APPLICATION FOR RESERVATIONS OF WATER IN THE MISSOURI RIVER BASIN ABOVE FORT PECK DAM

VOLUME 1

Summary, Purpose, Need, Amount,
Public Interest, Management Plan,
and Appendices

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INTRODUCTION

This is Volume 1 of a three-volume application for reservations of water in the Missouri River Basin submitted to the Board of Natural Resources and Conservation. Section 85-2-331(1), MCA authorizes this application from the headwaters to Fort Peck Dam. This volume contains the Summary, Purpose, Need, Amount (including details of methods used), Public Interest considerations, and a Management Plan as required by ARM 36.16.104 through 36.16.106.

Volume 2 contains specific information on each stream in the Missouri River Basin upstream from Canyon Ferry Dam for which a reservation is requested. Information presented includes a brief physical description of the stream or stream reach, the fisheries and wildlife resources associated with the stream, and the flow levels that are requested. The methods and data used in deriving the requested flows are also discussed. Streams are presented in a downstream order.

Volume 3 is similar in content to Volume 2, but includes streams in the Missouri Basin from Canyon Ferry Dam to Fort Peck Dam (see map in Summary section).

For purposes of this application, that portion of the Missouri River Basin above Canyon Ferry Dam is sometimes referred to as the "upper" Missouri Basin and that portion between Canyon Ferry Dam and Fort Peck Dam as the "middle" Missouri basin.

SUMMARY

Pursuant to Section 85-2-316, MCA, and Article II of the Constitution of the State of Montana which establishes that a clean and healthful environment is an inalienable right of Montana citizens, the Montana Department of Fish, Wildlife and Parks respectfully files application for reservations of water in the Missouri River Basin above Fort Peck Dam. Section 85-2-331(1), MCA, requires that water reservation applications for the basin below Fort Peck Dam be submitted by July 1, 1991.

Figure 1-1 is a Missouri River Basin map showing, in general, where the requested reservations will be applied to use. More detailed maps are contained in Volumes 2 and 3.

The purpose of the reservations herein applied for is to reserve waters, and flows thereof, for existing and future beneficial uses and to maintain a minimum flow, level and quality of water during such periods throughout each year in order to attain and serve existing and future beneficial uses.

Fish and wildlife populations and their habitats are inseparable. Therefore, preservation of fish and wildlife populations is necessarily dependent upon preservation of their habitats and all habitat components. The habitat components for streams and rivers are: (1) the physical streambed and banks, (2) the quantity of the water, and (3) the quality of the water.

Protection of the physical streambed and banks is provided by the Stream Protection Act (87-5-501, MCA) and the Natural Streambed and Land Preservation Act of 1975 (75-7-101, MCA). The prevention, abatement, and control of pollution in state waters is the responsibility of the Montana Department of Health and Environmental Sciences through 75-5-211, MCA. The 1973 Water Use Act provides the opportunity for the state or any political subdivision or agency thereof or the United States to apply to the Board of Natural Resources and Conservation to reserve waters for existing or future beneficial uses or to maintain a minimum flow, level or quality of water (Section 85-2-316, MCA).

Fish, wildlife, and outdoor recreational resources are important to human well-being and must be preserved for the use and enjoyment of current and future generations. These resources are owned by the people of the state and must be managed for the best public interest.

The Department of Fish, Wildlife and Parks (DFWP) has a two-fold responsibility: (1) to protect and enhance the abundant and diverse fish, wildlife, and recreational resources, and (2) to

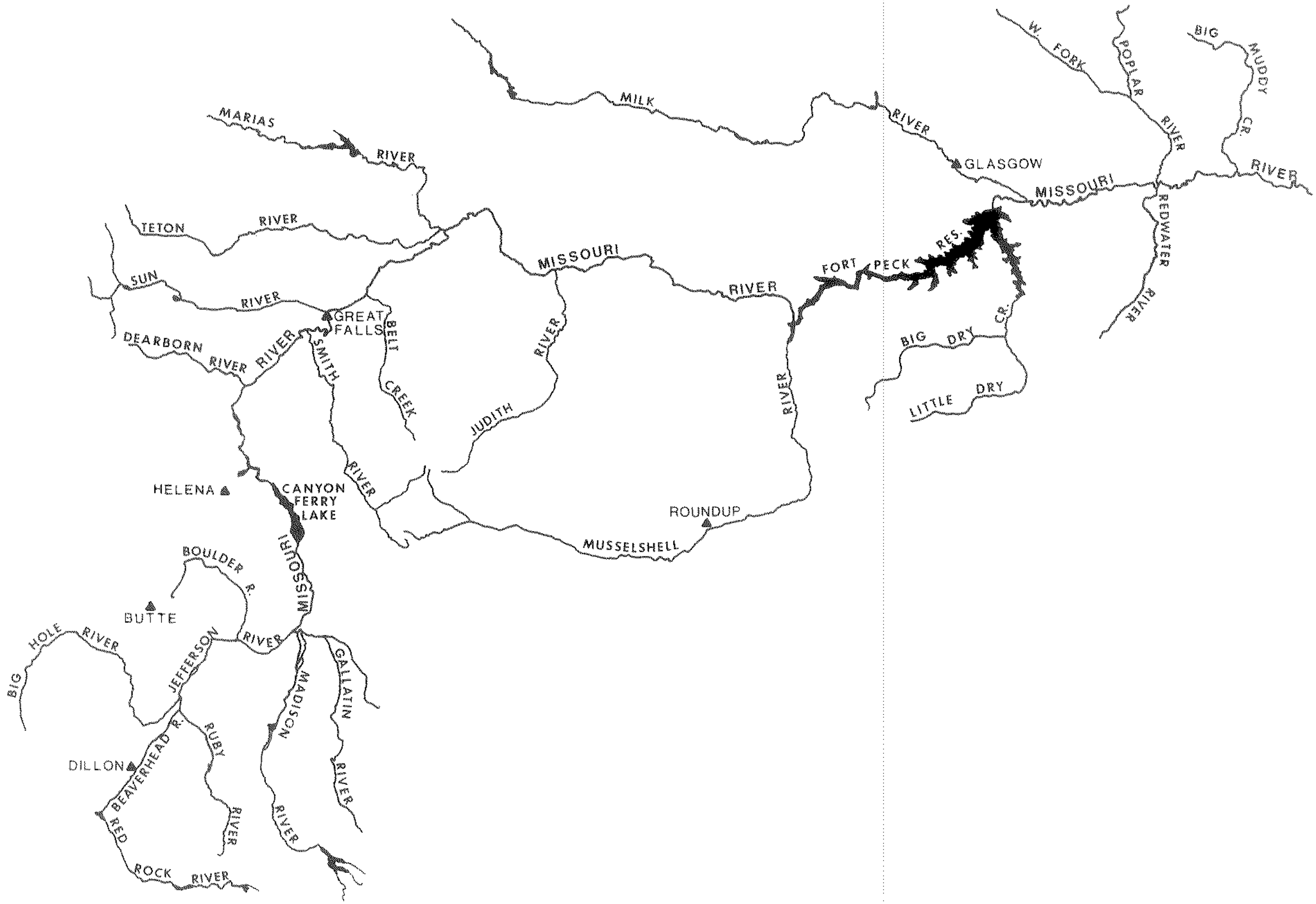

Figure 1-1. Map of Missouri River Basin above Fort Peck Dam.

provide optimum opportunities for diverse outdoor recreation that are commensurate with resource preservation. Water reservations for instream flows would serve to protect a vital component of stream fishery habitat and thereby assist in meeting those responsibilities.

The amounts of the reservations requested vary from small flow quantities in headwater tributaries to larger quantities on the lower mainstem Missouri River. Flows are requested for the mainstem of the Madison, Gallatin, Jefferson, Big Hole, Beaverhead, Red Rock, and Missouri rivers above Canyon Ferry Dam, as well as for 152 tributaries of those major streams. Below Canyon Ferry Dam requests are submitted for the mainstem Missouri, Dearborn, Sun, Marias, Teton, Smith, Judith and Musselshell rivers as well as for 82 tributaries to those major streams. Requests are also made for Bean Lake and Antelope Butte Swamp. The specific requests are later set forth in the "Analysis of the Amount of Water Necessary for the Purpose of the Reservations."

There are attached hereto, and made a part hereof, statements on the purpose of, the need for, amount of, and public interest of these requested reservations of water. These statements and their attachments are presented in support of this application for reservations of water and to meet the requirements of the Montana Water Use Act and applicable rules thereunder for the establishment of reservations of water for fish, wildlife and recreational uses.

THIS APPLICATION CONTAINS NO PROPOSED PROJECTS FOR USE OF THE RESERVED WATER.

PURPOSE OF THE RESERVATIONS

Section 85-2-102, MCA, and ARM 36.16.102 define beneficial use of water to include ". . . but not limited to agricultural (including stock water), domestic, fish and wildlife, industrial, irrigation, mining, municipal, power, and recreational uses; . . ." (Emphasis added.)

The purpose of the reservations is to reserve flows for existing and future beneficial uses so as to maintain a minimum flow, level or quality of water by month and throughout each year to attain and serve those beneficial uses as follows:

(1) for the benefit of the public for fish and wildlife uses; and

(2) for the benefit of the public for recreational uses.

The attainment and service of such uses are to:

(1) provide fish and wildlife habitat sufficient to accommodate a diversity of species comprising this natural resource at levels comparable to existing levels;

(2) contribute to, and maintain a clean, healthful and desirable environment;

(3) sustain adequate levels of water quality; and

(4) honor and support all existing water use rights.

The beneficiaries of the reservations will be the numerous and varied fish and other aquatic species currently inhabiting the streams and waters of the Missouri basin as well as those wildlife species which depend in one form or another on the flows and adjacent riparian areas along those streams. Other beneficiaries are the people of Montana, resident and non-resident fishermen, other stream-based recreationists who visit from other states, and those Montana businesses which depend upon the fisheries resources for their livelihood and economic well-being. Other benefits accrue to those non-fishermen who merely wish to enjoy the streamside setting and the associated animal and bird life provided by flowing waters.

Maintaining flows in stream channels also indirectly benefits those persons who divert water for consumptive uses by protecting them against upstream water users who may have lower water use priority dates than the reservations. At the same time, the reservations honor and support all existing water rights.

ANALYSIS OF THE NEED FOR THE RESERVATIONS

A water right for instream beneficial use for fish, wildlife, and recreational uses may be obtained, under existing Montana statutes, only by application for reservation and not by petition or application for a water use permit. Without these requested reservations, the beneficial uses of fish, wildlife, and recreation provided for by Montana law cannot be met or attained.

Existing water rights in the river basin will at all times be honored. If the reservations here requested are not granted, any waters available over and above such existing rights will be vulnerable to future appropriations by permit. If these future appropriations are allowed to be executed in advance of, or without, the reservations being established, the fish and wildlife resources will be permanently deprived of the waters necessary for their healthy survival. It is readily apparent when realistically considered, that under our current laws and regulations, waters once allowed to be appropriated might well never again be available to reservation for fish and wildlife purposes. The need for an adequate reservation now is thus dictated.

Instream reservations of water in the Missouri basin are necessitated by the basic life requirements of the fish, wildlife, and other living organisms that are dependent upon the flow of the Missouri River and its tributaries. The maintenance of healthy aquatic populations add to the human experience by creating high quality angling and other water-based recreational opportunities.

The instream reservations are needed to (1) maintain sufficient living space, (2) protect fish spawning and juvenile rearing areas, (3) protect the aquatic food base, (4) protect water quality, (5) maintain streamside riparian areas, (6) provide for high quality fishing opportunities, (7) sustain fishing-related economic benefits, and (8) help protect fish "Species of Special Concern."

(1) Living Space

Fish inhabiting a stream occupy specific habitats which are comprised of many components, including a preferred range of water velocities and depths. The quantity and quality of this physical habitat is influenced by the magnitude of the flows. It is through its impact on fish habitat that flow is believed to primarily regulate fish abundance. Simply stated, following long-term flow reductions, fish numbers tend to decrease in response to the shrinking habitat. Conversely, long-term flow increases allow for the expansion of the population.

Sufficient instream flows are essential for maintaining viable game fish populations at levels of abundance that are commensurate with the streams' biological capabilities and that satisfy the expectations of the angling majority, providing them with a high quality fishing experience. A reservation will help to accomplish these goals.

(2) Spawning and Juvenile Rearing Areas

Montana's nationally acclaimed trout streams, many of which are located within the Missouri basin, are sustained entirely by trout produced in the wild, making Montana the last bastion of wild trout fishing in the lower 48 states. Fisheries of many warm and coldwater lakes and reservoirs also depend on wild recruits spawned in tributaries. Stream riffles and side-channels are typically the prime sites chosen for spawning and the rearing of young. These sites are also the stream habitats that are most sensitive to flow reductions. Consequently, the production of the young recruits that are needed to sustain the vast majority of the basin's fisheries is strongly tied to the magnitude of the flows. The reservation will help preserve this reproductive capacity.

(3) Food Base

All aquatic organisms depend on lower forms of plants or other animals for food. These lower forms also have specific water requirements necessary to sustain growth and reproduction. Reduction in availability of lower aquatic forms ultimately reduces the abundance of those organisms at higher trophic levels.

The primary food of Montana's stream-dwelling game fish is aquatic invertebrates, which have their greatest production in stream riffles. Riffles are also highly sensitive to flow reductions. The health and well-being of the game fish populations and, in turn, the quality of the angling experience depend on the maintenance of sufficient riffle habitat to protect the fishes' food base. A reservation will help accomplish this task.

(4) Water Quality

Reduced streamflows during the normal low flow period affect the quality of water that is necessary to sustain aquatic organisms. Possible consequences of lowered streamflows are higher water temperatures, increased amounts of dissolved solids, increased nutrient concentrations, and lower dissolved oxygen levels, all of which are potentially harmful to aquatic life. Low flow conditions will reduce the amount of water available for dilution of industrial and municipal discharges, and non-point pollution. Current and future industrial and municipal waste discharge permits could be affected by chronic low flows.

Instream flow reservations are needed to prevent the further deterioration of water quality during low flow periods. Should existing pollution problems be corrected on those streams where poor water quality is presently limiting fish abundance, a reservation would help insure that sufficient flow is available in the future to allow populations to expand and reach the streams' biological potential.

(5) Riparian Areas

The riparian ecosystem of the Missouri River and its tributaries is a transitional zone between the aquatic and terrestrial habitats. This streamside zone of vegetation is characterized by the combination of high species diversity and densities, and high productivity. Many of the trees and shrubs that dominate this zone require groundwater within their rooting systems throughout the growing season.

The riparian zone is ecologically important because it provides seasonal and year-long habitat for more numbers and species of wildlife than any other habitat in Montana. In addition to its rich assemblage of plants and animals, the riparian zone plays an essential role in determining the quality of the aquatic environment for supporting fish and aquatic invertebrates. It also provides a buffer zone for dissipating overland flood flows and has high aesthetic and recreational values.

The extent and quality of riparian zones are directly linked to shallow groundwater tables that are continuous with, and recharged by, surface streamflows. Fluctuations in streamflow cause concomitant fluctuations in associated shallow groundwater tables. Although the specific relationships among riparian vegetation and the amount and availability of groundwater have not been quantified in the Missouri basin, requested instream flows are essential to the perpetuation of the existing plant communities and associated wildlife populations.

(6) Fishing Opportunities

The Missouri River and its tributaries are important fishing and recreational areas used by the people of Montana and the nation. Of the estimated 2.44 million angler-days of fishing use in Montana in 1985, roughly half (1.17 million angler-days) occurred in the Missouri basin upstream from Fort Peck Dam (McFarland 1989). This attests to the popularity and outstanding quality of the basin's fishery resources.

The recreational use of the basin's waters is important to the human experience, providing both enjoyment and relief from day-to-day pressures. Montana statutes recognize this resource as worthy of protection. The fish species that would be protected by the instream flow reservations contribute to the well-being of the people of Montana and visitors who enjoy the outstanding fishing opportunities Montana has to offer. In addition to sustaining current levels of water-based recreation, instream reservations would preserve the opportunity to enhance recreational uses on those waters where existing flow depletions are presently limiting fishing and other recreational uses.

(7) Economic Benefits

The Missouri basin's nationally acclaimed sport fisheries provide a significant boost to Montana's economy. Trout anglers on the state's lakes, reservoirs and streams spent, in 1985, an estimated $99.7 million while pursuing their sport (Duffield et al. 1987). About $50 million was spent while fishing the waters of the Missouri basin. Out-of-state visitors accounted for 256,000 angler-days of recreation in the Missouri basin in 1985, which is 49% of the total non-resident pressure for the state.

In 1987, Montana ranked fourth in the nation in the number of non-resident fishing licenses sold (U.S. Fish and Wildlife Service 1988). In 1985, based on a fishing pressure of 2.5 million days per year, the annual value of Montana's lake and stream fisheries totaled $215 million. In the same way that the price of farmland is related to the value of production, the recreational value of Montana's stream and lake "fishing assets" is on the order of $5 billion (Duffield 1988).

The travel industry adds millions of dollars to the state's economy each year and provides jobs for thousands of Montanans (Schwinden 1988). Without the quality fishing opportunities provided in the Missouri basin, Montana's expanding tourist industry, a major contributor to the state's economic base, would suffer. The continued generation of angling-related revenues depends on the maintenance of sufficient flows to protect the abundant wild fish stocks that characterize Montana's nationally renowned fisheries. Continued flow depletions will degrade some of the very resources that draw tourists to Montana. Instream reservations would help to protect this economic base.

(8) "Species of Special Concern"

The Missouri River Basin, particularly headwater tributaries, supports breeding populations of two fishes listed by DFWP and the Montana Chapter of the American Fisheries Society as "Species of Special Concern" (Holton 1986, Liknes 1984). Westslope cutthroat trout and the Montana grayling are native fishes that have been eliminated or severely reduced in numbers over much of their former range. Both species depend on relatively pristine habitat and a low level of competition with non-native fishes for their survival. Instream flow reservations would help maintain a vital component of the habitat still available for these species.

Summary

The reservation requests are for the amount of water necessary to sustain aquatic organisms without significant long-term reduction in quantity and quality. Increased water withdrawals over existing levels would, in the long run, reduce availability of habitat and consequently reduce the number of organisms which can occupy that habitat. There is a limit to the amount of water which can be removed from any stream channel without severely changing the quantity and quality of the aquatic species present, or limiting the biological potential of the stream. In portions of the Missouri River Basin, that limit has already been exceeded.

It is contended that if the requested reservations are not granted, the deterioration of the previously described aquatic habitat components and, therefore, recreational opportunities is inevitable. Instream flow reservations in the Missouri basin would serve to protect a vital component of stream fishery habitat and would assist in protecting the aquatic resources so necessary to the social and economic well-being of the people of Montana and the nation.

DETERMINATION OF THE AMOUNT OF THE RESERVATIONS

This section discusses in detail the methods used to derive the flow quantities requested for each stream reach in the application. The Wetted Perimeter Inflection Point Method was the primary method used. Several alternative methods were also used in situations where the primary method could not be used or where special circumstances required another approach. This volume does not contain the flow requests themselves. Those requests are contained in Volumes 2 and 3 of this application. The specific method used is described under each individual stream reach.

Also discussed in this section is the Water Availability information required by ARM 36.16.105B(2).

Primary Instream Flow Method

Numerous techniques have been developed for determining the instream flow requirements of fish and other aquatic life forms. These range from relatively simple office methods that base their recommendations on some flow quantity derived from the historic flow record, to the derivation of the actual biological-flow relationships from long-term field data collected in drought, normal and above normal water years.

The former approach was not chosen as DFWP's primary means for determining instream flows because DFWP believes that instream flow recommendations should, wherever possible, reflect stream-specific habitat and discharge relationships rather than a flow quantity derived solely from the flow record. Furthermore, the lack of sufficient flow data for the vast majority of Montana's streams precluded the use of almost all office methods. Moreover, the consensus among professionals is that this approach is most appropriate for deriving preliminary or reconnaissance-level recommendations (Estes and Orsborn 1986; Stalnaker and Arnette 1976).

Use of biological-flow relationships was impractical due to the extensive commitment of time, money and manpower that are needed to collect the ten or more years of field data that could be required to define these relationships for each stream or stream reach. The large number of streams in this application precluded the development of biological-flow relationships except in a few cases.

DFWP, recognizing the shortfalls of these approaches for this application, adopted the Wetted Perimeter Inflection Point Method to determine fishery flow needs. This method focuses on the well-founded assumption that the food supply can be a major factor influencing a stream's carrying capacity (the total number and pounds of fish that can be maintained by the aquatic habitat). The principal food of many of the juvenile and adult game fish inhabiting the streams of Montana is aquatic invertebrates, which are produced primarily in stream riffle areas. The method assumes that the game fish carrying capacity is related to food production, which, in turn, is a function of the amount of wetted perimeter in riffles.

Wetted perimeter is the distance along the bottom and sides of a channel cross-section in contact with water (Figure 1-2). As the flow in a stream channel increases, the wetted perimeter also increases, but the rate of gain of wetted perimeter is not constant throughout the entire range of flows.

A plot of wetted perimeter versus flow for stream riffle cross-sections generally shows two points, referred to as inflection points, where the rate of gain of wetted perimeter abruptly changes. In the example, (Figure 1-3), these inflection points occur at approximately 8 and 12 cfs. Below the lower inflection point, the stream flow is spreading out horizontally across the bottom, causing the wetted perimeter to increase rapidly for very small increases in flow. A point is eventually reached (at the lower inflection point) where the water starts to move up the sides of the active channel and the rate of increase of wetted perimeter begins to decline. At the upper inflection point, the stream is approaching its maximum width and begins to move up the banks as flow increases. Large increases in flow beyond the upper inflection point cause only small increases in wetted perimeter.

The area available for food production is considered near optimal at the upper inflection point because almost all of the available riffle area is wetted. At flows below the upper inflection point, the stream begins to pull away from the riffle bottom until, at the lower inflection point, the rate of loss of wetted bottom area begins to rapidly accelerate. Once flows are reduced below the lower inflection point, the riffle bottom is being exposed at an even greater rate and the area available for food production greatly diminishes. The method is intended to describe a threshold below which a stream's food producing capacity begins to decline (upper inflection point) and a threshold at which the loss is judged unacceptable (lower inflection point).

While the inflection point concept focuses on food production, there are indications that wetted perimeter relates to other factors that influence a stream's carrying capacity. One such factor is cover (or shelter), a well-recognized component of fish habitat.

In the headwater streams of Montana, overhanging or submerged bank vegetation and undercut banks are important components of

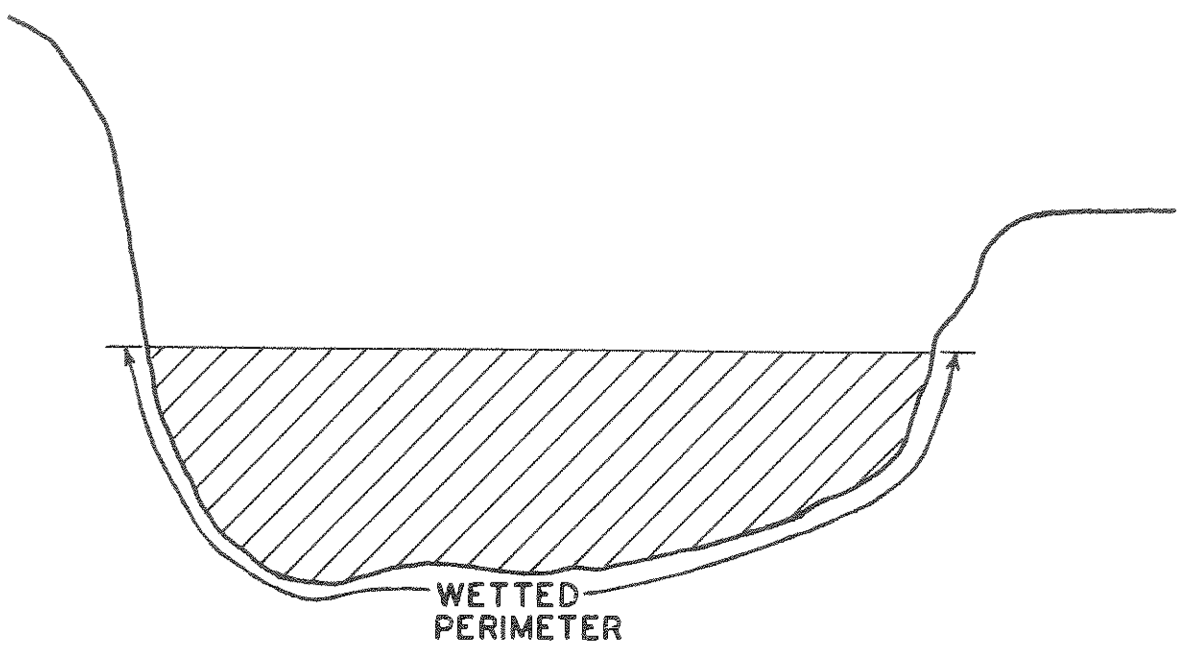

Figure 1-2. The wetted perimeter in a channel cross-section.

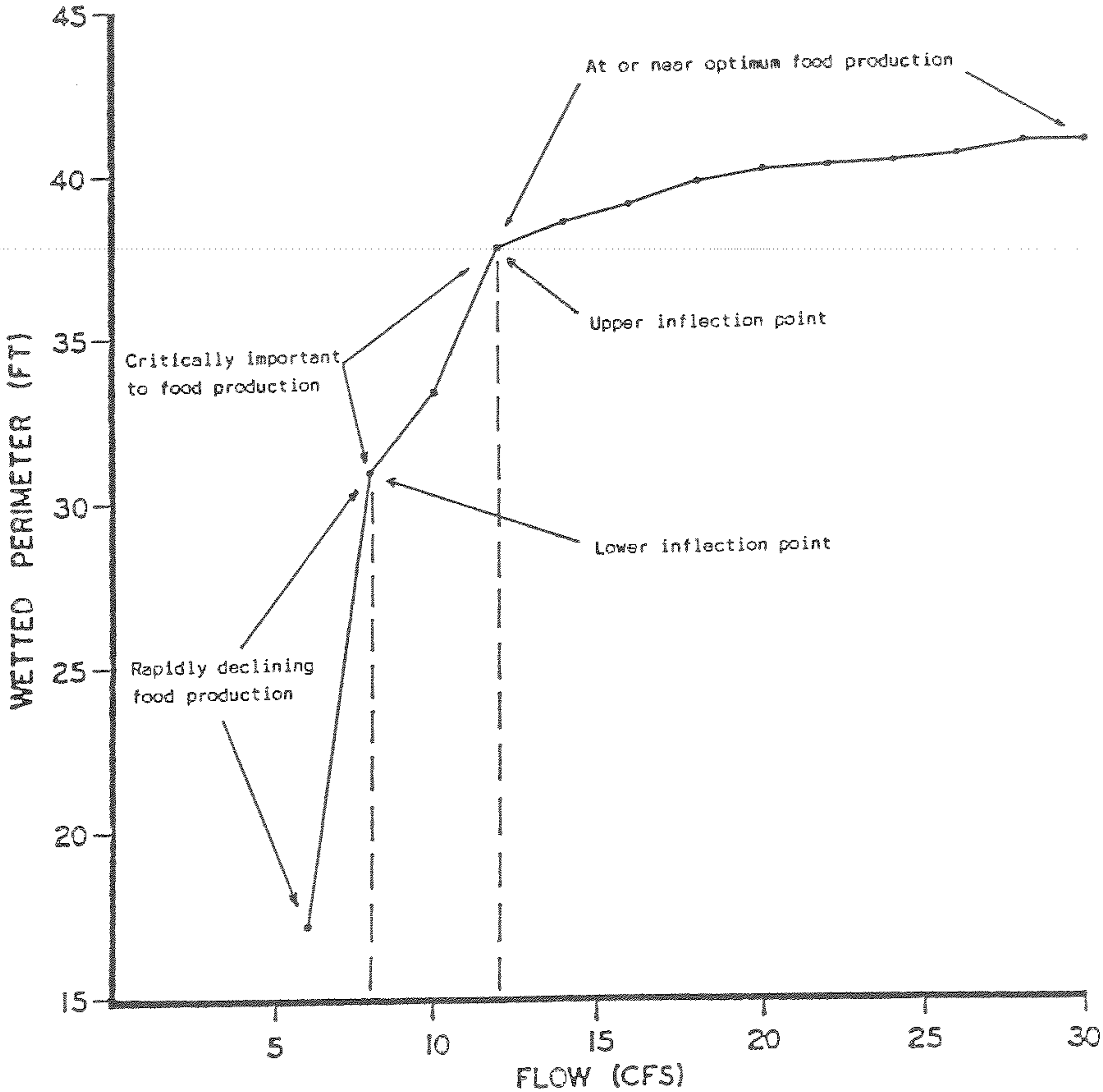

Figure 1-3. An example of a relationship between wetted perimeter and flow for a stream riffle cross-section showing upper and lower inflection points and their relationship to fish food production.

cover. The wetted perimeter-flow relationship for a stream channel is, in some cases, similar to the relationship between bank cover and flow. Flows exceeding the upper inflection point are considered to provide near optimal bank cover. Below the upper inflection point, the water pulls away from the banks, decreasing the amount of bank cover associated with water. At flows below the lower inflection point, the water is sufficiently removed from the bank cover to severely reduce its value as fish shelter. Support for this relationship is provided by Randolph (1984), who found a high correlation between riffle wetted perimeter at various flows and the total area of overhanging bank vegetation (r=0.88-1.00) and undercut banks (r=0.84-0.97) for three study sections in a small Montana stream.

In addition to producing food, riffles are used by many game fish species for spawning and the rearing of their young (Sando 1981 and Loar et. al. 1985). Consequently, the protection of riffles helps ensure that the habitat required for these critical life functions is also protected.

Riffles are the area of a stream most affected by flow reductions (Bovee 1974, Nelson 1977 and Loar et al. 1985). By requesting a flow that covers a large portion of the available riffle area, we are, at the same time, protecting both runs and pools--areas where adult fish normally reside.

The Wetted Perimeter Inflection Point Method provides a range of flows (between and including the lower and upper inflection points) from which a single instream flow recommendation is selected. Flows below the lower inflection point are judged undesirable based on their probable impacts on food production, bank cover, and spawning and rearing habitats, while flows at and above the upper inflection point are considered to provide near optimal conditions for fish. The upper and lower inflection points are believed to bracket those flows needed to maintain high and low levels of aquatic habitat potential. These habitat levels are defined as follows:

(1) <u>High Level of Aquatic Habitat Potential</u> -- That flow regime which will consistently produce abundant, healthy and thriving aquatic populations. In the case of game fish species, these flows would produce abundant game fish populations capable of sustaining a good to excellent sport fishery for the size of stream involved. For rare, threatened or endangered species, flows to accomplish the high level of aquatic habitat maintenance would: (a) provide the high population levels needed to ensure the continued existence of that species, or (b) provide the flow levels above those which would adversely affect the species.

(2) Low Level of Aquatic Habitat Potential -- That flow regime which will provide for only a low population of the species present. In the case of game fish species, a limited sport fishery could still be provided. For rare, threatened or endangered species, their populations would exist at low or marginal levels. In some cases, this flow level would not be sufficient to maintain certain species.

