Water-Resources Reconnaissance In Southeastern Part of Honey Lake Valley Lassen County, California

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1619-Z

Prepared in cooperation with U.S. Department of the Army

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By G. S. HILTON

CONTRIBUTIONS TO THE HYDROLOGY OF THE UNITED STATES

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CONTENTS

ILLUSTRATIONS

669496—63

WATER-RESOURCES RECONNAISSANCE IN SOUTHEASTERN PART OF HONEY LAKE VALLEY, LASSEN COUNTY, CALIFORNIA

By G. S. Hilton

ABSTRACT

Honey Lake Valley, in California along the California-Nevada State line, is a basin of interior drainage underlain by alluvial and lacustrine deposits. The rocks in the Honey Lake Valley area are divided into three geologic units: basement complex, volcanic rocks, and alluvial and lacustrine deposits.

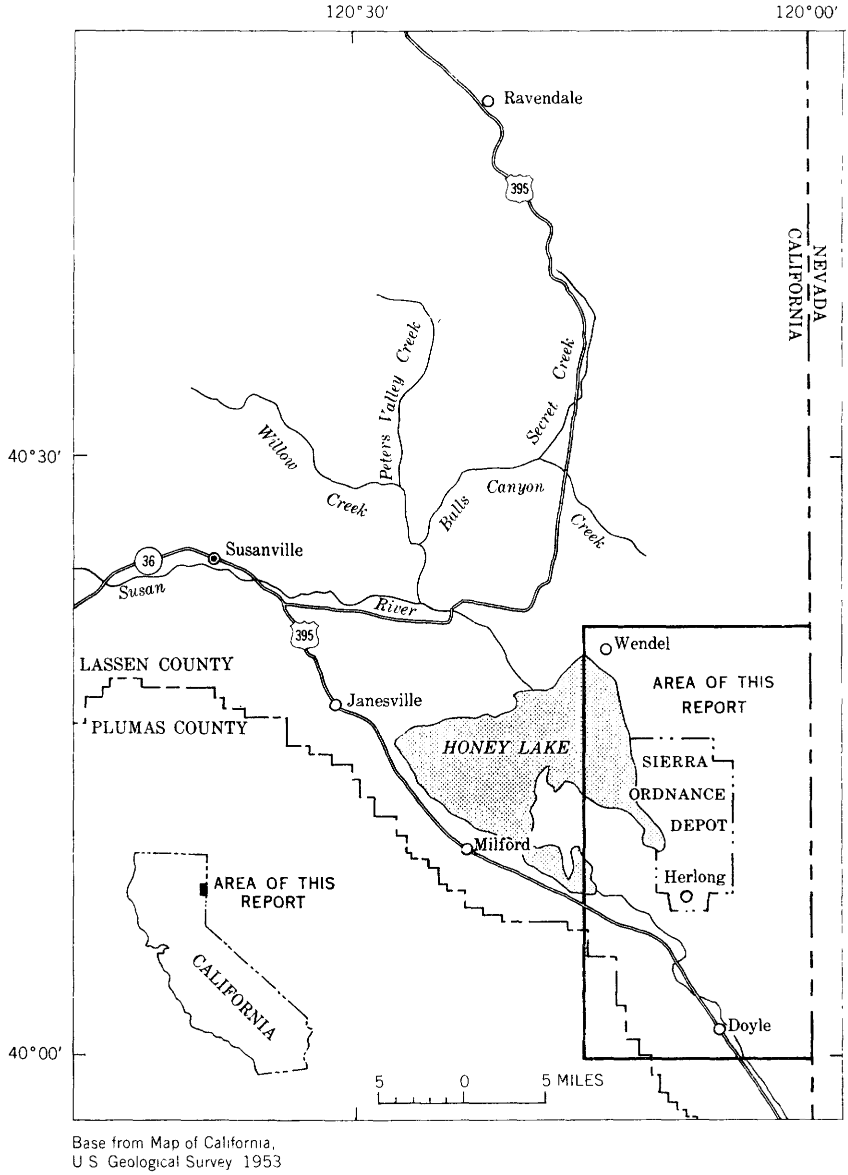
The basement complex consists primarily of igneous and metamorphic rocks that yield little or no water to wells. Volcanic rocks, dipping toward the valley, are exposed in the mountains in the northern part of the area; they contain extensively fractured and moderately permeable zones, which can transmit and store substantial quantities of ground water. Wells penetrating these volcanic rocks flow where they are overlain by less permeable materials. Yields in excess of 700 gpm (gallons per minute) have been reported. Alluvial and lacustrine deposits underlying the southeastern part of Honey Lake Valley are the major sources of ground water.

