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## CLIMATIC CHARACTERISTICS OF THE BOULDER DAM REGION

By GEORGE V. SAGER

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Boulder Dam is located in Black Canyon in the Colorado River about 30 miles southeast of Las Vegas, Nev., on the boundary line between Arizona and Nevada, in latitude  $36^{\circ}1'$  north, longitude  $114^{\circ}44'$  west. The name is a misnomer, having been given to the original project proposed for a dam in Boulder Canyon and continued in use after the site in Black Canyon was definitely chosen.

Work on the project started on September 17, 1930, when the rail connection between Las Vegas and the site of the dam was begun as the first unit. The estimated time of construction is 7 years, half of which has already passed. Construction has advanced rapidly and is now more than a year ahead of estimates.

The dam is of the arch-gravity type, 650 feet thick at the base, 45 feet at the top. The crest is to be 950 feet long and 582 feet above the river bed (surface of low water level). The river bed is 647 feet and the crest of the dam 1,229 feet above sea level.

The dam will form a reservoir 115 miles long, and from a few hundred feet to 8 miles wide, with an area of 227 square miles. It would take 2 full years average flow of the Colorado to fill the reservoir. As part of the flow must be permitted to pass down stream, it may be several years after storage begins before the dam is filled to capacity.

Black Canyon, in which the dam is located, is deep and narrow, with precipitous sides, as shown by the dam being only 950 feet long at a height of 582 feet. On the Arizona side the topography is rugged. On the Nevada side, after the rapid rise of the first few miles, the country is largely more rolling than mountainous, with some extensive level stretches.

The region in which the dam is situated is in the midst of the "Great American Desert." In Supön's classification it is in climatic province No. 26, North American Plateau and Mountain Province. "Great yearly and daily ranges. Dry." In Köppen's Botanical Classification it is in type B, the region of Xerophytes, plants which like dryness and high temperatures. In Ravenstein's Hygrothermal Types it is in type 8—"Warm and very dry."

In this study of the climate of the region consideration has been given to the records of those stations within 75 miles, air-line, from the dam. These include the site of the dam, Boulder City, Las Vegas, Logandale, Jean, and Searchlight in Nevada, and less than 50 miles distant from the dam, Fort Mohave and Needles, in Arizona and California, respectively, below the dam, and Kingman, Hackberry, and Truxton in the mountains of Arizona easterly from the dam and between 50 and 75 miles distant.

Boulder City, planned and constructed to house the workers on the project, is situated on rolling ground about 6 miles west-southwest of the dam at an elevation of 2,525 feet. The site was chosen to obtain the maximum of air drainage compatible with other essential factors and thus mitigate, so far as possible, the effects of the high summer temperatures of the region.

Las Vegas is situated in a broad valley at an elevation of 2,033 feet. Logandale is in the narrow valley of Muddy River at 1,400 feet elevation. Jean is in the northerly and easterly portion of a large valley which broadens out to the southward in California. The station is at an elevation of 2,864 feet and the valley floor ranges from 2,600 to 3,500 feet.

Searchlight is in the mountains near the southern tip of Nevada at an elevation of 3,445 feet. Kingman, Ariz., is on the highway from Los Angeles to Denver via Needles, Calif., and Flagstaff, Ariz., at an elevation of 3,326 feet; Hackberry, Ariz., is 20 miles northeast of Kingman, at 3,500 feet; Truxton is a few miles farther northeast, at 3,997 feet; Fort Mohave is on the Colorado River, elevation 540 feet; Needles, Calif., is a few miles south of Fort Mohave, and a few miles west of the Colorado River, at an elevation of 477 feet. Needles and Fort Mohave are in areas susceptible of irrigation by gravity from the dam.

In preparing data on the climatology of the region, the records through 1933 were included where practicable. For some of the California and Arizona stations, the means and extremes given in the respective sections of "Climatological Data of the United States by Sections—1930 edition" were used. The differences between the mean of a long-term record ending in 1930 and the same record ending in 1933 are trifling, so all data may be considered comparable.

