

TWENTY-SECOND ANNUAL REPORT

YELLOWSTONE RIVER

COMPACT COMMISSION

1973

YELLOWSTONE RIVER COMPACT COMMISSION  
421 Federal Building  
Helena, Montana

Honorable Stanley K. Hathaway  
Governor of the State of Wyoming  
Cheyenne, Wyoming

Honorable Thomas L. Judge  
Governor of the State of Montana  
Helena, Montana

Honorable Arthur A. Link  
Governor of the State of North Dakota  
Bismarck, North Dakota

Sirs:

Pursuant to Article III of the Yellowstone River Compact, the Commission submits the following twenty-second annual report of activities for the period ending September 30, 1973.

The Commission held a special meeting at Helena, Montana, on July 13, 1973. Mr. Grant W. Buswell, Administrator, Water Resources Division, Montana Department of Natural Resources and Conservation, and Mr. Floyd A. Bishop, Wyoming State Engineer, the designated representatives of their respective States, and Mr. Robert C. Williams, the designated Federal representative and chairman, were all present. Others present were William Christianson, Lt. Governor of Montana and John Andrews, Lt. Governor's office, Helena, Montana; James Barnett, Special Attorney General assigned to the Wyoming State Engineer's Office, Cheyenne, Wyoming; George Losleben, Assistant Attorney General of Montana, Helena, Montana; Don Ohnsted, Missouri River Basin Commission, Omaha, Nebraska; Robert Jones, Northern Great Plains Resource Study (BLM), Washington, D.C.; Willard Rhoads, Western States Water Council, Cody, Wyoming; Peter Pauly, Attorney for Intake Water Company, Helena, Montana; Myron Goodson, Department of Economic Planning and Development, Cheyenne, Wyoming; William F. Throm, Montana Water Resources Division, Helena, Montana; Martin Olsen, U.S. Bureau of Reclamation, Billings, Montana; Ted J. Doney, Department of Natural Resources and Conservation, Helena, Montana; Fred C. Boner, U.S. Geological Survey, Cheyenne, Wyoming; Vern Fahy, North Dakota State Water Commission, Bismarck, North Dakota; Alvin E. Bielefeld, Field Solicitor's Office, Department of the Interior, Billings, Montana; and George M. Pike and Betty L. Dean, U.S. Geological Survey, Helena, Montana.

Because most of the business of the Commission was transacted at the July meeting, the Commissioners decided to conduct the annual meeting this year by telephone conference. This was in tune with the national and state policies to conserve energy.

There were no incidents during the year that required administration of water in accordance with the provisions of the Compact. At the present level of water-resources development, the Commission feels that a program of intensive water-use regulations is not necessary. However, there was much activity that absorbed the attention of the Commission during the year. Because much of the demand for Yellowstone River water is for coal development outside of the basin, major emphasis was focused on Article X of the Compact. This Article prohibits the diversion of water outside the basin without unanimous consent of all the signatory states. Legal representatives appointed by the Governors of the three signatory States met concerning ways in which permission could be granted. The three principal ways discussed for presentation to the Governors were: (1) a bill for presentation to each legislature; (2) resolutions by the three legislatures; and (3) amend the Compact Article X, which requires Congressional approval.

The demand for Yellowstone River water for coal development outside of the basin brought about an attempt to eliminate Article X by legal action. Intake Water Company, a Delaware Corporation and a wholly owned subsidiary of Tenneco, Inc., has applied for an appropriation of water from the Yellowstone River for diversion in the vicinity of the community of Intake in Dawson County, Montana. Some of the water is planned for use outside of the basin in the lignite fields of North Dakota. The proposed diversion works will have an estimated cost of twenty million dollars.

With the above development in mind, Intake Water Company filed suit against the Commission and its members in Federal District Court in Billings, Montana, on June 29, 1973. The suit was divided into three counts as follows: (1) Count one asks that the Attorney General of Montana be enjoined from enforcing Section 89-846 of the Montana State Statutes, which forbids such out-of-State diversion without the consent of the Montana Legislature; (2) Count two asks that the Yellowstone River Compact Commission and its members be enjoined from enforcing Article X of the Compact, and that Article X be declared unconstitutional as an unwarranted burden on interstate commerce; and (3) Count three asks that the Commission be enjoined from enforcing Article X, and that Article X be declared unconstitutional as a violation of the equal protection clause of the 14th Amendment of the Federal Constitution. By letter from the Commission on August 24, the Attorney General of Montana was authorized to represent the Commission in the suit, and individual Commission members will be represented by their respective State and Federal Councils. At present there is on record a motion to dismiss the case. If not dismissed before then, the dismissal motion would be argued in 1974 or 1975.

Another show of interest in Yellowstone River water for coal development concerns a recent application by the Utah International Corporation for the diversion of water from the Powder River and a storage reservoir on Fence Creek, a Powder River tributary in Wyoming. Plans call for pumping water from the reservoir by

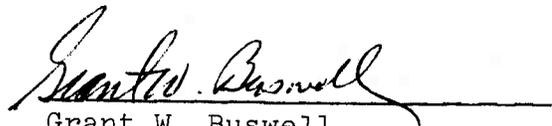
48-inch pipeline to the project site in Montana. The application states, "This application pertains to the diversion in the State of Wyoming of presently unused and unappropriated water of the Powder River allocated to the State of Montana for beneficial use in that State pursuant to Article V, B.4.a. of the Yellowstone River Compact, 1950." The original of this application is filed in the office of the State Engineer of Wyoming pursuant to Article VII, B. of the Yellowstone River Compact, 1950.

For Fiscal Year 1974 the budget for stream-gaging activities and annual report publication is \$15,540; for Fiscal Year 1975 the estimate is \$16,480; and for Fiscal Year 1976 the estimate is \$17,460. The amount of funds required for future Commission activities will depend largely on the outcome of water-development plans, inflation, and the degree of water administration required.

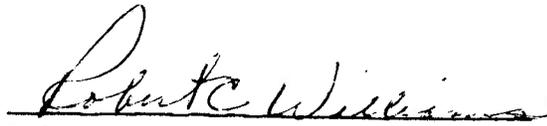
Respectfully submitted,



Floyd A. Bishop  
Commissioner for Wyoming



Grant W. Buswell  
Commissioner for Montana



Robert C. Williams  
Federal Representative

## GENERAL REPORT

### Cost:

The work funded by the Commission, which to date has been primarily concerned with the collection of required hydrologic data, has been financed through cooperative arrangements whereby Montana and Wyoming each bear one-fourth of the cost and the remaining one-half is borne by the United States. The salaries and necessary expenses of the State and Federal representatives, and hydrologic data made available by other agencies, are not evaluated or considered as expenses of the Commission.

The expense of the Commission during Fiscal Year 1973 was \$13,850, in accordance with the budget adopted for the year.

The budgets for Fiscal Years 1975 and 1976 were tentatively adopted subject to the availability of appropriations, and the budget for Fiscal Year 1974 was confirmed at the special meeting July 13, 1973.

The budgets for the three fiscal years are summarized as follows:

#### July 1, 1973 to June 30, 1974 (Fiscal Year 1974):

Continuation of existing stream-gaging program	\$15,540
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#### July 1, 1974 to June 30, 1975 (Fiscal Year 1975):

Continuation of existing stream-gaging program	\$16,480
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#### July 1, 1975 to June 30, 1976 (Fiscal Year 1976):

Continuation of existing stream-gaging program	\$17,460
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### Gaging Stations:

Gaging stations at the measuring sites specified in the Compact were continued in operation and satisfactory discharge records collected at each. In addition, a station on Prairie Dog Creek near the Montana-Wyoming State line was operated for Compact administration purposes. Locations of gaging and reservoir stations are shown on a map of the Yellowstone River basin at the end of the report.

During the Water Year ending September 30, 1973, annual stream-flow at the designated points of measurement in Montana was slightly above average except in the Clarks Fork basin where flow was 89 percent of average. No extremely high or low flows occurred. The spring breakup and the following snowmelt runoff were moderate .

Water stored in the mountain snowpack was below average at the end of March. During the month of April there was substantial precipitation, particularly at low elevations, that left soil moisture in excellent condition at the beginning of the growing season. Late-season water shortages were expected as a result of the below-average high-elevation snowpack in some areas that depend on natural flow. However, shortages were minimized by timely precipitation in August and September.

