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US DEPARTMENT OF THE INTERIOR
US GEOLOGICAL SURVEY

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NM-123, Part 1

Arkansas River Basin

By

W.C. Ballance

#339

United States
Department of the Interior
Geological Survey
Albuquerque, New Mexico

Arkansas River basin

By

W. C. Ballance

(A contribution for incorporation in a
State Planning Report to be prepared
by the New Mexico State Engineer Office.)

Prepared in cooperation with
the New Mexico State Engineer

December 1964

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Arkansas River basin

By

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Description

The Arkansas River basin in New Mexico is 17,066 square miles in extent and is in the northeastern part of the state (figs. 1 and 2).

Figure 1 (caption on next page) belongs near here.

Figure 2 (caption on next page) belongs near here.

Sub-basins within this major drainage area are Canadian River, Purgatoire River, Cimarron River, Carrizozo Creek, North Canadian River, and Carrizo Creek.

noff Counties ~~[included]~~ in the basin are Union, Colfax, Mora, Harding, and parts of San Miguel, Guadalupe, Quay, and Curry. The principle towns in the area are Raton, Springer, and Eagle Nest in Colfax County; Roy in Harding County; Mora in Mora County; Tucumcari in Quay County; and Clayton in Union County.

Figure 1.--Drainage basins of New Mexico

Figure 2.--Map of Arkansas River basin in New Mexico

Geography

The Arkansas River basin in New Mexico consists of six drainage areas. The Canadian River drainage area, 1-1 on figure 1, is 13,056 sq mi (square miles); the Purgatoire River drainage area, 1-2, is 90 sq mi; the Cimarron River drainage area, 1-3, is 710 sq mi; the Carrizozo Creek drainage area, 1-4, is 220 sq mi; the North Canadian River drainage area, 1-5, is 1,040 sq mi; and the Carrizo Creek drainage area, 1-6, is 1,950 sq mi.

The Arkansas River basin is drained mostly by the Canadian River and its tributaries (fig. 2). The Canadian River flows southward from its headwaters near the Colorado line west of Raton, into southern San Miguel County, then eastward into Texas and Oklahoma to its confluence with the Arkansas River. The other drainages are eastward and southeastward into Oklahoma and Texas, except the Purgatoire River which drains northward into Colorado.

The central and eastern part of the Arkansas River basin is in the Great Plains physiographic province; the western part is in the Southern Rocky Mountain physiographic province (Fenneman, 1931).

The southeastern part of the area is adjacent to the Southern High Plains of New Mexico and West Texas. This area has low relief; altitudes range around 4,000 feet. To the north and west the relief is greater with a gradual increase in altitude to ~~above~~ more than 10,000 feet on the west and northwest side of the basin.

Only a small part of the Arkansas River basin has been topographically mapped. Figure 3 indicates the areas that have been

Figure 3 (caption on next page) belongs near here.

~~previously~~ mapped, the areas in which mapping is in progress, and the areas ~~in which~~ that have not been mapped. ~~not mapped has been done~~.

Figure 3.--Status of topographic mapping in New Mexico

Geology

Rocks of Precambrian age crop out along the western border of Colfax County on the east slope of the Sangre de Cristo Mountains. The Sangre de Cristo Formation of Pennsylvanian and Permian ages and the Glorieta Sandstone of Permain age, crop out in a few small areas east of the Agua Fria Mountains in southwestern Colfax County, and are the only formations between Precambrian age and Triassic age in the area; the other rocks in that time interval are missing.

Rocks of Triassic, Jurassic, and Cretaceous ages crop out along streams and steep sided hills over most of the area.

Extrusive rocks of Tertiary and Quaternary age are common, as lava flows capping high mesas and as dikes and sills, in the north-central part of the basin.

Unconsolidated deposits of Tertiary and Quaternary age are present in buried valleys and on flood plains of rivers and creeks, and commonly cover the large plains areas of the central and southeastern parts of the basin. Table 1 is a generalized stratigraphic section in the Arkansas River basin, New Mexico.

Coal is mined in the north-central part of Colfax County from coal beds in the Vermejo and Raton Formations (Griggs, 1948, p. 16). Sand and gravel products are mined in Colfax and San Miguel Counties. Caliche and scoria have been mined in Union County (Baldwin and others, 1959, p. 91). Deposits of scoria, gravel, and clay appear to offer the most in economic use in the Arkansas River basin. Apparently, little has been done in the study and laboratory testing of these deposits.

A geologic map ~~for~~ of the northeastern quarter of New Mexico has been published under the title of U.S. Geological Survey Miscellaneous Geologic Investigations Map I-358 (Bachman and Dane, 1962). The map lists the more detailed maps from which it was compiled. A geologic map index of New Mexico (Boardman and others, 1956) has been published also by the Geological Survey and indicates many reports and maps available for New Mexico.

Soils and vegetation

Generally shallow, light- to medium-textured soils are found in the mountainous areas of Mora and western Colfax Counties. The central and southwestern parts of the basin have moderately deep to deep, medium- to heavy-textured soils interspersed with areas of shallow soils. The northern and southern parts have generally shallow soils in steeply rolling and rough broken areas and moderately deep and deep soils in valley bottoms and alluvial fans. Figure 4 is a soils

Figure 4 (caption on next page) belongs near here.

resource map of New Mexico which indicates zones of soil types.

The plant life zones in the Arkansas River basin range from lower Sonoran in the Canadian River valley in central Quay County to Hudsonian and Arctic in the high mountains of western Colfax County. Figure 5 illustrates the life zones and figure 6 illustrates the

Figure 5 (caption on next page) belongs near here.

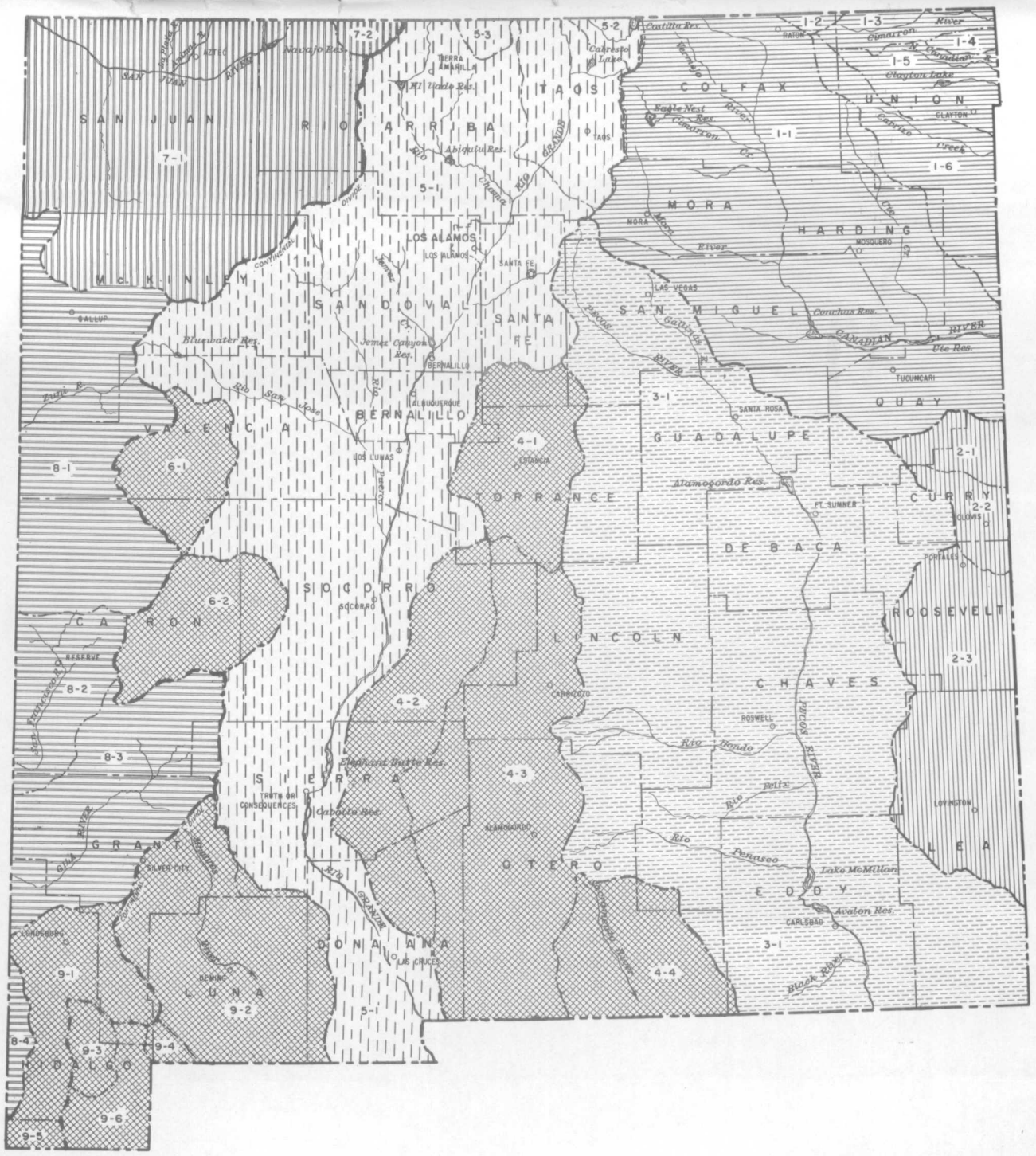
Figure 6 (caption on next page) belongs near here.

vegetative types in New Mexico. The high mountainous areas in the western part of the basin contain forest of spruce, fir, ponderosa pine, and aspen. The central and eastern part consist of grasslands with a border of pinyon and juniper on the north and west, and with a much larger woodland area on the south.

