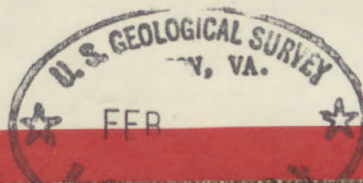
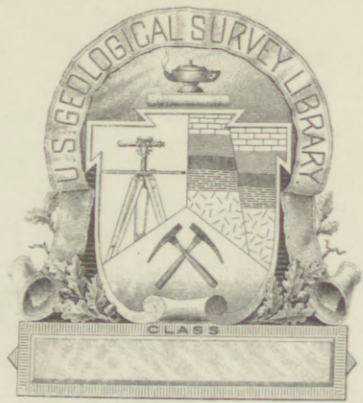


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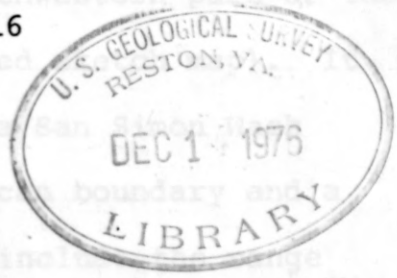
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Availability of ground water in the
Molenitus area, Papago Indian Reservation, Arizona, 1958

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By

L. A. Heindl

An investigation of the ground-water supply of the Papago Indian Reservation, Arizona, was made in 1958 by the U. S. Geological Survey, in cooperation with the Bureau of Indian Affairs as a part of the general Papago rehabilitation program. In connection with this investigation, the Bureau of Indian Affairs requested the U. S. Geological Survey to conduct a pumping test in the Molenitus area and to evaluate the possible effect of extensive ground-water pumpage for irrigation purposes on the ground-water resources of the area.

The Molenitus area is in the southwestern part of the Papago Indian Reservation (see attached sketch map). It includes about 100 square miles of the San Simon Wash drainage basin lying between the Mexican boundary and a series of discontinuous ranges which include the range southeast of Menager's Dam, the Mesquite Mountains, the low unnamed hills extending southeast of the Mesquite Mountains, and the north end of the La Lesna Mountains. The San Simon Wash drainage basin north of the Molenitus area extends from the northwest corner of the Papago Indian Reservation to the west front of the Baboquivari Mountains and includes about 2,000 square miles within the

Papago Indian Reservation. An additional area of about 300 square miles within the San Simon drainage basin lies in Mexico. The average gradient along San Simon Wash in the Molenitus area slopes southward about 7 feet per mile.

The hills along the margins of the Molenitus area are composed almost entirely of volcanic material and a few thin intercalated sedimentary beds. North of the Molenitus area, in the Kupk Hills and the north end of the Mesquite Mountains, there are areas of granitic and metamorphic rocks. The central part of the Molenitus area is partially filled with alluvial material whose total thickness is unknown but is locally more than 700 feet thick. In the two holes drilled for the pumping test in sec. 7, T. 19 S., R. 1 E., approximately 18 miles east of the southwest corner of the reservation, the gravel, sand, and silt encountered within the upper 200 feet includes fragments of granitic, metamorphic, and volcanic rocks. Between about 200 and 670 feet, the materials are predominantly fine sand, silt, and clay. From 670 to 718 feet the materials are pebble gravel, sand, and silt, and the gravel is predominantly of rhyolitic volcanic material.

The alinement of the hills between the Mesquite and La Lesna Mountains suggests that these hills are the exposed parts of a northwest-trending bedrock ridge. The deeper parts of the alluvium of the Molenitus area lie in a structural depression formed between this partially buried bedrock ridge and the volcanic range southeast of Menager's Dam. Alluvial deposits immediately underlying the surface

of the Molenitus area are continuous with those in the Komvo Valley to the north and the Great Plain to the east. The thickness of the alluvial deposits in passes between the hills separating the Molenitus area from the Komvo Valley and the Great Plain is not known, but in the vicinity of the southeastern tip of the Mesquite Mountains, fine-grained alluvial material is reported in well DW 31 to a depth of at least 312 feet.

Water-table altitudes in the San Simon Wash drainage basin indicate that the general movement of ground water into the Molenitus area is from the north and east, more or less paralleling the surface drainage. In the Molenitus area and to the immediate north, the water table slopes south and east at gradients of less than 5 feet per mile. Water-table contours are not shown because the paucity of data precludes sufficient control. The presence of ground water in the alluvium at well DW 31 suggests that ground water moves through alluvium between the southeastern tip of the Mesquite Mountains and the northwest end of the small hills forming the north boundary of the Molenitus area. Altitudes of the water table in the vicinity of the pumped well suggest there is movement of ground water into the area from the east.

A pumping test was conducted on the well located in sec. 7, T. 19 S., R. 1 E.; well DW 2 and the well 1,000 feet south of the pumped well were used as observation wells.

The pumped well is a churn-drilled hole, 715 feet deep, and has 20-inch casing to 624 feet. The casing was perforated from 208 to 613 feet with a Mills knife, with 10 one-half-inch by 4-inch cuts to the foot. A turbine pump with bowls set at 340 feet powered by a butane motor was installed for the test. DW 2 is an old drilled well reported to be 420 feet deep. The observation well 1,000 feet south of the pumped well is a rotary hole, 718 feet deep, with 5-inch casing to 350 feet and 3-inch casing from 360 to 718 feet and was perforated from 240 to the bottom of the hole. The observation well was cleaned by flushing it with clear water and bailing but was not pumped.

The pumped well was developed intermittently for a total of nearly 13 hours of pumping prior to the pumping test. During this time it discharged up to about 2,000 gpm (gallons per minute) with an average specific capacity of about 30 gallons per foot of drawdown.

