

13TH AMERICAN WATER RESOURCES CONFERENCE

FIELD TRIPWATER RIGHTS CONFLICTS IN USE OF A
COMMON-POOL AQUIFER, SANTA CRUZ VALLEY, ARIZONA

November 3, 1977
1:30 - 5:30 PM

- STOP NO. 1: San Xavier Indian Reservation
STOP NO. 2: Santa Cruz Valley Near Sahuarita
STOP NO. 3: Copper Mining-Milling Operation

Field Trip Committee:

K.J. DeCook (Chairman): University of Arizona
John W. Harshbarger: University of Arizona
Thomas Maddock, Jr.: U.S. Geological Survey

Acknowledgment - Sincere gratitude is extended to all those who provided information or assisted in planning and conducting this Field Trip, especially Susan Keith, University of Arizona; Charles E. Stott, Anamax Mining Company; William E. Strickland, Attorney; and J.J. Wright, Department of Water and Sewers, City of Tucson.

AMERICAN WATER RESOURCES ASSOCIATION
TUCSON AREA FIELD TRIP
November 3, 1977

Schedule

- 1:30 PM: Depart Marriott Hotel, Tucson.
- 1:45 PM: Arrive at Mission, San Xavier Indian Reservation.
- 2:30 PM: Depart Mission.
- 2:45 PM: Arrive Sahuarita Area for Brief Stop.
- 3:15 PM: Arrive at Anamax Mining Company Operation.
- 4:45 PM: Depart Mining District.
- 5:30 PM: Return to Marriott Hotel, Tucson.

INTRODUCTION

In the Santa Cruz Valley south of Tucson, ground water is withdrawn for agricultural, municipal, and industrial (mining-milling) uses--all from a common-pool ground-water reservoir in the Sahuarita-Continental Critical Ground-Water Subdivision. The combined rate of pumping has increased rapidly during the past 20 years or more, and water-level declines indicate serious overdraft of the water resource.

Litigation was initiated by Farmers Investment Company (FICO) in 1969, resulting in a 1976 decision by the Arizona Supreme Court which acted to restrain the mining companies and the City of Tucson from continuing to transport ground water to points of use outside the critical area from which it was pumped. In the spring of 1977, however, the Arizona Legislature enacted a statute (S. 1391) under which cities and industries may be exempted and allowed to transfer such pumped water, subject to claims for damages by landowners in the well-field area. Most recently, the Papago Indian Tribe has started litigation against other ground-water users in the Valley, seeking the reservation of ground waters in the Santa Cruz Valley for their use.

SAN XAVIER INDIAN RESERVATION

Orientation

Near the site of the present church of San Xavier del Bac, the original Spanish mission was founded in 1700 by Padre Eusebio Francisco Kino. The present structure was built by the Franciscan missionaries nearly a century later, and is still administered by that order. The area is an ideal desert oasis, which is the basic reason for the establishment and survival of the mission at this location.

Hydrologic Note

The river in the Mission area has undergone considerable geomorphic change within the past 100 years. Early (pre-1890) maps and reports indicate that the Santa Cruz River flowed perennially through much of this valley and disappeared underground to the northwest near Tucson. The stream channel varied from place to place, being poorly defined and choked with vegetation in some areas, and wide and sandy in others. Low marshy areas (cienagas) dotted the valley floor. Just to the north of the Mission, a lake was created in 1857 on the unentrenched floodplain behind a long, low, earth-fill dam to serve the needs of milling and recreation. Irrigation was practiced by the Papago and the Anglos, utilizing spring flows, flood flows, and water captured in acequias or infiltration galleries. A personal observation made in 1892 was as follows:^{1/}

This part of the reserve is naturally more valuable than any other piece of land I have seen in the Territory, because the water of the Santa Cruz River rises to the surface and flows almost 2 miles before leaving the Indian land. Here is also fully a thousand acres of the finest grazing land and more than seven thousand acres of the largest mesquite timber in the Territory.

Abruptly, the hydrologic regimen changed. Rainstorms cut an arroyo 5 - 20 feet deep, up to 150 feet wide and a mile long in a two-week period, and in 1892 the arroyo breached the dam at Silver Lake and cut into the drained floor of the lake. By 1912 the arroyo was 18 miles long.- Various hypotheses have been offered to explain this change in the hydrologic regimen (and the vegetation changes that accompanied it)--climatic change, over-grazing by cattle, and more recently, the "loci of entrenchment" idea whereby

irrigation canals, acequias, roads, and cow paths along the valley floor served to channelize runoff and thus induce gullying. In any case, what is seen now--the dry, steep-walled arroyo of the Santa Cruz--is hardly a subtle testimony to the rapidity of change, either natural or manmade, that can occur in this semi-arid environment.

