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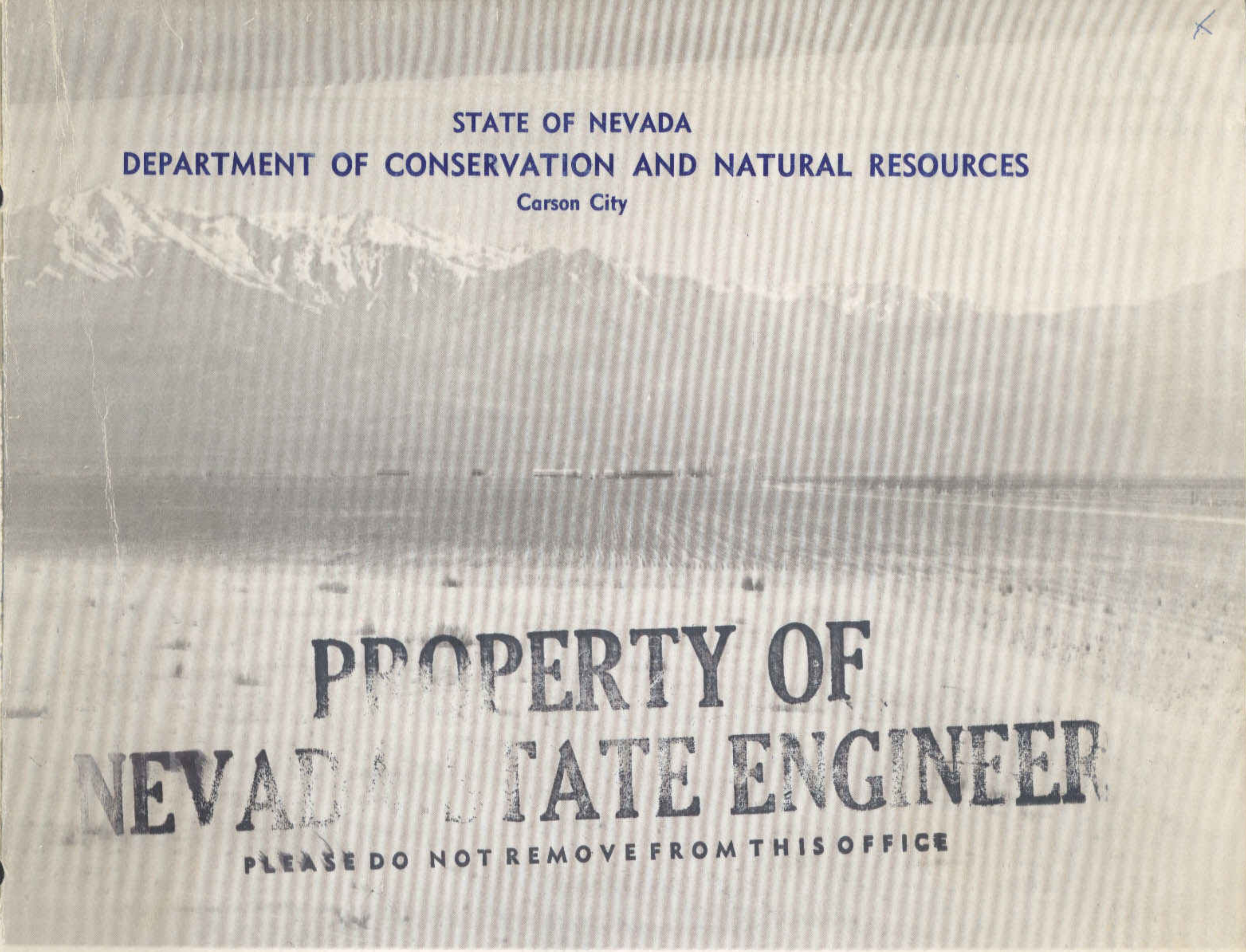

View, to the west, of Bottle Creek Ranch, Desert Valley. Jackson Mountains in the background.

GROUND-WATER RESOURCES – RECONNAISSANCE SERIES
REPORT 7

GROUND–WATER RESOURCES OF DESERT VALLEY, HUMBOLDT AND PERSHING COUNTIES, NEVADA

By
WILLIAM C. SINCLAIR
Geologist

Price $1.00

Prepared cooperatively by the
Geological Survey, U. S. Department of the Interior

APRIL 1962

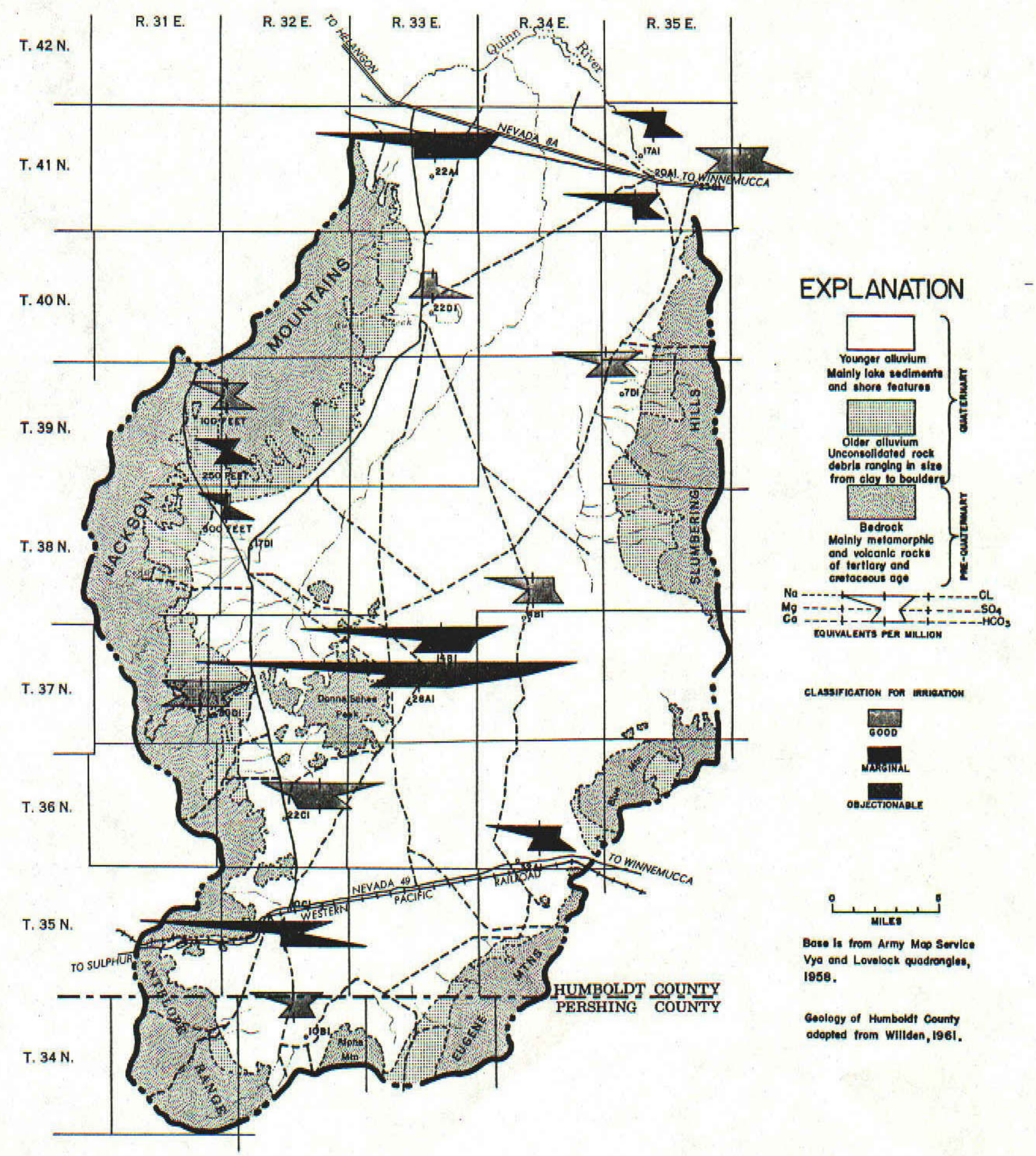

Plate 2—Diagrams showing chemical quality of ground water in Desert Valley.

William G. Sinclair (1961)

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FOREWORD

The seventh ground-water reconnaissance report is the second such report in the northwest Nevada area by William C. Sinclair, geologist of the U.S. Geological Survey, ground-water branch. His first report covered the Pine Forest Valley in Humboldt County, dated January 1962.

The report indicates very little ground water development at the present time. A more detailed study may be needed to supplement the present reconnaissance report, but such a study must wait on further development. This report, although brief, contains all the available information on the area.

This valley, like so many of the state's valleys where the average annual replenishment is small, contains a large amount of water in ground water storage.

Hugh A. Shamberger,
Director,
Department of Conservation
and Natural Resources

April 25, 1962

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GROUND-WATER RESOURCES OF DESERT VALLEY

HUMBOLDT AND PERSHING COUNTIES, NEVADA

by

William C. Sinclair

ABSTRACT

Desert Valley, in northwestern Nevada, is one of the arid basins in the Great Basin section of the Basin and Range physiographic province. Precipitation in the valley is generally insufficient to support perennial streamflow, but during periods of above-average runoff the valley drains northward to the Quinn River, an ephemeral stream.

Mountains, composed principally of metamorphic and volcanic rocks, form the drainage divides. These mountains were formed by faulting during the late Tertiary period. Material eroded from the bordering mountains has filled the valley with an estimated thickness of 6,000 to 8,000 feet of unconsolidated rock debris, including lake and stream deposits. This valley fill is the principal source of ground water in the valley. The estimated amount of ground water stored in the upper few hundred feet of the valley fill is about 40,000 acre-feet per foot of thickness of saturated deposits.

The ground-water reservoir is recharged by infiltration of precipitation, snowmelt, and streams that drain the bordering mountains. The estimated average annual recharge to the ground-water reservoir is on the order of 5,000 acre-feet per year. Under natural conditions the recharge to the ground-water reservoir is balanced by discharge of ground water by evaporation and transpiration. The amount of water recharged to and discharged from the ground-water reservoir along the course of the Quinn River is considered to be negligible.

The ground water best suited for irrigation is generally found around the periphery of the valley where underflow from the mountains and piedmont slopes may be intercepted before it comes into contact with highly mineralized lake sediments underlying the valley floor.