The final flow recommendation is generally selected from this range of flows by a consensus of the biologists who collected, summarized and analyzed all relevant field data for the stream of interest. The biologists' analyses of the stream resource form the basis of the flow selection process. Factors considered in the evaluation include: (1) level of recreational use, (2) existing level of environmental degradation, (3) water availability, and (4) size and composition of existing fish populations. Fish population information is a major consideration for all streams. A marginal or poor fishery may only justify a flow recommendation at or near the lower inflection point unless other considerations, such as the presence of "Species of Special Concern" (arctic grayling and westslope cutthroat trout, for example) warrant a higher flow. In general, streams with exceptional resident fish populations, those providing crucial spawning and/or rearing habitats for migratory populations, and those supporting significant populations of "Species of Special Concern" should be considered for flow recommendations that are at or near the upper inflection point. The Missouri Basin streams in this application are generally those with the highest resident fishery and/or spawning values and, consequently, for most of these streams upper inflection point flows are requested.

Other streams considered for upper inflection point recommendations are streams that have the capacity to provide an outstanding fishery, but are prevented from reaching their potential because of stream dewatering. Flows at the upper inflection point provide a goal to strive for should the means become available to improve streamflows through such measures as water storage projects or the purchase and/or lease of irrigation rights. Streams that are subjected to other forms of environmental degradation, such as mining pollution, and which have the potential (assuming other habitat factors are suitable) to support significant fisheries if reclaimed, are additional candidates for upper inflection point recommendations. Both of these categories describe some streams in this application.

The wetted perimeter-flow relationships for the streams of the Missouri Basin were derived using a wetted perimeter predictive (WETP) computer program developed in 1980 for the DFWP. WETP is a relatively simple computer model that eliminates the more complex data collecting and calibration procedures associated with similar computer programs in current use, while at the same time providing more accurate and reliable wetted perimeter predictions. An in-depth description of the WETP computer program and data collection procedures is provided in a publication titled "Guidelines for Using the Wetted Perimeter (WETP) Computer Program of the Montana Department of Fish, Wildlife and Parks" (Nelson 1989) (see Attachment 1).

When deriving instream flow recommendations for the rivers and streams of Montana, DFWP normally divides the annual flow cycle into two separate periods: (1) a relatively brief snow runoff or high flow period, when a large percentage (about 75%) of the annual water yield is passed through stream channels and (2) a non-runoff or low flow period which is characterized by relatively stable base flows maintained primarily by groundwater outflow. For headwater rivers and streams, the high flow period generally includes the months of May, June, and July, while the remaining months (approximately August through April) encompass the low flow period.

The Wetted Perimeter Inflection Point Method is normally applied only to the low flow period, and a separate method that addresses the high flow functions of channel maintenance and flushing of bottom sediments is applied to the high flow period. However, because most water users, particularly irrigators, are unable to divert a significant portion of the high runoff flows and, therefore, are incapable of materially impacting the high flow functions of bedload movement and sediment transport, the need for high flow recommendations may be unnecessary in most cases. The most probable causes for high flow reduction in most of Montana's unregulated streams would be mainstem impoundments. Therefore, extending the wetted perimeter recommendations through the high flow period -- a practice applied to the streams in this application -- should not jeopardize the maintenance of adequate high flows for most streams. Furthermore, Montana law [85-2-316(6), MCA] limits the granting of instream flows to no more than 50% of the average annual flow on gauged streams, thus eliminating (in many cases) flushing and channel maintenance flows from consideration in a reservation application.

Attachment 2 to this application is a comprehensive survey of the instream flow methods literature (Leathe and Nelson 1989), which relates the significance of existing methods to Montana's Wetted Perimeter Inflection Point Method. This synopsis includes the history of instream flow development, the relationship between streamflows and fish populations, a survey and analysis of instream flow methods (including available techniques, advantages and limitations, evaluation studies, and criteria for selecting an instream flow method), and finally, a discussion of why Montana chose to use the Wetted Perimeter Inflection Point Method in its instream flow program. This synopsis is an important component of DFWP's method and justification for the flows requested in this application and should be used in conjunction with the above method discussion.

In summary, the primary method used to determine the requested instream flows for streams and stream reaches in this application is the same -- the Wetted Perimeter Inflection Point Method combined with a knowledge of flow conditions and the fishery gained through field observations and electrofishing surveys. For a relatively few remaining waters, other methods, which are discussed in the following section, were used to derive recommendations.

Alternative Instream Flow Methods

While most of the flow requests in this application were derived from the Wetted Perimeter Inflection Point Method, some were based on the following four approaches:

1. Fixed Percentage Technique

Various non-field or office methods that use existing hydrologic information to derive instream flow recommendations are described in the literature. These methods are similar in that they are usually performed in the office with few, if any, on-site visits required. Office methods are generally deemed most appropriate for deriving preliminary or reconnaissance-level recommendations. Final recommendations are typically derived using various field methods. In Alaska, however, levels of instream flow protection granted by the governing authorities were based solely on office methods (Estes 1988), indicating that such methods are being accepted as primary instream flow methods in certain situations.

One of the better known office methods is the Tennant Method, sometimes referred to as the Montana Method (Tennant 1975). Recommendations of the Tennant Method are based on a fixed percentage of the average annual flow. Tennant describes 30% of the average annual flow as necessary to sustain good survival habitat for most aquatic species, and 60% as providing excellent to outstanding habitat for most aquatic species during their primary periods of growth and for the majority of recreational uses. Ten percent of the average is suitable only for sustaining short-term survival habitat, according to Tennant. The percentage selected as a recommendation depends on the stream's numerical rating in a fisheries classification system. The higher the rating, the greater the percentage recommended.

The purpose of this section is to describe the fixed percentage method used in this application to derive instream flow recommendations for the relatively few (27 total) streams in which time, budget, manpower, limited access, or other constraints prevented the use of the Wetted Perimeter Inflection Point Method, the Department's chosen field method. These 27 streams, all highly valued fisheries deserving maximum instream flow protection, are:

Beaverhead-Red Rock Sub-basin

Browns Canyon Creek
Red Rock River (Reach #1)
Reservoir Creek
West Fork Dyce Creek

Big Hole Sub-basin

Big Lake Creek
Delano Creek
Jacobson Creek
Rock Creek
Wyman Creek

Gallatin Sub-basin

Hell Roaring Creek

Jefferson Sub-basin

Halfway Creek

Madison Sub-basin

Cougar Creek
Duck Creek
Elk River
Moore Creek
Red Canyon Creek
Trapper Creek
Watkins Creek

Ruby Sub-basin

Coal Creek

Upper Missouri Sub-basin

Deep Creek

Smith Sub-basin

North Fork Deep Creek

Musselshell Sub-basin

Collar Gulch Creek

Marias Sub-basin

Badger Creek
Birch Creek
Cut Bank Creek
North Fork Deep Creek
South Fork Deep Creek

For this derivation, the high inflection point flows that were derived for those streams in which the Wetted Perimeter Inflection Point Method was applied, were expressed as percentages of the average annual flow. Percentages were derived for only those tributaries (mainstem rivers were eliminated, as were spring-fed streams) in which a calculation of the average annual flow was available when this analysis was completed in November 1988. The individual percentages in each sub-basin were averaged to derive a sub-basin mean (Table 1-1). The mean percentages were then applied to the corresponding sub-basin tributary streams in which recommendations from the Wetted Perimeter Inflection Point Method were unavailable.

Table 1-1. Upper inflection point flows expressed as percentages of the average annual flow for selected streams in the Missouri River Basin.

Sub-basin Streams	No. Streams	Upper Inflection Point Mean Percentage (Range)[a]
Beaverhead-Red Rock River tributaries	25	43 (16-70)
Big Hole River tributaries	21	32 (18-66)
Gallatin River tributaries (excludes East Gallatin River tributaries)	10	31 (25-39)
Jefferson River tributaries	7	36 (33-40)
Madison River tributaries	10	47 (29-61)
Ruby River tributaries	7	48 (37-54)
Upper Missouri River tributaries	7	34 (18-71)
Musselshell River tributaries	6	44 (39-58)
Smith River tributaries	9	27 (16-39)
Marias River tributaries	7	40 (24-68)

[a] Range excludes lowest and highest values to eliminate outliers which could skew the mean percentage.

For the evaluated streams in the Missouri River Basin, high inflection point flows, when averaged by sub-basin, ranged from 27-48% of the average annual flow. The majority of these percentages fall within the 30-60% range that Tennant describes as good to excellent.

The average annual flow was selected as the basis for deriving flow recommendations because it is the flow statistic most readily available for gauged streams. Also, for ungauged streams, the average annual flow can be estimated fairly accurately using various simulation techniques. While the average annual flow is not necessarily an indicator of a stream's normal flow condition for all seasons, it does provide a relative measure of the amount of water that is annually passed by the stream channel.

The average annual flows for the 27 streams were derived by the USGS. All but four of the 27 streams (Red Rock River--Reach #1, Badger, Birch and Cut Bank creeks) were ungauged and various flow simulation techniques were used to estimate their average annual flows (see Water Availability section).

For the sub-basin tributaries shown in Table 1-1, most were ungauged, and the USGS provided the majority of the average annual flow estimates. A few of these estimates were provided by the U.S. Forest Service.

Average annual flows used by Tennant reflect the virgin state prior to water depletions or other water developments. If non-virgin averages are used, recommendations will reflect depleted stream conditions and may result in less than ideal flows (Tennant 1975). The majority of average annual flows supplied by the USGS and used by DFWP in its derivations do not reflect the virgin state. The exclusive use of virgin flow averages would have resulted in sub-basin mean percentages slightly lower than those derived for the 10 sub-basins shown in Table 1-1. For example, if the average virgin flow is 100 cfs and the average high inflection point flow is 25 cfs, the mean percentage would be 25%. However, using a non-virgin (depleted) average flow of 75 cfs and the same inflection point flow of 25 cfs gives a mean percentage of 33%.

Other investigators have also examined fixed percentage techniques that reference the average annual flow. Swank and Phillips (1976) indicated that an optimum instream flow for streams within the area of the Blue, Wallowa and Cascade mountains of Oregon ranged from about 60-100% of the average annual flow. Wesche (1974) found that the rate of loss of the available trout cover in Wyoming's smaller streams (average annual flows less than 100 cfs) is reduced at its greatest rate at flows less than 25-27% of the average. Fish census data for Vancouver Island suggested that a mean monthly flow of not less than 20% of the average annual flow was required for the survival of cutthroat trout fry (Newcombe and Ptolemy 1985).

Summary

An office method that utilizes the average annual flow was developed to derive instream flow recommendations for 27 high quality streams in which the Wetted Perimeter Inflection Point Method could not be used to derive recommendations.

To develop this method, the high inflection point flows that were derived for those streams in which the Wetted Perimeter Inflection Point Method was applied, were expressed as percentages of their average annual flows. These percentages, when averaged by sub-basin, ranged from 27-48% of the average annual flow. The derived percentages were then applied to the average annual flows of the tributary streams where wetted perimeter information could not be obtained. The resulting flows were requested in this application.

2. Base Flow Approach

For some streams, often referred to as spring creeks, subsurface inflows are the major year-round water source. Unlike mountain streams which rely heavily on snow-melt for their water supply and, consequently, exhibit extreme flow peaks during the snow runoff months of April to July, the flows of spring creeks are relatively stable from season to season. Subsurface inflows not only stabilize annual flow patterns, but also moderate seasonal temperature fluctuations, causing peak temperatures in spring creeks to be cooler in summer and warmer in winter than in neighboring mountain streams. This creates temperatures more favorable for the year-round growth of trout. Warmer winter temperatures also reduce the potential for icing, thus lessening winter stress on trout. The dissolved mineral content of subsurface inflows, which is typically far greater than that of snow-melt, creates a fertile and highly productive aquatic environment. This combination of relatively stable flow and temperature regimes and high fertility gives spring creeks the potential to grow and sustain trout at levels that far exceed the biological capability of most other mountain streams.

The majority of Montana's spring creeks are short in length and originate in valley bottoms bordering mainstem rivers. These locales are generally prime agricultural areas and, as a result, spring creeks have suffered from man's activities. Decker-Hess (1986) concluded that most of the 68 Montana spring creeks that she inventoried were severely abused, a consequence of poor land use practices. Accumulations of in-channel sediments, trampled and overgrazed riparian areas, extensive re-channeling and dewatering, and banks barren of soil-stabilizing brush and other protective vegetation are prominent problems of many Montana spring creeks.

Efforts of public agencies to protect and preserve spring creeks have met with limited success. Some successes include the purchase by DFWP of much of one high quality spring creek, Poindexter Slough near Dillon, and the funding of a number of habitat improvement projects--primarily the fencing of riparian areas to exclude livestock--undertaken with the cooperation of the private landowners and local sportsmen groups. Public ownership of more spring creeks is unlikely due to the high costs of purchasing the prime agricultural land that surrounds them and reclaiming the badly abused aquatic environments. Private individuals have purchased some spring creeks as recreational properties and undertaken costly habitat improvements, greatly benefiting fish and wildlife populations. Overall, however, public and private efforts have not stemmed the continuing deterioration of Montana's spring creeks.

The challenge of fishing for highly selective trout that rise freely to a plethora of minute insect forms has led many fishing enthusiasts to rank spring creeks as the ultimate angling experience. The trout fishing fraternity avidly seeks out those remaining spring creeks that still sustain prolific insect hatches and an abundance of free-rising trout. Quality spring creeks have become a highly valued and scarce recreational commodity.

The maintenance of adequate instream flows is crucial to the well-being of the few remaining high quality spring creeks in Montana. The needed instream flow levels cannot be determined using the Wetted Perimeter Inflection Point Method. The relatively stable, year-round flows that characterize spring creeks prevent the collection of field data at a high, medium, and low flow, information needed to calibrate the WETP computer program. Consequently, another approach is required.

To protect the unique and highly valued spring creek resource, DFWP is requesting that the base flow, the lowest mean monthly flow for the year, be reserved for the maintenance of year-round fish and wildlife habitat. Base flow occurs typically during the winter when subsurface inflows are generally lowest for the year and, thus, reflects a normal low flow event. This level of protection should be sufficient to maintain the outstanding fish and wildlife habitat of spring creeks.

In this application, base flows are requested for 17 high quality spring creeks. These are:

Beaverhead-Red Rock Sub-basin

Poindexter Slough

Gallatin Sub-basin

Ben Hart Spring Creek
Thompson Spring Creek

Jefferson Sub-basin

Willow Spring Creek

Madison Sub-basin

Antelope Creek
Black Sand Spring Creek
Blaine Spring Creek
O'Dell Spring Creek
S.F. of the Madison River[a]

Ruby Sub-basin

Warm Springs Creek

Belt Creek Sub-basin

Big Otter Creek

Lake Helena-Hauser Reservoir

McGuire Creek[b]
Spokane Creek[b]
Silver Creek[b]

Sun Sub-basin

North Fork Willow Creek

Teton Sub-basin

McDonald Creek
Spring Creek

Footnotes

a Although not a "classic" spring creek, the South Fork of the Madison River is included because subsurface inflows have a stabilizing influence on seasonal flows, causing the South Fork to more closely resemble a large spring-fed creek than a typical snow-fed mountain stream.

b Separate summer and winter base flows are being requested for the 3 spring creeks in the Helena Valley. Discharge in all 3 creeks is strongly influenced by irrigation practices in the valley. Flows increase significantly during the irrigation season due to groundwater accretions. All 3 creeks provide important spawning habitat for large salmonids migrating out of the Hauser Reservoir-Lake Helena complex. The spawning runs are dependent upon the higher discharges that occur during the irrigation season. A base winter flow would not provide enough discharge to maintain these spawning runs.

Several flows were measured in each stream throughout the year to obtain information on the base flow characteristics of the stream and to identify the effects of irrigation. An average base summer flow was calculated using data collected between May and November, the period when spawning occurs in the streams. An average base winter flow was calculated for the remainder of the year. Both values are used in the flow requests for these streams.

3. Water Quality and Flow Management Maintenance

For three streams in the Madison sub-basin (Beaver and Cabin creeks and the West Fork Madison River) and four streams in the Gallatin sub-basin (East Gallatin River--Reach #1, Bridger, Rocky, and Sourdough creeks), all remaining, unappropriated water was requested to remain instream. The purpose of the request for the four Gallatin River tributaries is to protect water quality in the East Gallatin River, a stream with a history of pollution problems. For the three Madison River tributaries, the request is crucial for the continued success of the fishery flow management plan for the Madison River. The rationale for these requests is discussed under the respective stream write-ups in Volume 2.

Two additional streams, Stickney and Wegner creeks, tributaries to the Missouri River near the town of Craig, also had their flows determined by an alternative method. These streams are intermittent but are important in the Spring when runoff provides flows which allow rainbow trout to enter from the Missouri River to spawn. Flows requested were the mean annual flows as determined by the USGS and were requested for only 4 months of the year (see individual write-ups in Volume 3).

4. Biological-Flow Relationships

Flow requests for the Gallatin River--Reach #2, Madison River--Reach #4, and Narrows Creek (Red Rock--Beaverhead River Sub-basin) are based on biological-flow relationships developed from data collected in past years. Flow requests for Missouri River mainstem Reaches #2 through #6 are based on biological studies which relate flows required for seasonal biological needs of resident and migratory fish species as well as for goose nesting. These data are discussed in the respective write-ups for these waters.

The 50% of Average Annual Flow Limitation

Montana law [(85-2-316(6), MCA)], limits the amount of instream flow which the Board of Natural Resources and Conservation (Board) can grant to no more than 50% of the average annual flow (AAF) on gauged streams. This limitation, in many cases, can result in the granting of an instream flow that is excessively low, thus potentially damaging the existing fishery and impacting recreational opportunities. The 50% limitation can be too restrictive when gauged streams are (1) badly depleted, (2) spring-fed, (3) regulated, (4) when gauge sites chosen are located at or near the upstream boundary of the designated stream reach, and (5) when all remaining unappropriated flow is needed to protect fishery values.

1. Depleted Streams

The AAF for many gauged streams already reflects consumptive withdrawals for agricultural, industrial, and municipal uses. Agriculture alone accounts for 97.6% of all water diverted in Montana (Montana Department of Natural Resources and Conservation, 1986). This depleted, or non-virgin, AAF can be substantially less than the undepleted (virgin) AAF for the same stream site. For example, records from the gauge at the mouth of the Gallatin River (gauge #06052500) showed an AAF of 752 cfs for the 1953-67 period. Flows at this site reflect depletions to irrigate about 110,000 acres, as well as municipal withdrawals. For the same period, the SCS (Farnes and Schafer 1972) estimated the AAF without depletions for that site at 1,155 cfs, which is an increase of 54% above the depleted AAF of record. For the Big Hole River (gauge #06025500), the estimated AAF without depletions was 1,343 cfs for the 1958-72 period, which is 47% greater than the depleted AAF of record (913 cfs) for the same period (Farnes and Schafer 1975). The AAF at this gauge site reflects depletions to irrigate about 136,000 acres. Applying the 50% limitation to the depleted AAF, as derived from the gauge record, could produce an instream flow that short-changes the fishery resource.

2. Spring-fed Streams

The AAF, when calculated for most mountain streams, includes the high flows which occur during the spring runoff period. Many streams, often referred to as spring creeks, are fed primarily by subsurface water sources, such as springs and groundwater inflows. As a result, flows are fairly stable from month to month and lack the seasonal extremes that characterize those typical mountain streams in which snowpack is the main water source. An example is Big Spring Creek near Lewistown, a site having long-term gauge records (gauge #06111500). The AAF for the 25-year period of record is 107 cfs and the average base flow for the same period is 106 cfs, indicating a very stable flow pattern. The lowest flow observed at this gauge was 76 cfs. For Big Spring Creek, applying the 50% limitation yields a flow (53.5 cfs) that is inordinately low; one so low that it never occurs in nature, even during severe drought events. When monthly flows are relatively stable, as occurs in spring creeks, the 50% limitation will likely yield an unrealistic and undesirable fishery maintenance flow.

3. Regulated Streams

Regulation by large reservoirs tends to stabilize downstream flows, causing the flow pattern to more closely resemble that of a spring-fed creek than a mountain stream. An example is the Missouri River downstream from the reservoir complex near Helena. Here, the AAF for a 42-year period (gauge #06066500) is 5,678 cfs and the average base flow for the same period is about 4,160 cfs, indicating a fair degree of flow stability. In this case, applying the 50% limitation yields a flow (2,839 cfs) that is far less than that required for maintenance of the fishery. When a stream is regulated and its flow extremes are moderated, the 50% limitation can result in an undesirable instream flow.

4. <u>Gauge Location</u>

The location of the gauge used to determine the 50% AAF within the designated stream reach is important. As defined by DFWP, the reach for which an instream flow is requested serves merely to identify those junior water users who will be subject to the instream flow reservation, which is intended to be monitored at a site at or near the downstream boundary of the reach. A reach, as defined by DFWP, does not represent a stream segment having a similar flow regime and instream flow requirement throughout its length. The instream flow which DFWP typically derives for a site near the downstream boundary of the reach will likely exceed 50% of the AAF determined from any gauges located near the upstream boundary. This is due to the fact that the available water supply at the downstream end of a reach commonly exceeds the supply at the upstream end, a consequence of accretion. Applying the 50% limitation derived for these upper gauges to the entire length of a reach would likely result in an undesirable instream flow for the downstream-most segment. For example, the only long-term gauge on the East Gallatin River (gauge #06048000) is located near its origin at the confluence of Rocky and Sourdough creeks. Flows at this site are far less than those in downstream reaches and near the river's mouth. If the Board were to apply the 50% limitation derived at this gauge to the entire East Gallatin River, the granted flows would be insufficient to maintain the fishery.

5. <u>All Remaining Unappropriated Flow</u>

Instream flow needs for the vast majority of streams were derived from the wetted perimeter and associated fixed percentage methods. Under these methods, a <u>portion</u> of the existing flow is requested to satisfy fishery needs. For a few select tributary streams, circumstances require that <u>all</u> unappropriated water remain instream to protect fishery values. Such is the East Gallatin River where poor water quality stemming from municipal discharges and non-point pollution sources at Bozeman pose a continuing threat to the river's trout fishery. In this situation, all unappropriated flow in the upper East Gallatin River (Reach #1) and three headwater tributaries (Sourdough, Rocky, and Bridger creeks) is requested to remain instream for the purpose of providing the dilution flow that is needed to protect water quality and, in turn, the trout fishery of the East Gallatin River. These requests are fully discussed under the respective stream write-ups in Volume 2.

Applying the 50% limitation to the East Gallatin River-Reach #1 and Bridger Creek, sites having long-term gauges, will not provide sufficient flows to maintain suitable water quality in these streams.

Flows requested in this application are based on studies conducted to determine the instream flows required to maintain the fisheries resource at the desired level. In some cases, the flows requested in this application exceed the 50% limitation imposed by Section 85-2-316(6), MCA. To assist the Board in identifying the requested streams affected by this law, Table 1-2 has been developed which lists the streams in which flows requested exceed the 50% limitation. Since the length of record on a "gauged stream" is not defined by the statute, 10 years was selected as the minimum length of record required to determine the average annual flow. Only USGS gauges were used and Table 1-2 shows only those streams with gauges having 10 or more years of record.

Since the flow levels requested for each stream in this application are the flows required to maintain the fisheries resource at the desired level, any flows granted that are less than the requested levels will have some detrimental impacts on the resource.

To minimize the impacts of the 50% limitation, it is recommended that any reductions in requested flows made by the Board as a result of this law be made during the high flow period. As a guideline, those reductions should be made during the period from May 15 to July 1.

Also, we believe the average annual flow can be interpreted in acre-feet as well as in cfs and downward adjustments may be more effectively made on an acre-feet basis. For example, all of a reduction could be made during a 1-month period simply by reducing the total acre-feet requested in that month by the amount which is over 50% AAF. The reduced volume granted can then be converted to flow in cfs.

It should also be understood that in Table 1-2, the average annual flow shown is based on the actual period of record, not on the adjusted period of record (1937-86) discussed in the section entitled "Water Availability."

Water Availability

ARM 36.16.105B(2) requires the applicant to determine the physical availability of flows. Statistical information must include the monthly mean flows and the 20th, 50th, and 80th percentile exceedance frequency flows on a monthly basis throughout the year.

Through a cooperative agreement, DFWP contracted with the Helena office of the USGS to obtain this information. The completed work will be published as a USGS technical report entitled "Monthly Streamflow Characteristics for Selected Sites in the Upper Missouri River Basin, Montana, 1937-86 Base Period" by Charles Parrett, J.A. Hull, and Dave R. Johnson.

At the time this reservation application was completed, the final USGS report had not been officially released by that agency. However, Tables 1 and 4-9 of the report, which summarize the derived streamflow data, are presented in Appendix A. The narrative and statistical analyses pertaining to these data will be contained in the final report and forwarded to the Board upon receipt. Any corrections to these provisional data will also be brought to the Board's attention. Appendix A also contains final data from six additional streams not contained in the USGS report.

Table 1-2. Gauged streams (10 or more years of record) in the Missouri basin reservation application having flow recommendations that exceed 50% of the average annual flow (AAF).

Streams by Sub-basin	Requested flow (cfs)	USGS Gauge No.	AAF (cfs)	50% of AAF (cfs)	Period of Record (years)
Beaverhead-Red Rock					
Beaverhead River--Reach #1[a]	200	06015400	392	196	1963-83 (21)
Beaverhead River--Reach #2[b]	200	06018000	384	192	1951-83 (22)
Big Sheep Creek[c]	48	06013500	65	33	1947-79 (26)
Blacktail Deer Creek[d]	42	06017500	54	27	1947-66 (18)
Grasshopper Creek[e]	30	06015500	51.6	25.8	1921-61 (23)
Big Hole					
Big Hole River--Reach #3[f]	650	06025500	1,162	581	1924-87 (64)
Gallatin					
Bridger Creek[g]	36.6	06048500	36.6	18.3	1946-69 (24)
East Gallatin River--Reach #1[g]	121.3	06048000	84.7	42.4	1940-61 (22)
Gallatin River--Reach #3[h]	1,000	06052500	1,074	537	1894-87 (71)
Jefferson					
Jefferson River[i]	1,100	06026500	2,014	1,007	1941-72 (18)
Jefferson River[j]	1,100	06034500	2,121	1,061	1897-69 (31)
Madison					
Jack Creek[k]	28	06040300	47	24	1974-86 (13)
Madison River--Reach #2[l]	800	06038500	1,008	504	1910-87 (78)
Madison River--Reach #3[m]	1,000	06040000	1,432	716	1953-70 (13)
Madison River--Reach #4[n]	1,300	06042500	1,650	825	1894-50 (16)
Madison River--Reach #4[o]	1,300	06041000	1,777	889	1902-87 (49)
Ruby					
Ruby River--Reach #1[p]	102	06019500	182	91	1939-87 (49)
Mainstem Missouri					
Missouri River--Reach #2[q]	--	06065500	4,115	2,058	1923-42 (20)
Missouri River--Reach #3[r]	--	06066500	5,678	2,839	1945-87 (42)
Missouri River--Reach #3[s]	--	06074000	6,360	3,180	1902-15 (13)
Missouri River--Reach #3[t]	--	06078200	6,822	3,411	1957-87 (30)
Missouri River--Reach #4[u]	--	06090300	7,952	3,976	1956-87 (31)
Missouri River--Reach #4[v]	--	06090800	7,810	3,905	1890-1987 (97)
Missouri River--Reach #5[w]	--	06109500	8,666	4,333	1935-87 (52)
Missouri River--Reach #6[x]	--	06115000	8,855	4,428	1934-68 (34)
Missouri River--Reach #6[y]	--	06115200	9,415	4,708	1934-87 (53)
Helena Reservoir Complex					
Tenmile Creek[z]	12	06062500	17.8	8.9	1914-87 (73)
Dearborn					
Dearborn River[aa]	110	06073000	116	58	1921-53 (26)
Dearborn River[bb]	110	06073500	218	109	1945-69 (24)
Smith					
Smith River--Reach #1[cc]	90	06076690	173	87	1977-87 (10)
Sheep Creek[dd]	35	06077000	31.9	16.0	1941-72 (31)

Marias					
Marias River--Reach #2[ee]	500	06101500	852	426	1945-87 (34)
Marias River--Reach #3[ff]	560	06102000	952	476	1921-55 (34)
Marias River--Reach #3[gg]	560	06102050	977	489	1959-72 (13)
Judith					
Big Spring Creek--Reach #1[hh]	110	06111500	107	54	1932-57 (25)
Musselshell					
Flatwillow Creek[ii]	18	06127900	29	15	1912-56 (43)

Footnotes

a Average annual flow (AAF) at this gauge site, located at the upstream boundary of Reach #1, reflects depletions to irrigate about 76,500 acres, as well as regulation at Clark Canyon Dam. The 200 cfs recommendation is slightly less than the lowest mean monthly flow of the year (210 cfs in January) at this site. At the gauge (#0601600) near the downstream boundary of Reach #1, the 200 cfs recommendation equals 47% of the AAF, therefore not exceeding the 50% limitation.

b AAF at this site, located near the upstream boundary of Reach #2, reflects depletions to irrigate 128,400 acres as well as regulation at Clark Canyon Dam. Lowest mean monthly flow for the year at this site is 227 cfs (in July), which is greater than the 200 cfs recommendation. At the gauge (#06018500) near the downstream boundary of Reach #2, the 200 cfs recommendation equals 48% of the AAF, therefore not exceeding the 50% limitation.

c AAF reflects depletions to irrigate about 6,600 acres. Seasonal flows are relatively stable due to subsurface inflows. As a result, a limitation of 50% of the AAF yields a flow (33 cfs) that is considerably less than the stream's base flow of 42 cfs. During the period of record, daily flows at this site, even with depletions, have exceeded 33 cfs about 98% of the time.

d AAF reflects diversions to irrigate about 4,000 acres. A limitation of 50% of the AAF yields a flow (27 cfs) that is less than the stream's base flow of 30 cfs. During the period of record, daily flows at this site have exceeded 27 cfs about 90% of the time.

e AAF reflects depletions to irrigate about 12,500 acres.

f AAF reflects depletions to irrigate about 136,000 acres.

g For these two streams, all remaining, unappropriated water is being requested to help protect water quality in the East Gallatin River, a stream with a history of pollution problems.

h AAF reflects depletions to irrigate about 110,000 acres.

i AAF reflects depletions to irrigate about 300,000 acres.

j AAF reflects depletions to irrigate about 364,700 acres.

k Recommendation equals 60% of the AAF.

l Due to subsurface inflows in Yellowstone National Park and regulation at Hebgen Dam, the Madison River exhibits a larger base flow in proportion to its annual runoff than most other rivers in Montana, causing flows to be relatively stable. A limitation of 50% of the AAF yields a flow (504 cfs) that is considerably less than the lowest mean monthly flow of the year (681 cfs in May) at this site. For the period of record, daily flows at this site have exceeded 504 cfs about 90% of the time.

m At this Madison River gauge site, a limitation of 50% of the AAF yields a flow (716 cfs) that is far less than the lowest mean monthly flow (923 cfs in March) for the year. During the period of record, daily flows at this gauge site have exceeded 716 cfs about 95% of the time.

n At this Madison River gauge site, a limitation of 50% of the AAF yields a flow (825 cfs) that is far less than the lowest mean monthly flow (1,340 cfs in November) for the year. For the period of record, daily flows at this gauge site have exceeded 825 cfs about 95% of the time.

o At this Madison River gauge site, a limitation of 50% of the AAF yields a flow (889 cfs) that is far less than the lowest mean monthly flow (1,390 cfs in January and February) of the year. For the period of record, daily flows at this gauge site have exceeded 889 cfs over 95% of the time.

p AAF reflects depletions to irrigate about 3,000 acres. A limitation of 50% of the AAF yields a flow (91 cfs) that is less than the base winter flow of 102 cfs. During the period of record, daily flows at this gauge site have exceeded 91 cfs about 90% of the time.

