METHODS FOR ESTIMATING STREAMFLOW AT MOUNTAIN FRONTS IN SOUTHERN NEW MEXICO

By Scott D. Waltemeyer

U.S. GEOLOGICAL SURVEY
Water-Resources Investigations Report 93-4213

Prepared in cooperation with the
NEW MEXICO STATE ENGINEER OFFICE

Albuquerque, New Mexico
1994

U.S. DEPARTMENT OF THE INTERIOR

BRUCE BABBITT, *Secretary*

U.S. GEOLOGICAL SURVEY

Gordon P. Eaton, *Director*

For additional information
write to:

District Chief
U.S. Geological Survey
Water Resources Division
4501 Indian School Rd. NE, Suite 200
Albuquerque, New Mexico 87110

Copies of this report can
be purchased from:

U.S. Geological Survey
Earth Science Information Center
Open-File Reports Section
Box 25286, MS 517
Denver Federal Center
Denver, Colorado 80225

CONTENTS

FIGURES

TABLES

CONVERSION FACTORS

Multiply	By	To obtain
inch	25.40	millimeter
foot	0.3048	meter
mile	1.609	kilometer
square mile	2.590	square kilometer
cubic foot per second	0.02832	cubic meter per second
cubic foot per second per square mile	0.01093	cubic meter per second per square kilometer

METHODS FOR ESTIMATING STREAMFLOW AT MOUNTAIN FRONTS IN SOUTHERN NEW MEXICO

By Scott D. Waltemeyer

ABSTRACT

Streamflow from mountainous areas was investigated at selected mountain fronts in southern New Mexico. During most years streamflow infiltrates into the alluvial-basin aquifers at or near the mountain fronts. Streamflow at mountain fronts is potential recharge to these aquifers. Streamflow response to precipitation differed significantly between streams in southern and northern New Mexico.

Data for 13 gaging stations were used to determine a relation between mean annual streamflow and basin and climatic characteristics. Regression analysis was used to develop an equation to estimate mean annual streamflow at mountain fronts based on drainage area and mean annual precipitation. The average standard error of estimate for this equation is 46 percent. Channel-geometry measurements of active-channel width were determined for 6 of the 13 gaging stations. Regression analysis was used to develop an equation to estimate mean annual streamflow for streams using active-channel width. The average standard error of estimate for this relation is 29 percent.

Estimates using a regression equation based on regional relations of channel geometry usually are considered more reliable than those using a regression equation based on regional relations of basin and climatic characteristics. However, the sample size for these relations is small and the reported standard error of estimate may not represent that of the population. Active-channel-width measurements were made at 23 ungaged sites along the Rio Grande upstream from Elephant Butte Reservoir. More gaging stations are needed for a more comprehensive assessment of mean annual streamflow in southern New Mexico.

INTRODUCTION

A reliable estimate of the quantity of streamflow available for potential recharge to aquifers is important in hydrologic investigations. Estimated mean annual streamflow is often used to estimate recharge in ground-water model simulations (Kernodle and Scott, 1986; Kernodle and others, 1987). Mean annual streamflow, also referred to as average streamflow, is the mean for the period of record at a streamflow-gaging station where stage and discharge are measured on a continuous basis. Other reports have identified mountain-front recharge to be significant in recharging alluvial-basin aquifers. A procedure that uses multiple-regression analysis to estimate mean annual streamflow at mountain fronts was used to determine potential recharge for areas in northern New Mexico and southern Colorado (Hearne and Dewey, 1988). In northern New Mexico and southern Colorado mean annual streamflow is affected by size of drainage area, amount of winter precipitation, and degree of channel slope. Streamflow from mountain basins also is assumed to be potential recharge to alluvial-basin aquifers in the basin at or near the bedrock-alluvium contact. This was determined as part of the Southwest Alluvial-Basin Regional Aquifer-System Analysis (Wilkins, 1986). In that study, regional equations of mean annual streamflow were applied to the entire Rio Grande Basin upstream from Presidio, Texas. However, the validity of the regional equations in southern New Mexico and in Texas is not known. This report presents the results of an investigation conducted by the U.S. Geological Survey in cooperation with the New Mexico State Engineer Office to determine if the regional or similar equations are valid for estimating mean annual streamflow at mountain fronts in southern New Mexico. Two regional relations for estimating streamflow with basin and climatic characteristics and with channel-geometry characteristics were developed for application to southern New Mexico.

PHYSICAL SETTING AND CLIMATE

The physiography of southern New Mexico varies considerably and includes mountains, basins, and high plains. Mountains and basins predominate in the southeastern and southwestern part of the State. Some basins are termed "closed basin" because they contain a discontinuous surface-water channel or watercourse. These basins also are recharged at the mountain fronts by streamflow. Most of the annual precipitation in southern New Mexico is rainfall. Maximum mean monthly precipitation is in August. Precipitation during summer months is greater than during winter months when snowfall is predominant (Gabin and Lesperance, 1977). Streamflow response also is affected by the variability in precipitation: flow duration is shorter and hence the volume of water available for recharge is less during rainfall periods than snowfall periods. Lines of equal mean annual precipitation on a map showing 1931-60 data (U.S. Weather Bureau, no date) vary from 5 inches at the lowest altitudes to 30 inches in the mountains of southern New Mexico.

