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UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

A Proposed Streamflow-Data Program For New Mexico

By

John P. Borland

Open-file report

Albuquerque, New Mexico

September 1970

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ABSTRACT

A streamflow information system is proposed for New Mexico. This proposal resulted from a study in which the basic steps were (1) definition of the long-term program goals, (2) examination and evaluation of available data to determine which goals have been achieved, and (3) consideration of alternate programs and techniques for meeting the remaining goals.

The proposed program consists of both data collection and data analyses to efficiently provide the streamflow information required for (1) current water use and management, (2) planning and design, (3) determination of long-term trends, and (4) assessment of stream environment.

INTRODUCTION

The streamflow program of the U.S. Geological Survey in New Mexico has evolved through the years as Federal and State interests in surface-water resources have increased and as funds for operating stream-gaging stations have become available.

The beginning of surface-water investigations in New Mexico was in December 1888 when the Geological Survey established a camp on the Rio Grande near Embudo for the purpose of training employees to make streamflow measurements. A gaging station was built near the camp and the collection of continuous streamflow records started on January 1, 1889. Two more stations were placed in operation on the Rio Grande in that same year. In the years to follow, additional stations were built on the Rio Grande, San Juan, Piedra, Mora, and Sapello Rivers.

In 1907, the Territorial legislature enacted the basic surface-water code and established the position of Territorial Engineer, later to be State Engineer. This legislation resulted in a cooperative agreement between the Territory and the Survey which led to additional stations being built along the Rio Grande. The cooperative agreement was terminated in 1915 at which time the State assumed all responsibility for the 62 stations then in operation on streams throughout the State.

On July 1, 1931, a cooperative agreement was again reached and an office of the Geological Survey was established in Santa Fe. A period of rapid expansion followed this resumption of operation by the Survey, as needs for streamflow data were generated by programs of the Bureau of Reclamation, Bureau of Indian Affairs, U.S. Army Corps of Engineers, and the Rio Grande Joint Investigation. A maximum of 329 stations were operated during the period 1935-39. At the end of this period 159 stations remained in operation to fill the needs for streamflow data.

In 1949, a cooperative agreement was made with the State Highway Department to determine flood magnitudes on small streams. This resulted in a program for the establishment and operation of crest-stage gages. The program was expanded in 1965 to include flood-hydrograph stations to further examine the rainfall-runoff relation on small drainage areas. The present operation consists of 136 crest-stage gages and 27 flood-hydrograph stations with the locations shown in figure 1.

The stream-gaging program has continued to expand during the years with the present operation consisting of 206 continuous-record gaging stations. Locations of the stations are shown in figure 2. However, the increasing cost of operation, the restraint on funds and manpower, and the need for a greater variety of hydrologic information, made it imperative that a systematic evaluation of the streamflow-data program be made to determine how to apply the funds and manpower available in order to best serve State and Federal interests. The purpose of this study is to evaluate the streamflow data program and use this evaluation to design a program that will most efficiently produce the types of information needed. The study was supported with Federal funds of the Geological Survey.

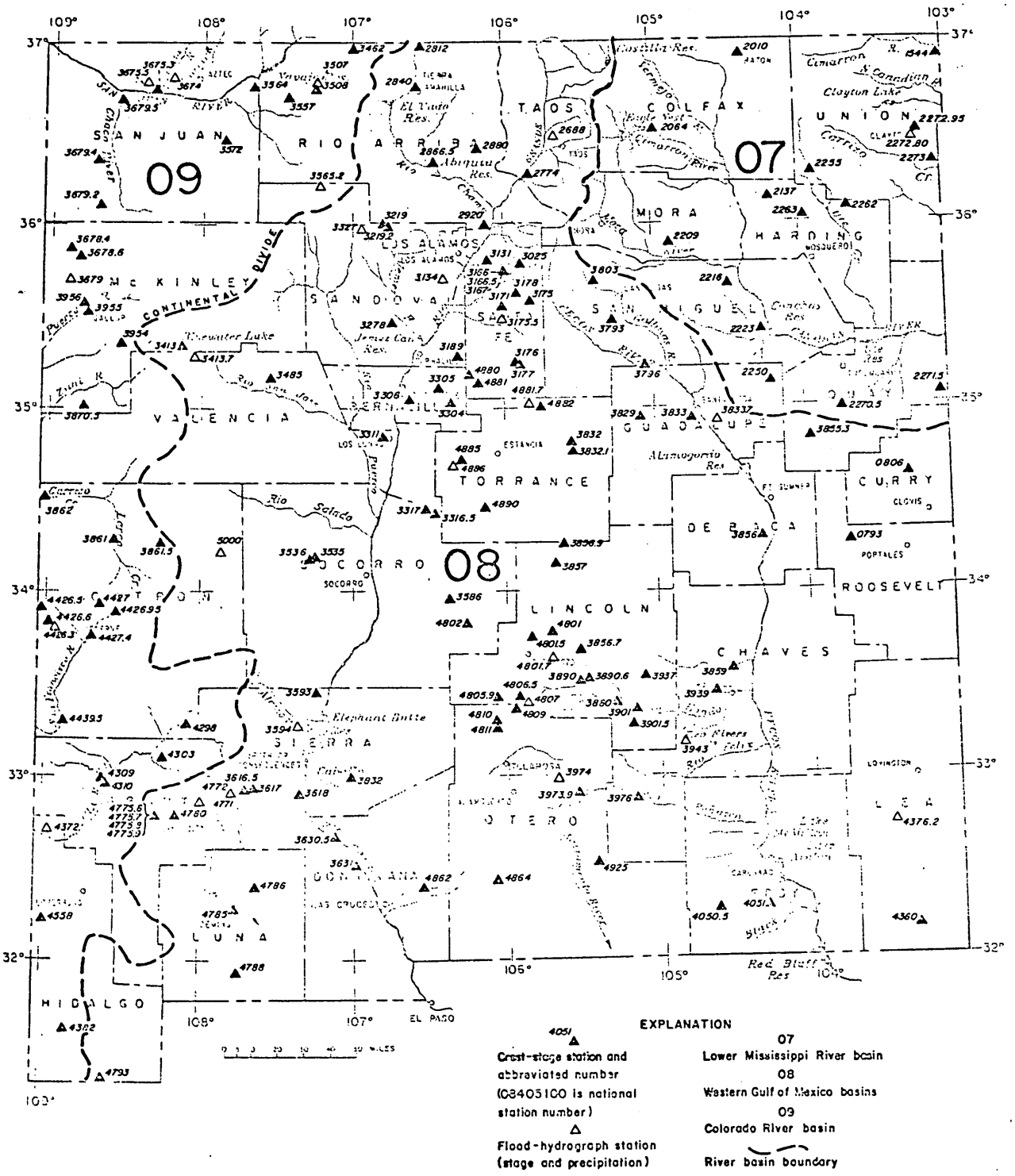

Figure 1.--Location of active floodflow partial record gaging stations as of June 30, 1970.

The concepts and procedures used in this study are presented in detail by Carter and Benson (1970), and are summarized only briefly in this report. The basic steps are: (1) definition of the long-term objectives of the streamflow data program in quantitative form, (2) examination and analysis of all available data to determine which objectives have already been met, (3) consideration of alternate means of meeting the remaining objectives, and (4) preparation of a proposed program of data collection and analysis to meet the remaining objectives.

HYDROLOGY OF THE STATE

New Mexico is the fifth largest State in the Union with an area of 121,700 square miles. An indication of the semiarid nature of the State is that only 0.1 of a percent of its area is covered by water. Precipitation varies greatly with a mean-annual rainfall of about 8 inches in the lower altitudes and about 24 inches in the higher mountains.

Most of the principal streams in the State flow in a southern direction. The principal stream, the Rio Grande, flows almost due south through the central part of the State. The other principal streams are the Pecos River, a major tributary to the Rio Grande, and the San Juan and the Gila Rivers, which flow into the Colorado River in southern Utah and southwestern Arizona respectively. The Canadian River is the only principal stream which flows eastward, into Texas and eventually into the Mississippi River.

The topography of the State is characterized by mountains, valleys, and large closed basins. Most of the perennial streams drain the high country, and are fed by snowmelt. It is not uncommon for some large streams that are considered to be perennial locally to be dry for long stretches in the channel. A majority of the streams in the southern half of the State are ephemeral and for months, sometimes years, are without flow, depending on summer rains for runoff.

CONCEPTS AND PROCEDURES USED IN THIS STUDY

The first step in this study was the classification of streamflow data into four types and the second step was the setting of goals for the streamflow program in terms of the elements to be defined and the accuracy needed. The existing data are then evaluated to determine which goals have already been met. Finally, the unmet goals are the basis for the proposed program of data collection and analysis. The procedures used in this study are presented with reference to the general framework shown in table 1.

Data for current uses such as day-to-day decisions on water management, assessment of current water availability, management of water quality, forecast of water hazards, and the surveillance necessary to comply with legal requirements are commonly obtained by operating a gaging station at the site under investigation. This element of the program is not subject to design but changes in response to needs.

Table 1.--Framework of design of data collection program

Type of data	Current use	Planning and Design			Long-term trends	Stream environment
		Natural Flow	Regulated Flow			
			Minor streams	Principal streams		
Goals	To provide current data on streamflow needed for day-by-day decisions on water management as required.	To provide information on statistical characteristics of flow at any site on any stream to the specified accuracy.			To provide a long-term data base of homogeneous records on natural-flow streams.	To describe the hydrologic environment of stream channels and drainage basins.
Drainage area limits	Full range	Full range	Full range	Full range	Full range	Full range
Accuracy goal	As required	Equivalent to 10 years of record.	Equivalent to 10 years of record.	Equivalent to 25 years of record.	Highest obtainable	As required
Approach	Operate gaging stations as required to provide specific information needed.	Relate flow characteristics to drainage basin characteristics using data for gaged basins.	Develop generalized relations that account for the effect of storage, diversion or regulation on natural flow characteristics.	Utilize analytical model of stream system with observed data as input to compute homogeneous records for both natural flow conditions and present conditions of development.	Operate a number of carefully selected gaging stations indefinitely	Observe and publish information on stream environment.
Evaluate available data	Identify stations where data is used currently and code the specific use of data.	Develop relationship for each flow characteristic and compare standard error with accuracy goal. Evaluate sample.	Appraise type of regulation, data available, and areas where relationships are needed.	Identify stream systems that should be studied using model approach and determine data requirements.	Select two stations in each WRC subregion to operate indefinitely for this purpose.	Evaluate information available in relation to goals.
Design future program	Identify goals that have not been attained. Consider alternate means of attaining goals. Identify elements of future program.					

Data used for planning and design are commonly the statistical characteristics of streamflow such as mean discharge, the floods of 10, 25, or 50-year recurrence intervals, flood volumes of 1, 3, or 7-day duration for various recurrence intervals, and 7-day low flows of 20-year recurrence intervals. These and other characteristics can be obtained from gaging-station records. Although a long record is desirable for defining statistical streamflow characteristics at a site, it is not feasible to collect records at every site where it may be needed. A number of such records are required to provide information that can be transferred to ungaged sites, or to sites where little streamflow data are available.

The transfer of information on streams having natural flow may be done by relating flow characteristics to basin characteristics such as drainage area, topography, and climate; by relating a short record to a longer one, or by interpolating between gaged points on a stream channel.

The definition of flow characteristics of a regulated stream is often complicated because of changes in flow during the period of record. Frequently it is not possible to obtain a long record under one condition of development. Transference of flow characteristics from one point to another on a regulated stream is difficult because the procedures used for natural streams, such as regression or interpolation, do not apply. A systems approach seems to be the most efficient way to define the flow characteristics of regulated streams. This approach requires some sort of analytical model of the stream system using as inputs, streamflow records, stage-capacity curves for reservoirs, operating rule curves for the release of water, losses due to evaporation and seepage, stream-channel geometry, and records of diversions and return flows including ground-water pumpage and aquifer characteristics. The model and associated data can be used to derive homogeneous data for both natural and regulated conditions.

Data to define long-term trends in streamflow can only be obtained by operating gaging stations indefinitely on a few natural streams. The records from these gaging stations will either affirm that the characteristics defined from the present records are good estimates of the long-term characteristics, or they will provide a basis for adjusting those short-term characteristics.

Environmental data describe the external features that affect the occurrence and use of streamflow, especially those features that relate to the use of water for recreation, waste disposal, conjunctive surface water-ground water supply, preservation of the aesthetic character of water features, and use of the flood plain.

GOALS OF THE NEW MEXICO STREAMFLOW-DATA PROGRAM

The objective of the New Mexico streamflow-data program is to provide information on flow at any point on any stream. Within this general objective, specific goals are set for each of the four types of data that represent the particular information needed.

Data For Current Use

The program goal for this type of data is to provide the particular information needed at specific sites for current use. Accuracy goals at a given site, as specified by the data user, can be met by intensive observation, or by more sophisticated instrumentation as needed.

Data For Planning And Design

The goal for this type of data is to define the statistical flow characteristics listed in table 2 within the given accuracy. This definition applies not only to all streams with natural flow, but also to those streams that are affected by regulation and diversion.

For the purpose of this study streams are classified as natural or regulated and further subdivided into principal and minor streams. In determining whether a stream is principal or minor more consideration was given to its economic value to the area or State than to the size of its drainage area. There are ephemeral streams with large drainage areas that yield little water and hence are considered minor in this type of determination. All principal streams in New Mexico are subject to regulation and therefore no further subdivision was made under natural flow.

In using past hydrologic experience to appraise the probability of future occurrences, some error must be tolerated. Natural streamflow, like other events related to climate, is generally random in occurrence and varies greatly in time and space. Statistical techniques used in the analysis of random events, therefore, are considered applicable. Measures of variability with time of annual mean flow and other streamflow characteristics are determined from the historical streamflow data, and the probable errors involved in defining streamflow characteristics can be appraised. The principal measure of the accuracy with which a particualr streamflow characteristic can be determined is the statistical measure of error, "standard error of estimate", and is expressed in this report as a percentage of the average value of the characteristic. The standard error is the estimated limit above and below the average within which about 67 percent of future values of the characteristics are expected to fall. Conversely, there is only one chance in three that future values will differ from the average by more than one standard error.

The accuracy goals shown for each flow characteristic are equivalent to 10 years of observed record for minor streams and 25 years of observed record for principal streams. The standard errors were calculated from a theoretical relation of standard error to an index of variability (for New Mexico streams) and selected number of years of record.

In general, the longer the record, the more reliable are the estimates of probable future occurrences. However, even with a long record, say 50 to 100 years or more, it is not possible to determine with great precision the probability of certain flow characteristics such as floods of a given magnitude, for example. The standard error of various streamflow parameters decreases with the years of available record, but at a decreasing rate, as shown in figure 3. The incremental economic value of the additional years of record beyond a reasonable limit in the planning and design of projects is under continuing study, but no usable guidelines are available now.