q Published USGS records for gauge 06065500, located at the head of Reach #2 below Hauser Dam, are for the period prior to 1942, long before Canyon Ferry and a number of other upstream reservoirs were constructed. This gauge does not reflect the post-Canyon Ferry flow regimen. The USGS gauge below Holter Dam at the head of Reach #3 (06066500) provides a better index of recent flows in Reach #2. Here, the AAF was 4,175,000 acre-feet/year for the post-Canyon Ferry period of record (1954-87). The flow request for Reach #2 totals 3,310,931 acre-feet/year or 79% of this AAF. Flows at this site reflect depletions to irrigate about 594,400 acres and regulation by 11 upstream reservoirs and power plants.

r Seasonal flow requests for Reach #3 total 3,187,048 acre-feet/year or 77% of the average annual flow (in acre-feet) at this gauge site, located at the head of Reach #3. Flows at this site reflect depletions to irrigate 594,400 acres and regulation at 11 upstream reservoirs and power plants.

s Seasonal flow requests for Reach #3 total 3,187,048 acre-feet/year or 69% of the average annual flow (in acre-feet) at this gauge site. Flows at this site reflect depletions to irrigate about 588,000 acres and regulation at two upstream dams. This site was operated before 1915.

t Seasonal flow requests for Reach #3 total 3,187,048 acre-feet/year or 64% of the average annual flow (in acre-feet) at this gauge site. Flows at this site reflect depletions to irrigate about 630,400 acres and regulation at 12 upstream reservoirs and power plants.

u Seasonal flow requests for Reach #4 total 3,644,204 acre-feet/year or 63% of the average annual flow (in acre-feet) at this gauge site. Flows at this site reflect depletions to irrigate about 750,400 acres and regulation at 20 upstream reservoirs and power plants.

v Seasonal flow requests for Reach #4 total 3,644,204 acre-feet/year or 64% of the average annual flow (in acre-feet) at this gauge site. Flows at this site reflect depletions to irrigate about 751,000 acres and regulation at 20 upstream reservoirs and power plants.

w Seasonal flow requests for Reach #5 total 4,324,788 acre-feet/year or 69% of the average annual flow (in acre-feet) at this gauge site. Flows at this site reflect depletions to irrigate about 850,400 acres and regulation at 26 upstream reservoirs and power plants.

x Seasonal flow requests for Reach #6 total 4,845,807 acre-feet/year or 76% of the average annual flow (in acre-feet) at this gauge site. Flows at this site reflect depletions to irrigate about 869,200 acres and regulation at 27 upstream reservoirs and power plants.

y Seasonal flow requests for Reach #6 total 4,845,807 acre-feet/year or 71% of the average annual flow (in acre-feet) at this gauge site. Flows at this site reflect depletions to irrigate about 870,400 acres and regulation at 27 upstream reservoirs and power plants.

z This gauge is located at stream mile 20.4 near the upstream boundary of the reach. At the USGS gauge (06063000) at stream mile 8.1 in the lower portion of the reach, the 12 cfs recommendation equals 44% of the AAF of record (46 years). Here, flows reflect depletions to irrigate about 1,200 acres and withdrawals for the water supply of Helena.

aa This gauge is located at stream mile 45 in the upper portion of the reach. Flows at this site reflect depletions to irrigate about 2,500 acres.

bb This gauge is located at stream mile 19 of the Dearborn River. Flows at this site reflect depletions to irrigate about 3,300 acres. The instream flow request of 110 cfs equals about 51% of the AAF at this site.

cc Flows at this gauge reflect depletions to irrigate about 19,300 acres and slight regulation by Smith River Reservoir. The instream flow request of 90 cfs equals 52% of the AAF of record (10 years) at this site.

dd This gauge is located at stream mile 28 in the upper half of Sheep Creek near the headwaters. The USGS estimated the AAF of Sheep Creek at its mouth at 90 cfs. At this site, the request is 39% of the AAF.

ee Flow is completely regulated by Tiber Reservoir since 1955. Above the station, water is diverted to irrigate about 65,000 acres.

ff Water is diverted to irrigate about 65,000 acres above the station. This gauge reflects flows prior to regulation by Tiber Reservoir.

gg Flows at this gauge reflect complete regulation by Tiber Reservoir.

hh Because Big Spring Creek is spring-fed, flows are stable year-round. At this gauge site, the AAF for the 25-year period of record was 107 cfs and the base flow for the same period was 106 cfs, indicating a very stable flow pattern. The lowest daily flow observed at this gauge was 76 cfs. For Big Spring Creek, a 50% limitation yields a granted flow (53.5 cfs) that is inordinately low; one so low that it never occurs in nature, even during severe drought events.

ii Increased diversion activity after 1930 greatly reduced the AAF at this gauge site. Prior to 1930, the AAF was 46.2 cfs (1912-30 period of record), with the lowest mean monthly flow of the year equal to 20 cfs. After 1930, the AAF was reduced to 14.3 cfs (1930-56 period of record) and the lowest mean monthly flows reduced to 2.4 cfs. The flow request of 18 cfs is reasonable (39% of AAF) when compared to the undepleted flows prior to 1930.

THE RESERVATIONS ARE IN THE PUBLIC INTEREST

These reservations of water are in the public interest. The public benefits which will accrue from the reservations are:

1. Continued perpetuation of the fish and wildlife resources whose very existence is in the public interest;

2. prevention of the gradual depletion of streamflows currently enjoyed by the public for recreational uses;

3. continued perpetuation of the fish and wildlife resources for current and future utilization by the public;

4. maintenance of water quality which contributes to a clean, healthful environment for the citizens of the state and the nation; and

5. contribution to the protection of and continued utilization of existing water rights.

A showing that the reservations are in the public interest, including their direct and indirect benefits and costs, is provided in the discussion which follows.

I. Direct Benefits and Costs of the Reservations

The following is pursuant to ARM 36.16.105C(1)(a) of the water reservation rules dated 12/31/88:

> In making a showing that the reservation is in the public interest, the application shall contain . . . an analysis of the direct benefits and costs associated with applying reserved water to the proposed beneficial use.

Direct benefits and costs are defined at ARM 36.16.102 (6) and (7) as:

(6) Direct benefits mean all benefits to the reservant derived from applying reserved water to the use for which it is granted, and

(7) Direct costs mean all costs to the reservant from applying reserved water to the beneficial use for the purpose granted.

The "use for which it is granted" is the perpetuation of existing biological populations within state waters and the recreational benefits derived by public utilization of these resources. Furthermore, since "the reservant" (DFWP) is a public agency charged with the protection and management of these resources and recreational opportunities, the benefits to the public and the department are mutually inclusive.

A. Direct Benefits

1. Fisheries and Fishing Opportunities

The direct benefits of reserving the requested instream flows include the preservation of the fisheries resource, continuation of fishing opportunities and recreational floating, and continued maintenance of the existing riparian communities.

Interest and utilization of public fishing resources in Montana continue to increase, despite the state's stable (or, at times, declining) population over the past 2 decades. In 1966, 159,466 resident fishing licenses were sold. By 1976 sales had increased to 170,000. In 1986, despite reports of recent widespread emigration from the state, 183,291 resident fishing licenses were sold (Herman 1988).

Montana is also highly valued for its fisheries resource by people from outside the state. In 1987, Montana ranked fourth in the nation for the number of non-resident fishing licenses sold (U.S. Fish and Wildlife Service, 1988). Despite being relatively isolated from major population centers, Montana attracts a disproportionately large number of nonresident anglers because of its unique and productive fisheries resource. The opinions of these visitors reflect the quality of fishing in Montana; 91.3% of surveyed non-resident anglers reported Montana to have good or excellent angling opportunities (Brock et. al. 1984).

The national significance of Montana trout streams was also brought clearly into focus in the spring, 1989, issue of Trout - The Magazine for Trout and Salmon Anglers. The feature article of this issue, a special publication commemorating the thirtieth anniversary of the magazine, was "America's 100 Best Trout Streams" (Alexander et al. 1989). Of these 100 nationally-acclaimed fishing streams, 12 are in Montana, which has the highest total of any state in the nation. Alaska ranks second to Montana with 11 listed streams, followed by Idaho (9), New York (6), and Wyoming (6). It is significant to note that 6 of America's best 100 trout streams, (i.e., the Beaverhead, Big Hole, Gallatin, Madison, Missouri, and Smith rivers) are in the portion of the Missouri Basin covered by this reservation request.

Even though fishing represents only one of many stream-related recreational activities, it serves as a valuable indicator of overall recreational use. Based upon a mail survey of fishing license holders, DFWP annually estimates the fishing pressure (angler use) of streams in Montana. During May through October, 1985, DFWP increased the intensity of the angler survey by doubling the number of questionnaires normally mailed (McFarland 1988). The results of this research emphasized the exemplary stream-based, public recreational benefits of the upper Missouri River.

The rivers and streams of the Missouri above Canyon Ferry Reservoir accounted for 375,239 of the total 1,193,000 days spent stream fishing in Montana during 1985. Despite being less than 10% of the geographic area of Montana, the upper Missouri supported 31.4% of the state's stream fishing. As is illustrated in Figure 1-4, no other geographic area of similar or even larger size supported nearly as high a percentage of total stream fishing in Montana. Angler use of streams in the upper Missouri Basin during 1985 is tabulated in Table 1-3.

The fact that hundreds of thousands of people annually fish the upper Missouri Basin is testimony to the exceptional wild (naturally reproducing) trout fishery that is found there. Very high angler success rates for wild brown and rainbow trout have made the Madison one of the most popular rivers in North America. Some reaches of the Madison contain over 3,500 catchable trout per mile. The salmonfly hatches of the Madison, Big Hole and Gallatin rivers are legendary, attracting a following of anglers who annually chase "the hatch" from river to river. Due to its relatively undeveloped watershed, the Big Hole is one of the largest trout streams outside designated national wilderness areas that remains essentially non-turbid during runoff. This river is also the home of the largest remaining population of stream-dwelling arctic grayling in the lower 48 states. The Gallatin River is another nationally-acclaimed trout stream, offering a wide variety of fishing experiences--from swift-gradient, mountain canyons to slow-moving, broad valley sections.

Values are the percentage of total, state-wide fishing days occuring in each river basin, and were computed from information collected during the 1985 DFWP fisheries survey (McFarland, 1988).

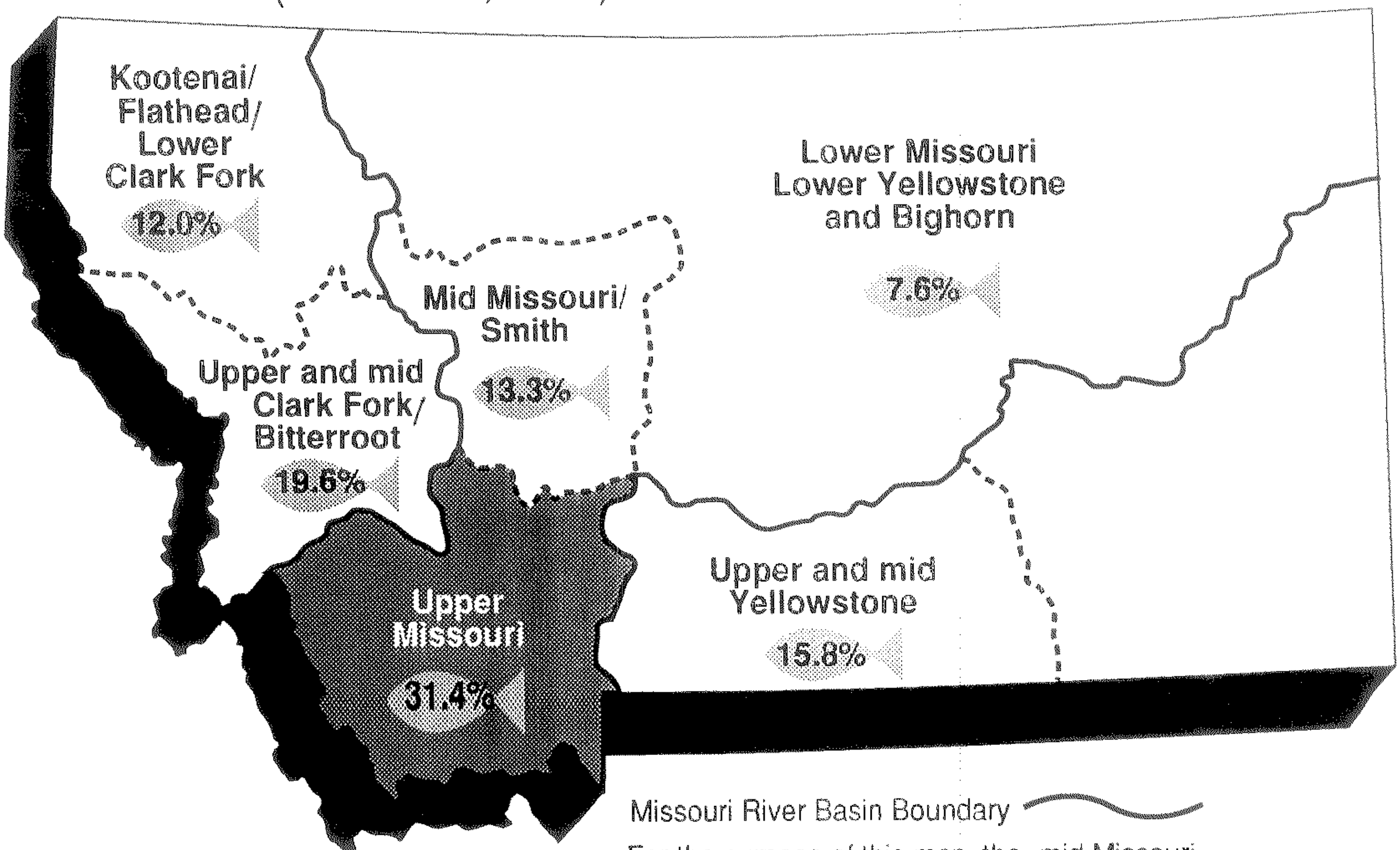

Figure 1-4. Fishing use of Montana river basins, 1985.

Table 1-3. Angler use of streams in the Upper Missouri River Basin during 1985.

Stream	Annual Angler Days
Beaverhead River	24,239
Big Hole River	47,910
East Gallatin River	6,191
Gallatin River	63,871
Madison River	108,712
Jefferson River and tributaries	29,129
Upper Missouri River and tributaries above Canyon Ferry Dam	25,419
Madison River tributaries	11,224
Gallatin and East Gallatin River tributaries	14,045
Beaverhead River tributaries (includes Ruby and Red Rock rivers and tributaries)	25,878
Big Hole River tributaries	18,621
Total	375,239
State Total	1,193,000 days
Percent of State Total	31.4%

Source: McFarland 1988.

Portions of the Madison, Big Hole, Gallatin, Beaverhead and Missouri rivers are exceptional fishing streams on a national scale and are rated by DFWP as Class One, "blue ribbon" trout streams (Montana Deptartment of Fish, Wildlife and Parks et al. 1980). This distinction has been given to only a select number of streams in Montana that are considered to have "the highest valued fishery resource" in the state. The Ruby, East Gallatin, Jefferson, and Red Rock rivers are also very important trout streams, as are many tributaries of the basin's major rivers. The tributaries not only serve as vital spawning streams for the larger rivers, but, themselves often contain an abundance of resident trout. These smaller trout streams provide heavily utilized backcountry stream fishing opportunities. For example, the Big Hole River tributaries received 18,624 days of angler use in 1985 and support fisheries for rainbow, brook and cutthroat trout and arctic grayling.

Below the origin of the Missouri River at the confluence of the Madison, Jefferson and Gallatin rivers, the mainstem of the Missouri and its numerous tributaries continue to provide additional high-quality trout fishing opportunities. The river above Canyon Ferry Reservoir not only contains resident populations of rainbow and brown trout, it also supports spawning migrations of trout from the reservoir; the important fishery for these migrants is the primary reason for the "blue ribbon" rating of the river between Toston Dam and Canyon Ferry Reservoir. The 3.5-mile stretch of free-flowing river between Hauser Dam and Holter Reservoir is also an important fishery for migrant trout and Kokanee salmon.

Fish migrations from reservoirs and lakes throughout the basin provide many important stream fishing opportunities. Many tributaries to reservoirs or lakes that contain a trout fishery support spawning runs when adequate habitat, water quality and instream flows exist in these feeder streams. In addition to the fishing they provide, these spawning runs also sustain the trout populations of many reservoirs and lakes themselves

Three species of trout - brown, rainbow and cutthroat - are the principal gamefish in the basin's coldwater lakes and reservoirs. Brown trout populations are exclusively maintained by the natural reproduction that occurs in spawning tributaries, while many populations of rainbow and cutthroat trout are annually augmented with plants of hatchery fish. In recent years, the DFWP's wild trout management program, a recognized successful program on the state's "Blue Ribbon" trout rivers, has been extended to include those lakes and reservoirs in the Upper Missouri Basin where spawning tributaries have the capacity to produce a sufficient number of wild recruits to sustain a quality sport fishery. Harrison Reservoir, a popular fishing water in the Jefferson River drainage that, in the past, received as many as 40,000 9-16 inch catchable hatchery rainbow trout each year, has been converted entirely to wild trout which sustain their numbers by reproducing in the reservoir's tributaries. Another example is Hebgen Reservoir (Madison River drainage), a popular fishing water where current fishing use is about 45,000 angler-days per year (McFarland 1989). Here, the DFWP is building the resident rainbow population by planting wild fish stocks - most of which originate from eggs collected annually from the Harrison Reservoir spawning run - that are capable of successfully reproducing in the reservoir's many tributaries, including the Madison River. The re-establishment of wild fish has proven so successful at Hebgen that all stocking is scheduled to cease by 1991-92 and possibly earlier.

Hatchery plants will continue in those lakes and reservoirs where reproductive levels are insufficient to meet management objectives and in waters where spawning tributaries are badly degraded and, thus, unproductive. An example of the former is Hyalite Reservoir in the Gallatin River drainage where the management objective is to allow a liberal harvest of cutthroat trout. Hyalite Reservoir annually receives about 20,000 McBride cutthroat trout fry - a wild stock originating in McBride Lake in Yellowstone National Park - to augment natural reproduction and help meet the management goal. Canyon Ferry Reservoir tributaries are examples of waters where habitat alterations, in-channel sediment accumulations and dewatering have severely degraded these feeder streams. The reservoir will likely continue to receive annual plants of rainbow trout despite recent and continuing efforts by DFWP to re-establish wild trout and improve natural reproduction. Canyon Ferry is one of Montana's most heavily fished bodies of water, receiving about 76,000 angler-days of pressure annually (McFarland 1989). Without major rehabilitation, the spawning tributaries are unlikely to supply enough wild recruits to satisfy the fishing demand.

Other coldwater fish species, including brook trout, mountain whitefish and arctic grayling that inhabit lakes and reservoirs, also rely exclusively on natural reproduction in tributary streams to maintain their numbers. The grayling, a species of "special concern" in Montana, has its most secure and stable populations in a relatively few Missouri Basin lakes and reservoirs, including Hyalite Reservoir, Elk Lake and the Red Rock Lakes. Stream-dwelling grayling populations, on the other hand, are rapidly dwindling and considered by many to have reached critical levels. Lakes and reservoirs may prove to be the last stronghold for the perpetuation of this species. Without high quality spawning tributaries, these populations will also be in jeopardy.

The benefits of adequate instream flows, therefore, extend beyond flowing waters to include preserving fishing opportunities in reservoirs and lakes. These water bodies support a significant amount of recreational fishing. In 1985, reservoirs and lakes in the Missouri Basin above Holter Dam supported 322,661 angler days; in the basin below Holter Dam to Fort Peck Reservoir, these water bodies supported 160,704 angler-days (McFarland 1988). Combining these figures demonstrates that the portion of the Missouri Basin covered by the reservation request supported 483,365 days of reservoir and lake fishing, which was 44.7% of the statewide total.

During 1985, the Missouri River from Holter Dam to the town of Cascade sustained over 6% of all stream fishing pressure in Montana (72,788 angler-days). Since this high amount of usage occurred along only 35 miles of river, this reach of the Missouri received more recreational fishing per mile than any other stream in Montana. The Madison River, for example, also received heavy use (108,712 angler-days, the highest total use of any stream), but it was dispersed along more than 80 miles of river. Rainbow trout comprise the bulk of the fishery in the Holter Dam to Cascade reach, although trophy-sized brown trout, some as large as 15 to 20 pounds, are occasionally taken by anglers.

From Cascade to the confluence with the Sun River near Great Falls, the Missouri continues to support a trout fishery. Some trout are found as far downstream as the confluence with the Marias River below Fort Benton.

The Smith River, which enters the Missouri just above Great Falls, is also an important trout stream. Although relatively small and inaccessible, it sustained 11,824 fishing days in 1985 (McFarland 1988).

There are other streams in the Missouri Basin that contain locally important trout populations. The upper Judith and Musselshell rivers, Big Spring Creek near Lewistown, and the 20-mile reach of the Marias River below Tiber Dam, provide quality trout fishing for residents of Lewistown, Harlowton, Chester and other nearby communities. For its size, Big Spring Creek is an exceptional rainbow and brown trout fishery, with population estimates approaching 3,000 catchable trout per mile (Leathe and Hill 1987). Without adequate instream flow protection for these and other tributaries of the middle Missouri, many residents of north-central Montana would have to travel several hours to find similar stream fishing.

From Morony Dam below Great Falls to Fort Peck Reservoir, the Missouri River and its tributaries support a warmwater fishery of national, if not international, significance. Although it presently receives a relatively small amount of angler use (see Table 1-4 for angler use data of streams in the middle Missouri), this 207-mile, free-flowing reach contains an exceptionally diverse, unique and presently under-utilized fishery.

Of the 18 families and 80 species of fish reported to occur in Montana (Brown 1971), 14 families and 53 species are found in this reach and/or its tributaries. Of Montana's 52 native fish species, 35 are found in the middle Missouri Basin (Berg 1981).

Table 1-4. Angler use of streams in the Middle Missouri River Basin during 1985.

Stream	Annual Angler Days
Missouri River and tributaries (between Marias River and Fort Peck Dam)	22,340
Missouri River (Canyon Ferry to Marias River; excluding the Holter to Cascade reach)	67,557
Missouri River (Holter to Cascade)	72,788
Marias River	5,925
Musselshell River	11,218
Smith River	11,824
Smith River tributaries	7,143
Total	198,795
State Total	1,193,000 days
Percent of State Total	16.7%

Source: McFarland 1988.

The paddlefish population of the middle Missouri/Fort Peck Reservoir system is of particular importance. Paddlefish are Montana's largest gamefish, with female specimens often reaching 5 to 6 feet in length and weighing 75 to 125 pounds. Once abundant during the Triassic Period 150 million years ago, these primitive fish are presently found in only two river basins--the Yangtze in China and the Mississippi/ Missouri (Hubbs and Lagler 1967; Romer 1962). Even in these basins, the distribution and abundance of paddlefish have been dramatically reduced during the past 100 years (Pflieger 1975; Rehwinkel 1975; Vasetskiy 1971). Although "spoonbill cats" once supported a significant commercial fishery, particularly along the Mississippi, stream channelization, dams, over-harvesting, and alteration of streamflows have reduced the range of paddlefish in the United States to only six isolated, self-sustaining Mississippi/Missouri populations (Berg 1980; Plieger 1975).

Growth rates in the middle Missouri/Fort Peck paddlefish population are superior to the other five remaining populations. The middle Missouri population is also older (in terms of average age of fish) and more secure than anywhere else in North America (Berg 1981). This security and biological success is largely due to the unaltered, free-flowing characteristics of this reach of river, which provides essential and irreplaceable spawning areas for paddlefish. Berg (1981) identified nine critical paddlefish spawning sites in the lower river from just below the confluence of the Marias River to just above Fort Peck Reservoir.

The relatively undeveloped characteristics of the middle Missouri also provide the most secure unaltered habitat remaining in the Mississippi/Missouri Basin for two other relics of the dinosaur era--the pallid and shovelnose sturgeons. Sitings of the pallid sturgeon have been rare over the past few decades (Brown 1971; Holton 1981). Only one pallid sturgeon was captured in the middle Missouri during electrofishing studies conducted by DFWP between 1975-80. Because of its presently rare occurrence, the U.S. Fish and Wildlife Service (USFWS) is considering listing the pallid sturgeon as an endangered species.

The shovelnose sturgeon population of the middle Missouri River is healthy and vigorous. Shovelnose residing in the Missouri above Fort Peck Reservoir are much larger than those found in the Missouri River in South Dakota, the Mississippi River in Iowa and the Chippewa River in Wisconsin. In those midwestern rivers, shovelnose sturgeon rarely exceeded 5 to 7 pounds, whereas several fish collected in the Missouri above Fort Peck Reservoir weighed over 10 pounds. In fact, the <u>average</u> size of shovelnose from the middle Missouri equalled or exceeded the <u>maximum</u> size of those from the South Dakota, Iowa and Wisconsin rivers (Berg 1981).

Significant sport populations of sauger and channel catfish are also found in the middle Missouri above Fort Peck. Growth of channel catfish in this river reach is equivalent or superior to growth in other northern waters and compares favorably with the growth of this species in lakes and rivers of southern states (Berg 1981). Channel catfish, sauger and shovelnose sturgeon all utilize the free-flowing middle Missouri, as well as lower reaches of the Marias and Judith rivers, for spawning. The middle Missouri also supports spawning runs of goldeye, bigmouth buffalo and smallmouth buffalo, which contribute to the commercial fishery in Fort Peck Reservoir.

Data for the middle Missouri River indicate relatively light harvest rates for all fish species. For example, only 0.5% of shovelnose sturgeon that were tagged by biologists were returned by anglers, compared to a 2.3% return in the Red Cedar/Chippewa rivers in Wisconsin (Berg 1981). Priegel (1973), in studies on the Menominee River in Wisconsin, felt that sturgeon populations can sustain harvest rates up to 5.0% without harm.

Cumulative paddlefish harvest rates in the middle Missouri are also low compared to other waters. Only 7.0% of the fish tagged between 1972-77 were returned by anglers. This compares to a 13.8% return rate between 1964-75 on the lower Yellowstone River in Montana (Elser 1976), and a 24.5% return rate during three years of tagging studies on the Osage River, Missouri (Purkett 1963). (This latter population no longer exists; paddlefish spawning sites on the free-flowing Osage River were eliminated by the reservoir behind Truman Dam in 1978.)

The above data, along with tag return information for channel catfish and sauger, indicate that the middle Missouri is an under-utilized fishery resource. Opportunities for steady growth in the recreational use of the middle Missouri are, therefore, very good. Protection of adequate instream flows would allow this potential to materialize as well as help assure the continued existence of the unique and valuable fishery resources themselves.

2. Floating

Preserving instream flows will directly benefit recreational floating by helping to maintain existing water depth and velocities on those streams large enough to accommodate canoes, rafts and other types of floating craft. Flows which are sufficient to enable these craft to operate will benefit recreational floaters as well as fishermen who float to fish these waters.

Rivers and streams in Montana provide exceptional recreational benefits to a broad spectrum of the public. Fifty-six percent of all Montanans fish and over 30% float in rafts, canoes or kayaks (Frost and McCool 1986).

A study conducted by the University of Montana (Frost and McCool 1986) documented that the Missouri River Basin is extensively used for water-based recreation by Montanans and out-of-state visitors. These researchers reported that about 35% of Montana river floaters considered rivers in the Missouri River Basin to be their favorite streams to float. The stream most cited by floaters was the Yellowstone River (19.7%) followed by the mainstem of the Missouri (11.2%) and the Madison River (8.8%).

The BLM has maintained recreational use data on 12 miles of the Madison River below Ennis Lake. This river reach is within the Beartrap Canyon Wilderness, a unit of the Lee

Metcalf Wilderness. The Beartrap offers raging rapids, solitude, magnificient scenery and outstanding recreational opportunities. Whitewater floating, bank and boat fishing, and hiking are popular activities (Bureau of Land Management 1989).

Between 1979-83, estimates of commercial and non-commercial floating and float fishing use in the Beartrap area between May 15 and September 7 increased 250% (from 300 to 1,050 users). By 1987, floating use had increased an additional 14% to 1,200 users. The same use was estimated for 1988. In 1988, an additional 4,100 persons (including hikers and bank fishermen) were estimated to have visited the river corridor by foot during the May 15-September 7 period (Bureau of Land Management 1989).

Of 784 floaters who actually registered to float the Beartrap in 1988, 71% were guided by commercial outfitters and 29% were in private parties. Approximately 84% of those 1988 floaters were residents and 16% were non-residents. In 1987 and 1988, respectively, 28% and 30% of persons floating the river were fishermen; the remaining 70-72% were running the river for the whitewater and wilderness experiences. In 1988, 25 states were represented by persons using the Beartrap corridor; 28% of all users were from out-of-state and 48% were from Bozeman. The remaining 24% were from other Montana cites and towns (Bureau of Land Management 1989).

The Smith River is also very popular with floaters. Although agricultural water diversions usually restrict floating opportunities sometime between mid-July and mid-August (depending on runoff), an average of 1,714 people floated the Smith during 1984-86 (Table 1-5). Floating the Smith usually takes several days. Because of these multi-day floats, the Smith actually supported about 7,000 floating days per year from 1984-86 (Montana Deptartment of Fish, Wildlife and Parks 1988).

The Smith and Madison rivers are the only rivers in the Missouri Basin above Fort Benton where floating use has been extensively evaluated. However, this is not to imply that the Missouri River and its other tributaries are not extensively used, and popular, for floating. Nearly half of the pages of a popular Montana floating guide (Fisher 1979) are devoted to float trips in the Missouri Basin. From the spectacular canyons of the Dearborn, Smith and Gallatin rivers to the meandering solitude of the Marias, Red Rock and middle Missouri rivers, the basin abounds with floating opportunities.

Table 1-5. Number of floaters using the Smith River.

Month/Week	1987	1986	1984	Total
May				
Week 1	52	79	35	166
Week 2	63	15	35	113
Week 3	118	55	93	266
Week 4	260	264	45	569
June				
Week 1	119	167	50	336
Week 2	183	233	147	563
Week 3	140	240	349	729
Week 4	58	380	413	851
July				
Week 1	10	114	502	626
Week 2	55	142	119	316
Week 3	57	114	32	203
Week 4	57	47	33	137
August				
Week 1	28	42	34	104
Week 2	7	31	18	56
Week 3	10	14	24	48
Week 4	23	34	3	60
Total	1,240	1,971	1,932	5,143

Source: Montana Deptartment Fish, Wildlife and Parks (1988).

The middle Missouri River from Fort Benton to Fort Peck Reservoir not only supports a unique, diverse and productive fish community, it is also the largest free-flowing and relatively unaltered, uninhabited segment of the nation's longest river. Congress, in recognition of the extraordinary biological, recreational, scenic and historical values found along this 149 miles of river, officially designated this reach as a National Wild and Scenic River in 1976. Although this designation allows minor withdrawals of water for agricultural purposes, no dams are allowed and specific protection measures must be taken before any large-scale human development can occur. For 149 miles the river winds through spectacular breaks, cliffs and badlands within a gorge several hundred feet below the Great Plains. There are no channel pilings, flood walls, rock and concrete flow deflectors, dams, reservoirs or large irrigation structures that typify the "Mighty Mo" as it sluggishly travels from Fort Peck to its confuence with the Mississippi River. Only from Fort Benton to Fort Peck does the Missouri remain as it existed for prairie-dwelling Native Americans, Lewis and Clark, and the steamboats that vanguarded the first major immigration of people into Montana during the last century.