Details of streamflow for Water Year 1973 and bar graphs showing comparisons with average flows during selected base periods and with the preceding year are given in Appendix B.

Diversions:

Opinions expressed by the two State representatives indicated that allocable diversions in Montana and Wyoming initiated since January 1, 1950, did not warrant detailed consideration and that use in the upstream State did not exceed Compact allowances.

Storage:

In reservoirs completed after January 1, 1950

Bighorn Lake, a U.S. Bureau of Reclamation project on the Bighorn River, and the largest storage project in the basin, contained 1,069,000 acre-feet at the beginning of the year and 1,072,000 acre-feet at the close. It fluctuated from a minimum of 881,500 acre-feet on March 12, 1973, to a maximum of 1,076,000 acre-feet on August 15, 1973. Boysen Reservoir, located on the Wind River and operated by the U.S. Bureau of Reclamation, began the year with 637,800 acre-feet in storage and ended with 737,300 acre-feet. Details regarding these reservoirs are given in Appendix C. The Commission is cognizant of other reservoirs in this general group and considers their aggregate effect to be insufficient to warrant the collection of storage data at this time.

In reservoirs existing on January 1, 1950

As a matter of record and general information, month-end storage data are given in Appendix D for reservoirs in existence above the points of measurement on January 1, 1950. These data are pertinent to allocation under Article V, Section C, Item 5 of the Compact.

RULES AND REGULATIONS FOR ADMINISTRATION OF  
THE YELLOWSTONE RIVER COMPACT

A compact, known as the Yellowstone River Compact, between the States of Wyoming, Montana and North Dakota, having become effective on October 30, 1951 upon approval of the Congress of the United States, which apportions the waters of certain interstate tributaries of the Yellowstone River which are available after the appropriative rights existing in the States of Wyoming and Montana on January 1, 1950 are supplied, and after appropriative rights to the use of necessary supplemental water are also supplied as specified in the Compact, the following rules and regulations are adopted subject to the provisions for amendment, revision or abrogation as provided herein.

## Article I. Collection of Water Records

- A. It shall be the joint and equal responsibility of the members of the states of Wyoming and Montana to collect, cause to be collected or otherwise furnish records of tributary stream flow at the points of measurement specified in Article V (B) of the Compact, or as near thereto as is physically or economically feasible or justified.

## 1. Clarks Fork

The gaging station known as Clarks Fork near Silesia, Montana and located in NE 1/4 SE 1/4 sec.1, T.4 S., R.23 E., shall be the point of measurement for the Clarks Fork.

## 2. Bighorn River (exclusive of Little Bighorn River)

The gaging station known as the Bighorn River at Bighorn, Montana and located in NE 1/4 NE 1/4 sec.33, T.5 N., R.34 E., shall temporarily be the designated point of measurement on that stream. The flow of the Little Bighorn River as measured at the gaging station near Hardin, Montana, and located in NE 1/4 NE 1/4 sec.19, T.1 S., R.34 E., shall be considered the point of measurement for that stream, except that if or when satisfactory records are not available, the records for the nearest upstream station with practical corrections for intervening inflow or diversion shall be used.

3. Tongue River

The gaging station known as the Tongue River at Miles City, Montana and located in SE 1/4, sec.23, T.7 N., R.47 E., shall temporarily be the point of measurement for that stream.

4. Powder River

The gaging station known as the Powder River near Locate, Montana and located in SW 1/4 sec.14, T.8 N., R.51 E., shall temporarily be the designated point of measurement for that stream.

- B. Records of total annual diversion in acre-feet above the points of measurement designated in the Compact for irrigation, municipal and industrial uses developed after January 1, 1950, shall be furnished by the members of the Commission for their respective states, at such time as the Commission deems necessary for interstate administration as provided by the terms of the Compact. Providing that if it be acceptable to the Commission, reasonable estimates thereof may be substituted.
- C. Annual records of the net change in storage in all reservoirs, not excluded under Article V (E) of the Compact, above the point of measurement specified in the Compact and completed after January 1, 1950, and the annual net change in reservoirs existing prior to January 1, 1950, which is used for irrigation, municipal and industrial purposes developed after January 1, 1950, shall be the primary responsibility of the member of the Commission in whose state such works are located; providing such data is not furnished by federal agencies under the provisions of Article III (D) of the Compact, or collected by the Commission.

Article II. Office and Officers

- A. The office of the Commission shall be located, and be that of the United States Geological Survey, in Helena, Montana.
- B. The Chairman of the Commission shall be the federal representative as provided in the Compact.
- C. The Secretary of the Commission shall be as provided for in Article III of these rules.
- D. The credentials of each member of the Commission shall be placed on file in the office of the Commission.

Article III. Secretary

- A. The Commission, subject to the approval of the Director of the United States Geological Survey, shall enter into cooperative agreements with the U.S. Geological Survey for such engineering and clerical services as may reasonably be necessary for the administration of the Compact. Said agreements shall provide that the Geological Survey shall:
  1. Maintain and operate gaging stations at or near the points of measurement specified in Article V (A) of the Compact.
  2. Assemble factual information on stream flow, diversion and reservoir storage for the preparation of an annual report to the Governors of the signatory states.
  3. Make such investigations and reports as may be requested by the Commission in aid of its administration of the Compact.
- B. Act as Secretary to the Commission.

Article IV. Budget

- A. At the annual meeting of each even numbered year or prior thereto, the Commission shall adopt a budget for operation during the ensuing biennium beginning July first. Such budget shall set forth the total cost of construction, maintenance and operation of gaging stations, the cost of engineering and clerical aid, and other necessary expenses excepting the salaries and personal expenses of the Commissioners. On odd-numbered years revisions of the budget shall be considered.
- B. It shall be the obligation of the Commissioners of the states of Montana and Wyoming to endeavor to secure from the Legislature of their respective states sufficient funds with which to meet the obligations of this Compact, except insofar as provided by the federal government.

Article V. Meetings

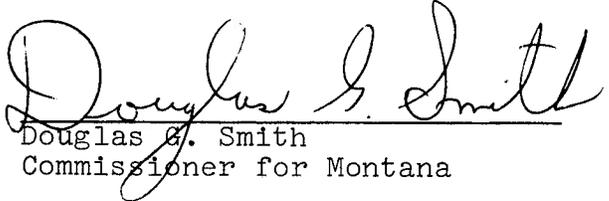
An annual meeting of the Commission shall be held each November at some mutually agreeable point in the Yellowstone River basin for consideration of the annual report for the water year ending the preceding September 30th, and for the transaction of such other business consistent with its authority; provided that by unanimous consent of the Commission the

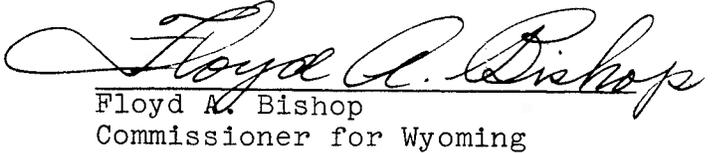
date and place of the annual meeting may be changed. Other meetings as may be deemed necessary shall be held at a time and place set by mutual agreement, for the transaction of any business consistent with its authority.

No action of the Commission shall be effective until approval by the Commissioners for the States of Wyoming and Montana.

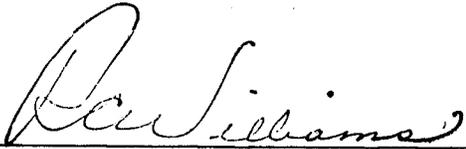
Article VI. Amendments, Revisions and Abrogations.

The Rules and Regulations of the Commission may be amended or revised by a unanimous vote at any meeting of the Commission.

  
Douglas G. Smith  
Commissioner for Montana

  
Floyd A. Bishop  
Commissioner for Wyoming

ATTESTED:

  
Robert C. Williams  
Federal Representative

Adopted November 17, 1953  
Amended November 9, 1970

## FACTORS FOR CONVERTING ENGLISH UNITS TO INTERNATIONAL SYSTEM (SI) UNITS

The following factors may be used to convert the English units published herein to the International System of Units (SI). Subsequent reports will contain both the English and SI unit equivalents in the station manuscript descriptions until such time that all data will be published in SI units.