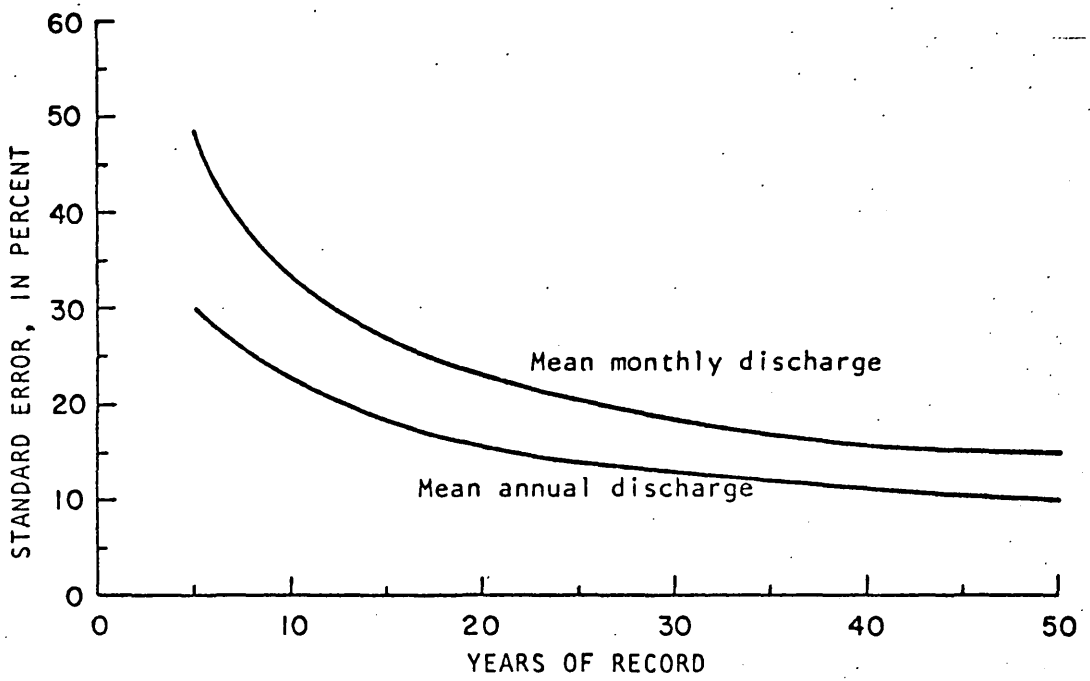

Figure 3.--Relation of standard error to length of record.

At sites on natural-flow streams where streamflow records are not available, an objective of the study is to define streamflow characteristics by means of the relation between the streamflow parameter and the characteristics of the drainage basin. This definition is normally accomplished by multiple-regression analysis, a statistical method of handling sample data that relate a streamflow characteristic to the topographic and climatic characteristics that affect streamflow. In many areas this analysis produces a regression equation that can be used to compute flow characteristics at any point on natural streams. The standard error of a regression equation provides a measure of the accuracy of an estimate made from the equation for an ungaged site. The "standard error of prediction" may also be compared with the error associated with the same characteristic defined from a given number of years of record in order to determine whether the accuracy objective has been met.

Table 2.--Accuracy goals

Streamflow characteristic	Standard error (percent)	
	10 years	25 years
Mean annual discharge	22	14
Standard deviation of annual discharge	22	14
Mean monthly discharge (average)	33	21
Standard deviation of monthly discharge (average)	22	14
50-year flood	65	40
7-day 2-year low flow	22	13
7-day 20-year low flow	32	20
7-day 50-year high flow	48	30

Data To Define Long-term Trends

The goal for this type of data is to operate indefinitely a small network of gaging stations on streams that are expected to be relatively free from man-made changes. One or two stations should be located in each major drainage area in the State, and stations should be located on streams that differ in physical characteristics.

Data On Stream Environment

Environmental data describe the flow, the stream channel, and the basin in terms that will be valuable in planning the use of the stream for any purpose such as recreation, waste disposal, conjunctive surface water-ground-water supply, and in guarding against water hazards. The long-range goals for this type of data in New Mexico are to provide on any stream where needed the information given below:

1. Stream channel geometry including widths, depths, slopes, hydraulic roughness, bars and berms, and description of bed and bank material.
2. Profiles of flood elevations and area subject to inundation by floods.
3. Data on land use including irrigated acreage, water storage, urban areas, cultivated, and forested acreage.
4. Time of travel of solutes in channels.
5. Data on location, extent, and characteristic of aquifers that are hydraulically connected to stream channels.
6. Basin characteristics: area, shape, land and stream slopes, geology and soils.
7. Climatic characteristics.
8. Recreational aspects of runoff.

EVALUATION OF EXISTING DATA IN NEW MEXICO

In this evaluation all available data are considered and analyzed in relation to program objectives. A separate evaluation is made for each of the four types of data.

Data For Current Use

More than one-half of the gaging stations in New Mexico are operated to provide data for current use. It is assumed that the need for this type of data is being met, and that this part of the program will be modified as requirements change. The 136 gaging stations operated in New Mexico to satisfy the need for current data and the principal uses of the data are identified in table A-1.

Data For Planning And Design

Statistical characteristics of streamflow can be defined by sample gaging, analytical methods of regionalization, systems studies, or any combination of the three. The following discussion of the evaluation of this type of data follows the framework shown in table 1.

Evaluation of the natural-flow system

The purpose of the evaluation of the natural-flow system is to determine how accurately the statistical characteristics that are listed as goals are defined by regionalization of the data now available.

The most effective way now known for defining statistical streamflow characteristics on a broad scale is to relate the streamflow characteristics to basin characteristics in equations developed by use of multiple-regression techniques applied to past data. Once the equation and its constants are defined, streamflow characteristics for a specific site in a given basin can be computed by substituting the appropriate values of the hydrologic variables in the formulas.

The 64 daily streamflow records used in the analysis and shown in figure 4 are those having 10 or more years of virtually unregulated flow, or flow that can be adjusted to natural conditions. For the analysis of peak discharges only, a combination of 163 continuous and crest-stage gage records having 8 or more years of virtually unregulated flow, or flow that could be adjusted to natural conditions, were used. The location of these stations is shown in figure 5. Flow characteristics were not adjusted to a base period, and because of regulation, not all flow characteristics were defined for each daily discharge record. At some stations, regulation materially affected low flows but insignificantly affected peaks. No records on large streams were used because these streams are regulated.

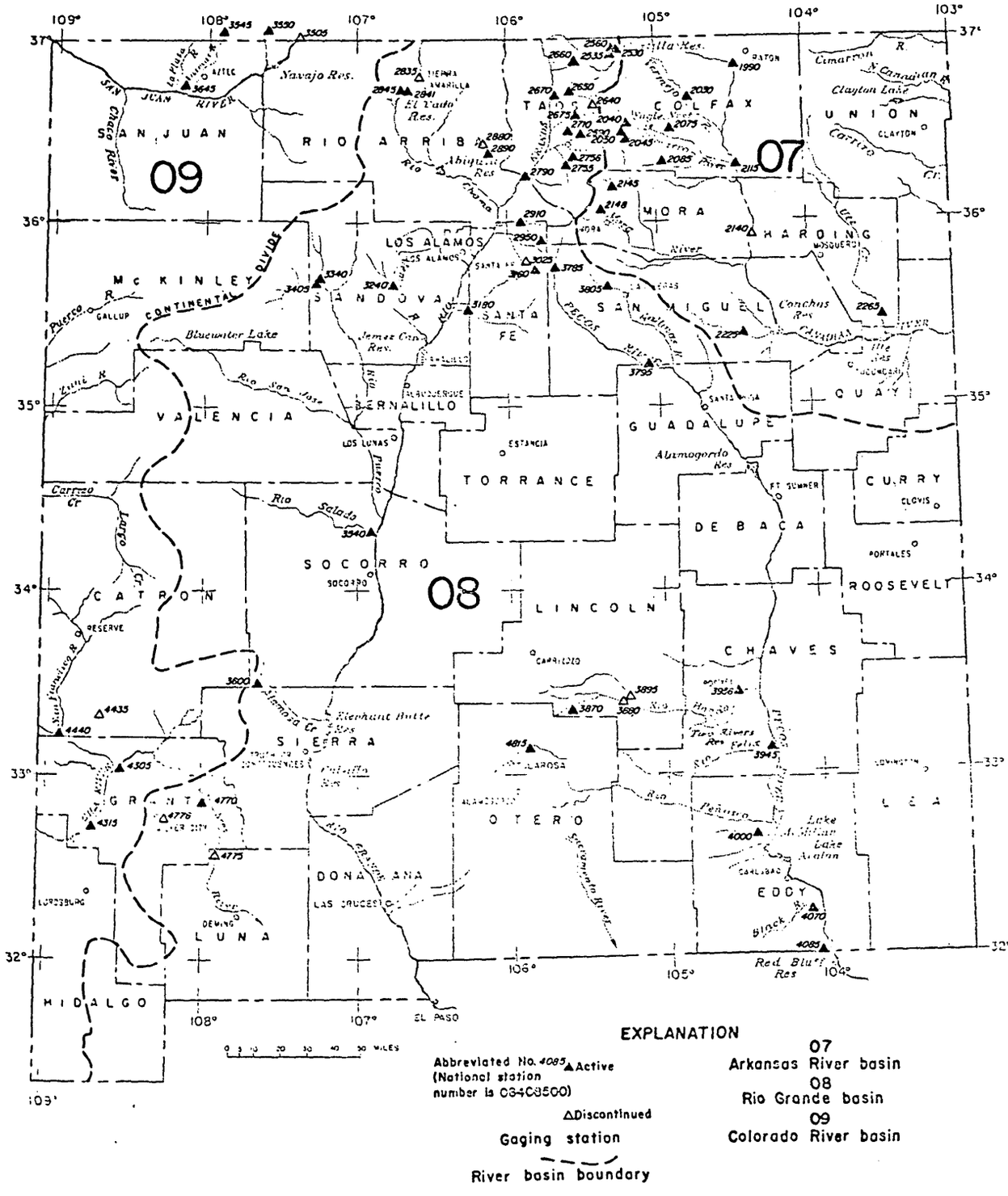

Figure 4.--Location of gaging stations used in all regression analyses.

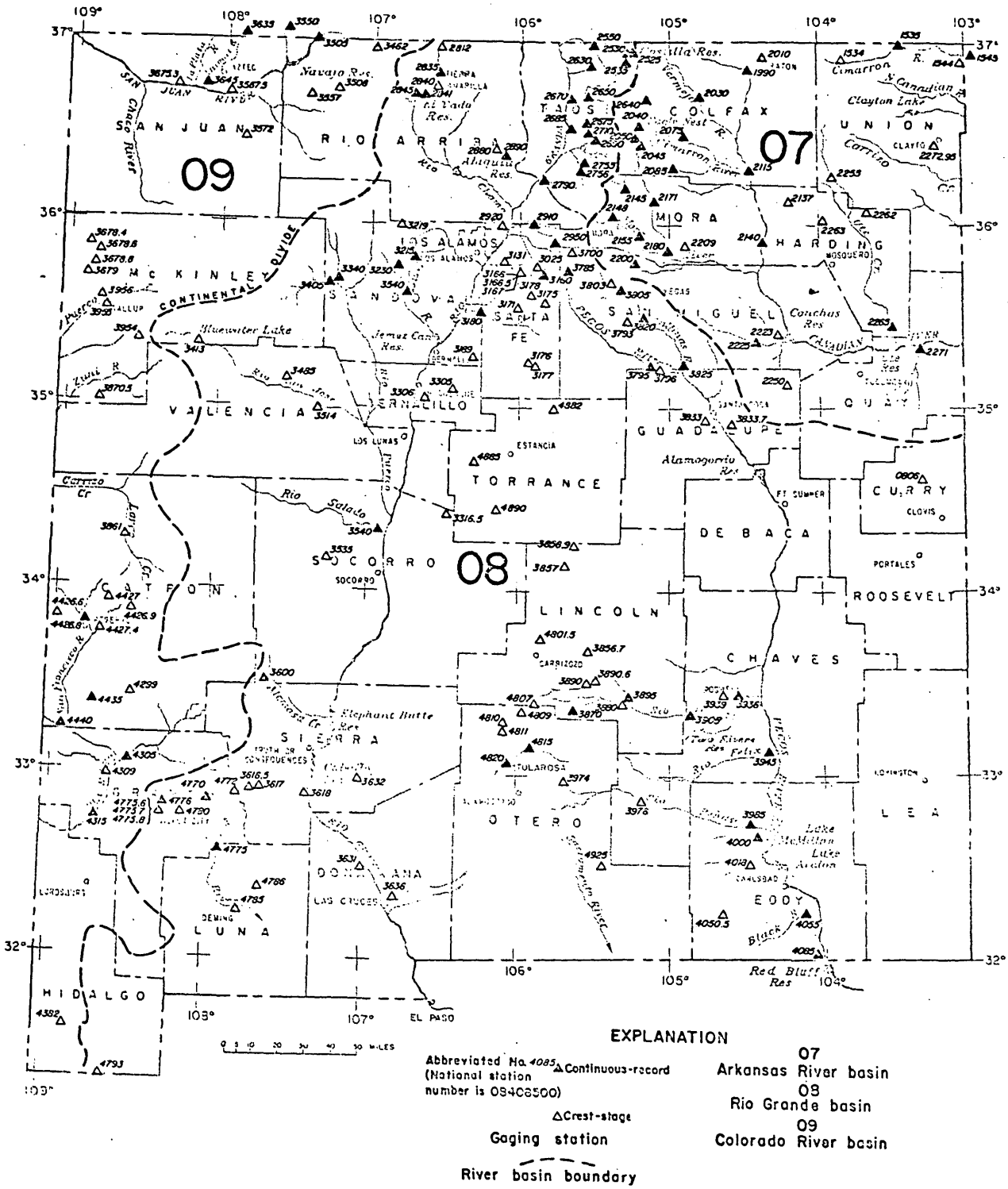

Figure 5.--Location of gaging stations used in regression analysis for peak flows.

Streamflow characteristics

The following streamflow characteristics defined at gaging stations include the full range of flow and represents those required for planning and design: Table A-2 shows selected streamflow characteristics for stations used in the analysis.

a. Low-flow characteristics are the annual minimum 7-day mean flows at 2-year, 5-year, 10-year, and 20-year recurrence intervals ($M_{7,2}$, $M_{7,5}$, etc.). These were determined from graphically drawn low-flow frequency curves.

b. Flood-peak characteristics are represented by discharges from the annual flood-frequency curve at recurrence intervals of 2, 5, 10, 25, and 50 years. In this report, these peak-flow rates are denoted as P_2, P_5, ..., P_{50}. The frequency curves were prepared as described by the Water Resources Council (1967).

c. Flood-volume characteristics represent the annual highest flow for 1-day, 3-day, and 7-day periods at recurrence intervals of 2, 5, 10, 25, and 50 years. These characteristics are noted symbolically in this report as $V_{1,2}$, $V_{1,5}$, $V_{3,10}$, etc. They were determined from frequency curves prepared as described by the Water Resources Council (1967).

d. Mean-flow characteristics are described by the mean of the annual means, Q_a, and by the means of record for each calendar month, Q_n, where the subscript refers to the numerical order of the month beginning with January as 1.

e. Flow-variability characteristics are represented by the standard deviation of the annual and monthly means. The symbols used are, respectively, SD_a and SD_n, where the subscript n refers to the numerical order of months with January as 1.

Drainage-basin characteristics

Drainage-basin characteristics defined for this study are:

Drainage area, (A), in square miles, is the total drainage area upstream from the gaging-station site and is that shown in the latest published U.S. Geological Survey reports.

Main channel length, (L), in miles, is the length of the main channel between the gaging station and the basin divide measured along the channel which drains the largest area, using the best available maps.

Elevation at gage, (E), in 1,000 feet above mean sea level, is the elevation of the gage determined from the best available maps.

Mean basin elevation, (E_m), in 1,000 feet above mean sea level, is the average of the elevations at 10 and 85 percent of channel length, as used by Benson (1964).

Shape factor, (S_h), dimensionless ratio, is equal to the main channel length squared, divided by drainage area, L^2/A.