Ground-Water Decline

Exploitation of the ground-water reservoir in this region also has begun to show its effects. The Santa Cruz River Valley (see map)^{2/} is bounded on the east and west by the Santa Rita and Sierrita Mountains. The valley is underlain by water-bearing alluvial materials attaining a thickness of several hundred feet and in places exceeding 2,000 feet. Ground-water recharge in this area is dependent upon streamflow and underflow from the south; however, recharge has been decreased by withdrawals of water from the river system in the upstream areas to the south. Simultaneously, local withdrawals of ground water in the San Xavier-Sahuarita area have increased rapidly over the years in the form of pumpage for agricultural, municipal, and industrial uses.

The combination of heavy ground-water pumpage and decreased ground-water recharge has resulted in perennial declines in static water levels in this area. As illustrated on the map, ground-water levels declined more than 50 feet during the period 1947-1970 near the San Xavier Mission; additional depletions since 1970 have brought the decline to nearly 100 feet in this area, and more than 100 feet further southward.

SANTA CRUZ VALLEY NEAR SAHUARITA

In this valley, ground water is withdrawn for agricultural, municipal, and mining use. Irrigation farming has been practiced by Anglo residents since about 1913.^{3/} Around 1940 numerous farms were consolidated, and large-capacity irrigation wells were constructed. The principal crops grown were cotton, feed-forage crops, and small grains, principally barley and wheat. In the 1960's pecans were planted on a large scale and now constitute the major crop. The following table indicates the recent level of ground-water use for crops in the Sahuarita district.

