USE AND AVAILABILITY OF CONTINUOUS STREAMFLOW RECORDS IN OKLAHOMA

By Stephen P. Blumer and Leland D. Hauth

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WILLIAM P. CLARK, Secretary

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Dallas L. Peck, Director

For additional information write to:

District Chief
U.S. Geological Survey
Water Resources Division
Room 621, Old Post Office Building
215 Dean A. McGee Avenue
Oklahoma City, Oklahoma 73102

Telephone: (405) 231-4256

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CONTENTS

ILLUSTRATIONS

TABLES

FACTORS FOR CONVERTING INCH-POUND TO METRIC (SI) UNITS

Multiply inch-pound units	by	To obtain SI units
	Length	
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
cubic foot (ft^3)	0.02832	cubic meter (m^3)
	Flow	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)

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ABSTRACT

This report documents the results of the data uses and funding portion of a study of the cost-effectiveness of the streamflow information program in Oklahoma. Presently, 123 continuous surface-water stations are operated in Oklahoma on a budget of $617,120. Data uses and funding sources are identified for each of the 123 stations. Data from most stations have multiple uses.

INTRODUCTION

The U.S. Geological Survey is the principal Federal agency collecting surface-water data in the Nation. The collection of these data is a major activity of the Water Resources Division of the USGS. The data are collected in cooperation with State and local governments and other Federal agencies. The USGS is presently (1984) operating approximately 8,000 continuous-record gaging stations throughout the Nation. Some of these records extend back to the turn of the century. Any activity of long standing, such as the collection of surface-water data, should be reexamined periodically, because of changes in objectives, technology, or external constraints. The last systematic nationwide evaluation of the streamflow-information program was completed in 1970 and is documented by Benson and Carter (1973). The USGS began another nationwide analysis of the stream-gaging program in 1983 that will be completed over a 5-year period with 20 percent of the program being analyzed each year. The objective of this analysis is to define and document the most cost-effective means of furnishing streamflow information.

For every continuous-record gaging station, the analysis identifies the principal uses of the data and relates these uses to funding sources. In addition, gaging stations are categorized as to whether their data are available to users in a real-time sense, on a daily basis during flood events, on a periodic basis, or at the end of the water year. This report is a compilation of the data uses and funding sources phase of the program. The second and third phases, described below, will be completed in subsequent years.

The second phase of the program is to identify less costly alternate methods of furnishing the needed streamflow data; among these are flow-routing models and statistical methods. The stream-gaging activity no longer is considered a network of observation points, but rather an integrated information system in which data are provided both by observation and synthesis.

The final part (third phase) of the program involves the use of Kalman-filtering and mathematical-programing techniques to define strategies for the operation of the necessary stations that minimize the uncertainty in the streamflow records for given operating budgets. Kalman-filtering techniques (Moss and Gilroy, 1980) are used to compute uncertainty functions for

individual stations relating the standard errors of computation or estimation of streamflow records to the frequencies of visits to the stream gages. A steepest descent optimization program uses these uncertainty functions, information on practical stream-gaging routes, the various costs associated with stream gaging, and the total District streamgaging budget to identify the visit frequency for each station so that total uncertainty in the overall network is minimized.

History of Stream-Gaging Program in Oklahoma

The stream-gaging program in Oklahoma has evolved through the years as Federal, State, and local needs for surface-water data have increased (fig. 1). Although some records had been collected since 1899, systematic collection of streamflow records in Oklahoma by the USGS did not begin until 1903. By 1906, fourteen gaging stations had been established in the State. This early hydrologic work provided data for the determination of irrigation potential of surface waters. This study was short lived, however, as only one continuous stream gage was operated past the end of 1908. Between 1909 and 1923 there were never more than two gaging stations in operation in Oklahoma at the same time. The Federal gaging station program began rebuilding in 1924. During 1928-32, the Corps of Engineers collected streamflow data under direction of the Flood Control Act of May 31, 1924.

In 1929 the U. S. Congress approved the use of Federal funds for participation with State agencies in performing water resource studies on a cooperative basis. The Federal-State cooperative program was initiated in Oklahoma in 1935 with the Oklahoma Water Resources Board (formerly the Oklahoma Planning and Resources Board). Between 1934 and 1939 the number of continuous stream-gaging stations increased from 12 to 63. Most of this growth was due to the new association with the Oklahoma Water Resources Board; however, the Corps of Engineers also established several stations during this period to round out the new State surface-water network.

In the early 1940's the program between the U.S. Geological Survey and the Corps of Engineers was increased. Several new stations were added and by 1945 over 80 gaging stations were in operation. The results of even short-term records proved the value of these records in the design of four Federal flood-control reservoirs under construction at that time.

A cooperative surface-water quality program was established in the mid-1940's. In the years which followed, several new stream gages were established to complement this program. Data use in 1947 was primarily reservoir planning and design and the management of reservoirs already in existence. Other data furnished to Federal agencies included: rating curves for use in flood warning systems for the U.S. Weather Bureau and detailed records of stream discharge for hydrologic studies conducted by the U.S. Bureau of Reclamation and the U.S. Soil Conservation Service.

The Flood Control Act of 1944 authorized the Department of Agriculture to undertake a program to control runoff and prevent soil erosion. Although considerable runoff data had been collected during the previous two decades for larger streams, few data were available on rainfall and runoff for small watersheds of the size subject to control by the floodwater-retarding and erosion-control measures which were planned by the Soil Conservation

