United States
Department of the Interior
Geological Survey

Letter regarding a further investigation to determine the possibilities of an additional water supply for the Army Air Force Flexible Gunnery School near Kingman, Arizona

By

S. F. Turner

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Tucson, Arizona
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408 N. Fourth Avenue
Tucson, Arizona

July 30, 1943

The District Engineer
U. S. Army Engineer Office
751 S. Figueroa Street
Los Angeles, California

Dear Sir:

In accordance with a telephone request from Mr. C. F. Hostrup of your office, S. F. Turner of the Geological Survey was flown to Kingman in an Army plane and made an investigation to determine the possibility of additional water for the enlargement of the AAF Flexible Gunnery School. For data on the present system you are referred to a previous report on this area by Turner and Poland, and a report by F. B. Stillman of the Salt Lake City Office of the Army Engineers.

Since the previous report was submitted there have been several new developments. Well No. 3, recommended in the previous report, was drilled to a depth of 375 feet. The only water encountered was at a shallow depth and the total production about 15 gallons a minute. Drilling was temporarily abandoned and the drill rig moved to No. 4 site selected by Messrs. Jorgenson and Stillman of the Army Engineers. No. 4 was located near a 6-inch test well put down by a mining company exploring for gold. The well had been tested with air lift and produced about 50 gallons a minute. Well No. 4 has been completed at a depth of 187 feet, all of the water being found above 135 feet. From 135 feet to 187 feet the well was drilled in hard gray basalt which resembled the basalt encountered in well 3. A pump will be installed on this new well as soon as it is received but in the meantime air lift is being used.

As soon as a suitable churn drill or spudder rig can be obtained, additional wells will probably be drilled at the locations of the dug shaft and diamond drill hole located about 6,500 feet westerly from Army No. 1 well. C. F. Hostrup and R. R. Wilson of the Army Engineers examined the sites of these two wells. The difference in water level elevations in the dug shaft and in the diamond drill hole together with evidence of cross faulting indicates that these two wells are probably in different basins and therefore it would be worth drilling a well at each site if additional water is needed at the present camp before a new supply is developed.

The geology of the volcanics is much more complicated than first supposed. B. D. Jorgenson located a fault that seals the water off from the prospective well site near the 400,000-gallon storage

tank. Therefore this site should not be drilled. However, well 3 is in a good location along this fault line. It is as close to the fault line as the present producing wells farther up Johnson Wash.

Turner and Wilson located a cross fault directly west of the 400,000-gallon tank that may account in part for the failure of the well at Lang Spring. There is evidence to indicate that there is considerable other cross faulting in the area. Additional well sites cannot be selected without detailed geology. It is, however, recommended that if additional water is needed from the volcanics after the shallow wells at the diamond drill hole and dug shaft are completed, well No. 3 should be drilled to the pre-Cambrian.

It is believed that the total supply available from the volcanics is insufficient for any enlargement of the Post although by careful work a supply sufficient for the present Post might be obtained. Therefore, other sources were inspected during this trip. The Colorado River at Lake Meade has been suggested as a source and this may be the final source selected although the development of water from this source would be very costly. It will require a 55-mile pipeline and approximately 2,100 feet of lift making the operation very expensive. The Round Valley area in the Big Sandy was inspected but the supply in this area is probably not sufficient for much enlargement at the Post and the pipeline would be almost as expensive as that to the Colorado River.

