Selected Hydrologic Data for the Upper Rio Hondo Basin, Lincoln County, New Mexico, 1945-2003

By Lisa C. Donohoe

Prepared in cooperation with
LINCOLN COUNTY

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Conversion Factors and Datum

Multiply	By	To obtain
Length		
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
Area		
square mile (mi^2)	2.590	square kilometer (km^2)
Flow rate		
foot per day (ft/d)	0.3048	meter per day (m/d)
Specific capacity		
gallon per minute per foot (gal/min/ft)	0.2070	liter per second per meter (L/s/m)
gallon per day per foot (gal/d/ft)	12.418	liter per day per meter (L/d/m)

Vertical coordinate information is referenced to the *National Geodetic Vertical Datum of 1929 (NGVD 29).*

Horizontal coordinate information is referenced to the *North American Datum of 1927 (NAD 27).*

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Abstract

Demands for ground and surface water have increased in the upper Rio Hondo Basin due to increases in development and population. Local governments are responsible for land-use and development decisions and, therefore, the governments need information about water resources in their areas. Hydrologic data were compiled for the upper Rio Hondo Basin and water-level data were collected during two synoptic measurements in March and July 2003.

Water-level data from March 2003 were contoured and compared with contours constructed in 1963. The 5,600-, 5,700-, and 5,800-foot March 2003 contours indicate that water levels rose. The 5,500-foot contour for March 2003 indicates a decline in water level. The 5,400-foot contour of March 2003 and the 1963 contour mostly coincide, indicating a static water level. The 5,300- and 5,200-foot contours for March 2003 cross the 1963 contours, indicating a decline in water levels near the Rio Ruidoso but a rise in water levels near the Rio Bonito. In eight hydrographs, 2003 water levels are shown to be higher than water levels from the mid- to late 1950's in five of the eight wells. For the same period of record, water levels in the three remaining wells were lower. Rising and declining water levels were highest in the northern part of the study area; the median rise was 4.01 feet and the median decline was 3.51 feet. In the southern part of the study area, the median water-level rise was 2.21 feet and the median decline was 1.56 feet.

Introduction

In October 2001, the U.S. Geological Survey (USGS), in cooperation with Lincoln County, south-central New Mexico, began an investigation to study the water resources of the upper Rio Hondo Basin. Increases in (1) population, (2) subdivision proposals, and (3) applications for permits to change locations of wells and places of use have prompted the need for more detailed water-resources information. This water-resources information will help Lincoln County planners and State officials address water-resources issues in the area.

As development and population in the upper Rio Hondo Basin have increased, so have the demands for ground and surface water and the concerns of current residents about their water resources. Local governments need a clear understanding of water resources in their areas because they are responsible for land-use and development decisions, decisions that must take water availability into account (New Mexico Office of the State Engineer, 2003a).

Purpose and Scope

This report presents water-level data for the upper Rio Hondo Basin collected during two synoptic measurements in 2003: a map of current (March 2003) water levels compared with a water-level map of the study area published by Mourant (1963); hydrographs of selected wells and streamflow and discharge measurements; streamflow-gaging station and discharge-measurement locations, identification numbers, and periods of record; annual precipitation data for stations in Capitan and Ruidoso; and locations and results of aquifer tests performed in the study area.

Available data were compiled from records maintained by the USGS and the New Mexico Office of the State Engineer (OSE) and from published reports and reports of public record. Types of data are discussed that are not available but would be beneficial to water-resources planners.

Information regarding losing and gaining reaches of the Rio Ruidoso, Rio Bonito, and Eagle Creek sometimes was contradictory (Follet, 1918; Powell, 1954; Mourant, 1963; Hall, 1964; W.K. Summers and Associates, 1977, 1984; Hirsch, 1986; Newcomer and Shomaker, 1991; Wasiolek, 1991; Atkins Engineering Associates, Inc., 1993, 2000; and Daniel B. Stephens and Associates, Inc., 2000). Because of contradictory information in these references, stream/aquifer interaction is not discussed in this report.

Description of Study Area

The upper Rio Hondo Basin (the Basin) is located in Lincoln and Otero Counties and the Mescalero Apache Indian Reservation in south-central New Mexico (fig. 1). In Lincoln County, the study area includes only the Basin. The Basin consists of two smaller subbasins of about equal area: the Rio Bonito and the Rio Ruidoso. Both subbasins lie south and east of the Capitan and Sacramento Mountains. The Rio Hondo is formed at the confluence of the Rio Bonito and Rio Ruidoso. Landscapes range from forested mountains to desert grasslands to vegetated riparian zones.

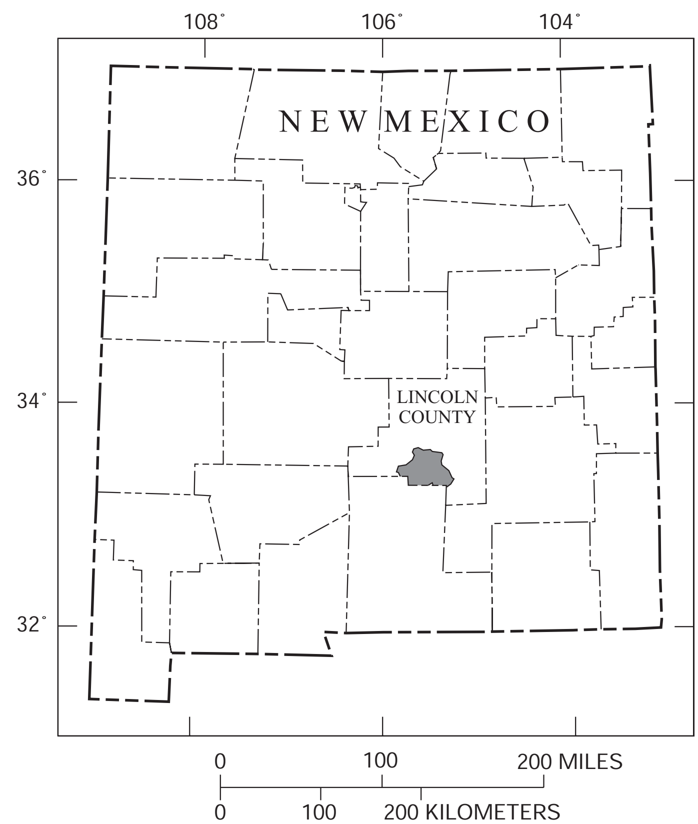


Figure 1. Location of study area, upper Rio Hondo Basin, N. Mex.

The area north of Rio Bonito is geologically and structurally complex (fig. 2). Figure 2 is a geologic map of the study area.

Tourism is a major component of the economy in the upper Rio Hondo Basin. The relatively cool summer climate encourages activities such as hiking, mountain biking, camping, and fishing. During the winter months, crowds are drawn to the snowy mountains for skiing and other winter sports. Additional contributors to the economy include ranching and irrigated agriculture.

Ground-water development is increasing in the Basin to meet the demands of increased tourism and to supply homes for new residents. New subdivisions are often centered on golf courses. Wilson and others (2003, p. 56) stated, "In many communities, self-supplied golf courses represent the largest water users in the commercial category."

Methods

A total of 70 wells were used in this study. Water levels in 33 of these wells were published in Mourant (1963). Sixty-six wells were measured in March 2003, 64 wells were measured in July 2003, and 1 well was measured in January 2003. Principal water-yielding units in which the wells are completed were obtained from Mourant (1963) and OSE field books and are listed in table 1.

A March 2003 water-level contour map was created for comparison with Mourant's (1963) water-level contour map (fig. 3). Contours published in Mourant (1963) were digitized for inclusion in this report (fig. 3).

Not all wells located in the Basin and published in Mourant were used in the current study; some wells could not be located, many were destroyed, or a reliable water level could not be measured. Additional wells in which water-level measurements could be obtained were selected on the basis of (1) historical water-level measurements by the USGS or the OSE and (2) the need for a water-level measurement in a particular area. In addition, non-domestic wells were chosen over domestic wells. Domestic wells were considered unsuitable because of daily use and the resulting drawdown around the wells, which often is not representative of the regional water level.

March and July were selected for water-level measurements because these 2 months typically correspond to periods when water levels are highest and lowest in the area, respectively. Most water levels were measured using a steel tape; the remainder were measured using an electric tape. Measurements are accurate to within 0.02 foot.

Contour flexures near streams generally indicate ground- and surface-water interaction. For example, upgradient flexures (pointing upstream) in contours generally indicate ground water flowing toward and recharging a stream; conversely, downgradient flexures (pointing downstream) generally indicate water flowing from the streambed to the aquifer. In this report, no specific attempt was made to indicate ground- and surface-water interaction through flexures in contours because of a paucity of data.

Acknowledgments

The author thanks Tom Stewart, Lincoln County Commissioner, and Patsy Sanchez, Lincoln County Planning Director, for their cooperation and support of the study. Walter Mourant, a USGS retiree, shared his historical knowledge of the study area. Ken Fresquez of the OSE in Roswell provided well information and answered many questions. Doug Rappuhn of the OSE in Santa Fe shared his knowledge of the study area and many reports. The Village of Ruidoso and Fort Stanton allowed access to several of their wells. Special thanks are extended to residents of the study area for sharing valuable information and granting access to their wells.

Hydrologic Data

Water-level, streamflow, and precipitation data are discussed in this section. Aquifer-test results also are discussed.

Water-Level Changes

Water-level altitudes were contoured using 64 water levels measured in March 2003 and 1 water level measured in January 2003 for comparison with 1963 water levels (Mourant, 1963) (fig. 3). The area north of Rio Bonito was not contoured because it is geologically and structurally complex.

Water levels were measured in 61 wells in both March and July 2003, and all water levels either rose or declined; no water level remained static (table 1). During that time, water levels rose as much as 65.02 feet (well 25) and declined as much as 53.9 feet (well 66). Excluding these two extremes of the range, water levels rose as much as 8.08 feet and declined as much as 10.25 feet. Of the 61 wells measured in both March and July 2003, water levels were lower in 52 of them in July 2003 than in March 2003. Because the seasonal water-level change in 54 of the 61 wells was less than 5 feet, the contours are probably a reasonable approximation of year-round water levels.

Water levels in wells 25 and 66 differed by greater than 50 feet between the March and July 2003 measurements (table 1). The water level in well 25 rose 65.02 feet between the March and July 2003 measurements. This rise in well 25 was most likely due to pumping of the well prior to and during the March 2003 measurement. The well was not pumping and had not been pumped for at least several weeks prior to the July 2003 measurement. The water level in well 66 declined 53.9 feet between March and July 2003. The primary use of well 66, as reported in the Water Administration Technical Engineering Resource System (New Mexico Office of the State Engineer, 2003c), is for irrigation. Use of the well likely increased between water-level measurements.