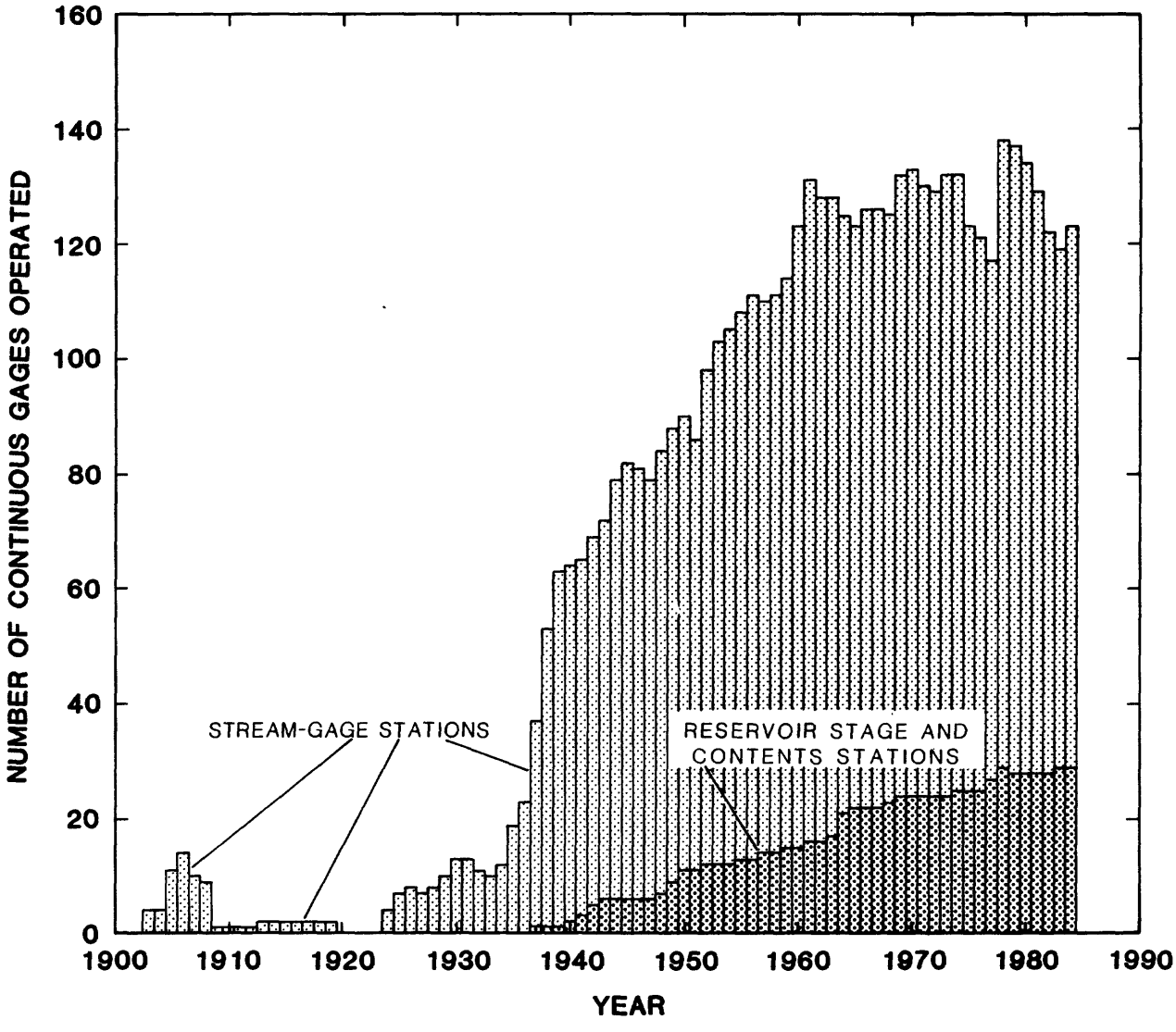

Figure 1.--History of continuous stream and reservoir gaging in Oklahoma.

Service (U.S. Department of Agriculture). Sandstone Creek in western Oklahoma was the first watershed in the nation to be controlled by these floodwater-retarding structures. Fourteen gaging stations were constructed in the 107 mi^2 study area during 1952 and 1953 and data were collected until 1974 when the project was completed.

During 1960 and 1961, seventeen continuous-record stations were added to the Oklahoma surface-water program. Several were associated with planned or recently completed Corps of Engineers reservoirs. Many were installed to measure the dissolved solids loads at numerous locations across the state. Over half the stations are still included in the 1984 program. Several additional stations were operated for short periods starting in late 1960's and early 1970's. The purpose of these stations was to expand the existing program for monitoring naturally occurring high concentrations of dissolved solids.

Both low-flow and peak-flow partial-record data-collection programs were begun in the 1960's. Neither program involved the collection of continuous record of stream discharge; low-flow measurements were made quarterly, whereas peak-flow determinations emphasized storm runoff events. The low-flow study was conducted in cooperation with Oklahoma Water Resources Board and, by the end of 1969, there were 34 stations in the program. The peak-flow partial-record program was begun in 1964 in cooperation with the Oklahoma Department of Transportation (formerly Oklahoma Department of Highways) and by the end of 1969 had 100 stations in operation.

Between 1976 and 1981, seventeen stations were operated as part of several coal hydrology studies in southeastern Oklahoma. The purpose of these studies is twofold: (1) to assess the regional hydrologic system and (2) to document and monitor any changes in the quantity and quality of surface and ground water as a result of strip mining of coal.

At present (1984) there are 123 continuous stream gages being operated on rivers and streams in Oklahoma and 29 on reservoirs.

Current Oklahoma Stream-Gaging Program

Oklahoma has, in general, an abundant water supply of good quality. Its distribution, however, is not uniform; in some areas there is a surplus of water, whereas in other areas the supply frequently is limited. Because agriculture is one of the principal industries in the State, the development of the water supplies has been, for the most part, oriented to the land. Water developments have been for irrigation, municipal supply, flood water retention, and power generation. Secondary benefits such as recreation and fishing are widely utilized at most lakes. Many gaging stations are operated in the State to monitor streamflows affected by these developments.

A considerable amount of the water supply has been allocated to development of power in the eastern part of the State, whereas only a small amount is used by industry. In 1980, the total hydroelectric power water use was estimated to be 39,000,000 acre-feet (Solley, Chase, and Mann, 1980). The 1984 combined ground water and surface water used by industry, thermoelectric power companies, municipalities, and domestic uses was projected to be 1,000,000 acre-feet annually (Oklahoma Water Resources Board, 1975).

About 900,000 acres are irrigated in Oklahoma, with approximately one-sixth by surface water and five-sixths by ground water (Solley, Chase, and Mann, 1980). Nearly one-third of the 150,000 acres irrigated by surface water are supplied by one impoundment. Lake Altus on the North Fork of the Red River supplies irrigation water to 47,000 acres. Nearly every stream in the western part of the State is affected to some extent by diversions for irrigation. Some streams, however, are affected so little that they can be considered as natural-flow streams. Several gaging stations are operated on streams affected by irrigation development to define the altered system.

For convenience, the State may be divided into 12 river basins (fig. 2). These are the same basin designations used by Stoner (1981) in a series of five reports on the water quality of Oklahoma streams. Location of continuous-record stream-gaging stations is shown in Figure 3.

The operation of the gaging-station network is shared by USGS and Corps of Engineers personnel. The U.S. Geological Survey is responsible for review and quality control. In addition, the Corps of Engineers operates some continuous stream gages as part of their own reservoir management program. Those gages are not included in this analysis.

The distribution by basin of the 123 stream gages in the Oklahoma program operated by the U.S. Geological Survey and the Corps of Engineers is as follows: Arkansas River mainstem, 8; Verdigris River, 10; Neosho River, 9; Illinois River, 5; Salt Fork Arkansas River, 5; Cimarron River, 12; Canadian River, 8; North Canadian River, 16; Deep Fork, 4; Red River mainstem, 24; North Fork Red River, 7; and Washita River, 15. The cost of operating these 123 stream gages in fiscal year 1984 was $617,120.