Figure 4.--Soil resources map of New Mexico.

Figure 5.--Life zones of New Mexico.

Figure 6.--Vegetative-type map of New Mexico.



BASIN INDEX

ARKANSAS RIVER BASIN
- 1-1, CANADIAN RIVER
- 1-2, PURGATOIRE RIVER
- 1-3, CIMARRON RIVER
- 1-4, CARRIZOZO CREEK
- 1-5, NORTH CANADIAN RIVER
- 1-6, CARRIZO CREEK

SOUTHERN HIGH PLAINS
- 2-1, RED RIVER
- 2-2, BRAZOS RIVER
- 2-3, LEA PLATEAU

PECOS RIVER BASIN
- 3-1, PECOS RIVER

CENTRAL CLOSED BASINS
- 4-1, ESTANCIA BASIN
- 4-2, JORNADA DEL MUERTO BASIN
- 4-3, TULAROSA BASIN
- 4-4, SALT BASIN

RIO GRANDE BASIN
- 5-1, RIO GRANDE
- 5-2, COSTILLA CREEK
- 5-3, RIO SAN ANTONIO

WESTERN CLOSED BASINS
- 6-1, NORTH PLAINS
- 6-2, SAN AUGUSTIN PLAINS

SAN JUAN RIVER BASIN
- 7-1, SAN JUAN RIVER
- 7-2, NAVAJO RIVER

LOWER COLORADO RIVER BASIN
- 8-1, LITTLE COLORADO RIVER
- 8-2, SAN FRANCISCO RIVER
- 8-3, GILA RIVER
- 8-4, SAN SIMON CREEK.

SOUTHWESTERN CLOSED BASINS
- 9-1, ANIMAS BASIN
- 9-2, MIMBRES BASIN
- 9-3, PLAYAS BASIN
- 9-4, WAMEL BASIN
- 9-5, SAN LUIS BASIN
- 9-6, HACHITA BASIN

0 5 10 20 30 40 50 60 70 80 90 100

SCALE IN MILES

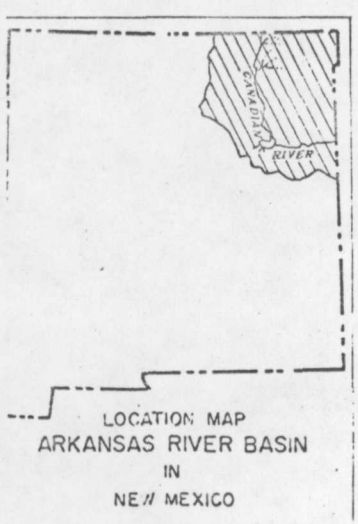
FIGURE 1

DRAINAGE BASINS OF NEW MEXICO

DRAINAGE BASIN INDEX

4- CANADIAN RIVER
4A- CARRIZO CREEK
4B- NORTH CANADIAN RIVER
8- CIMARRON RIVER
8A- CARRIZOZO CREEK
15- PURGATOIRE RIVER

RS CORRESPOND TO THOSE USED IN FIGURE 16



LOCATION MAP
ARKANSAS RIVER BASIN
IN
NEW MEXICO

LEGEND

- COUNTY SEAT
- OTHER TOWNS
- STATE LINE
- COUNTY LINE
- DRAINAGE BASIN BOUNDARY
- SUB BASIN BOUNDARY
- LANDS IRRIGATED PREDOMINANTLY FROM SURFACE WATER SOURCES.

FIGURE 2 ~~63~~

MAP OF
ARKANSAS RIVER B
IN NEW MEXICO

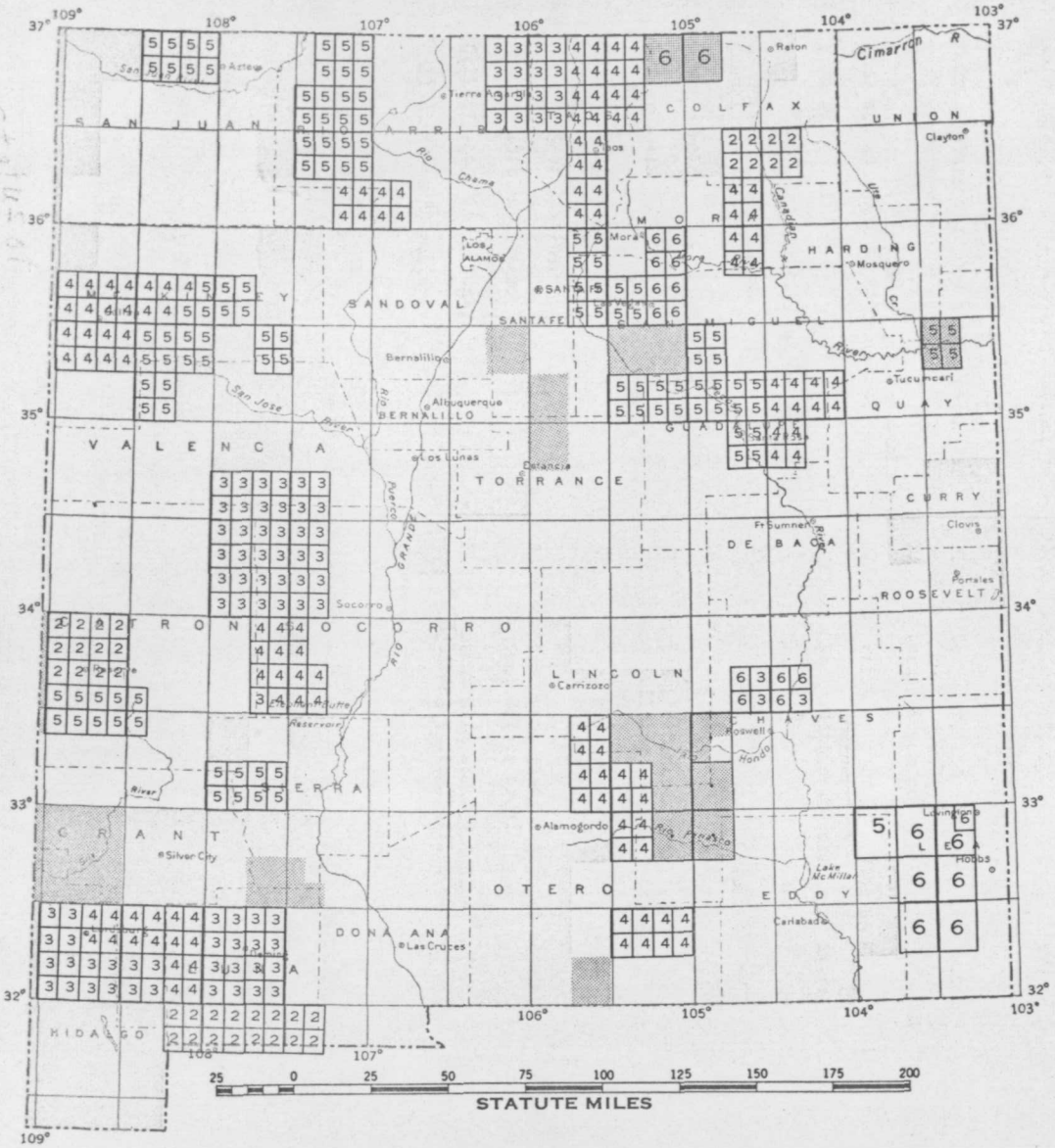
10 5 0 10 20
SCALE IN MILES

DRAWN BY J.J.FOX
JANUARY, 1955

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

NEW MEXICO

TOPOGRAPHIC DIVISON
ROCKY MOUNTAIN AREA
DENVER, COLORADO
OCTOBER 1, 1964



ADVANCE MATERIAL AVAILABLE FROM CURRENT TOPOGRAPHIC MAPPING QUARTERLY EDITION

2 Aerial photography completed. Information available from U.S. Geological Survey, Topographic Division, Federal Center, Bldg. 25, Denver, Colorado, 80225, or Map Information Office, U.S. Geological Survey, Washington, D.C., 20242.

3 Basic horizontal and vertical control surveys completed. Descriptions and unadjusted coordinates and/or elevations are available. Price 50 cents for each 15-minute quadrangle horizontal or vertical control list. See notes.

P 4 Prints of manuscripts compiled from aerial photographs are available at 50 cents each. Contours are shown in areas suitable for stereocontouring. Letter "P" indicates quadrangles on which contouring is not complete and which will require fieldwork to complete the contouring. (If shaded, see explanation below.)

5 Field mapping and checking completed. One-color advance prints (without names) available for 50 cents each. (If shaded, see explanation below.)

6 Final drafting completed. Partially-edited one-color advance prints (with names) available for 50 cents each. (If shaded, see explanation below.)

· Maps published since latest edition of Index to Topographic Mapping— May, 1964. See statement below regarding published maps. (If shaded, see explanation below.)

EXPLANATION OF SHADING

Maps of areas shaded will be (or have been) published at 1:62,500 scale only. However, 1:24,000-scale advance prints in 7½-minute units (without names) are and will remain available, with accuracy and contour interval appropriate for that scale. Each 7½-minute print is 50 cents, or $2 for prints covering a complete 15-minute quadrangle.

NOTES

1. Send requests for control lists and advance prints to U.S. Geological Survey, Topographic Division, Federal Center, Bldg. 25, Denver, Colorado, 80225. Check, money order or draft in correct amount made payable to U.S. Geological Survey should accompany order. Please do not send stamps. No discount allowed.

2. In ordering materials or requesting information, mark the area of interest on this index and forward it with your order. A new copy of the index will be returned to you for future use.

