UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Ground Water Branch

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# GROUND-WATER CONDITIONS DURING 1959

# AT THE MARINE CORPS BASE,

# TWENTYNINE PALMS, CALIFORNIA

By

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the Department of the Navy

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# GROUND-WATER CONDITIONS DURING 1959 AT THE MARINE CORPS BASE, TWENTYNINE PALMS, CALIFORNIA

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## SUMMARY AND CONCLUSIONS

The entire water supply for the Marine Corps Base, Twentynine Palms, Calif., is ground water pumped from wells at the Base. Because recharge to the ground-water supply is very small it is necessary to maintain constant surveillance of the amount and quality of the water in storage. For this purpose the Geological Survey, at the request of the Navy, has been making a continuing study since 1953. The results of the 1959 studies are reported below:

1. During the period July 1958 through June 1959 there were no significant changes in the geologic and hydrologic conditions at the Base. Pumpage from the ground-water supply was 1,940 acre-feet.

2. The records of water levels in wells indicate that the slow decline of water level observed during previous years continued during 1959, but the total usable ground water in storage remains large. A water shortage owing to depleted ground-water storage at the Base is not expected in the foreseeable future.

3. Insofar as can be determined by records of water levels in wells, the Marine Corps pumpage has not had any deleterious effect on the water supply of Mesquite basin from which a number of local residents obtain their water supply.

4. The yield and condition of the existing supply wells remain good.

5. No significant deterioration or change in the quality of the ground water occurred during 1959; however, the dissolved solids and fluoride content of ground water from Mesquite and Deadman basins continue to be marginal and thus for the Base supply it will be necessary to continue to blend these waters with the better quality water from Surprise Spring basin.

# INTRODUCTION

## Location and Extent of the Area

The Marine Corps Base area described in this report covers about 500 square miles in the southern part of the Mojave Desert region between long 116°00' and 116°30' W. and lat 34°05' and 34°30' N. The headquarters is only about 6 miles north of Twentynine Palms, which is a small desert community on the Twentynine Palms Highway about 150 miles east of Los Angeles (fig. 1).

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Figure 1. Map of part of southern California showing area covered by this report.

## Purpose and Scope of the Continuing Program and Report

The entire water supply for the Marine Corps Base is ground water pumped from wells at the Base. The wells penetrate alluvial deposits that contain relatively large quantities of potable ground water. However, recharge to the ground-water basins is very small and the ground water in storage is reduced each year, virtually by the amount pumped. Water of inferior quality, having a high fluoride content, occurs locally in some of the ground-water basins. For efficient use of the entire supply it is necessary to blend waters from two or more sources. Because of the depletion of ground water in storage and the local water-quality problems, the Navy desires to maintain a continuing inventory of the ground-water supply. Therefore, in 1953 the Navy requested that the Geological Survey continue the studies begun in the area before the facilities at the Base were constructed. Accordingly, the objectives of the continuing investigations are:

1. Keep the Navy and Marine Corps advised of all geologic and hydrologic conditions affecting the water supply of the Base.

2. Maintain a continuing record of the effect, or lack of effect, of pumping on water levels in Mesquite basin near Twentynine Palms, where there are ground-water withdrawals by local residents as well as by the Navy.

3. Continue periodic water-level measurements and operate water-level recorders in observation wells in Surprise Spring, Deadman, and Mesquite basins to determine the effect of pumping on storage in the basins and to obtain necessary data on spacing of any new supply wells that might be drilled.

4. Continue periodic measurements of static and pumping levels in the supply wells to ascertain their condition with regard to supply for the Base.

5. Collect periodic water samples from supply wells to determine whether any significant or critical changes in the quality of water are occurring, particularly with respect to the fluoride content.

6. Continue as technical adviser on ground-water problems and water-supply development at the Marine Corps Base.

7. Present a brief report after July 1, 1959, including the findings of 1 through 6 above; a summary of ground-water pumpage for Base supply by basins; and a tabulation of the basic geologic, hydrologic, and chemical data collected during the year.

This report on ground-water conditions at the Marine Corps Base, Twentynine Palms, Calif., during 1959 (July 1, 1958, to June 30, 1959) is the sixth continuing report prepared by the Geological Survey.

This investigation was made by the U. S. Department of the Interior, Geological Survey, under the direction of H. D. Wilson, Jr., district engineer in charge of ground-water investigations in California; and under the immediate supervision of Fred Kunkel, geologist in charge of the Long Beach subdistrict office.

## Well-Numbering System

The well-numbering system used in the Marine Corps Base, Twentynine Palms, Calif., investigation conforms to that used in virtually all ground-water investigations made by the Geological Survey in California since 1940. It has been adopted as official by the California Department of Water Resources and by the California Water Pollution Control Board for use throughout the state.

The wells are assigned numbers according to their locations in the rectangular system for the subdivision of public land. For example, in the number 2N/7-3B1 (fig. 2), which was assigned to supply well 2A

Figure 2. Map of the Twentynine Palms basin, California.

in Surprise Spring basin, the part of the number preceding the slash indicates the township (T. 2 N.), the part between the slash and the hyphen is the range (R. 7 E.), the number between the hyphen and the letter indicates the section (sec. 3), and the letter indicates the 40-acre subdivision of the section according to the system shown in the accompanying diagram.

| | | | |
|---|---|---|---|
| D | C | B | A |
| E | F | G | H |
| M | L | K | J |
| N | P | Q | R |

Within each 40-acre tract the wells are numbered serially as indicated by the final digit. Thus, well 2N/7-3B1 is the first well to be listed in the NW¼NE¼ sec. 3. Because all the Base is east of the San Bernardino meridian, but extends north and south of the San Bernardino base line, the township-location letter, N or S, is indicated preceding the slash and the range-location letter, E or W, is omitted.