Multiply English units	By	To obtain SI units
<i>Length</i>		
inches (in)	25.4	millimeters (mm)
	.0254	meters (m)
feet (ft)	.3048	meters (m)
yards (yd)	.9144	meters (m)
rods	5.0292	meters (m)
miles (mi)	1.609	kilometers (km)
<i>Area</i>		
acres	4047	square meters (m <sup>2</sup> )
	.4047	*hectares (ha)
	.4047	square hectometer (hm <sup>2</sup> )
	.004047	square kilometers (km <sup>2</sup> )
square miles (mi <sup>2</sup> )	2.590	square kilometers (km <sup>2</sup> )
<i>Volume</i>		
gallons (gal)	3.785	**liters (l)
	3.785	cubic decimeters (dm <sup>3</sup> )
	3.785x10 <sup>-3</sup>	cubic meters (m <sup>3</sup> )
million gallons (10 <sup>6</sup> gal)	3785	cubic meters (m <sup>3</sup> )
	3.785x10 <sup>-3</sup>	cubic hectometers (hm <sup>3</sup> )
cubic feet (ft <sup>3</sup> )	28.32	cubic decimeters (dm <sup>3</sup> )
	.02832	cubic meters (m <sup>3</sup> )
cfs-day (ft <sup>3</sup> /s-day)	2447	cubic meters (m <sup>3</sup> )
	2.447x10 <sup>-3</sup>	cubic hectometers (hm <sup>3</sup> )
acre-feet (acre-ft)	1233	cubic meters (m <sup>3</sup> )
	1.233x10 <sup>-3</sup>	cubic hectometers (hm <sup>3</sup> )
	1.233x10 <sup>-6</sup>	cubic kilometers (km <sup>3</sup> )
<i>Flow</i>		
cubic feet per second (ft <sup>3</sup> /s)	28.32	liters per second (l/s)
	28.32	cubic decimeters per second (dm <sup>3</sup> /s)
	.02832	cubic meters per second (m <sup>3</sup> /s)
gallons per minute (gpm)	.06309	liters per second (l/s)
	.06309	cubic decimeters per second (dm <sup>3</sup> /s)
	6.309x10 <sup>-5</sup>	cubic meters per second (m <sup>3</sup> /s)
million gallons per day (mgd)	43.81	cubic decimeters per second (dm <sup>3</sup> /s)
	.04381	cubic meters per second (m <sup>3</sup> /s)
<i>Mass</i>		
ton (short)	.9072	tonne (t)

\*The unit hectare is approved for use with the International System (SI) for a limited time. See NBS Special Bulletin 330, p.15, 1972 edition.

\*\*The unit liter is accepted for use with the International System (SI). See NBS Special Bulletin 330, p. 13, 1972 edition.

## MONTHLY SUMMARY OF DISCHARGE

Clarks Fork Yellowstone River near Silesia, Montana

LOCATION.--Lat 45°30'48", long 108°49'41", in NE¼SE¼ sec.1, T.4 S., R.23 E., Carbon County, on left bank 0.5 mi (0.8 km) downstream from Whitehorse Canal intake, 1.0 mi (1.6 km) upstream from Rock Creek, and 3 mi (4.8 km) south of Silesia.

DRAINAGE AREA.--2,093 sq mi (5,421 sq km).

PERIOD OF RECORD.--October 1969 to September 1973. Records for July 1921 to September 1969 (published as Clarks Fork Yellowstone River at Edgar) at site 5 mi (8.0 km) upstream not equivalent owing to diversion in Whitehorse Canal during irrigation season. Records since January 1950 available in annual reports of Yellowstone River Compact Commission.

GAGE.--Water-stage recorder. Altitude of gage is 3,410 ft (1,039 m), from topographic map.

EXTREMES.--Current year: Maximum discharge, 6,890 cfs (195 cu m/s) June 10, gage height, 6.09 ft (1.856 m); minimum daily, 140 cfs (3.96 cu m/s) Dec. 4.

Period of record: Maximum discharge, 11,800 cfs (334 cu m/s) June 10, 1972, gage height, 7.51 ft (2.289 m); minimum daily, 140 cfs (3.96 cu m/s) Dec. 4, 1972.

REMARKS.--Records good except those for winter period, which are poor. Diversions for irrigation of about 42,600 acres (17,200 sq hm) of which 1,100 acres (450 sq hm) lies below station. In addition, about 9,000 acres (3,640 sq hm) of land above station are irrigated by diversions from the adjoining Rock Creek basin.

<u>Month</u>	<u>Second foot days</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Runoff in acre-feet</u>
October 1972	29,455	1,010	775	950	58,420
November	20,069	869	340	669	39,810
December	14,469	707	140	467	28,700
January 1973	13,970	580	220	451	27,710
February	12,829	540	390	458	25,450
March	12,236	535	352	395	24,270
April	16,944	1,230	335	565	33,610
May	51,740	4,110	733	1,669	102,600
June	95,600	6,080	1,410	3,187	189,600
July	47,922	4,500	758	1,546	95,050
August	15,148	741	270	489	30,050
September 1973	<u>26,605</u>	1,710	456	887	<u>52,770</u>
Water year 1972-73	356,987	6,080	140	978	708,100

CLARKS FORK YELLOWSTONE RIVER NEAR SILESIA, MONT.  
(Replaces Clarks Fork Yellowstone River at Edgar)