The number of modern-day adventurers that utilize this historic river reach is significant. The Bureau of Land Mangement (1988) reported that in 1987 66,585 visitors spent 75,582 visitor-days annually along the Missouri between Fort Benton and the Fred Robinson Bridge, which is located just a few miles above Fort Peck Reservoir. These figures include many uses of this river reach (floating, fishing, hunting, camping, etc.).

Adequate instream flows are also important for the convenience and safety of floaters. Hazards, such as large boulders, logs, gravel bars, rip rap and diversion structures, can often be avoided by floaters if streamflows are high enough to allow manuevering. The requested flows would contribute to maintenance of water levels sufficient to reduce such inconveniences and safety hazards on floatable streams.

3. Riparian Areas

Instream flow reservations will help maintain the levels of water required to maintain the health and vigor of the plant and animal life which comprise the existing riparian communities along the Missouri Basin streams included in this application.

The often shallow-rooted, water-loving plants found in riparian areas depend upon adequate instream flows to maintain shallow, streamside aquifers. Because of the close connection with this water source, riparian areas contain highly diverse plant communities. They are also the most productive wildlife areas in North America and are utilized extensively by big game, furbearers, waterfowl, songbirds and small mammals. The biological abundance and diversity found within riparian areas attracts increasing numbers and kinds of persons who recreate along streams, i.e., photographers, bird-watchers, science students, hunters, berry-pickers, and naturalists.

4. Economic

Of the many recreational benefits provided by the rivers and streams of the Missouri Basin, fishing is unquestionably a highly valued commodity. A recent economic study (Duffield et al. 1987) determined the total aggregate value of stream fishing in Montana to be $122,000,000 per year. Remarkably, $50,962,000 per year, or 42% of the statewide total, was attributed to streams and rivers in the basin above Canyon Ferry Reservoir (Figure 1-5). A breakdown of net recreational fishing values for streams in the upper Missouri Basin is presented in Table 1-6.

Table 1-6. Net recreational fishing values of streams in the Upper Missouri River Basin during 1985.

Stream	Annual Value Per Day	Annual Angler Days	Annual Site Value
Beaverhead River	$ 95.75	24,239	$ 2,321,000
Big Hole River	108.55	47,910	5,201,000
East Gallatin River	142.80	6,191	884,000
Gallatin River	152.22	63,871	9,722,000
Madison River	161.06	108,712	17,509,000
Jefferson River and tributaries	79.21	29,129	2,307,000
Upper Missouri River and tributaries above Canyon Ferry Dam	87.72	25,419	2,230,000
Madison River tributaries	254.04	11,224	2,851,000
Gallatin and East Gallatin tributaries	171.54	14,045	2,409,000
Beaverhead tributaries (Includes Ruby and Red Rock rivers and tributaries)	139.47	25,878	3,609,000
Big Hole River tributaries	103.07	18,621	1,919,000
Total		375,239	$ 50,962,000
State Total			122,315,000
Percent of State Total			42%

Source: Duffield et al. 1987.

Basin values were computed from information presented in Duffield et al. (1987). Numbers in fish outlines are percentages of state-wide stream fishing values found within the basins.

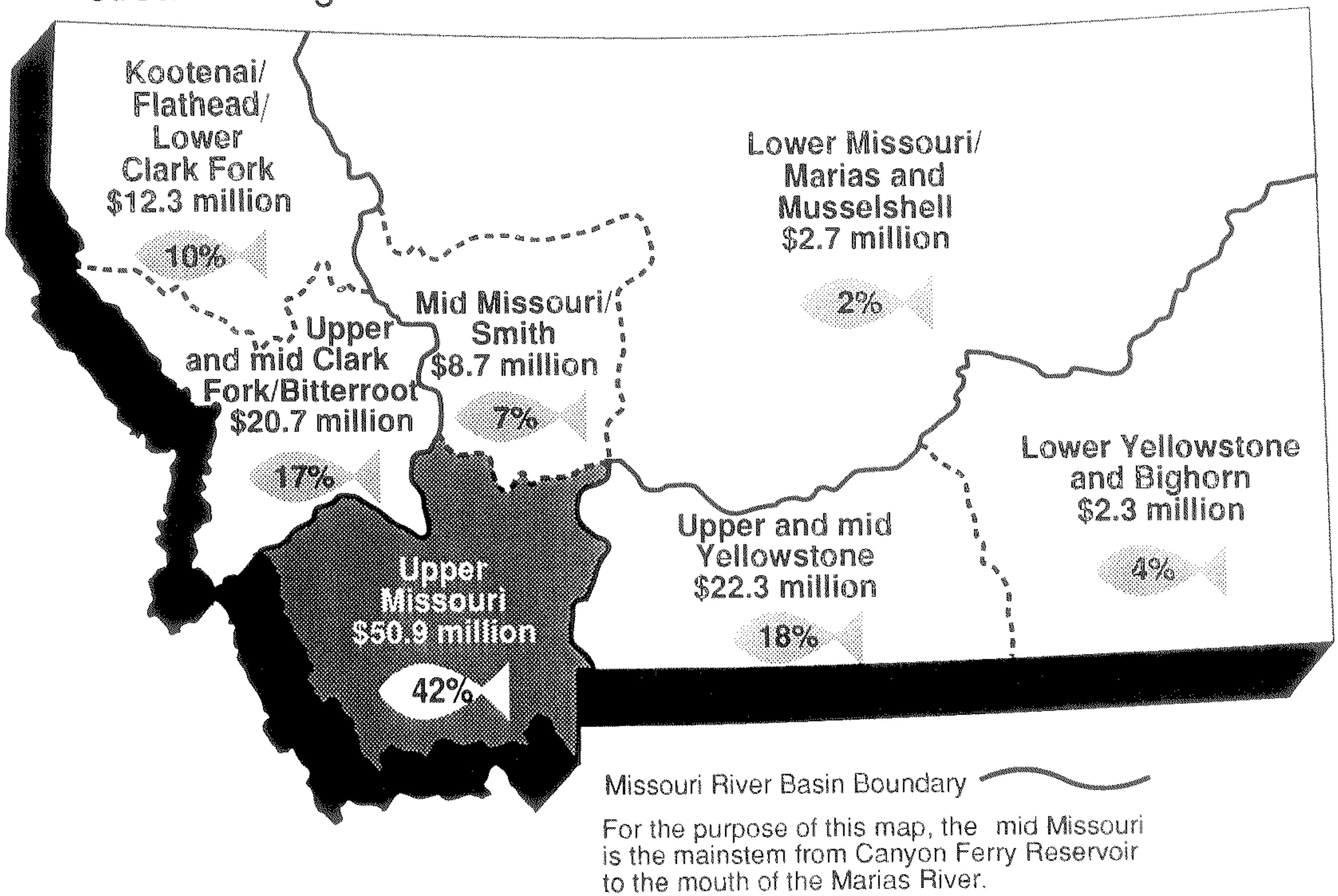

Figure 1-5. Net recreational fishing values of Montana river basins, 1985.

Of the 45 streams and/or stream reaches evaluated by Duffield et al. (1987), three of the most highly valued rivers in the state were in the upper Missouri Basin. The Madison was the most valuable river in Montana ($17,509,000 per year). The Gallatin was the third most valuable stream in the state ($9,722,000 per year), and the Big Hole was fourth ($5,201,000 per year). Only the upper Yellowstone ($10,905,000 per year) was more highly valued than the Gallatin or Big Hole.

In the middle Missouri River Basin between Canyon Ferry Reservoir and Fort Peck Dam, the net economic value of fishing was estimated to be $11,478,000 (Table 1-7). Approximately 9% of the total fishing value of all streams in the state was derived from streams in the middle Missouri Basin. Together, the streams in both the upper and middle Missouri basins accounted for about 51% of the total statewide fishing-related values.

The site values listed in Tables 1-6 and 1-7 were computed by multiplying the value of a fishing day on a given stream times the fishing pressure (as determined by the 1985 DFWP angler use survey). A Travel Cost Model was used to calculate the value per day for each stream. See Duffield et al. (1987) for a detailed discussion of this model.

Duffield et al. (1987) caution that their study did not quantify the <u>total</u> economic value of streams in Montana. Rather, the study addressed only the economic benefits attributed to fishing. These researchers further state that, based on the study's reported costs, the net present value (market value) of only stream fishing related recreation in Montana is roughly 3.1 billion dollars.

Instream flow reservations would help maintain these economic values by protecting the fishery resources from which they are derived.

Table 1-7. Net recreational fishing values of streams in the Middle Missouri River Basin during 1985.

Stream	Value Per Day	Annual Angler-days	Annual Site Value
Missouri River (between Marias River and Fort Peck Dam)	$ 77.84	22,340	$ 1,739,000
Missouri River (Canyon Ferry to Marias River excluding the Holter to Cascade reach)	61.36	67,557	4,145,000
Missouri River (Holter to Cascade)	50.33	72,788	3,663,000
Marias River	58.77	5,925	348,000
Musselshell River	55.96	11,218	628,000
Smith River	70.96	11,824	839,000
Smith River tributaries	16.29	7,143	116,000
Total		198,795	$ 11,478,000
State Total			$122,315,000
Percent of State Total			9.4%

Source: Duffield et al. 1987.

5. Summary

From its blue ribbon headwaters to its wild and scenic lower reaches, the Missouri River and its tributaries are enormous recreational and aesthetic assets to the people of Montana and the nation. The resources of the Missouri River system also provide a substantial economic base for the people of Montana. In order to protect these resources and provide future opportunities to enhance these public benefits, it is essential that the instream flows requested in this application be granted.

In addition to fishing, streams provide many other recreational benefits. Floating, camping, picnicking, swimming, birdwatching, sightseeing and hunting are all popular recreational activities conducted along the Missouri River and its tributaries. However, there is little data available that allows for economic analyses of the values of stream recreation other than fishing. The economic value of the Missouri and other streams in Montana would, therefore, be significantly higher than the fishing value of $122,000,000 per year if all other river-based recreational activities were also evaluated.

B. Direct Costs

Some stream reaches of the Missouri River Basin do not have gauges at appropriate locations to adequately monitor streamflows. Once reservations are granted, monitoring of streamflows on stream reaches will be necessary for protection of the granted flows. This may require installation of additional stream gauges or relocation of existing gauges. The costs of installing gauges would range from $600 to $17,500 per gauge, depending on the level of technology required for adequate monitoring (Karp 1987). Annual operating costs for each monitoring station would range from $800 to $5,500, depending on the complexity of the monitoring program (Karp 1987). Appendix B provides alternatives for stream gauge installation and operation and the estimated costs of each alternative.

Other direct costs are those associated with DFWP's inhouse operations to implement whatever program is required to protect the granted reservations. Specific cost information cannot be provided at this time.

II. Indirect Benefits and Costs of the Reservations

The following is pursuant to ARM 36.16.105C(1)(a) of the water reservation rules:

> In making a showing that the reservation is in the public interest, the application shall contain . . . A discussion of the indirect benefits and costs associated with applying water to beneficial use that considers the effects on (i) future economic activity, (ii) the environment, (iii) public health and safety, and (iv) the economic opportunity costs that the requested flow may have to parties other than the reservant.

Indirect benefits and costs are defined in ARM 36.16.102 (12) and (13), as:

(12) "Indirect benefits" means the benefits of applying reserved water to beneficial use that accrue to other uses or to parties other than the reservant and,

(13) "Indirect costs" means the costs of applying reserved water to beneficial use that accrue to other uses or to parties other than the reservant.

For the purpose of this application "indirect", therefore, refers to "uses or to parties other than" DFWP, and the DFWP reservations will be the means "of applying reserved water to beneficial use."

The economic considerations of these requirements, subsections (i) and (iv), are discussed below under **A., Effects of the Reservation on Future Economic Activity**, and under **C., Economic Opportunity Costs of the Reservation**, respectively. The indirect economic **benefits** of the reservation are covered in A., while indirect economic **costs**, including foregone opportunity costs, are addressed in C. Non-economic considerations, as per sections (ii) and (iii) above, are presented in B., **Effects of the Reservation on the Environment, Public Health, Welfare and Safety**.

When establishing and prioritizing water reservation requests, a major criterion utilized by the Board of Natural Resources and Conservation is an evaluation of the effects that a reservation may have upon "other uses or parties." The following discussion, therefore, presents the overall indirect benefits and costs of the DFWP reservation and its specific effects upon municipal, agricultural and industrial water users.

A. Effects of the Reservation on Future Economic Activity

1. An Overview of Indirect Economic Benefits

The instream flows requested in this application are necessary to protect the direct recreational and aesthetic benefits provided by the rivers and streams of the Missouri River Basin. Protection of these amenities also significantly contributes to the economic well-being of Montana.

Tourism, one of the fastest growing segments of Montana's economy, is directly related to the amenities of the state's natural environment, particularly those provided by rivers and streams. In 1986, nearly 2.8 million non-residents visited Montana, generating over $475,000,000 in income for the state (Montana Department of Commerce 1988).

Most major highways in Montana closely parallel rivers and streams. It is along these waterways that visitors gather many of their lasting impressions of the state. According to a survey of tourism in Montana conducted by Montana State University (Brock et. al. 1984), 95.4% of non-residents surveyed perceived Montana as good or excellent in terms of the state's outdoor recreation amenities. Maintaining the instream flows requested in this application would help protect the outstanding scenic and recreational values of the Missouri's free flowing waters and help ensure that tourists would continue to speak highly of the state's recreational resources.

Since word of mouth is often the best advertisement for any commodity, satisfied tourists would, in turn, stimulate continued growth for businesses supported by non-residents.

Recent labor statistics for Montana revealed that growth in tourism-related services sector jobs is already significant. During the first half of the 1980s when the wood products, metal mining, energy development and agricultural industries were floundering, the services sector of Montana's economy steadily generated 18,000 new jobs (Powers 1987).

The recreational and aesthetic attributes of rivers and streams that attract tourists are also responsible for attracting new, economically independent residents to Montana. As pollution, over crowding, crime rates and loss of natural areas continue to increase in major cities, an increasing number of retired persons and/or persons endowed with sufficient interest, dividend or rent incomes, are choosing to move to areas with uncrowded, high-quality recreational opportunities and aesthetically pleasing natural settings. Many of these persons, especially those seeking unmatched fishing, floating and scenic values, are moving to the Missouri Basin in Montana. The contribution to Montana's economy made by these independent, "non-labor" income sources is substantial; it presently accounts for over one-third of Montana's economic base. In recent years, non-labor income has added nearly 4 billion dollars per year to the state's economy, compared to Montana's total labor income of about 7 billion dollars per year (Powers 1987).

2. Economic Benefits to Other Uses or Parties

a. Municipalities/Businesses

Municipalities would benefit from the DFWP reservation because of increased assurances about the future physical availability of drinking water. Maintenance of instream flow levels would help sustain water levels at city intake structures and infiltration galleries. If incremental streamflow depletions were to continue as they have occurred in the past, relocation of these supply structures and/or development of alternative water supplies could be necessary. Either of these alternatives would be costly for municipalities.

The effects of the DFWP reservation upon the availability of surface drinking water supplies are important considerations to be weighed during water reservation deliberations. However, the economic benefits of the reservation to streamside communities also extend beyond the issue of municipal water supply sources. The recreational values of Missouri River Basin streams provide the basis for many thriving businesses in Ennis, West Yellowstone, Bozeman, Great Falls, Helena, Fort Benton, Three Forks and other smaller river communities.

The economic growth and stability of these communities, particularly the smaller ones, is highly dependent upon businesses supported by fishing, floating and other forms of river-based recreation.

Outfitting businesses clearly benefit from the maintenance of adequate instream flows. The percentage of statewide fishing and outfitting businesses that are located in the upper Missouri Basin closely approximates the angler-use data displayed earlier in Figure 1-4. About 31% (83 out of 270) of the licensed fishing outfitters and guides who requested to be listed in the Department of Commerce's 1988 Montana Travel Planner were headquartered in cities and towns of the Upper Missouri Basin.

In 1986, a statewide total of 205 registered Montana fishing outfitters provided 10,213 clients with 20,128 fishing days (Montana Department of Fish, Wildlife and Parks 1987). In that year, 187 outfitters also listed the major rivers that they worked. A total of 104 of those outfitters (56%) worked rivers and streams in the Missouri Basin.

Along with outfitting, municipalities in the Missouri Basin also depend upon the economic success of many other services sector businesses, ranging from motels, campgrounds and restaurants, to sporting goods stores, automobile service stations and gift shops. These businesses are dependent upon income from non-resident vistors. The DFWP reservation would help maintain the high quality recreational and scenic opportunities sought by tourists, thereby helping to secure this aspect of economic prosperity in the Missouri Basin.

The DFWP reservation would not only protect opportunities for the perpetuation and enhancement of recreational and service sector businesses, but the amenities it would help maintain would also help attract new kinds of businesses which offer employment opportunities beyond those traditionally credited to recreation. Specialty food and mail order companies, computer and data processing businesses, and consulting firms are examples of "distance-independent businesses", since they typically do not consider distance from markets a liability and, therefore, are often successful in "remote" areas like Montana (Birch 1986).

In his keynote address to the Governor's "Montana - An Economy in Transition" conference in May 1986, David Birch, a nationally renowned small business researcher, suggested as 2 of his 3 major recommendations for improving Montana's economy that: (1) better recognition be given to attracting distance-independent businesses; and (2) the state do a better job of promoting tourism (Birch 1986). Calling Montana "one of the most spectacularly beautiful places in the world," he concluded that the state should invest more effort towards promoting its natural attributes. This added promotion would not only enhance Montana's tourism businesses, the major source of economic growth in the state since 1980, but it would also most certainly help attract more distance-independent companies to Montana.

Areas of the state that are endowed with an abundance of spectacular trout rivers like the upper Missouri River Basin, have the highest potential for attracting both tourists and distance-independent companies. In fact, significant new growth in the latter is already evident in the upper basin. During the past three years, several small to mid-sized companies have moved to Bozeman. Much of the credit for attracting these businesses can be given to the Gallatin Development Corporation (GDC), a local business advocacy group that has definitely followed the advice of Birch (1986) about promoting an area's natural beauty. According to the executive director of the GDC, recreational opportunities and local trout streams are major selling points for attracting new businesses to the Bozeman area. The GDC promotional video "Pioneering for the Future," mentions fly fishing several times. As well, all of the newly-arrived distance-independent companies have at some time commented on the recreational opportunities available in the area (Smith 1988). Although not all-inclusive, some examples of these new businesses are:

Gibson Guitar Company, which moved part of its Nashville, Tennessee operations to Bozeman during the summer of 1988, and expects to employ 60 people by late 1989.

CCG Inc., a specialized consulting firm helping to market research ideas and concepts that are developed at Montana State University.

Life-Link, a sporting goods manufacturer that had expected to hire about 35 people during its first year in Bozeman, but greatly exceeded those expectations. The company started operations in March, 1988. By February, 1989, Life-Link had employed 75 full-time and 12 part-time employees. All but 8 employees were from the Bozeman area. The company predicts that its annual sales this year will be near $9,000,000 and that it will employ 150 people within the next 2 years (Bozeman Chronicle 1989).

Patagonia, a world-famous outdoor clothing manufacturer, recently moved the mail order portion of its company to the Gallatin Valley. Initially employing about 30 people, the company expects an increase to 100 employees during the next five years. A spokeswoman for Patagonia stated that Bozeman was chosen by the company "primarily because of the recreational opportunities not available in Ventura" (the former California site of the mail order business). She continues, "Ventura is a great town, but there is not a lot of great rivers. You can't fly-fish here either. Bozeman has all those things and you can get to [them] relatively easily" (Bozeman Chronicle 1987).

The DFWP flow reservation would help protect the aesthetic qualities and recreational opportunities that would continue to attract the above economic benefits to municipalities. These benefits, along with the amenities provided by rivers and streams to residents of streamside cities and towns, are important to the quality of life and the economic future of municipalities in the Missouri Basin.

b. Industry

Hydropower is a major beneficiary of the DFWP reservation. Nine hydroelectric facilities in the Montana portion of the Missouri Basin, including four near Great Falls, along with Holter, Hauser, Ennis, Canyon Ferry and Fort Peck dams, annually produce about 3.7 million megawatt hours of electricity (Mont. Dept. Nat. Res. and Cons. 1986). Nearly half of this electrical energy is produced at Canyon Ferry and Fort Peck dams.

Maintaining instream flows through water reservations would protect monetary benefits from existing electrical generation at publically-owned facilities. Water that is available in the Missouri River Basin not only passes through the Bureau of Reclamation's Canyon Ferry Dam and the U.S. Army Corps of Engineers' dam at Fort Peck, it also powers five other major hydropower generating facilities owned by the federal government in North Dakota and South Dakota. Table 1-8 presents the average generating capacity of each facility and the cumulative electrical generation per acre-foot of water as it passes from one facility to the next.

Table 1-8. Kilowatt-hour (KWH) generation per acre-foot (AF) of water (median water or most probable runoff).

Power Plant	Average Generation (KWH/AF)	Cumulative (KWH/AF)
Gavins Point	35	777
Fort Randall	95	742
Big Bend	56	647
Oahe	154	591
Garrison	148	437
Fort Peck	164	289
Canyon Ferry	125	125

Source: Schirk (1987).

There are varying concepts of how water in streams and reservoirs are most appropriately valued. Both the Western Area Power Administration (WAPA) and the U. S. Army Corps of Engineers (Corps) have provided estimates of the value of an acre-foot of water for hydropower in the Missouri River Basin. The value of an acre-foot of water passing through the 7 hydropower facilities would depend on the sale price of electricity. According to WAPA, the price of electricity ranges from 7.5 mils per kilowatt-hour (KWH) for "firm" power to 14 mils per KWH for "surplus" power (Schirk 1987). Based on the cumulative generation of electricity through the Missouri River mainstem dams (Table 1-8), the value of an acre-foot of water would range from $5.83 to $10.88.

The indirect economic benefits of the DFWP reservations to the nine hydroelectric facilities in the Montana portion of the basin is also significant. When the price of electricity, as quoted by the WAPA (Shirk 1987), is applied to the electrical production rates at these Montana facilities, the value of wholesale power produced ranges from $27,800,000 to $51,800,000 per year (i.e., 3.7 million megawatts per year x 7.5 to 14 mils per kilowatt-hour). These estimated values are conservative; roughly one-half of the hydroelectric power production in the Missouri Basin in Montana is from private facilities, which typically receive a much higher sale price for their electricity (Dodds 1989). For example, the Central Montana Electric Power Cooperative currently purchases firm power from federal hydro projects through WAPA for 8.22 mils/KWH (in October 1989 the rate is expected to increase to 9.30

mils/KWH). The cooperative also purchases coal-fired steam power from Montana Power Company (MPC) for about 40 mils/KWH. About 40% of the power purchased from MPC is hydro and about 60% steam power. The cooperative then sells a blend of hydro and steam power to consumers in the Missouri Basin for 26 mils/KWH. The Avoided Cost of power authorized to MPC by the Montana Public Service Commission is currently 41 mils/KWH. If the supply of hydropower were to be reduced because of instream flow reductions, the replacement cost of the power from steam plants at current rates would be at least 5 times the cost of hydropower (e.g. 40+ mils/KWH) (Central Montana Electric Power Corporation 1989). The overall price of electric power to these consumers is obviously held down by the availability of much cheaper hydropower. An indepth analysis of electric power costs will be made by DNRC during formulation of the Missouri Basin Reservations EIS (Dodds 1989).

Velehradsky (1987) provided a slightly lower estimate for the value of electrical production at the Corps' Missouri River facilities ($4.90/acre-foot). However, he also stated that the perceived benefits of hydropower are much greater than any current production estimates. If new power sources must be brought on line, the cost could be 60 mils per KWH or higher, or equivalent to about $41.00 per acre-foot.

The instream flows requested in this application and those required for existing hydropower facilities are mutually supportive as long as water release schedules from these dams are closely tied to the needs of fish and water-based recreation. The reservation would help maintain the electrical generating capacity of the hydropower plants on the Missouri River, which currently provide some of the most economical electrical power in the western states.

The DFWP reservation would also help stabilize industrial waste treatment costs. Maintaining instream flows in the Missouri River Basin would help provide sufficient water volumes to dilute and assimilate wastewater discharges from existing facilities. The Montana Department of Health and Environmental Sciences (DHES) only issues discharge permits to waste treatment facilities where there are sufficient streamflows to dilute the wastes. Each discharge permit has criteria attached specifying that receiving waters would be protected as long as streamflow does not fall below the 7-day, 10-year low flow limit for a given stream. (The 7-day, 10-year low flow is the lowest flow that would occur at a probability of once every 10 years for a consecutive 7-day period.) If the flow of receiving water falls below the 7-day, 10-year limit, waste discharges would not necessarily be curtailed, but the biological integrity of the streams would no longer be protected (Bahls 1989).

Instream flow reservations would help prevent streams receiving wastewater discharges from dropping below the 7-day, 10-year low flow limit established to prevent water quality degradation and damage to aquatic ecosystems. If flows should be depleted below minimum levels to provide adequate dilution and assimilation of wastewater discharges, prevention of damage to aquatic ecosystems would only be avoided by suspending the discharge of wastewater to streams. Preventing already permitted facilities from discharging wastes during these periods could pose serious operational and economic consequences. Either the treatment facilities would need to be upgraded to provide a higher level of treatment of various chemical compounds and organic materials in wastewater, or effluents would have to be disposed of on land or through some other means. Such measures would be extremely expensive. Preventing damage to aquatic ecosystems through maintenance of instream flows would be more cost effective than upgrading waste treatment facilities or land disposal of wastewater.

Municipalities would also be recipients of the above indirect economic benefit of the reservations, since there are nearly as many permitted municipal sewage treatment plant dischargers in the Missouri Basin (43) as there are industrial dischargers (46). All of the Montana Pollution Discharge Elimination System (MPDES) permitted facilities in the Missouri Basin that receive benefits associated with stabilized instream flows/waste treatment costs are listed in Table 1-9.

Last, and very important, the diversity and abundance of water-based recreational opportunities that are supported by the DFWP reservations provide the base for a highly diverse, environmentally-sensitive industry in the Missouri Basin. The amenities that would be protected by the reservations directly support water-based recreational businesses and also attract tourists, "distance-independent" businesses and people with independent incomes. Collectively, all of these businesses and income sources comprise an amenity-based, growth-oriented industry that is essential to the continued growth and prosperity of the basin.

Table 1-9. Montana permit discharge elimination system (MPDES)--municipal, industrial and placer mine permits.

Permittee	County	Receiving Water	Permit Expiration Date
Municipal Permits			
Dillon	Beaverhead	Beaverhead River	01-31-89
Townsend	Broadwater	Missouri River	05-31-93
Belt	Cascade	Belt Creek	01-31-89
Great Falls WTP	Cascade	Missouri River	05-31-92
Great Falls	Cascade	Missouri River	09-30-92
Village Water & Sewer	Cascade	Sun River	03-31-93
Vaughn	Cascade	Sun River	12-31-89
Big Sandy	Chouteau	Big Sandy Creek	10-31-88
Geraldine	Chouteau	Flathead Creek	05-31-93
Chouteau/ Highwood	Chouteau	Highwood Creek	01-31-89
Fort Benton WTP	Chouteau	Missouri River	05-31-89
Fort Benton WTP	Chouteau	Missouri River	08-31-91
Denton	Fergus	Wolf Creek	01-31-89
Lewistown	Fergus	Big Spring Creek	01-31-89
Willow Creek Sewer	Gallatin	Unnamed Drain Ditch	07-31-90
Bozeman	Gallatin	East Gallatin River	05-31-93
Three Forks	Gallatin	Madison River	10-31-89
Manhattan	Gallatin	Gallatin River	09-30-92
Cut Bank	Glacier	Cut Bank Creek	05-31-93
Browning	Glacier	Depot Creek/ Willow Creek	05-31-86
Whitehall	Jefferson	Jefferson River	12-31-89
Hillbrook Nursing Home	Jefferson	Prickly Pear Creek	03-31-89
Boulder	Jefferson	Boulder River	03-31-89
Hobson	Judith Basin	Unnamed Drainage	09-30-88
Stanford	Judith Basin	Skull Creek	05-31-91
Helena	Lewis & Clark	Prickly Pear Creek	05-31-91
US BOR Canyon Ferry	Lewis & Clark	Missouri River	08-31-89
US BOR CF Govt Camp	Lewis & Clark	Missouri River	08-31-89
Helena WTP	Lewis & Clark	Prickly Pear Creek	09-30-91
East Helena	Lewis & Clark	Prickly Pear Creek	05-31-91
Sheridan	Madison	Mill Creek	03-31-89
Ennis	Madison	Madison River	09-30-88
White Sulphur Springs	Meagher	Lone Willow Creek	05-31-93
Valier	Pondera	Unnamed Dry Creek Bed	11-30-89

Conrad	Pondera	Marias River	07-31-89
Brady Water Users	Pondera	South Pondera Coulee	05-31-93
Choteau	Teton	Teton River	01-31-89
Fairfield	Teton	Freezeout Lake	05-31-93
Dutton	Teton	Hunt Coulee	05-31-93
Toole/Sweetgrass	Toole	Unnamed Dry l. Bed	05-31-93
Sunburst	Toole	Unnamed Dry l. Bed	01-31-90
Shelby	Toole	Marias River	05-31-93
Fort Peck	Valley	Missouri River	05-31-93

Industrial Permits

Anaconda Minerals	Cascade	Missouri River	02-28-89
Janetski, Lee B.	Cascade	Missouri River	06-30-90
Antonioli, Mrs. P.	Cascade	Squaw Creek	12-31-89
MPC-Rainbow	Cascade	Missouri River	06-30-89
MPC-Black Eagle	Cascade	Missouri River	06-30-89
MT Refining Co.	Cascade	Missouri River	07-01-88
MPC-Ryan	Cascade	Missouri River	06-30-89
Genco Industries	Cascade	Belt Creek	07-31-92
Blue Range Mining	Fergus	Big Spring Creek	10-31-89
Blue Range Eng.	Fergus	East Fork Fords Creek	09-30-91
SourDough Cr Prop	Gallatin	Various	08-31-91
Ideal Basic Ind.	Gallatin	Missouri River	02-28-91
Beren Corp.	Glacier	Unnamed Slough	06-01-91
Flying J, Inc.	Glacier	Spring Coulee	05-31-93
Corbin Water Usrs	Jefferson	Corbin Creek	05-31-91
Boulder Ht Sprngs	Jefferson	Little Boulder River	05-31-92
MT Tunnels Mining	Jefferson	Trib. to Spring Creek	10-31-91
Pangea Mining	Jefferson	Basin Creek	05-31-93
Pangea Mining	Jefferson	Monitor Creek	05-31-93
Ash Grove Cement	Jefferson	Prickly Pear Creek	12-31-89
Gulf Titanium	Lewis & Clark	Jennies Fork	09-30-91
Black Hawk Mining	Lewis & Clark	Banner Creek	09-30-90
Clark, Dexter	Lewis & Clark	Spring Creek	12-31-92
MT Gold & Saphre	Lewis & Clark	Missouri River	06-30-88
MPC-Holter	Lewis & Clark	Missouri River	06-30-89
MPC-Hauser	Lewis & Clark	Missouri River	06-30-89
Century Silver	Lewis & Clark	Ten Mile Creek	08-31-92
Liquid Air Corp.	Lewis & Clark	Prickly Pear Creek	12-31-89
Uncle Sam Mines	Madison	Middle Fork Mill Crk	04-30-92
U.S. Grant Gold	Madison	Alder Creek	01-31-92
Rocky Mt. Mnrls	Madison	Rochester Creek	05-31-89
Red Pine/Shermont	Madison	Indian Creek	02-28-90
MT Talc	Madison	Johnny Gulch Creek	09-30-92
Cyprus Ind. Min.	Madison	Middle Fork Stone Crk	07-31-89
MPC-Madison	Madison	Madison River	06-30-89
Denimil Resources	Madison	Pony Creek	12-31-89
Cyprus Ind. Min.	Madison	Sweetwater Creek	05-31-93

Zortman-Landusky	Phillips	King Creek	10-31-91
Zortman-Landusky	Phillips	Various	10-31-91
Malta Ready Mix	Phillips	Milk River-Dodson Cnl	05-31-93
Western Reserves	Toole	Unnamed Closed Basin	07-31-89
Texaco, Inc.	Toole	Stockponds	10-31-88
Silver Fox Oil	Toole	Ephemeral Drainage	04-01-89
A & G Oil & Gas	Toole	Stockponds	04-30-88
East. Am. Energy	Toole	Unnamed Coulee	12-31-87
Devon Water, Inc.	Toole	Tiber Reservoir	11-30-88

Placer Mines & Suction Dredges

Golden Star	Beaverhead	Big Moosehorn Creek	09-90
Golden Star	Beaverhead	Ruby Creek	09-90
Golden Star	Beaverhead	Little Moosehorn Crk	09-90
Miragliotta, Vito	Beaverhead	Jeff Davis Creek	08-88
Searle Bros.	Beaverhead	Jeff Davis Creek	03-93
Towner, Bob	Beaverhead	Grasshopper Creek	07-89
Wright, Alan	Broadwater	Indian Creek	03-92
Klies, Forrest	Jefferson	Jack Creek	10-90
Klies, Forrest	Jefferson	Basin Creek	10-90
Jefferson Creek	Lewis & Clark	Jefferson Creek	06-86
Holzworth, Dick	Lewis & Clark	Skelly Creek	03-88
Modern Expl., etc.	Lewis & Clark	Prickly Pear Creek	12-92
Morris, Bud	Lewis & Clark	Hauser Lake	05-93
MT Gold & Saphr	Lewis & Clark	Missouri River	06-88
Fredriksen, etc.	Lewis & Clark	Missouri River	12-92
Sypult, Cleatus	Lewis & Clark	Madison Gulch	10-90
Placer Recovery	Lewis & Clark	Jefferson Creek	02-93
Brown's Gulch	Madison	Brown's Gulch Creek	09-86
Parker, Rodney	Madison	Barton Gulch	06-90
Lince, Carol G.	Madison	California Creek	08-92

Source: Water Quality Bureau, Montana Department of Health and Environmental Sciences, Helena, Montana, 1988. Computer list of MPDES permits.

c. Agriculture

Existing agricultural water right holders would benefit from the DFWP reservations because of increased legal and physical assurances about future delivery and supply of water for their crops and livestock. Although the long-term stability that would be provided to these landowners has not been quantified economically, it would be substantial as far as its influence on property values, crop production rates and reductions in legal costs which may arise from disputes between junior and senior water users. However, since no firm monetary data exist for these economic benefits, they have been incorporated into the discussion about non-economic benefits of the reservation (II.2.c).