METHODS FOR ESTIMATING STREAMFLOW AT MOUNTAIN FRONTS

Various properties were used to develop appropriate equations for estimating streamflow at mountain fronts in southern New Mexico. In this report two regional relations for estimating streamflow were developed and compared with basin-climatic characteristics and channel-geometry characteristics.

Regional streamflow relations have been developed for other areas of the State in previous studies. A regional relation was derived for streamflow data collected at all gaging stations statewide (Borland, 1970) using drainage area, main channel slope, mean annual precipitation, and latitude as significant explanatory variables. The average standard error of estimate (SEE) of the relation was 53 percent. Although this relation closely represents average streamflow from the mountainous regions of northern New Mexico, streamflow is significantly overestimated in southern New Mexico. This results even though the dispersion of streamflow data about the regional regression line is minimal.

Regional relations also have been derived for regions in northern New Mexico. Drainage area and mean annual winter (October through April) precipitation were determined to be significant for the Sangre de Cristo Mountains (fig. 1) (Hearne and Dewey, 1988). In areas where precipitation is primarily snowfall in northern New Mexico, the relation of streamflow to mean annual winter precipitation has greater statistical significance than to mean annual precipitation. In areas where precipitation is primarily rainfall in southern New Mexico, mean annual precipitation has more significance.

A comparison of streamflow characteristics for southern and northern New Mexico was made from statistical summaries presented by Waltemeyer (1988). The streamflows at the gaging stations in southern and northern New Mexico were standardized by drainage area. Unit streamflow for mean annual streamflow and annual maximum mean streamflow for 90 consecutive days with a 10-year recurrence interval are listed in table 1 (tables are in the back of the report). Unit streamflow for mean annual streamflow computed from records for five gaging stations in southern New Mexico averages 0.03 cubic foot per second (ft^3/s), whereas unit streamflow computed from records for four gaging stations in northern New Mexico averages 0.51 ft^3/s.

Equation Based on Regional Relations of Basin and Climatic Characteristics

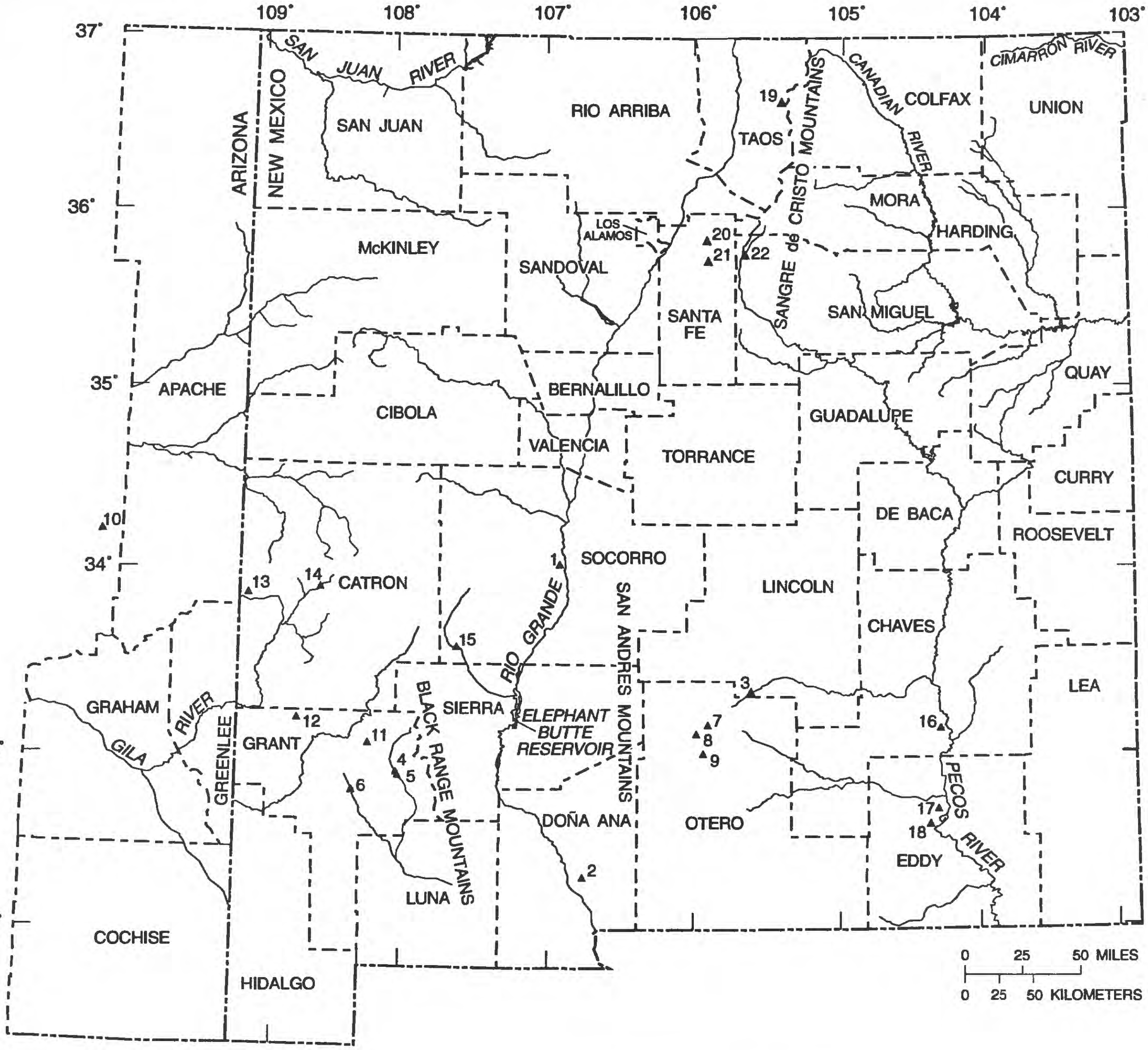
The streamflow-gaging stations (fig. 1) that are representative (at or upstream from mountain fronts) of natural flow at mountain fronts in southern New Mexico are listed in table 2. Data for 13 streamflow-gaging stations used in a regression analysis of mean annual streamflow with drainage area and mean annual precipitation resulted in the following equation:

$$Q_a = 1.70 \times 10^{-4} A^{1.35} P^{1.65} \qquad (1)$$

where Q_a is mean annual streamflow, in cubic feet per second;

A is drainage area, in square miles; and

P is mean annual precipitation, in inches.



EXPLANATION

▲2 STREAMFLOW-GAGING STATION AND SITE NUMBER--Locations described in tables 1-3

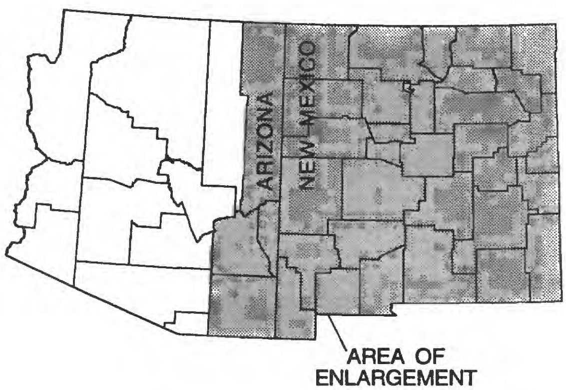


Figure 1.--Location of selected streamflow-gaging stations in New Mexico and Arizona.

The regression analysis resulted in an adjusted coefficient of determination of 0.91; thus 91 percent of the variation in mean annual streamflow is explained by the drainage area and mean annual precipitation. The average SEE is 46 percent. Estimates using equation 1 for ungaged sites at mountain fronts were made from the drainage area at the mountain-front sites and an interpolation of the mean annual precipitation. Most of the basin and climatic characteristics used in this analysis are stored in the Streamflow/Basin Characteristics file of the Water-Data Storage and Retrieval System (WATSTORE) listed in a report by Dempster (1983). Estimates for sites for which data were not available were determined as follows. Drainage area (A), in square miles, was determined by planimetering the delineated area on the largest scale topographic map available. Mean annual precipitation was determined using a grid sample for each basin as delineated on a map of normal annual precipitation (1931-60) published by the U.S. Weather Bureau (no date).

Equation Based on Regional Relations of Channel Geometry

Channel-geometry measurements provide a means for estimating long-term streamflow. Active-channel-width measurements of stream channels are relatively easy to make. Field reconnaissance of an area where the ground-water resources are being appraised for ground-water modeling also can incorporate channel-geometry measurements. Hedman and Osterkamp (1982) related streamflow characteristics to channel geometry and described the technique for measuring channel geometry for physiographic regions of the western United States. Regional relations as related to channel-geometry characteristics in New Mexico also were investigated by Kunkler and Scott (1976).

The regional relation of mean annual streamflow to active-channel width for the six stations listed in table 3 provides a mechanism for estimating streamflow at mountain fronts in southern New Mexico. Active-channel-width data for three of the six stations in table 3 were obtained from Kunkler and Scott (1976) and for three stations were determined during this study. Regression analysis of mean annual streamflow with active-channel width resulted in the following equation:

$$Q_a = 0.04\ W^{1.59} \qquad (2)$$

where W is active-channel width, in feet.

The average SEE for the regression analysis is 29 percent. However, the sample size is small and should not be compared for accuracy to the equations obtained by Kunkler and Scott (1976) or Hedman and Osterkamp (1982) (table 4). The variation in mean annual streamflow as determined by active-channel width (coefficient of determination) is 87 percent.

The regression analyses for which active-channel widths are used for streams in the deserts of the southwestern United States determined by Hedman and Osterkamp (1982), for all stations in New Mexico determined by Kunkler and Scott (1976), and for southern New Mexico (this report) are shown in figure 2 and table 4. The relation determined in this report for southern New Mexico has a similar response in streamflow to the relations determined for flow in ephemeral streams having sand and gravel channels found in the deserts of the southwestern United States by Hedman and Osterkamp (1982). The magnitudes of the estimated mean annual streamflow are slightly less for the relation determined for this analysis than for those estimated using equations developed by Hedman and Osterkamp (1982).