## SUMMARY OF TECHNICAL ADVICE GIVEN DURING 1959

As a part of the continuing program for 1959, the Geological Survey furnished technical advice on water-supply problems at the Marine Corps Base, as follows:

1. During the year, measurements of water levels in about 24 wells were supplied each month to Headquarters, U. S. Marine Corps, and to the Commanding General, Marine Corps Base, Twentynine Palms, Calif., to provide information on the status of ground-water conditions in the pumped basins.

2. Several informal meetings were held during the year with representatives of the Base Maintenance Office concerning various aspects of the Base water supply.

## GROUND-WATER CONDITIONS THROUGH JUNE 1959

### Pumpage from Base Supply Wells

During the period July 1958 through June 1959, flowmeters on the supply wells were inoperative. However, pumpage was estimated by the Navy on the basis of the total time each pump was operated and the yields of the wells. The estimated monthly pumpage from the individual supply wells and monthly and annual total pumpage from all wells are given in table 1. To show the distribution of pumpage graphically, annual totals for the period 1954-59 are plotted in bar-graph form on figure 3. Furthermore, to show the relation between pumpage and fluctuations of water levels in the wells, the average monthly pumpage from supply wells 1A, 2A, and 3A are shown on figures 6, 4, and 5, respectively, together with the hydrographs of these and other wells.

Table 1.--Estimated monthly pumpage, in acre-feet,[1/] from Navy supply wells, 1958-59[2/]

| Year and month | Deadman basin | Surprise Spring basin | | | Mesquite basin | Total |
|---|---|---|---|---|---|---|
| | SW 1A | SW 2A | SW 3A | Subtotal | SW 2 | |
| 1958 | | | | | | |
| July | 105 | 85 | 60 | 145 | 17 | 265 |
| August | 85 | 90 | 60 | 150 | 14 | 250 |
| September | 70 | 65 | 95 | 160 | 3 | 235 |
| October | 50 | 85 | 65 | 150 | 0 | 200 |
| November | 25 | 55 | 35 | 90 | 0 | 115 |
| December | 25 | 40 | 35 | 75 | 1 | 100 |
| 1959 | | | | | | |
| January | 20 | 35 | 45 | 80 | 1 | 100 |
| February | 15 | 45 | 35 | 80 | 0 | 95 |
| March | 25 | 40 | 40 | 80 | 3 | 110 |
| April | 25 | 60 | 50 | 110 | 3 | 140 |
| May | 20 | 55 | 55 | 110 | 13 | 145 |
| June | 30 | 75 | 55 | 130 | 22 | 180 |
| Total | 495 | 730 | 630 | 1,360 | 80 | 1,935 |
| Percent | 26 | 38 | 32 | 70 | 4 | 100 |

1. One acre-foot equals 325,851 gallons.

2. Estimates in gallons per month supplied by U. S. Navy and rounded to nearest 5 acre-feet by Geological Survey, except for SW 2 which is rounded to nearest acre-foot.

The estimated total pumpage from the four supply wells during the year ending June 1959 was slightly more than 1,900 acre-feet (table 1 and fig. 3), an increase of only about 100 acre-feet over that pumped

Figure 3. Annual pumpage from Navy supply wells.

in 1958. Of the total pumpage, about 1,360 acre-feet, or 70 percent, was derived from Surprise Spring basin (about 730 acre-feet, or 38 percent, from supply well 2A, and about 630 acre-feet, or 32 percent, from supply well 3A); nearly 500 acre-feet, or 26 percent, was derived from Deadman basin (supply well 1A); and about 80 acre-feet, or only 4 percent, was derived from Mesquite basin (old Navy supply well 2). Pumping from the four wells varied considerably throughout the year.

Table 1 shows that the maximum monthly pumpage occurred in July 1958, and was about 265 acre-feet, or an average of nearly 2.8 million gallons per day. The minimum occurred in February 1959, and was about 95 acre-feet, or an average of about 1.1 million gallons per day. The average daily pumpage for the year was about 5.5 acre-feet, or more than 1.7 million gallons.

## Yield and Condition of Supply Wells

The specific capacity of a well is the discharge of the well, in gallons per minute, divided by the drawdown of the water level in the well, in feet, after an extended pumping period. A pumping period of 48 hours is commonly used for comparing the specific capacities of individual wells. A decrease in specific capacity is the first indication of most of the mechanical difficulties that may affect a high-capacity well. Accumulations of sand in a well or clogging of the perforations, for example, are certain to cause a decrease in specific capacity. The Geological Survey has been making periodic measurements of the specific capacities of supply wells 1A, 2A, and 3A in order to check on their physical condition.

During 1959, when flowmeters on the supply wells were inoperative and the discharge could not be determined accurately, no measurements of specific capacity were made. However, on the basis of estimates of discharge and measurements of pumping levels in the wells, it appears that all the supply wells remained in good condition during the year.

