

EXPLANATION

As of July 1978

AREA FOR WHICH GROUND-WATER BASIC-DATA INVENTORY IS IN PROGRESS—As of July 1978 AREA FOR WHICH A REPORT IS IN PREPARATION—

AREA FOR WHICH A REPORT HAS BEEN RELEASED

- AREA BOUNDARY

---- WATER-PROVINCE BOUNDARY

STATUS OF GROUND-WATER INVENTORY

AREAS AND ABBREVIATIONS LSP = Lower San Pedro

AGF = Agua Fria basin ALT = Altar Valley basin LSC = Lower Santa Cruz ARA = Aravaipa Valley AVR = Avra Valley basin LVR = Lower Verde River BIC = Big Chino Valley BIS = Big Sandy Valley

MMU = McMullen Valley MNV = Monument Valley BWM = Bill Williams N-C = New River-Cave Creek BLM = Black Mesa BRB = Black River basin PSC = Peach Spring Canyon PRZ = Puerco-Zuni BOD = Bodaway Mesa RAN = Ranegras Plain BUT = Butler Valley

SAC = Sacramento Valley CDI = Canyon Diablo SAF = Safford basin CHV = Chevelon SRV = Salt River Valley CHN = Chinle COP = Coconino Plateau SBV = San Bernardino Valley SFP = San Francisco Peaks CHI = Colorado River, Hoover SFR = San Francisco River

Dam to Imperial Dam CON = Concho basin DOU = Douglas basin SSI = San Simon basin SSW = San Simon Wash DUN = Duncan basin SHV = Shivwits GIL = Gila Bend basin SNO = Snowflake GRD = Gila River drainage from Painted Rock STJ = St. Johns

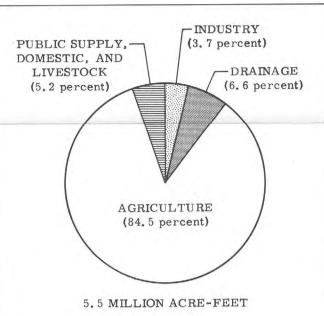
Dam to Texas Hill TON = Tonto basin GSK = Gila River from head TUB = Tuba City USR = Upper Salt River of San Carlos basin Reservoir to USP = Upper San Pedro Kelvin GTD = Gila River from Texas basin

Hill to Dome USC = Upper Santa Cruz GWA = Grand Wash VER = Upper Verde River HAR = Harquahala Plains VRG = Virgin River HAS = Hassayampa basin WAT = Waterman Wash HOL = Holbrook

WMD = Western Mexican HOP = Hopi drainage HOU = House Rock HUA = Hualapai Valley KAI = Kaibito WIL = Willcox basin KAN = Kanab