Ever since the time of the first investigation the writer has been thinking about the Hackberry Wash or Truxton Wash area as a source if additional water was needed at the airfield. Therefore, this area was investigated in the field and a well site selected. A map accompanying this report shows the approximate outlines of the drainage area of Hackberry Wash above the well site. This map is not very accurate but indicates that the drainage area is about 450 square miles. The average rainfall over the drainage area ranges from 10 to 20 inches a year, varying with the elevation. Many large floods have occurred on this wash. In 1904 a flood with a peak of approximately 49,000 second-feet washed out the railroad in several places. There was continuous flood flow in the wash during the month of August of that year. Newspaper items have described destructive floods in this wash in 1939 and 1940 to the writer's knowledge. The well site selected lies in a down-faulted area southwest of the Grand Wash Cliffs fault zone. According to reconnaissance reports covering this fault zone, the total throw on the fault zone ranges from a minimum of about 1,000 feet to a maximum of several thousand feet. Movement occurred along the fault as late as the Pleistocene times. The large wash flowing into this area together with steep gradients caused by the faulting should certainly cause the deposition of very coarse materials in the area selected. The rather large yield of the shallow wells in the wash fill above the town of Hackberry indicates that the material in the wash is quite permeable. The quality of the water in this area indicates that the water at the proposed well site will probably be quite hard but not heavily mineralized.

Because no wells have ever been drilled in the area below the town of Hackberry and because of the urgent need for speed in the development of a new supply, it was felt that it would be worthwhile to run geophysical tests of the area. Therefore, the Los Angeles District Office was requested to ask Mr. Poland of the Survey's Long Beach office to bring a resistivity outfit to Kingman. In order for us to have a needed assistant and extra transportation for the geophysical work, Mr. E. M. Cushing brought a Survey car to Kingman from the Tucson office and assisted in all of the geophysical work. Five probes were made in the Hackberry Wash area.

The locations of each test are shown on the accompanying map and are marked A to E., A being the site recommended for the test well. The exact location of each test is described on the accompanying illustration showing the results of the tests at each site. This geophysical work is still in the research stage and the results cannot be interpreted with certainty. The potentiometer used was not sensitive enough to give good results below 600 feet and this fact probably accounts for the scattering of the points below 600 feet. The extreme dryness of the soil in the area made it extremely difficult to obtain good contact with the ground. Holes had to be dug at each point on the traverse and these holes filled with water and let stand for an hour or so to obtain good contact. This also may account for some of the irregularities.

The graphs at A and D are discussed together since D was put in as a check on A. Both graphs show that the resistance increases down to 250 feet but below that point is almost constant. This suggests that the water level is between 250 and 300 feet. The slight amount of decrease in resistance suggests the water is lightly mineralized and in fairly coarse sand or gravel. Both graphs show an increase in resistance at 400 feet suggesting coarser material at this depth. The increase in resistance below 900 feet suggests rock of some kind but the data at that depth are not good enough to make predictions.

The curve at B suggests the water level is about 225 feet and this is logical since the surface elevation is lower than at A. The curve at C indicates water at a little more than 100 feet but this must be perched water caused by recharge from the bed of the wash as the surface elevation is not much less than that at A. The curve at E indicates water at 150 to 200 feet and again at 250 and 300 feet. Point E is located near the wash and the upper water level may be caused by recharge like that in C or the drop in resistance might be caused by a bed of finer material between 150 to 250 feet.

The large amount of resistance shown by the curves at depths considered below the water level indicates coarse materials. A comparison with the curve shown for Yucca shows the low resistance for fine materials indicated by the logs of the railroad well at Yucca.

The curves for many other localities in the Arizona desert are shown in a confidential report by H. V. Peterson. Not one of these curves shows as high a resistance below the water level as the sites in the Hackberry Wash area.

Recommendations:

The well at site A in Hackberry Wash should be drilled to a depth of 1,000 feet if bedrock is not encountered above that depth. A test pump should be installed of sufficient capacity to thoroughly test the maximum discharge available from the well. An airline should be installed to measure the water level during the test. The static level should be recorded at the start of the test. The pumping level should be measured at short time intervals at the start and longer intervals after the drawdown has reached approximate equilibrium. The following time intervals are suggested: 2, 5, 10, 20, 40, and 60 minutes, 1½, 2, 2½, 3, 4, 6, 8 hours and from then on 2 to 4 times a day. The above schedule is for pumping at a constant rate. If the rate is increased, the above schedule should be repeated. The time pumping is started and the time of any change in pumping rate should be carefully recorded in order to be able to compute the total gallons pumped from the well during the test. If the well is shut down during the test and at the close of the test, the water level should be measured on the above time scale for at least 3 days and probably longer. From the above data it will be possible to make some estimate of the capacity of the ground-water basin. If this estimate is sufficiently encouraging, two other wells should be drilled at approximately one-half mile intervals toward E or on a line N 29° W from A. Thus the third well would be near E. When these wells are completed a pumping test can be made using Thiem's method and a better estimate made of the capacity of the basin. For preliminary guidance it may be stated that the supply will probably be satisfactory if the production of the well at A is 800 to 1,000 gallons a minute with not more than 50 feet of drawdown.