Reservoir content stations are not considered continuous-streamflow gages; however, because of their importance to the regulated system, they are included in figure 1. Records from 29 reservoir stage and contents stations currently are published annually by the Oklahoma District. The distribution of these reservoirs by river basin are: Arkansas River mainstem, 4; Verdigris River, 4; Neosho River, 3; Illinois River, 1; Salt Fork Arkansas River, 1; Cimarron River, 0; Canadian River, 2; North Canadian River, 4; Deep Fork, 0; Red River mainstem, 7; North Fork Red River, 1; and Washita River, 2.

Selected hydrologic data, including drainage area, period of record, and mean annual flow for the 123 stations are given in Table 1 by station number in downstream order. Table 1 also provides the official name of each stream gage. Station identification numbers used throughout this report are the last six digits of the USGS's eight-digit downstream-order station number; the first two digits of the standard USGS station number for all stations used in this report are 07.

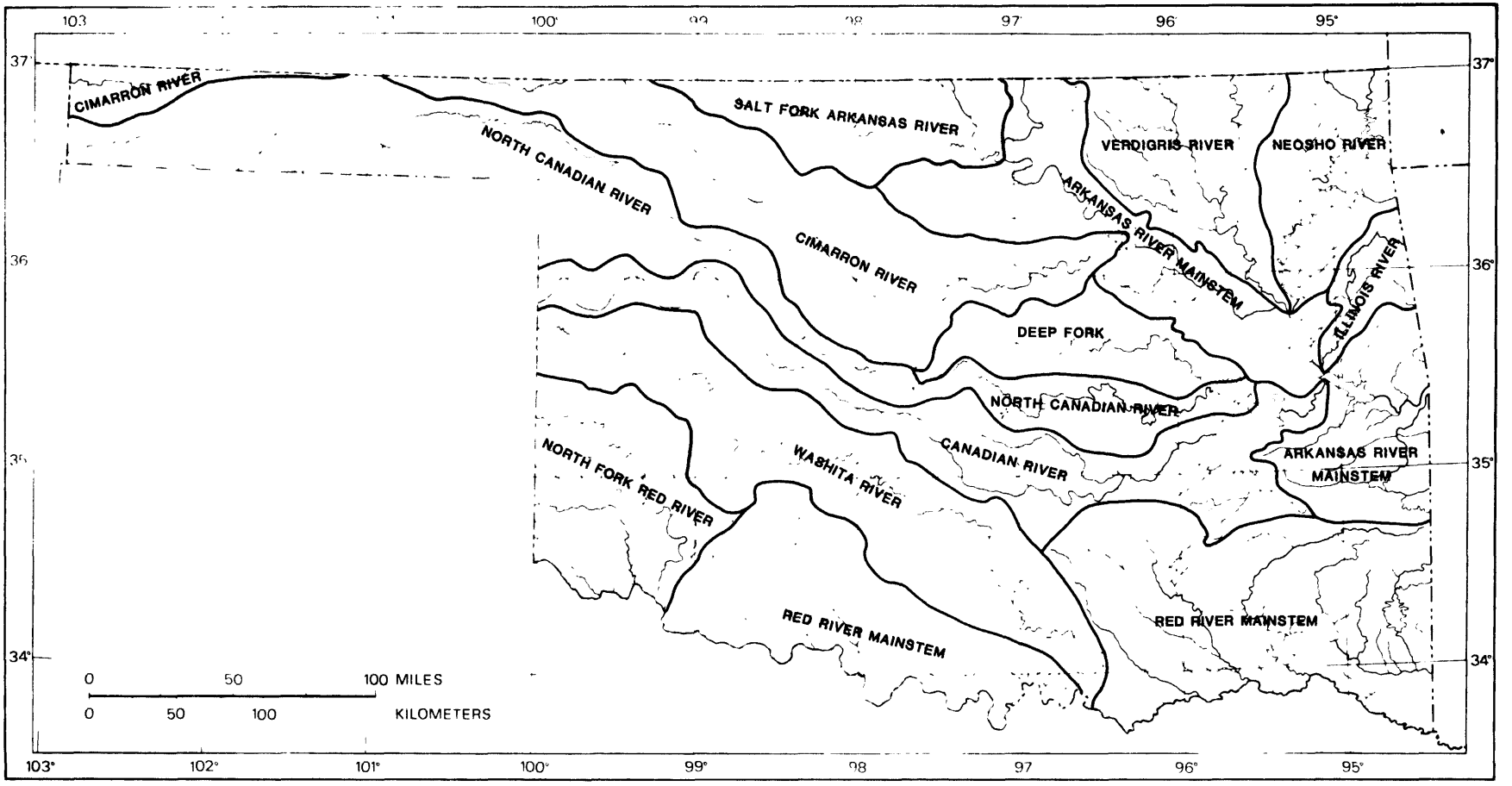

Figure 2.--River basins of Oklahoma.