The perennial yield, the amount of natural discharge that can be salvaged for beneficial use, does not exceed the estimated 5,000 acre-feet per year of average recharge and may be somewhat less. Gross pumpage in 1961 was only about 700 acre-feet.

INTRODUCTION

Purpose and scope of the investigation:

This report is the seventh in a series of reconnaissance studies of the valleys of northwestern Nevada within the area between latitude 41° and 42° N., and longitude 118° and 120° W. These studies are made by the U. S. Geological Survey in cooperation with the Department of Conservation and Natural Resources, State of Nevada, and are part of a statewide study to evaluate the ground-water resources of Nevada.

The purposes of this study are: (1) To determine the nature and extent of the aquifers; (2) to determine the occurrence and movement of ground water, including the areas of recharge and areas of discharge; (3) to determine the sources of recharge and to estimate the average annual recharge to the aquifers; (4) to estimate the quantity of ground water that can be developed perennially; and (5) to determine the chemical quality of the ground water and its suitability for irrigation and domestic use.

The field work for this report was done during April and May 1961. It consisted of a brief study of the physiographic features of the area and of the water-bearing character of the geologic units, an inventory of the wells and springs, and collection of samples of water for chemical analysis.

The assistance provided by residents of the area in supplying information about wells and springs is gratefully acknowledged. Information from the files of the Winnemucca Grazing District office of the U. S. Bureau of Land Management and data collected by the General Hydrology Branch of the U. S. Geological Survey as a part of a stock-well site study were also of value to this study.

Location and extent of the area:

Desert Valley lies principally in central Humboldt County, although the southern tip extends about 5 miles into northern Pershing County (fig. 1). The valley is a north-trending trough between Jackson Mountains on the west and Slumbering Hills and Blue Mountain on the east. The south end of the valley is bounded by the Antelope Range and Alpha and Eugene Mountains. Desert Valley is separated from its northward extension, Kings River Valley, by Quinn River which flows in a westerly direction, entering and leaving the valley through gaps in the bordering mountains.

The main part of the valley floor is about 10 miles wide and 40 miles long; the drainage area of the entire valley is about 1,000 square miles.

Nevada Highway 8A crosses the north end of the valley, connecting Winnemucca with northwestern Nevada and the neighboring States of Oregon and California. Nevada 49, a graded road, crosses the south end of the valley

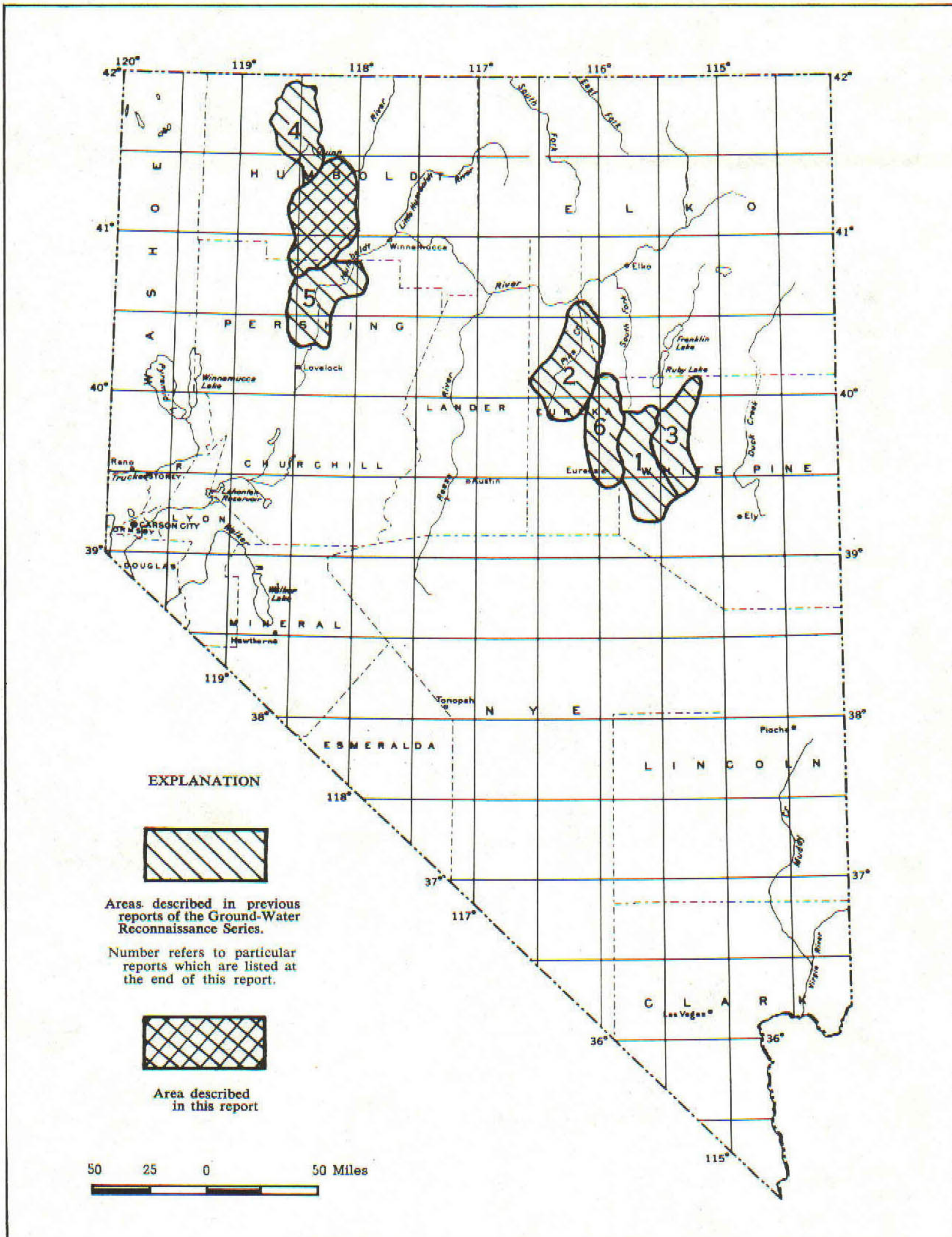

Figure 1.—Map of Nevada showing areas described in previous reports of the Ground-Water Reconnaissance Series and in this report.

parallel with the tracks of the Western Pacific Railroad Company and connects Jungo, the only town in the valley, with Winnemucca to the east and Sulphur to the west.

Jungo, which is about 35 miles west of Winnemucca, has a population of less than 100. Winnemucca had a population of 3,453 in 1960, according to the census, and is served by U.S. Highways 40 and 95, and the Southern Pacific and Western Pacific Railroads. Sulphur is a small mining community of less than 50 residents, about 20 miles west of Jungo. The loading of iron ore, mined in Jackson Mountains, at the Western Pacific siding in Jungo is the only industry in the valley.

Cattle are grazed throughout the valley, and several ranches along the west side of the valley irrigate a total of about 2,000 acres, principally hay, with streamflow from Jackson Mountains supplemented by ground water.

Numbering system for wells and springs:

The well-numbering system used in this report indicates the location of the wells within the rectangular subdivisions of the public lands, with reference to the Mount Diablo base line and meridian. The first two segments of a well number designate the township and range; the third segment is the number of the section followed by a letter which designates the quarter-section in which the well or spring is located. Following the quarter-section letter, a number indicates the order in which the well or spring was recorded within the subdivision. The letters A, B, C, and D designate respectively the northeast, northwest, southwest, and southeast quarters of the section. For example, well number 42/34-26D1 designates the first well recorded in the SE 1/4 sec. 26, T. 42 N., R. 34 E., Mount Diablo base and meridian.

GEORGRAPHIC FEATURES

Landforms and drainage:

Desert Valley is typical of many valleys in the Great Basin section of the Basin and Range physiographic province where block faulting has created a series of north-trending valleys and mountain ranges.

Precipitation in the Great Basin is generally insufficient to support perennial streams. Streamflow from the mountains, typically, infiltrates into the alluvial slopes bordering the mountains, except during flood stages and periods of high runoff when the streams discharge to the playa lakes in the center of the basin, from which the water evaporates in a relatively short time.

Mountains: The Jackson Mountains, which border the west side of Desert Valley, are a highly faulted complex of sedimentary, metamorphic, and volcanic rocks. The south end of the range is characterized by maturely weathered ridges and crests which rise only 1,500 to 2,000 feet above the valley floor. The northern two-thirds of the range has a more rugged topography and is considerably higher, about 4,500 feet above the valley floor. The highest peak in the range, altitude 8,910, is about 4,800 feet above the valley floor.

Several outliers of the Jackson Mountains rise above the alluvium of the valley fill. Donna Schee Peak, in the south-central part of the valley, is the largest of these. Most of the smaller outliers are near the north end of the valley where aeromagnetic surveys 1/ indicate the presence of other bedrock highs within the valley fill.

The Slumbering Hills rise about 2,000 feet above the valley floor and form the eastern drainage divide of the valley. A granitic intrusive occupies a large area in the center of the range which, otherwise, is composed principally of metamorphic rocks.

The southern end of the range is separated by a low alluvial saddle from Blue Mountain, which is a complex of steeply dipping metamorphic and volcanic rocks that rise abruptly from the valley floor to an altitude of about 7,400 feet.

The south end of the valley is rimmed by the Antelope Range and Alpha and Eugene Mountains which are composed principally of metamorphic and volcanic rocks. The southern drainage divide ranges in elevation above the valley floor from more than 3,000 feet in the Eugene Mountains to less than 100 feet in the intermontane gaps.

Piedmont slopes and valley floor: Alluvial fans mantle the mountainsides and coalesce to form a more or less continuous piedmont slope whose upper gradient of from 200 to 500 feet per mile merges almost imperceptibly into the relatively flat floor of the valley.

The valley floor has an area of about 670 square miles. The southern part is so level that hardly any erosion is evident other than minor wind effects. The northern part of the valley floor has a slight northward gradient, but, throughout its entire length of nearly 50 miles, the relief of the entire valley floor probably does not exceed 100 feet. Within the limits of this low relief a minor drainage divide appears to trend northeastward from Donna Schee Peak toward the Slumbering Hills.

The valley floor is composed of lake sediments, principally alkaline clays, but east of Donna Schee Peak large areas of mobile dunes are gradually moving eastward up the slope and through the gap between the Slumbering Hills and Blue Mountain.