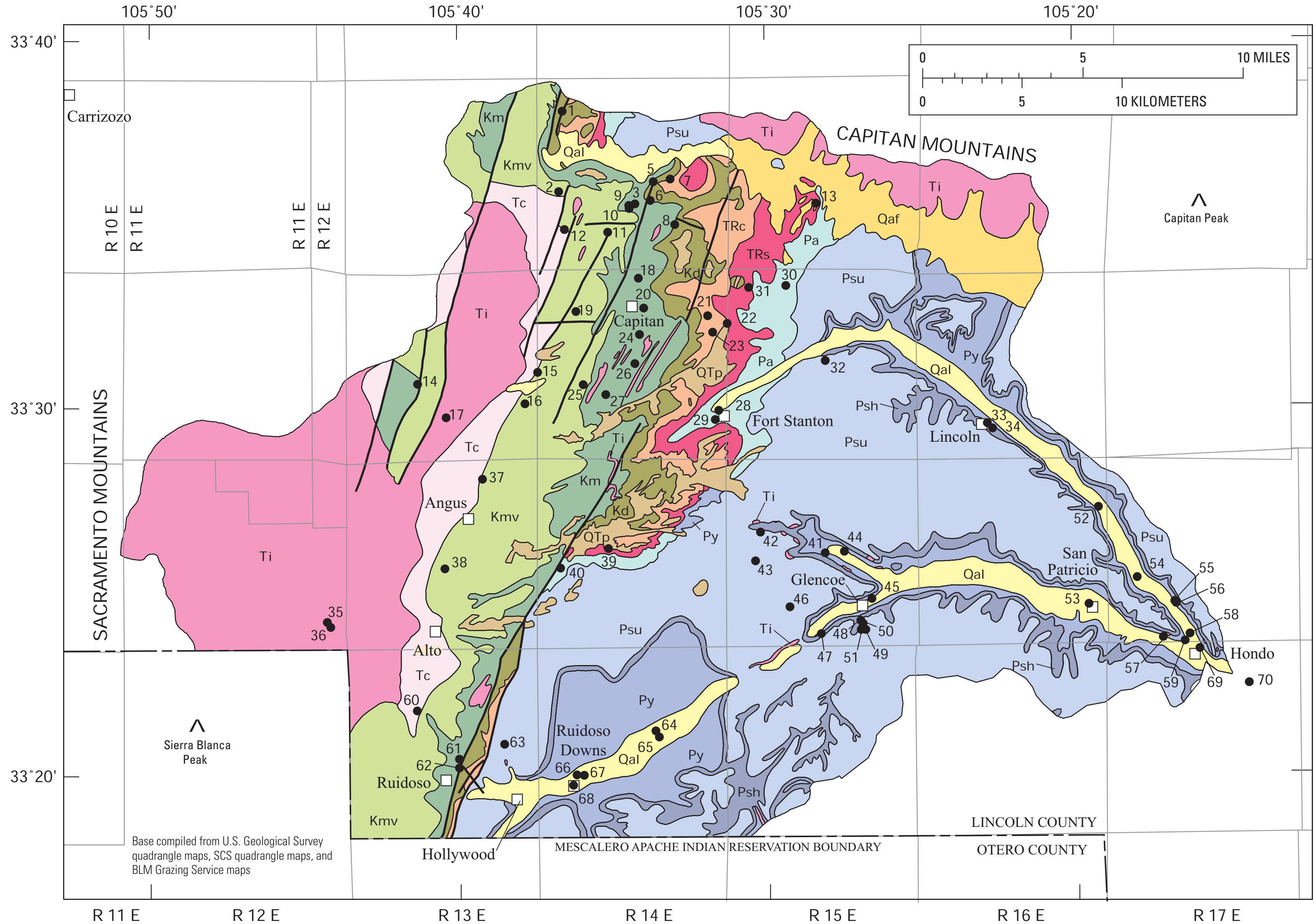
Compared with the 1963 contours (Mourant, 1963), the March 2003 contours indicate areas of rising, declining, and static water levels (fig. 3). Specifically, the 5,600-, 5,700-, and 5,800-foot March 2003 contours indicate that water levels rose. The 5,500-foot contour for March 2003 indicates a decline in water level. The 5,400-foot contours of March 2003 and 1963 mostly coincide, indicating a static water level in this area. The 5,300- and 5,200-foot contours for March 2003 cross the comparable1963 contours, indicating a decline in water levels near the Rio Ruidoso but a rise in water levels near the Rio Bonito. The limitations of Mourant's (1963) data and the March 2003 data and the subjective nature of contouring need to be taken into consideration when interpreting differences between 1963 and March 2003 contours.

The eight well hydrographs (figs. 4-11) in this report also were included in Mourant (1963) (table 1). Data for the hydrographs are stored in the USGS database, National Water Information System (*http://water.usgs.gov/nwis*). In the hydrographs, March 2003 water levels are higher than water levels from the mid- to late 1950's in five of the wells (wells 20, fig. 4; 21, fig. 5; 29, fig. 6; 41, fig. 8; and 54, fig. 9). For the same period of record, water levels in three wells were lower (wells 33, fig. 7; 61, fig. 10; and 65, fig. 11).

Comparisons of water levels published in Mourant (1963) and water levels measured in March 2003 are shown in figure 12. With the exceptions of wells 15 and 61, values are the difference between March 2003 water levels and Mourant (1963) water levels. Well 15 was not possible to measure in March 2003 because of broken equipment on the well; therefore, the July 2003 measurement was used to calculate the water-level difference. Well 61 was not measured in March or July 2003; therefore, the January 2003 measurement was used to calculate the water-level difference.

Within the study area, the rising and declining water levels were highest in the northern part of the Rio Bonito Basin (fig. 12). Water levels rose 28.56 feet in well 13, 22.18 feet in well 14, and 22.67 feet in well 20. Water levels declined 162.2 feet in well 25 and 69.74 feet in well 30 (table 1).

The rising water levels in wells 13, 14, and 20 may be the result of anthropogenic factors. In June 1988, well 13 was noted to be abandoned with a water level of 60.9 feet below land surface (New Mexico Office of the State Engineer, unpublished data, 1988). In October 1993, in the subsequent visit to the well, a new windmill had been installed at the well and the water level had risen approximately 30 feet. The well may have been redrilled and screened in a deeper water-yielding unit when the new windmill was installed between 1988 and 1993. Well 14 was deepened from 125 to 200 feet (New Mexico Office of the State Engineer, unpublished data, 1979). In 1956 the total depth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Capitan Peak
Sierra Blanca Peak
Capitan
Fort Stanton
Lincoln
Angus
Alto
Glencoe
San Patricio
Hondo
Ruidoso
Ruidoso Downs
Hollywood
LINCOLN COUNTY
OTERO COUNTY
MESCALERO APACHE INDIAN RESERVATION BOUNDARY
R 10 E
R 11 E
R 12 E
R 13 E
R 14 E
R 15 E
R 16 E
R 17 E
T 8 S
T 9 S
T 10 S
T 11 S
Base compiled from U.S. Geological Survey quadrangle maps, SCS quadrangle maps, and BLM Grazing Service maps

EXPLANATION

Qal	**Quaternary alluvium**
Qaf	**Quaternary alluvial fans**
QTp	**Quaternary pediment gravel**
Ti	**Tertiary igneous**—Intrusives and extrusives
Tc	**Tertiary Cub Mountain Formation**
Kmv	**Cretaceous Mesaverde Group, undivided**
Km	**Cretaceous Mancos Shale**
Kd	**Cretaceous Dakota Sandstone**
TRc	**Triassic Chinle Formation**
TRs	**Triassic Santa Rosa Sandstone**
Pa	**Permian Artesia Formation**
Psu	**Permian Upper San Andres Limestone**
Psh	**Permian Hondo Sandstone Member**
Py	**Permian Yeso Formation**
———	**Contact**
———	**Fault**
●	**Well**
63	**Well identifier (table 1)**

Figure 2. Generalized surficial geologic map of the Lincoln County study area (Modified from Mourant, 1963).

Table 1. Well locations and dates of water-level measurements.

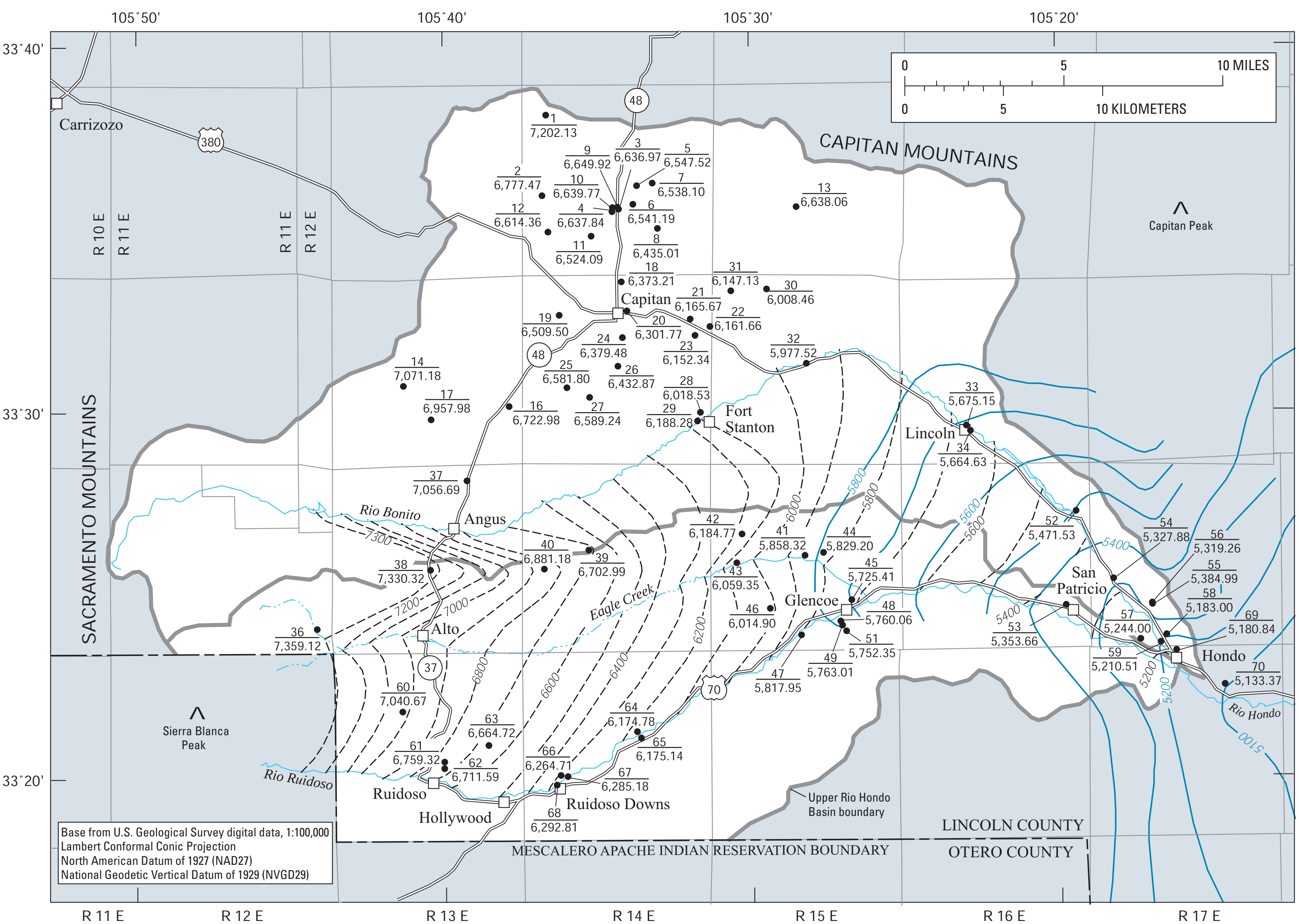
[Water-yielding unit—Quaternary (Q): alluvium (Qal); Tertiary (T): Cub Mountain Formation (Tc), intrusive and extrusive igneous rocks (Ti); Cretaceous (K): Mancos Shale (Km), Dakota Sandstone (Kd), Mesaverde Group (undivided) (Kmv); Triassic (Tr): Chinle Formation (TRc), Santa Rosa Sandstone (TRs); Permian (P): Artesia Formation (Pa), San Andres Limestone (Psa), Glorieta Sandstone (Pg), Yeso Formation (Py). Water-level measurements for wells highlighted in bold are shown in hydrographs in figures 4-11. Altitudes shown to the tenth were surveyed by the New Mexico Office of the State Engineer. Altitudes listed as a whole number were estimated from U.S. Geological Survey 7.5-minute topographic quadrangle maps. Altitude datum National Geodetic Vertical Datum of 1929 (NGVD 29); --, no data]