PUBLISHED MAPS

Published 7½′ or 15′ Quadrangles

State Index giving more detail available free. Published maps available at 30 cents each from U.S. Geological Survey, Denver Distribution Section, Federal Center, Bldg. 25, Denver, Colorado, 80225, or U.S. Geological Survey, Washington, D.C., 20242. On orders amounting to $10 or more a 20 percent discount is allowed; on orders amounting to $60 or more a 40 percent discount is allowed. Remittance may be made by check, money order or cash. Checks or money orders should be made payable to the U.S. Geological Survey.

Fig 3

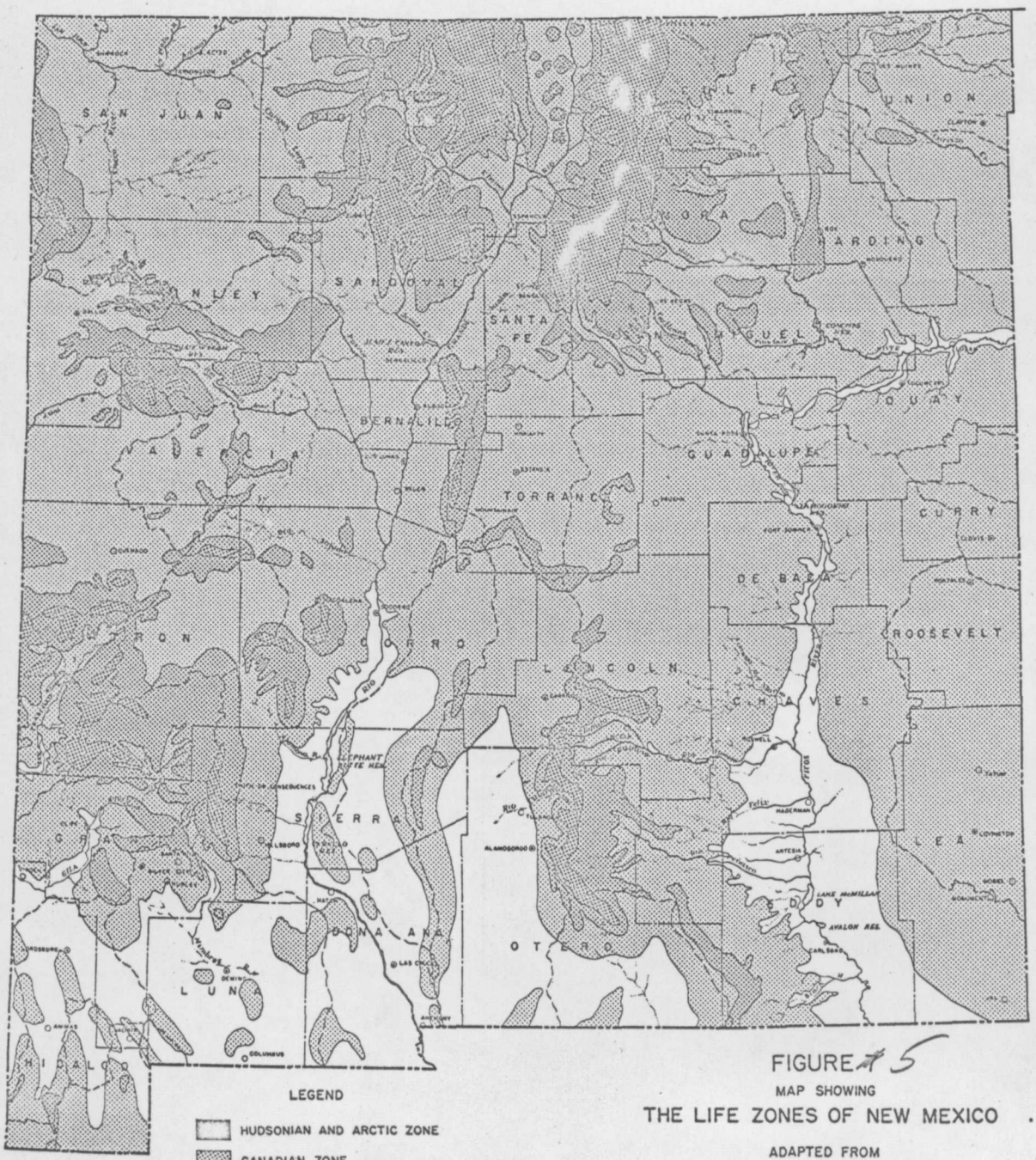


FIGURE 5

MAP SHOWING

THE LIFE ZONES OF NEW MEXICO

ADAPTED FROM

NORTH AMERICA FAUNA NO. 35

LIFE ZONES AND CROP ZONES OF NEW MEXICO

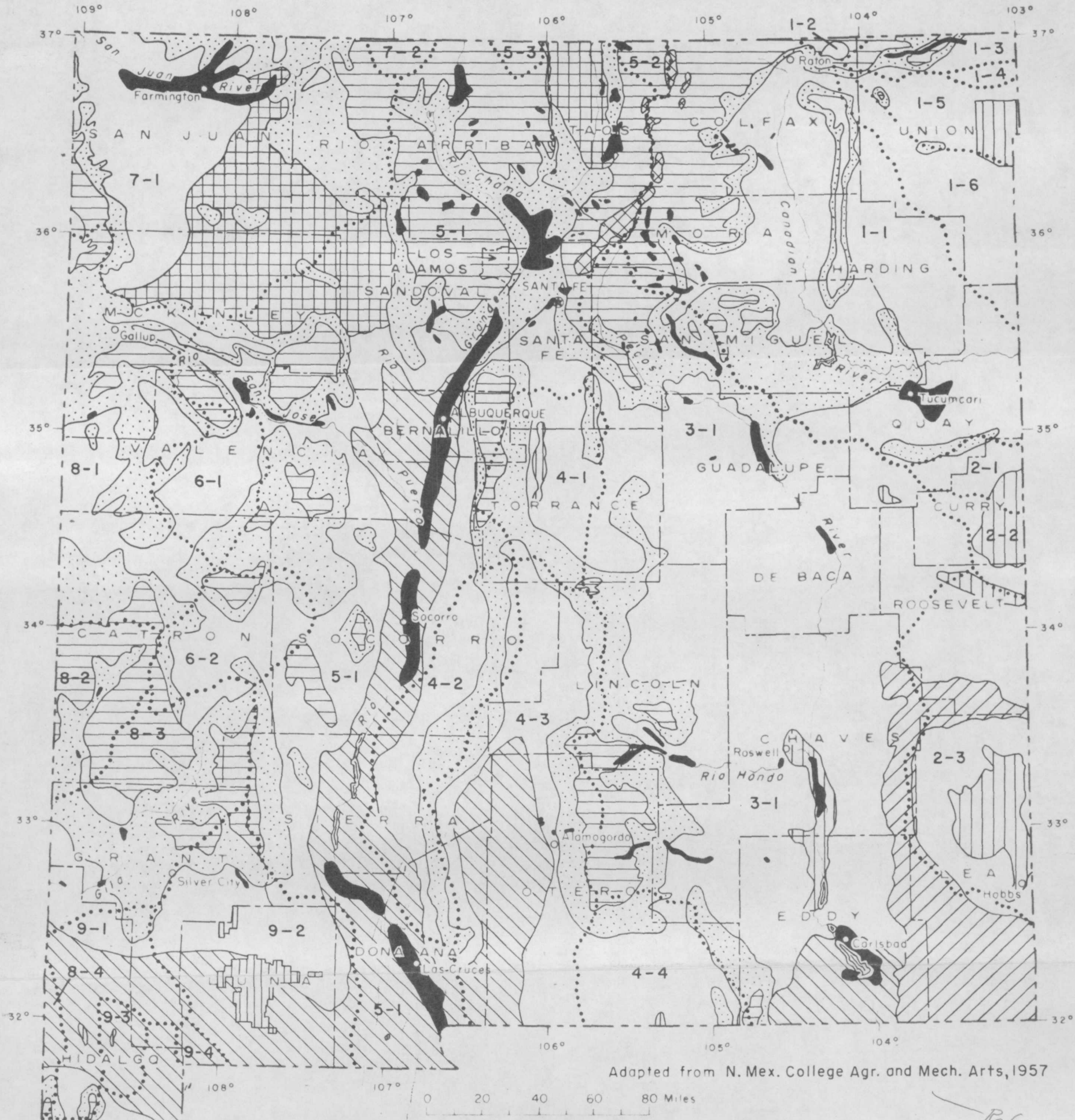
VERNON BAILEY, 1913, U.S. DEPARTMENT OF AGRICULTURE

DRAWN BY M.B. HUEY

JULY 1956

10 0 10 20 30 40 50 60

SCALE IN MILES



Adapted from N. Mex. College Agr. and Mech. Arts, 1957

EXPLANATION

- Semi-desert brush
- Grassland
- Shinnery
- Big sagebrush
- Woodland
- Forest
- Tundra
- Irrigated lands with water sources from surface water only or from surface water supplemented by pumping of ground water
- Irrigated lands with water source entirely from pumped or artesian ground water
- Lakes and reservoirs
- Outline of river basins (2-1)

