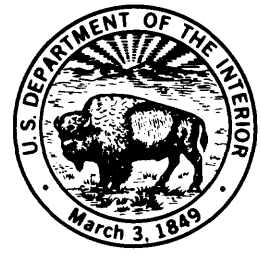
WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEARS 1988 AND 1989

Compiled by Daisie M. Oden

U.S. GEOLOGICAL SURVEY

Open-File Report 89-262



Cheyenne, Wyoming

1989

DEPARTMENT OF THE INTERIOR

MANUEL LUJAN, JR., Secretary

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, Director

FUNDING AGENCIES

City of Cheyenne
City of Evanston
City of Gillette
Laramie County
Lincoln County
Midvale Irrigation District
Northern Arapaho Tribe
Office of the Secretary of the Interior
Shoshone Tribe
Sublette County
Teton County
Town of Afton
Town of Evansville
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U.S. Bureau of Reclamation
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U.S. Forest Service
U.S. Geological Survey
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Wyoming Department of Environmental Quality
Wyoming Economic Development and Stabilization Board
Wyoming Highway Department
Wyoming Parks and Recreation Commission
Wyoming State Engineer
Wyoming Water Development Commission
Wyoming Water Research Center

For additional information
write to:

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Cheyenne, Wyoming 82001

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U.S. Geological Survey
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Building 810
Denver, Colorado 80225

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CONVERSION FACTORS

Readers who prefer to use metric units rather than the inch-pound units used in this report may use the following conversion factors:

Multiply inch-pound unit	By	To obtain metric unit
foot (ft)	0.3048	meter
square mile (mi^2)	2.590	square kilometer

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEARS 1988 AND 1989

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ABSTRACT

This report describes the water-resources activities of the U.S. Geological Survey, Wyoming District--hydrologic-data-collection programs and water-resources-appraisal projects. Much of the work is done in cooperation with other agencies. During Fiscal Years 1988 and 1989, cooperators included 10 State agencies, 5 counties, 3 cities, 2 towns, 1 irrigation district, 2 Indian Tribes, and 8 Federal agencies. This report serves both as a biennial progress report to the cooperating agencies and the general public, and as one means of coordination of water-resources activities with other agencies.

Lists and location maps are included for 180 streamflow stations, 6 reservoir stations, 120 surface-water-quality stations, 15 sediment stations, 88 ground-water-level observation wells, and 73 ground-water-quality sites that were in operation during Fiscal Year 1988 and (or) Fiscal Year 1989. During Fiscal Years 1987 and 1988, 17 streamflow stations, 13 surface-water-quality stations, 14 sediment stations, and 7 ground-water-level observation wells were discontinued. During Fiscal Year 1988 and through the first quarter of Fiscal Year 1989, 21 streamflow stations, 15 surface-water-quality stations, and 3 sediment stations were established or reactivated.

Descriptions, location maps, and progress statements are given for 4 data-collection projects and 27 water-resources-appraisal projects that were active (funded) during Fiscal Year 1988 and (or) Fiscal Year 1989. Also included are lists of 11 projects that were completed during Fiscal Years 1988 and 1989, 10 projects for which funding ended prior to 1988 and that are completed except for the final report(s), and 2 new projects that are expected to be funded during Fiscal Year 1989. The final section of the report is a bibliographic listing of reports by U.S. Geological Survey authors about the water resources of Wyoming.

INTRODUCTION

The U.S. Geological Survey is the Federal agency responsible for appraising the quantity, quality, and distribution of the Nation's surface-water and ground-water resources. Through its Water Resources Division, the Survey maintains data-collection networks, conducts interpretive studies, and supports hydrologic research in every State, the Commonwealth of Puerto Rico, and the American Trust Territories. It also works through cooperative programs with State, local, and other Federal agencies to help evaluate regional and local water problems. Results of these activities provide a basis for many major water-management decisions.

The purpose of this report is to describe the water-resources activities being done in Wyoming. The report also provides information to cooperating officials and the public about the accomplishments in the various appraisal projects during Fiscal Year 1988 (October 1, 1987, through September 30, 1988) and planned work for Fiscal Year 1989. The report is one phase of an effort to coordinate the water-resources activities of the U.S. Geological Survey with other water-related organizations.

Most of the water-resources activities in Wyoming are cooperatively financed by State, local, and other Federal agencies; these cooperating agencies are identified throughout this report. The activities are classified into two groups: (1) Data-collection programs (projects), and (2) water-resources-appraisal projects.

The data-collection programs and networks include (1) collecting records of streamflow and reservoir storage, (2) sampling and chemical analysis of water from streams and ground-water wells, (3) sampling and analysis of sediment in surface water, and (4) measuring water levels in wells. This report contains tables of monitoring sites for these four data-collection programs and networks. All four types of data collection also are done as part of many water-resources-appraisal projects; these short-term sites are not included in the tables in this report.

Water-resources-appraisal projects described in this report include the projects conducted during Fiscal Years 1988 and 1989. Projects completed prior to Fiscal Year 1988, but for which final reports were in preparation at the end of Fiscal Year 1988, are listed separately. An extensive listing of reports of results from previous activities is provided at the back of this report.

United States Department of the Interior

GEOLOGICAL SURVEY
Water Resources Division
2617 E. Lincolnway, Suite B
Cheyenne, Wyoming 82001

MESSAGE FROM THE DISTRICT CHIEF

Employees of the Wyoming District, Water Resources Division, U.S. Geological Survey, contribute to the understanding of Wyoming's water resources by monitoring and appraising the water resources of the State. The work we do not only benefits Wyoming, but the Nation as well, because water, whether above ground in streams and lakes or below ground in aquifers, follows no political boundaries.

As you can see in the pages that follow, our work consists of two groups of interrelated activities: (1) Monitoring of water quantity and quality at specific sites, and (2) studies of the hydrology of specific areas and (or) the hydrologic consequences of human activities. The information gathered in both types of activities, including any scientific interpretations of the information, is made available to the public as a basis for long-term as well as immediate use in managing Wyoming's finite water resources.

Over the years, our work has changed in response to changes in needs for water-resources information. Our monitoring-network operations have been and will continue to be the foundation upon which problem-oriented, multi-disciplinary hydrologic studies are based. New activities include the expansion of our statewide network for monitoring ground-water quality, a network of flood-monitoring stations in and around Cheyenne, and assessments of contamination of ground and surface water by organic compounds and (or) trace elements in selected areas.

Our capacity to carry out investigations is greatly enhanced by our partnerships with State, local, and other Federal agencies. For example, under the unique Federal-State Cooperative Water Resources Program, the Wyoming State Engineer has been our partner in hydrologic-network activities since 1915 and in interpretive studies since the 1940's; this cooperation is continuing. The many other agencies that co-sponsor the work we do are identified throughout this report. Needless to say, the U.S. Geological Survey values these partnerships highly.

The staff of the Wyoming District is dedicated to serving the public. In spite of budgetary uncertainties and the increasingly technical complexity of our work, I am confident that we can meet the challenges that lie ahead.

James E. Kircher
District Chief

ORIGIN OF THE U.S. GEOLOGICAL SURVEY

The U.S. Geological Survey was established by an act of Congress on March 3, 1879, providing a permanent Federal agency to conduct the systematic and scientific "classification of the public lands, and examination of the geological structure, mineral resources, and products of national domain." An integral part of that original mission includes publishing and disseminating the earth-science information needed to understand, to plan the use of, and to manage the Nation's energy, land, mineral, and water resources.

Since 1879, the research and fact-finding role of the U.S. Geological Survey has expanded and been modified to meet the changing needs of the Nation it serves. As part of that evolution, the U.S. Geological Survey has become the Federal Government's largest earth-science research agency, the Nation's largest civilian mapmaking agency, the primary source of data on the Nation's surface- and ground-water resources, and the employer of the largest number of professional earth scientists. Today's programs serve a diversity of needs and users. Programs include:

- Conducting detailed assessments of the energy and mineral potential of the Nation's land and offshore area.
- Investigating and issuing warnings of earthquakes, volcanic eruptions, landslides, and other geologic and hydrologic hazards.
- Conducting research on the geologic structure of the Nation.
- Studying the geologic features, structure, processes, and history of the other planets of our solar system.
- Conducting topographic surveys of the Nation, preparing topographic and thematic maps and related cartographic products.
- Developing and producing digital cartographic data bases and products.
- Collecting data on a routine basis to determine the quantity, quality, and use of surface and ground water.
- Conducting water-resource appraisals in order to describe the consequences of alternative plans for developing land and water resources.
- Conducting research in hydraulics and hydrology, and coordinating most Federal water-data acquisition.
- Using remotely sensed data to develop new cartographic-, geologic-, and hydrologic-research techniques for natural-resources planning and management.
- Providing earth-science information through an extensive publications program.

Along with its continuing commitment to meet the expanding and changing earth-science needs of the Nation, the U.S. Geological Survey remains dedicated to its original mission: to collect, analyze, interpret, publish, and disseminate information about the natural resources of the Nation--providing earth science to the public.

MISSION OF THE WATER RESOURCES DIVISION

The mission of the Water Resources Division is to provide the hydrologic information and understanding needed for the optimum utilization and management of the Nation's water resources for the overall benefit of the people of the United States.

This is accomplished, in a large part, through cooperation with other Federal and non-Federal agencies, by:

- Collecting, on a systematic basis, data needed for the continuing determination and evaluation of the quantity, quality, and use of the Nation's water resources.

- Conducting analytical and interpretive water-resource appraisals describing the occurrence, availability, and the physical, chemical, and biological characteristics of surface and ground water.

- Conducting basic and problem-oriented research in hydraulics, hydrology, and related fields of science to improve the scientific knowledge for investigations and measurement techniques.

- Disseminating the water data and the results of these investigations and research through reports, maps, computerized information services, and other forms of public releases.

- Coordinating the activities of Federal agencies in the acquisition of water data for streams, lakes, reservoirs, estuaries, and ground water.

- Providing scientific and technical assistance in hydrologic fields to State, local, and other Federal agencies, to licensees of the Federal Power Commission, and to international agencies on behalf of the U.S. Department of State.

DISTRICT ORGANIZATION

The water-resources activities of the Wyoming District Office are carried out by four operating sections (fig. 1). The Hydrologic Surveillance and Data Management Section designs, constructs, operates, and maintains the District's hydrologic-data stations and manages the collection, analysis, publication, and storage of hydrologic data. The Environmental Investigations Section is responsible for large, personnel-intensive hydrologic investigations requiring extensive coordination with other organizations--especially investigations of areas involving hazardous wastes. The Hydrologic Investigations and Research Section plans and executes water-resources investigations Statewide, including mathematical modeling of ground-water systems, application of open-channel hydraulics to surface-water problems, water-resources appraisals, and evaluation of the hydrologic effects of human activities such as irrigation of croplands or surface mining of coal. The Publications-Computer Services and Special Projects Section provides report-processing and computer services to the rest of the District. The Administrative Services Section provides administrative support to the rest of the District.

The District Office is located in Cheyenne, with smaller Field Headquarters located in Casper and Riverton (fig. 2). Personnel of the Field Headquarters do most of the hydrologic-data collection; the Casper office has responsibility for eastern Wyoming, and the Riverton office has responsibility for western Wyoming.

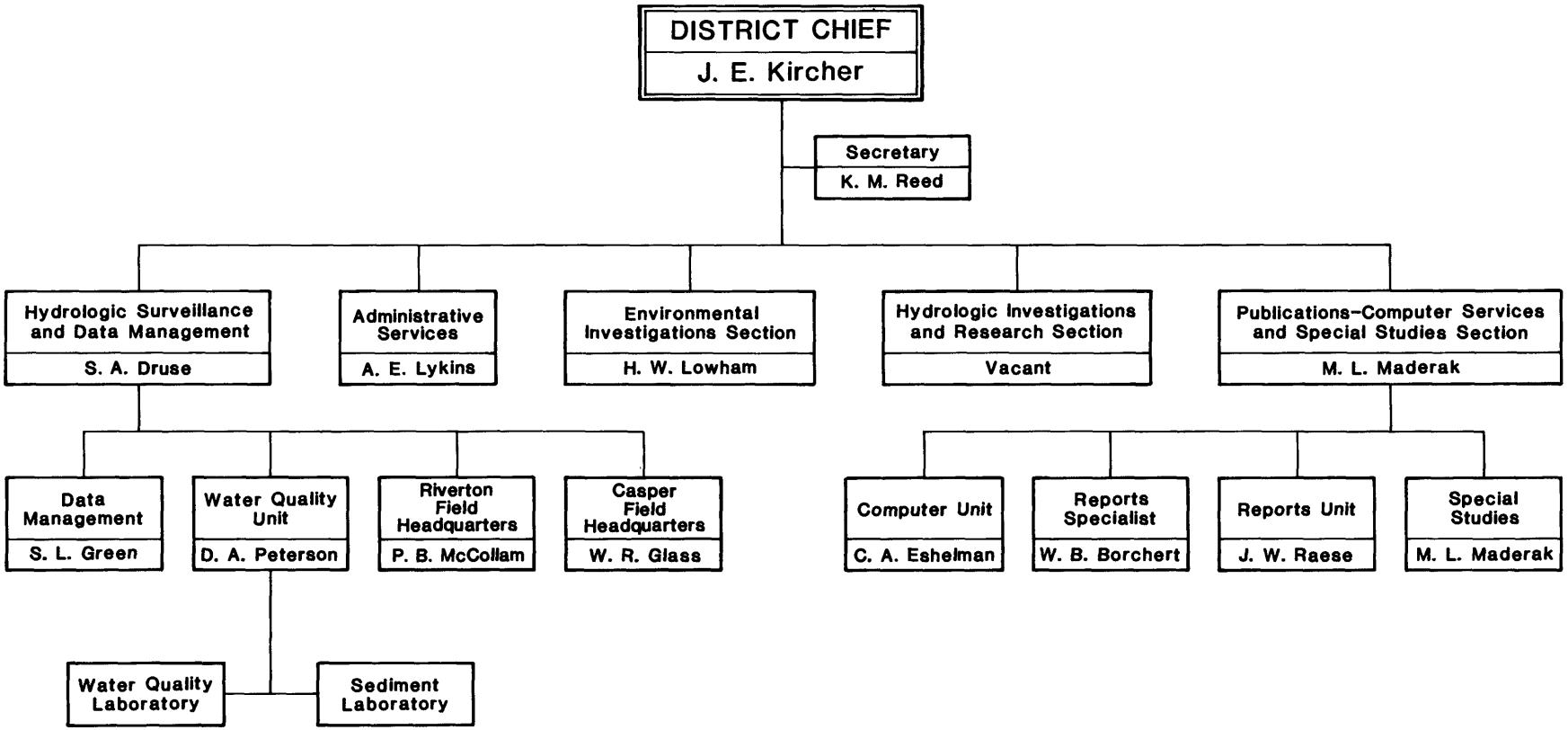


Figure 1.--Wyoming District organization.

Wyoming District Office

U.S. Geological Survey
Water Resources Division
2617 E. Lincolnway, Suite B
Cheyenne, WY 82001
(307) 772-2153
FTS 328-2153

Field Headquarters

2020 Fairgrounds Road
Plaza West, Suite 102
Casper, WY 82604
(307) 261-5485
FTS 328-5485

1225 Market Street
P.O. Box 431
Riverton, WY 82501
(307) 856-3771

Inquiries regarding activities described in this report may be directed to the District Office or Field Headquarters in which the work originated. (See fig. 2 for locations.)

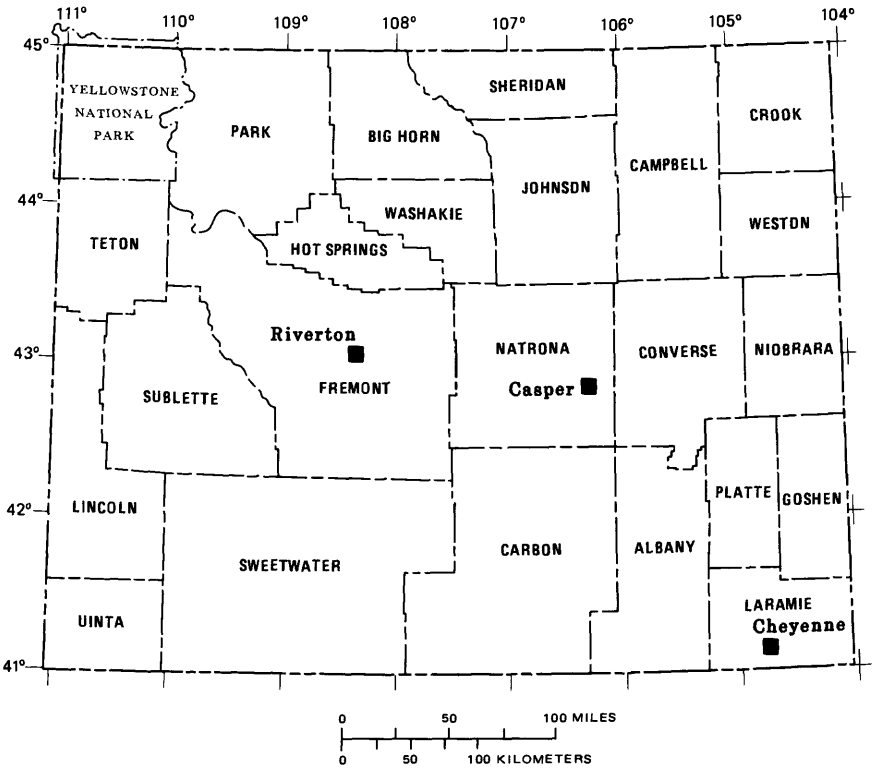
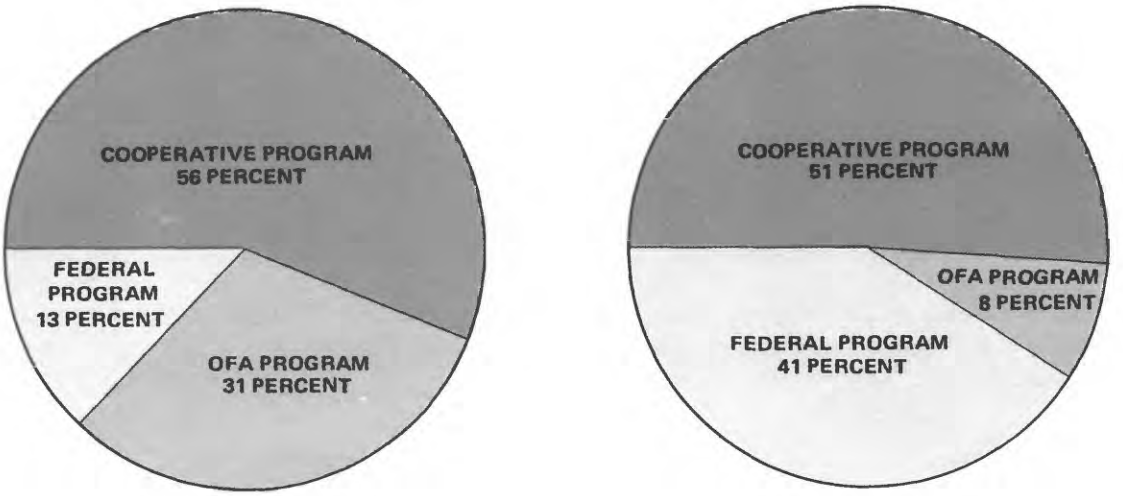


Figure 2.--Location of U.S. Geological Survey, Water Resources Division offices in Wyoming.

SOURCES OF FUNDING

Funds for carrying out the water-resources investigations of the U.S. Geological Survey in Wyoming are provided by many agencies. The agencies are classified by three major categories: (1) State and local agencies that provide funds or services, or both, generally matched on a 50-50 (percent) basis by U.S. Geological Survey funds (cooperative program); (2) other Federal agencies that transfer funds to the U.S. Geological Survey (OFA program); and (3) U.S. Geological Survey funds received by direct appropriation for activities that are national in scope (Federal program). The diagram below (fig. 3) shows the distribution of these funds in Wyoming by major category for Fiscal Years 1988 and 1989. During Fiscal Year 1989, about 50 percent of the funds were used for collection of hydrologic data and about 50 percent for interpretive hydrologic studies.



FISCAL YEAR 1988
TOTAL, ABOUT $3,802,000

FISCAL YEAR 1989
TOTAL, ABOUT $4,000,000

Figure 3.--Sources of funding.

DATA-COLLECTION SITES

Lists of data-collection sites and the kinds of hydrologic data being collected at each, for Fiscal Year 1989, are given as follows: Table 1, streamflow and reservoir stations; table 2, surface-water-quality stations; table 3, sediment stations; table 4, ground-water-level observation wells; and table 5, ground-water-quality sites. Lists of data-collection sites that were discontinued during Fiscal Years 1987 and 1988 are given in tables 6-9. Stations added during Fiscal Years 1988 and 1989 are identified in tables 1-5, under period of record.

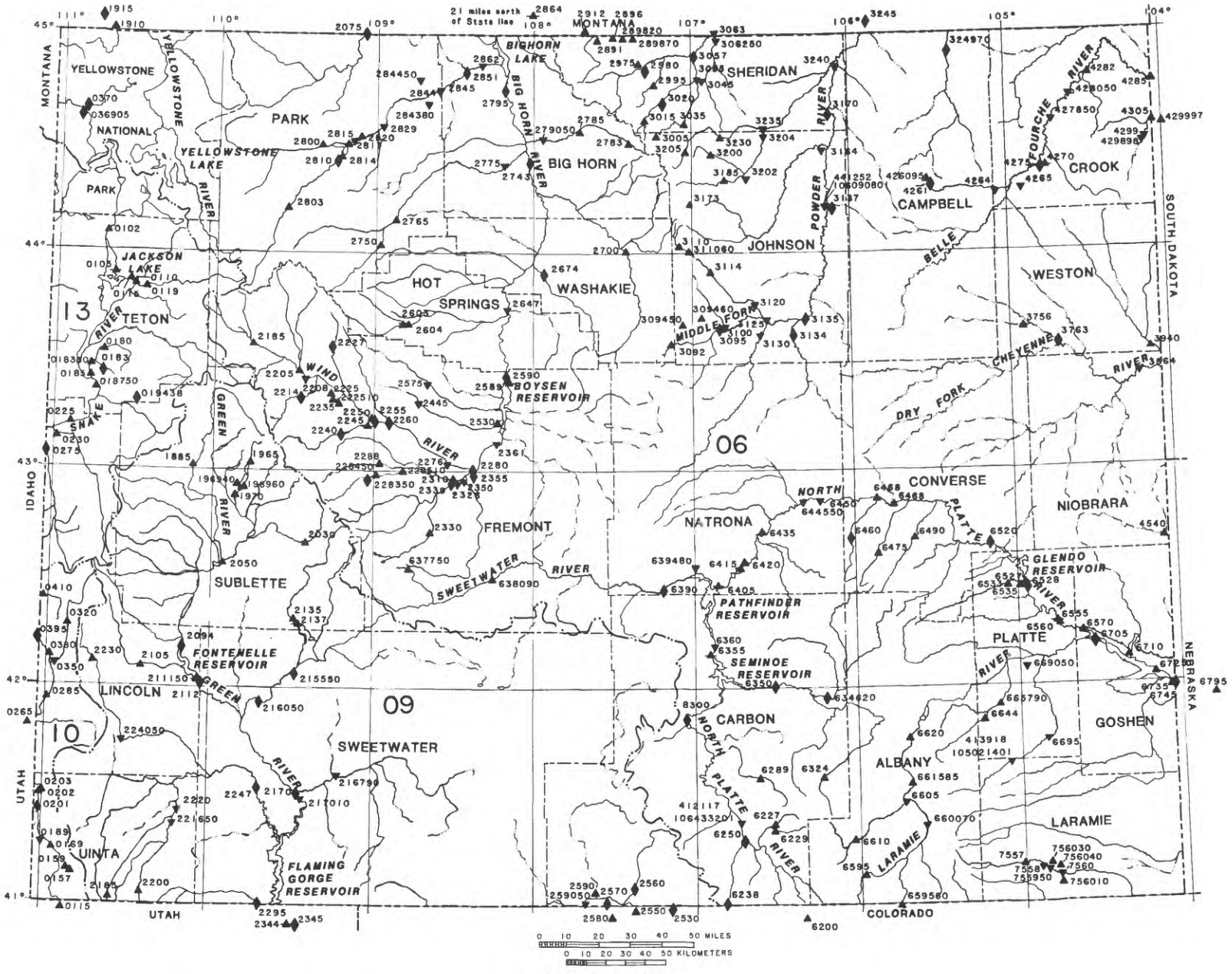
Station numbers for stations listed in tables 1-3 conform with the standard downstream order for listing stations within each major river basin. The first two digits of the assigned eight-digit number, such as 06207500, identifies the major river basin in which the stream resides. For example, digits '06' refer to the Missouri River Basin. The remaining six digits identify the relative position of the station, with numbers increasing in the downstream direction.

Three stations listed in table 2 and the observation wells listed in table 4 have 15-digit station numbers. The first six digits are the latitude in degrees, minutes, and seconds. The next seven digits are the longitude in degrees, minutes, and seconds. The last two digits indicate a sequence number.

The local well numbers listed in tables 4 and 5, ground-water-level observation wells and ground-water-quality sites, are based on the Federal system of land subdivision. A detailed explanation of this system can be found on the page preceding tables 4 and 5. The wells are listed in numerical order by county.

Abbreviations and codes are used to conserve space in the tables. Explanations of the abbreviations and codes precede each table.