Well identifier (fig. 3)	Well location	Mourant (1963) well location	Land-surface altitude (NGVD 29)	Principal water-yielding unit	Depth of well (feet)	Water level (feet below land surface)		
						Reported in Mourant (1963)	March 2003	July 2003
1	T08S R14E 07.212	--	7,245	Kd (TRs?)	--	--	42.87	47.70
2	T08S R14E 19.41121	T08S R14E 19.411	6,872.1	Km	120	100.2	94.63	95.28
3	T08S R14E 21.444	--	6,690	Qal	145	--	53.03	53.35
4	T08S R14E 21.444323	--	6,695	Qal	78	--	57.16	57.40
5	T08S R14E 22.231113	T08S R14E 22.142	6,655	Km	106	130	107.48	107.59
6	T08S R14E 22.342332	--	6,600	Km	110	--	58.81	59.08
7	T08S R14E 23.113311	--	6,611.5	Kd (Km?)	102	--	73.40	73.48
8	T08S R14E 26.31412	T08S R14E 26.314	6,453.2	Km	--	18.3	18.19	17.31
9	T08S R14E 28.212	--	6,760	Km	250	--	110.08	110.54
10	T08S R14E 28.221	--	6,700	Km	200	--	60.23	62.67
11	T08S R14E 28.333123	--	6,683	Km	--	--	158.91	150.83
12	T08S R14E 30.414442	T08S R14E 30.432?	6,638	Kmv	--	60??	23.64	24.97
13	T08S R15E 21.43314	T08S R15E 28.211	6,664.1	TRs	140	54.6	26.04	36.29
14	T09S R13E 21.31214	T09S R13E 21.312	7,130	Km (Kmv?)	200	81	58.82	63.27
15	T09S R13E 24.242	T09S R13E 24.242	6,682	Tc	55	15	--	118.51
16	T09S R13E 25.23111a	--	6,735	Qal	--	--	12.02	--
17	T09S R13E 27.311434	T09S R13E 27.311a	7,002	Ti	130	42.6	44.02	45.14
18	T09S R14E 03.13123	T09S R14E 03.131	6,382.7	Km	19	13.5	9.49	9.81
19	T09S R14E 08.133212	--	6,530.4	Km(?)	250	--	20.90	20.60
20	T09S R14E 10.13221	T09S R14E 10.132	6,338.5	Km	320	59.4	36.73	37.74
21	T09S R14E 12.32423	T09S R14E 12.324	6,216.9	TRs	120	54.2	51.23	53.36
22	T09S R14E 12.441	--	6,200	TRs	--	--	38.34	42.09
23	T09S R14E 13.12124	T09S R14E 13.121	6,269	TRc	138	120	116.66	112.80
24	T09S R14E 15.111414	T09S R14E 15.112	6,410	Km	150	--	30.52	30.19
25	T09S R14E 20.32323	T09S R14E 20.323	6,782	Km	240	38	200.20	135.18
26	T09S R14E 21.22221	--	6,450.6	Km	25	--	17.73	--
27	T09S R14E 21.333341	T09S R14E 21.333	6,633.3	Km	150	48.8	44.06	46.69
28	T09S R14 25.23342	T09S R14E 25.233	6,231.1	Psa	394.5	203	212.57	215.74
29	T09S R14E 25.34221	T09S R14E 25.324	6,207.8	Qal	45	19.6	19.52	20.65
30	T09S R15E 05.234444	T09S R15E 05.412	6,241	Pa	180	162.8	232.54	--
31	T09S R15E 06.32224	T09S R15E 06.411	6,219	Pa	180	71.3	71.87	72.96
32	T09S R15E 15.33133	T09S R15E 15.331	5,987.4	Pg	120	12.1	9.88	10.22
33	T09S R16E 28.33134	T09S R16E 28.333a	5,707.2	Qal	61	30.3	32.05	32.78
34	T09S R16E 33.112311	--	5,702.9	Py	130	--	38.27	38.71
35	T10S R12E 36.12322	--	7,844.6	Ti	500+	--	--	422.40

Table 1. Well locations and dates of water-level measurements.—Continued

[Water-yielding unit—Quaternary (Q): alluvium (Qal); Tertiary (T): Cub Mountain Formation (Tc), intrusive and extrusive igneous rocks (Ti); Cretaceous (K): Mancos Shale (Km), Dakota Sandstone (Kd), Mesaverde Group (undivided) (Kmv); Triassic (Tr): Chinle Formation (TRc), Santa Rosa Sandstone (TRs); Permian (P): Artesia Formation (Pa), San Andres Limestone (Psa), Glorieta Sandstone (Pg), Yeso Formation (Py). Water-level measurements for wells highlighted in bold are shown in hydrographs in figures 4-11. Altitudes shown to the tenth were surveyed by the New Mexico Office of the State Engineer. Altitudes listed as a whole number were estimated from U.S. Geological Survey 7.5-minute topographic quadrangle maps. Altitude datum National Geodetic Vertical Datum of 1929 (NGVD 29); --, no data]

Well identi-fier (fig. 3)	Well location	Mourant (1963) well location	Land-surface altitude (NGVD 29)	Principal water-yielding unit	Depth of well (feet)	Water level (feet below land surface)		
						Reported in Mourant (1963)	March 2003	July 2003
36	T10S R12E 36.231	--	7,780	Ti	--	--	420.88	--
37	T10S R13E 03.42433A	--	7,100	Tc	--	--	43.31	44.90
38	T10S R13E 22.13331	--	7,400	Kmv	93	--	69.68	75.12
39	T10S R14E 16.332331	T10S R14E 16.331	7,030	Kd	396	336.3	327.01	326.95
40	T10S R14E 19.233244	T10S R14E 19.233	6,910	Km	43	45.9	28.82	32.26
41	T10S R15E 16.444323	T10S R15E 21.222	5,891.2	Py	40	33.4	32.88	33.02
42	T10S R15E 18.242132	--	6,200	Qal	24	--	15.23	15.72
43	T10S R15E 19.214242	--	6,125	Qal (Pg?)	60	--	65.65	63.32
44	T10S R15E 22.122312	T10S R15E 22.124	5,844.1	Qal	20	14.4	14.90	15.62
45	T10S R15E 26.323113	T10S R15E 26.332a	5,734.5	Qal	55	11.3	9.09	9.55
46	T10S R15E 29.44112	--	6,068	Pg	60	--	53.10	53.38
47	T10S R15E 33.412242	T10S R15E 33.412	5,899.2	Qal	130	81.9	81.25	81.61
48	T10S R15E 34.221	--	5,860	Psa	140	--	99.94	101.08
49	T10S R15E 34.224	--	5,910	Psa	189	--	146.99	148.29
50	T10S R15E 34.422	--	5,880	Psa	175	--	--	123.04
51	T10S R15E 35.311	--	5,910	Psa	200	--	157.65	159.19
52	T10S R16E 12.32421	--	5,485.6	Py	425	--	14.07	14.75
53	T10S R16E 25.313423	--	5,411.5	Qal	86	--	57.84	58.60
54	T10S R17E 19.433124	T10S R17E 19.434	5,354.8	Qal	95	29.3	26.92	29.48
55	T10S R17E 29.423	--	5,475	Py	130	--	90.01	91.78
56	T10S R17E 29.423312	T10S R17E 29.423	5,381.6	Py	67	63.0	62.34	63.03
57	T10S R17E 32.34430	T10S R17E 32.344	5,255.0	Qal	69	9.8	11.00	11.27
58	T10S R17E 33.314	--	5,290	Qal	136	--	107.00	113.25
59	T10S R17E 33.33300	--	5,248.9	Qal	90	--	38.39	46.39
60	T11S R13E 09.33343	T11S R13E 09.333	7,064.3	TRc	100	19.6	23.63	25.18
61	T11S R13E 22.13214	T11S R13E 22.134	6,848.1	Km	225	62.7	[2]88.78	--
62	T11S R13E 22.34213	T11S R13E 22.431	6,724.2	Km	119	--	12.61	12.89
63	T11S R13E 23.22321	--	6,710	Pg	500	--	45.28	48.03
64	T11S R14E 15.4131312	T11S R14E 15.413	6,201.3	Qal	100	24.6	26.52	26.47
65	T11S R14E 15.432334	T11S R14E 15.431	6,235.6	Qal	90+	59.9	60.46	60.54
66	T11S R14E 29.112	--	6,340	Py	189	--	75.29	129.19
67	T11S R14E 29.121423	--	6,360	Py	122	--	74.82	75.46
68	T11S R14E 30.242	--	6,380	Qal	315	--	87.19	--
69	T11S R17E 04.124	--	5,238	Py (Qal?)	240	--	57.16	59.40
70	T11S R17E 11.134	--	5,200	Py	260	--	66.63	67.12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Fort Stanton
Lincoln
Angus
Alto
Ruidoso
Hollywood
Ruidoso Downs
Glencoe
San Patricio
Hondo
Rio Bonito
Eagle Creek
Rio Ruidoso
Rio Hondo
Upper Rio Hondo Basin boundary
LINCOLN COUNTY
OTERO COUNTY
MESCALERO APACHE INDIAN RESERVATION BOUNDARY
1 7,202.13
2 6,777.47
3 6,636.97
4 6,637.84
5 6,547.52
6 6,541.19
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11 6,524.09
12 6,614.36
13 6,638.06
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20 6,301.77
21 6,165.67
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31 6,147.13
32 5,977.52
33 5,675.15
34 5,664.63
36 7,359.12
37 7,056.69
38 7,330.32
39 6,702.99
40 6,881.18
41 5,858.32
42 6,184.77
43 6,059.35
44 5,829.20
45 5,725.41
46 6,014.90
47 5,817.95
48 5,760.06
49 5,763.01
51 5,752.35
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54 5,327.88
55 5,384.99
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57 5,244.00
58 5,183.00
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66 6,264.71
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68 6,292.81
69 5,180.84
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5200
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Base from U.S. Geological Survey digital data, 1:100,000
Lambert Conformal Conic Projection
North American Datum of 1927 (NAD27)
National Geodetic Vertical Datum of 1929 (NVGD29)

EXPLANATION

Water-level contours published in Mourant, 1963— Contour interval 100 feet. Datum is NGVD29

Water-level contours based on March 2003 data— Dashed where approximately located. Contour interval 100 feet. Water levels measured north of Rio Bonito were not contoured because the area is geologically and structurally complex. Datum is NGVD29

● **Well**

68 **Well identifier (table 1)**

6,292.81 **Water-level altitude, March 2003**

Figure 3. Mourant (1963) water-level contours and March 2003 water-level contours and altitudes.

of the well was 125 feet and the water level was 81.01 feet below land surface. In 1979 the total depth of the well was 200 feet and the water level was 54.82 feet below land surface. Between 1956 and 1979, the water level rose approximately 26 feet in the well. Well 20 was being used as a public supply well by the Village of Capitan when its water level was measured by Mourant in 1955 (U.S. Geological Survey, unpublished data, 1955). Currently (2003) the well is used occasionally by a small business and is located near wetlands that may recharge the well.

Water levels in wells 25 and 30 declined 162.2 and 69.74 feet, respectively. In well 25, the reported water level was 38 feet below land surface in March 1957. By August 1988, the subsequent visit to well 25, the water level had declined to 144 feet below land surface. Well 30 was possibly redrilled and completed in a deeper water-yielding unit after Mourant visited the well in March 1956. In 1956, the depth of the well was reported by Mourant (1963) to be 180 feet and the water level was 162.8 feet below land surface. In January 1979, the water level was 159.14 feet below land surface. In January 1984, the water level was 223.05 feet below land surface, about 64 feet deeper than the previous measurement. Because of the differences in water levels, the total depth of the well was measured again in 1984 and was approximately 240 feet deep (New Mexico Office of the State Engineer, unpublished data, 1984).

Overall, of the 22 wells in the Rio Bonito Basin for which water levels were published in Mourant (1963) and measured in 2003, water levels rose in 15 wells and declined in 7 wells. The median rise of water levels was 4.01 feet with a range of 0.08 to 36.36 feet; the median decline was 3.51 feet with a range of 0.57 to 162.2 feet. The previously described possible causes for the largest rises and declines need to be considered when evaluating the data.

Of the 11 wells in the Rio Ruidoso Basin for which water levels were published in Mourant (1963) and measured in March 2003, water levels rose in five wells and declined in six wells. The median rise of water levels was 2.21 feet with a range of 0.52 to 17.08 feet; the median decline was 1.56 feet with a range of 0.50 to 26.08 feet.