1/ D. R. Mabey, cited in Willden, 1957, unpublished Ph.D. thesis, Stanford University.

Streams: The streams that drain into Desert Valley from the surrounding mountains are fed principally by storm runoff and snowmelt. Their flow, therefore, is ephemeral, occurring principally during the spring and early summer. Although some of the streams that drain the Jackson Mountains are perennial in their upper reaches, most of them eventually seep into the relatively permeable piedmont slopes and do not reach the valley floor, especially during late summer and fall.

The major drainage is northward from north of Donna Schee Peak to the Quinn River. This drainageway and the Quinn River itself, carry water only during periods of unusually high runoff.

Climate:

Precipitation in Nevada is largely controlled by the topography. The prevailing westerly winds rise along the windward flank of each succeeding mountain range releasing precipitation as they gain altitude. Moving down the east slopes, the winds are warming and dry, thus creating arid conditions and release decreasing amounts of precipitation at the lower altitudes. The Jackson Mountains have some of the highest peaks in the area and, because they border the west side of Desert Valley, intercept a large share of the moisture moving into the area. The Slumbering Hills, along the east side of the valley, are relatively low and receive little precipitation.

The average annual precipitation for the 11 years of record at Jungo is 3.80 inches (U.S. Dept. of Agriculture, 1941, p. 979). Most of the precipitation throughout the valley occurs during the winter months as snow, which at the higher elevations may remain several weeks or months. The summers are notably dry. The precipitation in Desert Valley, therefore, is small, even by Nevada standards.

No record of temperature has been kept within the valley, but records from nearby weather stations indicate that the range is large, both daily and seasonally. The average annual temperature probably is near 50°F, and the growing season probably is only 3 to 4 months long, although freezing temperatures may occur in any month of the year.

The evaporation rate from a free-water surface is estimated to be about 4 feet per year, or more than 12 times the precipitation on the valley floor.

GEOLOGY

Previous investigations:

A preliminary geologic map of Humboldt County by Ronald Willden was published in 1961. The geologic units shown in plate 1 are based largely on that map. The geology of the Jackson Mountains was studied in some detail by Willden (unpublished Ph.D. thesis, 1957, Stanford University) and that paper was also of value in the preparation of this report.

A report on the gold deposits of Slumbering Hills by Frank C. Calkins was published in 1936, and a report on the quicksilver deposits of the Bottle Creek Mining District in the Jackson Mountains by R. J. Roberts published in 1940.

The late Pleistocene history of Desert Valley is, to a great extent, the history of Lake Lahontan, which was studied in detail by Russell (1885) and, more recently, by Morrison (1961).

Summary of geologic history:

The present topography of Desert Valley and the surrounding mountain ranges began to take form during the latter part of the Tertiary Period. At that time the country rock was broken and tilted by extensive faulting, raising the mountain ranges relative to the valley floor. This deformation continued into the Pleistocene Epoch.

Erosion of the uplifted blocks has partly filled the valley with alluvium. The log of well 35/32-10C1, at Jungo (table 4), shows 500 feet of lake sediments. A gravity survey by Mabey[1/] across the south end of the valley suggests that Desert Valley is underlain by about 6,000 to 8,000 feet of low-density fill. The total vertical displacement along the fault which borders the Jackson Mountains, therefore, appears to be in excess of 15,000 feet.

The Pleistocene Epoch, which is notable for extensive glaciation in other parts of the world, was attended by a series of lakes in many of the arid valleys of the Great Basin. The most recent of these, Lake Lahontan, intermittently covered a large part of western Nevada and attained a maximum altitude of about 4,380 feet. In Desert Valley, which was an embayment of Lake Lahontan more than 200 feet deep, the many stages and fluctuations of the lake are recorded in the complexity of the sediments which comprise the valley floor and in the shoreline features which terrace the surrounding hillsides.

PHYSICAL CHARACTER AND WATER-BEARING PROPERTIES OF THE ROCKS

Bedrock:

The consolidated rocks of the mountains are relatively impermeable and movement of ground water in them is largely through joints and other secondary openings. Although the total volume of water moving through bedrock may be quite large, the success of a well penetrating the bedrock is dependent on its tapping enough of the secondary water-bearing zones to yield the required amount of water. The chances of intercepting a sufficient number of zones are generally so poor that the consolidated bedrock, whether in the mountains or buried beneath the valley fill, probably would not yield large amounts of water to wells.

1/ D. R. Mabey, cited in Willden, 1957.

Valley fill:

The valley fill is composed principally of fluvio-lacustrine deposits and contains most of the ground water in the valley. Where it consists of fine-grained material, such as silt and clay or of poorly sorted alluvium, the permeability is very low and only small yields can be expected from wells. In contrast, well sorted sand and gravel strata have moderate to high permeabilities and will yield water readily to wells.

Older alluvium: Alluvial fans coalesce to form the piedmont slopes which flank the mountains. The older alluvium is a heterogeneous assortment of rock debris of moderate permeability. Moderate to large yields of water may be obtained from wells penetrating the older alluvium, because of its great saturated thickness. Pumping lifts along the piedmont slopes may be excessive, however, inasmuch as the water table is generally far below the land surface. The older alluvium dips beneath the younger alluvium at the highest Lahontan shoreline (plate 1).

Younger alluvium: The younger alluvium is composed mainly of lake sediments, which were deposited in Lake Lahontan, and locally, dune and stream deposits of post-Lahontan age. These sediments are predominantly silt and clay, which are deep-lake deposits, separated by layers of sand and gravel, which are principally stream deposits and reworked alluvium that accumulated during shallow stages of the lake and periods of emergence of the land surface. The sand and gravel strata are the best aquifers in the section of lake sediments and may yield large quantities of water to properly constructed wells.

GROUND-WATER

Occurrence and movement:

Most of the available ground water occurs in the unconsolidated sediments of the valley fill.

Ground water moves from recharge areas, the mountains and piedmont slopes, downgradient toward the axis of the valley where most of it is discharged by evapotranspiration. The water table, therefore, conforms roughly to the overlying topography. Plate 1 shows the depth to water and the altitude of the water table in most of the wells and springs in Desert Valley. Some of the altitudes were determined by spirit level, but most were obtained by averaging several aneroid barometer readings and probably are accurate only to within several feet. The altitudes do illustrate, however, that the water table beneath the valley floor is nearly flat. The westward gradient across the north end of the valley represents underflow along the course of the Quinn River.

Recharge:

The ground-water reservoir beneath Desert Valley is recharged by precipitation within the drainage basin. This recharge, which occurs almost entirely by seepage from streams crossing the piedmont slopes, is balanced, under natural conditions, by natural discharge of the ground water, principally from the valley floor.

The Quinn River, which forms the northern boundary of Desert Valley, may supply a minor amount of water to the ground-water reservoir at the northern end of the valley during high stages. However, the altitudes of water levels in wells near the Quinn River suggest that ground water is moving toward the river.

The approximate amount of precipitation within the drainage area each year can be computed from a map showing precipitation zones in Nevada (Hardman, 1936). Hardman mapped the precipitation zones chiefly on the basis of elevation, type of vegetation, and precipitation data available from the relatively few U.S. Weather Bureau climatological stations in existence at that time. Total precipitation within the drainage basin of Desert Valley is estimated to average about 300,000 acre-feet per year. This figure was derived by subdividing the drainage basin of the valley into precipitation zones and multiplying the area of each zone by the average precipitation as shown below:

Precipitation zone (inches)	Altitude of zone (feet)	Area of zone (acres)	Precipitation (acre-ft/yr) (rounded)	Percent recharge 1/	Approximate recharge (ac.-ft/yr)
15 - 20	above - 7,000	9,100	10,000	15	1,500
12 - 15	6,000 - 7,000	15,000	20,000	7	1,400
8 - 12	5,000 - 6,000	79,000	70,000	3	2,100
less than 8	below - 5,000	570,000	180,000	0	
Total (rounded)		670,000	300,000		5,000

1/ After Eakin (1951)

The amount of precipitation which infiltrates to the ground-water reservoir is determined largely by the vegetation, soil cover, and geology of the area. These and other factors combine to form what may be termed the recharge potential of the terrane, or its capacity to accept recharge. In areas of little precipitation, such as the valley floor, all, or nearly all, of the available moisture may be lost to evapotranspiration. Even when water stands in puddles and playa lakes as a result of excessive precipitation or runoff, the actual recharge still may be negligible because of the dense, impermeable nature of the clayey soil which is characteristic of much of the valley floor.

The principal source of recharge to the ground-water reservoir is seepage from streams crossing the alluvium of the piedmont slopes. The streambeds are composed of permeable gravel and the piedmont surface is generally well above the regional water table. Rapid infiltration is possible under these circumstances.

Recharge in the mountains is determined largely by the geology. The permeability of most consolidated rocks is relatively low; but secondary openings, such as bedding planes, joints, and fractures are important avenues of infiltration. The manner in which the various rock types weather, has a considerable effect on the recharge potential. A mantle of rock debris retards the runoff from precipitation and snowmelt and permits the water to infiltrate. Once beneath the land surface, the water may percolate into the bedrock or, in the case of less permeable rock types, move downward through the alluvium along the surface of the bedrock. Under favorable conditions, where the mantle thins or the bedrock surface crops out, it may reappear as springs and seeps supplying the base flow of the small streams draining the mountains.

The above discussion suggests that even under favorable conditions the percentage of precipitation that recharges ground water is small. It also indicates that the percentage for a given amount of precipitation varies considerably. Obviously, a detailed determination of the percentage of precipitation in each zone that recharges ground water is not practical. Therefore, ground-water recharge from precipitation is based on percentages determined empirically by Eakin (1951) from studies in eastern Nevada. Assuming these factors to be valid in Desert Valley, the total recharge to the ground-water reservoir is on the order of 5,000 acre-feet per year.

Discharge:

Ground water is discharged from the valley by evapotranspiration, springs, pumping, and, to a limited extent, by underflow from the valley,

Evaporation and transpiration: Evaporation from the ground-water reservoir occurs in areas where the water table intercepts the land surface, usually indicated by springs or seeps, or in areas where it is near enough to the land surface for the capillary fringe above the water table to lose water to the atmosphere. In Desert Valley, the areas where the water table is near enough to the land surface for a significant amount of water to be lost to the atmosphere are quite small, although, no doubt, a small amount of ground water is discharged in this manner.

