Arizona Railroad and flood the San Carlos Indian Agency. More than 14,000 acres of San Carlos Apache land would be covered with water. Of this, nearly 2,000 acres was irrigable. In addition, twenty Apache homes and 15 miles of road would be inundated with water. The cost for replacing the agency and other Apache losses was expected to be about $200,000. The damages to the railroad were set at $680,000.

To distribute the water to farmland downstream, a diversion dam would be necessary to divert water from the bed of the river into a distribution canal. This proposed dam (later called the Ashurst-Hayden Diversion Dam) was more than sixty miles downstream from San Carlos. While there would be seepage and evaporation losses, these losses would be made up with water entering the Gila River below San Carlos dam. Most notable among these sources of water was the San Pedro River, which joined the Gila some 35 miles below San Carlos. Even though the dam would be nearly 70 miles from irrigated farmland on the desert floor, any losses sustained enroute would be more than compensated from downstream sources.

The final questions to be addressed were the duty of the water and which lands were to be made part of the project. On the former question, a water supply of no more than 200,000 acre-feet per year was recommended. In arriving at this determination, the ACE adopted the conservative view that "water allotted to an acre of land should be made small, so as to enforce economy." Accordingly, 2 acre-feet of water was allocated per acre. This was admittedly "little more than enough for one grain crop, and enough for cotton, olives and some fruits." Nonetheless, this would allow the project's benefits to be "extended to a greater number of people," which would lower the per capita cost of the project. All canals and ditches were to be lined with concrete to conserve water.

As to the latter question, the Board noted that little public land remained within the potential project area, as speculators, in anticipation of a reclamation project, had bought up most of the land. There were, of course, private landowners in the Florence-Casa Grande area willing to place their lands under the project (i.e., mortgage them). Landowners representing 41,000 acres pledged to do so if the project should be built. With enough water to support 90,000 acres of cultivation, the ACE recommended 122,222 acre-feet of water be set aside for 55,000 acres of land outside the reservation (this did not include any Upper Valley lands).

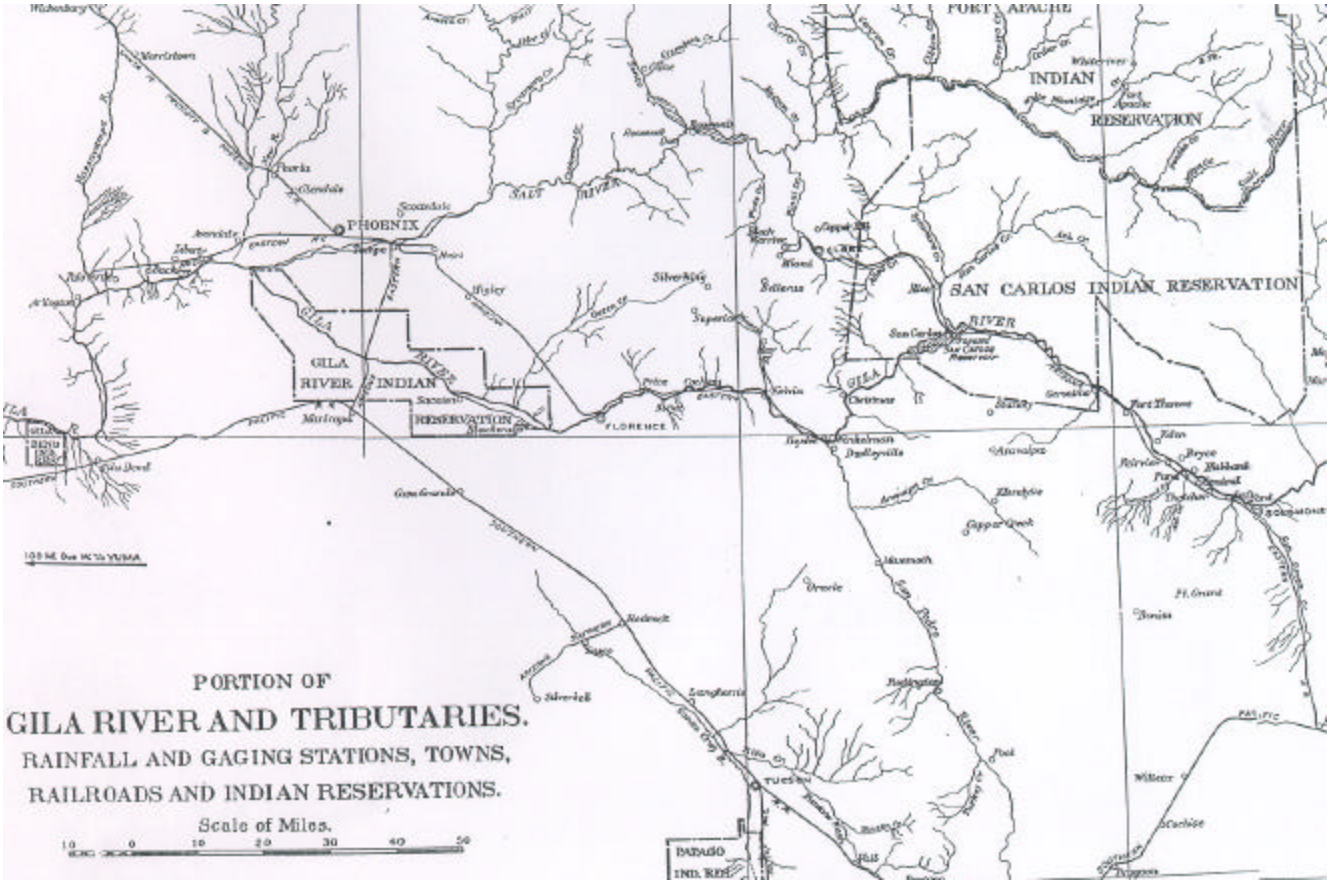
Acknowledging that the United States, on behalf of the Pimas, had a "right to take as much of the flow of the stream as may ever be required for the proper use of the Indians, and that private rights can not vest except to the flow of the stream in excess of that required for the Indians," the ACE recommended that 77,778 acre-feet of water be assigned to the Pima Reservation. While recognizing that the Pimas had farmed "from 30,000-52,000 acres" in the past, the Corps of Engineers adopted a plan to water 40,000 acres on the reservation. Of this, 10,000 acres were on the north side of the river (in the Sacaton Project) and 30,000 were to be on the south side. Since the Santan area had pump water, the lands on the north side were to receive just one acre-foot of water per acre (or the equivalent of 5,000 acres of land), for a total of 35,000 acres of land. The Little Gila River would serve as the main conduit for distributing the water to project lands. Indian Irrigation Engineer Charles Real Olberg