Streamflow

Hydrographs for streamflow-gaging stations Rio Ruidoso at Hollywood and Eagle Creek below South Fork near Alto are shown in figures 13 and 14. The drainage areas for these two streams are 8.14 and 120 square miles, respectively. The Hollywood gaging station has been in operation for about 51 years. Upstream from this station, the Village of Ruidoso diverts water for municipal use and returns a portion of the water as effluent from a sewage disposal plant downstream from the station (Byrd and others, 2003). The Eagle Creek gaging station has been in operation for about 26 years. Upstream from the Eagle Creek station, water is stored in small, unregulated recreational ponds on the Mescalero Apache Reservation (Byrd and others, 2003).

Though streamflow data have been collected at additional locations in the study area, the periods of record at the gaging stations are relatively short and, therefore, do not provide information on streamflow trends (table 2). Three streamflow-gaging stations are currently (2003) in operation in the upper Rio Hondo Basin; they include the two stations discussed in the previous paragraph and the Rio Ruidoso at Ruidoso gaging station. A hydrograph of data collected at Rio Ruidoso at Ruidoso is not included because of its relatively short period of record (about 5 years).

Precipitation

Annual precipitation data are shown for stations in Capitan and Ruidoso (figs. 15 and 16). The altitudes of the stations are 6,477 and 6,937 feet, respectively (National Oceanic and Atmospheric Administration, 1990-2002). Annual average precipitation from 1971 to 2000 for Capitan was 17.27 inches. For the same period, the average annual precipitation for Ruidoso was 22.17 inches (National Oceanic and Atmospheric Administration, 1990-2002). Higher altitudes in the study area receive greater amounts of precipitation. For example, Sierra Blanca Peak, at an altitude of 11,973 feet, receives an average estimated annual precipitation (1971-2000) of 41.25 inches. Capitan Peak, at an altitude of 10,083 feet, receives an average estimated annual precipitation (1971-2000) of 25.47 inches (U.S. Geological Survey, 1981; Oregon Climate Service, 2004). The lower altitudes in the study area, generally toward the south and east, receive lesser amounts of precipitation. For example, the town of Hondo (fig. 2) is at an altitude of 5,220 feet and receives an average estimated annual precipitation (1971-2000) of 13.70 inches (U.S. Geological Survey, 1989; Oregon Climate Service, 2004).

The current (2003) drought in the Southwest is being compared to the Southwest drought of 1942 to 1956. In comparison, the 1980’s to 1998 were relatively wet years for New Mexico. In November 2003, however, Lincoln County was designated a primary disaster area because of losses caused by drought (U.S. Department of Agriculture, 2003). Community wells in the upper Rio Hondo Basin went dry in the summer of 2003 (J. Hernandez, New Mexico Office of the State Engineer, written commun., 2004). The National Oceanic and Atmospheric Administration (2003, p. 3) stated “ . . . severe, long-duration (longer than 10 years) droughts are a common feature of New Mexico’s climate.”

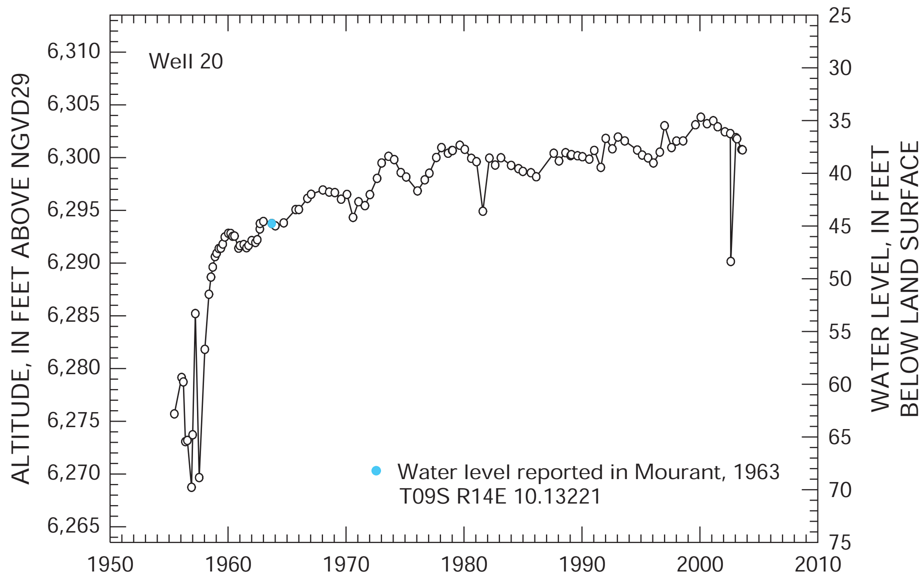


Figure 4. Water level over time in well T09S R14E 10.13221.

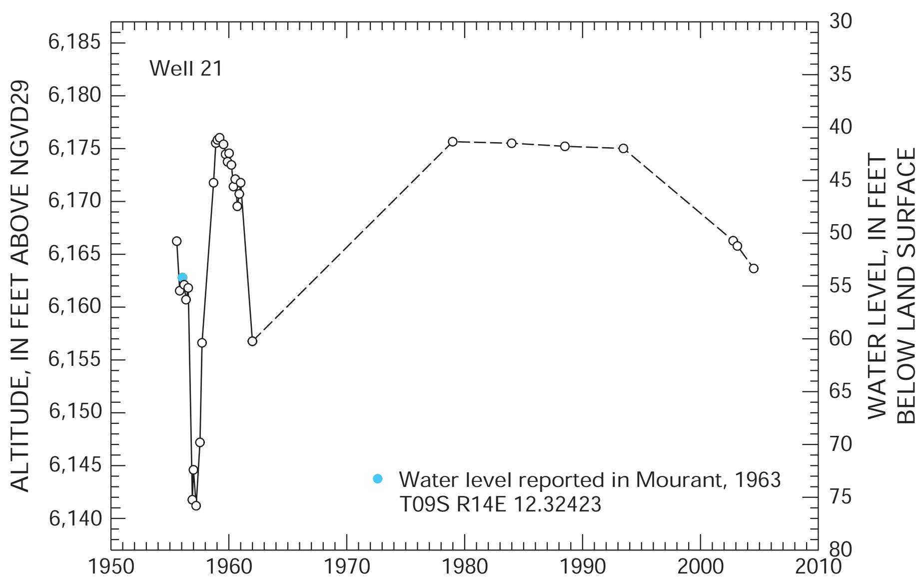


Figure 5. Water level over time in well T09S R14E 12.32423.

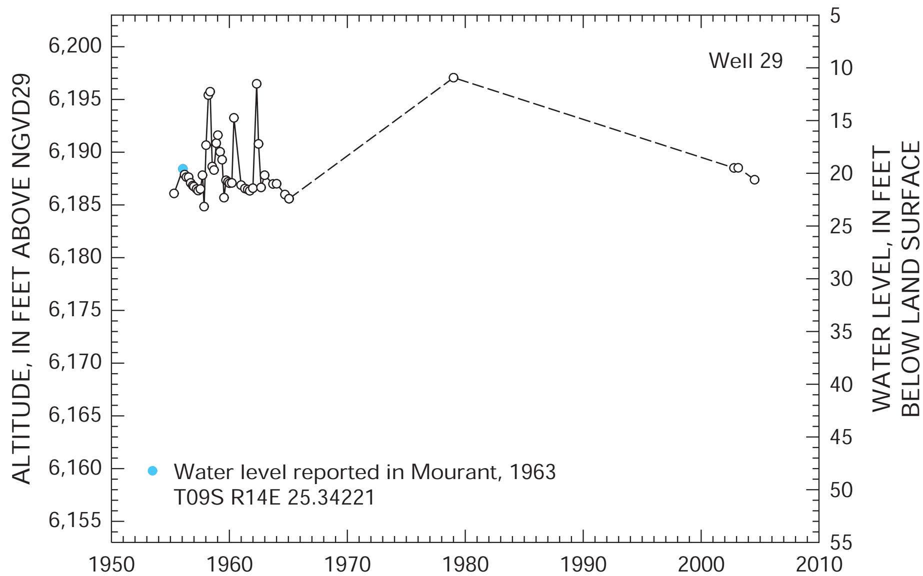


Figure 6. Water level over time in well T09S R14E 25.34221.

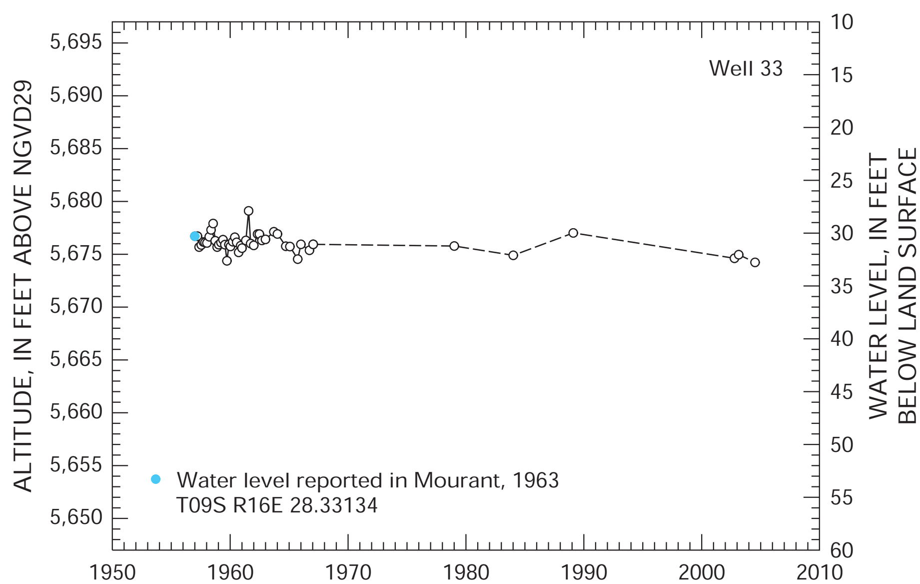


Figure 7. Water level over time in well T09S R16E 28.33134.

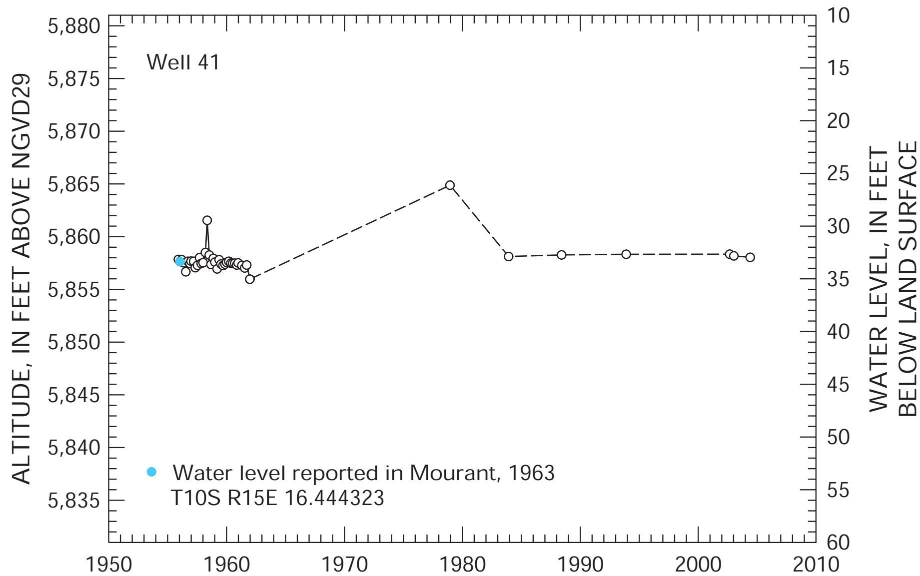


Figure 8. Water level over time in well T10S R15E 16.444323.