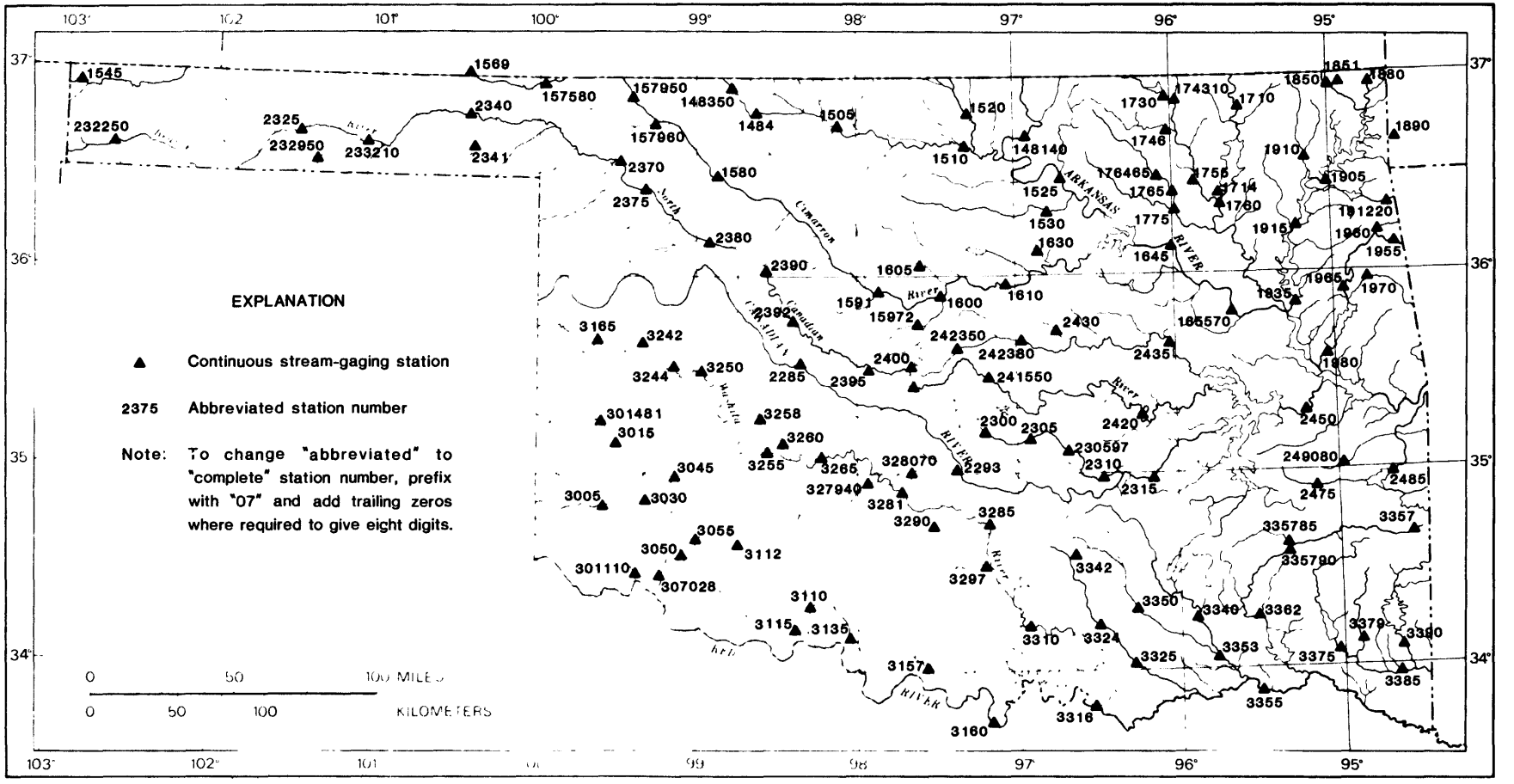

Figure 3.--Location of active stream-gaging stations in Oklahoma.

Table 1.--Selected hydrologic data for stations in the 1984 Oklahoma stream-gaging program [All stations are located in Oklahoma except as noted.]

STATION NUMBER	STATION NAME	DRAINAGE AREA (Square mile)	PERIOD OF RECORD	MEAN ANNUAL FLOW (Cubic feet per second)	
07148140	ARKANSAS R NR PONCA CITY	46,530	1977-	---	1/
07148350	SALT FK ARKANSAS R NR WINCHESTER	856	1959-	83.4	
07148400	SALT FK ARKANSAS R NR ALVA	1,009	1938-51,76-	150	
07150500	SALT FK ARKANSAS R NR JET	3,202	1937-	360	2/
07151000	SALT FK ARKANSAS R AT TONKAWA	4,528	1935-	715	2/
07152000	CHIKASKIA R NR BLACKWELL	1,859	1935-	473	
07152500	ARKANSAS R AT RALSTON	54,465	1925-	4,826 / 3,442	3/
07153000	BLACK BEAR CK AT PAWNEE	576	1944-	170	
07154500	CIMARRON R NR KENTON	1,106	1950-	22.2	
07156900	CIMARRON R NR FORGAN, KANS.	8,536	1965-	79.7	
07157580	CIMARRON R NR ENGLEWOOD, KANS.	10,096	1982-	---	1/
07157950	CIMARRON R NR BUFFALO	12,004	1960-	146	
07157960	BUFFALO CK NR LOVEDALE	408	1966-	10.5	
07158000	CIMARRON R NR WAYNOKA	13,334	1937-	333	
07159100	CIMARRON R NR DOVER	15,713	1973-	721	
07159720	COTTONWOOD CK NR NAVINA	247	1978-	---	1/
07160000	CIMARRON R NR GUTHRIE	16,892	1938-76,83-	889	
07160500	SKELETON CK NR LOVELL	410	1949-	114	
07161000	CIMARRON R AT PERKINS	17,852	1939-	1,153	
07163000	COUNCIL CK NR STILLWATER	31	1934-	10.8	
07164500	ARKANSAS R AT TULSA	74,615	1925-	6,554 / 6,790	3/
07165570	ARKANSAS R NR HASKELL	75,473	1972-	8,676	
07171000	VERDIGRIS R NR LENAPAH	3,639	1938-	2,599 / 2,369	3/
07171400	VERDIGRIS R NR OOLOGAH	4,339	1961-	2,622	2/
07173000	CANEY R NR HULAH	736	1937-	413 / 323	3/

Table 1.--Selected hydrologic data for stations in the 1984 Oklahoma stream-gaging program -- Continued.

STATION NUMBER	STATION NAME	DRAINAGE AREA (Square mile)	PERIOD OF RECORD	MEAN ANNUAL FLOW (Cubic feet per second)	
07174310	LITTLE CANEY R BLW COPAN LK NR COPAN	505	1982-	---	1/
07174600	SAND CK AT OKESA	139	1959-	66.4	
07175500	CANEY R NR RAMONA	1,955	1945-	928	
07176000	VERDIGRIS R NR CLAREMORE	6,534	1935-	3,723 / 3,725	3/
07176465	BIRCH CK BLW BIRCH LAKE NR BARNSDALL	66	1978-	---	1/
07176500	BIRD CK AT AVANT	364	1945-	191	
07177500	BIRD CK NR SPERRY	905	1938-	478	
07185000	NEOSHO R NR COMMERCE	5,876	1939-	3,435	
07185100	TAR CK AT MIAMI	52	1980-	---	1/
07188000	SPRING R NR QUAPAW	2,510	1939-	1,899	
07189000	ELK R NR TIFF CITY, MO.	872	1939-	745	
07190500	NEOSHO R NR LANGLEY	10,335	1939-	6,809	2/
07191000	BIG CABIN CK NR BIG CABIN	466	1947-	309	
07191220	SPAVINAW CK NR SYCAMORE	133	1961-	104	
07191500	NEOSHO R NR CHOUTEAU	11,546	1938-50,63-	7,491	2/
07193500	NEOSHO R BLW FT GBSN LAKE NR FT GIBSON	12,495	1950-	7,527	
07195500	ILLINOIS R NR WATTS	635	1955-	561	
07196000	FLINT CK NR KANSAS	110	1955-76,79-	113	
07196500	ILLINOIS R NR TAHLEQUAH	959	1935-	870	
07197000	BARON FORK AT ELDON	307	1948-	284	
07198000	ILLINOIS R NR GORE	1,626	1939,48,52, 54-	1,483	
07228500	CANADIAN R AT BRIDGEPORT	25,229	1944-64,69-	374	
07229300	WALNUT CK AT PURCELL	202	1965-	44.5	
07230000	LITTLE R BLW LAKE THUNDERBIRD NR NORMAN	257	1952-	58.9 / 15.1	3/
07230500	LITTLE R NR TECUMSEH	456	1943-	149 / 72.4	3/

Table 1.--Selected hydrologic data for stations in the 1984 Oklahoma stream-gaging program -- Continued.