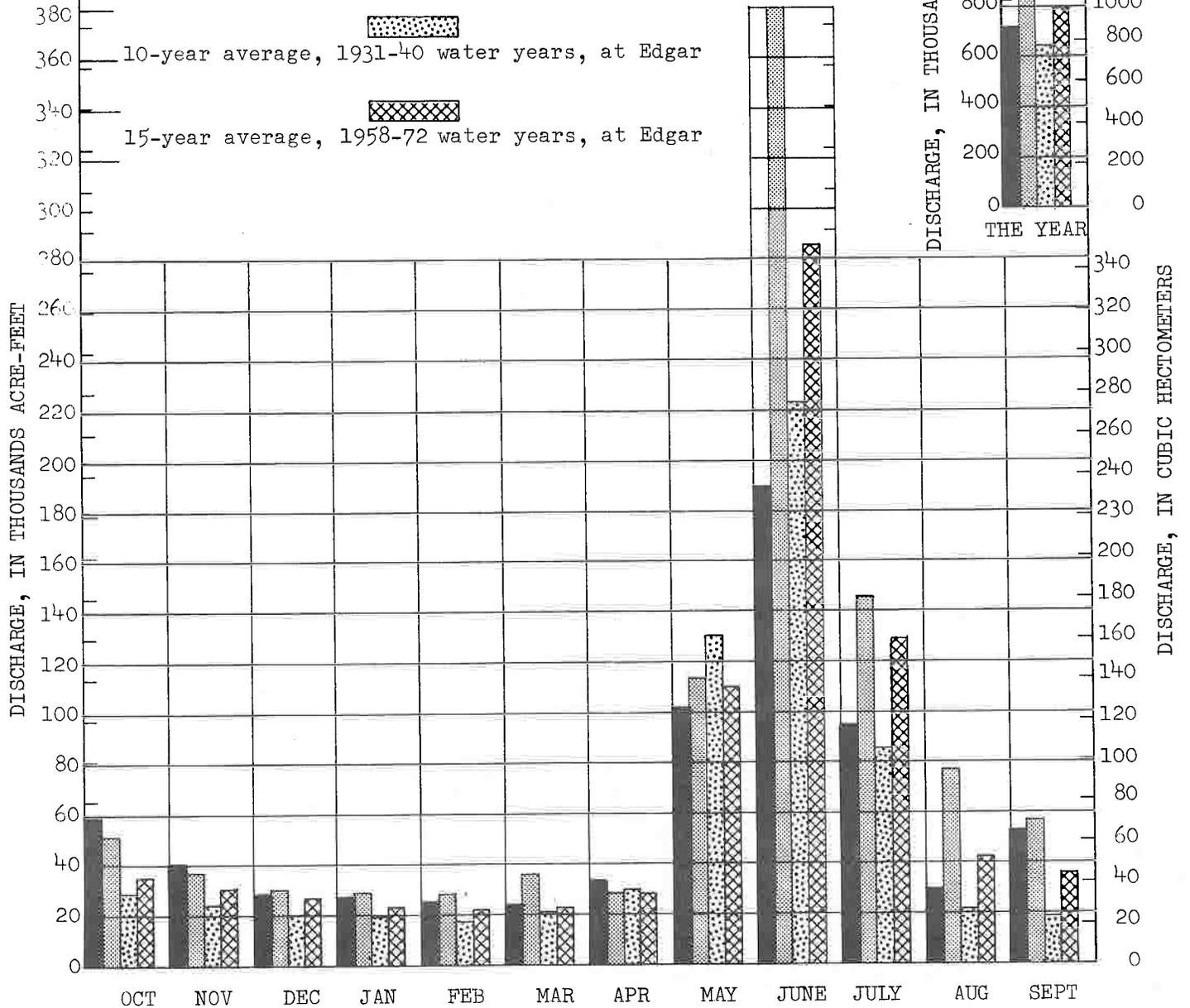
EXPLANATION

1973 water year, near Silesia

1972 water year, near Silesia

10-year average, 1931-40 water years, at Edgar

15-year average, 1958-72 water years, at Edgar



Comparison of discharge during 1973 water year with 1972 water year, near Silesia and with average discharge for the water years 1931-40 and 1958-72 at Edgar.

## MONTHLY SUMMARY OF DISCHARGE

## Little Bighorn River near Hardin, Montana

LOCATION.--Lat 45°44'08", long 107°33'27", in NE¼NE¼ sec.19, T.1 S., R.34 E., Big Horn County, on left bank 50 ft (15.2 m) downstream from bridge on Sarpy Road, 0.2 mi (0.3 km) upstream from terminal wasteway of Agency Canal, 0.6 mi (1.0 km) upstream from mouth, and 2.3 mi (3.70 km) east of Hardin.

DRAINAGE AREA.--1,294 sq mi (3,351 sq km).

PERIOD OF RECORD.--June 1953 to September 1973.

GAGE.--Water-stage recorder. Altitude of gage is 2,890 ft (881 m), from topographic map. Prior to Oct. 7, 1953, nonrecording gage at site 0.4 mi (0.64 km) downstream. Oct. 7, 1953, to May 6, 1963, water-stage recorder at site 0.3 mi (0.48 km) downstream. May 6, 1963, to Nov. 6, 1963, nonrecording gage at site 0.4 mi (0.64 km) downstream. All at different datums.

AVERAGE DISCHARGE.--20 years, 291 cfs (8.24 cu m/s), 210,800 acre-ft/yr (260 cu hm/yr).

EXTREMES.--Current year: Maximum discharge, 2,450 cfs (69.4 cu m/s) Apr. 26, gage height, 4.94 ft (1.506 m); minimum, 81 cfs (2.29 cu m/s) Nov. 23, gage height, 1.72 ft (0.524 m); minimum daily, 107 cfs (3.03 cu m/s) Nov. 30.

Period of record: Maximum discharge, 4,520 cfs (128 cu m/s) Apr. 2, 1965; maximum gage height, 11.78 ft (3.591 m) Mar. 20, 1960, site and datum then in use (backwater from ice); minimum discharge observed, 0.20 cfs (0.006 cu m/s) Aug. 7, 1961, result of discharge measurement.

REMARKS.--Records good except those for winter period, which are poor. Flow partly regulated by Willow Creek Reservoir (capacity, 23,000 acre-ft, 28.4 cu hm). Diversions for irrigation of about 17,000 acres (6,880 sq hm) above station. Figures of discharge given herein include flow of terminal wasteway of Agency Canal.

Month	Second-foot days	Maximum	Minimum	Mean	Runoff in acre-feet
October 1972	5,748	221	162	185	11,400
November	5,183	220	107	173	10,280
December	4,334	189	110	140	8,600
January 1973	4,415	180	110	142	8,760
February	4,790	400	110	171	9,500
March	9,121	460	186	294	18,090
April	19,796	2,380	187	660	39,270
May	39,442	1,880	585	1,272	78,230
June	34,545	1,790	478	1,152	68,520
July	9,294	552	207	300	18,430
August	5,620	215	158	181	11,150
September 1973	<u>7,829</u>	348	196	261	<u>15,530</u>
Water year 1972-73	150,117	2,380	107	411	297,800

## MONTHLY SUMMARY OF DISCHARGE

## Bighorn River at Bighorn, Montana

LOCATION.--Lat 46°08'50", long 107°28'00", in NE¼NE¼ sec.33, T.5 N., R.34 E., Treasure County, on right bank just downstream from bridge on old U.S. Highway 10, 0.3 mi (0.5 km) downstream from bridge on Interstate Highway 94, 0.7 mi (1.1 km) upstream from mouth, 1.3 mi (2.1 km) southwest of Bighorn, and 4.4 mi (7.1 km) east of Custer.

DRAINAGE AREA.--22,885 sq mi (59,272 sq km). At site used prior to Oct. 7, 1955, 22,410 sq mi (58,042 sq km).

PERIOD OF RECORD.--May 1945 to September 1973. Published as "near Custer", 1945-55. Records since January 1950 available in annual reports of Yellowstone River Compact Commission.

GAGE.--Water-stage recorder. Altitude of gage is 2,690 ft (820 m), by barometer. May 11 to Dec. 6, 1945, nonrecording gage, and Dec. 7, 1945, to Oct. 6, 1955, water-stage recorder, at site 4 mi (6.4 km) upstream at different datum.

AVERAGE DISCHARGE.--28 years, 3,870 cfs (110 cu m/s), 2,804,000 acre-ft/yr (3,460 cu hm/yr).

EXTREMES.--Current year: Maximum discharge, about 9,000 cfs (255 cu m/s) May 25 or 26 (backwater from Yellowstone River); maximum gage height observed, 9.61 ft (2.929 m) Dec. 11 (backwater from ice); minimum discharge, 625 cfs (17.7 cu m/s) Oct. 22, gage height, 0.78 ft (0.238 m), regulation of Yellowtail Dam; minimum daily, 1,300 cfs (36.8 cu m/s) July 20.

Period of record: Maximum discharge, 26,200 cfs (742 cu m/s) June 24, 1947, gage height, 8.79 ft (2.679 m), site and datum then in use, from rating curve extended above 12,500 cfs (354 cu m/s); maximum gage height recorded, 14.21 ft (4.331 m) Apr. 2, 1965; minimum discharge, about 275 cfs (7.79 cu m/s) Nov. 15, 1959, result of freezeup; minimum daily, 400 cfs (11.3 cu m/s) Apr. 4, 1967.

REMARKS.--Records good except those for period of backwater from Yellowstone River, which are poor. Flow regulated by Bighorn Lake beginning November 1965 (usable capacity, 1,356,000 acre-ft, 1,672 cu hm). Major regulation prior to November 1965 by 14 reservoirs in Wyoming and 1 in Montana with combined usable capacity of about 1,400,000 acre-ft, 1,726 cu hm (see Appendices C and D). Diversions for irrigation of about 465,000 acres (188,200 sq hm) above station.

Month	Second-foot days	Maximum	Minimum	Mean	Runoff in acre-feet	Adjusted runoff in acre-feet*
Oct. 1972	137,430	5,710	1,710	4,433	272,600	263,600
Nov.	162,290	5,730	4,350	5,410	321,900	243,100
Dec.	116,030	4,470	2,970	3,743	230,100	201,700
Jan. 1973	118,360	4,300	2,840	3,818	234,800	199,400
Feb.	104,890	4,370	3,220	3,746	208,000	176,600
Mar.	117,010	4,560	3,140	3,775	232,100	239,500
Apr.	121,180	7,020	2,400	4,039	240,400	287,900
May	204,620	8,690	5,060	6,601	405,900	461,400
June	204,640	8,270	4,580	6,821	405,900	408,900
July	76,570	4,750	1,300	2,470	151,900	199,500
Aug.	91,650	4,330	1,450	2,956	181,800	148,800
Sept. 1973	148,560	6,180	3,620	4,952	294,700	352,700
Water year 1972-73	1,603,230	8,690	1,300	4,392	3,180,000	3,183,000

\* Adjusted for change in contents in Bighorn Lake.