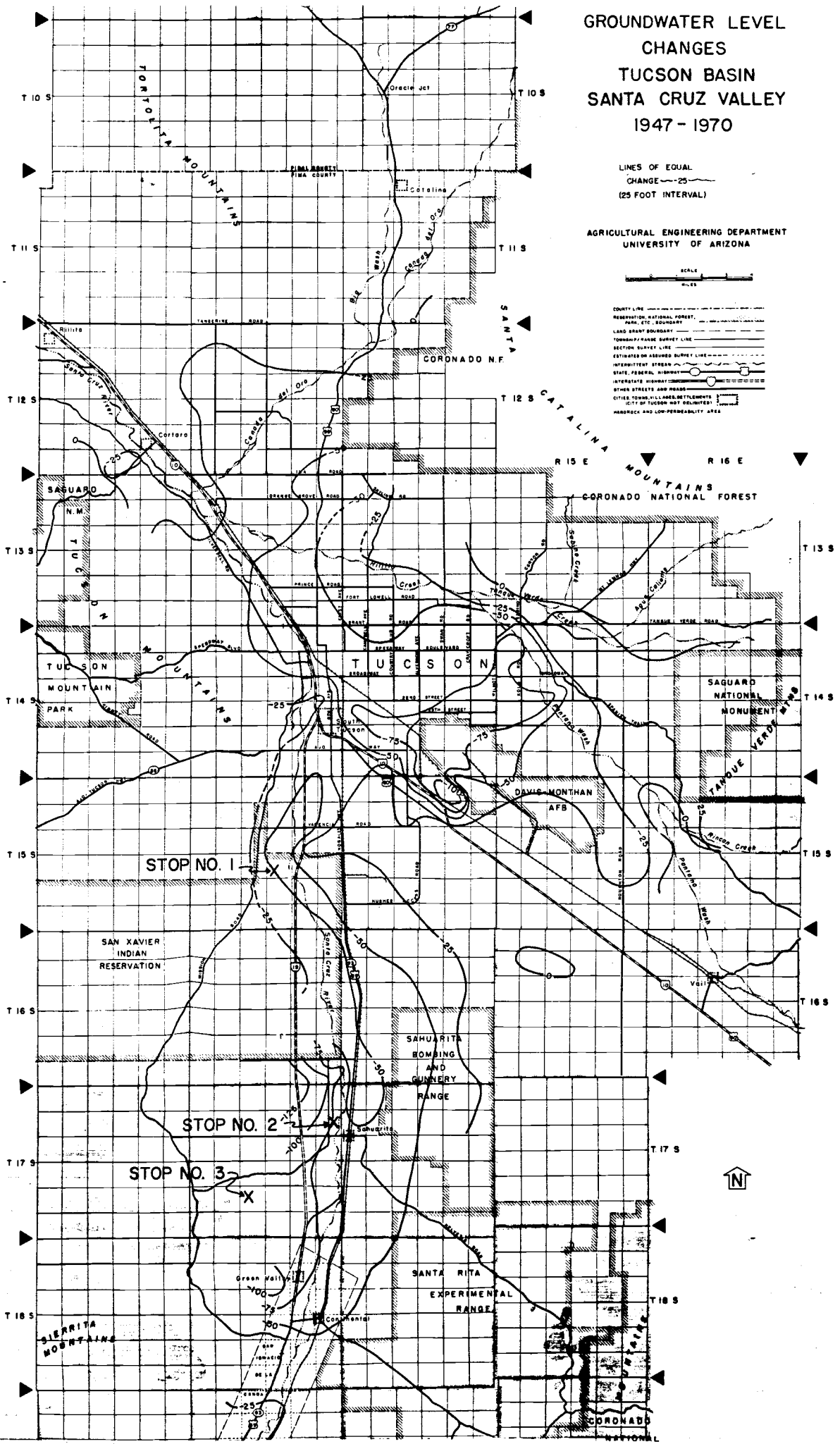
GROUNDWATER LEVEL CHANGES TUCSON BASIN SANTA CRUZ VALLEY 1947 - 1970

LINES OF EQUAL
CHANGE -25
(25 FOOT INTERVAL)

AGRICULTURAL ENGINEERING DEPARTMENT
UNIVERSITY OF ARIZONA



- COUNTY LINE
- RESERVATION NATIONAL FOREST, PARK, ETC. BOUNDARY
- LAND GRANT BOUNDARY
- TOWNSHIP RANGE SURVEY LINE
- SECTION QUARTER LINE
- ESTIMATED OR ASSUMED BURIED LINE
- INTERMITTENT STREAM
- STATE, FEDERAL, HIGHWAY
- INTERSTATE HIGHWAY
- OTHER STREETS AND ROADS
- CITY, TOWN, VILLAGE, SETTLEMENT
- CITY OF TUCSON NOT QUANTIFIED
- HARDROCK AND LOW-PERMEABILITY AREA



CORNADO NATIONAL

1976 CROP ACREAGE AND WATER PUMPED - SAHUARITA DISTRICT*

<u>CROP</u>	<u>ACRES</u>	<u>IRRIGATION WATER APPLIED (AC-FT/ACRE)</u>	<u>TOTAL (AC-FT)</u>
Cotton	897	3.5	3,140
Grain	1429	2.5	3,570
Sorghum	844	2.5	2,110
Pasture	45	4.0	180
Pecans	<u>5486</u>	3.5	<u>19,200</u>
Total Crop	8701**	3.2+	28,200**
Fallow	<u>386</u>	0	0
Total Acreage	9087	--	28,200

Total Water Application

* Courtesy of University of Arizona, Department of Soils, Water and Engineering.

** Equivalent to 3520 hectares and a water use of 34.8 million cubic meters for the year.

During the 1950's the City of Tucson began developing a well field in the Sahuarita area.^{3/} The altitude here is an advantage, because ground water pumped to the wellhead can flow northward by gravity to the City's storage reservoirs and distribution system. Nineteen wells eventually were developed in that region within the Sahuarita-Continental critical ground-water area in or northwest of the Sahuarita Bombing Range (see map). The combined pumping capacity of these wells was sufficient to provide about 6-7 percent of the City water requirements for a period of several years during the 1960's and early 1970's.

In 1969, however, a complaint was filed by Farmers Investment Company (FICO) against mining companies who had also begun to withdraw ground water from the Sahuarita area, and the City of Tucson became involved by intervention. The course of that legal action, and its long-range effects, will be described under "GROUND-WATER LITIGATION AND LEGISLATION."

USE OF WATER IN COPPER MINING-MILLING OPERATION

Geological and geophysical exploration during the 1950's disclosed the presence of large ore deposits in the Mission district south of Tucson, containing principally copper, molybdenum, and associated minerals. Large-scale mining and milling operations subsequently were developed by American Smelting and Refining Company, the Anaconda Company, Anamax Copper Mining Company, the Duval Corporation, Pima Mining Company, and others.