WHM = White Mountains WRB = White River basin WMN = Williamson Valley

LIC = Little Chino Valley LHA = Lower Hassayampa YUM = Yuma



ESTIMATED GROUND-WATER WITHDRAWAL

IN ARIZONA IN 1977

GWA COP PRZ CHV 19 NS STJ 36 MMU CHI 300 WAT) SAF 210 LSC 997 233 208 117 USC 269 75 DOU

EXPLANATION

ESTIMATED GROUND-WATER PUMPAGE, IN THOUSANDS OF ACRE-FEET

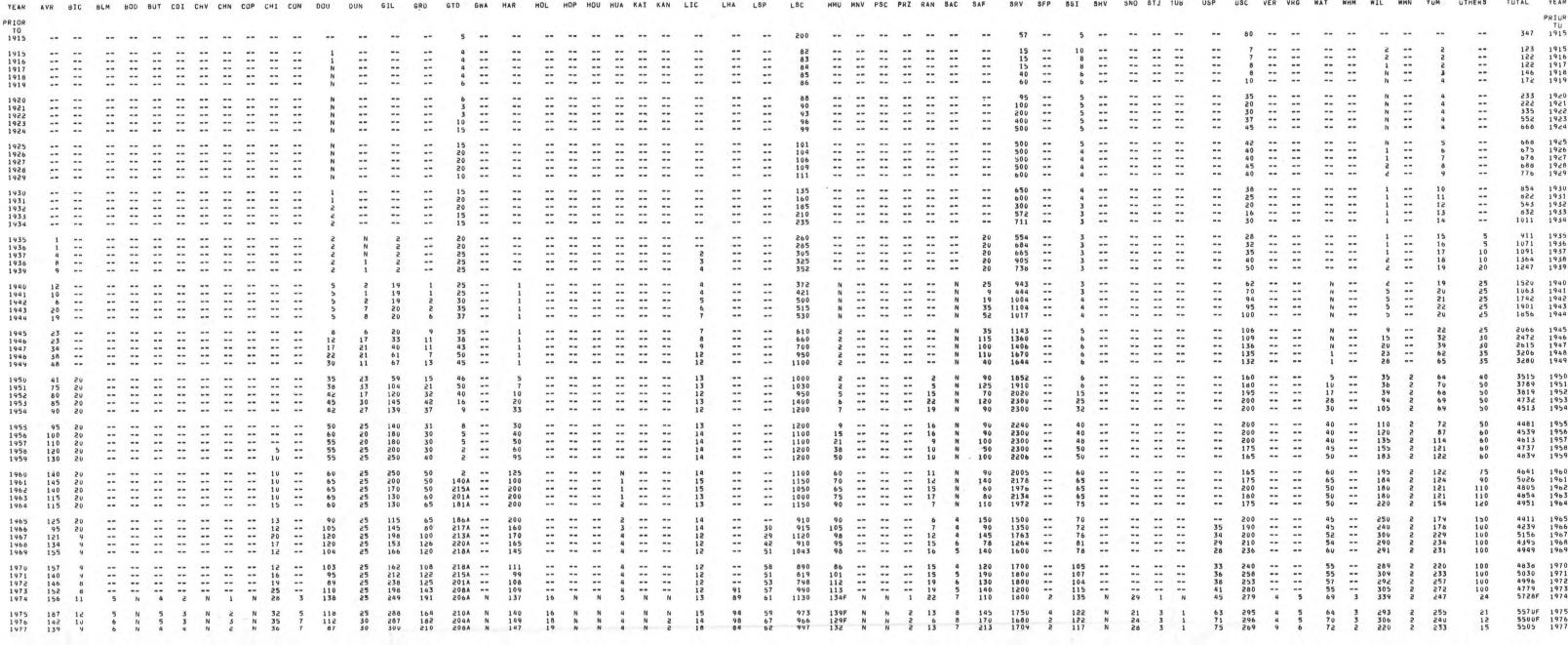
PUMPAGE LESS THAN 500 ACRE-FEET AREA BOUNDARY

■ ■ ■ ■ WATER-PROVINCE BOUNDARY

NOTE: In areas where no data are shown, the pumpage is mostly from domestic and stock wells, and the amount is unknown. The total pumpage in these areas is estimated to be about 15,000 acre-feet for 1977 (see table).

ESTIMATED GROUND-WATER PUMPAGE IN ARIZONA DURING 1977

ESTIMATED ANNUAL GROUND-WATER PUMPAGE, IN THOUSANDS OF ACRE-FEET, IN ARIZONA, BY AREA [NUMBERS ROUNDED TO NEAREST THOUSAND ACRE-FEET. AREA: AVR. SEE MAPS FOR LOCATION]



- EXPLANATION OF SYMBOLS N: PUMPAGE OF 500 ACRE-FEET OR LESS.
- A: WITHDRAWAL MOSTLY FOR DRAINAGE PURPOSES. B: PUMPAGE FOR THESE AREAS WAS NOT ESTIMATED PRIOR TO 1974. THUS, TOTAL IS FOR 1974-77 ONLY. ESTIMATED PUMPAGE BEFORE 1974 IS INCLUDED IN "OTHERS."
- C: PUMPAGE FOR LHA AREA WAS INCLUDED IN SRV AREA PRIOR TO 1973. THUS, TOTAL IS FOR 1973-77 ONLY. D: PUMPAGE FOR USP AND LSP AREAS WAS NOT ESTIMATED PRIOR TO 1966. THUS, TOTAL IS FOR 1966-77 ONLY. ESTIMATED PUMPAGE BEFORE 1966 IS INCLUDED IN "OTHERS."