INTRODUCTION

Honey Lake Valley is in California along the California-Nevada State line in the extreme southeastern part of Lassen County, Calif. The area of study, the southeastern part of the valley, including the Sierra Ordnance Depot, is outlined in figure 1. The depot can be reached from Susanville via U.S. Highway 395 and a paved county road to the town of Herlong. The area reported herein, which covers the valley floor in the vicinity of the depot, is about 15 miles wide and is bounded by mountains to the north and south and by Honey Lake to the west.

PURPOSE AND SCOPE

This study, a field reconnaissance and report, was made by the U.S. Geological Survey at the request of the Department of the Army to appraise briefly the water resources of the depot. The study included a brief geologic reconnaissance in July 1960 to determine the water-bearing properties of the geologic formations and the geologic struc-



Base from Map of California, U S Geological Survey 1953

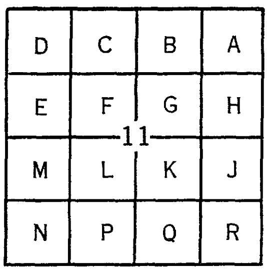
Figure 1.—Index map showing the southeastern part of Honey Lake Valley, Calif.

ture of the area south and east of Honey Lake. Water-level records, drillers' logs, and well records were collected to determine the source, occurrence, direction of movement, and points of discharge of ground water. Chemical analyses were studied to distinguish waters differing in chemical quality. Almost all the basic data were obtained from the

California Department of Water Resources (1960a and b). The fieldwork and the preparation of this report were under the supervision of H. D. Wilson, Jr., district engineer in charge of ground-water studies by the Geological Survey in California.

WELL-NUMBERING SYSTEM

Wells in the area are numbered according to their location in the township, range, and section—a system used by the U.S. Geological Survey and the California Department of Water Resources. Under this system each section is divided into 40-acre plots that are lettered. Wells are numbered within each of these 40-acre plots according to the order in which they were visited. The well number, for example, 27/16–11E1, has two parts. The part that precedes the hyphen indicates the township and range (T. 27 N., R. 16 E.), the numbers follow-lowing the hyphen indicate the section (sec. 11), the letter indicates the 40-acre subdivision of the section, and the final number is the serial number in the particular 40-acre subdivision. Accordingly, well 27/16–11E1 is the first well listed in the SW¼NW¼ sec. 11, T. 27 N., R. 16 E., Mount Diablo base line and meridian.



GEOLOGY

The area studied lies within the Basin and Range province, which extends from Nevada into California along the eastern margins of the Sierra Nevada. The Basin and Range province is characterized by fault-block mountains and basins of interior drainage that contain lakes and playas.

The southeastern part of Honey Lake Valley is bounded by mountains on the north and south. On the north the Amedee Mountains rise more than 3,000 feet above the valley floor—the highest point is an unnamed peak 7,574 feet above sea level. On the south the Long Valley Creek drainage separates the Diamond Mountains from the Fort Sage Mountains. Relief between these mountains and the valley measures about 3,000 feet. The highest point is McKesick Peak, 7,096 feet above sea level, in the Diamond Mountains.

The southeastern part of Honey Lake Valley consists primarily of the nearly flat bed of Honey Lake (alt about 4,000 ft), which is encroached upon by alluvial fans from the north and south. Long Valley Creek, to the south, has built an alluvial fan that extends from Doyle to Herlong, about 8 miles. The undulating surface of this alluvial fan slopes rather uniformly toward the north. Spencer and Skedaddle Creeks, which drain the Amedee Mountains to the north, have built smaller alluvial fans 2 to 3 miles out into the valley, and many smaller alluvial fans extending out from the Amedee Mountains also interrupt the flat surface of the lakebed.

For the purpose of this report, the rocks and deposits of the Honey Lake area have been differentiated on the basis of lithology, stratigraphic position, and water-yielding character into three groups as follows: (1) Basement complex, (2) volcanic rocks, and (3) alluvial and lacustrine deposits. The areal distribution of these rocks and deposits is shown on plate 1.

The diagrammatic cross section on plate 1 shows the configuration of the land surface and the stratigraphic and structural relationships of the geologic units. Because of the meager data, little is known of their subsurface relations.

The basement complex consists of igneous and metamorphic rocks of pre-Tertiary age exposed in the Diamond and Fort Sage Mountains. In addition, volcanic rocks and cemented sandstone of Tertiary age locally overlie the basement complex. However, owing to the short time available for mapping and the fact that none of these formations are considered as sources of ground water for the depot, they were included with the basement complex.

