SUMMARY OF DATA INDICATING GAIN OR LOSS OF STREAMFLOW ACROSS OUTCROPS OF PALEOZOIC FORMATIONS IN NORTHEASTERN WYOMING, 1974-91

By William R. Glass and LaVerne G. Sultz

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CONTENTS

CONTENTS--Continued

FIGURES

FIGURES--Continued

CONVERSION FACTORS

Multiply	By	To obtain
cubic foot (ft^3)	0.02832	cubic meter
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer

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ABSTRACT

Measurement of streamflow at sites upstream and downstream from outcrops of Paleozoic formations in northeastern Wyoming began in the summer of 1974. Computed discharges were compared to determine whether the streams were receiving net discharge from the Paleozoic formations (increase in discharge between upstream and downstream sites) or whether the Paleozoic formations were receiving net recharge from streamflow (decrease in discharge between upstream and downstream sites). Financial support for the study by the U.S. Geological Survey was provided by the Wyoming State Engineer and the Old West Regional Commission.

Streamflow-gaging stations were operated at 41 locations during parts of the period, October 1974 through September 1985. Discharge measurements were made at an additional 71 miscellaneous streamflow sites primarily during steady-state, low-flow periods in the summer and fall of 1974, 1975, 1985, and 1991.

Results of the study, including geohydrologic descriptions from the literature and results of streamflow data computations at each site, are reported. Tables of streamflow data are included in the report, and hydrographs and flow-duration curves illustrate computed differences in flow between the upstream and downstream sites.

INTRODUCTION

Because of increased development of energy resources (particularly coal) during the middle and late 1970s in northeastern Wyoming, studies were begun to determine reliable sources of additional water supplies. In particular, it was important to determine the potential of the Madison Limestone of Mississippian age because of proposed large withdrawals from the Madison for municipal and industrial use and for coal-slurry pipelines. Although water from the Madison Limestone had been used for years by the oil industry and by a few municipalities, little was known about how the aquifer would be affected by increased withdrawals. Recharge to the Madison Limestone and other Paleozoic formations, which might be hydraulically connected to the Madison, was unknown. Streamflow is a probable source of recharge to these Paleozoic formations.

In northeastern Wyoming, perennial streams in the Bighorn Mountains, the Black Hills, the Laramie Mountains, and the Hartville uplift commonly either originate from or cross outcrops of Paleozoic formations (fig. 1). Where streams cross the outcrops, streamflow might decrease because water infiltrates to the formations to recharge the ground-water system or, conversely, streamflow might increase because the formations discharge water to the streams.

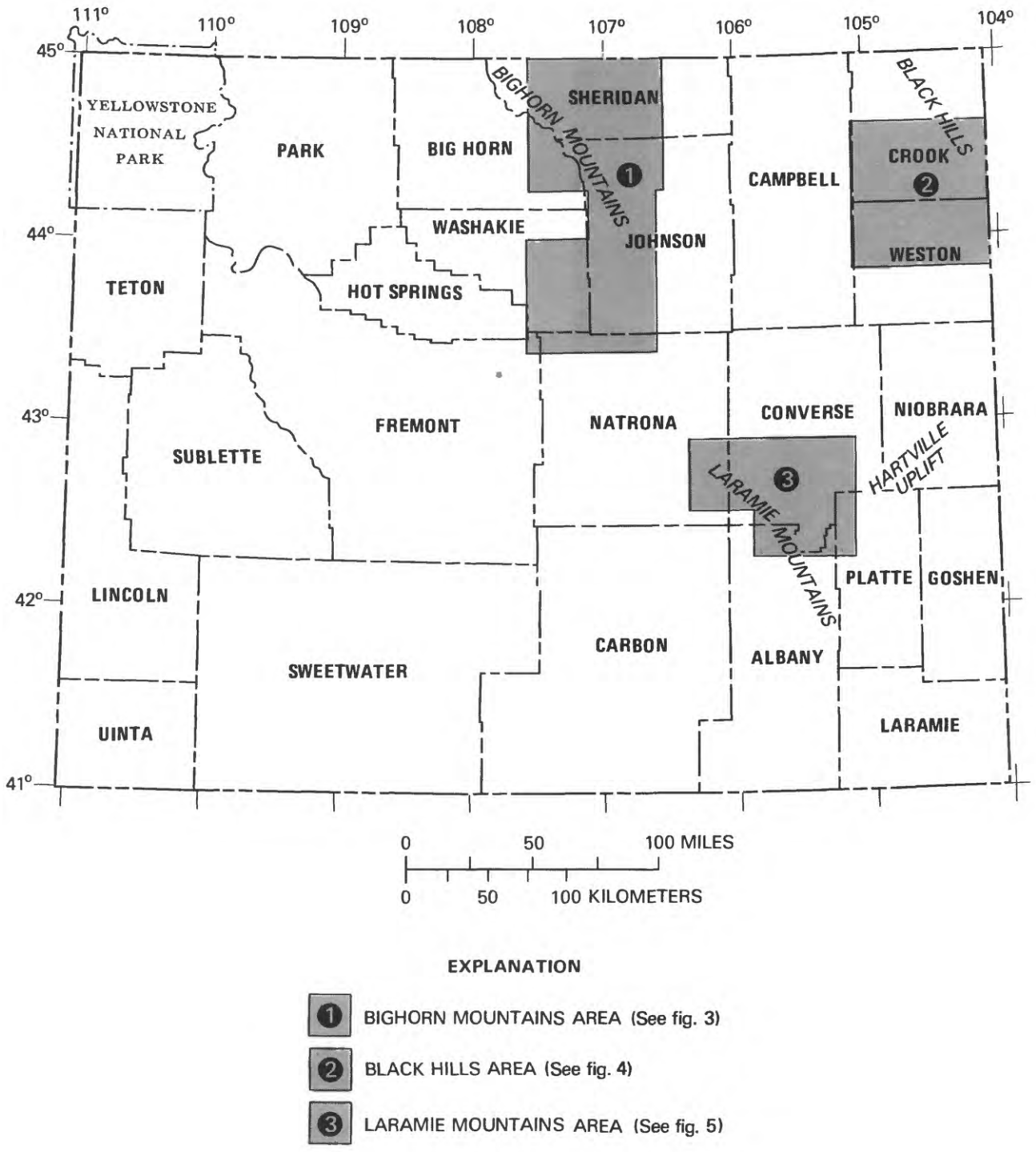

Figure 1.--Location of study areas in Wyoming.

Measurement of streamflow at sites upstream and downstream from these outcrops of Paleozoic formations began in the summer of 1974 and continued through 1985 to provide data for use in evaluating if the Paleozoic formations were receiving recharge from the streams or were discharging to the streams. The streamflow sites were again measured in the summer or fall of 1991. Additionally, four streamflow-gaging stations were reactivated in the Black Hills in April 1991, but streamflow records for 1991 are not included in this report. The authors summarize the discharge data, as computed for these sites during the study, in tables and graphs. The studies were done by the U.S. Geological Survey in cooperation with the Wyoming State Engineer. The Old West Regional Commission provided financial support for the work during 1974 and 1975.

Purpose and Scope

This report describes the streamflow-measurement sites, summarizes the streamflow data collected at these sites between 1974 and 1991, and presents the gain or loss of streamflow computed from the streamflow data. The streamflow-measurement sites were located upstream and downstream of outcrops of Paleozoic formations in the Bighorn Mountains area, Black Hills area, and Laramie Mountains area (fig. 1). The only streamflow-measurement sites discussed in this report are those identified during the reconnaissance in 1974 by Boner and others (1976). They investigated only one stream, Rawhide Creek, in the Hartville uplift, which was dry and showed no recent signs of flow in June 1974 (Boner and others, 1976, p. 16).

Most of the descriptions of the sites, including a summary of the geohydrology at the site and additional remarks, are from Boner and others (1976, p. 1-63), who described the sites in more detail on the basis of the 1974 geohydrologic reconnaissance of the streamflow-measurement sites and reported the discharges measured at the sites during 1974. The descriptions of the geology and hydrology of the study areas by Boner and others (1976) are included in this report.

The streamflow data are summarized in this report for streamflow-gaging stations and miscellaneous streamflow-measurement sites. For the streamflow-gaging stations, the streamflow data, which is summarized in tables and graphs, comprise measured discharge and computed monthly and annual mean discharge; mean monthly discharge is plotted as hydrographs, and the duration of daily mean discharge for period of record is shown by flow-duration curves. For the miscellaneous streamflow-measurement sites, discharges measured at these sites are listed in tables.

The computed gains and losses listed in tables or shown in graphs in this report were determined simply as either the difference between discharge measured at upstream and downstream sites at streamflow-gaging stations and miscellaneous streamflow-measurement sites or the difference between monthly mean and annual mean discharge computed for streamflow-gaging stations. All computed gain and loss values in this report are affected by inherent inaccuracies in discharge computations. No evaluation is made of the gains or losses on the basis of discharge-measurement or streamflow-record accuracy to determine if part or all of the gain or loss is an actual gain or loss or merely a difference resulting from inaccuracy of measurements or records; however, accuracy of the records and computed gains and losses are discussed

in general. No attempt is made to establish regional gain or loss relations, correlate gain or loss with precipitation, nor try to identify gain or loss with individual members of the Paleozoic sequence where measurement sites spanned more than one member of the sequence.

Acknowledgments

On behalf of the U.S. Geological Survey and the Wyoming State Engineer, the authors thank the many landowners who allowed access through their properties, which permitted construction and operation of the streamflow-gaging stations and measurement of streamflow.

STREAMFLOW GAIN AND LOSS STUDY

The study began with a geohydrologic reconnaissance during the summer of 1974. Thirty-two streamflow-gaging stations were installed during late summer and fall of 1974 to monitor continuous streamflow. No locations were selected in the Hartville uplift area. In addition, six existing streamflow-gaging stations were used in the study, and three stations were installed in March and April 1981 on Box Elder and Cottonwood Creeks in the Glenrock area. The four streamflow-gaging stations in the Black Hills area were reactivated in April 1991 to monitor effects of increased municipal withdrawals in the area. Most of the continuous-recording stations were operated for either two water years (1975 and 1976) or five water years (1975-79); a few stations were continued through 1985, to define long-term trends. (From October 1 to the succeeding September 30 represents a specific water year of the latter date, a period that best describes hydrologic cycles of precipitation and streamflow.)

An additional 66 miscellaneous streamflow-measurement sites were measured three times during low-flow periods in 1974 and 1975. At various times during the study, discharge at five additional sites also was measured to determine streamflow gain or loss across outcrops of the Paleozoic formations. The discharge was measured again at miscellaneous streamflow-measurement sites and all discontinued streamflow-gaging stations during the summer or fall of 1985, and again in 1991, to determine if changes in the trend of streamflow gains or losses had occurred since previous measurements.

Station and Site Selection

[Much of this section is paraphrased from Boner and others (1976, p. 6).]

Although the Madison Limestone contains the aquifer of major interest, the Paleozoic sequence generally is in hydraulic connection, particularly where fracturing occurs in the formations adjacent to the Madison. Therefore, in the northern and central parts of the Bighorn Mountains and in parts of the Laramie Mountains, streamflow was measured at sites as near as possible to the base of the Flathead Sandstone of Cambrian age, and as near as possible to the top of the Tensleep Sandstone (Casper Formation in the Laramie Mountains) of Pennsylvanian and Permian age. This was not possible, or desirable, at all measurement sites because unstable channel conditions and poor streamflow-measuring conditions at some of the sites at geologic contacts required locating the streamflow-gaging stations or miscellaneous streamflow-measurement sites either upstream or downstream of the geologic contacts. In the Black Hills, streamflow was measured at sites on the Englewood Limestone

of Devonian age and Lower Mississippian age, the Pahasapa Limestone of Lower Mississippian age or the Minnelusa Formation of Pennsylvanian age, and on the Minnekahta Limestone or Spearfish Formation of Permian age. The stratigraphic relation of the Paleozoic formations in the Bighorn Mountains, the Black Hills, and the Laramie Mountains is shown in figure 2. To monitor changes in flow in a stream between an upstream and downstream site, tributary inflow and streamflow diversions between the two sites had to be measured on many streams in addition to streamflow at the two sites.

The location of streamflow-gaging stations and of miscellaneous streamflow-measurement sites used in the study areas is shown in figures 3 (Bighorn Mountains), 4 (Black Hills), and 5 (Laramie Mountains). The location of sites and streamflow data are listed in the summaries of stream discharge and of gain and loss data for streamflow-gaging stations at the back of this report.

Data Collection

Streamflow-gaging stations related to this study were operated at 41 sites for parts of the period October 1974 to September 1985. Stage record at streamflow-gaging stations was collected by continuous graphic recorders or fixed-interval, digital-punch recorders (15-minute or 30-minute stage punches) or both. Originally 26 servomanometer units, floats in 8 stilling wells, and 4 pressure transducers were used to sense the stage and activate the recorders. During the study, five manometers and three transducers were replaced by eight stilling wells, and the remaining transducer was replaced by a manometer. Two stilling wells and a manometer were used on the gaging stations installed in 1981. Generally, the stilling-well gages produced the best stage record but were not suitable for streamflow-gaging stations where cold weather caused water in the wells to freeze. The gages were serviced 10 to 14 times per year.

At each visit, streamflow was measured so that the correlation of stage with discharge could be determined for each streamflow-gaging station. The discharge measurements were made according to standard U.S. Geological Survey procedures (Rantz and others, 1982, p. 80) using either standard AA or pygmy velocity meters, except where the stream was unwadable because of excessive depth, rapid velocity of flow, or other reasons. When this occurred, dye-dilution methods were used. Indirect-discharge methods were needed in only two instances to extend the stage-discharge relations more than 100 percent above area-velocity or dye-dilution definitions of discharge.

In addition to the streamflow data collected at the continuous-record stations, discharge measurements were made at an additional 71 miscellaneous streamflow-measurement sites. Streamflow was measured at these sites primarily during relatively steady-state low-flow periods during the summer and fall of 1974, 1975, 1985, and 1991 so that trends of gain or loss of streamflow could be determined within measurement accuracy. Figures 6-8 are presented to show comparison among flows in 1974, 1975, 1985, and 1991, primary years when streamflow was measured at the miscellaneous streamflow sites, with mean flow for period of record for a long-term station in each of the three study areas. Monthly mean flows are compared for streamflow stations, as follows: 06318500 Clear Creek near Buffalo, Wyo. (Bighorn Mountains--fig. 6); 06394000 Beaver Creek near Newcastle, Wyo. (Black Hills--fig. 7); and 06647500 Box Elder Creek at Boxelder, Wyo. (Laramie Mountains--fig. 8).

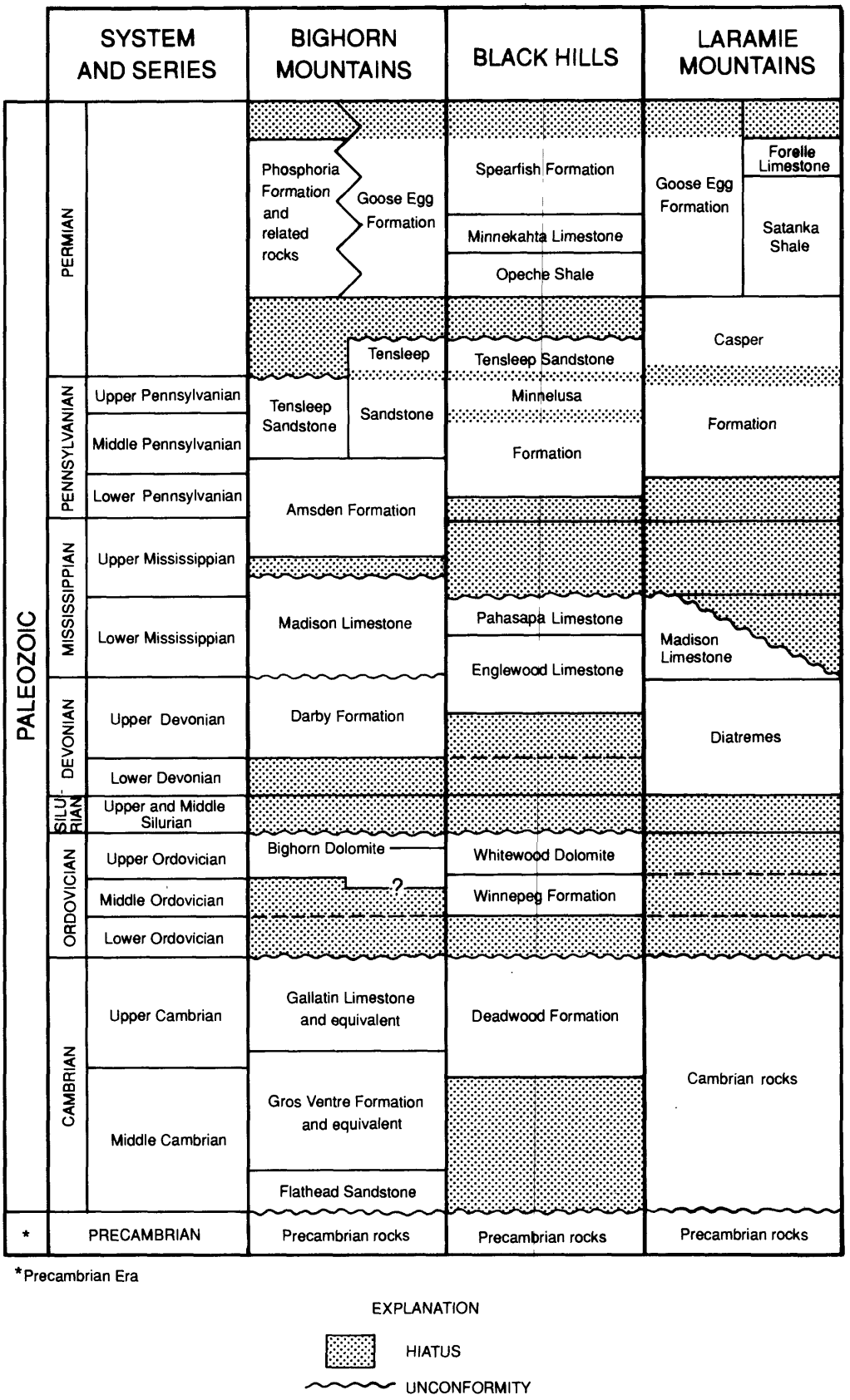

Figure 2.--Stratigraphic chart of the Paleozoic formations in the Bighorn Mountains, Black Hills, and Laramie Mountains (from Love, Christiansen, and Ver Ploeg, 1987).

At times streamflow measurements were made for related sites on different days due to limited access, distance, and topography between sites (many sites in the Bighorn and Laramie Mountains are above, at mouth of, or in canyons traversing steep foothills). In those instances, gain or loss is computed and shown in data tables in the back of this report if flows were thought to be stable through dates of the measurements.

Computation of Streamflow Records

Streamflow-record computation is the process of converting a daily record of stage (gage height) to discharge. The daily records of gage height are obtained from recorders at the gaging stations. The gage-height records are removed monthly from the graphic-stage and digital-stage recorders and are processed in an office. Graphic charts are processed and computed manually, but digital punch tapes are processed by computer.

A rating curve, referred to as a stage-discharge relation, is developed for each gaging station to convert gage heights to discharges. The rating curve, a plot of discharge as a function of gage height, is based on measurements of discharge and of gage height. To adequately define a rating curve, numerous discharge measurements are needed for a range of gage heights and discharges (Boner and others, 1976, p. 6).

Daily mean discharges are computed from the gage-height record using the gage-height and discharge tables and variations from the tables indicated by recent gage-height and discharge measurements. If the stage-discharge relation is subject to change because of frequent or continual change in the physical features that form the hydraulic control at the gaging station, the daily mean discharge is determined by the shifting-control method. As part of this method, correction factors based on the individual discharge measurements and notes of the personnel making the measurements are applied to the gage heights before the discharges are determined from the curves or tables. This shifting-control method also is used if the stage-discharge relation is changed temporarily because of aquatic growth or debris on the control. For some stations, formation of ice in the winter might obscure the stage-discharge relations so that daily mean discharges need to be estimated from other information, such as temperature and precipitation records, notes of observations, and records for other stations in the same or nearby basins for comparable periods (Druse and Rucker, 1986, p. 13).

For some gaging stations, there are periods when no gage-height record is obtained, or the recorded gage height is so faulty that it cannot be used to compute daily discharge. Gage height is not recorded if the recorder stops or fails to operate properly, if the stilling-well intakes are plugged, or if the recorder float is frozen in the well. For such periods, the daily mean discharges are estimated from the recorded range in gage height, previous or following record, discharge measurements, weather records, and comparison with other station records from the same or nearby basins. Monthly mean and annual mean discharges listed in the data tables in the back of this report are the arithmetic mean of the daily mean discharges.

The streamflow records are computed, and daily, monthly, and yearly values of discharge are published by water year in the annual water-data reports, by the U.S. Geological Survey (1975 and 1976-92).

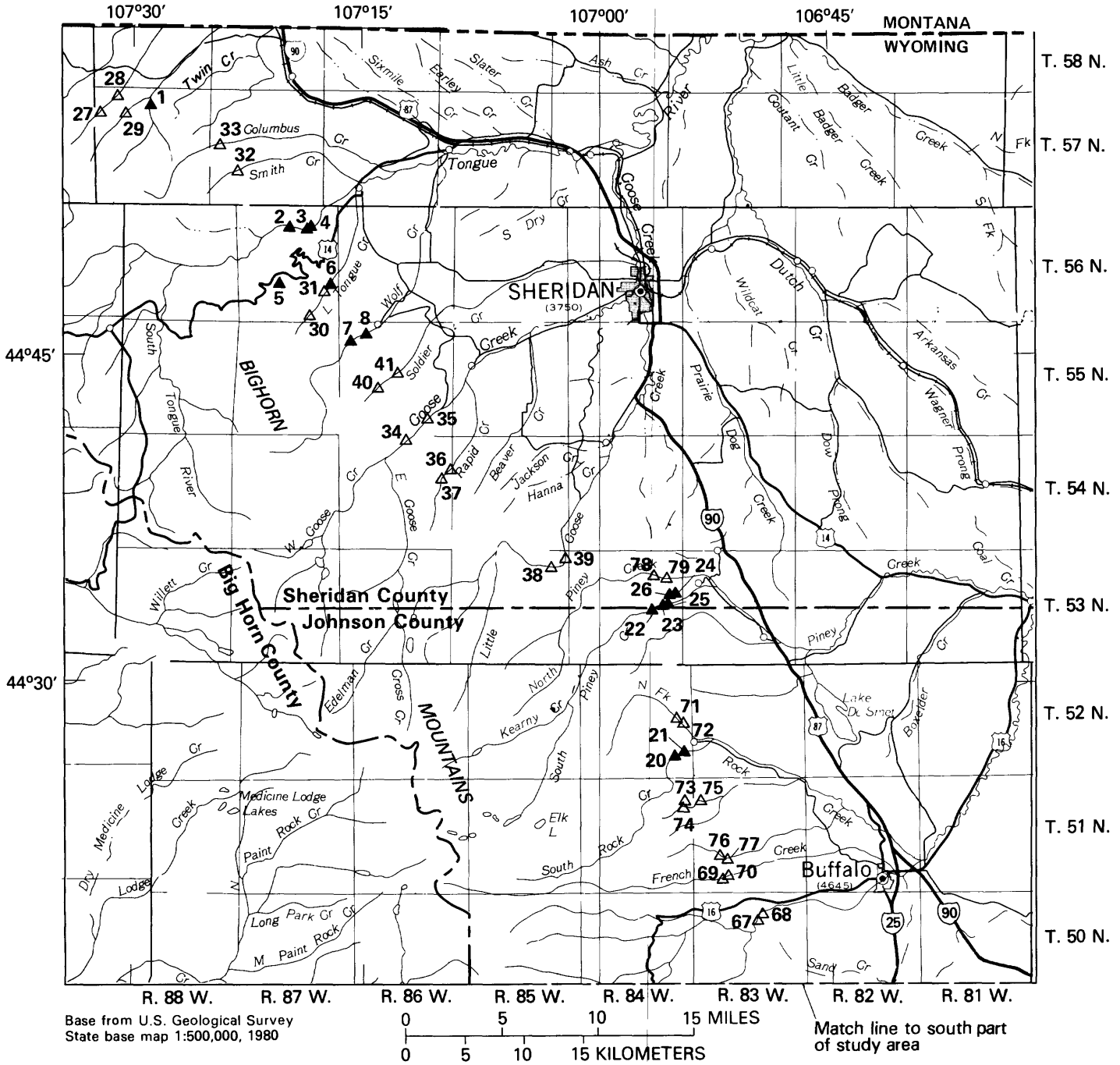

Figure 3.--Location of streamflow-measurement sites in the Bighorn Mountains.

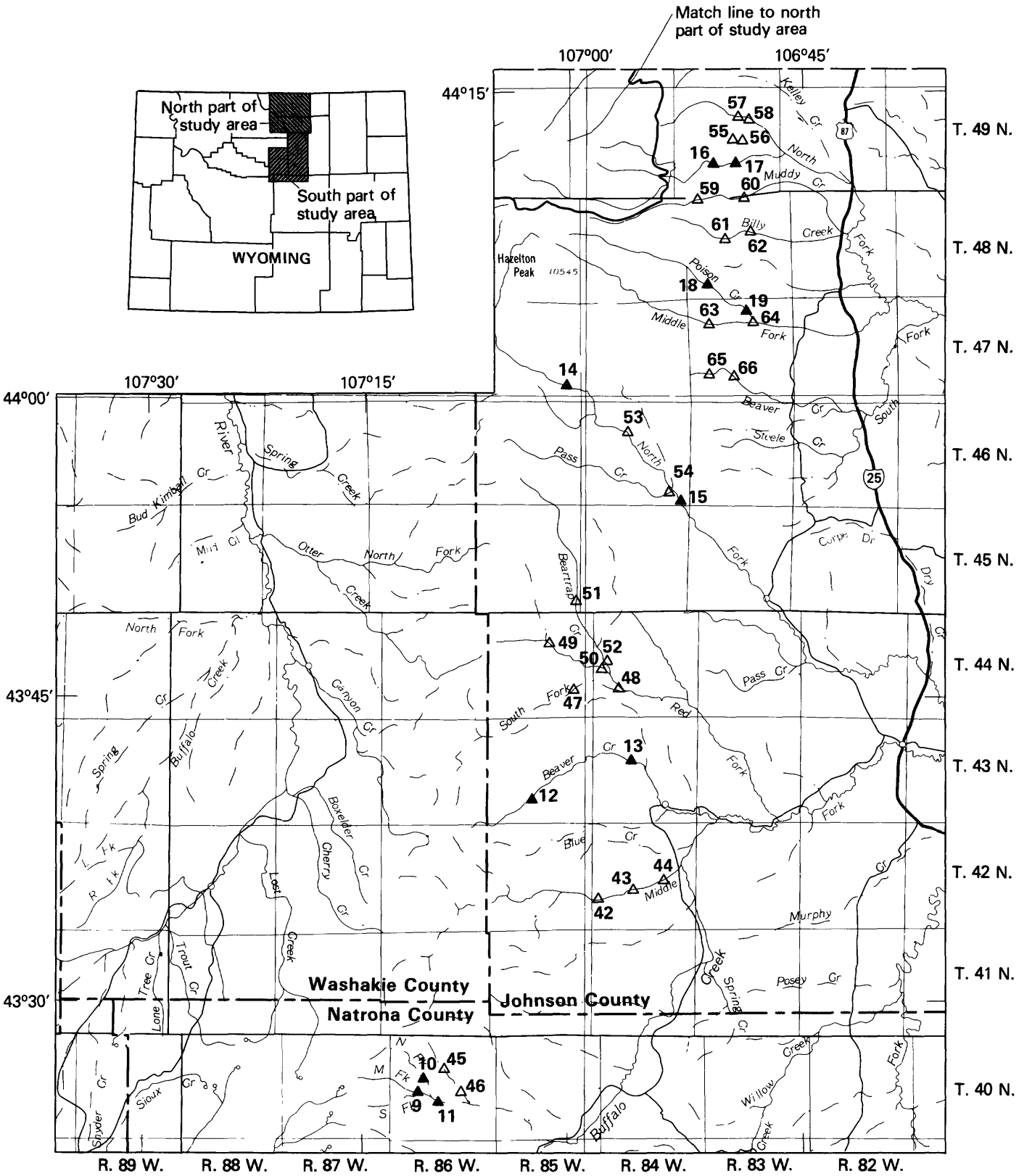

Figure 3.--Location of streamflow-measurement sites in the Bighorn Mountains--Continued.

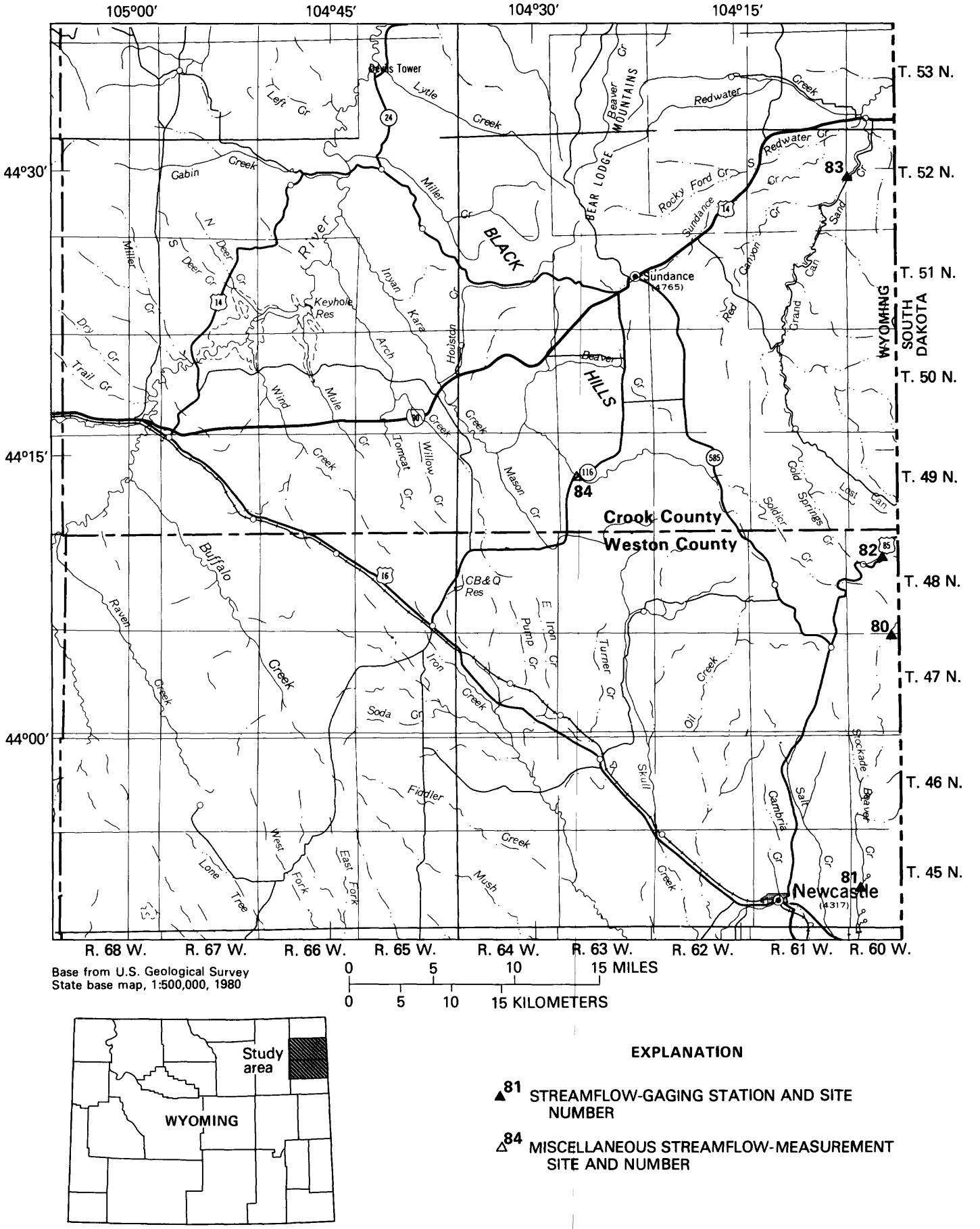

Figure 4.--Location of streamflow-measurement sites in the Black Hills.

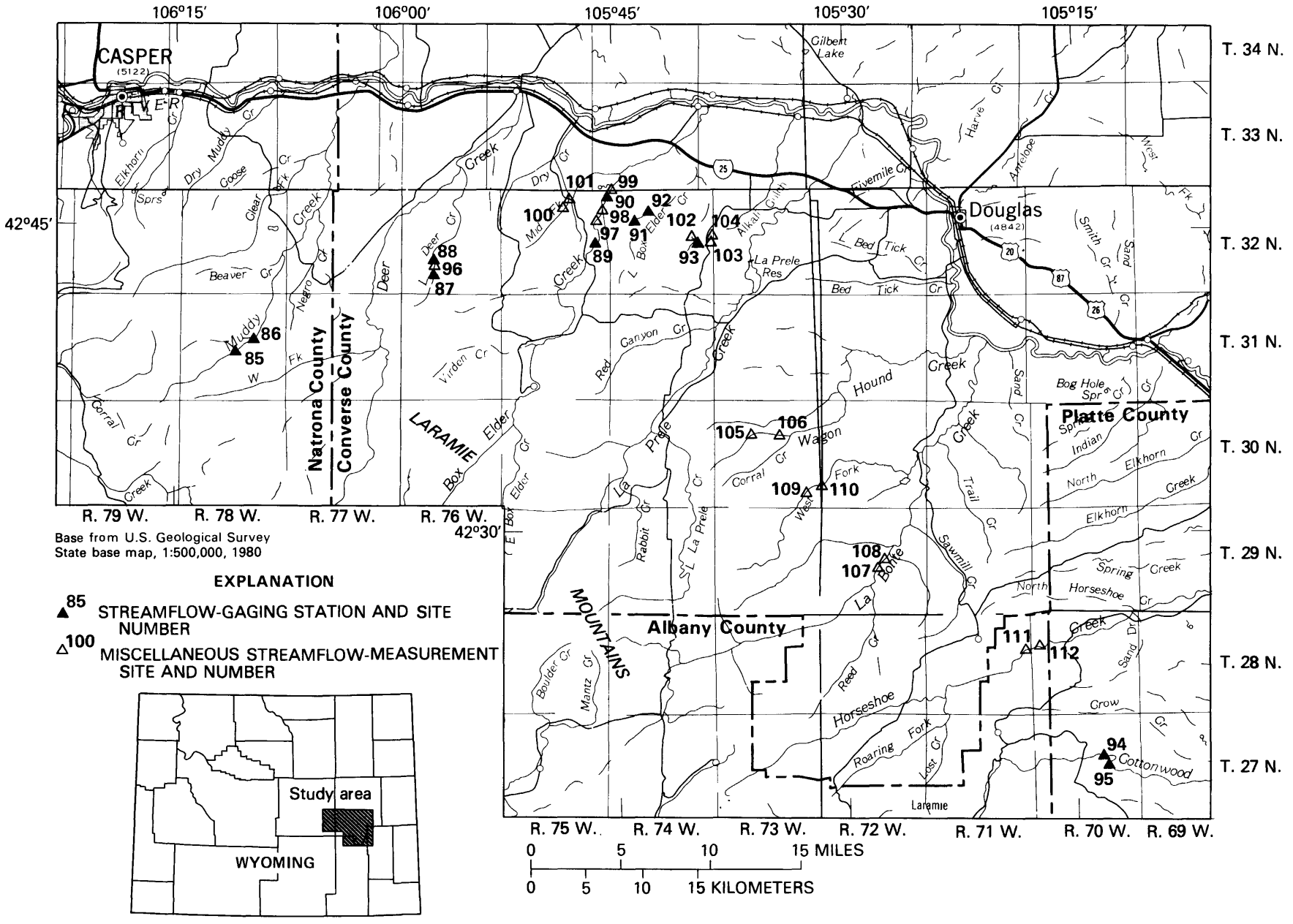

Figure 5.--Location of streamflow-measurement sites in the Laramie Mountains.

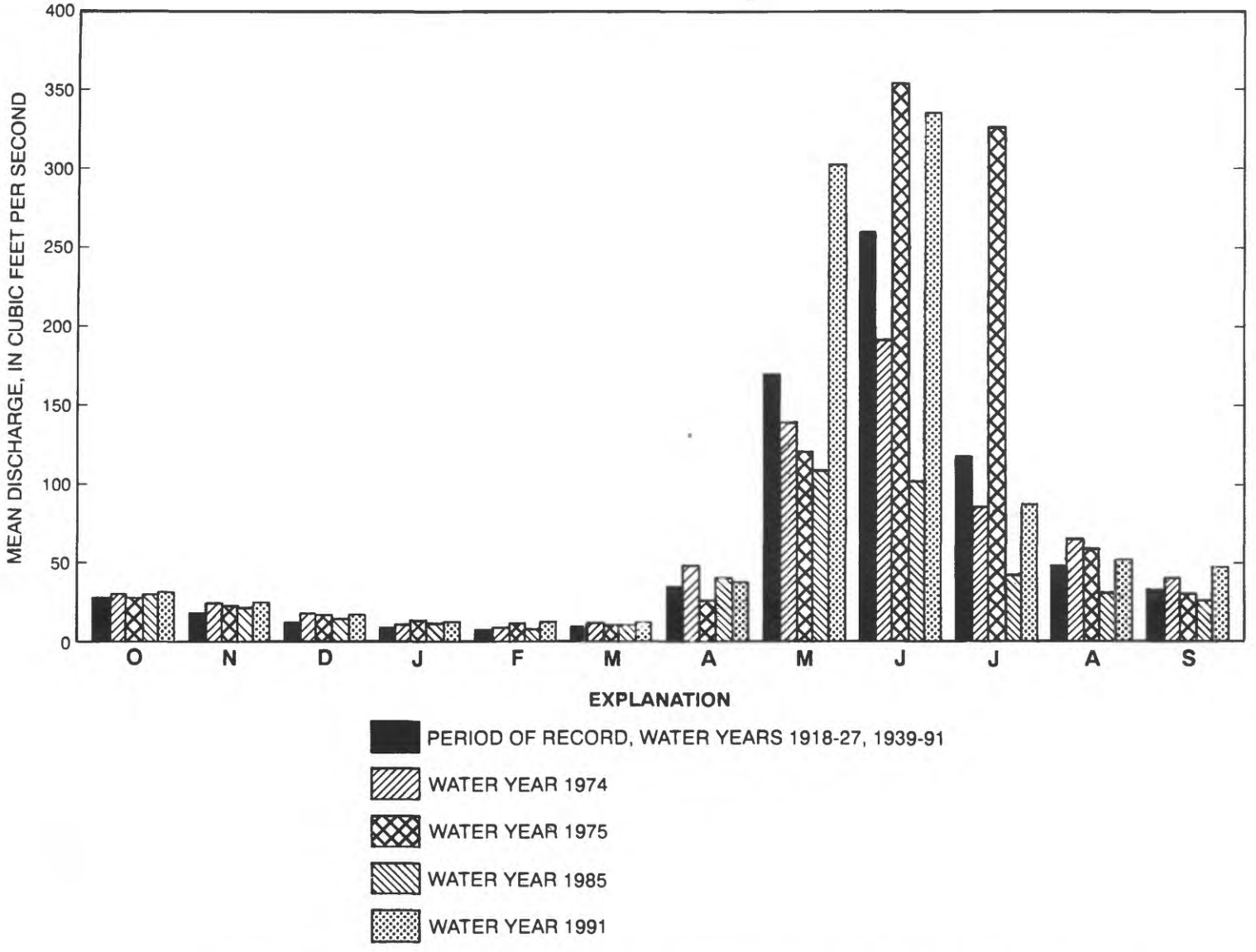

Figure 6.--Monthly mean discharge at streamflow-gaging station 06318500 Clear Creek near Buffalo, Wyo., Bighorn Mountains.

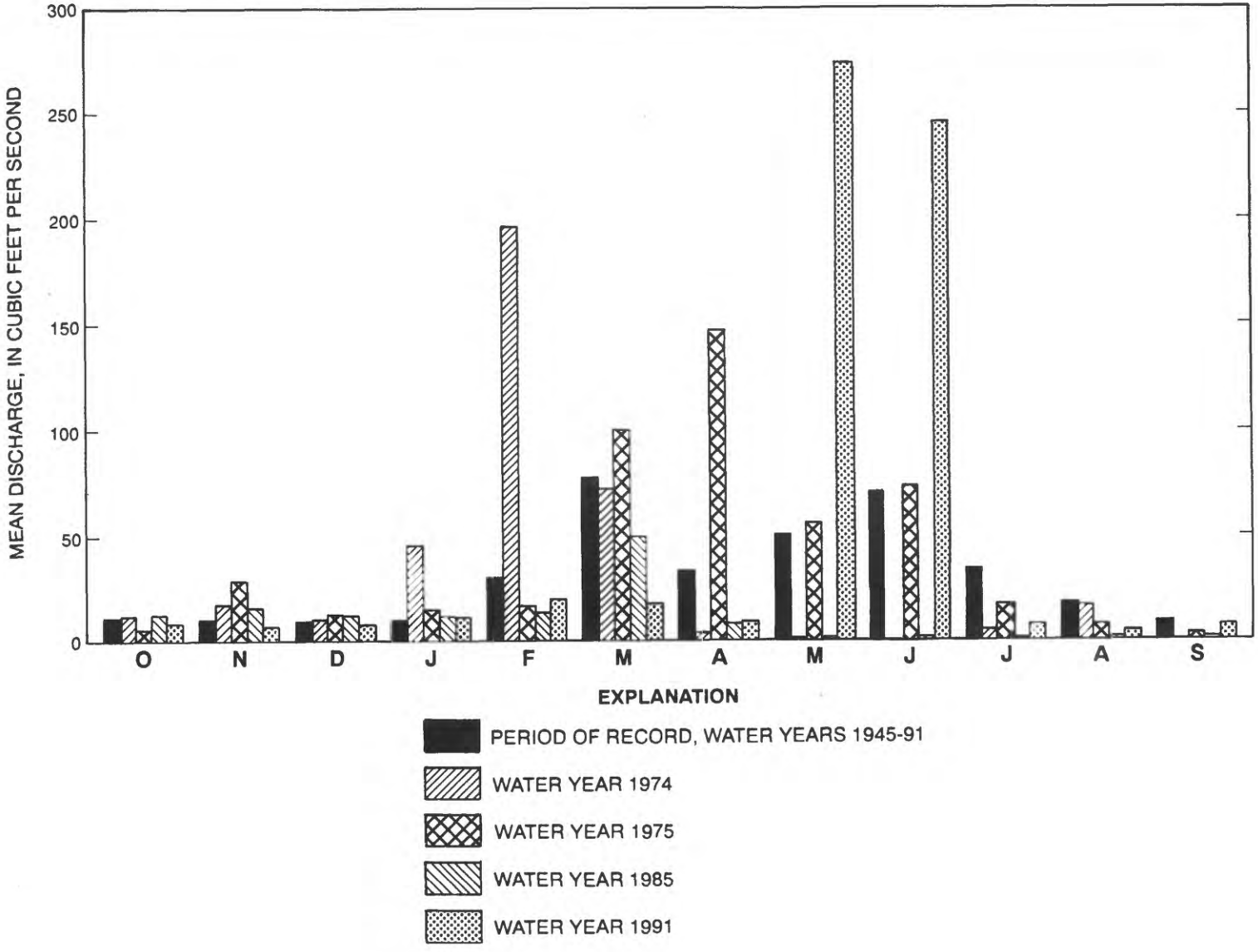

Figure 7.--Monthly mean discharge at streamflow-gaging station 06394000 Beaver Creek near Newcastle, Wyo., Black Hills.