Well sites at Yucca:

Turner and Wilson spent July 17 investigating the area near Yucca. At present the water supply for the airfield at Yucca is obtained from wells belonging to the Santa Fe Railroad at Yucca Station. Complete data on the three wells belonging to the railroad are available in the Los Angeles District office.

Well 1, 982 feet deep, 6¼ inch casing - In 1933 was producing 55 gallons a minute.

Well 2, 1,004 feet deep, 10 inches in diameter - In 1932 was producing 125 gallons a minute.

Well 3, 787 feet deep, 12 inches in diameter - In 1932 was producing 120 gallons a minute.

Log of well 3 shows that the material is fine grained and that most of the gravel is cemented. Wells 1 and 2 encountered lava or malapai in the bottom of the wells. The water level is now reported at 300 feet in the railroad well but Darton[1] reports that previous to 1915 the water in well 2 rose within 104 feet of the surface.

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1 Darton, N. H., Guidebook of the Western United States, Part C. The Santa Fe Route., U. S. Geol. Survey Bull. 613, p. 142, 1915.

The investigation showed that the area of valley fill in Sacramento Wash Valley is rather narrow. High lava hills are located 1½ miles west of Yucca and pre-Cambrian rocks are exposed near the edge of the pediment about 3 miles west of Yucca (see accompanying map). It is believed that sufficient water for the field can be obtained from two wells in the valley fill put down to bedrock providing the depth to bedrock is more than 700 feet.

In order to ascertain, if possible, the depth of bedrock a geophysical test was made at site F about 1,200 feet north-northwest of the present elevated tank at the airfield. The graph of this test is shown on the illustration with the graphs of the Hackberry Wash tests. This graph indicates that the water level is slightly more than 200 feet below the surface and that the water is mineralized or that the materials are very fine grained as the resistance is low. Since we know from the analysis of the water at Yucca that the water is probably not highly mineralized, it is concluded that the water-bearing material is fairly fine grained. There is some indication of a coarser bed at 650 feet as shown by the increased resistance at that point. Or this increased resistance may be caused by a lava bed.