Figure 5.--Vegetative type map of New Mexico

U.S. GOVERNMENT PRINTING OFFICE: 1959 O-533379

Figure 16.--Weather stations and climatologic divisions in New Mexico

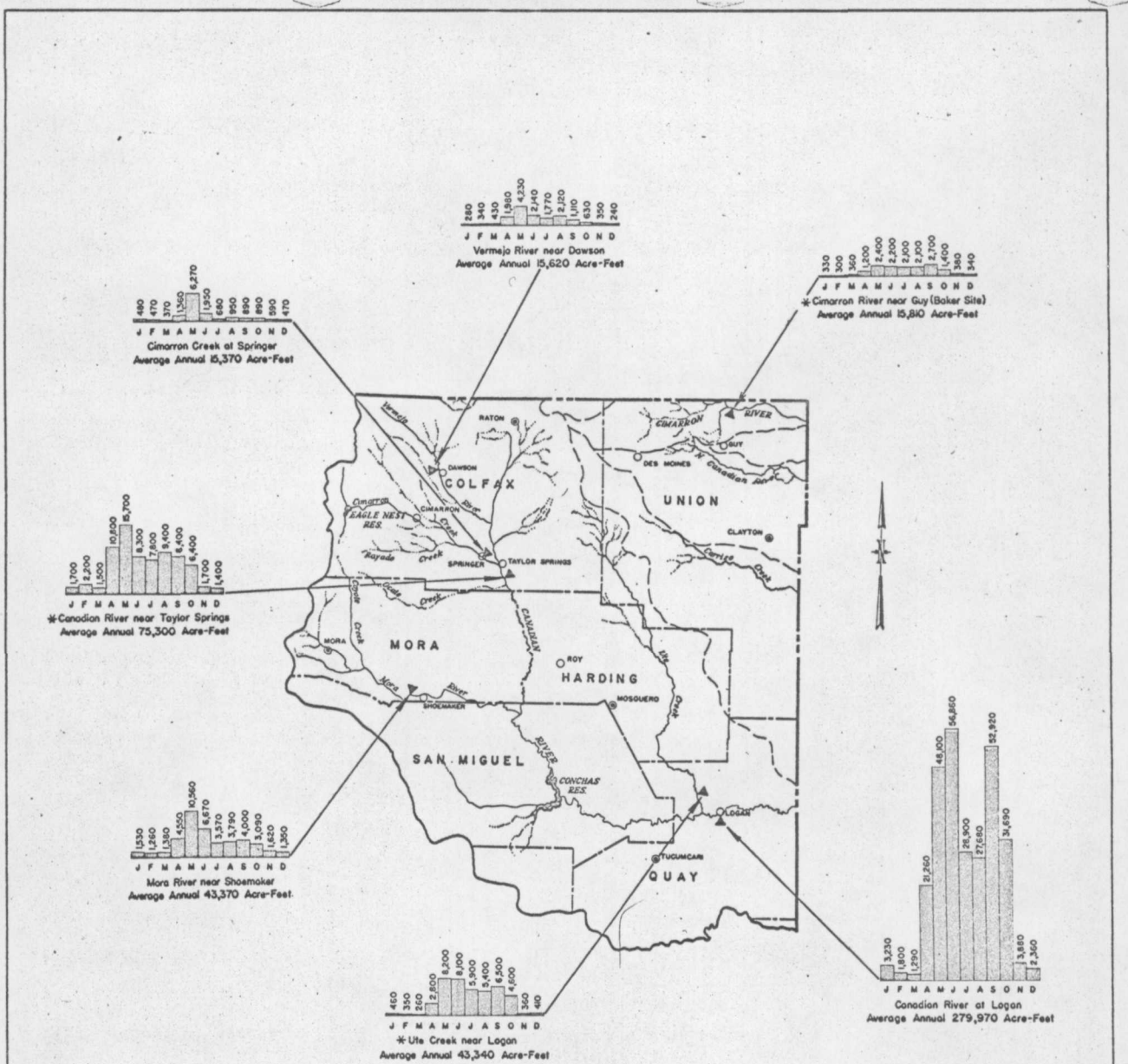


FIGURE 67 8

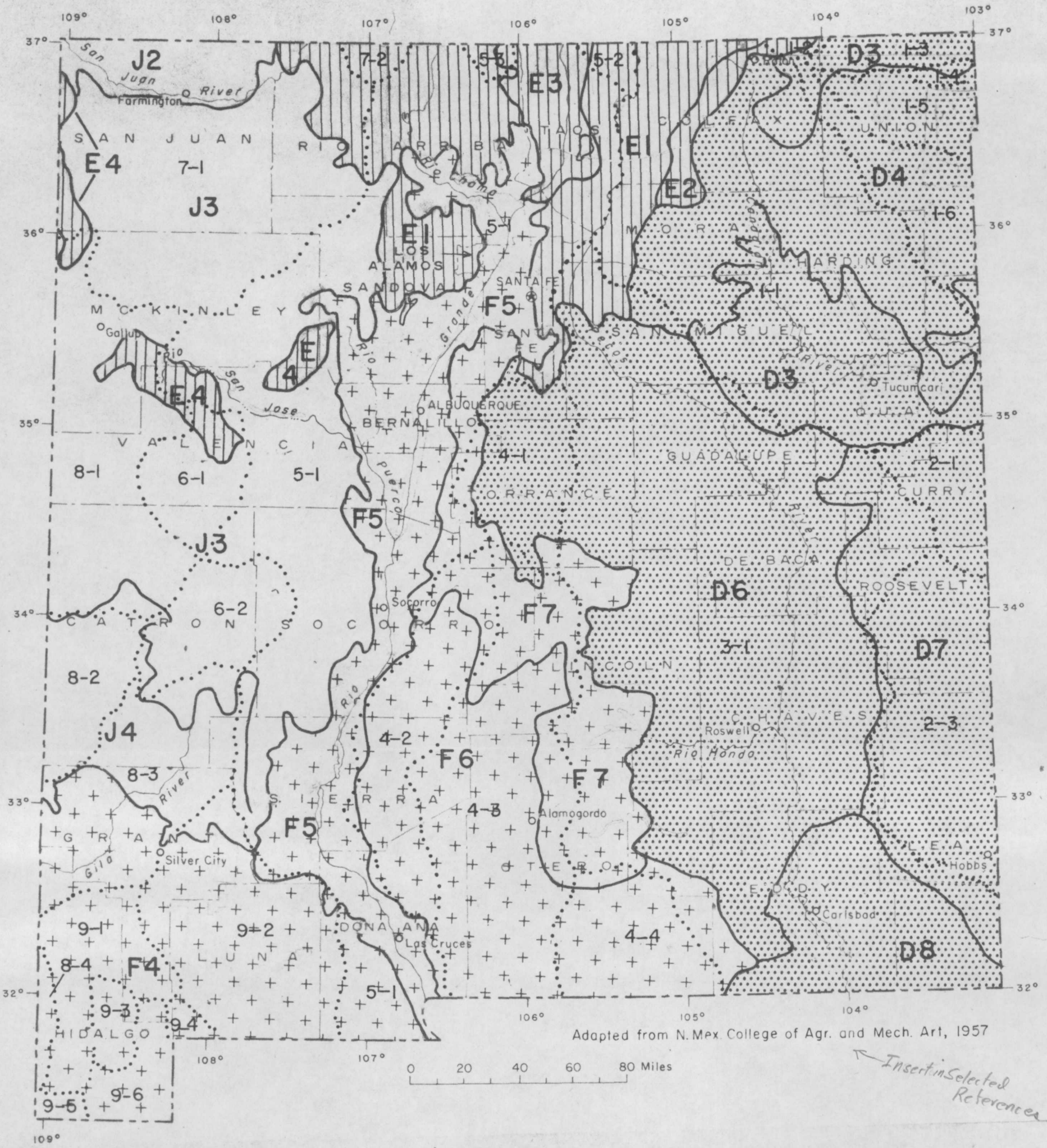
ARKANSAS RIVER BASIN
IN NEW MEXICO
AVERAGE MONTHLY AND ANNUAL DISCHARGES
AT
SELECTED GAGING STATIONS

10 5 0 10 20 30
SCALE IN MILES

COMPILED BY J. J. VANDERTULIP
TRACED BY E.M.HARRIS
NOVEMBER 1954

RECORDS TABULATED AND EXTENDED BY NEW MEXICO A.W.R. COORDINATION COMMITTEE, CONTAINED IN THEIR REPORT DATED JUNE 1953.

NOTE: ALL AVERAGES BASED ON 1930-1951 RECORDS EXCEPT THOSE



Adapted from N. Mex. College of Agr. and Mech. Art, 1957

Insert in Selected References ?

D_3 Generally shallow soils in steeply rolling and rough broken areas. Moderately deep and deep soils in valley bottoms and alluvial fans.

D_4 Largely moderately deep to deep, medium to heavy-textured soils interspersed with some areas of shallow soils; generally gently rolling topography.

D_6 Dominantly moderately deep to deep, medium-textured soils with rolling topography, interspersed with areas of shallow soils and deep sandy soils with dune-like topography.

D_7 Generally loose sandy soils with dune-like topography east of Pecos river, interspersed with areas of shallow to moderately deep, medium to heavy-textured soils west of Pecos river.

D_8 Similar to D-7, east of Pecos river, interspersed with areas of shallow to moderately deep, medium-textured soils west of Pecos river.

E_1, E_2, E_3, E_4 Largely shallow to moderately deep, light to medium-textured soils with rolling to mountainous topography. Generally shallow soils on escarpments and mountainous areas.

2-1 Outline of river basins

F_4 Generally light to medium-textured, deep and shallow soils with rolling topography, interspersed with low mountains. Dominantly shallow soils and rock outcrops in mountainous areas.

F_5 Large areas of light to medium-textured, shallow to moderately deep soils with gentle to moderate slopes.

F_6 Mesas, benchlands, and mountain slopes. Largely light to medium-textured, shallow to moderately deep soils on mesas and benchlands, and gravelly shallow soils on mountain slopes and foothills.