803 5436 2382 4358

- E: YUM AREA INCLUDES SOUTH GILA VALLEY, YUMA MESA, AND YUMA VALLEY. BEGINNING IN 1947 IN YUMA VALLEY, IN 1961 IN SOUTH GILA VALLEY, AND IN 1970 IN YUMA MESA, PUMPAGE WAS FOR DRAINAGE OF WATERLOGGED LANDS.
- G: "OTHERS" INCLUDES: AGUA FRIA BASIN, ALTAR VALLEY, ARAVAIPA VALLEY, BIG SANDY VALLEY, BILL WILLIAMS, BLACK RIVER BASIN, GILA RIVER FROM HEAD OF SAN CARLOS RESERVOIR TO KELVIN, HASSAYAMPA BASIN, LOWER VERDE VALLEY, NEW RIVER-CAVE CREEK, SAN BERNARDINO VALLEY, SAN FRANCISCO RIVER BASIN, SAN SIMON WASH, TONTO BASIN, UPPER SALT RIVER BASIN, WESTERN MEXICAN DRAINAGE, AND WHITE RIVER BASIN. PUMPAGE IN THESE AREAS IS MOSTLY FROM DOMESTIC AND STOCK WELLS AND THE AMOUNT IS UNKNOWN. TOTAL ANNUAL PUMPAGE FOR THESE AREAS IS ESTIMATED.

Introduction

In arid and semiarid regions such as Arizona, the availability of adequate water supplies has an effect on the type and extent of economic development. The nature and extent of the ground-water reservoirs must be known for proper management of this valuable resource. Since 1939, the U.S. Geological Survey has conducted a program of groundwater studies in cooperation with the State of Arizona, which is represented by the Arizona Water Commission. The program includes the collection and analysis of the geologic and hydrologic data necessary to evaluate the ground-water resources of the State. The basic data collected, the results of areal studies, and research findings are presented mainly in publications of the U.S. Geological Survey, but some appear in technical journals and other publications. (See section entitled "Recent publications prepared by personnel of the U.S. Geological Survey in Arizona.")

In spring 1974 the U.S. Geological Survey in cooperation with the Arizona Water Commission revised the system of collecting ground-water data in Arizona. Under the revised system, several selected areas (see map showing status of ground-water inventory) are studied in detail each year. The types of data collected include information on wells drilled since previous inventories, water-level measurements, pumpage data, and chemical quality-of-water data. The data collected for an area are entered into computer storage, and computer printouts are available to the public. In areas where sufficient data are available the computer printouts consist of three parts: (1) spring and well information, including construction and production data; (2) chemical analyses of ground water; and (3) water-level measurements for the period of record. The data are analyzed, and the results are presented in a series of maps. Typically, the maps show depth to water; change in water levels; altitude of the water table; and quality-of-water data, such as specific conductance, dissolved solids, and fluoride.

Reporting of Data

For use of those readers who may prefer to use metric units rather than U.S. inchpound units, the conversion factors for the terms used in this report are listed below:

Multiply inch-pound unit To obtain metric unit inch (in.) 25.4 millimeter (mm) foot (ft) 0.3048 meter (m) gallon per minute (gal/min) liter per second (L/s) 0.06309 acre-foot (acre-ft) cubic hectometer (hm³) 0.001233

Availability and Use of Water

In Arizona the availability of adequate and potable water supplies has as great an influence on the location of cities and cropland as any other factor. Agriculture is dependent almost entirely on irrigation because rainfall is inadequate for raising crops. Some surface water is available in a few areas, but the amount is not sufficient to meet the continually increasing demand. For many years, nearly two-thirds of Arizona's water supply has been withdrawn from the ground-water reservoirs; the principal use of the ground water is for the irrigation of crops, although municipal and industrial uses are increasing steadily.

The map on sheet 2 shows potential well production, depth to water in selected wells in spring 1978, and change in water levels in selected wells from 1973 to 1978. The map showing estimated ground-water pumpage gives the amount of water pumped in 1977; the annual and accumulated pumpage since the beginning of record are shown in the table. In 1977 the withdrawal of ground water was about 5.5 million acre-ft. In the last 5 years the withdrawal of ground water has averaged 5.4 million acre-ft per year. About 4.7 million acre-ft of ground water was used for the irrigation of crops in 1977; the rest was for public supply, industrial, domestic, and livestock uses, and some ground water was pumped for drainage of waterlogged lands. Through 1977, nearly 171 million acre-ft of ground water had been withdrawn from the ground-water reservoirs in Arizona. In addition to the ground water pumped, about 2.6 million acre-ft of surface water was withdrawn for use in the State in 1977; about 1.8 million acre-ft of the water was consumptively used, and the rest was returned to the Colorado River. Thus, the total water use was about 7.3 million acre-ft in 1977. The use of ground water and the effects of this use on the groundwater reservoirs in each of the three water provinces (see map showing water provinces, sheet 2) are discussed separately in the following sections.

