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OFFICE OF THE STATE ENGINEER

WATER RESOURCES BULLETIN No. 2

GROUND WATER IN LOVELOCK VALLEY, NEVADA

By
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FOREWORD

In conformance with an agreement entered into in July 1944 between the State Engineer of Nevada and the Director of the Geological Survey, U. S. Department of the Interior, a cooperative investigation of the ground-water resources of the Las Vegas Artesian Basin was begun in the summer of 1944. The more important results of this investigation have been summarized in a report by George B. Maxey and C. H. Jameson entitled "Progress Report on the Ground Water Resources of the Las Vegas Artesian Basin, Nevada," published in March 1945.

The forty-second session of the Legislature in 1945 made an appropriation of $35,000 for the biennium, to be matched by an equal amount by the Geological Survey, for a State-wide investigation of ground-water resources. A careful investigation of each of the valleys in the State is planned by the cooperating agencies, with a view to developing ground-water resources. There are a large number of arid and semiarid valleys, the careful investigation of which will require a period of years.

The program for the State Engineer is under the supervision of Hugh A. Shamberger, Assistant State Engineer, a highly efficient engineer of wide experience who has devoted years of study to Nevada's water problems and who has been responsible for the initiation of these investigations. The program of ground-water studies is conducted by the Geological Survey under the direction of Thomas W. Robinson, District Engineer in Nevada, for the Ground Water Division of the Geological Survey, with headquarters in Carson City. The State is fortunate that the Geological Survey has assigned a man to this work who has had much experience in the western States and is well qualified to handle the investigations of ground-water problems in Nevada.

All surface water in all streams has been appropriated, and if additional land is to be developed it must be by wise conservation of existing waters, and by drawing upon the underground-water resources. It is believed this program, if continued through support of the State Legislature and the Geological Survey, will lead to full development of the unexplored and unknown ground-water resources of the State.

This report is the first resulting from the State-wide investigation, and the second of a series to be known as Nevada Water

Resource Bulletins. As soon as the results of other individual ground-water studies become available, each will be published as units in the series.

ALFRED MERRITT SMITH,
State Engineer.

April 16, 1946.

GROUND WATER IN LOVELOCK VALLEY, NEVADA

By T. W. Robinson and J. C. Fredericks

INTRODUCTION

Lovelock Valley lies about 100 miles northeast of Reno, Nevada. The Humboldt River flows through the valley and empties into Humboldt Lake at the lower end of the valley. The principal city in this valley is Lovelock, which is on U. S. Highway 40 and the Southern Pacific Railroad. (See plate 1.) It is a center for farming and stock raising activities of the Lovelock Valley as well as for mining activities of the adjacent mountainous area. The population was 1,294 in 1940 and doubtless was somewhat greater in 1945.

The present water supply for the city of Lovelock is obtained from both surface and ground-water sources. The surface water supply comes from streams in three canyons, namely, Wright, Pole, and Wildhorse Canyons. These streams drain the west side of the high portion of the Humboldt Range, about due east of Oreana, and 16 to 19 miles northeast of Lovelock. The ground-water supply comes from two wells sunk in the alluvial material about opposite the mouth of Sacramento Canyon, and about 1½ miles west of the base of the Humboldt Range. The wells are used largely as a standby supply and generally are pumped in the summer months when the surface flow in the canyon streams is low, or during emergencies.

In 1945, and for a few years previous, the water supply for Lovelock was insufficient for the city's needs and the needs of the farms adjacent to the city. The shortage was felt most during the summer when the use was high. The present demand for water by the city and inhabitants of the surrounding area is estimated to be about one million gallons a day, but twice this amount is desirable to insure an adequate supply for a future growth.

The present report on the ground-water resources of the valley is a part of a State-wide program conducted in cooperation between the State Engineer and the United States Geological Survey.

GENERAL TOPOGRAPHIC FEATURES

Lovelock Valley which has a slight northeasterly trend, lies between two mountain ranges, the Trinity Range on the west, and the Humboldt Range on the east. For the purpose of this report, Lovelock Valley is considered to extend from the vicinity of Humboldt, at the north end of the Humboldt Range, to the vicinity of Ocala to the south. (See plate 1.) The valley is approximately 65 miles in length and between 6 and 12 miles in width. The Humboldt River enters the valley from the north end and drains into Humboldt Lake at the extreme south end of the valley.

The lower, or southern half of the valley, south from Woolsey, is ten to twelve miles wide and relatively flat, while the northern half of the valley narrows to six to eight miles in width. In this part of the valley lacustral and alluvial sediments of the valley floor have been moderately to deeply dissected by the entrenched Humboldt River and its tributary drainage. The valley floor slopes from an elevation of about 4,300 feet at the northern end to about 3,900 feet at the broader flat southern end.

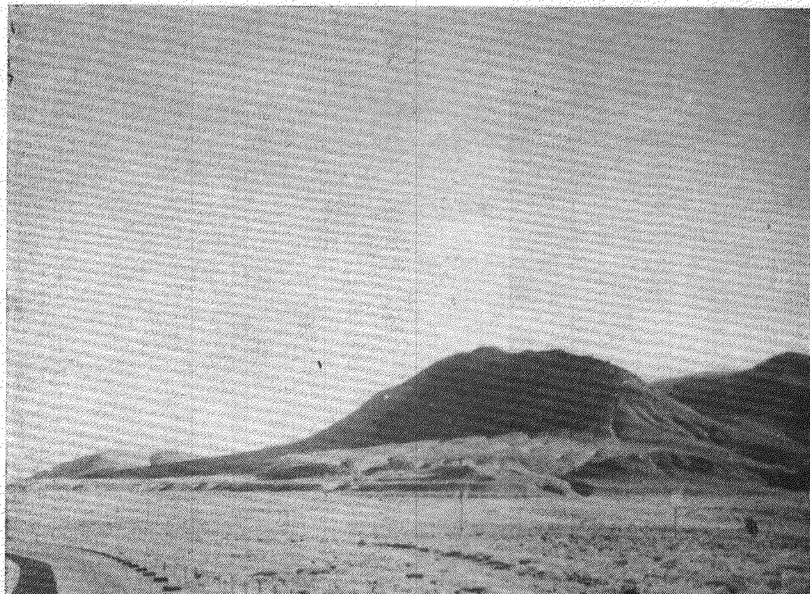
The Humboldt Range consists of two elongated mountain masses, with the northern part of the range en echelon to the east of the southern part. Starting at Oreana, fifteen miles north of Lovelock, the northern part of the range rises to an elevation of about 9,000 feet, or about 4,500 feet above the valley floor. The southern part of the range is much lower, rising to a maximum elevation of 6,419 feet, or only about 2,500 feet above the valley floor.