Active-channel widths at 23 ungaged sites (fig. 3) were measured in southern New Mexico to estimate mean annual streamflow along the Rio Grande upstream from Elephant Butte Reservoir (fig. 1). By use of equation 2 derived in this study and the active-channel widths listed in table 5, mean annual streamflow can be estimated for these additional ungaged sites.

Limitations and Improvement of Accuracy of the Equations

The application of the regression equations needs to be limited to the ranges of drainage area (20.7 to 184 square miles) and mean annual precipitation (6.0 to 25 inches) listed in table 2 and to the range of active-channel widths (15 to 55 feet) listed in table 3. The equations should be limited to use at mountain-front stream locations or upstream from those locations. The reliability of estimates derived from these equations could be improved by the following items.

(1) A current precipitation map using high-altitude snow-course precipitation data from the U.S. Soil Conservation Service.

(2) Additional streamflow-gaging stations (partial record and continuous record) at or upstream from mountain-front locations to increase the sample size and better represent the population needed to define the regional equations.

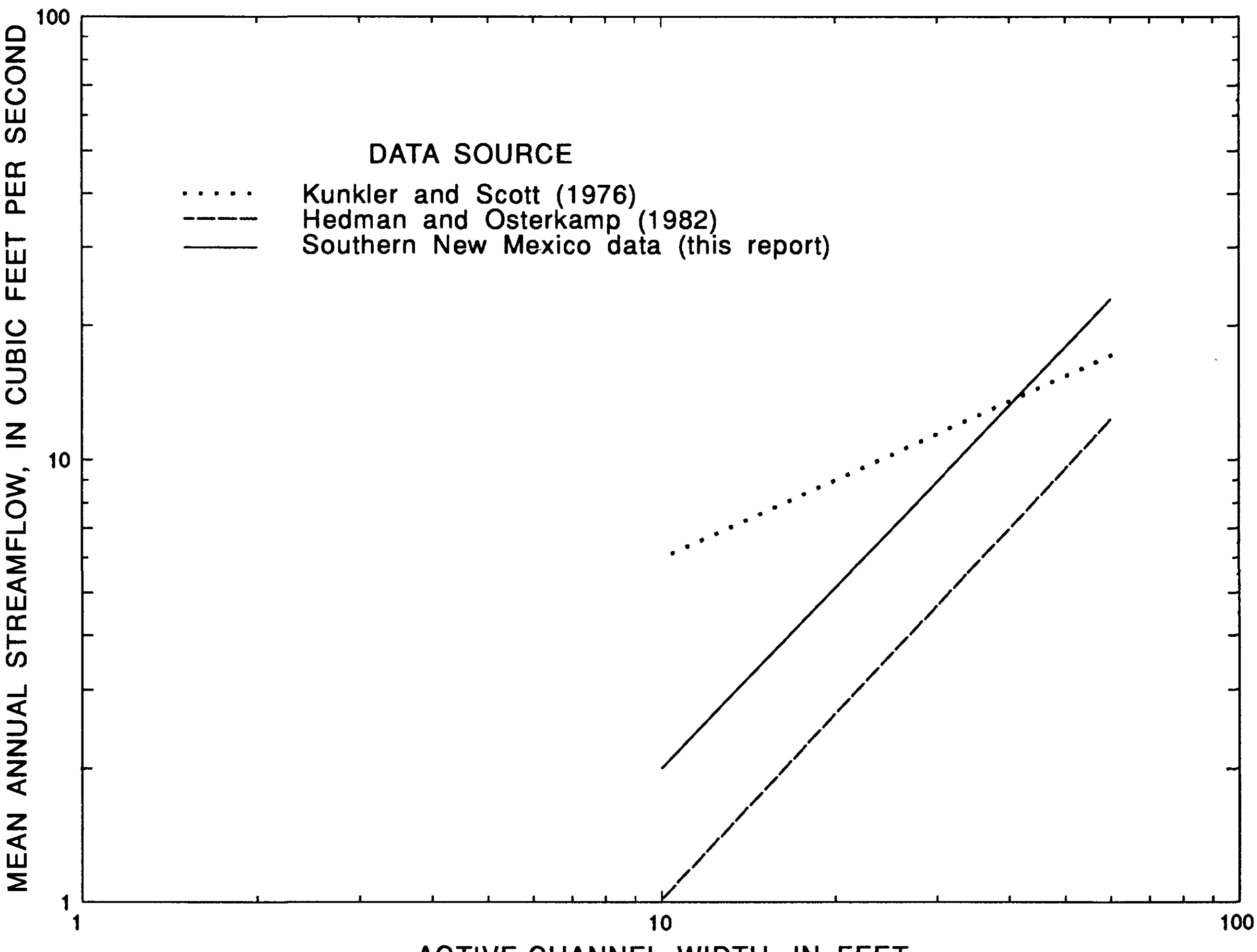


Figure 2.--Regression lines for mean annual streamflow at mountain fronts in southern New Mexico using regression equations derived from active-channel-width data.