Basin and Range lowlands province. -- The Basin and Range lowlands province is the most highly developed of the three water provinces. Although the province covers only about 45 percent of the State, it contains more than 90 percent of the cultivated land and more than 80 percent of the population. The major ground-water reservoirs are mainly sedimentary

deposits in the central parts of the basins, but small supplies of water can be obtained locally from the crystalline and consolidated sedimentary rocks in the mountains that bound the basins. In 1977 about 5.4 million acre-ft of water was withdrawn in the province, of which nearly 4.6 million acre-ft was used for the irrigation of crops. Through 1977, slightly more than 167 million acre-ft of ground water had been withdrawn; as a result, water levels are declining in much of the province.

In the Basin and Range lowlands province precipitation for 1973-77 was about 16 percent below the long-term average. (See U.S. Environmental Data Service, 1973 (v. 77), 1974 (v. 78), 1975 (v. 79), 1976 (v. 80), 1977 (v. 81), Climatological data—annual summary—Arizona: National Oceanic and Atmospheric Administration, v. 77, no. 13, 18 p.; v. 78, no. 13, 18 p.; v. 79, no. 13, 18 p.; v. 80, no. 13, 19 p.; v. 81, no. 13, 19 p.) This trend was common in most of the Western United States, and severe drought conditions occurred in some areas. The effect of the below-average precipitation on the ground-water reservoir is not known precisely but probably was minimal—mainly because the effect of large-scale pumping outweighs the effect of deficient precipitation.

In the southeastern part of the province the pattern of deficient precipitation was broken during the large floods in early October 1977; floods in the San Pedro and Santa Cruz Rivers caused widespread damage. At the weather stations in the southeastern part of the province, the average precipitation was 3.11 in., which is 2.33 in. more than the long-term average for October. (See U.S. Environmental Data Service, 1977, Climatological data—annual summary—Arizona: National Oceanic and Atmospheric Administration, v. 81, no. 13, 19 p.) Above-average precipitation continued into March 1978. (See U.S. Environmental Data Service, 1978, Climatological data—January, February, March— Arizona: National Oceanic and Atmospheric Administration, v. 82, no. 1 (January, 22 p.), 2 (February, 22 p.), and 3 (March, 21 p.).)

In the upper San Pedro and upper Santa Cruz areas water levels measured in spring 1978 were slightly higher than those measured in spring 1977. In the upper San Pedro area the average water-level change in 21 wells was +1.5 ft. A rise in water levels in the upper San Pedro area is not unusual because the ground-water reservoir responds readily to intermittent flow in the San Pedro River. In the upper Santa Cruz area the average change in 36 wells was +0.4 ft for 1977-78. Water levels have been declining in the upper Santa Cruz for at least the last 10 years. The water-level rises probably were caused by abovenormal ground-water recharge and reduced pumpage for preirrigation owing to the aboveaverage precipitation in the fall and winter of 1977-78.

Central highlands province. -- The Central highlands province is the smallest of the three water provinces. In this province ground water is obtained from thick sedimentary deposits in a few areas, from thin sedimentary deposits along stream channels, and locally from fractured crystalline and consolidated sedimentary rocks that are the dominant rock types in the province. Only a few thousand acres of land is under cultivation, and the amount of ground water withdrawn is small—about 38,000 acre-ft in 1977. The small amount of ground-water withdrawal has not resulted in any notable water-level declines except in parts of Chino Valley, where a decline of a few feet per year has been measured in the artesian aquifer.

Plateau uplands province. -- In the Plateau uplands province ground-water development is small compared with that in the Basin and Range lowlands province, but it is somewhat greater than that in the Central highlands province. Most of the ground water is pumped from layered sandstone that stores ground water under both confined and unconfined conditions and from thin deposits of sediment along the major streams. The use of ground water is limited largely to scattered farms and homesites, industrial and utility sites, and a few population centers, such as Flagstaff, Holbrook, and the White Mountains recreational areas. In 1977 about 78,000 acre-ft of ground water was withdrawn in the province. For the most part, no pattern of rise or decline in water levels is discernible.

Recent Publications Prepared by Personnel of the U.S. Geological Survey in Arizona

The following reports on the water resources and geology of Arizona were published or released to the open file from July 1, 1977, through June 30, 1978.

Aldridge, B. N., 1978, Unusual hydraulic phenomena of flash floods in Arizona, in Proceedings of the Conference on flash floods—hydrometeorological aspects: American Meteorological Society Preprints, p. 117-120.