B. Effects of the Reservation on the Environment, Public Health, Welfare and Safety

1. An Overview of Indirect, Non-Economic Benefits

The scenic and recreational values of rivers are largely a function of their water quantity (instream flows), water quality and riparian areas. As has been previously discussed, the DFWP reservations would help preserve these attributes, which are vital components of the Missouri Basin's natural environment. However, protection of the natural environment through adequate instream flows does far more than just preserve hydrologic conditions and biological abundance. It also benefits the **human environment** as well as the public's health, welfare and safety.

The combination of exercise and relaxation that is part of fishing, floating and other water-based recreation benefits physical health, while providing welcome relief from the mental stresses of everyday life. These recreational activities also require varying degrees of skill, and so become avenues for gaining a sense of personal accomplishment. To improve these skills requires better understanding of the functions of river systems, which, in turn, increases individual consciousness and self-confidence.

The sociological benefits of river recreation are also important. River outings provide opportunities for families and friends to socialize or meet new people in a relaxed and aesthetically pleasing setting. Sharing these pleasant experiences benefits and expands interpersonal relationships.

Many people float rivers only to fish, but others enjoy the cultural and historical aspects associated with flowing streams throughout the Missouri Basin. Retracing the journeys of early explorers like Lewis and Clark, Mullan, Colter, Bozeman and others would certainly require adequate instream flows for present-day river navigators. Yet, just as importantly, these streamflows also help preserve the natural setting or viewing backdrop of river bottoms, which has other important cultural and historic implications.

The scene at the Big Hole Battlefield National Monument, for example, would be greatly diminished without adequate instream flows--for it was within the lush riparian vegetation and braiding stream channels of Trail Creek that Chief Joseph and his band of Nez Perce confronted the U. S. Army. Further reductions in instream flows and/or riparian vegetation within the battlefield area would change the physical setting, and thus the historical and cultural experience of visitors. In a similar sense, it would be difficult to conjure up images of John Colter using the Gallatin River as a hiding place from fleet-footed warriors if the river near Headwaters State Park were to become further dewatered. And, the Missouri's Wild and Scenic stretch would not offer visitors the same historic feel if it no longer had streamflows similar to those that existed during the steamboat era.

In stories and songs--from Native American lore to the writings of today's authors and poets--rivers are never described merely as physical conduits where water runs downhill. Rather, it is the beauty or strength of rivers and/or the influence of rivers upon individuals and societies that resonate through human memory.

The rivers and streams of the Missouri Basin, therefore, not only provide ongoing recreational and health benefits, they are also vital and important linkages to our past. These flowing waters and the riparian vegetation that they nourish are as much a part of the historical, social and cultural environment of the basin as are any human-fabricated structures or devices. The DFWP instream flow reservations would, therefore, help protect irreplaceable components of the Missouri Basin's human environment.

In the sections that follow, other indirect non-economic benefits of the reservation to other uses or parties are described. It is important to note that **there are no indirect, non-economic costs of the reservation to the environment, public health, welfare or safety.**

2. Non-Economic Benefits to Other Users or Parties

a. Municipalities

The instream flows requested in the DFWP reservation application would continue to enhance the human environment for residents of municipalities of the Missouri Basin. Adequate streamflows would help enhance the visual attributes of river bottom lands by keeping riparian plant communities healthy and viable and by providing habitat for wildlife and birds that residents enjoy observing. The attractiveness of a stream is also closely tied to its water level. Discharge levels below those requested in this application would lead to increases in exposed (dewatered) channel reaches as well as decreases in total living space available for fish and other aquatic life. The reservations would help preserve both the volume and surface area of streams, thereby perpetuating sport fishing and, where presently conducted, river floating opportunities. These amenities are substantial and irreplaceable social, aesthetic and recreational benefits of the reservations to citizens of municipalities that border flowing streams. The opportunity to fish, float or swim in the streams, observe wildlife and birds, or to simply enjoy the serenity of sparkling waters beneath the shade of cottonwoods in a city park, contribute immeasurably to the quality of life in these communities.

A major public health benefit of the DFWP reservations is their role in protecting municipal water supplies. Many municipalities in the Missouri Basin utilize surface water or shallow, streamside aquifers as their drinking water sources. The reservations would help maintain stream discharge levels necessary to dilute the toxic effects of hazardous materials and microbial organisms that enter these streams. Some herbicides and pesticides that are used by farmers, ranchers, weed districts, and on urban gardens and lawns are quite persistent (slow to decompose) in the environment. Leaks, spills or improper application, storage and disposal of these chemicals result in contaminated surface and ground waters. Unless adequate dilution is available, concentrations of these substances in public water supplies can reach levels harmful to human health.

The benefit of maintaining adequate instream flows to dilute toxic substances is illustrated in the Missouri Basin by problems associated with the toxic element arsenic. High concentrations of this metal originate from geothermal sources in Yellowstone National Park and enter the Missouri River drainage via the Madison River (Knapton and Horpestad 1987). Tributaries to the Madison dilute arsenic concentrations, lowering concentrations downstream. The Environmental Protection Agency (EPA) measured arsenic concentrations of 200 to 300 micrograms per liter (ug/l) in the Upper Madison River (U.S. Environ. Protect. Agency 1972) whereas concentrations of 20 to 40 ug/l occurred in the Missouri River upstream from Canyon Ferry Reservoir (at Toston) (U.S. Geological Survey 1976-1985). Human health concerns exist because the allowable limit for arsenic in drinking water is 50 ug/l total recoverable arsenic [U. S. Environmental Protection Agency 1986; ARM 16.20.203(1)(a)].

Data collected by the U. S. Geological Survey (USGS) in 1985 and 1986 (Knapton and Horpestad 1987), show that arsenic levels exceed drinking water standards in the Madison River below Hebgen Lake (e.g., 78 to 180 ug/l), below Ennis Lake (49 to 100 ug/l), and at Three Forks (45 to 87 ug/l). Arsenic levels in the Missouri River at Toston ranged from 22 to 40 ug/l and below Canyon Ferry Reservoir from 22 to 34 ug/l.

Between March, 1986, and September, 1988, 16 samples were collected by the USGS from the Madison River at the Yellowstone Park boundary near West Yellowstone. The mean concentration of arsenic was 252 ug/l (max. = 360; min. = 140) (Knapton 1989). The Jefferson and Gallatin rivers, which do not have high arsenic concentrations (e.g. 3-10 ug/l and <1.0-2.0 ug/l, respectively. Knapton & Horpestad 1987; Knapton and Brosten 1987), are normally major diluters of the arsenic concentrations in the Madison River. A water sample collected by the USGS on August 17, 1988 (a drought year) at Toston contained 100 ug/l dissolved arsenic (at least twice the EPA drinking water standard). The previous maximum concentration recorded from 58 samples collected at that site since 1972 was 52 ug/l. The mean concentration of all 58 samples was 24 ug/l (Knapton 1989).

Extremely low flows prevailed in the Jefferson and Gallatin rivers in 1988. On August 17, 1988, the flow in the Jefferson River was only 52 cfs (8% of the long-term daily mean flow) and the Gallatin River was at only 60% of its long-term mean daily flow (Knapton 1989). This lack of streamflow for dilution caused the increased concentration of arsenic at Toston on August 17, 1988, illustrating the importance of adequate instream flows to protect the quality of public water supplies.

b. Industry

The two largest hydroelectric dams on the Missouri River in Montana, Canyon Ferry and Fort Peck, are operated by the federal government. Maintaining instream flows will benefit public welfare by assuring reliable water delivery for power generation at these federal facilities.

Many headwater trout streams in the Missouri Basin are presently impaired by discharges of acid and toxic metals from abandoned mining operations, e.g., the upper Wise River, Boulder River, Prickly Pear Creek (near Helena), Belt Creek (near Great Falls), Grasshopper Creek (near Bannack), and others. Reduction in instream flows would reduce the capacity of these streams to dilute the discharges, causing toxicity problems to spread farther downstream. This would result in degradation of more miles of viable fishing streams, adversely affecting the public welfare and detracting from the image of the mining industry in Montana.

c. Agriculture

Regardless of the amount of water apportioned for instream flow reservations, existing water rights in the basin would at all times be honored. In fact, if the DFWP's reservations are granted, existing water users would be provided with additional assurances of future surface and groundwater availability. Reserved instream flows would help maintain water levels at existing headgates and would provide a legal buffer to any future water development plans by new water users. During low flow years, maintenance of existing streamflows could also help ease conflicts between junior and senior water users in the basin.

Instream flows often recharge shallow, alluvial groundwater tables that adjoin rivers and streams. Maintenance of these vital groundwater systems provides additional benefits to agriculture.

The riparian vegetation that is supported by shallow groundwater, e.g., willows, cottonwoods, birch and aspen, all have extensive root systems that stabilize streambanks and channels. The soil stability provided by healthy, well-managed riparian areas not only prevents erosion, but good riparian areas also reduce the potential for flood damage to crops and farm buildings.

In many valleys of the upper basin, moist meadows and other riparian-like areas are often used to grow alfalfa and hay crops, or as highly productive pasture lands. Many of these sites are "sub-irrigated" by shallow water tables that are recharged by surface water. The DFWP reservation would help maintain these moist growing sites. New diversions could reduce essential recharge which could reduce the forage productivity of these existing agricultural lands.

Finally, streamside aquifers are often utilized as domestic, livestock or irrigation water supplies. The reservation would help sustain existing water table levels, and thereby, the availability and/or quantity of these shallow groundwater supplies.

C. Economic Opportunity Costs of the Reservations

1. Introduction

Agriculture is by far the largest offstream consumptive water user in Montana, accounting for approximately 97.6% (15.41 million acre-feet) of the water diverted (Mont. Dept. Nat. Res. and Cons. 1986). In the Missouri Basin in Montana, agriculture accounts for an even larger share of the water diverted by consumptive users--approximately 99% (7.99 million acre-feet). Of this diverted water, about 22% (1.76 million acre-feet) is actually consumed (Mont. Dept. Nat. Res. and Cons. 1986). Loss of water to the atmosphere from reservoir surfaces likely results in a nearly equal amount of water consumption in the basin. Estimates for reservoir evaporation losses specific to the Missouri Basin were not presented in the 1986 DNRC report. However, on a statewide basis in 1980, evaporation from reservoirs was estimated to account for 53.8% of all water consumption in Montana, while agricultural users consumed 44.6% for irrigation purposes (Mont. Dept. Nat. Res. and Cons. 1986).

In the Missouri Basin in Montana, use of surface water by municipalities and industry is relatively minor--about 1% of total water consumption. During 1980, 0.071 million acre-feet of water was diverted for municipal use, but only 0.025 million acre-feet was consumed. Water withdrawals for industry-owned water supplies were even less, amounting to 0.003 million acre-feet in 1980 (Mont. Dept. Nat. Res. and Cons. 1986). Even when the more highly populated and industrialized middle Missouri River states are included in these figures, non-agricultural uses are still relatively insignificant, amounting to less than 4% of the water consumed in the entire ten-state basin (O'Keefe, et al. 1986).

Agricultural uses of water are primarily for irrigation and to a lesser extent, for stock watering. Industrial uses include mining (placer and ore processing), manufacturing (process and cooling water) and hydropower. Municipal use is primarily for public water supplies.

2. Economic Costs to Other Uses or Parties

a. Municipalities

Future water demands for municipalities are difficult to predict because of problems associated with growth projections for cities and towns and uncertainties about the cost-effectiveness of surface water supplies in the future. Recent outbreaks of giardiasis in Bozeman and other smaller communities in the basin have prompted the need for additional treatment of surface drinking water supplies. Giardia cysts are not destroyed by conventional water treatment methods. Filters, which are large, costly and difficult to operate and maintain, are presently the most commonly prescribed treatment for removing the minute cysts.

Giardiasis is spread by mammalian feces. During the past decade, its incidence has increased dramatically in surface waters of the Northern Rockies. Because of the giardiasis outbreak and other water quality considerations, the 1986 Amendments to the Federal Safe Drinking Water Act require that all surface drinking water supplies be subjected to additional filtration requirements by the early 1990s. Treatment costs for surface drinking water sources will, therefore, inevitably increase, which will decrease the economic attractiveness of these sources for future drinking water supplies.

Presently, five municipalities in the upper Missouri River Basin are planning to supply more water for commercial, residential, and industrial needs by the year 2025 (HKM Associates 1987). Three of the communities (Dillon, Three Forks and Belgrade) plan to obtain the needed water from wells, whereas West Yellowstone and Bozeman will supplement their water supply from surface waters.

West Yellowstone plans to pump 2,550 acre-feet per year from Whiskey Springs at a rate of 1,582 gallons per minute (gpm) by the year 2025. Bozeman predicts that it will need an additional 4,030 acre-feet per year to supplement groundwater sources and water available from Hyalite Reservoir. Bozeman plans to construct a dam on Bozeman Creek to provide the water required by the year 2025.

Granting of instream flow reservations would probably not conflict with the needs of Bozeman for additional water because the proposed reservoir on Bozeman Creek would probably fill primarily during the high flow period in the spring when requested instream flows are normally exceeded. Instream flow reservations could affect West Yellowstone's proposed project because no water storage is anticipated. However, such an affect would depend on the respective priorities of the municipal and instream reservations. Instream reservations would not conflict with those communities obtaining additional water from wells.

b. **Industry**

Within the 10-state Missouri River Basin, the largest industrial use of water is for thermoelectric power generation; in 1978, 0.443 million acre-feet of water was diverted for the cooling water needs of coal-fired plants (O'Keefe et al. 1986). However, there are no existing thermoelectric plants in the portion of the Missouri Basin covered by this reservation request. The Salem Plant, still under consideration for construction by the Montana Power Company on the south side of the Missouri River below Morony Dam, would use process water pumped directly from the Missouri River. The water needs of this or any other future facility would be relatively minor. For example, water withdrawals for the seven coal-fired electric plants in the Yellowstone Basin amounted to 0.094 million acre-feet in 1980, but only about 10% of this water was actually consumed (Montana Department of Natural Resources and Conservation 1986). As well, if any coal-fired plants were to be built near Fort Peck Reservoir, water would be available for lease pursuant to authority granted by the 1987 Montana Legislature (HB 608).

Mining and processing of mined products is an important industry in the Missouri River Basin in Montana. Currently, there are approximately 36 active mining operations in the basin that have been issued permits by the Montana Department of State Lands (DSL) for the mining of talc (5 permits), gold (16 permits), limestone (5 permits), gypsum (2 permits), silica/quartz (6 permits), iron (1 permit) and chlorite (1 permit) (Table 1-10).

Table 1-10. Operating mines permitted by the Department of State Lands in the Missouri River Basin.

Company	County	Stream Drainage	Product	Process
Mt. Heagan Development Inc.	Jefferson	Boulder River	Gold	Cyanide Heap Leach
Searle Bros. Construction, Inc.	Beaverhead	Horse Prairie Cr	Gold	Placer
S and G Mining	Jefferson	Boulder River	Gold	Placer
Browns Gulch Mining	Madison	Alder Gulch	Gold	Placer
RLTCO	Beaverhead	Grasshopper Crk	Gold	Placer
Golden Sunlight Mine	Jefferson	Jefferson River	Gold	Cyanide Leach
Golden Star Mine	Beaverhead	Big Hole River	Gold	Placer
Continental Lime Inc.	Jefferson	Indian Creek	Limestone	Quarry
Hemphill Bros. Inc.	Jefferson	Boulder River	Quartz	Quarry
Stauffer Chemical Co.	Beaverhead	Big Hole River	Quartz	Quarry
Ideal Basic Ind	Gallatin	Missouri River	Limestone	Quarry
Cyprus Industrial	Madison	Madison River	Talc	Mine
Cyprus Industrial	Madison	Madison River	Talc	Mine
Cyprus Industrial	Beaverhead	Beaverhead River	Talc	Mine
Pfizer Inc.	Beaverhead	Beaverhead River	Talc	Mine
Willow Creek Talc	Madison	Ruby River	Talc	Mine
Cyprus Industrial	Jefferson	Jefferson River	Chlorite	Mine
Spotted Horse	Fergus	Spotted Horse Gulch	Gold	Cyanide Leach
Pauper's Dream	Lewis & Clark	Ten Mile Creek	Gold	Cyanide Leach
Pegasus	Phillips	Ephemeral Drainage	Gold	Cyanide Leach
Montana Tunnels	Jefferson	Spring Creek	Gold	Cyanide Leach
Mortenson Const.	Cascade	Missouri River	Gravel	Quarry
Intergem	Meagher	Missouri River	Iron	Open Pit
Walter Savoy	Cascade	Sun River	Rip-rap	Quarry
Chouteau County	Chouteau	Teton River	Rock rip-rap	Quarry
Ash Grove Cement	Jefferson	Prickly Pear Crk	Limestone	Quarry
U.S. Gypsum	Jefferson	Prickly Pear Crk	Gypsum	Quarry
Maronick Const.	Judith Basin	Judith River	Gypsum	Quarry
Maronick Const.	Jefferson	Prickly Pear Crk	Limestone	Quarry

Special Lady	Lewis & Clark	Ten Mile Creek	Gold	Placer
St. Joseph	Lewis & Clark	Ten Mile Creek	Gold	Placer
Gulf-Titanium	Lewis & Clark	Little Prickly Pear Creek	Gold	Cyanide Leach
AMAX	Judith Basin	Judith River	Gold/ Silver	Cyanide Leach
Kendall Venture	Fergus	Judith River	Gold	Cyanide Leach
Pacific Silica	Jefferson	Prickly Pear Crk	Silica	Quarry
Indian Creek	Jefferson	Indian Creek	Limestone	Quarry

Source: Montana Department of State Lands, Helena, Montana. Permit Application Files (November 1988)

The existing gold mines are primarily placer mines which are non-consumptive water users, and mines which extract gold through cyanide leaching of ore. Quartz and limestone are quarried for the production of cement, the processing of which consumes no water except for domestic purposes (i.e., drinking water and wastewater treatment). Talc, gypsum and chlorite mines consume little or no water in mining and processing.

Prospective gold mines have permits pending in the upper Missouri River Basin. The AGAU/Montoro Joint Venture in the Rattlesnake Creek drainage near Argenta proposes to process ore through cyanide heap leaching. The Yellowband Mine, also near Argenta, would process gold and silver ore through a flotation mill.

New gold and silver mines probably would be the largest future industrial consumers of water in the Missouri River Basin in Montana. To estimate the amount of water that might be needed by future mines, water use by existing mines in Montana has been determined (Table 1-11). Water use for 13 mines obtaining water from both surface and groundwater sources was 6,882.6 gpm for processing 208,400 tons of ore. Average water use was 529.4 gpm and average ore production was 16,031 tons per day (an average of 1 gpm is required to process 30 tons of ore per day).

Water use and production for mines obtaining water from surface sources (Table 1-12) was compared with water use and ore production for mines obtaining water from groundwater sources (Table 1-13). Mines obtaining water from surface sources processed a total of 57,850 tons of ore per day and used 2,197,440 gallons of water per day (1 gpm to process 38 tons/day). Mines obtaining water from groundwater sources processed 150,550 tons of ore per day and used 6,825,600 gallons of water per day (1 gpm to process 31.8 tons/day). Approximately 72% of the ore mined was processed utilizing groundwater.

Table 1-11. Water requirements, water sources and production of permitted precious metal mines in Montana.

Mine	County	Ore Production (tons/day)	Water Consumption (gpm)	Water Source
Spotted Horse	Fergus	50	1.6	Discharge from existing adit
Pauper's Dream	Lewis & Clark	1,500	28	Wells
ASARCO-Troy	Lincoln	60,000	1,700	Wells
Pegasus	Phillips	80,000	1,700	Wells
Jardine	Park	1,050	300	Bear Creek and Pine Creek
Beal Mountain Creek	Silver Bow	5,500	200	Beef-straight
Chartam	Broadwater	3,000	300	Wells
CoCa	Flathead	5,000	660	Wells
Black Pine	Granite	1,000	5	South Fork Lower Willow Creek
Montana Tunnels	Jefferson	15,000	918	600 to 900 gpm from Spring Creek, Prickley Pear Creek, and Clancy Creek, 90 gpm from adits
Golden Sunlight	Jefferson	35,000	700	Jefferson Slough
Mt. Heagan	Jefferson	300	20	Slaughterhouse Gulch Creek
Stillwater wells	Stillwater	1,000	350	Mine workings &
Total		208,400	6,882.6	
Average		16,031	529.4	

1 gpm to process 30.3 tons/day

Source: Montana Department of State Lands, Helena, Montana. Permit Application Files (November 1988).

Note: All of these mines are not in the Missouri River Basin.

Table 1-12. Ore production and water requirements for permitted precious metal mines obtaining water from surface sources in Montana.

Mine	County	Ore Production (tons/day)	Water Consumption (gpm)	Water Source
Jardine	Park	1,050	300	Bear Creek and Pine Creek
Beal Mountain	Silver Bow	5,500	200	Beefstraight Creek
Black Pine Willow	Granite	1,000	5	South Fork Lower Creek
Golden Sunlight	Jefferson	35,000	700	Jefferson Slough
Mt. Heagan	Jefferson	300	20	Slaughterhouse Gulch Creek
Montana Tunnels	Jefferson	15,000	300	Spring Creek
Total		57,850	1,525	
Average		9,642	254	

1 gpm to process 38 tons/day

Source: Montana Department of State Lands, Helena, Montana, Permit Application File (November 1988).

The impact that water reservations would have on future mining development in the Missouri River Basin would be related to the number of new mines opened and the water sources used to process ore. Estimating the numbers of mines that would open is speculative given the volatile nature of precious metals prices. Typically, gold and silver mining follow "boom and bust" cycles. Although mining in Montana may currently be expanding, it is not possible to predict whether this trend will continue.

According to McCulloch et al. (1988), gross production in 1988 from metal mines in Montana was up 45% from the previous year. The number of new or renewal exploration permits issued by DSL also increased from 56 in 1982 to 111 in 1987 and 192 in 1988 (McCulloch et al. 1988). Although it is speculative to predict future precious metal mining activities in the Missouri River Basin, a 7-year trend of wages and salaries paid to miners in the Missouri River Basin was tabulated for 1981-87 (Table 1-14). Mining in the Missouri River Basin provided 41.2% of salaries and wages paid throughout the state for metal mining in 1987. Wages and salaries increased in the upper Missouri River Basin from $2,392,000 in 1981 to $11,937,000 in 1987. In the Middle Missouri River Basin, wages and salaries increased from $4,359,000 in 1981 to $7,876,000 in 1987.

Table 1-13. Ore production and water requirements for permitted precious metal mines obtaining water from groundwater sources in Montana.

Mine	County	Ore Production (tons/day)	Water Consumption (gpm)	Water Source
Pauper's Dream	Lewis & Clark	1,500	28	Wells
Spotted Horse	Fergus	50	1.6	Discharge from existing adit
ASARCO-Troy	Lincoln	60,000	1,700	Wells
Pegasus	Phillips	80,000	1,700	Wells
Chartam	Broadwater	3,000	300	Wells
CoCa	Flathead	5,000	660	Wells
Stillwater	Stillwater	1,000	350	Mine workings & wells
Total		150,550	4,739.6	
Average		21,507	677	

1 gpm to process 31.8 tons/day

Source: Montana Department of State Lands, Helena, Montana. Permit Application Files (November 1988).

Table 1-14. Wages and salaries from metal mining in the Upper and Lower Missouri River basins (thousands of dollars).

		Middle Missouri River Basin		Upper Missouri River Basin	
Year	State Total	Wages/Salaries	Percent of State Total	Wages/Salaries	Percent of State Total
1987	$48,078	$7,876	16.4	$11,937[1]	24.8
1986	33,944	4,928	14.5	5,760	17.0
1985	26,812	3,392	12.6	5,091[2]	19.0
1984	32,988	6,737	20.4	4,864[3]	14.7
1983	44,683	4,311	9.6	6,044	13.5
1982	52,448	3,406[4]	6.5	2,307	4.4
1981	57,756	4,359[5]	7.5	2,392	4.1
Average	$42,387	$5,001	11.8	$ 5,485	12.9

Source: Montana Department of Labor and Industry, Montana Employment, Wages, and Contributions, Annual Average 1981-87.

1 Excludes Broadwater County for purposes of confidentiality.
2 Excludes Beaverhead County for purposes of confidentiality.
3 Excludes Gallatin County for purposes of confidentiality.
4 Excludes Meagher County for purposes of confidentiality.
5 Excludes Cascade County for purposes of confidentiality.

Fairly reliable estimates of the remaining precious metals resources in the Missouri River Basin can be derived by examining past mining activities in the basin because future mining is predicted to occur where mining has historically taken place (Webster 1988; Hahn 1988). New mining and ore processing technologies have made it economically feasible to extract metals from ore bodies that were previously not mined. According to Hahn (1988), minimum reserves of gold and silver in Montana are 8,012,000 and 617,165,000 ounces, respectively. Historic production of gold and silver in Montana was 20,396,000 and 950,253,000 ounces, respectively. The ratio of present estimated metal reserves to past production is 1:2.5 for gold and 1:1.5 for silver. If the estimated reserves of gold are correct, there are approximately .40 ounces of gold reserves for every ounce that already has been mined. Similarly, there are approximately .67 ounces of silver reserves for each ounce that has been mined.

To obtain an estimate of gold and silver reserves in the Missouri River Basin, historic gold and silver production was tabulated for mining districts in the basin (Table 1-15).

Approximately 57% of all gold and 16% of all silver mined in the state came from mining districts in the Missouri River Basin. Assuming that the ratio of reserves to mined production is 1:2.5 for gold and 1:1.5 for silver, there would be approximately 4,691,440 ounces of gold reserves and 100,224,342 ounces of silver reserves remaining in historic mining districts in the Missouri River Basin. Approximately 28% of the original reserves of gold and 40% of the original reserves of silver remain to be mined in the Missouri River Basin, provided new technologies allow for cost-effective extraction of these metals.

Table 1-15. Historic extraction of gold and silver in the Missouri River Basin.[1]

		Production (ounces)	
Mining District	County	Gold	Silver
Argenta	Beaverhead	64,400	562,000
Bannack	Beaverhead	387,000	141,000
Bluewing	Beaverhead	500	470,000
Bryant	Beaverhead	17,400	13,924,000
Elkhorn	Beaverhead	2,000	387,000
Polaris	Beaverhead	300	120,000
Vipond	Beaverhead	1,100	1,025,000
Confederate Gulch	Broadwater	650,000	7,570
Park	Broadwater	120,000	394,000
Radersburg	Broadwater	325,000	311,000
Winston	Broadwater	118,000	2,058,000
Neihart	Cascade	67,000	29,070,000
North Moccasin	Fergus	450,000	50,000
Warm Springs	Fergus	335,00	317,000
Alhambra/Basin	Jefferson	15,400	118,000
Boulder	Jefferson	480,000	14,770,000
Clancy	Jefferson	140,000	2,500,000
Elkhorn	Jefferson	100,000	12,600,000
Whitehall	Jefferson	563,000	277,000
Wickes	Jefferson	372,000	47,700,000
Barker	Judith Basin	3,500	2,738,000
Gould/Stemple	Lewis & Clark	345,000	500,000
Heddleston	Lewis & Clark	--	1,409,000
Lincoln	Lewis & Clark	682,000	120,000
Marysville	Lewis & Clark	1,390,000	8,880,000
York	Lewis & Clark	335,000	--
Rimini/Scratchgravel	Lewis & Clark	100,000	100,000
Norris	Madison	265,000	102,000
Pony	Madison	346,000	227,000
Renova	Madison	162,000	113,000
Sheridan	Madison	40,000	105,000
Silver Star	Madison	225,000	152,000

Tidal Wave	Madison	33,400	133,000
Virginia City	Madison	2,617,000	1,456,000
Washington	Madison	16,600	42,000
Castle Mountain	Meagher	--	4,270,000
Little Rockies	Phillips	960,000	2,440,000
Total		11,728,600	149,688,570
State Total		20,396,000	950,253,000
Percent of State Total		57.5%	15.7%

[1] Only mines which have produced more than 10,000 ounces of gold or more than 100,000 ounces of silver are listed.

Source: Hahn 1988. Gold and Silver Districts in Montana.

Basing future metals production in the Missouri River Basin on past statewide production (as just discussed) may underestimate the future metals reserves in the basin. Data for "proven" gold and silver reserves in the basin as of January 1989 (Hahn 1989) are shown in Table 1-16. (Proven reserves are silver and gold deposits that have been measured by actual exploration methods. It is assumed that metals from these ore bodies could be economically extracted at 1988 metals prices.) Assuming that both the statewide metals reserves and the Missouri River Basin proven reserves are correct, proven gold reserves in the basin would be 91% of the total state reserves. Similarly, the proven silver reserves in the basin would be 34% of the total state reserves.