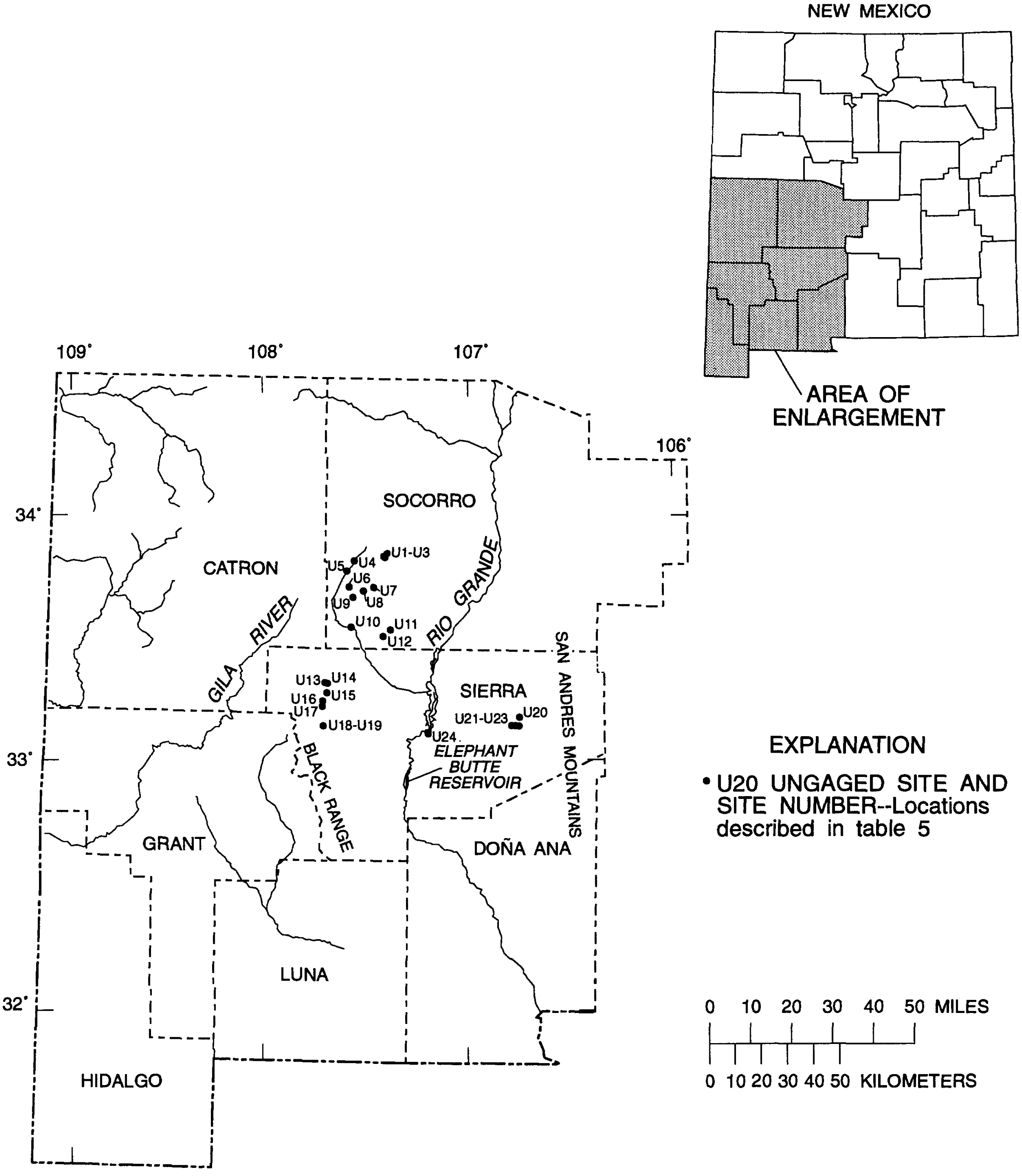


Figure 3.--Location of ungaged sites in southern New Mexico where active-channel-width measurements were made.

SUMMARY

Streamflow from mountainous areas was investigated at mountain fronts in regions of southern New Mexico. Streamflow at mountain fronts is a major source of potential recharge. Streamflow response to precipitation differed significantly between streams in southern and northern New Mexico. The volume of streamflow at mountain fronts in areas where precipitation is primarily snowfall in northern New Mexico is greater than the volume of streamflow at mountain fronts in areas where precipitation is primarily rainfall in southern New Mexico. Some basins in southern New Mexico also have closed basins in which all streamflow is potentially available for recharge. Two regional relations for estimating streamflow with basin and climatic characteristics and with channel-geometry characteristics were developed for application to southern New Mexico.

Mean annual streamflow estimated using a regression equation based on regional relations of active-channel width resulted in less error than an equation based on basin and climatic characteristics. However, the sample size available for this regression analysis is small. Active-channel-width data for 23 ungaged sites were provided for estimating mean annual streamflow along the Rio Grande upstream from Elephant Butte Reservoir. Estimates using a regression equation that is based on regional relations of drainage area and mean annual precipitation are considered less reliable. Error in this relation can be improved by using a more current precipitation map that is derived from data for mountainous areas. The number of gaging stations in the network in southern New Mexico is inadequate and needs to be supplemented with additional partial-record and continuous-record gaging stations to improve the accuracy of both regression equations.

REFERENCES CITED

Borland, J.P., 1970, A proposed streamflow-data program for New Mexico: U.S. Geological Survey Open-File Report, 71 p.