BIGHORN RIVER AT BIGHORN, MONT.  
 ADJUSTED FOR CHANGE IN CONTENTS IN BIGHORN LAKE  
 MINUS  
 LITTLE BIGHORN RIVER NEAR HARDIN, MONT.

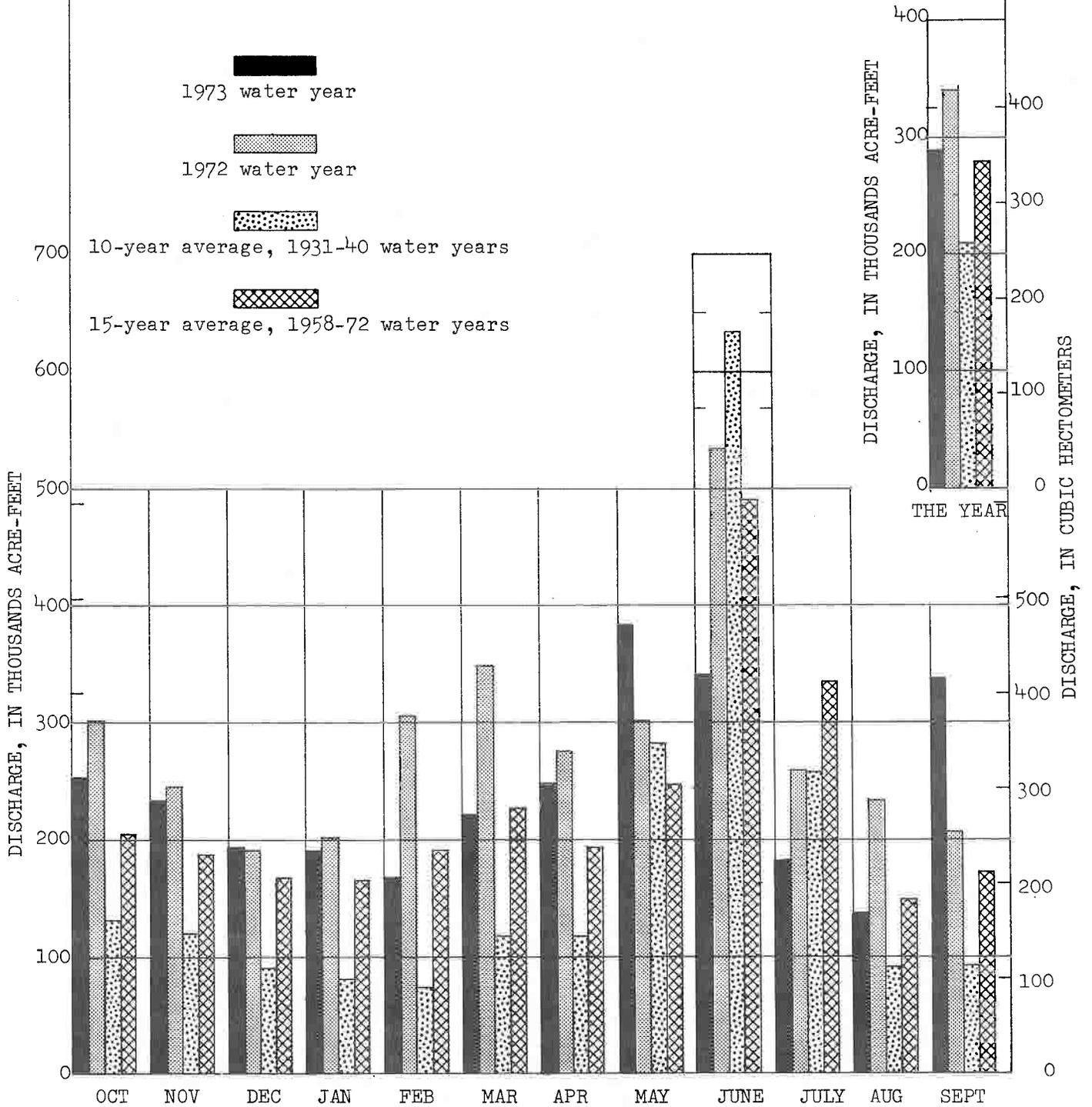
EXPLANATION

1973 water year

1972 water year

10-year average, 1931-40 water years

15-year average, 1958-72 water years



Comparison of discharge during 1973 water year with 1972 water year and with average discharge for water years 1931-40 and 1958-72

## MONTHLY SUMMARY OF DISCHARGE

## Prairie Dog Creek near Acme, Wyoming

LOCATION.--Lat 44°59'02", long 106°50'21", in NE¼SW¼SW¼ sec.23, T.58 N., R.83 W., Sheridan County, on right bank 600 ft (183 m) upstream from county bridge, 0.9 mi (1.5 km) upstream from mouth, 2.8 mi (4.5 km) downstream from Coutant Creek, and 7.6 mi (12.2 km) northeast of Acme.

DRAINAGE AREA.--358 sq mi (927 sq km).

PERIOD OF RECORD.--October 1970 to September 1973. Records for May 1965 to September 1970 in files of Office of Wyoming State Engineer.

GAGE.--Water-stage recorder. Altitude of gage is 3,450 ft (1,052 m), from topographic map.

EXTREMES.--Current year: Maximum discharge, 417 cfs (11.8 cu m/s) May 6, gage height, 4.52 ft (1.378 m), from rating curve extended above 190 cfs (5.38 cu m/s) on basis of step-backwater computation; minimum daily, 7.0 cfs (0.198 cu m/s) July 20.

Period of record: Maximum discharge, 673 cfs (19.1 cu m/s) May 22, 1972, gage height, 5.59 ft (1.704 m), from rating curve extended above 190 cfs (5.38 cu m/s) on basis of step-backwater computation; maximum gage height, 5.62 ft (1.713 m) Feb. 16, 1971 (backwater from ice); minimum daily discharge, 7.0 cfs (0.198 cu m/s) July 20, 1973.

REMARKS.--Records good except those for winter period, which are poor. Diversions for irrigation of about 13,600 acres (5,500 sq hm) above station of which about 60 acres (24 sq hm) lies below station. Flow supplemented by 3 transbasin diversions from North Piney Creek and South Piney Creek via Prairie Dog ditch, Piney and Cruse ditch and Mead-Coffeen ditch.

<u>Month</u>	<u>Second-foot days</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Runoff in acre-feet</u>
October 1972	1,370	55	34	44.2	2,720
November	1,036	47	24	34.5	2,050
December	959	36	22	30.9	1,900
January 1973	672	31	18	21.7	1,330
February	1,231	139	21	44.0	2,440
March	1,592	98	30	51.4	3,160
April	2,769	385	33	92.3	5,490
May	6,032	407	32	195	11,960
June	819	55	10	27.3	1,620
July	760.2	54	7.0	24.5	1,510
August	1,003	46	22	32.4	1,990
September 1973	<u>2,370</u>	115	38	79.0	<u>4,700</u>
Water year 1972-73	20,613.2	407	7.0	56.5	40,890

## MONTHLY SUMMARY OF DISCHARGE

## Tongue River at Miles City, Montana

LOCATION.--Lat 46°21'30", long 105°48'24", in SE¼ sec. 23, T.7 N., R.47 E., Custer County, on right bank 4 mi (6.4 km) south of Miles City and 8 mi (12.9 km) upstream from mouth.

DRAINAGE AREA.--5,379 sq mi (13,932 sq km).

PERIOD OF RECORD.--April 1938 to April 1942, April 1946 to September 1973. Published as "near Miles City" April 1938 to April 1942. Not equivalent to records published as "near Miles City" May 1929 to October 1932. Monthly discharge only for some periods, published in WSP 1309. Records since January 1950 available in annual report of Yellowstone River Compact Commission.

GAGE.--Water-stage recorder. Altitude of gage is 2,370 ft (722 m), by barometer. April 1938 to April 1942, nonrecording gage at site 8 mi (12.9 km) upstream at different datum. April 1946 to September 30, 1963, at datum 1.00 ft (0.30 m) higher.