F_7 Largely mountain ranges and foothill slopes. Dominantly medium-textured soils on mountain slopes, and moderately deep to deep soils on foothill slopes.

J_2 Dominantly medium-textured, shallow soils on steep slopes. Medium-textured moderately deep soils on sloping plains, and dissected mesas; and medium to heavy-textured deep soils in valleys.

J_3 Largely medium-textured, moderately deep to shallow soils interspersed with areas of light-textured soils. Generally rolling topography with steep slopes in mountainous areas.

J_4 Generally mountainous shallow soils interspersed with rock outcrops and small areas of moderately deep soils. Generally mountainous topography.

Figure 4.--Soils resource map of New Mexico

Figure 9.--General quality of shallow ground water in New Mexico

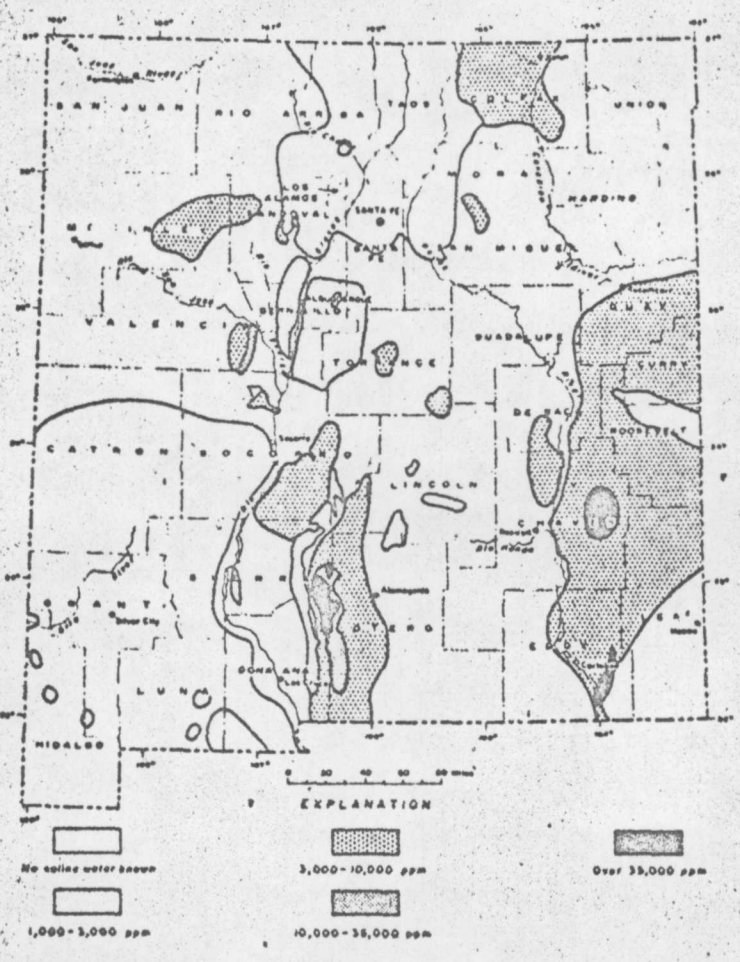


Figure 10.--General occurrence of saline ground water in New Mexico

Figure 8.--General availability of relatively fresh ground water in New Mexico

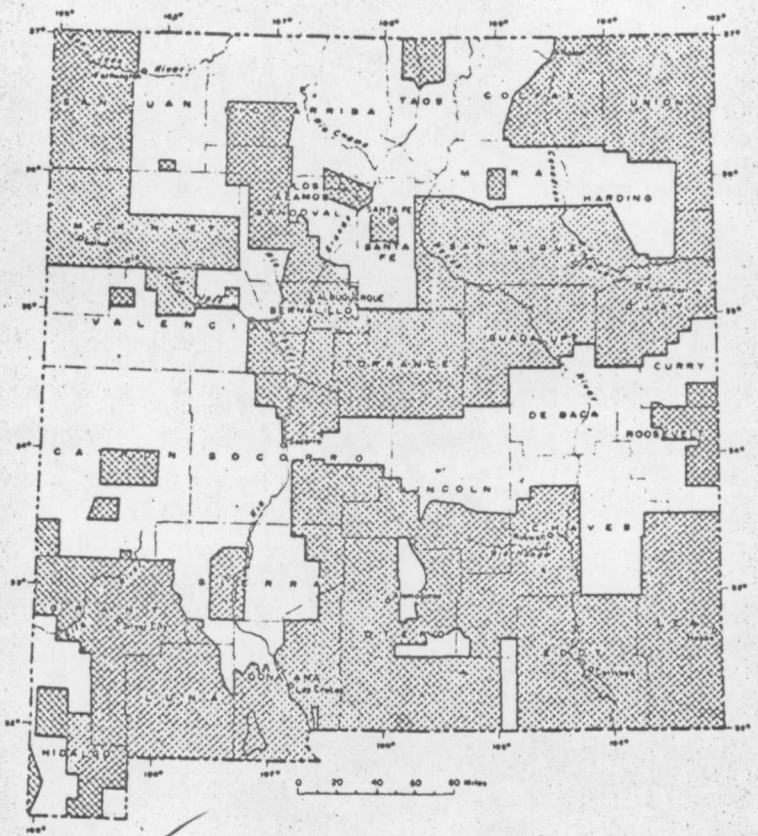


Figure 11.--Areas in New Mexico in which ground-water studies have been made.

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Figure 12.--Areas of observation of water-level fluctuation in New Mexico

Climatology

Weather stations are located at strategic points throughout the Arkansas River basin. (See figure 7 for weather station locations and climatologic division.) The Arkansas River basin includes parts of the Northern Mountains and Northeastern Plains climatologic divisions. Mean temperatures and precipitation at selected weather stations in the basin are listed in table 2. More detailed climatological information is given in the monthly climatologic reports by the U.S. Weather Bureau, Department of Commerce.

Figure 7 (caption on next page) belongs near here.

Figure 7.--Weather stations and climatologic divisions in New Mexico.

The mean evaporation rates at two places in the Arkansas River basin are listed in the following table (table 3). For more detailed information refer to the monthly and annual summary climatologic reports of the U.S. Weather Bureau, Department of Commerce.

Table 3.--Average evaporation, in inches, 1960.

(U.S. Weather Bureau)

Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Conchas Dam	-	-	-	9.81	11.55	13.42	12.85	11.80	9.65	6.95	-	-	-
*Tucumcari 3 NE	-	-	-	11.55	13.16	13.11	11.08	11.84	8.61	-	-	-	-

*Figures for 1960 only--no long term average.

Surface water

The Arkansas River basin has 52 gaging stations strategically located along the important creeks and rivers. Table 4 lists the gaging station, period of record, drainage area, average annual runoff and peak discharges. Figure 8 illustrates the average monthly and annual discharges at selected [gaging] stations.

Figure 8 (caption on next page) belongs near here.

Virgin flows were determined by adding estimated streamflow depletions to the recorded and/or estimated streamflows at key points along the Canadian and other streams in the area. The virgin flow based on the above assumptions are listed in table 5.

The total of the average water yield of the Canadian River drainage and the northeastern area of New Mexico is 563,420 acre-feet, of which about 9,110 acre-feet originates outside [of] New Mexico.

Table 2.--Mean temperature and precipitation at places in the Arkansas River basin, New Mexico

(U.S. Weather Bureau, 1959)