Three years of temperature records are available for Black Canyon at the site of the dam. This station is called Boulder Dam in the tables and text. The exact elevation is not available but it is approximately 650 feet above sea level. The record for these years was compared with the long-term records at Logandale and Needles. It was found that the long-term mean at Logandale was slightly lower month by month, and that at Needles, slightly higher during winter and lower during summer than the corresponding means, for the 3 years covered by the record, at Boulder Dam. When these results are applied to the record at Boulder Dam it appears that the temperatures for the 34- or 35-year period ending with 1933 were probably slightly lower in the months July to October and for March, and slightly higher in the other months of the year. The net annual change found was  $0.1^{\circ}$  cooler; the most important monthly

change was a reduction of the July mean temperature by 2.2° from 101.2° to 99°; thus showing that the 3 year's record 1931-33 represents nearly the true annual average temperature, and probably the extreme of high summer temperatures. These conclusions hold for the equally short record at Boulder City.

The short period of precipitation at Boulder City was in like manner compared with the long-term record at Las Vegas. The result showed a reduction in the annual quantity from 4.19 inches to 3.84 inches. The computed precipitation figures are used in the comparative tables.

Tables of mean monthly temperatures, mean maximum and mean minimum temperatures, mean daily ranges, highest and lowest temperatures of record, monthly and annual precipitation, greatest 24-hour rainfall, snowfall, wind, etc., for the stations in the vicinity of the dam

range during July is thus shown to be 24° at Boulder Dam and 29° at Greenland Ranch. The smaller daily range at Boulder Dam is probably due to it being "pocketed" in the Canyon, which cuts off the free nocturnal flow of air. Humidity in the Canyon may also be somewhat higher, lessening net loss of surface heat by radiation.

July mean temperatures at Needles average 94.1°; at Fort Mohave, 94.3°. Though lower in elevation and farther south their open exposure gives them 7° advantage over the site of Boulder Dam. Their average daily ranges are much wider: 28° at Needles; 35° at Fort Mohave; bringing average minimum temperatures down to 80° at Needles and 75° at Fort Mohave.

The mean July temperature at Boulder City, 90°, is 1° lower than that at Yuma, Ariz., and Imperial, Calif., and is 1° above that of Phoenix, Ariz. July means at Las Vegas, Logandale, Jean, and Searchlight average between 84° and 87° and compare with the University of Arizona, 86°, and San Antonio, Tex., 84°. They are only slightly above the average means at Galveston, 83°, and New Orleans, 82°.

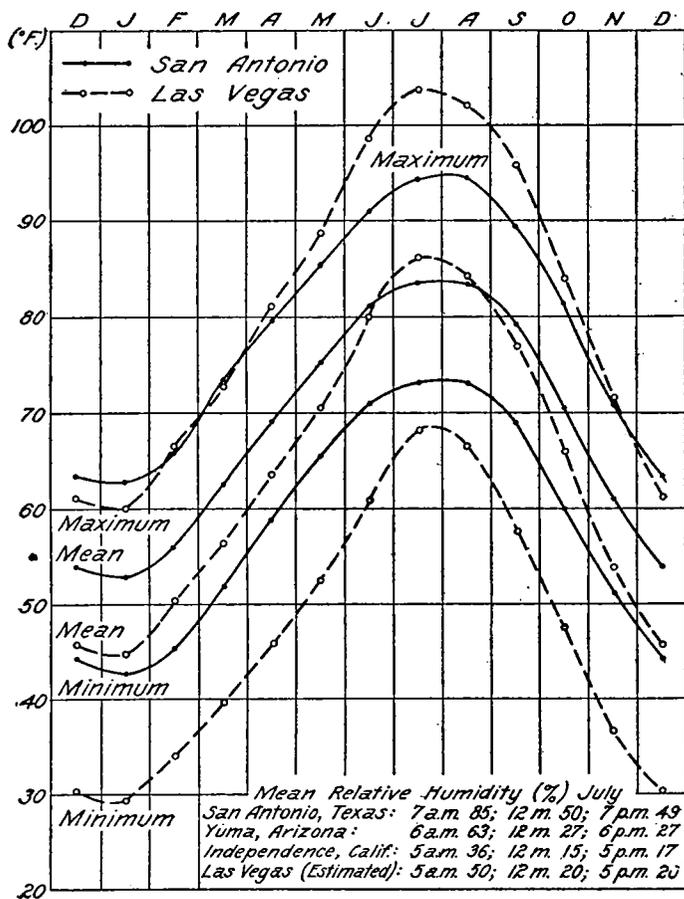
Winter temperatures in the area are delightful, the January mean being 42° at Boulder City and 47° at Boulder Dam; the other Nevada stations and Kingman, Ariz., have means between these limits. Truxton has a January mean of 39°; Needles and Fort Mohave of 52°.