The Trinity Range to the west rises to a maximum elevation of 7,332 feet with the average elevation above the valley floor being about 3,000 feet.

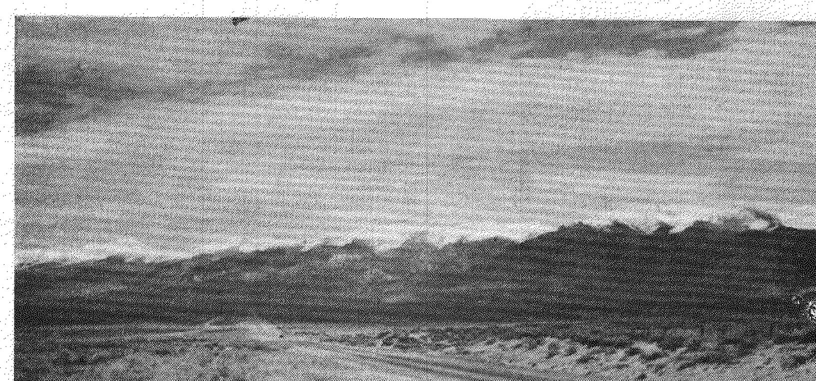
Along the eastern, western, and southern borders of the valley there are numerous well-preserved wave-cut terraces, gravel bars, and embankments which are topographic expressions of an ancient lake. About twenty miles south of Lovelock the ancient lake formed a barrier gravel bar which extends completely across the valley. This bar is about four and one-half miles long, one-fourth to one-half mile wide, and rises sixty to one hundred and twenty-five feet above the valley floor. Following the final dessication of the ancient lake, this barrier bar effectively dammed the Humboldt River to form Humboldt Lake, which periodically overflowed across the barrier and eventually cut a channel through the bar at its lowest point.

PRECIPITATION

The long-time record of precipitation at Lovelock shows that precipitation on the valley floor is low. The average annual precipitation at Lovelock, according to a fifty-four-year record by



Wave-cut terraces of ancient Lake Lahontan along the base of Woolsey Hill, about 10 miles northeast of Lovelock.



Snow line on the northern segment of the Humboldt Range, east of Oreana, April, 1945.

the U. S. Weather Bureau, is 4.23 inches, largely in the form of rains. The precipitation from year to year may range widely. The least recorded during the fifty-four-year period was 0.85 inches in 1905 and the greatest was 11.93 inches in 1925.

There are no records of precipitation in the adjacent mountain ranges, but undoubtedly it is greater than at Lovelock. The greatest snowfall occurs in the higher northern segment of the Humboldt Range, north from Oreana, where the snow frequently remains unmelted until late spring or early summer. The lower lying southern segment of the Humboldt Range, and the Trinity Range on the west side of the valley, receive only moderate to light snowfall. In the Trinity Range, especially, the snow does not remain long on the ground. As the greatest snowfall occurs in the northern segment of the Humboldt Range, the greatest runoff into the valley may be expected from this range.

GENERAL GEOLOGY

The rocks of the area may be divided into two general groups. These are (1) the older rocks of the adjacent mountains, and (2) the lake beds and alluvial deposits of the valley. The older rocks, which range from Triassic to Tertiary in age, are sedimentary, volcanic, igneous, and metamorphic. Included in this group are some alluvial deposits probably of Tertiary (?) age which occupy the upper part of the canyons of the mountain ranges. The physical characteristics of the older rocks, with the exception of the Tertiary (?) alluvium, indicate that they are not good water bearers, and the prospects of developing a large supply in them are poor. Water can doubtless be developed in the Tertiary (?) alluvium, but as the deposits are not extensive, they would soon become exhausted by long and continued pumping. For these reasons the older rocks will not be considered further as a source of water to increase the water supply of Lovelock. The lake beds and alluvial deposits, on the other hand, contain much good water-bearing material and are of prime importance as a source of ground water.

LAKE BEDS AND ALLUVIAL DEPOSITS

After an intensive geological investigation of a portion of the Basin and Range province, which included Lovelock Valley, I. C. Russell[1] determined that Lovelock Valley was occupied by a strait, or narrow channel of an extensive Quaternary Lake in

[1]Russell, I. C., Geological History of Lake Lahontan, a Quaternary Lake of Northwestern Nevada: U. S. Geol. Survey, Mon. 11, 1885.

northwestern Nevada, known as Lake Lahontan. Well-preserved beach terraces indicate that the high-water stage of Lake Lahontan was at an elevation of slightly more than 4,400 feet, which brings the shoreline almost up to, and in many places, actually against the base of the adjacent mountain ranges. Throughout the existence of Lake Lahontan, Lovelock Valley was the site of deposition of a considerable thickness of lacustrine marls, clays, silts, and sands, and coarser shallow-water or shoreline deposits.

The fine-grained sediments were generally deposited in the central or deeper part of the valley with occasional deposition of coarser sediments which were coincidental with periods of dessication of the lake. The fine-grained deposits of the central portion of the valley become increasingly coarse in the direction of the adjacent mountains, that is, toward the shores of Lake Lahontan.

During the period of its existence, the level of Lake Lahontan was not static, but rose and fell with periods of increasing or decreasing precipitation. As the water level of the lake rose and fell, the shoreline correspondingly advanced and retreated, which produced, respectively, shallow lake bed and alluvial deposition conditions. Around the borders of the ancient lake, there was produced a transition zone of interfingering layers of shallow lake beds and alluvial fan deposits.