The location of streamflow, reservoir, surface-water-quality and sediment stations is shown in figure 4. The station numbers are abbreviated by not showing the two-digit number and the last two digits if zero. The location of ground-water level observation wells is shown in figure 5. The location of ground-water-quality sites is shown in figure 6.



EXPLANATION

TWO-DIGIT BASIN NUMBER FOR MAJOR DRAINAGE BASIN

- 06 Missouri River basin (Yellowstone, Cheyenne, Niobrara and Platte River basins)
- 09 Upper Colorado River Basin (Green River basin)
- 10 The Great Basin (Bear River basin)
- 13 Snake River basin
- MAJOR DRAINAGE DIVIDE

- ▲6200 STREAMFLOW STATION AND NUMBER
- ▼259050 SURFACE-WATER-QUALITY AND (OR) SEDIMENT STATION AND NUMBER
- ◆6238 STREAMFLOW AND SURFACE-WATER-QUALITY AND (OR) SEDIMENT STATION AND NUMBER
- ▲6355 RESERVOIR STATION AND NUMBER

Station numbers are abbreviated by not showing two-digit basin number and last two digits if zero. (Exceptions: Two stations have 15-digit latitude-longitude sequence number.)

Figure 4.--Location of streamflow, reservoir, surface-water-quality, and sediment stations, 1989 water year.

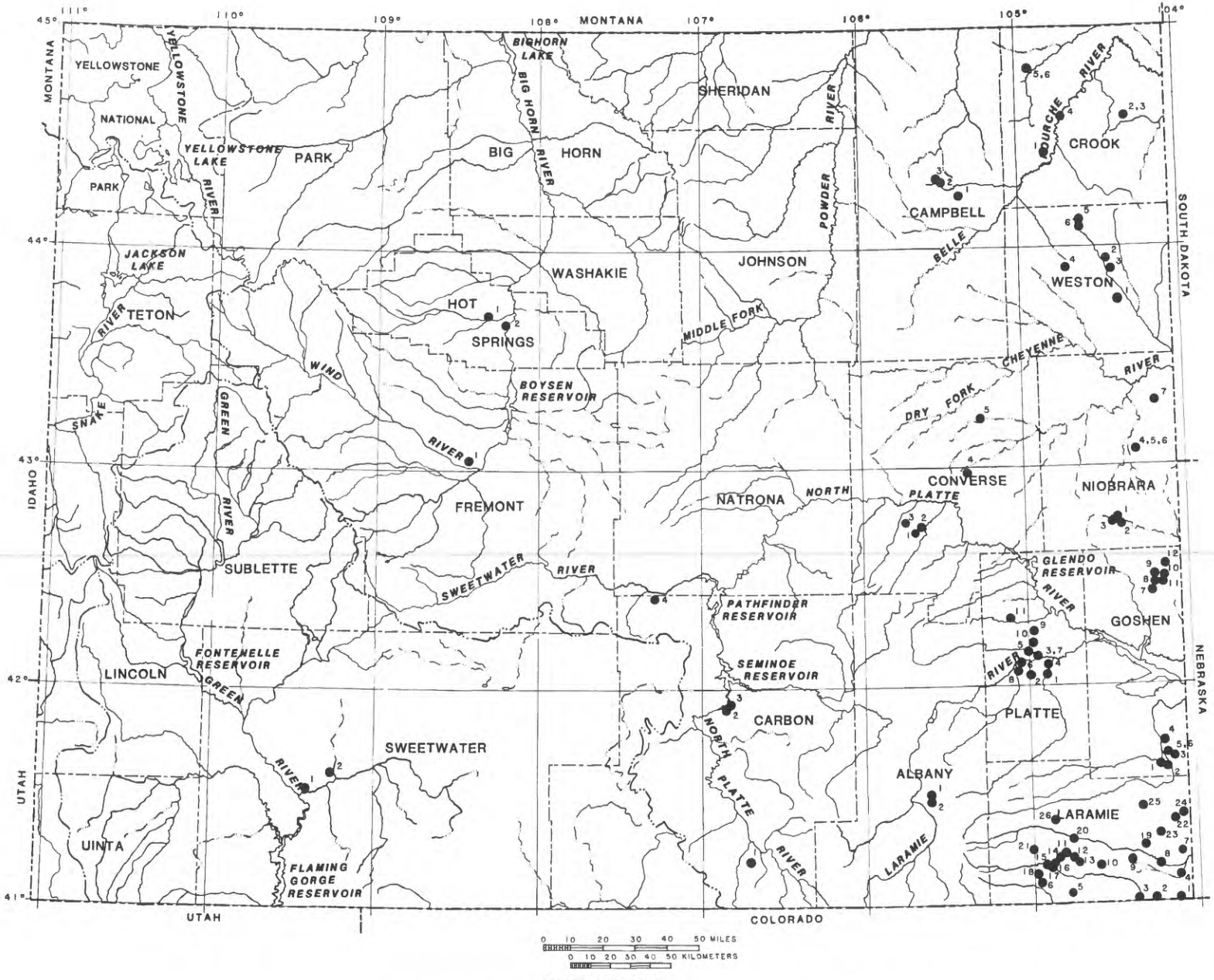
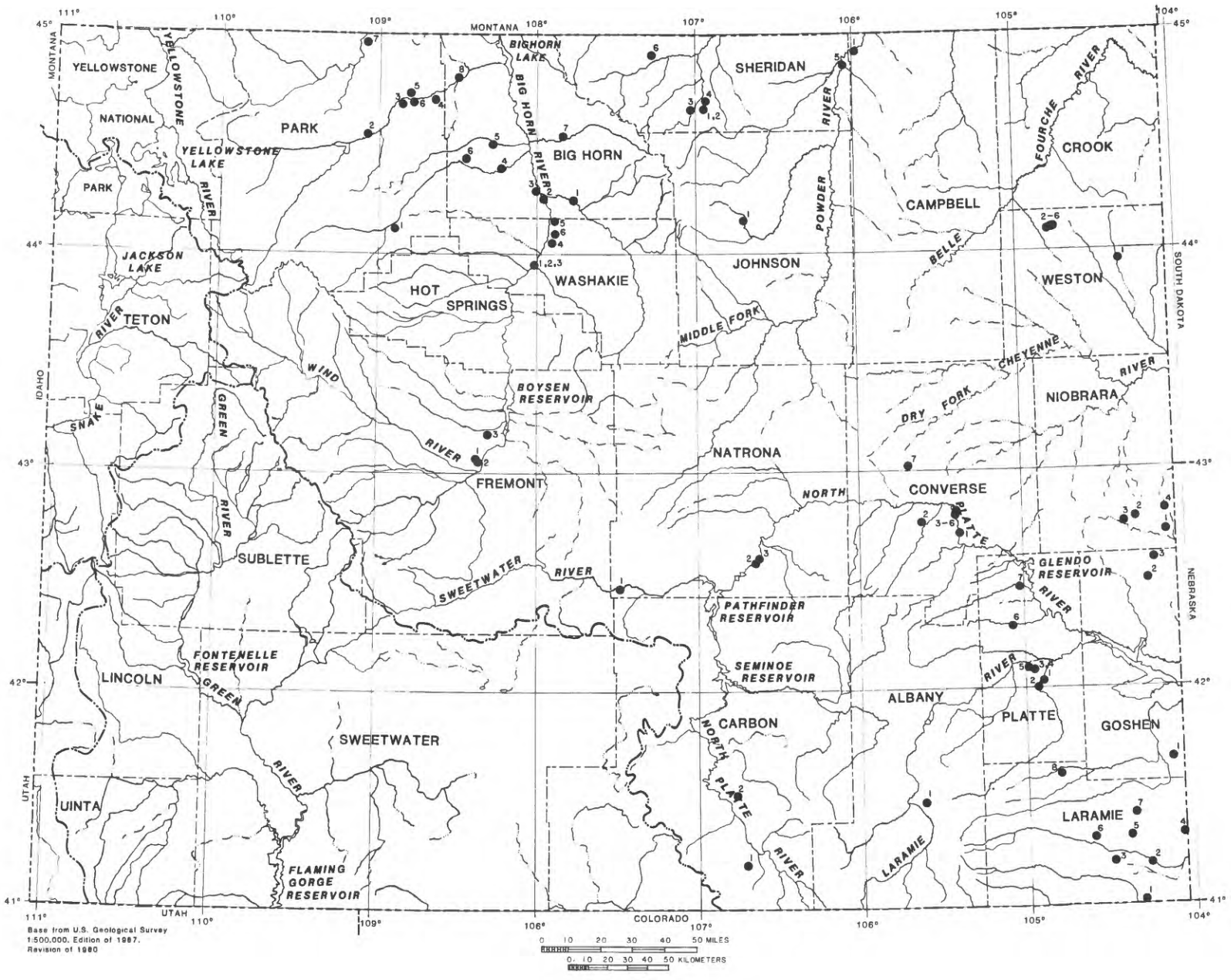


Figure 5.--Location of ground-water-level observation wells, 1989 water year.



EXPLANATION

WELL SAMPLED FOR GROUND-WATER QUALITY--Wells are numbered sequentially in each county and are listed in table 5.

MAJOR DRAINAGE DIVIDE

Figure 6.--Location of ground-water-quality sites, 1986-88.

Table 1.--Streamflow and reservoir stations

Explanation of abbreviations and codes used in table 1

Period of record: The dates given are the calendar years in which records began or ended.

Gage equipment:

D	digital recorder	S	staff gage
G	graphic recorder	T	telemark
M	manometer gage	W	well gage
P	satellite-relay platform		

Data frequency:

S	seasonal operation (no winter records)
Y	full-year operation

Field office:

C	Casper	NE	Nebraska District
CH	Cheyenne	R	Riverton
CO	Colorado District	S	Wyoming State Engineer
ID	Idaho District	SD	South Dakota District
MT	Montana District	UT	Utah District

Funding agency:

BRUC	Bureau of Reclamation, Colorado Region
BRUM	Bureau of Reclamation, Missouri Region
CE	Corps of Engineers
CHEY	City of Cheyenne
MRB	Geological Survey, support for other Interior Agencies
GILL	City of Gillette
MID	Midvale Irrigation District
TC	Teton County
UC	Uinta County
USE	Utah State Engineer
USGS	Geological Survey, Federal Program
WAG	Wyoming Attorney General
WDEQ	Wyoming Department of Environmental Quality
WRIR	Wind River Indian Reservation
WSE	Wyoming State Engineer
WWDC	Wyoming Water Development Commission
WWRC	Wyoming Water Research Center
--	Not funded through Wyoming District

Remarks:

HBM	hydrologic benchmark station
NASQAN	national stream-quality accounting network station
QW	also water-quality station
SED	also sediment station
USBR	furnished by Bureau of Reclamation

Table 1.--Streamflow and reservoir stations

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN					
06036905	Firehole River near West Yellowstone, Mont.	1983-	--	Y	MT	--	QW
06037000	Gibbon River near West Yellowstone, Mont.	1913-16, 1983-	--	Y	MT	--	QW
06191000	Gardner River near Mammoth, Yellowstone National Park	1938-72, 1984-	--	Y	MT	--	
06191500	Yellowstone River at Corwin Springs, Mont.	1889-93, 1910-		Y	MT	--	QW
06207500	Clarks Fork Yellowstone River near Belfry, Mont.	1921-	--	Y	MT	--	QW
06218500	Wind River near Dubois	1945-	D,W	Y	R	WSE	
06220500	East Fork Wind River near Dubois	1950-57, 1975-	D,M	Y	R	MRB	
06221400	Dinwoody Creek above lakes, near Burris	1957-78, 1989-	D,M	Y	R	WRIR	QW
06222500	Dry Creek near Burris	1909, 1921-40, 1989-	D,M	Y	R	WRIR	
06222510	Dry Creek Canal at headgate, near Burris	1989-	W	Y	R	WRIR	
06222700	Crow Creek near Tipperary	1962-	D,G,M	Y	R	MRB	QW
06223500	Willow Creek near Crowheart	1909, 1921-23, 1925-40, 1989-	D,M	Y	R	WRIR	
06224000	Bull Lake Creek above Bull Lake	1941-53, 1966-	D,M,P	Y	R	MRB, WRIR	QW
06224500	Bull Lake near Lenore	1938-	P	--	--	MRB	USBR
06225000	Bull Lake Creek near Lenore	1918-	G,M,P,T	Y	R	BRUM	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN--Continued					
06225500	Wind River near Crowheart	1945-	G,M,P,T	Y	R	BRUM, WRIR	QW
06226000	Wyoming Canal near Lenore	1941-45, 1949-82, 1988-	W,P	S	R	MRB, MID	
06228000	Wind River at Riverton	1906-08, 1911-	G,M,T,P	Y	R	CE, USGS, WRIR	NASQAN, QW,SED
06228350	South Fork Little Wind River above Washakie Reservoir, near Fort Washakie	1976-	D,G,M	Y	R	WRIR	QW
06228450	South Fork Little Wind River below Washakie Reservoir, near Fort Washakie	1989-	D,M	Y	R	WRIR	
06228510	Ray Canal at headworks, near Fort Washakie	1989-	W	S	R	WRIR	
06228800	North Fork Little Wind River near Fort Washakie	1989-	D,M	Y	R	WRIR	
06231000	Little Wind River above Arapahoe	1979-	D,M	Y	R	WRIR	QW
06233000	Little Popo Agie River near Lander	1946-	G,W	S	S	WSE	
06233900	Popo Agie River near Arapahoe	1979-	D,M	Y	R	WRIR	QW
06235500	Little Wind River near Riverton	1941-	M,P	Y	R	BRUM, CE, WRIR	QW
06244500	Fivemile Creek above Wyoming Canal, near Pavillion	1949-75, 1989-	D,M	Y	R	WRIR	QW
06253000	Fivemile Creek near Shoshoni	1941-42, 1948-83, 1989-	D,M	Y	R	MRB	
06258900	Boysen Reservoir	1951-	--	--	--	MRB	USBR
06259000	Wind River below Boysen Reservoir	1951-	D,M,P	Y	R	BRUM, MRB	QW

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
	YELLOWSTONE RIVER BASIN--Continued						
06260300	Anchor Reservoir	1960-	--	--	--	MRB	USBR
06260400	South Fork Owl Creek below Anchor Reservoir	1959-	D,G,W	S	R	BRUM	
06267400	East Fork Nowater Creek near Colter	1971-	D,G,M	Y	R	WSE	
06270000	Nowood River near Tensleep	1938-43, 1950-55, 1972-	D,G,M	Y	R	WSE	
06274300	Bighorn River at Basin	1984-	D,M	Y	R	WDEQ	QW
06275000	Wood River at Sunshine	1945-	D,G,M	Y	R	WSE	
06276500	Greybull River at Meeteetse	1897, 1903, 1920-	G,M	S	S	WSE	
06278300	Shell Creek above Shell Reservoir	1956-	D,W	Y	R	WSE	
06278500	Shell Creek near Shell	1940-	G,W	S	S	WSE	
06279500	Bighorn River at Kane	1928-	G,M,P	Y	R	CE,MRB	QW,SED
06280000	North Fork Shoshone River near Wapiti	1921-26, 1979-	G,M,P	Y	R	BRUM, MRB	
06280300	South Fork Shoshone River near Valley	1956-	D,G,M	Y	R	USGS	
06281000	South Fork Shoshone River above Buffalo Bill Reservoir	1903, 1905-08, 1921-26, 1973-	G,M,P	Y	R	MRB, WSE	QW
06281400	Diamond Creek near mouth, near Cody	1981-	D,W	Y	R	MRB	
06281500	Buffalo Bill Reservoir	1909-	--	--	--	MRB	USBR
06282000	Shoshone River below Buffalo Bill Reservoir	1921-	D,W,P	Y	R	BRUM	
06285100	Shoshone River near Lovell	1966-	D,G,M	Y	R	MRB	QW
06286400	Bighorn Lake near St. Xavier, Mont.	1965-	--	--	--	MRB	USBR

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
	YELLOWSTONE RIVER BASIN--Continued						
06289100	Red Canyon Creek near Parkman	1983-	D,G,M	Y	C	WAG	
06289600	West Pass Creek near Parkman	1983-	D,W	Y	C	WAG	
06289820	East Pass Creek near Dayton	1983-	D,W	Y	C	WAG	
06289870	Twin Creek near Parkman	1983-	D,W	Y	C	WAG	
06291200	Lodgegrass Creek at State line, near Wyola, Mont.	1983-	D,G,M	Y	C	WAG	
06297500	Highline Ditch near Dayton	1919-23, 1940-	G,W	S	C	WSE	
06298000	Tongue River near Dayton	1918-29, 1940-	D,W,P	Y	C	WSE	QW
06299500	Wolf Creek at Wolf	1945-	G,W	S	S	WSE	
06300500	East Fork Big Goose Creek near Big Horn	1953-	G,M	S	S	WSE	
06301500	West Fork Big Goose Creek near Big Horn	1953-	G,M	S	S	WSE	
06302000	Big Goose Creek near Sheridan	1929-	G,W	S	S	WSE	
06303500	Little Goose Creek in canyon, near Big Horn	1941-	G,W	S	S	WSE	
06305700	Goose Creek near Acme	1984-	D,W	Y	C	WSE	QW
06309200	Middle Fork Powder River near Barnum	1961-	D,G,M,W	Y	C	WSE	
06309450	Beaver Creek below Bayer Creek, near Barnum	1974-	D,W	Y	C	WSE	
06309460	Beaver Creek above White Panther Ditch, near Barnum	1974-	D,W	Y	C	WSE	
06309500	Middle Fork Powder River above Kaycee	1949-70, 1984-	D,W	Y	C	WWDC	QW
06311000	North Fork Powder River near Hazelton	1946-	D,G,M	Y	C	WSE	
06311060	North Fork Powder River below Bull Creek, near Hazelton	1974-	D,W	Y	C	WSE	
06311400	North Fork Powder River below Pass Creek, near Mayoworth	1974-	D,W	Y	C	WSE	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN--Continued					
06313400	Salt Creek near Sussex	1976-81 1982-	D,G,M	Y	C	WDEQ, WWDC	QW,SED
06313500	Powder River at Sussex	1938-40, 1950-57, 1977-84, 1985-	D,G,M	Y	C	WWDC	QW,SED
06313700	Dead Horse Creek near Buffalo	1971-	G,M	Y	C	WSE	QW
06317000	Powder River at Arvada	1919-	G,M	Y	C	WSE, WWDC	QW
06317300	Sourdough Creek near Buffalo	1985-	D,G,M	Y	C	WWDC	
06318500	Clear Creek near Buffalo	1894, 1896-99, 1917-27, 1938-	D,W	Y	C	WWDC	
06320000	Rock Creek near Buffalo	1941-	G,W	S	S	WSE	
06320500	South Piney Creek at Willow Park	1945-57, 1959-	G,W	S	S	WSE	
06323000	Piney Creek at Kearny	1902-06, 1910-17, 1919-23, 1940-	G,W,P	Y	S	WSE	
06324500	Powder River at Moorhead, Mont.	1929-72, 1974-	G,W	Y	MT	--	QW
06324970	Little Powder River above Dry Creek, near Weston	1972-	D,G,M	Y	C	WSE	QW

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		CHEYENNE RIVER BASIN					
06375600	Little Thunder Creek near Hampshire	1978-81, 1988-	D,G,M	Y	C	USGS, WSE	QW,SED
06376300	Black Thunder Creek near Hampshire	1972-	D,G,M	Y	C	WSE	
06394000	Beaver Creek near Newcastle	1943-	D,G,W	Y	C	USGS	
06426095	Burlington Lake ditch at Gillette	1988-	G,W	S	C	GILL	
06426100	Stonepile Creek at Gillette	1988-	D,W	S	C	GILL	QW,SED
06427000	Keyhole Reservoir near Moorcroft	1952-	--	--	--	MRB	USBR
06427500	Belle Fourche River below Keyhole Reservoir	1951-	G,M	Y	C	WSE	QW
06428200	Belle Fourche River near Alva	1989-	D,G,M	S	C	WSE	
06428500	Belle Fourche River at Wyoming-South Dakota State line	1946-	P	Y	SD	--	
06429997	Murray Ditch above headgate at Wyoming-South Dakota State line	1987-	--	S	SD	WSE	
06430500	Redwater Creek at Wyoming-South Dakota State line	1929-31, 1936-37, 1954-	G,W	Y	SD	WSE	
		NIOBRARA RIVER BASIN					
06454000	Niobrara River at Wyoming-Nebraska State line	1955-	D,W	Y	NE	--	
		PLATTE RIVER BASIN					
06620000	North Platte River near Northgate, Colo.	1904, 1915-	D,M,P	Y	C	USGS	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
	PLATTE RIVER BASIN--Continued						
06622700	North Brush Creek near Saratoga	1960-	D,G,M	Y	C	WSE	
06622900	South Brush Creek near Saratoga	1960-74, 1976-	G,W	S	S	WSE	
06623800	Encampment River above Hog Park Creek, near Encampment	1964-	G,M	Y	C	USGS	HBM,QW, SED
06625000	Encampment River at mouth, near Encampment	1940-	D,W	Y	C	WSE	QW
06628900	Pass Creek near Elk Mountain	1957-	G,M	Y	C	WSE	
06630000	North Platte River above Seminoe Reservoir, near Sinclair	1939-	G,W,P,T	Y	C	USGS, WSE	NASQAN, QW,SED
06632400	Rock Creek above King Canyon Canal, near Arlington	1965-	G,M	Y	C,S	WSE	
06634620	Little Medicine Bow River at Boles Spring, near Medicine Bow	1984-	D,M	Y	C	WSE	QW
06635000	Medicine Bow River above Seminoe Reservoir, near Hanna	1939-	G,W,P,T	Y	C	MRB, WSE	QW,SED
06635500	Seminoe Reservoir near Leo	1939-	--	--	--	MRB	USBR
06637750	Rock Creek above Rock Creek Reservoir	1962-	D,W	Y	R	WSE	
06638090	Sweetwater River near Sweetwater Station	1973-	D,M	Y	R	WSE	
06639000	Sweetwater River near Alcova	1913-24, 1938-	D,W,P,T	S	S	WSE	QW
06640500	Pathfinder Reservoir near Alcova	1909-	--	--	--	MRB	USBR
06641500	Alcova Reservoir at Alcova	1938-	--	--	--	MRB	USBR
06642000	North Platte River at Alcova	1904-05, 1934-	D,W	Y	C	WSE	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		PLATTE RIVER BASIN--Continued					
06643500	North Platte River near Goose Egg	1917-19, 1924, 1947, 1950-60, 1983-84, 1988-	G,M	Y	C	USGS	
06646000	Deer Creek in canyon, near Glenrock	1946-51, 1985-	D,G,M	Y	C	WWDC	QW,SED
06646600	Deer Creek below Millar Wasteway, at Glenrock	1961-	D,G,M	Y	C	WSE	
06646800	North Platte River near Glenrock	1959-	D,W,P	Y	C	CE,WSE	
06647500	Box Elder Creek at Boxelder	1946-51, 1961-67, 1971-	D,W	Y	C	WSE	
06649000	La Prele Creek near Douglas	1919-	G,W	S	S	WSE	
06652000	North Platte River at Orin	1895-99, 1917-18, 1924, 1958-	D,W,T	Y	C	WSE	QW
06652700	Glendo Reservoir near Glendo	1957-	--	--	--	MRB	USBR
06652800	North Platte River below Glendo Reservoir	1957-	D,W,T	Y	C	WSE	QW
06653300	Horseshoe Creek near Cassa	1961-68, 1988-	D,G,M	Y	C	WSE	
06653500	Horseshoe Creek near Glendo	1916-18, 1921-24, 1928-33, 1988-	D,W	Y	C	WSE	
06655500	Guernsey Reservoir near Guernsey	1928-	--	--	--	MRB	USBR

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
	PLATTE RIVER BASIN--Continued						
06656000	North Platte River below Guernsey Reservoir	1900-	D,M,W,T	Y	C	WSE	
06657000	North Platte River below Whalen Diversion Dam	1909-	G,M,P	Y	C	WSE	
06659500	Laramie River and Pioneer Canal near Woods	1912-24, 1926-27, 1931-	G,W	S	S	WSE	
06659580	Sand Creek at Colorado-Wyoming State line	1968-	G,W	S	S	WSE	
06661000	Little Laramie River near Filmore	1902-03, 1911-26, 1932-	G,W	S	S	WSE	
06661585	Laramie River near Bosler	1972-	G,W	Y	S	WSE	
06662000	Laramie River near Lookout	1912-17, 1921-27, 1932-	G,W	S	S	WSE	
06664400	Sybille Creek above Mule Creek, near Wheatland	1974-	G,W	S	S	WSE	
06665790	Sybille Creek above Canal No. 3, near Wheatland	1980-	G,W	S	S	WSE	
06670500	Laramie River near Fort Laramie	1915-	G,M,P,T	Y	C	CE,WSE	QW
06671000	Rawhide Creek near Lingle	1928-	G,W	S	S	WSE	
06672500	Cherry Creek Drain near Torrington	1931-32, 1935-	G,W	S	S	WSE	
06673500	Katzer Drain near Henry, Nebr.	1928-	G,W	S	S	WSE	
06674500	North Platte River at Wyoming-Nebraska State line	1929-	D,G,W,P	Y	C	CE,WSE	QW