Babcock, H. M., 1977, Annual summary of ground-water conditions in Arizona, spring 1976 to spring 1977: U.S. Geological Survey Water-Resources Investigations 77-106,

Brown, D. E., Carmony, N. B., and Turner, R. M., 1978, Drainage map of Arizona showing perennial streams and some important wetlands: Arizona Game and Fish Department map, scale 1:1,000,000.

Hjalmarson, H. W., 1978, Delineation of flood hazards in the Cave Creek quadrangle, Maricopa County, Arizona: U.S. Geological Survey Miscellaneous Investigations Series Map I-843-B, 1 sheet.

7823 218 218 1335 118 5837

Jones, J. E., 1977, Calculation of evapotranspiration using color-infrared photography: U.S. Geological Survey Professional Paper 655-O, 45 p. Kirdar, Edib, Schumann, H. H., and Warskow, W. L., 1977, The application of aerial and satellite snow-mapping techniques for multi-purpose reservoir system operations

in Arizona, in Western Snow Conference, 45th, Albuquerque, New Mexico, 1977. Proceedings: Spokane, Washington, U.S. Soil Conservation Service, p. 95-101. Laney, R. L., 1976, Water-level declines, land subsidence, and earth fissures in south-

central Arizona, in Proceedings of the 20th annual Arizona watershed symposium: Arizona Water Commission Report 8, p. 30-39. Laney, R. L., Raymond, R. H., and Winikka, C. C., 1978, Maps showing water-level declines, land subsidence, and earth fissures in south-central Arizona: U.S.

Geological Survey Water-Resources Investigations 78-83, maps. Laney, R. L., Ross, P. P., and Littin, G. R., 1978, Maps showing ground-water conditions in the eastern part of the Salt River Valley area, Maricopa and Pinal Counties,

Arizona — 1976: U.S. Geological Survey Water-Resources Investigations 78-61, maps. Levings, G. W., 1977, Progress report on the Black Mesa, Arizona, ground-water monitoring program, in International Technical Conference on Slurry Transportation,

2d, Las Vegas, Nevada, 1977, Proceedings: Washington, D.C., Slurry Transport

Association, p. 94-96. Levings, G. W., and Farrar, C. D., 1978, Map showing ground-water conditions in the House Rock area, Coconino County, Arizona—1976: U.S. Geological Survey Water-

Resources Investigations 78-15, map. Mann, L. J., White, N. D., and Wilson, R. P., 1978, Maps showing ground-water conditions in the Willcox area, Cochise and Graham Counties, Arizona—1975: U.S.

Roeske, R. H., 1978, Areas subject to inundation by the 100-year flood in Avra Valley. Pima County, Arizona: U.S. Geological Survey Water-Resources Investigations 78-33, map.

Geological Survey Water-Resources Investigations 78-60, maps.

Ross, P. P., 1977, Arability map of the Tucson area, Arizona: U.S. Geological Survey Miscellaneous Investigations Series Map I-844-N, 1 sheet.

1977, Map showing ground-water conditions in the lower Verde River area, Maricopa, Yavapai, and Gila Counties, Arizona-1976: U.S. Geological Survey

Water-Resources Investigations 77-113, map. 1978, Maps showing ground-water conditions in the western part of the Salt

River Valley area, Maricopa County, Arizona—1977: U.S. Geological Survey Water-Resources Investigations 78-40, maps.

Thomsen, B. W., and Stulik, R. S., 1978, Hydrologic data for the Copper Basin area. a potential mining area in Yavapai County, Arizona: U.S. Geological Survey Open-File Report 78-413, 51 p.

U.S. Geological Survey, 1977, Activities of Water Resources Division in Arizona: U.S. Geological Survey duplicated report, 20 p.

1977, Water resources data for Arizona, water year 1976: U.S. Geological Survey Water-Data Report AZ-76-1, 674 p.

1977, Water-resources investigations in Arizona, 1977: U.S. Geological Survey folder.

1978, Progress report on Black Mesa monitoring program — 1977: U.S. Geological Survey Open-File Report 78-459, 38 p.

Wilkins, D. W., 1978, Maps showing ground-water conditions in the Yuma area, Yuma County, Arizona — 1975: U.S. Geological Survey Water-Resources Investigations 78-62, maps.

Winikka, C. C., Raymond, R. H., and Laney, R. L., 1978, Water-level declines for 1923-77, land subsidence for 1952-77, and earth fissures as of 1977 in south-central Arizona [abs.]: Geological Society of America Abstracts with programs, v. 10, no. 3, p. 154.