Since the dessication of Lake Lahontan, recent alluvial deposits, eroded from the adjacent mountain ranges, have covered this transition zone along the eastern and western slopes of the basin. At the same time deposition by the Humboldt River and Humboldt Lake have covered the sediments in the relatively broad flat lower part of the valley.

GROUND WATER

The lake beds and alluvial deposits serve as a storage reservoir for the ground water in the valley. The total thickness of these deposits is unknown, but the few deep well logs (see table 1) that are available, show that they are at least several hundred feet thick.

There are two main and one minor sources of recharge to the lake beds and alluvial deposits. The two main sources are the Humboldt River and runoff from the adjacent mountains, and the minor source is the direct precipitation on the land surface. The spreading of Humboldt River water for irrigation in the central and lower parts of the valley presents an excellent opportunity for recharge. There is also the possibility of some recharge direct from the Humboldt River by percolation into ancient buried channels of that river. Runoff from the adjacent mountain ranges upon the alluvial fans along the margin of the valley causes recharge to the ground water by downward percolation through the coarse material of the fans. Recharge from this source is probably greatest on the east side of the valley, north of Oreana, where runoff from the Humboldt Range is greatest. In times of high runoff or floods, part of the runoff from the mountains reaches the valley floor as surface flow. Part of the runoff that percolates downward as ground water undoubtedly also reaches the valley floor by underflow through the alluvial fans.

The greater part of the ground water entering the valley is believed to be discharged by evaporation and transpiration in the southern part of the valley where the water table is near the surface. Some, no doubt, percolates into Humboldt Lake and is discharged by overflow to the south through the narrow channel in the barrier bar. There may be some percolation through the barrier bar, but the amount is not believed to be large.

In the central part of the valley, the water that may be recovered by wells occurs in sand and gravel layers of the predominantly fine-grained sediments. Along the margins of the valley, water occurs in a poorly sorted mixture of sand and gravel with varying amounts of finer material. Here there are few distinct layers of sand and gravel.

WATER TABLE

The water table in the relatively flat half of the valley south from Woolsey is near the surface. The spreading of Humboldt River water throughout the lower half of the valley for irrigation purposes has produced a high water table more widespread than would normally exist with the water of the Humboldt being confined to the river channel.

Water-level measurements, in the fall of 1945, indicated that the water table is within 2 to 15 feet of the land surface, depending upon the topography. The slope of the water table is southward toward Humboldt Lake.

SHALLOW AND DEEP WATER-BEARING BEDS NEAR LOVELOCK

That both shallow and deep water-bearing beds are present in the vicinity of Lovelock is indicated by data obtained from a series of wells drilled by Mr. Friedman, of the Intermountain Investment Company, between November 1929 and March 1930, along the north line of sections 34 and 35, T. 27 N., R. 31 E. (Plate 1.) Logs of nine of the wells (see table 1) indicate that seven were less than 100 feet deep, while the other two were 510 and 524 feet deep, respectively. Reports indicate that the water in all of the wells was under artesian pressure, but only for one of the deep wells, according to reports, was it sufficient to flow at the land surface. Of the nine wells drilled, one did not warrant testing. The other eight produced from 150 to 600 gallons a minute during a long pumping test. (See table 3.) The wells were intended as irrigation wells, but were all abandoned, due largely to the quality of water, which was not considered suitable for irrigation use, or to the low yield.

Residents of Lovelock report that a deep well was drilled by the old Central Pacific Railroad Company about 50 yards southwest of the Pershing Hotel, probably between the years 1890 and 1900. Information concerning the well is very meager as apparently the record of it has been lost. Conflicting reports on the depth of the well range from 900 to 2,700 feet. When drilling was completed the well flowed, but the amount is unknown. It is reported that the water, because of its high mineral content, was unsuitable for use, and the well was abandoned and eventually filled in.

The presence of shallow aquifers northwest of Lovelock is indicated by an irrigation well 27/31–16C1, owned by H. J. Murrish, and known as the "Pitt Well." This well, located about 3½ miles northwest of Lovelock, is reported as between 60 and 100 feet deep. It was not in use in 1945 as the power unit had been destroyed by fire. Mr. Murrish reports that when in use, it delivered a "10-inch stream of water" (probably between 500 and 1,000 gallons a minute), and was capable of irrigating from 25 to 50 acres of land. The quality of the water, however, is poor. (See table 2.)

At Toulon, about 12 miles southwest of Lovelock, well No. 25/30–8C1, owned by the Rare Metals Corporation, was drilled to a depth of 210 feet. This well is reported to have been pumped at the rate of 446 gallons a minute for five hours with a 30-foot drawdown. The water is used for milling purposes, but is not satisfactory for domestic use. (See table 2.)

That the aquifers are not necessarily continuous is shown by the record of well 25/30–2A1, owned by the United States Navy, Derby Airport, and located about four miles east of Toulon. The log of the well shows it penetrated seven feet of fine sand and then 205 feet of "black tule muck" to a depth of 212 feet. When tested it yielded only a few gallons of water every hour. The quality of the water was unsatisfactory.