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		PLATTE RIVER BASIN--Continued					
06679500	North Platte River at Mitchell, Nebr.	1901-10, 1911, 1912-13, 1916-18, 1920-	D,G,W	Y	NE	--	
06755700	Crow Creek below North Fork, at Silver Crown	1987-	D,W	Y	CH	CHEY	
06756010	Allison Draw at U.S. Highway 85/87, at Cheyenne	1987-	D,W,T	S	CH	CHEY	
06756030	Dry Creek at Vista Lane, at Cheyenne	1987-	D,W,T	S	CH	CHEY	
06756040	Dry Creek tributary at Converse Avenue, at Cheyenne	1987-	D,W,T	S	CH	CHEY	
		GREEN RIVER BASIN					
09188500	Green River at Warren Bridge, near Daniel	1931-	M,P	Y	R	WSE	
09196500	Pine Creek above Fremont Lake	1954-	D,W,P	Y	R	USGS	
09196940	Fremont ditch near Pinedale	1985-86, 1988-	W	S	R	WSE	
09196960	Highland ditch near Pinedale	1985-86, 1988-	W	S	R	WSE	
09197000	Pine Creek below Fremont Lake	1910-12, 1915-18, 1985-86, 1988-	M	Y	R	WSE	
09203000	East Fork River near Big Sandy	1938-	D,M	Y	R	WSE	
09205000	New Fork River near Big Piney	1954-	M,P	Y	R	WSE	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		GREEN RIVER BASIN--Continued					
09209400	Green River near La Barge	1963-	M,P	Y	R	USGS, WSE	NASQAN, QW,SED
09210500	Fontenelle Creek near Herschler Ranch, near Fontenelle	1951-	D,M	Y	R	USGS	
09211150	Fontenelle Reservoir near Fontenelle	1964-	--	--	--	--	USBR
09211200	Green River below Fontenelle Reservoir	1963-	G,M,P	Y	R	BRUC	QW
09213500	Big Sandy River near Farson	1914-17, 1920-24, 1926-34, 1935-	M,P	S	R	WSE	
09213700	Big Sandy Reservoir near Farson	1987-	P	Y	R	BRUC	
09215550	Big Sandy River below Farson	1981-	D,M	Y	R	WSE	QW
09216050	Big Sandy River at Gasson Bridge, near Eden	1972-	D,M	Y	R	WSE	QW
09217000	Green River near Green River	1951-	G,M,P	Y	R	BRUC, USGS	QW,SED
09218500	Blacks Fork near Millburne	1939-	D,M	Y	R	WSE	
09220000	East Fork of Smiths Fork near Robertson	1939-	G,M	S	S	WSE	
09223000	Hams Fork below Pole Creek, near Frontier	1952-	G,M,P	Y	R	USGS	
09224700	Blacks Fork near Little America	1962-	M,P	Y	R	USGS	QW
09229500	Henrys Fork near Manila, Utah	1928-	M,P	Y	R	USGS	QW
09234400	Flaming Gorge Reservoir at Flaming Gorge Dam, Utah	1962-	--	Y	--	--	USBR
09234500	Green River near Greendale, Utah	1950-	--	Y	UT	--	QW
09253000	Little Snake River near Slater, Colo.	1942-74, 1950-	--	Y	CO	--	
09255000	Slater Fork near Slater, Colo.	1931-	--	Y	CO	--	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		GREEN RIVER BASIN--Continued					
09256000	Savery Creek near Savery	1941-71, 1972, 1985-	G,M	Y	C	WWDC	QW,SED
09257000	Little Snake River near Dixon	1910-23, 1938-	G,M,P	S	C	WSE	QW
09258000	Willow Creek near Dixon	1953-	--	Y	CO	--	
09259000	Muddy Creek near Baggs	1915-16, 1918, 1988-	G,M	Y	C	WWRC	
		BEAR RIVER BASIN					
10011500	Bear River near Utah-Wyoming State line	1942-	--	Y	UT	--	
10015700	Sulphur Creek above reservoir, near Evanston	1957-	G,W	Y	UT	--	
10015900	Sulphur Creek below reservoir, near Evanston	1958-	D,W	Y	UT	--	
10016900	Bear River at Evanston	1984-	D,M	S	R	UC	
10020100	Bear River above reservoir, near Woodruff, Utah	1961-	G,W	Y	UT	--	QW
10020200	Woodruff Narrows Reservoir near Woodruff, Utah	1965-	--	--	--	--	
10020300	Bear River below reservoir, near Woodruff, Utah	1961-	D,W	Y	UT	--	
10026500	Bear River near Randolph, Utah	1943-	--	Y	UT	--	
10028500	Bear River below Pixley Dam, near Cokeville	1941-43, 1952-56, 1958-	G,W	S	UT	--	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		BEAR RIVER BASIN--Continued					
10032000	Smiths Fork near Border	1942-	G,W	Y	UT	--	
10038000	Bear River below Smiths Fork, near Cokeville	1954-	--	Y	UT	--	
10039500	Bear River at Border	1937-	G,W	Y	UT	USGS	NASQAN, QW,SED
10041000	Thomas Fork near Wyoming-Idaho State line	1949-	D,W	Y	UT	--	
		SNAKE RIVER BASIN					
13010200	Snake River above Jackson Lake, at Flagg Ranch	1983-	--	Y	ID	--	
13010500	Jackson Lake near Moran	1908-79, 1984-	--	Y	ID	--	USBR
13011000	Snake River near Moran	1903-	D,W	Y	ID	--	
13011500	Pacific Creek at Moran	1906, 1917-18, 1944-75, 1978-	--	Y	ID	--	
13011900	Buffalo Fork above Lava Creek, near Moran	1965-	G,M	Y	ID	--	
13018000	Flat Creek near Jackson	1933-41, 1989-	D,G,M	S	R	TC	
13018300	Cache Creek near Jackson	1962-	G,W	Y	R	USGS	HBM,QW, SED
13018350	Flat Creek below Cache Creek, near Jackson	1989-		S	R	TC	
13018500	Flat Creek near Cheney	1917-18, 1989-	D,G,M	S	R	TC	
13018750	Snake River below Flat Creek, near Jackson	1975-	D,G,M	Y	ID	USGS	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
	SNAKE RIVER BASIN--Continued						
13019438	Little Granite Creek at mouth, near Bondurant	1982-	D,G,M	Y	ID	--	QW
13022500	Snake River above reservoir, near Alpine	1917-18, 1937-39, 1953-	G,W	Y	ID	--	
13023000	Greys River above reservoir, near Alpine	1917-18, 1937-39, 1953-	G,M	Y	ID	--	
13027500	Salt River above reservoir, near Etna	1953-	D,W	Y	ID	--	QW
13046680	Boundary Creek near Bechler Ranger Station	1985-	--	Y	ID	--	

Table 2.--Surface-water-quality stations

Explanation of abbreviations and codes used in table 2

Period of record: The dates given are the calendar years in which records began or ended.

Data frequency:

BM	bimonthly
C	continuous (recorder)
D	daily
HL	high and low flow samples only
HLM	high flow, low flow, mid-summer
M	every six weeks plus two events
Q	quarterly
SS	sample during spraying season (frequency determined in late spring)

Analysis schedule:

1	salinity (major constituents)
2	specific conductance
3	daily temperature (observed or recorder)
4	suspended and dissolved organic carbon
5	field determinations of: pH, specific conductance, dissolved oxygen, temperature, and (or) turbidity
6	fecal coliform, and (or) fecal streptococcus
7	nutrient
8	trace metals
9	pesticides
10	radiochemical
11	field determinations of specific conductance and temperature
12	specific conductance and temperature (continuous monitors)
13	selenium
14	field alkalinity

Field office:

C	Casper
CH	Cheyenne
ID	Idaho District
MT	Montana District
R	Riverton
UT	Utah District

Funding agency:

BRUC	Bureau of Reclamation, Colorado Region
GILL	City of Gillette
MRB	Geological Survey, support for other Interior Agencies
USGS	Geological Survey, Federal Program
WDA	Wyoming Department of Agriculture
WDEQ	Wyoming Department of Environmental Quality
WRIR	Wind River Indian Reservation
WWDC	Wyoming Water Development Commission
--	Not funded through Wyoming District

Remarks:

HBM	hydrologic benchmark station
NASQAN	national stream-quality accounting network station
SED	also sediment station
SW	also streamflow station

Table 2.--Surface-water-quality stations

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
			YELLOWSTONE RIVER BASIN				
06036905	Firehole River near West Yellowstone, Mont.	1983-	--	--	MT	--	SW
06037000	Gibbon River near West Yellowstone, Mont.	1983-	--	--	MT	--	SW
06191500	Yellowstone River at Corwin Springs, Mont.	1965, 1969-74, 1984-	--	--	MT	--	SW
06207500	Clarks Fork Yellowstone River near Belfry, Mont.	1965-	SS	7	MT	WDA	SW
06220800	Wind River above Red Creek, near Dubois	1986-	BM	1	R	WRIR	
			HL	8		WRIR	
			SS	9		WRIR	
06221400	Dinwoody Creek above lakes, near Burris	1989-	Q	1,8	R	WRIR	SW
06222700	Crow Creek near Tipperary	1974-	M	11	R	MRB	SW
06224000	Bull Creek above Bull Lake	1974-	M	11	R	MRB	SW
			Q	2,8		WRIR	
06225500	Wind River near Crowheart	1986-	BM	1	R	WRIR	SW
			HL	8		WRIR	
			SS	9		WRIR	
06227600	Wind River near Kinnear	1985-	Q	10	R	WRIR	
06228000	Wind River at Riverton	1947-50,	BM	1,5,6,7,	R	USGS	NASQAN,
		1953,	BM	8,14		USGS	SW,SED
		1965-	Q	10		WRIR	
06228350	South Fork Little Wind River above Washakie Reservoir, near Fort Washakie	1976-	BM	1,8,11	R	WRIR	SW

Table 2.--Surface-water-quality stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
			YELLOWSTONE RIVER BASIN--Continued				
06231000	Little Wind River above Arapahoe	1966-	BM	1	R	WRIR	SW
			Q	10		WRIR	
			HL	8		WRIR	
			SS	9		WRIR	
06232600	Popo Agie River at Hudson Siding, near Hudson	1984-	Q	5,6,7	R	WDEQ	
06233900	Popo Agie River near Arapahoe	1979-	BM	1	R	WRIR	SW
			Q	10		WRIR	
			HL	8		WRIR	
			SS	9		WRIR	
			SS	9		WDA	
06235000	Beaver Creek near Arapahoe	1950-53, 1958-81, 1985-	Q	10	R	WRIR	
06235500	Little Wind River near Riverton	1965-	Q	10	R	WRIR	SW
			Q	5,6		WDEQ	
			HL	7		WDEQ	
06236100	Wind River above Boysen Reservoir, near Shoshoni	1974-	Q	5,6,7	R	WDEQ	
06244500	Fivemile Creek above Wyoming Canal	1949-58, 1961-75, 1989-	BM	1	R	WRIR	SW
			HL	8		WRIR	
			SS	9		WRIR	
06257500	Muddy Creek near Pavillion	1949-58, 1961-73, 1989-	BM	1	R	WRIR	
			HL	8		WRIR	
			SS	9		WRIR	
06259000	Wind River below Boysen Reservoir	1953-54, 1960-	BM	8	R	MRB	SW
06264700	Bighorn River at Lucerne	1966-	Q	5,6,7,13	R	WDEQ	

Table 2.--Surface-water-quality stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN--Continued					
06274300	Bighorn River at Basin	1984-	Q	5,6,7	R	WDEQ	SW
06277500	Greybull River near Basin	1951-53, 1965-	SS	7,9	R	WDA	
06279050	Shell Creek at Porter Gulch, near Greybull	1983-	SS	9	R	WDA	
06279500	Bighorn River at Kane	1947-53,	BM	5,8	R	MRB	SW,SED
		1955-57,	Q	5,6,7		WDEQ	
		1960-	SS	9		WDA	
06281000	South Fork Shoshone River above Buffalo Bill Reservoir	1981-	C	3	R	MRB	SW
			M	7		MRB	
06281700	Shoshone River above Demaris Hot Springs, near Cody	1988-	M	1,5,7	R	MRB	
06282900	Shoshone River above Dry Creek, near Cody	1974-	Q	5,6,7,13	R	WDEQ	
06284380	Roan Wash near Garland	1985-	SS	9	R	WDA	
06284400	Shoshone River near Garland	1974-	SS	7,9	R	WDA	
06284450	Bitter Creek below sewage lagoon, near Powell	1981-	Q	5,6,7	R	WDEQ	
06284500	Bitter Creek near Garland	1958-60,	Q	6	R	WDEQ	
		1969-	SS	7,9		WDA	
06285100	Shoshone River near Lovell	1966-	M	11	R	USGS	SW
			Q	6		WDEQ	
06286200	Shoshone River at Kane	1976-	Q	5,6,7	R	WDEQ	
06298000	Tongue River near Dayton	1967-81, 1988-	SS	7	C	WDA	SW
06302000	Big Goose Creek near Sheridan	1988-	SS	7	C	WDA	SW
06304500	Little Goose Creek near Sheridan	1979-	Q	5,6	C	WDEQ	
			SS	9		WDA	

Table 2.--Surface-water-quality stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN--Continued					
06305500	Goose Creek below Sheridan	1959-60, 1961-64, 1967-	Q	5,6,7	C	WDEQ	
06305700	Goose Creek near Acme	1984-	Q	7	C	WDEQ	SW
06306250	Prairie Dog Creek near Acme	1983-	SS	9	C	WDA	
06306300	Tongue River at State line, near Decker, Mont.	1965-	Q	5,6,7,8	MT	WDEQ	
			SS	9		WDA	
06309500	Middle Fork Powder River above Kaycee	1949-54, 1984-	M	1,5,6,7	C	WWDC	SW
06310000	Red Fork near Barnum	1989-	M	1,5	C	WWDC	
06312000	North Fork Powder River near Kaycee	1989-	M	1,5	C	WWDC	
06312500	Powder River near Kaycee	1968-	BM	1	C	WWDC	
			Q	1,5,6,7		WDEQ	
06313000	South Fork Powder River near Kaycee	1968-81,	M	1,5	C	WWDC	SED
		1983-	M	13		WDEQ	
06313400	Salt Creek near Sussex	1967-81,	BM	1	C	WWDC	SW,SED
		1983-	Q	1,13		WDEQ	
06313500	Powder River at Sussex	1949-53,	BM	1	C	WWDC	SW,SED
		1977-	Q	1,13		WDEQ	
441252-106090801	Powder River above Dead Horse Creek, near Buffalo	1989-	M	1,5	C	WWDC	
06313700	Dead Horse Creek near Buffalo	1989-	M	1,5	C	WWDC	SW
06316400	Crazy Woman Creek at upper station, near Arvada	1966-81,	M	1,5	C	WWDC	
		1983-	SS	9		WDA	
06317000	Powder River at Arvada	1946-53,	M	2	C	USGS	SW,SED
		1967-	BM	1		WWDC	
			Q	1		WDEQ	
06320200	Clear Creek below Rock Creek, near Buffalo	1975-	Q	5,6,7	C	WDEQ	

Table 2.--Surface-water-quality stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN--Continued					
06320400	Clear Creek at Ucross	1975-81, 1983-	SS	9	C	WDA	
06323500	Piney Creek at Ucross	1950-54, 1983-	M SS	1,5 9	C	WWDC WDA	
06324000	Clear Creek near Arvada	1950-54, 1966-	M SS	1,5 7,9	C	WWDC WDA	
06324500	Powder River near Moorhead, Mont.	1951-53, 1956-57, 1969-72, 1975-83, 1987-	SS	9	MT	WDA	SW
06324970	Little Powder River above Dry Creek, near Weston	1972-81, 1986-	Q	1	C	WDEQ	SW
		CHEYENNE RIVER BASIN					
06375600	Little Thunder Creek near Hampshire	1978-81, 1988-	Q	1,4,5,8	C	MRB	SW,SED
06386400	Cheyenne River near Riverview	1975-	SS	9	C	WDA	
06426100	Stonepile Creek at Gillette	1988-	Q	5,6,7	C	GILL	SW,SED
06426400	Donkey Creek near Moorcroft	1977-	Q	5,6,7	C	WDEQ	
06426500	Belle Fourche River below Moorcroft	1975-	Q SS	6,7,13 9	C	WDEQ WDA	
06427500	Belle Fourche River below Keyhole Reservoir	1984-	SS	9	C	WDA	SW
06427850	Belle Fourche River at Devils Tower	1967-	SS	9	C	WDA	
06428050	Belle Fourche River below Hulett	1981-	Q SS	5,6,7,13 9	C	WDEQ WDA	

Table 2.--Surface-water-quality stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
			CHEYENNE RIVER BASIN--Continued				
06429898	Sand Creek above Ranch A, near Beulah	1988-	SS	9	C	WDA	
06429900	Sand Creek at Ranch A, near Beulah	1988-	SS	9	C	WDA	
			PLATTE RIVER BASIN				
06623800	Encampment River above Hog Park Creek, near Encampment	1967-	Q Q HL	1,5,6,7, 8 10	C	USGS USGS USGS	HBM,SW, SED
06625000	Encampment River at mouth, near Encampment	1965-86, 1988-	Q	5,6,7	C	WDEQ	SW
412117-106433201	North Platte River at Highway 130, north of Saratoga	1977-78, 1984-	SS	9	C	WDA	
06630000	North Platte River above Seminoe Reservoir, near Sinclair	1960-	BM BM Q	4 1,5,6,7 8	C	MRB USGS USGS	SW,SED
06634620	Little Medicine Bow River at Boles Spring, near Medicine Bow	1985-	Q	10,13	C	WDEQ	SW
06635000	Medicine Bow River above Seminoe Reservoir, near Hanna	1965-	BM Q	1,4,5,7 10,13	C	MRB WDEQ	SW,SED
06636000	North Platte River above Pathfinder Reservoir	1969-82, 1988-	BM	1,4,5,7	C	MRB	SED
06639000	Sweetwater River near Alcova	1964-	Q	10	C	WDEQ	SW
06639480	Horse Creek at Highway 220, near Alcova	1983-	SS	9	C	WDA	
06644550	North Platte River at Casper	1971-	SS	9	C	WDA	
06645000	North Platte River below Casper	1950-52, 1957-59, 1967-	M	5,6,7	C	WDEQ	

Table 2.--Surface-water-quality stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
			PLATTE RIVER BASIN--Continued				
06646000	Deer Creek in canyon, near Glenrock	1985-	M	1,5,6,7	C	WWDC	SW,SED
			HLM	13		WWDC	
06652000	North Platte River at Orin	1966-	SS	9	C	WDA	SW
			Q	5,6,7		WDEQ	
06652800	North Platte River below Glendo Reservoir	1966-	SS	9	C	WDA	SW
06660070	Laramie River above Howell	1980-	Q	5,6,7	CH	WDEQ	
06660500	Laramie River at Two Rivers	1966-	SS	9	CH	WDA	
06669050	Wheatland Creek below Wheatland	1983-	Q	5,6,7	CH	WDEQ	
413918-105021401	Chugwater Creek at Platte-Laramie County line, near Chugwater	1984-	SS	9	CH	WDA	
06669500	Chugwater Creek at Chugwater	1984-	SS	9	CH	WDA	
06670500	Laramie River near Fort Laramie	1966-86, 1987-	SS	7	C	WDA	SW
06674500	North Platte River at Wyoming-Nebraska State line	1965-	M	11	C	USGS	SW
			Q	5,6		WDEQ	
			SS	7		WDA	
06755800	Crow Creek at Roundtop Road, near Cheyenne	1986-	SS	9	CH	WDA	
06755950	Crow Creek at F. E. Warren AFB	1983-	Q	5,6,7,8	CH	WDEQ	
			SS	9		WDA	
06756000	Crow Creek near Cheyenne	1983-	M	5,6,7,8	CH	WDEQ	
			SS	9		WDA	
			GREEN RIVER BASIN				
09209400	Green River near La Barge	1963-	BM	1,5,6,7	R	USGS	NASQAN,
			Q	8		USGS	SW,SED

Table 2.--Surface-water-quality stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
			GREEN RIVER BASIN--Continued				
09211200	Green River below Fontenelle Reservoir	1967-	M	1,7	R	BRUC	SW
09215550	Big Sandy River below Farson	1981-	M	1,11	R	WSE	SW
09216050	Big Sandy River at Gasson Bridge, near Eden	1981-	M	1,11	R	WSE	SW
			S	9		WDA	
09216790	Bitter Creek above Killpecker Creek, at Rock Spings	1983-	SS	9	R	WDA	
09217000	Green River near Green River	1951-	D	2,3	R	USGS	SW,SED
			BM	1,5,7		BRUC	
09217010	Green River below Green River	1973-	M	7	R	WDEQ	
			Q	5,6		WDEQ	
09221650	Smiths Fork near Lyman	1974-	SS	9	R	WDA	
09222000	Blacks Fork near Lyman	1962-	SS	9	R	WDA	
09224050	Hams Fork near Diamondville	1975-	Q	5,6,7,13	R	WDEQ	
			SS	9		WDA	
09224700	Blacks Fork near Little America	1951-	C	12	R	USGS	SW
			M	1		USGS	
			Q	13		WDEQ	
09229500	Henrys Fork near Manila, Utah	1951-	SS	9	R	WDA	SW
09234500	Green River near Greendale, Utah	1956-	--	--	UT	--	SW
09256000	Savery Creek near Savery	1985-	M	1,5,6,7	C	WWDC	SW,SED
			HLM	13		WWDC	
09257000	Little Snake River near Dixon	1975-	SS	9	C	WDA	SW
09259050	Little Snake River below Baggs	1981-	Q	5,6,7,13	C	WDEQ	
			SS	9		WDA	

Table 2.--Surface-water-quality stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
		BEAR RIVER BASIN					
10018900	Yellow Creek at mouth, near Evanston	1984-	Q	5,6,7	R	WDEQ	
10020100	Bear River above reservoir, near Woodruff, Utah	1968-	Q	5,6,7	R	WDEQ	SW
10035000	Smiths Fork near Cokeville	1983-	SS	9	R	WDA	
10039500	Bear River at Border	1966-	--	--	UT	--	NASQAN, SW,SED
		SNAKE RIVER BASIN					
13018300	Cache Creek near Jackson	1965-	BM	1,5,6,7	R	USGS	HBM,SW,
			Q	8		USGS	SED
			HL	10		USGS	
13019438	Little Granite Creek at mouth, near Bondurant	1982-	--	--	ID	--	SW,SED
13027500	Salt River above reservoir, near Etna	1965-	SS	9	R	WDA	SW

Table 3.--Sediment stations

Explanation of abbreviations and codes used in table 3

Period of record: The dates given are the calendar years in which records began or ended.

Data frequency:

BM	bimonthly
D	daily (observer)
HML	high, medium and low flow samples only
I	infrequent, whenever enough sediment in suspension to do analysis
M	every six weeks plus two events
Q	quarterly

Analysis schedule:

1	suspended-sediment concentration
2	particle-size distribution
3	0.062-mm sieve analysis
4	bed material particle-size distribution

Field office:

C	Casper
ID	Idaho District
R	Riverton
UT	Utah District

Funding agency:

GILL	City of Gillette
MRB	Geological Survey, support for other Interior Agencies
USGS	Geological Survey, Federal Program
WWDC	Wyoming Water Development Commission

Remarks:

HBM	hydrologic benchmark station
NASQAN	national stream-quality accounting network station
QW	also water-quality station
SW	also streamflow station

Table 3.--Sediment stations

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN					
06228000	Wind River at Riverton	1986-	BM	1,3	R	USGS	NASQAN, SW,QW
06279500	Bighorn River at Kane	1946-64,	M	1	R	MRB	SW,QW
		1969-	I	2		MRB	
		CHEYENNE RIVER BASIN					
06375600	Little Thunder Creek near Hampshire	1978-81, 1988-	Q	1,2,3	C	MRB	SW,QW
06426100	Stonepile Creek at Gillette	1988-	M	1	C	GILL	SW,QW
		PLATTE RIVER BASIN					
06623800	Encampment River above Hog Park near Encampment	1964-	Q	1,3	C	USGS	HBM,SW, QW
06630000	North Platte River above Seminoe Reservoir, near Sinclair	1986-	BM	2	C	MRB	SW,QW
			BM	1,3		USGS	
06635000	Medicine Bow River above Seminoe Reservoir, near Hanna	1988-	BM	1,2,3	C	MRB	SW,QW
06636000	North Platte River above Pathfinder Reservoir	1988-	BM	1,2,3	C	MRB	QW
06646000	Deer Creek in canyon, near Glenrock	1985-	M	1	C	WWDC	SW,QW
			I	2		WWDC	
		GREEN RIVER BASIN					
09209400	Green River near LaBarge	1986-	BM	1,3	R	USGS	NASQAN, SW,QW

Table 3.--Sediment stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
		GREEN RIVER BASIN--Continued					
09217000	Green River near Green River	1951-	D	1	R	USGS	SW,QW
			I	2		USGS	
			M	1		USGS	
			HML	4		USGS	
09256000	Savery Creek near Savery	1985-	M	1	C	WWDC	SW,QW
			I	2		WWDC	
		BEAR RIVER BASIN					
10039500	Bear River at Border	1966-	--	--	UT	--	NASQAN, SW,QW
		SNAKE RIVER BASIN					
13018300	Cache Creek near Jackson	1968-	--	--	R	USGS	HBM,SW, QW
13019438	Little Granite Creek at mouth, near Bondurant	1982-	--	--	ID	USGS	SW,QW

Table 4.--Ground-water-level observation wells

Explanation of abbreviations and codes used in table 4

Map no.: Sequential number (by county) used to show location of well on figure 5.