During the test, the well was pumped at an average rate of about 1,350 gpm for 44 hours and 18 minutes, and the pumping test was stopped because of motor failure. The static water level in the pumped well is about 209 feet below the surface and the drawdown during the test was about 45 feet. The specific capacity of the well during the test is the same as that obtained during the preliminary pumping, about 30 gallons per foot of drawdown. The coefficient of transmissibility of the aquifer in the vicinity of the pumped well, based on data from the pumped well, is about 300,000 gpd (gallons per day). This indicates that the aquifer is capable of transmitting about

300,000 gpd at a gradient of 1 foot per foot per foot of lineal extent. The data from the observation wells in general substantiate the above estimate of the coefficient of transmissibility, but are inadequate to allow a quantitative estimate of the coefficient of storage or specific yield of the aquifer. At the end of the pumping test, the observation well showed drawdown of less than 1 foot and well DW 2, located about 5,700 feet from the pumped well, showed no drawdown.

The transmissibility of the aquifer in the vicinity of the pumped well compares favorably with those estimated in areas of extensive irrigation development in Pinal County and other irrigated areas in southern Arizona. The nature of the materials composing the aquifer, obtained from an examination of the drill-cutting samples, suggests that the coefficient of storage of this aquifer probably does not differ significantly from those in highly developed irrigated areas in southern Arizona.

The chemical quality of the water sampled during the pumping test has not yet been determined. Partial analyses made by commercial firms show calculated total dissolved solids ranging from 325 to 360 ppm (parts per million), with bicarbonate and carbonate combined and chloride as the predominant anions. The analysis by the Geological Survey made in 1954 of the water in well DW 2 shows a total of 327 ppm, composed predominantly of bicarbonate, sulfate, and chloride anions. The water from well DW 2

contains about 15 ppm of fluoride. The temperature of the water from the pumped well during pumping was about 114° F; that from well DW 2 is 116° F.

Pertinent facts regarding the hydrologic characteristics of the alluvium in the Molenitus area are summarized as follows:

1. The saturated part of the alluvium is more than 500 feet thick.
2. Ground water moves into the Molenitus area from the north and east from an alluvial basin about 2,000 square miles in area.
3. The gradients of the water table in the Molenitus area and its general vicinity are low, probably less than 5 feet per mile.
4. The depth to water in the vicinity of sec. 7, T. 19 S., R. 1 E., is about 210 feet and about 175 feet where San Simon Wash crosses the Mexican boundary.
5. The specific capacity of the pumped well in sec. 7, T. 19 S., R. 1 E., is about 30 gallons per foot of drawdown. The well yielded about 2,000 gpm for a short period and was pumped steadily for more than 44 hours at 1,350 gpm with a drawdown of about 45 feet.
6. The drawdown at the observation well 1,000 feet south of the pumped well after 44 hours of pumping was less than 1 foot. There was no drawdown recorded at the second observation well (DW 2) about 5,700 feet from the pumped well.

7. The coefficient of transmissibility in the vicinity of the pumping test is about 300,000 gpd per lineal foot under a hydraulic gradient of 1:1. The gradient in the area is probably less than 5 feet per mile.

8. The coefficient of storage is probably of about the same magnitude as that in extensively developed irrigated areas in southern Arizona, estimated to be between 10 and 20 percent.

9. The water is suitable for most irrigation purposes, but leaching may be required to prevent the accumulation of sodium carbonate. The high fluoride content may require treatment to meet Public Health standards for domestic use.

Conclusions regarding the ground-water potential and the effect of pumping for irrigation purposes in the Molenitus area are as follows:

1. Sufficient data for a long-term prognosis of the effects of extensive irrigation are lacking. The water table in the immediate vicinity of the irrigation wells will decline, but the rates of decline cannot be quantitatively predicted. In a general way, we believe they will be low to moderate, compared to the rates of decline in other heavily irrigated areas in southern Arizona. The effect of removal of ground water in the Molenitus area on stock and domestic wells beyond the Molenitus area will depend on the magnitude of ground water removed, but the resulting declines will probably be small to negligible in wells 5 miles and more away from the irrigated area.

2. It is estimated that within the Molenitus area, exclusive of recharge, there are about 500,000 acre-feet of ground water available from storage per 100-foot thickness of saturated sediment. The rate of movement of ground water into the area, in effect recharge, is slow and cannot be quantitatively estimated at this time; however it is believed that the amount would be small.

3. If the Molenitus area is opened for irrigation development, the following measures would provide data necessary for a more detailed evaluation of the ground-water resources in the basin:

- a. Drilling logs and drill-cutting samples should be obtained on all wells drilled.
- b. The water from all wells should be sampled and records kept on changes in chemical quality and temperature.
- c. Water levels in all irrigation wells should be recorded periodically.
- d. The observation well south of the pumped well in sec. 7, T. 19 S., R. 1 E., should be maintained as an observation well if it remains more or less within the area of irrigation development.
- e. The following locations outside the irrigated area are recommended for regular water-table fluctuation observation: (1) DW 31, to check the northward effect of pumping in the Molenitus

area; (2) one of the Toro wells 5 miles east of DW 2, to check on water-table fluctuations east of the pumped area; (3) DW 2; and (4) a well along the Mexican border south of the irrigated area to check on the effect of ground-water removal on the water table along the international boundary.

f. Complete discharge and power consumption records should be kept to serve as a basis of estimating the amount of ground water removed.

g. The effect of extensive ground-water removal for irrigation purposes should be re-evaluated following a limited period of development, possibly after 5 years.

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