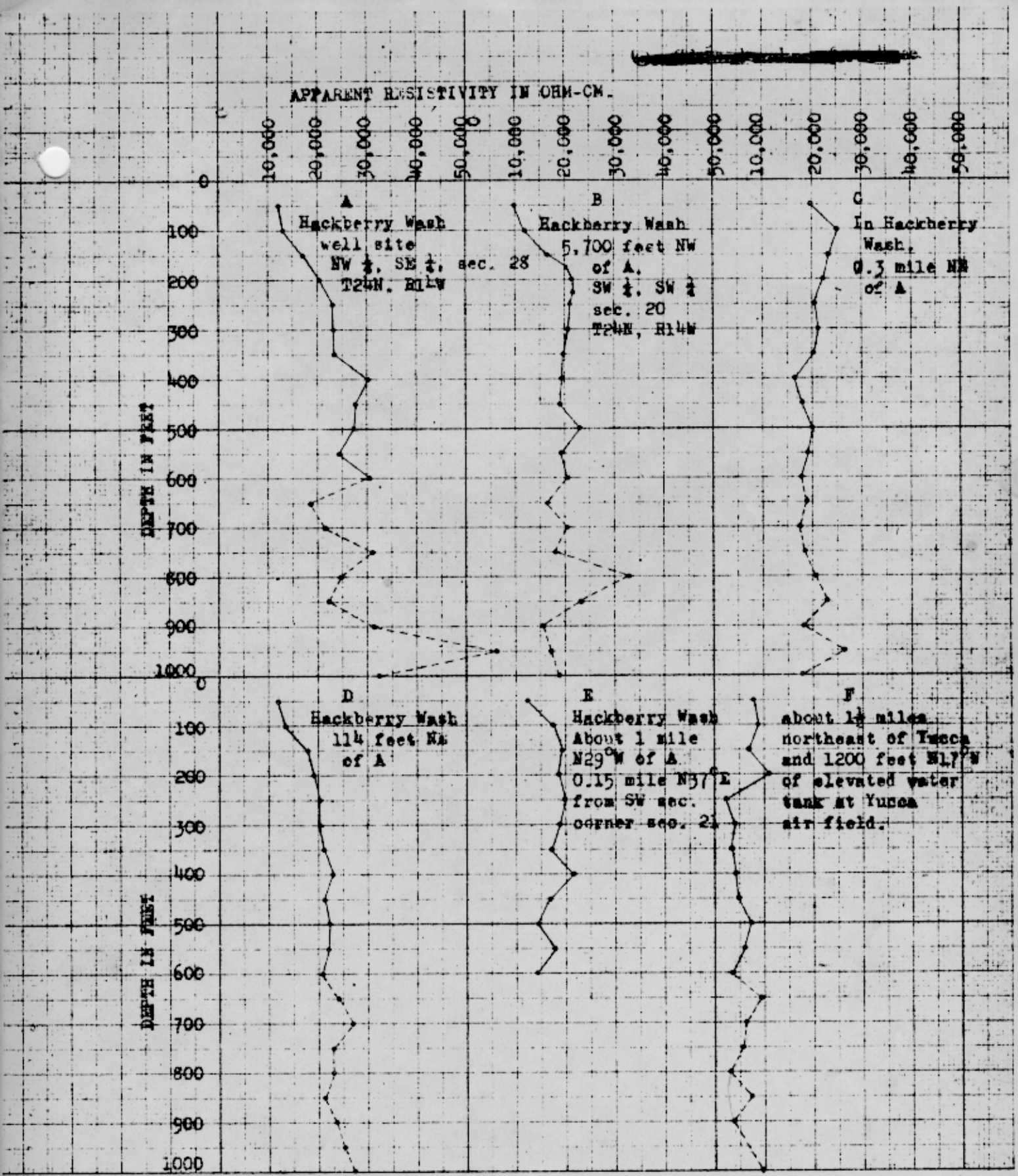
The surface elevation at F is considerably higher than the surface elevation at the railroad wells and thus the depth to water of slightly more than 200 feet is a check on Darton's statement of 104 feet at the railroad wells. It is probable that the steady pumping at the railroad station has lowered the water level during recent years.

It is recommended that the first well be put down at site F and if this well does not supply sufficient water, the next test be put in the northwest corner of the airfield at site G. Since site G is nearer a creek flowing out of the Hualpai Mountains to the east, somewhat coarser materials should be encountered at this point. The same records should be kept of pumping tests on these wells as recommended for the wells in Hackberry Wash.