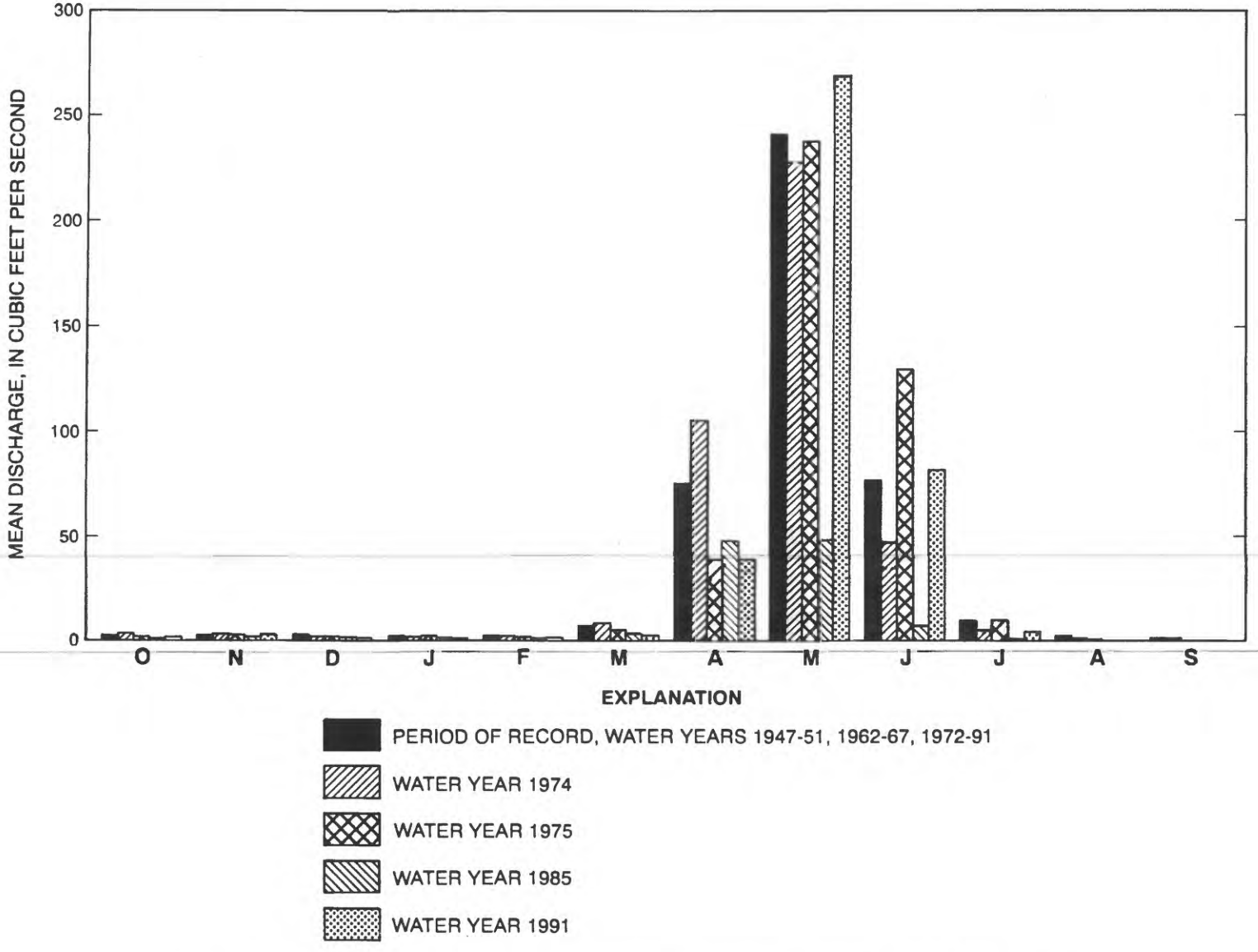

Figure 8.--Monthly mean discharge at streamflow-gaging station 06647500 Box Elder Creek at Boxelder, Wyo., Laramie Mountains.

Accuracy of Streamflow Records, Measurements, and Computed Gain or Loss

At the time each record is computed, checked, and reviewed, all aspects of the reliability of the record are assessed. The accuracy rating assigned to each annual streamflow record is recorded in the annual water-data reports (U.S. Geological Survey, 1975 and 1976-92).

Four accuracy classifications are used to rate station records. A rating of excellent means that about 95 percent of the daily mean discharges are within 5 percent of the true discharge; good, within 10 percent; fair, within 15 percent; and poor means that 95 percent of the daily mean discharges might be in error by more than 15 percent (Novak, 1985, p. 65).

The accuracy classification of a station record is a subjective evaluation that depends primarily on the stability of the stage-discharge relation, the completeness and reliability of the gage-height record, and the frequency and reliability of gage-height and discharge measurements. Accuracy of discharge values computed for special conditions, such as backwater, ice effect, unstable control, or periods of no gage-height record, usually is less than that for stable stage-discharge conditions.

Accuracy of most of the streamflow-gaging station records published in this report is considered to be good or fair except for periods of missing record or for periods affected by backwater from ice; for such periods, accuracy is less than fair. Particular care was taken at the streamflow-gaging stations to obtain accurate discharge records so that gains or losses in the streamflow could be determined; however, at streamflow-gaging stations where the gain or loss of streamflow was less than 10 percent of the total flow, the reliability of the computed gain or loss might be uncertain.

Accuracy of discharge measurements can be affected by the condition of the measurement equipment, by the geometric and roughness characteristics of the measurement section, by changes in stage, by irregular vertical-velocity distributions, and by other factors (Rantz and others, 1982, p. 179). Discharge measurements made during this study were generally rated good (an error of less than ± 5 percent) or fair (an error of less than ± 8 percent), and a small number of measurements were rated poor (an error of greater than ± 8 percent). Because of measurement errors, a single pair of measurements might not be sufficient to determine if a gain or loss occurs in a reach, especially if the gain or loss is a small percentage of the discharge (Boner and others, 1976, p. 6).

The users of the values of computed gain or loss of streamflow that are given in this report need to be aware of the accuracy limitations of these values and need to consider the overall effect that small percentage errors at high flow might have on the values of gain or loss of streamflow computed from annual mean discharge. For example, if an error of 5 percent occurred during a high-flow month when the mean discharge was 200 ft^3/s, an error of 10 ft^3/s would occur in the mean discharge for the month. A similar 5-percent error during a low-flow month, when the mean discharge might have been 5 ft^3/s, would result in an error in the mean discharge of only 0.25 ft^3/s. Though the percentage error in these two theoretical cases was the same, 5 percent, the error during the high-flow month would change the annual mean discharge, and thus the gain or loss computed from it, 40 times more than would the error during the low-flow month.

Considering the accuracy of the discharge records as percentage errors (magnitude of error divided by true discharge and multiplied by 100) also illustrates that a loss in discharge of 5 ft^3/s would be better defined at low flow than it would be at high flow.

Because station-record errors, which are based on the accuracy of the values of daily mean discharge, are random in time and space, trends of streamflow gains and losses based on the difference between monthly discharges at upstream and downstream streamflow stations will have less error than individual values of daily mean discharge.

At most of the sites in this report, streamflow primarily originates from snowmelt or from springs. Rainfall at times contributed runoff between the gaging-station pairs and affected daily streamflow gain or loss computations, but the runoff from rainfall generally was infrequent and did not have a significant effect on most monthly and annual computations of streamflow gain or loss.

SUMMARY

Measurement of streamflow in perennial streams at sites upstream and downstream from outcrops of Paleozoic formations began in the summer of 1974, continued through 1985, and was resumed again at selected sites, in 1991. Results of the data collection previously reported in Boner and others (1976) and in the annual streamflow-data reports for Wyoming (U.S. Geological Survey, 1975 and 1976-92) are summarized, compiled, and illustrated by graphs in this report.

The computed monthly mean and annual mean discharge is listed in data tables for the period of record through 1985 for each streamflow-gaging station and is followed by computed values of gain or loss of streamflow between the upstream and downstream sites. Results of comparative discharge measurements and computed gain or loss of streamflow are listed in tables for the streamflow-gaging stations outside the period of continuous gage-height record and for miscellaneous streamflow-measurement sites during the period of the study. Monthly mean discharge hydrographs, annual mean discharge graphs, and flow-duration graphs show trends of streamflow and the computed net gain and loss of streamflow in the reach between streamflow gages.

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PRESENTATION OF DATA

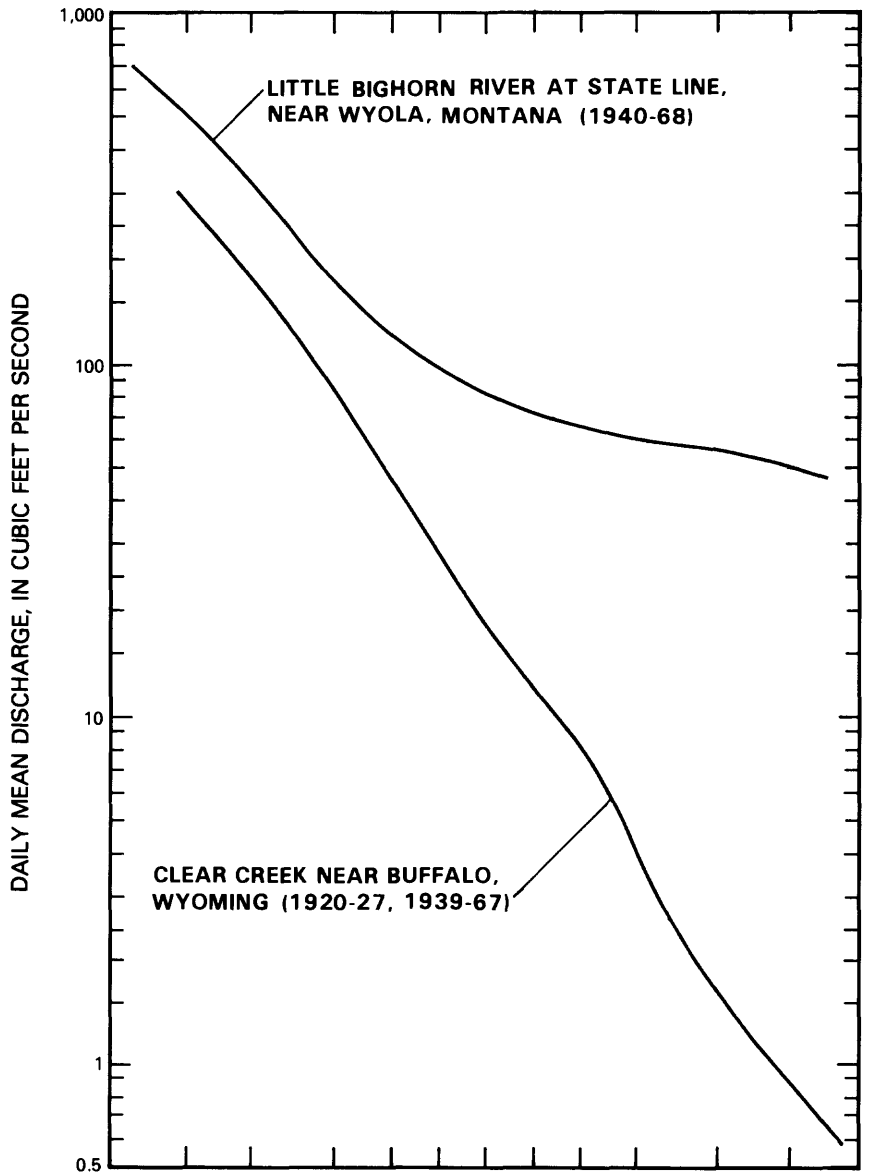
Descriptions of streamflow-measurement sites and streamflow data collected in this study are summarized, by geographic area, in tables and graphs in the following pages of this report. Site descriptions, results of discharge measurements made in 1974, 1975, 1985, and 1991, and the computed gain or loss in streamflow indicated by those measurements between the upstream and downstream sites are presented. Site descriptions comprise the location, drainage area, period of record, gage information, geohydrology, and remarks related to hydrologic conditions found at the site. Much of the information in the site description, including most of the descriptions of the geohydrology at the site, is from Boner and others (1976). An expanded discussion of the geohydrology of each site is in Boner and others (1976); however, additional or revised descriptions of geohydrology and additional information in remarks, both based on observations made during the data collection in this study, are given in the site descriptions of this report.

For the paired streamflow-gaging stations, comparative annual mean discharge and monthly mean discharge are given in tables and graphs that indicate computed streamflow gains or losses for the respective period of record. The yearly tables of daily streamflow are not included in this report but may be obtained from U.S. Geological Survey offices in Cheyenne, Casper, or Riverton, Wyo.

Flow-duration curves are presented to illustrate the range and types of streamflow that occurred at each site for the period of record. The following description of flow-duration curves is paraphrased from Boner and others (1976, p. 17). The shape of flow-duration curves for streams originating in an area of Precambrian crystalline rocks, where streams derive much of their flow from snowmelt and rainfall runoff, usually is different from those for streams that derive much of their flow from ground water. The flow-duration curve of a stream in areas of Precambrian rocks typically is steep because most of the snowmelt enters the stream rapidly and directly rather than from a ground-water reservoir. In areas underlain by extensive aquifers, such as those in some Paleozoic formations, much of the snowmelt recharges a ground-water reservoir; this water commonly is discharged to the streams more slowly and over a much longer period of time. The flow-duration curves for these streams that receive snowmelt and rainfall runoff are steeper than curves for streams that receive ground-water contributions. This difference in the shape of the flow-duration curves for the two types of streamflow is illustrated by figure 9, which shows the flow-duration curves for the Little Bighorn River, which drains an area underlain mostly by Paleozoic rocks, and for Clear Creek, which drains an area underlain mostly by Precambrian crystalline rocks.

Geology and Hydrology of Bighorn Mountains Area
(from Boner and others, 1976, p. 16 and 17)

The Paleozoic formations consist, in ascending order, of the Flathead Sandstone and the Gros Ventre and Gallatin Formations of Cambrian age, the Bighorn Dolomite of Ordovician age, the Darby Formation of Devonian age, the Madison Limestone of Mississippian age, the Amsden Formation of Mississippian and Pennsylvanian age, and the Tensleep Sandstone of Pennsylvanian and Permian age. The aggregate thickness of these formations in the northern part of the Bighorn Mountains in Wyoming is nearly 3,000 feet. The section thins southward to less than 1,000 feet. The Bighorn Dolomite and the Darby Formation are not present in the southern part of the mountains.



Modified from Boner and others (1976, p. 18)

Figure 9.--Flow-duration curves for Little Bighorn River at State line, near Wyola, Mont., and for Clear Creek, near Buffalo, Wyo.

Fractures, which increase the permeability of the formations, are present throughout the area. The rocks locally are shattered in areas of most intense deformation. Solution openings, or fractures enlarged by solution, can be seen in every canyon. Solution is most common in the Madison Limestone, which contains extensive caves. Solution features also were observed in the Gallatin and Gros Ventre Formations, the Bighorn Dolomite, the Amsden Formation, and the Tensleep Sandstone.

Ground water, lakes and ponds, snowmelt, and direct runoff from precipitation are the principal sources of water in streams flowing off the Bighorn Mountains. In the central part of the mountains, the ground-water contribution to streamflow is derived from the Precambrian crystalline rocks, glacial deposits, and the White River Formation of Oligocene age. Although the crystalline rocks are the only widespread unit, they commonly contribute little ground water to streamflow because of low permeability; therefore, most streamflow is from sources other than ground water. In the northern and southern parts of the mountains, lakes and ponds are not as great a factor in sustaining low flows as they are in the central part of the mountains. In the northern and southern parts of the mountains, the Paleozoic formations occur in a much larger area and contribute much of the streamflow.

Description of Sites and Summary of Streamflow Data and Computed Gains and Losses at Streamflow-Gaging Stations, 1974-91

East Pass Creek

Site 1--Station 06289800 East Pass Creek near Parkman

LOCATION.--Lat 44°56'37", long 107°29'05", in sec. 4, T. 57 N., R. 88 W. (unsurveyed), Sheridan County, 0.6 mile upstream from Taffner Creek, 1.5 miles downstream from West Fork, and 7.7 miles southwest of Parkman.

DRAINAGE AREA.--11.6 square miles.

PERIOD OF RECORD.--Water years 1975 and 1976.

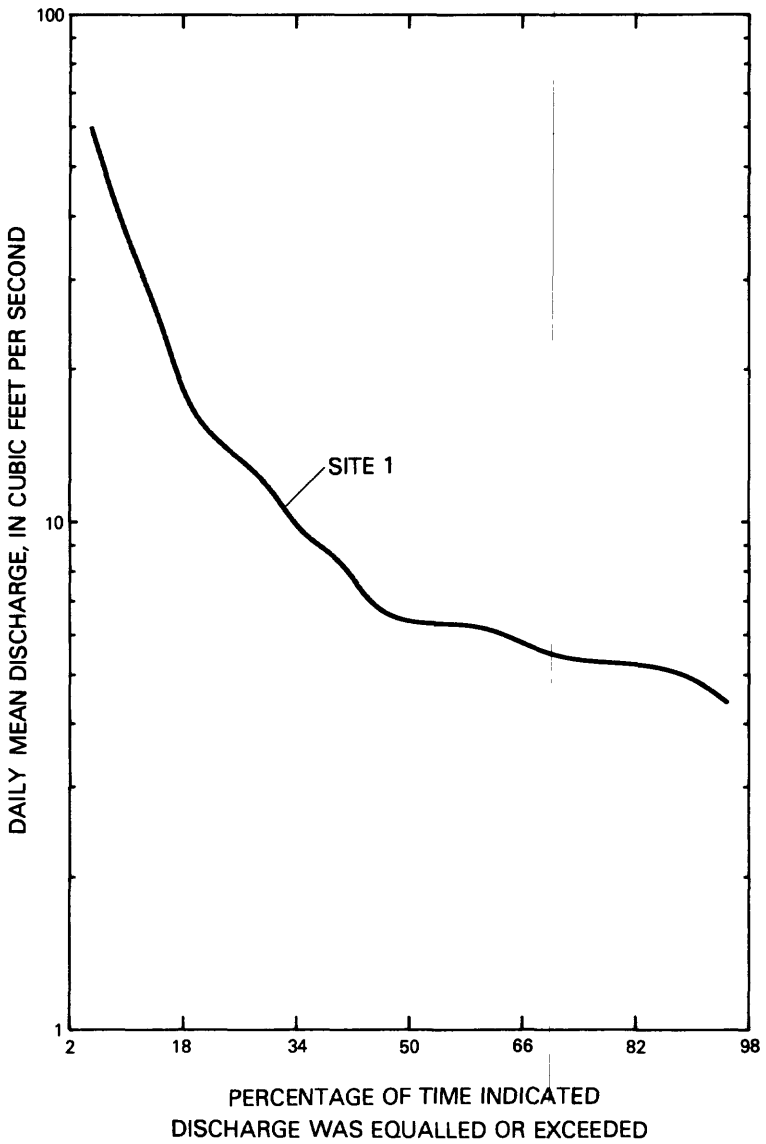
GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The measurement site is in the center of a small anticlinal ridge on which the Tensleep Sandstone is exposed.

REMARKS.--Discharge at this site is considered as a gain during nonrunoff periods because streamflow originates from springs issuing from Paleozoic formations.

Discharge measurements and computed gain or loss of streamflow in East Pass Creek for site 1

	Discharge, in cubic feet per second	
Date	Site 1	Computed gain (+) or loss (-)
9-04-74	9.10	+9.10
10-25-74	5.96	+5.96
11-12-74	7.06	+7.06
8-22-85	6.00	+6.00
9-09-91	7.57	+7.57



Flow-duration curve for daily mean discharge, water years 1975 and 1976.

Monthly and annual mean discharge of East Pass Creek, site 1

Water year	Site number	Discharge, in cubic feet per second												Annual mean
		Monthly mean												
		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	
1975	1	6.75	7.01	6.41	4.82	5.65	5.44	8.17	45.1	78.5	29.4	12.1	8.78	18.2
1976	1	7.86	6.44	5.79	5.43	5.67	5.62	9.72	29.7	32.6	13.2	8.27	7.59	11.5

Tongue River

Site 2--Upstream Station 06297480 Tongue River at Tongue Canyon Campground, near Dayton

LOCATION.--Lat 44°50'45", long 107°19'56", in SE1/4 NE1/4 NW1/4 sec. 10, T. 56 N., R. 87 W., Sheridan County, Bighorn National Forest, at bridge on forest service trail, 0.2 mile upstream from Tongue Canyon campground, 1 mile upstream from Highline Ditch intake, 2.1 miles downstream from Sheep Creek, and 3.8 miles southwest of Dayton.

DRAINAGE AREA.--202 square miles.

PERIOD OF RECORD.--Water years 1975-79.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The upstream site is on strike with, and near the top of, the Bighorn Dolomite.

Sites 3 and 4--Diversion at Station 06297500 (site 3) Highline Ditch near Dayton and Downstream Station 06298000 (site 4) Tongue River near Dayton

LOCATION.--Lat 44°50'58", long 107°18'14", in NE1/4 NE1/4 NE1/4 sec. 11, T. 56 N., R. 87 W., Sheridan County, 0.5 mile upstream from Crystal Draw, 0.6 mile downstream from Highline Ditch intake, and 2.5 miles southwest of Dayton.

DRAINAGE AREA.--204 square miles.

PERIOD OF RECORD.--Water years 1919-29, 1941 to current year (1992). Data for water years 1975-79 are presented.

GAGE.--Water-stage recorder. A water-stage recorder is also in operation on Highline Ditch. These gaging stations are a part of the cooperative program with the Wyoming State Engineer.

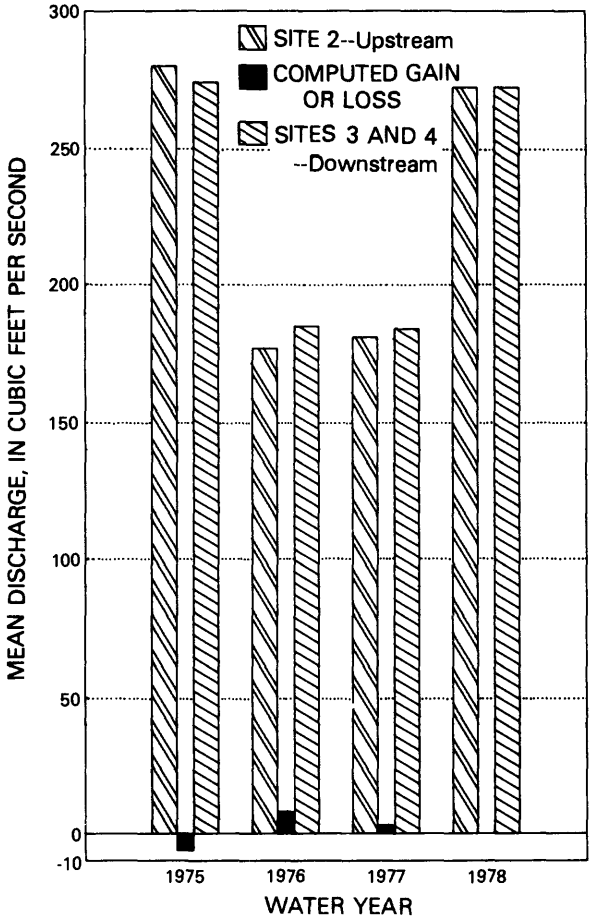
GEOHYDROLOGY.--The downstream site is on strike with the Amsden Formation.

Discharge measurements and computed gain or loss of streamflow in Tongue River between upstream site 2 and combined downstream sites 3 and 4

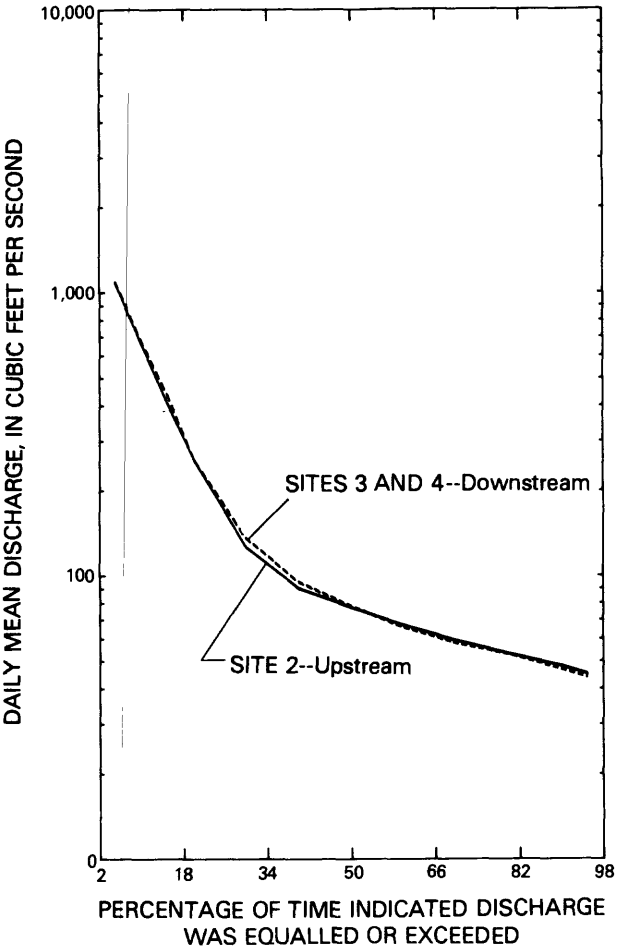
Date	Discharge, in cubic feet per second		
	Site 2	Sites 3 and 4	Computed gain (+) or loss (-)
7-17-74	223	225	+2.0
9-25-74	99.7	93.4	-6.3
10-07-74	57.3	64.8	+7.5
11-12-74	61.0	66.0	+5.0
8-23-85	78.7	[1]78.0	- .7
8-31-91	80.8	89.1	+8.3
10-12-91	75.6	74.8	- .8

[1]Discharge measured August 22, 1985; stages at sites 3 and 4 on August 22 were about the same as on August 23.

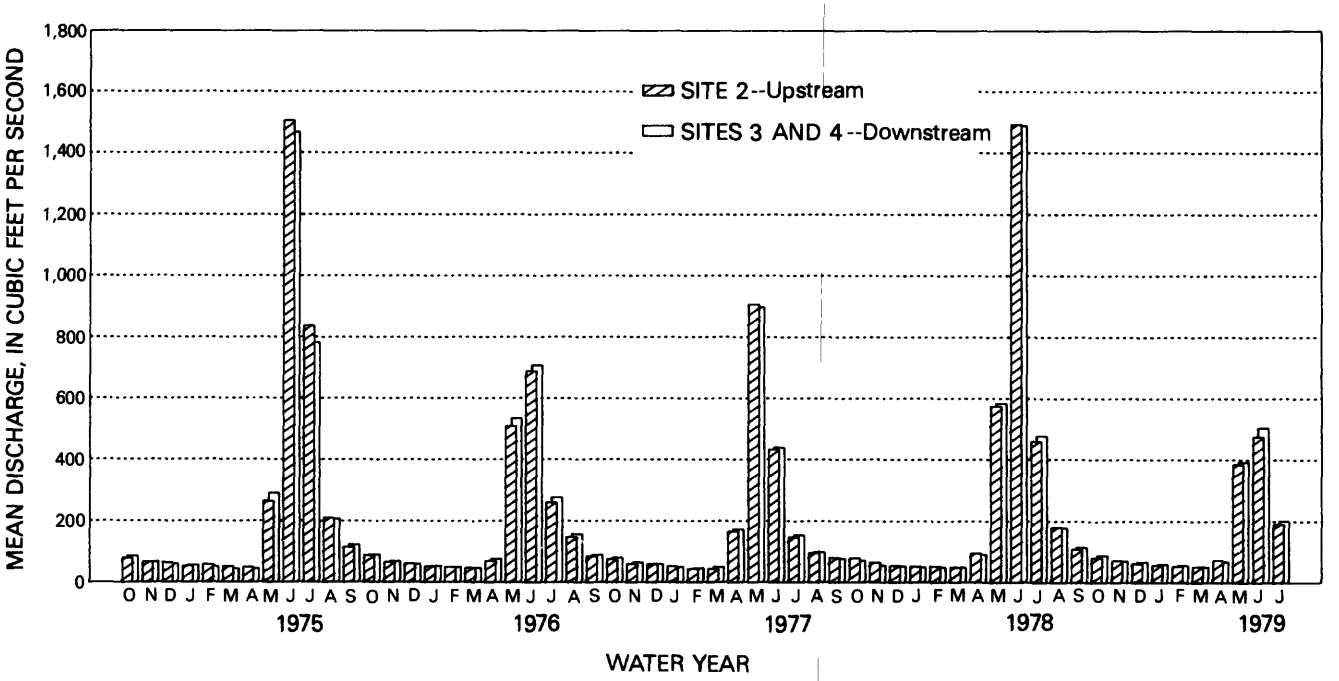
Tongue River



Annual mean discharge and annual computed gain or loss of streamflow, water years 1975-78.



Flow-duration curves for daily mean discharge, water years 1975-78.



Monthly mean discharge, water years 1975-79.

Monthly and annual mean discharge of Tongue River, sites 2, 3 and 4

[Computed gain (+) or loss (-) of flow between sites for period of record, in cubic feet per second]

Water year	Site number	Discharge, in cubic feet per second: Monthly mean Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual mean
1975	2	78.9	66.5	64.7	53.7	58.5	52.3	49.4	265	1,506	837	210	115	280
	3,4 total	86.3	66.8	60.9	56.9	52.7	44.3	44.2	291	1,468	782	208	123	274
Gain or loss		+7.4	+.3	-3.8	+3.2	-5.8	-8.0	-5.2	+26	-38	-55	-2	+8	-6
1976	2	87.3	65.7	60.7	52.6	50.0	46.5	69.9	509	689	260	147	85.2	177
	3,4 total	90.5	69.0	59.5	53.8	50.1	47.2	76.7	534	708	277	157	90.0	185
Gain or loss		+3.2	+3.3	-1.2	+1.2	+.1	+.7	+6.8	+25	+19	+17	+10	+4.8	+8
1977	2	75.4	60.7	59.4	52.5	43.8	43.6	166	906	432	147	96.1	80.3	181
	3,4 total	80.1	65.5	60.1	50.7	45.8	50.6	173	897	439	154	99.6	77.4	184
Gain or loss		+4.7	+4.8	+.7	-1.8	+2.0	+7.0	+7	-9	+7	+7	+3.5	-2.9	+3
1978	2	79.3	64.3	54.7	52.6	53.5	50.1	96.1	575	1,493	459	181	109	272
	3,4 total	70.7	56.4	53.6	50.4	49.5	49.7	92.2	584	1,489	478	180	116	272
Gain or loss		-8.6	-7.9	-1.1	-2.2	-4.0	-.4	-3.9	+9	-4	+19	-1	+7	0
1979	2	81.1	72.9	62.3	58.1	54.2	52.9	74.2	385	476	191	--	--	--
	3,4 total	89.3	71.5	68.4	60.5	57.3	52.9	69.8	393	505	202	130	81.0	149
Gain or loss		+8.2	-1.4	+6.1	+2.4	+3.1	0	-4.4	+8	+29	+11	--	--	--

Little Tongue River

Site 5--Upstream Station 06298480 Little Tongue River at Steamboat Point, near Dayton

LOCATION.--Lat 44°48'25", long 107°20'47", in SW1/4 SE1/4 SE1/4 sec. 21, T. 56 N., R. 87 W., Sheridan County, Bighorn National Forest, 0.4 mile downstream from unnamed tributary, 0.5 mile northeast of Fallen City, 0.6 mile east of Steamboat Point, 3.0 miles upstream from South Fork Little Tongue River, and 6.3 miles southwest of Dayton.

DRAINAGE AREA.--11.4 square miles.

PERIOD OF RECORD.--Water years 1975 and 1976.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The site is on strike with Gallatin and Gros Ventre Formations and near the base of the Bighorn Dolomite.

Site 6--Downstream Station 06298490 Little Tongue River above South Fork Little Tongue River, near Dayton

LOCATION.--Lat 44°48'22", long 107°17'44", in SW1/4 SE1/4 SW1/4 sec. 24, T. 56 N., R. 87 W., Sheridan County, 0.3 mile downstream from Bighorn National Forest boundary, 0.5 mile upstream from South Fork Little Tongue River, and 5.0 miles southwest of Dayton.

DRAINAGE AREA.--14.1 square miles.

PERIOD OF RECORD.--Water years 1975 and 1976.

GAGE.--Water-stage recorder.

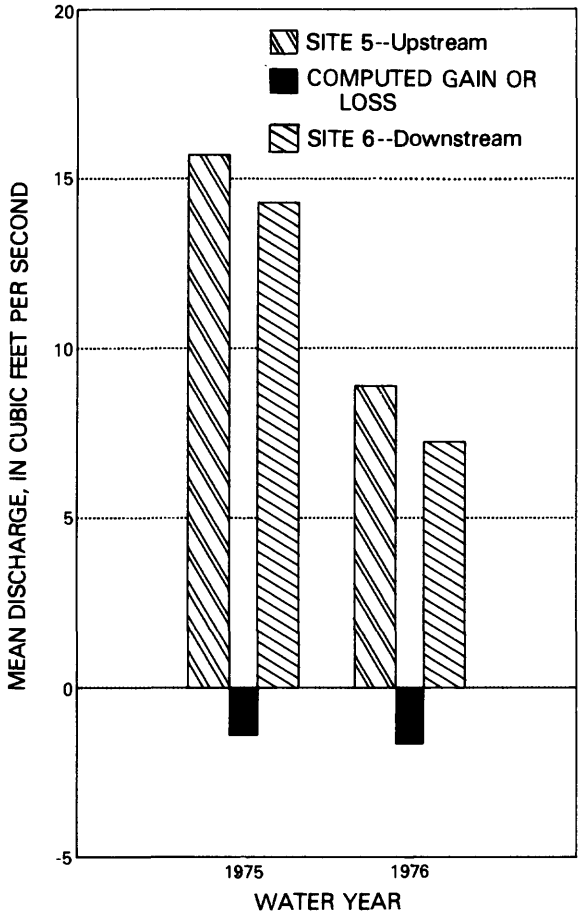
GEOHYDROLOGY.--The site is on strike with, and approximately at the top of, the Tensleep Sandstone.

Discharge measurements and computed gain or loss of streamflow in Little Tongue River between sites 5 and 6

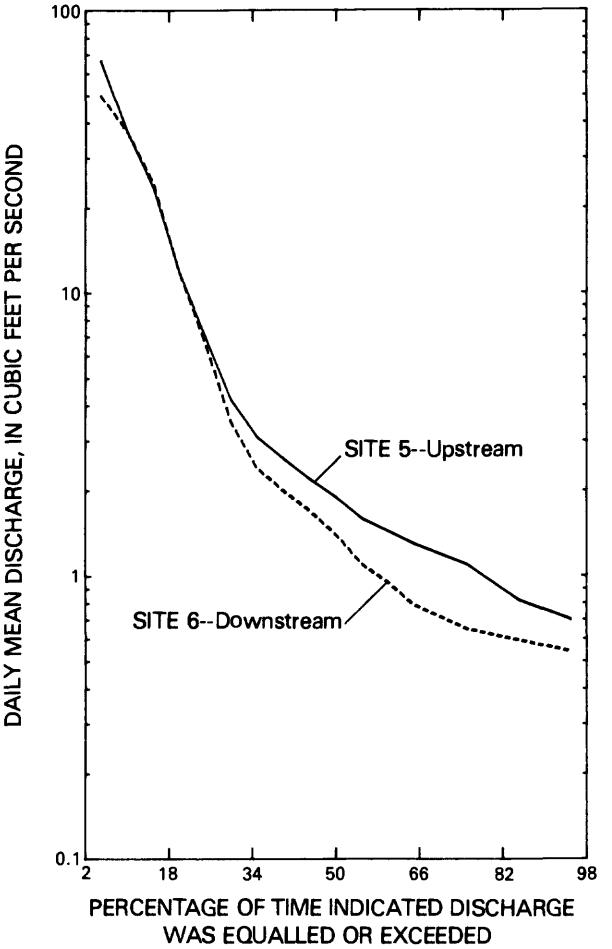
Discharge, in cubic feet per second				
Date	Site 5	Date	Site 6	Computed gain (+) or loss (-)
7-17-74	6.43	7-17-74	4.40	-2.03
9-25-74	1.52	9-25-74	.87	-.65
10-09-74	2.98	10-09-74	1.42	-1.56
11-14-74	1.92	11-14-74	.90	-1.02
[1]8-19-85	1.64	[1]8-20-85	.58	-1.06
9-10-91	3.15	9-10-91	.85	-2.30

[1]Hydrographer was unable to measure discharges at both sites on the same day; however, stable flows were assumed to occur between measurements.

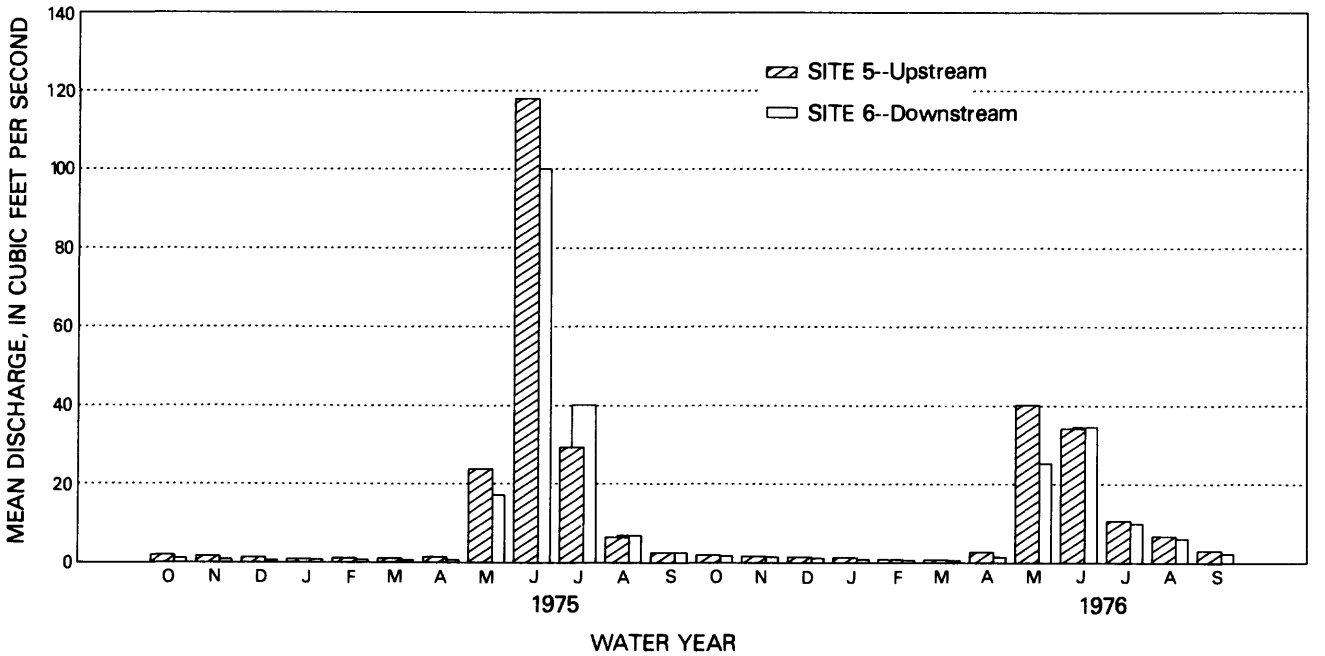
Little Tongue River



Annual mean discharge and annual computed gain or loss of streamflow, water years 1975 and 1976.



Flow-duration curves for daily mean discharge, water years 1975 and 1976.



Monthly mean discharge, water years 1975 and 1976.

Monthly and annual mean discharge of Little Tongue River, sites 5 and 6

[Computed gain (+) or loss (-) of flow between sites for period of record, in cubic feet per second]

Water year	Site number	Discharge, in cubic feet per second: Monthly mean Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual mean
1975	5	1.99	1.67	1.35	0.84	1.06	0.99	1.41	23.8	118	29.3	6.49	2.62	15.7
	6	1.16	.87	.64	.71	.71	.58	.70	17.2	100	40.2	6.97	2.59	14.3
Gain or loss		-.83	-.80	-.71	-.13	-.35	-.41	-.71	-6.6	-18	+10.9	+.48	-.03	-1.4
1976	5	2.00	1.67	1.51	1.33	.88	.80	2.78	40.2	34.3	10.8	6.86	3.20	8.89
	6	1.80	1.54	1.22	.86	.72	.65	1.52	25.3	34.6	10.1	6.24	2.32	7.24
Gain or loss		-.20	-.13	-.29	-.47	-.16	-.15	-1.26	-14.9	+.3	-.7	-.62	-.88	-1.65

Wolf Creek

Site 7--Upstream Station 06299480 Wolf Creek below Alden Creek, near Wolf

LOCATION.--Lat 44°45'36", long 107°15'53", in SW1/4 NW1/4 NE1/4 sec. 7, T. 55 N., R. 86 W., Sheridan County, Bighorn National Forest, 0.5 mile upstream from forest boundary, 1.1 miles upstream from Red Canyon Creek, 1.2 miles west of Wolf, and 1.5 miles downstream from Alden Creek.

DRAINAGE AREA.--32.8 square miles.

PERIOD OF RECORD.--Water years 1975 and 1976.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The site is on strike with, and near the base of, the Bighorn Dolomite.

Site 8--Downstream Station 06299490 Wolf Creek above Red Canyon Creek, near Wolf

LOCATION.--Lat 44°45'54", long 107°14'48", in NE1/4 SE1/4 SW1/4 sec. 5, T. 55 N., R. 86 W., Sheridan County, 0.4 mile upstream from Red Canyon Creek, 0.5 mile downstream from Bighorn National Forest boundary, and 0.6 mile southwest of Wolf.

DRAINAGE AREA.--33.8 square miles.

PERIOD OF RECORD.--Water years 1975 and 1976.

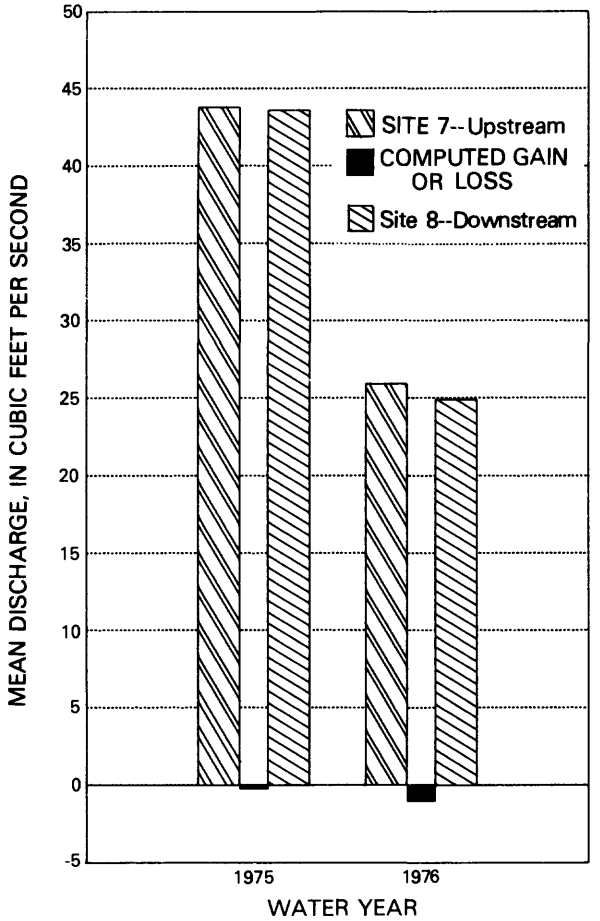
GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The site is on strike with the Amsden Formation.