Most of the natural discharge of ground water is effected by phreatophytes, whose roots descend to the water table or to the capillary fringe above it. Greasewood is the most common phreatophyte in the valley and its presence generally indicates that the water table is within about 40 feet of the surface.

Throughout most of Desert Valley, the greasewood is quite sparse, although locally it grows in dense patches and stringers that apparently are controlled by the character of the soil. Because of the varying density and erratic distribution of the greasewood over the valley floor, its role in the discharge of ground water is difficult to assess and no attempt has been made to estimate the amount of ground water it discharges.

Springs: Springs and seeps occur along the flanks of the mountains, commonly issuing from the alluvium at the heads of canyons, where the water table intercepts the land surface. These springs are the source of many of the small streams that drain the mountains. The water discharged by these springs is either lost by evaporation and transpiration near the source or along the stream channel into which the spring discharges, or it is returned to the ground-water reservoir as seepage from the stream. All the springs are small, the individual discharge commonly being only a few gallons per minute. Most of the springs are used to water stock. Additional information on some of the springs in the valley is given in table 2.

Pumpage: Through 1961, the ground-water regimen in Desert Valley had been only slightly affected by pumping. Two large-capacity wells (40/33-22D1 and 40/33-23C1), which produce about 1,000 gpm (gallons per minute) each, are used for supplemental irrigation of about 400 acres at the Bottle Creek Ranch. The pumpage is about 400 to 500 acre-feet per year. Most of the other wells in the valley are for stock or domestic use. The total pumpage in 1961 probably was no more than 700 acre-feet.

Underflow from the valley: A relatively small amount of ground water probably leaves the north end of the valley as underflow. Judging from the low gradient (about 2 feet per mile) of the water table and the narrow gap (about 3 miles wide) in the bedrock north of the Jackson Mountains through which the ground water must flow, the underflow out of the valley probably is not more than 100 or 200 acre-feet per year.

Perennial yield:

The perennial yield is the maximum rate at which water can be withdrawn from a ground-water system for an indefinite period of time without permanently depleting the supply. It is ultimately limited by the amount of recharge available to the system.

The net amount of ground water that can be pumped perennially in Desert Valley without causing a continuing decline in ground-water levels is limited to the amount of natural discharge that can be salvaged. The allowable gross pumpage may exceed the net pumpage to the extent that some of the ground water returns to the ground-water reservoir and is suitable for reuse. The perennial yield of the valley can be determined more accurately after several years of extensive development.

Ground water in storage:

The amount of recoverable ground water in storage in the valley fill of Desert Valley is many times the average annual recharge. An estimate of the magnitude of the recoverable water in storage can be obtained by computing the amount of ground water that will drain from the sedimentary deposits for each foot of lowering of water level in the valley fill. A value of 10 percent is considered to be a conservative estimate of the amount of water by volume that will drain from the sediments. The drainable unconsolidated deposits are estimated to include almost the entire volume of valley fill, which has an area of about 430,000 acres.

Ground water recovered from a lowering of water levels, would thus be on the order of about 40,000 acre-feet per foot of lowering--or about 8 times the average annual recharge. If water levels generally were lowered 100 feet, the amount of water removed from storage would roughly equal the total recharge for 800 years. Much of the water in storage within the valley fill, however, is of poor quality and, in addition, it would not be practicable to lower the water table over a large area. Thus, the amount of usable ground water in storage, which is available on an economic basis, is probably far less than the gross amount calculated above.

CHEMICAL QUALITY OF THE GROUND WATER

The chemical constituents of ground water are acquired by the solution of minerals in the material with which the water comes in contact, in the air, on the surface, and in the ground. In general, the dissolved-solids content of the water is determined by the solubility of the rock or soil, the area and duration of contact, and other factors such as pressure and temperature.

Water for irrigation:

The suitability of water for irrigation may be evaluated on the basis of the salinity hazard, the sodium (alkali) hazard, and the concentration of bicarbonate, boron, and other ions.

Salinity hazard: The salinity hazard depends on the concentration of dissolved solids. It is normally measured in terms of the electrical conductivity, or specific conductance, of the water expressed as micromhos per centimeter at 25°C. The electrical conductivity is an approximate measure of the concentration of the ionized constituents of the water. Water of low conductivity generally is more suitable for irrigation than water of high conductivity.

Sodium (alkali) hazard: The sodium, or alkali, hazard is indicated by the sodium-adsorption ratio (SAR), which may be expressed by the formula:

$$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}}$$

in which concentrations are expressed in equivalents per million (U.S. Salinity Lab. Staff, 1954). If the proportion of sodium among the cations is high, the alkali hazard is high; but if calcium and magnesium predominate, the alkali hazard is low. An SAR in excess of about 10, or less where specific conductance is high, probably will present a sodium hazard in the fine-textured soils of Desert Valley.

Bicarbonate ion: Residual sodium carbonate (RSC), which may be defined by the formula:

$$RSC = (CO_3^{--} + HCO_3^{-}) - (Ca^{++} + Mg^{++}),$$

in which concentrations are expressed in equivalents per million, is a measure of the hazard involved in the use of high-bicarbonate water. If residual sodium carbonate is greater than 2.5 epm (equivalents per million), the water is not suitable for irrigation. The water is marginal if the residual sodium carbonate is between 1.25 and 2.5 epm, and is probably safe if the residual sodium carbonate is less than 1.25 epm (U.S. Salinity Lab. Staff, 1954).

Boron: Nearly all natural water contains boron in amounts that range from a trace to several parts per million. Although boron in small amounts is essential to plant growth, it is toxic at concentrations slightly higher than the optimum. Scofield (1936, p. 286) proposed limits for boron in irrigation water, depending on the sensitivity of the crops to be irrigated. In general, boron in excess of 3 ppm (parts per million) is injurious to most crops.

Classification and interpretation of analyses:

Chemical analyses were made of water from 14 wells and 1 spring in Desert Valley. The results of these analyses are listed in table 3. Geochemical interpretation of the analyses is aided by the diagrams on plate 2. These are drawn by plotting the concentrations of six key ions, in equivalents per million, and connecting the plotted points (Stiff, 1951). Ground water in Desert Valley is of three general types, as illustrated by the diagrams: sodium chloride (well 37/33-28A1), sodium bicarbonate (35/32-10C1), calcium bicarbonate (well 40/33-22D1), and various combinations of these types.

The high sodium content of much of the water was apparently derived from the lake sediments underlying the valley floor. Lake Lahontan had no outlet, and inflow was balanced by evaporation, causing the waters to become increasingly saline. Precipitation of minerals from solution took place along with the deposition of clay and silt held in suspension in the lake water. The redundant chemistry of the Lahontan deposits is very complex and is beyond the scope of this report. In general, however, the principal minerals deposited were marl and tufa (CaCo3), gypsum ($CaSO_4$), and various complex chloride, sulfate, and carbonate salts of sodium. These salts are easily taken into solution again by ground water percolating through the sediments.

During periods of complete desiccation of the lake, the saline clays and the silts were buried beneath aeolian deposits, much as they are today in the dune areas and by encroachment of alluvium along the toes of the piedmont

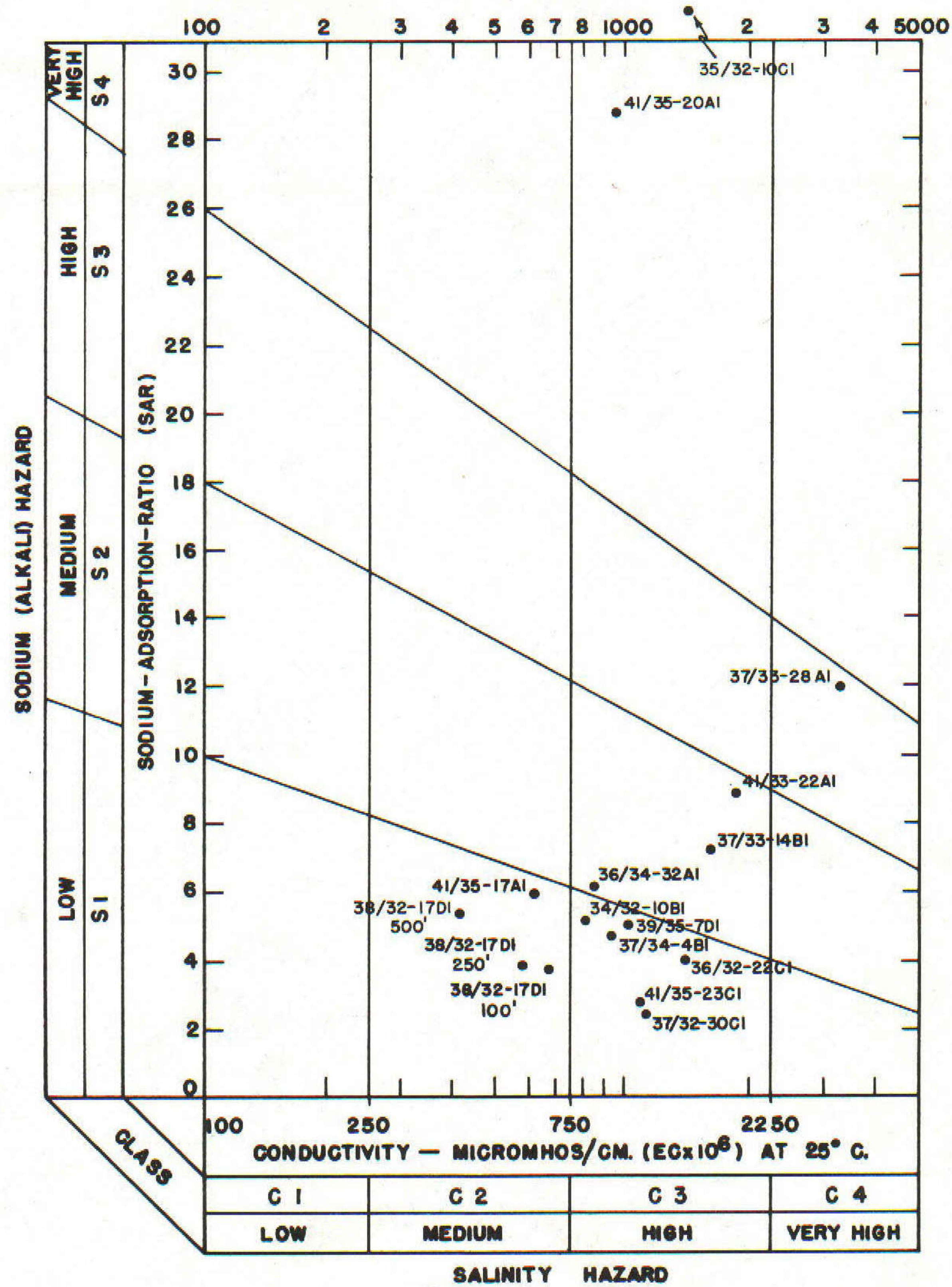

Figure 2. - - Classification of irrigation water on the basis of conductivity and sodium-adsorption-ratio.

slopes and off the mouths of the principal streams. Encroaching waters of the next lake stage then reworked these coarse-grained deposits into the well sorted sand and gravel layers that form the principal aquifers in the section of lake deposits. These aquifers contain very little soluble material, and water moves through them at a comparatively rapid rate from the recharge areas along the alluvial slopes. Even when overlain by saline deposits these aquifers may yield comparatively fresh water to wells.