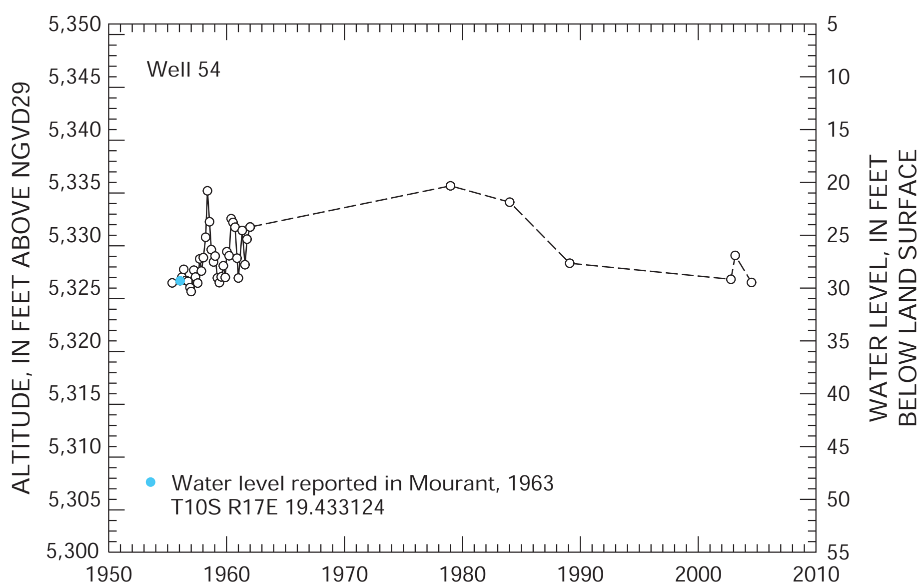


Figure 9. Water level over time in well T10S R17E 19.433124.

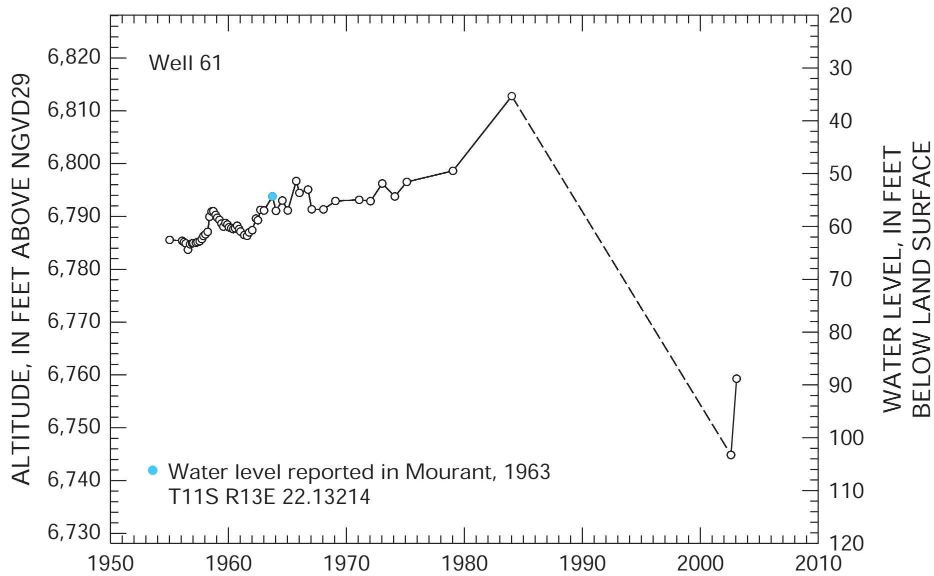


Figure 10. Water level over time in well T11S R13E 22.13214.

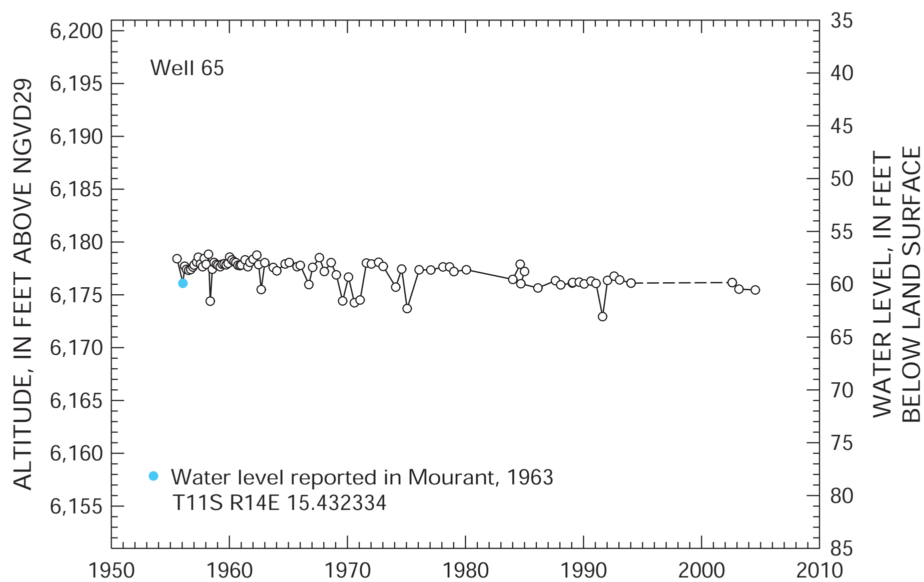


Figure 11. Water level over time in well T11S R14E 15.432334.

Summary of Aquifer-Test Results

Aquifer tests performed on wells can provide important information about the hydraulic properties of the aquifers from which the wells produce water. Hydraulic aquifer properties are used by consultants, government regulators, and planners to help determine the rate at which water can be pumped from an aquifer without impairing nearby wells.

Aquifer-test results were compiled primarily from reports of public record obtained from the OSE. Results of aquifer tests were obtained for 25 wells within the study area (table 3). Of the 25 wells with aquifer-test data, 16 are clustered east and northeast of Alto between Rio Bonito and Eagle Creek (fig. 13).

Several wells have results for more than one aquifer test, more than one type of aquifer-test analysis, or results from analyses by more than one consultant; therefore, the hydraulic properties for a well often range in values (table 3). Transmissivity, hydraulic conductivity, specific capacity, and storativity values are listed in table 3. Transmissivity is equal to the product of the hydraulic conductivity and aquifer thickness. Hydraulic conductivity is the volume of water that will move through the surrounding material in a unit of time. Specific capacity, the ratio of the pumping rate to drawdown of the water in a well, is both a measure of the capacity of an aquifer to transmit water to a well and of the capacity of the well screen to transmit water from the aquifer into the well casing. Storativity is a measure of the volume of water that an aquifer releases from or takes into storage per unit area under a unit change in head.

Tertiary igneous intrusives and extrusives (Ti) transmissivity values ranged from 39.8 to 22,000 gal/d/ft. Only one value each of hydraulic conductivity and specific capacity was reported for the volcanics, 4.63 ft/d and 0.07 gal/min/ft, respectively. The two storativity values were 0.0003 and 0.0014.

Transmissivity values of the Cretaceous Mesaverde Formation (Kmv) ranged from 350 to 2,576 gal/d/ft. Hydraulic conductivity ranged from 0.39 to 3.44 ft/d. No specific capacity values were reported for the Mesaverde, and storativity ranged from 0.0001 to 0.005.

Cretaceous Mancos Shale (Km) transmissivity values ranged from 100 to 1,957 gal/d/ft. Hydraulic conductivity ranged from 0.04 to 1.60 ft/d. No specific capacity values were reported for the Mancos Shale. Storativity ranged from 0.0001 to 0.03.

Several wells were screened in the Mancos Shale and Cretaceous Dakota Sandstone (Kd). Transmissivity values of these wells ranged from 934 to 24,343 gal/d/ft, and hydraulic conductivity ranged from 0.20 to 5.28 ft/d. Only one value of specific capacity was reported, 0.96 gal/min/ft, and storativity ranged from 0.0001 to 0.0005.

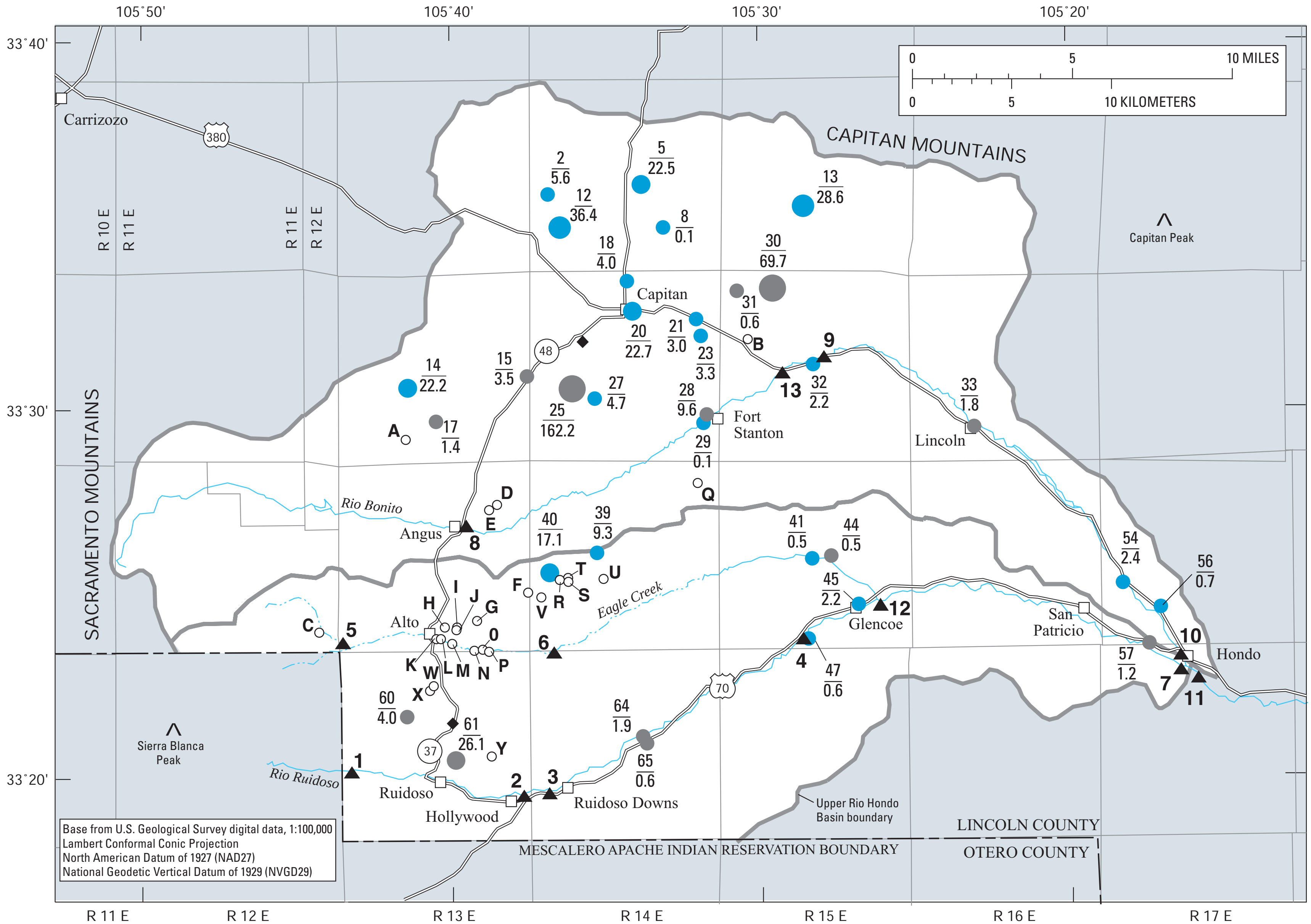
The Permian San Andres Formation (Psa) transmissivity values ranged from 1 to 429,000 gal/d/ft. The transmissivity value of 429,000 gal/d/ft was calculated using data collected during well recovery. The well recovered within 5 minutes and three measurements were taken during this time. Due to the limited amount of data associated with the transmissivity value of 429,000 gal/d/ft, this value should be used with caution. The range of transmissivity values becomes 1 to 25,366 gal/d/ft when the anomalous value of 429,000 gal/d/ft is not included. Hydraulic conductivity of the San Andres ranged from 1.26 to 42.31 ft/d. Only two values of specific capacity were reported: ~1 and 5.1 gal/min/ft. Storativity ranged from 0.0001 to 0.005.