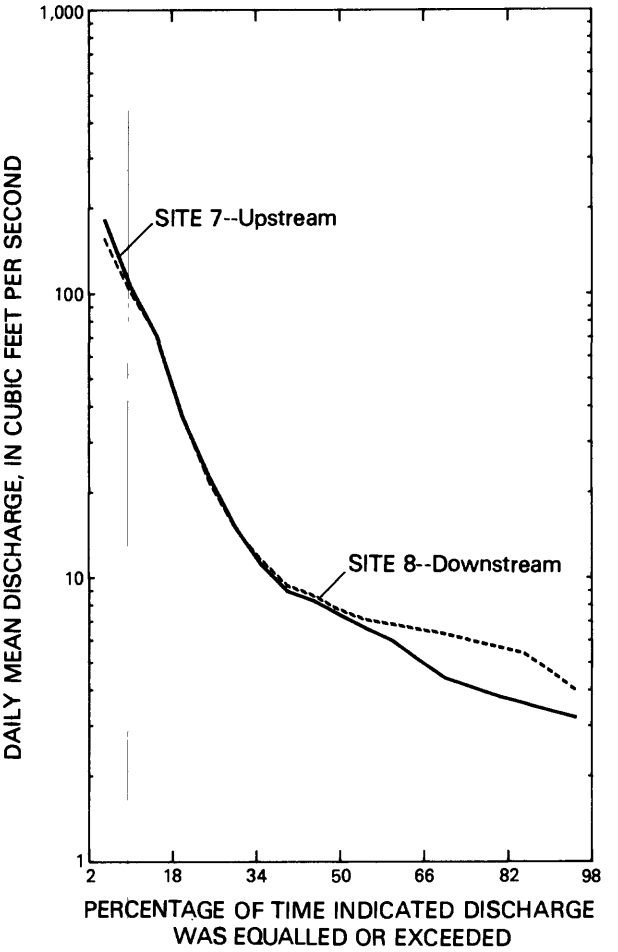
Discharge measurements and computed gain or loss of streamflow in Wolf Creek between sites 7 and 8

Discharge, in cubic feet per second				
Date	Site 7	Date	Site 8	Computed gain (+) or loss (-)
7-18-74	22.7	7-18-74	21.9	-0.8
10-23-74	6.38	10-27-74	5.83	-.55
11-12-74	6.79	11-12-74	7.03	+.24
8-14-85	11.3	8-14-85	11.2	-.1
9-11-91	10.3	9-11-91	9.98	-.3

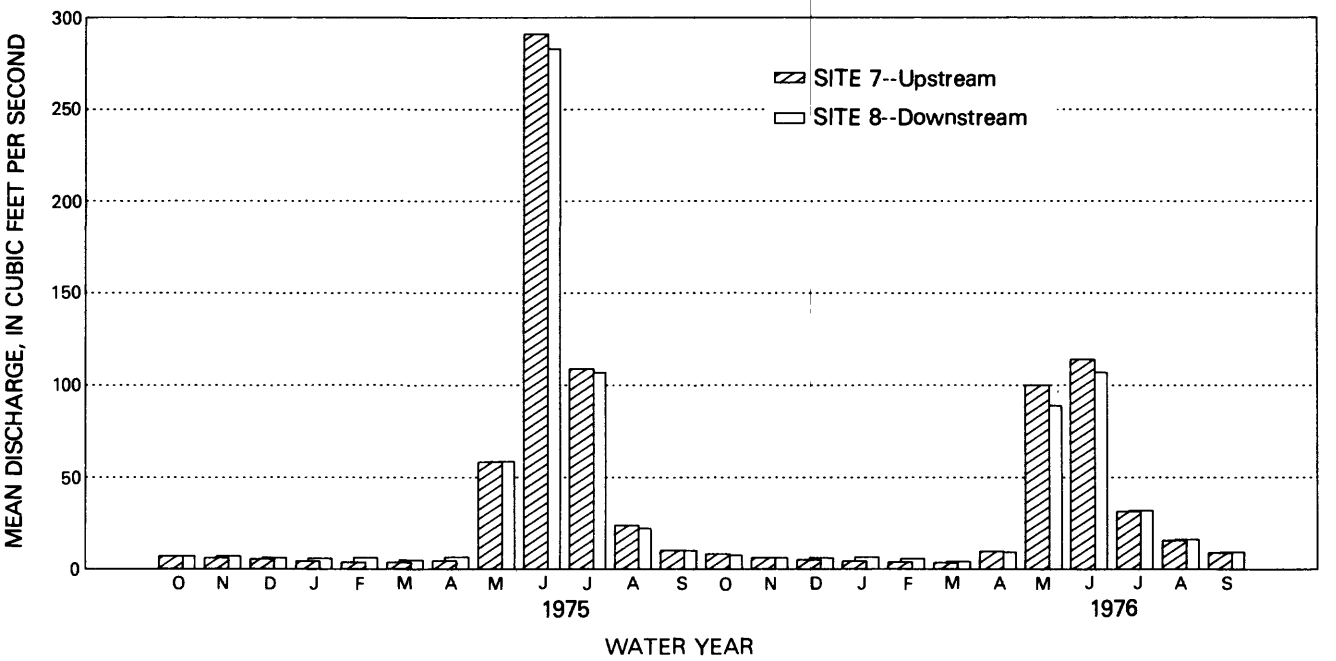
Wolf Creek



Annual mean discharge and annual computed gain or loss of streamflow, water years 1975 and 1976.



Flow-duration curves for daily mean discharge, water years 1975 and 1976.



Monthly mean discharge, water years 1975 and 1976.

Monthly and annual mean discharge of Wolf Creek, sites 7 and 8

[Computed gain (+) or loss (-) of flow between sites for period of record, in cubic feet per second]

Water year	Site number	Discharge, in cubic feet per second: Monthly mean Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual mean
1975	7	7.02	6.11	5.32	4.23	3.63	3.57	4.51	58.3	291	109	23.6	10.1	43.8
	8	7.16	7.09	6.25	5.89	6.19	4.78	6.54	58.6	283	107	22.1	10.1	43.6
Gain or loss		+.14	+.98	+.93	+1.66	+2.56	+1.21	+2.03	+.3	-8	-2	-1.5	0	-.2
1976	7	8.17	6.26	5.07	4.29	3.81	3.48	9.63	100	114	31.5	15.6	8.95	25.9
	8	7.62	6.19	6.15	6.61	5.77	4.17	9.25	89.0	107	31.9	16.1	9.38	24.9
Gain or loss		-.55	-.07	+1.08	+2.32	+1.96	+.69	-.38	-11	-7	+.4	+.5	+.43	-1.0

Buffalo Creek

Site 9--Combination Upstream Station 06309260 Buffalo Creek above North Fork Buffalo Creek near Arminto

LOCATION.--Lat 43°25'33", long 107°11'18", in SW1/4 NW1/4 NE1/4 sec. 20, T. 40 N., R. 86 W., Natrona County, 400 feet downstream from South Fork Buffalo Creek, 0.8 mile upstream from North Fork Buffalo Creek, and 17.5 miles north of Arminto.

DRAINAGE AREA.--8.80 square miles.

PERIOD OF RECORD.--Water years 1975-79.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--Madison Limestone and the underlying Cambrian rocks are exposed along Buffalo Creek about 400 feet downstream from the mouth of Middle Fork Buffalo Creek.

Site 10--Combination Upstream Station 06309270 North Fork Buffalo Creek near Arminto

LOCATION.--Lat 43°26'11", long 107°10'58", in SE1/4 SE1/4 NE1/4 sec. 17, T. 40 N., R. 86 W., Natrona County, 1.3 miles upstream from mouth, and 18 miles north of Arminto.

DRAINAGE AREA.--8.10 square miles.

PERIOD OF RECORD.--Water years 1975-79.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--Madison Limestone and the underlying Cambrian rocks are exposed along the North Fork Buffalo Creek. At the time of the original reconnaissance, all of the flow in North Fork Buffalo Creek was lost to a sinkhole in the SE1/4 NW1/4 SW1/4 sec. 16, T. 40 N., R. 86 W. The streambed at the sinkhole is covered with a thin layer of alluvium and no Madison Limestone is exposed.

REMARKS.--Observations and data collected during water years 1975-79 indicated that flow at the upstream site on North Fork Buffalo Creek had to exceed about 8 ft^3/s before any flow would occur past the sinkhole on North Fork Buffalo Creek. The loss of flow on North Fork Buffalo Creek was the major component of the total loss of flow in Buffalo Creek.

Site 11--Downstream Station 06309280 Buffalo Creek below North Fork Buffalo Creek near Arminto

LOCATION.--Lat 43°25'08", long 107°09'59", in NE1/4 NW1/4 SE1/4 sec. 21, T. 40 N., R. 86 W., Natrona County, 0.3 mile downstream from North Fork Buffalo Creek, 1.8 miles upstream from Pine Creek, and 18 miles north of Arminto.

DRAINAGE AREA.--18.6 square miles.

PERIOD OF RECORD.--Water years 1975-79.

GAGE.--Water-stage recorder.

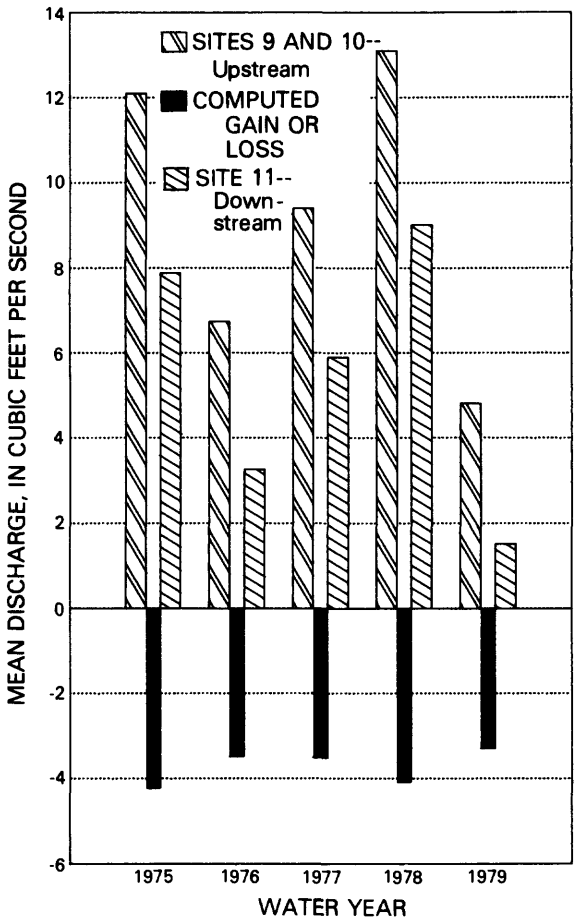
GEOHYDROLOGY.--The contact of the Madison Limestone and the Amsden Formation is exposed on hillsides near the station. Exposures along the creek are poor, but the contact is probably located near the station.

REMARKS.--A pipeline became operational in July 1979, that carried some flow past the sinkhole on North Fork Buffalo Creek; however, the pipeline was in disrepair and not being used during the 1985 measurements.

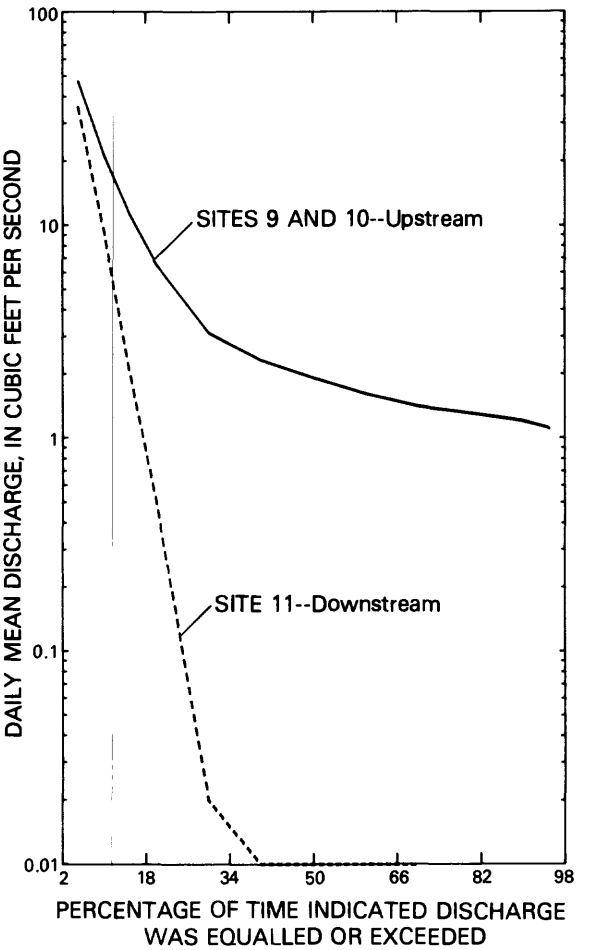
Discharge measurements and computed gain or loss of streamflow in Buffalo Creek between combined upstream sites 9 and 10 in relation to downstream site 11

[--, not measured]

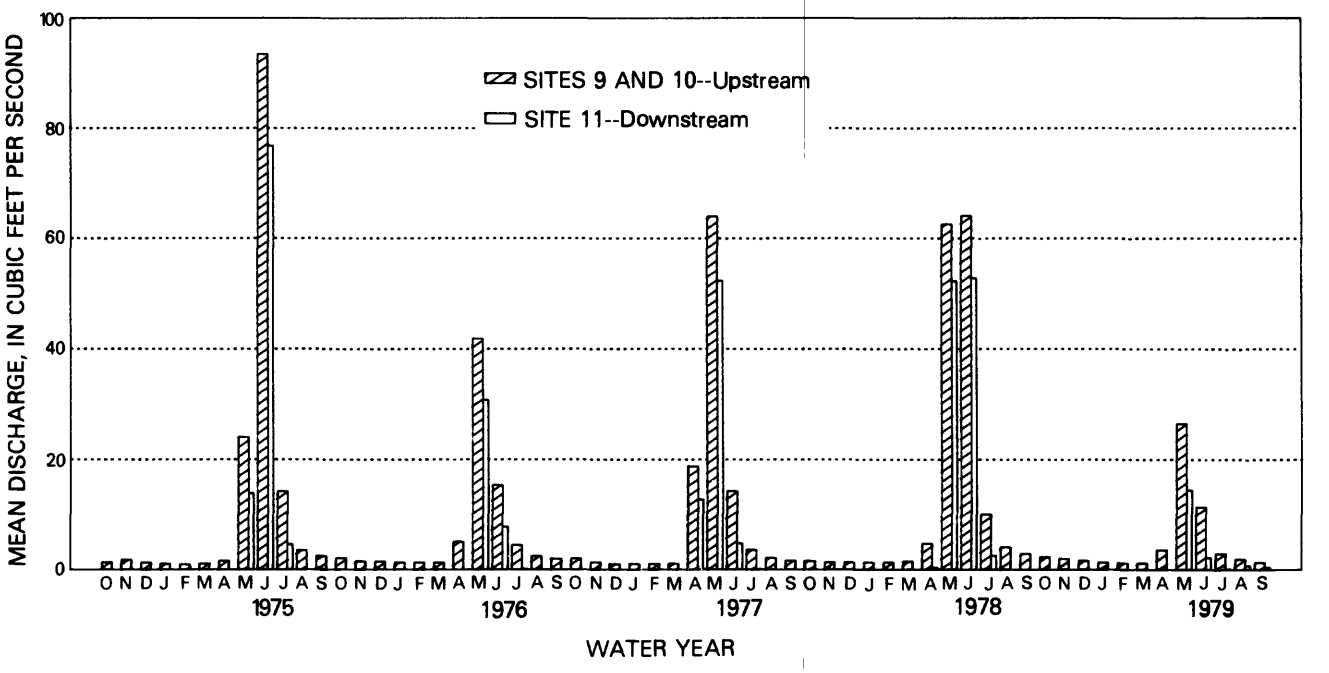
Discharge, in cubic feet per second						
Date	Site 9	Date	Site 10	Date	Site 11	Computed gain (+) or loss (-)
8-27-74	0.11	8-28-74	0.95	8-27-74	0	-1.06
--	--	--	--	10-16-74	0	--
--	--	--	--	10-24-74	0	--
11-12-74	.28	11-14-74	1.46	--	--	--
12-05-74	.38	12-03-74	1.01	12-05-74	0	-1.39
5-14-85	3.54	5-14-85	6.68	5-14-85	.01	-10.2
9-03-85	.21	9-03-85	1.02	9-03-85	0	-1.23
6-27-91	2.52	6-27-91	3.44	6-27-91	.72	-5.24



Annual mean discharge and annual computed gain or loss of streamflow, water years 1975-79.



Flow-duration curves for daily mean discharge, water years 1975-79.



Monthly mean discharge, water years 1975-79.

Monthly and annual mean discharge of Buffalo Creek, sites 9, 10, and 11

[Computed gain (+) or loss (-) of flow between sites for period of record, in cubic feet per second]

Water year	Site number	Discharge, in cubic feet per second: Monthly mean Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual mean
1975	9	0.23	0.30	0.28	0.23	0.20	0.29	0.49	13.3	34.9	6.34	1.02	0.43	4.83
	10	1.12	1.50	1.02	.82	.75	.80	1.10	10.8	58.6	8.00	2.55	2.10	7.39
	9,10 total	1.35	1.80	1.30	1.05	.95	1.09	1.59	24.1	93.5	14.34	3.57	2.53	12.22
	11	0	0	0	0	0	0	0	13.9	76.8	4.63	0	0	7.88
Gain or loss		-1.35	-1.80	-1.30	-1.05	-.95	-1.09	-1.59	-10.2	-16.7	-9.71	-3.57	-2.53	-4.34
1976	9	.54	.46	.36	.29	.33	.35	.96	15.3	7.34	1.60	.61	.55	2.40
	10	1.60	1.06	1.15	1.04	.99	.97	4.16	26.6	8.07	2.88	1.84	1.46	4.34
	9,10 total	2.14	1.52	1.51	1.33	1.32	1.32	5.12	41.9	15.41	4.48	2.45	2.01	6.74
	11	0	0	0	0	0	0	0	30.8	7.86	.11	.013	0	3.26
Gain or loss		-2.14	-1.52	-1.51	-1.33	-1.32	-1.32	-5.12	-11.1	-7.55	-4.37	-2.44	-2.01	-3.48
1977	9	.61	.39	.28	.26	.28	.28	8.43	24.7	6.45	1.03	.46	.32	3.65
	10	1.43	.99	.74	.75	.77	.81	10.4	39.3	7.81	2.58	1.67	1.33	5.76
	9,10 total	2.04	1.38	1.02	1.01	1.05	1.09	18.83	64.0	14.26	3.61	2.13	1.65	9.41
	11	0	0	0	0	0	0	12.8	52.3	4.81	.094	0	0	5.90
Gain or loss		-2.04	-1.38	-1.02	-1.01	-1.05	-1.09	-6.03	-11.7	-9.45	-3.52	-2.13	-1.65	-3.51
1978	9	.35	.27	.27	.25	.31	.30	1.98	28.1	24.4	4.25	1.20	.68	5.21
	10	1.23	1.06	1.06	1.05	1.00	1.21	2.77	34.5	39.7	5.82	2.91	2.22	7.90
	9,10 total	1.58	1.33	1.33	1.30	1.31	1.51	4.75	62.6	64.1	10.07	4.11	2.90	13.11
	11	0	0	0	0	0	0	.40	52.2	52.8	2.56	0	0	9.02
Gain or loss		-1.58	-1.33	-1.33	-1.30	-1.31	-1.51	-4.35	-10.4	-11.3	-7.51	-4.11	-2.90	-4.09
1979	9	.55	.50	.41	.39	.36	.31	1.38	10.7	5.00	.98	.48	.25	1.79
	10	1.76	1.48	1.24	.96	.87	.89	2.24	15.8	6.40	1.94	1.43	1.08	3.02
	9,10 total	2.31	1.98	1.65	1.35	1.23	1.20	3.62	26.5	11.40	2.92	1.91	1.33	4.81
	11	0	0	0	0	0	0	0	14.5	2.22	.11	.69	.41	1.52
Gain or loss		-2.31	-1.98	-1.65	-1.35	-1.23	-1.20	-3.62	-12.0	-9.18	-2.81	-1.22	-.92	-3.29

Pipeline transported flow past the sinkhole on North Fork Buffalo Creek after July 26, 1979.

Beaver Creek (tributary to Middle Fork Powder River)

Site 12--Upstream Station 06309450 Beaver Creek below Bayer Creek, near Barnum

LOCATION.--Lat 43°39'54", long 107°03'45", in SE1/4 SE1/4 NW1/4 sec. 28, T. 43 N., R. 85 W., Johnson County, 0.3 mile downstream from Bayer Creek and 7.7 miles west of Barnum.

DRAINAGE AREA.--10.9 square miles.

PERIOD OF RECORD.--Water years 1975 to 1989. Data for water years 1975-85 are presented.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--Bighorn Dolomite (?) and the underlying Cambrian rocks are exposed in the hillside about 80 feet above Beaver Creek (Boner and others, 1976, p. 33).

Site 13--Downstream Station 06309460 Beaver Creek above White Panther Ditch, near Barnum

LOCATION.--Lat 43°41'52", long 106°56'52", in SE1/4 SW1/4 NW1/4 sec. 16, T. 43 N., R. 84 W., Johnson County, 0.1 mile upstream from White Panther Ditch and 3.0 miles northwest of Barnum.

DRAINAGE AREA.--24.2 square miles.

PERIOD OF RECORD.--Water years 1975 to 1989. Data for water years 1975-85 are presented.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The top of the Tensleep Sandstone is exposed at the mouth of the canyon (Boner and others, 1976, p. 33).

REMARKS.--Periods of snowmelt or rainfall at times increased the tributary inflow between sites on Beaver Creek, particularly during April-June and during heavy runoff in water years 1978 and 1984. The ungaged tributary inflow for those periods makes gains attributable to discharge from the Paleozoic formations uncertain.

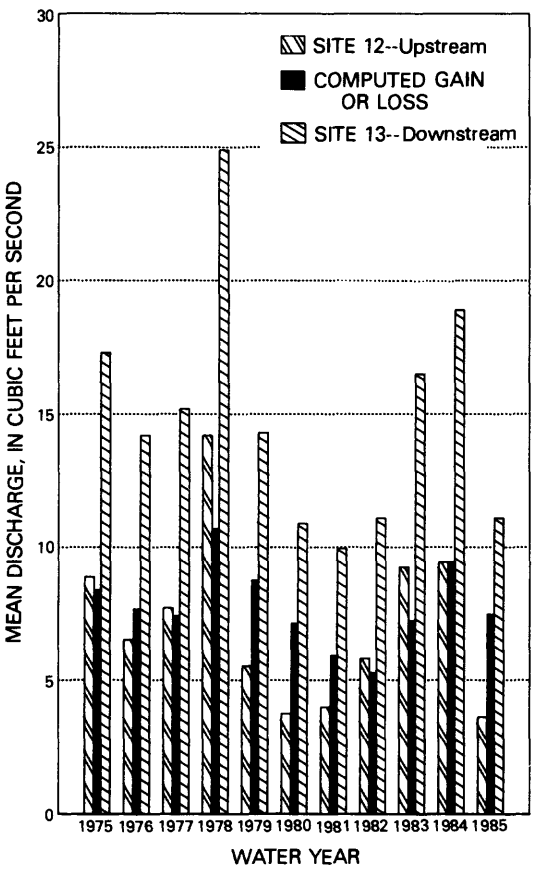
A partial seepage run was made September 11, 1975, to identify sources of inflow between the streamflow-gaging stations on Beaver Creek. Surface-water inflow was found in only one tributary; 1.21 ft^3/s was measured in a left-bank tributary about 1 mile downstream from the upstream gage. Other increases in flow were noted from springs along the Beaver Creek channel.

Discharge measurements and computed gain or loss of streamflow in Beaver Creek between sites 12 and 13

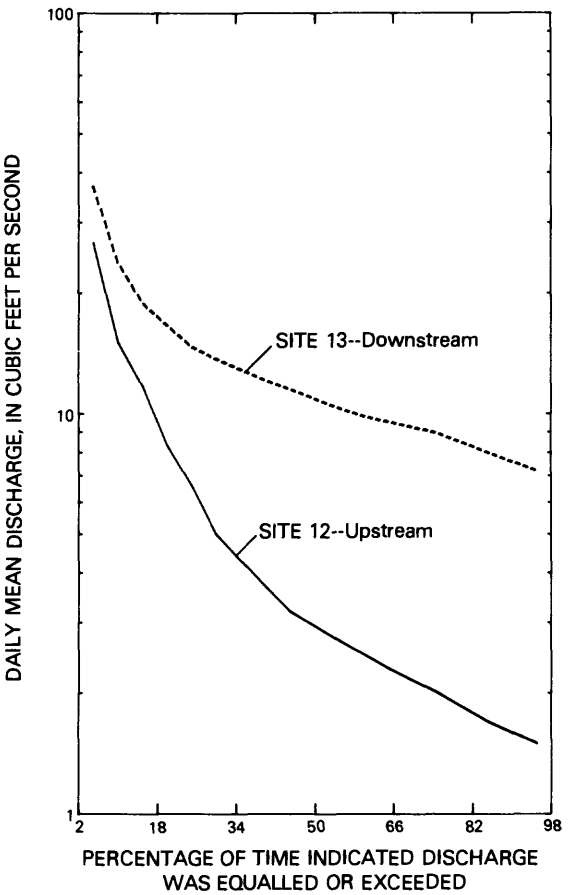
[--, not measured]

Discharge, in cubic feet per second				
Date	Site 12	Date	Site 13	Computed gain (+) or loss (-)
8-29-74	1.94	8-30-74	7.13	+5.19
--	--	11-01-74	7.90	--
11-07-74	2.04	--	--	--
--	--	11-21-74	8.06	--
8-27-85	3.51	8-27-85	9.74	+6.23
12-05-86	2.62	12-05-86	9.31	+6.69
9-03-91	3.40	9-03-91	11.3	+7.90

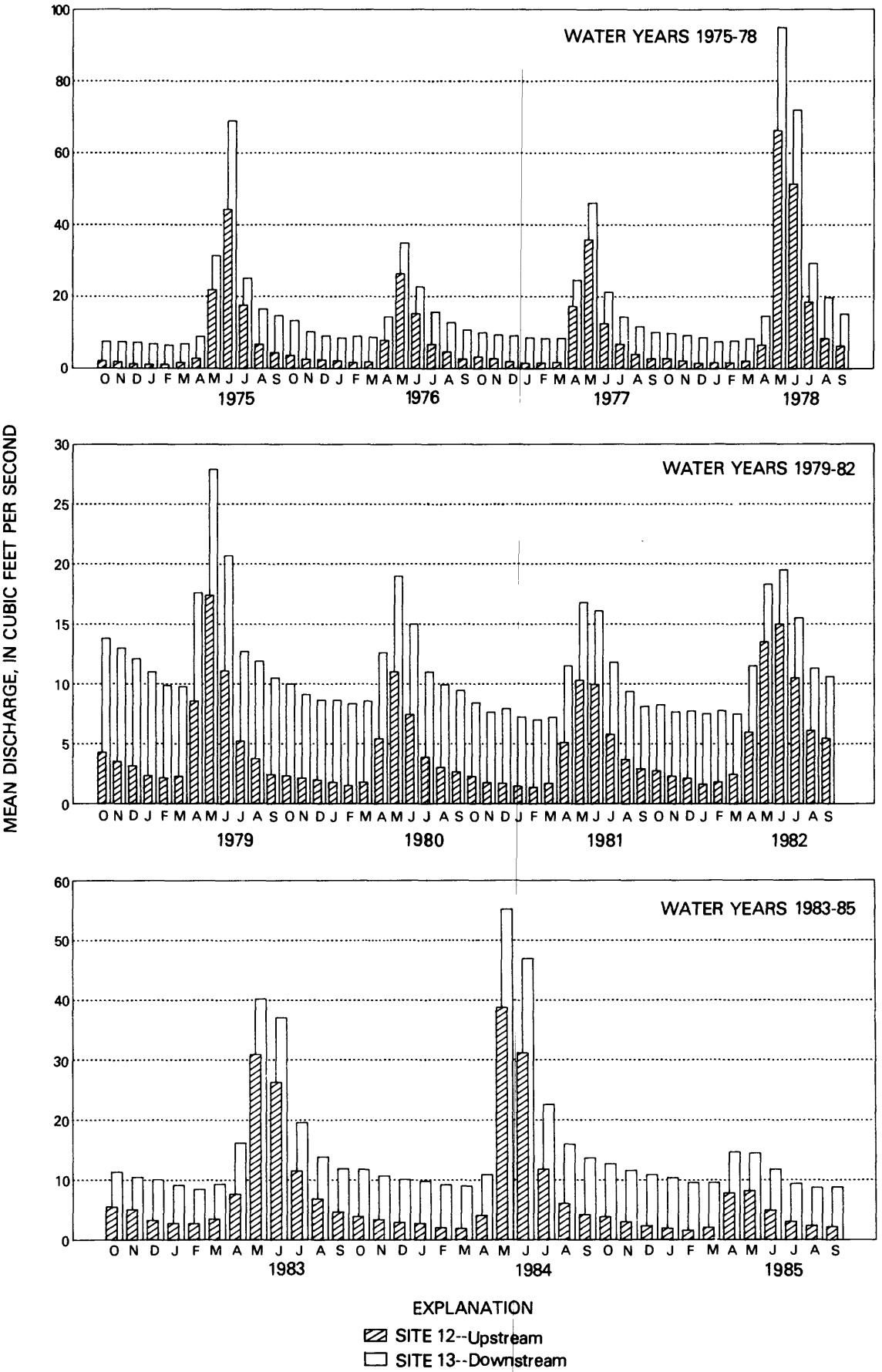
Beaver Creek



Annual mean discharge and annual computed gain or loss of streamflow, water years 1975-85.



Flow-duration curves for daily mean discharge, water years 1975-85.



Monthly mean discharge, water years 1975-85.

Monthly and annual mean discharge of Beaver Creek, sites 12 and 13

[Computed gain (+) or loss (-) of flow between sites, water years 1975-85, in cubic feet per second]

Water year	Site number	Discharge, in cubic feet per second: Monthly mean: Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual mean
1975	12	2.14	1.86	1.30	1.10	1.07	1.66	2.87	21.9	44.3	17.6	6.71	4.47	8.94
	13	7.45	7.43	7.25	6.81	6.43	6.83	8.87	31.4	69.0	25.1	16.5	14.7	17.3
Gain or loss		+5.31	+5.57	+5.95	+5.71	+5.36	+5.17	+6.00	+9.5	+24.7	+7.5	+9.79	+10.2	+8.36
1976	12	3.67	2.60	2.45	2.17	1.73	1.83	7.88	26.4	15.3	6.73	4.66	2.69	6.53
	13	13.3	10.2	9.10	8.50	8.99	8.68	14.4	35.0	22.7	15.7	12.8	10.7	14.2
Gain or loss		+9.63	+7.6	+6.65	+6.33	+7.26	+6.85	+6.52	+8.6	+7.4	+8.97	+8.14	+8.01	+7.67
1977	12	3.29	2.80	1.97	1.54	1.61	1.75	17.3	35.9	12.5	6.77	4.06	2.84	7.73
	13	10.0	9.34	9.11	8.58	8.36	8.40	24.6	46.1	21.3	14.4	11.7	10.1	15.2
Gain or loss		+6.71	+6.54	+7.14	+7.04	+6.75	+6.65	+7.3	+10.2	+8.8	+7.63	+7.64	+7.26	+7.47
1978	12	2.82	2.25	1.55	1.69	1.72	2.15	6.54	66.3	51.4	18.5	8.33	6.31	14.2
	13	9.76	9.25	8.62	7.49	7.75	8.33	14.6	95.0	72.0	29.3	19.7	15.2	24.9
Gain or loss		+6.94	+7.00	+7.07	+5.80	+6.03	+6.18	+8.06	+28.7	+20.6	+10.8	+11.37	+8.89	+10.7
1979	12	4.30	3.53	3.16	2.33	2.15	2.29	8.58	17.4	11.1	5.23	3.76	2.43	5.54
	13	13.8	13.0	12.1	11.0	9.87	9.77	17.6	27.9	20.7	12.7	11.9	10.5	14.3
Gain or loss		+9.50	+9.47	+8.94	+8.67	+7.72	+7.48	+9.02	+10.5	+9.6	+7.47	+8.14	+8.07	+8.76
1980	12	2.32	2.14	1.98	1.78	1.50	1.78	5.44	11.0	7.45	3.90	3.03	2.66	3.76
	13	10.0	9.11	8.64	8.63	8.36	8.57	12.6	19.0	15.0	11.0	9.93	9.45	10.9
Gain or loss		+7.68	+6.97	+6.66	+6.85	+6.86	+6.79	+7.16	+8.0	+7.55	+7.10	+6.90	+6.79	+7.14
1981	12	2.29	1.75	1.70	1.45	1.36	1.69	5.10	10.3	9.95	5.80	3.71	2.92	4.01
	13	8.43	7.66	7.95	7.25	7.02	7.21	11.5	16.8	16.1	11.8	9.38	8.12	9.95
Gain or loss		+6.14	+5.91	+6.25	+5.80	+5.66	+5.52	+6.40	+6.5	+6.15	+6.00	+5.67	+5.20	+5.94
1982	12	2.75	2.30	2.14	1.63	1.81	2.46	5.98	13.5	15.0	10.5	6.10	5.46	5.82
	13	8.25	7.68	7.76	7.52	7.77	7.50	11.5	18.3	19.5	15.5	11.3	10.6	11.1
Gain or loss		+5.50	+5.38	+5.62	+5.89	+5.96	+5.04	+5.52	+4.8	+4.5	+5.0	+5.20	+5.14	+5.28

Monthly and annual mean discharge of Beaver Creek, sites 12 and 13--Continued

Water year	Site number	Discharge, in cubic feet per second: Monthly mean: Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual mean
1983	12	5.52	5.07	3.25	2.78	2.71	3.49	7.68	30.9	26.3	11.5	6.87	4.65	9.26
	13	11.4	10.5	10.1	9.18	8.50	9.35	16.2	40.2	37.1	19.6	13.9	11.9	16.5
Gain or loss		+5.88	+5.43	+6.85	+6.40	+5.79	+5.86	+8.52	+9.3	+10.8	+8.1	+7.03	+7.25	+7.24
1984	12	3.91	3.39	2.91	2.73	2.03	1.91	4.08	38.8	31.2	11.8	6.06	4.20	9.45
	13	11.8	10.7	10.1	9.82	9.22	9.03	10.9	55.2	47.0	22.6	16.0	13.7	18.9
Gain or loss		+7.89	+7.31	+7.19	+7.09	+7.19	+7.12	+6.82	+16.4	+15.8	+10.8	+9.94	+9.50	+9.45
1985	12	3.85	3.02	2.33	1.93	1.59	2.05	7.85	8.21	4.96	3.09	2.38	2.21	3.63
	13	12.7	11.6	10.9	10.4	9.60	9.58	14.7	14.5	11.8	9.39	8.74	8.82	11.1
Gain or loss		+8.85	+8.58	+8.57	+8.47	+8.01	+7.53	+6.85	+6.29	+6.84	+6.30	+6.36	+6.61	+7.47

North Fork Powder River

Site 14--Upstream Station 06311060 North Fork Powder River below Bull Creek, near Hazelton

LOCATION.--Lat 44°00'29", long 107°01'08", in NE1/4 SE1/4 SW1/4 sec. 25, T. 47 N., R. 85 W., Johnson County, 20 feet downstream from Bull Creek, 1.5 miles upstream from Gammon Creek, 2.1 miles downstream from Dullknife Reservoir, and 6.8 miles southwest of Hazelton.

DRAINAGE AREA.--32.3 square miles.

PERIOD OF RECORD.--1975 to current water year (1992). Data for water years 1975-85 are presented.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The area is extensively faulted. The main fault zone extends east-west along the North Fork Powder River in the vicinity of Bull Creek, where the fault is displaced as much as 1,400 feet.

REMARKS.--This gaging station is a part of the cooperative program with the Wyoming State Engineer. Monthly discharge measurements also were made on Gardner Creek at mouth, a tributary 6.0 miles downstream.

Site 15--Downstream Station 06311400 North Fork Powder River below Pass Creek, near Mayoworth

LOCATION.--Lat 43°54'41", long 106°53'20", in NW1/4 NE1/4 SE1/4 sec. 36, T. 46 N., R. 84 W., Johnson County, 0.8 mile downstream from Pass Creek, 1.0 mile northwest of the Hat Ranch, and 7.2 miles northwest of Mayoworth.

DRAINAGE AREA.--100 square miles.

PERIOD OF RECORD.--1975 to current water year (1992). Data for water years 1975-85 are presented.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The geohydrology of the site was not recorded in Boner and others (1976), but is thought to be Tensleep Sandstone.

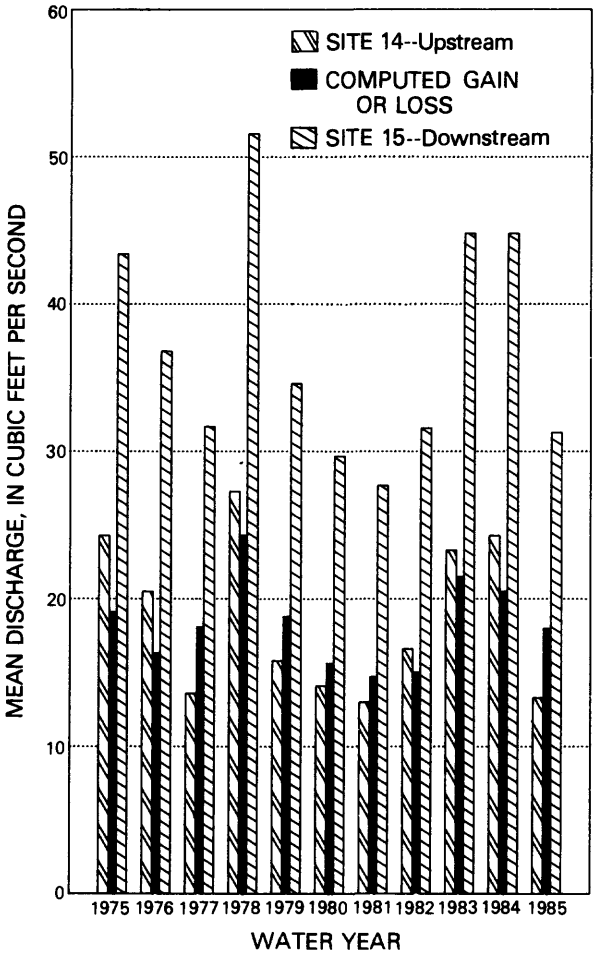
REMARKS.--This gaging station is a part of the cooperative program with the Wyoming State Engineer. Monthly discharge measurements also were made on Pass Creek at mouth, a tributary 0.8 mile upstream.

Discharge measurements and computed gain or loss of streamflow in North Fork Powder River between sites 14 and 15

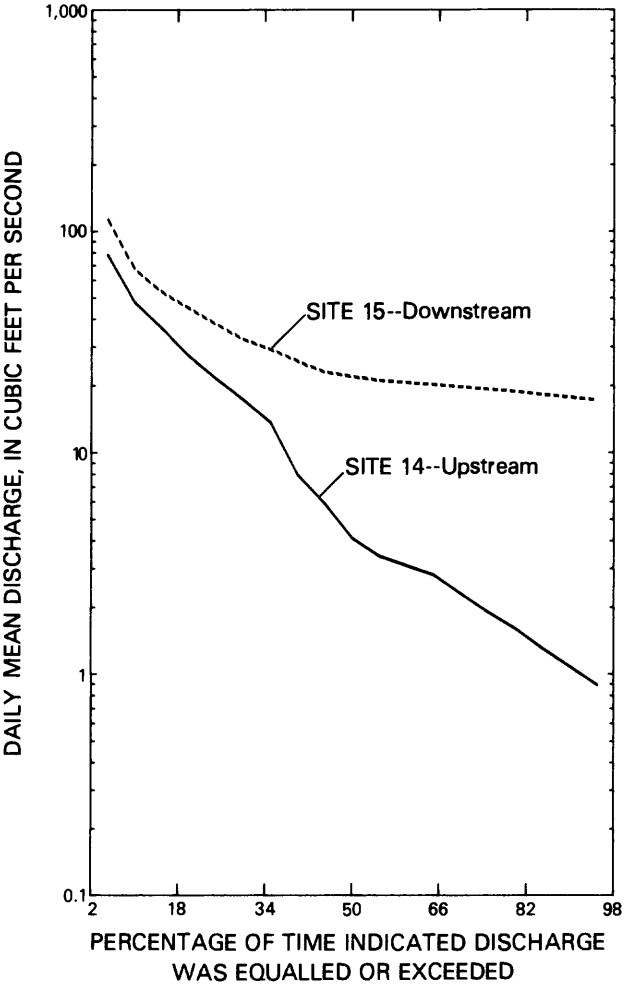
[--, not measured]

Discharge, in cubic feet per second				
Date	Site 14	Date	Site 15	Computed gain (+) or loss (-)
--	--	7-22-74	50.0	--
8-15-74	18.1	--	--	--
9-10-74	8.45	--	--	--
10-07-74	4.14	--	--	--
11-06-74	3.08	--	--	--
--	--	11-21-74	19.2	--
12-03-74	1.65	--	--	--
3-18-75	1.48	3-18-75	16.4	[1]+14.9
4-21-75	1.52	4-21-75	15.7	[1]+14.2
11-24-75	2.38	11-25-75	19.6	[1]+17.2
8-30-85	17.8	8-29-85	27.7	[1]+9.9
9-26-91	4.81	9-27-91	22.3	+17.5

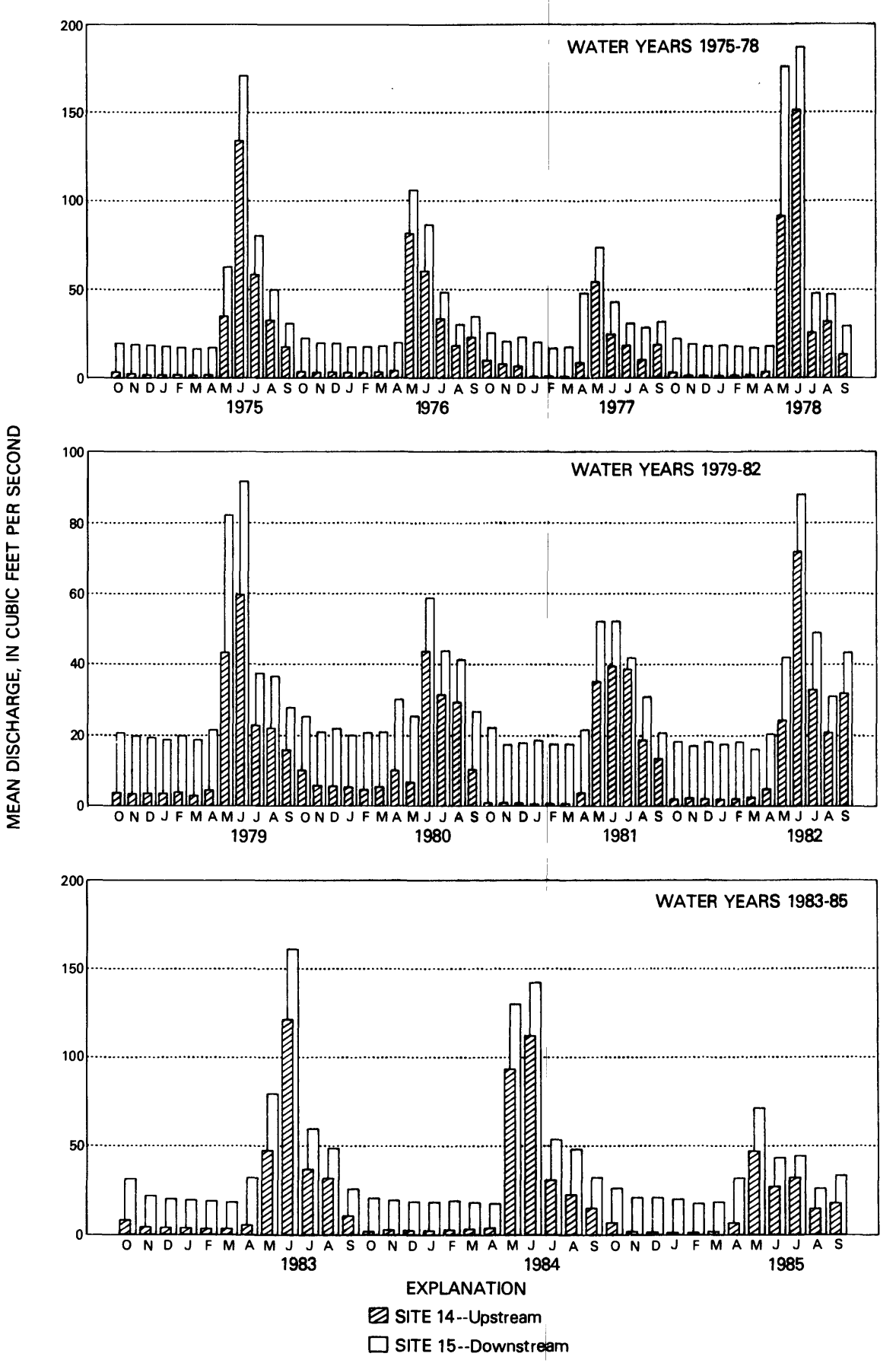
[1]Streamflow gains computed without considering effects of tributary inflow from Gardner Creek (site 53) and Pass Creek (site 54).