## Water-Level Fluctuations

During the period July 1958 through June 1959, periodic measurements of water levels were made in 26 wells; automatic water-level recorders were operated on 3 of these wells. The periodic water-level measurements are presented in table 2. For convenience of reference, a cross index of U. S. Navy well numbers and U. S. Geological Survey well numbers is included as table 3. Water-level fluctuations in representative wells in Surprise Spring, Deadman, and Mesquite basins are depicted by hydrographs on figures 4, 5, 6, and 7.

Table 2.--Records of water levels in wells, Twentynine Palms basin, California

(Water levels are in feet below land-surface datum)

1N/8-1R1. Moyer. Altitude 1,903 ft.

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| July 14, 1958 | 125.07 | Nov. 6, 1958 | 125.07 | Mar. 11, 1959 | 125.03 |
| Aug. 12 | 125.05 | Dec. 4 | 125.08 | Apr. 7 | 125.01 |
| Sept. 11 | 125.10 | Jan. 6, 1959 | 125.04 | May 11 | 125.05 |
| Oct. 7 | 125.08 | Feb. 6 | 125.04 | June 10 | 125.08 |

1N/8-12G1. W. Hockett. Depth 420 ft. Altitude 1,972.7 ft.

| | | | | | |
|---|---|---|---|---|---|
| July 14, 1958 | 196.93 | Jan. 6, 1959 | 196.96 | Apr. 7, 1959 | 196.92 |
| Aug. 12 | 196.94 | Feb. 6 | 196.97 | | |
| Nov. 6 | 196.94 | Mar. 11 | 196.93 | | |

1N/9-4R1 (Old SW 1). U. S. Navy. Depth 500 ft. Altitude 1,736.8 ft.

| | | | | | |
|---|---|---|---|---|---|
| July 14, 1958 | 13.40 | Nov. 6, 1958 | 12.99 | Mar. 11, 1959 | 12.89 |
| Aug. 12 | 13.02 | Dec. 4 | 12.92 | Apr. 7 | 12.89 |
| Sept. 11 | 12.97 | Jan. 6, 1959 | 12.89 | May 11 | 12.97 |
| Oct. 7 | 12.97 | Feb. 6 | 12.89 | June 10 | 13.04 |

1N/9-5G1 (Old SW 2). U. S. Navy. Depth 500 ft. Altitude 1,779.2 ft.

| | | | | | |
|---|---|---|---|---|---|
| Aug. 12, 1958 | 5.32 | Dec. 4, 1958 | 5.73 | Apr. 7, 1959 | 5.20 |
| Sept. 11 | 5.22 | Jan. 6, 1959 | 5.21 | May 11 | 5.27 |
| Oct. 7 | 5.22 | Feb. 6 | 5.38 | June 10 | 5.58 |
| Nov. 6 | 5.25 | Mar. 11 | 5.34 | | |

1N/9-5Q2. W. Singleton. Depth 148 ft. Altitude 1,801 ft.

| | | | | | |
|---|---|---|---|---|---|
| July 14, 1958 | 28.74 | Nov. 6, 1958 | 28.87 | Mar. 11, 1959 | 28.55 |
| Aug. 12 | 28.86 | Dec. 4 | 28.74 | Apr. 7 | 28.48 |
| Sept. 11 | 28.87 | Jan. 6, 1959 | 28.63 | May 11 | 28.61 |
| Oct. 7 | 28.88 | Feb. 6 | 28.57 | June 10 | 28.73 |

1N/9-5R1. M. Elliott. Depth 93.8 ft. Altitude 1,788.8 ft.

| | | | | | |
|---|---|---|---|---|---|
| July 14, 1958 | 19.23 | Dec. 4, 1958 | 19.55 | Apr. 7, 1959 | 19.32 |
| Sept. 11 | 19.36 | Jan. 6, 1959 | 19.54 | May 11 | 19.30 |
| Oct. 7 | 19.42 | Feb. 6 | 18.49 | June 10 | Well obstructed |
| Nov. 6 | 19.50 | Mar. 11 | 19.38 | | |

Table 2.--Records of water levels in wells, Twentynine Palms basin, California--Continued

1N/9-7H1. Paul Carson. Depth 110 ft. Altitude 1,843.3 ft.

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| July 14, 1958 | 69.39 | Nov. 6, 1958 | 69.36 | Mar. 11, 1959 | 69.35 |
| Aug. 12 | 69.40 | Dec. 4 | 69.36 | Apr. 7 | 69.33 |
| Sept. 11 | a69.68 | Jan. 6, 1959 | 69.34 | May 11 | 69.36 |
| Oct. 7 | 69.39 | Feb. 6 | 69.32 | June 10 | a69.47 |

1N/9-9M2. O. Taylor. Depth 61.5 ft. Altitude 1,810.0 ft.

| | | | | | |
|---|---|---|---|---|---|
| July 14, 1958 | 38.02 | Nov. 6, 1958 | 37.97 | Mar. 11, 1959 | 37.91 |
| Aug. 12 | 38.05 | Dec. 4 | 37.93 | Apr. 7 | 37.77 |
| Sept. 11 | 37.95 | Jan. 6, 1959 | 37.82 | May 11 | 37.87 |
| Oct. 7 | 38.01 | Feb. 6 | 37.92 | June 10 | 38.06 |