Data Gaps and Needs

The concentration of aquifer-test data near Alto and the sparsity in other areas of the upper Rio Hondo Basin indicate a need for more aquifer tests in other parts of the basin. In particular, information would benefit planning efforts from aquifer tests in areas of rapid population growth that characterize hydraulic properties (1) of aquifers traditionally used for water supplies and (2) of aquifers that may have marginal water quality but could be used for future water supplies. Aquifer tests conducted in geologically and structurally complex areas to determine the degree to which the variable geology and structure influence hydraulic properties and the lateral continuity of aquifers also would be beneficial. Additional knowledge about the water resources in the upper Rio Hondo Basin will help local and State officials make prudent land-use and development decisions. Understanding the needs of local officials and residents and working closely with the OSE and other agencies are necessary to guide future scientific studies. Future studies may include examination, description, and reporting of drill cuttings and geophysical logging of wells being deepened or installed, especially in areas where the population is increasing and in communities where current wells are going dry. Drill cuttings and geophysical logs will provide information about possible localized confining units and water-yielding characteristics of the rocks.

Very few wells are measured regularly in the Eagle Creek Basin by either the USGS or the OSE. A reconnaissance of the basin and identification of wells appropriate for regular measurement are necessary to develop a useful network. If wells appropriate for regular measurement are not identified and located, drilling of new wells may be necessary in areas where information is needed.

Reports submitted to the OSE as part of a subdivision proposal estimate recharge when approximating 40-year water supplies. A substantial proportion of recharge in the upper Rio Hondo Basin occurs as mountain-front recharge (Waltemeyer, 2001). Chloride-balance and water-yield regression methods are used to estimate mountain-front recharge (Anderholm, 2001). Not only are recharge estimates necessary to approximate 40-year water supplies, recharge is also an important parameter in ground-water models. Recharge estimates help provide information about the estimated time necessary to replenish water-yielding units, flow paths from recharge areas to supply wells, and where recharge is likely occurring.


105°50'
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0 5 10 MILES
0 5 10 KILOMETERS
CAPITAN MOUNTAINS
Capitan Peak
SACRAMENTO MOUNTAINS
Sierra Blanca Peak
Carrizozo
380
Capitan
48
Fort Stanton
Lincoln
Angus
Alto
Rio Bonito
Eagle Creek
Rio Ruidoso
Glencoe
San Patricio
Hondo
Ruidoso
Hollywood
Ruidoso Downs
37
70
Upper Rio Hondo Basin boundary
LINCOLN COUNTY
OTERO COUNTY
MESCALERO APACHE INDIAN RESERVATION BOUNDARY
2 5.6
5 22.5
12 36.4
8 0.1
13 28.6
18 4.0
30 69.7
31 0.6
20 22.7
21 3.0
23 3.3
14 22.2
15 3.5
27 4.7
25 162.2
28 9.6
29 0.1
32 2.2
33 1.8
17 1.4
40 17.1
39 9.3
41 0.5
44 0.5
45 2.2
47 0.6
54 2.4
56 0.7
57 1.2
60 4.0
61 26.1
64 1.9
65 0.6
A B C D E F G H I J K L M N O P Q R S T U V W X Y
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Base from U.S. Geological Survey digital data, 1:100,000
Lambert Conformal Conic Projection
North American Datum of 1927 (NAD27)
National Geodetic Vertical Datum of 1929 (NVGD29)

EXPLANATION

More than 25-foot increase

10- to 25-foot increase

0- to 10-foot increase

0- to 10-foot decrease

10- to 25-foot decrease

25- to 50-foot decrease

More than 50-foot decrease

65 — **Well identifier (table 1)**

0.6 — **Difference between water level measured in March 2003 and water level reported in Mourant (1963)**—Values rounded for space consideration. Water-level measurements listed in table 1. Two exceptions: well 15 was measured in July 2003 and well 61 was measured in January 2003

▲3 **Streamflow-gaging station and identifier (table 2)**

◆ **Precipitation station**

○Y **Aquifer-test location and well identifier (table 3)**

Figure 12. Water-level increase or decrease since Mourant's (1963) study, streamflow-gaging station and discharge measurement locations, precipitation station locations, and aquifer-test locations.

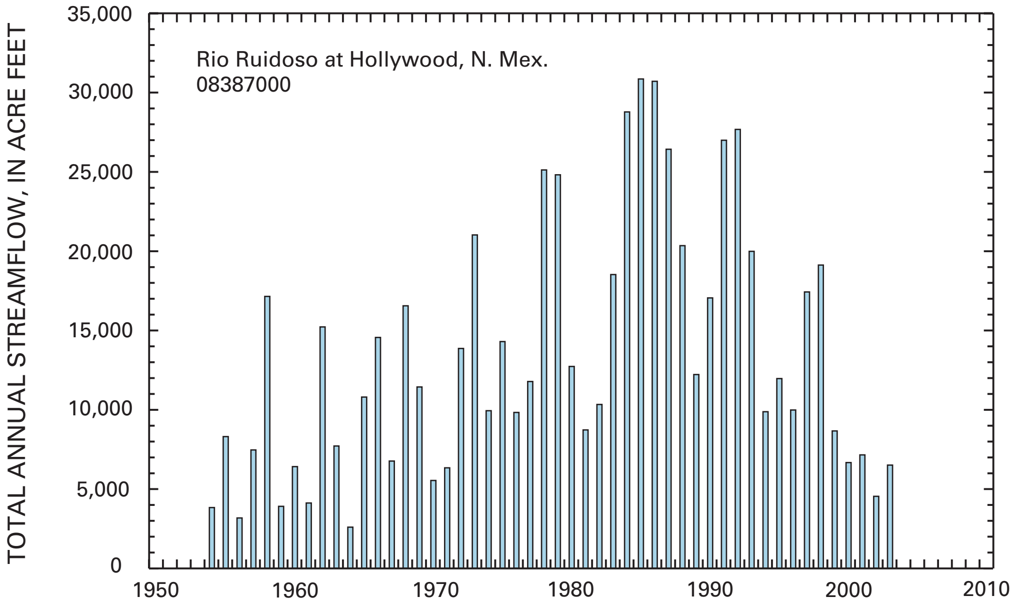

Figure 13. Total annual streamflow at Rio Ruidoso at Hollywood, N. Mex., streamflow-gaging station.

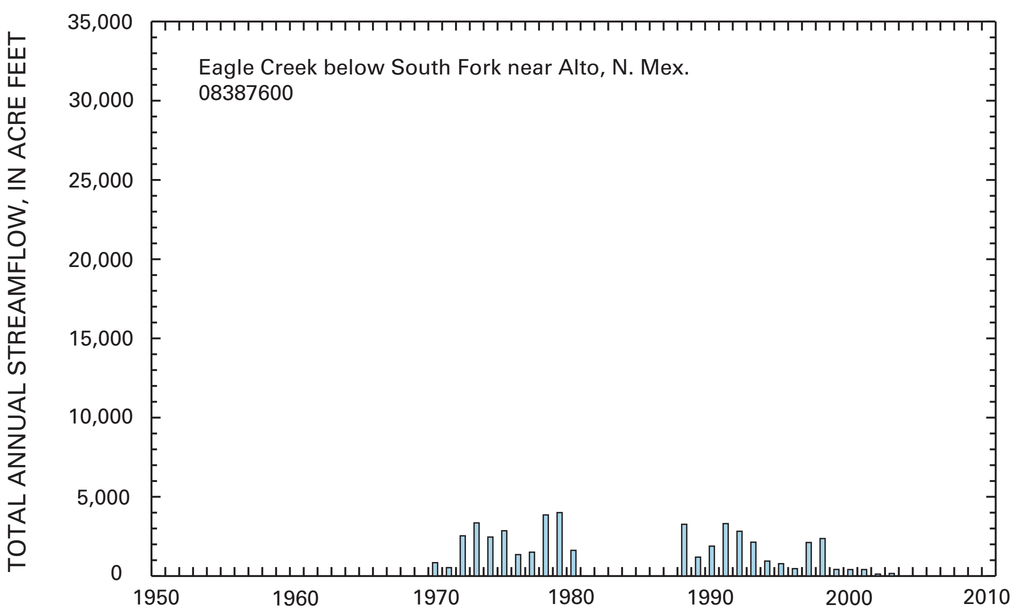

Figure 14. Total annual streamflow at Eagle Creek below South Fork near Alto, N. Mex., streamflow-gaging station.

Table 2. Streamflow-gaging stations, station identification numbers, and periods of record.

[--, no station number]

Station identifier (fig. 12)	Streamflow-gaging station	Station identification number	Period of record	
			From	To
1	Rio Ruidoso at Ruidoso, N. Mex.	08386505	10/28/98	09/30/04
2	F. Herrera Ditch south at Hollywood, N. Mex.	08386900	04/29/60 09/29/70	09/28/68 09/28/83
3	Rio Ruidoso at Hollywood, N. Mex.	08387000	09/29/53	09/30/04
4	Rio Ruidoso near Glencoe, N. Mex.	08387500	08/17/10	11/06/11
5	Eagle Creek below South Fork near Alto, N. Mex.	08387600	08/25/69 04/25/88	12/29/80 09/30/04
6	Eagle Creek near Alto, N. Mex.	08387800	09/29/69	12/29/80
7	Rio Ruidoso at Hondo, N. Mex.	08388000	08/09/30	09/28/55
8	Rio Bonito at Angus, N. Mex.	08388500	07/01/08 08/10/30	08/31/09 10/08/31
9	[1]Rio Bonito near Lincoln, N. Mex.	08389055	07/01/08 08/12/30 04/01/99	07/14/09 10/08/31 10/07/02
10	Rio Bonito at Hondo, N. Mex.	08389500	08/07/30	09/28/55
11	Rio Hondo at Hondo, N. Mex.	08390000	08/08/30	07/31/31
12	Rio Ruidoso at Glencoe, N. Mex.	--	06/16/08	07/17/09
13	Bonito River below Fort Stanton, N. Mex.	--	05/21/08	08/31/09

[1]The site name for 1908-09 data is Bonito River at Government Springs near Fort Stanton, N. Mex. The location descriptions for Bonito River at Government Springs near Fort Stanton, N. Mex., and Rio Bonito near Lincoln, N. Mex., plot the sites very close to one another and are likely the same location.

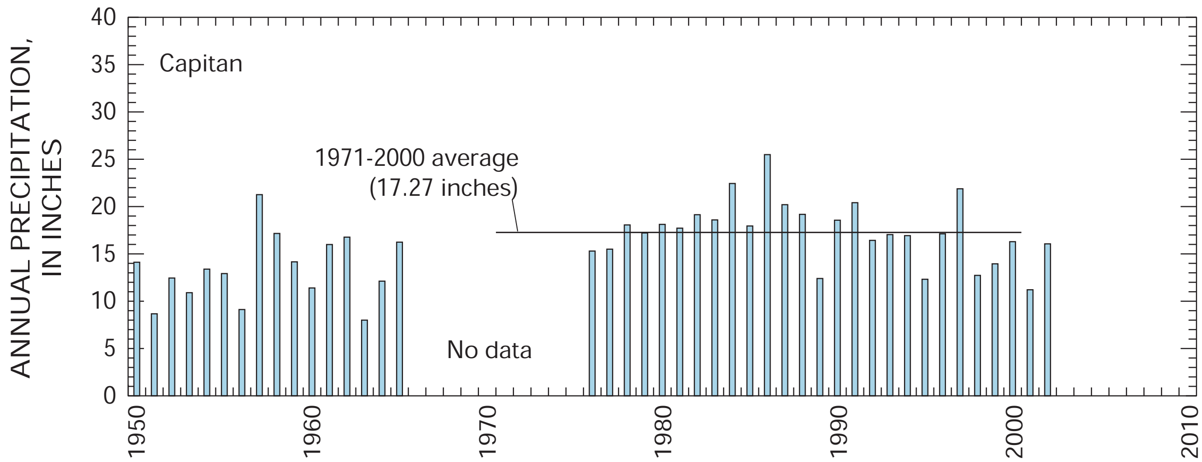

Figure 15. Annual precipitation at Capitan, N. Mex. (National Oceanic and Atmospheric Administration, 1990-2002).