SHALLOW AND DEEP WATER-BEARING BEDS NEAR OREANA

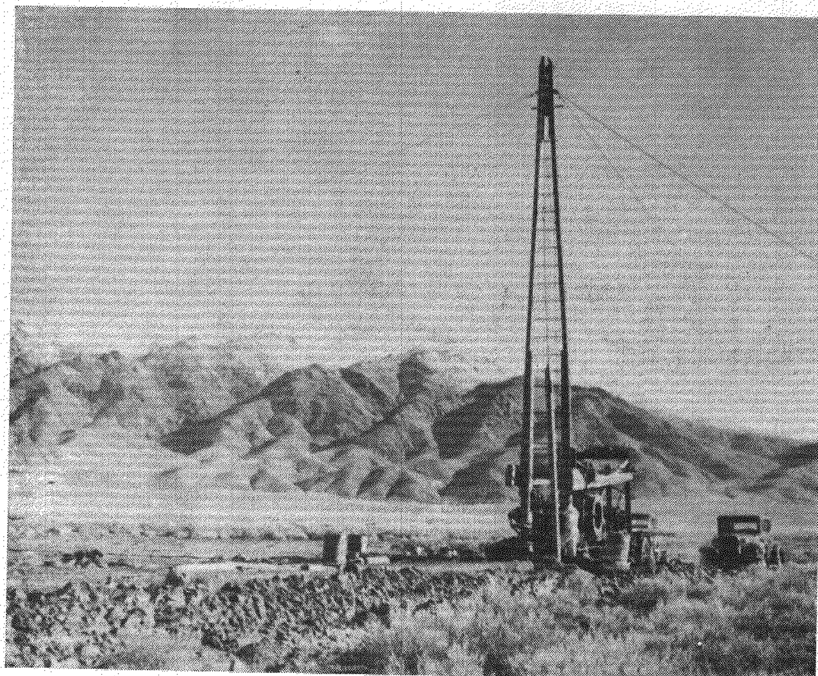
Oreana is located 15 miles northeast of Lovelock and about five miles northeast of the point where the Humboldt River emerges from its broad, meandering, deeply-entrenched channel, on to the flat floor of the valley.

The elevation of the land surface at the Oreana railroad station is 4,158 feet, which is approximately 110 feet above the Humboldt River and 165 feet higher than at Lovelock.

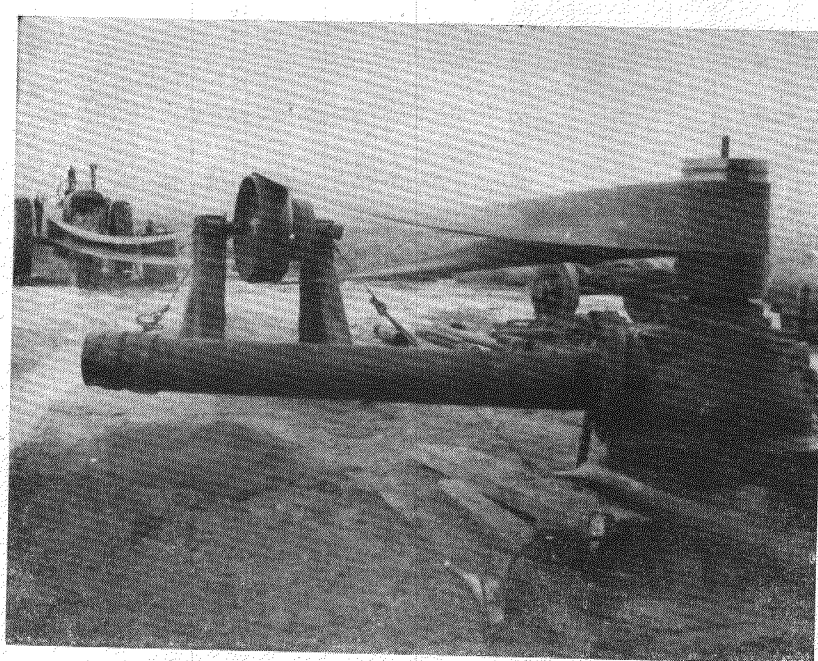
In 1907 and 1908 the Southern Pacific Company drilled a well, (29/33–31B1), Oreana No. 1, at the Oreana station, which penetrated to a depth of 992 feet. According to the log of the well furnished by the Southern Pacific Company, water was encountered at the following depths: 80–82, 90–95, 142–144, 290–310, 370–380, 432–440, and 915–920 feet. The well was filled and plugged with concrete at the 675-foot level. The water level rose to within 105 feet of the land surface. Water from this well is being used for locomotive boilers, but the presence of mineral salts unfavorable for boiler use led the Southern Pacific Company to seek a supply of better quality. Consequently, a 432-foot well (29/33–33C1), Oreana No. 2, was drilled in the fall of 1945 by the Southern Pacific Company, 2½ miles directly east of Oreana station and about 1½ miles west of the base of the Humboldt Range. It is located on the alluvial fan opposite the mouths of Sacramento, Limerick, and Rochester Canyons.

The first water encountered in this well was at 90 feet, where the water level rose to within 73 feet of the land surface. As drilling progressed the water level dropped to a little over 90 feet until a depth of 398 feet was reached. In the last 34 feet of the well, between 398 and 432 feet, the water level rose to within 66 feet of the land surface. During a 48-hour pump test, from December 18 to 20, 1945, this well yielded approximately 400 gallons a minute with a 15-foot drawdown. A mineral analysis of the water indicated that it was of satisfactory quality. (See table 2.) The specific capacity of the well (27 gallons a minute per foot of drawdown) indicates that the well may be pumped at a considerably higher rate without excessive drawdown.

The two Lovelock city wells, Nos. 1 and 2 (29/33–33A1 and A2),



Drilling the Southern Pacific Co. well, Oreana No. 2.



48-hour pump test on Southern Pacific Co. well, Oreana No. 2.

used as a standby supply, are located about one-half mile northeast of the Southern Pacific Company's new well, Oreana No. 2. These wells are located about the same distance west of the base of the Humboldt Range and on the same alluvial fan as Oreana No. 2. The Lovelock No. 1 well is 336 feet deep and the No. 2 well is reported to be within a few feet of the same depth. The land surface at both of these wells is about 25 feet higher than at the Oreana No. 2 well. The water of these wells is also of satisfactory quality. (See table 2.)

On January 9, 1945, the water level in Lovelock No. 1 well was 83.45 feet below the land surface. On the same date, the measured yield of the No. 2 well, 100 feet northeast of No. 1 well, was 475 gallons a minute.