The variation in the quality of ground water, as shown on plate 2 is due principally to the varied composition of the deposits tapped by different wells and to the length of time the water has been in contact with the sediments.

The diagrams on plate 2 also indicate that five wells in the valley yield water of objectionable quality for irrigation and two others are marginal. The principal causes of poor quality of the water are high sodium and residual sodium carbonate. Water from two of the wells, which is classified as objectionable on these counts, also contains excessive amounts of boron (table 3).

Three chemical analyses were made of water from well 38/32-17D1. The water was obtained by means of a special sampling device from depths of 100, 250, and 500 feet. The well, whose casing is perforated throughout its entire length below the water table, had not been pumped for several months prior to being sampled. Although the dissolved-solids content of the water appears to decrease with depth, the residual sodium carbonate increases. Thus the quality of the water for irrigation apparently deteriorates with depth. This may be due to upward leakage of sodium bicarbonate water from the deeper aquifers, which, judging from the driller's log (table 4), are not the principal aquifers. Further investigation is needed to explain the differences in mineralization that apparently exist at various depths in this well.

Well 40-33-22D1 yields relatively fresh water of the calcium-bicarbonate type and is of very good quality for irrigation. This water probably represents the type of ground water present in the alluvial slopes that has not come into contact with the soluble evaporite deposits of the valley fill.

Water for domestic use:

Most of the water from wells in Desert Valley is within the limits prescribed for drinking water by the U.S. Public Health Service (1961). The notable exception to this is the high concentration of fluoride and arsenic in water from well 35/32-10C1 at Jungo.

Temperature:

The temperature of water from wells sampled in Desert Valley averaged about 60°F and ranged from 53° to 67°F, except for the water from well 41/35-20A1, which is 80°F. The temperature of the water from several springs that were checked, ranged from 55° to 59°F and averaged about 58°F.

CONCLUSIONS

The best sources of ground water in Desert Valley are the sand and gravel aquifers buried within the less permeable deposits of the valley fill. These aquifers probably are most productive along the margins of the valley floor, and particularly opposite the mouths of canyons where streams have created channels filled with coarse, well-sorted material at various depths within the lake sediments underlying the valley floor.

The estimated average annual recharge to the ground-water reservoir of Desert Valley is on the order of 5,000 acre-feet. The perennial yield, which is the amount of water than can be salvaged from natural discharge, may approach this figure, depending on the areas developed and the conservation measures that are used.

The estimated amount of recoverable ground water in storage in the valley is about 40,000 acre-feet per foot of saturated sediments. Although some ground water must be withdrawn from storage to induce movement of water toward a pumping well, the long-term net draft on the ground-water reservoir should not exceed the perennial yield, if a long-term decline in water levels and a large depletion of the water in storage are to be avoided.

Chemical analyses indicate that much of the ground water in Desert Valley is suitable for irrigation and domestic use. The water becomes highly mineralized toward the central part of the valley, however, and excessive pumping near the margins of the valley could reverse the gradient of the water table and induce mineralized water to flow toward the area of pumping.

Future development of ground water appears to be most promising along the lower piedmont slope, flanking the northern half of the Jackson Mountains. This area receives a large share of the total recharge to the valley, much of which probably could be intercepted before it moves into the saline sediments comprising the younger alluvium.

TABLE 4

Driller's log of wells in Desert Valley,
Humboldt and Pershing Counties, Nevada.

	Thickness (feet)	Depth (feet)
42/34-26D1		
Topsoil and sand	10	10
Clay	90	100
Clay, sandy, and gravel	25	125
Clay	45	170
Clay and sand	35	205
Sand	25	230
41/33-4B1		
Adobe, yellow	30	30
Sand, brown, water-bearing	17	47
Clay, blue	16	63
Sand, blue	2	65
Sand, blue, water-bearing	22	87
Clay, gray	23	110
Sand, brown, water-bearing	7	117
Clay, brown, water-bearing	5	122
Sand, brown	21	143
Clay, brown	7	150
Clay, brown	7	157
Clay, sandy, yellow	40	197
Clay, hard, brown	11	208
Clay, sandy, brown	35	243
Clay, brown	13	256
Clay, yellow	11	267
Quicksand, brown	29	296
Clay, yellow	6	302
Sand, gray	11	313
Clay, yellow	37	350
41/35-17A1		
Clay, and talc	26	26
Sand and clay, water-bearing	4	30
Clay, and talc	2	32
Hardpan	2	34
Sand, some clay	14	48
Clay, hard	2	50
Sand, some clay	8	58
Limestone, blue (?)	22	80
41/34-8B1	32	32
Clay, sandy, brown, water-bearing	13	45
Clay, blue	15	60
Gravel, blue	21	81
Gravel, blue and clay	21	102
Clay, sandy, gray	21	123
Clay, sandy, blue	3	126
Sand, blue, water-bearing	15	141
Clay, blue	17	158
Sand, coarse, brown, water-bearing	11	169
Clay, blue	12	181
41/34-8C1		
Clay, gray, gypsiferous	18	18
41/34-13D1		
Adobe, yellow	18	18
Shale, blue	18	36
Clay, yellow, cave	9	42
Not reported	28	70
Blue	30	100
Sand, blue	15	115
Clay, brown	12	127
Clay, sandy, brown	18	145
Gravel, coarse sand	8	153
Sand, coarse	7	160
40/33-7A1		
Soil	4	4
Alluvium, some gravel	8	12
Clay	2	14
Clay, consolidated, red	44	58
Rhyolite breccia (unconformity at 90 ft.), some water at 60 ft.	32	90
Argillite, blue	7	97
Argillites, gneisses, and meta-volcanics, water from 97-130 feet	33	130

TABLE 4 (continued)

	Thickness (feet)	Depth (feet)
41/35-20A1		
Clay and silt	20	20
Sand, and clay, water-bearing	10	30
Sand, fine	3	33
Sand, clay streaks	12	45
Quicksand	13	58
Sand and clay	5	63
Sand, fine, and clay	4	67
Sand, flowing	15	82
Sand and gravel	9	91
Sand, fine	3	94
Gravel and sand	16	110
Conglomerate, tight	2	112
40/33-22D1		
Topsoil	4	4
Gravel, cemented	6	10
Clay, gray	7	17
Gravel	109	126
Sand and gravel	5	131
Clay with gravel	39	170
Clay	4	174
Gravel, loose	6	180
Clay and gravel	26	206
Clay, hard	2	208
Sheet rock	2	210
Gravel, cemented	32	242
Clay, hard	14	256
Clay, joints	14	270
Clay, yellow, and sheet rock	60	330
Lava rock	15	345
Set rock	15	360
Shale, blue	36	396
Clay, sandy	4	400
Lava rock, loose	5	405
Set rock	13	418
Lava, black sand	7	425

	Thickness (feet)	Depth (feet)
40/33-7A1 (continued)		
Greenstone, some intercalated clay	127	257
Altered diabase (?) and clay	27	284
Clay	39	323
Diabase	2	325
40/33-7A2		
Alluvium	22	22
Volcanic tuff	248	270
Altered rhyolite	55	325
Diabase dike	3	328
39/32-13D2, drilled into spring		
39/32-13D1		
Basalt, medium brown	5	5
Basalt, hard, black water came in at 19 feet and rose to 7 feet	14	19
Basalt, very tight	33	52
39/33-13C1		
Sandy clay	40	40
Sand, fine (40% .006)	20	60
Gravel, fine to coarse with 2 ft. of blue mud at bottom	27	87
39/33-20C2		
Clay, gravel & boulders	40	40
Siliceous rock	8	48
Gravel, large (2-inch), and sand (heaving)	31	79
39/33-20C3		
Not reported	40	40
Sand, cemented, hardpan	23	63
Clay, light green	27	90
Sand, coarse, and gravel strata	20	110
Clay, dark green	2	112

TABLE 1—RECORD OF WELLS IN DESERT VALLEY, HUMBOLDT AND PERSHING COUNTIES, NEVADA

Use of Water: C, construction; D, domestic; Ind., industrial; I, irrigation; O, observation; RR, railroad; S, stock.

Water level: M, measured; R, reported.

Altitude: Determined from altimeter readings.

Remarks: Number is log number in files of State Engineer.