The Anamax Company, which began production in 1969, is an example of open-pit mining accompanied by the flotation and leaching processes of ore recovery and concentration. The open-pit mine, approaching 1,000 feet in depth in 1977, exposes both the sulfide and oxide copper-bearing zones, underlying several hundred feet of alluvial overburden. The sulfide mill, utilizing the flotation process, is the principal facility for concentrating the ore, having a capacity of 40,000 tons per day; it is also a principal point of water use. At full operation, the input water requirement would be approximately 15,000 acre-feet per year for this and all other water-using processes. Expressed in terms of unit water requirement for the mining-milling operation, the water input is approximately 350 gallons per ton of ore processed. The oxide ore is stockpiled and concentrated by an acid leaching process, with a capacity of about 10,000 tons per day.

During much of 1977 the actual rate of ore processing, using these two methods, was on the order of 30,000 tons per day in total; because of recent slack in the copper market and growth of stockpiled reserves, the current production rate at Anamax has been reduced to about 24,000 tons per day, and the input water needs are correspondingly less.

The water required is for milling; water storage (fire and mill emergency supply); conveyance of tailings; landscape watering and dust control (used oil is now being applied to roadways and workyards to reduce water use); and generation of electrical energy (more than half of the mine-mill power requirement is generated by a 50-megawatt plant fired by fuel oil and requiring about 500 acre-feet per year of cooling water). In addition, there are unavoidable evaporation and seepage losses at various points.

GROUND-WATER LITIGATION AND LEGISLATION

The legal consequences of these multiple uses of ground water arise from two principal points of contention--(1) continued and rapid overdraft or "mining" of the ground-water reservoir in the Santa Cruz Valley, and (2) the transport of ground water off the lands where it is pumped, and to points of use by the mines and the City outside the Sahuarita-Continental Critical ground-water district. Much of what the Courts have had to consider has revolved around interpretation of "reasonable use," in terms of transfer of the water from point of pumping to point of use.

The FICO Decision

Farmers Investment Company (FICO), the principal agricultural water-using interest in the Sahuarita-Continental area, filed a complaint in 1969 and an amended complaint in 1973 against certain mining companies which were pumping ground water from the valley to the mine-mill complex several miles upslope to the west. The City of Tucson, which also was pumping ground water near Sahuarita and conveying it to reservoirs some ten miles to the north, later became a party by intervention.

Several appeals in this action were consolidated, and the State Supreme Court in August 1976 presented a decision restraining the mining interests from transfer of water outside the critical area, and affirming an order preventing the City of Tucson from pumping and transporting water to outside areas of use, from wells completed after April 12, 1972.

State Legislation

In response to the FICO decision and for other purposes, a bill was passed by the Arizona Legislature in 1977 which provided that entities such as cities, towns, and industries could obtain a certificate of exemption and not be enjoined from transferring water to points within their service areas (contrary to the FICO ruling) provided further, however, that a party injured by such transfer shall be entitled to recover damages.

It is well recognized that this is not the ultimate answer to the transfer question, or to the needs for ground-water legislation in Arizona; the statute itself established a ground-water management study commission to make recommendations and prepare additional legislation.

The Papago Complaint

A portion of the Papago Indian Reservation, known as the San Xavier District, extends into the Santa Cruz Valley not far from the areas of ground-water pumpage and use just described. The Papago Indian Tribe contends that its ground-water resource is being diminished by adjacent pumpers, and in an effort to protect its remaining supply, has initiated litigation against the State of Arizona, City of Tucson, the mining and agricultural interests and all other non-Indians pumping ground water from the Santa Cruz Basin.

This action is significant, not only to this valley but on a much broader scale, because it is part of a program currently being pursued by the Indians and utilizing both litigation and legislation, to quantify and reserve Indian water rights, both surface and underground, based on the Winters or reserved rights doctrine. The attached statement by the Papago Tribal Chairman, Cecil Williams, illustrates some points of view adopted by the Indians in their advocacy of a new Federal policy on Indian water rights.

REFERENCES

1. Crouse, Cornelius W., Annual Reports of the Commissioner of Indian Affairs to the Secretary of the Interior for the Year 1892. (Excerpt from Letter of Mr. Crouse, p. 213).
2. Matlock, W.G. and P.R. Davis, Ground Water in the Santa Cruz Valley, Arizona, Agricultural Experiment Station Technical Bulletin 194, The University of Arizona, Tucson, 1972.
3. Schwalen, H.C. and R.J. Shaw, Ground Water Supplies of Santa Cruz Valley of Southern Arizona Between Rillito Station and the International Boundary, Agricultural Experiment Station Technical Bulletin 288, The University of Arizona, Tucson, 1957.