QUALITY OF WATER

In general, the water from both shallow and deep wells in the southern part of the valley, from Woolsey south to Humboldt Lake, is rather highly mineralized. The available analyses (see table 2) show that the wells having the highest mineral content are at the extreme southern end of the valley, near Humboldt Lake; wells 25/30–8C1, Rare Metals Corporation, and 25/31–8B1, T. Derby, having a total solids content of 3,368 and 2,978 parts per million, respectively.

The quality of ground water improves somewhat between these wells and Woolsey. However, the total solids content remains fairly high, ranging from 1,095 to 2,214 parts per million.

There is no analysis available for the reported deep well drilled in the city of Lovelock by the Central Pacific Railroad Company, but residents of Lovelock report that the quality of water yielded by this well was very poor. The fact that the water was not used by the Railroad Company is further evidence of its poor quality. An analysis was made of one of the nine wells drilled by Mr. Friedman of the Intermountain Investment Company near Lovelock. There is no information to show from which well the sample was taken and therefore it has not been included in the table of analyses. The water was very highly mineralized, having 6,588 parts per million of total solids, and 3,180 parts per million of chlorides, along with other objectionable salts in excessive amounts.

Several factors contribute to the highly mineralized condition of the ground water between Woolsey and Humboldt Lake. The basin has very poor exterior drainage due to the confining nature of the barrier bar at the west end of Humboldt Lake. Movement of ground water through fine-grained sediments of the type which underlie the Lovelock basin is relatively slow. Poor exterior drainage and the slow movement of the ground water has made it possible for large amounts of salts to be leached from the highly mineralized marls and fine-grained sediments in the Lake Lahontan deposits.

The source of the ground water in this part of the valley is largely Humboldt River water which is already moderately mineralized. At the "Pitt Diversion Dam," about five miles northeast of Lovelock, samples[2] taken in July and August 1941, and in June, July, and November 1942, for mineral analysis range from 663 to 860 parts per million of total solids. The addition of more salts to this water, by leaching of the Lake Lahontan sediments, produces ground water of unsatisfactory quality.

In the transition zone of interfingering lake beds and alluvial deposits along the margin of the valley, and especially in the vicinity east of Oreana, the situation is different. Here the material is not so highly mineralized as that in the beds further to the west, and the drainage is good, and therefore the amount of contamination by leaching of the lake beds is considerably reduced. The source of the ground water in this area is the relatively lightly mineralized water from the canyons draining the higher portion of the Humboldt Range. As a result, in the area east of Oreana, the ground water is of satisfactory quality, as shown by the analysis (see table 2) of water from the Southern Pacific Company Oreana No. 2 well and the city wells.

West of the transition zone the influence of the lake sediments on the quality of the ground water is reflected by the higher mineral content of the water. This is shown by the analyses of water from wells 29/33–31B1, Oreana No. 1, and 29/33–31C1 (see table 2), Lee Center Service Station, which are located about four miles west of the base of the Humboldt Range. The mineral content of the water from both these wells is higher than that of the water from Oreana No. 2 well or the city wells. The increased mineral content is believed due, in large part, to the leaching of the mineralized lake sediments by the ground water in its movement westward between the two groups of wells.

SUMMARY OF GROUND-WATER CONDITIONS

Ground water in the Lake Lahontan sediments of the lower valley, which includes Lovelock and vicinity, is on the whole

[2]Miller, M. R., The Quality of the Water of the Humboldt River: State of Nevada, Biennial Report of the State Engineer for the Period July 1, 1940, to July 30, 1942, inclusive, p. 111, 1942, and for the fiscal year ending June 30, 1943–1944, p. 52, 1944.

highly mineralized. This is true of both the shallow and deep water-bearing beds. The most favorable water conditions occur in the transition zone of interfingering lake beds and alluvial deposits in the area east of Oreana and extending northward between the base of the Humboldt Range and U. S. Highway 40. In this area the conditions are most favorable for developing a water supply suitable in quality and also sufficient in quantity to care for the city's increased needs over a period of years. The quality and quantity of water that may be expected from individual wells in this area is shown by the mineral analyses and yields of the present city wells and the Oreana No. 2 well drilled by the Southern Pacific Company in 1945. There are doubtless other areas in the transition zone along the margin of the valley where ground water of suitable quality may be obtained, but the prospects of developing and withdrawing large amounts of water without depletion of the ground-water reservoirs are not favorable.

TABLES

The three tables that follow show in tabular form the data collected concerning drillers' logs of wells, mineral analyses of well water, and well records for representative wells in the Lovelock Valley. Not all of the wells in the valley are listed, but only those which give information bearing on the problem.

The wells are identified by a numbering system based on the network of surveys by the General Land Office. This numbering system also serves to locate the well in the township, range, and section. The first two numerals of the number is the township, the second two separated from the first two by a slant is the range, the next one or two numerals separated by a dash is the section. The section has been divided into four 160-acre tracts, each of which has been assigned a letter. Beginning with the northeast quarter the letters have been assigned in a counter clockwise direction. Thus the northeast quarter is "A," the northwest quarter "B," the southwest quarter "C," and the southeast quarter "D." The first well recorded is designated by the numeral 1, the second, 2, and so forth. Thus the first well located in the northeast quarter of section 2, Township 25 N., Range 30 E. would be numbered 25/30–2A1, the second would be 25/30–2A2, and so forth.

On Figure 1, only that part of the number designating the section, quarter section, and the order in which the well was recorded is shown. The township and range numbers are shown on the edges of Figure 1.

TABLE 1

Drillers' Logs of Wells in Lovelock Valley, Nevada

25/30–2A1. U. S. Navy, Derby Airport. Diameter 6 inches, perforated 50 to 200 feet.

Material	Thickness	Depth	Material	Thickness	Depth
Sand, fine	7	7	Muck, black, tule	205	212

27/31–34A1. Intermountain Investment Co. (Friedman Well No. 1.) Land surface altitude 3,972 feet; drilled in 1930; diameter, 24 inches, perforated 30 to 49 feet. Well cemented back from 54 to 49 feet. When perforated, water level rose to within 15 feet of the land surface.