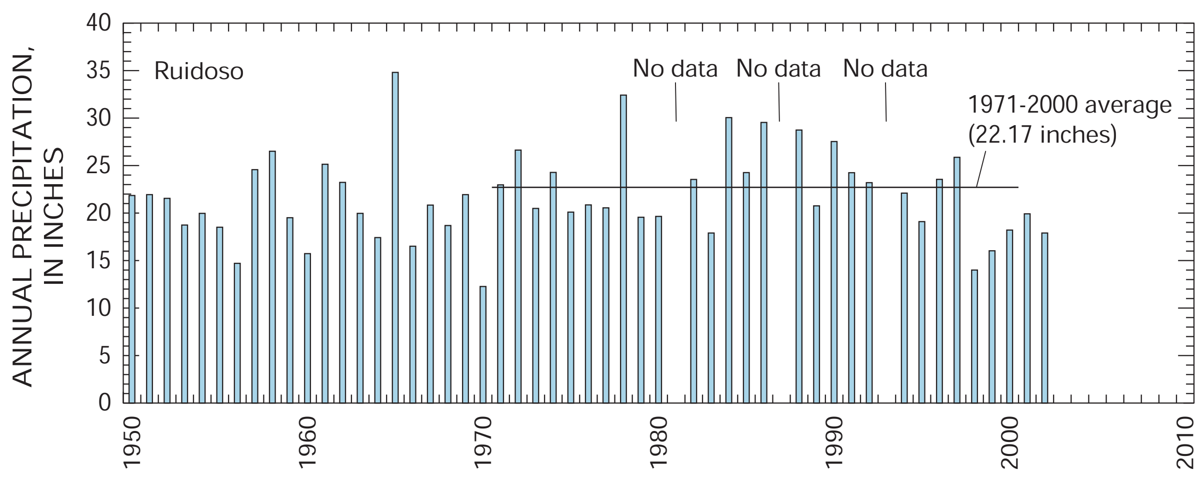

Figure 16. Annual precipitation at Ruidoso, N. Mex. (National Oceanic and Atmospheric Administration, 1990-2002).

Table 3. Locations and results of aquifer tests performed in the study area.

[gal/d/ft, gallons per day per foot; ft/d, feet per day; gal/min/ft, gallons per minute per foot; --, no data; NMOSE, New Mexico Office of the State Engineer]

Well identi -fier (fig. 3)	Well location	Principal water-yielding unit (fig. 2)	Well description	Type of test	Date of test
A	T09S R13E 33.114	Kmv	LaMay Ranch Estates	Drawdown and recovery	July 21-23, 1976
B	T09S R15E 18.232	Psu	Village of Capitan	Drawdown	April 25-26, 1985
B	T09S R15E 18.232	Psu	Village of Capitan	Drawdown	April 25-26, 1985
B	T09S R15E 18.232	Psu	Village of Capitan	Recovery	April 25-26, 1985
B	T09S R15E 18.23224	Psu	Village of Capitan	Drawdown	April 25-26, 1985
B	T09S R15E 18.23224	Psu	Village of Capitan	Drawdown	April 25-26, 1986
C	T10S R12E 36.122	Ti	Village of Ruidoso	Drawdown	--
D	T10S R13E 11.2424	Km/Kd	The Hideout Well No. 6	Drawdown	January 2-3, 2001
D	T10S R13E 11.2424	Km/Kd	The Hideout Well No. 6	Drawdown	January 2-3, 2001
E	T10S R13E 11.3111	Kmv	The Hideout Well No. 9	Step drawdown	January 23, 2001
E	T10S R13E 11.3111	Kmv	The Hideout Well No. 9	Step drawdown	January 23, 2001
F	T10S R13E 25.22243	Km	Alto Village	Drawdown	September 1-3, 1981
F	T10S R13E 25.22243	Km	Alto Village	Drawdown	September 1-3, 1981
G	T10S R13E 26.41111	Km	Alto Village	Drawdown	--
H	T10S R13E 34.123	Km	Alto Village Well #9	Drawdown and recovery	August 3-9, 1977
H	T10S R13E 34.123	Km	Alto Village Well #9	Discharge data	--
I	T10S R13E 34.223	Km	Alto Village Well #10	Recovery	August 3-9, 1977
I	T10S R13E 34.223	Km	Alto Village Well #10	Discharge data	--
J	T10S R13E 34.232	Km	Alto Village Well #5	Drawdown and recovery	August 3-9, 1977
J	T10S R13E 34.232	Km	Alto Village Well #5	Discharge data	--
K	T10S R13E 34.311	Km	Alto Village Well #2 (Old)	Discharge data	--
L	T10S R13E 34.311	Km	Alto Village Well #2 (New)	Step drawdown	April 9-11, 1980
L	T10S R13E 34.3111	Km	Alto Village Well #2 (New)	Drawdown	--
M	T10S R13E 34.413	Kmv	Alto Village Well #1A	Discharge data	--
N	T10S R13E 35.343	Km	Alto Village E-1 at 375 feet	Step drawdown	June 2, 1983
N	T10S R13E 35.343	Km	Alto Village E-1 at 670 feet	Step drawdown	August 16, 1983
N	T10S R13E 35.34313	Km	Alto Village E-1	Drawdown	[1]July 26-27, 19??
N	T10S R13E 35.34313	Km	Alto Village E-1	Drawdown	[1]July 26-27, 19??
O	T10S R13E 35.43314	Km/Kd	Alto Village	Drawdown	October 30-November 4, 1995
O	T10S R13E 35.43314	Km/Kd	Alto Village	Drawdown	October 30-November 4, 1995
O	T10S R13E 35.43314	Km/Kd	Alto Village	Drawdown	October 30-November 4, 1995
O	T10S R13E 35.43314	Km/Kd	Alto Village	Drawdown	October 30-November 4, 1995
P	T10S R13E 35.434	Km/Kd	Alto Village E-2	Step drawdown	August 24, 1983
P	T10S R13E 35.43432	Km/Kd	Alto Village E-2	Drawdown	--
Q	T10S R14E 01.31234	Psu	Sierra Blanca Airport	Drawdown	--
R	T10S R14E 19.424	TRs	Rainmakers Subdivision S-7	Drawdown and recovery	May 9-10, 2003
S	T10S R14E 20.313	TRs	Rainmakers Subdivision S-4	Drawdown	--
T	T10S R14E 20.313	Psu	Rainmakers Subdivision S-6	Drawdown and recovery	March 21-27, 2003
U	T10S R14E 21.323	Psu	Rainmakers Subdivision S-5	Drawdown	April 17-21, 2002
V	T10S R14E 30.14122	Psu	Sun Mountain	Drawdown	May 21-22, 1997
V	T10S R14E 30.14122	Psu	Sun Mountain	Drawdown	May 21-22, 1997
W	T11S R13E 09.222	Ti	Well A	Drawdown	June 21-23, 2002
W	T11S R13E 09.222	Ti	Well A	Drawdown and recovery	June 21-23, 2002
X	T11S R13E 09.223	Ti	Well B	Drawdown	June 21-23, 2002
Y	T11S R13E 23.22	Psu/Py	Gavilan Canyon	Step drawdown	July 11, 2001
Y	T11S R13E 23.22	Psu/Py	Gavilan Canyon	Drawdown and recovery	July 12-13, 2001

Table 3. Locations and results of aquifer tests performed in the study area.—Continued

[gal/d/ft, gallons per day per foot; ft/d, feet per day; gal/min/ft, gallons per minute per foot; --, no data; NMOSE, New Mexico Office of the State Engineer]

Well identifier (fig. 12)	Well location	Transmissivity (gal/d/ft)	Hydraulic conductivity (ft/day)	Specific capacity (gal/min/ft)	Storativity	Reference	New Mexico Office of the State Engineer file number
A	T09S R13E 33.114	1,162 to 1,898	--	--	0.005	4	--
B	T09S R15E 18.232	18,166	--	--	0.0001	5	H-1943-Expl (H-685-S2)
B	T09S R15E 18.232	8,622 to 9,341	--	--	--	5	H-1943-Expl (H-685-S2)
B	T09S R15E 18.232	429,000	--	5.1	--	6	H-1943-Expl
B	T09S R15E 18.23224	19,535 to 25,366	--	--	--	7	H-1943-Expl
B	T09S R15E 18.23224	25,000	42.31	--	--	5	H-1943-Expl
C	T10S R12E 36.122	22,000	4.63	--	0.0014	5	--
D	T10S R13E 11.2424	2,592	0.63	--	0.0001	5	H-3050(3)
D	T10S R13E 11.2424	1,937	--	--	--	5	H-3050(3)
E	T10S R13E 11.3111	2,576	[2]0.56 to [3]3.44	--	0.0001	5	H-3046(1)
E	T10S R13E 11.3111	606	--	--	--	5	H-3046(1)
F	T10S R13E 25.22243	1,913	1	--	0.0001	5	H-719-S-14
F	T10S R13E 25.22243	1,278 to 1,957	--	--	--	5	H-719-S-14
G	T10S R13E 26.41111	443	0.19	--	--	5	H-719-S-11
H	T10S R13E 34.123	600 to 1,600	0.53 to 0.90	--	0.006 to 0.009	8	H-719-S-8
H	T10S R13E 34.123	300 to 650	0.27 to 0.57	--	0.001	8	H-719-S-8
I	T10S R13E 34.223	540	0.16	--	--	8	H-719-S-9
I	T10S R13E 34.223	100	0.09	--	0.001	8	H-719-S-9
J	T10S R13E 34.232	990 to 1,800	0.88 to 1.60	--	0.014	8	H-719-S-4
J	T10S R13E 34.232	1,000 to 1,400	0.90 to 1.24	--	0.001	8	H-719-S-4
K	T10S R13E 34.311	150	0.67	--	0.001	8	H-719-S (Old)
L	T10S R13E 34.311	200 to 800	--	--	0.03	9	H-719-S (New)
L	T10S R13E 34.3111	160	0.04	--	--	5	H-719-S (New)
M	T10S R13E 34.413	350 to 600	0.39 to 0.67	--	0.001	8	H-719
N	T10S R13E 35.343	290	0.11	--	--	10	H-719-S-16 (H-719-E-1)
N	T10S R13E 35.343	1,400	0.31	--	--	10	H-719-S-16 (H-719-E-1)
N	T10S R13E 35.34313	1,957	0.42	--	0.00045	5	H-719-S-16 (H-719-E-1)
N	T10S R13E 35.34313	1,004 to 1,432	--	--	--	5	H-719-S-16 (H-719-E-1)
O	T10S R13E 35.43314	22,296 to 24,343	--	--	0.0004 to 0.0005	10	H-719-S-18
O	T10S R13E 35.43314	22,298 to 24,340	--	--	0.0004 to 0.0005	5	H-719-S-18
O	T10S R13E 35.43314	23,320	5.28	--	0.00045	5	H-719-S-18
O	T10S R13E 35.43314	1,632	--	0.96	--	5	H-719-S-18
P	T10S R13E 35.434	2,200	0.49	--	--	10	H-719-S-17 (H-719-E-2)
P	T10S R13E 35.43432	934	0.20	--	--	5	H-719-S-17 (H-719-E-2)
Q	T10S R14E 01.31234	4,000	3.02	--	--	5	H-2049-Expl
R	T10S R14E 19.424	4,000	--	--	0.005	11	H-1122-S-7 (H-3408-Expl)
S	T10S R14E 20.313	4,000	--	--	0.005	11	H-1122-S-4
T	T10S R14E 20.313	1,000 to 1,650	--	--	0.005	11	H-1122-S-6 (H-3409-Expl)
U	T10S R14E 21.323	1	--	--	0.005	11	H-1122-S-5
V	T10S R14E 30.14122	2,803	[2]1.26,[3]2.55	~1	0.0001	5	H-694
V	T10S R14E 30.14122	1,372	--	--	--	5	H-694
W	T11S R13E 09.222	101	--	0.07	--	12	H-03148
W	T11S R13E 09.222	39.8 to 56	--	--	--	12	H-03148
X	T11S R13E 09.223	412	--	--	0.0003	12	H-02496
Y	T11S R13E 23.22	--	--	17.5 to 28.7	--	13	H-272-S-9
Y	T11S R13E 23.22	79,288 to 177,276	--	17.5	--	13	H-272-S-9

[1]Year of test not legible on author's copy. [2]Calculated using saturated thickness. [3]Calculated using screened interval. [4]Earth Environmental Consultants, Inc., 1976. [5]Daniel B. Stephens and Associates, Inc., 2000. [6]Atkins-Landfair, Inc., 1985. [7]Hirsch, 1986. [8]W.K. Summers & Associates, 1977. [9]W.K. Summers & Associates, 1980. [10]W.K. Summers & Associates, 1983. [11]New Mexico Office of the State Engineer, 2003b. [12]Darr, 2003. [13]Peery and Finch, 2001.