Main channel slope, (S), in feet per mile, is the average slope between points 10 and 85 percent of the distance from the gaging site to the basin divide (main channel length). The main channel slope was computed as the difference in elevation, in feet, at the 10 and 85 percent points divided by the length, in miles, between the two points, using the best available topographic maps.

Storage factor, (S_t), area of lakes and ponds, expressed as a percent of the drainage area with 1 percent added.

Mean annual precipitation, (Pm), in inches, was determined for each basin from an isohyetal map prepared by the U.S. Weather Bureau (no date b). The parameter used was mean annual precipitation minus 7.00 inches.

Mean October through April precipitation, (Pa), in inches, was determined for each basin from an isohyetal map prepared by the U.S. Weather Bureau (no date a).

Mean May through September precipitation, (Ps), in inches, was determined for each basin from an isohyetal map prepared by the U.S. Weather Bureau (no date b). The parameter used was mean May through September precipitation minus 3.00 inches.

Rainfall intensity, 2 year 24 hour, (1), in inches, was determined for each basin from rainfall intensity map prepared by the U.S. Weather Bureau.

Mean Minimum January temperature, (T), in degrees Fahrenheit, was determined for each basin from maps published in the U.S. Weather Bureau series (Climates of the States).

Latitude of center of drainage basin, (LA), in degrees minus 30, determined to nearest degree using the best available topographic maps.

Longitude at center of drainage basin, (LO), in degrees minus 100, was determined to nearest degree using the best available topographic maps.

Soils infiltration index, (S_i), is an index of soil infiltration capacity calculated by the U.S. Soil Conservation Service from information on soil type, cover, and agricultural practices divided by 10.

Values of the above basin characteristics for each of the 163 gaging stations used in the analysis are listed in table A-3.

Regression analysis

The next step was to relate each of the streamflow characteristics to basin and climatic characteristics in equations developed by using multiple regression techniques. The equation has the form $Y = aA^b S^{b2} p^{b}3 - - -$, where Y is a statistical streamflow characteristic; A, S, and P are topographic or climatic characteristics; a is the regression constant; and b_1, b_2, and b_3 are exponents obtained by regression. This method is described by Benson (1962). In this study all 15 of the basin characteristics were used initially in each regression. The computer was programmed to calculate the regression equation, the standard error of estimate, and the significance of each basin parameter. It was programmed then to repeat the calculations, omitting the least significant basin parameter in each calculation until only the most significant basin parameter remained. After relations for a given streamflow characteristic had all been computed, the entire computation process was repeated using another streamflow characteristic along with the same set of basin characteristics.

Table A-4 shows, for each of 50 streamflow characteristics, the regression constant, the regression coefficient (exponent) for all statistically significant basin parameters, and the standard error.

The standard errors shown in table A-4 should be compared with the corresponding values of table 2 to determine whether the accuracy goals have been met.

Adequacy of flow characteristics estimates

Comparison of the standard errors of estimate in table A-4 with the accuracy goals of table 2 indicates that regression relations defined in this analysis are of inadequate accuracy to meet the goals for planning and design data. To meet the goals there is therefore a need either for additional streamflow data, or improved technique for transferring available data, or for both additional data and improved analysis.

Regression relations were defined in this analysis on the assumption that the relation between flow and basin characteristics is linear if all characteristics are transformed to logarithms. Alternate transformations or model forms may be more useful and provide more reliable estimates. Also, the regression study used as independent variables only those basin characteristics that could be readily obtained from maps or available data. Additional or alternate variables, which might require measurements in the basin such as channel size and shape, or soil characteristics, might improve the estimating relations. More detailed analysis obviously offers promise of improved regression relations.

The success of improving and using regression relations for estimating design and planning flow information depends upon the adequacy of the sample of flow records used in the analysis. Ideally, the sample will include long-term records on areally distributed basins which sample the range of characteristics that exist in New Mexico. Inspection of the basin characteristics in table A-3 shows that daily flow records over 10 years in length sample a wide range of characteristics on basins of a size greater than 10 square miles, and flood records over 10 years in length adequately sample the range of characteristics for basins of all sizes. However, figures 4 and 5 show that the areal distribution gages could be improved, and study of flow records indicates that there is need for a sample of records on ephemeral streams.

As an alternate to use of regression relations defined from basin characteristics, other methods might be considered for transferring planning and design information to ungaged sites. Most alternate methods require obtaining some information at the design point. For example, Riggs (1969) proposed a method for defining mean annual flows from mid-month discharge measurements over a period of time, Moore (1968) suggested methods of estimating mean flows from runoff-altitude relations, or from channel width-depth measurements. In general, the flow data needed to develop these alternate techniques is the same as required for defining regression relations.

Evaluation of the regulated-flow system

The goals for regulated streams are more difficult to attain because the technique of regionalization does not apply, the characteristics are not necessarily stationary in time and a meaningful correlation seldom exists between flows at two sites if at least one of the flows is regulated. A systems approach may be used to define the characteristic of regulated streamflow under different patterns of regulation, or under the condition of natural flow. Systems studies for all of the regulated-streams systems in New Mexico will require a major effort. Therefore, the present evaluation is limited to identifying the regulated streams in New Mexico and evaluating the amount of data available.

The stream systems in New Mexico materially affected by diversions for irrigation and reservoir regulation are: Rio Grande, Pecos, Rio Chama, Cimarron, Canadian, San Juan, Gila, and San Francisco Rivers. The Rio Grande, Gila, Canadian, and San Juan Rivers are major interstate streams with complex regulation patterns; system studies for these streams should not be limited to the parts in New Mexico.

Streamflow records obtained before and after reservoir or major diversion channel construction and records of reservoir contents, diversions and inflows will be useful and necessary for system studies. Available records for regulated New Mexico streams are shown in table A-1. Daily records of reservoir contents and canal flows are available for selected sites in the most regulated basins.

Data To Define Long-term Trends

At present, two stations, Rio Mora near Terrero and Mogollon Creek near Cliff, are designated as long-term trend stations and are to be operated indefinitely. Due to the variable climatic and hydrologic conditions in New Mexico, additional long-term trend stations should be operated. Several existing gages that have a long period of accurate record on natural streamflows from basins that are expected to remain in a natural condition in the future would qualify for selection as long-term trend stations.

Data On Stream Environment

Many environmental factors were determined for the drainage basins used for the present study, particularly basin characteristics such as drainage area, stream slope, land elevations, channel shape, area of lakes and ponds, mean annual precipitation, and rainfall intensity.

Flood plains have been outlined on 16 topographic quadrangle maps and flood profiles defined for selected streams. Detailed channel surveys have been made at the two long-term trend gaging stations. Channel surveys have been made at many sites in connection with indirect determinations of peak flows for unusual floods.

THE PROPOSED PROGRAM

The information developed in different segments of this study has been merged and applied in planning a streamflow-information program that would eventually attain as many of the remaining goals as possible within the limits of available funds. For the optimum program a balance must be maintained between data collection and data analysis as continuous interaction between the two is needed, not only to gain a better understanding of the hydrologic system, but also to guide future evaluation of the program in meeting ever-changing needs and in adapting to changing technology.

Data Collection

Data for current use

Operation of the 136 stations, identified as presently meeting the needs for current-purpose data (table A-1), should be continued. The changing needs will be assessed continuously, and the data-collection network will be modified by adding or discontinuing stations as needs change for current-purpose data. Also the needs for this type of data will be examined for each site, and a determination made as to whether a continuous record of daily discharge is required or a measure of a specific-flow characteristics such as peak flow or instantaneous flow, would suffice.

Data for planning and design

Natural-flow streams

None of the flow characteristics required for planning and design can be estimated by defined regression relations with an accuracy adequate to meet the goals. To provide planning and design data of desired accuracy will require additional data, improved or alternate analyses, or both additional data and improved or alternate analyses.

Selection of a gaging network to obtain additional natural-flow data requires considering the adequacy of sampled drainage basins and the required length of flow records on those basins. In general, the proposed future daily discharge gaging network was selected to improve the areal distribution of gaged basins, to increase the sample of ephemeral streams, and to maintain only a limited number of gages with records of more than 15 to 20 years (a 15 to 20-year record is assumed to be adequate for defining the flow characteristics needed in analytical studies). The existing network of partial-record flood gages should be continued in operation until 10-15 years of data are available at each crest-stage gage site and until enough data are available to define a rainfall-runoff model for each flood-hydrograph-rainfall gage site.

On this basis the following daily discharge gages, with over 10 years of record are not recommended for continued operation in the future program:

Station no.	Station name	Years record
07214800	Rio la Casa near Cleveland	13
08263000	Latir Creek near Cerro	32
08284500	Willow Creek near Parkview	32
08291000	Santa Cruz River at Cundiyo	39
08289000	Rio Ojo Caliente at La Madera	36
08321500	Jemez River below East Fork near Jemez Springs	12
08323000	Rio Guadalupe at Box Canyon near Jemez Springs	11
08334000	Rio Puerco above Chico Arroyo near Guadalupe	18
08380500	Gallinas River near Montezuma	53
08393600	North Spring River at Roswell	11

In an effort to improve the areal distribution of gaged basins the following daily discharge gaging stations, which had been discontinued after a short period of operation, are recommended for reestablishment:

Station no.	Station name
08080600	Running Water Draw near Clovis
08330500	Tijeras Arroyo at Albuquerque
08348500	Encinal Creek near Casa Blanca
08480700	Indian Creek near Three Rivers

To better define the streamflow characteristics on natural-flow ephemeral streams the conversion of the following crest-stage gages to daily discharge record sites for a period of 10 years is recommended.

Station no.	Station name
07154400	Carrizozo Creek near Kenton, Okla.
07201000	Raton Creek at Raton, N. Mex.
07225000	Pajarito Creek at Newkirk, N. Mex.
07225500	Ute Creek near Gladstone, N. Mex.
07227295	Sandy Arroyo tributary near Clayton, N. Mex.
08317600	San Cristobal Arroyo near Galisteo, N. Mex.
08321900	Rio de las Vacas near Senorita, N. Mex.
08331650	Canado Montoso near Scholle, N. Mex.
08341300	Bluewater Creek above Bluewater Dam near Bluewater, N. Mex.
08353500	LaJencia Creek near Magdalena, N. Mex.
08363100	Rio Grande tributary near Radium Springs, N. Mex.
08383300	Pintada Arroyo near Santa Rosa
08385600	Yeso Arroyo near Fort Sumner
08385700	Cloud Canyon near Gallinas, N. Mex.
08437620	Monument Draw tributary near Monument, N. Mex.
08492500	Cornucopia Canyon near Pinon, N. Mex.
08350800	Vaqueros Canyon near Gobernador, N. Mex.
09367950	Chaco River near Waterflow
09386100	Largo Creek near Quemado, N. Mex.
09438200	Animas Creek near Cloverdale, N. Mex.

Regulated-flow, minor streams

Flows of numerous minor streams in New Mexico are affected by the works of man; for example, by small reservoirs, by diversion for and return from irrigation, and by runoff from urban areas. In general, systems studies of all minor streams are impractical because of the great number of streams and because the costs of systems studies may exceed the planning and design benefits resulting from accurate hydrologic data. Generalized estimating relations, similar to the regression relations for natural-flow characteristics, will be required also for regulated minor streams, and may be defined from a representative sample of gaged basins. Probably the most important of these regulated minor stream planning and design flow characteristics are:

(1) Floodflows below reservoirs and stock ponds,

(2) Floodflows in urban areas,

(3) Annual and seasonal flows below reservoirs and ponds.

Some data on these flow characteristics is currently being obtained, and except for those sites with over 20 years of record for unchanged regulation conditions, these gages should continue in operation in the future program. Gages with over 20 years of record for unchanged conditions are considered to have adequate data for definition of the regulated flow characteristics. Although detailed information on regulation patterns yet may need to be obtained, no additional flow data are required at the following sites:

Station no.	Regulated minor streams	Years record
07211000	Cimarron R. at Springer, N. Mex.	44
07215500	Mora R. at La Cueva, N. Mex.	41
07216500	Mora R. nr. Golondrinas, N. Mex.	51
07218000	Coyote Cr. nr. Golondrinas, N. Mex.	40
08268500	Arroyo Hondo at Arroyo Hondo, N. Mex.	52
08342000	Bluewater Cr. nr. Bluewater, N. Mex.	46
08343000	Rio San Jose at Grants, N. Mex.	27
08343500	Rio San Jose nr. Grants, N. Mex.	32
08351500	Rio San Jose at Correo, N. Mex.	25
08352500	Rio Puerco at Rio Puerco, N. Mex.	34
08390500	Rio Hondo at Diamond "A" Ranch nr. Roswell	29
09367500	La Plata R. nr. Farmington	30

Insufficient data currently are available to define the desired generalized equations for estimating flow characteristics on regulated, minor streams. No specific additional gaging sites are recommended, but it is emphasized that this type of data collection should receive more effort in New Mexico.

Regulated flow, principal streams

For the purpose of this study consideration of this category of data was limited only to identifying the regulated-stream systems and available data. In New Mexico these are: Rio Grande from Colorado to Texas, Pecos River below Alamogordo Dam, San Juan River below Navajo Dam, Canadian River below Cimarron River, and Gila River below Duncan Valley. Priority should be given to the Rio Grande, Pecos, and San Juan Rivers, in that order, as funds become available for systems analysis.

The proposed programs should include provisions to continue the collection of records of inflow, outflow, reservoir contents, diversions, operation schedules, and other pertinent hydrologic data at the major reservoirs in the regulated-streams systems.

However, gaging stations in these basins that have more than 25 years of record under the existing regulation conditions and that are not classified for another type of data collection need, are not recommended for continued operation in the proposed network. These stations are:

Station no.	Regulated Principal Streams	Years record
07224500	Canadian R. below Conchas Dam, N. Mex.	27
08319000	Rio Grande at San Felipe, N. Mex.	43

Data to define long-term trends in streamflow

The two stations operated for a short time for this purpose in the current program should be continued in operation indefinitely. As a part of this study, 12 additional stations in the present program have been designated as long-term trend stations. These should be operated indefinitely to meet the needs for this type of data. The additional stations were selected to provide a long-term sample reflecting areal coverage of the State, a range of drainage area size, and a variety of climatic and physiographic characteristics. The 14 stations identified in this category and proposed for operation indefinitely are listed in table 3 and shown in figure 6.