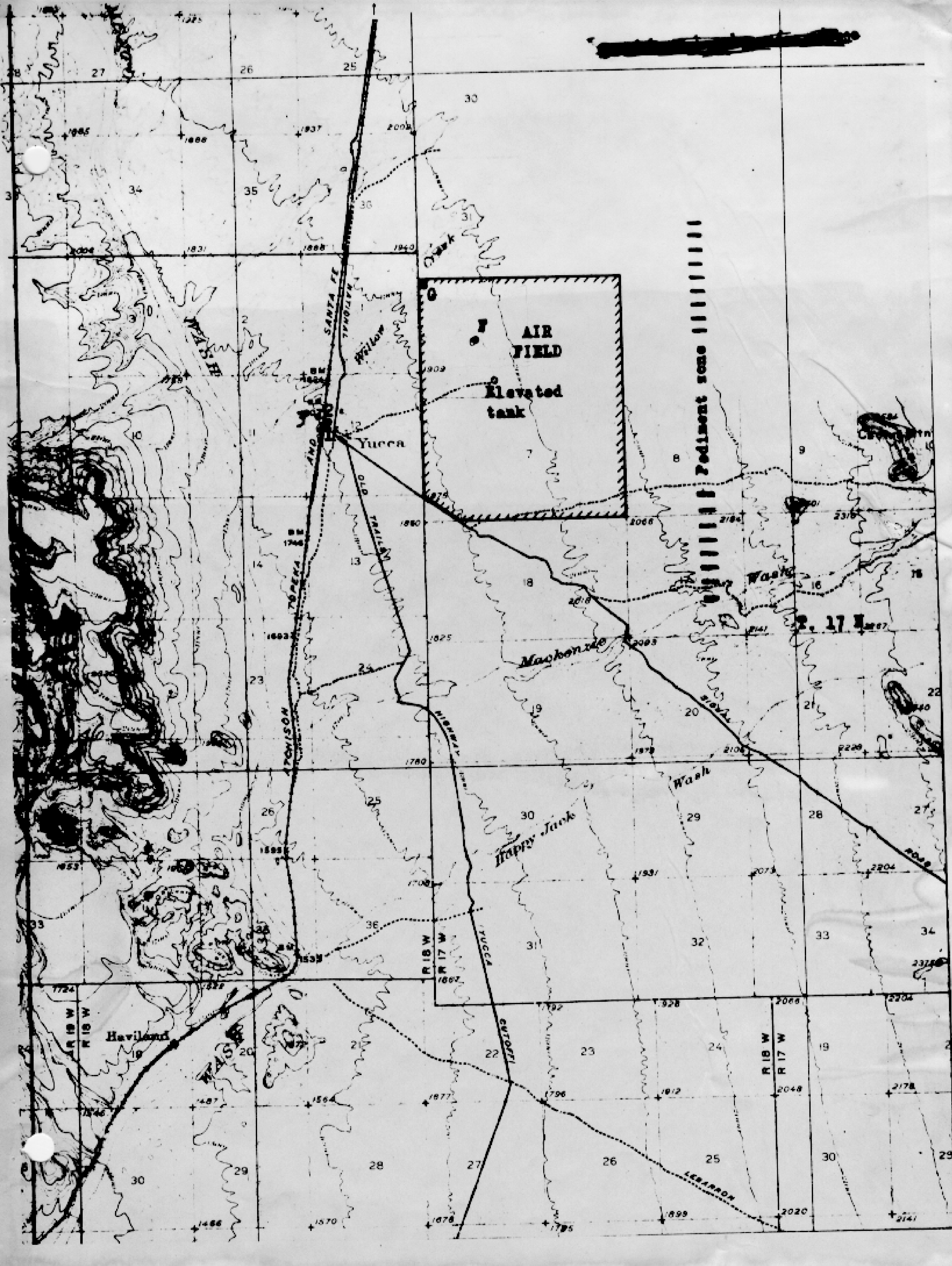
Respectfully submitted,

Samuel F. Turner
Hydraulic Engineer

SFT/ms



CURVES SHOWING APPARENT RESISTIVITY IN HACKBERRY WASH AND YUCCA AREAS
NEAR KINGMAN, ARIZONA.
U. S. Geological Survey. July 1943.