and Pima Superintendent Frank Thackery sought to persuade the ACE to allocate water for 50,000 acres on the reservation. The project was to "be confined, as far as practical, to lands near the river." This would lessen transmission losses and allow return water to be used again downstream.

The cost for the storage dam and distribution system, including concrete lined canals, totaled $6,312,983. Of this, $2,437,091 was the Pima share of the San Carlos dam, the (Ashurst-Hayden) diversion dam, the distribution system for 35,000 acres of land and engineering fees. The off-reservation portion amounted to $3,875,892 and included 61% of San Carlos dam, a distribution system for 55,000 acres and engineering fees.

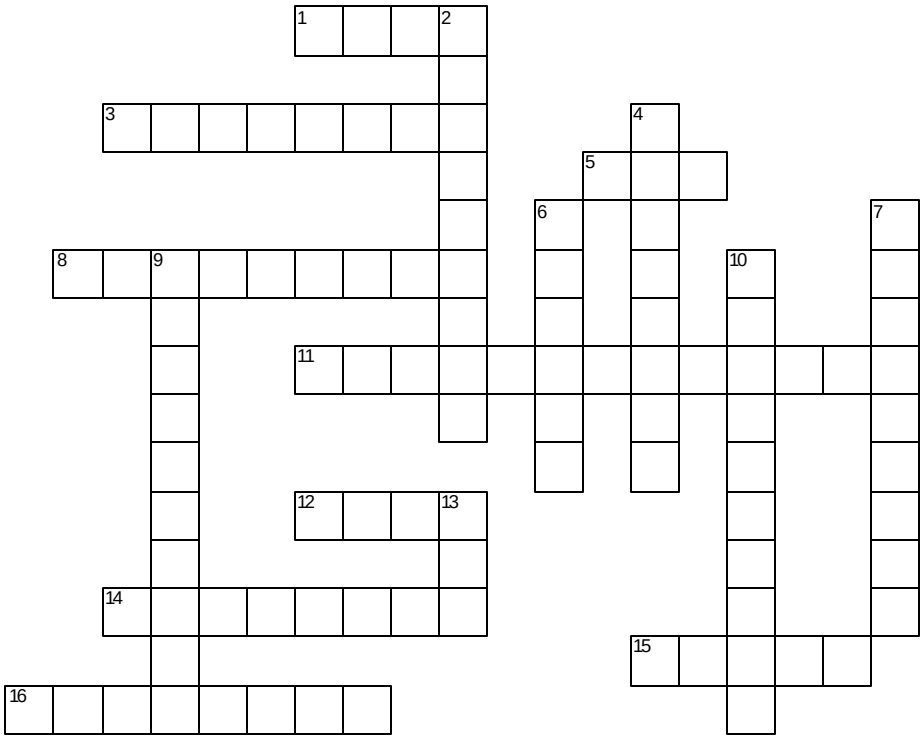
The Corps of Engineers made one last recommendation, one that had been ignored for nearly 30 years. Before any planning or construction should occur, it was imperative that the United States Justice Department "obtain an adjudication of all water rights in the Gila River," including Pima rights. In the meantime, the United States should file a claim to all surplus and unappropriated waters in the Gila River watershed on behalf of the project. Under no circumstances should Congress give up the San Carlos site.