1N/9-16D1. Whited. Depth 96 ft. Altitude 1,812.9 ft.

| | | | | | |
|---|---|---|---|---|---|
| July 14, 1958 | 40.09 | Nov. 6, 1958 | a47.25 | Mar. 11, 1959 | 39.95 |
| Aug. 12 | 40.41 | Dec. 4 | 39.96 | Apr. 7 | 39.74 |
| Sept. 11 | a50.70 | Jan. 6, 1959 | 39.98 | May 11 | a55.24 |
| Oct. 7 | 41.36 | Feb. 6 | 39.90 | June 10 | 40.04 |

1N/9-16R3. G. Michells. Depth 153.9 ft. Altitude 1,777 ft.

| | | | | | |
|---|---|---|---|---|---|
| July 14, 1958 | 11.13 | Nov. 6, 1958 | b11.78 | Mar. 11, 1959 | 12.02 |
| Aug. 12 | 11.33 | Dec. 4 | b12.70 | Apr. 7 | 11.85 |
| Sept. 11 | 11.23 | Jan. 6, 1959 | 11.82 | May 11 | 11.82 |
| Oct. 7 | 11.28 | Feb. 6 | 12.23 | June 10 | 11.76 |

1N/9-17E1. Barry. Depth 133 ft. Altitude 1,882.7 ft.

| | | | | | |
|---|---|---|---|---|---|
| July 14, 1958 | 108.05 | Nov. 6, 1958 | 108.06 | Mar. 11, 1959 | 108.00 |
| Aug. 12 | 108.07 | Dec. 4 | 108.03 | Apr. 7 | 107.99 |
| Sept. 11 | 108.05 | Jan. 6, 1959 | 108.00 | May 11 | 108.04 |
| Oct. 7 | 108.06 | Feb. 6 | 107.99 | June 10 | 108.07 |

2N/7-2C1 (TW 5). U. S. Navy. Depth 400 ft. Altitude 2,272.1 ft.

| | | | | | |
|---|---|---|---|---|---|
| July 15, 1958 | 37.97 | Nov. 6, 1958 | 39.05 | Mar. 12, 1959 | 38.73 |
| Aug. 12 | c38.40 | Dec. 4 | c38.54 | Apr. 7 | c38.94 |
| Sept. 11 | 38.74 | Jan. 6, 1959 | 38.30 | May 11 | 39.51 |
| Oct. 8 | c38.97 | Feb. 6 | 38.74 | June 10 | 39.81 |

a. Well being pumped.
b. Well pumped recently.
c. Nearby well being pumped.

2N/7-3A1 (SW 3A). U. S. Navy. Depth 560 ft. Altitude 2,300.9 ft.

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| July 14, 1958 | 67.66 | Jan. 6, 1959 | 68.69 | May 11,1959 | c70.94 |
| Aug. 12 | b70.19 | Feb. 6 | b70.00 | June 10 | b70.31 |
| Oct. 8 | 69.66 | Mar. 12 | 68.44 | | |

2N/7-3B1 (SW 2A). U. S. Navy. Depth 700 ft. Altitude 2,355.8 ft.

| | | | | | |
|---|---|---|---|---|---|
| July 14, 1958 | 113.16 | Jan. 6, 1959 | 113.39 | Mar. 12, 1959 | b116.06 |
| Dec. 4 | c114.60 | Feb. 6 | 114.14 | Apr. 7 | 114.42 |

2N/7-4M1 (TW 12). U. S. Navy. Depth 500.0 ft. Altitude 2,442.2 ft.

| | | | | | |
|---|---|---|---|---|---|
| July 14, 1958 | 190.62 | Nov. 6, 1958 | 190.82 | Mar. 12, 1959 | 191.07 |
| Aug. 12 | 190.66 | Dec. 4 | 190.77 | Apr. 7 | 191.08 |
| Sept. 11 | 190.74 | Jan. 6, 1959 | 191.00 | May 11 | 191.19 |
| Oct. 8 | 190.78 | Feb. 6 | 190.97 | June 10 | 191.18 |

2N/7-14K1 (TW 11). U. S. Navy. Depth 644.0 ft. Altitude 2,532.1 ft. Oct. 8, 1958, 336.98; Apr. 7, 1959, 336.89.

2N/8-24H1 (TW 1). U. S. Navy. Depth 320.0 ft. Altitude 1,856.2 ft.

| | | | | | |
|---|---|---|---|---|---|
| July 14, 1958 | 81.01 | Nov. 6, 1958 | 81.06 | Apr. 7, 1959 | a86.67 |
| Aug. 12 | 81.02 | Dec. 4 | 80.98 | May 11 | 81.06 |
| Sept. 11 | 80.60 | Jan. 6, 1959 | 81.01 | June 10 | a85.39 |
| Oct. 8 | 81.07 | Mar. 12 | 81.03 | | |

2N/8-26J1. S. Stubbs. Depth 185 ft. Altitude 1,938 ft.

| | | | | | |
|---|---|---|---|---|---|
| July 14, 1958 | 156.48 | Jan. 6, 1959 | 156.25 | May 11,1959 | 156.26 |
| Aug. 12 | 156.28 | Feb. 6 | 156.1 | June 10 | b162.64 |
| Oct. 8 | 156.36 | Mar. 11 | b159.21 | | |
| Nov. 6 | 158.05 | Apr. 7 | 157.37 | | |