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AIR
FIELD
Elevated
tank
Yucca
Pediment zone
Willow
Creek
SANTA FE
ATCHISON
TOPEKA
OLD TRAILS
HIGHWAY
YUCCA
CUTOFF
Happy Jack
Wash
Mackenzie
Haviland
WASH
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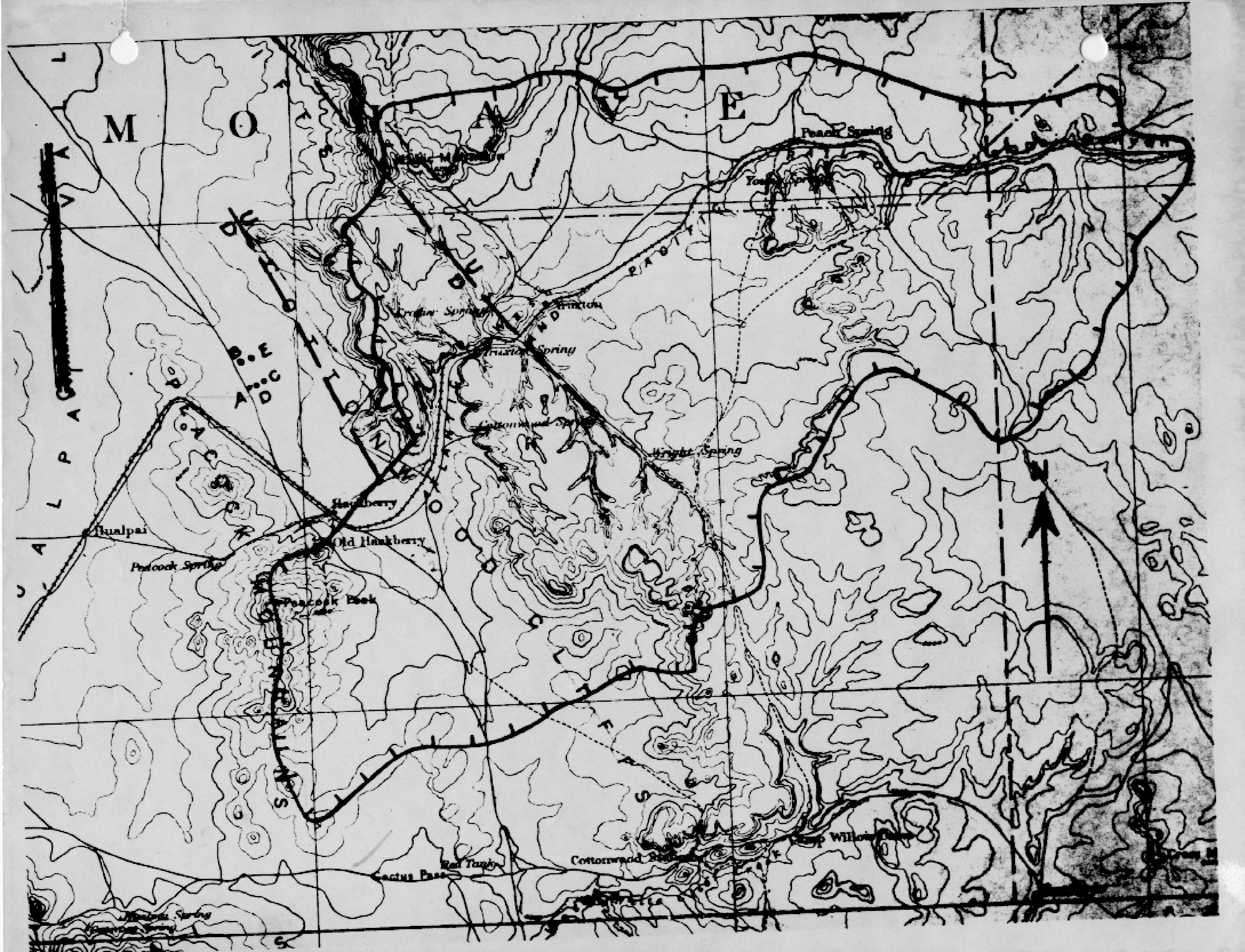

M O
E
Peach Spring
Crozier Spring
Truxton
Truxton Spring
Cottonwood Spring
Wright Spring
Hackberry
Old Hackberry
Hualpai
Peacock Spring
Peacock Peak
Cottonwood
Red Tank
Cactus Pass