Table 3.--Proposed gaging stations for monitoring long-term trends

Station no.	Station name	Drainage area
07208500	Rayado Creek at Sauble Ranch, near Cimarron, N. Mex.	65.0
07222500	Conchas River at Variadero, N. Mex.	52.3
08271000	Rio Lucero near Arroyo Seco, N. Mex.	16.6
08340500	Arroyo Chico near Guadalupe, N. Mex.	1,390
08360000	Alamosa Creek near Monticello, N. Mex.	403
08377900	Rio Mora near Terrero, N. Mex.	53.2
08378500	Pecos River near Pecos, N. Mex.	189
08408500	Delaware River near Red Bluff, N. Mex.	689
08477200	Iron Creek near Kingston, N. Mex. (presently operated as flood-hydrograph station)	0.74
08480700	Indian Creek near Three Rivers, N. Mex. (presently operated as flood-hydrograph station)	6.8
08481500	Rio Tularosa near Bent, N. Mex.	120
09367950	Chaco River near Waterflow, N. Mex. (presently operated as crest-stage gage)	4,350
09386900	Rio Nutria near Ramah, N. Mex.	71.4
09430600	Mogollon Creek near Cliff, N. Mex.	69

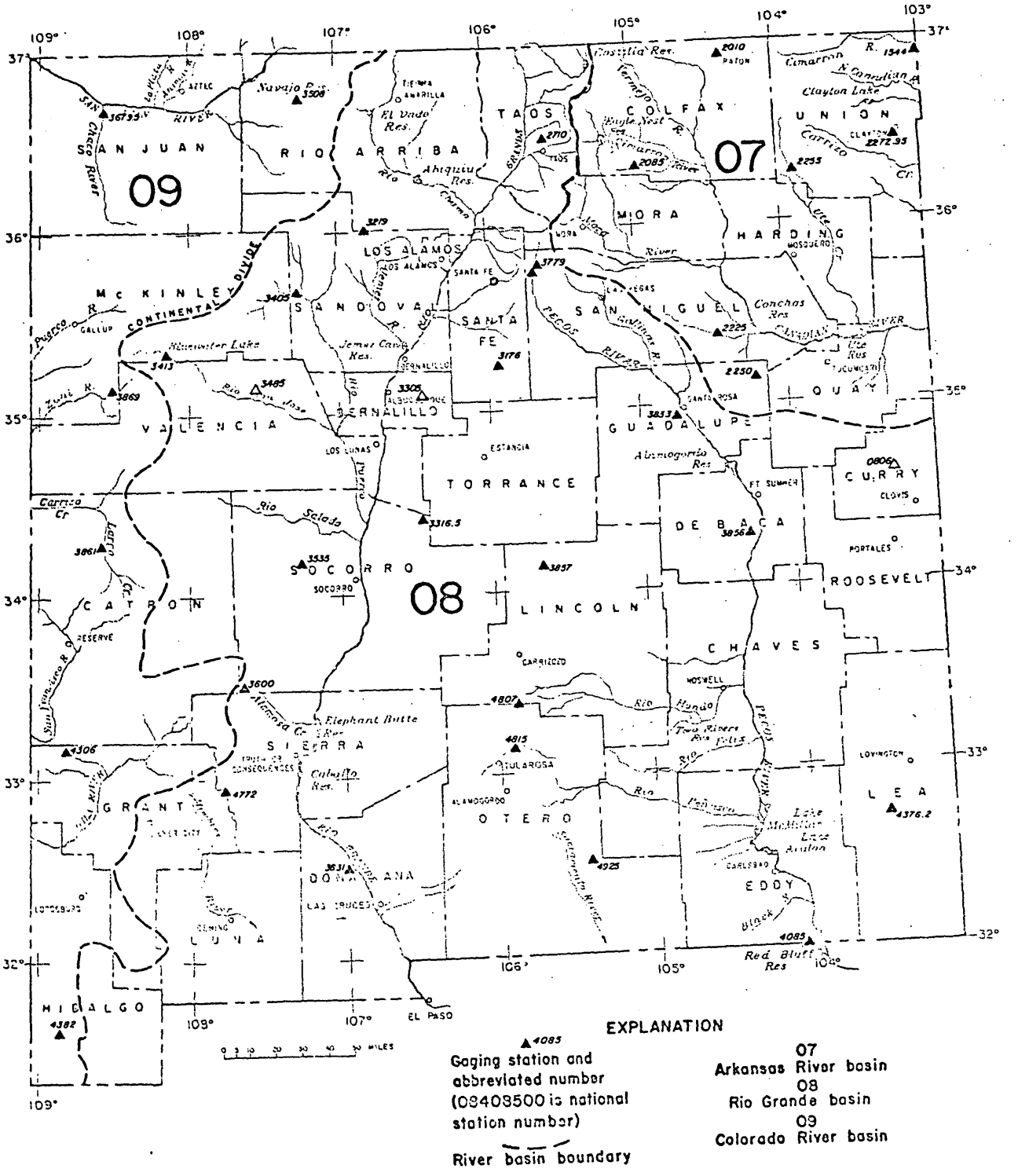

Figure 6.--Location of additional gaging stations for proposed program.

Data analysis

The streamflow-data network operated through the years supplies a base for analysis and reports thereon which should be started as soon as the proposed streamflow-data program can be implemented. Some aspects of data analysis are of a continuing nature, with the data collection effort continuing, reoriented as necessary to fill gaps or eliminate deficiencies, and provide data for continuing future analysis.

The proposed program of data analysis for New Mexico streams may be classed in two phases--those based on data collected to date, and those for which additional data will be required.

Studies with available data - Efforts must continue to define improved methods for estimating planning and design information on natural-flow streams. Alternate forms of the regression model may provide more reliable estimates. Considerable effort might be expanded to define variables that adequately describe geology, precipitation, and the effects of soils and storage. Channel geometry measurements seem to offer excellent promise as basin characteristics, especially for mountainous areas where precipitation indices are poorly defined. Base flow measurements may be an excellent tool for delineating hydrologically similar areas, and thus may describe a geologic index. Several other basin indices also may be improved by more detailed analyses.

Using currently available data, the following analyses and appropriate reports should be scheduled for completion as soon as practical:

1. Magnitude and frequency of peak flows--an update of the report, "Magnitude and frequency of floods in New Mexico," which was prepared in 1962 and used discharge records through 1959.
2. Flood-volume-frequency and storage requirements.
3. Statistics of mean annual, seasonal, and monthly flows.
4. Low flow characteristics of perennial streams.
5. Flood warning maps.

Studies of forthcoming data - Utilizing available data to the extent possible, but depending on the collection of additional data specifically required, the following studies should be initiated as a part of the proposed streamflow data program.

1. Regulated-streams systems, giving first priority to the Rio Grande and Pecos River basins.
   a. Study of channel gains and losses in the lower Rio Grande, evaluating the effect of bank storage during the study.
   b. Evaluate the effect that ground-water pumping has upon streamflow in selected basins.
   c. Study characteristics of reservoir released and flood waves.
2. Time of travel and dispersion of solutes in selected streams in New Mexico.
3. Areas inundated by floodwaters and flood profiles on principal streams in the State.
4. Frequency of flooding in urban and suburban areas.
5. The effects of small reservoirs and ponds on streamflow characteristics.

These are only a few of the data analyses and hydrologic studies that should be made in New Mexico. Changing needs for streamflow information and changing technology in water-related fields must be continuously evaluated in light of the data analysis that should be generated under the streamflow data program for New Mexico.

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Appendix tables

Appendix A-1.--Gaging stations in operation and proposed for network

Column 1: B, benchmark or long-term-trend station.

Column 2: C, current-purpose station; [], station is no longer needed for the purpose indicated.

Columns 3-5: Purposes for which current-purpose station is operated; 1, assessment; 2, operation; 3, forecasting; 4, disposal; 5, water quality; 6, compact or legal; 7, research or special study.

Column 6: P, principal-stream station; H, hydrologic station except when classified as P; R, regulated stream; [], station is no longer needed for the purpose indicated.

Column 7: Describes the effect of regulation or diversion on low flow and monthly flow; blank, no appreciable effect; 1, no appreciable effect on daily flow (diurnal fluctuation only); 2, no appreciable effect on weekly low flow; 3, monthly flow not appreciably affected by diversion or affected not over 10 percent by regulation; 4, monthly flow affected, but published data available to adjust to natural conditions with an error of less than 10 percent (Adjustments limited to diversions that completely bypass the station and to not more than two reservoirs.); 5, effect of regulation has not been evaluated; 6, effect on daily flow appears (more than 10%); 7, effect on weekly flow appears (more than 10%); 8, effect on monthly flow appears (more than 10%) and data is not available to adjust to natural flow with an error of less than 10%; 9, effect of regulation varies from month to month or season to season.

Column 8: Indicates the effect of regulation on peak flow; blank, no appreciable effect; 1, annual peak flow by less than 10 percent; 2, annual peak flow affected by more than 10 percent; 3, annual peak flow affected by undetermined amount.

Column 9: Describes how the station is financed; 1, federal; 2, coop program; 3, OFA; 4, combination of 1 and 2; 5, combination of 1 and 3; 6, combination of 2 and 3; 7, combination of 1, 2, and 3.

Station number	Station name	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
07153500	Cimarron R. nr. Guy, N. Mex.	--	C	5	--	--	R	5	1	2
7154400	Carrizozo Cr. nr. Kenton, Okla	--	--	--	--	--	H	--	--	2
7199000	Canadian R. nr. Hebron, N. Mex.	--	C	5	--	--	R	5	1	2
7201000	Raton Cr. at Raton, N. Mex.	--	--	--	--	--	H	--	--	2
7203000	Vermejo R. nr. Dawson, N. Mex.	--	C	5	--	--	H	3	1	2
7204000	Moreno Cr. at Eagle Nest, N. Mex.	--	C	2	--	--	R	9	1	2
7204500	Cieneguilla Cr. nr. Eagle Nest, N. Mex.	--	C	2	--	--	R	9	1	2
7205000	Sixmile Cr. nr. Eagle Nest, N. Mex.	--	C	2	--	--	H	9	1	2
7206000	Cimarron R. blw Eagle Nest Dam, N. Mex.	--	--	--	--	--	R	6	2	2
7207000	Cimarron R. Nr. Cimarron, N. Mex.	--	--	--	--	--	R	6	2	2
7207500	Ponil Cr. nr. Cimarron, N. Mex.	--	C	2	--	--	H	9	1	2
7208500	Rayado Cr. at Sauble Ranch, nr. Cimarron, N. Mex.	B	C	1	3	--	H	--	--	2
7211000	Cimarron R. at Springer, N. Mex.	--	--	--	--	--	[R]	6	3	2
7214500	Canadian R. nr. Taylor Springs, N. Mex.	--	C	5	--	--	R	9	1	3
7214500	Mora R. nr. Holman, N. Mex.	--	C	2	--	--	R	9	1	2
7214800	Rio la Casa nr. Cleveland, N. Mex.	--	--	--	--	--	[H]	3	1	2
7215100	La Cueva Canal blw wasteway at La Cueva, N. Mex.	--	--	--	--	--	R	6	2	2
7215500	Mora R. at La Cueva, N. Mex.	--	--	--	--	--	[R]	9	3	2
7216500	Mora R. nr. Golondrinas, N. Mex.	--	--	--	--	--	[R]	9	3	2
7217100	Coyote Cr. abv Guadalupita, N. Mex.	--	--	--	--	--	R	9	1	2
7218000	Coyote Cr. nr. Golondrinas, N. Mex.	--	--	--	--	--	[R]	9	1	2
7220000	Sapello R. at Sapello, N. Mex.	--	--	--	--	--	R	9	1	2
7220100	Lake Isabel feeder Canal nr. Sapello, N. Mex.	--	--	--	--	--	R	6	2	2
7221000	Mora R. nr. Shoemaker, N. Mex.	--	C	2	--	--	R	9	1	2
7221500	Canadian R. nr. Sanchez, N. Mex.	--	C	2	--	--	R	9	1	3
7222500	Conchas R. at Variadero, N. Mex.	B	--	--	--	--	H	3	1	3
7223000	Bell Ranch Canal blw Conchas Dam, N. Mex.	--	--	--	--	--	R	6	2	3
7223300	Conchas Canal blw Conchas Dam, N. Mex.	--	C	5	--	--	R	6	2	2
7224500	Canadian R. blw Conchas Dam, N. Mex.	--	--	--	--	--	[R]	6	2	3
7225000	Pajarito Cr. at Newkirk, N. Mex.	--	--	--	--	--	H	--	--	2
7225500	Ute Cr. nr. Gladstone, N. Mex.	--	--	--	--	--	H	--	--	2
7226500	Ute Cr. nr. Logan, N. Mex.	--	C	5	--	--	H	3	1	2
7227000	Canadian R. at Logan, N. Mex.	--	--	--	--	--	R	6	2	2
7227100	Revuelto Cr. nr. Logan, N. Mex.	--	C	5	--	--	H	9	1	2
7227200	Tramperos Cr. nr. Stead, N. Mex.	--	--	--	--	--	H	5	1	2
7227295	Sandy Arroyo Trib nr. Clayton, N. Mex.	--	--	--	--	--	H	--	--	2
08080600	Running Water Draw nr. Clovis, N. Mex.	--	--	--	--	--	H	--	--	2
8252500	Costilla Cr. abv Costilla Dam, N. Mex.	--	C	6	2	--	H	3	1	2
8253000	Casias Cr. nr. Costilla, N. Mex.	--	C	6	2	--	H	3	1	2
8253500	Santistevan Cr. nr. Costilla, N. Mex.	--	C	6	2	--	H	3	1	2
8254000	Costilla Cr. blw Costilla Dam, N. Mex.	--	C	6	2	--	R	6	2	2
8254500	Costilla Cr. nr. Amalia, N. Mex.	--	C	6	2	--	R	6	2	2
8255500	Costilla Cr. nr. Costilla, N. Mex.	--	C	6	2	5	R	6	2	2
8256000	Acequia Madre at Costilla, N. Mex.	--	C	6	2	--	R	6	2	2
8256500	Mesa Ditch nr. Garcia, Colo.	--	C	6	2	--	R	6	2	2