AVERAGE DISCHARGE.--30 years (1938-41, 1946-73), 427 cfs (12.1 cu m/s), 309,400 acre-ft/yr (381 eu hm/yr),

EXTREMES.--Current year: Maximum discharge, 4,330 cfs (1,230 cu m/s) June 19, gage height, 7.15 ft (2.179 m); minimum daily, 60 cfs (1.70 cu m/s) Apr. 15, but may have been less during period of ice effect.

Period of record: Maximum discharge, 13,300 cfs (3,770 cu m/s) June 15, 1962, gage height, 12.33 ft (3.758 m), present datum, from rating curve extended above 5,200 cfs (1,470 cu m/s) on basis of float measurement; maximum gage height, 13.27 ft (4.045 m), present datum, Mar. 19, 1960, Feb. 15, 1971 (ice jam); no flow July 9-19, Aug. 13, 14, Sept. 28, 1940.

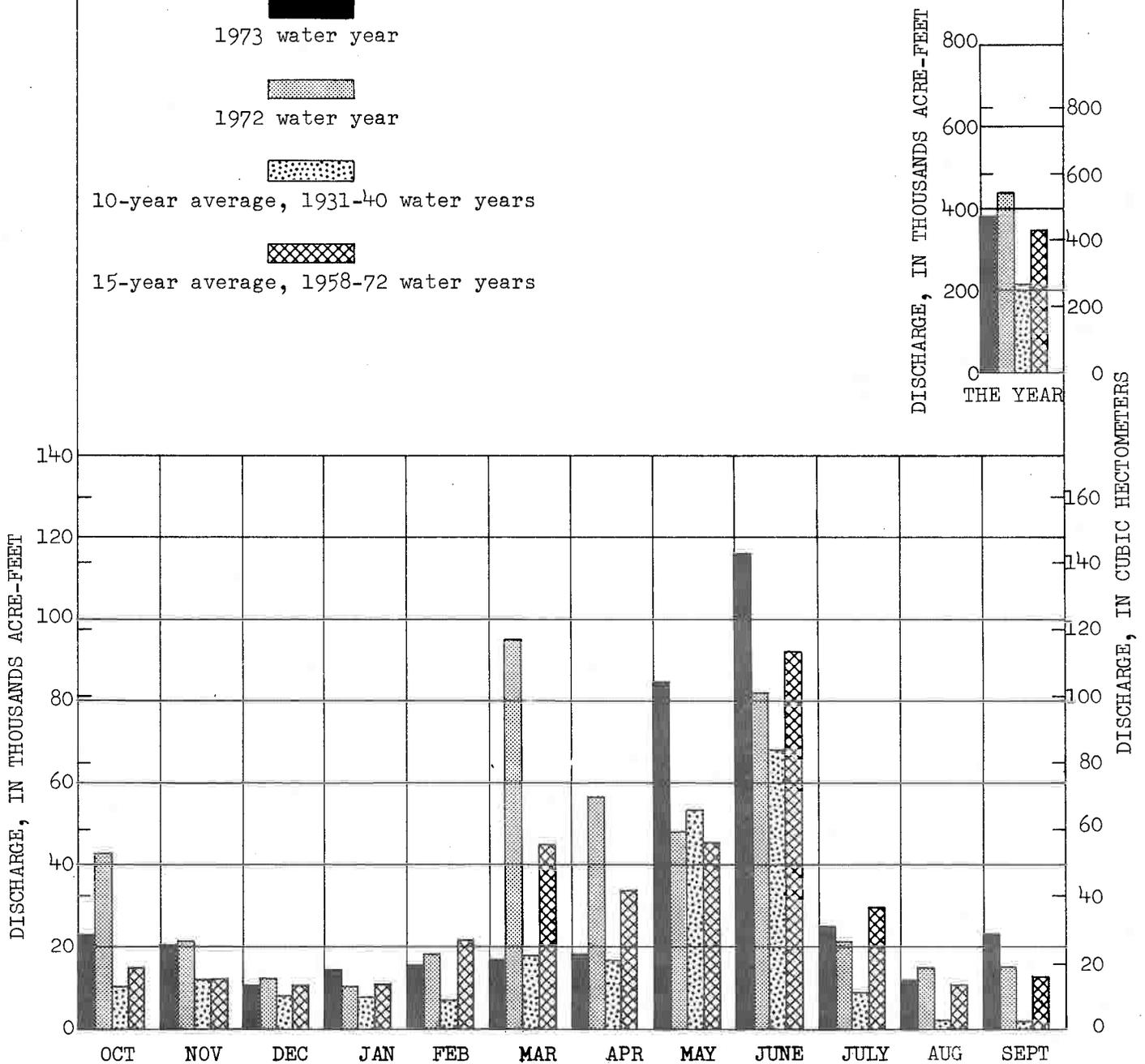
REMARKS.--Records good except those for winter period, which are poor. Flow regulated by Tongue River Reservoir (Appendix C) and many small reservoirs in Wyoming (combined capacity, about 15,000 acre-ft, 18.5 cu hm). Diversions for irrigation of about 90,000 acres (36,420 sq hm) above station.

<u>Month</u>	<u>Second-foot days</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Runoff in acre-feet</u>
October 1972	11,632	416	316	375	23,070
November	10,250	396	220	342	20,330
December	5,320	250	72	172	10,550
January 1973	7,320	280	190	236	14,520
February	7,817	404	210	279	15,500
March	8,662	432	186	279	17,180
April	9,354	1,060	60	312	18,550
May	42,693	2,500	744	1,377	84,680
June	58,454	3,650	888	1,948	115,900
July	12,691	859	150	409	25,170
August	6,016	316	138	194	11,930
September 1973	<u>11,787</u>	1,830	140	393	<u>23,380</u>
Water year 1972-73	191,996	3,650	60	526	380,800

TONGUE RIVER AT MILES CITY, MONT.

EXPLANATION

- 1973 water year
- 1972 water year
- 10-year average, 1931-40 water years
- 15-year average, 1958-72 water years



Comparison of discharge during 1973 water year with 1972 water year and with average discharge for water years 1931-40 and 1958-72

## MONTHLY SUMMARY OF DISCHARGE

## Powder River near Locate, Montana

LOCATION.--Lat 46°26'56", long 105°18'44", in NW¼SW¼ sec.14, T.8 N., R.51 E., Custer County, on left bank 1.5 mi (2.4 km) downstream from bridge on U.S. Highway 12 at present site of Locate (5 mi, 8.0 km, west of former site of Locate), 1.5 mi (2.4 km) upstream from Locate Creek, and 25 mi (40.2 km) west of Miles City.

DRAINAGE AREA.--13,194 sq mi (34,172 sq km). Area at site used prior to Oct. 1, 1965, 13,189 sq mi (34,160 sq km).

PERIOD OF RECORD.--March 1938 to September 1973. Records since January 1950 available in annual reports of Yellowstone River Compact Commission.

GAGE.--Water-stage recorder. Altitude of gage is 2,390 ft (728 m), by barometer. Prior to July 11, 1947, nonrecording gage at bridge 1.5 mi (2.4 km) upstream and July 11, 1947, to Sept. 30, 1965, water-stage recorder at site near bridge at different datum. Oct. 1, 1965, to Oct. 4, 1966, nonrecording gage, and Oct. 5, 1966, to Apr. 15, 1969, water-stage recorder at site 200 ft (61 m) upstream at present datum.

AVERAGE DISCHARGE.--35 years, 621 cfs (17.6 cu m/s), 449,900 acre-ft/yr (555 cu hm/yr).

EXTREMES.--Current year: Maximum discharge observed, 4,400 cfs (125 cu m/s) June 19, gage height, 5.72 ft (1.743 m); maximum gage height, 5.76 ft (1.756 m) Mar. 6; minimum discharge, 48 cfs (1.36 cu m/s) July 25, gage height, 1.51 ft (0.460 m).

Period of record: Maximum discharge observed, 31,000 cfs (878 cu m/s) Feb. 19, 1943, gage height, 11.23 ft (3.423 m), site and datum then in use, from rating curve extended above 17,000 cfs (481 cu m/s); no flow Jan. 16, to Feb. 12, Feb. 22-24, 1950, July 27, Sept. 21-27, Oct. 1, 1960, Sept. 4-8, 1961.