Reservations of instream flows in the Missouri River Basin would have no impact on existing mining or new mines utilizing groundwater, but they could affect future mining and ore processing if the new mines were to rely entirely upon surface water for consumptive purposes. Development of new mines requiring surface water could be less restricted if water storage facilities were utilized or alternative groundwater supplies were available. Also, the purchase of existing water rights and a change in beneficial use is a possible way of satisfying future mining water needs.

Table 1-16. Proven gold and silver reserves in the Missouri River Basin.

District	Gold Reserve	Silver Reserve
Winston	360,000	--
North Moccasin	60,000	--
Warm Springs	24,000	175,000
Elkhorn	500,000	--
Whitehall	2,500,000	2,500,000
Wickes	2,520,000	23,660,000
Lincoln	103,000	120,000
Marysville	50,000	--
Rimini	270,000	--
Jardine	330,000	--
New World	100,000	--
Little Rockies	500,000	7,750,000
Total	7,317,000	34,205,000

Source: Montana Department of State Lands, Helena, Montana, 1989.

c. Agriculture

Revenues from agriculture in the Missouri River Basin are nearly equally provided by livestock and crop production. Average cash receipts from crops for the 7-year period (1980-86) contributed approximately 43% of the total state crop revenues (Tables 1-17 and 1-18). Similarly, livestock production in the Missouri River Basin provided about 43% of total state livestock revenues (Tables 1-17 and 1-18).

Irrigated land in the Missouri River Basin comprises about 50% of all irrigated land in the state (Tables 1-19 and 1-20). Non-irrigated land in the basin makes up about 43% of all dryland agriculture on a statewide basis (Tables 1-19 and 1-20). The Upper Missouri River Basin has about 24% of the irrigated land in the state, whereas the middle basin has approximately 25% of the state's irrigated land. The middle basin differs from the upper basin primarily in the amount of dryland farming. The middle basin has about 40% of the dryland agriculture in the state compared with only 2.4% of the total state dryland farming in the upper basin.

Instream water reservations would not affect existing agricultural use in the basin, nor would they necessarily preclude the use of groundwater or water stored in offstream reservoirs for the development of additional irrigation. Reservations could limit future expansion of irrigated agriculture if new surface water sources are needed. However, even the maximum potential cost of the DFWP reservation to new irrigated crop acreage in the upper Missouri Basin would be relatively small. Deluca (1989) provided a higher estimate for the number of existing irrigated acres in the upper basin (622,250 acres) than is displayed in Table 1-19 (407,896 acres). As of March 24, 1989, the Jefferson Valley, Broadwater and Gallatin Conservation Districts had submitted reservation requests for irrigation of 38,010 additional acres upstream from Canyon Ferry Reservoir, of which 23,925 acres would require surface water sources (Mont. Dept. Nat. Res. and Cons. 1989). If no other reservation applications for agricultural surface water diversions are submitted by other upper basin conservation districts and if these conservation district reservation applications represent the majority of the remaining irrigable lands feasible to develop with surface water, the opportunity for growth in irrigated agriculture in the upper basin would essentially be limited to a 3.6% to 5.9% increase over existing acres. The potential cost that the DFWP reservations could have upon agriculture above Canyon Ferry would, therefore, be to inhibit this relatively small increase in total irrigated acreages.

In the Middle Missouri River Basin, irrigated acreage estimates by Deluca (234,250 acres) were lower than those shown in Table 1-20 (425,319). As of March 24, 1989, information was not available regarding reservation requests by conservation districts in the lower basin. DNRC is currently compiling these figures, while refining estimates of existing and potentially irrigable lands throughout the basin.

Table 1-17. Livestock and crops cash receipts in the Upper Missouri River Basin[1] (thousands of dollars).

Year	Livestock Receipts	State Total	Percent of State Total	Crop Receipts	State Total	Percent of State Total
1986	$119,700	$838,353	14.3	$37,385	$493,015	7.6
1985	124,522	902,859	13.8	42,639	422,444	10.1
1984	114,022	844,683	13.5	34,684	653,780	5.3
1983	98,651	731,537	13.5	44,893	846,939	5.3
1982	88,667	724,805	12.2	60,714	980,328	6.2
1981	86,218	705,528	12.2	53,007	854,196	6.2
1980	98,470	828,880	11.9	41,102	660,450	6.2
Average	$104,321	$796,663	13.1	$44,918	$701,593	6.4

[1] Includes Beaverhead, Broadwater, Gallatin, Jefferson, and Madison counties.

Source: Montana Crop and Livestock Reporting Service.

Table 1-18. Livestock and crops cash receipts in the Middle Missouri River Basin[1] (thousands of dollars).

Year	Livestock Receipts	State Total	Percent of State Total	Crop Receipts	State Total	Percent of State Total
1986	$241,741	$838,353	28.8	$184,082	$493,015	37.3
1985	272,147	902,859	30.1	136,036	422,444	32.2
1984	248,880	844,683	29.5	252,933	653,780	38.7
1983	215,725	731,537	29.5	328,134	846,939	38.7
1982	228,313	724,805	31.5	355,893	980,328	36.3
1981	222,745	705,528	31.6	311,016	854,196	36.4
1980	261,051	828,880	31.5	240,195	660,450	36.4
Average	$241,515	$796,663	30.3	$258,327	$701,593	36.8

[1] Includes Cascade, Chouteau, Fergus, Glacier, Judith Basin, Lewis and Clark, Meagher, Phillips, Pondera, Teton, Toole, Petroleum, Wheatland, Golden Valley, Musselshell, and Garfield counties.

Source: Montana Crop and Livestock Reporting Service.

Table 1-19. Irrigated and non-irrigated land in the Upper Missouri River Basin.[1]

Year	Upper Missouri River Basin Irrigated	State Total	Percent of State Total	Upper Missouri River Basin Non-irrigated	State Total	Percent of State Total
1987	360,770	1,618,500	22.3	201,400	7,623,000	2.6
1986	344,470	1,601,000	21.5	175,000	7,814,200	2.2
1985	428,830	1,635,200	26.2	171,500	5,977,500	2.8
1984	481,300	1,805,600	26.7	164,400	7,377,400	2.2
1983	395,700	1,538,900	25.7	220,700	7,151,400	3.1
1982	417,850	1,729,900	24.1	155,400	7,926,200	2.0
1981	426,350	1,733,300	24.6	144,000	7,932,600	1.8
Average	407,896	1,666,057	24.5	176,057	7,400,329	2.4

[1] Includes Beaverhead, Broadwater, Gallatin, Jefferson, and Madison counties.

Source: Montana Crop and Livestock Reporting Service.

Table 1-20. Irrigated and non-irrigated land in the Middle Missouri River Basin.[1]

Year	Middle Missouri River Basin Irrigated	State Total	Percent of State Total	Middle Missouri River Basin Non-irrigated	State Total	Percent of State Total
1987	410,150	1,618,500	25.3	3,121,000	7,623,000	40.9
1986	429,280	1,601,000	26.8	3,207,900	7,814,200	41.1
1985	382,500	1,635,200	23.4	2,367,800	5,977,500	39.6
1984	462,700	1,805,600	25.6	3,141,500	7,377,400	42.6
1983	405,400	1,538,900	26.3	2,959,100	7,151,400	41.4
1982	460,400	1,729,900	26.6	3,105,100	7,926,200	39.2
1981	426,800	1,733,300	24.6	3,097,100	7,982,600	38.8
Average	425,319	1,666,057	25.5	2,999,929	7,407,471	40.5

[1] Includes Cascade, Chouteau, Fergus, Glacier, Judith Basin, Lewis and Clark, Meagher, Phillips, Pondera, Teton, Toole, Petroleum, Wheatland, Golden Valley, Musselshell, and Garfield counties.

Source: Montana Crop and Livestock Reporting Service.

III. Effects of Not Granting the Reservations

A. Loss of Irretrievable Resources and Economic Opportunity

Not granting the DFWP reservations would cause irreplaceable losses to the widespread benefits associated with the protection of adequate instream flows in the Missouri River Basin. Incremental streamflow depletions would continue to reduce critical components of the natural environment, including fish, wildlife, riparian areas and water quality. This, in turn, would reduce the recreational activities supported by these resources, including fishing, floating, hunting and sight-seeing. The human environment would be similarly impacted through loss of scenic values and diminution of the basin's cultural, historical and social environment.

Long-term economic costs would be significant if instream flow depletions were to continue in the Missouri River Basin. The brunt of these losses would be borne by streamflow-dependent recreational businesses and the cities and towns that receive the benefits of these enterprises. However, since the recreational and scenic attributes that attract people to the basin would also diminish, these municipalities would also sustain other economic opportunity losses (i.e, being less attractive to distance-independent companies, tourists and new potential residents with independent incomes). Services sector jobs would also be impacted. Not granting the DFWP flow reservations would preclude a unique opportunity to support and protect, collectively, the public interest, the environment and business interests. Denial of the reservations would be particularly incongruous at a time when the newly established "bed-tax" is beginning to fund multi-million dollar, nationwide advertising campaigns for recreational and services sector businesses, and local economic development organizations like the Gallatin Development Corporation are beginning to attract new kinds of businesses to the Missouri Basin.

Without instream protection, other significant benefits to municipalities, agriculture and industry would also be diminished. New consumptive uses of water would continue to reduce downstream water availability and hydropower production. The recharge of streamside aquifers, the assimilative capacity of streams and the viability of riparian ecosystems and sub-irrigated croplands would be diminished. Industrial and municipal waste treatment costs could increase. The potential for contamination of public drinking water supplies by hazardous chemicals would become more likely, as would additional impacts to streams receiving mine discharges. Water disputes between consumptive users could worsen as water availability at headgates declines. The effects of not granting the reservation would, therefore, be cumulative, and in many cases irretrievable, to a broad spectrum of resources and water users in the Missouri River Basin.

B. Alternative Actions That Could Be Taken If the Reservations Are Not Granted

1. No Action

A no-action alternative regarding water reservations in the Missouri River Basin would result in the same costs to recreation, fish and wildlife, economics, aesthetic qualities and other public amenities that were just described in the Effects of Not Granting the Reservation. Other alternative actions that could reasonably be taken to protect these amenities and economic assets are described below. With the possible exception of Alternative 2, (intensification of water conservation and management practices) these alternatives either are more costly, would be less immediate, lack legislative mandates and/or would be more limited in applicability, than would granting the DFWP reservations as requested in this application.

2. Intensification of Water Conservation and Management Practices

Examples of water conservation practices include better maintenance and lining of ditches, converting irrigation projects from flood to sprinkler systems, limiting the use of sprinklers during windy periods and, diverting only the amount of water actually needed for adequate crop production. The latter involves installation and/or better management of water diversion and delivery systems, including improved operation and use of headgates and flumes to accurately measure water delivered to users; better information and education about water needs for specific crops throughout the basin's widely varying soil, climatic and topographic conditions; better irrigation scheduling; and increased utilization of water commissioners.

Proper water conservation and management practices not only enhance water efficiency, they also reduce soil erosion by preventing overland (sheet) runoff from croplands and minimizing volumes of silt-laden irrigation return flows. As such, application of the above measures should be encouraged regardless of any other legal directions elected during this reservation process.

Although worthwhile and necessary, good water conservation and management practices do not represent a viable alternative to reserving instream flows. In many instances, any water conserved, and thus left instream, may simply be diverted by other offstream users. Even if the state were to offer to pay for the infrastructure necessary to improve efficiency in agricultural water use which, in turn, would reduce offstream diversion rates and theoretically increase instream flow levels, the water right holder may not be able, under present law, to transfer the conserved portion of his former use to another beneficial use. Whether the saved water may be transferred by the conservor, or whether the next junior water user needing the water is entitled to the water, is an unanswered issue in Montana water law. Further, it is uncertain, as discussed in the next section, whether a present water right may be transferred to an instream use and protected for that use.

3. Buying or Leasing of Water Rights

The ability of DFWP or another state agency to hold instream water rights, other than a water reservation, for maintaining minimum flow, level, or quality of water is uncertain. One possibility is the transfer of existing rights to instream uses. The existing rights would be obtained through purchase, lease or donation and transferred to instream uses through the administrative change process. A recent Montana Supreme Court decision denied a claim by DFWP for a pre-1973 existing right for instream or inlake purposes. The Court held that a pre-1973 instream or inlake right did not exist because a diversion is a required element. The Court also indicated that notice and intent may be requirements. Whether or not a diversion is still a requirement after the enactment of the 1973 Water Use Act for fish, wildlife and recreational purposes must be considered an open question. Litigation would undoubtedly be necessary to resolve the question.

The legislature can, and has, acted on transfers to instream purposes in passing House Bill 707 (Chapter 658, Laws of 1989). This act creates a water leasing study, potentially with pilot leases. Transfers of existing rights to instream use may evolve as a useful tool. However, it is important to recognize both the potential benefits and limitations of this concept.

An example of potential benefits is a stream where present water users would be willing to lease their offstream rights as part of a water conservation program. Specifically, water users would receive annual lease payments and farm their lands as usual except during low water years. Then, in accordance with lease agreements, normally diverted water would be left instream. The annual lease payments would provide compensation to landowners for any irrigated crop damage suffered during the low flow years. Crop losses could also be reduced if the landowners planted non-irrigated crops on the leased land following years when snowpack is low enough to curtail normal irrigation practices.

Even if, or when, transfers of perfected water rights to instream uses are allowed, the buying or leasing of water would still not be a viable, basin-wide approach for enhancing instream flows. The administration and logistics of such an extensive program would be exceedingly complex, and the cost would be high. This alternative might, however, be best applied in drainages that are severely dewatered and where present offstream users are willing to sell or lease their rights. In contrast, the reservation process provides an opportunity to protect instream values when <u>future</u> consumptive uses are considered. The reservation system cannot deal with present water shortages but can protect against exacerbating these shortages.

4. Constructing Offstream Water Storage Facilities

The construction of offstream reservoirs that would store runoff waters and release them during the summer is an often overrated alternative for enhancing instream flows. Construction, operation and maintenance costs are usually prohibitive, unless cooperatively undertaken with offstream users. Even then, there is considerable uncertainty about agreed-upon releases ever reaching critical downstream reaches.

The same problems associated with protecting transferred water rights also apply to water that is purchased from storage facilities. The water release arrangement for Painted Rocks Reservoir exemplifies these problems.

Located in the headwaters of the Bitterroot River, this state-owned facility was originally constructed for irrigation use. Since part of this offstream use has never materialized, DFWP has routinely purchased water to be delivered to Bell Crossing near Stevensville, relieving chronically dewatered reaches of the river. However, until a water commissioner was appointed by the court in the mid-1980s, most of this purchased water was diverted for offstream use before reaching Bell Crossing.

In addition to cost, the hydrogeology of the drainage considered for a reservoir site which could provide instream flow benefits in a given stream must be considered before the project can be built. Constructed facilities must be able to provide the instream benefits attributed to the project. Therefore, the availability of suitable storage sites is a major factor in any analysis of the instream flow benefits of storage. The case of the proposed irrigation/recreation reservoir on the Little Boulder River illustrates this point. During the environmental analysis of this proposal, it was found that the thick, unconsolidated gravels of the Boulder Valley cause the river to be a "losing stream" (i.e., in most reaches it looses more surface water than it normally receives as recharge during summer low-flow conditions). Much of the water released from this proposed reservoir would have, therefore, recharged the valley's groundwater instead of augmenting instream flows (Reichmuth 1984). Similar hydrogeologic conditions may occur in other drainages of the Missouri River Basin.

Reservoirs often create other environmental costs, including:

1. Detrimental effects to cold water fisheries resulting from increased temperatures of stored waters;

2. detrimental effects to stability and diversity of stream channels and riparian areas because of reduced frequencies of flushing flows;

3. increased depletion of surface water because of increased evaporation rates; and

4. concentrations of dissolved solids (salinity) and other contaminants like nutrients and pesticides within reservoirs due to surface evaporation.

Use of storage may be a feasible means to obtain instream flows in certain cases, but due to considerations of cost, site suitability and environmental effects, it cannot be considered a substitute for acquisition of instream flows through the reservation process.

5. Revising the Process for Conditioning Water Right Permits

For water use applications or transfer of water rights exceeding 4,000 acre-feet per year and 5.5 cfs, MCA 85-2-311 (2)(c) requires that certain "public interest" and "reasonable use" criteria be met before approval to divert the water is granted. Criteria to be evaluated include demands on future water supply; needs to preserve instream flows; benefits to the applicant and the state; effects on water quality, including the potential for creating saline seep; the feasibility of using other (low-quality) water; and consideration of other adverse environmental impacts.

Although the above "conditioning" of water use permits would certainly be helpful for protecting instream flows from large offstream diversions, it does not represent a widely applicable alternative to the water reservation process. Applications for water use that are large enough to trigger utilization of the above criteria are very uncommon. In fact, 80% of all water use permits issued by DNRC since July 1973 have been for quantities less than 1.0 cfs and only 8% could have possibly triggered the public interest criteria (McKinney 1988).

To be an effective component of an instream protection strategy, the conditioning of water use permits must, therefore, be revised to include the review of much smaller requests. Instead of an arbitrary volume figure, conditions triggering the use of public interest/reasonable use criteria should instead be guided by the effects of an application upon a given stream's available flow and upon the cumulative basin-wide impacts of all future water appropriations. Unfortunately, there are few streams in the basin that have enough stream gauging data to document existing available flows. Nor have enough streams in the basin been adjudicated, which makes documentation of existing use extremely difficult.

Finally, even if conditioning of permits were to be revised to incorporate some smaller "triggering criteria," this alternative should only be considered as a supplement to the protection of instream flows through water reservations. Unless conditioning criteria were to be applied to <u>every</u> water use application in the Missouri River Basin (an unlikely situation in the foreseeable future), many "small" water use permits (i.e., those still not surpassing the revised criteria), could continue to be granted without adequate consideration of immediate and cumulative effects upon fish and wildlife uses. Further, the state's policy decision of how much instream water to reserve for the future is a function of the reservation process that is not addressed systematically, if at all, in the water permitting process.

6. Closing Basins

Montana water law at MCA 85-2-319 states that DNRC "may by rule reject permit applications or modify or condition permits issued in a highly appropriated basin or sub-basin," but "only upon a petition signed by at least 25% or 10, whichever is less" of present water users in the basin or sub-basin. The petition must allege that throughout or during certain times of the year there are no unappropriated waters in the basin; the rights of present users will be adversely affected; or further uses will interfere unreasonably with other already permitted uses, or uses for which water has been reserved. Upon receiving a petition, DNRC must either deny it, or if needed, conduct a water availability study and initiate rule-making proceedings.

A petition to close the Musselshell River Basin has been submitted to DNRC by the Deadman's Basin Water Users Association. A water availability study is being conducted, and a predictive model is being developed to better examine the concerns raised in the petition and to determine if rule-making proceedings will be necessary.

On March 30, 1983, DNRC closed the Milk River mainstem to any further applications "for direct diversion without storage of waters . . . for irrigation or any other consumptive use." The department acted to close the river (except for some reaches during runoff periods), pursuant to MCA 85-2-321, a legislatively-mandated water availability study and rule making procedure directed specifically at the Milk River Basin (Mont. Dept. Nat. Res. and Cons. 1983).

Both the Musselshell and Milk River proceedings occurred because of concerns raised by existing offstream water users in already "highly appropriated" basins. These is no opportunity in Montana water law for the general public or state agencies to initiate action to close basins because of instream flow concerns (thereby preventing the over-appropriated conditions occurring in the above basins). By the time closures are initiated and administratively implemented, there may be no water available for instream flow needs. As such, this procedure is not a viable alternative to the timely implementation of instream flow reservations.

7. Application of the Public Trust Doctrine

The Montana Supreme Court applied the public trust doctrine in two 1984 decisions involving the public's right to use water courses for recreational pursuits such as fishing and floating. The court held that "under the public trust doctrine and the 1972 Montana Constitution, any surface waters that are capable of recreational use may be so used by the public without regard to streambed ownership or navigability for nonrecreational purposes" [Montana Coalition for Stream Access v. Curran, 210 Mt. 38, 53, 682 p.2d, 163 (1984)]. To implement these court decisions, the 1985 Montana Legislature passed the Stream Access Law. The Montana Supreme Court has found the public trust doctrine embodied in the provision in Article IX, Section 3(3) of the

1972 Montana Constitution specifying that all waters of the state "are the property of the state for the use of its people" [Galt v. State of Montana, 731 p. 2d 912, 44 St. Rep. 103, 106 (1987)]. In 1987, the Court overruled in the Galt case an appeal by landowners that the Stream Access Law was an unconstitutional taking of private property without just compensation. The Court has not addressed whether the public trust doctrine applies to established water rights and would thus require recognition of instream values in the exercise of those rights.

The limits to, and effectiveness of, the public trust doctrine for protecting instream flows in Montana remains largely untested. As an absolute protection strategy, it should probably be considered only as an alternative of last resort. Hopefully, the spirit and intent of the doctrine will guide and direct the final decision for an adequate amount of instream flow protection for fish, wildlife and recreation in the Missouri River Basin through the reservation process.

MANAGEMENT PLAN

ARM 36.16.106(2) states "A management plan shall accompany all reservation applications for instream use(s), as defined in ARM 36.16.102(14), and shall include an explanation of how reserved instream flows will be protected from future depletions by later priority water users."

The following addresses that requirement.

Monitoring Instream Water Reservations

Implementation of a reservation monitoring/protection program will be an evolutionary process. A water reservation usually obtains a priority date on the day it is granted by the Board and by law cannot affect any existing water users. In the Missouri Basin, the priority date of all reservations has already been established by the legislature as July 1, 1985. Only subsequent (junior) water use permit holders will be affected. The timing and degree to which we monitor individual streams will depend on the extent of that junior water use. As time passes, streams accumulating the most junior users will be monitored more intensively than those with fewer junior users. As the number of junior users increases and the total effects of those new diversions become more apparent, our monitoring program will be expanded.

Protection of instream flows will be accomplished by what has become known as the "Reach Concept." For most waters, tributaries in particular, most instream flow recommendations were derived at a site near the stream's mouth, with the designated reach extending from the mouth to the headwaters. As defined by DFWP, a designated reach merely serves to identify those junior water users who will be subject to the instream reservation, which was derived and will be monitored at a site on the lower stream. A reach, as defined by DFWP, does not represent a stream segment having the same flow regime and instream flow requirement throughout its length. It is, simply, a means to identify those junior users who would be contacted if DFWP makes a "call" for its water.

From a practical standpoint, the protection of water reservations is key to any instream flow program, and monitoring of those flows is the key to protection. It makes little difference whether a granted flow is for a short reach or a long reach of stream. A monitoring site must be established which can be used to trigger the protective procedures. Since only junior water users are affected, shutting off only those users above a monitoring site will affect actual streamflow within a reach in proportion to the location and the amount of their appropriations. Therefore, it makes no difference whether there is more than one reach or what length the reach is, the junior users are the only ones affected.

DFWP currently monitors and enforces its Yellowstone reservations and Murphy Rights through the use of established USGS gauging stations on the main river and some major tributaries. This procedure appears to be effective in the enforcement program because it allows us to monitor junior users on all ungauged tributaries above the gauge sites. Therefore, all junior users above the gauge sites are affected whether they are on the mainstem or the tributaries. Prior existing rights are not affected and only the status quo of streamflow conditions at the time the reservations are granted is maintained. Because our requests would allow some new future depletions, the status quo is the "best" condition that could be maintained. If new depletions do occur, future streamflows could be less than existing flows during some time periods.

Once the reservations in the Missouri basin are granted, mainstem river segments will initially be monitored using established USGS gauges. We will also look at the feasibility of moving a gauge to another location or reactivating a discontinued gauge. Tributaries having existing gauges will be similarly handled. For tributary streams without gauges, we would monitor flows at the nearest mainstem or tributary gauge which is below the confluence of that ungauged tributary. Junior users in all tributary streams above the respective gauge would be notified if the granted flows are not being met at that gauge.

The reservations will not make more water available; they will, at best, only preserve an existing flow condition. As previously mentioned, this existing condition begins on the date the reservations' priority date is established by the Board. We protect flows from those junior users who are issued permits after that date. Senior water users are not affected and the reservations, of course, cannot control natural flow levels which may occur below the granted reservation amounts. By shutting off junior users only, we protect the streamflows at whatever level they may occur below the reservations, even without gauging each stream.

There is, however, one obvious problem with this approach. If all upstream junior users are keying to a flow level on the lower stream, the potential exists for a single, large, new <u>consumptive</u> user in the headwaters to severely dewater an upper stream segment without materially impacting flow near the stream's mouth, where the instream flow is monitored and protected. However, the chance of this occurring is remote because new large consumptive uses, especially those associated with agriculture, are more likely to occur on the lower than on the upper stream. These new large diversions would also be subject to the reservation as junior users. The solution to this problem relates to our original statement regarding instream flow protection--it is an evolutionary process. Consequently, we could install a new gauge and begin to monitor flows on that tributary when there are a sufficient number (or flow quantity) of junior permits to have a significant effect on the flow. Otherwise, if there is little possibility of the junior users affecting a given tributary's flow, we would monitor those persons at a downstream site.

A non-consumptive use in which water is diverted and then returned to the source up to several miles downstream--a characteristic of small hydro-electric development--possesses a far greater threat to the upstream fishery under this approach. Because the diverted water is returned, flow of the lower stream would not be impacted, yet lengthy upstream segments could suffer severe or total dewatering. However, in the case of these small hydro developments, a practical solution to these potential dewatering problems is to rely on FERC hydro license conditions, rather than on the water reservation process, to recommend and protect an instream flow for a specific project.

Placing a "Call" on the Water

DFWP is in the best position to determine the extent of a monitoring/enforcement program for granted instream reservations and we will proceed in a manner similar to what has evolved in the Yellowstone Basin and with our Murphy Rights.

The first step is to monitor applications for new water use permits which will be junior to the reservations if the permit is granted. DFWP notifies each applicant, either through a letter or the objection process, that an instream flow reservation exists in the source of supply and that, at some future time, he/she may be asked to cease water use because of low water conditions. All junior water use permits are conditioned to existing rights at the time the permit is issued, and in most cases where DFWP objects, the permit is specifically conditioned to the senior instream flow reservations. In some cases where granting the requested permit would routinely interfere with our reservations, we object and request the permit be denied.

If a drought or low flow year is eminent, DFWP obtains from DNRC a current listing of all water users who are junior to the reservations. (Some of those users are already known to us and from this list we update our existing lists.) An initial letter is sent to them in June advising them of flow conditions and informing them that they might be subject to a "call" for their junior water. If flow conditions deteriorate and fall below the reservations, DFWP sends a second letter to junior users that they must cease their diversions until flows again rise above the reservations. A stream gauge is assigned for them to monitor flow levels, and they are given phone numbers of DFWP and the closest DNRC Water Rights Field Office so they can call for up-to-date flow information.

Shutting off junior users will not always increase flow levels in a drought year and flows may remain below the reservations for the entire irrigation season. DFWP realizes its reservations cannot always be met under drought conditions (as we experienced in 1988).

To date, DFWP has relied on voluntary compliance by junior users when calling for its water. Eventually a more efficient system must be developed, such as use of water commissioners to distribute water according to priority dates. This is a future need and will be somewhat influenced by the results of the ongoing adjudication process. However, it is very important to the long-term success of the protection of instream flow reservations. Also, DNRC has authority to enforce compliance by junior permit holders. We would follow the established DNRC procedures to obtain compliance by those junior users (as we also did in 1988).

Finally, once reservations are granted, the responsibility of DFWP to protect those reservations begins. How, when, and where this is done depends on several factors:

1. Need. How many junior water users are there to protect against?

2. DFWP Funds Available. Funding levels may vary. Our ability to contract with USGS for gauging stations will depend upon the annual availability of these funds.

3. USGS Funds Available. Federal funding levels (USGS matching money) are often uncertain due to budget reduction efforts by the federal government. Our ability to contract with USGS will also depend on its level of funding.

A broader base of funding at the state level would enable a stronger gauging network to be established in the long term and would provide benefits to all Montana water users.

Stream Gauging Costs

There are a number of ways to obtain stream gauging data, ranging from observations of a simple staff gauge to the more sophisticated satellite stations which make "real time" flow data available.

One of the requirements of any monitoring/protection program is the availability of flow data when it is needed, usually on a daily basis so junior users can be informed of their water use possibilities. "Real time" stations have been established by the USGS and National Weather Service at several locations in Montana. DFWP has access to this information through the Helena USGS office. DFWP has also utilized staff gauges read by observers who report the flow levels by telephone upon request. Whatever system is used, access to the data when needed is very important. (Many existing gauge stations cannot be readily accessed.)

Thus, a consideration in any monitoring program is the expense of obtaining the needed data. In the long term, new gauging stations may have to be established or existing stations moved to a more desirable location. Decisions must be made as to the type of stations needed and their associated costs. Existing stations must continue to be operated.

The approximate costs of installation and operation of various types of stream gauging equipment are shown in Appendix B. The costs are approximate and may need revision at the time a gauging program is considered.