2N/9-30P2. Emery Ball. Depth 55.8 ft. Altitude 1,790 ft.

| | | | | | |
|---|---|---|---|---|---|
| July 14, 1958 | 28.13 | Nov. 6, 1958 | 28.58 | Apr. 7, 1959 | 27.81 |
| Aug. 12 | 28.30 | Jan. 6, 1959 | 28.21 | May 11 | 27.99 |
| Sept. 11 | 28.45 | Feb. 6 | 28.01 | June 10 | 28.19 |
| Oct. 8 | 28.55 | Mar. 11 | 27.89 | | |

3N/7-18D1 (TW 6). U. S. Navy. Depth 449 ft. Altitude 2,403.7 ft. Oct. 8, 1958, 146.83.

3N/7-31E1 (TW 9). U. S. Navy. Depth 430.0 ft. Altitude 2,514.3 ft. Oct. 8, 1958, 249.86.

a. Well being pumped.
b. Well pumped recently.
c. Nearby well being pumped.

3N/7-35F1. U. S. Navy. Altitude 2,284.5 ft.

| Date | Water level | Date | Water level | Date | Water level |
|---|---|---|---|---|---|
| July 14, 1958 | 9.81 | Nov. 6, 1958 | c10.75 | Mar. 12, 1959 | 10.56 |
| Aug. 12 | c10.07 | Dec. 4 | 10.35 | Apr. 7 | 10.72 |
| Sept. 11 | 10.40 | Jan. 6, 1959 | 10.24 | May 11 | 11.19 |
| Oct. 8 | c10.64 | Feb. 6 | 10.58 | June 10 | 11.47 |

3N/8-17L1 (TW 3). U. S. Navy. Depth 512.0 ft. Altitude 1,850.4 ft. July 14, 1958, 47.60; Nov. 6, 47.72.

3N/8-29C1 (TW 8). U. S. Navy. Depth 800.0 ft. Altitude 1,890.9 ft.

| | | | | | |
|---|---|---|---|---|---|
| July 14, 1958 | c89.07 | Nov. 6, 1958 | 88.86 | Mar. 12, 1959 | 88.80 |
| Aug. 12 | 88.99 | Dec. 4 | 88.79 | Apr. 7 | 88.89 |
| Sept. 11 | 88.91 | Jan. 6, 1959 | 88.85 | May 11 | 89.02 |
| Oct. 8 | 88.92 | Feb. 6 | 88.93 | June 10 | 88.96 |

3N/8-29L1 (SW 1A). U. S. Navy. Depth 600.0 ft. Altitude 1,905.7 ft.

| | | | | | |
|---|---|---|---|---|---|
| Aug. 12, 1958 | b104.58 | Dec. 4, 1958 | 103.30 | May 11, 1959 | b106.53 |
| Oct. 8 | 103.47 | Jan. 6, 1959 | 103.38 | June 10 | 103.41 |
| Nov. 6 | 103.36 | Apr. 7 | 103.42 | | |

3N/8-33B1 (TW 2). U. S. Navy. Depth 526.0 ft. Altitude 1,845.7 ft.

| | | | | | |
|---|---|---|---|---|---|
| July 14, 1958 | 43.76 | Nov. 6, 1958 | 43.91 | Mar. 12, 1959 | 43.94 |
| Aug. 12 | 43.87 | Dec. 4 | 43.91 | Apr. 7 | 43.93 |
| Sept. 11 | 43.88 | Jan. 6, 1959 | 43.93 | May 11 | 43.97 |
| Oct. 8 | 43.90 | Feb. 6 | 43.92 | June 10 | 43.96 |

b. Well pumped recently.
c. Nearby well being pumped.

Table 3.--Cross index of U. S. Navy well numbers and U. S. Geological Survey well numbers

| U. S. Navy number[1] | USGS number | Ground-water basin |
|---|---|---|
| Supply wells: | | |
| SW 1 | 1N/9- 4M1 | Mesquite |
| SW 2 | 1N/9- 5G1 | Do. |
| SW 3 | 3N/8-34D1 | Deadman |
| SW 1A | 3N/8-29L1 | Deadman |
| SW 2A | 2N/7- 3B1 | Surprise Spring |
| SW 3A | 2N/7- 3A1 | Do. |
| Test wells: | | |
| TW 1 | 2N/8-24M1 | Mesquite |
| TW 2 | 3N/8-33B1 | Deadman |
| TW 3 | 3N/8-17L1 | Do. |
| TW 5 | 2N/7- 2C1 | Surprise Spring |
| TW 6 | 3N/7-18D1 | Do. |
| TW 8 | 3N/8-29C1 | Deadman |
| TW 9 | 3N/7-31E1 | Surprise Spring |
| TW 10 | 3N/7-13M1 | Deadman |
| TW 11 | 2N/7-14K1 | Unnamed |
| TW 12 | 2N/7- 4M1 | Surprise Spring |

| USGS number | U. S. Navy number[1] | Ground-water basin |
|---|---|---|
| 1N/9- 4M1 | SW 1 | Mesquite |
| 5G1 | SW 2 | Do. |
| 2N/7- 2C1 | TW 5 | Surprise Spring |
| 3A1 | SW 3A | Do. |
| 3B1 | SW 2A | Do. |
| 4M1 | TW 12 | Do. |
| 14K1 | TW 11 | Unnamed |
| 2N/8-24M1 | TW 1 | Mesquite |
| 3N/7-13M1 | TW 10 | Deadman |
| 18D1 | TW 6 | Surprise Spring |
| 31E1 | TW 9 | Do. |
| 3N/8-17L1 | TW 3 | Deadman |
| 29C1 | TW 8 | Do. |
| 29L1 | SW 1A | Do. |
| 33B1 | TW 2 | Do. |
| 34D1 | SW 3 | Do. |