REMARKS.--Records good except those for winter period, which are poor. Some regulation by three reservoirs in Wyoming with combined usable capacity of 36,800 acre-ft (45.4 cu hm). Diversions for irrigation of about 52,000 acres (21,000 sq hm).

Month	Second-foot days	Maximum	Minimum	Mean	Runoff in acre-feet
October 1972	10,375	544	176	335	20,580
November	10,991	502	110	366	21,800
December	3,505	150	70	113	6,950
January 1973	5,800	230	140	187	11,500
February	6,825	440	200	244	13,540
March	18,820	1,570	424	607	37,330
April	22,305	2,270	326	744	44,240
May	60,600	2,960	1,080	1,955	120,200
June	50,607	3,870	490	1,687	100,400
July	13,558	1,840	54	437	26,890
August	8,186	1,630	112	264	16,240
September 1973	19,604	2,580	92	653	38,880
Water year 1972-73	231,176	3,870	54	633	458,500

POWDER RIVER NEAR LOCATE, MONT.

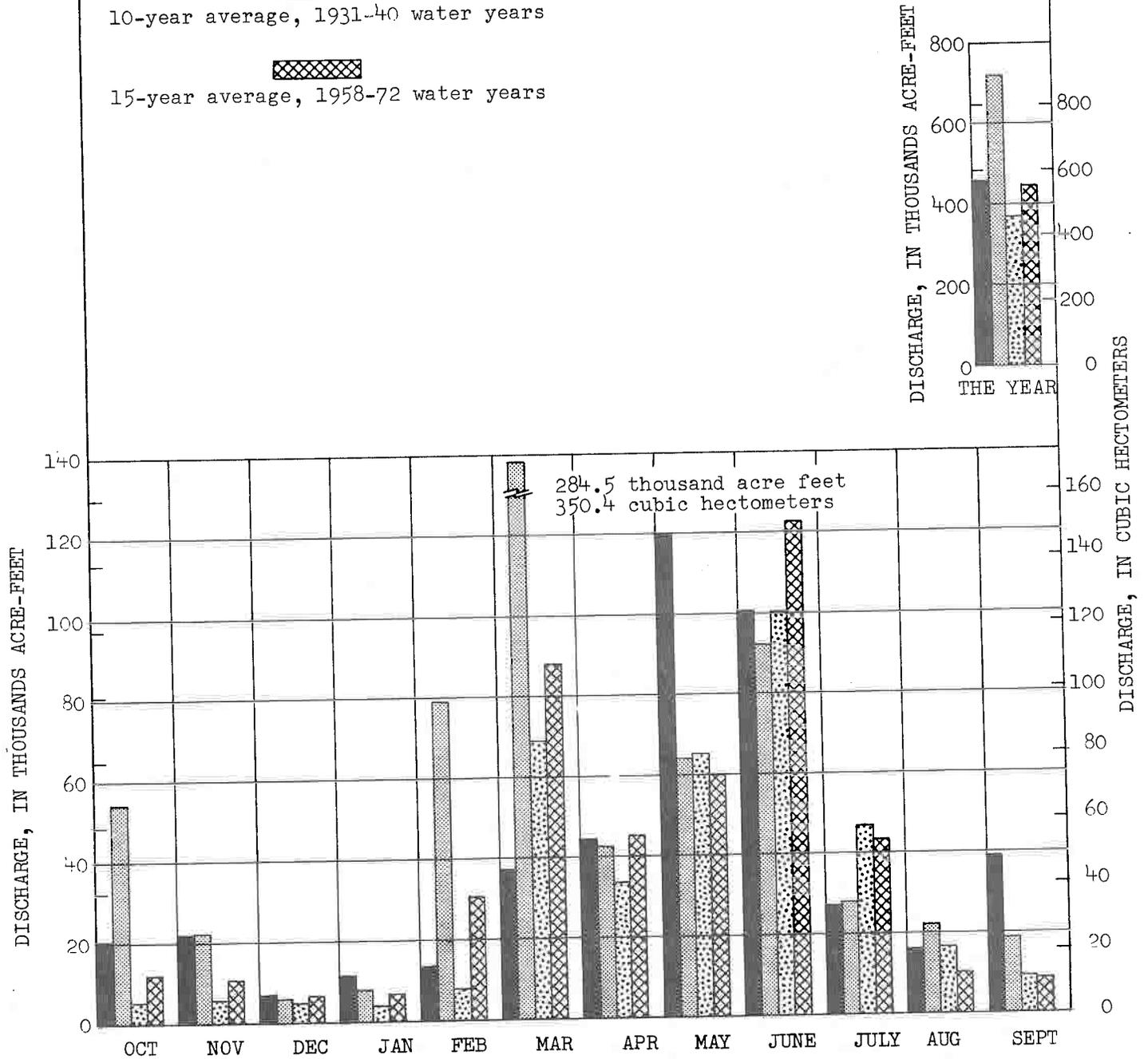
EXPLANATION

1973 water year

1972 water year

10-year average, 1931-40 water years

15-year average, 1958-72 water years



Comparison of discharge for 1973 water year with 1972 water year and with average discharge for water years 1931-40 and 1958-72

## RESERVOIRS COMPLETED AFTER JANUARY 1, 1950

## Boysen Reservoir, Wyoming

LOCATION.--Lat 43°25'00", long 108°10'37", in NW¼NW¼ sec.16, T.5 N., R.6 E., Fremont County, at dam on Wind River, 13 mi (20.9 km) north of Shoshoni, Wyoming.

DRAINAGE AREA.--7,700 sq mi (19,943 sq km).

RECORDS AVAILABLE.--October 1951 to September 1973 (monthend contents only).

GAGE.--Water-stage recorder. Datum of gage is at mean sea level, datum of 1933 (levels by Bureau of Reclamation).

EXTREMES.--Current year: Maximum daily contents, 750,400 acre-ft (925 cu hm) Sept. 15, 16, elevation, 4,725.42 ft (1,440.31 m); minimum daily, 437,300 acre-ft (539 cu hm) Mar. 18-22, elevation, 4,706.72 ft (1,434.61 m).

Period of record: Maximum daily contents, 862,500 acre-ft (1,060 cu hm) July 6, 7, 1967, elevation, 4,730.83 ft (1,441.96 m); minimum daily (since normal use of water started), 189,800 acre-ft (234 cu hm) Mar. 18, 19, 1956, elevation, 4,684.18 ft (1,427.74 m), capacity table then in use.

REMARKS.--Reservoir is formed by rock-fill dam completed in October 1951. Storage began Oct. 11, 1951. Usable capacity, 742,100 acre-ft (915 cu hm) between elevation 4,657.0 ft (1,419.5 m), invert of penstock pipe, and 4,725.0 ft (1,440.2 m), top of spillway gate. Dead storage, 59,880 acre-ft (73.8 cu hm) below elevation 4,657.0 ft (1,419.5 m). Prior to Jan. 1, 1966, usable capacity was 757,800 acre-ft (934 cu hm) and dead storage was 62,000 acre-ft (76.4 cu hm), at same elevations. Crest of dam is at elevation 4,758 ft (1,450 m). Figures given herein represent usable contents. Water used for irrigation, flood control, and power development.

COOPERATION.--Records furnished by Bureau of Reclamation.

<u>Month</u>	<u>Water-surface elevation in feet</u>	<u>Contents in acre-feet*</u>	<u>Change in contents during month in acre-feet</u>
September 30, 1972 . . . . .	4,719.40	637,800	--
October 31 . . . . .	4,718.27	617,900	-19,900
November 30 . . . . .	4,715.65	573,400	-44,500
December 31 . . . . .	4,711.87	513,200	-60,200
January 31, 1973 . . . . .	4,709.29	474,400	-38,800
February 28 . . . . .	4,707.39	446,800	-27,600
March 31 . . . . .	4,706.83	438,800	-8,000
April 30 . . . . .	4,709.78	481,600	+42,800
May 31 . . . . .	4,718.58	623,300	+141,700
June 30 . . . . .	4,722.83	700,500	+77,200
July 31 . . . . .	4,724.75	737,300	+36,800
August 31 . . . . .	4,722.94	702,500	-34,800
September 30, 1973 . . . . .	4,724.75	737,300	+34,800
Water year 1972-73			+99,500

\* Does not include dead storage of 59,880 acre-ft (73.8 cu hm).