PERSONS INVOLVED IN DEVELOPING INFORMATION
USED IN PREPARING THIS APPLICATION

Department of Fish, Wildlife and Parks

Permanent Fisheries Personnel

Name	Present Location
Jeff Bagdanov	Bozeman
Rob Brooks	Bozeman
Jim Darling	Billings
Janet Decker-Hess	Kalispell
Ken Frazer	Billings
Wade Fredenberg	Bozeman
Bill Gardner	Fort Benton
Kent Gilge	Chinook
Paul Hamlin	Great Falls
Bill Hill	Choteau
Steve Leathe	Great Falls
Mark Lere	Helena
Bob McFarland	Bozeman
Steve McMullin	Helena
Fred Nelson	Bozeman
Edward Nevala	Great Falls
Dick Oswald	Dillon
Mike Poore	Columbus
Bruce Rehwinkel	Townsend
Mark Schafer	Helena
Brad Shepard	Twin Bridges
Liter Spence	Helena
Mike Vaughn	Billings
Dick Vincent	Bozeman
Jerry Wells	Missoula
Dan Welsh	Fort Peck
Bill Wiedenheft	Fort Peck
Alfred Wipperman	Helena
Raymond Zubick	Kalispell

Part-time Fisheries Personnel

Mark Albers	No longer employed
G. Wayne Black	Bozeman
Les Everts	No longer employed
Fran Fitzgerald	No longer employed
Tom Greason	Bozeman
Julie Harrington	No longer employed
Craig Hess	No longer employed
Robert Ingram	No longer employed
George Liknes	Great Falls

Jerry Mayala	Helena
Tim Mosolf	No longer employed
Mark Schollenberger	No longer employed
Jose Serrano-Piche	Great Falls
Ken Sinay	Choteau
Dolores Wallace-Mosolf	No longer employed
Charles Weichler	No longer employed

Full-time Wildlife Personnel

Tom Carlson	Townsend
Howard Chrest	Retired
Mike Frisina	Butte
John Kada	Bozeman
Fred King	Bozeman
Gary Olson	Conrad
Joel Peterson	Bozeman
Graham Taylor	Great Falls
Harry Whitney	Bozeman

U.S. Forest Service

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Len Walch	Helena National Forest

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Lewis Meyers	Dillon
James Roscoe	Dillon

U.S. Geological Survey

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Charles Parrett	Helena

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APPENDIX A

Water Availability Data for Streams in the Missouri River Basin

Compiled by the U.S. Geological Survey, Helena, Montana

Table 1.--*Sites and methods used for estimation*

[--, -, not applicable]

				Estimation method				
Site No.	Stream name	Streamflow-gaging station No.	Gage	Basin characteristics	Channel width	Concurrent measurement	Weighted-average estimate	Drainage-area ratio adjustment
1	Hellroaring Creek near Lakeview	--	-	X	X	X	X	-
2	Corral Creek near Lakeview	--	-	X	X	X	X	-
3	Antelope Creek near Lakeview	--	-	X	X	X	X	-
4	Red Rock Creek near Lakeview	--	-	X	X	X	X	-
5	Tom Creek near Lakeview	--	-	X	X	X	X	-
6	Narrows Creek at mouth, near Lakeview	--	-	X	-	-	-	-
7	Odell Creek near Lakeview	--	-	X	X	X	X	-
8	Jones Creek near Lakeview	--	-	X	X	-	X	-
9	Red Rock River near Kennedy Ranch, near Lakeview	06011000	X	-	-	-	-	-
10	Peet Creek at county road, near Lakeview	--	-	X	X	-	X	-
11	Long Creek near Lakeview	--	-	X	X	X	X	-
12	East Fork Clover Creek at mouth, near Monida	--	-	X	-	-	-	-
13	Red Rock River below Lima Reservoir, near Monida	06012500	X	-	-	-	-	-
14	Cabin Creek above Simpson Creek, near Lima	--	-	X	X	-	X	-
15	Indian Creek above Simpson Creek, near Lima	--	-	X	X	-	X	-
16	Simpson Creek above Indian Creek, near Lima	--	-	X	X	-	X	-
17	Deadman Creek near Dell	--	-	X	X	X	X	-
18	Big Sheep Creek below Muddy Creek, near Dell	06013500	X	-	-	-	-	-
19	Red Rock River at Red Rock	06014500	X	-	-	-	-	-
20	Black Canyon Creek near Grant	--	-	X	X	X	X	-
21	Shennon Creek near mouth, near Grant	--	-	X	X	-	X	-
22	Frying Pan Creek near Grant	--	-	X	X	X	X	-
23	Trapper Creek at mouth, near Grant	--	-	X	X	-	X	-
24	Bear Creek near Grant	--	-	X	X	X	X	-
25	Bloody Dick Creek near Grant	--	-	X	X	X	X	-
26	Horse Prairie Creek near Grant	06015000	X	-	-	-	-	-
27	Rape Creek above reservoir, near Grant	--	-	X	X	-	X	-
28	Painter Creek near Grant	--	-	X	-	-	-	-
29	Browns Canyon Creek near Grant	--	-	X	-	-	-	-
30	Medicine Lodge Creek near Grant	--	-	X	X	X	X	-
32	Pole Creek near mouth, near Polaris	--	-	X	-	-	-	-
33	Reservoir Creek at mouth, near Polaris	--	-	X	-	-	-	-
34	East Fork Dyce Creek at mouth, near Polaris	--	-	X	X	-	X	-
35	West Fork Dyce Creek at mouth, near Polaris	--	-	X	X	-	X	-
36	Grasshopper Creek near Dillon	06015500	X	-	-	-	-	-
37	Beaverhead River at Barretts	06016000	X[1]	-	-	-	-	-
38	East Fork Blacktail Creek near Dillon	--	-	X	X	X	X	-
39	West Fork Blacktail Creek near Dillon	--	-	X	X	X	X	-
40	Blacktail Deer Creek near Dillon	06017500	X	-	-	-	-	-
41	Beaverhead River near Dillon	06018000	X	-	-	-	-	-
42	Beaverhead River near Twin Bridges	06018500	X	-	-	-	-	-
43	Corral Creek at mouth, near Alder	--	-	X	-	-	-	-
44	Coal Creek at mouth, near Alder	--	-	X	-	-	-	-
45	Ruby River above the forks, near Alder	--	-	X	-	-	-	-
46	East Fork Ruby River at mouth, near Alder	--	-	X	-	-	-	-
47	West Fork Ruby River at mouth, near Alder	--	-	X	-	-	-	-
48	Cottonwood Creek at mouth, near Alder	--	-	X	-	-	-	-
49	Warm Springs Creek at mouth, near Alder	--	-	X	-	-	-	-
50	North Fork Greenhorn Creek at mouth, near Alder	--	-	X	X	-	X	-
51	Ruby River above reservoir, near Alder	06019500	X	-	-	-	-	-
52	Mill Creek at Forest Service boundary, near Sheridan	--	-	X	X	X	X	-
53	Wisconsin Creek at Forest Service boundary, near Sheridan	--	-	X	X	X	X	-
54	Ruby River near Twin Bridges	06023000	X	-	-	-	-	-
55	Big Hole River near Jackson	06023500	X	-	-	-	-	-
56	Andrus Creek near mouth, near Jackson	--	-	X	-	-	-	-

Table 1.--*Sites and methods used for estimation*--Continued

Site No.	Stream name	Stream-flow-gaging station No.	Gage	Estimation method: Basin char-ac-teris-tics	Chan-nel width	Con-cur-rent meas-ure-ment	Weight-ed-average estimate	Drain-age-area-ratio adjust-ment
57	Fox Creek at mouth, near Jackson	--	-	X	-	-	-	-
58	Governor Creek near Jackson	--	-	X	X	X[2]	X	-
59	Warm Springs Creek at Jackson	--	-	X	X	X[2]	X	-
60	Miner Creek near Jackson	06024000	X		-	-	-	-
61	Big Lake Creek near mouth, near Wisdom	--	-	X	-	-	-	-
62	Steel Creek above Francis Creek, near Wisdom	--	-	X	X	X	X	-
63	Francis Creek at mouth, near Wisdom	--	-	X	-	X	X	-
64	Steel Creek near mouth, near Wisdom	--	-	X	X	X	X	-
65	Swamp Creek near mouth, near Wisdom	--	-	X	X	X[2]	X	-
66	Joseph Creek at mouth, near Wisdom	--	-	X	-	-	-	-
67	Trail Creek near Wisdom	06024500	X	-	-	-	-	-
68	Ruby Creek at mouth, near Wisdom	--	-	X	X	X	X	-
69	Tie Creek at Forest Service boundary, near Widsom	--	-	X	-	-	-	-
70	Johnson Creek near Wisdom	--	-	X	X	X[2]	X	-
71	Mussigbrod Creek near Wisdom	--	-	X	X	X[2]	X	-
72	North Fork Big Hole River near mouth, near Wisdom	--	-	X	X	X[2]	X	-
73	Big Hole River below North Fork, near Wisdom	--	-	-	-	-	-	X
74	Pintlar Creek near Forest Service boundary, near Wisdom	--	-	X	X	X	X	-
75	Big Hole River below Mudd Creek, near Wisdom	--	-	-	-	X[2]	-	-
76	Fishtrap Creek at mouth, near Wise River	--	-	X	X	X	X	-
77	Lamarche Creek near Wise River	--	-	X	X	X	X	-
78	Seymour Creek near Wise River	--	-	X	-	-	-	-
79	Tenmile Creek at mouth, near Wise River	--	-	X	-	-	-	-
80	Sevenmile Creek at mouth, near Wise River	--	-	X	-	-	-	-
81	Corral Creek at mouth, near Wise River	--	-	X	-	-	-	-
82	Twelvemile Creek at mouth, near Wise River	--	-	X	-	-	-	-
83	Sullivan Creek at mouth, near Wise River	--	-	X	-	-	-	-
84	Oregon Creek near mouth, near Wise River	--	-	X	-	-	-	-
85	California Creek above American Creek, near Wise River	--	-	X	-	-	-	-
86	American Creek at mouth, near Wise River	--	-	X	-	-	-	-
87	Sixmile Creek at mouth, near Wise River	--	-	X	-	-	-	-
88	French Creek near mouth, near Wise River	--	-	X	-	-	-	-
89	Deep Creek near Wise River	--	-	X	X	X	X	-
90	Bear Creek near Wise River	--	-	X	X	X	X	-
91	Bryant Creek at mouth, near Wise River	--	-	X	-	-	-	-
92	Big Hole River near Wise River	06024580	X	-	-	-	-	-
93	Johnson Creek at mouth, near Wise River	--	-	X	-	-	-	-
94	Meadow Creek near Wise River	--	-	X	-	-	-	-
95	Jacobson Creek at mouth, near Wise River	--	-	X	-	-	-	-
96	Mono Creek at mouth, near Wise River	--	-	X	-	-	-	-
97	Wyman Creek at mouth, near Wise River	--	-	X	-	-	-	-
98	Lacy Creek at mouth, near Wise River	--	-	X	-	-	-	-
99	Gold Creek at mouth, near Wise River	--	-	X	-	-	-	-
100	Pattengail Creek at mouth, near Wise River	--	-	X	-	-	-	-
101	Sheep Creek at mouth, near Wise River	--	-	X	-	-	-	-
102	Wise River near Wise River	06024590	X	-	-	-	-	-
103	Adson Creek at mouth, near Wise River	--	-	X	-	-	-	-
104	Jerry Creek near Wise River	--	-	X	X	X	X	-
105	Divide Creek at Divide	--	-	X	X	X	X	-
106	Canyon Creek near Divide	--	-	X	X	X	X	-
107	Moose Creek near Divide	--	-	X	X	X	X	-
108	Trapper Creek near Melrose	--	-	X	X	X	X	-
109	Camp Creek at Melrose	--	-	X	X	X	X	-
110	Big Hole River near Melrose	06025500	X	-	-	-	-	-
111	Willow Creek near Glen	06025800	X	-	-	-	-	-

Site No.	Stream name	Stream-flow-gaging station No.	Gage	Estimation method: Basin characteristics	Channel width	Concurrent measurement	Weighted-average estimate	Drainage-area-ratio adjustment
112	Birch Creek near Glen	06026000	X	-	-	-	-	-
113	Hells Canyon Creek near Twin Bridges	--	-	X	X	X	X	-
114	Jefferson River near Twin Bridges	06026500	X	-	-	-	-	-
115	Whitetail Creek near Whitehall	06029000	X	-	-	-	-	-
117	Boulder River above High Ore Creek, near Basin	--	-	-	-	-	-	X
118	Boulder River near Boulder	06033000	X	-	-	-	-	-
119	Little Boulder River near Boulder	--	X[3]	-	-	-	-	-
120	Boulder River above Cabin Gulch, near Boulder	--	-	-	-	-	-	X
121	Boulder River near Cardwell	--	-	-	-	X[4]	-	-
122	South Boulder River near Jefferson Island	06034000	X	-	-	-	-	-
123	Jefferson River at Sappington	06034500	X	-	-	-	-	-
124	South Willow Creek near Pony	--	-	X	X	X	X	-
125	North Willow Creek at Pony	--	-	X	X	X	X	-
126	Willow Creek near Harrison	06035000	X	-	-	-	-	-
127	Norwegian Creek near Harrison	06035500	X	-	-	-	-	-
129	Jefferson River near Three Forks	06036650	X	-	-	-	-	-
130	Madison River near West Yellowstone	06037500	X	-	-	-	-	-
131	Duck Creek near West Yellowstone	--	-	X	X	X	X	-
132	Cougar Creek near West Yellowstone	--	-	X	X	X	X	-
133	Grayling Creek near West Yellowstone	--	-	X	X	X	X	-
134	Red Canyon Creek near West Yellowstone	--	-	X	X	X	X	-
135	South Fork Madison River near West Yellowstone	--	-	-	-	X	-	-
136	Watkins Creek near West Yellowstone	--	-	X	X	X	X	-
137	Trapper Creek near West Yellowstone	--	-	X	X	X	X	-
138	Madison River below Hebgen Lake, near Grayling	06038500	X	-	-	-	-	-
139	Cabin Creek near West Yellowstone	--	-	X	X	X	X	-
140	Beaver Creek near West Yellowstone	--	-	X	X	X	X	-
141	Elk River at mouth, near Cameron	--	-	X	-	-	-	-
142	Soap Creek at mouth, near Cameron	--	-	X	-	-	-	-
143	Antelope Creek at mouth, near Cameron	--	-	X	-	-	-	
144	West Fork Madison River near Cameron	06039200	X	-	-	-	-	-
145	Squaw Creek near Cameron	--	-	X	X	X	X	-
146	Standard Creek near Cameron	--	-	X	X	X	X	-
147	Ruby Creek near Cameron	--	-	X	X	X	X	-
148	Indian Creek near Cameron	--	-	X	X	X	X	-
149	Madison River near Cameron	06040000	X	-	-	-	-	-
150	Blaine Spring Creek near Cameron	06040010	X[5]	-	-	-	-	-
151	O'Dell Creek near Ennis	--	-	-	-	X	-	-
152	Jack Creek near Ennis	06040300	X	-	-	-	-	-
153	Moore Creek at Ennis	--	-	X	X	X	X	-
154	North Fork Meadow Creek at Forest Service boundary, near Ennis	--	-	X	X	X	X	-
155	North Fork Meadow Creek at Highway 287, near Ennis	--	-	-	X	X	X	-
156	Madison River below Ennis Lake, near McAllister	06041000	X	-	-	-	-	-
157	Hot Springs Creek near Norris	--	-	X	X	X	X	-
158	Cherry Creek near Norris	--	-	X	X	X	X	-
159	Madison River near Three Forks	06042500	X	-	-	-	-	-
160	Cache Creek at mouth, near West Yellowstone	--	-	X	-	-	-	-
161	Taylor Creek near Grayling	06043000	X	-	-	-	-	-
162	Porcupine Creek near Gallatin Gateway	--	-	X	X	X	X	-
163	Gallatin River above West Fork, near Big Sky	--	-	-	-	-	-	X

Site No.	Stream name	Stream-flow-gaging station No.	Gage	Estimation method: Basin char-ac-teris-tics	Chan-nel width	Con-cur-rent meas-ure-ment	Weight-ed-average estimate	Drain-age-area-ratio adjust-ment
164	South Fork West Fork Gallatin River near Gallatin Gateway	--	-	X	X	X	X	-
165	Middle Fork West Fork Gallatin River near Gallatin Gateway	--	-	X	X	X	X	-
166	West Fork Gallatin River near Gallatin Gateway	--	-	X	X	X	X	-
167	Squaw Creek near Gallatin Gateway	--	-	X	X	X	X	-
168	Hellroaring Creek near Gallatin Gateway	--	-	X	X	X	X	-
169	South Fork Spanish Creek near Gallatin Gateway	--	-	X	X	X	X	-
170	Spanish Creek near Gallatin Gateway	--	-	X	X	X	X	-
171	Gallatin River near Gallatin Gateway	06043500	X	-	-	-	-	-
172	Big Bear Creek near Gallatin Gateway	--	X[6]	-	-	-	-	-
173	South Cottonwood Creek near Gallatin Gateway	06044500	X[6]	-	-	-	-	-
174	Baker Creek near Manhattan	--	X[6]	-	-	-	-	-
175	Rocky Creek near Bozeman	06046500	X[6]	-	-	-	-	-
176	Bear Canyon Creek near Bozeman	06047000	X[6]	-	-	-	-	-
177	Sourdough Creek near Bozeman	06047500	X[6]	-	-	-	-	-
178	East Gallatin River at Bozeman	06048000	X	-	-	-	-	-
179	Bridger Creek near Bozeman	06048500	X	-	-	-	-	-
180	East Gallatin River near Belgrade	06049000	X[6]	-	-	-	-	-
181	East Fork Hyalite Creek near Bozeman	--	X[7]	-	-	-	-	-
182	West Fork Hyalite Creek near Bozeman	--	X[7]	-	-	-	-	-
183	Hyalite Creek at Hyalite Ranger Station, near Bozeman	06050000	X	-	-	-	-	-
184	Hyalite Creek above Interstate 90, near Bozeman	--	-	-	X	X	X	-
185	Thompson Creek near Belgrade	--	X[6]	-	-	-	-	-
186	Ben Hart Creek near Belgrade	--	X[6]	-	-	-	-	-
187	Reese Creek near Belgrade	06051000	X[6]	-	-	-	-	-
188	East Gallatin River near Manhattan	--	-	X	X	X	X	-
189	Gallatin River near Logan	06052500	X	-	-	-	-	-
190	Sixteenmile Creek near Ringling	06053000	X	-	-	-	-	-
191	Sixteenmile Creek near Maudlow	--	-	-	-	-	-	X
192	Sixteenmile Creek near Toston	--	-	X	X	X	X	-
193	Missouri River near Toston	06054500	X	-	-	-	-	-
194	Crow Creek near Radersburg	06055500	X	-	-	-	-	-
195	Dry Creek near Toston	--	-	X	X	X	X	-
196	Deep Creek below North Fork, near Townsend	--	-	X	X	X	X	-
197	Duck Creek near Townsend	--	-	X	X	X	X	-
198	Confederate Gulch near Winston	--	-	X	X	X	X	-
199	Beaver Creek near Winston	--	X[8]	-	-	-	-	-
200	Avalanche Gulch near Winston	--	-	X	X	X	X	-
201	Spokane Creek near East Helena	--	-	X	X	X	X	-
202	McGuire Creek at county road, near East Helena	--	-	-	-	X	-	-
203	Trout Creek at mouth, near East Helena	--	-	X	X	X	X	-
204	Prickly Pear Creek near Clancy	06061500	X	-	-	-	-	-
205	Prickly Pear Creek at mouth, near East Helena	--	-	X	X	X	X	-
206	Tenmile Creek near Rimini	06062500	X	-	-	-	-	-
207	Tenmile Creek near Helena	06063000	X	-	-	-	-	-
208	Sevenmile Creek near mouth, near Helena	--	-	X	X	X	X	-
209	Tenmile Creek at mouth, near East Helena	--	-	-	X	X	X	-
210	Silver Creek at Interstate 15, near Helena	--	-	-	-	X	-	-
211	Beaver Creek at mouth, near East Helena	--	X[8]	-	-	-	-	-
212	Elkhorn Creek near mouth, near Wolf Creek	--	-	X	X	X	X	-
213	Willow Creek below Elkhorn Creek, near Wolf Creek	--	-	X	X	X	X	-

Site No.	Stream name	Stream-flow-gaging station No.	Gage	Estimation method: Basin char-ac-teris-tics	Chan-nel width	Con-cur-rent meas-ure-ment	Weight-ed-average estimate	Drain-age-area-ratio adjust-ment
214	Cottonwood Creek above Beartooth Ranch, near Wolf Creek	--	-	X	X	X	X	-
217	Virginia Creek at mouth, near Canyon Creek	--	-	X	X	X	X	-
218	Canyon Creek below Cottonwood Creek, near Canyon Creek	--	-	X	X	X	X	-
219	Little Prickly Pear Creek near Canyon Creek	06071000	X	-	-	-	-	-
220	Lyons Creek near Wolf Creek	--	-	X	X	X	X	-
221	Wolf Creek at mouth, at Wolf Creek	--	-	X	X	X	X	-
222	Little Prickly Pear Creek near Wolf Creek	06071300	X	-	-	-	-	-
223	Wegner Creek near Craig	--	-	X	X	-	X	-
224	Stickney Creek near Craig	--	-	X	-	-	-	-
226	Middle Fork Dearborn River at Highway 200, near Wolf Creek	--	-	X	X	X	X	-
227	South Fork Dearborn River at Highway 434, near Wolf Creek	--	-	X	X	X	X	-
228	Dearborn River near Craig	06073500	X	-	-	-	-	-
229	Flat Creek above Slew Creek, near Craig	--	-	X	X	X	X	-
230	Sheep Creek at mouth, near Cascade	--	-	X	X	X	X	-
232	North Fork Smith River at Highway 89, near White Sulphur Springs	--	-	-	X	X	X	-
233	South Fork Smith River at mouth, near White Sulphur Springs	--	-	X	X	X	X	-
234	Smith River below forks, near White Sulphur Springs	--	-	-	X	X	X	-
235	Big Birch Creek at mouth, near White Sulphur Springs	--	-	X	X	X	X	-
236	Newlan Creek below Charcoal Gulch, near White Sulphur Springs	--	-	X	X	X	X	-
237	Camas Creek near mouth, near White Sulphur Springs	--	-	X	X	X	X	-
238	Smith River near Fort Logan	06076690	X	-	-	-	-	-
239	Sheep Creek near White Sulphur Springs	06077000	X	-	-	-	-	-
240	Sheep Creek near mouth, near White Sulphur Springs	--	-	X	X	X	X	-
241	Eagle Creek near mouth, near White Sulphur Springs	--	-	X	X	X	X	-
242	Rock Creek River below Buffalo Canyon, near White Sulphur Springs	--	-	X	X	X	X	-
243	Tenderfoot Creek below South Fork, near White Sulphur Springs	--	-	X	X	X	X	-
244	Smith River near Eden	06077500	X	-	-	-	-	-
245	Hound Creek near mouth, near Cascade	--	-	X	X	X	X	-
246	Missouri River near Ulm	06078200	X	-	-	-	-	-
247	North Fork Sun River near Augusta	06078500	X	-	-	-	-	-
248	Sun River near Augusta	06080000	X	-	-	-	-	-
249	Sun River below diversion dam, near Augusta	06080900	X	-	-	-	-	-
250	Willow Creek near Anderson Lake, near Augusta	--	-	X	X	X	X	-
251	North Fork Willow Creek below Cutrock Creek, near Augusta	--	-	X	X	X	X	-
254	Smith Creek near Augusta	06082500	X	-	-	-	-	-
255	Ford Creek near Augusta	06083500	X	-	-	-	-	-
256	Elk Creek near Augusta	06084500	X	-	-	-	-	-
257	Sun River at Simms	06085800	X	-	-	-	-	-
260	Missouri River near Great Falls	06090300	X	-	-	-	-	-
261	Dry Fork at mouth, at Monarch	--	-	X	X	X	X	-

Site No.	Stream name	Stream-flow-gaging station No.	Gage	Estimation method: Basin char-ac-teris-tics	Chan-nel width	Con-cur-rent meas-ure-ment	Weight-ed-average estimate	Drain-age-area-ratio adjust-ment
262	Tillinghast Creek above Joice Creek, near Monarch	--	-	X	X	X	X	-
263	Pilgrim Creek at mouth, near Monarch	--	-	X	X	-	X	-
264	Logging Creek at Logging Creek Campground, near Monarch	--	-	X	X	X	X	-
265	Belt Creek near Monarch	06090500	X	-	-	-	-	-
266	Big Otter Creek above Never Sweat Creek, near Raynesford	--	-	-	X	X	X	-
267	Belt Creek near Portage	06090610	X	-	-	-	-	-
268	Highwood Creek below Smith Creek, near Highwood	--	-	X	X	X	X	-
269	Missouri River at Fort Benton	06090800	X	-	-	-	-	-
270	Shonkin Creek below Bishop Creek, near Highwood	--	-	X	X	X	X	-
271	South Fork Two Medicine River near East Glacier	--	-	X	X	X	X	-
273	South Fork Badger Creek near Browning	--	-	X	-	-	-	-
274	North Fork Badger Creek near Browning	--	-	X	-	-	-	-
278	Birch Creek at Swift Dam, near Valier	06094500	X	-	-	-	-	-
279	South Fork Dupuyer Creek near Dupuyer	--	-	X	-	-	-	-
280	North Fork Dupuyer Creek near Dupuyer	--	-	X	-	-	-	-
281	Dupuyer Creek below Scoffin Creek, near Dupuyer	--	-	X	X	X	X	-
282	Birch Creek near Valier	06098100	X	-	-	-	-	-
283	Cut Bank Creek near Browning	06098500	X	-	-	-	-	-
284	Cut Bank Creek at Cut Bank	06099000	X	-	-	-	-	-
285	Marias River at Sullivan Bridge, near Cut Bank	--	-	-	-	X	-	-
286	Marias River near Shelby	06099500	X	-	-	-	-	-
287	Marias River at "F" Bridge, above Tiber Reservoir, near Shelby	--	-	-	-	-	-	X
288	Marias River near Loma	06102050	X	-	-	-	-	-
290	Teton River near Strabane	--	-	-	-	X	-	-
291	McDonald Creek near Strabane	--	-	-	-	X	-	-
292	North Fork Deep Creek near Choteau	--	-	X	-	-	-	-
293	South Fork Deep Creek near Choteau	--	-	X	-	-	-	-
294	Deep Creek near Choteau	--	-	-	-	X	-	-
295	Teton River near Dutton	06108000	X	-	-	-	-	-
296	Missouri River at Virgelle	06109500	X	-	-	-	-	-
297	Lost Creek at mouth, near Utica	--	-	X	-	-	-	-
298	Yogo Creek at mouth, near Utica	--	-	X	X	X	X	-
299	Middle Fork Judith River near Utica	06109780	X	-	-	-	-	-
301	South Fork Judith River at Indian Hill Campground, near Utica	--	-	-	X	X	X	-
303	Judith River above Courtneys Creek, at Utica	--	-	-	X	X	X	-
306	East Fork Big Spring Creek at mouth, near Lewistown	--	-	X	X	X	X	-
307	Big Spring Creek above Cottonwood Creek, near Hanover	--	-	-	-	X	-	-
309	Cottonwood Creek at Highway 200, near Lewistown	--	-	-	X	X	X	-
310	Beaver Creek at county road, near Lewistown	--	-	X	X	X	X	-
311	Big Spring Creek at mouth, near Lewistown	--	-	-	-	X	-	-
312	Warm Springs Creek above Meadow Creek, near Hilger	--	-	-	-	X	-	-
313	Judith River near Winifred	06113500	X	-	-	-	-	-
315	Cow Creek below forks, near Cleveland	--	-	X	X	-	X	-
316	Missouri River near Landusky	06115200	X	-	-	-	-	-
317	North Fork Musselshell River near Delpine	06115500	X	-	-	-	-	-

Table 1.--*Sites and methods used for estimation*--Continued

Site No.	Stream name	Streamflow-gaging station No.	Gage	Estimation method: Basin characteristics	Channel width	Concurrent measurement	Weighted-average estimate	Drainage-area-ratio adjustment
318	Checkerboard Creek near Checkerboard	--	-	X	X	X	X	-
319	Spring Creek below Whitetail Creek, near Checkerboard	--	-	X	X	X	X	-
320	North Fork Musselshell River near mouth, near Martinsdale	--	-	-	X	X	X	-
321	Alabaugh Creek at mouth, near Lennep	--	-	X	X	X	X	-
322	Cottonwood Creek below Loco Creek, near Martinsdale	--	-	X	X	X	X	-
323	South Fork Musselshell River above Martinsdale	06118500	X	-	-	-	-	-
324	Big Elk Creek at mouth, at Twodot	06120000	X	-	-	-	-	-
325	Musselshell River at Harlowton	06120500	X	-	-	-	-	-
326	American Fork near Harlowton	06121000	X	-	-	-	-	-
330	Careless Creek below Little Careless Creek, near Hedgesville	--	-	-	X	X	X	-
331	Swimming Woman Creek below Dry Coulee, near Franklin	--	-	-	X	X	X	-
333	Musselshell River near Roundup	06126500	X	-	-	-	-	-
335	Flatwillow Creek below the forks, near Grass Range	--	-	X	X	X	X	-
338	Musselshell River near Mosby	06130500	X	-	-	-	-	-
339	Big Dry Creek above Little Dry Creek, near Van Norman	--	-	-	-	-	-	X
340	Little Dry Creek near Van Norman	--	-	-	-	X	-	-
341	Big Dry Creek near Van Norman	06131000	X	-	-	-	-	-
Totals			100	179	138	139	139	7

[1]Monthly streamflow characteristics based on record after construction of Clark Canyon Reservoir.

[2]Based on 12 streamflow measurements made in water years 1982-83.

[3]U.S. Soil Conservation Service gage.

[4]Based on 12 streamflow measurements made in water year 1986.

[5]Gaged record available for 1 year (water years 1971-72).

[6]Estimated monthly flows available for water years 1952-54.

[7]Montana Department of Natural Resources and Conservation gage.

[8]U.S. Forest Service gage.