STATION NUMBER	STATION NAME	DRAINAGE AREA (Square mile)	PERIOD OF RECORD	MEAN ANNUAL FLOW (Cubic feet per second)	
07230597	LITTLE R NR BOWLEGS	550	1983-	---	1/
07231000	LITTLE R NR SASAKWA	865	1942-	398 / 230	3/
07231500	CANADIAN R AT CALVIN	27,952	1905-07,44-	1,516	
07232250	BEAVER R NR FELT	879	1980-	---	1/
07232500	BEAVER R NR GUYMON	2,139	1937-	23.7	
07232950	COLDWATER CK NR GUYMON	1,926	1981-	---	1/
07233210	BEAVER R NR HARDESTY	4,770	1978-	---	1/
07234000	BEAVER R AT BEAVER	7,955	1937-	97.7	
07234100	CLEAR CK NR ELMWOOD	170	1965-	7.01	
07237000	WOLF CK NR FORT SUPPLY	1,739	1937-	104 / 57.1	3/
07237500	NORTH CANADIAN R AT WOODWARD	11,589	1906,38-	187	
07238000	N CANADIAN R NR SEILING	12,261	1946-	208	
07239000	N CANADIAN R AT CANTON	12,484	1937-	256 / 163	3/
07239200	N CANADIAN R NR WATONGA	12,692	1980-	---	1/
07239500	N CANADIAN R NR EL RENO	13,042	1903-08,37-	264 / 193	3/
07240000	LAKE HEFNER CANAL NR OKC	---	1944-	---	4/
07241000	N CANADIAN R BLW LAKE OVERHOLSER NR OKC	13,222	1952-68,73-	98.5	
07241550	N CANADIAN R NR HARRAH	13,501	1968-	272	
07242000	N CANADIAN R NR WETUMKA	14,290	1937-	648	
07242350	DEEP FK NR ARCADIA	105	1969-	64.0	
07242400	DEEP FK AT WARWICK	532	1984-	---	1/
07243000	DRY CK NR KENDRICK	69	1955-	19.9	
07243500	DEEP FK NR BEGGS	2,018	1938-	781	
07245000	CANADIAN R NR WHITEFIELD	47,576	1938-	6,005 / 5,063	3/
07247500	FOURCHE MALINE NR RED OAK	122	1938-	125	

Table 1.--Selected hydrologic data for stations in the 1984 Oklahoma stream-gaging program -- Continued.

STATION NUMBER	STATION NAME	DRAINAGE AREA (Square mile)	PERIOD OF RECORD	MEAN ANNUAL FLOW (Cubic feet per second)
07248500	POTEAU R NR WISTER	993	1938-	1,325 / 1,037 3/
07249080	BRAZIL CK NR WALLS	69.1	1979-81,84-	--- 1/
07300500	SALT FK RED R AT MANGUM	1,566	1905-06,38-	86.2
07301110	SALT FK RED R NR ELMER	1,878	1979-	--- 1/
07301481	N FK RED R NR SAYRE	2,159	1978-	--- 1/
07301500	N FK RED R NR CARTER	2,337	1944-62,64-	118
07303000	N FK RED R BLW LAKE ALTUS NR LUGERT	2,515	1930-32,43-50,51-62,64-	--- 5/
07304500	ELK CK NR HOBART	549	1905-08,49-	71.0
07305000	N FK RED R NR HEADRICK	4,244	1905-08,37-	455 / 263 3/
07305500	W OTTER CK AT SNYDER LK NR MT PARK	132	1903-08,51-	23.0 / 2.55 3/
07307028	N FK RED R NR TIPTON	4,681	1983-	--- 1/
07311000	E CACHE CK NR WALTERS	675	1938-68,69-	160
07311200	BLUE BEAVER CK NR CACHE	24.6	1964-	8.88
07311500	DEEP RED RUN NR RANDLETT	617	1949-	111
07313500	BEAVER CK NR WAURIKA	563	1953-	107
07315700	MUD CK NR COURTNEY	572	1960-	110
07316000	RED R NR GAINESVILLE, TEX.	30,782	1936-	2,657
07316500	WASHITA R NR CHEYENNE	794	1937-	28.6
07324200	WASHITA R NR HAMMON	1,387	1969-	27.7
07324400	WASHITA R NR FOSS	1,551	1956-57,61-	17.1
07325000	WASHITA R NR CLINTON	1,977	1935-	146 / 54.0 3/
07325500	WASHITA R AT CARNEGIE	3,129	1937-	314 / 222 3/
07325800	COBB CK NR EAKLY	132	1968-	20.3
07326000	COBB CK NR FT COBB	313	1939-	50.2 / 16.2 3/
07326500	WASHITA R AT ANADARKO	3,656	1903-08,63-	362

Table 1.--Selected hydrologic data for stations in the 1984 Oklahoma stream-gaging program -- Continued.

STATION NUMBER	STATION NAME	DRAINAGE AREA (Square mile)	PERIOD OF RECORD	MEAN ANNUAL FLOW (Cubic feet per second)
07327490	LITTLE WASHITA R NR NINNEKAH	208	1963-	28.4
07328070	WINTER CK NR ALEX	33	1964-	8.46
07328100	WASHITA R AT ALEX	4,787	1964-	373
07328500	WASHITA R NR PAULS VALLEY	5,330	1937-	676
07329000	RUSH CK AT PURDY	145	1940-53,82-	72
07329700	WILDHORSE CK NR HOOVER	604	1969-	163
07331000	WASHITA R NR DICKSON	7,202	1928-	1,351
07331600	RED R AT DENISON DAM NR DENISON, TEX.	39,720	1961-	5,684 / 4,201 3/
07332400	BLUE R AT MILBURN	203	1965-	130
07332500	BLUE R NR BLUE	476	1936-	290
07334000	MUDDY BOGGY CK NR FARRIS	1,087	1937-	864
07334200	BYRDS MILL SPNG NR FITTSTOWN	---	1959-	6.97
07335000	CLEAR BOGGY CK NR CANEY	720	1942-	464
07335300	MUDDY BOGGY CK NR UNGER	2,273	1982-	--- 1/
07335500	RED R AT ARTHUR CITY, TEX.	44,531	1906-12,36-	9,266 / 7,583 3/
07335700	KIAMICHI R NR BIG CEDAR	40.1	1965-	74.2
07335785	JACK FK AT SARDIS LAKE	275	1984-	---
07335790	KIAMICHI R NR CLAYTON	708	1980-	---
07336200	KIAMICHI R NR ANTLERS	1,138	1972-	1,449
07337500	LITTLE R NR WRIGHT CITY	645	1929-31,44-	917 / 885 3/
07337900	GLOVER CK NR GLOVER	315	1961-	446
07338500	LITTLE R BL LUKFATA CK NR IDABEL	1,226	1946-	1,622 / 1,687 3/
07339000	MOUNTAIN FK NR EAGLETOWN	787	1924-25,29-	1,291 / 1,350 3/

1/ No mean annual flow published, less than 5 years of streamflow record

2/ Post-regulation figure only, no pre-regulation data available

3/ First figure, pre-regulation; second figure, post-regulation

4/ Diversion to Lake Hefner

5/ Figure not available

USES, FUNDING SOURCES, AND AVAILABILITY OF CONTINUOUS STREAMFLOW DATA

The relevance of a stream gage is defined by the uses made of the data collected at the gage. The uses of the data from each gage in the Oklahoma program were identified by a survey of known data users. The survey documented the importance of each gage and identified gaging stations that may be considered for discontinuation.