Dempster, G.R., 1983, Streamflow/basin characteristics--Chap. II, section A, of WATSTORE user's guide: U.S. Geological Survey Open-File Report 79-1336-I, v. 4, p. A-24 to A-34.

Gabin, V.L., and Lesperance, L.E., 1977, New Mexico climatological data--Precipitation, temperature, evaporation, and wind, Monthly and annual means, 1850-1975: Socorro, N. Mex., W.K. Summers and Associates, 436 p.

Hearne, G.A., and Dewey, J.D., 1988, Hydrologic analysis of the Rio Grande basin north of Embudo, New Mexico, Colorado and New Mexico: U.S. Geological Survey Water-Resources Investigations Report 86-4113, 244 p.

Hedman, E.R., and Osterkamp, W.R., 1982, Streamflow characteristics related to channel geometry of streams in western United States: U.S. Geological Survey Water-Supply Paper 2193, 16 p.

Kernodle, J.M., Miller, R.S., and Scott, W.B., 1987, Three-dimensional model simulation of transient ground-water flow in the Albuquerque-Belen Basin, New Mexico: U.S. Geological Survey Water-Resources Investigations Report 86-4194, 86 p.

Kernodle, J.M., and Scott, W.B., 1986, Three-dimensional model simulation of steady-state ground-water flow in the Albuquerque-Belen Basin, New Mexico: U.S. Geological Survey Water-Resources Investigations Report 84-4353, 57 p.

Kunkler, J.L., and Scott, A.G., 1976, Flood discharges of streams in New Mexico as related to channel geometry: U.S. Geological Survey Open-File Report 76-414, 30 p.

U.S. Weather Bureau [n.d.], Normal annual precipitation, 1931-60, State of New Mexico: U.S. Department of Commerce map, 1 sheet, scale 1:500,000.

Waltemeyer, S.D., 1988, Statistical summaries of streamflow data in New Mexico through 1985: U.S. Geological Survey Water-Resources Investigations Report 88-4228, 204 p.

Wilkins, D.W., 1986, Southwest Alluvial-Basin Regional Aquifer-System study in parts of Colorado, New Mexico, and Texas, in Sun, R.J., ed., Regional Aquifer-System Analysis Program of the U.S. Geological Survey--Summary of projects, 1978-84: U.S. Geological Survey Circular 1002, p. 107-115.

Table 1.–Comparison of streamflow characteristics for southern and northern New Mexico

[Unit streamflow (left column) values calculated from mean annual streamflow values; unit streamflow (right column) values calculated from annual maximum mean streamflow for 90 consecutive days with a 10-year recurrence interval. Data from Waltemeyer, 1988]

Site number (fig. 1)	Station number and name	Drainage area (square miles)	Unit streamflow (cubic feet per second per square mile)		Mean annual streamflow (cubic feet per second)	Annual maximum mean streamflow for 90 consecutive days with a 10-year recurrence interval (cubic feet per second)
	Southern New Mexico					
15	08360000 Alamosa Creek near Monticello	403	0.02	0.04	[1]8.3	16
17	08400000 Fourmile Draw near Lakewood	265	.02	.15	[1]3.7	39
18	08401200 South Seven Rivers near Lakewood	220	.02	.26	[1]4.3	58
4	08477000 Mimbres River near Mimbres	152	.07	.32	11	49
14	09442692 Tularosa River above Aragon	94.0	.04	.09	[1]3.5	8.9
	Northern New Mexico					
19	08264000 Red River near Red River	19.1	0.89	3.93	17	75
20	08294300 Rio Nambe at Nambe Falls near Nambe	34.2	.29	1.14	10	39
21	08302500 Tesuque Creek above diversions near Santa Fe	11.0	.29	1.64	3.2	18
22	08377900 Rio Mora near Terrero	53.2	.58	2.97	31	158

[1]Mean annual streamflow values differ from values in tables 2 and 3 due to different period of record used for the computation and because values from Hearne and Dewey (1988) are rounded.

Table 2.--Drainage area, mean annual streamflow, and mean annual precipitation data used for regression analysis

[Data from Hearne and Dewey (1988) and from files of the U.S. Geological Survey. Data from Hearne and Dewey (1988) are rounded in nonstandard form. Stations are in New Mexico unless otherwise indicated. Water year is October 1 through September 30]

Site number (fig. 1)	Station number and name	Drainage area (square miles)	Mean annual streamflow (cubic feet per second)	Mean annual precip-itation (inches)	Period of record (water years)
1	08355300 Arroyo de la Matanza at Socorro	46.0	0.42	[1]6.0	1970-77
2	08363700 Tortugas Arroyo near Las Cruces	20.7	.24	[1]7.5	1931-41, 1958-71
3	08387000 Rio Ruidoso at Hollywood	120	14.9	25	1954-81
4	08477000 Mimbres River near Mimbres	152	11.0	16	1931-76
5	08477110 Mimbres River at Mimbres	184	20.7	[1]16	1979-89
6	08477600 San Vicente Arroyo at Silver City	26.5	.80	16	1954-65
7	08481500 Tularosa Creek near Bent	120	11.7	21	1949-89
8	08482000 Rio Tularosa near Tularosa	140	15.3	20	1939-47
9	08484500 La Luz Creek at La Luz	62.7	10.1	[1]15	1983-88
10	09390500 Show Low Creek near Lakeside, Arizona	68.6	14.9	24	1953-88
11	09430150 Sapillo Creek below Lake Roberts	78.0	4.73	[1]16	1965-71
13	09442653 Trout Creek near Luna	27.1	2.34	[1]19	1969-73
14	09442692 Tularosa River above Aragon	94.0	3.47	8	1967-89

[1]Mean annual precipitation as determined for this study.