Annual mean discharge and annual computed gain or loss of streamflow, water years 1975-85.



Flow-duration curves for daily mean discharge, water years 1975-85.



Monthly mean discharge, water years 1975-85.

Monthly and annual mean discharge of North Fork Powder River, sites 14 and 15

[Computed gain (+) or loss (-) of flow between sites, water years 1975-85, in cubic feet per second]

Water year	Site number	Discharge, in cubic feet per second												
		Monthly mean												Annual mean
		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	
1975	14	3.27	2.32	1.76	1.78	1.73	1.55	1.78	34.9	134	58.5	32.6	17.6	24.3
	15	19.6	18.8	18.5	17.9	17.2	16.4	17.1	62.9	171	80.5	49.9	30.8	43.4
Gain or loss		+16.3	+16.5	+16.7	+16.1	+15.5	+14.8	+15.3	+28.0	+37	+22.0	+17.3	+13.2	+19.1
1976	14	3.57	3.05	3.30	3.01	2.92	3.32	4.22	81.6	60.4	33.5	18.3	22.9	20.1
	15	22.5	19.8	19.6	17.5	17.6	18.1	20.0	106	86.6	48.4	30.2	34.6	36.8
Gain or loss		+18.9	+16.7	+16.3	+14.5	+14.7	+14.8	+15.8	+24.4	+26.2	+14.9	+11.9	+11.7	+16.7
1977	14	9.81	7.90	6.62	.80	.88	1.00	8.59	54.4	24.7	18.4	10.3	18.8	13.6
	15	25.4	20.7	23.1	20.2	16.7	17.5	47.9	74.0	43.0	30.8	28.5	31.7	31.7
Gain or loss		+15.6	+12.8	+16.5	+19.4	+15.8	+16.5	+39.3	+19.6	+18.3	+12.4	+18.2	+12.9	+18.1
1978	14	3.08	1.45	1.37	1.35	1.45	1.67	3.58	91.4	151	25.7	31.9	13.4	27.3
	15	22.3	19.3	18.1	18.5	17.9	17.0	18.1	176	187	47.9	47.4	29.3	51.6
Gain or loss		+19.2	+17.8	+16.7	+17.1	+16.4	+15.3	+14.5	+84.6	+36	+22.2	+15.5	+15.9	+24.3
1979	14	3.74	3.46	3.58	3.58	3.93	2.99	4.51	43.3	59.7	22.9	22.1	15.9	15.8
	15	20.7	19.8	19.4	18.8	19.9	18.8	21.6	82.2	91.7	37.5	36.6	27.9	34.6
Gain or loss		+17.0	+16.3	+15.8	+15.2	+16.0	+15.8	+17.1	+38.9	+32.0	+14.6	+14.5	+12.0	+18.8
1980	14	10.2	5.88	5.71	5.41	4.66	5.48	10.2	6.78	43.7	31.5	29.4	10.4	14.1
	15	25.4	21.0	22.0	20.1	20.8	21.0	30.2	25.5	58.8	43.8	41.3	26.8	29.7
Gain or loss		+15.2	+15.1	+16.3	+14.7	+16.1	+15.5	+20.0	+18.7	+15.1	+12.3	+11.9	+16.4	+15.6
1981	14	1.03	1.02	.87	.69	.73	.86	3.79	35.2	39.5	38.7	18.8	13.5	13.0
	15	22.3	17.5	18.0	18.7	17.6	17.7	21.7	52.2	52.2	41.9	30.9	20.8	27.7
Gain or loss		+21.3	+16.5	+17.1	+18.0	+16.9	+16.8	+17.9	+17.0	+12.7	+3.2	12.1	+7.3	+14.7

Monthly and annual mean discharge of North Fork Powder River, sites 14 and 15--Continued

Water year	Site number	Discharge, in cubic feet per second												
		Monthly mean												Annual mean
		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	
1982	14	1.98	2.29	2.14	2.02	2.12	2.46	4.86	24.4	71.8	32.9	20.9	31.9	16.6
	15	18.4	17.2	18.3	17.7	18.3	16.2	20.5	42.0	88.0	49.0	31.1	43.3	31.6
Gain or loss		+16.4	+14.9	+16.2	+15.7	+16.2	+13.7	+15.6	+17.6	+16.2	+16.1	+10.2	+11.4	+15.0
1983	14	8.22	4.24	3.91	3.65	3.30	3.25	5.30	47.2	121	36.6	31.7	10.5	23.3
	15	31.5	21.9	20.2	19.6	19.0	18.3	32.2	79.4	161	59.7	48.5	25.8	44.8
Gain or loss		+23.3	+17.7	+16.3	+15.9	+15.7	+15.0	+26.9	+32.2	+40	+23.1	+16.8	+15.3	+21.5
1984	14	1.72	2.61	2.34	2.15	2.57	3.00	3.66	93.3	112	30.6	22.4	14.7	24.3
	15	20.6	19.4	18.5	18.3	19.0	18.1	17.5	130	142	53.6	48.0	32.3	44.8
Gain or loss		+18.9	+16.8	+16.2	+16.1	+16.4	+15.1	+13.8	+36.7	+30	+23.0	+25.6	+17.6	+20.5
1985	14	6.60	1.66	1.33	1.08	1.11	1.59	6.54	46.9	27.0	32.1	14.5	17.7	13.3
	15	26.2	20.9	20.9	20.0	17.6	18.4	32.0	71.4	43.2	44.3	26.1	33.3	31.3
Gain or loss		+19.6	+19.2	+19.6	+18.9	+16.5	+16.8	+25.5	+24.5	+16.2	+12.2	+11.6	+15.6	+18.0

North Fork Crazy Woman Creek

Site 16--Upstream Station 06313950 North Fork Crazy Woman Creek below Pole Creek, near Buffalo

LOCATION.--Lat 44°11'11", long 106°51'12", in NW1/4 NE1/4 SW1/4 sec. 28, T. 49 N., R. 83 W., Johnson County, Bighorn National Forest, 8 feet upstream from bridge, 0.7 mile upstream from forest boundary, 3.4 miles downstream from Pole Creek, 4.0 miles west of Klondike Ranch, and 13 miles southwest of Buffalo.

DRAINAGE.--43.4 square miles.

PERIOD OF RECORD.--Water years 1974-84.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The upstream site is along strike of the Gallatin and Gros Ventre Formations and near the base of the Bighorn Dolomite.

Site 17--Downstream Station 06314000 North Fork Crazy Woman Creek near Buffalo

LOCATION.--Lat 44°11'16", long 106°49'48", in SW1/4 SW1/4 NE1/4 sec. 27, T. 49 N., R. 83 W., Johnson County, 70 feet upstream from bridge on county road, 2.1 miles upstream from Spring Draw, 3.0 miles west of Klondike Ranch, and 13 miles southwest of Buffalo.

DRAINAGE AREA.--44.9 square miles.

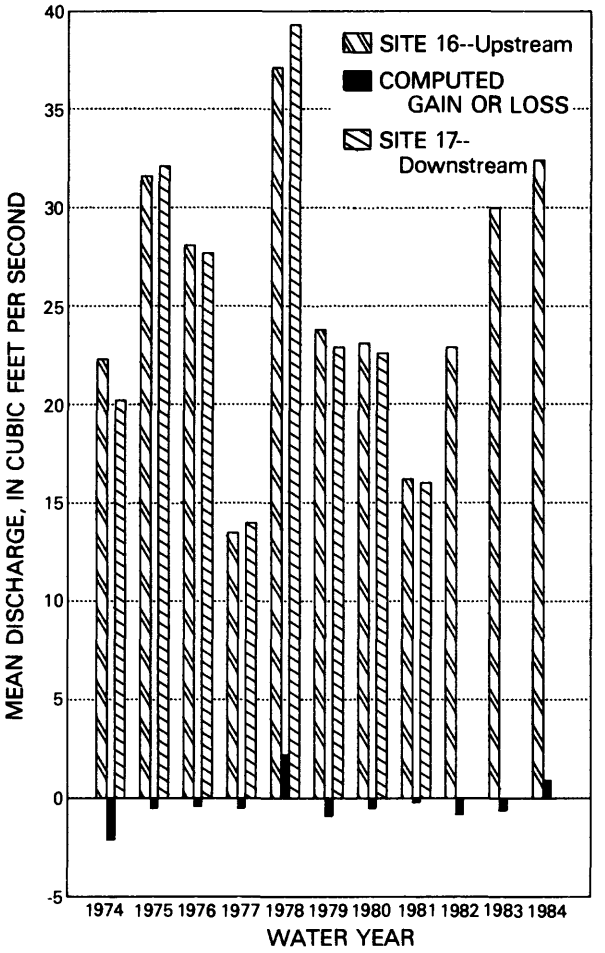
PERIOD OF RECORD.--Water years 1974-84.

GAGE.--Water-stage recorder.

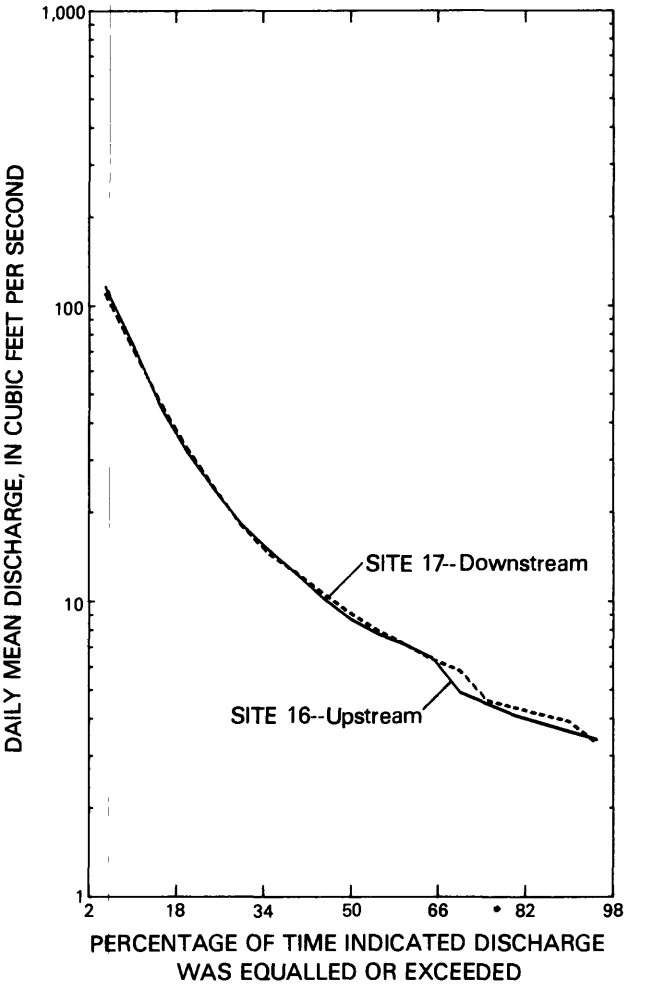
GEOHYDROLOGY.--The downstream site is just upstream from, and on strike with, the top of the Tensleep Sandstone.

Discharge measurements and computed gain or loss of streamflow in North Fork Crazy Woman Creek between sites 16 and 17

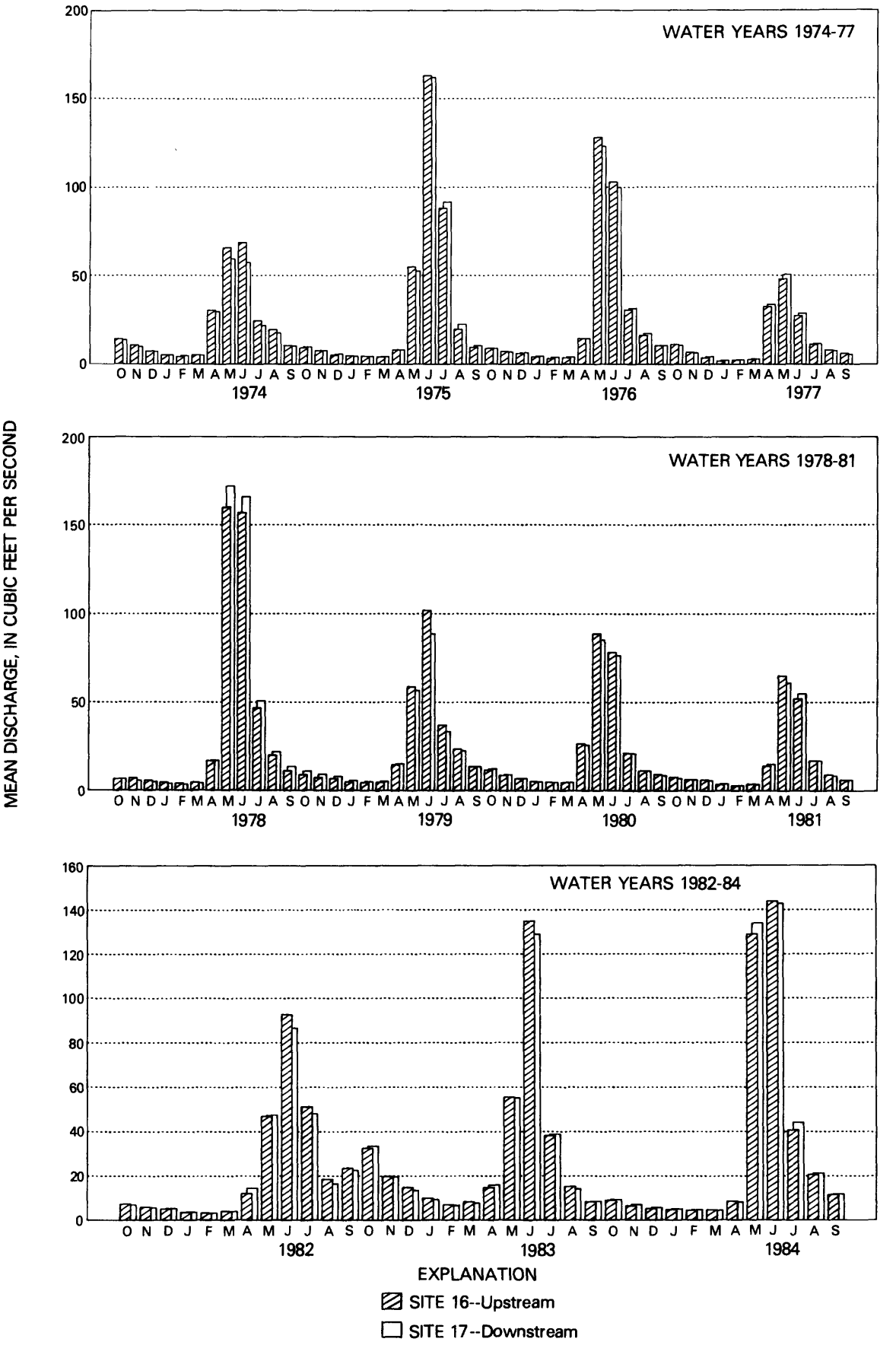
Discharge, in cubic feet per second				
Date	Site 16	Date	Site 17	Computed gain (+) or loss (-)
7-08-74	23.8	7-08-74	22.6	-1.2
8-08-74	27.6	8-08-74	25.9	-1.7
9-10-74	10.1	9-10-74	9.68	-.42
9-25-74	8.98	9-25-74	9.81	+.83
10-07-74	17.2	10-07-74	15.7	-1.5
11-19-74	8.36	11-19-74	7.75	-.61
6-24-85	17.2	6-24-85	17.1	-.1
8-22-85	4.46	8-22-85	5.15	+.69
9-06-91	8.55	9-06-91	7.43	-1.12



Annual mean discharge and annual computed gain or loss of streamflow, water years 1974-84.



Flow-duration curves for daily mean discharge, water years 1974-84.



Monthly mean discharge, water years 1974-84.

Monthly and annual mean discharge of North Fork Crazy Woman Creek, sites 16 and 17

[Computed gain (+) or loss (-) of flow between sites for period of record, in cubic feet per second]

Water year	Site number	Discharge, in cubic feet per second												
		Monthly mean												Annual mean
		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	
1974	16	14.3	10.8	7.38	5.21	4.31	5.24	30.3	65.7	68.7	24.5	19.5	10.5	22.3
	17	13.8	10.0	7.12	5.26	4.88	5.08	29.6	59.3	57.4	21.7	17.7	10.4	20.2
Gain or loss		-.5	-.8	-.26	+.05	+.57	-.16	-.7	-6.4	-11.3	-2.8	-1.8	-.1	-2.1
1975	16	9.19	7.59	5.16	4.77	4.54	4.11	8.10	54.8	163	88.3	19.6	9.52	31.6
	17	9.76	7.75	5.76	4.59	4.53	4.40	8.16	52.4	162	91.8	22.5	10.5	32.1
Gain or loss		+.57	+.16	+.60	-.18	-.01	+.29	+.06	-2.4	-1	+3.5	+2.9	+1.0	+.5
1976	16	8.91	7.17	6.15	4.20	3.33	3.66	14.6	128	103	30.5	16.3	10.5	28.1
	17	8.81	6.92	6.39	4.63	4.13	4.19	14.6	123	100	31.3	17.4	10.7	27.7
Gain or loss		-.10	-.25	+.24	+.43	+.80	+.53	0	-5	-3	+.8	+1.1	+.2	-.4
1977	16	11.2	6.83	3.74	1.75	2.35	2.57	32.4	47.9	27.3	11.2	7.95	6.12	13.5
	17	10.7	6.51	4.36	2.37	2.56	2.98	33.6	50.5	28.7	11.7	7.61	5.61	14.0
Gain or loss		-.5	-.32	+.62	+.62	+.21	+.41	+1.2	+2.6	+1.4	+.5	-.34	-.51	+.5
1978	16	6.66	7.00	5.67	4.55	4.02	4.59	16.7	160	157	46.7	19.8	11.0	37.1
	17	6.67	5.61	4.80	3.85	3.49	4.15	17.0	172	166	50.8	21.8	13.5	39.3
Gain or loss		+.01	-1.39	-.87	-.70	-.53	-.44	+.3	+12	+9	+4.1	+2.0	+2.5	+2.2
1979	16	8.86	7.23	6.69	4.75	4.44	4.70	14.5	58.9	102	37.1	23.4	13.5	23.8
	17	10.9	9.13	7.99	5.68	5.11	5.19	15.1	56.7	88.8	33.4	22.5	13.5	22.9
Gain or loss		+2.04	+1.90	+1.30	+.93	+.67	+.49	+.6	-2.2	-13.2	-3.7	-.9	0	-.9
1980	16	11.7	8.49	6.78	5.04	4.80	4.58	26.5	88.9	78.4	21.1	11.3	9.24	23.1
	17	12.3	9.06	6.95	4.94	4.70	4.70	25.7	85.4	76.6	21.0	11.1	8.62	22.6
Gain or loss		+.6	+.57	+.17	-.10	-.10	+.12	-.8	-3.5	-1.8	-.1	-.2	-.62	-.5

Monthly and annual mean discharge of North Fork Crazy Woman Creek, sites 16 and 17--Continued

Water year	Site number	Discharge, in cubic feet per second												
		Monthly mean												Annual mean
		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	
1981	16	7.76	6.32	6.08	3.58	2.83	3.73	14.0	65.1	52.0	16.8	8.89	5.95	16.2
	17	6.89	6.28	5.83	4.00	2.94	3.50	14.9	61.0	54.9	16.9	8.73	5.99	16.0
Gain or loss		-.87	-.04	-.25	+.42	+.11	-.23	+.9	-4.1	+2.9	+.1	-.16	+.04	-.2
1982	16	7.32	5.91	5.02	3.57	3.25	3.97	12.1	47.0	92.7	51.2	18.5	23.6	22.9
	17	6.92	5.71	5.27	3.72	3.21	3.89	14.5	47.5	86.7	48.0	16.5	22.6	22.1
Gain or loss		-.40	-.20	+.25	+.15	-.04	-.08	+2.4	+.5	-6.0	-3.2	-2.0	-1.0	-.8
1983	16	32.6	19.8	14.8	9.86	6.99	8.23	14.8	55.5	135	38.2	15.3	8.26	30.0
	17	33.6	19.6	13.6	9.32	6.76	7.70	15.9	55.2	129	38.9	14.3	8.44	29.4
Gain or loss		+1.0	-.2	-1.2	-.54	-.23	-.53	+1.1	-.3	-6	+.7	-1.0	+.18	-.6
1984	16	8.92	6.47	5.26	4.84	4.49	4.71	8.55	129	144	40.7	20.7	11.5	32.4
	17	9.30	7.13	5.75	5.20	4.81	4.55	8.21	134	143	44.2	21.3	11.8	33.3
Gain or loss		+.38	+.66	+.49	+.36	+.32	-.16	-.34	+5	-1	+3.5	+.6	+.3	+.9

Poison Creek

Site 18--Upstream Station 06315480 Poison Creek below Tetley Spring, near Mayoworth

LOCATION.--Lat 44°05'29", long 106°51'47" in SE1/4 NW1/4 NW1/4 sec. 32, T. 48 N., R. 83 W., Johnson County, 0.6 mile downstream from Tetley Spring, and 16 miles north of Mayoworth.

DRAINAGE AREA.--19.0 square miles.

PERIOD OF RECORD.--Water years 1975 and 1976.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The site probably is along the strike of the Gallatin and Gros Ventre Formations, but landslide deposits conceal the bedrock.

Site 19--Downstream Station 06315490 Poison Creek near Mayoworth

LOCATION.--Lat 44°04'12", long 106°49'17", in SW1/4 NE1/4 SW1/4 sec. 3, T. 47 N., R. 83 W., Johnson County, 1.1 miles upstream from mouth, and 16 miles north of Mayoworth.

DRAINAGE AREA.--24.7 square miles.

PERIOD OF RECORD.--Water years 1975 and 1976.

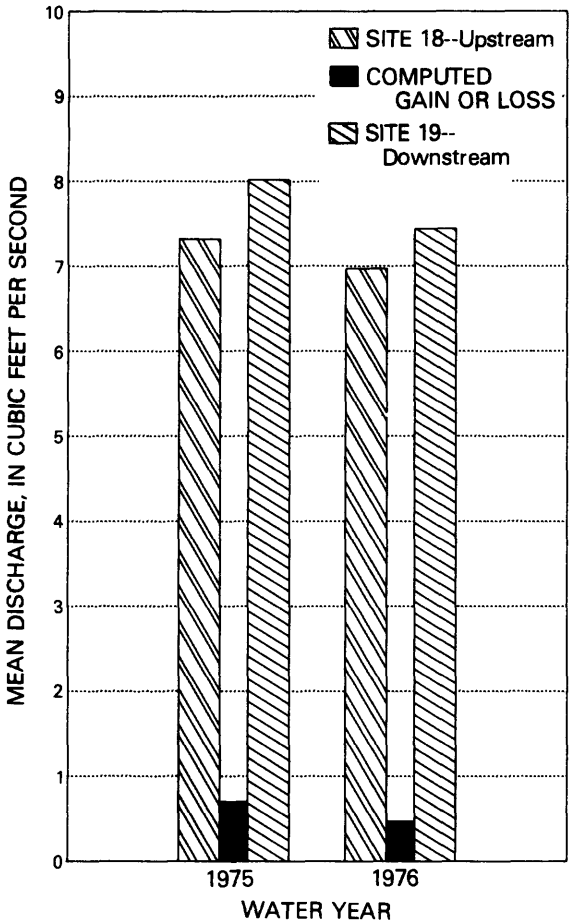
GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The downstream measurement site is just upstream from the top of the Tensleep Sandstone.

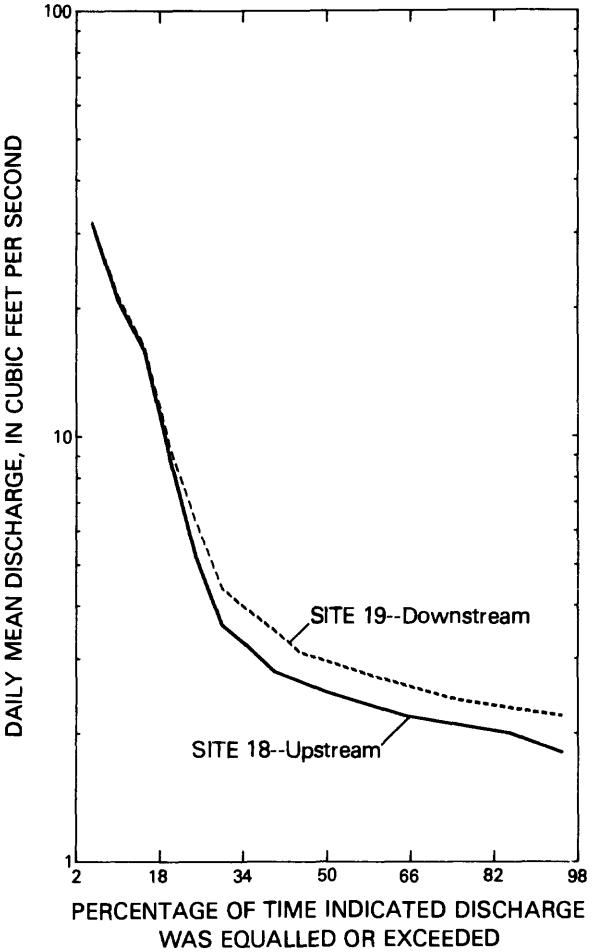
Discharge measurements and computed gain or loss of streamflow in Poison Creek between sites 18 and 19

Discharge, in cubic feet per second				
Date	Site 18	Date	Site 19	Computed gain (+) or loss (-)
9-08-74	2.58	9-08-74	2.95	+0.37
10-25-74	2.66	10-26-74	3.15	+.49
6-28-85	3.32	6-28-85	5.13	+1.81
8-15-85	2.34	8-15-85	3.48	+1.14
9-17-91	2.61	9-17-91	3.32	+0.71

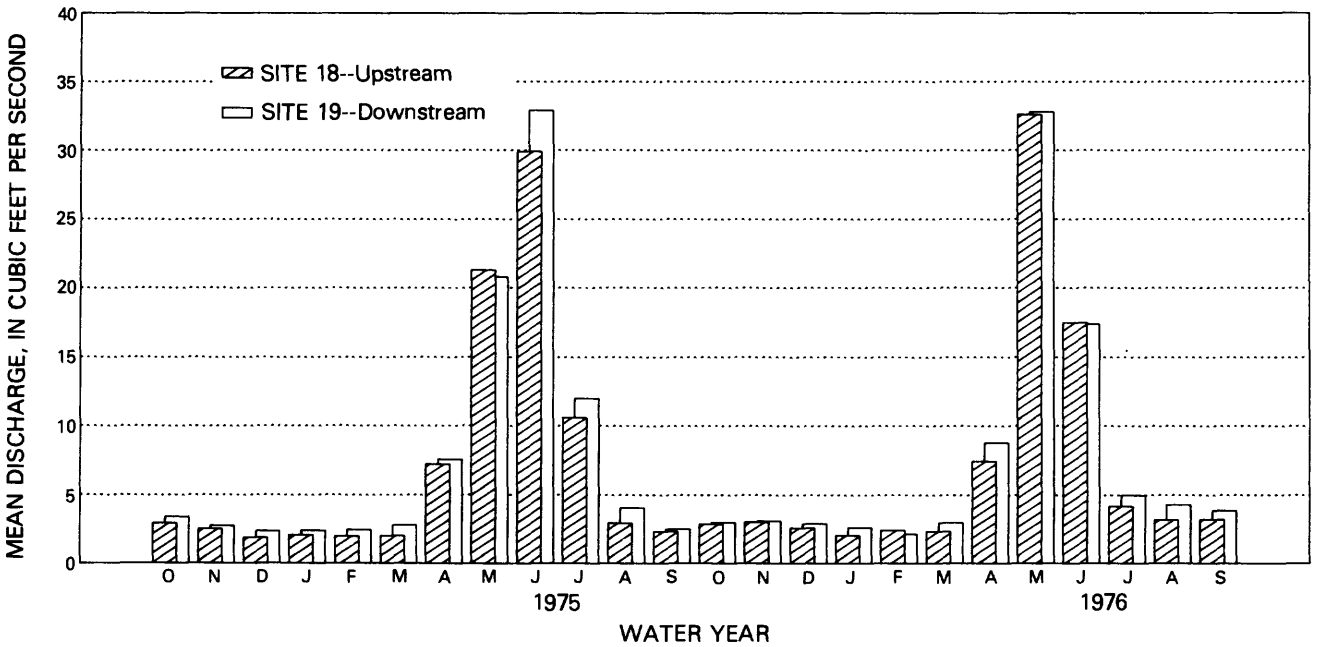
Poison Creek



Annual mean discharge and annual computed gain or loss of streamflow, water years 1975 and 1976.



Flow-duration curves for daily mean discharge, water years 1975 and 1976.



Monthly mean discharge, water years 1975 and 1976.

Monthly and annual mean discharge of Poison Creek, sites 18 and 19

[Computed gain (+) or loss (-) of flow between sites for period of record, in cubic feet per second]

Water year	Site number	Discharge, in cubic feet per second: Monthly mean: Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual mean
1975	18	2.94	2.52	1.88	2.07	1.97	2.01	7.21	21.3	29.9	10.6	2.95	2.34	7.32
	19	3.41	2.76	2.38	2.41	2.46	2.81	7.56	20.8	32.9	12.0	4.08	2.52	8.02
Gain or loss		+.47	+.24	+.50	+.34	+.49	+.80	+.35	-.5	+3.0	+1.4	+1.13	+.18	+.70
1976	18	2.89	3.04	2.60	2.05	2.43	2.35	7.46	32.6	17.5	4.19	3.20	3.22	6.97
	19	3.01	3.11	2.92	2.64	2.14	3.00	8.78	32.8	17.4	4.99	4.30	3.87	7.44
Gain or loss		+.12	+.07	+.32	+.59	-.29	+.65	+1.32	+.2	-.1	+.80	+1.10	+.65	+.47

South Rock Creek

Site 20--Upstream Station 06319470 South Rock Creek at forest boundary, near Buffalo

LOCATION.--Lat 44°26'37", long 106°55'12", in SW1/4 SW1/4 SW1/4 sec. 25, T. 52 N., R. 84 W., Johnson County, just downstream from Bighorn National Forest boundary, 0.2 mile downstream from unnamed tributary, 0.7 mile upstream from Red Canyon, and 13 miles northwest of Buffalo.

DRAINAGE AREA.--40.3 square miles.

PERIOD OF RECORD.--Water years 1975 and 1976.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The site is on strike with the Gallatin and Gros Ventre Formations and near the base of the Bighorn Dolomite.

Site 21--Downstream Station 06319480 South Rock Creek above Red Canyon, near Buffalo

LOCATION.--Lat 44°26'36", long 106°54'36", in SW1/4 SW1/4 SE1/4 sec. 25, T. 52 N., R. 84 W., Johnson County, 0.2 mile upstream from Red Canyon, and 13 miles northwest of Buffalo.

DRAINAGE AREA.--40.5 square miles.

PERIOD OF RECORD.--Water years 1975 and 1976.

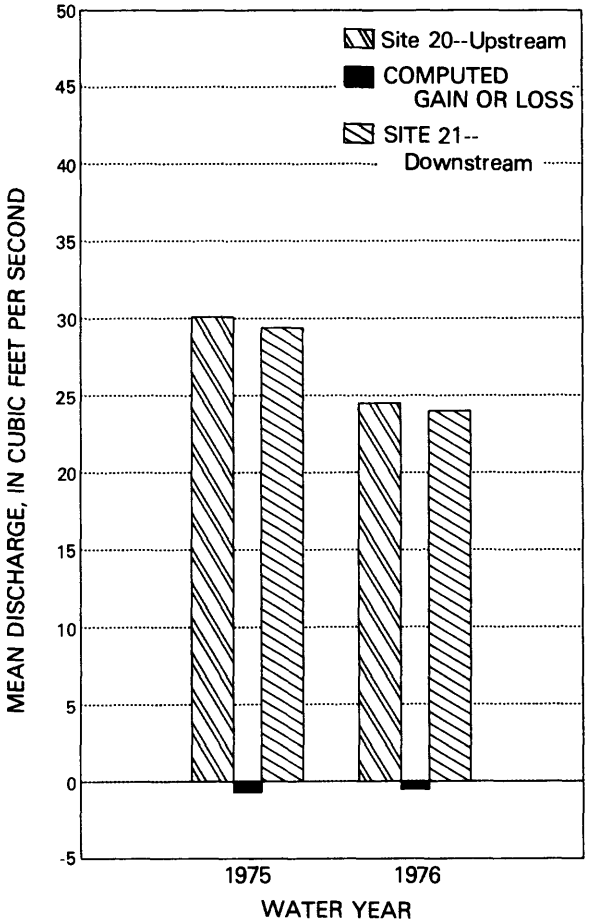
GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The site is on strike with, and just upstream from, the top of the Tensleep Sandstone.

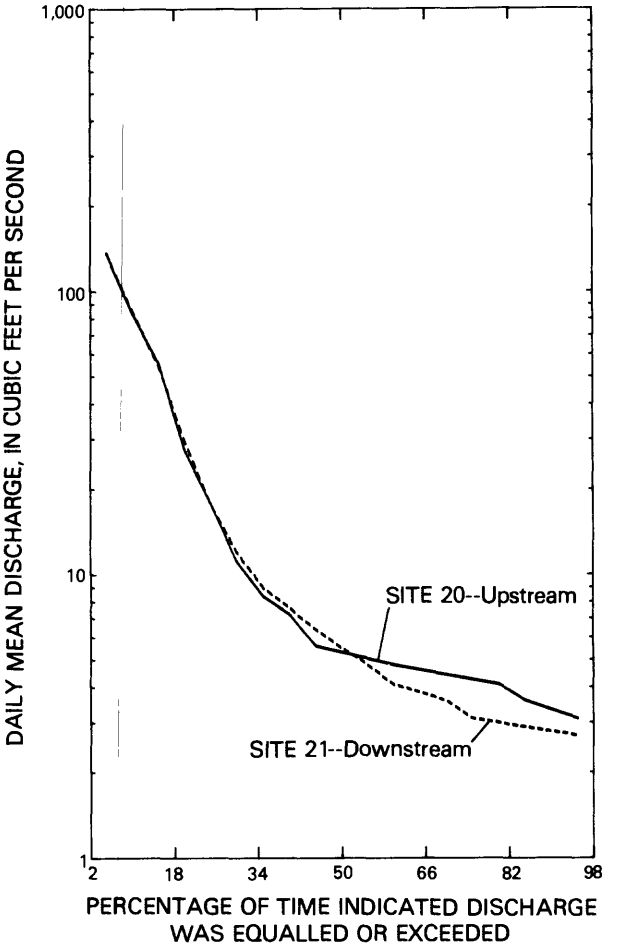
Discharge measurements and computed gain or loss of streamflow in South Rock Creek between sites 20 and 21

Discharge, in cubic feet per second				
Date	Site 20	Date	Site 21	Computed gain (+) or loss (-)
9-06-74	10.0	9-06-74	9.30	-0.70
11-13-74	5.47	11-13-74	4.95	-.52
8-21-85	5.80	8-21-85	4.97	-.83
9-01-91	4.04	9-01-91	5.87	+1.83

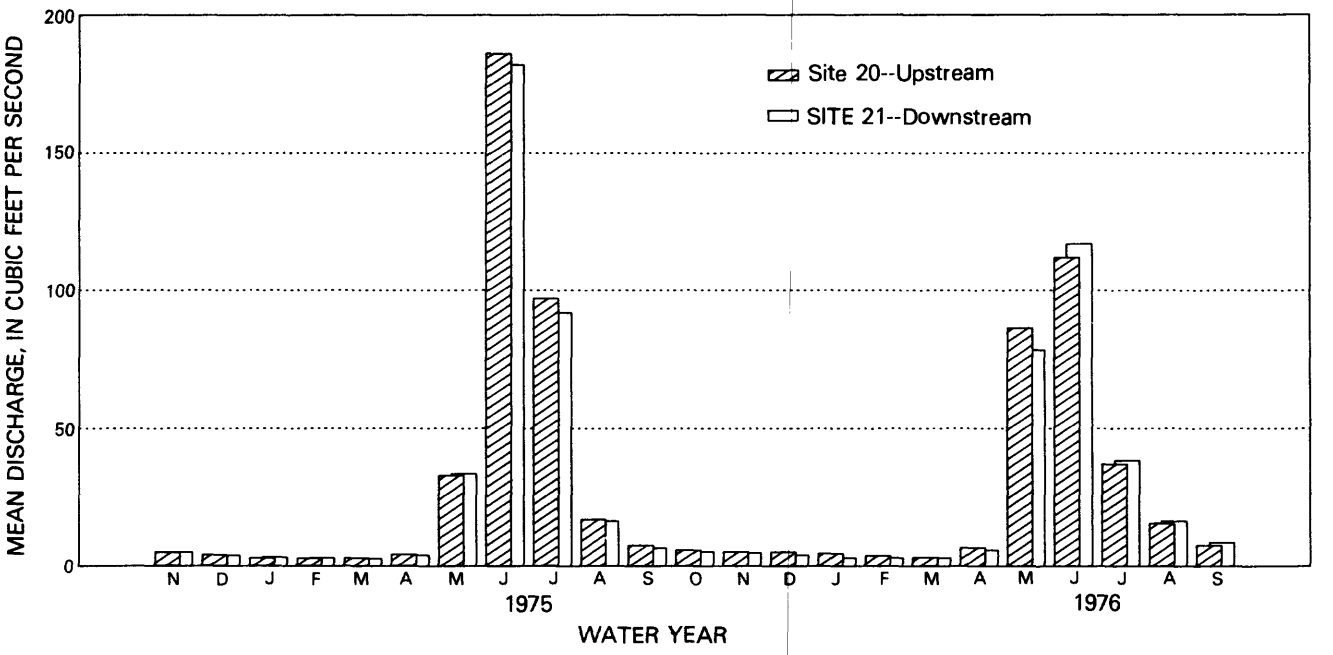
South Rock Creek



Annual mean discharge and annual computed gain or loss of streamflow, water years 1975 and 1976.



Flow-duration curves for daily mean discharge, water years 1975 and 1976.



Monthly mean discharge, water years 1975 and 1976.

Monthly and annual mean discharge of South Rock Creek, sites 20 and 21

[Computed gain (+) or loss (-) of flow between sites for period of record, in cubic feet per second; --, not measured]

Water year	Site number	Discharge, in cubic feet per second												
		Monthly mean												Annual mean
		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	
1975	20	--	4.92	3.99	2.87	2.76	2.86	4.21	32.9	186	96.9	17.0	7.58	--
	21	--	5.12	3.95	3.38		3.05	2.81	4.07	33.6	182	91.9	16.5	6.67
	--													
Gain or loss		--	+.20	-.04	+.51	+.29	-.05	-.14	+.7	-4	-5.0	-.5	-.91	--
1976	20	5.84	5.21	5.13	4.60	3.72	3.16	6.76	86.3	112	37.1	15.6	7.56	24.5
	21	5.35	4.88	4.00	3.05	3.09	3.01	5.93	78.4	117	38.5	16.5	8.62	24.0
Gain or loss		-.49	-.33	-1.13	-1.55	-.63	-.15	-.83	-7.9	+5	+1.4	+.9	+1.06	-.5

South Piney Creek

Site 22--Upstream Station 06321000 South Piney Creek near Story

LOCATION.--Lat 44°33'26", long 106°56'11", in NW1/4 NE1/4 NE1/4 sec. 23, T. 53 N., R. 84 W., Johnson County, Bighorn National Forest, 2.3 miles southwest of Story, and 3.3 miles upstream from confluence with North Piney Creek.

DRAINAGE AREA.--69.4 square miles.

PERIOD OF RECORD.--Water years 1951-79. Data for water years 1975-79 are presented.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--Site 22 is on strike with, and near the top of, the Gallatin and Gros Ventre Formations. Sinks near the base of the Bighorn Dolomite are between this site and site 25. Water that sinks in the Bighorn Dolomite in the canyon of South Piney Creek is known to discharge in Spring Creek (Don Dexter, Wyoming Game and Fish Commission, oral commun., 1974).

REMARKS.--Flows of both Spring Creek and Mead-Coffeen Ditch are used at the Story Fish Hatchery with some mixing prior to release. The downstream gage on Mead-Coffeen Ditch and the gage on Spring Creek are downstream from the fish hatchery. In determining gain or loss in the total South Piney, Mead-Coffeen Ditch, and Spring Creek area, the upstream gage on Mead-Coffeen Ditch was ignored, and the flow of the downstream sites on South Piney Creek (site 25) and Mead-Coffeen Ditch (site 24) were combined with Spring Creek (site 26) and then compared to the upstream site on South Piney Creek (site 22).