Data uses identified by the survey were categorized into nine classes, described in the following section. The sources of funding for each gage and the frequency at which data are provided to the users were also compiled and are defined later.

Data-Use Classes

The following definitions were used to categorize each known use of streamflow data for each continuous stream gage.

Regional Hydrology

For data to be useful in defining regional hydrology, a stream gage must be largely unaffected by man-made storage or diversion. In this class of use, the effects of man on streamflow are not necessarily small, but the effects are limited to those caused primarily by land-use and climate changes. Large amounts of man-made storage may exist in the basin, provided the outflow is uncontrolled. These stations are useful in developing regionally transferable information based on the relationship between basin characteristics and streamflow.

Forty-five stations in the Oklahoma network are classified in the regional hydrology data-use category. Three of the stations are special cases in that they are designated bench-mark or index stations. The Oklahoma District operates two hydrologic bench-mark stations, Blue Beaver Creek near Cache (311200) and Kiamichi River near Big Cedar (335700), which serve as indicators of hydrologic conditions in watersheds relatively free of manmade alteration. The only index station in the State, Washita River near Dickson (331000), is used to report current hydrologic conditions.

Hydrologic Systems

Stations that can be used for accounting, that is, to define current hydrologic conditions and the sources, losses, and movement of water through hydrologic systems including regulated systems, are designated as hydrologic systems stations. They include diversions and return flows and stations that are useful for defining the interaction of water systems.

The bench-mark and index stations are included in the hydrologic systems category because they account for current and long-term conditions of each hydrologic system. Twenty-nine stations are gaged for reservoir-inflow measurement, whereas twenty-four stations are reservoir-outflow measurement sites. These stations quantify the regulated systems gaged. Thirty-six stations are gaged for State adjudication of water rights and five stations are gaged for State verification of interstate compacts. Additionally, the diversion from the North Canadian River to Lake Hefner is gaged in cooperation with the City of Oklahoma City.

Legal Obligations

Some stations provide records of flows for the verification or enforcement of existing treaties, compacts, and decrees. This category contains those stations that the U.S. Geological Survey is required to operate to satisfy a legal responsibility. The Arkansas River Compact designates the U.S. Geological Survey to operate seven gaging stations needed for the equitable distribution of water between the States of Oklahoma and Arkansas. Four stations are operated to distribute the Red River streamflow among the States of Texas, Oklahoma, Arkansas, and Louisiana. Those stations which the U.S. Geological Survey is not required to operate to satisfy a legal responsibility, but which may have State legal ramifications, such as adjudication of water rights, are included in the hydrologic systems category.

Planning and Design

Gaging stations in this category of data use are used for the planning and design of a specific project (for example, a dam, levee, floodwall, navigation system, water-supply diversion, hydropower plant, or waste-treatment facility) or groups of structures. The planning and design category is limited to those stations that were instituted for such purposes and where this purpose is still valid.

Six stations in the 1984 Oklahoma program are in the designated planning and design category. These stream gages contribute data to several future impoundment pre-planning and design studies located throughout the State.

Project Operation

Gaging stations in this category are used, on an ongoing basis, to assist water managers in making operational decisions such as reservoir releases, hydropower operations, or diversions. The project operation use generally implies that the data are routinely available to the operators on a rapid-reporting basis. For projects on large streams, data may only be needed every few days.

There are 49 stream gages in Oklahoma which are used as reservoir management stations. Many reservoirs are both monitored for upstream inflow and downstream outflow. One station, North Canadian River near Harrah (241550), is used as a monitor gage for water used in the cooling phase of electrical power generation. The gage at Byrd's Mill Spring (334200) monitors spring discharge at a municipal supply inlet for the City of Ada.

Hydrologic Forecasts

Gaging stations in this category are regularly used to provide information for hydrologic forecasting. These stations are used to make flood forecasts for a specific river reach, or periodic (daily, weekly, monthly, or seasonal) flow-volume forecasts for a specific site or region. The hydrologic forecast use generally implies that the data are routinely available to the forecasters on a rapid-reporting basis. On large streams, data may only be needed every few days.

Fifty-one stations used primarily by the National Weather Service for flood forecasting and for reservoir-inflow forecasting are included in the hydrologic-forecast category.

Water-Quality Monitoring

Gaging stations where water-quality or sediment-transport monitoring is being conducted are designated as water-quality monitoring sites. Stations operated as part of the National Stream-Quality Accounting Network (NASQAN) are included in this category. NASQAN stations are operated to define both the variability and historic trend in stream quality.

Fourteen stations in the Oklahoma program are NASQAN stations. Water-quality samples from two bench-mark stations, Blue Beaver Creek near Cache (311200) and Kiamichi River near Big Cedar (335700), are used to indicate water-quality characteristics of streams that have been and probably will continue to be relatively free of manmade influences. NASQAN stations are part of a nationwide network designated to assess water-quality trends of large streams. Additionally, 22 stations are operated to monitor sediment transport and 16 stations are designated as other water-quality monitoring sites for the measurement of various physical properties and chemical constituents for several cooperators.

Research

Gaging stations in this category are operated for a particular research or water-investigation study. Typically these are only operated for a few years.

The Tar Creek at Miami stream gage is the only station presently used in the support of research activities. Water discharging from abandoned zinc mines in northeastern Oklahoma has caused high concentrations of cadmium, lead, and zinc and low pH values in Tar Creek. Due to the complexity of this investigation and the potential hazardous discharge, this station probably will be gaged continuously for several years.

Other

In addition to the eight data-use classes described above, an additional class has been designated to provide streamflow information for recreational planning, primarily for canoeists, rafters, and fishermen. The Oklahoma District provides this type of information on an irregular basis for the Illinois River near Watts (195500).