Station	January		February		March		April		May		June		July		August		September		October		November		December		Annual	
	Temp. (°F)	Prec. (inches)	Temp.	Prec.	Temp.	Prec.	Temp.	Prec.	Temp.	Prec.	Temp.	Prec.	Temp.	Prec.	Temp.	Prec.	Temp.	Prec.	Temp.	Prec.	Temp.	Prec.	Temp.	Prec.	Temp.	Prec.
Abbott	-	0.34	-	0.25	-	0.39	-	0.78	-	2.10	-	1.70	-	2.39	-	3.07	-	1.52	-	1.12	-	0.45	-	0.25	-	14.36
Amistad	-	.46	-	.44	-	.50	-	1.34	-	2.52	-	1.41	-	2.06	-	2.37	-	1.66	-	.85	-	.43	-	.56	-	14.60
Bell Ranch	36.8	.31	40.8	.37	47.3	.55	56.6	1.11	64.6	1.86	74.8	1.55	78.6	2.26	77.3	2.60	70.6	1.92	58.7	.79	44.9	.40	38.0	.37	57.4	14.09
Bueyeros	-	.34	-	.43	-	.42	-	.99	-	2.40	-	1.86	-	2.18	-	2.26	-	1.78	-	.79	-	.40	-	.36	-	14.21
Capulin 6 SSE	26.8	.46	30.2	.25	35.0	.54	44.2	1.05	52.6	2.08	62.5	1.61	67.0	2.94	66.1	3.35	59.0	1.70	48.3	.83	35.9	.44	29.2	.28	36.4	15.53
Clayton 9 SE	33.7	.29	36.9	.31	42.7	.47	52.4	1.16	60.8	2.96	71.1	1.78	75.3	2.57	73.5	2.32	66.3	1.66	55.7	.84	42.2	.36	35.7	.30	53.9	15.02
Clayton WB AP	32.9	.27	36.6	.37	41.5	.66	51.0	1.13	59.9	2.59	69.6	1.91	74.1	2.56	72.9	2.01	65.9	1.87	55.1	1.30	42.4	.39	35.1	.36	53.1	15.42
Cimarron	32.1	.42	35.3	.49	40.7	.65	49.1	1.20	56.9	2.22	66.1	1.29	70.0	2.05	68.6	2.50	62.3	1.51	52.6	.91	40.3	.59	34.4	.32	50.7	14.15
Dawson	-	.32	-	.40	-	.61	-	1.22	-	2.31	-	1.52	-	2.62	-	2.86	-	1.66	-	.92	-	.46	-	.26	-	15.16
Hayden 6 NE	-	.33	-	.37	-	.39	-	1.44	-	2.82	-	1.46	-	2.38	-	2.21	-	1.81	-	.84	-	.39	-	.36	-	14.80
Ione	-	.41	-	.34	-	.45	-	1.01	-	2.43	-	1.41	-	2.65	-	2.46	-	2.02	-	.85	-	.42	-	.36	-	14.81
Levy	-	.73	-	.51	-	.63	-	1.11	-	2.21	-	1.78	-	2.64	-	2.83	-	2.05	-	1.07	-	.69	-	.37	-	16.62
Logan	-	.35	-	.32	-	.42	-	1.06	-	2.33	-	1.62	-	2.12	-	2.17	-	1.54	-	.90	-	.45	-	.46	-	13.74
Miami	31.9	.40	35.4	.41	40.9	.54	49.3	1.24	57.2	2.23	66.1	1.76	70.1	2.27	68.9	2.92	63.1	1.64	53.2	.97	40.3	.57	33.8	.30	50.9	15.25
Mosquero	35.9	.51	37.1	.46	41.9	.47	51.2	1.14	59.2	2.48	68.8	1.87	73.0	2.93	71.2	2.63	64.5	2.02	54.5	.76	42.0	.53	34.9	.37	52.7	16.17
Newkirk	-	.44	-	.52	-	.56	-	.90	-	1.82	-	1.61	-	2.06	-	2.14	-	1.90	-	.75	-	.44	-	.46	-	13.60
Obar	39.6	.32	40.0	.36	47.2	.53	56.4	1.36	65.2	2.33	75.0	1.70	79.1	2.48	77.7	2.62	70.6	1.72	59.2	.97	45.5	.38	38.6	.34	57.6	15.11
Pasomonte	-	.36	-	.34	-	.38	-	1.07	-	2.07	-	1.81	-	2.34	-	2.60	-	1.73	-	.92	-	.27	-	.27	-	14.16
Pennington	-	.35	-	.49	-	.42	-	1.33	-	2.44	-	1.81	-	2.77	-	2.56	-	1.93	-	.90	-	.34	-	.33	-	15.67
Quay	-	.39	-	.36	-	.42	-	.73	-	2.22	-	1.16	-	2.25	-	2.22	-	1.56	-	1.12	-	.47	-	.41	-	13.31
Raton WB AP	26.2	.42	32.0	.37	38.1	.64	46.9	1.08	55.7	2.17	63.9	1.72	68.6	2.50	67.4	2.49	60.8	2.01	51.1	1.10	38.4	.57	29.4	.35	48.2	15.42
Roy	-	.41	-	.47	-	.52	-	.85	-	2.53	-	1.59	-	2.09	-	2.11	-	1.90	-	1.19	-	.45	-	.50	-	14.61
San Jon 2 SW	37.7	.40	42.2	.31	48.5	.45	57.6	.96	65.6	2.42	75.9	1.49	79.4	2.62	78.0	2.45	71.3	1.27	60.1	1.07	46.4	.51	39.5	.55	58.5	15.50
Sedan 7 NW	-	.35	-	.41	-	.48	-	1.29	-	2.63	-	1.72	-	2.20	-	2.70	-	1.81	-	.80	-	.42	-	.40	-	15.21
Solano	-	.36	-	.42	-	.55	-	.81	-	2.30	-	1.90	-	2.48	-	2.50	-	2.00	-	.89	-	.49	-	.42	-	15.12
Springer	29.9	.45	34.7	.36	40.9	.56	50.1	1.13	58.5	1.88	67.4	1.67	71.4	2.33	69.9	2.93	63.2	2.00	52.7	1.03	39.2	.61	31.1	.34	50.8	15.29
Tucumcari 3 NE	37.6	.40	41.2	.44	47.5	.54	57.1	.90	65.4	2.38	75.6	1.47	79.4	2.47	77.9	2.41	71.1	1.46	60.1	.97	46.4	.53	39.0	.50	58.2	14.47
Valmora	30.6	.47	33.9	.35	38.8	.49	47.5	.91	55.2	2.03	64.2	1.78	68.7	2.94	67.4	2.75	61.5	2.06	51.3	1.10	38.9	.56	33.3	.35	49.3	15.79
Yates 6 S	-	.33	-	.38	-	.47	-	.81	-	2.25	-	1.69	-	2.24	-	2.37	-	1.87	-	.92	-	.29	-	.31	-	13.93

Figure 8.--Arkansas River basin, in New Mexico, average monthly and annual discharges at selected gaging stations.

Table 1.--Summary of gaging station records

Period of record Water years (1900, 1910, 1920, 1930, 1940, 1950, 1960, 1970)	Sta. No.	Gaging station	Drainage area (sq mi)	Average runoff acre-feet per year through 1963	Peak discharge		
					Date	cfs	cfs per sq mi
		ARKANSAS RIVER BASIN: Part 7					
	1535	Cimarron River near Guy	545	7,890	10- 5-54	8,500	15.6
	1540	Cimarron River near Folsom	895	7,460	5-17-28	4,300	4.80
	1990	Canadian River near Hebron	229	3,790	5-19-55	a6,860	30.0
	1995	Chicorica Creek below Lake Maloya	26	2,140	5-18-55	2,230	85.8
	2000	Chicorica Creek below East Fork near Raton	71	4,200	-	-	-
	2005	Chicorica Creek near Raton	87	-	6-12-13	6,100	70.1
	2015	Uña de Gato Creek near Hebron	224	-	7- 7-49	a718	3.21
	2020	Chicorica Creek near Hebron	381	8,760	b	15,000	39.4
	2030	Vermejo River near Dawson	301	14,260	8- 6-40	c9,000	29.9
	2040	Moreno Creek at Eagle Nest	82	d	9- 1-46	240	2.93
	2045	Cieneguilla Creek near Eagle Nest	56	d	4-23-42	500	8.93
	2050	Six Mile Creek near Eagle Nest	11	d	4-11-37	125	11.36
	2060	Cimarron Creek below Eagle Nest Dam	167	9,340	6-14-55	205	1.23
	2062	McEvoy Creek near Eagle Nest	1.95	-	4-30-62	1.37	0.70
	2063	Tolby Creek near Eagle Nest	8.5	-	4-20-62	27.3	3.21
	2064	Clear Creek near Ute Park	7.44	-	5-13-62	28.3	3.80
	2065	Cimarron Creek at Ute Park	260	e22,800	5-10-16	700	2.69
	2070	Cimarron Creek near Cimarron	294	14,620	6- 6-58	580	1.97
	2075	Ponil Creek near Cimarron	171	9,340	8- 8-29	5,200	30.4
	2085	Rayado Creek at Sauble Ranch near Cimarron	65	10,280	4-23-42	850	13.1
	2095	Rayado Creek near Miami	76	3,530	4-23-42	-	-
	2100	Rayado Creek near Springer	77	-	-	-	-
	2105	Urraca Creek near Cimarron	6.3	-	6-10-13	-	-
	2110	Cimarron Creek at Springer	1,032	12,810	6- 6-58	f6,250	6.06
	2115	Canadian River near Taylor Springs	2,853	77,460	9-29-04	91,100	31.9
	2120	East Fork Ocate Creek at Ocate	35	3,980	-	-	-
	2140	Canadian River near Roy	4,066	93,390	4-23-42	f63,800	15.7
	2145	Rio Agua Negra near Holman	57	9,560	7-22-54	4,700	82.5
	2146	Vigil Canyon at Holman	2.8	1,350	6- 6-58	87	31.1
	2147	Agua Fria Creek near Holman	9.2	4,170	8- 6-59	138	15.0
	2148	Rio de la Casa near Cleveland	23	10,790	8- 6-59	2,260	98.3
	2155	Mora River at La Cueva	173	20,700	9-23-41	f1,530	8.84
	2156	Cebolla River near Golondrinas	64	4,230	8- -52	9,300	145.3
	2165	Mora River near Golondrinas	267	25,700	8-22-52	f14,000	52.4
	2170	Coyote Creek below Black Lake	48	3,340	6- 6-58	913	19.0
	2171	Coyote Creek above Guadalupita	71	7,310	6- 6-58	1,390	19.6
	2175	Coyote Creek at Guadalupita	90	-	-	-	-
	2180	Coyote Creek near Golondrinas	215	8,690	8-17-61	f4,050	18.8
	2181	Mora River near Watrous	521	39,240	7- 8-62	f7,050	13.5
	2187	Manuelitas Creek near Rociada	52	8,690	8-23-57	1,410	27.1
	2200	Sapello River at Sapello	132	19,760	8- 4-57	6,160	46.7
	2205	Sapello River at Los Alamos	144	-	6-11-13	11,400	79.1
	2206	Sapello River near Watrous	213	12,520	8- 5-57	f5,860	27.5
	2210	Mora River near Shoemaker	1,104	43,940	6- 3-48	f15,200	13.8
	2215	Canadian River near Sanchez	6,015	169,400	9- 2-42	f87,800	14.6
	2220	Canadian River near Bell Ranch	6,200	128,100	6- 3-37	f47,800	7.71
	2225	Conchas River at Variadero	523	13,630	9- 1-42	44,000	84.1
	2245	Canadian River below Conchas Dam	7,417	g70,950	6- 3-37	f73,000	9.84
	2260	Ute Creek near Bueyeros	620	12,160	8-16-53	39,000	62.9
	2265	Ute Creek near Logan	2,073	21,570	1941	70,000	33.8
	2270	Canadian River at Logan	11,141	g178,800	9-30-04	278,000	25.0
	2271	Revuelto Creek near Logan	786	-	7- 9-60	26,700	34.0
		BRAZOS RIVER BASIN: Part 8					
	0806	Running Water Draw near Clovis	109	1,480	9- 6-57	7,090	65.0
		RIO GRANDE BASIN: Part 8					
	2475	San Antonio River at Ortiz, Colo.	110	19,260	4-15-37	1,750	15.9
	2480	Los Pinos River near Ortiz, Colo.	167	90,500	5-12-41	3,160	18.9
	2515	Rio Grande near Lobatos, Colo.	7,700	453,200	6- 8-05	13,200	1.71
	2525	Costilla Creek above Costilla Dam	26	d	7-22-54	3,870	149
	2530	Casias Creek near Costilla	19	d	6-11-57	122	6.42
	2535	Santistevan Creek near Costilla	2.5	d	8-11-41	18	7.20
	2540	Costilla Creek below Costilla Dam	55	12,310	5- 9-42	286	5.20
	2545	Costilla Creek near Amalia	140	d	4-25-58	689	4.92
	2550	Ute Creek near Amalia	12	d	6- 8-55	69	5.75
	2555	Costilla Creek near Costilla	195	32,720	5-11-42	1,150	5.90
	2605	Costilla Creek below diversion dam, at Costilla	197	d	7-22-54	525	2.66
	2610	Costilla Creek at Garcia, Colo.	200	d	5-11-42	h1,000	5.00
	2625	Costilla Creek near Jaroso, Colo.	290	1,650	5-19-58	360	1.24
	2630	Latir Creek near Cerro	10	4,610	6- 3-42	121	12.1
	2635	Rio Grande near Cerro	8,440	249,000	6-22-49	9,740	1.15