Local well no.:
The well-numbering procedure used is based on the Federal system of land subdivision. The first segment of the number is the township (north); the second number segment is the range (west); the third number segment is the section, which is followed by a first letter designating the quarter section, a second letter, if shown, designating the quarter-quarter section, etc., (a - NE1/4, b - NW1/4, c - SW1/4, d - SE1/4). Well 52-063-25dcd02, for example, is in the SE1/4 of the SW1/4 of the SE1/4 of section 25, Township 52 North, Range 63 West. The number 02 indicates it is the second well in the quarter-quarter-quarter section. Numbers for wells in Fremont County begin with an additional uppercase letter that designates the quadrant of the Wind River Meridian and Base Line System. The quadrants are lettered A, B, C, and D in a counter-clockwise direction beginning with A in the northeast quadrant.

Period of record: The dates given are the calendar years in which records began or ended. A record consists of one or more measurements during a calendar year.

Geologic source code: The following codes have been retrieved from the Water Data Storage and Retrieval System (WATSTORE) of the U.S. Geological Survey and may not follow the current usage of the Survey.

Era	System	Series	Geologic source code	Formation name
Cenozoic	Quaternary	Holocene	111ALVM	Alluvium
			111SPBK	Spoil bank
			111TRRC	Terrace deposits
	Tertiary	Pliocene	121NRPK	North Park Formation[1]
			121OGLL	Ogallala Formation[1]
		Miocene	122ARKR	Arikaree Formation
		Oligocene	123BRUL	Brule Formation
			123WRVR	White River Formation or Group
		Eocene	124WDRV	Wind River Formation
			124WSTC	Wasatch Formation

Explanation of abbreviations and codes used in table 4--Continued

Era	System	Series	Geologic source code	Formation name
		Paleocene	125FRRS	Ferris Formation[2]
			125LEBO	Lebo Member of Fort Union Formation
Mesozoic	Cretaceous	Upper Cretaceous	211FXHL	Fox Hills Sandstone
		Lower Cretaceous	217LKOT	Lakota Formation
Paleozoic	Permian	Upper Permian	311PRKC	Park City Formation[3]
		Lower Permian	317CSPR	Casper Formation[4]
			317MNLS	Minnelusa Formation[5]
			317TSLP	Tensleep Formation[4]
	Mississippian	Upper Mississipian	331MDSN	Madison Limestone[6]
		Lower Mississipian	337PHSP	Pahasapa Limestone

[1] Now designated Miocene by the U.S. Geological Survey

[2] Includes Upper Cretaceous

[3] Includes Lower Permian

[4] Includes Upper and Middle Pennsylvanian

[5] Includes Pennsylvanian

[6] Includes Lower Mississippian

Data frequency:

C continuous (graphic or digital recorder)
M monthly (12 visits per year)

Field office:

C Casper
CH Cheyenne Hydrologic Surveillance Section
P Project Personnel
R Riverton
S Wyoming State Engineer

Explanation of abbreviations and codes used in table 4--Continued

Funding agency:

SE/PD	Wyoming State Engineer with support from Wyoming Economic Development and Stabilization Board
USGS	Geological Survey, Federal Program

Local name: Indicates a reference name of the well

Table 4.--Ground-water-level observation wells

Map no.	Station no.	Local well no.	Period of record	Geologic source	Data frequency	Field office	Funding agency	Local name
				ALBANY COUNTY				
1	411751105312701	15-073-01dba01	1983-	317CSPR	C	S	SE/PD	Huntoon #1
2	411703105314001	15-073-12dbb01	1983-	317CSPR	C	S	SE/PD	Huntoon #2
				CAMPBELL COUNTY				
1	441117105192901	49-070-31bbb01	1983-	211FXHL	C	S	SE/PD	HE #1
2	441748105323301	50-072-20cab01	1985-	125LEBO	C	S	SE/PD	Dickinson
3	441819105305701	50-072-21aba01	1983-	124WSTC	C	S	SE/PD	Gillette H-13
				CARBON COUNTY				
1	411234106424601	14-083-03cab01	1980-	121NRPK	C	C	USGS	Helmer
2	415430106493801	22-084-01bcb01	1983-	111SPBK	C	C	USGS	St. Marys
3	415535106482301	23-083-31bbb01	1984-	125FRRS	C	C	USGS	Medicine Bow #1
4	422338107145001	28-087-16cca01	1981-	122ARKR	C	C	SE/PD	Split Rock
				CONVERSE COUNTY				
1	424413105365801	32-073-16ccc01	1987-	--	C	S	SE/PD	Natural Bridge Prod.
2	424420105364201	32-073-16cdb01	1986-	--	C	S	SE/PD	Natural Bridge
3	424520105440501	32-074-08dbc01	1980-	331MDSN	C	C	SE/PD	Barber
4	425902105210701	35-071-23ccd01	1986-	--	C	S	SE/PD	Pan Eastern
5	431140105151901	37-070-10cbb01	1986-	--	C	S	SE/PD	Bill #6
				CROOK COUNTY				
1	442540104493501	51-066-06dcb01	1981-	331MDSN	C	S	SE/PD	Madison M-8
2	442734104215001	52-063-25dcd01	1985-	--	M	S	SE/PD	Cole Well 3-A

Table 4.--Ground-water-level observation wells--Continued

Map no.	Station no.	Local well no.	Period of record	Geo-logic source	Data fre-quency	Field office	Funding agency	Local name
				CROOK COUNTY--Continued				
3	442734104215002	52-063-25dcd02	1985-	--	M	S	SE/PD	Cole Well 3-B
4	443453104425602	53-065-18bbd02	1962-	337PHSP	M	C	SE/PD	Devils Tower
5	444854104534501	56-067-28aab01	1983-	331MDSN	C	S	SE/PD	#41 Madison
6	444854104534502	56-067-28aab02	1983-	331MDSN	C	S	SE/PD	#41 Minnelusa
7	445542104383701	57-065-15dac01	1986-	331MDSN	C	S	SE/PD	USGS M-1
				FREMONT COUNTY				
1	430205108243201	A 1-4-28acc01	1984-	124WDRV	M	R	SE/PD	Brentwood #1
				GOSHEN COUNTY				
1	413852104115801	19-061-04abc01	1972-	111ALVM	C	S	SE/PD	Sanders
2	413810104102301	19-061-10aab01	1980-	123BRUL	C	S	SE/PD	LaGrange #1
3	414049104074501	20-060-30bbb01	1980-	123BRUL	C	S	SE/PD	LaGrange #2
4	414348104101301	20-061-03dad01	1980-	123WRVR	C	S	SE/PD	LaGrange #3
5	414128104094502	20-061-23bdb02	1978-	123BRUL	C	S	SE/PD	Rain Station
6	414051104100701	20-061-23ccc01	1972-	111ALVM	C	S	SE/PD	Meir
7	422512104135501	28-061-06aba01	1979-	122ARKR	C	S	SE/PD	Goshen #2
8	422519104095101	28-061-02ccd01	1986-	--	C	S	SE/PD	Prairie Center #6
9	422928104121401	29-061-17aad01	1980-	122ARKR	C	S	SE/PD	Prairie Center #4
10	422849104090801	29-061-23abb01	1979-	122ARKR	C	S	SE/PD	Goshen #1
11	422730104094801	29-061-26cbb01	1980-	122ARKR	C	S	SE/PD	Prairie Center #3
12	423549104120901	30-061-09bbb01	1980-	122ARKR	C	S	SE/PD	Prairie Center #5
				HOT SPRINGS COUNTY				
1	434136108183301	43-095-18cba01	1983-	317TSLP	C	R	SE/PD	UTW-1
2	433933108121901	43-095-25cdd01	1983-	311PRKC	C	R	SE/PD	UTW-3

Table 4.--Ground-water-level observation wells--Continued

Map no.	Station no.	Local well no.	Period of record	Geo-logic source	Data fre-quency	Field office	Funding agency	Local name
				LARAMIE COUNTY				
1	410059104072401	12-060-07ddd01	1977-	123BRUL	C	S	SE/PD	Laramie #1
2	410100104160301	12-062-13baa01	1975-	111TRRC	C	S	SE/PD	SE Carpenter
3	410111104233102	12-063-15aaa02	1973-	123BRUL	C	S	SE/PD	SW Carpenter
4	410703104071201	13-060-05ccb01	1969-	123BRUL	M	S	SE/PD	Glantz
5	410324104481701	13-066-32bbd01	1986-	1210GLL	C	S	SE/PD	Winchester Hills
6	410530104574001	13-068-13ccc01	1942-50, 1969-	1210GLL	C	CH	SE/PD	Borie
7	411238104070801	14-060-05bcb01	1957-	123BRUL	C	S	SE/PD	Gross
8	411022104141201	14-061-18ddd01	1977-	123WRVR	C	S	SE/PD	Laramie #2
9	411114104242501	14-063-15aaa01	1977-	122ARKR	C	S	SE/PD	Laramie #3
10	411005104355001	14-064-19bcc01	1977-	1210GLL	C	S	SE/PD	Laramie #9
11	411147104490501	14-066-07add01	1984-	1210GLL	C	S	SE/PD	Nat'l Land Co. #1
12	411210104452001	14-066-10aba01	1977-	1210GLL	C	S	SE/PD	Laramie #8
13	410940104435701	14-066-23ddd01	1986-	1210GLL	C	S	SE/PD	Whitney Road
14	411213104501401	14-067-12abb01	1984-	1210GLL	C	S	SE/PD	Laramie #10
15	411034104554001	14-067-18ddc01	1956-	1210GLL	C	CH	SE/PD	Bell #14
16	410930104524701	14-067-27bac01	1986-	1210GLL	C	S	SE/PD	Round Top
17	410838104530401	14-067-34bbc01	1986-	1210GLL	C	S	SE/PD	Rolling Hills
18	410757104582302	14-068-35ddc02	1969-	1210GLL	C	CH	SE/PD	King #3
19	411531104194701	15-062-20aaa01	1977-	1210GLL	C	S	SE/PD	Laramie #4
20	411725104454601	15-066-10bab01	1977-	1210GLL	C	S	SE/PD	Laramie #7
21	411400104595901	15-068-27ccc01	1984-	1210GLL	C	S	SE/PD	MX West B-7
22	412227104081401	16-060-07bbb02	1975-	1210GLL	C	S	SE/PD	SW of Albin
23	411136104125301	16-061-17aaa01	1977-	1210GLL	C	S	SE/PD	Laramie #5
24	412343104053101	17-060-33cbb01	1975-	1210GLL	C	S	SE/PD	Albin
25	412605104203001	17-062-17ccc01	1982-	1210GLL	C	S	SE/PD	Laramie #6
26	412400104533901	17-067-33baa01	1986-	1210GLL	C	S	SE/PD	MX North B-1

Table 4.--Ground-water-level observation wells--Continued

Map no.	Station no.	Local well no.	Period of record	Geo-logic source	Data fre-quency	Field office	Funding agency	Local name
				NIOBRARA COUNTY				
1	424709104194101	32-062-05baa01	1979-	122ARKR	C	S	SE/PD	Niobrara #1
2	424244104202001	32-062-32bbb01	1970-	122ARKR	C	C	USGS	Node
3	424544104260601	32-063-08daa01	1979-	122ARKR	C	S	SE/PD	Niobrara #2
4	430422104183201	36-062-28ab01	1974-	331MDSN	C	C	USGS	ETSI T-2
5	430422104183202	36-062-28ab02	1974-	217LKOT	C	C	SE/PD	ETSI O-2
6	430421104200701	36-062-28bbd01	1983-	317MNLS	C	S	SE/PD	ETSI T-1
7	431321104090001	38-061-35dca01	1983-	317MNLS	C	S	SE/PD	ETSI M-1
				PLATTE COUNTY				
1	420237104532101	24-067-21aab01	1979-	111ALVM	C	S	SE/PD	Preuit
2	420246104590301	24-068-22aab01	1980-	122ARKR	C	S	SE/PD	Platte #1
3	420718104553901	25-067-19dda01	1979-	122ARKR	C	P	SE/PD	Wilhelm
4	420524104530201	25-067-34ccd01	1980-	122ARKR	C	S	SE/PD	Platte #2
5	420859104565001	25-068-12dda01	1980-	122ARKR	C	S	SE/PD	Platte #4
6	420840105000401	25-068-15bbd01	1980-	122ARKR	C	S	SE/PD	Platte #6
7	420748104565051	25-068-24aad01	1980-	122ARKR	C	S	SE/PD	Platte #3
8	420613105024401	25-068-31aaa01	1979-	122ARKR	C	P	SE/PD	Platte #7
9	421443104574601	26-068-12cbd01	1980-	122ARKR	C	S	SE/PD	Rutherford
10	421128104575801	26-068-36bbb01	1981-	122ARKR	C	S	SE/PD	Platte #5
11	421722105042401	27-069-25abc01	1981-	123WRVR	C	S	SE/PD	Cottonwood
				SWEETWATER COUNTY				
1	413228109220801	18-106-16ada01	1981-	124WSTC	C	R	USGS	Oil Shale Green River
2	413850109150601	19-105-10bbb01	1984-	--	C	R	SE/PD	Rock Spgs Golf Course

Table 4.--Ground-water-level observation wells--Continued

Map no.	Station no.	Local well no.	Period of record	Geo-logic source	Data fre-quency	Field office	Funding agency	Local name
				WESTON COUNTY				
1	434544104233701	44-063-26cac01	1982-	--	M	S	SE/PD	WSW #1
2	435822104243101	46-063-10cda01	1982-	--	M	S	SE/PD	BHP #3
3	435807104224901	46-063-15add01	1984-	--	M	S	SE/PD	BHP #4
4	435610104433001	46-066-25dbb01	1984-	331MDSN	M	S	SE/PD	Terra
5	440633104364201	47-065-01bab01	1983-	--	M	S	SE/PD	Upton #6
6	440530104381001	48-065-35ccb01	1982-	337PHSP	M	S	SE/PD	Upton #4

Table 5.--Ground-water-quality sites

Explanation of abbreviations and codes used in table 5

Map no.: Sequential number (by county) used to show location of well on figure 6.

Station no.: Station identification number which consists of latitude, longitude, and a two-digit sequence number.

Local well no.:

The well-numbering procedure used is based on the Federal system of land subdivision. The first segment of the number is the township (north); the second number segment is the range (west); the third number segment is the section, which is followed by a first letter designating the quarter section, a second letter, if shown, designating the quarter-quarter section, etc., (a - NE1/4, b - NW1/4, c - SW1/4, d - SE1/4). Well 14-062-12bcd02, for example, is in the SE1/4 of the SW1/4 of the NW1/4 of section 12, Township 14 North, Range 62 West. The number 02 indicates it is the second well in the quarter-quarter-quarter section. Numbers for wells in Fremont County begin with an additional uppercase letter that designates the quadrant of the Wind River Meridian and Base Line System. The quadrants are lettered A, B, C, and D in a counter-clockwise direction beginning with A in the northeast quadrant.

Analysis schedule:

1 major dissolved ions (salinity)
2 herbicides

The sites listed comprise the statewide ground-water-quality reconnaissance network, which is operated in cooperation with the Wyoming Department of Agriculture. The sample design is based on division of the State into four quarters, with a different quarter of the State sampled each year. Within the selected quadrant, approximately 25 active wells in irrigated areas are selected to be sampled. Personnel from the Cheyenne office have collected one sample per well, although some wells have been resampled as noted in the table.

Table 5.--Ground-water-quality sites

Map no.	Station no.	Local well no.	Water year(s) sampled	Analysis schedule
		ALBANY COUNTY		
1	412857105380401	17-073-06bbb	1986	1
		BIG HORN COUNTY		
1	441449107464801	49-091-03cbb01	1987-88	1, 2
2	441514107580801	49-092-06	1987	1, 2
3	441726108004901	50-093-05	1987-88	1, 2
4	442346108135701	51-095	1987	1, 2
5	442620108270801	52-096-31bcb01	1987	1, 2
6	443020108171001	52-095	1987-88	1, 2
7	443223107503001	53-091-29cbc	1987	1, 2
8	444832108302501	56-097-26ca	1987	1, 2
		CAMPBELL COUNTY		
1	445510105590401	57-076-15ddb	1988	1, 2
		CARBON COUNTY		
1	413133106462701	18-083-18dcc	1986	1
2	411221106424901	14-083-03cda	1986	1
		CONVERSE COUNTY		
1	424310105232601	32-071-29adb	1988	1, 2
2	424621105371501	32-073-04cbb01	1988	1, 2
3	424826105245601	33-071-30add	1988	1, 2
4	424834105244301	33-071-29bbb	1988	1, 2
5	424908105242601	33-071-20bdc01	1988	1, 2
6	425209105535001	34-075-31dca01	1988	1, 2
7	430127105414401	35-074-11aac01	1988	1, 2
		FREMONT COUNTY		
1	430335108221301	A1-004-14dcb01	1987	1, 2
2	430414108223301	A1-004-11ccd01	1987	1, 2
3	431107108180502	A2-005-04bbb01	1987	1, 2
		GOSHEN COUNTY		
1	414028104071801	20-060-30bdd01	1986	1
2	422958104134801	27-061-07db01	1986	1
3	423527104112901	30-061-09acc01	1988	1, 2

Table 5.--Ground-water-quality sites--Continued

Map no.	Station no.	Local well no.	Water year(s) sampled	Analysis schedule
		JOHNSON COUNTY		
1	440932106421001	48-082-03bdc01	1988	1, 2
		LARAMIE COUNTY		
1	410135104183500	12-062-03ccc	1986	1
2	411143104160801	14-062-12bcd02	1986	1
3	411222104291701	14-064-1dba01	1986	1
4	411851104362001	16-065-36acb01	1986	1
5	411905104231801	16-063-26ddd01	1986	1
6	411941104041401	16-060-27abc01	1986	1
7	412523104210701	17-062-19dbc	1986	1
8	413634104475901	19-066-17cdc	1986	1
		NATRONA COUNTY		
1	422849107291401	29-089-16ddc01	1987	1, 2
2	423536106392401	30-082-03ccc01	1987-88	1, 2
3	423648106375701	31-081-35bdc01	1987-88	1, 2
		NIOBRARA COUNTY		
1	424303104070701	32-060-30cbd01	1988	1, 2
2	424539104222401	32-063-12cbd01	1988	1, 2
3	424654104182501	32-062-04aca01	1988	1, 2
4	424859104073001	33-061-24ddc01	1988	1, 2
		PARK COUNTY		
1	440732108535601	48-100-18ddc	1987	1, 2
2	443253109045101	53-102-25aad01	1987	1, 2
3	444126108513401	54-100-2abb01	1987	1, 2
4	444147108472801	55-099-33cdb01	1987-88	1, 2
5	444217108390900	55-098-34bcb01	1987-88	1, 2
6	444425108483701	55-099-17cdd01	1987	1, 2
7	445744109051901	58-101-31dad01	1987	1, 2
		PLATTE COUNTY		
1	420046104552401	24-067-32bbc01	1986	1
2	420224104531601	24-067-21adc01	1986	1
3	420523104563801	25-067-31ccd	1986	1
4	420523104563902	25-067-31ccc02	1986	1
5	420559104585301	25-068-35bcb	1986	1
6	421733105042201	27-069-24dcc	1986	1
7	422818105013501	29-068-21bcc01	1986	1

Table 5.--Ground-water-quality sites--Continued

Map no.	Station no.	Local well no.	Water year(s) sampled	Analysis schedule
		SHERIDAN COUNTY		
1	443938106565601	54-084-14bbb01	1988	1, 2
2	443938106565602	54-084-14bbb02	1988	1, 2
3	443939107014901	54-084-18bbb01	1988	1, 2
4	444155106561801	55-084-35acd01	1988	1, 2
5	445131106033901	56-076-06cab01	1988	1, 2
6	445436107163401	57-086-17ccc01	1988	1, 2
		WASHAKIE COUNTY		
1	435720108005701	46-093-15cab01	1988	1, 2
2	435724108010901	46-093-15bdd01	1987-88	1, 2
3	435724108011601	46-093-15bcc01	1987-88	1, 2
4	440334107542301	47-092-09bcc01	1987-88	1, 2
5	440547107525701	48-092-27ccd01	1987-88	1, 2
6	440915107532501	48-092-04ddc01	1987-88	1, 2
		WESTON COUNTY		
1	435722104210701	46-062-19bca01	1988	1, 2
2	440610104471901	48-066-33abc01	1988	1, 2
3	440632104455603	48-066-26ccb03	1988	1, 2
4	440636104451804	48-066-26cbd04	1988	1, 2
5	440640104450001	48-066-26cad01	1988	1, 2
6	440642104443802	48-066-26dbc02	1988	1, 2

Table 6.--Streamflow stations discontinued in water years 1987 and 1988

Station number	Station name	Period of record	Other data still being collected
	YELLOWSTONE RIVER BASIN		
06284500	Bitter Creek near Garland	1950-53, 1957-60, 1968-87	water quality
06284800	Whistle Creek near Garland	1958-60, 1968-87	
06285400	Sage Creek at Sidon Canal, near Deaver	1958-60, 1968-87	
06288600	Little Bighorn River below Dayton Gulch, near Burgess Junction	1983-87	
06288700	Dry Fork below Lick Creek, near Burgess Junction	1983-87	
06288975	Elkhorn Creek above Fuller Ranch Ditch, near Parkman	1983-87	
06288990	West Fork Little Bighorn River near Parkman	1983-87	
06317340	Little Sourdough Creek near Buffalo	1985-88	
	CHEYENNE RIVER BASIN		
06365300	Dry Fork Cheyenne River near Bill	1976-81, 1985-87	
06365900	Cheyenne River near Dull Center	1976-81, 1985-87	
06426500	Belle Fourche River below Moorcroft	1952-87	water quality
	PLATTE RIVER BASIN		
06647890	Little Box Elder Creek near Careyhurst	1974-88	
06647900	Little Box Elder Creek at Little Box Elder Cave, near Careyhurst	1974-88	
	GREEN RIVER BASIN		
09212500	Big Sandy River at Leckie Ranch, near Big Sandy	1910-11, 1939-87	
09253400	Battle Creek near Encampment	1956-63, 1985-88	
09255400	East Fork Savery Creek near Encampment	1956-58, 1985-88	
09255900	Big Sandstone Creek near Savery	1956-58, 1985-88	

Table 7.--Surface-water-quality stations discontinued in water years 1987 and 1988

Station number	Station name	Period of record	Other data still being collected
	YELLOWSTONE RIVER BASIN		
06280000	North Fork Shoshone River near Wapiti	1979-87	streamflow
06284800	Whistle Creek near Garland	1959-60, 1969-87	
06285400	Sage Creek at Sidon Canal, near Deaver	1958-60, 1969-87	
	CHEYENNE RIVER BASIN		
06365300	Dry Fork Cheyenne River near Bill	1977-81, 1987	
06365900	Cheyenne River near Dull Center	1977-81, 1987	
	PLATTE RIVER BASIN		
06642000	North Platte River at Alcova	1965-87	streamflow
06643510	North Platte River above Poison Spider Creek, near Goose Egg	1977-80, 1983-87	
06644085	North Platte River at Mills	1970-87	
06644500	Casper Creek at Casper	1970-87	
06661500	Little Laramie River at Two Rivers	1965-87	
06664400	Sybille Creek above Mule Creek, near Wheatland	1984-87	streamflow
	GREEN RIVER BASIN		
09196500	Pine Creek above Fremont Lake	1985, 1987	streamflow
09216810	Killpecker Creek at Rock Springs	1975-80, 1982-87	

Table 8.--Sediment stations discontinued in water years 1987 and 1988

Station number	Station name	Period of record	Other data still being collected
	YELLOWSTONE RIVER BASIN		
06267400	East Fork Nowater Creek near Colter	1986	streamflow
06313000	South Fork Powder River near Kaycee	1949-53, 1983-87	streamflow, water quality
06313400	Salt Creek near Sussex	1976-81, 1983-84, 1986-87	streamflow, water quality
06313500	Powder River at Sussex	1949-53, 1967, 1976-84, 1986-87	streamflow, water quality
06313700	Dead Horse Creek near Buffalo	1986	streamflow
06317000	Powder River at Arvada	1946-57, 1967-79, 1983-84, 1986-87	streamflow, water quality
	CHEYENNE RIVER BASIN		
06365300	Dry Fork Cheyenne River near Bill	1977-81, 1986	
06365900	Cheyenne River near Dull Center	1975-81, 1986	
06376300	Black Thunder Creek near Hampshire	1986-87	streamflow
06426500	Belle Fourche River below Moorcroft	1947-52, 1976-83, 1986-87	water quality
	PLATTE RIVER BASIN		
06643500	North Platte River near Goose Egg	1983-84, 1986-87	water quality
	GREEN RIVER BASIN		
09253400	Battle Creek near Encampment	1986-87	
09255400	East Fork Savery Creek near Encampment	1986-87	
09255900	Big Sandstone Creek near Savery	1986-87	

Table 9.--Ground-water-level observation wells discontinued in water years 1987 and 1988

Station number	Local well number	Period of record	Local name
		CAMPBELL COUNTY	
441817105293901	50-072-22dba01	1985-87	S-8
		CONVERSE COUNTY	
424555105563801	32-076-03ccd01	1986-87	Little Deer Creek
		FREMONT COUNTY	
422632107540501	29-093-36db01	1974-87	Jeffrey City
430051108240901	A1-004-33ddb01	1951, 1961-87	Teton S
		LARAMIE COUNTY	
411131104041801	14-060-10dbb01	1973-87	Pine Bluffs
410900104110701	14-061-22dcc01	1975-87	Brown
411214104293301	14-064-01dcb01	1977-88	Hollenbeck

DATA-COLLECTION PROJECTS

PROJECT TITLE: Surface-water stations (WY 00-001)

FUNDING AGENCIES: Wyoming State Engineer, Wyoming Attorney General's Office, Wyoming Department of Environmental Quality, Wyoming Water Development Commission, Wyoming Water Research Center, Teton County, Uinta County, City of Gillette, Town of Evansville, Northern Arapaho Tribe, Shoshone Tribe, Midvale Irrigation District, U.S. Bureau of Indian Affairs, U.S. Bureau of Land Management, U.S. Bureau of Reclamation, U.S. Corps of Engineers, U.S. Forest Service, and U.S. Geological Survey

PROJECT LEADER: Stanley A. Druse

FIELD LOCATION: Statewide

PERIOD OF PROJECT: Ongoing

PROBLEM: Surface-water information is needed for purposes of surveillance, planning, design, hazard warning, operation, and management in related fields such as water supply, hydroelectric power, flood control, irrigation, bridge and culvert design, wildlife management, pollution abatement, flood-plain management, and water-resources development. To provide this information, an appropriate data base is necessary.