1. TW, test well; SW, supply well.

In the year ending June 1959, pumping from supply wells 2A and 3A continued to cause a decline of water levels in the vicinity of Surprise Spring. The hydrographs of supply well 2A and test well 12 are shown on figure 4, and the hydrographs of supply well 3A and test well 5 are

Figure 4. Hydrographs of supply well 2A and test well 12.

shown on figure 5. This report discusses principally the longer term

Figure 5. Hydrographs of supply well 3A and test well 5.

trends that have occurred to date.

Pumping at supply wells 2A and 3A continued through the year at an average rate of nearly 57 acre-feet per month per well, or only about 2 acre-feet more per month than during the previous year. The rate of water-level decline remained about the same, as is shown by the hydrographs for wells 2A and 3A (figs. 4 and 5). If the average monthly pumping rate during 1959 is continued during future years, the rate of water-level decline at the wells will decrease gradually, provided that as water levels are drawn down the local barriers (fig. 2) do not cut off the source of supply.

In Deadman basin the only significant water-level fluctuations occurred in the eastern part of the basin where supply well 1A is located. The fluctuations in this area are shown on figure 6 by the

Figure 6. Hydrographs of supply well 1A and test wells 2 and 8.

hydrographs of supply well 1A (3N/8-29Q1) and test wells 2 (3N/8-33B1) and 8 (3N/8-29C1).

Since May 1957 there has been considerable pumping from supply well 1A (fig.6) and the hydrographs at the end of June 1959 show declines in water levels of about 1.4 feet since November 1952 at supply well 1A and about 1.5 feet since July 1952 at test well 8 (fig.6). This downward trend is expected to continue as pumping from supply well 1A continues.

By about August 1958 the altitude of the water level at test well 8 (3N/8-29C1) had declined to almost the same level as that in test well 2 (3N/8-33B1) where the rate of water-level decline through 1959 has been very small. The altitude of the water surface in both wells remained about the same during the entire year. The water-level measurements for test well 2, therefore, plot in nearly the same places on the graph as do those for test well 8. For this reason, the hydrograph for test well 2 was not plotted on figure 6 for the period July 1958 through June 1959.

During 1959 supply well 1A was pumped at an average rate of about 41 acre-feet per month, or at a rate of about 4 acre-feet per month more than during 1958, and about 34 acre-feet per month more than during 1957. As a result of increased pumping, the rate of water-level decline increased, as is shown by the hydrographs for supply well 1A and test well 8 (fig. 6).

Monthly water-level measurements are made in 13 observation wells in Mesquite basin to determine whether pumping old Navy supply well 2 and Navy wells in the other basins is causing any decline in water levels in domestic wells. Figure 7 shows hydrographs for five selected

Figure 7. Hydrographs of five wells in Mesquite basin and graph of pumpage from old Navy wells 1 and 2.

wells whose fluctuations are representative of the basin.

From May 1952 to June 1959 shallow well 23/9-30P2 shows a decline of about 0.7 foot. Deeper wells 13/9-5Q2 and 16C3 show declines of about 0.7 foot to 1.7 feet. This slightly greater downward trend in the latter two wells probably is caused in part by the prolonged drought which started in 1945, and an indeterminate amount of the decline probably is due to pumping by the Navy and others in Mesquite basin.

## Chemical Quality of the Ground-Water Supply

Water samples from supply wells 1A, 3A, and old Navy well 2 were analyzed by the Geological Survey during October 1958 to determine whether any significant changes in the chemical quality of the supply were taking place. These analyses are presented in table 4. In general the analyses, when compared with those of 1954, show only minor changes in the chemical character of the water.

Using the average values for the fluoride content of the water from each well, it can be calculated that 20 percent of water from supply well 1A when mixed with 40 percent each from supply wells 2A and 3A would result in a blended water having a total concentration of 1.5 ppm (parts per million) fluoride, which is the maximum allowed by the Public Health Service [1] for interstate carriers.