## RESERVOIRS COMPLETED AFTER JANUARY 1, 1950

## Anchor Reservoir, Wyoming

LOCATION.--Lat 43°39'50", long 108°49'27", in sec.26, T.43 N., R.100 W., Hot Springs County, at dam on South Fork Owl Creek, 2 mi (3.22 km) downstream from Middle Fork, 3 mi (4.83 km) southeast of Anchor, and 32 mi (51.5 km) west of Thermopolis.

DRAINAGE AREA.--125 sq mi (324 sq km), approximately.

RECORDS AVAILABLE.--November 1960 to September 1973 (monthend contents only).

GAGE.--Water-stage recorder. Datum of gage is at mean sea level (Bureau of Reclamation datum).

EXTREMES.--Current year: Maximum daily contents, 3,420 acre-ft (4.22 cu hm) May 21, elevation, 6,392.63 ft (1,948.47 m); no storage on many days.

Period of record: Maximum daily contents, 9,250 acre-ft (11.4 cu hm) July 4, 1967, elevation, 6,418.52 ft (1,956.36 m); no storage on many days each year.

REMARKS.--Reservoir is formed by concrete arch dam completed in 1960. Total capacity, 17,230 acre-ft (21.2 cu hm) between elevation 6,343.75 ft (1,933.58 m), invert of river outlet, and 6,441.00 ft (1,963.22 m), spillway crest, including 68 acre-ft (83,800 cu m) below elevation 6,343.75 ft (1,933.58 m). Prior to Oct. 1, 1971, total capacity was 17,350 acre-ft (21.4 cu hm) with 149 acre-ft (0.184 cu hm) below the invert. Figures given herein represent total contents. Water is used for irrigation of lands in Owl Creek basin.

COOPERATION.--Records furnished by Bureau of Reclamation.

<u>Month</u>	<u>Water-surface elevation in feet</u>	<u>Contents in acre-feet</u>	<u>Change in contents during month in acre-feet</u>
September 30, 1972 . . . . .	--	0	-
October 31 . . . . .	--	0	-
November 30 . . . . .	--	0	-
December 31 . . . . .	--	0	-
January 31, 1973 . . . . .	--	0	-
February 28 . . . . .	--	0	-
March 31 . . . . .	--	0	-
April 30 . . . . .	6,352.00	197	+197
May 31 . . . . .	6,383.47	2,170	+1,973
June 30 . . . . .	--	0	-2,170
July 31 . . . . .	6,350.85	171	+171
August 31 . . . . .	--	0	-171
September 30, 1973 . . . . .	6,365.52	681	+681
Water year 1972-73			+681

## RESERVOIR COMPLETED AFTER JANUARY 1, 1950

Bighorn Lake near St. Xavier, Montana

LOCATION.--Lat 45°18'27", long 107°57'26", in SW $\frac{1}{4}$ SE $\frac{1}{4}$  sec.18, T.6 S., R.31 E., Big Horn County, in block 13 of Yellowtail Dam on Bighorn River, 1.3 mi (2.09 km) upstream from Grapevine Creek, 15.5 mi (24.9 km) southeast of St. Xavier, and at mile 81.0 (130.3 km).

DRAINAGE AREA.--19,626 sq mi (50,831 sq km).

PERIOD OF RECORD.--November 1965 to September 1973 (monthend contents only). Prior to October 1969, published as "Yellowtail Reservoir".

GAGE.--Water-stage recorder in powerhouse control room. Datum of gage is at mean sea level (levels by Bureau of Reclamation).

EXTREMES.--Current year: Maximum contents, 1,076,000 acre-ft (1,330 cu hm) Aug. 15, elevation, 3,638.31 ft (1,108.96 m); minimum daily, 881,500 acre-ft (1,090 cu hm) Mar. 12, elevation, 3,618.03 ft (1,102.78 m).

Period of record: Maximum contents, 1,346,000 acre-ft (1,660 cu hm) July 6, 1967, elevation, 3,656.43 ft (1,114.48 m); minimum since first filling, 660,700 acre-ft (815 cu hm) Mar. 11, 1970, elevation, 3,584.45 ft (1,092.54 m).

REMARKS.--Reservoir is formed by thin concrete-arch dam; construction began in 1961; completed in 1967. Storage began Nov. 3, 1965. Usable capacity, 1,356,000 acre-ft (1,670 cu hm) between elevation, 3,296.5 ft (1,004.8 m), river outlet invert, and 3,657.0 ft (1,114.7 m), top of flood control. Elevation of spillway crest, 3,593 ft (1,095 m). Normal maximum operating level, 1,097,000 acre-ft (1,350 cu hm), elevation, 3,640 ft (1,109 m). Minimum operating level, 483,400 acre-ft (596 cu hm), elevation, 3,547 ft (1,081 m). Dead storage, 18,970 acre-ft (23.4 cu hm) below elevation 3,296.5 ft (1,004.8 m). Figures given herein represent usable contents. Water is used for power production, flood control, irrigation, and recreation.

COOPERATION.--Elevations and capacity table furnished by Bureau of Reclamation.

Month	Water-surface elevation in feet	Contents in acre-feet*	Change in contents during month in acre-feet
September 30, 1972 . . . . .	3,637.76	1,069,000	--
October 31 . . . . .	3,637.01	1,060,000	-9,000
November 30 . . . . .	3,629.64	981,200	-78,800
December 31 . . . . .	3,626.63	952,800	-28,400
January 31 1973 . . . . .	3,622.60	917,400	-35,400
February 28 . . . . .	3,618.64	886,000	-31,400
March 31 . . . . .	3,619.65	893,400	+7,400
April 30 . . . . .	3,625.31	940,900	+47,500
May 31 . . . . .	3,631.16	996,400	+55,500
June 30 . . . . .	3,631.45	999,400	+3,000
July 31 . . . . .	3,635.89	1,047,000	+47,600
August 31 . . . . .	3,632.84	1,014,000	-33,000
September 30, 1973 . . . . .	3,637.99	1,072,000	+58,000
Water year 1972-73			+3,000

\* Does not include dead storage of 18,970 acre-ft (23.4 cu hm).

## RESERVOIRS IN EXISTENCE ON JANUARY 1, 1950

The extent, if any, of the use of reservoirs in this category which may be subject to Compact allocations was not determined. As a matter of hydrologic interest the monthend contents in acre-feet of four reservoirs are given. The first three reservoirs are in the Bighorn River basin, Wyoming and data on contents were furnished by the U.S. Bureau of Reclamation. Tongue River Reservoir in Montana is operated under the supervision of the Water Resources Division of the Montana Department of Natural Resources and Conservation, which agency furnished operating data.

## Contents in acre-feet

<u>Month</u>	<u>a/Bull Lake</u>	<u>b/Pilot Butte Reservoir</u>	<u>c/Buffalo Bill Reservoir</u>	<u>d/Tongue River Reservoir</u>
September 30, 1972	121,800	17,590	373,200	32,800
October 31	119,800	14,530	341,900	29,280
November 30	118,800	18,500	332,000	26,210
December 31	118,900	17,660	311,000	27,400
January 31, 1973	118,800	17,730	279,500	27,570
February 28	118,100	17,730	248,600	29,100
March 31	116,000	19,030	217,800	38,480
April 30	112,800	24,060	190,900	48,770
May 31	133,300	27,580	238,300	54,000
June 30	153,100	29,210	361,600	61,700
July 31	150,600	29,120	353,800	51,200
August 31	135,200	16,470	275,200	36,200
September 30, 1973	145,000	18,360	241,400	41,790
Change in Contents during water year	+23,200	+770	-131,800	+8,990

a/ Total contents, from revised capacity table effective Oct. 1, 1965.

b/ Usable contents. Dead storage is 5,360 acre-ft (6.61 cu hm).

c/ Total contents, from revised capacity table based on survey of 1959. Contents prior to October 1960 based on survey of 1941.

d/ Usable contents. Dead storage is 1,400 acre-ft (1.73 cu hm). Contents based upon sedimentation surveys of October 1948.