Well No. and location	Owner	Date drilled	Diameter (inches)	Depth (feet)	Depth of principal aquifers (feet)	Measuring Point: Altitude (feet)	Measuring Point: Above land surface (feet)	Measuring Point: Description	Water Level: Below measuring point (feet)	Water Level: M or R	Water Level: Date	Use	Remarks
42/34-26D1	U. S. Bureau of Land Management	—	8	230	—	—	0.5	Top of pipe clamp	12.3	M	5- 4-61	S	Log
41/33-4B1	—	9-49	8	350	110-122	4,098	1	Top of casing	3.6	M	4-27-61	C, S	Log; 1204
41/33-22A1	—	—	—	—	—	4,127	.5	Concrete pump base	21.4	M	5- 4-61	S	Chemical analysis
41/33-34A1	—	—	—	—	—	—	—	—	—	—	—	—	—
41/34-8B1	—	8-49	8	181	126-141	4,117	2	Top of casing	9.9	M	4-27-61	C	Log; 1203
41/34-8C1	U. S. Geological Survey	6-61	4	18	14-17	4,118	1	Top of casing	14.6	M	6- 4-61	O	Log
41/34-13D1	—	8-49	8	160	145-160	4,121	0	Top of casing	10.9	M	4-27-61	C	Log; 1202
41/35-17A1	Sod House Ranch	8-50	16	80	50-58	—	—	—	11.5	R	8-28-50	I	Log; 1597, chemical analysis
41/35-20A1	Sod House Ranch	—	16	112	82-110	—	1	Top of casing	4.1	R	4-12-51	I	Log; 1596
41/35-23C1	—	—	6	27	10-27	4,126	—	—	—	—	—	S	Chemical analysis
40/33-7A1	Triangle Mine	1-57	8	325	97-130	—	—	—	45	R	1- 4-57	D, I, Ind.	Log; 3647
40/33-7A2	Triangle Mine	1-57	9	328	270-325	—	—	—	39	R	1- -57	D, Ind.	Log; 4051
40/33-22D1	Bottle Creek Ranch	11-50	16-14	425	17-131	4,164	—	—	47	R	11-28-50	I	Log; 1892
40/33-23C1	Bottle Creek Ranch	—	—	—	—	—	—	—	—	—	—	I	—
40/33-26B1	Bottle Creek Ranch	—	12	—	—	—	.5	Top of casing	33.8	M	4-27-61	I, S	Not used, heavy pumping nearby
40/35-16A1	U. S. Bureau of Land Management	—	8	—	—	4,150	1	Top of pipe clamp	31.4	M	4-11-61	S	—
40/35-29C1	—	—	—	50	—	4,157	0	Concrete pump base	39.2	M	4-11-61	S	—
39/32-13D2	A. DeLong	12-46	—	52	—	—	—	—	—	—	—	D, S	—
39/32-35D1	McKirning	—	—	65	—	—	—	—	45	R	10-28-60	D, S	—
39/33-13C1	A. DeLong	11-46	—	87	60-85	4,139	2.3	Casing cap	24.6	M	4-26-61	S	Log
39/33-20A1	A. DeLong	—	10	130	90	4,159	1	Casing cap	31.4	M	4-26-61	S	—
39/33-20C1	A. DeLong	—	10	60	60	—	—	—	—	—	—	D	—
39/33-20C2	A. DeLong	11-43	10	79	48-79	4,177	0	Hole in pump	44.1	M	4-27-61	S	Log
39/33-20C3	A. DeLong	—	6	112	90-110	4,143	1	Top of casing	24.4	M	4-27-61	S	Log; 1496
39/33-26B1	—	—	6	87	65-85	4,146	1	Wood pump base	26.9	M	4-26-61	S	Log
39/33-33D1	—	11-46	—	95	70-80	4,150	0	Concrete pump base	28.3	M	4-26-61	S	Log
39/35-7D1	—	—	—	—	—	4,215	—	—	—	—	—	S	—
38/32-17C1	Bill DeLong	—	16	206	—	—	—	—	—	—	—	I	Not used
38/32-17D1	Bill DeLong	6-59	16-14	575	68-244	4,254	0	Top of casing	62.1	M	4-14-60	I	Log; 4979, not used
38/32-20A1	Bill DeLong	6-49	6	66	54-66	4,246	0	Concrete pump base	48	M	4-26-61	S	Log; 923
38/32-20A2	Bill DeLong	1,930±	6	300	—	4,251	0	Slot in casing	54.6	M	4-26-61	D, S	—
38/32-28A1	—	—	60	92	—	4,161	0	Wood cribbing	41.3	M	4- 8-61	D, S	Not used
38/32-28A2	—	—	8	—	—	4,161	.5	Wood pump base	41.9	M	4- 8-61	D, S	Not used
38/32-29B1	W. G. Austin	3-56	10	100	50-59	4,178	.5	Slot in casing	37.2	M	4- 8-61	Ind.	Log; 3372
38/32-35C1	—	—	—	53	—	4,174	0	Wood pump base	31.3	M	4- 8-61	S	Not used
38/33-21A1	U. S. Bureau of Land Management	—	—	45	—	4,147	.5	Wood pump base	35.3	M	4-26-61	S	—
38/34-1B1	U. S. Bureau of Land Management	—	8	—	—	4,158	.5	Wood pump base	52.5	M	4-11-61	S	—
38/34-16C1	—	—	8	55	—	4,139	0	Wood pump base	32.5	M	4-14-60	S	—
38/34-24B1	U. S. Bureau of Land Management	—	8	70	—	4,179	.5	Top of casing	66.7	M	4-11-61	S	—
37/33-14B1	U. S. Bureau of Land Management	—	8	—	—	4,160	0	Top of 4-inch block	—	M	3-11-60	S	—
37/33-28A1	U. S. Bureau of Land Management	—	—	—	—	4,150	0	Top of 4-inch block	34.8	M	4- 8-61	S	—
37/34-4B1	—	—	8	43	—	4,132	0	Top of 2-inch pipe elbow	16.5	M	4- 8-61	S	—
37/34-21C1	—	—	8	77	—	4,159	.5	Top of casing	42.6	M	4-14-60	S	—
37/34-23B1	—	—	8	—	—	—	.5	Top of casing	24.7	M	6- 3-61	S	—
37/34-34C1	—	—	—	—	—	—	.3	Top of 4-inch block	62.1	M	6- 3-61	S	—
36/32-22C1	U. S. Bureau of Land Management	2-60	6	140	90-93	4,168	1	Top of casing	55.5	M	4- 6-61	S	Log; 5669
36/34-5C1	U. S. Bureau of Land Management	—	14	53	—	4,168	0	Top of casing	49.1	M	4- 8-61	S	—
36/34-22A1	U. S. Bureau of Land Management	44	—	80	40-80	—	—	—	—	—	—	S	Log
36/34-30D1	—	—	—	—	—	4,172	0	Top of pipe clamp	58.8	M	4- 8-61	S	—
36/34-32A1	—	—	—	94	—	4,187	1	Top of 4-inch block	71.3	M	4- 7-61	S	—
35/32-10C1	Western Pacific Railroad	—	—	500	336-348	4,163	—	—	60	R	1961	RR	Log
34/32-10B1	U. S. Bureau of Land Management	11-57	6	153	145-153	4,183	3	Top of casing	75.2	M	4- 6-61	S	Log; 3959
34/33-6A1	U. S. Bureau of Land Management	3-36	8	97	84-89	—	—	—	54	R	3-26-36	S	Log; 302

TABLE 2—RECORD OF SPRINGS IN DESERT VALLEY, HUMBOLDT AND PERSHING COUNTIES. NEVADA

Use: D, domestic; S, stock; I, irrigation. Altitude: Determined from altimeter readings. Discharge is estimated.

Spring No.	Name	Probable source	Discharge (gpm)	Date	Altitude	Use	Temperature (°F)	Remarks
41/33–29B1	----	volcanic rocks	2	2–23–61	4,600	S	55	Piped to stock tanks; spec. cond. 1,100 micromhos
40/32–11D1	----	----	----	----	----	----	----	
40/32–12C1	McAdoo	----	----	----	----	----	----	
40/33–5C1	----	----	----	----	----	----	----	
40/33–8B1	Baldwin	----	small	10–30–61	4,700	S	57	Piped to stock tanks; spec. cond. 700 micromhos
40/33–19A1	----	alluvium	small	10–30–61	4,700	S	----	
40/33–29B1	Bottle Creek	alluvium	10±	10–30–61	4,750	D, S	----	Piped to Bottle Creek Ranch
40/35–36B1	Camp	----	----	----	----	----	----	
39/32–2A1	Shanks	----	----	----	----	----	----	
39/32–13D1	Delong	basalt	2	2–23–61	4,700	S	----	Piped to stock tank; spec. cond. 700 micromhos
39/32–27D1	Willow Creek	alluvium	----	----	----	S, I	----	
39/33–7A1	----	----	2	----	4,450	S	59	Spring mound; spec. cond. 1,000 micromhos
37/31–1B1	Rattlesnake	----	----	----	----	----	----	
37/31–15A1	Clear	----	----	----	----	----	----	
37/32–30C1	Dunnisher	----	7	2–23–61	4,650	S	59	Pipe driven into seep area; chemical analysis
37/34–4B2	----	valley fill	----	----	4,120	S	----	Sump in dune area
37/34–19A1	----	valley fill	----	----	4,110	S	----	Sump in dune area
36/32–5B1	Strebor	----	----	----	----	----	----	
36/35–6D1	Rose Mountain	----	1	8–11–61	5,000±	S	----	Piped 2 miles to stock tank in Ne¼ sec. 3, T. 36 N., R. 34 E.
35/33–36D1	Corral	----	----	----	----	----	----	

TABLE 3—CHEMICAL ANALYSES OF GROUND WATER IN DESERT VALLEY, HUMBOLDT AND PERSHING COUNTIES, NEVADA

(Analyses by U. S. Geological Survey unless otherwise stated. Constituents in parts per million. For further information on classification for irrigation, see fig. 2 and p. 11.)