Table 3.—Mean annual streamflow and active-channel-width data used for regression analysis in southern New Mexico

[Stations are in New Mexico. Water year is October 1 through September 30]

Site number (fig. 1)	Station number and name	Mean annual streamflow (cubic feet per second)	Active-channel width (feet)	Period of record (water years)
15	08360000 Alamosa Creek near Monticello	8.27	21	1931-41, 1958-71
16	08394500 Rio Felix at Old Highway Bridge near Hagerman	14.1	[1]42	1940-87
17	08400000 Fourmile Draw near Lakewood	4.21	[1]22	1951-89
18	08401200 South Seven Rivers near Lakewood	4.68	[1]20	1963-89
14	09442692 Tularosa River above Aragon	3.47	15	1967-89
12	09430600 Mogollon Creek near Cliff	30.1	55	1968-89

[1]Active-channel-width data from Kunkler and Scott (1976).

Table 4.--Regression equations used for estimating mean annual streamflow from active-channel-width data for southern New Mexico

[Q_a, mean annual streamflow, in cubic feet per second; W, active-channel width, in feet]

Regression equation	Average standard error of estimate (percent)	Number of sites used in regression analysis	Applicable region	Source
$Q_a = 0.04\ W^{1.40}$	75	30	Deserts of southwestern United States	Hedman and Osterkamp, 1982
$Q_a = 1.58\ W^{0.58}$	82	79	All of New Mexico	Kunkler and Scott, 1976
$Q_a = 0.04\ W^{1.59}$	29	6	Southern New Mexico upstream from mountain fronts	This report

Table 5.--Description of ungaged sites and active-channel widths

[Site locations shown in figure 3; T., Township; R., Range; sec., section]

Site U1. Big Rosa Canyon near Monticello, N. Mex.

LOCATION--Latitude 33°52'15", longitude 107°24'18", in T. 5 S., R. 6 W., Socorro County, in Cibola National Forest, 1.3 miles downstream from Water Canyon, 35 miles northeast of Monticello.

Active-channel width: 12 feet

Site U2. Water Canyon near Monticello, N. Mex.

LOCATION--Latitude 33°51'23", longitude 107°25'06", in T. 5 S., R. 6 W., Socorro County, in Cibola National Forest, 0.1 mile upstream from mouth, 33 miles northeast of Monticello.

Active-channel width: 5.5 feet

Site U3. Big Rosa Canyon near Monticello, N. Mex.

LOCATION--Latitude 33°51'18", longitude 107°24'52", in T. 5 S., R. 6 W., Socorro County, in Cibola National Forest, 0.1 mile upstream from Water Canyon, 32 miles northeast of Monticello.

Active-channel width: 5.0 feet

Site U4. Bear Trap Canyon near Monticello, N. Mex.

LOCATION--Latitude 33°50'22", longitude 107°33'57", in T. 5 S., R. 7 W., Socorro County, in Cibola National Forest, 0.2 mile upstream from U.S. Forest Service road junction, 32 miles north of Monticello.

Active-channel width: 5.5 feet

Site U5. Bear Trap Canyon near mouth near Monticello, N. Mex.

LOCATION--Latitude 33°47'53", longitude 107°36'02", in T. 6 S., R. 7 W., Socorro County, 0.8 mile downstream from Turkey Creek, 17 miles north of Monticello.

Active-channel width: 10 feet

Site U6. Whitewater Canyon near Monticello, N. Mex.

LOCATION--Latitude 33°43'57", longitude 107°35'23", on section line in SE1/4SE1/4SE1/4 of sec. 6, T. 7 S., R. 7 W., Socorro County, in Cibola National Forest, 1.5 miles downstream from fork of East Whitewater Canyon, 25 miles north of Monticello.

Active-channel width: 15 feet

Table 5.--Description of ungaged sites and active-channel widths--Continued

Site U7. West Red Canyon near Winston, N. Mex.

LOCATION--Latitude 33°43'57", longitude 107°28'04", Socorro County, in Cibola National Forest, 0.8 mile downstream from Tool Box Spring, and 26 miles northeast of Monticello.

Active-channel width: 4.4 feet

Site U8. West Red Canyon at Red John Box near Monticello, N. Mex.

LOCATION--Latitude 33°42'56", longitude 107°31'07", T. 7 S., R. 7 W., Socorro County, in Cibola National Forest, 0.4 mile upstream from Box Draw Canyon, 33 miles north of Monticello.

Active-channel width: 5.5 feet

Site U9. West Red Canyon at mountain front near Winston, N. Mex.

LOCATION--Latitude 33°41'28", longitude 107°34'104", in T. 7 S., R. 7 W., Socorro County, in Cibola National Forest, 0.3 mile downstream from Hutchison Branch, 32 miles north of Monticello.

