DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUMMARY OF GROUND WATER SUPPLY CONDITIONS

FORT HUACHUCA, ARIZONA

JULY 1970

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

and several small cut-off walls and a transmission pipeline in Garden Canyon. An observation well located along Elevenmile Road about 1.3 miles northwest of Libby Field was proposed but not approved.

15. The Los Angeles District has prepared a long-range plan of study of ground water and surface water supplies at Fort Huachuca, including recommendations for observation and test wells. With the transfer of functions to the Sacramento District, it was decided to have an immediate study made to accomplish the following tasks.

a. Collection of available information on existing wells in the vicinity of the post wells to update the USGS Water Supply Paper.

b. Evaluation of information and of recommendations for geological investigation and for the construction of observation wells required to monitor the ground-water basin in the vicinity of the post wells.

c. Preparation of cost estimates for well construction.

d. Updating of the USGS ground-water contour map of 1963.

e. Preparation of a draft report, which is herein presented, to describe the findings and to serve as a basis for broader studies.

16. Geology and ground water. - A detailed description of geologic conditions in the Fort Huachuca area is contained in U.S. Geological Survey Water Supply Paper 1819-D. Much of the information contained in the following paragraphs was developed from that report and during discussions with S. G. Brown and E. S. Davidson of the U.S. Geological Survey in Tucson.

17. The aquifer in the Fort Huachuca area is made up of two geologic formations called the upper and lower units of basin fill by the USGS.

Information from well logs and a few outcrops indicate that the lower unit is a poorly sorted, mostly heterogeneous mixture of silt, sand, pebbles, cobbles and boulders as much as one foot in diameter. Bedding is lenticular to tabular and some layers show cross bedding. The unit is about 235 feet thick in the post well field and Sierra Vista area, and is thicker on the west side of the area in the vicinity of Lyle Canyon. Cementation is variable both vertically and laterally. The upper unit consists of weakly cemented, soft reddish brown clay, gravel, sand and silt. It grades from a very permeable alluvial fan gravel near the mouths of major streams along the Huachuca Mountains to relatively impermeable silt and limy clay containing a few sand-stone beds near the San Pedro River at Charleston. Both units have been tilted slightly, the lower unit as much as 20 degrees and the upper unit as much as 5 degrees. The lower unit is apparently cleaner and more permeable in the basin away from the mountain front and is the better water producer. However, the variation within the formation regarding particle size, sorting and degree of cementation results in a somewhat spotty aquifer that has fair to good permeability in one area or at one depth and only poor to fair permeability at another area or depth. The fan-gravel facies of the upper unit has good to very good permeability; the sand and silt facies farther out in the basin has fair to good permeability, and the silt and clay facies has poor permeability.

18. Terrace deposits and recent stream alluvium cover a large part of the present land surface. They are very permeable but relatively thin, and mostly above the ground-water table. They contribute to the ground-water resources

by providing open channels for surface water to infiltrate to the ground water reservoir.

19. The basin fill material is underlain by a brownish red to brownish gray conglomerate called the Pantano Formation. It consists of a mixture of volcanic, shale, limestone and quartzite fragments in a matrix of coarse to fine, dirty sandstone. It is moderately well cemented and appears to contain sufficient fines to make it tight. Some water may be transmitted through fractures in the upper part of the formation, but in general it is a poor water producer.

20. The Huachuca Mountains on the southwest boundary of the sub-basin are made up of a faulted complex of granite, limestone, conglomerate and claystone ranging in age from Pre-Cambrian to Cretaceous. The rocks are impermeable, and any water stored or transmitted is dependent on fractures or solution cavities. Inasmuch as the springs in the two major canyons have recently been developed to exploit their supplies of water, no further discussion of the mountains is considered necessary in this report.

21. Ground water relations. - One of the purposes of the present study is to update the USGS ground-water contour map of 1961. It was found that very few well owners have measuring devices installed in their water wells, and that measuring the water levels in most wells would require the removal of pumps. Therefore, to measure the water levels in a sufficient number of wells to produce a current contour map was beyond the scope of this study. Many well owners were contacted, however, and information was obtained where wells were recently constructed or where the well pumps had been pulled recently for servicing. The USGS has been measuring a large number of wells in the basin over a period of several years, and information on these was

obtained from them. The accompanying ground-water contour map is a composit of measurements taken mostly in 1968 and 1969. In some areas older readings were used to fill in blank areas. The map presents all the information that is available at the present time. In the Fort Huachuca-Sierra Vista area, the 1961 water contours are shown as dotted lines for comparison with the present interpretation.

22. A comparison of the USGS map compiled in 1961 and the accompanying map indicates that there is no general decline of the water level on a basin wide scale. In fact, the only area of any size that shows a definite decline is that surrounding the wells at Fort Huachuca and Sierra Vista. In the Huachuca City area there are not enough reliable data available for an evaluation of water levels. Water level readings indicate a decline of 3 feet in one well and 16 feet in another one since 1961. East of Huachuca City, water levels are about the same as 1961; in one well the water level is up 3 feet. In the area south and southeast of Sierra Vista the difference between the present ground-water map and the 1961 map is the result of new information from additional wells, which provides a better definition of the water surface in that area. Compared to the water levels read in 1961, recent measurements have varied only a few feet, up or down.