Funding Sources

The four sources of funding for the streamflow-data program are:

1. Federal program.--Funds that have been directly allocated to the USGS.

2. Other Federal Agency (OFA) program.--Funds that have been transferred to the USGS by other Federal Agencies.

3. Cooperative program.--Funds for the cooperative program are generally provided on a 50-50 matching basis where 50 percent of the funds are provided by the USGS and 50 percent of the funds are provided by the non-Federal cooperating agency.

4. Other non-Federal.--Funds that are provided entirely by a non-Federal agency and are not matched by USGS funds.

In all four categories, the identified sources of funding pertain only to the collection of streamflow data; sources of funding for other activities, particularly collection of water-quality samples, that might be carried out at the site may not be the same as those identified herein.

Frequency Of Data Availability

Frequency of data availability refers to the times at which the streamflow data may be furnished to the users. In this category, four distinct possibilities exist. Data can be furnished (1) on a real-time basis by direct-access telemetry equipment (includes both telephone-accessed equipment and satellite-data collection platforms), (2) by telephone calls, usually daily, made from the gaging station by local observers or USGS personnel directly to the National Weather Service during floods, (3) by periodic release of provisional data, or (4) by publication through the annual data report published by the USGS for Oklahoma (U.S. Geological Survey, 1982). These four categories are designated T, C, P, and A, respectively, in table 2. In the current Oklahoma program data for 121 stations are made available through the annual report, data from 66 stations are available on a real-time basis, data from many stations are relayed directly to the National Weather Service and the Corps of Engineers, and at least some data are released on a provisional basis at the majority of stations.

Data-Use Presentation

Data-use and ancillary information are presented for each continuous-gaging station in Table 2, which is replete with footnotes to expand the information conveyed. The entry of an asterisk in the table indicates that the category of data use or type of funding applies, but no footnote is required.

Table 2.--Data use and sources of funding for each stream-gaging station in Oklahoma

STATION NUMBER	DATA USE									FUNDING				FREQUENCY OF DATA AVAILABILITY
	REGIONAL HYDROLOGY	HYDROLOGIC SYSTEMS	LEGAL OBLIGATIONS	PLANNING AND DESIGN	PROJECT OPERATION	HYDROLOGIC FORECASTS	WATER-QUALITY MONITORING	RESEARCH	OTHER	FEDERAL PROGRAM	OTHER FEDERAL AGENCY PROGRAM	COOPERATIVE PROGRAM	OTHER NON-FEDERAL	
07148140		1									2			A
07148350	*	3										4		A
07148400					5		6				2			A
07150500		1			5		6				2	7		TA
07151000		8			5	9					2			TA
07152000	*	10				9						4		TA
07152500		8			5	9	6,11			*	2	7		TA
07153000	*	8			5	9	6				2			TA
07154500	*									*				A
07156900		3										4		A
07157580		3		12			13				14	4		A
07157950		10					11,13			*		4		A
07157960	*	3										4		A
07158000		5				9					2			A
07159100		8			5	9					2			TA
07159720	*	3		12		9	6,13				14	4		A
07160000		3				9						4		A
07160500	*	3										4		A
07161000		8			5	9	6,11			*	2	7		A
07163000	*	3										4		TA
07164500		1			5	9	11,13			*	2			TA
07165570		8	15		5	9					2			TA
07171000		8			5	9					2			TAC
07171400		1									2			A
07173000		1									2			TA

1. Reservoir outflow station
2. U.S. Corps of Engineers, Tulsa District
3. Adjudication of water rights
4. Oklahoma Water Resources Board
5. Reservoir Management Station
6. Sediment-transport-monitoring station
7. Oklahoma Conservation Commission
8. Reservoir inflow station
9. Flood forecasting, National Weather Service
10. Arkansas River Compact Administration Station (Okla., Kans.)
11. Water-quality monitoring station, NASQAN program
12. Data base for impoundment design
13. Water-quality monitoring, other
14. U.S. Bureau of Reclamation
15. Arkansas River Compact Administration Station (Okla., Ark.)

* Data use or type of funding applies
T Instantaneously via telemetry
A Annually
C Daily via telephone call

Table 2.--Data use and sources of funding for each stream-gaging station in Oklahoma--Continued

STATION NUMBER	DATA USE									FUNDING				FREQUENCY OF DATA AVAILABILITY
	REGIONAL HYDROLOGY	HYDROLOGIC SYSTEMS	LEGAL OBLIGATIONS	PLANNING AND DESIGN	PROJECT OPERATION	HYDROLOGIC FORECASTS	WATER-QUALITY MONITORING	RESEARCH	OTHER	FEDERAL PROGRAM	OTHER FEDERAL AGENCY PROGRAM	COOPERATIVE PROGRAM	OTHER NON-FEDERAL	
07174310		1			5						2			A
07174600					12						2			A
07175500		3			5		13				2	4		TA
07176000			15		5	9					2			TAC
07176465		1									2			A
07176500					5	9					2			TA
07177500			15		5	9					2			TA
07185000		8				9	6				2	16		TA
07185100	*	8						17				4		A
07188000	*	8			5	9						18		TA
07189000	*	8			5							18		TA
07190500		1			5							18		TA
07191000	*				5							18		TA
07191220	*		15		5							19,20		A
07191500		1,8			5							18		TA
07193500		1	15				11			*	2			TA
07195500		8	15			9			21		2			TAC
07196000	*	15				9						4		A
07196500		3,8			5	9	6				2	4		TAC
07197000	*	3,8				9					2	4		TA
07198000		1					13				2	4		TA
07228500		3				9	13					4		A
07229300	*	3										4		A
07230000		1			5							22		A
07230500					5	9					2			A

1. Reservoir outflow station
2. U.S. Corps of Engineers, Tulsa District
3. Adjudication of water rights
4. Oklahoma Water Resources Board
5. Reservoir Management Station
6. Sediment-transport-monitoring station
8. Reservoir inflow station
9. Flood forecasting, National Weather Service
11. Water-quality monitoring station, NASQAN program
12. Data base for impoundment design
13. Water-quality monitoring, other
15. Arkansas River Compact Administration Station (Okla., Ark.)
16. City of Claremore
17. Abandoned mine water-outflow-discharge monitor
18. Grand River Dam Authority
19. Oklahoma County Health Department
20. City of Tulsa
21. Recreational planning
22. Central Oklahoma Master Conservancy District

* Data use or type of funding applies
T Instantaneously via telemetry
A Annually
C Daily via telephone call

Table 2.--Data use and sources of funding for each stream-gaging station in Oklahoma--Continued