Water quantity is a major concern in the upper Rio Hondo Basin, but water quality also becomes an issue in populated areas. The 2003 New Mexico State Water Plan (New Mexico Office of the State Engineer, 2003a, p. 2) says, "Water quality issues must have equal standing with water quantity issues." Though mountain aquifers and streams often provide high-quality water due to recharge from snowmelt and rain, septic tanks can negatively affect water quality. According to the New Mexico Environment Department (2000, p. 2), septic tanks are "the single largest source of ground-water pollution in the state." In addition, other activities within the upper Rio Hondo Basin may affect water quality. Once contaminated, aquifers and streams are extremely expensive to remediate and, in many cases, remediation is not feasible at any cost. Periodic water-quality sampling will help provide data about the effects of population increases in the upper Rio Hondo Basin.

Summary

Hydrologic data were compiled for the upper Rio Hondo Basin and water-level data were collected during two synoptic measurements in March and July 2003. This water-resources information will help Lincoln County planners and State officials address water-resources issues in the area.

A total of 70 wells were used in this study. Water levels in 33 of the wells were published in an OSE report in 1963. Sixty-six wells were measured in March 2003, 64 wells were measured in July 2003, and 1 well was measured in January 2003.

Compared with the 1963 contours, the 5,600-, 5,700-, and 5,800-foot March 2003 contours indicate that water levels rose. The 5,500-foot contour for March 2003 indicates a decline in water level. The 5,400-foot contours for March 2003 and 1963 mostly coincide, indicating a static water level. The 5,300- and 5,200-foot contours for March 2003 cross the 1963 contours, indicating a decline in water levels near the Rio Ruidoso but a rise in water levels near the Rio Bonito.

In eight well hydrographs, 2003 water levels are higher than water levels from the mid- to late 1950's in five of the wells. For the same period of record, water levels in three wells were lower.

Within the study area, the rising and declining water levels were highest in the northern part of the study area. The median rise of water levels was 4.01 feet and ranged from 0.08 to 36.36 feet. The median decline of water levels was 3.51 feet and ranged from 0.57 to 162.2 feet. In the southern part of the study area, the median rise of water levels was 2.21 feet and ranged from 0.52 to 17.08 feet. The median decline in water levels was 1.56 feet and ranged from 0.50 to 26.08 feet.

Transmissivity values, in units of gallons/day/foot, ranged from 39.8 to 22,000 in the igneous intrusives and extrusives; from 350 to 2,576 in the Mesaverde; from 100 to 1,957 in the Mancos Shale; from 934 to 24,343 in the Mancos Shale and Dakota Sandstone; and from 1 to 429,000 in the San Andres. Hydraulic conductivity, in units of feet/day, was 4.63 (only one value reported) in the igneous intrusives and extrusives; ranged from 0.39 to 3.44 in the Mesaverde; ranged from 0.04 to 1.60 in the Mancos Shale; ranged from 0.20 to 5.28 in the Mancos Shale and Dakota Sandstone; and ranged from 1.26 to 42.31 in the San Andres. Specific capacity, in units of gallons/minute/foot, was 0.07 (only one value reported) in the igneous intrusives and extrusives; 0.96 (only one value reported) in the Mancos Shale and Dakota Sandstone; and ~1 and 5.1 (two values reported) in the San Andres. Specific capacity values were not reported for the Mesaverde and Mancos Shale. Storativity, dimensionless, was 0.0003 and 0.0014 for the igneous intrusives and extrusives; ranged from 0.0001 to 0.005 in the Mesaverde; ranged from 0.0001 to 0.03 in the Mancos Shale; ranged from 0.0001 to 0.0005 in the Mancos Shale and Dakota Sandstone; and ranged from 0.0001 to 0.005 in the San Andres.

References Cited

Anderholm, S.K., 2001, Mountain-front recharge along the eastern side of the Middle Rio Grande Basin, central New Mexico (revised): U.S. Geological Survey Water-Resources Investigations Report 00-4010, 36 p.

Atkins Engineering Associates, Inc., 1993, Geohydrologic analysis of groundwater supplies within the vicinity of the Rio Bonito Ranch within townships 9 and 10 south, ranges 13 and 14 east, N.M.P.M., Lincoln County, New Mexico: Consulting report prepared for Charles D. Patterson Properties of the Southwest, Wimberley, Tex., 9 p., 5 exhibits.

Atkins Engineering Associates, Inc., 2000, Rio Bonito streamflow conditions and surface water irrigation requirement below Government Spring, Lincoln County, New Mexico: Consulting report prepared for The Hideout of Lincoln County, R.D. Hubbard Enterprises, 22 p., 4 exhibits.

Atkins-Landfair, Inc., 1985, Village of Capitan exploratory well drilling Number H-1943-EXPL: Consulting report prepared for Village of Capitan, N. Mex., 19 p.

Byrd, F.D., Lange, K.M., and Beal, L.V., 2003, Water resources data, New Mexico, water year 2002: U.S. Geological Survey Water-Data Report NM-02-1, 433 p.

Daniel B. Stephens and Associates, Inc., 2000, Groundwater impact analysis for proposed transfer applications, Water rights 02696, 02894, 01400, 01401, H-209, 01406-C, 01384, H-47, H-2068, and H-2070 through H-2076: Consulting report prepared for R.D. Hubbard Enterprises, Inc., Palm Desert, Calif., 31 p., 3 app., exhibits FF 4 and FF 8, calculation sheets for H694, H-719 - S-14, H-719 - S-16, H-719 - S-18, H-1943-Expl, well 9, well 6.

Darr, M.J., 2003, Geohydrologic investigation report, Proposed "Alpine Village Cabins" Subdivision, Lincoln County, New Mexico: Consulting report prepared for Ken Keegan, 47 p.

Earth Environmental Consultants, Inc., 1976, Hydrogeology of LaMay Ranch Estates, Lincoln County, New Mexico: Consulting report prepared for Fred Glover and Fred LaMay, Belen, N. Mex., 19 p.

Follett, W.W., 1918, Final report on a hydrographic survey of the Bonito and Hondo Rivers and of Eagle Creek in Lincoln County, New Mexico: Consulting report prepared for El Paso & Rock Island Railway Company in 1913 and 1914, El Paso, Tex., 253 p.

Hall, F.R., 1964, Chemistry of water of a section of the eastern flank of the Sacramento Mountains, Lincoln and Otero Counties, New Mexico, *in* New Mexico Geological Society Guidebook: 15th Field Conference, Ruidoso Country, p. 161-170.

Hirsch, R.J., 1986, Hydrogeologic evaluation of the impacts of pumping Sierra Blanca Airport Commission well H-2049X: New Mexico State Engineer Office, unnumbered report, variously paged.

Mourant, W.A., 1963, Water resources and geology of the Rio Hondo drainage basin, Chaves, Lincoln, and Otero Counties, New Mexico: New Mexico State Engineer Technical Report 28, 85 p., 7 pls.

National Oceanic and Atmospheric Administration, 1990-2002, Climatological data, annual summary, New Mexico: Asheville, N.C., no. 13, variously paged (published annually).

National Oceanic and Atmospheric Administration, 2003, Climate of 2003 – July, New Mexico drought, at URL *http://www.ncdc.noaa.gov/oa/climate/research/2003/jul/st029dv00pcp200307.html*, accessed March 2004.

New Mexico Environment Department, 2000, Ground water, New Mexico's buried treasure, at URL *http://www.nmenv.state.nm.us/gwb/buried_treasure.htm*, accessed January 2004.

New Mexico Office of the State Engineer, 2003a, New Mexico State Water Plan, December 23, 2003, at URL *http://www.seo.state.nm.us/water-info/NMWaterPlanning/2003StateWaterPlan.pdf*, accessed December 2003.

New Mexico Office of the State Engineer, 2003b, Subdivision memos, at URL *http://www.seo.state.nm.us/water-info/subdiv-memos/2291-3.pdf*, accessed March 2004.

New Mexico Office of the State Engineer, 2003c, Water Administration Technical Engineering Resource System (WATERS database), at URL *http://www.seo.state.nm.us/water-info/index.html*, accessed December 2003.

Newcomer, R.W., Jr., and Shomaker, J.W., 1991, Water resources of the Ruidoso-Carrizozo-Tularosa areas, Lincoln and Otero Counties, New Mexico, *in* New Mexico Geological Society Guidebook: 42nd Field Conference, Sierra Blanca, Sacramento and Capitan Ranges, p. 339-341.

Oregon Climate Service, 2004, Spatial Climate Analysis Service Data Extractor, at URL *http://mistral.oce.orst.edu/www/mapserv/nn/index.phtml*, accessed March 2004.

Peery, R.L., and Finch, S.T., 2001, Hydrogeologic assessment of well H-272-S-9, Village of Ruidoso, New Mexico: Consulting report prepared for Stein and Brockmann, P.A., Attorneys at Law, Santa Fe, N. Mex., 13 p., 2 app.

Powell, W.C., 1954, Report on the supply and uses of the waters of upper Bonito River and Eagle Creek, Lincoln County, New Mexico: Consulting report prepared for New Mexico Interstate Stream Commission and New Mexico State Engineer Office, 93 p.

U.S. Department of Agriculture, 2003, Farm Service Agency, at URL *http://www.fsa.usda.gov/pas/FullStory.asp?StoryID=1483*, accessed March 2004.

U.S. Geological Survey, 1981, Capitan Peak quadrangle, New Mexico Lincoln County: U.S. Geological Survey topographic 7.5-minute series quadrangle map, scale 1:24,000.

U.S. Geological Survey, 1989, San Patricio quadrangle, New Mexico Lincoln County: U.S. Geological Survey topographic 7.5-minute series quadrangle map, scale 1:24,000.

Waltemeyer, S.D., 2001, Estimates of mountain-front streamflow available for potential recharge to the Tularosa Basin, New Mexico: U.S. Geological Survey Water-Resources Investigation Report 01-4013, 8 p.

Wasiolek, Maryann, 1991, The hydrogeology of the Permian Yeso Formation within the upper Rio Hondo Basin and the eastern Mescalero Apache Indian Reservation, Lincoln and Otero Counties, New Mexico, *in* New Mexico Geological Society Guidebook: 42nd Field Conference, Sierra Blanca, Sacramento and Capitan Ranges, p. 343-351.

Wilson, B.C., Lucero, A.A., Romero, J.T., and Romero, P.J., 2003, Water use by categories in New Mexico counties and river basins, and irrigated acreage in 2000: New Mexico State Engineer Technical Report 51, 164 p.

W.K. Summers & Associates, 1977, Ground-water resources, Alto Village – Deer Park Woods Subdivision: Consulting report prepared for Lakeside Corporation, Alto, N. Mex., 81 p., 9 pls.

W.K. Summers & Associates, 1980, Hydrogeological evaluation of Alto Village new well #2, April 1980: Consulting report, 55 p.

W.K. Summers & Associates, 1983, Hydrogeologic evaluation of exploration wells Eagle Creek #1 and #2 near Alto Village, New Mexico: Consulting report prepared for Lakeside Corporation, Alto, N. Mex., 54 p.

W.K. Summers & Associates, 1984, Ground-water availability to the Pines of Gavilan, a proposed subdivision in Lincoln County, New Mexico: Consulting report prepared for J.W. Pearson and Associates, Ruidoso, N. Mex., 18 p., 1 app., 7 pls.