July maximum temperatures average 113° and minimum temperatures 89° at Boulder Dam. The July average maximum is 97° at Searchlight and 100° to 106° at the other Nevada stations. Truxton averages 95°, Kingman 97°. Mean minimum temperatures in July range from 64° at Truxton to 78° at Boulder City. The smallest daily range is 24° at Boulder City, the greatest, 37° at Logandale.

Closely related to mean maximum and mean minimum temperatures are the absolute extremes of temperature. The highest temperature officially recorded in the United States is 134° at Greenland Ranch in Death Valley. Boulder Dam runs this a close second with 128°. Needles has had 125°; Fort Mohave, 127°; Logandale, 119°; Las Vegas, 118°; Kingman, 117°; Jean, 116°; Boulder City, 112°; Searchlight and Truxton have had 110°. These, of course, were all in July or August. On the other hand, 22° has been recorded in winter at Boulder Dam, 31° at Needles, 18° at Fort Mohave, 12° at Boulder City and Searchlight, 8° at Las Vegas and Kingman, 6° at Logandale, -3° at Truxton, and -8° at Jean.

Being in the midst of the desert, precipitation is very scanty. The 3-year average at Boulder City has already been given as 4.19 inches, and the probable 35-year average as 3.84 inches. No record of precipitation is available at Boulder Dam, but, being 1,800 feet lower and evaporation from falling rain being great in such a region, it must necessarily be considerably less. Other annual averages are: Jean, 4.35 inches; Needles, 4.45 inches; Las Vegas, 4.79 inches; Logandale, 5.42 inches; Fort Mohave, 5.09 inches; Searchlight, 7.75 inches; Hackberry, 8.08 inches; Truxton, 9.91 inches and Kingman, 10.92 inches.

Comparing the average at Boulder City, 3.84 inches, with that of other dry stations we find that Clay City, Nev., has an average of 3.2 inches; Hot Springs, Churchill County, Nev., 3.37 inches; Thorne, Nev., 3.39 inches; Heber, Imperial Valley, Calif., 2.22 inches, and several other California stations less than 2.5 inches; while Greenland Ranch, Death Valley, the driest station in the United States, has a long-term average of only 1.45 inches. That portion of the area lower than 3,000 feet receives



accompany this paper. Some comparative data for other well-known places have also been included.

The mean annual temperature at Boulder Dam is 72.8°; Fort Mohave, 72.1°; Needles, 71.8°. These are the lowest in elevation in the area and average approximately the same. Jean, Las Vegas, Logandale, and Boulder City, at elevations 1,400 to 2,900 feet, average 64° to 66°; Searchlight averages 64°; Kingman, 61° and Truxton, the highest station, 59°. The decrease of temperature with increase in elevation is thus clearly evident. The mean monthly temperature at Boulder Dam during July is 101.2°. That at Greenland Ranch in Death Valley, 178 feet below sea level and the hottest station in the United States, is 102°. The mean July maximum temperature at the dam is 113.2°, that at Greenland Ranch, 116.4°. The mean July minimum at Boulder Dam is 89.2°, at Greenland Ranch, 87.6°. The mean daily

only slightly more moisture than the driest portions of Imperial and Death Valleys, both below the level of the sea.

Characteristic of a desert, precipitation, when it does fall, comes largely in the form of heavy showers of short duration. The greatest 24-hour rainfall is 2 inches at Jean, 1.98 inches at Las Vegas, 2.38 inches at Logandale, 2.23 inches at Searchlight, and, probably owing to its short period of record, only 0.93 inch at Boulder City.

The tendency to infrequent, but heavy showers is further shown by the record of the average number of days with precipitation, 0.01 inch or more of rain or melted snow. The average number per year ranges from 15 at Fort Mohave to 25 at Logandale for the lower stations, and from 30 at Searchlight to 36 at Truxton for those above 3,000 feet.

Snow seldom falls; several winters pass at times at most stations without snowfall. Then there may be one storm with from a trace to several inches. The average annual quantities are made up of the depths from a few storms. The average annual depths are: Fort Mohave, "Trace"; Logandale, 0.4 inch; Las Vegas, 1.4 inch; Jean, 1.5 inch; Searchlight, 3 inches; Kingman, 4 inches; Truxton 6 inches.

The prevailing direction of the wind is from the south during 8 months, March to October, and from the north November to February, with south running a close second. At Las Vegas south predominates, even during the winter months. There is no record of wind movement, but, following the regime of desert regions, it is probably fairly large.