Site 23--06321020 Mead-Coffeen Ditch above Fish Hatchery, near Story (Diversion from South Piney Creek upstream site)

LOCATION.--Lat 44°33'41", long 106°55'45", in NE1/4 SW1/4 SW1/4 sec. 13, T. 53 N., R. 84 W., Sheridan County, at roadway 0.3 mile southwest of fish hatchery, 0.4 mile downstream from intake, and 1.9 miles southwest of Story.

PERIOD OF RECORD.--Water years 1975-79.

GAGE.--Water-stage recorder.

Site 24--Downstream Station 06321040 Mead-Coffeen Ditch below Fish Hatchery, near Story

LOCATION.--Lat 44°34'07", long 106°55'29", in NE1/4 SE1/4 NW1/4 sec. 13, T. 53 N., R. 84 W., Sheridan County, at upstream side of county road, 0.3 mile northeast of fish hatchery, 1.1 miles downstream from intake, and 1.4 miles southwest of Story.

PERIOD OF RECORD.--Water years 1975-79.

GAGE.--Water-stage recorder.

Site 25--Downstream Station 06321100 South Piney Creek below Mead-Coffeen Ditch, near Story

LOCATION.--Lat 44°33'29", long 106°55'50", in SW1/4 SW1/4 SW1/4 sec. 13, T. 53 N., R. 84 W., Sheridan County, 0.3 mile downstream from Mead-Coffeen Ditch intake, 0.5 mile upstream from Big Piney Ditch intake, and 2.1 miles southwest of Story.

DRAINAGE AREA.--69.5 square miles.

PERIOD OF RECORD.--Water years 1975-79.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The downstream site is on strike with the easternmost outcrop of Paleozoic rocks (Madison Limestone) on the south side of the canyon. The Wasatch Formation occurs east of this outcrop.

Site 26--Combination Downstream Station 06321800 Spring Creek near Story

LOCATION.--Lat 44°34'07", long 106°55'34", in NE1/4 SE1/4 NW1/4 sec. 13, T. 53 N., R. 84 W., Sheridan County, at upstream side of county road, 0.3 mile northeast of fish hatchery, 1.4 miles upstream from mouth, and 1.4 miles southwest of Story.

PERIOD OF RECORD.--Water years 1975-79.

GAGE.--Water-stage recorder.

Discharge measurements and computed gain or loss of streamflow in South Piney Creek between sites 22 and 26

[--, not measured]

Date	Discharge, in cubic feet per second						
	Site 22	Site 23	Site 24	Computed gain (+) or loss (-)[1]	Site 25	Site 26	Computed gain (+) or loss (-)[2]
7-16-74	109	21.3	--	--	90.7	--	--
10-27-74	24.9	.94	2.54	+1.60	22.5	2.52	+2.66
11-11-74	24.4	.95	[3]2.27	+1.32	20.6	[3]1.93	+.40
8-20-85	113	20.3	20.0	-.3	[4]77.4	11.9	-3.7
10-21-85	28.6	.72	1.19	+.47	21.8	6.05	+.44
9-28-91	29.2	3.09	2.53	-.56	16.1	11.4	+.83

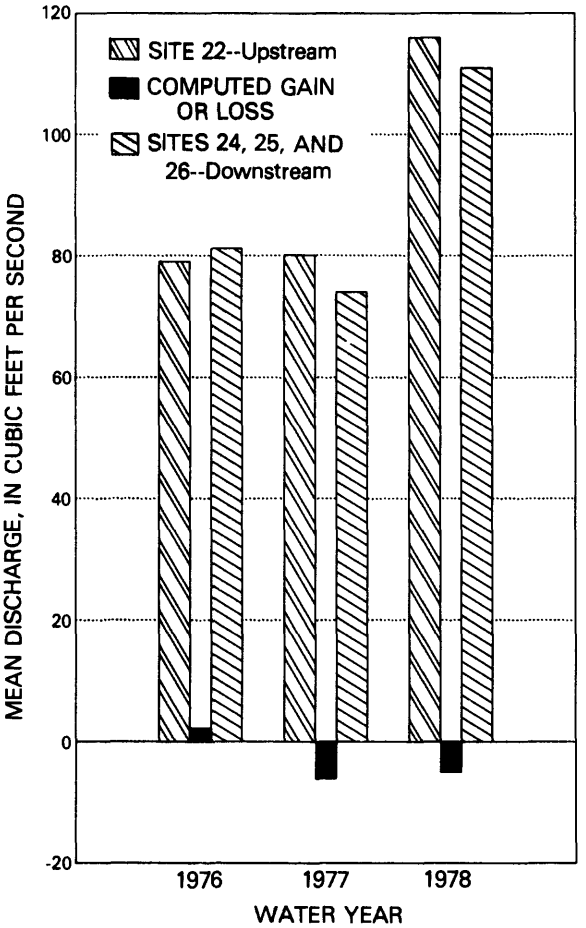
[1]Site 24 minus site 23. Spring Creek flow (site 26) may be diverted into Mead-Coffeen Ditch between sites 23 and 24.

[2]Computed by adding sites 24, 25, and 26 and subtracting site 22.

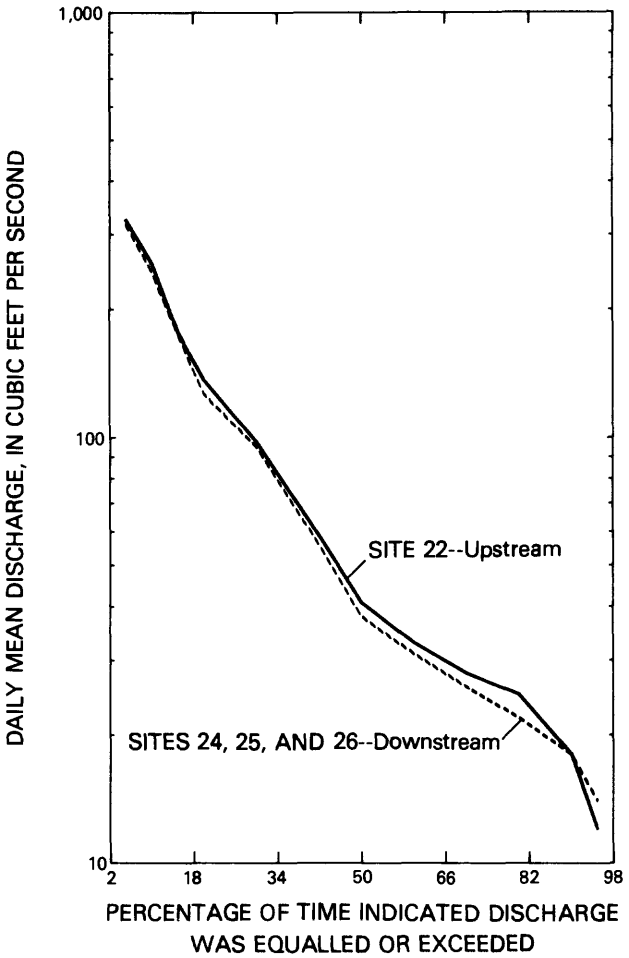
[3]Discharge measured November 13, 1974.

[4]Includes 0.75 cubic feet per second in bypass ditch.

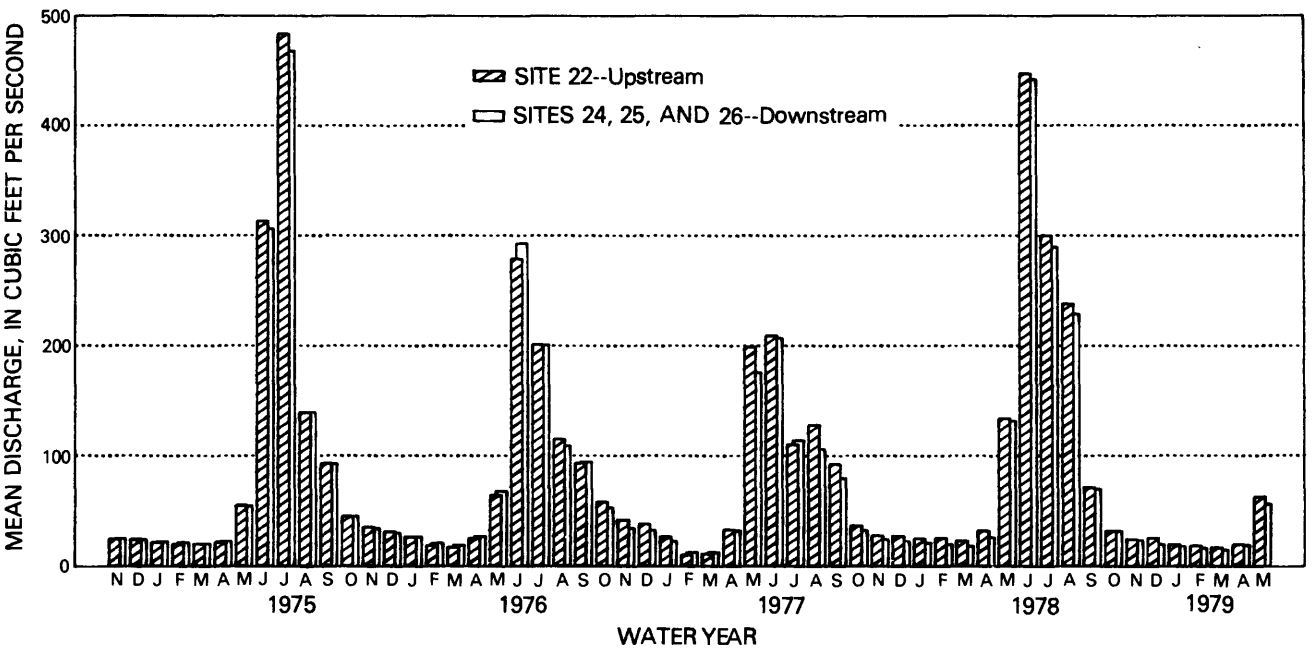
South Piney Creek



Annual mean discharge and annual computed gain or loss of streamflow, water years 1976-78.



Flow-duration curves for daily mean discharge, water years 1976-78.



Monthly mean discharge, water years 1975-79.

Monthly and annual mean discharge of South Piney Creek, Mead-Coffeen Ditch, and Spring Creek, sites 22, 24, 25, and 26

[Computed gain (+) or loss (-) of flow between sites for period of record, in cubic feet per second; --, not measured]

Water year	Site number	Discharge, in cubic feet per second: Monthly mean Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual mean
1975	22	--	24.7	24.2	21.3	19.6	19.9	21.9	55.0	313	483	139	92.7	--
	24	--	2.53	3.38	3.56	3.35	3.65	4.23	6.75	19.2	13.8	20.7	14.7	--
	25	--	21.1	18.0	15.7	15.4	14.0	15.6	43.1	279	448	112	71.9	--
	26	--	2.09	3.56	3.75	3.31	3.40	3.57	5.53	7.55	6.63	7.20	6.60	--
24,25,26	total	--	25.7	24.9	23.0	22.1	21.0	23.4	55.4	306	468	140	93.2	--
Gain or loss[1]		--	+1.0	+.7	+1.7	+2.5	+1.1	+1.5	+.4	-7	-15	+1	+.5	--
1976	22	45.0	34.9	30.9	26.2	18.6	16.7	25.2	64.1	279	201	115	92.9	79.0
	24	7.84	5.06	4.77	3.85	3.35	2.79	3.67	9.82	16.3	14.2	19.1	18.5	9.12
	25	33.9	26.3	22.1	21.4	16.3	15.2	21.2	54.7	270	182	80.2	65.4	67.3
	26	4.06	3.37	3.83	2.18	1.92	1.66	2.95	4.29	6.56	5.29	10.1	10.6	4.73
24,25,26	total	45.8	34.7	30.7	27.4	21.6	19.6	27.8	68.8	293	201	109	94.5	81.1
Gain or loss[1]		+.8	-.2	-.2	+1.2	+3.0	+2.9	+2.6	+4.7	+14	0	-6	+1.6	+2.1
1977	22	57.8	41.7	38.1	26.6	9.95	10.8	33.1	199	209	110	128	92.2	80.1
	24	13.7	6.29	2.82	3.07	2.12	1.86	3.13	4.04	8.60	16.9	18.9	15.8	8.15
	25	32.0	24.4	27.1	17.3	8.89	8.79	25.4	168	193	89.7	76.2	54.5	60.7
	26	7.13	3.86	2.72	2.70	1.72	2.02	3.94	4.36	5.10	7.58	9.97	9.88	5.10
24,25,26	total	52.8	34.5	32.6	23.1	12.7	12.7	32.5	176	207	114	105	80.2	73.9
Gain or loss[1]		-5.0	-7.2	-5.5	-3.5	+2.75	+1.9	-.6	-23	-2	+4	-23	-12.0	-6.2
1978	22	36.6	27.8	27.2	25.2	25.6	22.9	32.2	134	447	300	238	71.4	116
	24	4.84	3.58	4.21	4.37	4.40	4.14	3.58	4.29	5.13	7.63	22.0	8.33	6.40
	25	23.6	16.8	14.4	12.4	10.5	9.37	17.6	122	431	277	199	55.7	99.5
	26	3.95	4.29	4.33	4.61	4.89	4.75	5.11	5.84	6.15	5.49	7.78	6.22	5.29
24,25,26	total	32.4	24.7	22.9	21.4	19.8	18.3	26.3	132	442	290	229	70.2	111
Gain or loss[1]		-4.2	-3.1	-4.3	-3.8	-5.8	-4.6	-5.9	-2	-5	-10	-9	-1.2	-5

Monthly and annual mean discharge of South Piney Creek, Mead-Coffeen Ditch, and Spring Creek, sites 22, 24, 25, and 26--Continued

Water year	Site number	Discharge, in cubic feet per second												
		Monthly mean												Annual mean
		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	
1979	22	32.0	24.4	25.8	19.4	18.5	16.7	19.8	62.6	205	168	146	106	70.6
	24	3.77	2.38	1.79	.93	.76	.66	.56	6.66	--	--	--	--	--
	25	24.4	17.6	14.8	13.9	12.8	10.6	13.6	41.3	170	147	--	--	--
	26	4.01	3.93	3.45	3.24	3.04	3.61	5.12	8.32	--	--	--	--	--
24,25,26	total	32.2	23.9	20.0	18.1	16.6	14.9	19.3	56.3	--	--	--	--	--
Gain or loss[1]		+.2	-.5	-5.8	-1.3	-1.9	-1.8	-.5	-6.3	--	--	--	--	--

[1]Computed by adding sites 24, 25, and 26 and subtracting site 22.

Description of Sites and Summary of Streamflow Data and Computed Gains and Losses at Miscellaneous-Measurement Sites, 1974, 1975, 1985, and 1991

South Fork West Pass Creek

Site 27--Upstream Station

LOCATION.--Lat 44°56'01", long 107°32'32", in NW1/4 SW1/4 NW1/4 sec. 7, T. 57 N., R. 88 W., Sheridan County, at Bighorn National Forest boundary, and 11 miles west of Parkman.

GEOHYDROLOGY.--The site is along the strike of the Gallatin and Gros Ventre Formations near the base of the Bighorn Dolomite.

Site 28--Downstream Station

LOCATION.--Lat 44°56'52", long 107°31'05", in SE1/4 NW1/4 NW1/4 sec. 5, T. 57 N., R. 88 W. (unsurveyed), Sheridan County, 0.1 mile upstream from North Fork West Pass Creek, and 9 miles west of Parkman.

GEOHYDROLOGY.--The site is about on strike with the top of the Tensleep Sandstone.

Discharge measurements and computed gain or loss of streamflow in South Fork West Pass Creek between sites 27 and 28

Discharge, in cubic feet per second				
Date	Site 27	Date	Site 28	Computed gain (+) or loss (-)
8-29-74	2.97	8-29-74	4.86	+1.89
10-23-74	2.48	10-23-74	4.13	+1.65
11-17-74	2.56	11-17-74	4.76	+2.20
7-22-75	9.06	7-22-75	12.0	+2.94
8-18-75	6.10	8-18-75	7.93	+1.83
9-09-75	4.91	9-09-75	5.53	+.62
9-22-75	4.59	9-22-75	7.07	+2.48
8-22-85	1.81	8-22-85	2.78	+.97
9-25-91	2.72	9-25-91	3.40	+.68

West Fork Taffner Creek

Site 29--Downstream Station

LOCATION.--Lat 44°56'08", long 107°30'25", in SE1/4 NW1/4 NE1/4 sec. 8, T. 57 N., R. 88 W. (unsurveyed), Sheridan County, 1.0 mile downstream from Bighorn National Forest boundary, and 9 miles west of Parkman.

GEOHYDROLOGY.--The measurement site is near, and along strike with, the Tensleep and Amsden contact.

REMARKS.--No upstream station; the basin is entirely underlain by Paleozoic rocks.

Discharge measurements and computed gain or loss of streamflow in West Fork Taffner Creek, site 29

	Discharge, in cubic feet per second	
Date	Site 29	Computed gain (+) or loss (-)
9-04-74	1.05	+1.05
10-23-74	1.42	+1.42
11-17-74	.89	+.89
7-22-75	3.16	+3.16
8-18-75	1.61	+1.61
9-09-75	1.20	+1.20
9-22-75	.87	+.87
8-21-85	.54	+.54
9-09-91	.78	+.78

South Fork Little Tongue River

Site 30--Upstream Station

LOCATION.--Lat 44°46'13", long 107°18'53", in NW1/4 SE1/4 SW1/4 sec. 35, T. 56 N., R. 87 W., Sheridan County, Bighorn National Forest, 0.1 mile downstream from unnamed tributary, 2.2 miles southwest of Horseshoe Ranch, and 7.0 miles south of Dayton.

GEOHYDROLOGY.--The site is on strike with the Flathead Sandstone.

Site 31--Downstream Station

LOCATION.--Lat 44°47'58", long 107°17'28", in SE1/4 SE1/4 NW1/4 sec. 25, T. 56 N., R. 87 W., Sheridan County, 0.4 mile south of Horseshoe Ranch, 0.8 mile downstream from Bighorn National Forest boundary, and 5.4 miles south of Dayton.

GEOHYDROLOGY.--The site is on strike with, and near the base of, the Tensleep Sandstone.

Discharge measurements and computed gain or loss of streamflow in South Fork Little Tongue River between sites 30 and 31

Discharge, in cubic feet per second				
Date	Site 30	Date	Site 31	Computed gain (+) or loss (-)
8-27-74	0.60	8-27-74	1.26	+0.66
10-22-74	.59	10-21-74	2.62	+2.03
11-17-74	.84	11-17-74	1.38	+.54
7-22-75	4.69	7-22-75	6.74	+2.05
8-18-75	2.03	8-18-75	2.82	+.79
9-22-75	.79	9-22-75	1.63	+.84
8-20-85	.59	8-20-85	.92	+.33
9-11-91	.82	9-11-91	1.52	+.70

Smith Creek

Site 32--Downstream Station

LOCATION.--Lat 44°53'29", long 107°23'26", in NE1/4 NE1/4 NW1/4 sec. 29, T. 57 N., R. 87 W., Sheridan County, 0.4 mile downstream from Bighorn National Forest boundary, 5.2 miles south of Parkman, and 5.6 miles west of Dayton.

GEOHYDROLOGY.--The site is on strike with, and at about the top of, the Tensleep Sandstone. The creek heads in the Gallatin and Gros Ventre outcrops.

Discharge measurements and computed gain or loss of streamflow in Smith Creek, site 32

	Discharge, in cubic feet per second	
Date	Site 32	Computed gain (+) or loss (-)
8-28-74	0.96	+0.96
10-22-74	.99	+.99
11-17-74	.84	+.84
7-22-75	2.31	+2.31
8-18-75	1.38	+1.38
9-22-75	1.13	+1.13
8-21-85	.54	+.54
9-10-91	.95	+.95

Columbus Creek

Site 33--Downstream Station

LOCATION.--Lat 44°54'43", long 107°24'36", in SE1/4 NE1/4 SW1/4 sec. 18, T. 57 N., R. 87 W., Sheridan County, 0.8 mile downstream from Bighorn National Forest boundary, and 5.5 miles southwest of Parkman.

GEOHYDROLOGY.--The site is on strike with the Tensleep Sandstone, but about 50 feet below the top. Columbus Creek heads in the Madison Limestone, but it is incised into rocks of Cambrian age between the headwater and the mouth of the canyon.

Discharge measurements and computed gain or loss of streamflow in Columbus Creek, site 33

	Discharge, in cubic feet per second	
Date	Site 33	Computed gain (+) or loss (-)
9-04-74	3.39	+3.39
10-22-74	2.60	+2.60
11-17-74	3.19	+3.19
7-22-75	10.7	+10.7
8-18-75	6.10	+6.10
9-22-75	3.81	+3.81
8-21-85	2.10	+2.10
9-10-91	2.60	+2.60

Big Goose Creek

Site 34--Upstream Station

LOCATION.--Lat 44°41'08", long 107°12'07", in NW1/4 SW1/4 NE1/4 sec. 3, T. 54 N., R. 86 W., Sheridan County, Bighorn National Forest, 0.4 mile upstream from forest boundary, 1.4 miles upstream from Red Canyon, and 5.6 miles southwest of Beckton.

GEOHYDROLOGY.--The site is on strike with the Flathead Sandstone.

Site 35--Downstream Station

LOCATION.--Lat 44°42'08", long 107°10'51", in NW1/4 NE1/4 sec. 35, T. 55 N., R. 86 W., Sheridan County, at gaging station, 0.4 mile upstream from Cave Creek, and 14 miles southwest of Sheridan.

GEOHYDROLOGY.--The site is about on strike with the Cloverly Formation of Cretaceous age.

Discharge measurements and computed gain or loss of streamflow in Big Goose Creek between sites 34 and 35

Discharge, in cubic feet per second				
Date	Site 34	Date	Site 35	Computed gain (+) or loss (-)[1]
2-12-75	15.7	2-12-75	15.4	-0.3
8-21-85	56.1	8-21-85	52.9	-3.2
10-02-85	37.3	10-02-85	32.8	-4.5
9-27-91	26.9	9-27-91	26.6	-.3

[1]Discharge figure includes flow in PK Ditch and Sheridan city diversion.

Rapid Creek

Site 36--Upstream Station

LOCATION.--Lat 44°39'37", long 107°10'01", in NW1/4 NE1/4 NW1/4 sec. 13, T. 54 N., R. 86 W., Sheridan County, at Bighorn National Forest boundary, 0.8 mile upstream from Big Goose and Beaver Ditch diversion, and 8.6 miles west of Big Horn.

GEOHYDROLOGY.--The site is on strike with the Gallatin and Gros Ventre Formations near the base of the Bighorn Dolomite.

Site 37--Downstream Station

LOCATION.--Lat 44°39'47", long 107°09'40", in NE1/4 SW1/4 SE1/4 sec. 12, T. 54 N., R. 86 W., Sheridan County, 0.3 mile downstream from Bighorn National Forest boundary, 0.5 mile upstream from Big Goose and Beaver Ditch diversion, and 8.2 miles west of Big Horn. Included are two ditches that divert flow upstream from this site.

GEOHYDROLOGY.--The site is on strike with, and near the base of, the Tensleep Sandstone.

REMARKS.--Flow in Rapid Creek during the irrigation season is supplemented by transbasin diversion from East Fork Big Goose Creek downstream from Park Reservoir. Two canals divert flow at times between the upstream and downstream stations during the irrigation season. The canal flows were measured and added to the flow of the downstream station in computing gain or loss of streamflow.

Discharge measurements and computed gain or loss of streamflow in Rapid Creek between sites 36 and 37

	Discharge, in cubic feet per second			
Date	Site 36	Date	Site 37	Computed gain (+) or loss (-)
7-19-74	24.3	7-19-74	[1]22.6	-1.7
10-22-74	.92	10-22-74	1.56	+.64
11-17-74	1.00	11-17-74	1.61	+.61
7-22-75	81.0	7-22-75	[1]72.7	-8.3
8-18-75	54.5	8-18-75	[1]52.9	-1.6
9-22-75	11.1	9-22-75	[1]10.8	-.3
8-22-85	19.8	8-22-85	[1]22.3	+2.5
10-02-85	1.24	10-02-85	1.56	+.32
10-11-91	.96	10-11-91	1.28	+.32

[1]Includes flow in irrigation canals.

Little Goose Creek

Site 38--Upstream Station

LOCATION.--Lat 44°35'07", long 107°03'02", in SW1/4 NW1/4 NW1/4 sec. 12, T. 53 N., R. 85 W., Sheridan County, 0.1 mile downstream from Bighorn National Forest boundary, and 7.3 miles southwest of Big Horn.

GEOHYDROLOGY.--The site is on strike with the Gallatin and Gros Ventre Formations.

Site 39--Downstream Station 06305500

LOCATION.--Lat 44°35'46", long 107°02'22", in SE1/4 SW1/4 NE1/4 sec. 1, T. 53 N., R. 85 W., Sheridan County, at gaging station, 100 feet upstream from headgate of lower Peralta Ditch, and 6.5 miles southwest of Big Horn.

GEOHYDROLOGY.--The site, at an existing gaging station, is near the top of the Tensleep Sandstone.

Discharge measurements and computed gain or loss of streamflow in Little Goose Creek between sites 38 and 39

Discharge, in cubic feet per second				
Date	Site 38	Date	Site 39	Computed gain (+) or loss (-)
2-12-75	5.16	2-12-75	7.58	+2.42
9-24-75	[1]59.7	9-24-75	56.2	[1]-3.5
8-23-85	37.0	8-23-85	39.9	+2.9
10-01-85	14.4	10-01-85	16.5	+2.1
9-28-91	14.7	9-28-91	17.8	+3.1

[1]Dye-dilution measurement at upstream site.

Soldier Creek

Site 40--Upstream Station

LOCATION.--Lat 44°43'27", long 107°14'07", in NW1/4 NW1/4 SW1/4 sec. 21, T. 55 N., R. 86 W., Sheridan County, Bighorn National Forest, 0.6 mile downstream from south forest boundary, 1.0 mile upstream from north forest boundary, and 15 miles west of Sheridan.

GEOHYDROLOGY.--The site is on strike with the Gallatin and Gros Ventre Formations and just below the base of the Bighorn Dolomite.

Site 41--Downstream Station

LOCATION.--Lat 44°44'04", long 107°12'59", in SW1/4 SW1/4 SW1/4 sec. 15, T. 55 N., R. 86 W., Sheridan County, 0.3 mile downstream from Bighorn National Forest boundary, and 13.5 miles west of Sheridan.

GEOHYDROLOGY.--The site is about on strike with the top of the Tensleep Sandstone.

Discharge measurements and computed gain or loss of streamflow in Soldier Creek between sites 40 and 41

Discharge, in cubic feet per second				
Date	Site 40	Date	Site 41	Computed gain (+) or loss (-)
9-05-74	0.29	9-05-74	0.55	+0.26
10-22-74	.62	10-22-74	.52	-.10
11-17-74	.38	11-17-74	.35	-.03
7-22-75	1.67	7-22-75	1.74	+.07
8-18-75	.67	8-18-75	.83	+.16
9-22-75	.42	9-22-75	.69	+.27
8-23-85	.42	8-23-85	.39	-.03
9-12-91	.51	9-12-91	.45	-.06

Middle Fork Powder River

Site 42--Upstream Station

LOCATION.--Lat 43°34'59", long 106°59'10", in NW1/4 NE1/4 NW1/4 sec. 30, T. 42 N., R. 84 W., Johnson County, 2.7 miles downstream from Bachaus Creek, 4.1 miles upstream from Buffalo Creek, and 6.8 miles southwest of Barnum.

GEOHYDROLOGY.--Madison Limestone and underlying Cambrian rocks are exposed in the canyon walls.

Site 43--Madison and Amsden contact

LOCATION.--Lat 43°35'36", long 106°56'59", in SW1/4 NW1/4 sec. 21, T. 42 N., R. 84 W., Johnson County, 0.3 mile downstream from Outlaw Cave, and 5 miles southwest of Barnum.

GEOHYDROLOGY.--The Madison Limestone and Amsden Formation contact is exposed at river level. The Madison Limestone has extensive solution openings just above river level, and many small seeps and springs issue from the limestone.

Site 44--Downstream Station

LOCATION.--Lat 43°36'05", long 107°54'38", in SE1/4 SW1/4 SW1/4 sec. 14, T. 42 N., R. 84 W., Johnson County, 1.6 miles upstream from Buffalo Creek at mouth of canyon, and 4.3 miles south of Barnum.

GEOHYDROLOGY.--The top of the Tensleep Sandstone is exposed at the mouth of the canyon.

Discharge measurements and computed gain or loss of streamflow in Middle Fork Powder River between sites 42 and 44

[--, not measured]

Discharge, in cubic feet per second						
Date	Site 42	Date	Site 43	Date	Site 44	Computed gain (+) or loss (-)
9-10-74	13.6	9-09-74	[1]17.1	9-09-74	16.6	+3.0
10-17-74	14.6	--	--	10-17-74	18.2	+3.6
11-15-74	12.6	--	--	11-15-74	17.6	+5.0
7-24-75	42.4	--	--	7-24-75	42.6	+.2
8-20-75	22.0	--	--	8-20-75	28.9	+6.9
9-23-75	17.0	--	--	9-23-75	19.9	+2.9
--	--	9-04-85	16.3	--	--	--
10-22-85	16.0	10-22-85	[2]21.7	10-22-85	21.8	+5.8
9-05-91	14.4	9-05-91	[3]17.0	--	--	--
--	--	9-06-91	17.4	9-06-91	18.2	--

[1]Gain +3.5. [2]Gain +5.7. [3]Gain +2.6.

Pine Creek

Site 45--Upstream Station

LOCATION.--Lat 43°26'34", long 107°09'23", in SE1/4 SW1/4 SW1/4 sec. 10, T. 40 N., R. 86 W., Natrona County, 200 feet downstream from unnamed tributary, and 19 miles north of Arminto.

GEOHYDROLOGY.--Madison Limestone and the underlying Cambrian rocks are exposed in the hillside east of Pine Creek.

Site 46--Downstream Station

LOCATION.--Lat 43°25'38", long 107°08'26", in NW1/4 NW1/4 NW1/4 sec. 23, T. 40 N., R. 86 W., Natrona County, 1.0 mile upstream from mouth, and 18 miles north of Arminto.

GEOHYDROLOGY.--The Madison Limestone and Amsden Formation contact is exposed.

Discharge measurements and computed gain or loss of streamflow in Pine Creek between sites 45 and 46

Discharge, in cubic feet per second				
Date	Site 45	Date	Site 46	Computed gain (+) or loss (-)
8-28-74	0.44	8-28-74	0	-0.44
10-16-74	.42	10-16-74	0	-.42
11-15-74	.32	11-15-74	0	-.32
7-24-75	2.71	7-24-75	2.05	-.66
8-12-75	1.55	8-12-75	1.22	-.33
9-23-75	.82	9-23-75	.36	-.46
5-14-85	.87	5-14-85	.34	-.53
9-03-85	.46	9-03-85	.28	-.18
6-27-91	1.57	6-27-91	.94	-.63

South Fork Red Fork Powder River

Site 47--Upstream Station

LOCATION.--Lat 43°45'12", long 107°01'14", in NE1/4 SW1/4 NE1/4 sec. 26, T. 44 N., R. 85 W., Johnson County, 2.8 miles upstream from confluence with North Fork Red Fork, and 8.5 miles northwest of Barnum.

GEOHYDROLOGY.--Bighorn Dolomite and underlying Cambrian rocks are exposed along the streambed.

Site 48--Downstream Station

LOCATION.--Lat 43°45'26", long 106°57'40", in NW1/4 NW1/4 NE1/4 sec. 29, T. 44 N., R. 84 W., Johnson County, 0.4 mile upstream from confluence with North Fork Red Fork, 1.0 mile downstream from unnamed tributary, and 6.9 miles northwest of Barnum.

GEOHYDROLOGY.--The top of the Tensleep Sandstone is exposed at the mouth of the canyon.

Discharge measurements and computed gain or loss of streamflow in South Fork Red Fork Powder River between sites 47 and 48

	Discharge, in cubic feet per second			
Date	Site 47	Date	Site 48	Computed gain (+) or loss (-)
9-11-74	5.21	9-11-74	7.19	+1.98
10-19-74	4.98	10-18-74	7.95	+2.97
11-15-74	4.78	11-15-74	6.39	+1.61
7-24-75	18.7	7-24-75	22.3	+3.6
8-20-75	11.6	8-20-75	13.2	+1.6
9-23-75	8.10	9-23-75	10.5	+2.4
8-23-85	5.37	8-23-85	8.47	+3.1
9-03-91	7.08	9-03-91	8.45	+1.37

North Fork Red Fork Powder River

Site 49--Upstream Station

LOCATION.--Lat 43°02'35", long 107°47'57", in SE1/4 NE1/4 NW1/4 sec. 10, T. 44 N., R. 85 W., Johnson County, 300 feet downstream from Baldwin Creek, 1.0 mile upstream from School Section Draw, and 12 miles northwest of Barnum.

GEOHYDROLOGY.--Bighorn Dolomite and the underlying Cambrian rocks are exposed along the streambed.

Site 50--Downstream Station

LOCATION.--Lat 43°46'18", long 106°58'24", in NE1/4 NE1/4 NE1/4 sec. 19, T. 44 N., R. 84 W., Johnson County, 100 feet upstream from Beartrap Creek and 8.0 miles northwest of Barnum.

GEOHYDROLOGY.--Sandstone near the middle of the Tensleep Sandstone is exposed near the mouth of Beartrap Creek.

Discharge measurements and computed gain or loss of streamflow in North Fork Red Fork Powder River between sites 49 and 50

Discharge, in cubic feet per second				
Date	Site 49	Date	Site 50	Computed gain (+) or loss (-)
9-12-74	2.08	9-12-74	2.52	+0.44
10-18-74	1.81	10-18-74	2.14	+.33
11-15-74	1.85	11-15-74	1.77	-.08
7-21-75	8.76	7-24-75	12.3	+3.54
8-20-75	5.21	8-20-75	5.49	+.28
9-23-75	3.79	9-23-75	3.85	+.06
8-26-85	1.82	8-26-85	1.63	-.19
9-03-91	2.54	9-03-91	3.33	+.79

Beartrap Creek

Site 51--Upstream Station

LOCATION.--Lat 43°49'30", long 107°00'40", in SE1/4 SW1/4 NE1/4 sec. 36, T. 45 N., R. 85 W., Johnson County, 11 miles west of Mayoworth.

GEOHYDROLOGY.--Bighorn Dolomite and the underlying Cambrian rocks are exposed along the streambed.

Site 52--Downstream Station

LOCATION.--Lat 43°46'18", long 106°58'18", in NE1/4 NE1/4 NE1/4 sec. 19, T. 44 N., R. 84 W., Johnson County, 100 feet upstream from mouth, and 10 miles southwest of Mayoworth.

GEOHYDROLOGY.--Sandstone near the middle of the Tensleep is exposed near the mouth.

Discharge measurements and computed gain or loss of streamflow in Beartrap Creek between sites 51 and 52

Discharge, in cubic feet per second				
Date	Site 51	Date	Site 52	Computed gain (+) or loss (-)
9-13-74	5.96	9-12-74	6.51	+0.55
10-18-74	5.78	10-18-74	7.92	+2.14
11-15-74	4.05	11-15-74	4.64	+.59
7-24-75	12.6	7-24-75	16.1	+3.5
8-20-75	9.86	8-20-75	11.7	+1.84
9-23-75	9.67	9-23-75	9.56	-.11
8-26-85	5.86	8-26-85	6.67	+.81
9-04-91	[1]6.11	9-03-91	6.45	+.34

[1]Hydrographer was unable to measure site 9-03-91 because of equipment problems; however, stage did not change between dates at a streamflow-gaging station upstream.

Gardner Creek

Site 53--Gardner Creek--Tributary between sites 14 and 15 on North Fork Powder River

LOCATION.--Lat 43°58'15", long 106°57'02", in SW1/4 SE1/4 NE1/4 sec. 9, T. 46 N., R. 84 W., Johnson County, 10 feet upstream from mouth, 8.6 miles south of Hazelton, and 13 miles northwest of Mayoworth.

Pass Creek

Site 54--Pass Creek--Tributary between sites 14 and 15 on North Fork Powder River

LOCATION.--Lat 43°55'13", long 106°53'51", in SE1/4 SE1/4 SW1/4 sec. 25, T. 46 N., R. 84 W., Johnson County, at mouth, and 8.0 miles northwest of Mayoworth.

Inflow of Gardner and Pass Creeks (sites 53 and 54) to North Fork Powder River between sites 14 and 15

[--, not measured]

Discharge, in cubic feet per second			
Date	Site 53	Date	Site 54
7-23-74	4.1	7-22-74	3.18
11-07-74	4.4	11-21-74	3.93
12-03-74	4.0	--	--
1-22-75	4.1	1-22-75	3.42
--	--	2-24-75	3.50
3-18-75	4.0	3-18-75	3.29
4-21-75	4.0	4-21-75	3.46
5-27-75	3.9	5-27-75	9.95
--	--	6-10-75	10.7
7-10-75	4.2	--	--
7-25-75	4.2	7-25-75	4.24
8-20-75	4.0	8-20-75	4.32
9-23-75	4.1	9-23-75	4.51
8-30-85	4.1	8-29-85	3.64
9-26-91	3.7	9-27-91	3.71

Unnamed Tributary (tributary to North Fork Crazy Woman Creek)

Site 55--Upstream Station Unnamed tributary to North Fork Crazy Woman Creek

LOCATION.--Lat 44°12'33", long 106°49'52", in NE1/4 NE1/4 NW1/4 sec. 22, T. 49 N., R. 83 W., Johnson County, 0.6 mile downstream from Bighorn National Forest boundary, 3.2 miles west of Klondike Ranch, and 11.5 miles southwest of Buffalo.

GEOHYDROLOGY.--The site is on strike with the Gallatin and Gros Ventre Formations near the base of the Bighorn Dolomite.

Site 56--Downstream Station Unnamed tributary to North Fork Crazy Woman Creek

LOCATION.--Lat 44°02'29", long 106°49'26", in NW1/4 NE1/4 NE1/4 sec. 22, T. 49 N., R. 83 W., Johnson County, 1.0 mile downstream from Bighorn National Forest boundary, 3.6 miles west of Klondike Ranch, and 11.3 miles southwest of Buffalo.

GEOHYDROLOGY.--The site is near the top of the Tensleep Sandstone.

Discharge measurements and computed gain or loss of streamflow of unnamed tributary to North Fork Crazy Woman Creek between sites 55 and 56

	Discharge, in cubic feet per second			
Date	Site 55	Date	Site 56	Computed gain (+) or loss (-)
8-27-74	0.07	8-27-74	0	-0.07
11-15-74	.07	11-15-74	0	-.07
7-23-75	.64	7-23-75	.10	-.54
8-19-75	.16	8-19-75	0	-.16
9-24-75	.14	9-24-75	0	-.14
6-28-85	.12	6-28-75	0	-.12
9-22-91	.11	9-22-91	0	-.11

Little North Fork Crazy Woman Creek

Site 57--Upstream Station

LOCATION.--Lat 44°13'43", long 106°49'49", in SW1/4 NW1/4 SE1/4 sec. 10, T. 49 N., R. 83 W., Johnson County, 3.7 miles northwest of Klondike Ranch, and 10 miles southwest of Buffalo.

GEOHYDROLOGY.--The site is on strike with the Flathead Sandstone.

Site 58--Downstream Station

LOCATION.--Lat 44°13'34", long 106°49'00", in NE1/4 SW1/4 SW1/4 sec. 11, T. 49 N., R. 83 W., Johnson County, 3.0 miles northwest of Klondike Ranch, and 10.5 miles southwest of Buffalo.

GEOHYDROLOGY.--The site is along strike with the Tensleep Sandstone.

REMARKS.--The discharge measurement at the downstream site on Aug. 7, 1974, was made prior to a rainstorm. The rain on Aug. 7 probably increased flow in the stream, which accounts for the higher discharge at the upstream site on Aug. 8; however, the flow was not remeasured at the downstream site. Other discharge measurements indicated either similar flows at both sites or a gain in discharge at the downstream site.

Discharge measurements and computed gain or loss of streamflow in Little North Fork Crazy Woman Creek between sites 57 and 58

Discharge, in cubic feet per second				
Date	Site 57	Date	Site 58	Computed gain (+) or loss (-)
10-17-73	2.00	10-17-73	2.60	+0.60
8-08-74	[1]2.29	8-07-74	1.40	([1])
11-16-74	1.06	11-16-74	1.52	+.46
7-23-75	6.21	7-23-75	6.08	-.13
8-19-75	2.47	8-19-75	2.46	-.01
9-24-75	1.10	9-24-75	1.90	+.80
6-28-85	1.80	6-28-85	2.66	+.86
8-22-85	.99	8-22-85	1.85	+.86
9-06-91	.67	9-06-91	1.62	+.95

[1]Do not compare discharge. Rainstorm prior to 8-08-74 measurement at upstream site.

Muddy Creek

Site 59--Upstream Station

LOCATION.--Lat 44°09'36", long 106°52'24", in SE1/4 SW1/4 NE1/4 sec. 6, T. 48 N., R. 83 W., Johnson County, 6.0 miles southwest of Klondike Ranch, and 15.5 miles southwest of Buffalo.

GEOHYDROLOGY.--The site is on strike with the Gallatin and Gros Ventre Formations.

Site 60--Downstream Station

LOCATION.--Lat 44°09'45", long 106°49'10", in NE1/4 SE1/4 NW1/4 sec. 3, T. 48 N., R. 83 W., Johnson County, 3.5 miles southwest of Klondike Ranch, and 14 miles southwest of Buffalo.

GEOHYDROLOGY.--The site is on strike with the top of the Tensleep Sandstone.

REMARKS.--The earliest measurements in 1974, 1975, and 1985 indicated a loss of streamflow between sites on Muddy Creek, but succeeding measurements in those years indicated gain in streamflow.

Discharge measurements and computed gain or loss of streamflow in Muddy Creek between sites 59 and 60

Discharge, in cubic feet per second				
Date	Site 59	Date	Site 60	Computed gain (+) or loss (-)
10-16-73	1.33	10-16-73	1.37	+0.04
8-06-74	.85	8-06-74	.71	-.14
10-20-74	.61	10-20-74	.72	+.11
11-16-74	.42	11-16-74	.61	+.19
7-23-75	2.48	7-23-75	2.31	-.17
8-19-75	.26	8-19-75	.80	+.54
9-23-75	.29	9-23-75	.55	+.26
6-27-85	1.89	6-27-85	1.44	-.45
8-23-85	.09	8-23-85	.55	+.46
7-02-91	2.26	7-02-91	2.54	+.28
9-06-91	.13	9-06-91	.59	+.46

Billy Creek

Site 61--Upstream Station

LOCATION.--Lat 44°07'44", long 106°50'35", in NE1/4 NW1/4 SW1/4 sec. 16, T. 48 N., R. 83 W., Johnson County, 6.0 miles southwest of Klondike Ranch, and 16 miles southwest of Buffalo.

GEOHYDROLOGY.--The site is on strike with the Gallatin and Gros Ventre Formations.