OBJECTIVE: (1) Collect sufficient surface-water data to satisfy needs for current-purpose uses such as (a) assessment of water resources, (b) operation of reservoirs or industries, (c) prediction of stage or discharge, (d) pollution controls and disposal of wastes, (e) discharge data to accompany water-quality measurements, (f) compact and legal requirements, and (g) research or special studies; and (2) collection of data necessary for analytical studies to define for any location the statistical properties of, and trends in, the occurrence of water in streams and lakes for use in planning and design.

APPROACH: Standard methods of data collection will be used as described in the series, "Techniques of Water-Resources Investigations of the United States Geological Survey," and partial-record gaging will be used where it serves the required purpose instead of complete-record gaging.

PROGRESS AND SIGNIFICANT RESULTS: Computation and compilation of surface-water data for the 1987 Water Year data report were completed ahead of schedule, and the report was transmitted to the printer on May 18, 1988. The level of activity was about the same as the previous year--seven stations were added during the year and four stations were to be discontinued at the end of the Water Year. The Wyoming State Engineer's office operates 26 of the gages, mostly seasonal, for direct-service credit. The timely completion of the data report allowed the District to be the first in the Nation, and first ever, to have the data report recorded on the Geological Survey Headquarters-sponsored CD-ROM. The Wyoming contribution to the 1988/89 National Water Summary, on floods and drought, was completed by S.A. Druse as a prototype report. The District also was selected to test the AA current meter with polymer bucket wheels. A report summarizing the data collected during 1974-86, to evaluate streamflow gains or losses across the outcrop of the Madison Limestone, was completed by W.R. Glass and L.G. Sultz and submitted to the District Office for editorial review.

PLANS FOR FISCAL YEAR 1989: Four streamgaging stations operated for the Wyoming Water Development Commission will be discontinued at the beginning of the 1989 Water Year. A program with the Shoshone and Arapaho Tribes will be initated with transfer of stations originally funded by the U.S. Bureau of Indian Affairs and with the addition of 7 continuous-record stations and 16 partial-record stations. The Wyoming State Engineer will be adding 1 station to the network. Six additional stations will be equipped with data-collection platforms, bringing the total to 36, some of which are operated by the National Weather Service.

REPORTS PUBLISHED DURING FISCAL YEARS 1987 and 1988:

Druse, S.A., Glass, W.R., McCollam, P.B., and Kennedy, H.I., 1987, Water-resources data - Wyoming--water year 1986: U.S. Geological Survey Water-Data Report, WY-86-1, 474 p.

Druse, S.A., Glass, W.R., McCollam, P.B., and Peterson, D.A., 1988, Water-resources data - Wyoming--water year 1987: U.S. Geological Survey Water-Data Report, WY-87-1, 396 p.

Druse, S.A., and Wahl, K.L., 1988, Cost-effectiveness of the streamflow-gaging program in Wyoming: U.S. Geological Survey Water-Resources Investigations Report 87-4264, 35 p.

PROJECT TITLE: Ground-water stations (WY 00-002)

FUNDING AGENCIES: Wyoming State Engineer, Wyoming Economic Development and Stabilization Board, and U.S. Geological Survey

PROJECT LEADER: Hugh I. Kennedy

FIELD LOCATION: Statewide

PERIOD OF PROJECT: Ongoing

PROBLEM: (1) Long-term water-level records are needed to evaluate the effects of climatic variations on the recharge to and discharge from the ground-water systems to provide a data base from which to (a) measure the effects of development, (b) assist in the prediction of future supplies, and (c) provide data for management of the resource. (2) Short-term water-level records also are needed for (a) ground-water resources assessment, (b) areal investigations, and (c) water-use investigations.

OBJECTIVE: (1) Collect sufficient water-level data to provide a minimum long-term data base so that the general hydrological response to climatic variations and induced stresses is known and potential problems can be defined early enough to allow planning and management; and (2) provide a data base against which short-term records acquired in areal studies can be analyzed. This analysis must (a) provide an assessment of the ground-water resource, (b) allow prediction of future conditions, (c) detect and define pollution and supply problems, and (d) provide the data base necessary for ground-water management.

APPROACH: The most advantageous locations for long-term observations will be determined. This network will be refined as records become available and detailed areal studies of the ground-water system more closely define the aquifers, their properties, and the stresses to which they are subjected.

PROGRESS AND SIGNIFICANT RESULTS: Computation and compilation of ground-water-level data for the 1988 Water Year were completed and were maintained at a near-current status. The biennial ground-water-level report for the 10-year period, 1978-1987, was submitted to the printer on March 15, 1988, more than 1 year ahead of the previous report's publication schedule. The monitoring network was decreased by 1 well to a total of 89, of which 61 wells are operated by the Wyoming State Engineer for direct-service credit.

PLANS FOR FISCAL YEAR 1989: The operating plan for the network will remain the same, with the Wyoming State Engineer's Office continuing to operate a large number of sites for direct-service credit. The one deep, high-pressure well that was discontinued because of freezing problems is projected to be reactivated.

REPORTS PUBLISHED DURING FISCAL YEARS 1987 AND 1988:

Druse, S.A., Glass, W.R., McCollam, P.B., and Kennedy, H.I., 1987, Water-resources data - Wyoming--water year 1986: U.S. Geological Survey Water-Data Report, WY-86-1, 474 p.

Druse, S.A., Glass, W.R., McCollam, P.B., and Peterson, D.A., 1988, Water-resources data - Wyoming--water year 1987: U.S. Geological Survey Water-Data Report, WY-87-1, 396 p.

Kennedy, H.I., and Green, S.L., 1988, Ground-water levels in Wyoming, 1978 through September 1987: U.S. Geological Survey Open-File Report 88-187, 132 p.

Kennedy, H.I., and Oberender, C.B., 1987, Ground-water levels in Wyoming, 1976 through 1985: U.S. Geological Survey Open-File Report 87-456, 122 p.

PROJECT TITLE: Water-quality stations (WY 00-003)

FUNDING AGENCIES: Wyoming Department of Agriculture, Wyoming State Engineer, Wyoming Department of Environmental Quality, Wyoming Water Development Commission, City of Gillette, Northern Arapaho Tribe, Shoshone Tribe, U.S. Bureau of Indian Affairs, U.S. Bureau of Reclamation, U.S. Forest Service, and U.S. Geological Survey

PROJECT LEADER: David A. Peterson

FIELD LOCATION: Statewide

PERIOD OF PROJECT: Ongoing

PROBLEM: Water-resource planning and water-quality assessment require a nationwide base level of relatively standardized information. For intelligent planning and realistic assessment of the water resource, the chemical and physical quality of surface and ground water must be defined and monitored.

OBJECTIVE: Provide a national bank of water-quality data for broad Federal planning and action programs and to provide data for State and Federal management of interstate waters.

APPROACH: A network of water-quality stations will be operated at stream sites to provide data on average chemical concentrations, loads, and trends as required by planning and management agencies. Selected ground-water wells also will be sampled.

PROGRESS AND SIGNIFICANT RESULTS: Funding to the water-quality monitoring program increased slightly during 1988, in spite of withdrawal of support by the U.S. Bureau of Land Management. In addition to 102 active surface-water sites throughout Wyoming, 26 wells were sampled in the northeastern quadrant of the State. The Wyoming Department of Agriculture laboratory provided analyses of major dissolved constituents for direct-services credit. Water-quality data were compiled, checked, and published in the annual data report for 1987. Quality-assurance activities included participation in the Standard Reference Sample program and field-check samples from the annual national program and the quarterly internal program.

PLANS FOR FISCAL YEAR 1989: Minor adjustments in the surface-water-quality network are expected. In the ground-water-quality network, approximately 25 wells will be sampled in the southwestern quadrant of Wyoming. The Wyoming Department of Agriculture will continue to provide chemical analyses of water samples.

REPORTS PUBLISHED DURING FISCAL YEARS 1987 AND 1988:

Druse, S.A., Glass, W.R., McCollam, P.B., and Kennedy, H.I., 1987, Water-resources data - Wyoming--water year 1986: U.S. Geological Survey Water-Data Report, WY-86-1, 474 p.

Druse, S.A., Glass, W.R., McCollam, P.B., and Peterson, D.A., 1988, Water-resources data - Wyoming--water year 1987: U.S. Geological Survey Water-Data Report, WY-87-1, 396 p.

PROJECT TITLE: Sediment stations (WY 00-004)

FUNDING AGENCIES: Wyoming State Engineer, Wyoming Water Development Commission, Wyoming Department of Environmental Quality, City of Gillette, U.S. Bureau of Reclamation, U.S. Forest Service, and U.S. Geological Survey

PROJECT LEADER: Stanley A. Druse

FIELD LOCATION: Statewide

PERIOD OF PROJECT: Ongoing

PROBLEM: Water-resource planning and water-quality assessment require a nationwide base level of relatively standardized information. Sediment concentrations and discharges in rivers and streams must be defined and monitored.

OBJECTIVE: (1) Provide a national bank of sediment data for use in broad Federal and State planning and action programs, (2) provide data for Federal and State management of interstate waters, and (3) provide data for interpretation in areal studies.

APPROACH: A network of sediment stations will be established and operated to provide data on areal and temporal averages and trends of sediment concentration, sediment discharges, and particle-size distribution of sediment being transported by rivers and streams.

PROGRESS AND SIGNIFICANT RESULTS: Computation and compilation of sediment data were processed ahead of schedule, helping to allow publication of the 1987 data report ahead of the previous year. Thirteen stations were operated during the year with three of them (mountain stations) being sampled for total load during the spring runoff season. All concentration analyses and 0.062 millimeter-split analyses were done in the District Sediment Lab.

PLANS FOR FISCAL YEAR 1989: The three mountain stations will be discontinued and total-load data will be analyzed as part of an investigative project. The discontinuance of these stations will free up some automatic samplers, which are being considered for installation at sites where the project may expand--such as for the City of Gillette.

REPORTS PUBLISHED DURING FISCAL YEARS 1987 AND 1988:

Druse, S.A., Glass, W.R., McCollam, P.B., and Kennedy, H.I., 1987, Water-resources data - Wyoming--water year 1986: U.S. Geological Survey Water-Data Report, WY-86-1, 474 p.

Druse, S.A., Glass, W.R., McCollam, P.B., and Peterson, D.A., 1988, Water-resources data - Wyoming--water year 1987: U.S. Geological Survey Water-Data Report, WY-87-1, 396 p.

WATER-RESOURCES-APPRAISAL PROJECTS

PROJECT TITLE: Water-use data system for Wyoming (WY 84-007)

FUNDING AGENCIES: Wyoming State Engineer and U.S. Geological Survey

PROJECT LEADER: Charles L. Qualls

FIELD LOCATION: Statewide

PERIOD OF PROJECT: January 1984 through September 1991

PROBLEM: The demand for water for a variety of competing uses in Wyoming is expected to continue to increase. Planners and managers at all levels of government need detailed, accurate water information in order to assure that maximum benefits are derived from the available water. Available water-use data for Wyoming may be inconsistent for current management needs. The Geological Survey has designed and implemented a program to develop a uniform national data base of water-use information. A water-use data system is needed in Wyoming, not only to meet national needs, but to provide State agencies with the detailed information needed for water planning and administration.

OBJECTIVE: Establish a water-use data system that is responsive to the needs of water planners at both the State and national levels. The system will provide for the collection, storage, retrieval, and dissemination of water-use data. The data base will include quantitative information about water rights, withdrawals, transfers, and returns.

APPROACH: The State Water-Use Data System (SWUDS), part of the National Water Information System (NWIS) of the U.S. Geological Survey, has been loaded onto the Wyoming District computer. Population of the SWUDS is to be accomplished, region-by-region or basin-by-basin, as project work in the regions or basins allow, beginning with water-use data to be collected as part of the Wind River Indian Reservation water-use program.

PROGRESS AND SIGNIFICANT RESULTS: Interactive computer programs to demonstrate the capability of using a Geographic Information System (GIS) to compute consumptive water use by agriculture in the Green River area were begun. For the same project, GIS coverages of irrigated fields and human-influenced phreatophytic zone boundaries (county and township/range), hydrography, and 7.5-minute topographic quandrangles were created. Main and supporting software for the program to calculate consumptive water use were obtained. Supporting climatological data were obtained, as were crop-distribution data. For the water-use project, in general, a poster session was designed and presented at the American Water Resources Association's Symposium on Water-Use Data, Tucson, Arizona, in August, detailing water use in Wyoming in 1985.

PLANS FOR FISCAL YEAR 1989: Programs to run an interactive computerized geographic information system demonstration model to calculate consumptive agricultural water use in the Green River project area will be completed. A project proposal will be prepared for a water-use project to be run in cooperation with the Wyoming State Engineer and the Shoshone and Arapaho Tribes on the Wind River Indian Reservation. Also, in conjunction with the Wind River Indian Reservation water-use project, it is planned to start entering data into the State Water-Use Data System (SWUDS).

REPORTS COMPLETED DURING FISCAL YEAR 1989:

Schuetz, J.R., in press, Wyoming [Water supply and demand], in National water summary 1987--Selected hydrologic events and water-supply and demand: U.S. Geological Survey Water-Supply Paper 2350.

PROJECT TITLE: Flood investigations in Wyoming (WY 59-010)

FUNDING AGENCIES: Wyoming Highway Department, Lincoln County, Town of Afton, and U.S. Geological Survey

PROJECT LEADER: Stanley A. Druse

FIELD LOCATION: Statewide

PERIOD OF PROJECT: July 1958 through September 1988 (project completed)

PROBLEM: The optimal design of highway-drainage structures requires a knowledge of the magnitude and frequency of peak discharges expected at a given site. This knowledge may be derived either from data collected at the desired location or from regional analysis of peak-flow characteristics. The paucity of peak-flow data for small drainage basins in Wyoming, particularly for ephemeral streams, restricts the use of the regionalization techniques presently available. A network of peak-flow partial-record sites is needed to supplement the existing network of continuous-record streamflow stations.

OBJECTIVE: Obtain sufficient basic hydrologic data to define the magnitude and frequency of floods on a regional basis for the entire State and to publish the interpretative analyses in easily usable form. On request from the cooperator, flood-flow characteristics of streams at specific sites will be determined by studying certain factors as: (1) History of past floods, (2) distribution of flow across the flood-plain and main channel, and (3) mean velocities in the main channel and overflow areas.

APPROACH: Available flood data will be analyzed, and sites for crest-stage gages will be selected where they will best supplement the existing network of continuous-record stream-gaging stations. Stage-discharge relations will be defined for each crest-stage site by recording water stage and by making current-meter measurements, indirect measurements of peak flow, or by using the "step-backwater method." Basin characteristics that are pertinent in flood-frequency analysis will be determined. Frequency characteristics will be related to basin characteristics by regression analysis. Peak-flow measurements will be made at miscellaneous sites when unusual floods occur.

PROGRESS AND SIGNIFICANT RESULTS: A report on use of paleoflood investigations was approved as Water-Resources Investigations Report 88-4209. A report on flood boundaries and water-surface profile for the 100-year flood in Swift Creek near Afton, Wyoming, was approved as Water-Resources Investigations Report 88-4064. A report, "Floodflow characteristics of Wyoming streams--a compilation of previous investigations," was published by the State of Wyoming.

REPORTS COMPLETED DURING FISCAL YEARS 1988 AND 1989.

Cooley, M.E., in press, Use of paleoflood investigations to improve flood-frequency analyses of plains streams in Wyoming: U.S. Geological Survey Water-Resources Investigations Report 88-4209.

Druse, S.A., Lowham, H.W., Cooley, M.E., and Wacker, A.M., 1988, Floodflow characteristics of Wyoming streams--a compilation of previous investigations: Cheyenne, Wyoming Highway Department report, 9 sections with separate pagination.

Rankl, J.G., and Wallace, J.C., in press, Flood boundaries and water-surface profile for the computed 100-year flood, Swift Creek at Afton, Wyoming, 1986: U.S. Geological Survey Water-Resources Investigations Report 88-4064.

PROJECT TITLE: Precipitation, infiltration, and runoff relations for small basins in Wyoming (WY 80-054)

FUNDING AGENCY: U.S. Bureau of Land Management and U.S. Geological Survey

PROJECT LEADER: James G. Rankl

FIELD LOCATION: Statewide

PERIOD OF PROJECT: January 1980 through September 1982; October 1986 through September 1988 (project completed)

PROBLEM: Federal regulations concerning surface mining of coal and reclamation operations specify use of precipitation-frequency criteria for hydraulic design. The problem is to determine runoff volumes from small drainage basins for selected precipitation frequencies. Variability of infiltration rates of soils and other surficial material requires an understanding of the hydrologic processes controlling the relations of precipitation, infiltration, and runoff in small drainage basins.

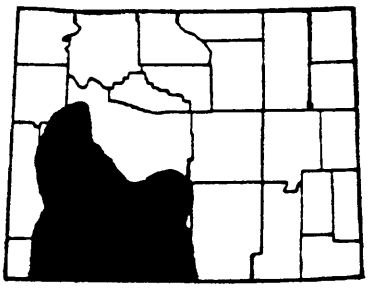
OBJECTIVE: Define infiltration-rate-curves for soils and other surficial materials and determine the relation between infiltration rates computed from basin studies and those computed from infiltration tests.

APPROACH: Rainfall-runoff data previously collected at small ephemeral basins will be used with Soil Conservation Service soil maps and descriptions to define infiltration-rate curves. Infiltrometer data will be collected using a hand-portable model developed by McQueen, U.S. Geological Survey and the rainfall simulator of the Survey Public Lands Hydrology Program. These data will be analyzed statistically and compared to basin runoff.

PROGRESS AND SIGNIFICANT RESULTS: A report, "A point-infiltration model for estimating runoff from rainfall on small basins in semiarid areas of Wyoming," was approved on June 1, 1988, for publication as a Water-Supply Paper.

REPORT COMPLETED DURING FISCAL YEAR 1988:

Rankl, J.G., 1989, A point-infiltration model for estimating runoff from rainfall on small basins in semiarid areas of Wyoming: U.S. Geological Survey Open-File Report 88-337 (also in press as a Water-Supply Paper).



PROJECT TITLE: Upper Colorado River Basin regional aquifer-system analysis, Wyoming (WY 82-070)

FUNDING AGENCY: Geological Survey

PROJECT LEADER: Lawrence J. Martin

FIELD LOCATION: Southwestern Wyoming

PERIOD OF PROJECT: October 1981 through September 1988 (project completed except for the final reports)

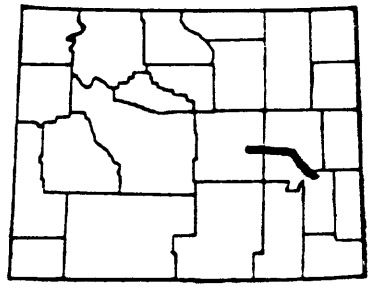
PROBLEM: Ground-water supplies are needed to augment surface-water supplies for mineral development in the Green River basin of Wyoming. The regional availability and quality of supply, hydrologic consequences of development and subsequent disposal of waste water need to be investigated. Overall knowledge of the operation of the three-dimensional ground-water-flow system and its interaction with the surface-water regime is required to assess the effects of ground-water development and to ensure such development does not impair compliance with compacts affecting the upper Colorado River and its tributaries.

OBJECTIVE: (1) Identify aquifer units within the overall hydrogeologic framework, (2) quantitatively estimate aquifer and confining-unit hydraulic properties and parameters, (3) identify structural settings favorable for the development of secondary permeability, (4) infer ground-water flow-system operation and its interaction with the surface-water flow regime, (5) assess regional distribution of ground-water quality and availability of supply, and (6) develop the capability of assessing consequences of current and projected ground-water use.

APPROACH: Water-well, drill-stem-test, and geophysical data from previous investigations will be used to establish the overall hydrogeologic framework, to estimate aquifer and confining-bed hydraulic properties and parameters, and to infer spatial distribution of ground-water quality. Digital-modeling and parameter-estimation techniques will be employed to the extent feasible to develop and refine a conceptualization of overall ground-water flow-system operation. Current and historical ground-water-use data will be collected.

PROGRESS AND SIGNIFICANT RESULTS: A professional paper and four Water-Resources Investigations Reports have completed colleague review and are being processed for submittal for approval.

PROJECT TITLE: Reaeration coefficients and traveltime for major rivers in Wyoming (WY 85-090)



FUNDING AGENCIES: Wyoming Department of Environmental Quality and U.S. Geological Survey

PROJECT LEADER: James G. Rankl

FIELD LOCATION: East-central Wyoming

PERIOD OF PROJECT: March 1985 through March 1989 (suspended January 1, 1986; re-activated 1987) (Project completed)

PROBLEM: The water quality of major rivers in Wyoming is being impacted by discharge of wastewater by industry and municipalities, and by return flow from irrigation. The Wyoming Department of Environmental Quality, Water Quality Division, requires information on reaeration for management activities relative to discharge requirements for municipalities and industries. In addition, information is needed for predicting the downstream dispersion of hazardous-material spills and non-point source pollutants such as sediment and nutrients.

OBJECTIVE: (1) Determine reaeration coefficients for reaches of major rivers in Wyoming, which can be used to quantify the process of reaeration by which the stream replaces dissolved oxygen consumed by organic waste; and (2) determine traveltime and dispersion of solutes.

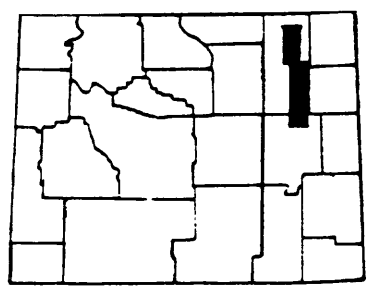
APPROACH: Propane will be injected into the stream by bubbling the gas through a porous-tube diffuser like those used for aeration in waste-water treatment plants. A solution of rhodamine dye and water will be injected at the same point. Eight sites on four rivers have been selected for reaeration studies. At a minimum, each site will require measurements at two cross sections. Twenty gas-water samples will be needed at each cross section to define the gas-concentration curve. Traveltime measurements will be made at high and low flows. For this study, reaeration and traveltime measurements will be made on the North Platte River. Future studies may be done on the Bear and Shoshone Rivers.

PROGRESS AND SIGNIFICANT RESULTS: A report for the North Platte River was completed and was approved for publication by the State of Wyoming.

REPORT COMPLETED DURING FISCAL YEAR 1989:

Rankl, J.G., and Carnevale, M.A., in press, Traveltime and reaeration coefficients for the North Platte River, Casper to Orin, Wyoming: Wyoming Department of Environmental Quality report.

PROJECT TITLE: The occurrence, mobility, and geochemical controls affecting selenium concentrations in ground waters and associated rocks disturbed by mining, Powder River basin, Wyoming (WY 86-094)



FUNDING AGENCY: Wyoming Department of

Environmental Quality and U.S. Geological Survey

PROJECT LEADER: David L. Naftz

FIELD LOCATION: Northeastern Wyoming

PERIOD OF PROJECT: February 1986 through February 1988 (project completed)

PROBLEM: Recent mining for coal and uranium in the Powder River basin of Wyoming has increased selenium concentrations above baseline levels in water from selected wells completed in Tertiary-age aquifers. Due to its proximity to land surface, water from these aquifers is utilized frequently for domestic and livestock uses. Present and future development of coal and uranium resources in the area has the potential to degrade ground water beyond the Class III Use Suitability for livestock.

OBJECTIVE: (1) Characterize pre-mining selenium concentrations in ground water at each of two selected mine sites, (2) characterize the occurrence of selenium in lithologic materials at each mine site, (3) determine the effects of mining on selenium mobility in post-production water, and (4) investigate the geochemical controls on selenium concentration in post-development ground water.

APPROACH: Selenium and other constituents will be analyzed in samples from pre-mining ground water in close proximity to post-development ground water at three selected mine sites. Samples of post-development ground water also will be analyzed. Weathered and unweathered overburden samples will be obtained and analyzed by a variety of techniques, including mineralogical analyses, sulfur and carbon form analyses, and sequential extraction methods. Results gained from the overburden analyses and ground-water analyses of pre- and post-development water will be used to investigate geochemical controls on selenium concentration.

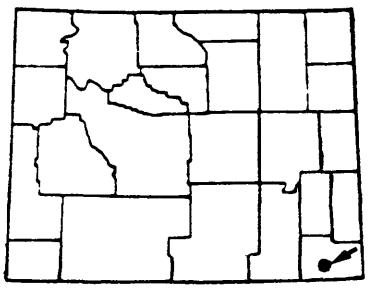
PROGRESS AND SIGNIFICANT RESULTS: A report, "Cumulative Potential Hydrologic Impacts of Surface Coal Mining in the Eastern Powder River Structural Basin," was completed, reviewed, printed, and published as Water-Resources Investigations Report 88-4046. A second report, "Geochemical Processes Controlling Selenium in Ground Water After Mining," has been approved for publication in an outside technical journal. A third report was published in the American Geophysical Union 1988 Hydrology Days Proceedings. Project completed.