Appendix A-1.--Gaging stations in operation and proposed for network - Continued

Station number	Station name	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
08257500	Cordillera Ditch at Garcia, Colo.	--	C	6	2	--	R	6	2	2
8258000	Cerro Canal at Costilla, N. Mex.	--	C	6	2	--	R	6	2	2
8258500	Association Ditch at Costilla, N. Mex.	--	--	--	--	--	R	6	2	2
8259000	Cerro Canal nr. Jaroso, Colo.	--	C	6	2	--	R	6	2	2
8259500	N. Mex. Br. Cerro Canal nr. Jaroso, Colo.	--	C	6	2	--	R	6	2	2
8260500	Costilla Cr. blw div. dam, at Costilla, N. Mex.	--	C	6	2	--	R	6	2	2
8261000	Costilla Cr. at Garcia, Colo.	--	C	6	2	--	R	6	2	2
8262000	Eastdale No. 1 Intake Canal nr. Jaroso, Colo.	--	C	6	2	--	R	6	2	2
8263000	Latir Cr. nr. Cerro, N. Mex.	--	--	--	--	--	[H]	--	--	2
8263500	Rio Grande nr. Cerro, N. Mex.	--	--	--	--	--	R	9	3	3
8264500	Red R. blw Zwergle damsite nr. Red River, N. Mex.	--	--	--	--	--	H	--	--	2
8264900	South Ditch nr. Questa, N. Mex.	--	--	--	--	--	R	6	2	2
8265000	Red R. nr. Questa, N. Mex.	--	--	--	--	--	R	9	1	2
8265500	Llano Ditch nr. Questa, N. Mex.	--	--	--	--	--	R	6	2	2
8266000	Cabresto Cr. nr. Questa, N. Mex.	--	C	2	--	--	R	4	1	2
8267000	Red R. at mouth, nr. Questa, N. Mex.	--	C	5	--	--	R	3	1	2
8267500	Rio Hondo nr. Valdez, N. Mex.	--	C	7	--	--	H	--	--	2
8268500	Arroyo Hondo at Arroyo Hondo, N. Mex.	--	--	--	--	--	[R]	9	2	2
8268700	Rio Grande nr. Arroyo Hondo, N. Mex.	--	C	7	--	--	R	9	3	3
8269000	Rio Pueblo de Taos nr. Taos, N. Mex.	--	C	7	--	--	H	--	--	3
8271000	Rio Lucero nr. Arroyo Seco, N. Mex.	B	C	7	--	--	H	--	--	3
8275000	Rio Fernando de Taos nr. Taos, N. Mex.	--	C	7	--	--	H	3	--	3
8275300	Rio Pueblo de Taos nr. Ranchito, N. Mex.	--	C	7	--	--	R	6	2	2
8275500	Rio Grande del Rancho nr. Talpa, N. Mex.	--	C	7	--	--	H	3	1	1
8275600	Rio Chiquito nr. Talpa, N. Mex.	--	C	7	--	--	R	--	--	3
8276300	Rio Pueblo de Taos blw Los Cordovas, N. Mex.	--	C	7	--	--	R	9	2	2
8276500	Rio Grande blw Taos Jct Bridge nr. Taos, N. Mex.	--	C	7	--	--	R	9	3	2
8279000	Rio de Penasco at Dixon, N. Mex.	--	C	7	--	--	R	9	1	2
8279500	Rio Grande at Embudo, N. Mex.	--	C	7	--	--	R	9	3	1
8280100	San Juan lateral abv San Juan Pueblo, N. Mex.	--	C	7	--	--	R	6	2	3
8280200	San Juan Pueblo ditch abv San Juan Pueblo, N. Mex.	--	C	7	--	--	R	6	2	3
8280700	Guique ditch nr. San Juan Pueblo, N. Mex.	--	C	7	--	--	R	6	2	3
8281100	Rio Grande abv San Juan Pueblo, N. Mex.	--	C	7	--	--	R	9	3	2
8284100	Rio Chama nr. La Puente, N. Mex.	--	C	2	--	--	R	9	1	2
8284200	Willow Cr. abv Heron Res. nr. Parkview, N. Mex.	--	C	2	--	--	H	--	--	3
8284200	Willow Cr. at Steel bridge nr. Parkview, N. Mex.	--	--	--	--	--	H	3	1	3
8284300	Horse Lake Cr. abv Heron Res., nr. Parkview, N. Mex.	--	C	2	--	--	R	5	3	3
8284400	Horse Lake Cr. at mouth nr. Parkview, N. Mex.	--	--	--	--	--	R	5	3	3
8284500	Willow Cr. nr. Parkview, N. Mex.	--	--	--	--	--	[H]	3	1	3
8285500	Rio Chama blw El Vado Dam, N. Mex.	--	C	6	2	--	R	6	2	2
8286500	Rio Chama abv Abiquiu Res., N. Mex.	--	C	5	--	--	R	6	2	3
8287000	Rio Chama blw Abiquiu Res., N. Mex.	--	C	5	--	--	R	6	2	3
8289000	Rio Ojo Caliente at La Madera, N. Mex.	--	--	--	--	--	[H]	9	1	2
8289500	Chamita Ditch nr. Chamita, N. Mex.	--	C	7	--	--	R	6	2	3
8289800	Hernandez ditch at Hernandez, N. Mex.	--	C	7	--	--	R	6	2	3
8290000	Rio Chama nr. Chamita, N. Mex.	--	C	5	--	--	R	6	2	3
8291000	Santa Cruz R. at Cundiyo, N. Mex.	--	--	--	--	--	[H]	3	1	2
8294300	Rio Nambe at Nambe Falls, nr. Nambe, N. Mex.	--	C	2	--	--	H	--	--	3
8295200	Rio En Medio nr. Santa Fe, N. Mex.	--	C	7	--	--	H	--	--	2
8302200	North Fork Tesuque Cr. nr. Santa Fe, N. Mex.	--	C	7	--	--	H	--	--	2
8302300	Middle Fork Tesuque Cr. nr. Santa Fe, N. Mex.	--	C	7	--	--	H	--	--	2
8302400	South Fork Tesuque Cr. nr. Santa Fe, N. Mex.	--	C	7	--	--	H	--	--	2
8304100	Little Tesuque Cr. nr. Santa Fe, N. Mex.	--	C	7	--	--	H	--	--	2
8304200	Little Tesuque Cr. Trib No. 4 nr. Santa Fe, N. Mex.	--	C	7	--	--	H	--	--	2
8304300	Little Tesuque Cr. Trib No. 3 nr. Santa Fe, N. Mex.	--	C	7	--	--	H	--	--	2
8304400	Little Tesuque Cr. Trib No. 2 nr. Santa Fe, N. Mex.	--	C	7	--	--	H	--	--	2
8313000	Rio Grande at Otowi Bridge nr. San Ildefonso, N. Mex.	--	C	1	2	6	R	9	2	2
8314500	Rio Grande at Cochiti, N. Mex.	--	C	5	--	--	R	9	2	2
8316000	Santa Fe R. nr. Santa Fe, N. Mex.	--	C	6	--	--	R	6	2	2
8317200	Santa Fe R. abv Cochiti Res., N. Mex.	--	--	--	--	--	R	5	3	3
8317600	San Cristobal Arroyo nr. Galisteo, N. Mex.	--	--	--	--	--	H	--	--	2
8317850	Galisteo Cr. abv Galisteo Res., N. Mex.	--	--	--	--	--	H	--	--	3
8317950	Galisteo Cr. blw Galisteo Dam, N. Mex.	--	--	--	--	--	R	6	2	3
8318000	Galisteo Cr. at Domingo, N. Mex.	--	C	5	--	--	R	6	2	3
8319000	Rio Grande at San Felipe, N. Mex.	--	--	--	--	--	[R]	9	2	2

Appendix A-1.--Gaging stations in operation and proposed for network - Continued

Station number	Station name	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
08321500	Jemez R. blw East Fork nr. Jemez Springs, N. Mex.	--	--	--	--	--	[H]	--	--	6
8321900	Rio de las Vacas nr. Senorita, N. Mex.	--	--	--	--	--	H	--	--	2
8323000	Rio Guadalupe at Box Canyon nr. Jemez, N. Mex.	--	--	--	--	--	[H]	--	--	6
8324000	Jemez R. nr. Jemez, N. Mex.	--	--	--	--	--	H	--	--	6
8329000	Jemez R. blw Jemez Canyon Dam, N. Mex.	--	C	6	5	--	R	6	2	3
8329100	Piedra Lisa Arroyo nr. Bernalillo, N. Mex.	--	C	5	--	--	R	6	2	3
8329900	North Floodway Channel nr. Alamada, N. Mex.	--	--	--	--	--	R	6	2	2
8330000	Rio Grande at Albuquerque, N. Mex.	--	C	2	5	--	R	9	2	3
8330500	Tijeras Arroyo at Albuquerque, N. Mex.	--	--	--	--	--	H	--	--	2
8331650	Canado Montoso nr. Seholle, N. Mex.	--	--	--	--	--	H	--	--	2
8331990	Rio Grande C. C. nr. Bernardo, N. Mex.	--	C	5	--	--	R	6	2	2
8332010	Rio Grande Floodway nr. Bernardo, N. Mex.	--	C	5	--	--	R	6	2	2
8332030	Lower San Juan Riverside Dr. nr. Bernardo, N. Mex.	--	--	--	--	--	R	6	2	2
8332050	Bernardo Int. Dr. nr. Bernardo, N. Mex.	--	C	5	--	--	R	6	2	2
8334000	Rio Puerco abv Chico Arroyo nr. Guadalupe, N. Mex.	--	--	--	--	--	[H]	--	--	2
8340500	Arroyo Chico nr. Guadalupe, N. Mex.	B	--	--	--	--	H	--	--	1
8341300	Bluewater Cr. abv Bluewater Dam nr. Bluewater, N. Mex.	--	--	--	--	--	H	--	--	2
8342000	Bluewater Cr. nr. Bluewater, N. Mex.	--	--	--	--	--	[R]	6	2	1
8343000	Rio San Jose at Grants, N. Mex.	--	--	--	--	--	[R]	6	1	3
8343100	Grants Canyon at Grants, N. Mex.	--	--	--	--	--	H	--	--	3
8343500	Rio San Jose nr. Grants, N. Mex.	--	--	--	--	--	[R]	9	3	3
8348500	Encinal Cr. nr. Casa Blanca, N. Mex.	--	--	--	--	--	H	--	--	2
8351500	Rio San Jose at Correo, N. Mex.	--	--	--	--	--	[R]	9	1	3
8352500	Rio Puerco at Rio Puerco, N. Mex.	--	--	--	--	--	[R]	9	1	2
8353000	Rio Puerco nr. Bernardo, N. Mex.	--	C	5	--	--	R	9	1	2
8353500	La Jencia Cr. nr. Magdalena, N. Mex.	--	--	--	--	--	H	--	--	2
8354000	Rio Salado nr. San Acacia, N. Mex.	--	C	5	--	--	H	--	--	2
8354500	Socorro Main Canal N. at San Acacia, N. Mex.	--	C	2	--	--	R	6	2	2
8354800	Rio Grande C. C. at San Acacia, N. Mex.	--	C	2	5	--	R	6	2	2
8354900	Rio Grande floodway at San Acacia, N. Mex.	--	C	2	5	--	R	6	2	2
8355200	Nogal Arroyo Floodway nr. Socorro, N. Mex.	--	--	--	--	--	R	6	2	3
8355300	Arroyo de la Matanza nr. Socorro, N. Mex.	--	--	--	--	--	H	--	--	3
8356000	Socorro Main Canal S. nr. San Antonio, N. Mex.	--	C	2	--	--	R	6	2	6
8356500	San Antonio Riverside Dr. nr. San Antonio, N. Mex.	--	C	2	--	--	R	6	2	6
8357000	Elmendorf Int. Dr. nr. San Antonio, N. Mex.	--	C	2	--	--	R	6	2	6
8357500	San Antonio Riverside Dr. nr. San Marcial, N. Mex.	--	C	2	--	--	R	6	2	6
8358300	Rio Grande C. C. at San Marcial, N. Mex.	--	C	2	5	--	R	6	2	2
8358400	Rio Grande floodway at San Marcial, N. Mex.	--	C	2	5	--	R	6	2	2
8358550	Milligan Gulch nr. San Marcial, N. Mex.	--	--	--	--	--	H	--	--	2
8360000	Alamosa Cr. nr. Monticello, N. Mex.	B	--	--	--	--	H	--	--	2
8361000	Rio Grande blw Elephant Butte Dam, N. Mex.	--	C	6	1	2	R	6	2	1
8362500	Rio Grande blw Caballo Dam, N. Mex.	--	C	6	2	--	R	6	2	3
8363100	Rio Grande Trib nr. Radium Springs, N. Mex.	--	--	--	--	--	H	--	--	2
8363700	Tortugas Arroyo nr. Las Cruces, N. Mex.	--	C	5	--	--	R	6	2	3
8364000	Rio Grande at El Paso, Texas	--	C	6	--	--	R	9	2	3
8377900	Rio Mora nr. Terrero, N. Mex.	B	C	5	--	--	H	--	--	1
8378500	Pecos R. nr. Pecos, N. Mex.	B	C	6	--	--	H	--	--	1
8379500	Pecos R. nr. Anton Chico, N. Mex.	--	C	5	--	--	R	9	1	2
8380500	Gallinas R. nr. Montezuma, N. Mex.	--	--	--	--	--	[H]	--	--	2
8382500	Gallinas R. nr. Colonias, N. Mex.	--	C	6	--	--	R	9	1	1
8382800	Pecos R. abv Los Esteros damsite nr. Santa Rosa, N. Mex.	--	--	--	--	--	R	9	1	2
8383000	Pecos R. at Santa Rosa, N. Mex.	--	C	1	5	6	R	9	1	2
8383300	Pintada Arroyo nr. Santa Rosa, N. Mex.	--	--	--	--	--	H	--	--	2
8383500	Pecos R. nr. Puerto de Luna, N. Mex.	--	C	5	6	2	R	9	1	2
8384500	Pecos R. blw Alamogordo Dam, N. Mex.	--	C	1	6	2	R	6	2	2
8385000	Fort Summer main canal nr. Fort Sumner, N. Mex.	--	C	6	2	--	R	6	2	2
8385520	Pecos R. blw Fort Sumner, N. Mex.	--	--	--	--	--	R	6	2	2
8385600	Yeso Arroyo nr. Fort Sumner, N. Mex.	--	--	--	--	--	H	--	--	2
8385700	Cloud Canyon nr. Gallinas, N. Mex.	--	--	--	--	--	H	--	--	2
8386000	Pecos R. nr. Acme, N. Mex.	--	C	5	6	2	R	6	2	2
8387000	Rio Ruidoso at Hollywood, N. Mex.	--	C	2	--	--	R	4	1	2
8387600	Eagle Cr. blw South Fork nr. Alto, N. Mex.	--	--	--	--	--	H	3	1	2
8387800	Eagle Cr. nr. Alto, N. Mex.	--	--	--	--	--	R	6	2	2
8390500	Rio Hondo at Diamond "A" Ranch nr. Hondo, N. Mex.	--	--	--	--	--	[R]	9	1	3
8390800	Rio Hondo blw Diamond "A" Dam nr. Roswell, N. Mex.	--	--	--	--	--	R	6	2	3