Material	Thickness	Depth	Material	Thickness	Depth
Loam, yellow	15	15	Gravel, sandy	2	46
Clay, sandy	22	37	Clay, blue, sandy	7	53
Gravel	7	44	Clay, blue	1	54

27/31–34A2. Intermountain Investment Co. (Friedman Well No. 2.) Land surface altitude 3,972.5 feet; drilled in 1929–1930; diameter, 24 inches, perforated 45 to 58 feet. Well cemented back from 61½ to 58 feet. When perforated, water level rose to within 18½ feet of the land surface.

Material	Thickness	Depth	Material	Thickness	Depth
Loam, yellow	23	23	Clay, blue, sandy	13	45
Clay	9	32	Gravel	5	50
			Clay, blue, sandy	11½	61½

27/31–34B1. Intermountain Investment Co. (Friedman Well No. 3.) Land surface altitude 3,970.5 feet. Drilled in 1929–1930; diameter, 12 inches. Perforated in place, 8 cuts per ring, ⅜ by 3 inches; rings, 10 inches apart, 32 to 53, 191 to 207, 473 to 484, and 492 to 507 feet. When perforated, water level rose to within 16½ feet of the land surface.

Material	Thickness	Depth	Material	Thickness	Depth
Soil	11	11	Clay, bluish green, and gravel, little	12	395
Clay, yellow	21	32	Clay, blue	78	473
Gravel, small, and sand	21	53	Gravel and sand	11	484
Sand, fine, blue	12	65	Sand	8	492
Clay, black	30	95	Gravel and sand	13	505
Clay, blue	80	175	Clay, grey	9	514
Clay, black (gas)	16	191	Clay, sandy with gravel	7	521
Gravel, coarse, and sand	14	205	Clay, grey	3	524
Clay, bluish green	178	383			

27/31–34B2. Intermountain Investment Co. (Friedman Well No. 4.) Land surface altitude 3,970.5 feet; drilled in 1929–1930; diameter, 24 inches. Perforated 35 to 47 feet. When perforated, water level rose to within 16½ feet of the land surface. Well cemented back from 51 to 47 feet.

Material	Thickness	Depth	Material	Thickness	Depth
Loam, yellow	16	16	Gravel	6	43
Clay, sandy	9	25	Clay, sandy, blue	8	51
Sand, coarse and gravel	12	37			

27/31–35B1. Intermountain Investment Co. (Friedman Well No. 1E.) Land surface altitude 3,971.5 feet. Drilled in 1929–1930; diameter, 24 inches. Perforated 30 to 58 feet. When well was perforated, water level rose to within 17½ feet of the land surface.

Material	Thickness	Depth	Material	Thickness	Depth
Loam, yellow	17	17	Gravel	17½	48
Clay	13½	30½	Clay, blue	11	59

27/31–35B2. Intermountain Investment Co. (Friedman Well No. 2E.) Land surface altitude 3,972 feet. Drilled in 1929–1930; diameter, 24 inches. Perforated from 30 to 55 feet. Well cemented back from 74 to 55 feet. When well was perforated, water level rose to within 18 feet of the land surface.

Material	Thickness	Depth	Material	Thickness	Depth
Loam, yellow	18	18	Sand	23	62
Clay	14	32	Clay, blue	12	74
Gravel	7	39			

27/31–35B3. Intermountain Investment Co. (Friedman Well No. 3E.) Land surface altitude 3,972 feet; drilled in 1929–1930; diameter 24 inches, perforated from 34 to 68½ feet. Well cemented back from 72 to 68½ feet. When well was perforated, water level rose to within 18 feet of the land surface.

Material	Thickness	Depth	Material	Thickness	Depth
Loam, yellow	15	15	Gravel	7	41
Clay, sandy	4	19	Sand	17	58
Clay	4	23	Sand, coarse	1	59
Clay, sandy	11	34	Clay, blue	13	72

27/31–35B4. Intermountain Investment Co. (Friedman Well No. 4E.) Land surface altitude 3,972 feet; drilled in 1929–1930. Diameter 24 inches, perforated from 26 to 87½ feet. Well cemented back from 90 to 87½ feet. When well was perforated, water level rose to within 18 feet of the land surface.

Material	Thickness	Depth	Material	Thickness	Depth
Loam, yellow	17	17	Clay, blue	½	33½
Clay	3	20	Sand with gravel	10½	44
Clay, sandy	4	24	Sand	22½	66½
Gravel, fine	9	33	Clay, blue, sandy	23½	90

27/31–35B5. Intermountain Investment Co. (Friedman Well No. 5E.) Land surface altitude 3,942.5 feet. Drilled in 1929–1930. Diameter, 24 inches to 58½ feet, 12 inches from 58½ to 510 feet. 24-inch casing to 58½ feet, perforated from 34½ to 58½ feet. 12-inch casing from 58½ to 451½ feet, perforated in place from 274 to 280 feet, and from 223 to 232 feet. Open hole from 451½ to 510 feet. When well was perforated, water level rose to within 18 feet of the land surface.

Material	Thickness	Depth	Material	Thickness	Depth
Soil	3	3	Sand, fine and clay, grey	52	275
Clay	26	29	Gravel with clay	5	280
Gravel	20	49	Clay, black	14	294
Clay	5	54	Clay, blue	18	312
Clay, black	69	123	Clay, sandy, blue	21	333
Sand, fine and clay, grey	49	172	Clay, grey	87	420
Clay, black	32	204	Clay, greenish	4	424
Clay, grey	19	223	Clay, greenish grey	86	510

29/33-31B1. Southern Pacific Company, Oreana No. 1. Land surface altitude, 4,158 feet. Drilled in 1908. Diameter, 12 inches to 441 feet, 10 inches from 441 to 675 feet. Well cemented back from 992 to 675 feet. When well was completed, water level rose to within 105 feet of the land surface.