REPORTS COMPLETED DURING FISCAL YEARS 1988 AND 1989:

Martin, L.J., Naftz, D.L., Lowham, H.W., and Rankl, J.R., 1988, Cumulative potential hydrologic impacts of surface coal mining in the eastern Powder River structural basin, northeastern Wyoming: U.S. Geological Survey Water-Resources Investigations Report 88-4046, 201 p.

Naftz, D.L., and Rice, J.A., Geochemical processes controlling selenium in ground water after mining, Powder River basin, Wyoming. [Approved as an article in the technical journal, Applied Geochemistry.]

PROJECT TITLE: Site characterization and preparation of a remedial-action plan for the Installation Restoration Program at F.E. Warren Air Force Base, Wyoming (WY 86-095)



FUNDING AGENCY: U.S. Air Force

PROJECT LEADER: L. Rodney Larson

FIELD LOCATION: Southeastern Wyoming

PERIOD OF PROJECT: December 1985 through December 1990

PROBLEM: Contamination of ground water and (or) soil has been suspected or identified at 18 sites at F.E. Warren Air Force Base, Wyoming. The degree and extent of the contamination were not known. These 18 sites have been included in the Air Force Installation Restoration Program at the Base.

OBJECTIVE: The objectives are to assess the effects of the 18 contaminated sites on ground-water quality and to recommend appropriate action to the Air Force. Sites that are recommended for cleanup will have a remedial action plan prepared by a subcontractor. Cleanup methodologies will be screened along with their environmental impacts.

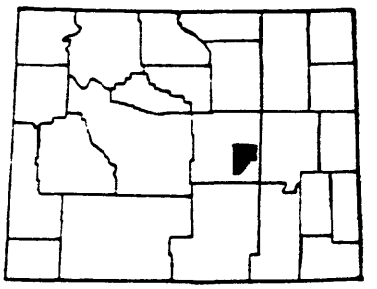
APPROACH: Water-level observation wells will be drilled and logged, aquifer tests performed, and a potentiometric-surface map prepared. Stream-discharge measurements will be made and historical streamflow data analyzed. Soil-gas and surface geophysical surveys will be made to detect and delineate contaminant plumes. Monitoring wells will be drilled and sampled for each of the 18 sites. Core samples of soils will be taken and analyzed to assess soil contamination and potential ground-water contaminants.

PROGRESS AND SIGNIFICANT RESULTS: An administrative draft report summarizing contamination of the soils, surface water and ground water of F.E. Warren Air Force Base was completed on schedule and submitted to the Air Force on October 15, 1987. The investigation of 18 sites on the Base showed that remedial action was warranted at one site, no further action was recommended for 9 sites, and additional investigation was recommended for 8 sites. Following review of the draft report by the Air Force, it was determined that additional work was needed, especially to define apparent new source areas of contamination. A workplan for an expanded study was developed and approved by the Air Force. As part of the new work, an additional 119 2-inch test wells and 60 4-inch monitoring wells were drilled. Additional soil samples were obtained at selected sites. Field gas chromatography was successfully used in conjunction with the 2-inch test wells to locate areas of TCE (trichloroethylene) contamination. These data were used to determine locations of the permanent 4-inch monitoring wells.

PLANS FOR FISCAL YEAR 1989: Following interpretation of the additional data, the draft report will be revised, especially to show plumes of contamination. Another draft administrative progress report summarizing the October 1988 data is scheduled for submittal to the Air Force by April 1, 1989. A quarterly program of sampling ground and surface waters was begun in October 1988 and will be completed in July 1989. A draft report incorporating all

data (1987-1989) is scheduled for submittal to the Air Force by December 1, 1989. This report also will describe additional areas (beyond the original 18 sites) found to be contaminated during the course of investigation.

PROJECT TITLE: Water-quality field screening of irrigation drainage from the Kendrick Project near Casper, Wyoming (WY 86-096)



FUNDING AGENCY: Office of the Secretary of the Interior

PROJECT LEADER: David A. Peterson

FIELD LOCATION: Central Wyoming

PERIOD OF PROJECT: January 1986 through November 1987 (project completed)

PROBLEM: The Department of the Interior needs to identify and address any present or potential irrigation-drainage contamination problems associated with Interior Department irrigation projects, wildlife refuges, or other management areas that receive water from projects funded by the Department. The Department is conducting a nationwide review of water quality of irrigation drainage and the potential of the drainage waters to cause harmful effects on human health or on fish and wildlife. The Bureau of Reclamation's Kendrick Project in central Wyoming is one of the 19 areas that have been identified for further study.

OBJECTIVE: Determine if irrigation-drainage waters from the Kendrick Project have potential to cause harmful effects on human health or on fish and wildlife, or to affect other water uses.

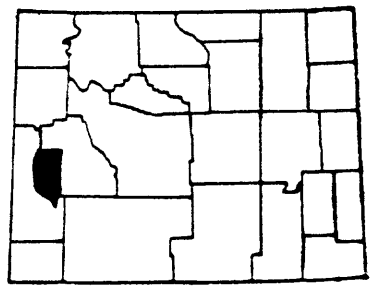
APPROACH: An interagency study team has been formed. The U.S. Geological Survey and the U.S. Bureau of Reclamation will collect two sets of water samples and one set of bottom-material samples at approximately 12 surface-water sites. Also, five wells and the finished water from the City of Casper's treatment plant will be sampled. The samples will be analyzed for a prescribed suite of trace elements and pesticides. The U.S. Fish and Wildlife Service will do biological sampling on plants, plankton, invertebrates, fish, birds, and bird eggs. Tissue samples will be analyzed for a prescribed suite of chemical parameters. The Wyoming Game and Fish Department will be consulted on game and fish populations and related matters. The study team will prepare a final report that summarizes and assesses the data collected.

PROGRESS AND SIGNIFICANT RESULTS: Water-Resources Investigations Report 87-4255 received Director's approval on November 18, 1987, and was published. The project was a reconnaissance-level study, and samples of water, lake-bottom sediments, and biota in and near the area showed elevated concentrations of selenium. Project completed.

REPORT PUBLISHED DURING FISCAL YEAR 1988:

Peterson, D.A., Jones, W.E., and Morton, A.G., 1988, Reconnaissance investigation of water quality, bottom sediment, and biota associated with irrigation drainage in the Kendrick Reclamation Project area, Wyoming, 1986-87: U.S. Geological Survey Water-Resources Investigations Report 87-4255, 57 p.

PROJECT TITLE: Hydrogeology of the Riley Ridge-La Barge area, southwestern Wyoming (WY 86-097)



FUNDING AGENCY: U.S. Bureau of Land Management

PROJECT LEADER: Marion L. Maderak

FIELD LOCATION: Southwestern Wyoming

PERIOD OF PROJECT: June 1986 through September 1989

PROBLEM: Extensive development of oil and gas fields in southwest Wyoming has occurred in recent years. Detailed hydrogeologic studies of the area never have been conducted to determine the extent, thickness, or water quality of aquifers in the area. This information is needed by the U.S. Bureau of Land Management to develop a consistent plan for protection of the freshwater resource and to develop a monitoring plan to evaluate the effect of oil and gas development on ground-water resources in the area.

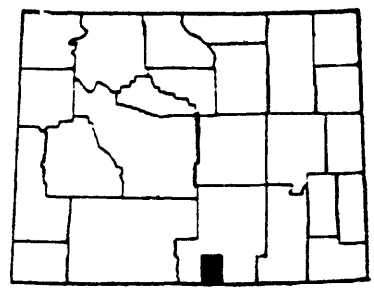
OBJECTIVE: Define the ground-water resources of the Riley Ridge-La Barge area. Aquifers and confining units in the area will be identified, described, and mapped. This study will improve the overall understanding of the hydrologic system in the Green River basin. The scope of the study will be limited to aquifers that yield water with dissolved-solids concentrations less than 5,000 milligrams per liter.

APPROACH: Data from water-well records at the State Engineer's Office and oil- and gas-well records at the office of the U.S. Bureau of Land Management, Rock Springs, Wyoming, will be compiled and used to produce maps and cross sections showing potentiometric surfaces, thickness of aquifers, structure contours, and recharge/discharge areas. Aquifers in the study area will be described, including lithology, rates of ground-water movement, and aquifer transmissivity.

PROGRESS AND SIGNIFICANT RESULTS: Colleague review of the project report was completed, and the report is being revised for submittal for Headquarters approval.

PLANS FOR FISCAL YEAR 1989: Revisions of the project report will be completed. The report will be submitted for Director's approval.

PROJECT TITLE: Assessment of selenium concentrations in soils, sediments, and water; Sandstone Reservoir Project, Carbon County, Wyoming (WY 86-098)



FUNDING AGENCY: Wyoming Water Development Commission and U.S. Geological Survey

PROJECT LEADER: David L. Naftz

FIELD LOCATION: South-central Wyoming

PERIOD OF PROJECT: June 1986 through September 1988 (project completed except for the final report)

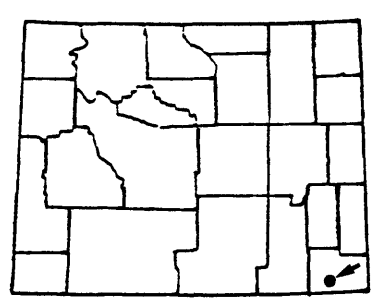
PROBLEM: The proposed Sandstone Reservoir Project, located in the Sierra Madre Mountains near Baggs, Wyoming, will flood soils and sediments that are known to contain selenium. The Steele Shale and the Haystack Member of the Mesa Verde Group, as well as alluvial and landslide deposits derived from these formations, are present in the proposed reservoir area. Flooding of the seleniferrous soils by the construction of Sandstone Reservoir could result in high selenium concentrations in the reservoir waters by dissolution, desorption, and oxidation of selenium-bearing materials.

OBJECTIVE: (1) Determine baseline selenium concentrations in surface and ground water, (2) determine baseline concentrations of total selenium in soils and bedrock materials, and (3) determine the probable chemical form(s) of selenium in selected soil and bedrock samples within the area to be flooded by the proposed Sandstone Reservoir. If the occurrence and availability of selenium is determined to be significant, a second-phase study will be designed and proposed to estimate effects of the reservoir on selenium concentrations in the water.

APPROACH: Baseline selenium concentrations will be measured in surface and ground waters, soils, rocks, and vegetation in the vicinity of the proposed Sandstone Reservoir. Areas containing seleniferrous plants will be utilized as one criterion for selecting sites where soil and bedrock samples will be obtained. Maps will be prepared that show the surface geology, areas of seleniferrous vegetation, sample-site locations, and concentration of selenium at each of the sites. Selected soil and bedrock samples will undergo a series of sequential extractions to determine the chemical form(s) of the selenium.

PROGRESS AND SIGNIFICANT RESULTS: Interpretation of data was completed. The report was completed and submitted for review.

PROJECT TITLE: Flood investigation for Cheyenne, Wyoming (WY 87-100)



FUNDING AGENCY: Wyoming Highway Department, Laramie County, City of Cheyenne, and U.S. Geological Survey

PROJECT LEADER: Myron L. Smalley

FIELD LOCATION: Southeastern Wyoming

PERIOD OF PROJECT: October 1986 through September 1991

PROBLEM: The City of Cheyenne, Wyoming, is susceptible to extreme flooding due to its location in the foothills of the Laramie Mountains. Streams in this area pose a significant flood hazard from intense thunderstorms, especially during the months of July and August. Although more than 80 years of precipitation data are available, the relation between precipitation and runoff has not been defined for rural areas around Cheyenne or for urban areas within the city limits.

OBJECTIVE: (1) Determine the relation between rainfall and runoff for both rural and urban areas, and (2) use the results of the rainfall and runoff relations in conjunction with the 80 years of precipitation data to develop peak and volume frequencies. The peak and volume frequencies will be used by the City of Cheyenne to design the proper size openings for hydraulic structures.

APPROACH: Three streamflow-gaging stations equipped with stage sensors and recording precipitation gages will be installed on channels of three small drainage basins entering the Cheyenne area. An additional site will be installed on Henderson Drain to sample a completely urbanized area. A streamflow-gaging station will be located about 15 miles west of Cheyenne for the purpose of collecting hydrologic data. All sites will be equipped with a flood-alert system operated by the National Weather Service. Hydrologic data will be collected for a period of 4 to 5 years.

PROGRESS AND SIGNIFICANT RESULTS: Flood-alert electronic equipment was installed at the remaining two sites, and all seven remote sites were upgraded and brought into communication with the central receiving site at the office of the National Weather Service. Discharge measurements were obtained at three of the four recording gages during summer rainfall-runoff events, which were of short duration and small magnitude.

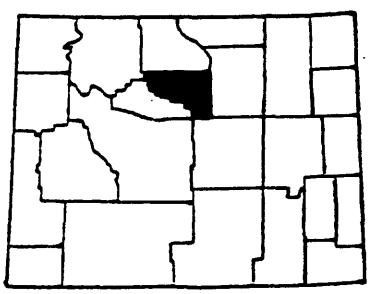
PLANS FOR FISCAL YEAR 1989: Theoretical ratings will be developed at each gaging site, and discharge measurements will be made as opportunities arise. A streamflow-gaging station is planned for Henderson Drain prior to next year. Electronic transfer of data to the Geological Survey data base will be accomplished. A flood study will be conducted on a 3- to 4-mile reach of Child Creek, north of Cheyenne. Data records will be prepared for publication in the annual Water-Data Report or a separate data report.

PROJECT TITLE: Water resources of Washakie County, Wyoming (WY 87-102)

FUNDING AGENCY: Wyoming State Engineer and U.S. Geological Survey

PROJECT LEADER: David D. Susong

FIELD LOCATION: North-central Wyoming



PERIOD OF PROJECT: October 1986 through September 1989

PROBLEM: Ground water of poor chemical quality has long been a problem for residents in the county. Demand for water suitable for domestic use has increased with urban development near the towns of Worland and Tensleep. Water quality and the potential yield of aquifers in the county need to be evaluated.

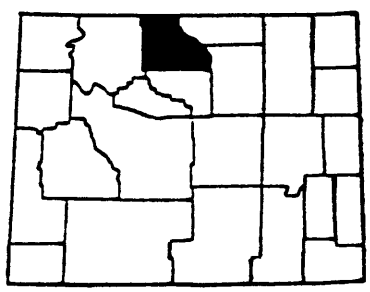
OBJECTIVE: To describe the hydrologic conditions in the county. Determine the general occurrence, chemical quality, and availability of ground water.

APPROACH: Representative wells and springs will be inventoried and the specific conductance of ground water will be measured. Samples of ground water will be collected for mineral analysis. Some ground water will be analyzed to determine if specific contaminants are in the water. Observation wells will be established and monitored for water-level fluctuations.

PROGRESS AND SIGNIFICANT RESULTS: A new project chief completed orientation of the study and area. Well schedules were completed for sites in outlying parts of the county.

PLANS FOR FISCAL YEAR 1989: The following tasks will be accomplished: (1) Develop detailed workplan and report outline, (2) inventory discharge data for wells withdrawing water in oil fields, (3) check artesian irrigation wells in Tensleep area for shut-in pressure, (4) tabulate data collected to date, and (5) complete the project report.

PROJECT TITLE: Water resources of Big Horn County, Wyoming (WY 87-103)



FUNDING AGENCY: Wyoming State Engineer and U.S. Geological Survey

PROJECT LEADER: Earl W. Cassidy

FIELD LOCATION: North-central Wyoming

PERIOD OF PROJECT: October 1986 through September 1989

PROBLEM: It is desirable to consolidate data concerning water resources in Big Horn County into a publication that is easily usable by planners and the general public. Data on ground-water quality and availability are lacking in many areas. Water quality is a primary concern countywide, and the potential for agricultural contamination of shallow ground water exists in many areas. There is a need to establish a network of ground-water monitoring wells to evaluate changes in reservoir pressure and yields in flowing wells along the western flanks of the Bighorn Mountains.

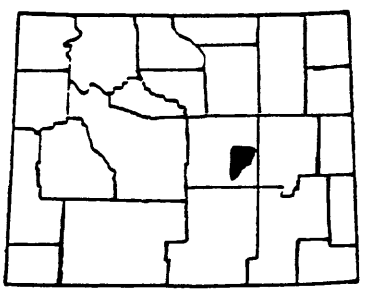
OBJECTIVE: Describe and characterize the water resources and hydrology of Big Horn County. This includes delineating the availability and quality of water from aquifers throughout the county and the construction of potentiometric-surface maps where enough data are available.

APPROACH: Data will be compiled from previous studies and the files of State and Federal agencies. Additional representative wells will be inventoried and water levels measured. Water-quality samples will be collected for inorganic water-chemistry analyses. Selected ground-water samples also will be evaluated for agricultural herbicides and insecticides. Yields and pressures from selected monitoring wells along the Bighorn Mountains front will be recorded at regular intervals to evaluate long-term reservoir trends.

PROGRESS AND SIGNIFICANT RESULTS: Well-head pressures in selected artesian wells were measured before and during the irrigation season to characterize short- and long-term trends. In 1988, ground-water sampling for herbicide and insecticide analyses was completed for 24 wells in areas where intensive agriculture is practiced. Of the results received to date, 2 of the 12 samples contained detectable levels of insecticides. Three of 8 wells sampled in 1987 contained detectable levels of herbicides. A county-wide well inventory was completed, which included sampling for chemical analyses in 75 wells. Seepage runs were conducted on three streams that cross outcrops of Paleozoic rocks to characterize the magnitude of this possible recharge component. A county-wide network of ground-water monitoring wells was established to characterize the magnitude of seasonal water-level fluctuations in alluvial and bedrock aquifers.

PLANS FOR FISCAL YEAR 1989: Continued monitoring of yields and pressures in flowing wells and water-level measurements in the ground-water monitoring network are planned. Data compilation, analyses, and results are to be completed. The project report will be completed, reviewed, and submitted for approval by the Director.

PROJECT TITLE: Trace elements in water, soil, and rocks of the Kendrick Irrigation Project, Natrona County, Wyoming (WY 87-104)



FUNDING AGENCY: Wyoming Department of Environmental Quality and U.S. Geological Survey

PROJECT LEADER: David A. Peterson

FIELD LOCATION: Central Wyoming

PERIOD OF PROJECT: August 1987 through September 1990

PROBLEM: Elevated concentrations of selenium were found in samples of surface and ground water, bottom sediment, and biota of the Kendrick Project during a field-screening study conducted in 1986-87 as part of the Department of the Interior's Irrigation Drainage Program. Due to the limited number of samples collected during the field-screening study, the extent of the elevated selenium concentrations could not be assessed and further study appears to be warranted.

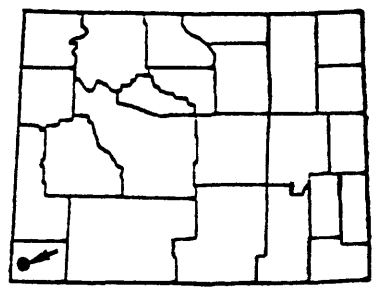
OBJECTIVE: Determine location and seasonal variation of selenium and other trace elements in surface and ground water, and whether irrigation-drainage waters have potential to cause harmful effects on human health and on fish and wildlife, or to affect other water uses.

APPROACH: Location and seasonal variation of trace elements in surface water will be determined through a monitoring program of regularly scheduled visits in conjunction with miscellaneous samples. Nine stream sites (monthly samples) and four pond sites (quarterly samples) have been selected for monitoring. Constituents of interest include dissolved and suspended forms of trace elements, field parameters, turbidity, and suspended sediment.

PROGRESS AND SIGNIFICANT RESULTS: Monthly sampling at nine stream sites began in January 1988, and quarterly sampling at four wetland sites began in March 1988. Sample sites were added along the North Platte River to better enable use of a water-quality model. The Wyoming Department of Environmental Quality operated the model and provided related computer software for direct-services credit.

PLANS FOR FISCAL YEAR 1989: Data collection will be complete as of December 1988. Data will be analyzed and the project report prepared.

PROJECT TITLE: Streamflows and channel characteristics of the Bear River at Evanston, Wyoming (WY 88-105)



FUNDING AGENCY: Wyoming Parks and Recreation Commission, Uinta County, City of Evanston, and U.S. Geological Survey

PROJECT LEADER: Marion L. Maderak

FIELD LOCATION: Southwestern Wyoming

PERIOD OF PROJECT: January 1987 through September 1990

PROBLEM: Channel alterations caused by high flows of 1983 and 1984, by landowners constricting and straightening the channel to increase property area, and by the City of Evanston adding riprap and dikes to control bank erosion and flooding have resulted in channel instability. The channel instability has caused the formation of a headcut that has lowered the channel through the town as much as 3 feet. Bank erosion has caused water-quality problems, the loss of fish habitat, increased flooding in some areas, and the destruction of streamside property in other areas.

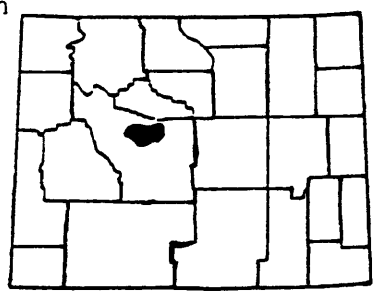
OBJECTIVE: Provide background hydrologic and hydraulic information to be used as an aid to a comprehensive plan for the correction of channel problems and the re-beautification of the Bear River at and near Evanston, Wyoming.

APPROACH: Aerial photos will be used to document changes in channel and sinuosity. An advisory committee of hydrologists, engineers, fishery biologists, and planners will review background data and make recommendations for corrective actions, and possible funding. The U.S. Geological Survey will evaluate the effects of the proposed corrective actions, such as drop structures and jetties, on streamflow and channel characteristics, river hydraulics, and 100-year flood flows.

PROGRESS AND SIGNIFICANT RESULTS: Areas of active bank erosion and channel modification were determined. Suspended-sediment and bedload data were collected during spring runoff. Additional cross sections were surveyed to determine channel changes that may result from installation of a stabilizing structure. The project field work is about 60 percent completed. The report outline was completed, but will need revision when more results are available.

PLANS FOR FISCAL YEAR 1989: Additional suspended-sediment and bed-load data will be collected during the 1989 spring runoff to evaluate any change in loads resulting from installation of the stabilizing structure. The hydraulics of the study reach will be evaluated using a surface-water computer model. Additional cross-sectional data will be obtained to evaluate the effects of diversion and stabilizing structures on channel characteristics. The wetlands and vegetation inventory will be completed.

PROJECT TITLE: Field screening study of water quality, bottom sediments, and biota of the Riverton Irrigation Project, Fremont County, Wyoming (WY 88-106)



FUNDING AGENCY: Office of the Secretary of the Interior

PROJECT LEADER: David A. Peterson

FIELD LOCATION: Central Wyoming

PERIOD OF PROJECT: October 1987 through September 1989

PROBLEM: The Department of the Interior Irrigation Drainage Program selected 19 areas in the western United States where irrigation drainage may have negative effects on wildlife such as the deformed birds observed at Kesterson National Wildlife Refuge in California. Nine areas were studied during 1986-87; the Riverton Project is one of 10 areas to be studied during 1988-89.

OBJECTIVE: Determine whether irrigation drainage has caused or has the potential to cause harmful effects on human health or on fish and wildlife, or to affect other beneficial uses of the water.

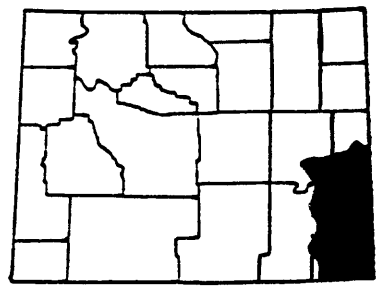
APPROACH: Sampling sites for surface water and bottom sediment will be selected at the upstream and downstream edges of the project, as well as within. Streams and canals to be sampled include Muddy Creek, Fivemile Creek, and Wyoming Canal. Ocean Lake and other State wildfowl management areas also will be sampled. Water analyses will include trace elements and pesticides; bottom sediments will be analyzed for major and minor elements; and biota from several trophic levels will be analyzed for trace elements and organochlorine pesticides.

PROGRESS AND SIGNIFICANT RESULTS: Samples were collected during August 1988 for analyses of trace elements and pesticides in water and bottom sediment. Based on field reconnaissance, two sites on the Wind River were dropped from

the study, and two sites on wetlands were shifted to different locations. Biological sampling and observations began in the spring and continued through the summer.

PLANS FOR NEXT FISCAL YEAR: Surface-water-quality samples will be collected during November 1988. Following receipt of data from the laboratory, the data will be analyzed and the project report will be prepared. The report will be ready for colleague review by August 1, 1989.

PROJECT TITLE: Description and analysis of water-level changes in the High Plains Aquifer, Wyoming (WY 88-107)



FUNDING AGENCY: Wyoming State Engineer and U.S. Geological Survey

PROJECT LEADER: Charles A. Qualls

FIELD LOCATION: Southeastern Wyoming

PERIOD OF PROJECT: April 1988 through September 1992

PROBLEM: In response to concerns over the status of conditions in the High Plains (Ogallala) aquifer, Congress has directed the U.S. Geological Survey to monitor water levels in the aquifer and to report the results annually to them.

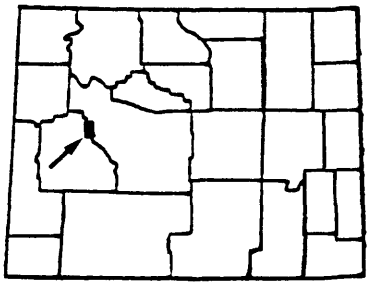
OBJECTIVE: The directive from Congress will be met by preparing an annual report with information concerning (1) changes in water levels or storage, (2) changes in water quality with time, (3) factors such as climatic and land-use conditions that affect the aquifer, and (4) results of an analysis of the relationships between causative factors and changes in the aquifer.