Well or spring number	Date collected	Temperature (°F)	Specific conductance (micromhos at 25°C)	Dissolved solids (ppm)	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Hardness as $CaCO_3$	Hardness Non-Carbonate	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)—(epm)	pH	
41/33-22A1	10-30-60	55	1930	....	....	48	29	326	18	0	305	....	280	....	....	....	240	0	9.2	0.20	7.9	
41/35-17A1	6-23-59	....	622	431	69	22	3.9	116	+	....	200	64	54	1.0	.8	.31	70	0	6.1	1.9	7.9	Aluminum, 1.5
41/35-20A1	10-26-54	80	941	541	4.8	2.2	.8	197	18	36	211	70	106	1.4	.2	....	9	0	28.6	4.55	9.0	Manganese, .23 ; Zinc, 1.2
41/35-23C1	10-29-54	53	1130	720	59	83	29	120	12	....	369	114	118	.9	2.4	....	326	24	2.9	0	7.2	Manganese, 1.6 ; Zinc, 2.0
40/33-22D1	8- 6-61	53	566	....	....	58	17	30	1.5	0	276	32	22	....	....	....	214	0	.9	0	7.8	
39/35-7D1	2-26-61	67	1000	640	63	46	9.7	146	12	0	204	94	157	.3	2.2	.87	154	0	5.1	.26	7.8	
38/32-17D1	2-27-61	60	675	431	46	38	7.1	98	8.8	0	224	43	80	.8	2.5	.56	124	0	3.8	1.19	7.8	Sampled at 100 feet
38/32-17D1	2-27-61	60	589	385	55	30	4.6	90	9.4	0	215	31	61	1.0	2.7	.53	95	0	4.0	1.62	7.7	Sampled at 250 feet
38/32-17D1	2-27-61	66	425	301	52	14	1.0	78	10	0	208	17	22	1.1	1.0	.67	38	0	5.5	2.65	8.0	Sampled at 500 feet
37/32-30C1	2-27-61	59	1200	763	44	101	24	106	8.3	0	199	114	214	.2	3.6	.59	350	187	2.5	0	7.2	
37/33-14B1	10-28-60	55	1680	....	49	63	21	264	14	0	208	235	290	.7	.6	.9	244	73	7.4	0	7.7	
37/33-28A1	2-26-61	58	3440	2230	41	117	38	606	22	0	235	599	680	.6	.5	3.0	448	255	12	0	7.7	
37/34-4B1	2-26-61	56	925	606	49	48	8.5	136	10	0	222	126	90	.9	21	.89	155	0	4.8	.54	7.7	
36/32-22C1	2-27-61	59	1370	773	16	55	41	164	5.9	0	233	88	274	.5	.3	.81	304	113	4.1	0	7.6	
36/34-32A1	2-26-61	59	858	532	29	28	8.8	147	8.2	0	250	103	85	.6	3.2	1.1	107	0	6.3	1.96	8.0	
36/34-32A1	11- 1-60	....	806	....	....	24	7.5	143	6.8	0	238	....	75	....	....	....	91	0	6.5	2.08	8.0	
35/32-10C1	2-26-61	....	1680	1070	60	7.2	2.4	391	6.6	9	570	88	210	2.9	.5	3.3	28	0	32	9.08	8.4	Arsenic, .18*
34/32-10B1	2-26-61	....	814	520	62	37	5.1	129	4.8	4	152	85	124	.6	.6	1.0	113	0	5.3	.36	8.4	

*Analysis by Abbott A. Hanks, Inc., San Francisco, 1936, for Western Pacific R.R. Co.

TABLE 4 (continued)

	Thick-ness (feet)	Depth (feet)
39/33-26B1		
Sand, fine, and clay	40	40
Sand, too fine for perforations	25	65
Gravel, coarse	20	85
Mud, blue	2	87
39/33-33D1		
Sand, fine, water at 40 ft.	40	40
Sand, white, 36% pans .006 screen	20	60
Sand, white, and fine gravel	10	70
Sand, white, and coarse gravel	10	80
Mud, blue, and coarse gravel	12	92
38/32-29B1		
Topsoil, sandy clay	8	8
Clay, soft, yellow	9	17
Clay, soft, with gravel	18	35
Gravel, fine, cemented	15	50
Gravel, pea size, loose, clean	9	59
Clay and gravel conglomerate	21	80
Gravel, fine, clean	8	88
Clay, hard	4	92
Gravel, coarse, clean	8	100
36/32-22C1		
Topsoil and clay	33	33
Quicksand	8	41
Clay, sticky, yellow	34	75
Clay, brown, and gravel	18	93
Clay, sticky, yellow	47	140
38/32-17D1		
Topsoil, sandy loam	9	9
Clay	9	18
Gravel, loose, dry	15	33
Clay	11	44
Gravel, loose, dry	19	63
Clay	5	68
Gravel, loose	25	93
Gravel, cemented	11	104
Gravel, loose	12	116
Gravel and clay, hard and dry	38	154
Clay, soft	32	186
Gravel, loose	18	204
Gravel, cemented	19	223
Gravel, loose	21	244
Clay, hard, blue, few layers fine sand	331	575
38/32-20A1		
Clay	12	12
Gravel	11	23
Clay	27	50
Gravel, coarse	16	66
35/32-10C1		
Adobe	40	40
Clay, yellow	68	108
Clay, blue	10	118
Clay, yellow (184 feet shows water)	107	225
Clay, hard, blue	21	246
Clay, soft, yellow	10	256
Clay, blue	24	280
Sand	4	284
Clay, soft, mushy	4	288
Clay, sandy, soft, with small hard streaks, some blue streaks	12	300
Clay, hard, blue	36	336
Clay, soft, brown (water)	12	348
Clay, yellow	40	388
Clay, fine, hard	70	458
Clay, sandy, soft, yellow	2	460
Clay, hard, yellow	40	500

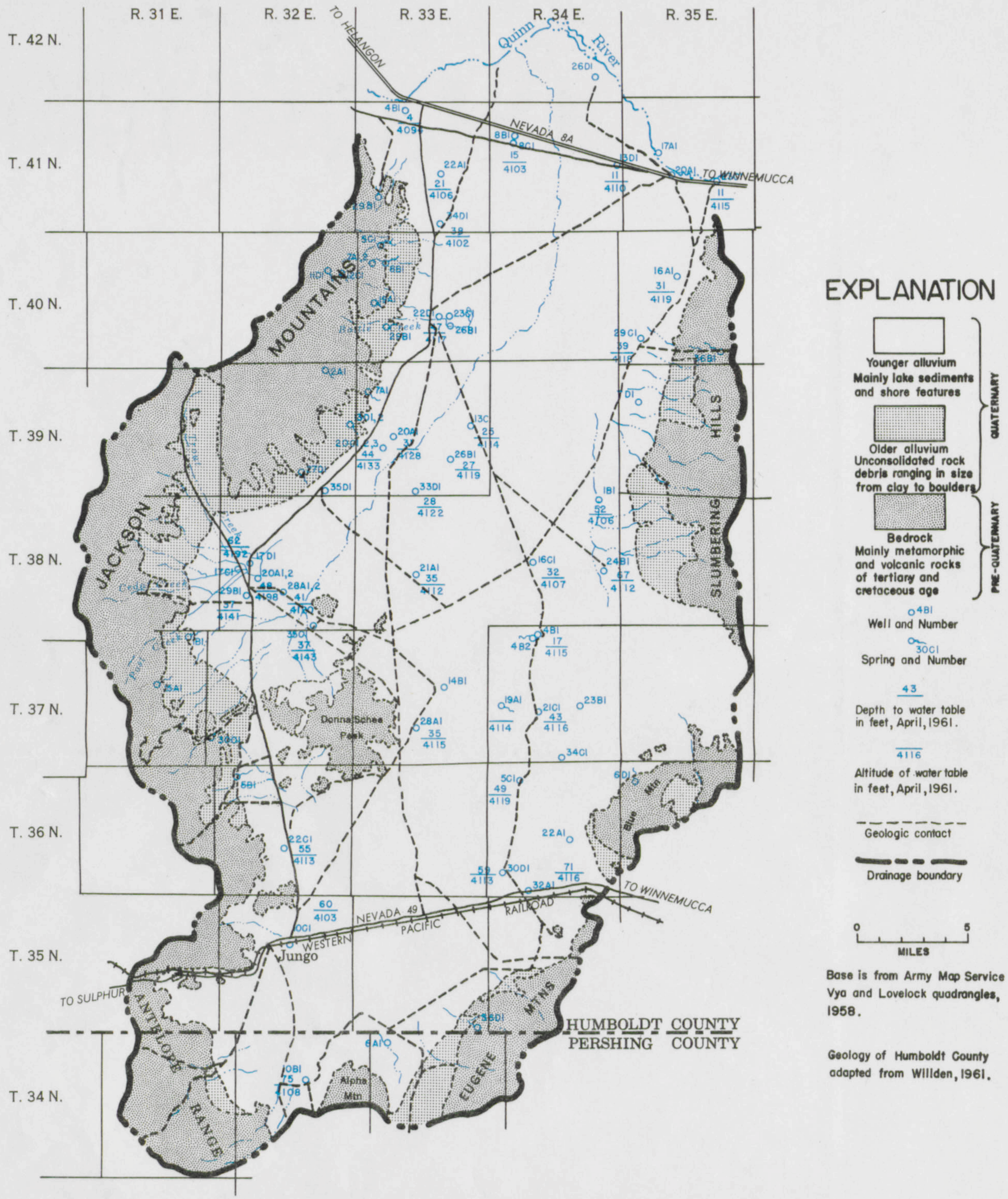

Plate 1—Generalized geologic and hydrologic map of Desert Valley.

William C. Sinclair (1961)