Site 62--Downstream Station

LOCATION.--Lat 44°08'05", long 106°48'54", in SW1/4 NW1/4 NE1/4 sec. 15, T. 48 N., R. 83 W., Johnson County, 5.0 miles southwest of Klondike Ranch, and 15 miles southwest of Buffalo.

GEOHYDROLOGY.--The site is on strike with the Tensleep Sandstone and just upstream from the top of the formation.

Discharge measurements and computed gain or loss of streamflow in Billy Creek between sites 61 and 62

Discharge, in cubic feet per second				
Date	Site 61	Date	Site 62	Computed gain (+) or loss (-)
10-16-73	1.21	10-16-73	1.34	+0.13
8-08-74	.83	8-08-74	.88	+.05
10-20-74	.80	10-20-74	1.38	+.58
11-16-74	.91	11-16-74	1.16	+.25
7-23-75	1.74	7-23-75	1.81	+.07
8-19-75	1.45	8-19-75	1.12	-.33
9-23-75	1.08	9-23-75	1.36	+.28
6-24-85	1.10	6-24-85	1.09	-.01
8-22-85	.99	8-22-85	.95	-.04
9-17-91	1.08	9-17-91	1.17	+.09

Middle Fork Crazy Woman Creek

Site 63--Upstream Station

LOCATION.--Lat 44°03'33", long 106°51'58", in SW1/4 SW1/4 NW1/4 sec. 8, T. 47 N., R. 83 W., Johnson County, 100 feet downstream from Doyle Creek, 3.6 miles upstream from Poison Creek, and 16 miles north of Mayoworth.

GEOHYDROLOGY.--The site is on an exposure of Precambrian rocks.

Site 64--Downstream Station

LOCATION.--Lat 44°03'33", long 106°49'01", in SW1/4 SW1/4 NE1/4 sec. 10, T. 47 N., R. 83 W., Johnson County, 0.6 mile upstream from Poison Creek and 16 miles north of Mayoworth.

GEOHYDROLOGY.--The site is upstream from a small diversion in an area where the Tensleep Sandstone crops out.

Discharge measurements and computed gain or loss of streamflow in Middle Fork Crazy Woman Creek between sites 63 and 64

Discharge, in cubic feet per second				
Date	Site 63	Date	Site 64	Computed gain (+) or loss (-)
9-08-74	5.42	9-08-74	5.74	+0.32
10-19-74	5.71	10-19-74	6.57	+.86
11-15-74	4.78	11-15-74	6.51	[1]+1.73
7-25-75	30.1	7-25-75	34.7	+4.6
8-21-75	12.0	8-21-75	9.82	-2.2
9-23-75	6.64	9-23-75	6.42	-.22
6-28-85	14.9	6-28-85	16.9	+2.0
8-15-85	4.78	8-15-85	4.80	+.02
9-17-91	11.4	9-17-91	9.97	[2]-1.43

[1]May be affected by diurnal fluctuation caused by ice formation.
[2]May have been affected by increased flow at one or both sites from precipitation that day.

Beaver Creek (tributary to South Fork Crazy Woman Creek)

Site 65--Upstream Station Tributary to South Fork Crazy Woman Creek

LOCATION.--Lat 44°01'03", long 106°51'55", in NW1/4 SW1/4 NW1/4 sec. 29, T. 47 N., R. 83 W., Johnson County, 3.6 miles upstream from Corpe Creek, and 13 miles north of Mayoworth.

GEOHYDROLOGY.--The site is on the dip slope of the Flathead Sandstone.

Site 66--Downstream Station Tributary to South Fork Crazy Woman Creek

LOCATION.--Lat 44°01'12", long 106°50'05", in NE1/4 NW1/4 NE1/4 sec. 28, T. 47 N., R. 83 W., Johnson County, 1.2 miles upstream from Corpe Creek, and 13 miles north of Mayoworth.

GEOHYDROLOGY.--The site is at the top of the Tensleep Sandstone.

REMARKS.--Gains in flow in 1975 were measured during a high streamflow year, whereas the losses measured in 1974 and 1985 occurred during low streamflow years.

Discharge measurements and computed gain or loss of streamflow in Beaver Creek between sites 65 and 66

Discharge, in cubic feet per second				
Date	Site 65	Date	Site 66	Computed gain (+) or loss (-)
9-10-74	0.04	9-10-74	0	-0.04
10-19-74	.03	10-19-74	0	-.03
11-15-74	.03	11-15-74	0	-.03
7-25-75	1.08	7-25-75	2.97	+1.89
8-21-75	.32	8-21-75	1.19	+.87
9-23-75	.15	9-23-75	.96	+.81
6-27-85	.27	6-27-85	0	-.27
7-13-91	.49	7-13-91	0	-.49

Clear Creek

Site 67--Upstream Station

LOCATION.--Lat 44°19'15", long 106°49'52", in NE1/4 SE1/4 NW1/4 sec. 10, T. 50 N., R. 83 W., Johnson County, 0.5 mile east of Bighorn National Forest boundary, 1.3 miles downstream from Grommund Creek, and 7.2 miles west of Buffalo.

GEOHYDROLOGY.--The site is near the Precambrian and Cambrian contact and the stream flows parallel to the contact at the site.

Site 68--Downstream Station

LOCATION.--Lat 44°19'23", long 106°49'40", in NE1/4 NW1/4 NE1/4 sec. 10, T. 50 N., R. 83 W., Johnson County, 0.6 mile east of Bighorn National Forest boundary, 1.0 mile upstream from Mosier Gulch, and 7.0 miles west of Buffalo.

GEOHYDROLOGY.--The site is on the outcrop of the Wasatch Formation. Most of the Paleozoic section is faulted out along the stream channel between the sites.

Discharge measurements and computed gain or loss of streamflow in Clear Creek between sites 67 and 68

Discharge, in cubic feet per second				
Date	Site 67	Date	Site 68	Computed gain (+) or loss (-)
8-06-74	76.0	8-06-74	72.7	-3.3
10-20-74	52.9	10-20-74	44.2	-8.7
11-16-74	[1]22.8	11-16-74	[1]27.1	[1]+4.3
8-19-75	45.2	8-19-75	50.1	+4.9
9-22-75	29.5	9-22-75	[2]24.3	-5.2
8-16-85	35.9	8-16-85	41.6	+5.7
9-17-85	23.6	9-17-85	26.3	+2.7
10-14-91	33.5	10-14-91	[3]33.6	+.1

[1]Slush ice and anchor ice noted at both sites. Discharge comparison may not be valid because of diurnal fluctuation.

[2]Poor measurement because of uneven bottom, irregular velocities, and use of AA velocity meter at shallow depths.

[3]Includes diversion by City of Buffalo.

French Creek

Site 69--Upstream Station

LOCATION.--Lat 44°21'01", long 106°51'48", in SW1/4 NE1/4 NE1/4 sec. 32, T. 51 N., R. 83 W., Johnson County, Bighorn National Forest, 0.1 mile upstream from Eagle Ditch diversion, 0.2 mile upstream from forest boundary, 0.4 mile downstream from Willow Creek, and 8.3 miles west of Buffalo.

GEOHYDROLOGY.--The site is about on strike with the Bighorn Dolomite and Madison Limestone contact.

Site 70--Downstream Station

LOCATION.--Lat 44°21'03", long 106°51'44", in SE1/4 NE1/4 NE1/4 sec. 32, T. 51 N., R. 83 W., Johnson County, Bighorn National Forest, 260 feet upstream from Eagle Ditch diversion, 0.1 mile upstream from forest boundary, 0.5 mile downstream from Willow Creek, and 8.2 miles west of Buffalo.

GEOHYDROLOGY.--The site is on strike with the top of the Paleozoic outcrop.

Discharge measurements and computed gain or loss of streamflow in French Creek between sites 69 and 70

Discharge, in cubic feet per second				
Date	Site 69	Date	Site 70	Computed gain (+) or loss (-)
9-09-74	1.43	9-09-74	1.43	0
10-21-74	2.06	10-21-74	2.27	+.21
11-16-74	2.73	11-16-74	2.02	[1]-.71
7-23-75	48.3	7-23-75	45.9	-2.4
8-19-75	17.8	8-19-75	18.7	+.9
9-24-75	6.53	9-24-75	6.50	-.03
8-21-85	8.45	8-21-85	8.37	-.08
9-25-91	2.36	9-25-91	2.73	+.37

[1]Discharge comparison may not be valid. Some area streams had diurnal fluctuations from ice formation/thaw.

North Rock Creek

Site 71--Upstream Station

LOCATION.--Lat 44°28'30", long 106°55'13", in NW1/4 SW1/4 SW1/4 sec. 13, T. 52 N., R. 84 W., Johnson County, at Bighorn National Forest boundary, 1.6 miles northwest of H F Bar Ranch, and 14 miles northwest of Buffalo.

GEOHYDROLOGY.--Site is underlain by Precambrian rock.

Site 72--Downstream Station

LOCATION.--Lat 44°28'08", long 106°54'46", in SW1/4 NE1/4 NW1/4 sec. 24, T. 52 N., R. 84 W., Johnson County, just upstream from Pheasant Creek, 1.0 mile northwest of H F Bar Ranch, and 13 miles northwest of Buffalo.

GEOHYDROLOGY.--The area upstream to the mouth of the canyon is underlain by colluvium. The outcrop of the Paleozoic section is absent because of faulting.

Discharge measurements and computed gain or loss of streamflow in North Rock Creek between sites 71 and 72

Discharge, in cubic feet per second				
Date	Site 71	Date	Site 72	Computed gain (+) or loss (-)
9-06-74	15.4	9-06-74	16.8	+1.4
10-21-74	1.77	10-21-74	1.52	-.25
11-16-74	.50	11-16-74	1.01	+.51
7-23-75	38.0	7-23-75	40.8	+2.8
8-19-75	44.7	8-19-75	53.2	+8.5
9-24-75	23.6	9-24-75	22.5	-1.1
8-21-85	25.8	8-21-85	25.6	-.2
9-27-91	1.75	9-27-91	1.83	+.08

North Fork Sayles Creek

Site 73--Combination Upstream Station

LOCATION.--Lat 44°24'26", long 106°54'22", in SE1/4 SW1/4 NE1/4 sec. 12, T. 51 N., R. 84 W., Johnson County, Bighorn National Forest, 0.2 mile upstream from forest boundary, 0.2 mile upstream from mouth, and 11 miles northwest of Buffalo.

Site 74--Combination Upstream Station unnamed tributary to North Fork Sayles Creek

LOCATION.--Lat 44°24'20", long 106°54'09", in NE1/4 NE1/4 SE1/4 sec. 12, T. 51 N., R. 84 W. (unsurveyed), Johnson County, Bighorn National Forest, 0.1 mile upstream from forest boundary, 3.6 miles south of H F Bar Ranch, and 11 miles northwest of Buffalo.

GEOHYDROLOGY.--The site is on strike with, and near the top of, the Gallatin and Gros Ventre Formations.

Site 75--Downstream Station

LOCATION.--Lat 44°24'36", long 106°53'29", in SE1/4 NE1/4 NW1/4 sec. 7, T. 51 N., R. 83 W., Johnson County, 0.5 mile downstream from Bighorn National Forest boundary, 3.4 miles south of H F Bar Ranch, and 10 miles northwest of Buffalo.

GEOHYDROLOGY.--The site is on strike with the Tensleep Sandstone and is just below the top.

REMARKS.--The authors believe that both the tributary (previously measured as the total upstream flow of North Fork Sayles Creek) and the mainstem should have been measured as a combined upstream site for the 1985 streamflow measurements, because the drainage areas are approximately equal, and both streams lost flow into the Gallatin-Gros Ventre Formations.

Discharge measurements and computed gain or loss of streamflow in North Fork Sayles Creek between combined upstream sites 73 and 74 in relation to downstream site 75

[--, not measured]

Discharge, in cubic feet per second						
Date	Site 73	Date	Site 74	Date	Site 75	Computed gain (+) or loss (-)
--	--	9-07-74	0.04	9-07-74	0.15	--
--	--	10-21-74	.13	10-21-74	.18	--
--	--	11-16-74	.02	11-16-74	.15	--
--	--	7-23-75	1.38	7-23-75	1.78	--
--	--	8-19-75	.21	8-19-75	.40	--
--	--	9-24-75	.11	9-24-75	.18	--
6-26-85	0.09	6-26-85	.10	6-26-85	.25	[1]+0.06
8-29-91	.01	8-29-91	.02	8-29-91	.14	[1]+.11

[1]Gain or loss of discharge computed by adding flow of sites 73 and 74, then subtracting the result from flow of site 75.

Johnson Creek

Site 76--Upstream Station

LOCATION.--Lat 44°21'53", long 106°52'17", in SE1/4 NE1/4 NW1/4 sec. 29, T. 51 N., R. 83 W., Johnson County, Bighorn National Forest, 0.6 mile upstream from Eagle Ditch, 0.6 mile upstream from forest boundary, and 8.7 miles west of Buffalo.

GEOHYDROLOGY.--The site is near the middle of the Flathead Sandstone.

Site 77--Downstream Station

LOCATION.--Lat 44°21'53", long 106°51'47", in NE1/4 SE1/4 NE1/4 sec. 29, T. 51 N., R. 83 W., Johnson County, Bighorn National Forest, just upstream from Eagle Ditch, 0.1 mile upstream from forest boundary, and 8.2 miles west of Buffalo.

GEOHYDROLOGY.--The site is in an area of talus and landslide deposits. Paleozoic rocks younger than the Flathead Sandstone are absent along the stream course because of faulting.

Discharge measurements and computed gain or loss of streamflow in Johnson Creek between sites 76 and 77

Discharge, in cubic feet per second				
Date	Site 76	Date	Site 77	Computed gain (+) or loss (-)
9-07-74	0.03	9-07-74	0.09	+0.06
10-21-74	.14	10-21-74	.19	+.05
11-16-74	.19	11-16-74	.22	+.03
7-23-75	1.84	7-23-75	1.94	+.10
8-19-75	.31	8-19-75	.47	+.16
9-24-75	.07	9-24-75	.21	+.14
6-26-85	.35	6-26-85	.43	+.08
9-25-91	.11	9-25-91	.17	+.06

North Piney Creek

Site 78--Upstream Station

LOCATION.--Lat 44°34'57", long 106°56'50", in NW1/4 SE1/4 NW1/4 sec. 11, T. 53 N., R. 84 W., Sheridan County, 1.9 miles downstream from Gin Creek, and 3.0 miles west of Story.

GEOHYDROLOGY.--The site is on strike with, and near the top of, the Gallatin and Gros Ventre Formations.

Site 79--Downstream Station 06321500 North Piney Creek near Story

LOCATION.--Lat 44°34'50", long 106°55'55", in NW1/4 SW1/4 sec. 12, T. 53 N., R. 84 W., Sheridan County, at gaging station, 2.1 miles west of Story, and 3.2 miles upstream from confluence with South Piney Creek.

GEOHYDROLOGY.--The site is on the outcrop of the Wasatch Formation of Eocene age.

Discharge measurements and computed gain or loss of streamflow in North Piney Creek between sites 78 and 79

Discharge, in cubic feet per second				
Date	Site 78	Date	Site 79	Computed gain (+) or loss (-)
7-21-74	20.3	7-21-74	22.5	+2.2
10-21-74	12.0	10-21-74	9.91	-2.09
11-16-74	7.17	11-16-74	8.67	+1.50
7-23-75	50.5	7-23-75	46.7	-3.8
8-21-75	19.5	8-21-75	16.3	-3.2
9-24-75	7.68	9-24-75	9.13	+1.45
8-20-85	9.93	8-20-85	11.0	+1.07
9-25-91	9.87	9-25-91	9.77	-.10

Geology and Hydrology of Black Hills Area
(from Boner and others, 1976, p. 35)

The Black Hills is an elongate dome with approximate dimensions of 120 miles north and south and as much as 60 miles east and west. The core of the dome consists predominantly of Precambrian igneous and metamorphic rocks. The Precambrian rocks are surrounded by concentric outcrops of successively younger Paleozoic and Mesozoic rocks that dip away from the central area. The Paleozoic and Mesozoic rocks are steeply inclined along the eastern side of the Black Hills and are gently dipping on the western side.

The Paleozoic formations, the ones of primary interest, are, in ascending order, the Deadwood Formation of Cambrian and Ordovician age, the Winnipeg Formation and Whitewood Dolomite of Ordovician age, the Englewood Limestone of Devonian and Mississippian age, the Madison Limestone (locally known as the Pahasapa Limestone) of Mississippian age, the Minnelusa Formation of Pennsylvanian and Permian age, the Opeche Shale and Minnekahta Limestone of Permian age, and the Spearfish Formation of Permian and Triassic age. The Madison Limestone is more than 600 feet thick in Spearfish Canyon in the northern part of the Black Hills, and thins to about 300 feet in the southern part.

The degree of hydraulic connection between the Madison Limestone and both the underlying and overlying rocks varies from excellent to very poor (see Gott and others, 1974). However, in the western part of the Black Hills along Stockade Beaver Creek, the hydraulic connection between the Madison Limestone and the overlying Minnelusa Formation, Opeche Shale, Minnekahta Limestone, and Spearfish Formation probably is good.

Description of Sites and Summary of Streamflow Data and Computed Gains and Losses at Streamflow-Gaging Stations, 1974-91

Beaver Creek/Stockade Beaver Creek

Site 80--Upstream Station 06392900 Beaver Creek at Mallo Camp, near Four Corners

LOCATION.--Lat 44°05'04", long 104°03'41", in NE1/4 NE1/4 sec. 4, T. 47 N., R. 60 W., Weston County, at Mallo Campground, 500 feet upstream from headquarters building, 800 feet upstream from dam, and 3.8 miles east of Four Corners.

DRAINAGE AREA.--10.3 square miles.

PERIOD OF RECORD.--Water years 1975-82 and 1991 to current year (1992). Data for water years 1975-82 are presented.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The canyon floor and walls are red to yellow sandstone of the Minnelusa Formation. An outcrop of the Minnekahta Limestone is a few hundred feet west of the canyon wall.

Site 81--Downstream Station 06392950 Stockade Beaver Creek near Newcastle

LOCATION.--Lat 43°51'30", long 104°06'23", in SW1/4 SE1/4 sec. 19, T. 45 N., R. 60 W., Weston County, at downstream side of bridge on county road, 0.6 mile upstream from South Draw, 2.5 miles north of LAK Reservoir, and 4.7 miles east of Newcastle.

DRAINAGE AREA.--107 square miles.

PERIOD OF RECORD.--Water years 1975-82 and 1991 to current year (1992). Data for water years 1975-82 are presented.

GAGE.--Water-stage recorder.

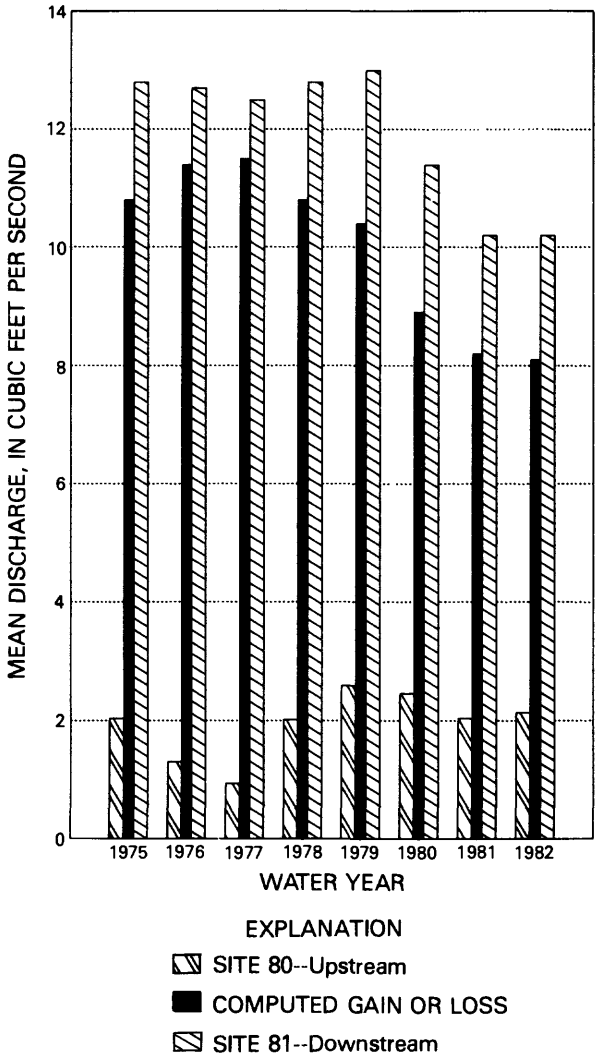
GEOHYDROLOGY.--The valley floor at this site and for several miles upstream is Spearfish Formation. On the west the valley walls are Sundance Formation overlain by rocks of the Morrison Formation, both of Jurassic age, and the Inyan Kara Group of Cretaceous age. The eastern valley wall consists of Minnekahta Limestone underlain by Opeche Shale and Minnelusa Formation.

REMARKS.--Flow at this site is affected at times by irrigation diversions and by return flow from irrigation. A large increase in surface water drainage area occurs between upstream site 80 and downstream site 81.

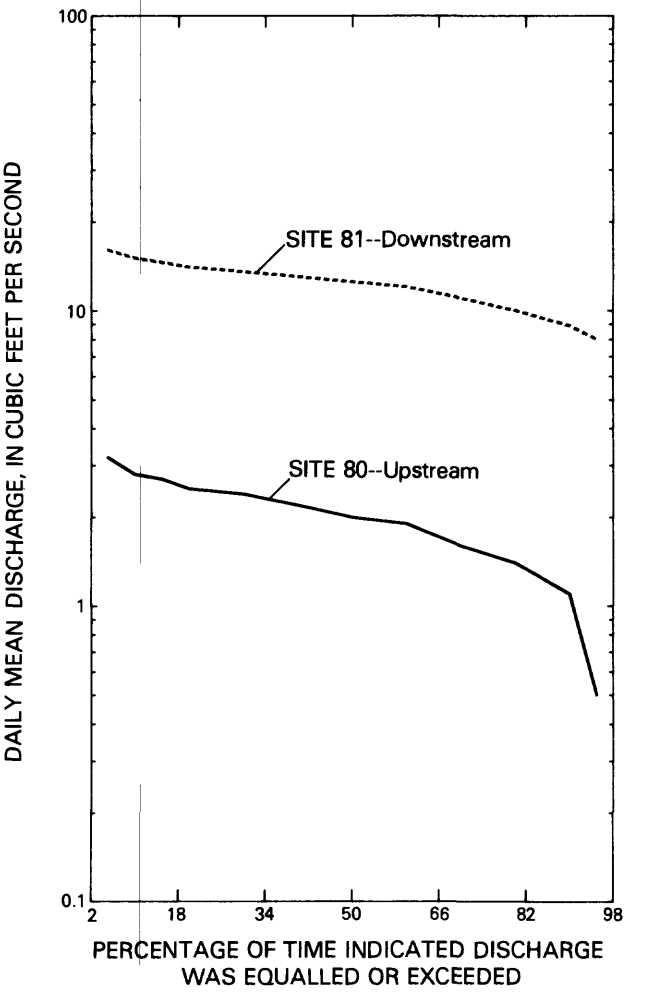
Discharge measurements and computed gain or loss of streamflow in Beaver Creek/Stockade Beaver Creek between sites 80 and 81

	Discharge, in cubic feet per second			
Date	Site 80	Date	Site 81	Computed gain (+) or loss (-)
9-06-74	1.77	9-06-74	10.5	+8.7
10-22-74	1.84	10-24-74	14.1	+12.3
11-12-74	1.88	11-13-74	12.4	+10.5
6-25-85	2.20	6-25-85	[1]9.38	+7.18
9-24-91	1.65	9-23-91	10.1	+8.45

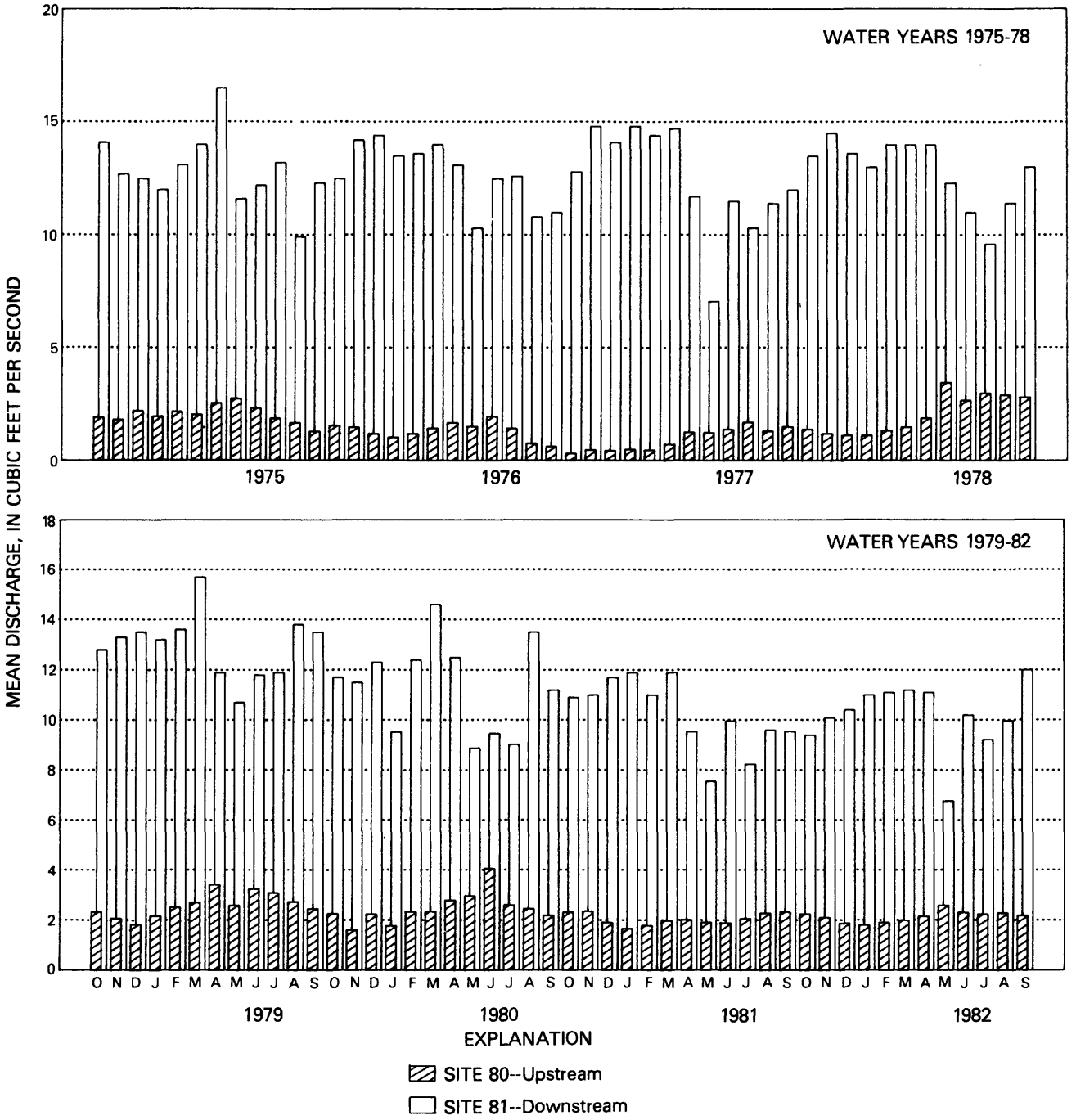
[1]Some diversion for irrigation and return flow between sites 80 and 81 was occurring at time of measurement.



Annual mean discharge and computed gain or loss of streamflow, water years 1975-82.



Flow-duration curves for daily mean discharge, water years 1975-82.



Monthly mean discharge, water years 1975-82.

Monthly and annual mean discharge of Beaver Creek/Stockade Beaver Creek, sites 80 and 81

[Computed gain (+) or loss (-) of flow between sites, water years 1975-82, in cubic feet per second]

Water year	Site number	Discharge, in cubic feet per second: Monthly mean Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual mean
1975	80	1.90	1.80	2.20	1.95	2.16	2.03	2.55	2.75	2.33	1.87	1.67	1.29	2.04
	81	14.1	12.7	12.5	12.0	13.1	14.0	16.5	11.6	12.2	13.2	9.93	12.3	12.8
Gain or loss		+12.2	+10.9	+10.3	+10.0	+10.9	+12.0	+14.0	+8.8	+9.9	+11.3	+8.3	+11.0	+10.8
1976	80	1.55	1.48	1.18	1.03	1.18	1.44	1.69	1.52	1.96	1.43	.75	.62	1.32
	81	12.5	14.2	14.4	13.5	13.6	14.0	13.1	10.3	12.5	12.6	10.8	11.0	12.7
Gain or loss		+11.0	+12.7	+13.2	+12.5	+12.4	+12.6	+11.4	+8.8	+10.5	+11.1	+10.0	+10.4	+11.4
1977	80	.31	.47	.44	.49	.46	.71	1.25	1.23	1.38	1.70	1.31	1.51	.94
	81	12.8	14.8	14.1	14.8	14.4	14.7	11.7	7.04	11.5	10.3	11.4	12.0	12.5
Gain or loss		+12.5	+14.3	+13.7	+14.3	+13.9	+14.0	+10.4	+5.8	+10.1	+8.6	+10.1	+10.5	+11.6
1978	80	1.39	1.19	1.11	1.11	1.33	1.48	1.88	3.44	2.66	2.97	2.89	2.78	2.02
	81	13.5	14.5	13.6	13.0	14.0	14.0	14.0	12.3	11.0	9.59	11.4	13.0	12.8
Gain or loss		+12.1	+13.3	+12.5	+11.9	+12.7	+12.5	+12.1	+8.9	+8.3	+6.6	+8.5	+10.2	+10.8
1979	80	2.32	2.06	1.82	2.17	2.51	2.70	3.41	2.58	3.24	3.09	2.73	2.45	2.59
	81	12.8	13.3	13.5	13.2	13.6	15.7	11.9	10.7	11.8	11.9	13.8	13.5	13.0
Gain or loss		+10.5	+11.2	+11.7	+11.0	+11.1	+13.0	+8.5	+8.1	+8.6	+8.8	+11.1	+11.0	+10.4
1980	80	2.25	1.61	2.23	1.77	2.33	2.34	2.79	2.97	4.05	2.60	2.45	2.19	2.46
	81	11.7	11.5	12.3	9.52	12.4	14.6	12.5	8.88	9.47	9.02	13.5	11.2	11.4
Gain or loss		+9.4	+9.9	+10.1	+7.7	+10.1	+12.3	+9.7	+5.9	+5.4	+6.4	+11.0	+9.0	+8.9
1981	80	2.31	2.35	1.90	1.66	1.78	1.98	2.02	1.91	1.88	2.06	2.28	2.33	2.04
	81	10.9	11.0	11.7	11.9	11.0	11.9	9.53	7.55	9.96	8.24	9.60	9.55	10.2
Gain or loss		+8.6	+8.6	+9.8	+10.2	+9.2	+9.9	+7.5	+5.6	+8.1	+6.2	+7.3	+7.2	+8.2
1982	80	2.25	2.11	1.87	1.80	1.90	1.99	2.15	2.59	2.30	2.24	2.28	2.18	2.14
	81	9.40	10.1	10.4	11.0	11.1	11.2	11.1	6.77	10.2	9.22	9.97	12.0	10.2
Gain or loss		+7.1	+8.0	+8.5	+9.2	+9.2	+9.2	+9.0	+4.2	+7.9	+7.0	+7.7	+9.8	+8.1

Cold Springs Creek/Sand Creek

Site 82--Upstream Station 06429500 Cold Springs Creek at Buckhorn

LOCATION.--Lat 44°09'14", long 104°04'39", in NW1/4 sec. 9, T. 48 N., R. 60 W., Weston County, 155 feet upstream from U.S. Highway 85, and 1.4 miles northeast of Buckhorn.

DRAINAGE AREA.--19.0 square miles.

PERIOD OF RECORD.--Water years 1975-82 and 1991 to current year (1992). Data for water years 1975-82 are presented.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--Surface rocks are Minnelusa Formation and consist of yellow to red crossbedded sandstone, limestone, anhydrite, and shale.

Site 83--Downstream Station 06429905 Sand Creek near Ranch A, near Beulah

LOCATION.--Lat 44°29'42", long 104°06'34", in SW1/4 sec. 18, T. 52 N., R. 60 W., Crook County, 0.4 mile north of Fish Genetics Laboratory headquarters, 0.9 mile upstream from Hospital Gulch, and 3.6 miles south of Beulah.

DRAINAGE AREA.--260 square miles.

PERIOD OF RECORD.--Water years 1975-82 and 1991 to current year (1992). Data for water years 1975-82 are presented.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The valley floor is Englewood or Pahasapa Limestone (stratigraphically equivalent to the Madison Limestone) and the walls are red to yellow sandstone, shale, and limestone of the Minnelusa Formation.

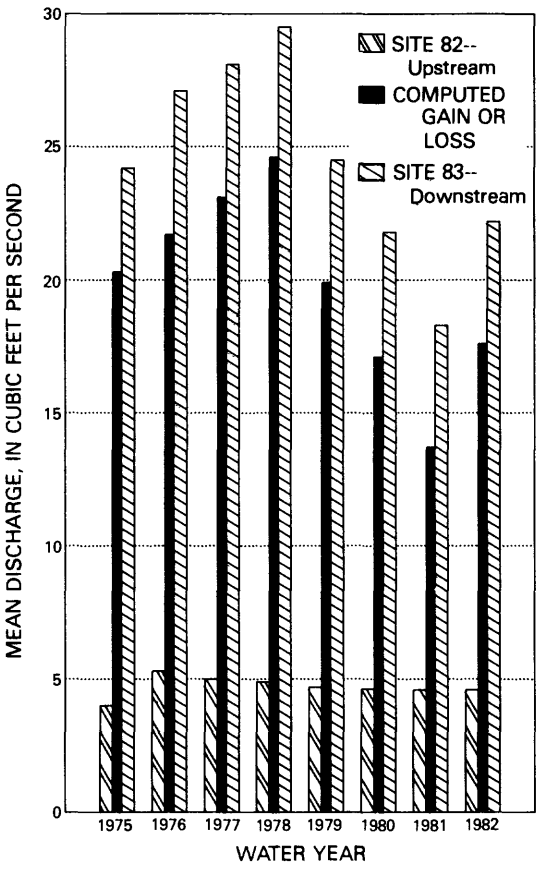
REMARKS.--In most years, Sand Creek has no flow 10 to 11 months of the year for much of the reach between the entrance to U.S. Forest Service land south of Trout Genetics Lab and site 82. Outflow from U.S. Forest Service land to Genetics Lab land is zero most of the time. For 10 miles upstream, flow was zero in June, and spring discharge from the many small springs in both canyon walls did not reach the valley floor except where piped from 1976-80 (L.W. Howells, U.S. Geological Survey, written commun., 1990). A large increase in surface water drainage area occurs between upstream site 82 and downstream site 83.

Discharge measurements and computed gain or loss of streamflow in Cold Springs Creek/Sand Creek between sites 82 and 83

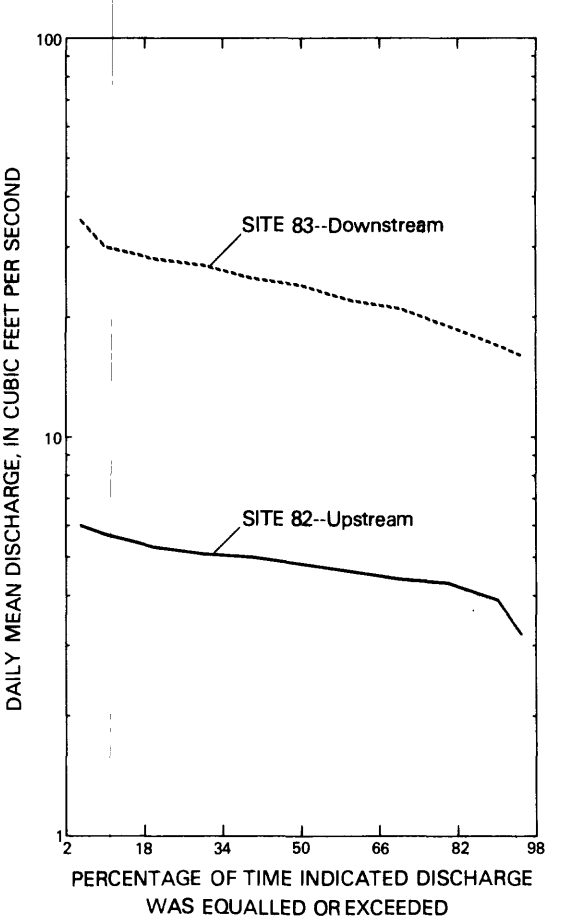
[--, not measured]

Discharge, in cubic feet per second				
Date	Site 82	Date	Site 83	Computed gain (+) or loss (-)
9-05-74	3.82	9-05-74	27.0	+23.2
--	--	9-18-74	26.6	--
--	--	10-03-74	25.7	--
10-23-74	2.43	--	--	--
11-12-74	2.44	11-12-74	24.0	+21.6
6-25-85	4.73	6-25-85	19.8	+15.1
9-24-91	3.72	9-24-91	14.0	+10.3

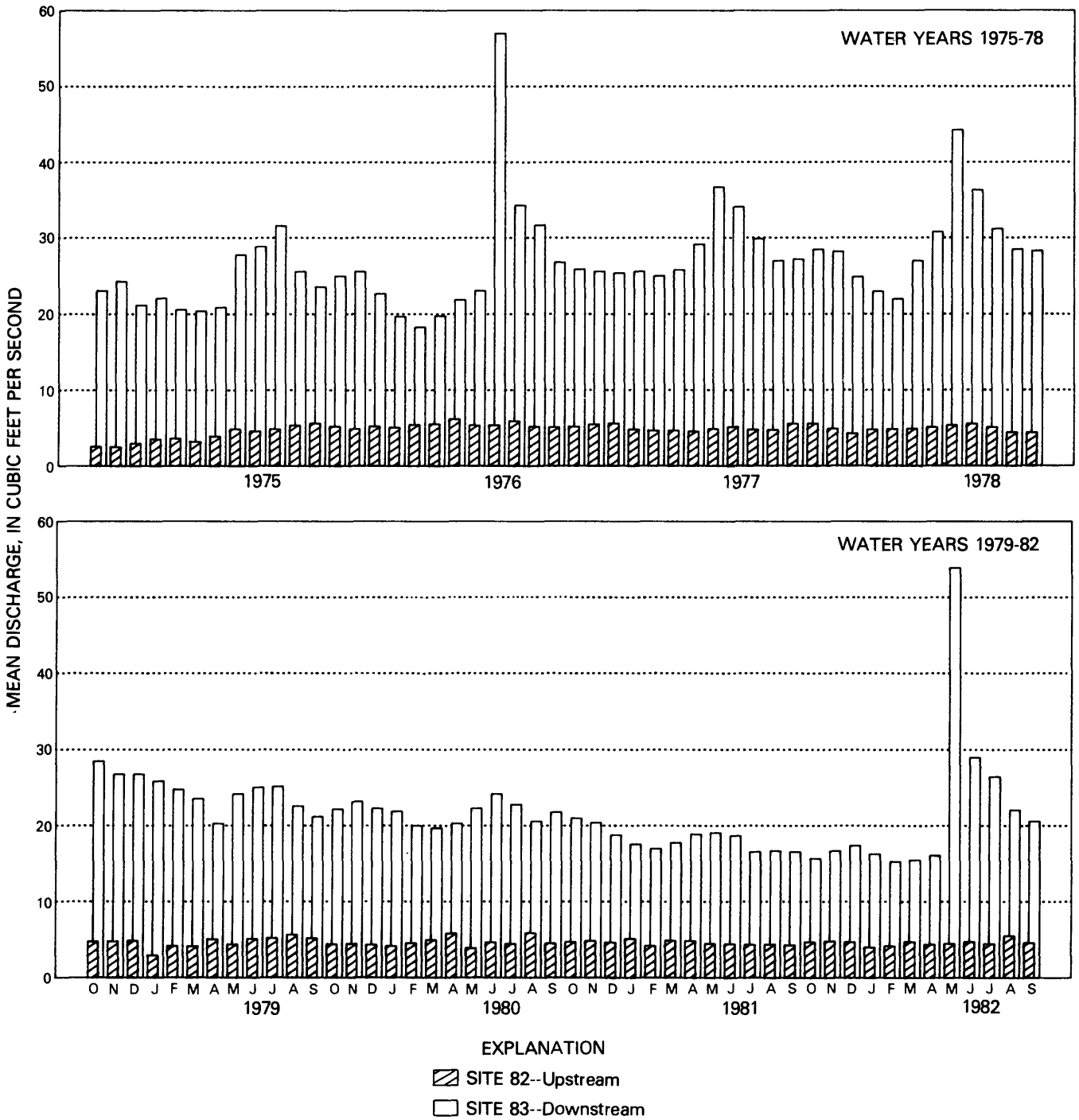
Cold Springs Creek/Sand Creek



Annual mean discharge and annual computed gain or loss of streamflow, water years 1975-82.



Flow-duration curves for daily mean discharge, water years 1975-82.



Monthly mean discharge, water years 1975-82.