23. In the Fort Huachuca-Sierra Vista area, available data indicate a decline from 1961 to 1970 of about 12 feet in well 1a and of about 20 feet in well 4. Data on the other wells appeared to be conflicting and are not used. The indicated rates of decline are 1.3 and 2.2 feet per year, less than the 3 feet per year reported by the USGS for the period from 1959 to 1963. These data should be enlarged by systematic readings on the base wells, but they do indicate a continued decline due to over-pumping of the available ground

water by post wells and by private wells. The Fort Huachuca well field and the wells of Sierra Vista and the surrounding area are all drawing from the same body of ground water. Because of the concentration of wells, there is a mutual interference between the city wells and the post wells. This has been indicated by aquifer tests and has been confirmed by long term water level measurements. The result is that the post has only partial control over the problems in its own well field; as water use is increased in Sierra Vista because of growing population and business, the post well field will be adversely affected.

24. Selected areas of interest. - Several areas of interest are apparent on the ground water map, Fig. 1. In the north half of T.21S., R.20E., extending from Sierra Vista north to the Babocomari River, there are no wells except for those in the northwest corner near Huachuca City. This area was designated in the USGS Water Supply Paper 1819-D as the most favorable area withiln reasonable distance from the post, and the present report concurs. Water levels in adjacent wells (Fig. 1) suggest that the gound water surface has a gentle gradient sloping northeast. The flat gradient probably is related to higher than average permeability. The area is favorable for testing and is outside the area of drawdown around the post well field.

25. The area within the reservation boundary north and northwest of Libby Field also has no wells and the shape of the ground water contours is not known. Observation wells are needed both as a guide for future test wells and to monitor the water table as it may be affected by natural changes, surface water diversion, or pumping of new wells.

26. The area south of Sierra Vista and below the mouth of Garden Canyon lacks wells, except for those recently drilled at the mouth of the canyon. Observation or test wells are needed here for the same reasons as stated in paragraph 25. Most of the currently diverted surface water comes from Garden Canyon, and monitor wells for information on possible effects on ground water are needed.

27. In the west half of T.22S., R.21E., about 4 miles southeast of Sierra Vista and outside the reservation boundary, the 4200 foot water contour projects northeastward toward the San Pedro River. This indicates that the water table probably is nearly flat, and the area is favorable for water exploration. The area, however, is not far from the group of private wells east of Sierra Vista and may be affected by further private development.

28. Well drilling methods. - Most of the wells in this part of Arizona are reported to have been drilled by cable tool (churn drill); in this method casing is driven down as the hole is drilled. A casing diameter of 16 inches is common for a production well. An estimate obtained in 1970 from a contractor in Bisbee, Arizona for a 16-inch churn drill hole, 800 feet deep, was $26,200 for the well and $7,600 for development and testing. These figures are without overhead, inspection, or contingency. A well of this size can be fully tested, and put into production if it pans out. A small-diameter observation hole, however, will not accomodate a test pump at the depths required in this area.

29. The other major drilling method uses a rotary bit, and drilling mud is used instead of casing to keep the hole open. If there are no rigs of this type operating in the area, contractors from outside the area can be interested in bidding on a drilling job. Because a casing is not used initially, an electric log of the hole can be made. Electric logs of test or production wells are desirable, especially in new areas. Small-diameter holes can either be cased, or reamed to a larger diameter for test or production casing. Judging from recent contracts for wells drilled with rotary rigs in central California, the direct cost for a small-diameter (6 or 8 inch) observation hole would be about $12,500. The direct cost for a 16-inch production well would be about $35,000, or approximately the same as for a comparable churn-drill well.

30. Summary and conclusions. - The conclusions drawn from the present study are summarized in the following items.

a. The geologic and hydrologic relations indicate that the ground water in the subject area is all part of the same hydraulic system, which largely represents water storage, and is recharged by insoak that probably is a small part of the surface runoff.

b. The ground water in the area of the post well field is overdrawn, and a large cone of depression has been formed in the water table. Water levels in the area of influence (a radius of 1 to 2 miles) have continued to decline and will continue until and unless pumping is reduced. The private wells in the Sierra Vista area interact with the post well field in forming the cone of depression of the ground water table. There is no control over the rate of pumping nor over the drilling of new wells in the privately owned area.

c. Contributions of water from the canyon developments and from reclaimed sewage are significant but not of major size. Most of the post supply will necessarily come from wells, unless water becomes available from Charleston Reservoir or other sources.

d. Increasing the pumping capacity in or near the post well field will aggravate the problem of declining water levels. The water requirements for the base should not be increased until new sources of water have been put on line to lower the pumping rate from the existing well field, and to furnish reserve pumping capacity.

e. Additional production wells should be sought in undeveloped areas of interest. The primary area of interest within the Reservation is north of Sierra Vista.

f. Water level data are lacking in the areas north and northwest of Sierra Vista and south of Sierra Vista. Observation holes or test wells are needed to determine the shape of the gound water surface and to provide information for further exploration.

31. Recommendations. - Because of the critical situation in the existing well field, and the reported interest in increasing the water demand, it is recommended that the following needs should be fulfilled concurrently.

a. A full-size test well is recommended at the approximate location shown on Fig. 1, in sec. 15, T.21S., R.20E. This well should be fully developed and tested. An electric log is desirable and it is recommended that a rotary rig be specified.

b. Approximately six small-diameter observation holes are recommended, the first one to be drilled in sec. 9, T.21S., R.20E., the second to be drilled north of Libby Field, in the approximate area already recommended by the Los Angeles District, as shown on Fig. 1. Other holes should be located as new information indicates.

c. When a well capable of production is developed, it is recommended that connection to the post system be made as soon as possible to relieve the overdraft on the existing well field.

d. All wells should be fitted with openings suitable for insertion of a water level probe. All pumped wells should have an airline, carefully installed. An adequate water-level measuring device with a probe should be used consistently. Water levels should be measured monthly. Procedures for measurement and recording should be standarized.

e. The total cost including overhead for a large-diameter test well and approximately 6 small-diameter observation holes is estimated as $125,000.