Appendix A-1.--Gaging stations in operation and proposed for network - Concluded

Station number	Station name	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
08393200	Rocky Arroyo abv Two Rivers Res. nr. Roswell, N. Mex.	--	--	--	--	--	H	--	--	3
8393300	Rocky Arroyo blw Rocky Dam nr. Roswell, N. Mex.	--	--	--	--	--	R	6	2	3
8393600	North Spring R. at Roswell, N. Mex.	--	--	--	--	--	[H]	--	--	3
8394100	Pecos R. nr. Hagerman, N. Mex.	--	C	2	--	--	R	6	2	2
8394500	Rio Felix at old Highway Bridge nr. Hagerman, N. Mex.	--	C	2	--	--	R	9	1	2
8395500	Pecos R. nr. Lake Arthur, N. Mex.	--	C	2	--	--	R	6	2	2
8396500	Pecos R. nr. Artesia, N. Mex.	--	C	2	5	6	R	6	2	2
8398500	Rio Penasco at Dayton, N. Mex.	--	C	5	6	--	R	9	1	1
8399500	Pecos R. (Kaiser Channel) nr. Lakewood, N. Mex.	--	C	6	2	--	R	6	2	2
8400000	Fourmile Draw nr. Lakewood, N. Mex.	--	C	6	--	--	H	--	--	1
8401000	Pecos R. blw McMillan Dam, N. Mex.	--	C	6	2	--	R	6	2	2
8401200	South Seven Rivers nr. Lakewood, N. Mex.	--	C	6	--	--	H	--	--	2
8401900	Rocky Arroyo at highway bridge nr. Carlsbad, N. Mex.	--	C	6	--	--	R	9	1	2
8402000	Pecos R. at damsite 3 nr. Carlsbad, N. Mex.	--	C	6	2	--	R	6	2	2
8403500	Carlsbad main canal nr. Carlsbad, N. Mex.	--	C	6	2	--	R	6	2	1
8404000	Pecos R. blw Avalon Dam, N. Mex.	--	C	6	2	--	R	6	2	1
8405000	Pecos R. at Carlsbad, N. Mex.	--	C	6	2	5	R	6	2	2
8405500	Black R. abv Malaga, N. Mex.	--	C	6	2	--	R	9	1	2
8406500	Pecos R. nr. Malaga, N. Mex.	--	C	6	5	--	R	6	2	2
8407000	Pecos R. at Pierce Canyon Crossing nr. Malaga, N. Mex.	--	C	6	5	--	R	6	2	2
8407500	Pecos R. at Red Bluff, N. Mex.	--	C	1	6	5	R	6	2	2
8408500	Delaware R. nr. Red Bluff, N. Mex.	B	C	6	2	--	H	2	1	2
8437620	Monument Draw Trib nr. Monument, N. Mex.	--	--	--	--	--	H	--	--	2
8476300	Mimbres R. at McKnight damsite, nr. Mimbres, N. Mex.	B	C	5	--	--	H	--	--	2
8477000	Mimbres R. nr. Mimbres, N. Mex.	--	C	3	--	--	R	9	1	2
8480700	Indian Cr. nr. Three Rivers, N. Mex.	--	--	--	--	--	H	--	--	2
8481500	Rio Tularosa nr. Bent, N. Mex.	B	C	5	--	--	R	9	1	2
8486250	Tularosa Valley Trib nr. White Sands, N. Mex.	--	--	--	--	--	R	3	1	3
8486260	Tularosa Valley Trib at White Sands, N. Mex.	--	--	--	--	--	R	3	1	3
8492500	Cornucopia Canyon nr. Pinon, N. Mex.	--	--	--	--	--	H	--	--	2
09346400	San Juan R. nr. Carracas, Colo.	--	C	5	6	--	R	9	1	1
9349800	Piedra R. nr. Arboles, Colo.	--	C	5	6	--	R	9	1	1
9350800	Vaqueros Canyon nr. Gobernador, N. Mex.	--	--	--	--	--	H	--	--	2
9354500	Los Pinos R. at La Boca, Colo.	--	C	5	6	--	R	6	2	1
9355000	Spring Cr. at La Boca, Colo.	--	C	6	--	--	H	3	1	1
9355500	San Juan R. nr. Archuleta, N. Mex.	--	C	2	5	--	R	6	2	2
9363500	Animas R. nr. Cedar Hill, N. Mex.	--	C	5	--	--	R	9	1	2
9364500	Animas R. at Farmington, N. Mex.	--	C	2	5	--	R	9	1	2
9365000	San Juan R. at Farmington, N. Mex.	--	C	2	5	3	R	6	2	2
9367500	La Plata R. nr. Farmington, N. Mex.	--	--	--	--	--	[R]	9	1	2
9367950	Chaco R. nr. Waterflow, N. Mex.	--	--	--	--	--	H	--	--	2
9368000	San Juan R. at Shiprock, N. Mex.	--	C	1	6	5	R	6	2	1
9386100	Largo Cr. nr. Quemado, N. Mex.	--	--	--	--	--	H	--	--	2
9386900	Rio Nutria nr. Ramah, N. Mex.	B	--	--	--	--	H	--	--	3
9386950	Zuni R. abv Zuni Res., N. Mex.	--	--	--	--	--	R	6	2	3
9430150	Sapillo Cr. blw Lake Roberts nr. Silver City, N. Mex.	--	--	--	--	--	R	6	2	2
9430500	Gila R. nr. Gila, N. Mex.	--	C	1	3	--	R	9	1	2
9430600	Mogollon Cr. nr. Cliff, N. Mex.	B	C	5	--	--	H	--	--	1
9431500	Gila River nr. Redrock, N. Mex.	--	C	5	--	--	R	9	1	2
9438200	Animas Cr. nr. Cloverdale, N. Mex.	--	--	--	--	--	H	--	--	2
9442653	Trout Cr. nr. Luna, N. Mex.	--	--	--	--	--	R	9	1	2
9442680	San Francisco R. nr. Reserve, N. Mex.	--	--	--	--	--	R	9	1	2
9442692	Tularosa R. nr. Aragon, N. Mex.	--	--	--	--	--	H	--	--	2
9443000	San Francisco R. nr. Alma, N. Mex.	--	--	--	--	--	R	9	1	2
9444000	San Francisco R. nr. Glenwood, N. Mex.	--	C	3	5	--	R	9	1	2

Appendix A-2.--Selected flow characteristics for gaging stations used in regression analysis

Station number	Station	Years record	Q_a	SDQ_a	$M_{7,2}$	$V_{1,50}$	$V_{3,50}$	Q_{50}
07199000	Canadian R. nr. Hebron, N. Mex.	22	8.22	11.3	--	7,530	3,780	40,200
7203000	Vermejo R. nr. Dawson, N. Mex.	41	19.2	16.5	0.98	2,490	1,330	9,730
†7204000	Moreno Cr. at Eagle Nest, N. Mex.	32	--	--	.54	183	192	--
†7204500	Cieneguilla Cr. nr. Eagle Nest, N. Mex.	32	--	--	.63	468	435	740
7205000	Sixmile Cr. nr. Eagle Nest, N. Mex.	10	2.25	.95	--	58.3	57.5	155
7207500	Ponil Cr. nr. Cimarron, N. Mex.	26	11.0	8.84	.62	596	546	6,240
7208500	Rayado Cr. at Sauble Ranch, nr. Cimarron, N. Mex.	41	13.4	9.28	2.15	954	732	750
7211500	Canadian R. nr. Taylor Springs, N. Mex.	23	106	132	2.95	48,780	28,300	82,000
*7214000	Canadian R. nr. Roy, N. Mex.	29	132	165	2.20	66,220	35,610	13,900
7214500	Mora R. nr. Holman, N. Mex.	15	13.5	9.97	1.84	610	499	--
7214800	Rio la Casa nr. Cleveland, N. Mex.	12	14.1	5.66	2.12	352	278	--
7222500	Conchas R. at Variadero, N. Mex.	32	17.6	22.5	--	11,220	5,860	58,500
7226500	Ute Cr. nr. Logan, N. Mex.	26	27.6	16.7	--	9,560	4,020	53,400
†08252500	Costilla Cr. abv Costilla, N. Mex.	21	--	--	2.33	321	213	274
†8253000	Casias Cr. nr. Costilla, N. Mex.	17	--	--	3.16	162	151	166
†8253500	Santistevan Cr. nr. Costilla, N. Mex.	19	--	--	.76	23.4	22.6	21.0
8263000	Latir Cr. nr. Cerro, N. Mex.	23	5.37	1.87	1.81	93.6	86.0	156
*8264000	Red R. nr. Red River, N. Mex.	14	15.5	5.74	3.35	237	237	299
8265000	Red R. nr. Questa, N. Mex.	38	47.8	20.3	12.8	913	857	1,050
8267000	Red R. at mouth nr. Questa, N. Mex.	17	80.2	18.8	44.7	690	694	--
8267500	Rio Hondo nr. Valdez, N. Mex.	34	35.4	14.1	9.08	496	480	609
8269000	Rio Pueblo de Taos nr. Taos, N. Mex.	17	29.4	16.6	5.29	932	880	1,010
8271000	Rio Lucero nr. Arroyo Seco, N. Mex.	24	23.3	8.96	4.92	275	253	304
8275500	Rio Grande del Rancho nr. Taos, N. Mex.	16	19.7	9.04	3.66	379	362	--
8275600	Rio Chiquito nr. Talpa, N. Mex.	11	8.46	3.77	1.75	178	164	--
8279000	Rio de Penasco at Dixon, N. Mex.	35	79.5	49.3	8.69	1,600	1,440	2,120
*8283500	Rio Chama at Park View, N. Mex.	27	334	160	17.4	7,290	6,580	9,760
8284100	Rio Chama nr. La Puente, N. Mex.	13	311	135	17.7	7,180	6,740	--
*8284500	Willow Cr. nr. Park View, N. Mex.	25	13.7	11.2	--	1,240	1,080	3,790
*8288000	El Rito Cr. nr. El Rito, N. Mex.	19	18.8	12.4	.72	709	604	1,020
8289000	Rio Ojo Caliente at La Madera, N. Mex.	36	69.2	45.5	3.43	2,780	2,500	3,380
8291000	Santa Cruz R. at Cundiyo, N. Mex.	35	28.3	15.6	6.46	499	437	1,730
*8295000	Rio Nambe nr. Nambe, N. Mex.	19	10.6	6.52	2.33	186	168	3,460
*8302500	Tesuque Cr. abv diversions nr. Santa Fe, N. Mex.	15	3.21	2.18	.64	74.9	66.7	1,040
8316000	Santa Fe R. nr. Santa Fe, N. Mex.	13	12.0	7.33	1.36	307	279	--
8318000	Galisteo Cr. at Domingo, N. Mex.	23	9.98	7.33	--	4,020	1,840	28,100
8324000	Jemez R. nr. Jemez, N. Mex.	15	63.1	23.8	13.9	1,160	1,000	7,540
8334000	Rio Puerco abv Arroyo Chico nr. Guadalupe, N. Mex.	17	12.9	9.23	--	2,140	1,400	--
8340500	Arroyo Chico nr. Guadalupe, N. Mex.	25	24.4	15.6	--	3,600	2,240	14,600
8354000	Rio Salado nr. San Acacia, N. Mex.	17	14.2	9.11	--	2,180	1,810	35,600
8360000	Alamosa Cr. nr. Monticello, N. Mex.	16	8.56	1.27	6.06	1,190	441	14,700
8378500	Pecos R. nr. Pecos, N. Mex.	40	97.6	47.5	18.4	1,450	1,290	2,540
8379500	Pecos R. nr. Anton Chico, N. Mex.	43	129	91.3	5.29	6,800	3,930	38,500
8380500	Gallinas Cr. nr. Montezuma, N. Mex.	42	18.5	15.2	2.44	1,140	685	7,770
8387000	Rio Ruidoso at Hollywood, N. Mex.	15	11.8	6.70	1.41	217	180	--
*8388000	Rio Ruidoso at Hondo, N. Mex.	25	19.0	24.6	.59	3,490	2,180	16,700
*8389500	Rio Bonito at Hondo, N. Mex.	25	10.3	15.0	--	--	--	13,300
8393600	North Spring R. at Roswell, N. Mex.	10	--	--	--	155	65.7	--
8394500	Rio Felix at old highway bridge nr. Hagerman, N. Mex.	29	16.2	21.0	.42	14,980	7,020	34,200
8400000	Fourmile Draw nr. Lakewood, N. Mex.	17	--	--	--	9,630	2,780	--
8405500	Black R. abv Malaga, N. Mex.	21	14.9	10.8	3.53	9,330	4,110	75,000
8408500	Delaware R. nr. Red Bluff, N. Mex.	31	14.3	14.2	.29	15,730	5,930	74,100
8477000	Mimbres R. nr. Mimbres, N. Mex.	38	10.8	7.72	2.02	606	466	1,430
*8477500	Mimbres R. nr. Faywood, N. Mex.	29	14.6	13.3	1.26	3,010	1,470	19,200
*8477600	San Vicente Arroyo at Silver City, N. Mex.	12	--	--	--	191	78.6	--
8481500	Rio Tularosa nr. Bent, N. Mex.	20	9.50	1.23	3.96	182	64.7	7,200
*09350500	San Juan R. at Rosa, Colo.	33	1,022	519	105	15,340	13,700	23,000
9355000	Spring Cr. at La Boca, Colo.	17	28.3	3.81	2.19	253	174	--
9363500	Animas R. nr. Cedar Hill, N. Mex.	34	902	321	171	12,620	11,430	14,500
9364500	Animas R. at Farmington, N. Mex.	45	871	377	82.1	12,660	11,670	18,500
9430500	Gila R. nr. Gila, N. Mex.	40	131	78.9	29.2	9,530	5,540	15,100
9431500	Gila R. nr. Redrock, N. Mex.	31	180	128	15.9	22,110	10,730	24,300
*9443500	Whitewater Cr. nr. Mogollon, N. Mex.	10	17.4	--	--	--	--	--
9444000	San Francisco R. nr. Glenwood, N. Mex.	41	67.5	51.3	10.7	5,390	3,710	8,580

† seasonal record
* discontinued station

Appendix A-3.--Physical and climatic characteristics of drainage basins for gaging stations used in regression analysis