The Army Corps of Engineers concluded that the San Carlos project was indeed feasible and practicable. However, such a project should not be undertaken until all legal uncertainties were cleared up. Rights to the waters of the Gila River had to be adjudicated, a process that could take decades. To ensure that federal money was well spent, the ACE declared that all eligible Pima land not actually irrigated by the Pimas should be "leased to white farmers or otherwise farmed under the direction of the Indian Bureau." The politicking of the dam could now begin. Driving the process was the beneficial use of the water.



Source: House Document 791, Map 1 San Carlos Irrigation Project, 1914

The Army Corps of Engineers Evaluates San Carlos Damsite



Constructed using Crossword Weaver

ACROSS

1. The estimated number of feet of water that would evaporate from the reservoir every year.
3. The only way to remove silt from the reservoir floor.
5. This canyon was the site on the San Carlos Apache Reservation evaluated by the Corps of Engineers.
8. This rock at the upper dam site was of a better quality.
11. This type of power could be generated by the proposed dam.
12. This substance is carried in the Gila River and is an important fertilizing factor.
14. This river in southern Arizona joins with the Gila River below the San Carlos site.
15. Between 1898-1904 and 1908-1910 the average water flow into the dam site was ___ average.
16. One of these is equal to 325,851 gallons of water (and will cover 1 acre of land with 1 foot of water).

DOWN

2. Three of these were appointed to evaluate the San Carlos site.
4. All canals were to be lined with this.
6. This BIA engineer recommended the Pimas be given enough water for 50,000 acres of land.
7. This Indian agency would be flooded with the proposed reservoir.
9. It means to settle a dispute in a court.
10. This river was to be the main conduit for delivering water on the reservation.
13. How many hundreds of thousands of acre-feet of water did the Corps of Engineers recommend for irrigation purposes each year?

Teacher Plan for "The 1913 San Carlos Dam site Study"

Terms to know and understand

- Acre-foot
- Reservoir
- Silt
- Dredging
- Mortgage
- Adjudication

Objectives

Students will be able to:

1. Synthesize data and evaluate the most feasible capacity for a storage reservoir.
2. Evaluate data and draw conclusions from it.

Critical Thinking:

- Would it be better to build a large dam to hold the greatest volume of water and irrigate as much land as possible during the years water was available or to build a dam with moderate storage capacity and regulate the flow of water to irrigate a smaller number of acres with a greater assurance of water being available year after year? If a reservoir were planned for storing no more than 500,000 acre-feet of water (while releasing no more than 200,000 acre-feet for use in any one year), wouldn't it be a waste of water when nearly 200,000 acre-feet was released over the dam in 1905 and 1907, without being able to use it? Why is it better to plan a stable amount of water each year than to take and use all that can be stored?

Activities

- After completing its study of the San Carlos project, the Army Corps of Engineers agreed the project was feasible and practical. However, they recommended that Congress clearly define the issue of water rights before any activity begin on the project. Why was this so important? Do you think Congress accepted this advice? And why do you think the ACE suggested that Pima lands not farmed be leased out to non-Indians?
- Use the following water inflow data and have students produce a chart showing the rate of water inflow into the San Carlos (Box) Canyon between 1895-1912. Then have the students chart the annual use of 200,000 acre-feet of water for irrigation purposes, and a maximum storage capacity of 500,000 acre-feet. Have them graph the approximate amount of water that would have to be released from the dam each year.

Year: Acre-feet	***Year: Acre-feet***	***Year: Acre-feet***	***Year: Acre-feet***	***Year: Acre-feet***	***Year: Acre-feet***
1895: 438,985	1898: 327,512	1901: 190,104	1904: 162,697	1907: 635,904	1910: 109,956
1896: 554,585	1899: 194,529	1902: 099,936	1905: 1,011,082	1908: 338,000	1911: 375,767
1897: 464,957	1900: 153,965	1903: 112,856	1906: 426,686	1909: 273,384	1912: 383,972

About P-MIP

The Pima-Maricopa Irrigation Project is authorized by the Gila River Indian Community to construct all irrigation systems for the Community. When fully completed, P-MIP will provide irrigation for up to 146,330 acres of farmland. P-MIP is dedicated to three long-range goals:

- Restoring water to the Akimel O'otham and Pee Posh.
- Putting Akimel O'otham and Pee Posh rights to the use of water to beneficial use.
- Demonstrating and exercising sound management to ensure continuity of the Community's traditional economy of agriculture.