The record at Las Vegas shows that an average of 18 days monthly during winter, 19 monthly in spring, 20 monthly in summer and 22 monthly in fall are recorded as clear, and only 5 days monthly in winter, spring and summer, and 3 monthly in autumn, as cloudy. That at Logandale shows 19 clear days monthly in winter, 21 in spring, 23 in summer and 24 in autumn; 5 cloudy days monthly in winter, 3 in spring, 2 in summer, and 2 in fall. These are the only records readily available but they are fully representative of the region. Moreover, cloudy days in such a region are seldom, if ever, completely overcast.

The only record of relative humidity in the district is one of 18 to 19 days, at 7 a.m., 1 p.m., and 4 p.m., made at irregular intervals between July 12 and August 6, 1931, inclusive, at Boulder City, by the engineering force of Six Companies, Inc. These readings were made outside of the company's several dormitories, so are not strictly comparable. The temperature mean of the 7 a.m. observations is 82° and the relative humidity 27 percent. The temperature mean at 1 p.m. is 96° and the relative humidity 19 percent. At 4 p.m. the temperature mean is 97° and the relative humidity 17 percent. These relative humidities are characteristically low desert-type readings and compare well with humidities at the same temperature elsewhere in the desert. At Reno, for example, temperatures of 96° occurred at the time of 3 observations in July 1931 with average relative humidities of 15 percent. Yuma, with about the same average temperatures as Boulder City, has an average of 18 percent at noon and 6 p.m. during May and June but these rise to 27 percent during July and to 30 percent at noon and 32 percent at 6 p.m. during August. The comparison here is considerably in favor of Boulder City if we assume the few readings available to be representative, as they probably are. The relative humidity at New Orleans, in contrast, averages 63 percent at noon during the 3 summer months.

No record of evaporation is available. Lee's Ferry, Ariz., at 3,142 feet elevation and with 17,000 miles of wind annually averages 87 inches per year; Yuma, elevation 127 feet, wind movement 11,000 miles, averages 79 inches; Yuma Citrus Station, elevation 187 feet, wind movement 22,000 miles, averages 124 inches; Clay City, Nev., elevation 2,100 feet, and comparable as to exposure but with 64,000 miles wind, averages 142 inches. A study of these figures has led to the conclusion that the annual average evaporation at the lower stations in the Boulder Dam area could easily be above 100 inches from a land-surface exposure, but would probably be less than 50 inches from the reservoir owing in part to its protection from wind and partly to its lowish temperature, being fed largely from melted snows in the mountains of Colorado and Wyoming. The Bureau of Reclamation Engineers estimated annual losses by evaporation at 600,000 acre-feet, which would represent 41 inches of evaporation were the reservoir to be full all the time. As this would rarely be the case, their estimates must have been between 41 and 50 inches.

The capacity of the power plant below will be 1,000,000 to 1,200,000 horsepower to be sold at \$0.00163 per kilowatt-hour for primary power, \$0.0005 per kilowatt-hour for secondary. Eighteen percent of this is available to Nevada and the same quantity to Arizona. The question is frequently asked: Other conditions being favorable, would the climate of the region permit of the development of large industries and a large growth in population in the region of Boulder Dam, where this cheap power could be most economically used? The answer is emphatically, "yes." High daytime temperatures can be borne without injury and without serious discomfort in well-ventilated surroundings, and the wide daily range of temperature assures the opportunity to obtain a good night's rest. During 5 years in San Juan, P.R., I found that whenever the minimum temperature dropped below 78° I could count on a good night's rest. The relative humidity there averages 75 to 80 percent and the nights are very still. Furthermore, my sleeping apartment was not ideally arranged for ventilation. Had it been, nights with minimum temperatures 80° or 81° would not have caused difficulty. Galveston has a mean minimum in July of 78.6° and a moist climate. New Orleans has a July mean minimum of 75.4° and also a high humidity. The comparison is all to the advantage of Boulder City, whose mean minimum is 78.4° and whose humidity is low. Las Vegas and Logandale, in the area topographically best suited for industrial plants have mean July minima of 68° and 69°, respectively; Jean, 73°; Searchlight, 71°; Kingman, 66°; Truxton, 64°.