The rocks of the basement complex yield water almost entirely from secondary openings, such as fractures, fault zones, and weathered zones that occupy only a very small part of the total volume of the rocks. The largest yields of water are generally obtained relatively near the surface. Fractures and cracks usually are larger and more numerous near the surface. Because rocks of this unit yield little or no water to wells, they are not important as sources of ground water.

Volcanic rocks of Quaternary and Tertiary age of predominantly andesitic composition that dip toward the valley are exposed in the Amedee Mountains in the northern part of the area. These rocks not only are fractured but also contain vesicles (holes caused by escape of gases from the lava as it cooled) and flow tunnels or lava tubes. Because of these openings the volcanic rocks are moderately permeable and transmit and store substantial quantities of ground water. Wherever present, the overlying permeable alluvial and lacustrine deposits of sand and gravel conduct water into these porous zones.

Wells penetrating the volcanic rocks may flow where the permeable zones are overlain by less permeable materials (pl. 1). Yields in excess of 700 gpm (gallons per minute) from "lava" have been reported. It is probable that substantial increases could be made in the quantity of water withdrawn from the volcanic rocks.

Alluvial and lacustrine deposits of Quaternary and Tertiary age consisting of clay, silt, sand, and gravel constitute the deposits underlying the southeastern part of Honey Lake Valley. Long Valley Creek is the source of an extensive alluvial fan composed of granitic materials, which enters Honey Lake Valley from the south. Well logs indicate that coarse deposits underlie this alluvial fan in the vicinity of Doyle. Smaller alluvial fans exposed along a prominent fault scarp of the Diamond Mountains consist of coarse detritus for short distances valleyward.

To the north, the alluvial fans of Skedaddle and Spencer Creeks encroach upon Honey Lake Valley but to a far lesser extent than the alluvial fan of Long Valley Creek. Redeposited volcanic detritus, which is coarsest near the Amedee Mountains, constitutes the materials of these alluvial fans. All the alluvial fans merge and interfinger valleyward with the fine-grained lake deposits underlying the central part of the valley floor and are the major source of ground water in the area.

WATER RESOURCES

Precipitation within the watershed area is the ultimate source of the water resources of Honey Lake Valley. U.S. Weather Bureau records for a station at Doyle, the nearest long-term official Weather Bureau station to the area of investigation, indicate an average annual precipitation of about 9.5 inches for the period 1931–52. Approximately two-thirds of the precipitation occurs during the period from November through March; only about half an inch falls during July, August, and September. In 1956 the Doyle station was discontinued, but the station at Susanville probably is similar climatically. Precipitation at Susanville in 1959 was 10.44 inches, of which about 8 inches fell from December through March.

Because of the unequal seasonal distribution of the precipitation, ground water is preferred as a source of supply for the depot. Water-level contours shown on plate 1 indicate that ground water moves from the apexes of the alluvial fans to the valley. Ground water probably underlies the alluvial fan of Long Valley Creek and the alluvial and lacustrine deposits of Honey Lake Valley as a single ground-water body. Because wells of the Sierra Ordnance Depot pump for longer periods and yield larger quantities of water than other wells in the area, there is a cone of depression in the vicinity of these wells. The water-level contours indicate ground-water movement toward the cone of depression created by the pumping at these wells.

On the north side of Honey Lake Valley, ground water moves toward the valley from the alluvial fans of Spencer and Skedaddle Creeks into the alluvial and lacustrine deposits and appears to move toward the cone of depression at the Ordnance Depot (plate 1). Lack of wells and hence water-level data precludes any conclusion as to whether the ground-water body underlying these alluvial fans is hydraulically connected with that underlying the alluvial fan of Long Valley Creek.

Recharge to the ground water comes from precipitation on the immediate area. Surface runoff moves overland into streams such as Long Valley, Spencer, Skedaddle, and several unnamed creeks. Upon reaching Honey Lake Valley, water from these streams percolates downward into the underlying ground-water body. Storm runoff from most of the streams disappears quickly beneath their respective alluvial fans. Only Long Valley Creek, having a drainage area of 567 square miles, has perennial flow to the valley.

Honey Lake is the sump for drainage from Long Valley Creek; however, only during periods of high runoff does water from the creek reach the lakebed. Runoff from the drainage basins to the north disappears beneath the valley floor within a short distance south of the Amedee Mountains.

The flow of Long Valley Creek has been measured by the California Department of Water Resources since 1957. In 1958, a wet year, monthly discharges ranged from about 100 acre-feet in August to about 6,500 acre-feet in April. In 1959, a dry year, monthly discharges ranged from about 150 acre-feet in August to about 800 acre-feet in February.