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1. U. S. Public Health Service, 1946, Drinking water standards: Report, v. 61, no. 11

Table 4.—Chemical analyses of water from the Navy supply wells

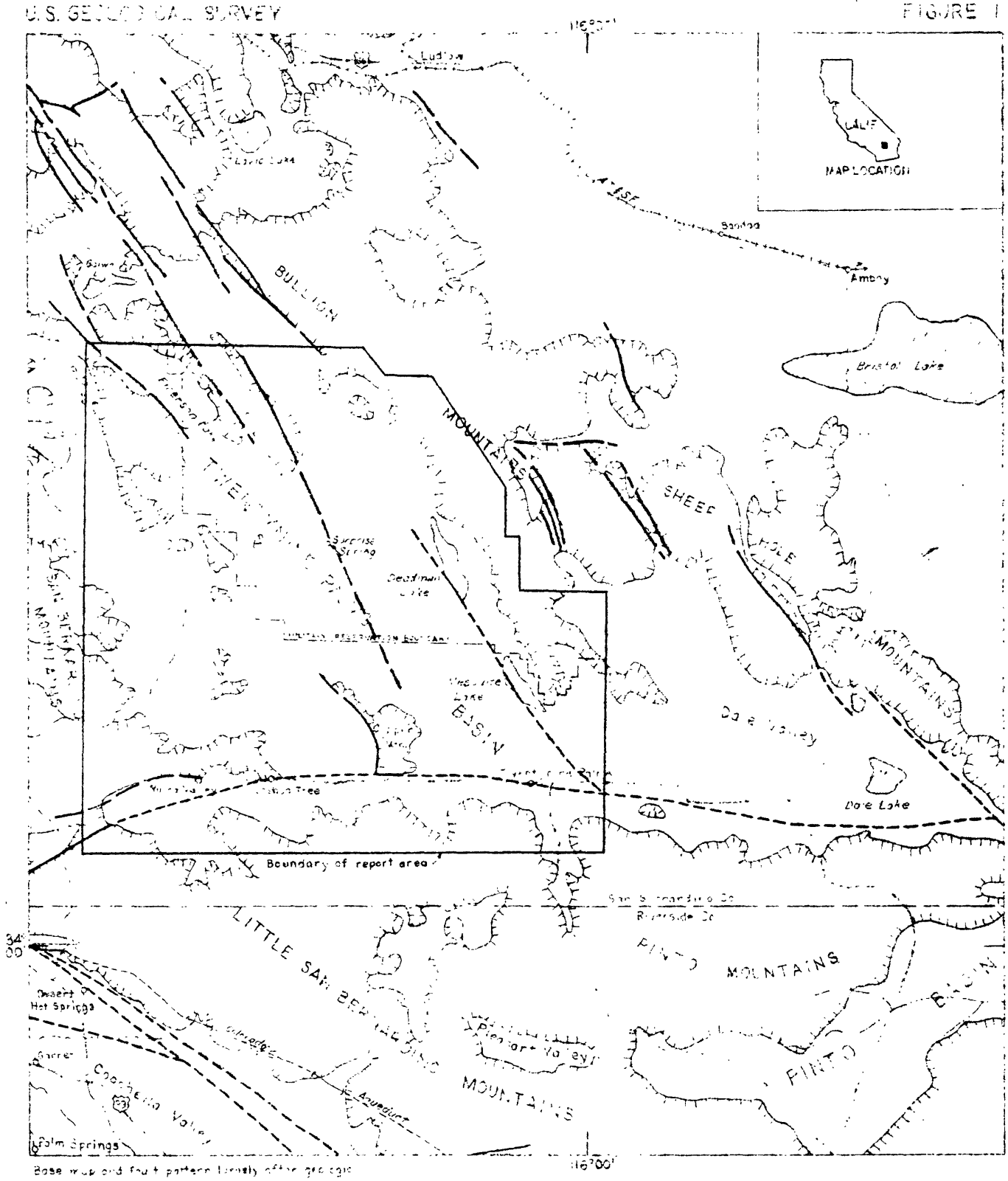
Constituents: Values shown in parentheses were calculated by the Ground Water Branch.

Analyzing laboratory: GS, U. S. Geological Survey, Quality of Water Branch, Sacramento, Calif.

| | Supply well 1A (3N/8-29L1) | Supply well 2A (2N/7-33L) | Supply well 3A (2N/7-34A1) | Navy well 2 (1N/9-5G1) |
|---|---|---|---|---|
| Date collected | 10-8-58 | 10-8-58 | 10-8-58 | 10-8-58 |
| Constituents in parts per million | | | | |
| Silica ($SiO_2$) | | | | |
| Iron (Fe) | | | | |
| Calcium (Ca) | 43 | 13 | 12 | 32 |
| Magnesium (Mg) | 3.0 | .4 | 1.0 | 3.3 |
| Sodium (Na) | 294 | 53 | 52 | 192 |
| Potassium (K) | 2.0 | 2.2 | 1.8 | 2.0 |
| Bicarbonate ($HCO_3$) | 83 | 83 | 85 | 71 |
| Carbonate ($CO_3$) | 0 | 0 | 0 | 0 |
| Sulfate ($SO_4$) | (374) | (42) | (47) | (331) |
| Chloride (Cl) | 207 | 28 | 21 | 60 |
| Fluoride (F) | 5.0 | .4 | .8 | 10 |
| Nitrate ($NO_3$) | | | | |
| Boron (B) | | | | |
| Dissolved solids | | | | |
| Sum of determined constituents | (969) | (180) | (178) | (665) |
| Hardness, total | 120 | 34 | 34 | 93 |
| noncarbonate | 52 | 0 | 0 | 35 |
| Percent sodium | 84 | 76 | 76 | 81 |
| Specific conductance (micromhos at 77°F) | 1,620 | 313 | 292 | 1,070 |
| pH | 6.8 | 6.8 | 7.0 | 6.8 |
| Temperature (°F) | 79 | 82 | 81 | 74 |
| Depth of well, feet | 600 | 700 | 560 | 500 |
| Analyzing laboratory | GS | GS | GS | GS |
| Laboratory number | 28223 | 28225 | 28224 | 28226 |

U.S. GEOLOGICAL SURVEY

FIGURE 1




Base map and fault pattern largely after geologic map of California (Jennings, ed.)