To give a graphic idea of the temperature conditions in this region as compared with some other location that is well known and has had a favorable development, a graph has been prepared (fig. 1) showing the relations between the maximum, minimum, and mean monthly temperatures at Las Vegas and at San Antonio, Tex. The latter is a city of considerable size, having with its suburbs a population of 280,000 at the last United States census and large manufacturing and commercial interests. While it would not be chosen for a summer resort, there is no question of the healthfulness of its climate and the well-being of its inhabitants.

Glancing first at the graphs of the mean temperatures we note that Las Vegas has the lower mean temperatures for more than 10 months of the year. From about June 21 to August 15 the mean temperature at Las Vegas is higher than that at San Antonio. Now looking at the graphs of the maximum and minimum temperatures we

note that the maximum temperature at Las Vegas is higher than that at San Antonio from about April 10 to November 15, lower than at San Antonio from November 15 to February 1 and about the same between February 1 and April 10. The minimum temperature at Las Vegas is 5° to 15° lower throughout the year. It is at once apparent that the midsummer period, June 20 to August 15, is the only part of the year when the comparison is to the disadvantage of Las Vegas. But a glance at the tables of relative humidities inserted beneath the graphs shows that this disadvantage is largely or entirely overcome by the more favorable humidity. A relative humidity of 20 percent at Las Vegas, as contrasted with 50 percent at San Antonio (noon readings), will undoubtedly more than offset the few degrees higher temperature at Las Vegas.

Thus, not only do the moderate night temperatures and low humidities make living conditions easily bearable in the probable industrial zone during the hottest months, but the records at the mountain stations indicate that there are many places within 2 hours by auto that would make ideal summer resorts or locations for summer homes. Furthermore, a glance at the fall, winter and spring temperatures and a consideration of the freedom of this region from storms and its high proportion of fair days and bright sunshine, leaves no doubt that the shores of the lake, which will be formed by the impounding of the waters of the Colorado, will have every climatic qualification for becoming recognized as a nearly ideal fall, winter and spring pleasure resort.

TEMPERATURES (°F.), BOULDER DAM REGION

TABLE 1.—Mean monthly temperatures

Stations	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Boulder City, Nev.	42.0	44.8	58.0	62.9	70.0	83.2	90.4	88.7	82.0	69.3	55.6	43.9	65.9
Boulder Dam, Nev.	47.3	53.3	65.0	72.0	79.7	89.9	101.2	97.0	88.7	77.5	67.3	54.1	72.8
Fort Mohave, Ariz.	51.7	56.5	63.2	70.7	79.0	88.4	94.3	92.5	84.5	72.3	60.2	51.8	72.1
Jean, Nev.	44.2	48.5	57.9	62.8	69.7	79.6	86.8	85.5	76.0	61.1	52.0	42.7	64.0
Las Vegas, Nev.	44.6	50.3	56.2	63.3	70.4	79.9	86.1	84.3	76.7	65.7	53.7	45.5	64.7
Logandale, Nev.	44.7	50.7	57.0	63.8	71.5	80.3	87.4	85.0	77.1	65.9	53.6	44.7	65.1
Needles, Calif.	51.6	57.3	63.5	70.7	78.7	87.5	94.1	91.9	83.4	71.1	59.3	52.9	71.8
Searchlight, Nev.	44.2	48.9	54.3	60.6	68.3	78.7	83.9	81.7	75.8	62.5	54.6	45.4	63.5
Kingman, Ariz.	43.8	47.6	51.7	58.4	65.0	73.0	82.0	80.3	73.4	62.5	52.3	43.7	61.4
Truxton, Ariz.	39.4	44.6	49.6	55.6	63.0	73.1	79.5	77.5	70.9	60.7	50.4	40.4	58.7

TABLE 2.—Mean maximum temperatures

Stations	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Boulder City, Nev.	49.0	52.8	67.4	73.2	80.6	95.0	102.3	100.4	93.5	79.1	64.1	51.0	75.7
Boulder Dam, Nev.	55.7	61.9	76.9	85.2	91.7	102.2	113.2	109.3	102.6	87.2	67.8	54.1	84.0
Fort Mohave, Ariz.	64.7	71.2	77.1	86.8	93.4	104.7	109.8	107.6	90.2	74.8	64.4	55.1	86.8
Jean, Nev.	57.4	61.0	69.6	77.3	84.2	95.4	100.4	100.0	90.0	77.8	64.4	55.1	77.5
Las Vegas, Nev.	59.9	66.4	72.8	81.0	88.6	98.9	103.8	102.1	95.9	83.9	71.1	61.0	82.1
Logandale, Nev.	59.0	65.4	73.2	81.1	89.3	100.5	105.8	103.1	96.1	83.3	70.3	59.1	82.4
Needles, Calif.	63.5	69.8	77.3	85.6	93.6	103.6	107.9	105.2	98.8	86.5	72.0	62.6	85.0
Searchlight, Nev.	53.1	58.3	65.6	72.9	81.3	92.3	97.1	94.6	88.4	75.7	65.5	55.8	75.4
Kingman, Ariz.	56.7	61.4	66.4	74.6	82.3	93.8	97.4	95.5	89.8	78.6	67.0	56.4	76.7
Truxton, Ariz.	52.5	59.3	66.0	72.0	80.0	91.7	94.9	93.1	87.2	77.7	66.7	54.8	74.7