29 (pgs 29a thru 29e follows)

Table 5.--Virgin streamflows in the Arkansas River basin, New Mexico.

Gaging station	Average annual flow in acre-feet	Remarks
Vermejo River near Dawson	16,930	
Cimarron Creek at Springer	52,760	
Canadian River near Taylor Springs	132,600	About 550 acre-feet of inflow from Colorado
Canadian River near Roy	165,200	
Mora River near Shoemaker	88,500	There are 3 small diversions from the Rio Grande basin not reflected
Canadian River at Sanchez	283,770	
Conchas River near Variadero	18,430	
Canadian River at Conchas Dam	333,500	
Ute Creek near Logan	46,800	
Canadian River at Logan	433,790	
Canadian River at State line	451,420	Outflow point
Trujillo Creek at State line New Mexico-Texas	7,410	Outflow point (about 1,000 acre-feet of inflow from Texas)
Major Long's and Carrizo Creeks at State line New Mexico-Texas	39,000	Outflow point
North Canadian River at State line New Mexico-Texas	20,880	Outflow point
Cimarron River near Guy at State line New Mexico-Texas	18,690	About 4,660 acre-feet of inflow from Colorado
Cimarron River at State line New Mexico-Texas	38,720	Outflow point (about 7,560 acre-feet of inflow from Colorado)
Trinchero Creek at State line New Mexico-Colorado	2,970	Outflow point
Purgatoire west of Raton at State line New Mexico-Colorado	3,020	Outflow point

Base flow and runoff is regulated by reservoirs in the Canadian River basin. ~~Reservoirs in the basin~~ Those that have a usable capacity of 30,000 acre-feet or more are listed in table 6. Small reservoirs are used to control sediment and the rate of runoff in areas subject to flooding.

Table 6.--Reservoirs, in the Arkansas River basin, New Mexico, that have a usable capacity of 30,000 acre-feet or more.

Name of reservoir and stream	Type of dam	Original capacity (acre-feet)	Dead storage (acre-feet)	Present capacity (acre-feet)	Usable capacity (acre-feet)	Use
Conchas (Canadian River)	Concrete	370,200	98,000	370,200	271,400	FIR
Eagle Nest (Cimarron Creek)	Concrete	79,120	0	79,120	79,120	IR
Use: F, flood control; I, irrigation; R, recreation.						

In the Arkansas River basin, there are 10 key sites from which samples are collected for suspended-sediment concentration and suspended-sediment load determinations of. Sediment studies are vital to the determination of sediment deposition in stream channels and reservoirs. Table 7 lists the name and location of the sediment stations, the period of record, daily suspended-sediment concentration and daily suspended-sediment load in the Arkansas River basin. For further information, refer to water-supply papers published by the U.S. Geological Survey.

Stations on

Table 5.--Summary of suspended-sediment ~~station~~ records for streams in New Mexico

Period of record Water years	Sta. No.	Station	Frequency of sampling	Daily suspended-sediment concentration (ppm)		Suspended-sediment load (tons/day)	
				Max.	Min.	Max.	Min.
		ARKANSAS RIVER BASIN: ~~Part 7~~					
	1535	Cimarron River near Guy	M	-	-	-	-
	2015	Chicorica Creek near Hebron	D	28,400	NF	79,800	0
	2030	Vermejo River near Dawson	D	39,800	NF	94,500	0
	2180.5	Mora River at Loma Parda	D	-	4	e200,000	.5
	2260	Ute Creek near Bueyeros	D	21,700	NF	840,000	0
	2640	Red River near Red River	M	153	1	13	.01
	2645	Red River below Dwargle damsite, near Red River	M	-	-	-	-
	2675	Rio Hondo near Valdez	M	76	.2	3.09	.01
	2682	Rio Hondo at damsite, at Valdez	M	-	-	-	-
		RIO GRANDE BASIN: Part 8					
	2775	Rio Grande de Ranchos near Talpa	M	338	3	99.4	.04
	2795	Rio Grande at Embudo	D	10,200	4	51,000	4
	2845	Willow Creek near Park View	M	6,120	7	15,300	.02
	2865	Rio Chama above Abiquiu Reservoir	D	-	-	-	-
	2870	Rio Chama below Abiquiu Dam	D	-	-	-	-
	2875	Rio Chama near Abiquiu	D	58,000	3	248,000	<.5
	2900	Rio Chama near Chamita	D	55,500	NF	209,000	0
	2943	Rio Nambe at Nambe Falls, near Nambe	M	-	-	-	-
	2950	Rio Nambe near Nambe	M	906	1	37.4	.01
	3130	Rio Grande at Otowi Bridge, near San Ildefonso	D	42,600	11	366,000	3
	3145	Rio Grande at Cochiti	W	44,700	6	186,000	<.5
	3180	Galisteo Creek at Domingo	D	96,300	NF	1,600,000	0
	3190	Rio Grande at San Felipe	W	38,300	84	86,200	22
	3290	Jemez River below Jemez Canyon Dam	D	118,000	NF	167,000	0
	3291	Piedra Lisa Arroyo near Bernalillo	D	13,600	NF	570	0
	3295	Rio Grande near Bernalillo	D	75,000	NF	1,680,000	0
	3300	Rio Grande at Albuquerque	W	62,300	11	610,000	<.5
	3315	Rio Grande near Belen	W	23,900	84	88,200	1
	3320	Rio Grande near Bernardo	D	-	-	348,000	0
	3340	Rio Puerco below Cabezon	D	166,000	NF	730,000	0
	3405	Chico Arroyo near Guadalupe	D	113,000	NF	1,220,000	0
	3515	Rio San Jose at Correo	D	120,000	NF	364,000	0
	3525	Rio Puerco at Rio Puerco	D	210,000	NF	1,800,000	0
	3530	Rio Puerco near Bernardo	D	230,000	NF	2,240,000	0
	3540	Rio Salado near San Acacia	D	102,000	NF	793,000	0
	3548	Rio Grande Conveyance Channel at San Acacia	D	131,000	NF	423,000	0
	3549	Rio Grande Floodway at San Acacia	D	196,000	NF	1,760,000	0
	3555	Rio Grande at San Antonio	D	122,000	NF	1,200,000	0
	3580	Rio Grande Conveyance Channel below heading near San Marcial	D	138,000	NF	294,000	0
	3581	Rio Grande (Tiffany Channel) at San Marcial	D	41,700	NF	40,600	0
	3583	Rio Grande Conveyance Channel at San Marcial	D	122,000	NF	356,000	0
	3584	Rio Grande Floodway at San Marcial[a]	D	117,000	NF	966,000	0
	3637	Tortugas Arroyo near Las Cruces	D	-	-	-	-
	3640	Rio Grande at El Paso	D	-	-	-	-
		PECOS RIVER BASIN: Part 8					
	3830	Pecos River at Santa Rosa	D	30,800	8	276,000	<.5
	3834	Pecos River at Puerto de Luna	D	59,200	20	1,510,000	4
	3905	Rio Hondo at Diamond "A" Ranch, near Roswell	D	64,900	NF	630,000	0
	3965	Pecos River near Artesia	D	20,900	NF	183,000	0
	3985	Rio Penasco at Dayton	D	30,000	NF	600,000	0
		SAN JUAN RIVER BASIN: Part 9					
	3430	Rio Blanco near Pagosa Springs, Colo.	M	906	1	1,580	.04
	3443	Navajo River above Chromo, Colo.	M	483	2	717	.07
	3505	San Juan River at Rosa	D	14,700	3	77,400	3
	3555	San Juan River near Archuleta	D	34,200	1	522,000	<.5
	3565	San Juan River near Blanco	D	51,300	8	418,000	1
	3570	San Juan River at Bloomfield	D	101,000	7	1,110,000	4
	3645	Animas River at Farmington	D	56,100	1	337,000	<.5
	3680	San Juan River at Shiprock	D	86,000	2	1,700,000	1
		GILA RIVER BASIN: Part 9					
	4300	Gila River near Gila	D	17,500	1	14,800	<.5
	4440	San Francisco River near Glenwood	M	2,470	10	190	.28
	4445	San Francisco River at Clifton, Ariz.	M	-	-	-	-

Note: NF, no flow

a/ Prior to 1954, published as Rio Grande at San Marcial

e Estimated

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Dissolved-solids content of surface water depends on the readily soluble constituents of the rocks over which the water flows. Table 8 lists the names and locations of chemical-quality monitoring stations in the Arkansas River basin and includes the maximum and minimum of daily dissolved-solids concentration and load. For more detailed information refer to water-supply papers published by the U.S. Geological Survey.