Valley area

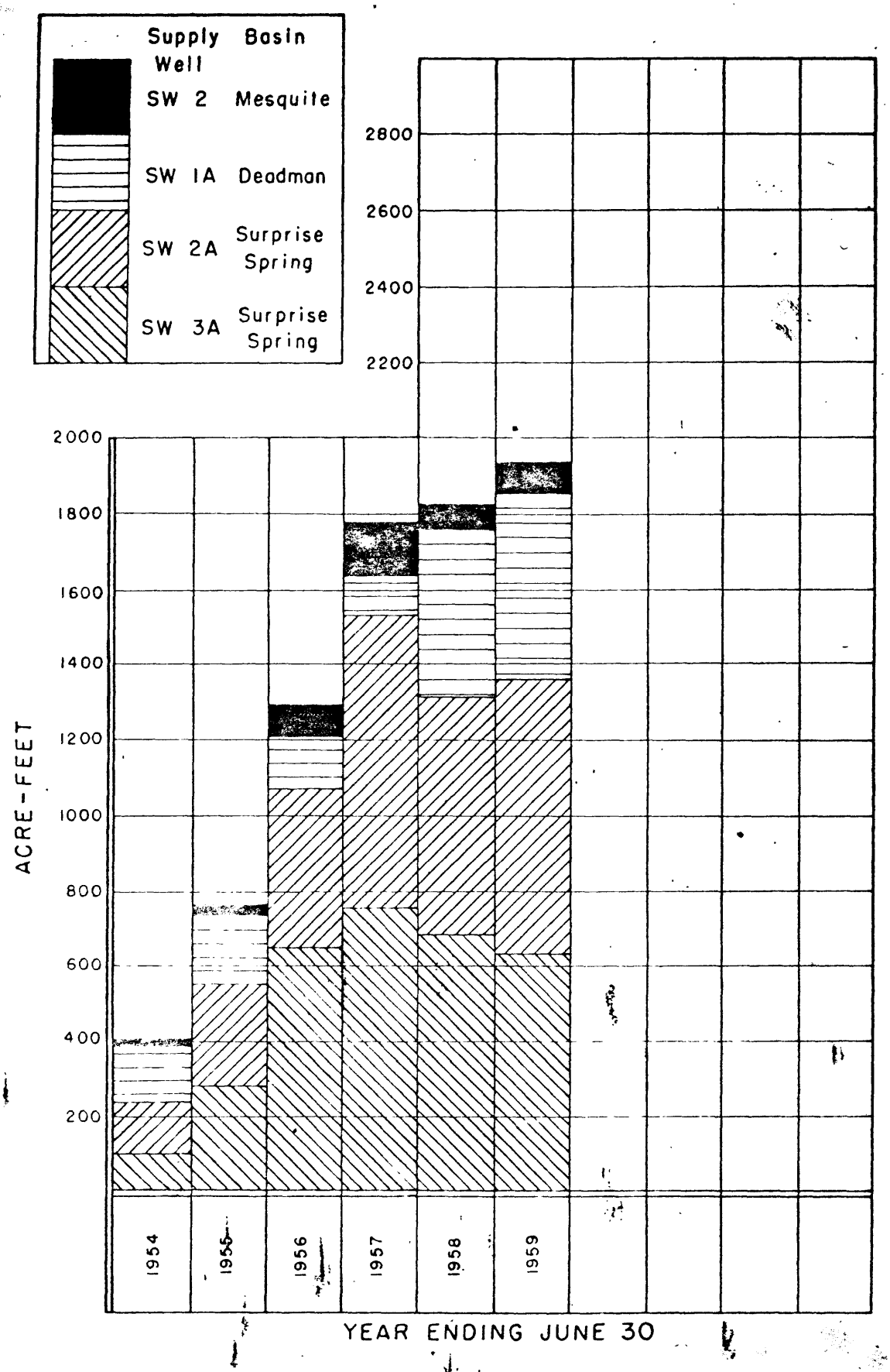
Mountain area

Fault
Dashed where inferred

# MAP OF PART OF SOUTHERN CALIFORNIA SHOWING AREA COVERED BY THIS REPORT

0 8 16 Miles

Scale 1:500,000 approx.




ANNUAL PUMPAGE FROM NAVY SUPPLY WELLS

U. S. GEOLOGICAL SURVEY

Test well 12(2/7-4H1) Altitude 2,442.2 feet; depth 500.0 feet

Supply well 2A(2/7-3B1) Altitude 2,355.3 feet; depth 700.0 feet

Water level, in feet above sea level

2255
2250
2245
2240
2235

Monthly pumpage (millions of gallons)

0
10
20
30

1952 1953 1954 1955 1956 1957 1958 1959 19 19

HYDROGRAPHS OF SUPPLY WELL 2A AND TEST WELL 12 AND GRAPH OF PUMPAGE FROM SUPPLY WELL 2A, SURPRISE SPRING BASIN

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