TABLE 3.—Mean minimum temperatures

Stations	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Boulder City, Nev.	35.0	36.8	48.4	52.6	59.5	71.4	78.4	77.0	70.4	59.5	47.2	36.8	56.1
Boulder Dam, Nev.	38.9	44.2	53.0	60.0	67.7	77.6	89.2	84.8	74.7	63.6	46.8	33.9	61.6
Fort Mohave, Ariz.	38.7	41.8	47.2	54.2	61.3	69.3	75.2	74.7	65.6	54.6	44.2	33.5	55.2
Jean, Nev.	31.2	33.6	41.4	48.2	55.2	63.8	73.2	71.0	61.6	49.0	39.6	30.3	50.4
Las Vegas, Nev.	29.2	34.4	39.9	45.7	52.3	60.8	68.4	66.6	57.5	47.5	36.4	30.1	47.3
Logandale, Nev.	30.5	36.0	40.6	46.6	53.2	61.9	69.0	66.9	58.1	47.5	37.0	30.4	47.9
Needles, Calif.	38.8	44.4	49.9	56.1	63.2	71.9	80.1	77.5	67.0	55.7	45.5	39.8	57.3
Searchlight, Nev.	35.3	39.9	44.0	48.3	55.4	65.1	70.8	69.7	63.3	53.7	44.0	35.9	51.6
Kingman, Ariz.	30.9	34.4	37.0	42.2	48.8	57.1	66.5	65.0	57.1	46.6	37.6	31.4	46.2
Truxton, Ariz.	26.3	29.8	34.4	39.1	46.0	54.6	64.0	62.2	55.0	44.0	34.3	26.8	43.0

TABLE 4.—Mean daily ranges

Stations	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Boulder City	14.0	16.0	19.0	20.6	21.1	23.6	23.9	23.4	23.1	19.6	16.9	14.9	19.6
Boulder Dam	16.8	17.7	23.0	25.2	24.0	24.6	24.0	24.5	27.9	23.6	21.0	15.9	22.4
Fort Mohave	26.0	29.4	29.0	32.6	32.1	35.4	34.6	32.9	31.0	30.9	28.2	24.8	31.6
Jean	26.2	24.4	23.5	29.0	29.0	31.6	27.2	29.0	28.6	26.8	24.6	24.8	27.1
Las Vegas	30.7	32.3	33.3	35.3	36.3	38.1	34.4	35.5	37.4	36.4	34.7	30.9	34.8
Logandale	28.5	29.4	32.6	33.5	37.6	40.6	36.6	36.1	39.0	36.6	33.3	28.2	34.8
Needles	28.7	25.5	28.0	30.0	30.4	32.2	27.6	27.7	31.6	29.4	26.3	22.8	28.3
Searchlight	17.9	19.5	22.6	24.6	25.9	27.1	23.8	23.8	27.1	24.1	21.2	18.5	23.1
Kingman	25.9	27.4	29.4	32.4	33.5	35.7	30.9	30.5	32.3	32.0	29.4	25.0	30.5
Truxton	26.2	29.5	31.6	32.9	34.0	37.1	30.9	30.9	32.2	33.7	32.4	28.0	31.7

TABLE 5.—Extreme maximum temperatures

Stations	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Boulder City	69	75	88	93	98	107	112	112	105	91	78	67	112
Boulder Dam	74	86	96	105	107	115	123	124	115	99	81	70	128
Fort Mohave	81	92	103	110	117	127	124	124	117	108	94	81	127
Jean	78	79	88	95	112	116	116	110	106	91	83	78	116
Las Vegas	80	89	96	102	114	113	118	115	110	101	89	91	118
Logandale	87	86	93	103	114	117	119	117	114	101	91	79	119
Needles	83	90	96	106	118	123	125	122	116	112	90	86	125
Searchlight	76	76	82	94	101	110	109	107	102	95	86	78	116
Kingman	73	81	95	102	106	110	112	117	107	99	89	77	117
Truxton	77	78	84	89	106	110	110	106	99	85	89	74	110