Monthly and annual mean discharge of Cold Springs Creek/Sand Creek, sites 82 and 83

[Computed gain (+) or loss (-) of flow between sites for period of record, in cubic feet per second]

Water year	Site number	Discharge, in cubic feet per second: Monthly mean Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual mean
1975	82	2.53	2.48	2.94	3.54	3.61	3.18	3.88	4.86	4.59	4.86	5.36	5.63	3.96
	83	23.1	24.3	21.2	22.1	20.6	20.4	20.9	27.8	28.9	31.6	25.6	23.6	24.2
Gain or loss		+20.6	+21.8	+18.3	+18.6	+17.0	+17.2	+17.0	+22.9	+24.3	+26.7	+20.2	+18.0	+20.2
1976	82	5.21	4.89	5.22	5.07	5.43	5.54	6.17	5.37	5.37	5.90	5.18	5.11	5.37
	83	25.0	25.6	22.7	19.7	18.3	19.8	21.9	23.1	57.0	34.3	31.7	26.8	27.1
Gain or loss		+19.8	+20.7	+17.5	+14.6	+12.9	+14.3	+15.7	+17.7	+51.6	+28.4	+26.5	+21.7	+21.7
1977	82	5.17	5.48	5.59	4.81	4.64	4.66	4.53	4.86	5.13	4.78	4.72	5.56	4.99
	83	25.9	25.6	25.4	25.6	25.0	25.8	29.2	36.7	34.1	29.9	27.0	27.2	28.1
Gain or loss		+20.7	+20.1	+19.8	+20.8	+20.4	+21.1	+24.7	+31.8	+29.0	+25.1	+22.3	+21.6	+23.1
1978	82	5.58	4.88	4.25	4.76	4.83	4.89	5.07	5.35	5.55	5.10	4.41	4.39	4.92
	83	28.5	28.2	24.9	23.0	22.0	27.0	30.8	44.3	36.3	31.2	28.5	28.3	29.5
Gain or loss		+22.9	+23.3	+20.6	+18.2	+17.2	+22.1	+25.7	+39.0	+30.7	+26.1	+24.1	+23.9	+24.6
1979	82	4.74	4.76	4.83	2.93	4.15	4.09	5.04	4.36	5.09	5.17	5.62	5.15	4.66
	83	28.5	26.8	26.3	25.9	24.8	23.6	20.3	24.2	25.1	25.2	22.6	21.2	24.5
Gain or loss		+23.8	+22.0	+21.5	+23.0	+20.6	+19.5	+15.3	+19.8	+20.0	+20.0	+17.0	+16.0	+19.8
1980	82	4.39	4.43	4.31	4.13	4.52	4.95	5.78	3.85	4.63	4.42	5.84	4.49	4.65
	83	22.2	23.2	22.3	21.9	20.0	19.7	20.3	22.3	24.2	22.8	20.6	21.8	21.8
Gain or loss		+17.8	+18.8	+18.0	+17.8	+15.5	+14.7	+14.5	+18.4	+19.6	+18.4	+14.8	+17.3	+17.1
1981	82	4.69	4.82	4.61	5.09	4.16	4.86	4.82	4.45	4.42	4.33	4.34	4.26	4.57
	83	21.0	20.4	18.8	17.6	17.0	17.8	18.9	19.1	18.7	16.6	16.7	16.6	18.3
Gain or loss		+16.3	+15.6	+14.2	+12.5	+12.8	+12.9	+14.1	+14.6	+14.3	+12.3	+12.4	+12.3	+13.7
1982	82	4.67	4.77	4.66	3.97	4.15	4.71	4.36	4.45	4.71	4.45	5.51	4.56	4.58
	83	15.7	16.7	17.4	16.3	15.3	15.5	16.1	53.9	29.0	26.5	22.1	20.6	22.2
Gain or loss		+11.0	+11.9	+12.7	+12.3	+11.1	+10.8	+11.7	+49.4	+24.3	+22.0	+16.6	+16.0	+17.6

Description of Site and Summary of Streamflow Data and Computed Gains and Losses at Miscellaneous-Measurement Site, 1974-91

Inyan Kara Creek

Site 84--06427700 Inyan Kara Creek near Upton (former crest-stage station)

LOCATION.--Lat 44°13'45", long 104°26'45", in S1/2 sec. 17, T. 49 N., R. 63 W., Crook County, at bridge on State Highway 116, and 13.0 miles northeast of Upton.

GEOHYDROLOGY.--Bedrock at this site is Sundance Formation, but there are higher areas nearby of Spearfish Formation. Inyan Kara Creek originates from a spring near the Spearfish and Minnekahta contact in the northeast corner of T. 49 N., R. 62 W. It flows along the Spearfish and Minnekahta contact and gains water from other contact springs.

REMARKS.--Irrigation diversions upstream from the original measuring site reduced flow during the 1985 measurement. A discharge of 0.05 cubic feet per second was made at the original site June 25, 1985, but upstream from the diversions in SE1/4 NE1/4 SW1/4 sec. 11, T. 49 N., R. 63 W., a discharge of 1.30 cubic feet per second was measured.

Discharge measurements and computed gain or loss of streamflow in Inyan Kara Creek between origination point at spring and site 84

	Discharge, in cubic feet per second	
Date	Site 84	Computed gain (+) or loss (-)
9-05-74	1.14	+1.14
6-25-85	.05	[1]+1.30
12-10-91	1.91	+1.91

[1]Because of irrigation diversions upstream from the measurement site, a second measurement, 1.30 cubic feet per second, was made at the road crossing in SE1/4 NE1/4 SW1/4 sec. 11, T. 49 N., R. 63 W.

Geology and Hydrology of Laramie Mountains Area
(from Boner and others, 1976, p. 7 and 8)

Along the northern and northeastern flanks of the Laramie Mountains, the Madison Limestone forms a narrow, sinuous outcrop that seldom exceeds a mile in width. The continuity of the Madison outcrop is often broken by a mantle of Tertiary rocks that laps onto the flanks of the mountains. The Madison in this area comprises a basal conglomeratic sandstone unit, a middle unit of massive limestone, and an upper unit of limestone with chert lenses. The basal sandstone unit and upper cherty unit are conformable with the middle unit of limestone. The Madison is underlain by Precambrian granite and metamorphic rocks and overlain by massive sandstone of the Casper Formation of Pennsylvanian and Permian age. Disconformities separate the Madison from these underlying and overlying rocks. The Madison is about 300 feet thick in its area of outcrop south of Casper but wedges out southward along the east flank of the Laramie Mountains. The Madison is 112 feet thick in its outcrop along Horseshoe Creek southwest of Glendo (Maughan, 1963, p. C25).

The basal sandstone of the Madison Limestone consists predominantly of rounded quartz and feldspar pebbles in a matrix of quartz sand and was derived from weathering of the underlying Precambrian granite. The sandstone is well cemented and probably has little intergranular (primary) permeability. The sandstone has some secondary permeability in the form of fractures, mostly along bedding planes. Hydraulic connection between the basal sandstone unit and the underlying Precambrian rocks and overlying middle unit of limestone probably is poor. The basal sandstone in this area of outcrop is thickest along the northern flank of the Laramie Mountains and seems to wedge out southward. The basal sandstone was not observed south of Wagon Hound Creek, although Maughan (1963, p. C25) reported finding 1 foot of the basal sandstone along Horseshoe Creek.

The middle unit of the Madison Limestone consists predominantly of gray to pink, massive, partly sandy, dolomitic limestone. The middle unit also contains minor amounts of tan to salmon, fine-grained, thin-bedded to massive sandstone. The middle unit has little primary permeability. Fractures and fist-sized solution openings along bedding planes are common, however. Where the fractures and solution openings cross the bedding planes, the secondary permeability of the limestone is increased. Larger solution openings and caves are found locally. Although the middle unit is at least 200 feet thick along the northern flank of the Laramie Mountains, it, too, wedges out southward. Along Cottonwood Creek southwest of Glendo, the middle unit is about 100 feet thick.

The upper, cherty, unit of the Madison consists predominantly of gray, thin-bedded to massive, partly silty limestone interbedded with yellowish-gray, thin-bedded chert. Fractures and fist-sized solution openings are common in the limestone, and the chert usually is extensively fractured. Hydraulic connection between this upper cherty unit and both the underlying middle unit of limestone and the overlying Casper Formation probably is good in most areas. The thickness of the upper unit varies because of post-Madison, pre-Casper erosion; however, the upper unit of the Madison is seldom more than 50 feet thick at its outcrop along the northern and northeastern flanks of the Laramie Mountains.

The Casper Formation, at its outcrop along the northern and northeastern flanks of the Laramie Mountains, consists predominantly of tan to pink, fine-grained, massive, crossbedded sandstone and limestone near the top and interbedded, tan to salmon, thick-bedded sandstone and limestone near the base. Locally, a conglomeratic sandstone is found at the base of the formation. Sandstones in the Casper Formation usually are poorly cemented and friable, and they have some intergranular (primary) permeability. Limestones in the Casper have little primary permeability, but secondary permeability, in the form of fractures and solution openings, is common. The Casper Formation is about 850 feet thick near La Prele Reservoir west of Douglas (Rapp, 1953, p. 11).

Description of Sites and Summary of Streamflow Data and Computed Gains and Losses at Streamflow-Gaging Stations, 1974-91

Smith Creek

Site 85--Upstream Station 06645150 Smith Creek above Otter Creek, near Casper

LOCATION.--Lat 42°38'59", long 106°10'46", in NE1/4 NW1/4 NW1/4 sec. 22, T. 31 N., R. 78 W., Natrona County, 1.3 miles upstream from Otter Creek and 16 miles southeast of Casper.

DRAINAGE AREA.--9.91 square miles.

PERIOD OF RECORD.--Water years 1975-79 and 1988 to current year (1992). Data for water years 1975-79 are presented.

GAGE.--Water-stage recorder. Prior to Oct. 1, 1976, at site 200 feet downstream.

GEOHYDROLOGY.--The basal sandstone unit of the Madison and the underlying Precambrian granite are exposed in the hillside north of Smith Creek.

Site 86--Downstream Station 06645160 Smith Creek at Otter Creek, near Casper

LOCATION.--Lat 42°39'24", long 106°09'40", in NE1/4 NW1/4 SW1/4 sec. 14, T. 31 N., R. 78 W., Natrona County, 0.2 mile upstream from Otter Creek, and 16 miles southeast of Casper.

DRAINAGE AREA.--10.9 square miles.

PERIOD OF RECORD.--Water years 1975-79.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--Smith Creek crosses the contact of the Madison Limestone and the Casper Formation at this site.

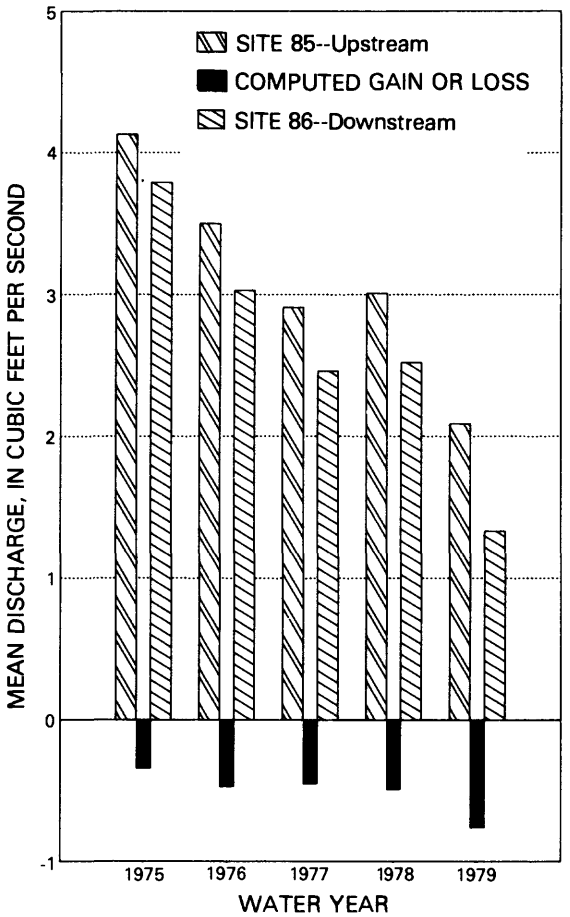
REMARKS.--Longtime local residents said that prior to either 1984 or 1985, Smith Creek had never been dry at the downstream-gaging station. Gaging of streamflow in Otter Creek (tributary to Smith Creek) and in Smith Creek at a site 1.4 miles downstream from site 86, after 1985, has shown that Smith Creek picks up flow in the reach downstream from Otter Creek, but it is uncertain if the inflow is the same as that being lost in the reach between sites 85 and 86.

Discharge measurements and computed gain or loss of streamflow in Smith Creek between sites 85 and 86

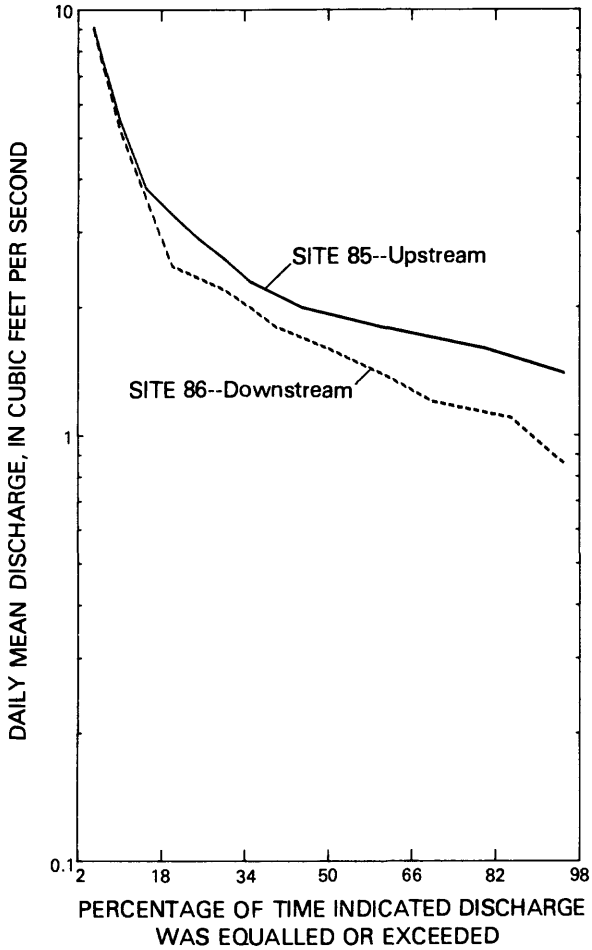
[--, not measured]

Discharge, in cubic feet per second				
Date	Site 85	Date	Site 86	Computed gain (+) or loss (-)
8-01-74	2.98	8-01-74	2.57	-0.41
10-16-74	2.42	10-17-74	1.86	-.56
12-04-74	1.90	12-04-74	1.61	-.29
6-05-85	2.66	6-05-85	1.22	-1.44
9-05-85	1.42	9-05-85	0	-1.40
9-05-85	1.38	--	--	--
6-19-91	1.98	6-19-91	0	-1.98
9-19-91	1.25	9-19-91	0	-1.25

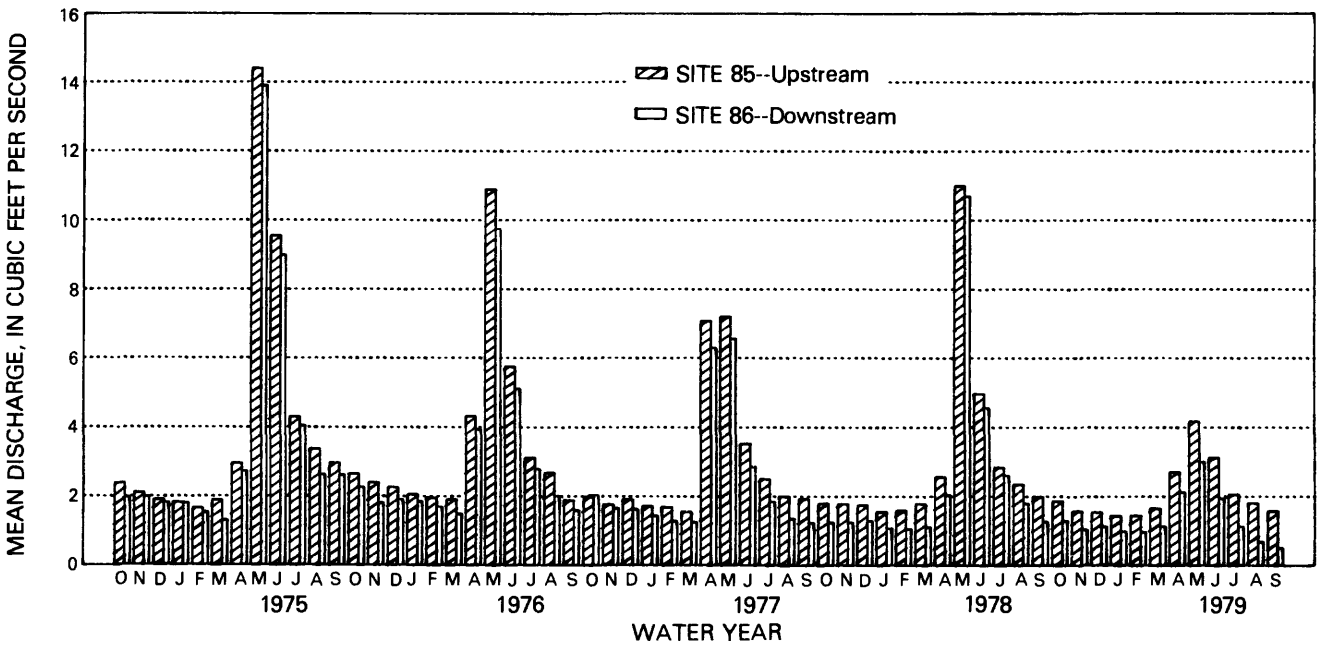
Smith Creek



Annual mean discharge and annual computed gain or loss of streamflow, water years 1975-79.



Flow-duration curves for daily mean discharge, water years 1975-79.



Monthly mean discharge, water years 1975-79.

Monthly and annual mean discharge of Smith Creek, sites 85 and 86

[Computed gain (+) or loss (-) of flow between sites for period of record, in cubic feet per second]

Water year	Site number	Discharge, in cubic feet per second: Monthly mean Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual mean
1975	85	2.38	2.11	1.90	1.82	1.66	1.89	2.96	14.4	9.55	4.30	3.37	2.97	4.13
	86	1.97	2.00	1.82	1.81	1.54	1.31	2.72	13.9	9.00	4.05	2.63	2.62	3.79
Gain or loss		-.41	-.11	-.08	-.01	-.12	-.58	-.24	-.5	-.55	-.25	-.74	-.35	-.34
1976	85	2.65	2.40	2.26	2.06	1.96	1.91	4.32	10.9	5.76	3.12	2.68	1.89	3.50
	86	2.26	1.81	1.91	1.85	1.70	1.50	3.95	9.75	5.11	2.80	2.01	1.60	3.03
Gain or loss		-.39	-.59	-.35	-.21	-.26	-.41	-.37	-1.15	-.65	-.32	-.67	-.29	-.47
1977	85	1.99	1.76	1.91	1.72	1.69	1.56	7.09	7.21	3.53	2.51	2.00	1.94	2.91
	86	2.04	1.66	1.62	1.44	1.28	1.26	6.30	6.57	2.87	1.85	1.36	1.23	2.46
Gain or loss		+.05	-.10	-.29	-.28	-.41	-.30	-.79	-.64	-.66	-.66	-.64	-.71	-.45
1978	85	1.80	1.79	1.75	1.56	1.60	1.79	2.57	11.0	4.97	2.85	2.35	2.00	3.01
	86	1.25	1.24	1.30	1.07	1.06	1.11	2.05	10.7	4.56	2.61	1.81	1.27	2.52
Gain or loss		-.55	-.55	-.45	-.49	-.54	-.68	-.52	-.3	-.41	-.24	-.54	-.73	-.49
1979	85	1.87	1.58	1.55	1.44	1.45	1.66	2.71	4.18	3.13	2.07	1.81	1.58	2.09
	86	1.30	1.03	1.13	.98	.97	1.13	2.13	3.01	1.95	1.13	.69	.51	1.33
Gain or loss		-.57	-.55	-.42	-.46	-.48	-.53	-.58	-1.17	-1.18	-.94	-1.12	-1.07	-.76

Little Deer Creek

Site 87--Upstream Station 06646280 Little Deer Creek above East Cart Creek, near Glenrock

LOCATION.--Lat 42°42'54", long 105°57'51", in NW1/4 NW1/4 SW1/4 sec. 28, T. 32 N., R. 76 W., Converse County, 0.3 mile upstream from East Cart Creek, and 11.2 miles south of Glenrock.

DRAINAGE AREA.--3.89 square miles.

PERIOD OF RECORD.--Water years 1975 and 1976.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The basal sandstone unit of the Madison and the underlying Precambrian granite are exposed along the streambed.

Site 88--Downstream Station 06646300 Little Deer Creek below East Cart Creek, near Glenrock

LOCATION.--Lat 42°43'17", long 105°57'57", in NW1/4 NW1/4 NW1/4 sec. 28, T. 32 N., R. 76 W., Converse County, 0.3 mile downstream from East Cart Creek, and 10.8 miles south of Glenrock.

DRAINAGE AREA.--7.48 square miles.

PERIOD OF RECORD.--Water years 1975 and 1976.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The contact of the Madison Limestone and the Casper Formation is exposed in the hillside east of the creek, and the station is located near the contact.

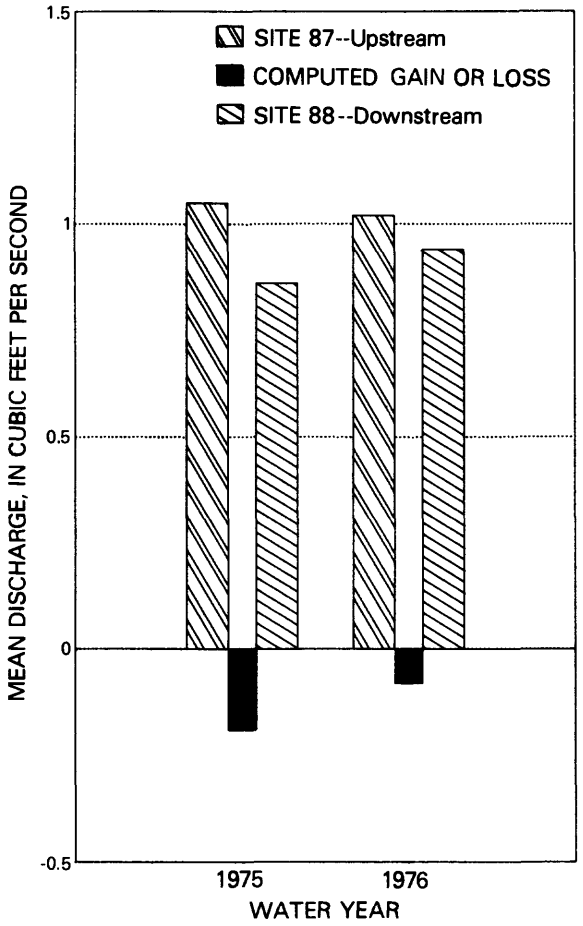
REMARKS.--The downstream streamflow site was located at the contact of the Madison Limestone and the Casper Formation. This site was 0.3 mile downstream from East Cart Creek, whereas the upstream site was 0.3 mile upstream from East Cart Creek. During operation of the streamflow gages, it was observed that East Cart Creek does flow during the direct runoff period, and at times the tributary inflow exceeded the loss of flow into the Madison. Therefore, the daily streamflow records for the two sites can not be used directly to determine recharge to the Madison while East Cart Creek was flowing. Measured flows of East Cart Creek are listed in the table for site 96.

Discharge measurements and computed gain or loss of streamflow in Little Deer Creek between sites 87 and 88

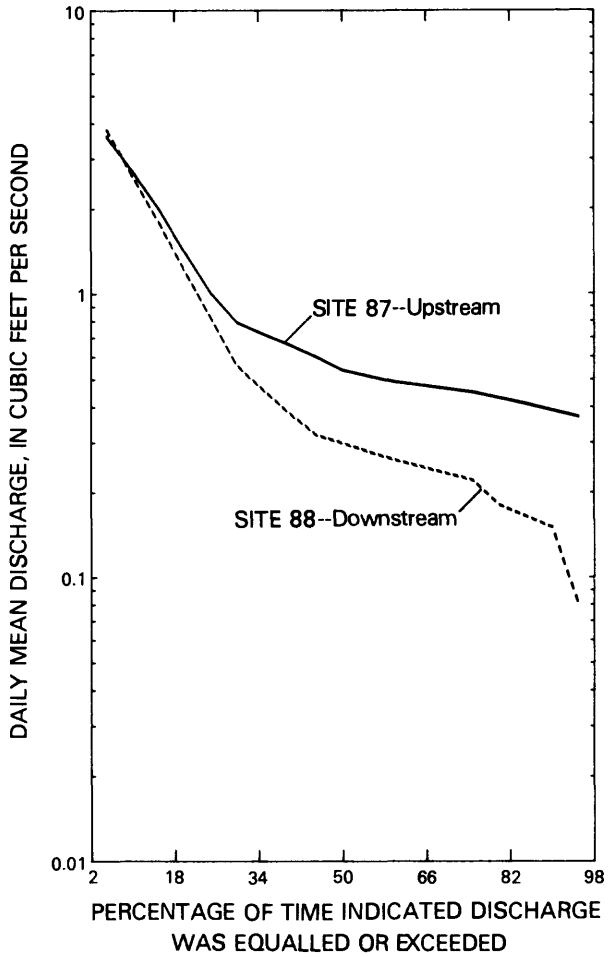
Discharge, in cubic feet per second				
Date	Site 87	Date	Site 88	Computed gain (+) or loss (-)
7-31-74	1.09	7-31-74	0.55	-0.54
10-10-74	.68	10-09-74	.35	-.33
12-03-74	.67	12-03-74	.50	-.17
5-21-85	[1]1.30	5-21-85	1.07	-.23
9-04-85	.38	9-04-85	0	-.38
7-29-91	.52	7-29-91	.17	-.35

[1]Includes 0.02 cubic feet per second in East Cart Creek tributary.

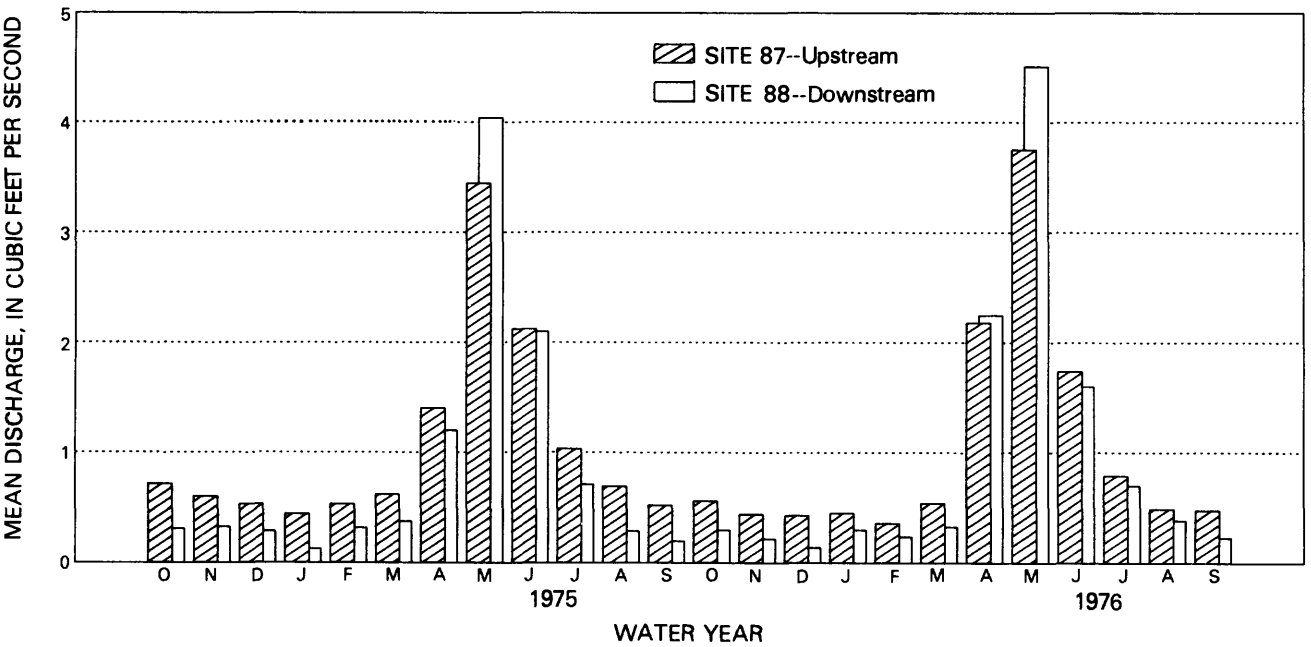
Little Deer Creek



Annual mean discharge and annual computed gain or loss of streamflow, water years 1975 and 1976.



Flow-duration curves for daily mean discharge, water years 1975 and 1976.



Monthly mean discharge, water years 1975 and 1976.

Monthly and annual mean discharge of Little Deer Creek, sites 87 and 88

[Computed gain (+) or loss (-) of flow between sites for period of record, in cubic feet per second]

Water year	Site number	Discharge, in cubic feet per second: Monthly mean Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual mean
1975	87	0.71	0.60	0.53	0.44	0.53	0.62	1.40	3.44	2.12	1.03	0.69	0.52	1.05
	88	.31	.33	.29	.13	.32	.38	1.20	4.04	2.10	.71	.29	.20	.86
Gain or loss		-.40	-.27	-.24	-.31	-.21	-.24	-.20	+.60	-.02	-.32	-.40	-.32	-.19
1976	87	.56	.44	.43	.45	.36	.54	2.18	3.75	1.74	.79	.49	.48	1.02
	88	.30	.22	.14	.30	.24	.33	2.25	4.51	1.60	.70	.39	.23	.94
Gain or loss		-.26	-.22	-.29	-.15	-.12	-.21	+.07	+.76	-.14	-.09	-.10	-.25	-.08

Discharge at site 88 increased by flow from East Cart Creek, affecting computation of gain or loss.

Box Elder Creek

Site 89--Upstream Station 06647800 Box Elder Creek near Boxelder

LOCATION.--Lat 42°43'54", long 105°47'14", in NW1/4 sec. 24, T. 32 N., R. 75 W., Converse County, 0.2 mile upstream from Converse County Park, 0.9 mile downstream from bridge on Boxelder Road, 9.3 miles north of Boxelder, and 13.5 miles southeast of Glenrock.

DRAINAGE AREA.--136 square miles.

PERIOD OF RECORD.--Water years 1981-84.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--Site is in area of outcrops of Precambrian granite about 2.5 miles upstream from the Madison and granite contact (miscellaneous-measurement site 97). Access to the contact is difficult in Box Elder Canyon and the more accessible site was chosen after comparative measurements on August 14, 1974, indicated little difference in discharge between that measured at the gage site (5.28 ft^3/s) and that measured at the contact (5.36 ft^3/s). Additional measurements were made between 1974 and 1985 at sites 89, 90, and 97-99 during seepage runs to compare streamflow at gage sites and contacts (see page 130).

Site 90--Downstream Station 06647810 Box Elder Creek at Converse County Park, near Careyhurst

LOCATION.--Lat 42°46'11", long 105°46'21", in SW1/4 sec. 6, T. 32 N., R. 74 W., Converse County, 0.1 mile upstream from northern boundary of Converse County Park, 2.3 miles upstream from Hunton Creek, 7.8 miles southwest of Careyhurst, and 7.8 miles southeast of Glenrock.

DRAINAGE AREA.--138 square miles.

PERIOD OF RECORD.--Water years 1981-84.

GAGE.--Water-stage recorder.

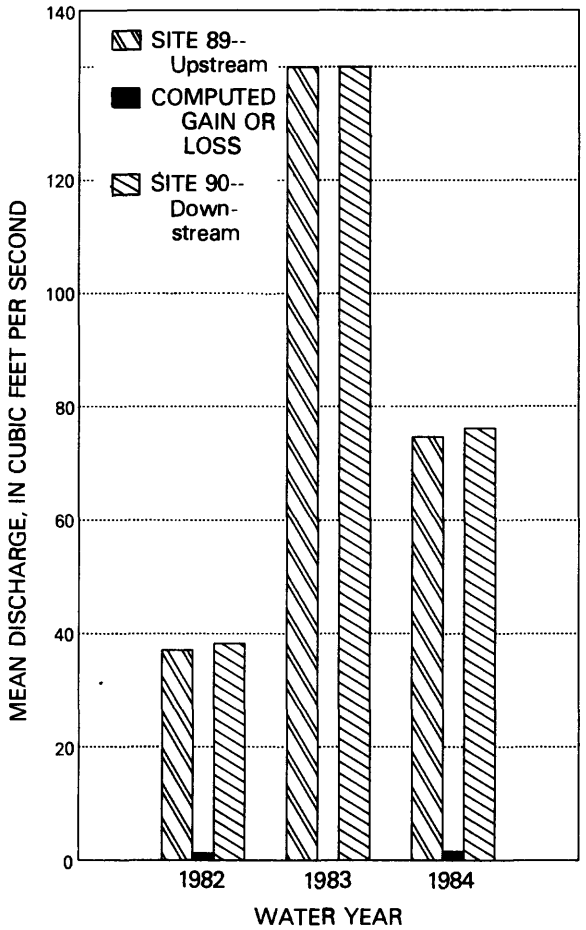
GEOHYDROLOGY.--The Casper Formation forms canyon walls at the site and is present at the streambed level at the gaging station.

REMARKS.--Due to the limited access into Box Elder Canyon, streamflow-gaging site 90 was located about 0.7 mile downstream from the Madison-Casper contact, miscellaneous-measurement site 98 (contact as indicated by M.E. Lowry, U.S. Geological Survey, oral commun., 1981; according to Boner and others, 1976, p. 14, the contact was located about 0.5 mile farther downstream).

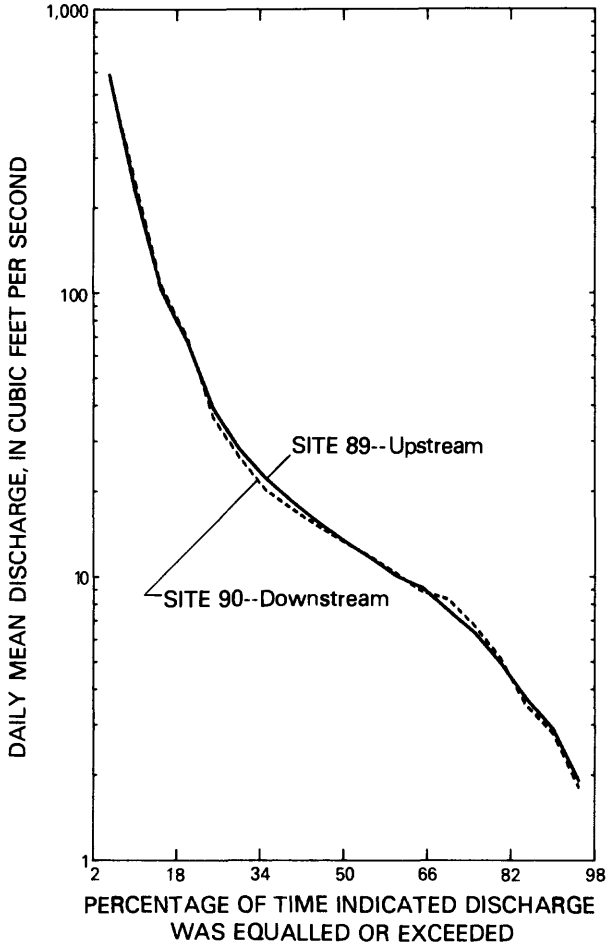
Discharge measurements and computed gain or loss of streamflow in Box Elder Creek between sites 89 and 90

Discharge, in cubic feet per second				
Date	Site 89	Date	Site 90	Computed gain (+) or loss (-)
6-03-81	30.4	6-03-81	29.3	-1.1
7-14-81	4.94	7-14-81	4.44	-.5
9-04-81	.96	9-04-81	1.00	+.04
9-11-81	1.14	9-11-81	1.11	-.03
8-02-82	7.24	8-03-82	6.92	-.32
9-02-82	1.23	9-02-82	1.16	-.07
10-07-82	4.77	10-07-82	4.84	+.07
11-18-82	30.2	11-18-82	28.7	-1.5
8-03-83	15.1	8-03-83	14.9	-.2
9-07-83	5.10	9-07-83	5.02	-.08
10-17-83	9.86	10-17-83	8.97	-.89
7-16-84	12.6	7-16-84	12.6	0

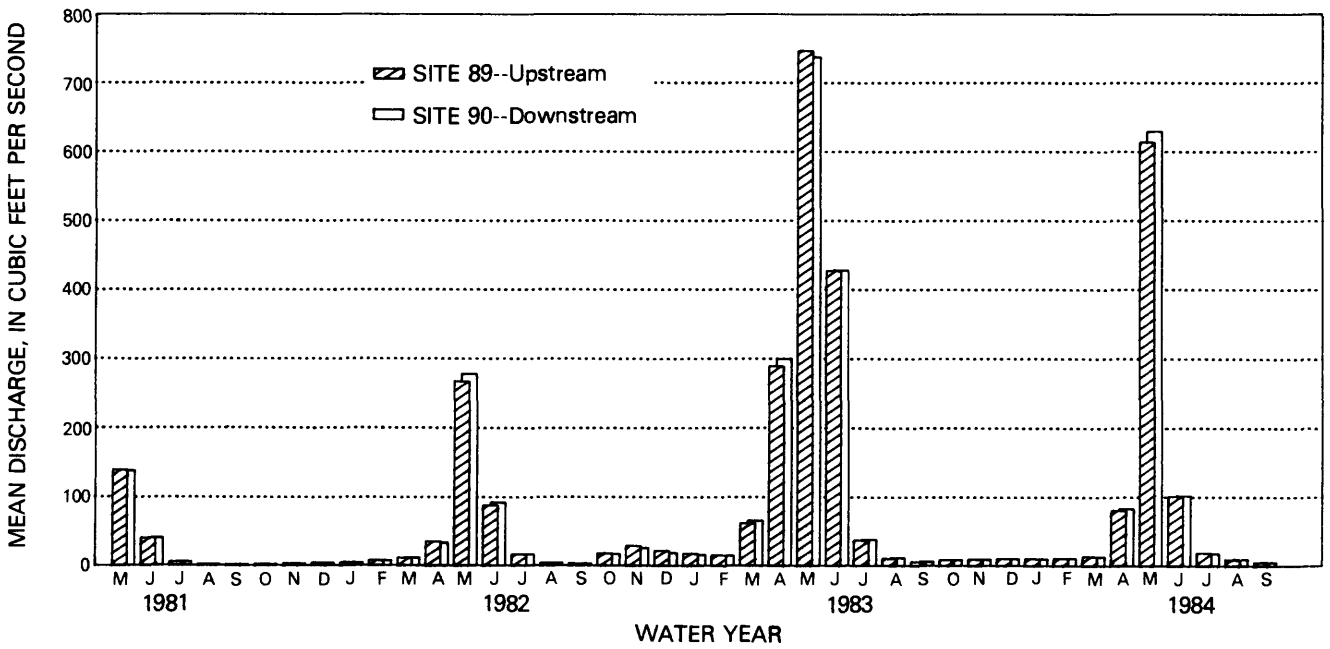
Box Elder Creek



Annual mean discharge and annual computed gain or loss of streamflow, water years 1982-84.



Flow-duration curves for daily mean discharge, water years 1982-84.



Monthly mean discharge, water years 1981-84.

Monthly and annual mean discharge of Box Elder Creek, sites 89 and 90

[Computed gain (+) or loss(-) of flow between sites for period of record, in cubic feet per second; --, not measured]

Water year	Site number	Discharge, in cubic feet per second: Monthly mean Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual mean
1981	89	--	--	--	--	--	--	--	139	40.1	4.75	1.40	1.09	--
	90	--	--	--	--	--	--	--	138	40.7	5.35	1.46	1.08	--
Gain or loss		--	--	--	--	--	--	--	-1.0	+.6	+.6	+.06	-.01	--
1982	89	1.46	2.22	3.46	3.87	6.99	10.7	35.3	267	87.8	15.9	3.42	2.77	37.1
	90	1.54	2.32	3.43	3.87	7.00	11.1	33.6	278	92.1	16.1	3.44	2.71	38.3
Gain or loss		+.08	+.10	-.03	0	+.01	+.4	-1.7	+11	+4.3	+.2	+.02	-.06	+1.2
1983	89	17.8	28.7	21.5	17.4	15.1	62.3	289	747	427	37.2	10.2	5.47	140
	90	16.7	25.8	18.5	15.6	14.3	66.1	300	738	428	38.3	11.0	5.74	140
Gain or loss		-1.1	-2.9	-3.0	-1.8	-.8	+3.8	+11	-9	+1	+1.1	+.8	+.27	0
1984	89	8.09	8.80	10.1	9.96	10.6	13.0	80.9	614	101	18.6	8.77	4.87	74.7
	90	8.08	8.92	9.74	9.74	10.5	12.7	83.4	630	102	17.7	9.47	5.07	76.2
Gain or loss		-.01	+.12	-.36	-.22	-.10	-.3	+2.5	+16	+1	-.9	+.7	+.20	+1.5

Little Box Elder Creek

Site 91--Upstream Station 06647890 Little Box Elder Creek near Careyhurst

LOCATION.--Lat 42°45'04", long 105°44'25", in SE1/4 SW1/4 SE1/4 sec. 8, T. 32 N., R. 74 W., Converse County, 4.6 miles southwest of Barber Ranch, and 7.6 miles southwest of Careyhurst.

DRAINAGE AREA.--7.18 square miles.

PERIOD OF RECORD.--Water years 1975-85.

GAGE.--Water-stage recorder. Prior to Sept. 25, 1980, at site 170 feet downstream.

GEOHYDROLOGY.--The contact of the basal sandstone of the Madison Limestone and the underlying Precambrian granite are exposed at the site.

Site 92--Downstream Station 06647900 Little Box Elder Creek at Little Box Elder Cave, near Careyhurst

LOCATION.--Lat 42°45'38", long 105°43'33", in NE1/4 SE1/4 NW1/4 sec. 9, T. 32 N., R. 74 W., Converse County, 0.3 mile southwest of Little Box Elder Cave, 3.6 miles southwest of Barber Ranch, and 6.6 miles southwest of Careyhurst.

DRAINAGE AREA.--8.47 square miles.

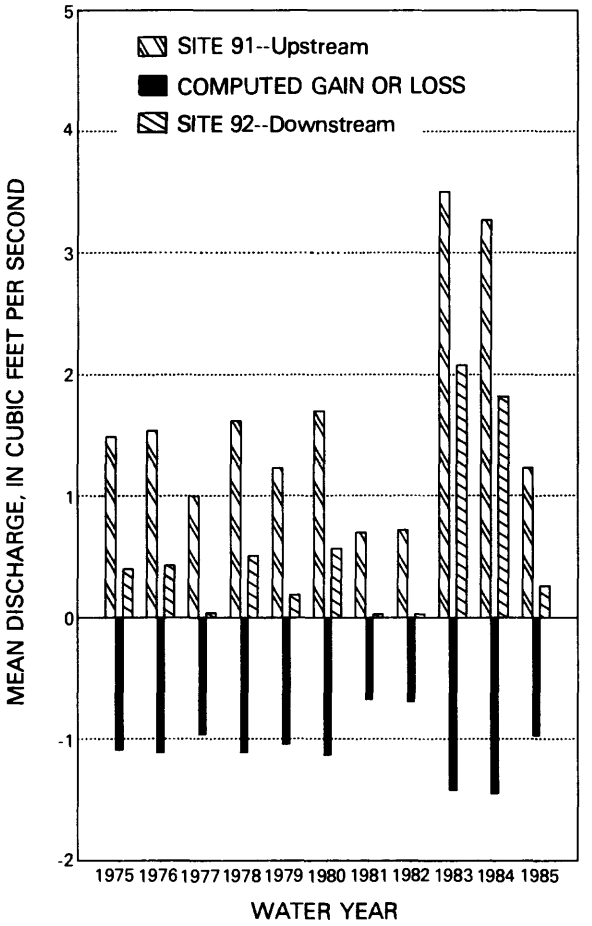
PERIOD OF RECORD.--Water years 1975-85.

GAGE.--Water-stage recorder.