Material	Thickness	Depth	Material	Thickness	Depth
Loam, yellow	20	20	Sandstone	10	320
Clay	5	25	Clay, sandy	[e]20	340
Blue clay	5	30	Sandstone	8	348
Granite	8	38	Clay, sandy	5	353
Quartz	6	44	Sandstone (hard)	7	360
Rock, grey	6	50	Sandstone (soft)	10	370
Shale, grey	4	54	Sandstone (soft)	[f]10	380
Rock, grey	16	70	Clay, blue	52	432
Shale, grey	2	72	Shale, sandy	[g]8	440
Rock, grey	6	78	Shale	265	705
Granite	2	80	Boulders and gravel	30	735
Gravel	[a]2	82	Shale, blue	91	826
Clay, sandy	4	86	Shale, yellow	10	836
Gravel, concreted	4	90	Clay, fire	5	841
Gravel and boulders	[b]5	95	Shale, blue	61	902
Rock, grey	25	120	Sand	5	907
Sandstone	22	142	Shale	8	915
Gravel, coarse	[c]2	144	Sand, black	[h]5	920
Clay, yellow	48	192	Talc	15	935
Rock, grey	72	264	Talc, white	5	940
Clay, yellow	18	282	Shale, yellow	25	965
Gravel, concrete	4	286	Limestone	10	975
Rock, grey	4	290	Shale, blue	15	990
Clay, sandy	[d]20	310	Shale, yellow	2	992

[a]First water. [b]Second water. [c]Third water.
[d]Fourth water. [e]Fifth water [f]Sixth water.
[g]Seventh water. [h]Eighth water.

29/33-33A1. City of Lovelock, Well No. 1. Land surface altitude, approximately 4,290 feet; drilled in 1929.

Material	Thickness	Depth	Material	Thickness	Depth
Soil	23	23	Clay	5	209
Gravel	2	25	Boulders	4	213
Clay, sandy	18	43	Rock and boulders	2	215
Gravel, fine	3	46	Boulders	3	218
Clay, sandy	12	58	Sandstone	4	222
Gravel and boulders	6	64	Gravel, soft	9	231
Boulders	2	66	Clay	3	234
Rock	1	67	Sandstone	5	239
Clay, sandy	10	77	Solid rock	2	241
Rock	2	79	Clay	5	246
Clay	12	91	Rock, hard	3	249
Gravel, soft	4	95	Clay	2	251
Gravel, hard	2	97	Gravel, soft	3	254
Clay	11	108	Boulders	2	256
Gravel	10	118	Clay	6	262
Clay, sandy	7	125	Gravel	5	267
Gravel, soft	5	130	Clay	10	277
Boulders	4	134	Clay and boulders	3	280
Clay, sandy	5	139	Clay	9	289
Gravel	2	141	Sandstone	9	298
Sandstone	9	150	Clay	1	299
Boulders	3	153	Rock, hard	8	307
Clay, sandy	4	157	Clay and boulders	4	311
Boulders	3	160	Clay	3	314
Sandstone	14	174	Sandstone (hard)	8	322
Boulders	2	176	Gravel	8	330
Clay, sandy	14	190	Clay	2	332
Boulders	3	193	Clay and boulders	4	336
Sandstone and boulders	11	204			

29/33-33C1. Southern Pacific Company, Oreana No. 2. Land surface altitude 4,264 feet. Drilled by Dalton in 1945. Diameter, 12 inches, casing perforated 95 to 125 feet; 20 slots ⅜ by 4 inches, 130 to 425 feet. 84 slots 13/16 inches by 3 feet, 6 slots per 20-foot joint.

Material	Thickness	Depth
Clay, sandy	46	46
Gravel (dry)	20	66
Clay, brown	7	73
Gravel (dry)	7	80
Clay	5	85
Gravel (dry)	6	91
Clay	4	95
Gravel	[a]29	124
Clay	11	135
Gravel	30	165
Clay	2	167
Gravel	7	174
Clay	2	176
Gravel	2	178
Clay	3	181
Gravel	3	184
Clay	10	194
Gravel	3	197
Clay	6	203
Clay and gravel	12	215
Sand and gravel	[b]9	224
Clay and gravel	8	232
Gravel	5	237
Clay and gravel	10	247
Gumbo, clay and gravel	19	266
Gravel, cemented	18	284
Gravel and sand	14	298
Gumbo, clay and gravel	6	304
Gravel, coarse	3	307
Clay and gravel	7	314
Clay and gravel, coarse	15	329
Clay and coarse gravel	11	340
Gravel and clay	15	355
Rock, coarse and clay	7	362
Rock and some clay	[c]14	376
Clay and gravel, coarse	22	398
Clay and gravel	[d]34	432

[a]Water level at 73 feet.
[b]Water level at 93.7 feet.
[c]Water level at 91 feet.
[d]Water level at 66 feet.

TABLE 2

Analyses of Water from Representative Wells in Lovelock Valley, Nevada

(Analyses by Public Service Division, University of Nevada, under the direction of Wayne B. Adams, Commissioner, Department of Food and Drugs. Analyses in parts per million.)

Well Number	Owner	Date of Analysis	Total Solids	Silica (SiO_2)	Iron and Aluminum (Fe and Al)	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na and K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulphate (SO_4)	Chloride (Cl)	Alkalinity (as $CaCO_3$)	Hardness (as $CaCO_3$)
25/30-8C1	Rare Metals Corp.	Apr. 17, 1936	3368	58	Tr.	Tr.	0	1288	151	608	260	1260		
25/31-8B1	Tom Derby	May 12, 1937	2978	63	Tr.	142	36	835	0	434	251	1204		
26/31-9A1	Big Meadow Cem. Assn.	Oct. 18, 1945	2214	50	Tr.	103	40	605	7	464	387	666	380	422
27/31-16C1	H. J. Murrish	Dec. 7, 1944	1142	65	Tr.	126	34	215	0	439	119	310		
27/31-20D1	U. S. Grazing Service (Cemetery Well)	Oct. 18, 1945	1309	45	Tr.	7	Tr.	487	26	603	183	245	494	18
27/31-22B1	J. Tenente	Feb. 28, 1946	1620	40	Tr.	35	15	636	0	700	69	506	574	149
27/31-26B1	City of Lovelock	1934	1095	50	Tr.	120	38	207	0	434	106	312	98	456
27/32-7A1	Wm. Elges	Jan. 23, 1945	1550	90	Tr.	198	58	240	0	434	221	473		
28/32-28A1	Herman Marker	Oct. 18, 1945	1800	53	Tr.	41	15	645	0	900	258	278	738	164
29/33-31B1	Southern Pacific Co. (Oreana No. 1)	Feb. 28, 1946	415	32	Tr.	46	16	73	0	176	78	81	144	181
29/33-31C1	Lee Center Filling Station	1934	578	56	Tr.	84	26	84	0	183	68	168		
29/33-33A2	City of Lovelock Well No. 2	Feb. 1, 1946	298	23	Tr.	55	10	30	0	154	51	45	126	178
29/33-33C1	Southern Pacific Co. (Oreana No. 2)	Jan. 2, 1946	283	28	Tr.	49	3	39	0	115	53	49	94	135