TABLE 6.—Extreme minimum temperatures

Stations	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Boulder City	28	12	35	31	38	52	66	67	58	46	26	17	12
Boulder Dam	30	22	39	46	50	60	67	73	61	49	33	29	22
Fort Mohave	18	24	31	30	37	52	58	54	48	35	24	19	18
Jean	-6	18	24	24	30	43	46	40	31	28	14	4	-6
Las Vegas	8	10	16	26	28	35	40	47	38	29	14	12	8
Logandale	6	17	19	25	29	40	49	48	37	29	19	10	6
Needles	21	23	23	33	39	46	60	60	40	36	25	23	21
Searchlight	14	17	23	30	30	40	48	51	43	34	15	12	12
Kingman	9	11	16	20	29	34	45	43	31	27	13	9	8
Truxton	-3	3	16	23	29	38	41	40	38	25	10	0	-3

TABLE 7.—Comparative temperatures

Stations	Number of years record	Mean temperatures		Mean maximum temperatures		Mean minimum temperatures		Mean daily range	
		Jan.	July	Jan.	July	Jan.	July	Jan.	July
		Boulder City	2-3	42.0	90.4	49.0	102.3	35.0	78.4
Boulder Dam	3	47.3	101.2	55.7	113.2	35.9	89.2	16.8	24.0
Las Vegas	23-25	44.6	86.1	59.9	103.8	29.9	68.4	30.7	35.4
Logandale	28	44.7	87.4	59.0	105.8	30.5	69.0	28.5	36.8
Jean	6-9	44.2	86.8	57.4	100.4	31.2	73.2	26.2	27.2
Searchlight	20	44.2	83.9	53.1	97.1	35.3	70.8	17.8	26.3
Needles	31	51.6	94.1	63.5	107.9	33.2	80.1	24.7	27.8
Imperial, Calif.	5	54.9	91.2	70.6	106.0	37.0	75.3	33.6	30.7
Yuma, Ariz.	53	54.5	91.0	66.8	105.4	42.2	76.6	24.6	28.8
Phoenix, Ariz.	27	51.8	89.2	64.2	102.4	39.5	76.0	24.7	26.4
University of Arizona, (Tucson)	35	50.0	85.6	65.1	98.7	34.9	72.4	30.2	26.3
San Antonio, Tex.	36	52.7	83.5	62.6	94.0	42.5	72.9	20.1	21.1
Galveston, Tex.	49	55.9	83.4	67.0	88.0	45.8	78.6	11.2	9.4
New Orleans, La.	60	54.7	82.4	62.3	89.3	40.7	75.4	15.3	13.9
Greenland Ranch, Calif.	20	51.4	102.0	64.9	116.4	36.9	87.6	23.0	28.8
Fort Mohave	44	51.7	94.3	64.7	109.8	38.7	75.2	26.0	34.6
Kingman	27	43.8	82.0	56.7	97.4	30.9	66.5	25.8	30.9
Truxton	14	39.4	79.5	52.5	94.9	26.3	64.0	26.2	30.9

TABLE 8.—Precipitation, Boulder Dam Region

[Inches and hundredths]

TABLE 9.—Comparative precipitation

Clay City, Nev.; east edge of Death Valley region.....	3. 20
Hot Springs, Churchill County, Nev.....	3. 37
Greenland Ranch, Death Valley, Calif.; elevation 178 feet.....	1. 45
Heber, Imperial Valley, Calif.; elevation 20 feet below sea level.....	2. 22
Bagdad, San Bernardino County, Calif.; elevation 784 feet.....	2. 28

TABLE 10.—Greatest precipitation in 24 hours

Stations	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Boulder City.....	0.44	0.44	T	0.39	0.26	0.04	0.60	0.68	0.65	0.13	0.61	0.93	0.93
Jean.....	1.25	.75	1.30	1.00	.10	T	1.85	.50	2.00	1.00	1.25	.40	2.00
Las Vegas.....	1.53	.96	1.55	.63	1.03	.45	1.98	1.35	1.00	1.40	.86	1.35	1.98
Logandale.....	1.63	1.45	1.18	.90	1.20	1.20	.94	2.38	1.42	1.04	2.00	1.62	2.38
Searchlight.....	2.23	1.66	1.57	1.06	.67	.49	1.60	3.30	2.02	1.69	.70	1.81	2.33