STATION NUMBER	DATA USE									FUNDING				FREQUENCY OF DATA AVAILABILITY
	REGIONAL HYDROLOGY	HYDROLOGIC SYSTEMS	LEGAL OBLIGATIONS	PLANNING AND DESIGN	PROJECT OPERATION	HYDROLOGIC FORECASTS	WATER-QUALITY MONITORING	RESEARCH	OTHER	FEDERAL PROGRAM	OTHER FEDERAL AGENCY PROGRAM	COOPERATIVE PROGRAM	OTHER NON-FEDERAL	
07230597				12			6,13				14			A
07231000		3				9						4		A
07231500		3,8				9	6,11			*	2	4,7		TA
07232250	*	23										4		A
07232500	*	8					6				2			TA
07232950	*	3										4		A
07233210		1					6				2			A
07234000					5	9	11				2			TA
07234100	*	3										4		A
07237000		1									2			A
07237500		8			5	9	11			*	2			TA
07238000		8				9	6				2			TA
07239000		1									2			TAC
07239200					5	9					2			TA
07239500					5	9						24		TAC
07240000		25										24		A
07241000		8				9	6				2	24		TA
07241550					26		6					27		TAC
07242000		3,8				9	6,11			*	2	4,7		TAC
07242350	*			12			6,13				2			TA
07242380	*				5		6				2			TA
07243000	*									*				A
07243500	*	3,8				9	6,11			*	2	4,7		TA
07245000		1,3	15		5		11,13			*	2	4		TA
07247500	*	3					13					4		A

1. Reservoir outflow station
2. U.S. Corps of Engineers, Tulsa District
3. Adjudication of water rights
4. Oklahoma Water Resources Board
5. Reservoir Management Station
6. Sediment-transport-monitoring station
7. Oklahoma Conservation Commission
8. Reservoir inflow station
9. Flood forecasting, National Weather Service
11. Water-quality monitoring station, NASQAN program
12. Data base for impoundment design
13. Water-quality monitoring, other
14. U.S. Bureau of Reclamation
15. Arkansas River Compact Administration Station (Okla., Ark.)
23. Canadian River Compact Administration Station (Okla., Tex., N.Mex.)
24. City of Oklahoma City
25. Diversion quantification station
26. Monitoring station for water used in generation of electric power
27. Oklahoma Gas and Electric Co.

* Data use or type of funding applies
T Instantaneously via telemetry
A Annually
C Daily via telephone call

Table 2.--Data use and sources of funding for each stream-gaging station in Oklahoma--Continued

STATION NUMBER	DATA USE									FUNDING				FREQUENCY OF DATA AVAILABILITY
	REGIONAL HYDROLOGY	HYDROLOGIC SYSTEMS	LEGAL OBLIGATIONS	PLANNING AND DESIGN	PROJECT OPERATION	HYDROLOGIC FORECASTS	WATER-QUALITY MONITORING	RESEARCH	OTHER	FEDERAL PROGRAM	OTHER FEDERAL AGENCY PROGRAM	COOPERATIVE PROGRAM	OTHER NON-FEDERAL	
07248500		1									2			TA
07249080	*						13			*				A
07300500	*	3	28			9						4		A
07301110	*	3		12			11			*		4		A
07301481	*	8			5						2			TPAC
07301500	*	3,8				9						29,30		TAC
07303000		1										29,30		TA
07304500					5		13					31		A
07305000					5	9	11			*	2			TAC
07305500		1										31		A
07307028		3										4		A
07311000					5		13					32		A
07311200	33	33					33			*				A
07311500	*	3										4		A
07313500		1				9	3				2			TA
07315700	*	3										4		A
07316000		8	28			9					2			TAC
07316500	*	28										4		TA
07324200	*	8					13					34		A
07324400		1					13					34		A
07325000					5	9					2			TAC
07325500					5	9						34		TA
07325800		8										35		A
07326000		1										35		A
07326500		3			5	9						4		TA

1. Reservoir outflow station
2. U.S. Corps of Engineers, Tulsa District
3. Adjudication of water rights
4. Oklahoma Water Resources Board
5. Reservoir Management Station
8. Reservoir inflow station
9. Flood forecasting, National Weather Service
11. Water-quality monitoring station, NASQAN program
12. Data base for impoundment design
13. Water-quality monitoring, other
28. Red River Compact Administration Station (Okla., Tex., La., Ark.)
29. City of Altus
30. Lugert-Altus Irrigation District
31. Mountain Park Master Conservancy District
32. City of Lawton
33. Hydrologic bench mark station
34. Foss Master Conservancy District
35. Fort Cobb Master Conservancy District

* Data use or type of funding applies
T Instantaneously via telemetry
P Periodically
A Annually
C Daily via telephone call

Table 2.--Data use and sources of funding for each stream-gaging station in Oklahoma--Continued

STATION NUMBER	DATA USE									FUNDING				FREQUENCY OF DATA AVAILABILITY
	REGIONAL HYDROLOGY	HYDROLOGIC SYSTEMS	LEGAL OBLIGATIONS	PLANNING AND DESIGN	PROJECT OPERATION	HYDROLOGIC FORECASTS	WATER-QUALITY MONITORING	RESEARCH	OTHER	FEDERAL PROGRAM	OTHER FEDERAL AGENCY PROGRAM	COOPERATIVE PROGRAM	OTHER NON-FEDERAL	
07327490	*	3										4		A
07328070	*	3										4		A
07328100		3			5	9						4		TAC
07328500		3				9						4		TAC
07329000	*	3		12								4		A
07329700	*	3										4		A
07331000	36	8,36			5	9	6,11			*	2	7		TAC
07331600		1	28								2			A
07332400	*	3										4		A
07332500	*				5	9					2			TA
07334000					5	9					2			TA
07334200					37							38		A
07335000	*				5	9					2			TA
07335300		28										4		A
07335500		3	28		5	9					2			TAC
07335700	33	33					6,33			*	2			A
07335785		1									2			TA
07335790					5						2			TA
07336200		8									2			TAC
07337500					5						2			TA
07337900	*				5	9					2			TA
07338500					5	9					2			TAC
07339000					5	9					2			TAC

1. Reservoir outflow station
2. U.S. Corps of Engineers, Tulsa District
3. Adjudication of water rights
4. Oklahoma Water Resources Board
5. Reservoir Management Station
6. Sediment-transport-monitoring station
7. Oklahoma Conservation Commission
8. Reservoir inflow station
9. Flood forecasting, National Weather Service
11. Water-quality monitoring station, NASQAN program
12. Data base for impoundment design
28. Red River Compact Administration Station (Okla., Tex., La., Ark.)
33. Hydrologic bench mark station
36. Long term index gaging station
37. Water supply management station
38. City of Ada

* Data use or type of funding applies
T Instantaneously via telemetry
A Annually
C Daily via telephone call

SUMMARY

At present (1984) there are 123 continuous gages being operated on rivers and streams in Oklahoma at a cost of $617,120. A review of the data used in funding information presented in Table 2 indicates that the data from most stations in the Oklahoma network have multiple uses. Many of the gaging stations are used on an ongoing basis for accounting and for project operation. Although stations may have been established for one specific purpose, the availability of the data has, in itself, produced other uses for the data.

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