TABLE 3

Hydrologic Data for Representative Wells in Lovelock Valley, Nevada

(Use of water—A, Abandoned; D, Domestic; Ind, Industrial; Irr, Irrigation; P, Public Service; R, Railroad; S, Stock.)

Well Number	Owner	Type (Dr. Drilled)	Depth in feet	Diameter	Water Level: Feet below land-surface datum	Water Level: Date of Measurement	Use	Remarks
25/30-2A1	U. S. Navy	Dr.	212	6 in.	7		A	Log; few gals. an hour.
25/30-8C1	Rare Metals Corp.	Dr.	210	....	14.2	January 10, 1946	Ind	Analysis; yield, 446 gals. a min.
25/30-8C2	Rare Metals Corp.	Dug	19.3	20x20 ft.	13.5	January 10, 1946	Ind.	
25/31-4C1	Unknown	Dug	......	4x4 ft.	1.6	June 28, 1945	None	
25/31-8B1	T. Derby	Dr.	14.5	8½ in.	3.0	January 10, 1946	None	Analysis.
26/31-2C1	W. W. Carpenter	Dr.	19.8	6 in.	8.5	January 10, 1946	S	Owner reports quality poor.
26/31-9A1	Big Meadow Cem. Ass'n	Dr.	44	....	9.7	October 12, 1945	Irr	Analysis.
27/31-2D1	Vic Sebbas	Dug	20	42 in.	3.4	June 28, 1945	S	
27/31-16C1	H. J. Murrish	Dr.	60-100	....	10.8	October 11, 1945	Irr	Analysis; yields 10-in. stream.
27/31-20D1	U. S. Grazing Service (Cemetery well)	Dr.	48	6 in.	33.45	October 11, 1945	S	Analysis; yield, 30 gals. a min.
27/31-22B1	J. Tenente	Dr.	......	8 in.	10.8	January 8, 1946	S	Analysis.
27/31-26B1	City of Lovelock	(a)	50	(a)	7.2	January 8, 1946	P	Analysis.
27/31-26C1	Pershing Gen. Hospital	Dr.	37	8 in.	6.5	October 12, 1945	Irr.	
27/31-29C1	Pacific States Savings & Loan Company	Dug	20.5	6x6 ft.	3.72	June 29, 1945	S	

27/31–34A1	Intermountain Invest. Co. (Friedman No. 1)	Dr.	49	24 in.			A	Log; yield, 200 gals. a min.
27/31–34A2	Intermountain Invest. Co. (Friedman No. 2)	Dr.	58	24 in.			A	Log; yield, 150 gals. a min.
27/31–34B1	Intermountain Invest. Co. (Friedman No. 3)	Dr.	524	12 in.			A	Log; yield, 200 gals. a min.
27/31–34B2	Intermountain Invest. Co. (Friedman No. 4)	Dr.	47	24 in.			A	Log.
27/31–35B1	Intermountain Invest. Co. (Friedman No. 1E)	Dr.	58	24 in.			A	Log; yield, 500 gals. a min.
27/31–35B2	Intermountain Invest. Co. (Friedman No. 2E)	Dr.	55	24 in.			A	Log; yield, 200 gals. a min.
27/31–35B3	Intermountain Invest. Co. (Friedman No. 3E)	Dr.	68½	24 in.			A	Log; yield, 450 gals. a min.
27/31–35B4	Intermountain Invest. Co. (Friedman No. 4E)	Dr.	87½	24 in.			A	Log; yield, 600 gals. a min.
27/31–35B5	Intermountain Invest. Co. (Friedman No. 5E)	Dr.	510	24-12 in.			A	Log; yield, 600 gals. a min.
27/32–7A1	W. Elges	Dr.	19.0	8 in.	4.76	June 28, 1945		Analysis.
28/32–14D1	U. S. Grazing Service (Highway well)	Dr.	220	8 in.	167.7	January 9, 1946	S	Yield, 46 gals. a min.
28/32–28A1	Herman Marker	Dug	24	8 in.	17.05	October 11, 1945	D	Analysis.
29/33–31B1	Southern Pacific Co. (Oreana No. 1)	Dr.	675	12-10 in.	105	1908	R	Analysis; Log; yields about 75 gals. a min.
29/33–31C1	Lee Center Filling Sta.	Dr.	76				D	Analysis.
29/33–33A1	City of Lovelock (Well No. 1)	Dr.	336		83.45	January 9, 1946	P	Analysis; Log.
29/33–33A2	City of Lovelock (Well No. 2)	Dr.					P	Analysis; yield, 425 gals. a min.
29/33–33C1	Southern Pacific Co. (Oreana No. 2)	Dr.	432	12 in.	66.17	January 9, 1946	R	Analysis; log; yield, 400 gals. a min.

(a) 25-foot dug pit, 12 by 16 feet, 6-inch casing from bottom of pit to 50 feet.

UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY

STATE ENGINEER OF NEVADA

WATER RESOURCES BULLETIN No. 2, PLATE 1