TABLE 11.—Days with 0.01 inch or more of precipitation

Stations	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Boulder City.....	12	12	3	0	2	1	4	1	2	1	2	3	33
Fort Mohave.....	12	12	3	0	2	1	4	1	2	1	2	3	33
Las Vegas.....	12	12	3	0	2	1	4	1	2	1	2	3	33
Logandale.....	12	12	3	0	2	1	4	1	2	1	2	3	33
Needles.....	12	12	3	0	2	1	4	1	2	1	2	3	33
Searchlight.....	12	12	3	0	2	1	4	1	2	1	2	3	33
Kingman.....	12	12	3	0	2	1	4	1	2	1	2	3	33
Truxton.....	12	12	3	0	2	1	4	1	2	1	2	3	33

TABLE 12.—Snowfall; monthly and annual averages

Stations	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Fort Mohave.....	T	0	0	T	0	0	0	0	0	0	0	0	T
Jean.....	0.4	0.2	0	T	T	0	0	0	0	0	0	0	1.5
Las Vegas.....	0.6	0.1	T	T	0	0	0	0	0	0	T	0	1.4
Logandale.....	T	0	0	T	0	0	0	0	0	0	0	0	0.4
Searchlight.....	1.2	0.4	0.4	T	T	0	0	0	0	0	0	0	3.0
Kingman.....	1.6	0.4	0.4	T	T	0	0	0	0	0	0	0	3.0
Truxton.....	1.9	1.1	0.8	0	0.1	0	0	0	0	0	0.1	1.7	5.7

TABLE 13.—Wind; prevailing direction

Stations	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Las Vegas.....	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
Logandale.....	p.	p.	s.	s.	s.	s.	s.	s.	s.	s.	p.	p.	s.
Fort Mohave.....	p.	p.	s.	s.	s.	s.	s.	s.	s.	p.	p.	p.	s.
Needles.....	p.	p.	s.	w.	w.	s.	s.	s.	s.	w.	p.	p.	s.

TABLE 14.—Relative humidity (percent) [comparative]

Stations	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Yuma, Ariz.:													
6 a.m.....	57	59	58	56	57	56	63	68	66	61	57	57	60
12 m.....	27	27	23	20	18	18	27	32	29	26	26	34	26
6 p.m.....	33	30	25	19	18	18	27	30	28	29	33	37	27

Stations	Winter	Spring	Summer	Fall	Year
New Orleans, La.					
8 a.m.....	85	83	83	83	84
12 m.....	68	62	63	62	64
8 p.m.....	73	69	72	72	72

	Number observations	Mean temperature	Mean relative humidity
Boulder City, Nev.; mean temperatures and relative humidities, 18 to 19 daily observations between July 12 and Aug. 6, 1931:			
7 a.m.....	18	82.4	27
1 p.m.....	18	96.5	19
4 p.m.....	19	97.1	17

TABLE 15.—Average annual evaporation

	Elevation feet	Average annual wind	Average annual total evaporation
Lees Ferry.....	3,142	17,280	Inches 87
Yuma Citrus.....	187	21,700	124
Yuma.....	127	11,000	79
Clay City.....	2,185	64,000	142

NOTE.—Engineer's estimate for Boulder Lake 41 plus, inches.<sup>1</sup> 65 percent <sup>2</sup> of 79 inches, evaporation at Yuma, equals 51 inches.

<sup>1</sup> 600,000 acre-feet divided by 145,000 (maximum area of reservoir in acres).  
<sup>2</sup> Generally accepted relation between land station and open water exposure.

TABLE 16.—Days clear, partly cloudy and cloudy, Boulder Dam region

Stations	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Las Vegas:													
Clear.....	18	16	19	18	20	22	19	21	22	23	21	20	239
Partly cloudy.....	8	7	6	6	5	4	7	5	5	5	5	5	70
Cloudy.....	5	5	5	6	6	4	5	5	3	3	3	5	56
Logandale:													
Clear.....	20	18	21	21	22	25	21	23	24	26	23	20	264
Partly cloudy.....	6	6	7	6	6	4	7	5	4	3	4	5	64
Cloudy.....	5	4	3	3	3	1	3	2	2	2	3	5	37