APPROACH: Data on ground-water levels will be collected, and new observation wells will be installed where necessary. Data that have been collected by State agencies will be compiled and reviewed. All data will be analyzed and presented in annual reports.

PROGRESS AND SIGNIFICANT RESULTS: Two wells were drilled by personnel from the Wyoming State Engineer's Office and are available for addition to the ground-water-level network. The Wyoming State Engineer continued to collect data for direct-services credit. Water meters were purchased for installation on irrigation wells to study water use; identification of specific wells for metering is underway. Water-level data were updated and made available to project personnel at the U.S. Geological Survey, Central Region Office, Denver, Colorado. The Wyoming section of the annual report was prepared and submitted to the Central Region.

PLANS FOR FISCAL YEAR 1988: The following tasks are planned: (1) Identify representative wells for studying irrigation water use and install meters; (2) develop data base and algorithms to compute water use; (3) obtain crop-distribution data and meteorologic data; (4) collect water-level and rainfall data; and (5) establish new water-level (ground-water) sites to improve areal data coverage.

PROJECT TITLE: Glacial ice-core geochemistry of selected alpine glaciers, Wind River Range, Wyoming (WY 88-108 and WY 88-109)



FUNDING AGENCY: Western Wyoming College and U.S. Geological Survey

PROJECT LEADER: David L. Naftz

FIELD LOCATION: West-central Wyoming

PERIOD OF PROJECT: March 1988 through September 1990

PROBLEM: As a result of current and possible future economic development in the Green River basin in Wyoming, areas within the Wind River Range may be susceptible to atmospheric deposition of sulfuric acid. Because most collection of baseline information was not begun until 1983, existing sources of acid deposition in the Green River basin have the potential to obscure the meaning of "pre-development baseline conditions" and possibly affect future regulatory decisions. Chemical analyses of snow and ice samples from glaciers in the Wind River Range could provide insight into these pre-development conditions.

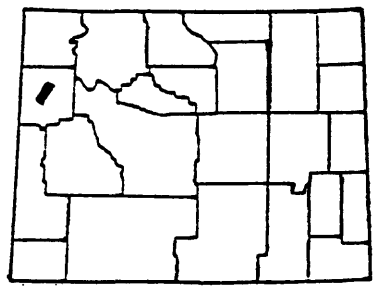
OBJECTIVE: Define the chemical differences in wet and dry atmospheric deposition through time (pre-development to present) in watersheds in the Wind River Range by sampling snow and ice from large alpine glaciers in the Range.

APPROACH: Sampling will be conducted in two phases. Phase I will include sampling of one glacier. The following year, Phase II will include sampling of multiple points on four glaciers. Samples will be collected at 0.5-meter intervals, to a maximum depth of 20 meters. Tritium and fluorocarbon concentrations will be determined with depth to infer a relative time marker in the ice and snow. Historical trends in the chemical composition of precipitation will be determined by analyzing the ice and snow cores for changes in concentration with depth of selected major, minor, and trace constituents.

PROGRESS AND SIGNIFICANT RESULTS: Sampling was completed on Bull Lake glacier to a depth of 3 meters. Twenty-five ice samples were submitted for analyses of major and trace elements, S-34/S-32 isotopic ratios, tritium, and halocarbon concentrations. Preliminary results from the halocarbon analyses show detectable amounts of fluorocarbon in selected ice samples.

PLANS FOR FISCAL YEAR 1989: Sampling will be expanded to other glaciers in the Wind River Range. An ice auger will be modified to allow for samples to be taken to depths of 20 meters in the ice. Howard Taylor from the National Research Program will be a co-investigator for the remaining term of the project.

PROJECT TITLE: A geographic information system for evaluating potential disturbance of Bald Eagles by recreational use of the Snake River in Grand Teton National Park, Wyoming (WY 88-110)



FUNDING AGENCY: U.S. Geological Survey

PROJECT LEADER: James F. Wilson, Jr.

FIELD LOCATION: Northwestern Wyoming

PERIOD OF PROJECT: March 1988 through September 1989

PROBLEM: The Snake River and its valley downstream from Jackson Lake Dam in Grand Teton National Park, Wyoming, are used heavily during the summer for recreational activities--especially for scenic float trips and for trout fishing. If uncontrolled, this human use of the area disturbs the nesting and foraging of bald eagles that live along the river. The recreational capacity of the area varies directly with the flow and velocity of the river. The National Park Service needs management tools for controlling recreational use of the river so as to minimize disturbance of the eagles.

OBJECTIVE: The objective is to develop an interactive Geographic Information System (GIS) for assessing the potential disturbance of bald eagles by rafting and other recreational use of the Snake River.

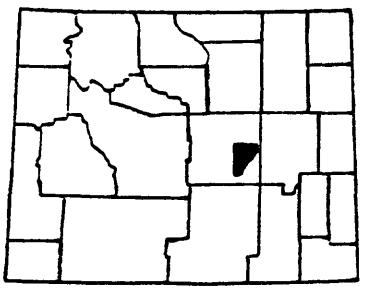
APPROACH: A Geographic Information System (GIS) will be created from basic coverages of hydrography and cultural features at 7.5-minute scale, and thematic coverages of eagle nests and forage areas, eagle-disturbance zones, river thalweg, and flow data from the gaging station below the dam. Analyses will be based on monthly river-usage data. A previously developed mathematical model of rafting versus disturbance of eagles will be evaluated for application of GIS procedures. Separate analyses also will be made of selected river reaches by "routing" rafts down the river under selected scenarios of streamflow and timing and number of rafts. The GIS techniques will be used to determine the degree of potential disturbance as rafts pass through areas used by eagles, or to delineate protected zones into which human passage is controlled.

PROGRESS AND SIGNIFICANT RESULTS: A Geographic Information System (GIS) was created for a four-quadrangle (1:24,000) area of Grand Teton National Park. Coverages include streams, lakes, roads, eagle nests, and recreation turnouts along the Snake River. The GIS software was used to create specified buffers (disturbance zones) along the river and around the eagle nests. Streamflow statistics were compiled. The National Park Service cumulative-effects model for estimating percent of eagle habitat disturbed by river rafting and bank usage was obtained and loaded onto the local computer. Meetings with the National Park Service scientists were held to determine how streamflow information can be used in the GIS. Statistics on recreational use of the Snake River were obtained from the National Park Service.

PLANS FOR FISCAL YEAR 1989: The relationship of traveltime (based on surface velocity) to discharge in the Snake River below Jackson Lake Dam will be developed from previously published regression equations. The relationship

will be used to make rough estimates of hypothetical rafting and the corresponding degree of eagle disturbance in the buffer zones. The cumulative-effects model also will be adapted to the GIS, although the applicability will be minimal. A report describing results of the study will be completed, reviewed, and submitted for approval.

PROJECT TITLE: Detailed study and assessment of irrigation drainage in the Kendrick Reclamation Project area, Wyoming (WY 88-111)



FUNDING AGENCY: Office of the Secretary of the Interior

PROJECT LEADER: David L. Naftz

FIELD LOCATION: Central Wyoming

PERIOD OF PROJECT: October 1987 through September 1990

PROBLEM: Samples taken on or near the Kendrick Project have shown elevated concentrations of selenium in water, bottom sediments, and biota. The studies to date have been at a reconnaissance level and, with the data currently available, an evaluation of whether the elevated concentrations are localized or widespread requires additional information. In addition, the geochemical and biological processess controlling the mobility and availability of selenium and associated trace elements are not understood at the Kendrick Project. An understanding of these processes is needed to evaluate the magnitude of potential toxicity problems and provide data for any mitigative measures that may be needed.

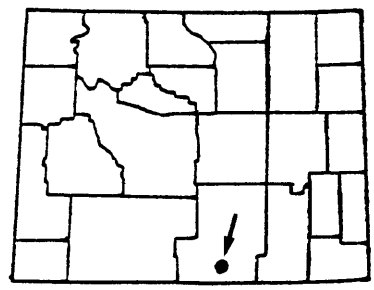
OBJECTIVE: To determine the extent, magnitude, and effects of contaminants associated with irrigation drainage and, where effects are documented, the sources and exposure pathways that cause contamination.

APPROACH: An interagency study team has been formed. Work elements include: (1) Sampling tributaries; (2) locating and sampling domestic and livestock wells; (3) determining bird nesting success, species composition, and frequency of use; (4) determining contaminant levels in rainbow trout and waterfowl; (5) determining relationships between trace-element concentrations in Kendrick waterfowl and fish to those in water, sediment, and diet organisms; (6) determining which irrigated areas are contributing the largest concentrations of selenium; (7) determining the physical and geochemical process controlling selenium mobility; and (8) determining the geologic sources of selenium and associated trace elements.

PROGRESS AND SIGNIFICANT RESULTS: Collection of plant and soil samples in and adjacent to the irrigated areas was completed. Chemical analyses of plant samples are complete. Water-quality monitoring at numerous stream, drain, and wetland sites is continuing. Two extensive water-quality surveys of drains were completed in the irrigated areas of the project. Sites were selected for the ground-water investigation.

PLANS FOR FISCAL YEAR 1989: Water-quality monitoring will be continued at selected stream, drain, and wetland sites. Interpretation of the soil, plant, and water-quality data will begin. Wells will be installed to determine the vertical and lateral distribution of selenium and associated trace elements. Automatic samplers will be used to collect samples at selected sites to monitor the effect of natural runoff on selenium transport and concentration.

PROJECT TITLE: Sediment transport of streams in the Sierra Madre, Wyoming (WY 88-112)



FUNDING AGENCY: Wyoming Water Development Commission and U.S. Geological Survey

PROJECT LEADER: James G. Rankl

FIELD LOCATION: South-central Wyoming

PERIOD OF PROJECT: October 1987 through September 1989

PROBLEM: In response to a proposal to divert water from streams draining the west slope of the Sierra Madre in Wyoming, the U.S. Forest Service is concerned that subsequent reduced flows may alter the sediment-transport capacity of streams and cause deterioration of fishery habitat downstream from the diversions. Specific concerns are: (1) That high flows may be significantly reduced in the stream channels downstream from the diversions; and (2) that fine sediments normally flushed through the system may deposit in streambed gravels downstream from the diversions, inhibiting fish habitat and breeding conditions.

OBJECTIVE: (1) Define the total sediment discharge passing through the reaches of the three streamflow-gaging stations on Battle Creek, Big Sandstone Creek, and East Fork Savery Creek; (2) identify the magnitude and duration of streamflow required to maintain historical channel conditions; and (3) develop a method to evaluate the effects of reducing high flows on the transport of sediments in mountain streams having limited sediment supply and to predict transport capabilities of such streams.

APPROACH: Sediment transport relations based on 3 years of data collection will be derived for the gaged sites and compared with data-based relations from downstream sites and several miscellaneous locations. If there is no significant difference between sites, a regional relation can be developed for the basin, providing a methodology to predict the amount of water that can be diverted at each site. This would be advantageous if potential for future development exists for the basin.

PROGRESS AND SIGNIFICANT RESULTS: All streamflow, suspended-sediment, bedload, and bed-material data needed for the project have been collected. Channel surveys have been completed for the three continuous-record stations. All sediment samples have been analyzed. Relations between bedload and discharge, and between suspended-sediment concentration and water discharge have been analyzed. Preliminary analysis indicates that a relation between the sediment transported by the streams and sediment availability can be established.

PLANS FOR FISCAL YEAR 1989: The relation between sediment transport and stream discharge will be related to the hydraulic characteristics of the streams and to geology in order to regionalize the results for the study area. The first draft of the report will be completed by June 30, 1989.

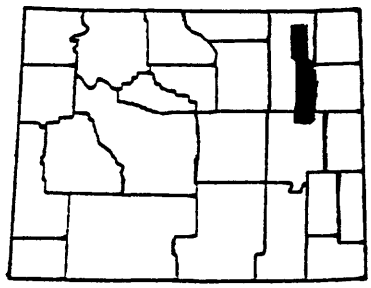
PROJECT TITLE: Test update of the data base for the Ground-Water Site Inventory System, Wyoming (WY 88-113)

FUNDING AGENCY: U.S. Bureau of Land Management and U.S. Geological Survey

PROJECT LEADER: Charles A. Qualls

FIELD LOCATION: Northeastern Wyoming

PERIOD OF PROJECT: April 1988 through September 1990



PROBLEM: The U.S. Bureau of Land Management (BLM) needs access to a computerized data base with information on all, or at least most, of the water wells in the State. The BLM frequently needs information on the location of wells in the vicinity of a proposed development. The BLM also has occasional need for information on well construction, water levels, and water quality in a given area.

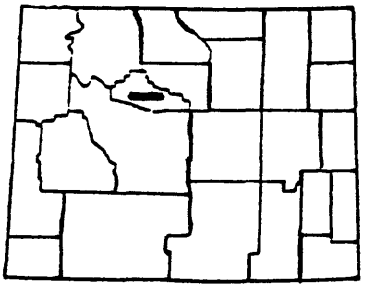
OBJECTIVE: The U.S. Geological Survey maintains a computerized data base, the Ground-Water Site Inventory (GWSI), as part of its National Water Information System (NWIS). The objective of this study is to examine the GWSI data base for a specific area in the Casper District of the BLM, to identify well information that should be modified or deleted from GWSI, to obtain new information on wells in the area, and to make a refined data base available to BLM staff in the Casper District and the Wyoming State Office.

APPROACH: The initial effort of the study will be an examination of an area of Campbell and Converse Counties, northeastern Wyoming. The GWSI data base will be examined, and data will be protected for sites with water-quality data or other evidence of past field inspections. Additional data from the State Engineer's Office will be examined for inclusion in GWSI, and the updated data base will be made available to the BLM in a computerized format.

PROGRESS AND SIGNIFICANT RESULTS: A Geographic Information System coverage was created from the Wyoming State Engineer (WSE) well data for a 30-by-30-minute pilot area. Ground Water Site Inventory (GWSI) data for the same area were retrieved and compared to the WSE data. It was determined that GWSI records match only about 5 percent of the WSE records. Algorithms to reformat the WSE data could be developed to enter WSE data and statistically check data for accuracy, although much manual work still would be required to fill GWSI requirements.

PLANS FOR FISCAL YEAR 1989: Plans will be discussed at a meeting with the U.S. Bureau of Land Management to continue the project to cover other pilot areas for further study or to develop a project to enter WSE well data into GWSI statewide.

PROJECT TITLE: Quality of surface water and ground water in the Owl Creek basin, Wind River Indian Reservation, Wyoming (WY 88-114)



FUNDING AGENCY: Northern Arapaho Tribe and U.S. Geological Survey

PROJECT LEADER: Kathy M. Ogle

FIELD LOCATION: Central Wyoming

PERIOD OF PROJECT: July 1988 through December 1989

PROBLEM: Water quality limits the use of water in much of the Owl Creek basin. Surface water is used for irrigation, but has a high to very high salinity hazard. Water from the alluvial aquifer generally is unsuitable for most purposes other than stock watering. Water for domestic supply must be hauled to ranches in the area at a substantial cost to the Arapaho Tribe.

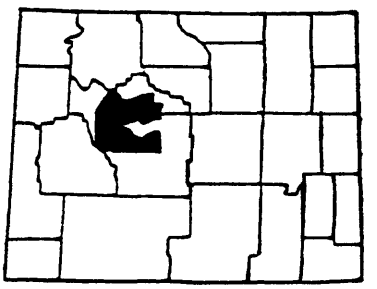
OBJECTIVE: Assess whether the quantity and quality of surface or ground water in the Owl Creek basin is suitable as a potential source of drinking-water supply.

APPROACH: (1) Compile data from U.S. Geological Survey and private consultants; (2) analyze data to determine where additional data are needed; (3) collect additional surface-water and ground-water data; and (4) perform quality control of non-Survey data, and enter into the computer data base.

PROGRESS AND SIGNIFICANT RESULTS: A reconnaissance trip was made to the area. A literature search was started--some data exist from previous studies of the area. These data are available, as are a limited amount of data from the Indian Health Service. Additional data were gathered in January 1989.

PLANS FOR FISCAL YEAR 1989: A literature search will be conducted, and data will be compiled. The data will be examined to determine which parts of the study area need additional data collection. A workplan and outline for the report have been developed. Additional data will be collected in March. A draft report will be completed by December 1989.

PROJECT TITLE: Hydrologic appraisal of the Wind River Indian Reservation, Wyoming (WY 88-115)



FUNDING AGENCY: Northern Arapaho Tribe, Shoshone Tribe, and U.S. Geological Survey

PROJECT LEADER: Richard L. Daddow

FIELD LOCATION: Central Wyoming

PERIOD OF PROJECT: July 1988 through September 1991

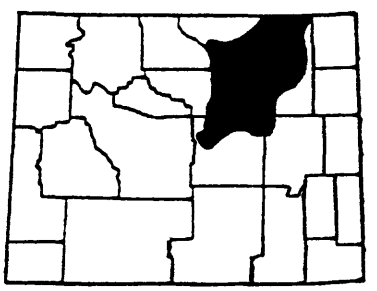
PROBLEM: A comprehensive appraisal of the ground-water resources of the area was undertaken 20 years ago. No comprehensive appraisal of the surface-water resources has been published, although substantial amounts of data have been gathered. An understanding of the quantity and quality of the water resources of the reservation is necessary before the water resources can be fully utilized.

OBJECTIVE: (1) Appraise the water resources of the Wind River Reservation, and (2) write a comprehensive report to be used by water-resources managers.

APPROACH: (1) Compile data; (2) do preliminary data analysis to identify areas where more data are needed; (3) develop and implement data-collection plan; and (4) do final data analysis and prepare report.

PROGRESS AND SIGNIFICANT RESULTS: Numerous Federal, State, and local agencies and private consulting firms were contacted about the availability of water-resources data and reports about the reservation, and a computerized literature search was completed. A meeting was held with representatives of the Tribes to discuss special concerns and to coordinate the study. A preliminary water-resources data retrieval from the U.S. Geological Survey surface-water, ground-water, and water-quality data bases was completed. Preparation of a base map of the reservation by the U.S. Bureau of Land Management, Wyoming State Office, was started. A preliminary field reconnaissance of the reservation was conducted.

PLANS FOR FISCAL YEAR 1989: A detailed workplan will be developed and an annotated outline of the project report will be completed. A detailed literature review will be completed. Compilation and computer entry of water-resources data will be completed. Additional field reconnaissance will be done. Preliminary analysis of water-resources data will be done, and areas will be identified where more data are needed. A field data-collection plan will be developed and implemented. A geographic information system will be developed for the reservation. Periodic project-review meetings will be held with Tribal representatives to discuss project progress and planned activities.



PROJECT TITLE: Water quality of the Powder River, Wyoming and Montana (WY 88-116)

FUNDING AGENCY: Wyoming State Engineer, Wyoming Water Development Commission, and U.S. Geological Survey

PROJECT LEADER: Juli B. Lunsford

FIELD LOCATION: Northeastern Wyoming and Southeastern Montana

PERIOD OF PROJECT: July 1988 through September 1990

PROBLEM: Water from the Powder River and its tributaries is used for irrigation, industry, and domestic and livestock supply. Water in the downstream reach of the river always has been of marginal quality for irrigation. Dissolved-solids concentrations tend to be greater during

periods of lower flow, particularly during the summer irrigation season, and smaller during periods of high flow, such as spring runoff. Additional knowledge and understanding of the water-quality characteristics of the river system is needed before managers can evaluate potential changes in quality resulting from hydrologic changes.

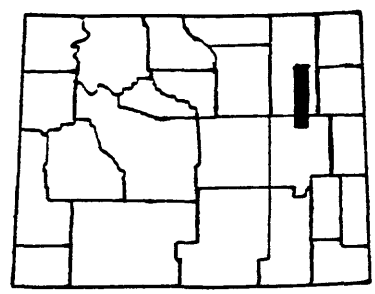
OBJECTIVE: (1) Compile and expand available water-quality data for the basin; (2) determine water-quality characteristics of the Powder River and its major tributaries; (3) develop a conceptual model of the river system; and (4) develop a computer-based mass-balance accounting model for the river system.

APPROACH: (1) Compile streamflow and water-quality data, measure mean-daily specific conductance in the Powder River at Sussex, Wyo., sample 13 sites on a near-monthly basis for 18 months, analyze samples for common ions and field parameters; (2) conduct synoptic flow and water-quality measurements on mainstem and significant tributaries, determine land use and water use, evaluate data for trends; (3) develop a conceptual model; and (4) develop mass-balance model to check conceptual model and to provide managers a tool for future resource evaluation.

PROGRESS AND SIGNIFICANT RESULTS: Exploratory data analysis is complete. An annotated outline has been written. Gaps in the data record have been identified. Regular water-quality sampling began in July 1988 and is continuing. Reconnaissance-type sampling scheduled for fall of 1988 has been postponed until 1989 due to extremely dry conditions. Possible components of a conceptual model have been identified. A computer model has been selected, and tentative model nodes have been assigned.

PLANS FOR FISCAL YEAR 1989: Data-collection activities, including three synoptic samping events, will be continued. Statistical analysis and trend analysis will be made of data for major water-quality stations. The conceptual model will be developed, and work will proceed to develop regression relations and calibrate a computer model.

PROJECT TITLE: Ground-water recharge and discharge in backfilled spoil material at surface coal mines, Powder River Basin, Wyoming (WY 88-117)



FUNDING AGENCY: U.S. Bureau of Land Management and U.S. Geological Survey

PROJECT LEADER: Kathy M. Ogle

FIELD LOCATION: Northeastern Wyoming

PERIOD OF PROJECT: June 1988 through September 1990

PROBLEM: Surface coal-mine operations at current leases in Campbell and northern Converse Counties eventually will disturb over 82,000 acres of land in northeastern Wyoming. After mining, the reclaimed coal spoil undergoes weathering, settling, and compacting for an unknown period of time before

reaching equilibrium. Rubblizing of the overburden during mining and disturbance of the original stratigraphic order during backfilling probably will change the hydraulic properties of the backfilled spoil material and increase potential for dissolution of minerals. Because the mines are located in a recharge area, any changes in transmissivity or recharge rate could affect well yields in a large area.

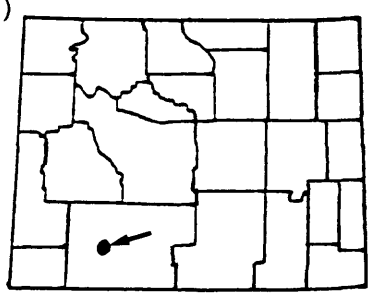
OBJECTIVE: (1) Determine the source(s) of recharge to and discharge from backfilled spoils; (2) estimate the length of time required to recharge the backfilled spoils to a steady-state condition; (3) determine aquifer properties of the backfilled spoils; and (4) interchange study results with project chiefs of related spoils studies in Colorado and Montana.

APPROACH: Precipitation gages will be used to determine the volume of water entering the ground-water and surface-water system at each of two to three sites. The volume of water in the unsaturated zone will be measured using a neutron probe to show changes in soil-water content during the year, and changes in unsaturated zone storage from year to year. Gravity lysimeters will be buried in reclaimed spoils below the root zone to sample water that is representative of recharge from surface infiltration. Monitoring wells will be completed in the reclaimed spoil aquifer, in underburden, and in undisturbed areas. These wells will be used to (1) identify changes in ground-water storage; (2) define the potentiometric surface of aquifers; and (3) conduct aquifer tests of the spoil aquifer.

PROGRESS AND SIGNIFICANT RESULTS: Two sites have been identified for the installation of lysimeters and observation wells. Permission to install the monitoring equipment is pending as of late October 1988. The basic equipment has been ordered and is being prepared as required for installation.

PLANS FOR FISCAL YEAR 1989: The level of financial support available from the U.S. Bureau of Land Management will be identified. Additional funding will be pursued to support related water-quality studies and to monitor the existing installation. Additional equipment will be ordered following receipt of a funding committment by the cooperator.

PROJECT TITLE: Effects of in-situ oil-shale retorting on water quality near Rock Springs, Wyoming (WY 88-118)



FUNDING AGENCY: U.S. Department of Energy

PROJECT LEADER: Juli B. Lunsford

FIELD LOCATION: Southwestern Wyoming

PERIOD OF PROJECT: July 1988 through September 1990

PROBLEM: A variety of experimental in-situ oil-shale retorting techniques was used from 1969-1979 at the U.S. Department of Energy sites near Rock Springs, in southwestern Wyoming. Water of very poor quality was produced during the experiments. Recent sampling indicated that the plume of contaminated water had migrated from the experiment site to a nearby creek,

which ultimately discharges into the Green River and Flaming Gorge Reservoir. Contaminants also might move from the oil-shale aquifer into the underlying aquifer (which can be used for domestic supply); it is unclear whether the two formations are hydraulically connected.

OBJECTIVE: To determine the current nature and extent of the contamination at all sites in the study area, and to investigate the movement and fate of the contaminants in the hydrologic system.

APPROACH: Twelve to 15 monitoring wells will be drilled and logged. Wells will be constructed and sampled according to National Water Quality Assessment field procedures for ground water. The wells will have screens 10 to 15 feet in length and will be screened at different depths in the formation to enable definition of the plume in three dimensions and estimation of vertical leakage between layers. Head-space analyses will be performed in the field using a portable gas chromatograph, and wells will be sampled for a wide range of organic and inorganic constituents.

PROGRESS AND SIGNIFICANT RESULTS: Start of work was delayed pending a signed interagency agreement for funding. A detailed workplan and observation-well specifications have been developed, and drilling has been scheduled. Initial site reconnaissance was completed. A new base map of the project area has been drafted, and an annotated outline for the report has been started.