Records of water level in wells, collected by the California Department of Water Resources, do not show an appreciable decline in water levels during the 3 years 1957–60. Therefore, artificial and natural discharge from the ground-water body or bodies is probably balanced by recharge from stream percolation and direct penetration of precipitation.

The extent to which ground-water withdrawals from these areas can be increased without exceeding the long-term supply is not known. Coarse materials capable of yielding considerable quantities of water underlie the alluvial fan of Long Valley Creek near the Diamond and Fort Sage Mountains; for example, well logs near Doyle show a preponderance of water-bearing sand and gravel to depths in excess of 500 feet.

In the northern part of the area, additional supplies of ground water might be developed from the deposits underlying alluvial fans of Spencer and Skedaddle Creeks and lesser alluvial fans and lacustrine deposits. Lack of well logs, however, precludes any conclusion as to which areas would be the most productive.

CHEMICAL QUALITY OF WATER

Following the usage of Piper and Garrett [1] (1953, p. 26), three general types of ground water are noted in the southeastern part of Honey Lake Valley as follows: (1) Sodium-bicarbonate water near Amedee Mountains, (2) calcium-bicarbonate water near Diamond Mountains, and (3) water varying in predominant concentrations (calcium sodium and bicarbonate sulfate water) near Herlong. Plate 2, following the system described by Hem (1959, p. 179–180), shows selected chemical analyses of surface and ground water in the area studied.

Chemical analyses of water

Well	Year of analysis	Dissolved solids (ppm)	Percent sodium	Carbonate + bicarbonate (equivalents per million)	Sulfate (equivalents per million)	Chloride +fluoride +nitrate (equivalents per million)
25/17-17A1	1958	279	37	3.28	0.31	0.62
26/16- 3B2	1958	303	53	3.38	.75	.47
4H1	1958	355	60	3.54	.90	1.02
15D1	1956	368	48	3.41	1.71	.64
21J1	1958	295	17	3.98	.21	.49
35P1	1958	221	27	3.15	.03	.32
27/16-11E1	1959	1,210	57	2.30	3.83	13.20
35Q1	1958	354	50	3.11	1.58	.58
36P1	1958	553	39	3.36	3.98	1.12
27/17- 3H1	1956	1,140	93	10.11	1.44	7.51
28/17-19B2	1958	165	84	1.64	.37	.36
20R1	1956	170	76	1.77	.31	.25
35D1	1958	156	85	1.56	.33	.38
Long Valley Creek NE¼ sec. 1, T. 25 N., R. 16 E.	1958	380	46	4.00	1.35	.70

In the northern part of the area, sodium bicarbonate water predominates, reflecting the character of the water derived from weathering of the andesitic volcanic rock. Wells tapping the alluvial deposits and (or) the volcanic rocks generally yield water of similar quality. Near the Diamond Mountains, wells yield water of a calcium bicarbonate type indicative of constituents derived from the weathering of the basement complex. Wells near the ordnance depot penetrating the alluvial deposits of Long Valley Creek and the lacustrine deposits

[1] In this report, terms describing the general chemical character of a water are used in particular senses as in the following example: (1) calcium bicarbonate designates a water in which calcium amounts to 50 percent or more of the cations (bases) and bicarbonate to 50 percent or more of the anions (acids) in equivalents per million; (2) calcium sodium bicarbonate designates a water in which calcium and sodium are first and second, respectively, in order of abundance among the cations but neither amounts to 50 percent of the cation total. Similar nomenclature is applied to the anion components.

yield sodium calcium bicarbonate sulfate water. The dissolved solids content and percentage of sulfate increase to the north of Doyle and from the west to east. An increase in dissolved solids from Doyle to Herlong is shown by comparison of the analyses of water from wells 25/17–17A1 and 27/16–35Q1. From west to east the percentage of sulfate increase is reflected by the analyses of water from wells 27/16–35Q1 and 27/16–36P1.

The analysis of water from well 27/16–11E1 (depot well 6) shows the water to be of the sodium chloride type. Water from this well is used rarely except for industrial purposes. It has a high dissolved-solids content, 1,200 ppm (parts per million), a chloride content of 462 ppm, and a total hardness of 405 ppm.

One analysis of surface water from Long Valley Creek shows a sodium-calcium bicarbonate water similar to that of water from wells near sec. 35, T. 27 S., R. 16 E. This suggests that Long Valley Creek recharges the ground-water body north and northwest of Doyle.

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