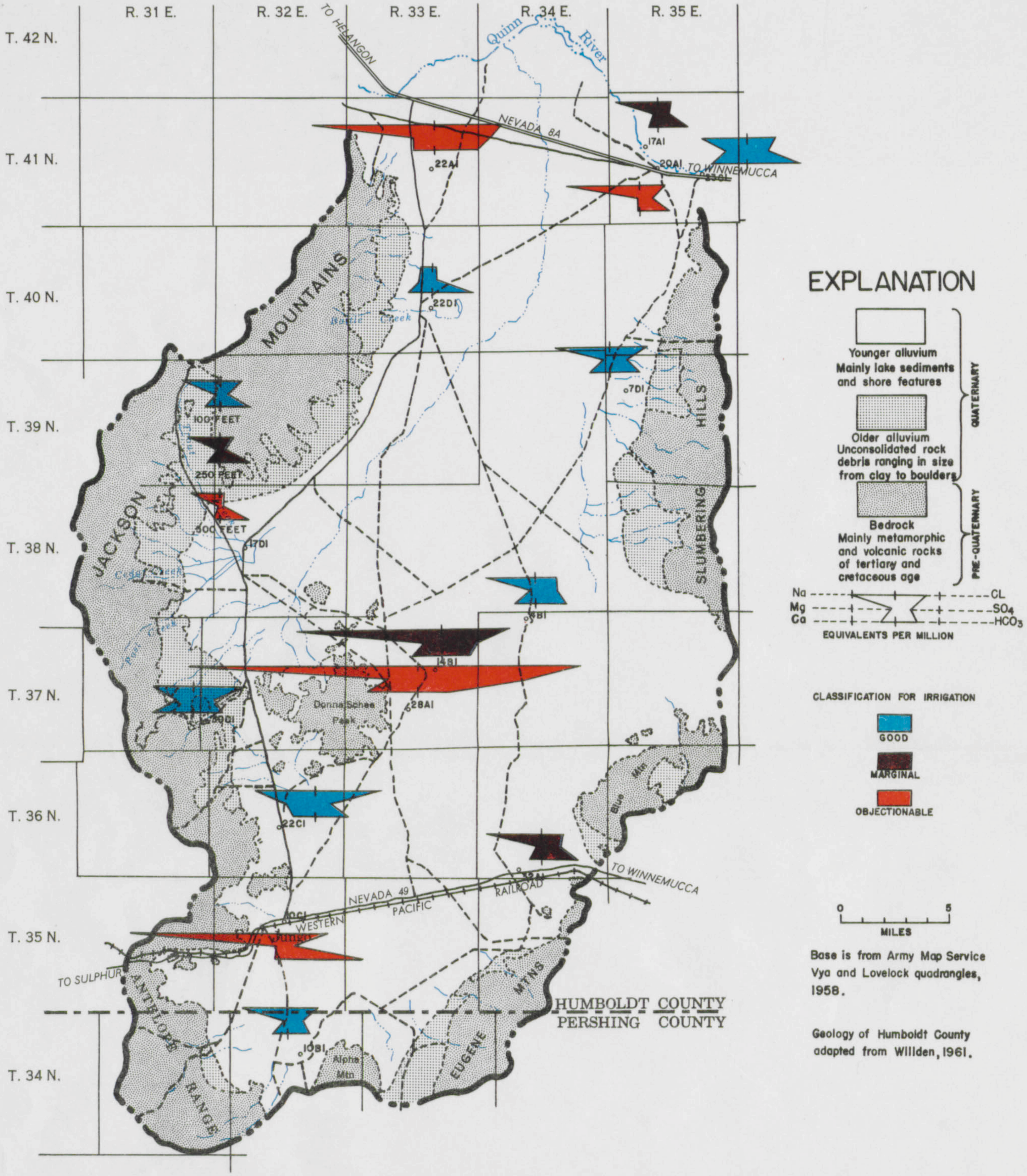

Plate 2—Diagrams showing chemical quality of ground water in Desert Valley.

William C. Sinclair (1961)

TABLE 4. (continued)

	Thickness (feet)	Depth (feet)
36/34-22A1		
Topsoil and sand	10	10
Sand	20	30
Sandy gravel	10	40
Gravel, fine	40	80
34/32-10B1		
Topsoil	2	2
Clay	44	46
Clay and sand	38	84
Sand	4	88
Sand and clay	32	120
Sand	6	126
Clay and sand	6	132
Sand	8	140
Clay	5	145
Gravel and sand	8	153

	Thickness (feet)	Depth (feet)
34/33-6A1		
Soil, soft, gray	3	3
Gravel, medium, gray	4	7
Clay, soft, yellow	33	40
Sandy clay, soft, yellow	44	84
Sand, soft, gray (water)	5	89
Clay, soft, yellow	8	97

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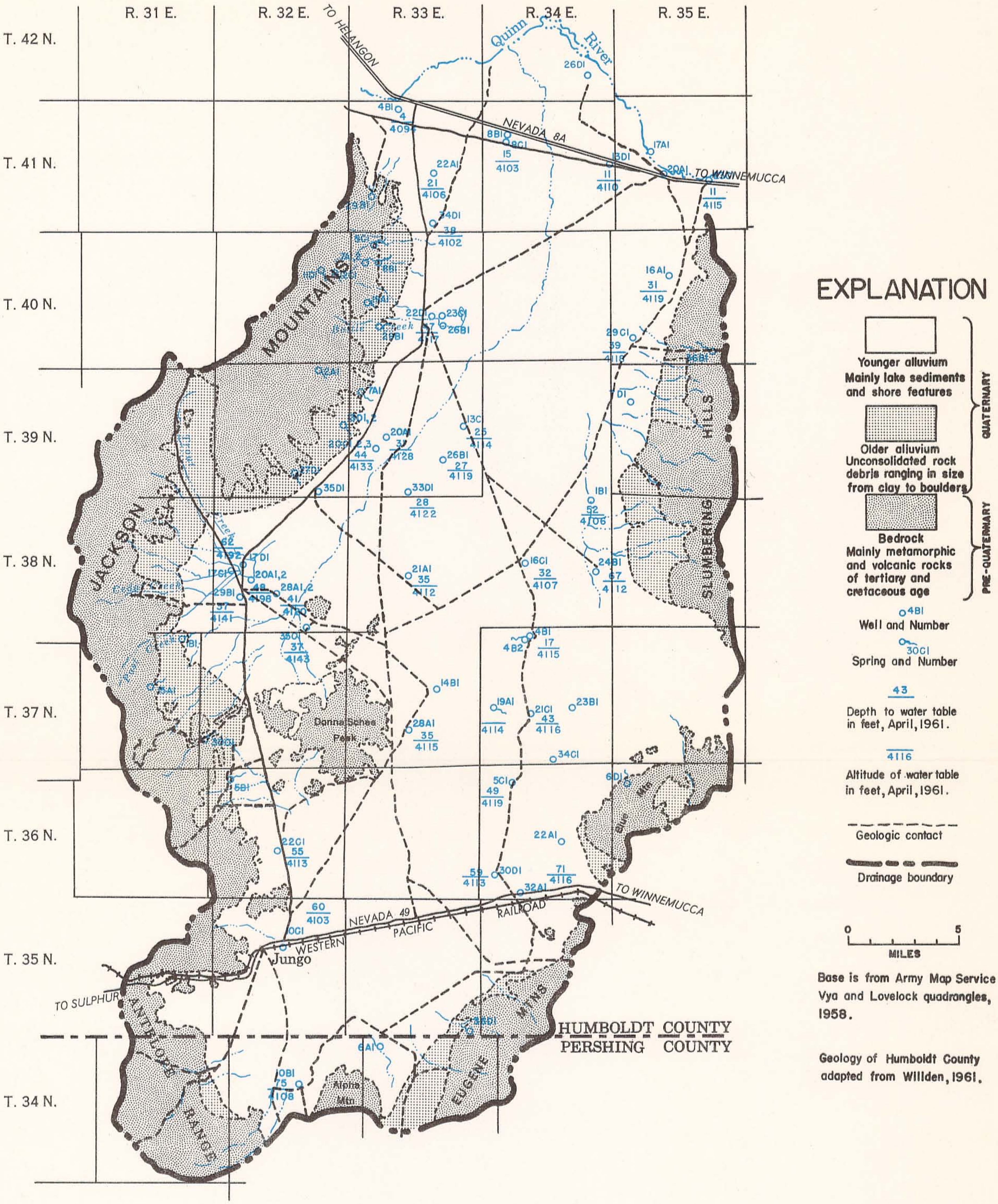

Plate 1—Generalized geologic and hydrologic map of Desert Valley.

William C. Sinclair (1961)

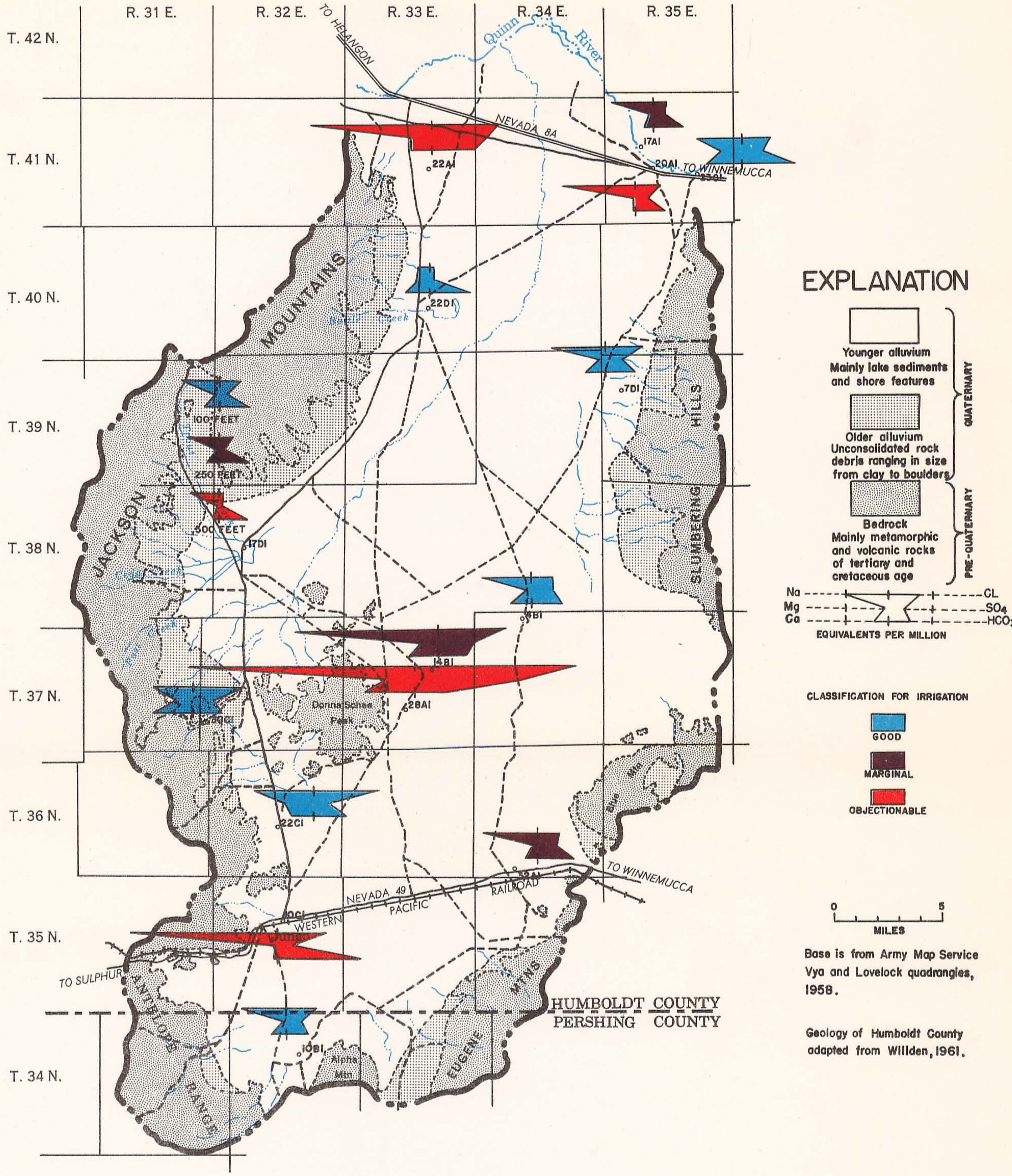

Plate 2—Diagrams showing chemical quality of ground water in Desert Valley.

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