Station number	A	L	E	E_m	S_h	S	S_t	P_m	P_a	P_s	I	T_j	LA	LO	S_l
071534	73.00	17.30	6.42	7.13	4.10	99.0	1.03	13.10	5.79	9.00	2.25	12.0	6.83	4.00	--
71535	545.00	54.00	4.90	6.00	5.33	50.0	1.18	9.00	5.00	8.00	2.28	14.0	6.94	3.77	8.5
71544	111.00	34.20	4.38	4.92	10.50	38.0	1.01	8.38	5.20	7.61	2.38	17.0	6.83	3.17	--
71545	1,038.00	104.00	4.26	5.48	10.40	26.0	1.00	11.00	5.50	8.10	2.15	16.0	7.00	3.00	--
* 71990	229.00	47.40	6.25	7.36	9.81	53.8	1.04	11.00	6.00	9.00	2.35	12.0	6.92	4.68	8.0
72010	14.40	7.60	6.64	7.12	4.01	143.0	1.14	10.76	6.46	8.32	2.40	12.0	7.00	4.50	--
* 72030	301.00	51.40	6.38	7.73	8.78	62.9	1.28	12.00	7.00	9.00	2.38	11.0	6.90	4.98	7.5
* 72040	73.80	14.40	8.20	8.69	2.81	81.0	1.12	13.00	8.00	8.00	1.76	4.0	6.65	5.29	7.5
* 72045	56.00	15.70	8.20	8.84	4.40	102.0	1.41	12.00	8.00	9.00	1.53	4.0	6.42	5.26	7.0
* 72050	10.50	6.50	8.20	9.36	4.02	429.0	1.09	13.00	9.00	8.00	1.50	4.0	6.53	5.31	6.5
* 72075	171.00	28.00	6.63	7.86	4.58	99.0	1.11	11.00	7.00	8.00	2.32	8.0	6.68	5.10	8.0
* 72085	65.00	17.50	6.72	8.35	4.71	212.0	1.51	14.00	8.00	11.00	2.30	6.0	6.40	5.12	8.0
* 72115	2,850.	87.2	5.64	6.88	2.67	34.4	1.58	10.0	6.0	8.0	2.19	12.0	6.71	4.70	7.5
72137	4.20	4.00	5.89	6.06	3.81	100.0	1.00	7.20	4.10	6.45	2.00	14.0	6.17	4.33	--
* 72140	4,066.	127.8	4.89	6.30	4.02	27.1	1.70	10.00	6.0	8.0	2.14	13.0	6.57	4.65	8.0
* 72145	57.00	12.90	7.86	8.68	2.92	156.0	1.01	15.00	9.00	11.00	2.18	6.0	6.19	5.34	7.0
* 72148	23.00	10.80	7.64	9.62	5.07	446.0	2.23	17.00	10.00	11.00	2.35	10.0	6.00	5.46	8.0
72155	173.00	32.60	7.00	7.86	6.14	65.2	1.25	14.00	8.00	10.00	2.18	6.0	6.06	5.37	8.0
72171	71.00	18.10	7.70	8.20	4.61	68.4	2.79	12.00	7.00	9.00	2.10	4.0	6.27	5.24	--
72180	215.00	41.00	6.78	7.73	7.82	45.3	3.00	12.00	7.00	9.00	2.18	7.0	6.12	5.21	--
72200	132.00	23.70	6.91	7.60	4.26	67.4	1.11	16.00	8.00	11.00	2.20	14.0	5.82	5.39	8.0
72209	18.40	10.20	6.30	6.75	5.65	99.0	2.09	10.00	5.20	9.09	2.15	11.0	5.83	5.00	--
72223	65.00	19.00	4.58	5.05	5.55	60.0	1.00	7.04	4.50	6.20	1.98	22.0	5.50	4.50	--
* 72225	523.00	52.30	4.43	5.40	5.23	48.4	1.86	8.00	5.00	7.00	2.00	22.0	5.39	4.76	9.0
72250	55.00	16.00	4.51	4.79	4.65	41.0	2.60	7.09	4.00	6.77	2.12	24.0	5.00	4.33	--
72255	256.00	33.50	5.80	6.43	4.38	44.0	1.39	8.60	4.00	8.58	2.15	14.0	6.50	4.00	--
72262	34.00	14.30	4.49	4.84	6.01	61.0	1.03	8.75	4.00	7.90	2.15	18.0	6.00	3.67	--
72263	68.00	19.10	5.45	5.82	5.36	34.0	1.88	7.50	4.10	7.50	2.12	15.0	6.17	4.00	--
* 72265	2,060.	120.7	3.84	5.09	7.07	25.7	1.75	8.0	4.0	8.0	2.19	17.0	6.03	3.85	8.5
72271	786.00	63.10	3.67	4.09	5.07	13.2	1.15	8.00	4.00	7.00	2.30	23.0	5.00	3.63	8.5
7227295	1.25	2.67	5.11	5.17	5.70	53.0	1.00	9.00	4.00	8.00	2.25	17.0	6.33	3.33	--
080806	109.00	26.00	4.25	4.42	6.20	15.0	4.49	8.84	4.00	9.22	2.35	21.0	4.67	3.33	--
* 82525	26.00	10.00	9.43	10.40	3.85	227.0	1.42	18.00	12.00	10.00	1.95	4.0	6.96	5.24	7.0
* 82530	19.00	5.20	9.40	10.40	1.42	461.0	1.00	18.00	12.00	10.00	2.15	4.0	6.95	5.29	7.0
* 82535	2.50	3.40	9.49	10.70	4.62	862.0	3.00	19.00	10.00	12.00	2.15	4.0	6.88	5.28	7.0
82550	12.00	6.40	8.90	10.40	3.41	629.0	1.00	19.00	12.00	11.00	2.00	2.0	6.94	5.37	7.5
* 82630	10.00	5.40	8.28	9.83	2.92	704.0	1.00	17.00	14.00	8.00	1.70	4.0	6.83	5.31	7.0
* 82640	19.10	6.20	9.39	10.60	2.01	477.0	1.42	18.00	13.00	11.00	1.70	4.0	6.58	5.38	6.5
* 82650	113.00	22.80	7.45	8.91	4.60	137.0	1.09	14.00	11.00	8.00	1.55	5.0	6.67	5.43	7.0
* 82670	190.00	33.40	6.60	8.36	5.87	104.0	1.08	15.00	11.00	7.00	1.50	5.0	6.70	5.45	7.0
* 82675	36.20	11.70	7.65	9.32	3.78	336.0	1.06	16.00	12.00	9.00	1.85	8.0	6.58	5.48	7.0
82685	65.60	19.50	6.68	8.45	5.80	219.0	1.03	13.00	10.00	8.00	1.60	8.0	6.57	5.54	--
* 82690	66.60	15.30	7.40	8.74	3.52	210.0	1.09	17.84	9.21	8.55	1.51	8.0	6.50	5.33	7.0
82710	16.60	8.80	8.05	9.61	4.66	406.0	1.12	17.00	12.00	10.00	1.29	8.0	6.51	5.46	7.5
* 82755	83.00	19.00	7.24	9.72	4.35	194.0	1.02	15.00	10.00	9.00	1.67	7.0	6.24	5.50	7.5
* 82756	37.00	16.80	7.22	8.56	7.63	168.0	1.00	15.00	10.00	9.00	1.75	6.0	6.31	5.45	7.5
* 82790	305.00	39.60	5.85	7.76	5.14	113.0	1.02	14.27	9.05	8.85	1.82	10.0	6.17	5.67	7.5
82812	27.70	9.90	8.31	9.50	3.54	296.0	1.04	20.40	16.38	8.90	1.55	4.0	7.00	6.50	--
* 82835	405.00	33.00	7.28	8.41	2.69	79.8	1.18	15.00	12.00	7.00	1.50	3.0	6.88	6.48	8.0
82840	49.70	17.00	7.52	8.46	3.93	138.0	1.05	13.48	9.99	7.03	1.48	6.0	6.67	6.50	--
* 82841	480.	41.3	7.03	8.18	3.55	63.6	1.20	17.0	13.0	9.0	1.48	3.0	6.84	6.48	8.5
* 82845	193.00	17.80	6.94	7.60	1.64	48.1	1.23	11.00	10.00	5.00	1.33	2.0	6.81	6.70	8.5
* 82880	50.50	17.80	7.18	8.76	6.27	166.0	1.10	15.32	12.03	7.39	1.47	6.0	6.50	6.33	8.5
* 82890	419.00	35.90	6.36	7.90	3.08	104.0	1.06	9.00	10.00	6.00	1.45	6.0	6.56	6.14	8.0
* 82910	86.00	16.70	6.46	8.65	3.24	320.0	1.00	13.00	10.00	8.00	1.86	14.0	5.96	5.79	8.0
82920	34.50	18.20	6.12	7.68	9.59	200.00	1.00	13.42	9.85	8.40	1.87	15.0	6.00	6.33	--
* 82950	38.20	12.30	6.30	8.29	3.96	400.0	1.00	14.59	10.21	8.35	1.66	16.0	5.83	5.83	8.0
* 83025	11.70	8.30	7.11	8.71	5.89	450.0	1.00	10.11	7.91	6.30	1.50	16.0	5.67	5.83	8.0
83131	1.23	2.63	6.45	6.61	4.38	142.0	1.00	4.00	4.40	4.00	1.40	17.0	5.67	6.17	--
* 83160	22.3	11.5	7.72	9.12	5.93	343.	1.49	16.0	12.0	9.0	2.19	16.0	5.73	5.80	7.5
83166	.33	1.25	7.16	7.25	4.73	153.0	1.00	6.00	4.90	4.90	1.40	16.0	5.67	6.00	--
831665	1.30	2.55	7.03	7.17	5.00	119.0	1.00	6.00	5.00	4.90	1.40	16.0	5.67	6.00	--
83167	2.92	5.38	6.83	7.22	9.91	95.0	1.00	5.00	4.80	4.90	1.40	16.0	5.67	6.00	--
83171	.47	1.48	6.02	6.12	4.66	159.0	1.00	3.50	4.00	3.20	1.30	16.0	5.50	6.17	--
83175	11.30	6.88	6.94	7.60	4.19	181.0	1.00	10.10	7.82	7.32	1.73	15.0	5.50	5.83	--
83176	116.00	19.20	6.19	6.80	3.18	73.0	1.08	6.67	4.94	6.00	1.64	16.0	5.33	5.67	--
83177	2.15	3.45	6.27	6.52	5.53	169.0	1.00	6.00	4.60	5.00	1.58	16.0	5.33	5.83	--
83178	.56	1.77	7.20	7.52	5.59	468.0	1.00	8.00	5.80	6.00	1.70	16.0	5.67	5.83	--
* 83180	640.00	47.00	5.26	6.01	3.45	37.6	1.02	6.00	5.00	5.00	1.51	16.0	5.42	5.93	8.0
83189	45.20	11.00	6.28	6.59	2.68	60.0	1.02	5.35	6.00	4.84	1.40	16.0	5.17	6.17	--
83215	173.00	29.20	6.70	8.18	4.93	57.1	1.20	18.00	12.00	11.00	2.00	5.0	5.91	6.53	8.5
83219	26.80	11.20	8.12	9.28	4.68	232.0	1.03	17.60	11.90	9.00	1.98	.1	6.00	6.37	--
83230	235.00	32.90	6.02	8.20	4.61	132.0	1.05	15.00	11.00	9.00	1.98	4.0	5.92	6.75	8.5
* 83240	470.00	36.30	5.62	7.75	2.80	140.0	1.07	16.00	10.00	9.00	1.90	6.0	5.89	6.68	8.5
83305	75.30	16.20	5.66	6.38	3.49	95.0	1.01	8.53	7.25	6.00	1.54	18.0	5.00	6.50	--
83306	133.00	28.80	4.99	5.93	6.24	83.0	1.02	7.81	6.77	5.05	1.51	19.0	5.00	6.50	--
833165	35.00	9.30	5.30	6.15	2.47	190.0	1.01	5.50	4.50	5.00	1.45	20.0	4.33	6.50	--
* 83340	420.00	58.80	5.95	6.54	8.23	23.4	1.02	9.00	7.00	6.00	1.44	9.0	5.95	6.97	8.7
* 83405	1,390.00	51.80	5.92	6.62	1.93	21.9	1.10	7.00	5.00	5.00	1.10	14.0	5.70	7.42	8.7
83413	75.00	18.00	7.43	7.82	4.32	44.0	1.05	9.32	7.29	6.62	1.50	13.0	5.17	8.33	--

Appendix A-3.--Physical and climatic characteristics of drainage basins for gaging stations used in regression analysis - Continued

Station number	A	L	E	E_m	S_h	S	S_t	P_m	P_a	P_s	I	T_j	LA	LO	S_j
083485	6.19	7.20	6.65	7.53	8.37	256.0	1.03	4.88	4.00	4.95	1.38	17.0	5.17	7.50	--
83514	437.00	68.10	5.54	6.50	10.60	35.0	1.51	3.00	3.57	3.37	1.20	18.0	4.83	7.50	--
83535	195.00	19.10	6.11	6.88	1.87	87.0	1.02	5.52	4.48	5.35	1.44	18.0	4.17	7.33	--
* 83540	1,380.00	75.00	4.76	5.95	4.08	35.6	1.09	5.00	4.00	4.00	1.28	16.0	4.39	7.39	8.5
* 83600	403.00	28.10	6.14	7.02	1.96	73.5	1.00	9.00	6.00	7.00	1.56	14.0	3.68	7.65	8.0
836165	21.50	8.30	5.74	6.60	3.20	282.0	1.00	11.44	8.81	8.05	1.77	24.0	2.83	7.67	--
836166	.58	1.15	5.68	5.94	2.28	417.0	1.00	7.00	5.50	5.00	1.62	24.0	2.83	7.67	--
83617	35.40	11.40	5.40	6.38	3.67	202.0	1.01	10.50	7.96	7.65	1.74	24.0	2.83	7.67	--
83618	119.00	31.20	4.23	5.30	8.18	81.0	1.02	7.57	5.96	5.67	1.63	24.0	2.83	7.50	--
83631	.40	1.37	3.90	4.15	4.70	259.0	1.00	3.00	4.00	3.00	1.40	26.0	2.50	7.00	--
83632	25.40	12.10	4.67	5.02	5.76	70.0	1.12	3.00	4.30	3.27	1.43	24.0	3.00	7.00	--
83636	13.50	9.70	4.04	4.56	6.97	115.0	1.00	3.00	4.00	3.00	1.20	26.0	2.34	6.70	7.5
83780	160.00	20.50	5.98	9.24	2.63	178.0	1.15	21.00	12.00	12.00	2.17	14.0	5.86	5.63	7.0
* 83785	189.00	23.20	7.50	9.14	3.85	144.0	1.06	17.00	11.00	11.00	2.17	14.0	5.84	5.63	7.5
83793	122.00	29.40	6.24	7.18	7.08	79.0	1.09	12.56	6.66	9.88	2.03	18.0	5.50	5.33	--
* 83795	1,050.00	110.00	5.13	6.82	11.50	35.7	1.03	11.00	7.00	8.00	1.87	15.0	5.52	5.48	8.5
83796	.16	.55	5.43	5.47	1.89	116.0	1.00	7.00	5.30	6.00	1.72	20.0	5.17	5.33	--
83803	7.60	4.35	7.14	7.42	2.49	144.0	1.00	15.60	8.50	9.00	2.15	14.0	5.67	5.33	--
* 83805	84.00	16.30	6.95	8.18	3.16	196.0	1.00	15.00	7.00	11.00	2.28	15.0	5.71	5.42	7.5
83820	313.00	36.00	5.93	7.21	4.14	82.0	1.80	12.00	6.00	10.00	2.11	16.0	5.47	5.17	--
83825	610.00	81.00	4.94	6.22	10.80	37.0	1.57	10.00	5.00	9.00	2.06	16.0	5.18	4.92	--
83833	896.00	68.20	4.61	5.70	5.19	35.0	1.20	6.52	4.81	6.56	1.68	22.0	5.00	5.33	--
838337	.37	1.05	4.50	4.64	2.98	371.0	1.00	6.00	4.10	6.40	1.88	24.0	4.83	4.67	--
838567	6.07	4.80	6.33	6.74	3.80	203.0	1.00	12.00	6.50	7.00	1.80	22.0	3.67	5.67	--
838569	.60	1.40	6.81	6.83	3.27	24.0	1.00	8.40	5.25	7.00	1.64	21.0	4.17	5.67	--
83857	10.00	6.00	6.72	7.09	3.60	138.0	1.00	9.00	5.75	7.50	1.63	21.0	4.17	5.67	--
* 83870	120.00	16.70	6.36	8.02	2.37	252.0	1.07	18.00	10.00	13.00	1.87	22.0	3.30	5.70	6.0
* 83880	290.00	36.70	5.20	6.46	4.64	78.0	1.07	13.74	7.92	10.88	1.90	20.0	3.33	5.50	7.0
83890	85.00	27.60	6.03	7.02	8.96	84.0	1.12	14.01	7.77	11.29	2.00	21.0	3.50	5.67	--
838906	.72	2.00	5.96	6.35	5.56	333.0	1.00	9.00	4.75	9.00	1.90	20.0	3.50	5.50	--
* 83895	295.00	33.60	5.20	6.19	3.83	58.0	1.04	11.48	6.06	9.83	1.93	21.0	3.67	5.50	8.2
83905	947.00	66.60	4.18	5.48	4.68	42.8	1.03	11.00	6.00	10.00	1.92	22.0	3.37	5.40	8.0
* 83936	19.50	4.60	3.57	3.66	1.00	47.8	1.51	5.00	4.00	5.00	1.98	24.0	3.39	4.58	8.0
83939	397.00	64.40	3.74	4.82	10.40	39.0	2.34	7.29	4.27	7.25	1.98	22.0	3.50	5.00	--
* 83945	932.00	108.00	3.40	5.21	12.50	39.4	1.02	9.00	5.00	8.00	1.98	22.0	3.23	5.21	8.2
83974	3.08	2.88	7.62	8.06	2.69	359.0	1.03	16.00	8.00	12.50	2.07	22.0	3.00	5.67	--
83976	583.00	47.60	5.31	6.90	3.89	78.0	1.23	14.00	6.99	9.12	2.02	22.0	3.00	5.50	--
83985	1,060.00	95.50	3.39	5.39	8.60	47.7	1.19	11.00	6.00	9.00	2.02	23.0	2.84	5.27	--
* 84000	265.00	64.80	3.30	4.38	15.80	40.1	1.32	7.00	4.00	6.00	2.00	24.0	2.73	4.87	8.2
84018	254.00	43.30	3.55	4.66	7.38	60.0	1.20	6.20	4.00	6.48	2.00	28.0	2.33	4.67	--
840505	.20	.65	4.18	4.22	2.11	15.0	1.00	6.90	4.00	6.35	2.00	28.0	2.33	4.67	--
* 84055	343.00	56.70	3.07	4.18	9.37	47.6	1.05	8.00	5.00	7.00	2.00	28.0	2.10	4.50	--
* 84085	689.00	60.20	2.90	3.92	5.26	39.5	1.05	7.00	5.00	6.00	2.00	27.0	1.84	4.47	8.5
* 84770	152.00	26.10	5.97	7.08	4.48	97.8	1.03	14.00	10.00	8.00	1.65	28.0	2.99	7.97	8.6
84772	.74	1.15	7.68	8.24	1.79	1,020.0	1.00	17.80	10.50	12.50	1.95	24.0	2.83	7.83	--
* 84775	460.00	51.00	5.03	6.17	5.65	51.3	1.03	11.00	8.00	8.00	1.58	26.0	2.84	7.88	8.8
847756	5.10	4.85	6.05	6.29	4.61	115.0	1.02	10.50	7.30	6.50	1.80	23.0	2.83	8.33	--
847757	2.12	3.60	5.99	6.21	6.11	143.0	1.00	10.00	6.50	6.20	1.70	23.0	2.83	8.17	--
847758	10.00	6.40	5.90	6.18	4.10	106.0	1.01	10.50	7.00	6.75	1.75	23.0	2.83	8.33	--
* 84776	26.50	7.10	5.86	6.16	1.90	95.0	1.25	9.00	6.00	6.00	1.75	24.0	2.77	8.27	9.0
84780	18.80	8.50	5.99	6.54	3.84	144.0	1.00	10.20	7.09	6.78	1.70	24.0	2.83	8.17	--
84785	1,370.00	87.90	4.33	5.60	5.64	35.0	1.04	6.98	5.57	5.33	1.56	24.0	2.67	9.00	--
84786	.55	1.35	4.41	4.51	3.31	164.0	1.00	3.00	4.00	3.00	1.40	26.0	2.50	7.00	--
84793	4.30	4.05	5.17	5.48	4.10	179.0	1.00	6.00	6.00	5.50	1.75	28.0	1.33	8.67	--
848015	31.00	12.60	5.56	6.03	5.12	78.0	1.06	9.75	7.00	8.00	1.80	23.0	3.83	5.83	--
84807	6.80	5.70	6.24	7.89	4.78	730.0	1.01	19.60	12.21	13.90	2.00	24.0	3.33	5.83	--
84809	10.90	9.80	5.28	7.00	8.81	436.0	1.06	16.73	9.00	10.25	1.85	24.0	3.33	5.83	--
84810	96.00	19.60	4.51	5.74	4.00	150.0	1.02	14.24	8.89	9.06	1.58	26.0	3.33	6.00	--
84811	13.80	12.20	4.50	5.51	10.80	199.0	1.01	8.60	6.75	6.00	1.74	26.0	3.33	6.00	--
* 84815	120.00	20.60	5.45	6.82	3.54	146.0	1.00	14.00	8.00	10.00	1.98	24.0	3.13	5.77	6.5
84820	140.00	27.90	4.80	6.34	5.56	123.0	1.03	13.00	7.00	9.00	1.97	25.0	3.14	5.79	7.8
84882	10.00	6.45	6.55	6.76	4.16	75.0	1.02	6.00	4.40	6.00	1.60	16.0	5.00	5.67	--
84835	18.20	10.60	6.68	7.51	6.18	184.0	1.00	13.05	8.61	8.10	1.81	18.0	4.67	6.33	--
84890	3.90	4.00	6.77	6.92	4.10	83.0	1.00	5.50	4.20	5.50	1.60	18.0	4.33	6.17	--
84925	16.60	11.60	5.47	6.00	8.11	105.0	1.06	8.20	4.90	5.75	2.05	23.0	2.50	5.50	--
093462	168.00	23.80	6.72	7.23	3.37	50.0	1.07	10.72	9.85	5.23	1.40	.1	6.83	6.83	--
* 93505	1,990.	65.4	5.98	7.08	2.15	39.8	1.10	20.0	18.00	8.0	1.68	2.0	7.23	7.04	8.0
93508	60.00	21.10	6.60	7.15	7.42	40.0	1.21	7.99	7.61	4.20	1.33	2.0	6.83	7.17	--
* 93550	58.00	17.50	6.16	6.86	5.28	97.3	1.02	5.0	10.00	10	1.39	7.0	7.10	7.53	8.5
93557	19.80	6.07	6.41	6.59	1.86	74.0	1.13	5.10	6.50	2.70	1.22	8.0	6.67	7.33	--
935675	1.38	2.30	5.50	5.62	3.83	116.0	1.00	2.80	5.00	1.30	1.00	14.0	6.67	8.00	--
93572	.20	1.15	6.79	6.83	6.61	70.0	1.00	4.10	4.90	2.60	1.15	14.0	6.50	7.83	--
* 93635	1,090.	78.30	5.96	7.95	5.62	52.8	1.41	22.0	16.0	14.0	1.93	3.0	7.48	7.86	8.0
93645	1,360.	113.2	5.28	7.35	9.42	41.2	1.37	22.0	17.0	8.0	1.50	6.0	7.37	7.82	8.0
936753	2.96	5.40	5.23	5.41	9.85	76.0	1.10	1.00	4.50	1.00	1.00	16.0	6.67	8.33	--
936784	2.10	3.20	6.81	7.12	4.88	229.0	1.00	9.00	7.00	4.90	1.60	15.0	5.83	8.83	--
936786	8.70	6.95	6.52	6.89	5.55	118.0	1.01	7.00	6.40	4.50	1.50	15.0	5.83	8.83	--
936788	26.90	10.20	6.32	6.86	3.87	124.0	1.01	6.00	6.00	3.50	1.35	15.0	5.67	8.83	--
93679	7.05	7.95	6.28	6.62	8.96	96.0	1.06	5.75	5.90	3.25	1.32	15.0	5.67	8.83	--
93861	151.00	26.50	6.90	7.63	4.65	62.0	1.33	8.61	5.87	6.33	1.47	12.0	4.17	8.50	--