PLANS FOR FISCAL YEAR 1989: The workplan for this year is to drill, log, and sample 8 to 13 monitoring wells. The wells will be located at the edges of the plume, as predicted from previous model studies and recent sampling, to determine the full extent of contamination. Results of water-quality sampling will be compared with previous model predictions to identify processes affecting transport of contaminants in this system, such as conservative transport, adsorption, or biodegradation. A workplan for research into basic processes related to point-source contamination in a fractured-rock aquifer is being developed in conjunction with this project, funded through the Office of Water Quality, U.S. Geological Survey, Reston, Virginia.

PROJECTS COMPLETED DURING FISCAL YEARS 1988 AND 1989

Project Number	Project Title	Project Leader
WY 59-010	Flood Investigations in Wyoming	Stanley A. Druse
WY 80-054	Precipitation, infiltration, and runoff relations for small basins in Wyoming	James G. Rankl
WY 80-056	Streamflow characteristics of energy mineral areas in Wyoming	Hugh W. Lowham
WY 82-068	Hydrologic evaluation of the shallow aquifer system in Saratoga Valley, south-central Wyoming	Marvin A. Crist
WY 83-077	Hydrology of the Madison Limestone in the Glenrock area, east-central Wyoming	David A. Peterson
WY 83-078	Hydrologic properties of the alluvial deposits along the Powder River between Sussex, Wyoming and Moorhead, Montana	Bruce H. Ringen
WY 83-079	Evaluation of the ground-water observation-well program for the Powder River basin and adjacent area, northeastern Wyoming	Marvin A. Crist
WY 85-082	Effects of population growth and coal mining activity on the hydrologic system near Gillette, Wyoming	Marvin A. Crist
WY 84-085	A study of the geochemical and hydrological processes in coal spoil, Wyoming	L. Rodney Larson
WY 85-089	Hydrology of selected areas, Powder River basin, Wyoming	James L. Fogg
WY 85-090	Reaeration coefficients and traveltime for major rivers in Wyoming	James G. Rankl
WY 86-094	The occurrence, mobility, and geochemical controls effecting selenium concentrations in ground waters and associated rocks disturbed by mining, Powder River basin, Wyoming	David L. Naftz

PROJECTS COMPLETED DURING FISCAL YEARS 1988 AND 1989

Project Number	Project Title	Project Leader
WY 86-096	Water-quality field screening of irrigation drainage from the Kendrick Project near Casper, Wyoming	David A. Peterson

PROJECTS COMPLETED EXCEPT FOR REPORT(S)

The following is a list of projects, showing the project number, the project title, and the project leader, that have been completed except for the approval of the final report(s). Funding for these projects ended prior to Fiscal Year 1988.

Project Number	Project Title	Project Leader
WY 81-060	Ground-water hydrology of the southern Powder River Uranium District, Wyoming	Marlin E. Lowry
WY 82-070	Upper Colorado River Basin Regional Aquifer-System Analysis, Wyoming	Lawrence J. Martin
WY 82-072	Stream-aquifer interaction in the Upper Bear River Valley of Wyoming and Utah	Kent C. Glover
WY 83-076	Fluvial system in energy-mineral areas of Wyoming	Hugh W. Lowham
WY 84-081	Water resources of Park County, Wyoming	Marlin E. Lowry
WY 85-087	Ground-water resources in the Overthrust belt and eastern Lincoln County, Sublette County, and northwestern Sweetwater County	Marion L. Maderak
WY 85-091	Geohydrology of the High Plains Aquifer, Cheyenne, Wyoming	Marvin A. Crist
WY 86-098	Assessment of selenium concentrations in soils, sediments, and water; Sandstone Reservoir Project, Carbon County, Wyoming	David L. Naftz
WY 86-099	Summary and assessment of investigations for evaluating the effects of coal development on ground-water resources in the Powder River basin, northeastern Wyoming	James F. Wilson, Jr.

NEW PROJECTS IN FISCAL YEAR 1989

The following list of projects, showing the project number, the project title, and the project leader, are new in Fiscal Year 1989.

Project Number	Project Title	Project Leader
--	Water resources of Hot Springs County, Wyoming	Earl W. Cassidy
--	Water-quality trend study	David A. Peterson

WATER-RESOURCES INFORMATION

A monthly summary of the national water situation is presented in a newsletter, "National Water Conditions," available free upon request to the Hydrologic Information Unit, U.S. Geological Survey, 419 National Center, Reston, VA 22092. Requests for miscellaneous water information and information about programs in other states may be referred to Water Resources Division, U.S. Geological Survey, 440 National Center, Reston, VA 22092. Streamflow, ground-water, and water-quality data are available in several series of publications.

Hydrologic Data Prior to 1971

Records of streamflow, ground-water levels, and quality of water were published for many years as Geological Survey Water-Supply Papers, as explained below. The Water-Supply Papers are not listed in this report; information about them can be obtained from the Cheyenne office of the Geological Survey.

Records of daily flows of streams prior to 1971 were published in the Water-Supply Paper series, "Surface-Water Supply of the United States," which was released in numbered parts as determined by natural drainage basins. Data for Wyoming are published in Parts 6, 9, 10, and 13. Until 1961, this was an annual series; monthly and yearly summaries of these data were compiled in two reports: "Compilation of Records of Surface Waters of the United States through September 1950," and "Compilation of Records of Surface Waters of the United States, October 1950 to September 1960." A 5-year compilation was published for the period, 1965-70.

Ground-water levels and artesian pressures in observation wells prior to 1975 were reported by geographic areas in a 5-year Water-Supply Paper series. Data for Wyoming are in "Ground-Water Levels in the United States, Northwestern States."

Surface-water-quality data prior to 1971 were published annually in the Water-Supply Paper series "Quality of Surface Waters of the United States," which also was released in numbered parts as determined by natural drainage basins. Data for Wyoming are in Parts 6, 9, 10, and 13.

Hydrologic Data After 1970

Beginning with the 1971 water year, the Water-Supply Paper series described above was replaced by a new publication series, "U.S. Geological Survey Water-Data Reports." For Water Years 1971-74 surface-water records and water-quality records were published in separate volumes. Beginning with 1975 this series combines under one cover: streamflow data, water-quality data for surface and ground water, and ground-water-level data for each State. For Wyoming, the title is "Water Resources Data - Wyoming--Water Year (date)." Since 1975 the reports are numbered: "U.S. Geological Survey Water-Data Report WY-(year)-1 or 2"; reports for 1971-74 are unnumbered. These reports are listed in a subsequent section of this report.

Flood Information

Methods for estimating the magnitude and frequency of floods for streams in Wyoming are given in Water-Resources Investigations Report 88-4045; methods for estimating flood volumes and hydrographs on small plains streams are described in Water-Supply Paper 2056 (see listings that follow). The U.S. Geological Survey also has outlined flood-prone areas on topographic maps as part of a nationwide Federal program for managing flood losses. In Wyoming 225 flood-prone area maps have been completed. These maps, available at no charge from the District Office in Cheyenne, show areas estimated to be inundated by a 100-year flood. Official flood-insurance maps are available from the Federal Emergency Management Agency (toll-free phone number 1-800-638-6620).

SELECTED PUBLICATIONS ON WATER RESOURCES

General Information

The U.S. Geological Survey announces all its publications in a monthly report, "New Publications of the Geological Survey." Subscription to this monthly listing is available free upon request to the Mailing List Unit, U.S. Geological Survey, 582 National Center, Reston, VA 22092. All publications are for sale unless specifically stated otherwise; prepayment is required. Checks or money orders should be payable to: "Department of the Interior--USGS." Prices, which are subject to change, are not included here. Information on price and availability should be obtained from listed sales offices before placing an order.

Additional information about Geological Survey products and sources where they may be obtained is given in "A Guide to Obtaining USGS Information," U.S. Geological Survey Circular 900, available without cost from the Books and Open-File Reports Section, U.S. Geological Survey, Federal Center, Box 25425, Denver, CO 80225.

The Geological Survey National Center maintains a library with an extensive earth-sciences collection. Local libraries may obtain books, periodicals, and maps through interlibrary loan by writing to U.S. Geological Survey Library, 950 National Center, Reston, VA 22092, telephone (703) 860-6671.

Publications pertaining to water resources in Wyoming are listed below. The list includes all reports published during the last 15 years and selected older reports. Most of these reports are available for inspection at the Geological Survey offices in Cheyenne, Casper, and Riverton and also at large public and university libraries. The sources for obtaining copies of the reports are given for each report series. Because many of the older reports are out of print, loan copies are available from the District Office in Cheyenne.

Professional Papers (P)

Professional papers are sold by U.S. Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225.

P 501-D. Variation of permeability in the Tensleep Sandstone in the Bighorn basin, Wyoming, as interpreted from core analyses and geophysical logs, by J.D. Bredehoeft, in Geological Survey Research 1964, Chap. D, by U.S. Geological Survey, p. D166-D170. 1964.

P 550-D. The White River Formation as an aquifer in southeastern Wyoming and adjacent parts of Nebraska and Colorado, by M.E. Lowry, in Geological Survey Research 1966, Chap. D, by U.S. Geological Survey, p. D217-D222. 1966.

P 622-A. The hydraulics of overland flow on hillslopes, by W.W. Emmett. 1970.

P 700-D. Synthesizing hydrographs for small semiarid drainage basins, by G.S. Craig, Jr., in Geological Survey Research 1970, Chap. D, by U.S. Geological Survey, p. D238-D243. 1970.

P 813-C. Summary appraisals of the Nation's ground-water resources--Upper Colorado Region, by Don Price and Ted Arnow. 1974.

P 813-G. Summary appraisals of the Nation's ground-water resources--Great Basin Region, by T.E. Eakin, Don Price, and J.R. Harrill. 1976.

P 813-Q. Summary appraisals of the Nation's ground-water resources--Missouri Basin Region, by O.J. Taylor. 1978.

P 813-S. Summary appraisals of the Nation's ground-water resources--Pacific Northwest Region, by B.L. Foxworthy. 1979.

P 1117. Scour and fill in a stream channel, East Fork River, western Wyoming, by E.D. Andrews. 1979.

P 1130. Hydrologic and human aspects of the 1976-77 drought, by H.F. Matthai. 1979.

P 1164. Effects of coal mine subsidence in the Sheridan, Wyoming area, by C.R. Dunrud and F.W. Osterwald. 1980.

P 1242. Perennial-streamflow characteristics related to channel geometry and sediment in the Missouri River basin, by W.R. Osterkamp and E.R. Hedman. 1982.

P 1244. Floods of May 1978 in southeastern Montana and northeastern Wyoming, by Charles Parrett, D.D. Carlson, G.S. Craig, Jr., and E.H. Chin.

P 1273-A. Stratigraphy and sedimentary facies of the Madison Limestone and associated rocks in parts of Montana, Nebraska, North Dakota, South Dakota, and Wyoming, by J.A. Peterson. 1984.

P 1273-B. Correlation of Paleostructure and sediment deposition in the Madison Limestone and associated rocks in parts of Montana, North Dakota, South Dakota, Wyoming, and Nebraska, by D.L. Brown, R.K. Blankennagel, L.M. MacCary, and J.A. Peterson. 1984.

P 1273-C. Relationship of porosity and permeability to petrology of the Madison Limestone in rock cores from three test wells in Montana and Wyoming, by P.A. Thayer. 1983.

P 1273-D. Apparent water resistivity, porosity, and water temperature of the Madison Limestone and underlying rocks in parts of Montana, Nebraska, North Dakota, South Dakota, and Wyoming, by L.M. MacCary. 1984.

P 1273-E. Potentially favorable areas for large-yield wells in the Red River Formation and Madison Limestone in parts of Montana, North Dakota, South Dakota, and Wyoming, by L.M. MacCary, E.M. Cushing, and D.L. Brown. 1983.

P 1273-G. Geohydrology of the Madison and associated aquifers in parts of Montana, North Dakota, South Dakota, and Wyoming, by J.S. Downey. 1984.

P 1277-A. Hydrologic and morphologic changes in channels of the Platte River basin in Colorado, Wyoming, and Nebraska; a historical perspective, by H.R. Eschner, R.F. Hadley, and K.D. Crowley. 1983.

P 1277-B. Effects of water development on surface-water hydrology, Platte River basin in Colorado, Wyoming, and Nebraska upstream from Duncan, Nebraska, by J.E. Kircher, and M.R. Karlinger. 1983.

P 1330. A seismic-stratigraphic investigation of the Madison and associated aquifers; application to ground-water exploration, Powder River basin, Montana-Wyoming, edited by A.H. Balch. 1988.

P 1338. Effects of organic wastes on water quality from the processing of oil shale from the Green River Formation, Colorado, Utah, and Wyoming, by J.A. Leenheer and T.I. Noyes. 1986.

P 1400-A. Summary of the High Plains Regional Aquifer-System Analysis in parts of Colorado, Kansas, Nebraska, New Mexico, South Dakota, Texas, Oklahoma, and Wyoming, by J.B. Weeks, E.D. Gutentag, F.J. Heimes, and R.R. Luckey. 1988.

P 1400-B. Geohydrology of the High Plains aquifer in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming, by E.D. Gutentag, F.J. Heimes, N.C. Krothe, R.R. Luckey, and J.B. Weeks. 1984.

P 1400-C. Mapping irrigated cropland from Landsat for determination of water-use from the High Plains aquifer in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming, by G.P. Thelin and F.J. Heimes. 1987.

P 1400-D. Digital simulation of ground-water flow in the High Plains aquifer in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming, by R.R. Luckey, E.D. Gutentag, F.J. Heimes, and J.B. Weeks. 1986.

P 1400-E. Effects of future ground-water pumpage on the High Plains aquifer in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming, by R.R. Luckey, E.D. Gutentag, F.J. Heimes, and J.B. Weeks. 1988.

P 1402-A. The regional aquifer system underlying the Northern Great Plains in parts of Montana, North Dakota, South Dakota, and Wyoming--summary, by J.S. Downey and G.A. Dinwiddie. 1988.

P 1402-B. Geologic framework of the ground-water system in Jurassic and Cretaceous rocks in the Northern Great Plains in parts of Montana, North Dakota, South Dakota, and Wyoming, by L.O. Anna. 1986.

P 1402-C. Geochemistry of ground water in two sandstone aquifer systems in the Northern Great Plains in parts of Montana and Wyoming, by Thomas Henderson. 1985.

P 1402-D. Freshwater heads and ground-water temperatures in aquifers of the Northern Great Plains in parts of Montana, North Dakota, South Dakota, and Wyoming, by D.H. Lobmeyer. 1985.

P 1402-E. Geohydrology of bedrock aquifers in the Northern Great Plains in parts of Montana, North Dakota, South Dakota, and Wyoming, by J.S. Downey. 1986.

P 1464. Summary of the U.S. Geological Survey and U.S. Bureau of Land Management national coal-hydrology program, 1974-86, edited by L.J. Britton, C.L. Anderson, D.A. Goolsby, and B.P. Van Haveren. In press.

Journal of Research of the Geological Survey

The Journal of Research Series has been discontinued. Separate prints of the articles listed below are available from the District Chief, Cheyenne, Wyoming.

Iron in water near wastewater lagoons in Yellowstone National Park, Wyoming, by E.R. Cox, vol. 6, no. 3, p. 319-324. 1978.

Hydrologic characteristics of the Madison Limestone, the Minnelusa Formation, and equivalent rocks as determined by well-logging formation evaluation, Wyoming, Montana, South Dakota, and North Dakota, by W.J. Head and R.H. Merkel, vol. 5, no. 4, p. 473-485. 1977.

Water-Supply Papers (W)

Water-Supply Papers are sold by U.S. Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225.

W 1261. A postglacial chronology for some alluvial valleys in Wyoming, by L.B. Leopold and J.P. Miller. 1954.

W 1373. Sedimentation and chemical quality of surface waters in the Wind River basin, Wyoming, by B.R. Colby, C.H. Hembree, and F.H. Rainwater. 1956.

W 1375. Ground-water resources of the Riverton irrigation project area, Wyoming, by D.A. Morris, O.M. Hackett, K.E. Vanlier, and E.A. Moulder, with a section on Chemical quality of ground water, by W.H. Durum. 1959.

W 1377. Geology and ground-water resources of Goshen County, Wyoming, by J.R. Rapp, F.N. Visher, and R.T. Littleton, with a section on Chemical quality of ground water, by W.H. Durum. 1957.

W 1458. Geology and ground-water resources of the Rawlins area, Carbon County, Wyoming, by D.W. Berry. 1960.

W 1490. Geology and ground-water resources of Platte County, Wyoming, by D.A. Morris and H.M. Babcock, with a section on Chemical quality of ground water, by R.H. Langford. 1960.

W 1531. Hydrology of the upper Cheyenne River basin: Part A. Hydrology of stock-water reservoirs in upper Cheyenne River basin, by R.C. Culler; Part B. Sediment sources and drainage-basin characteristics in upper Cheyenne River basin, by R.F. Hadley and S.A. Schumm. 1961.

W 1532-A. Hydrologic effects of water spreading in Box Creek basin, Wyoming, by R.F. Hadley, I.S. McQueen, and others. 1961.

W 1535-E. Chemical degradation on opposite flanks of the Wind River Range, Wyoming, by C.H. Hembree and F.H. Rainwater. 1961.

W 1539-V. Availability of ground water in the Bear River Valley, Wyoming, by C.J. Robinove and D.W. Berry, with a section on Chemical quality of ground water, by J.G. Conner. 1963.

W 1576-I. Ground-water resources of the Wind River Indian Reservation, Wyoming, by L.J. McGreevy, W.G. Hodson, and S.J. Rucker, IV. 1969.

W 1596. Geology and ground-water resources of the Greybull River--Dry Creek area, Wyoming, by C.J. Robinove and R.H. Langford. 1963.

W 1669-E. Ground-water resources and geology of the Lyman-Mountain View area, Uinta County, Wyoming, by C.J. Robinove and T.R. Cummings. 1963.

W 1698. Ground-water resources and geology of northern and western Crook County, Wyoming, by H.A. Whitcomb and D.A. Morris, with a section on Chemical quality of ground water, by R.H. Langford. 1964.

W 1788. Ground-water resources and geology of Niobrara County, Wyoming, by H.A. Whitcomb, with a section on Chemical quality of the ground water, by T.R. Cummings. 1965.

W 1806. Ground-water resources and geology of northern and central Johnson County, Wyoming, by H.A. Whitcomb, T.R. Cummings, and R.A. McCullough. 1966.

W 1807. Ground-water resources of Sheridan County, Wyoming, by M.E. Lowry and T.R. Cummings. 1966.

W 1809-C. Ground water in the Upper Star Valley, Wyoming, by E.H. Walker. 1965.

W 1834. Geology and ground-water resources of Laramie County, Wyoming, by M.E. Lowry and M.A. Crist, with a section on Chemical quality of ground water and of surface water, by J.R. Tilstra. 1967.

W 1897. Ground-water resources of Natrona County, Wyoming, by M.A. Crist and M.E. Lowry. 1972.

W 2009-C. Chemical quality of surface water in the Flaming Gorge Reservoir area, Wyoming and Utah, by R.J. Madison and K.M. Waddell. 1973.

W 2023. Selenium in waters in and adjacent to the Kendrick Project, Natrona County, Wyoming, by M.A. Crist. 1974.

W 2039-A. Chemical quality and temperature of water in Flaming Gorge Reservoir, Wyoming and Utah, and the effects of the reservoir on the Green River, by E.L. Bolke and K.M. Waddell. 1975.

W 2056. Analysis of runoff from small drainage basins in Wyoming, by G.S. Craig, Jr. and J.G. Rankl. 1978.

W 2058. Dissolved-oxygen depletion and other effects of storing water in Flaming Gorge Reservoir, Wyoming and Utah, by E.L. Bolke. 1979.

W 2193. Streamflow characteristics related to channel geometry of streams in western United States, by E.R. Hedman and W.R. Osterkamp. 1982.

W 2199. Verification of step-backwater computations on ephemeral streams in northeastern Wyoming, by S.A. Druse. 1982.

W 2250. National water summary 1983--hydrologic events and issues, by U.S. Geological Survey. 1984.

W 2275. National water summary 1984--hydrologic events, selected water-quality trends, and ground-water resources, by U.S. Geological Survey. 1985.

W 2289. Artesian pressures and water quality in Paleozoic aquifers in the Ten Sleep area of the Bighorn basin, north-central Wyoming, by M.E. Cooley. 1986.

W 2300. National water summary 1985--hydrologic events and surface-water resources, by U.S. Geological Survey. 1986.

W 2322. Leachate migration from an in-situ oil-shale retort near Rock Springs, Wyoming, by K.C. Glover. 1988.

W 2325. National water summary 1986--hydrologic events and ground-water quality, by U.S. Geological Survey. 1988.

W 2350. National water summary 1987--hydrologic events and water supply and demand, by U.S. Geological Survey. In press.

Circulars (C)

Single copies of circulars still in print are available free from U.S. Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225.

C 743. Land and natural resource information and some potential environmental effects of surface mining of coal in the Gillette area, Wyoming, by W.R. Keefer and R.F. Hadley. 1976.

C 839. Assessment of impacts of proposed coal-resource and related economic development on water resources, Yampa River basin, Colorado and Wyoming--A summary, compiled and edited by T.D. Steele and D.E. Hillier. 1981.

C 900. Guide to obtaining USGS information, compiled by Kurt Dodd, H.K. Fuller, and P.F. Clark (revised). 1986.

C 1001. Estimated use of water in the United States in 1980, by W.B. Solley, E.B. Chase, and W.B. Mann, IV. 1983.

C 1002. Regional Aquifer-System Analysis Program of the U.S. Geological Survey: Summary of projects, 1978-84, by R.J. Sun (editor). 1986.

C 1004. Estimated use of water in the United States in 1985, by W.B. Solley, C.F. Merk, and R.R. Price. 1988.

Water-Resources Investigations Reports (WRIR)

Reports in this series are available for inspection at the Wyoming and Reston, Virginia, offices of the U.S. Geological Survey. Selected reports may be purchased either as microfilm or hard copy from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161; the NTIS ordering number is given in parentheses at the end of the citation. Further information about these reports may be obtained from the District Chief, Water Resources Division, Cheyenne.

WRIR 3-75. Hydrologic analysis of the valley-fill aquifer, North Platte River valley, Goshen County, Wyoming, by M.A. Crist. 1975. (PB-243 226/AS).

WRIR 63-75. Preliminary digital model of ground-water flow in the Madison Group, Powder River basin and adjacent areas, Wyoming, Montana, South Dakota, North Dakota, and Nebraska, by L.F. Konikow. 1976.

WRIR 8-76. Digital model to predict effects of pumping from the Arikaree aquifer in the Dwyer area, southeastern Wyoming, by G.C. Lines. 1976.

WRIR 76-77. Hydrologic effects of hypothetical earthquake-caused floods below Jackson Lake, northwestern Wyoming, by W.R. Glass, T.N. Keefer, and J.G. Rankl. 1976.

WRIR 76-112. Techniques for estimating flow characteristics of Wyoming streams, by H.W. Lowham. 1976. (PB-264 224/AS)

WRIR 76-118. Geohydrology of the Albin and LaGrange areas, southeastern Wyoming, by W.B. Borchert. 1976.

WRIR 77-72. Physical, chemical, and biological relations of four ponds in the Hidden Creek strip-mine area, Powder River basin, Wyoming, by D.J. Wangsness. 1977. (PB-273 512/AS)

WRIR 77-103. An analysis of salinity in streams of the Green River basin, Wyoming, by L.L. DeLong. 1977. (PB-275 728/AS)

WRIR 77-107. Preliminary model of the Arikaree aquifer in the Sweetwater River basin, central Wyoming, by W.B. Borchert. 1977.

WRIR 77-111. Hydrologic evaluation of the Arikaree Formation near Lusk, Niobrara and Goshen Counties, Wyoming, by M.A. Crist. 1977.

WRIR 78-13. An analysis of stream temperatures, Green River basin, Wyoming, by H.W. Lowham. 1978. (PB-284 062/AS)

WRIR 78-96. Preliminary applications of Landsat images and aerial photography for determining land-use, geologic, and hydrologic characteristics--Yampa River basin, Colorado and Wyoming, by F.J. Heimes, G.K. Moore, and T.D. Steele. 1978.

WRIR 78-121. The biology of Salt Wells Creek and its tributaries, southwestern Wyoming, by M.J. Engelke, Jr. 1978. (PB-300 828/AS)

WRIR 78-122. Traveltime, unit-concentration, longitudinal-dispersion, and reaeration characteristics of upstream reaches of the Yampa and Little Snake Rivers, Colorado and Wyoming, by D.P. Bauer, R.E. Rathbun, and H.W. Lowham. 1979. (PB-80 129 521/AS)

WRIR 79-6. Hydrogeologic features of the alluvial deposits in the Greybull River valley, Bighorn basin, Wyoming, by M.E. Cooley and W.J. Head. 1979.

WRIR 79-47. Effect on sediment yield and water quality of a nonrehabilitated surface mine in north-central Wyoming, by B.H. Ringen, L.M. Shown, R.F. Hadley, and T.K. Hinkley. 1979. (PB-299 868/AS)

WRIR 79-1291. Hydrogeologic features of the alluvial deposits in the Nowood River drainage area, Bighorn basin, Wyoming, by M.E. Cooley and W.J. Head. 1979.

WRIR 80-8. Analysis of stream quality in the Yampa River basin, Colorado and Wyoming, by D.A. Wentz and T.D. Steele. 1980. (PB-81 108 904/AS)

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