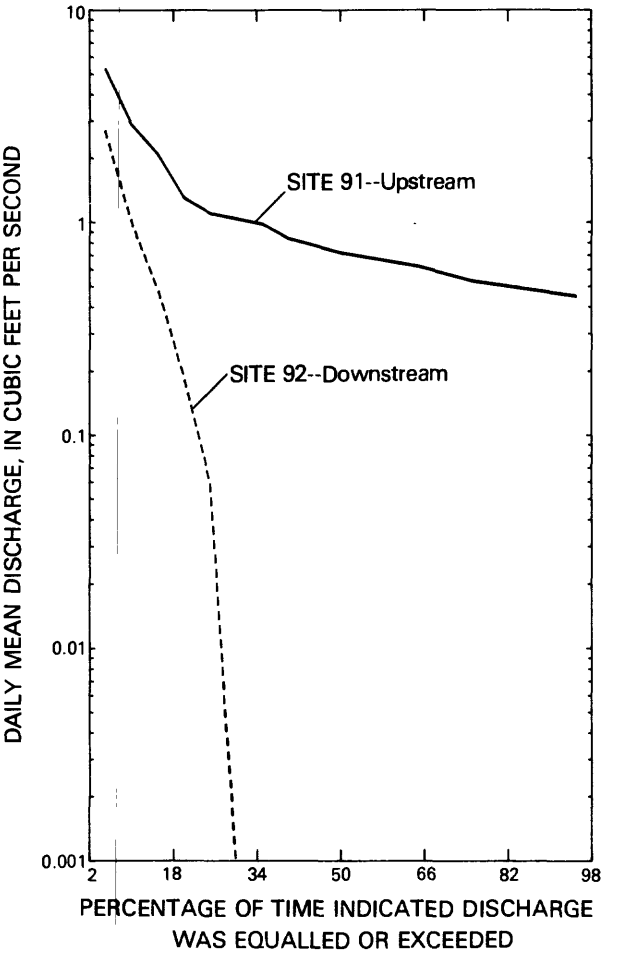
GEOHYDROLOGY.--Boner and others (1976) reported the station to be located at the contact of the Madison Limestone and the Casper Formation; however, the contact of the Madison Limestone and the Casper Formation has been observed to be farther upstream by later examination (M.E. Lowry, U.S. Geological Survey, oral commun., 1981). The downstream-gaging station was kept at the original site, which is on the Casper Formation, according to Lowry.

Discharge measurements and computed gain or loss of streamflow in Little Box Elder Creek between sites 91 and 92

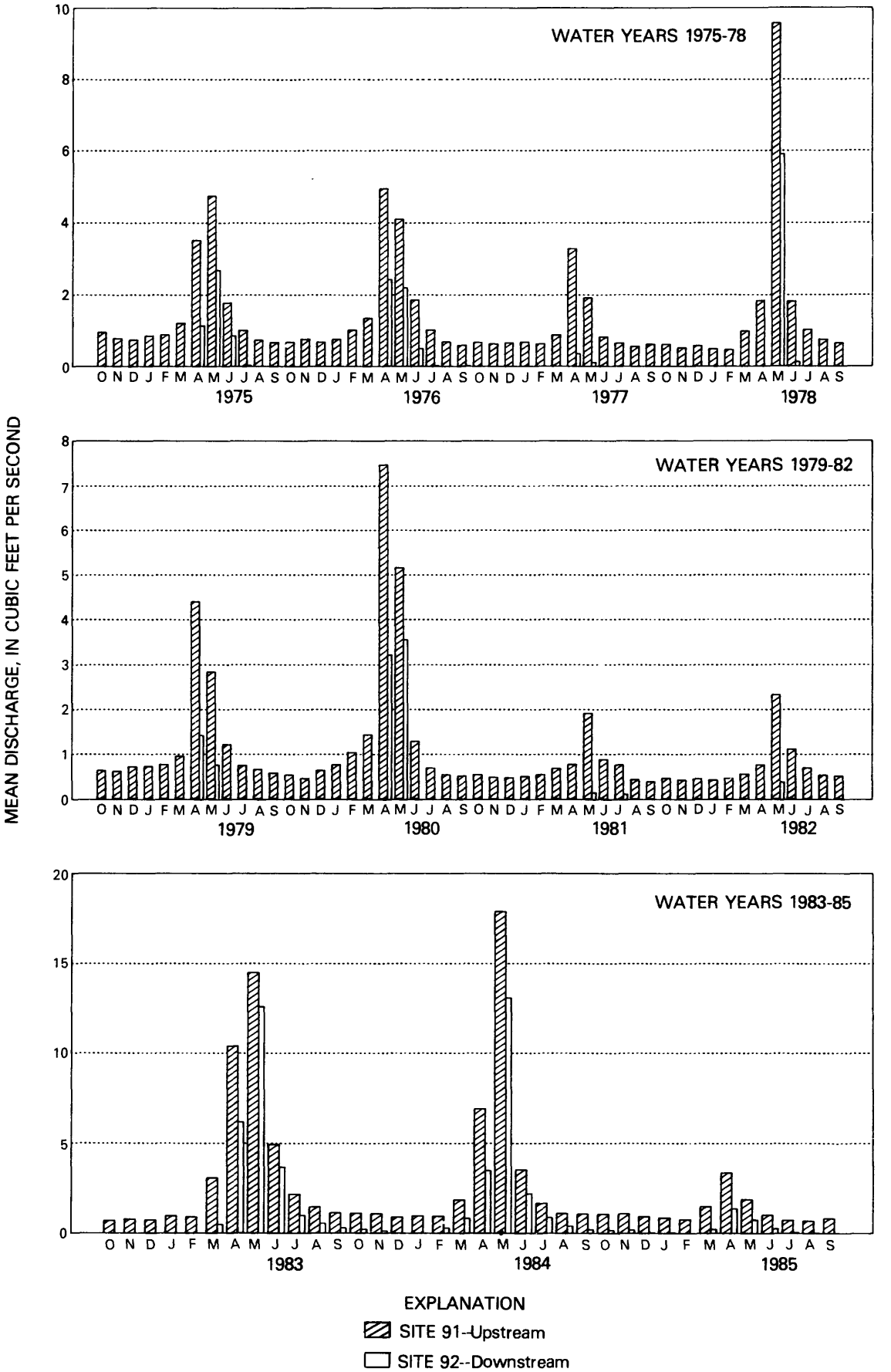
Discharge, in cubic feet per second				
Date	Site 91	Date	Site 92	Computed gain (+) or loss (-)
7-29-74	0.87	7-29-74	0	-0.87
10-10-74	.95	10-10-74	0	-.95
12-04-74	.74	12-04-74	0	-.74
7-01-85	.88	7-01-85	.11	-.77
8-01-91	.77	8-01-91	.38	-.39



Annual mean discharge and annual computed gain or loss of streamflow, water years 1975-85.



Flow-duration curves for daily mean discharge, water years 1975-85.



Monthly mean discharge, water years 1975-85.

Monthly and annual mean discharge of Little Box Elder Creek, sites 91 and 92

[Computed gain (+) or loss (-) of flow between sites for period of record, in cubic feet per second]

Water year	Site number	Discharge, in cubic feet per second: Monthly mean Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual mean
1975	91	0.96	0.78	0.74	0.86	0.89	1.21	3.52	4.75	1.78	1.01	0.74	0.67	1.49
	92	0	0	0	0	0	0	1.14	2.69	.86	.027	0	0	.40
Gain or loss		-.96	-.78	-.74	-.86	-.89	-1.21	-2.38	-2.06	-.92	-.98	-.74	-.67	-1.09
1976	91	.68	.76	.68	.76	1.02	1.35	4.95	4.11	1.86	1.02	.69	.59	1.54
	92	0	0	0	0	0	0	2.43	2.20	.50	.025	0	.019	.43
Gain or loss		-.68	-.76	-.68	-.76	-1.02	-1.35	-2.52	-1.91	-1.36	-1.00	-.69	-.57	-1.11
1977	91	.67	.63	.66	.68	.63	.88	3.29	1.92	.83	.65	.56	.62	1.00
	92	0	0	0	0	0	0	.36	.11	0	0	0	0	.04
Gain or loss		-.67	-.63	-.66	-.68	-.63	-.88	-2.93	-1.81	-.83	-.65	-.56	-.62	-.96
1978	91	.62	.52	.58	.49	.47	.99	1.84	9.57	1.82	1.03	.75	.65	1.62
	92	0	0	0	0	0	0	0	5.91	.13	.003	0	0	.51
Gain or loss		-.62	-.52	-.58	-.49	-.47	-.99	-1.84	-3.66	-1.69	-1.03	-.75	-.65	-1.11
1979	91	.63	.61	.71	.72	.76	.95	4.39	2.83	1.21	.74	.65	.57	1.23
	92	0	0	0	0	0	0	1.44	.78	0	0	.012	0	.19
Gain or loss		-.63	-.61	-.71	-.72	-.76	-.95	-2.95	-2.05	-1.21	-.74	-.64	-.57	-1.04
1980	91	.53	.45	.63	.76	1.03	1.43	7.45	5.15	1.28	.69	.54	.51	1.70
	92	0	0	0	0	0	0	3.23	3.57	.007	0	0	0	.57
Gain or loss		-.53	-.45	-.63	-.76	-1.03	-1.43	-4.22	-1.58	-1.27	-.69	-.54	-.51	-1.13
1981	91	.54	.48	.47	.50	.54	.68	.77	1.91	.88	.76	.43	.38	.70
	92	0	0	0	0	0	0	0	.16	.007	.13	0	0	.026
Gain or loss		-.54	-.48	-.47	-.50	-.54	-.68	-.77	-1.75	-.87	-.63	-.43	-.38	-.67

Monthly and annual mean discharge of Little Box Elder Creek, sites 91 and 92--Continued

Water year	Site number	Discharge, in cubic feet per second, Monthly mean Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual mean
1982	91	0.46	0.42	0.45	0.42	0.46	0.55	0.76	2.32	1.11	0.69	0.53	0.51	0.72
	92	0	0	0	0	0	0	0	.40	0	0	0	0	.034
Gain or loss		-.46	-.42	-.45	-.42	-.46	-.55	-.76	-1.92	-1.11	-.69	-.53	-.51	-.69
1983	91	.71	.78	.74	.97	.91	3.08	10.4	14.5	4.93	2.17	1.47	1.14	3.50
	92	0	0	0	0	0	.49	6.18	12.6	3.69	1.00	.56	.30	2.08
Gain or loss		-.71	-.78	-.74	-.97	-.91	-2.59	-4.22	-1.9	-1.24	-1.17	-.91	-.84	-1.42
1984	91	1.11	1.09	.90	.97	.95	1.87	6.91	17.9	3.54	1.67	1.11	1.08	3.27
	92	.21	.12	0	0	.29	.83	3.49	13.1	2.20	.88	.40	.20	1.82
Gain or loss		-.90	-.97	-.90	-.97	-.66	-1.04	-3.42	-4.8	-1.34	-.79	-.71	-.88	-1.45
1985	91	1.07	1.10	.94	.86	.77	1.50	3.37	1.89	1.03	.74	.70	.83	1.23
	92	.16	.18	.04	.03	0	.21	1.38	.76	.26	.05	.02	0	.26
Gain or loss		-.91	-.92	-.90	-.83	-.77	-1.29	-1.99	-1.13	-.77	-.69	-.68	-.83	-.97

Cottonwood Creek near Careyhurst

Site 93--Upstream Station 06647920 Cottonwood Creek near Careyhurst (see miscellaneous-measurement site 102 for downstream station)

LOCATION.--Lat 42°44'21", long 105°40'22", in SW1/4 NW1/4 SW1/4 sec. 13, T. 32 N., R. 74 W., Converse County, 0.5 mile upstream from unnamed tributary, 0.6 mile west of Spring Canyon Road, and 7.6 miles south of Careyhurst.

DRAINAGE AREA.--2.33 square miles.

PERIOD OF RECORD.--Water years 1981-84.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The basal sandstone of the Madison and the underlying Precambrian granite are exposed at the station.

REMARKS.--A crest-stage gage was installed at downstream miscellaneous-measurement site 102 in 1981 at the site where flow was noted to cease during the 1974 geohydrologic reconnaissance (SE1/4 SE1/4 NE1/4 sec. 14, T. 32 N., R. 74 W.). A site farther downstream was not used because a normally dry tributary entered downstream from that point. Flow was noted several times as disappearing into a sinkhole in the gage pool. Streamflow measurements were made in a bedrock section between the gage control and the downstream tributary. These measurements correlated well with stages recorded at the gage.

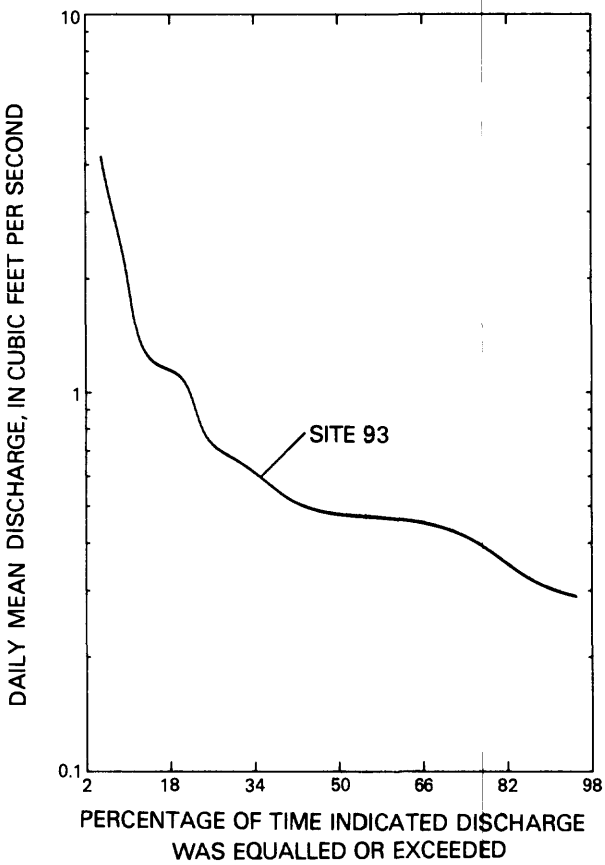
Discharge measurements and computed gain or loss of streamflow in Cottonwood Creek near Careyhurst between sites 93 and 102

[--, not measured]

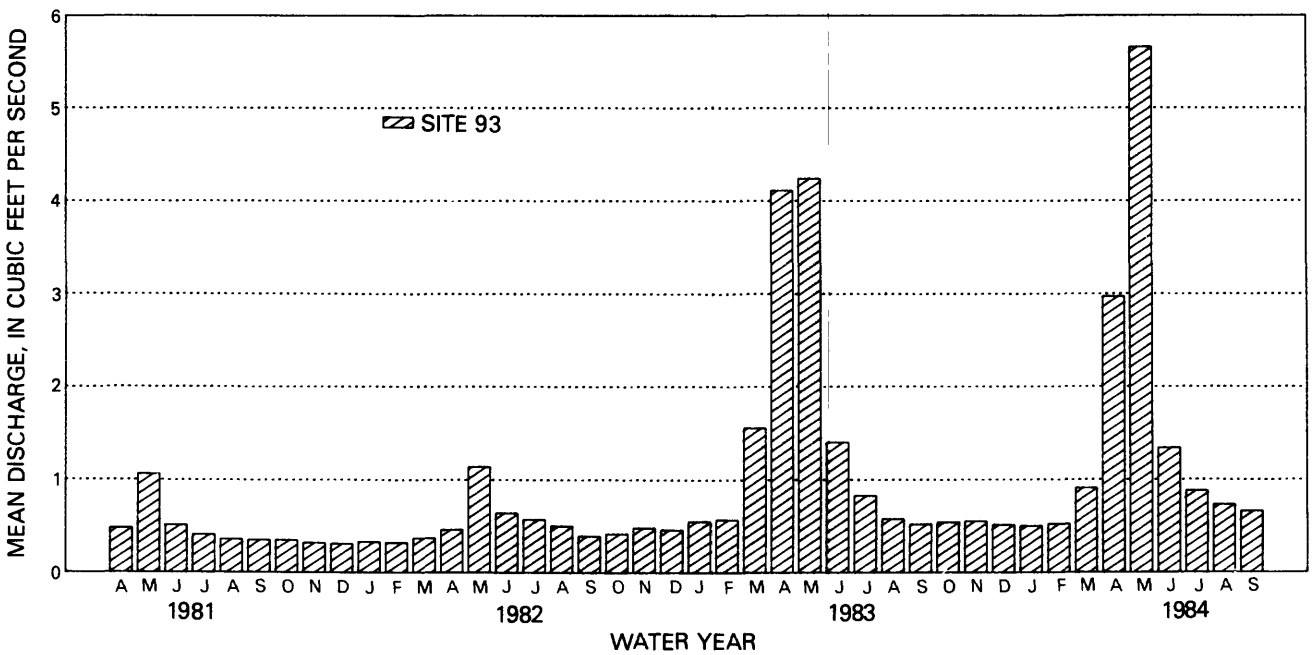
Discharge, in cubic feet per second				
Date	Site 93	Date	Site 102	Computed gain (+) or loss (-)[1]
7-30-74	0.64	7-30-74	0	-0.64
10-11-74	.67	10-11-74	0	-.67
11-07-74	.61	11-07-74	0	-.61
6-05-75	.86	6-05-75	.12	-.74
7-22-75	.33	7-22-75	0	-.33
8-28-75	.50	8-28-75	0	-.50
--	--	5-17-81	4.09	-3.26
--	--	5-18-81	.91	-1.63
--	--	5-23-81	.34	-1.15
--	--	10-27-82	0	-.53
--	--	3-03-83	0	-1.10
4-11-83	1.71	4-11-83	.95	-.76
--	--	5-04-83	6.97	-1.33
--	--	5-05-83	3.19	-.99
--	--	5-18-83	6.34	-2.47
6-05-83	1.85	6-05-83	.92	-.93
6-13-83	3.22	6-13-83	1.99	-1.23
--	--	7-16-83	0	-.83
--	--	11-04-83	0	-.57
--	--	5-25-84	2.19	-1.18
--	--	6-21-84	0	-1.03
--	--	7-24-84	0	-.79
--	--	10-12-84	0	-.72
5-16-85	.80	5-16-85	.01	-.79
8-01-91	.53	8-01-91	0	-.53

[1]Where no discharge is listed for site 93, the discharge and gain or loss were computed from a recorded stage and computed discharge (from stage/discharge relations), after correcting for travel time between sites.

Cottonwood Creek near Careyhurst



Flow-duration curve for daily mean discharge, water years 1982-84.



Monthly mean discharge, water years 1981-84.

Monthly and annual mean discharge of Cottonwood Creek near Careyhurst, site 93

[--, not measured]

Water year	Site number	Discharge, in cubic feet per second												
		Monthly mean												Annual mean
		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	
1981	93	--	--	--	--	--	--	0.48	1.06	0.51	0.41	0.36	0.35	--
1982	93	0.35	0.32	0.31	0.33	0.32	0.37	.46	1.14	.64	.57	.50	.39	0.48
1983	93	.42	.48	.46	.55	.57	1.55	4.11	4.24	1.40	.83	.58	.52	1.31
1984	93	.54	.55	.51	.50	.52	.91	2.97	5.66	1.34	.88	.73	.66	1.32

Cottonwood Creek near Binford

Site 94--Upstream Station 06654510 Cottonwood Creek below Dagley Creek, near Binford

LOCATION.--Lat 42°18'53", long 105°13'33", in NW1/4 SE1/4 NE1/4 sec. 15, T. 27 N., R. 70 W., Platte County, 0.2 mile downstream from Dagley Creek, 0.2 mile upstream from diversion tunnel inlet, 1.1 miles downstream from Cottonwood Falls, 1.3 miles downstream from bridge on county road, and 7.0 miles southeast of Binford.

DRAINAGE AREA.--54.0 square miles.

PERIOD OF RECORD.--Water years 1975 and 1976.

GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The middle unit of the Madison is in fault contact with Precambrian granite at the station.

Site 95--Downstream Station 06654520 Cottonwood Creek below tunnel outlet, near Binford

LOCATION.--Lat 42°18'27", long 105°13'08", in SE1/4 SW1/4 SW1/4 sec. 14, T. 27 N., R. 70 W., Platte County, 700 feet downstream from diversion tunnel outlet, 1.9 miles downstream from Dagley Creek, and 7.5 miles southeast of Binford.

DRAINAGE AREA.--57.2 square miles.

PERIOD OF RECORD.--Water years 1975 and 1976.

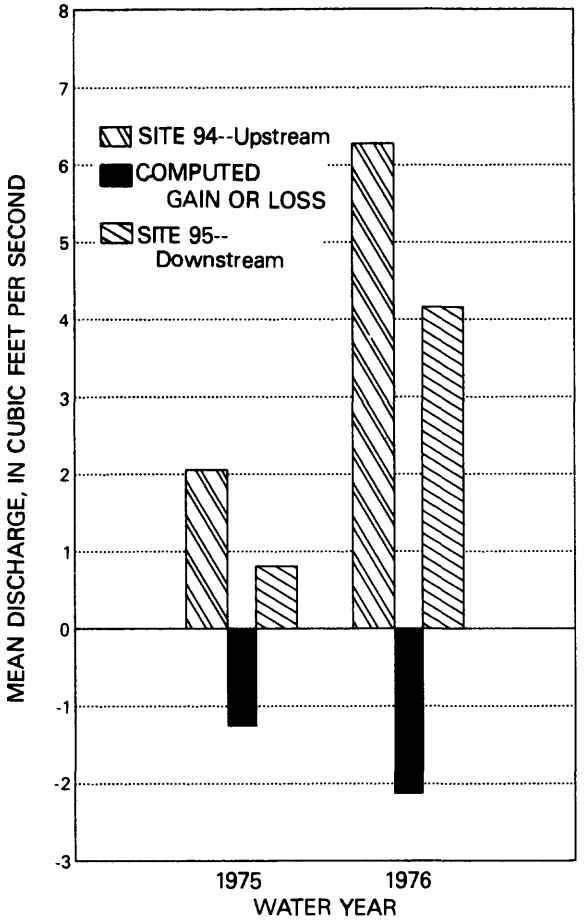
GAGE.--Water-stage recorder.

GEOHYDROLOGY.--The middle unit of the Madison is in fault contact with Precambrian granite and metamorphic rocks at the station.

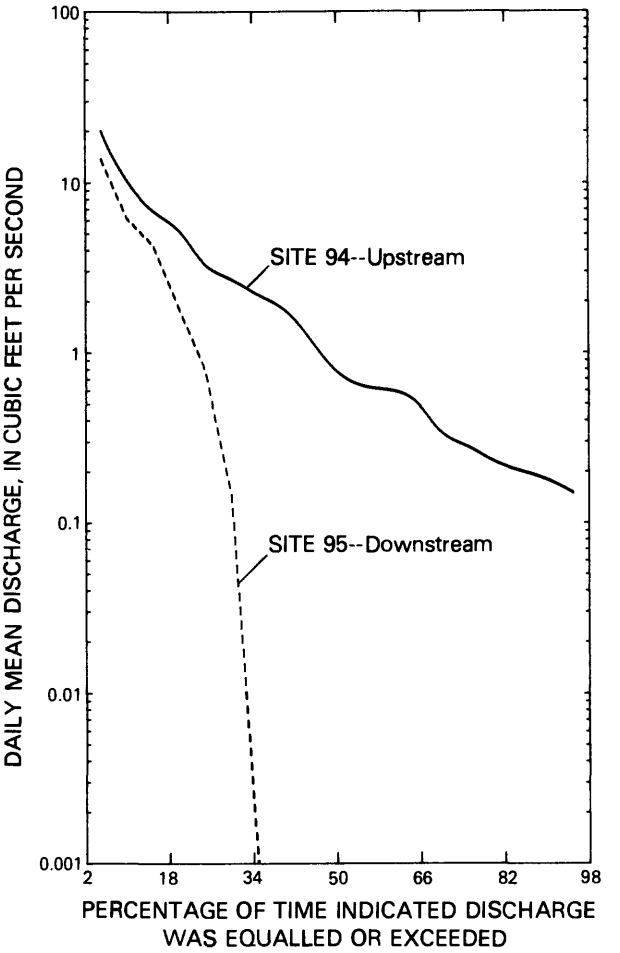
Discharge measurements and computed gain or loss of streamflow in Cottonwood Creek near Binford between sites 94 and 95

Discharge, in cubic feet per second				
Date	Site 94	Date	Site 95	Computed gain (+) or loss (-)
6-17-74	8.42	6-17-74	4.83	-3.59
7-25-74	.60	7-24-74	0	- .60
8-05-74	.57	8-05-74	0	- .57
9-04-74	.26	9-04-74	0	- .26
10-01-74	.29	10-01-74	0	- .29
11-05-74	.28	11-05-74	0	- .28
6-06-85	1.50	6-06-85	0	-1.50
9-10-91	1.08	9-10-91	0	-1.08

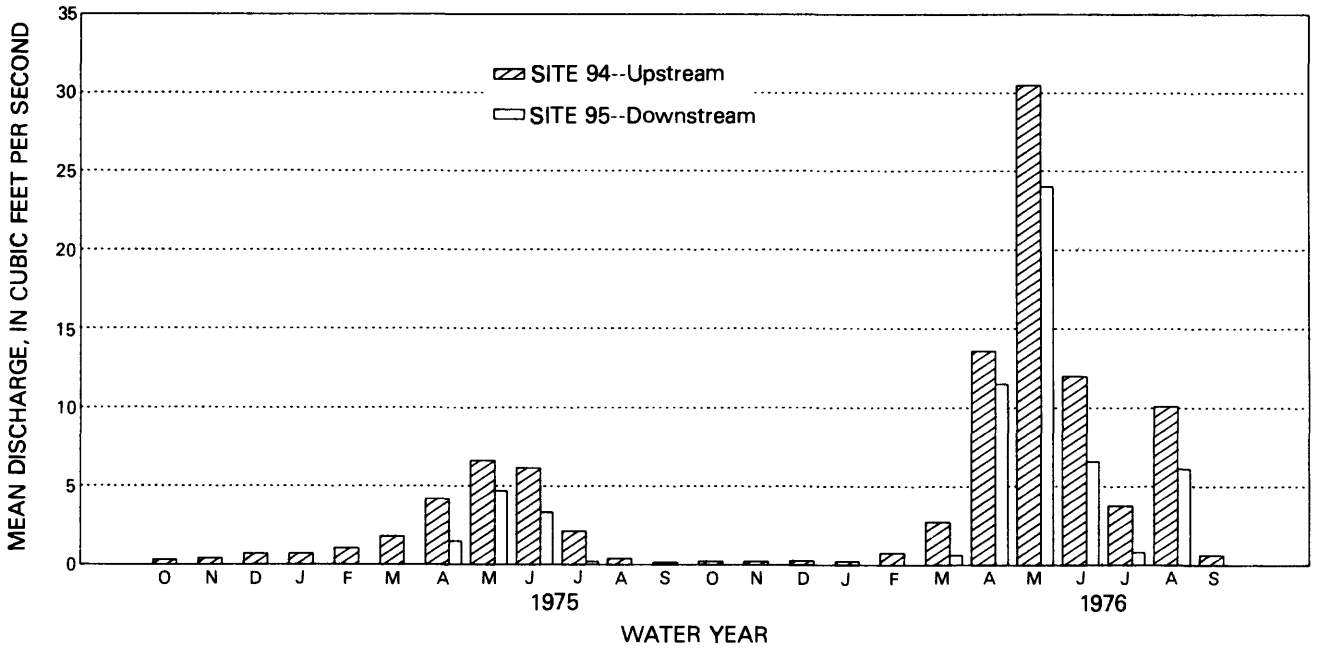
Cottonwood Creek near Binford



Annual mean discharge and annual computed gain or loss of streamflow, water years 1975 and 1976.



Flow-duration curves for daily mean discharge, water years 1975 and 1976.



Monthly mean discharge, water years 1975 and 1976.

Monthly and annual mean discharge of Cottonwood Creek near Binford, sites 94 and 95

[Computed gain (+) or loss (-) of flow between sites for period of record, in cubic feet per second]

Water year	Site number	Discharge, in cubic feet per second												
		Monthly mean												Annual mean
		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	
1975	94	0.32	0.42	0.70	0.71	1.06	1.81	4.19	6.63	6.15	2.13	0.40	0.15	2.06
	95	0	0	0	0	0	0	1.50	4.69	3.34	.19	0	0	.81
Gain or loss		-.32	-.42	-.70	-.71	-1.06	-1.81	-2.69	-1.94	-2.81	-1.94	-.40	-.15	-1.25
1976	94	.23	.23	.28	.24	.78	2.77	13.6	30.5	12.0	3.77	10.1	.63	6.28
	95	0	0	0	0	0	.64	11.5	24.0	6.59	.82	6.10	0	4.16
Gain or loss		-.23	-.23	-.28	-.24	-.78	-2.13	-2.10	-6.50	-5.41	-2.95	-4.00	-.63	-2.12

East Cart Creek

Site 96--Tributary between Little Deer Creek gaging stations

LOCATION.--Lat 42°43'04", long 105°57'42", in NE1/4 SW1/4 NW1/4 sec. 28, T. 32 N., R. 76 W., Converse County, at mouth, 11.0 miles south of Glenrock.

Tributary inflow of East Cart Creek (site 96) to Little Deer Creek between sites 87 and 88

Date	Discharge, in cubic feet per second Site 96
5-05-76	1.00
6-10-76	.04
5-21-85	.02
7-29-91	0

Box Elder Creek

Site 97--Precambrian-Madison contact

LOCATION.--Lat 42°45'13", long 105°47'07", in SW1/4 sec. 12, T. 32 N., R. 75 W., Converse County, Converse County Park, 1.6 miles upstream from canals at canyon mouth, and 8.4 miles southeast of Glenrock.

Site 98--Madison-Casper contact

LOCATION.--Lat 42°45'46", long 105°46'35", in NW1/4 NW1/4 sec. 7, T. 32 N., R. 74 W., Converse County, Converse County Park, 0.8 mile upstream from canals at canyon mouth, and 8.1 miles southeast of Glenrock.

Site 99--Box Elder Creek at canyon mouth (top of Casper Formation)

LOCATION.--Lat 42°46'19", long 105°46'19", in W1/2 sec. 6, T. 32 N., R. 74 W., Converse County, at Converse County Park boundary, 20 feet upstream from canals at canyon mouth, and 7.6 miles southeast of Glenrock.

Discharge measurements and computed gain or loss of streamflow in Box Elder Creek between sites 97, 98, and 99

[--, not measured]

Discharge, in cubic feet per second							
Date	Site 97	Date	Site 98	Computed gain (+) or loss (-)	Date	Site 99	Computed gain (+) or loss (-)[1]
6-26-74	24.4	6-26-74	30.9	+6.5	--	--	--
8-13-74	[2]6.05	--	--	--	--	--	--
8-14-74	[2]5.28	8-14-74	6.11	+ .83	--	--	--
8-14-74	5.36	8-14-74	6.11	+ .75	--	--	--
10-18-74	[2]4.53	10-18-74	4.93	+ .40	--	--	--
11-06-74	[2]6.04	11-06-74	6.72	+ .68	--	--	--
7-21-75	[2]10.7	7-21-75	9.79	- .91	--	--	--
8-25-75	[2]2.26	8-25-75	2.33	+ .07	--	--	--
9-24-75	[2]2.52	9-24-75	2.33	- .19	--	--	--
6-13-81	32.4	6-13-81	30.2	-2.2	--	--	--
7-14-81	4.92	7-14-81	4.90	- .02	7-14-81	5.09	+0.19
9-11-81	1.07	9-11-81	1.10	+ .03	9-11-81	1.23	+ .13
8-03-82	7.66	8-03-82	7.36	- .30	8-03-82	7.21	- .15
9-02-82	1.22	9-02-82	1.32	+ .10	9-02-82	1.60	+ .28
10-07-82	4.62	10-07-82	5.21	+ .59	10-07-82	5.12	- .09
11-18-82	33.6	11-18-82	30.3	-3.3	11-18-82	34.2	+3.9
8-03-83	17.2	8-03-83	15.4	-1.8	8-03-83	15.8	+ .4
9-07-83	5.15	9-07-83	5.17	+ .02	9-07-83	5.52	+ .35
10-17-83	10.7	10-17-83	10.3	- .4	10-17-83	12.2	+1.9
7-16-84	12.6	7-16-84	12.6	0	7-16-84	14.1	+1.5
6-12-85	13.2	6-12-85	13.2	0	6-12-85	13.0	- .2
8-02-91	9.06	8-02-91	7.44	-1.62	8-02-91	7.45	+.01
11-12-91	6.12	11-12-91	6.94	+.82	11-12-91	7.82	+.88

[1] Change in discharge through Casper Formation.

[2] Upstream measurement made at site 3.3 miles upstream from Precambrian-Madison contact.

Hunton Creek

Site 100--Combination Upstream Station

LOCATION.--Lat 42°45'43", long 105°48'54", in SW1/4 NE1/4 NE1/4 sec. 10, T. 32 N., R. 75 W., Converse County, 0.4 mile upstream from West Fork Hunton Creek, 0.8 mile upstream from bridge on Boxelder Road, and 7.1 miles southeast of Glenrock. Also included is flow of West Fork Hunton Creek at Lat 42°45'40", long 105°49'13", in NW1/4 SW1/4 NE1/4 sec. 10, T. 32 N., R. 75 W., Converse County, 0.6 mile upstream from mouth, and 7.2 miles southeast of Glenrock.

GEOHYDROLOGY.--Both Hunton Creek and West Fork Hunton Creek are in an alluvial valley, and no bedrock is exposed along their banks. The basal sandstone of the Madison and the underlying Precambrian granite are exposed in a hillside 100 feet east of Hunton Creek at the upstream station.

Site 101--Downstream Station

LOCATION.--Lat 42°46'20", long 105°48'47", in SE1/4 SE1/4 NE1/4 sec. 3, T. 32 N., R. 75 W., Converse County, at bridge on Boxelder Road, 0.4 mile downstream from West Fork Hunton Creek, and 6.6 miles southeast of Glenrock. Also included is flow diversion at lat 42°46'10", long 105°48'53", in SE1/4 NE1/4 SE1/4 sec. 3, T. 32 N., R. 75 W., Converse County, 15 feet upstream from culvert in road to Cossart Ranch, and 6.8 miles southeast of Glenrock.

GEOHYDROLOGY.--The Madison and Casper contact is exposed on hillsides a quarter of a mile east and west of Hunton Creek.

Discharge measurements and computed gain or loss of stramflow in Hunton Creek between sites 100 and 101

Discharge, in cubic feet per second				
Date	Site 100	Date	Site 101	Computed gain (+) or loss (-)
6-27-74	0.67	6-27-74	0.85	+0.18
10-10-74	.10	10-10-74	0	-.10
11-06-74	.18	11-06-74	0	-.18
5-14-75	6.50	5-14-75	5.96	-.54
7-21-75	.46	7-21-75	.50	+.04
8-25-75	.09	8-25-75	0	-.09
7-02-85	.33	7-02-85	.003	-.33
7-31-91	.69	7-31-91	.58	-.11

Cottonwood Creek near Careyhurst

Site 102--Downstream Station (see site 93 for upstream station)

LOCATION.--Lat 42°44'34", long 105°40'40", in SW1/4 SE1/4 NE1/4 sec. 14, T. 32 N., R. 74 W., Converse County, on left bank at the Madison and Casper contact, at small tributary from old mining gulch, and 7.3 miles south of Careyhurst.

REMARKS.--For gain or loss in streamflow at site 102, refer to the table accompanying site 93.

Spring Canyon Creek

Site 103--Upstream Station

LOCATION.--Lat 42°44'09", long 105°39'32", in SW1/4 SE1/4 SE1/4 sec. 13, T. 32 N., R. 74 W., Converse County, 300 feet downstream from unnamed tributary, 0.4 mile upstream from reservoir, and 7.9 miles south of Careyhurst.

GEOHYDROLOGY.--The basal sandstone of the Madison Limestone and the underlying Precambrian granite are exposed along the right bank at the site.

Site 104--Downstream Station

LOCATION.--Lat 42°44'30", long 105°39'37", in NE1/4 NW1/4 SE1/4 sec. 13, T. 32 N., R. 74 W., Converse County, just upstream from reservoir, 100 feet upstream from unnamed tributary, and 7.5 miles south of Careyhurst.

GEOHYDROLOGY.--The contact of the Madison Limestone and the Casper Formation is exposed in the hillside east of the creek.

Discharge measurements and computed gain or loss of streamflow in Spring Canyon Creek between sites 103 and 104

	Discharge, in cubic feet per second			
Date	Site 103	Date	Site 104	Computed gain (+) or loss (-)
6-28-74	0.08	6-28-74	0.08	0
10-11-74	.03	10-11-74	.04	+.01
11-06-74	.04	11-06-74	.04	0
6-05-75	.23	6-05-75	.30	+.07
7-22-75	.04	7-22-75	.03	-.01
8-28-75	.01	8-28-75	.02	+.01
7-01-85	.01	7-01-85	.01	0
9-10-91	.09	9-10-91	.07	-.02

Wagon Hound Creek

Site 105--Upstream Station

LOCATION.--Lat 42°34'48", long 105°36'42", in NE1/4 SW1/4 SW1/4 sec. 9, T. 30 N., R. 73 W., Converse County, 0.1 mile upstream from unnamed diversion, 2.3 miles upstream from Nagle Ditch diversion, and 16 miles southwest of Douglas.

GEOHYDROLOGY.--The basal sandstone unit of the Madison Limestone overlies Precambrian granite at the station.

Site 106--Downstream Station

LOCATION.--Lat 42°34'47", long 105°35'38", in NE1/4 SW1/4 SW1/4 sec. 10, T. 30 N., R. 73 W., Converse County, 1.3 miles upstream from Nagle Ditch diversion, and 15.5 miles southwest of Douglas. Also included is flow of unnamed diversion at lat 42°34'52", long 105°36'36", in SW1/4 NE1/4 SW1/4 sec. 9, T. 30 N., R. 73 W., Converse County, at end of culvert 20 feet downstream from intake, and 16 miles southwest of Douglas.

GEOHYDROLOGY.--The contact of the Madison Limestone and the Casper Formation is not exposed along the creek but is exposed on hillsides north and south of the creek.

Discharge measurements and computed gain or loss of streamflow in Wagon Hound Creek between sites 105 and 106

Discharge, in cubic feet per second				
Date	Site 105	Date	Site 106	Computed gain (+) or loss (-)
6-21-74	2.26	6-21-74	2.50	+0.24
10-03-74	.21	10-03-74	.10	-.11
11-05-74	.68	11-05-74	.21	-.47
6-06-75	10.5	6-06-75	10.7	+.2
7-24-75	.40	7-24-75	.37	-.03
8-29-75	.02	8-29-75	0	-.02
7-10-85	.62	7-10-85	0	-.62
8-28-91	.10	8-28-91	.02	-.08

La Bonte Creek

Site 107--Upstream Station

LOCATION.--Lat 42°28'05", long 105°28'25", in SE1/4 SW1/4 NW1/4 sec. 22, T. 29 N., R. 72 W., Converse County, 100 feet upstream from unnamed diversion, 1.0 mile upstream from Rutherford Creek, and 6.9 miles northwest of Esterbrook.

GEOHYDROLOGY.--Madison Limestone and underlying Precambrian metamorphic rock are exposed at the site.

Site 108--Downstream Station

LOCATION.--Lat 42°28'32", long 105°27'58", in NW1/4 SW1/4 SE1/4 sec. 15, T. 29 N., R. 72 W., Converse County, 0.5 mile upstream from Indian Creek, and 6.9 miles northwest of Esterbrook. Also included is flow of unnamed diversion about 600 feet south on right bank.

GEOHYDROLOGY.--Chert and limestone of the upper, cherty unit of the Madison are exposed in the streambed at the gage site according to Boner and others (1976, p. 11); however, M.E. Lowry (U.S. Geological Survey, written commun., 1985) said the site was near the top of the Casper Formation.

Discharge measurements and computed gain or loss of streamflow in La Bonte Creek between sites 107 and 108

Discharge, in cubic feet per second				
Date	Site 107	Date	Site 108	Computed gain (+) or loss (-)
6-19-74	29.8	6-19-74	29.1	-0.7
10-01-74	1.40	10-01-74	1.43	+.03
11-04-74	2.06	11-04-74	2.54	+.48
7-23-75	3.52	7-23-75	3.40	-.12
8-27-75	.42	8-27-75	.77	+.35
9-23-75	.98	9-23-75	1.00	+.02
7-10-85	1.60	7-10-85	1.49	-.11
8-28-91	2.33	8-28-91	2.39	+.06

West Fork La Bonte Creek

Site 109--Upstream Station

LOCATION.--Lat 42°31'48", long 105°33'15", in SW1/4 NW1/4 NW1/4 sec. 36, T. 30 N., R. 73 W., Converse County, 0.5 mile upstream from Mill Creek, and 17 miles southwest of Douglas. Also included is flow of Mill Creek at the mouth.

GEOHYDROLOGY.--Madison Limestone and underlying Precambrian granite are exposed at the site.

Site 110--Downstream Station

LOCATION.--Lat 42°32'25", long 105°32'12", in center sec. 25, T. 30 N., R. 72 1/2 W., Converse County, 0.5 mile upstream from Gooseberry Creek, 0.8 mile downstream from Mill Creek, and 16 miles southwest of Douglas.

GEOHYDROLOGY.--The Madison and Casper contact is not exposed along the creek but is covered by alluvium and Tertiary rock. The contact is exposed on a hillside north of the creek.

Discharge measurements and computed gain or loss of streamflow in West Fork La Bonte Creek between sites 109 and 110

Discharge, in cubic feet per second				
Date	Site 109	Date	Site 110	Computed gain (+) or loss (-)
6-20-74	10.7	6-20-74	11.3	+0.6
10-02-74	.64	10-02-74	.77	+.13
11-05-74	.79	11-05-74	1.01	+.22
6-06-75	59.9	6-06-75	62.9	+3.0
7-24-75	2.07	7-24-75	2.12	+.05
9-23-75	.13	9-23-75	.12	-.01
7-09-85	.07	7-09-85	.09	+.02
7-27-91	1.31	7-27-91	1.39	+.08

Horseshoe Creek

Site 111--Upstream Station

LOCATION.--Lat 42°24'08", long 105°18'38", in SW1/4 NW1/4 NE1/4 sec. 13, T. 28 N., R. 71 W., Albany County, Medicine Bow National Forest, 1.0 mile upstream from Three Cripples Creek, 1.8 miles downstream from Soldier Creek, and 2.7 miles east of Esterbrook.

GEOHYDROLOGY.--Madison Limestone and underlying Precambrian granite are exposed along the right bank. Near the granite contact, the Madison Limestone consists predominantly of gray to pink massive partly sandy limestone. Maughan (1963, p. C25) reports 1 foot of basal sandstone in the Madison in this locality, but a typical exposure was not found during the reconnaissance of June 18, 1974.

Site 112--Downstream Station

LOCATION.--Lat 42°24'17", long 105°17'47", in NW1/4 NE1/4 NW1/4 sec. 18, T. 28 N., R. 70 W., Albany County, Medicine Bow National Forest, 0.2 mile upstream from Three Cripples Creek, and 3.4 miles east of Esterbrook.

GEOHYDROLOGY.--Sandstone in the basal part of the Casper Formation and in the underlying Madison Limestone are exposed along the right bank of the creek. Bedrock along this reach of the stream is covered by a broad alluvial floodplain on the left bank and a talus-covered slope on the right bank. Therefore, correct identification of the bedrock unit that underlies the gage site was not possible.

Discharge measurements and computed gain or loss of streamflow in Horseshoe Creek between sites 111 and 112

Discharge, in cubic feet per second				
Date	Site 111	Date	Site 112	Computed gain (+) or loss (-)
6-18-74	37.2	6-18-74	34.7	-2.5
9-30-74	2.18	9-30-74	2.02	-.16
11-04-74	4.00	11-04-74	3.50	-.50
5-15-75	107	5-15-75	94.3	-12.7
7-23-75	4.18	7-23-75	3.73	-.45
8-27-75	.48	8-27-75	.15	-.33
7-09-85	.60	7-09-85	.65	+.05
9-10-91	2.31	9-10-91	3.15	+.84

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