Stations on

Table 3.--Summary of chemical-quality ~~stations~~ records for streams in New Mexico

Period of record Water years (1900, 1910, 1920, 1930, 1940, 1950, 1960, 1970)	Sta. No.	Station	Frequency of sampling	Daily dissolved solids concentration (ppm) Max.	Daily dissolved solids concentration (ppm) Min.	Daily dissolved solids load (tons) Max.	Daily dissolved solids load (tons) Min.
		ARKANSAS RIVER BASIN: ~~Part 7~~					
	2030	Vermejo River near Dawson	M	385	189	-	-
	2040	Moreno Creek at Eagle Nest	M	224	144	-	-
	2045	Cieneguilla Creek near Eagle Nest	M	174	75	-	-
	2050	Six-mile Creek near Eagle Nest	M	177	84	-	-
	2065	Cimarron Creek at Ute Park	D	285	100	78	2.1
	2085	Rayado Creek at Sauble Ranch near Cimarron	M	116	50	-	-
	2110	Cimarron Creek at Springer	M	2,940	1,200	-	-
	2115	Canadian River near Taylor Springs	M	2,970	1,570	-	-
	2205	Sapello River at Los Alamos	D	512	142	-	-
	2215	Canadian River near Sanchez	D	2,320	133	4,410	.8
	2239	Conchas Canal below Conchas Dam	M	-	-	-	-
	2260	Ute Creek near Bueyeros	D	674	142	653	.38
	2265	Ute Creek near Logan	D-M	1,210	201	1,740	1.17
	2270	Canadian River at Logan	D	8,330	224	8,450	1.72
	2271	Revuelto Creek near Logan	D	1,910	250	6,000	2.49
		RIO GRANDE BASIN: Part 8					
	2492	Rio Grande above Culebra Creek near Lobatos, Colo.	D	805	100	2,690	.34
	2900	Rio Chama near Chamita	M	-	-	-	-
	3130	Rio Grande at Otowi Bridge near San Ildefonso	D	1,030	137	4,730	93.4
	3200	Jemez River near Jemez Springs	M	189	117	7.6	2.8
	3210	East Fork Jemez River near Jemez Springs	M	133	76	4.3	1.5
	3215	Jemez River below East Fork near Jemez Springs	M	-	-	-	-
	-	Jemez River above Rio Guadalupe near Jemez	D	587	256	-	-
	3235	Rio Guadalupe near Jemez Springs	D	295	103	21	2.6
	3240	Jemez River near Jemez	M	459	170	-	-
	3300	Rio Grande at Albuquerque	M	361	119	2,130	42.4
	3320	Rio Grande near Bernardo	D	1,780	207	8,270	3.86
	3530	Rio Puerco near Bernardo	M	4,150	1,180	11,080	25
	3550	Rio Grande at San Acacia	D	2,950	183	16,100	.2
	3581	Rio Grande Tiffany Channel at San Marcial	D	1,730	220	2,840	.24
	3583	Rio Grande Conveyance Channel at San Marcial	D	2,010	240	4,430	.58
	3584	Rio Grande Floodway at San Marcial[a]	D	1,950	233	16,400	.4
	3610	Rio Grande below Elephant Butte Dam	W	1,170	426	3,790	5.2
	3625	Rio Grande below Caballo Dam	D	912	375	7,710	2.3
	-	Rio Grande below Leasburg Dam	D	1,260	419	7,770	53.2
	3640	Rio Grande at El Paso, Tex.	D	3,830	426	8,290	22.8
		PECOS RIVER BASIN: Part 8					
	3795	Pecos River near Anton Chico	D	185	96	810	16
	3805	Gallinas River near Montezuma	D-M	386	120	138	2
	3810	Gallinas River at Montezuma	M	-	-	-	-
	3830	Pecos River at Santa Rosa	D	2,320	174	2,490	30
	3834	Pecos River at Puerto de Luna	D	2,740	220	16,020	106
	3845	Pecos River below Alamogordo Dam	D	2,730	435	9,930	.31
	3860	Pecos River near Acme	D	19,870	594	71,900	2.1
	3870	Rio Ruidoso at Hollywood	M	-	-	-	-
	3905	Rio Hondo at Diamond "A" Ranch near Roswell	M	1,450	252	1,820	3.52
	3965	Pecos River near Artesia	D	16,300	461	99,700	.4
	-	Pecos River near Dayton	D	5,120	748	30,100	1,060
	4010	Pecos River below McMillan Dam[b]	M	6,070	4,930	-	-
	-	Pecos River at Ford Crossing above Major Johnson Springs near Lakewood	M	6,160	1,470	-	-
	4015	Pecos River below Major Johnson Springs near Carlsbad	M	-	-	-	-
	4020	Pecos River at Damsite 3, near Carlsbad	W	4,970	316	-	-
	4035	Carlsbad main canal at head near Carlsbad	D	7,430	552	5,700	14.5
	4045.10	Pecos River above Carlsbad flume at Carlsbad	M	-	-	-	-
	4050	Pecos River at Carlsbad	D	3,810	360	79,700	27.7
	4053.50	Black River below Mayes Ranch near White City	M	-	-	-	-
	40540	Black River at Harkey Crossing near Malaga	M	2,000	480	-	-
	4065	Pecos River near Malaga	D	9,100	384	123,400	133
	4070	Pecos River at Pierce Canyon Crossing near Malaga	D	23,700	280	e100,000	103
	4075	Pecos River at Red Bluff	D	22,800	456	95,500	106
		TULAROSA VALLEY BASIN: Part 8					
	4815	Rio Tularosa near Bent	M	-	-	-	-

Ground water

The aquifers in the Arkansas River basin consist of unconsolidated sands and gravels, and sandstone, limestone, and some low-yield shales. Sandstone is the most areally extensive aquifer in the basin.

For more details on ~~physical properties~~ and water-bearing characteristics of formations, refer to the stratigraphic section in the Arkansas River basin (table 1). Known or probable aquifers are designated by asterisks in the stratigraphic-unit column.

The greatest use of ground water in the Arkansas River basin is for stock. Ground water is generally used for municipal supplies (Dinwiddie, 1964, and Trauger and Bushman, 1964); however, in those areas where large supplies are needed surface water is utilized.

Large supplies of ground water are not readily available; recharge is chiefly local and nearly all originates as precipitation within the basin.

The quality of ground water ~~varies~~ differs in accordance with the solubility of the constituents of the various rocks through which the water flows. For this reason, the quality of ground water ~~varies~~ ranges widely from aquifer to aquifer and also, to a lesser extent, from one locality to another in the same aquifer. Table 9 indicates the quality of water that is obtained from wells at a few places in the Arkansas River basin.

Table 9.--Analysis of water from selected wells in the Arkansas River basin, New Mexico.

Geologic source ~~Aquifer~~ and location	Sulfate (ppm)	Chloride (ppm)	Conductance (micromhos at 25°C)	Total hardness (as $CaCO_3$)
Colfax County				
Alluvium in Maxwell Grant	893	12	200	733
Alluvium on King Ranch	118	49	85.9	314
Dakota Sandstone	62	34	200	53
Union County				
Ogallala Formation near Clayton	29	14	232	483
San Miguel County				
Alluvium	28	49	363	310
Magdalena Limestone	303	78	961	778
Chinle ~~Shale~~ Formation	303	80	973	202
Quay County				
Entrada Sandstone	56	13	580	236
Morrison Formation	112	36	833	348
Chinle Formation	120	44	1,000	76

Figures 9, 10, and 11 indicate the general distribution of quality of ground water and its availability in New Mexico.

Figure 9 (caption on next page) belongs near here.

Figure 10(caption on next page) belongs near here.

Figure 11(caption on next page) belongs near here.

Figure 9.--General quality of shallow ground water in New Mexico.

Figure 10.--General occurrence of saline ground water in New Mexico.

Figure 11.--General availability of relatively fresh ground water in New Mexico.

Ground-water studies have been made in several places in the Arkansas River basin (fig. 12). The principal published reports on

Figure 12 (caption on next page) belongs near here.

the area are Baldwin and Bushman (1957)--Union County; Griggs (1948)--eastern Colfax County; Griggs and Hendrickson (1951)--San Miguel County; and Trauger and Bushman (1964)--vicinity of Tucumcari, Quay County.

In most parts of New Mexico where ground water is being used in quantity for irrigation, municipal and industrial purposes, the U.S. Geological Survey measures water levels periodically in a network of observation wells (fig. 13). The Arkansas River basin has no areas

Figure 13 (caption on next page) belongs near here.

where large supplies of ground water ~~is~~ are used for irrigation; however, water levels are measured periodically in 7 wells in the Capulin area. This locality is underlain by volcanic cinders ~~which~~ that contain large quantities of ground water, at shallow depth, and was at one time considered as a source of water for the city of Raton.

Figure 12.--Areas in New Mexico in which ground-water studies have been made.

Figure 13.--Areas of observation of water-level fluctuation in New Mexico.

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