Active-channel width: 11 feet

Site U10. Alamosa Creek near Monticello, N. Mex.

LOCATION--Latitude 33°34'07", longitude 107°34'28", in SE1/4NE1/4SE1/4 of sec. 32, T. 8 S., R. 7 W., Socorro County, 1.6 miles downstream from Monticello Box and gaging station 08360000, 14 miles northwest of Monticello.

Active-channel width: 21 feet

Site U11. Nogal Canyon near Monticello, N. Mex.

LOCATION--Latitude 33°33'40", longitude 107°22'58", in SW1/4NW1/4NW1/4 of sec. 5, Socorro County, in Cibola National Forest, 0.5 mile downstream from Corn Canyon, 12 miles northeast of Monticello.

Active-channel width: 5.0 feet

Site U12. Rock Springs Canyon near Monticello, N. Mex.

LOCATION--Latitude 33°32'06", longitude 107°25'06", in NE1/4NE1/4NE1/4 of sec. 14, T. 9 S., R. 5 W., Socorro County, in Cibola National Forest, at Rock Spring, 10 miles northeast of Monticello.

Active-channel width: 10 feet

Table 5.--Description of ungaged sites and active-channel widths--Continued

Site U13. Chloride Creek near Winston, N. Mex.

LOCATION--Latitude 33°20'25", longitude 107°42'11", in SE1/4NE1/4SE1/4 of sec. 19, T. 11 S., R. 8 W., Sierra County, 1.7 miles upstream from Chloride, 3 miles west of Winston.

Active-channel width: 13 feet

Site U14. Chloride Creek near mouth near Chloride, N. Mex.

LOCATION--Latitude 33°20'16", longitude 107°41'37", in SW1/4SW1/4NW1/4 of sec. 20, Sierra County, 0.8 mile upstream from Chloride, 2 miles west of Winston.

Active-channel width: 16 feet

Site U15. South Fork near Winston, N. Mex.

LOCATION--Latitude 33°18'14", longitude 107°42'56", in T. 11 S., R. 9 W., Sierra County, in Gila National Forest, 0.3 mile downstream from Colossal Mine, 6.0 miles southwest of Winston.

Active-channel width: 17 feet

Site U16. Monument Creek near Winston, N. Mex.

LOCATION--Latitude 33°15'55", longitude 107°42'50", in T. 12 S., R. 9 W., Sierra County, in Gila National Forest, at Bald Eagle Windmill, 7 miles southwest of Winston.

Active-channel width: 10 feet

Site U17. North Fork Palomas Creek near Winston, N. Mex.

LOCATION--Latitude 33°14'36", longitude 107°42'50", in T. 12 S., R. 9 W., Sierra County, at Dines Ranch, 8 miles south of Winston.

Active-channel width: 11 feet

Site U18. North Fork Palomas Creek near Winston, N. Mex.

LOCATION--Latitude 33°17'56", longitude 107°41'37", in NE1/4SE1/4SE1/4 of sec. 31, T. 12 S., R. 8 W., Sierra County, 0.2 mile downstream from Willow Creek, 9.0 miles south of Winston.

Active-channel width: 29 feet

Table 5.--Description of ungaged sites and active-channel widths--Concluded

Site U19. South Fork Palomas Creek near Winston, N. Mex.

LOCATION--Latitude 33°09'55", longitude 107°42'24", in T. 13 S., R. 8 W., Sierra County, 1.2 miles downstream from Hermosa at Pelican Group Mine, about 13.0 miles south of Winston.

Active-channel width: 22 feet

Site U20. Unnamed arroyo near Engle, N. Mex.

LOCATION--Latitude 33°12'35", longitude 106°44'35", in SE1/4NW1/4NW1/4 of sec. 53, T. 13 S., R. 2 E., Sierra County, in San Andres Mountains, 1.3 miles upstream from windmill, 17 miles east of Engle.

Active-channel width: 4.5 feet

Site U21. Unnamed arroyo near Engle, N. Mex.

LOCATION--Latitude 33°10'34", longitude 106°46'52", in NE1/4NW1/4SW1/4 of sec. 18, T. 13 S., R. 2 E., Sierra County, in San Andres Mountains, 0.5 mile upstream from mountain front, 16 miles east of Engle.

Active-channel width: 26 feet

Site U22. Unnamed arroyo tributary near Engle, N. Mex.

LOCATION--Latitude 33°10'25", longitude 106°45'51", in NW1/4SW1/4SW1/4 of sec. 17, T. 13 S., R. 2 E., Sierra County, in San Andres Mountains, on southernmost fork 0.2 mile upstream from confluence, 16 miles east of Engle.

Active-channel width: 11 feet

Site U23. Unnamed arroyo tributary near Engle, N. Mex.

LOCATION--Latitude 33°10'21", longitude 106°44'50", in center of SW1/4SW1/4 of sec. 16, T. 13 S., R. 7 E., Sierra County, in San Andres Mountains, 0.5 mile upstream from New Tank, 17 miles east of Engle.

Active-channel width: 11 feet

☆ U.S. GOVERNMENT PRINTING OFFICE: 1994-575-729/05088