Appendix A-3.--Physical and climatic characteristics of drainage basins for gaging stations used in regression analysis - Concluded

Station number	A	L	E	E_m	S_h	S	S_t	P_m	P_a	P_s	I	T_j	LA	LO	S_1
938705	19.00	7.30	7.18	7.36	2.80	50.0	1.26	5.75	5.25	3.75	1.25	10.0	5.00	8.67	--
93954	14.50	5.70	7.42	7.78	2.24	147.0	1.21	8.50	6.50	4.90	1.50	10.0	5.33	8.50	--
93955	558.00	49.40	6.50	6.97	4.37	22.0	1.13	5.91	5.90	4.17	1.24	18.0	5.50	8.50	--
93956	.42	1.00	6.60	6.66	2.38	111.0	1.00	4.50	5.75	3.50	1.18	15.0	5.67	8.83	--
94299	89.60	18.50	7.27	7.78	3.82	63.0	1.02	11.20	8.17	7.75	1.71	18.0	3.50	8.50	--
* 94305	1,864.	86.3	4.90	6.10	4.00	37.1	1.01	11.0	7.0	7.0	1.58	16.0	3.26	8.26	8.5
94309	228.00	35.70	4.50	5.27	5.59	31.0	1.08	9.82	6.51	5.99	1.69	26.0	3.17	8.67	--
* 94315	2,829.0	115.2	4.09	5.74	4.69	31.5	1.05	10.0	7.0	7.0	1.58	16.0	3.26	8.26	8.5
94382	157.00	15.10	5.02	5.22	1.45	31.0	1.00	8.26	7.27	5.96	1.82	28.0	1.50	8.83	--
944266	32.00	12.60	7.31	7.98	4.96	107.0	1.12	12.50	9.14	7.00	1.60	12.0	3.83	9.00	--
944268	350.00	40.90	5.83	6.88	4.78	59.8	1.13	10.00	8.00	7.00	1.72	12.0	3.88	8.92	8.2
944269	89.00	13.80	6.75	7.47	2.14	129.0	1.02	7.33	5.90	5.97	1.49	13.0	4.00	8.50	--
944277	94.60	14.10	6.76	7.55	2.10	127.0	1.26	7.50	6.40	6.50	1.43	12.0	4.00	8.67	--
944274	426.00	33.80	5.95	7.00	2.68	75.0	1.01	7.39	6.32	5.97	1.53	15.0	3.83	8.50	--
* 94435	34.0	13.4	5.67	7.28	5.28	262.	1.00	16.0	10.0	11.0	1.86	21.0	3.34	8.74	8.1
* 94440	1,653.	80.0	4.55	5.77	3.87	33.0	1.05	10.0	8.0	7.0	1.69	17.0	3.68	8.73	8.4

* Indicates gaging stations used in regressions other than peaks.

Appendix A-4.--Summary of regression equations

$$Y = aA^{b1} L^{b2} E^{b3} E_m^{b4} S_h^{b5} S^{b6} S_t^{b7} P_m^{b8} P_a^{b9} P_s^{b10} I^{b11} T_j^{b12} LA^{b13} LO^{b14} SI^{b15}$$

Dependent variable	Exponent of basin characteristic														Regression constant	Standard error of estimate (percent)
Y	A	L	E	E_m	S_h	S	S_t	P_m	P_a	P_s	I	T_j	LA	LO	SI	a	
Q_a	1.01	--	--	--	--	0.448	--	--	2.51	--	--	--	0.537	--	--	3.24×10^{-5}	53
Q_1	1.61	--	--	--	0.788	1.71	--	--	3.46	--	--	--	-1.19	--	--	6.88×10^{-10}	83
Q_2	.817	--	--	--	--	--	--	--	4.03	1.23	--	--	-1.01	--	--	8.18×10^{-6}	103
Q_3	.777	--	--	--	--	--	--	--	4.67	--	--	--	--	--	--	9.20×10^{-6}	143
Q_4	.758	--	--	--	--	--	--	--	4.89	--	1.94	--	--	--	--	5.42×10^{-6}	106
Q_5	.793	--	--	--	--	--	--	--	5.16	1.63	--	--	--	-4.35	4.82	4.59×10^{-8}	95
Q_6	1.24	--	--	--	.757	.842	--	--	4.00	--	--	--	.971	-2.85	--	1.96×10^{-6}	90
Q_7	.648	--	--	-2.47	--	--	--	--	1.80	1.38	--	--	1.68	--	--	8.50×10^{-3}	77
Q_8	.795	--	--	--	--	--	--	--	.844	1.07	--	--	.632	--	--	2.81×10^{-3}	68
Q_9	1.06	--	--	-2.67	--	.761	--	--	.876	2.23	-1.46	--	1.07	--	--	2.60×10^{-4}	68
Q_{10}	.788	--	--	--	--	--	--	--	1.79	1.10	--	--	--	--	--	5.12×10^{-4}	72
Q_{11}	.723	--	--	--	--	--	--	--	3.39	2.41	--	--	--	--	--	7.18×10^{-7}	123
Q_{12}	1.47	--	--	--	.735	1.44	--	--	3.45	1.63	--	--	-.947	--	--	1.22×10^{-10}	101
SD_a	.850	--	--	--	--	--	--	--	2.94	--	--	--	--	-1.96	2.62	4.85×10^{-5}	67
SD_1	.895	--	--	--	--	--	--	--	2.48	1.38	--	--	-1.34	--	--	8.60×10^{-5}	95
SD_2	.886	--	--	--	--	--	--	--	1.58	1.94	--	--	--	2.72	--	2.06×10^{-7}	104
SD_3	No meaningful equation derived.																
SD_4	.872	--	--	--	--	--	--	--	3.71	--	2.50	--	--	--	--	2.14×10^{-5}	124
SD_5	.856	--	--	--	--	--	--	--	4.19	1.31	--	--	--	-4.94	5.42	4.06×10^{-7}	91
SD_6	.935	--	--	--	.612	--	--	--	3.81	--	--	--	1.10	-4.48	--	1.24×10^{-2}	96
SD_7	.881	--	--	--	--	--	--	--	2.28	--	--	--	--	-2.37	--	9.30×10^{-2}	110
SD_8	.824	--	--	--	--	--	--	--	.826	--	--	--	--	--	--	5.12×10^{-2}	81
SD_9	.957	--	--	--	--	--	--	--	--	1.89	--	--	--	--	--	2.06×10^{-3}	85
SD_{10}	.926	--	--	--	--	--	--	--	.847	1.18	--	--	--	--	--	1.36×10^{-3}	104
SD_{11}	.805	--	--	--	-	--	--	--	2.31	2.30	--	--	--	--	--	4.30×10^{-6}	107
SD_{12}	.902	--	--	--	--	--	--	--	2.46	2.22	--	--	-.927	--	--	8.60×10^{-5}	95
M7.2	.566	--	--	--	--	--	--	--	3.32	--	--	--	--	--	--	1.36×10^{-4}	101
M7.5	1.16	--	--	--	--	1.75	--	--	--	--	--	-0.902	--	3.77	--	1.28×10^{-8}	127
M7.10	1.18	--	--	--	--	1.86	--	--	--	--	--	-.915	--	4.14	--	2.82×10^{-9}	142
M7.20	1.20	--	--	--	--	1.95	--	--	--	--	--	-.927	--	4.41	--	8.51×10^{-10}	158
FV1.2	.931	--	--	--	--	--	--	--	1.83	--	--	--	--	-1.43	4.09	1.08×10^{-4}	59
FV1.5	.941	--	--	--	--	--	--	--	1.40	--	--	--	--	-1.89	4.07	1.27×10^{-3}	55

Appendix A-4.--Summary of regression equations - Concluded

$$Y = aA^{b1} L^{b2} E^{b3} E_m^{b4} S_h^{b5} S^{b6} S_t^{b7} P_m^{b8} P_a^{b9} P_s^{b10} I^{b11} T_j^{b12} LA^{b13} LO^{b14} SI^{b15}$$

Dependent variable	Exponent of basin characteristic															Regression constant	Standard error of estimate (percent)
Y	A	L	E	E_m	S_h	S	S_t	P_m	P_a	P_s	I	T_j	LA	LO	SI	a	
FV1,10	.953	--	--	--	--	--	--	--	1.17	--	--	--	--	-2.18	4.02	5.07×10^{-3}	55
FV1,25	.972	--	--	--	--	--	--	--	.929	--	--	--	--	-2.51	3.95	2.39×10^{-2}	60
FV1,50	.988	--	--	--	--	--	--	--	.771	--	--	--	--	-2.74	3.90	6.79×10^{-2}	66
FV3,2	.921	--	--	--	--	--	--	--	2.42	--	--	--	--	-1.56	3.78	5.70×10^{-5}	62
FV3,5	.924	--	--	--	--	--	--	--	2.01	--	--	--	--	-1.98	3.83	5.28×10^{-4}	56
FV3,10	.933	--	--	--	--	--	--	--	1.79	--	--	--	--	-2.26	3.83	1.84×10^{-3}	55
FV3,25	.950	--	--	--	--	--	--	--	1.57	--	--	--	--	-2.60	3.82	7.70×10^{-3}	56
FV3,50	.965	--	--	--	--	--	--	--	1.42	--	--	--	--	-2.84	3.80	2.03×10^{-2}	60
FV7,2	.965	--	--	1.50	--	--	--	--	2.36	--	--	--	--	-1.61	4.22	8.60×10^{-7}	61
FV7,5	.904	--	--	--	--	--	--	--	2.55	--	--	--	--	-2.09	3.53	2.99×10^{-4}	58
FV7,10	.910	--	--	--	--	--	--	--	2.37	--	--	--	--	-2.39	3.61	8.97×10^{-4}	56
FV7,25	.922	--	--	--	--	--	--	--	2.17	--	--	--	--	-2.76	3.68	3.06×10^{-3}	56
FV7,50	.934	--	--	--	--	--	--	--	2.05	--	--	--	--	-3.02	3.72	7.01×10^{-3}	59
P_2	.511	--	--	-3.43	.331	--	-1.13	--	--	--	1.37	--	.886	1.43	--	3.22×10^{2}	109
P_5	.473	--	--	-3.59	.383	--	-1.03	--	--	--	1.32	--	.713	1.08	--	2.63×10^{3}	95
P_{10}	.467	--	--	-2.92	.414	--	-.755	--	--	--	--	--	--	--	--	4.45×10^{4}	97
P_{25}	.454	--	--	-2.00	.354	--	-.984	--	-.909	--	.896	--	--	--	--	4.85×10^{4}	99
P_{50}	.459	--	--	-1.87	.378	--	-.929	--	-1.16	--	.897	--	--	--	--	7.71×10^{4}	102