Table 1.--*Sites and methods used for estimation*--Continued

Site No.	Stream name	Streamflow-gaging station No.	Gage	Estimation method: Basin characteristics	Channel width	Concurrent measurement	Weighted-average estimate	Drainage-area-ratio adjustment
366	ROCK CREEK AT MOUTH NEAR WISDOM	---	-	X	-	-	-	-
367	DELANO CR AT MOUTH NR WISE RIVER	---	-	X	-	-	-	-
368	HALFWAY CR AT MOUTH NR WHITEHALL	---	-	X	-	-	-	-
369	N.F. DEEP CR AT MOUTH NR MILLIGAN	---	-	X	-	-	-	-
370	COLLAR GULCH AT MOUTH NR MAIDEN	---	-	X	-	-	-	-
371	BADGER CR BELOW FORKS NR BROWNING	---	-	X	-	-	-	-

Table 4.--Estimated monthly streamflow characteristics for October and November

[Q.XX, monthly mean streamflow for specified month exceeded XX percent of the years, in cubic feet per second; QM, mean monthly streamflow for specified month, in cubic feet per second]

Site No.	Stream name	October Q.90	October Q.80	October Q.50	October Q.20	October QM	November Q.90	November Q.80	November Q.50	November Q.20	November QM
1	Hellroaring Creek near Lakeview	6	7	9	11	9	5	6	7	8	7
2	Corral Creek near Lakeview	.7	.8	1	1	1	.6	.7	.9	1	.8
3	Antelope Creek near Lakeview	.1	.2	.2	.4	.3	.1	.2	.2	.3	.3
4	Red Rock Creek near Lakeview	11	12	14	17	15	10	11	12	14	12
5	Tom Creek near Lakeview	.4	.5	.7	1	1	.3	.4	.5	1	.8
6	Narrows Creek at mouth, near Lakeview	.1	.2	.3	.5	.4	.1	.2	.2	.3	.3
7	Odell Creek near Lakeview	5	6	7	9	8	4	5	6	7	6
8	Jones Creek near Lakeview	.5	.7	1	2	1	.4	.6	.9	1	1
9	Red Rock River near Kennedy Ranch, near Lakeview	38	49	66	88	67	41	48	70	84	67
10	Peet Creek at county road, near Lakeview	.5	.7	1	2	1	.5	.6	.9	1	1
11	Long Creek near Lakeview	2	3	3	5	4	2	2	3	4	3
12	East Fork Clover Creek at mouth, near Monida	.7	1	1	2	2	.6	.8	1	2	1
13	Red Rock River below Lima Reservoir, near Monida	11	17	45	84	57	5	12	23	58	40
14	Cabin Creek above Simpson Creek, near Lima	.2	.3	.5	.8	.6	.2	.3	.4	.6	.5
15	Indian Creek above Simpson Creek, near Lima	.3	.5	.7	1	.8	.3	.4	.6	1	.7
16	Simpson Creek above Indian Creek, near Lima	.4	.5	.8	1	1	.3	.5	.7	1	.8
17	Deadman Creek near Dell	3	4	5	7	5	3	4	5	6	5
18	Big Sheep Creek below Muddy Creek, near Dell	39	46	59	72	59	45	47	54	62	55
19	Red Rock River at Red Rock	180	210	290	360	300	190	220	260	300	270
20	Black Canyon Creek near Grant	2	2	2	3	3	2	2	2	3	2
21	Shennon Creek near mouth, near Grant	.4	.6	.8	1	1	.4	.5	.7	1	.7
22	Frying Pan Creek near Grant	1	2	2	3	2	1	2	2	2	2
23	Trapper Creek at mouth, near Grant	.3	.4	.7	1	.8	.3	.4	.6	.7	.6
24	Bear Creek near Grant	3	3	4	5	4	3	3	4	4	4
25	Bloody Dick Creek near Grant	11	13	17	22	18	11	13	15	19	16
26	Horse Prairie Creek near Grant	29	34	44	57	45	33	37	44	54	45
27	Rape Creek above reservoir, near Grant	.2	.3	.5	.7	.5	.2	.3	.4	.5	.4
28	Painter Creek near Grant	2	2	3	4	3	1	2	3	3	3
29	Browns Canyon Creek near Grant	1	1	2	3	2	.9	1	2	2	2
30	Medicine Lodge Creek near Grant	5	6	8	12	10	4	6	8	13	10
32	Pole Creek near mouth, near Polaris	.6	.8	1	2	1	.5	.7	1	1	1
33	Reservoir Creek at mouth, near Polaris	.9	1	2	2	2	.7	1	1	2	1
34	East Fork Dyce Creek at mouth, near Polaris	.5	.8	1	2	1	.5	.7	1	1	1
35	West Fork Dyce Creek at mouth, near Polaris	.3	.4	.6	1	.8	.2	.4	.6	.8	.6
36	Grasshopper Creek near Dillon	24	27	34	46	36	29	34	39	45	39
37	Beaverhead River at Barretts	200	230	360	480	380	190	250	410	520	390
38	East Fork Blacktail Creek near Dillon	15	17	21	22	19	16	16	19	19	17
39	West Fork Blacktail Creek near Dillon	5	7	10	12	9	7	7	9	11	9
40	Blacktail Deer Creek near Dillon	35	38	44	49	44	30	35	42	50	44
41	Beaverhead River near Dillon	140	180	330	520	380	280	340	490	610	500

Table 4.--*Estimated monthly streamflow characteristics for October and November*--Continued

Site No.	Stream name	October Q.90	Q.80	Q.50	Q.20	QM	November Q.90	Q.80	Q.50	Q.20	QM
42	Beaverhead River near Twin Bridges	220	260	440	640	480	380	440	600	710	590
43	Corral Creek at mouth, near Alder	.4	.6	1	1	1	.4	.5	.7	1	.8
44	Coal Creek at mouth, near Alder	2	2	3	4	3	1	2	3	3	3
45	Ruby River above the forks, near Alder	6	8	11	14	11	6	7	9	12	10
46	East Fork Ruby River at mouth, near Alder	2	3	4	6	4	2	2	3	4	4
47	West Fork Ruby River at mouth, near Alder	3	3	5	7	5	2	3	4	5	4
48	Cottonwood Creek at mouth, near Alder	3	4	5	8	6	3	3	5	6	5
49	Warm Springs Creek at mouth, near Alder[1]	46	48	50	54	51	46	47	49	52	49
50	North Fork Greenhorn Creek at mouth, near Alder	1	2	3	4	3	1	2	2	3	2
51	Ruby River above reservoir, near Alder	91	100	120	140	120	100	110	120	140	120
52	Mill Creek at Forest Service boundary, near Sheridan	7	9	11	14	11	6	7	9	11	9
53	Wisconsin Creek at Forest Service boundary, near Sheridan	5	6	7	10	8	4	5	6	8	7
54	Ruby River near Twin Bridges	140	170	230	260	220	160	190	220	250	220
55	Big Hole River near Jackson	12	13	17	22	18	9	10	13	18	14
56	Andrus Creek near mouth, near Jackson	3	4	5	7	6	3	3	4	6	5
57	Fox Creek at mouth, near Jackson	2	2	3	5	4	2	2	3	4	3
58	Governor Creek near Jackson	14	16	19	25	21	13	15	18	20	18
59	Warm Springs Creek at Jackson	8	9	11	16	13	8	9	11	15	12
60	Miner Creek near Jackson	6	7	11	16	12	7	8	10	13	11
61	Big Lake Creek near mouth, near Wisdom	3	4	6	8	6	3	4	5	7	5
62	Steel Creek above Francis Creek, near Wisdom	2	2	3	4	3	2	2	3	3	3
63	Francis Creek at mouth, near Wisdom	3	4	4	6	5	3	3	4	5	4
64	Steel Creek near mouth, near Wisdom	5	6	8	11	9	5	6	7	8	7
65	Swamp Creek near mouth, near Wisdom	6	7	9	13	11	6	6	8	9	8
66	Joseph Creek at mouth, near Wisdom	2	3	4	7	5	2	3	4	5	4
67	Trail Creek near Wisdom	15	17	21	26	22	15	16	19	22	19
68	Ruby Creek at mouth, near Wisdom	4	5	7	10	8	4	5	6	9	7
69	Tie Creek at Forest Service boundary, near Wisdom	5	7	9	14	10	5	6	8	11	9
70	Johnson Creek near Wisdom	3	4	5	8	7	3	4	5	7	6
71	Mussigbrod Creek near Wisdom	2	3	4	6	5	2	2	3	4	4
72	North Fork Big Hole River near mouth, near Wisdom	29	34	43	58	47	28	31	39	48	41
73	Big Hole River below North Fork, near Wisdom	110	130	190	280	210	130	150	190	260	200
74	Pintlar Creek near Forest Service boundary, near Wisdom	5	6	7	12	9	4	5	6	8	7
75	Big Hole River below Mudd Creek, near Wisdom	120	150	210	310	230	140	160	210	280	220
76	Fishtrap Creek at mouth, near Wise River	5	7	8	15	12	5	6	7	12	9
77	Lamarche Creek near Wise River	11	12	16	22	18	9	10	13	18	14
78	Seymour Creek near Wise River	6	7	10	15	12	5	7	9	12	10
79	Tenmile Creek at mouth, near Wise River	2	2	4	5	4	2	2	3	4	3
80	Sevenmile Creek at mouth, near Wise River	.4	.6	.9	1	1	.3	.5	.7	1	.8
81	Corral Creek at mouth, near Wise River	.5	.7	1	2	1	.4	.6	.9	1	1

Site No.	Stream name	October Q.90	October Q.80	October Q.50	October Q.20	October QM	November Q.90	November Q.80	November Q.50	November Q.20	November QM
82	Twelvemile Creek at mouth, near Wise River	1	2	3	4	3	1	2	2	3	3
83	Sullivan Creek at mouth, near Wise River	2	2	3	5	3	1	2	3	3	3
84	Oregon Creek near mouth, near Wise River	.2	.3	.4	.7	.5	.2	.2	.3	.5	.4
85	California Creek above American Creek, near Wise River	2	3	4	5	4	2	2	3	4	3
86	American Creek at mouth, near Wise River	.5	.7	1	2	1	.4	.6	.8	1	.9
87	Sixmile Creek at mouth, near Wise River	.3	.5	.7	1	.8	.3	.4	.6	.8	.6
88	French Creek near mouth, near Wise River	4	5	7	9	7	4	4	6	7	6
89	Deep Creek near Wise River	22	25	31	35	30	21	23	27	27	25
90	Bear Creek near Wise River	1	1	2	2	2	.9	1	1	1	1
91	Bryant Creek at mouth, near Wise River	2	2	3	4	3	1	2	3	3	3
92	Big Hole River near Wise River	160	200	280	430	320	200	230	290	390	300
93	Johnson Creek at mouth, near Wise River	1	1	2	3	2	.8	1	2	2	2
94	Meadow Creek near Wise River	2	2	3	5	4	2	2	3	4	3
95	Jacobson Creek at mouth, near Wise River	8	10	14	21	16	7	9	13	18	13
96	Mono Creek at mouth, near Wise River	.9	1	2	3	2	.8	1	2	2	2
97	Wyman Creek at mouth, near Wise River	4	6	8	11	9	4	5	7	9	7
98	Lacy Creek at mouth, near Wise River	3	4	5	7	6	2	3	4	6	5
99	Gold Creek at mouth, near Wise River	1	2	2	4	3	1	1	2	3	2
100	Pattengail Creek at mouth, near Wise River	11	14	19	27	21	11	13	17	22	18
101	Sheep Creek at mouth, near Wise River	2	2	3	5	4	1	2	3	4	3
102	Wise River near Wise River	35	41	54	85	61	35	40	48	57	49
103	Adson Creek at mouth, near Wise River	1	1	2	3	2	1	1	2	2	2
104	Jerry Creek near Wise River	6	7	9	11	10	5	6	7	8	7
105	Divide Creek at Divide	2	3	3	6	5	2	3	3	6	5
106	Canyon Creek near Divide	3	4	5	9	7	3	3	4	8	6
107	Moose Creek near Divide	5	5	6	7	6	5	5	6	7	6
108	Trapper Creek near Melrose	4	4	6	8	6	4	4	5	7	6
109	Camp Creek at Melrose	1	2	3	5	3	.9	1	2	4	3
110	Big Hole River near Melrose	310	360	490	710	530	350	400	490	650	520
111	Willow Creek near Glen	7	8	10	12	10	6	7	8	10	8
112	Birch Creek near Glen	11	12	15	20	16	7	8	10	13	11
113	Hells Canyon Creek near Twin Bridges	2	2	3	4	3	2	2	3	4	3
114	Jefferson River near Twin Bridges	770	900	1300	1700	1300	1100	1200	1500	1800	1500
115	Whitetail Creek near Whitehall	3	4	7	10	7	2	2	2	3	3
117	Boulder River above High Ore Creek, near Basin	14	19	29	47	32	19	22	28	36	30
118	Boulder River near Boulder	18	24	37	60	41	25	28	36	46	38
119	Little Boulder River near Boulder	8	10	12	15	12	7	7	9	12	10
120	Boulder River above Cabin Gulch, near Boulder	23	30	42	63	46	30	33	41	50	43
121	Boulder River near Cardwell	29	36	52	77	57	37	41	51	62	53
122	South Boulder River near Jefferson Island	13	14	18	25	19	11	12	14	19	15
123	Jefferson River at Sappington	870	1000	1500	1900	1500	1300	1500	1600	1900	1700
124	South Willow Creek near Pony	3	6	17	33	17	7	9	22	27	19
125	North Willow Creek at Pony	2	5	12	18	11	6	8	15	17	13
126	Willow Creek near Harrison	4	11	30	52	31	16	19	37	44	34
127	Norwegian Creek near Harrison	5	6	7	8	7	5	6	6	7	6

Table 4.--*Estimated monthly streamflow characteristics for October and November*--Continued

Site No.	Stream name	October Q.90	October Q.80	October Q.50	October Q.20	October QM	November Q.90	November Q.80	November Q.50	November Q.20	November QM
129	Jefferson River near Three Forks	1100	1300	1800	2200	1800	1400	1500	1900	2200	1900
130	Madison River near West Yellowstone	340	380	440	500	440	340	390	430	470	420
131	Duck Creek near West Yellowstone	22	24	28	32	27	20	21	25	26	23
132	Cougar Creek near West Yellowstone	7	9	11	20	16	6	8	10	18	14
133	Grayling Creek near West Yellowstone	16	19	23	34	28	13	15	18	25	21
134	Red Canyon Creek near West Yellowstone	.3	.4	.5	2	1	.2	.4	.6	2	1
135	South Fork Madison River near West Yellowstone	98	100	110	130	110	91	95	100	110	100
136	Watkins Creek near West Yellowstone	2	2	2	4	3	1	2	2	4	3
137	Trapper Creek near West Yellowstone	1	2	2	3	3	1	1	2	3	2
138	Madison River below Hebgen Lake, near Grayling	480	880	1400	1800	1300	690	830	1400	1900	1400
139	Cabin Creek near West Yellowstone	7	8	10	16	13	5	6	7	11	9
140	Beaver Creek near West Yellowstone	21	24	29	37	31	18	20	25	31	26
141	Elk River at mouth, near Cameron	11	14	19	29	22	10	12	18	25	19
142	Soap Creek at mouth, near Cameron	.6	.8	1	2	2	.5	.7	1	2	1
143	Antelope Creek at mouth, near Cameron[2]	14	15	16	19	17	13	14	15	17	16
144	West Fork Madison River near Cameron	42	44	51	59	54	37	41	45	56	48
145	Squaw Creek near Cameron	6	6	8	10	8	5	6	7	9	7
146	Standard Creek near Cameron	5	5	7	8	7	4	5	6	7	6
147	Ruby Creek near Cameron	3	3	4	5	4	3	3	4	5	4
148	Indian Creek near Cameron	19	23	28	37	31	16	19	24	31	25
149	Madison River near Cameron	970	1100	1700	2100	1600	880	1000	1600	2100	1600
150	Blaine Spring Creek near Cameron	24	24	27	30	27	22	23	24	26	25
151	O'Dell Creek near Ennis	110	110	110	110	110	100	100	100	110	100
152	Jack Creek near Ennis	19	21	23	25	23	14	15	18	19	18
153	Moore Creek at Ennis	.6	.7	.9	2	1	.5	.7	.8	2	1
154	North Fork Meadow Creek at Forest Service boundary, near Ennis	6	8	11	17	12	4	5	8	10	8
155	North Fork Meadow Creek at Highway 287, near Ennis	4	4	6	10	7	3	3	4	6	5
156	Madison River below Ennis Lake, near McAllister	1100	1400	2000	2400	1900	1100	1400	2100	2500	2000
157	Hot Springs Creek near Norris	5	6	7	10	8	4	5	6	8	7
158	Cherry Creek near Norris	20	22	27	31	26	17	19	22	25	22
159	Madison River near Three Forks	1100	1400	2000	2500	2000	1300	1400	1900	2300	1900
160	Cache Creek at mouth, near West Yellowstone	2	3	4	6	4	2	2	3	5	4
161	Taylor Creek near Grayling	22	25	29	37	31	17	20	25	34	26
162	Porcupine Creek near Gallatin Gateway	5	6	7	10	8	4	5	6	8	7
163	Gallatin River above West Fork, near Big Sky	190	210	240	320	250	160	170	210	250	210
164	South Fork West Fork Gallatin River near Gallatin Gateway	12	15	19	28	21	10	12	15	19	15
165	Middle Fork West Fork Gallatin River near Gallatin Gateway	5	6	8	12	9	5	5	7	9	7
166	West Fork Gallatin River near Gallatin Gateway	24	29	37	52	39	20	23	29	36	29
167	Squaw Creek near Gallatin Gateway	14	15	19	23	19	13	14	17	20	17
168	Hellroaring Creek near Gallatin Gateway	18	20	25	31	25	16	17	21	24	20

Site No.	Stream name	October Q.90	Q.80	Q.50	Q.20	QM	November Q.90	Q.80	Q.50	Q.20	QM
169	South Fork Spanish Creek near Gallatin Gateway	11	13	17	23	18	10	11	13	15	13
170	Spanish Creek near Gallatin Gateway	24	28	36	47	36	21	23	29	34	28
171	Gallatin River near Gallatin Gateway	350	380	450	590	470	300	330	380	470	390
172	Big Bear Creek near Gallatin Gateway	5	5	6	8	6	4	4	5	6	5
173	South Cottonwood Creek near Gallatin Gateway	15	16	19	23	20	13	14	16	20	16
174	Baker Creek near Manhattan[3]	64	70	100	130	100	71	92	110	120	110
175	Rocky Creek near Bozeman	8	10	13	20	15	9	10	13	19	14
176	Bear Canyon Creek near Bozeman	2	2	3	4	3	1	2	2	4	3
177	Sourdough Creek near Bozeman	10	11	15	17	15	10	11	13	15	13
178	East Gallatin River at Bozeman	34	42	51	62	54	38	46	51	57	51
179	Bridger Creek near Bozeman	7	8	10	15	11	6	7	9	13	10
180	East Gallatin River near Belgrade	40	44	61	80	63	39	44	58	72	58
181	East Fork Hyalite Creek near Bozeman	4	5	6	8	7	3	4	5	6	5
182	West Fork Hyalite Creek near Bozeman	9	10	12	16	13	7	8	10	12	10
183	Hyalite Creek at Hyalite Ranger Station, near Bozeman	24	28	36	52	39	17	19	27	34	27
184	Hyalite Creek above Interstate 90, near Bozeman	6	7	9	15	11	4	5	7	9	8
185	Thompson Creek near Belgrade	27	30	33	36	33	27	28	33	35	32
186	Ben Hart Creek near Belgrade	29	29	31	32	31	29	29	30	32	31
187	Reese Creek near Belgrade	6	7	8	11	8	7	7	8	10	9
188	East Gallatin River near Manhattan	170	180	210	230	190	160	170	190	210	180
189	Gallatin River near Logan	560	600	850	1100	840	610	780	890	1000	890
190	Sixteenmile Creek near Ringling	1	4	7	9	6	4	4	5	7	5
191	Sixteenmile Creek near Maudlow	17	18	29	37	30	18	20	28	33	28
192	Sixteenmile Creek near Toston	20	23	34	51	41	21	26	36	50	40
193	Missouri River near Toston	3100	3500	4400	5400	4500	3700	4000	4700	5600	4800
194	Crow Creek near Radersburg	12	13	15	19	16	9	10	12	15	12
195	Dry Creek near Toston	2	2	4	5	4	2	2	3	4	3
196	Deep Creek below North Fork, near Townsend	8	9	10	15	12	7	8	9	13	11
197	Duck Creek near Townsend	3	4	5	6	5	3	3	4	4	4
198	Confederate Gulch near Winston	5	6	7	9	7	4	5	6	7	6
199	Beaver Creek near Winston	2	3	5	8	6	2	3	5	7	5
200	Avalanche Gulch near Winston	.7	1	1	3	3	.8	1	2	4	3
201	Spokane Creek near East Helena	3	3	4	6	5	3	3	4	5	4
202	McGuire Creek at county road, near East Helena	6	7	8	8	8	7	7	7	8	7
203	Trout Creek at mouth, near East Helena	13	13	15	15	14	12	12	14	16	14
204	Prickly Pear Creek near Clancy	17	19	28	35	29	19	20	27	31	27
205	Prickly Pear Creek at mouth, near East Helena	22	24	30	36	31	24	25	31	35	31
206	Tenmile Creek near Rimini	.3	.5	1	3	3	.4	.6	1	3	2
207	Tenmile Creek near Helena	1	3	5	12	7	3	4	7	13	9
208	Sevenmile Creek near mouth, near Helena	1	1	2	4	3	1	1	2	4	3
209	Tenmile Creek at mouth, near East Helena	2	3	5	8	6	3	3	5	6	5
210	Silver Creek at Interstate 15, near Helena	8	8	11	12	11	8	9	11	11	11
211	Beaver Creek at mouth, near East Helena	5	6	8	11	8	6	6	7	11	8
212	Elkhorn Creek near mouth, near Wolf Creek	3	3	4	6	5	3	3	4	6	5
213	Willow Creek below Elkhorn Creek, near Wolf Creek	2	2	3	5	4	2	2	3	6	4

Table 4.--*Estimated monthly streamflow characteristics for October and November*--Continued

Site No.	Stream name	October Q.90	Q.80	Q.50	Q.20	QM	November Q.90	Q.80	Q.50	Q.20	QM
214	Cottonwood Creek above Beartooth Ranch, near Wolf Creek	.5	.6	.9	2	1	.4	.6	1	2	1
217	Virginia Creek at mouth, near Canyon Creek	3	4	6	9	7	3	4	7	9	7
218	Canyon Creek below Cottonwood Creek, near Canyon Creek	4	5	8	15	11	4	6	9	16	11
219	Little Prickly Pear Creek near Canyon Creek	12	13	18	25	20	11	15	20	26	21
220	Lyons Creek near Wolf Creek	5	5	7	9	7	5	6	7	9	7
221	Wolf Creek at mouth, at Wolf Creek	2	3	4	7	5	2	3	4	6	4
222	Little Prickly Pear Creek near Wolf Creek	35	44	58	85	65	42	49	64	79	64
223	Wegner Creek near Craig[4]	0	0	0	0	0	0	0	0	0	0
224	Stickney Creek near Craig[5]	0	0	0	0	0	0	0	0	0	0
226	Middle Fork Dearborn River at Highway 200, near Wolf Creek	7	8	11	16	13	7	8	10	12	10
227	South Fork Dearborn River at Highway 434, near Wolf Creek	6	7	10	14	11	6	7	9	11	9
228	Dearborn River near Craig	41	48	70	91	72	46	51	68	92	72
229	Flat Creek above Slew Creek, near Craig	7	8	13	17	13	8	9	12	17	13
230	Sheep Creek at mouth, near Cascade	13	16	23	25	21	10	12	17	18	15
232	North Fork Smith River at Highway 89, near White Sulphur Springs	3	4	6	11	8	3	4	7	14	8
233	South Fork Smith River at mouth, near White Sulphur Springs	8	9	12	17	13	9	10	11	14	12
234	Smith River below forks, near White Sulphur Springs	11	12	18	26	20	9	12	18	29	20
235	Big Birch Creek at mouth, near White Sulphur Springs	17	20	32	41	29	21	22	28	31	25
236	Newlan Creek below Charcoal Gulch, near White Sulphur Springs	3	3	5	8	6	4	5	6	8	6
237	Camas Creek near mouth, near White Sulphur Springs	3	4	5	9	7	3	5	6	9	7
238	Smith River near Fort Logan	90	96	120	140	120	98	100	110	120	110
239	Sheep Creek near White Sulphur Springs	11	12	15	18	16	9	10	13	15	13
240	Sheep Creek near mouth, near White Sulphur Springs	16	19	26	38	31	12	16	22	31	25
241	Eagle Creek near mouth, near White Sulphur Springs	2	2	3	6	5	1	2	3	4	4
242	Rock Creek below Buffalo Canyon, near White Sulphur Springs	8	9	11	15	13	6	8	10	13	11
243	Tenderfoot Creek below South Fork, near White Sulphur Springs	13	16	21	27	23	11	13	16	19	16
244	Smith River near Eden	92	110	140	190	170	89	100	130	200	150
245	Hound Creek near mouth, near Cascade	13	15	21	30	24	10	13	18	25	21
246	Missouri River near Ulm	3200	3700	4700	6000	4800	3500	4200	5000	6200	5300
247	North Fork Sun River near Augusta	65	71	94	140	110	67	69	86	110	92
248	Sun River near Augusta	100	110	110	120	110	55	170	240	360	270
249	Sun River below diversion dam, near Augusta	80	96	130	190	140	60	79	130	160	130
250	Willow Creek near Anderson Lake, near Augusta	2	2	3	5	4	2	2	3	4	3
251	North Fork Willow Creek below Cutrock Creek, near Augusta	3	3	3	4	3	3	3	3	4	3
254	Smith Creek near Augusta	6	7	14	21	15	4	6	12	16	12
255	Ford Creek near Augusta	12	13	16	18	16	6	7	10	14	11
256	Elk Creek near Augusta	19	32	45	65	48	21	25	33	53	39
257	Sun River at Simms	110	130	190	250	200	140	160	210	240	210
260	Missouri River near Great Falls	4100	5000	5500	6800	5800	4200	4900	5600	7300	5900
261	Dry Fork at mouth, at Monarch	7	8	11	17	14	6	7	10	14	11

Site No.	Stream name	October Q.90	October Q.80	October Q.50	October Q.20	October QM	November Q.90	November Q.80	November Q.50	November Q.20	November QM
262	Tillinghast Creek above Joice Creek, near Monarch	6	7	9	11	10	6	6	8	10	8
263	Pilgrim Creek at mouth, near Monarch	5	6	9	13	10	5	6	7	10	8
264	Logging Creek at Logging Creek Campground, near Monarch	6	7	9	10	9	6	6	8	8	7
265	Belt Creek near Monarch	35	41	52	74	65	29	31	45	62	49
266	Big Otter Creek above Never Sweat Creek, near Raynesford	2	4	5	6	5	4	5	5	7	6
267	Belt Creek near Portage	17	21	37	61	46	14	18	31	48	34
268	Highwood Creek below Smith Creek, near Highwood	5	6	7	10	9	4	5	6	7	6
269	Missouri River at Fort Benton	3800	4300	5400	6900	5600	4000	5000	5600	7200	6000
270	Shonkin Creek below Bishop Creek, near Highwood	3	4	5	8	6	3	3	4	4	4
271	South Fork Two Medicine River near East Glacier	12	14	21	31	23	10	14	24	37	23
273	South Fork Badger Creek near Browning	9	13	18	28	20	9	11	16	23	17
274	North Fork Badger Creek near Browning	9	11	16	25	19	8	10	15	21	16
278	Birch Creek at Swift Dam, near Valier	18	25	55	110	64	.3	1	4	19	12
279	South Fork Dupuyer Creek near Dupuyer	2	3	4	6	5	2	2	3	5	4
280	North Fork Dupuyer Creek near Dupuyer	2	3	5	7	5	2	3	4	6	4
281	Dupuyer Creek below Scoffin Creek, near Dupuyer	6	7	10	16	12	5	8	10	15	12
282	Birch Creek near Valier	29	36	47	53	45	25	30	44	57	44
283	Cut Bank Creek near Browning	23	31	56	94	66	25	34	52	78	56
284	Cut Bank Creek at Cut Bank	30	35	58	110	77	31	37	59	85	63
285	Marias River at Sullivan Bridge, near Cut Bank	180	210	310	510	380	190	210	310	420	330
286	Marias River near Shelby	180	210	320	530	390	190	210	320	430	340
287	Marias River at "F" Bridge, above Tiber Reservoir, near Shelby	210	240	370	620	460	220	240	370	510	400
288	Marias River near Loma	470	540	810	1100	860	330	370	630	840	640
290	Teton River near Strabane	13	15	20	24	20	7	16	20	25	21
291	McDonald Creek near Strabane	9	9	10	12	11	9	10	10	11	11
292	North Fork Deep Creek near Choteau	3	4	6	9	7	3	4	5	7	6
293	South Fork Deep Creek near Choteau	3	4	6	9	7	3	4	5	7	5
294	Deep Creek near Choteau	7	8	11	13	11	7	8	11	12	10
295	Teton River near Dutton	28	40	63	110	75	34	44	70	97	76
296	Missouri River at Virgelle	4000	4900	6100	7700	6300	4800	5400	6400	7600	6600
297	Lost Creek at mouth, near Utica	5	7	9	13	10	5	6	8	11	9
298	Yogo Creek at mouth, near Utica	.3	.5	1	4	3	.2	.7	1	4	3
299	Middle Fork Judith River near Utica	4	5	8	14	10	2	3	4	7	4
301	South Fork Judith River at Indian Hill Campground, near Utica	1	2	2	4	3	1	1	2	2	2
303	Judith River above Courtneys Creek, at Utica	7	10	13	21	17	5	8	10	15	12
306	East Fork Big Spring Creek at mouth, near Lewistown	5	6	8	12	9	4	5	7	10	8
307	Big Spring Creek above Cottonwood Creek, near Hanover	110	120	130	130	130	100	110	120	120	120
309	Cottonwood Creek at Highway 200, near Lewistown	3	3	4	7	6	2	3	4	5	4
310	Beaver Creek at county road, near Lewistown	2	4	7	9	7	5	6	8	11	9
311	Big Spring Creek at mouth, near Lewistown	98	110	130	140	130	85	94	110	120	110

Table 4.--*Estimated monthly streamflow characteristics for October and November*--Continued

Site No.	Stream name	October Q.90	October Q.80	October Q.50	October Q.20	October QM	November Q.90	November Q.80	November Q.50	November Q.20	November QM
312	Warm Springs Creek above Meadow Creek, near Hilger	100	100	110	120	110	97	100	110	110	110
313	Judith River near Winifred	240	240	420	550	410	240	240	450	580	420
315	Cow Creek below forks, near Cleveland	3	3	4	6	5	2	3	4	5	4
316	Missouri River near Landusky	4300	5300	6700	8100	6800	5100	5900	6800	8000	7100
317	North Fork Musselshell River near Delpine	4	5	6	9	7	5	6	7	9	7
318	Checkerboard Creek near Checkerboard	1	1	2	3	2	.7	1	1	2	2
319	Spring Creek below Whitetail Creek, near Checkerboard	3	4	6	8	6	3	3	4	5	5
320	North Fork Musselshell River near mouth, near Martinsdale	5	6	9	13	10	6	7	9	11	10
321	Alabaugh Creek at mouth, near Lennep	2	3	4	5	4	2	2	3	4	3
322	Cottonwood Creek below Loco Creek, near Martinsdale	10	13	17	22	18	8	10	12	14	12
323	South Fork Musselshell River above Martinsdale	11	18	30	40	31	13	18	28	35	28
324	Big Elk Creek at mouth, at Twodot	.6	.9	7	15	8	.3	.9	10	14	9
325	Musselshell River at Harlowton	19	45	71	110	76	35	54	76	110	81
326	American Fork near Harlowton	.0	.2	2	5	3	.0	.0	2	4	2
330	Careless Creek below Little Careless Creek, near Hedgesville	.5	.6	.8	2	1	.4	.6	.7	1	1
331	Swimming Woman Creek below Dry Coulee, near Franklin	.5	.6	.9	2	1	.3	.5	.5	1	.9
333	Musselshell River near Roundup	12	25	68	110	73	15	33	64	120	74
335	Flatwillow Creek below the forks, near Grass Range	3	3	4	15	10	2	4	4	14	10
338	Musselshell River near Mosby	2	15	69	120	82	10	36	74	140	87
339	Big Dry Creek above Little Dry Creek, near Van Norman	.0	.0	.2	2	1	.0	.0	.2	1.3	.8
340	Little Dry Creek near Van Norman	.1	.2	2	5	3	.2	.4	1	3	2
341	Big Dry Creek near Van Norman	.1	.3	2	8	5	.3	.5	2	4	3

[1]Includes estimated spring flow of about 40 cubic feet per second, based on information provided by Montana Department of Fish, Wildlife and Parks.

[2]Includes estimated spring flow of about 10 cubic feet per second, based on information provided by Montana Department of Fish, Wildlife and Parks.

[3]Estimated long-term monthly streamflow characteristics may not reflect the current flow regime because of upstream streamflow regulation.

[4]Stream is known to be dry except for periods of runoff. Calculated flows were adjusted by subtracting 7 cubic feet per second.

[5]Stream is known to be dry except for periods of runoff. Calculated flows were adjusted by subtracting 8 cubic feet per second.

Table 4.-- Estimated monthly streamflow characteristics for October and November.

[Q.XX, monthly mean streamflow for specified month exceeded XX percent of the years, in cubic feet per second; QM, mean monthly streamflow for specified month, in cubic feet per second]

Site no.	Stream name	October Q.90	Q.80	Q.50	Q.20	QM	November Q.90	Q.80	Q.50	Q.20	QM
366	ROCK CREEK AT MOUTH NEAR WISDOM	4	5	7	10	8	4	5	6	8	6
367	DELANO CREEK AT MOUTH NEAR WISE RIVER	0.1	0.2	0.3	0.5	0.4	0.1	0.1	0.2	0.3	0.3
368	HALFWAY CREEK AT MOUTH NEAR WHITEHALL	1	2	2	3	3	1	1	2	3	2
369	N.F DEEP CREEK AT MOUTH NR MILLIGAN	0.8	1	2	3	2	0.7	1	1	2	2
370	COLLAR GULCH AT MOUTH NEAR MAIDEN	0.2	0.3	0.5	0.8	0.6	0.2	0.3	0.4	0.6	0.5
371	BADGER CREEK BEL FORKS NR BROWNING	19	24	33	50	37	18	21	31	43	32

Table 5.--*Estimated monthly streamflow characteristics for December and January*

[Q.XX, monthly mean streamflow for specified month exceeded XX percent of the years, in cubic feet per second; QM, mean monthly streamflow for specified month, in cubic feet per second]

Site No.	Stream name	December					January				
		Q.90	Q.80	Q.50	Q.20	QM	Q.90	Q.80	Q.50	Q.20	QM
1	Hellroaring Creek near Lakeview	5	5	6	6	6	4	5	5	6	5
2	Corral Creek near Lakeview	.6	.6	.7	.7	.7	.5	.5	.6	.7	.6
3	Antelope Creek near Lakeview	.1	.1	.2	.3	.2	.1	.1	.2	.2	.2
4	Red Rock Creek near Lakeview	9	9	10	11	10	8	9	10	11	9
5	Tom Creek near Lakeview	.3	.4	.5	.7	.6	.3	.3	.5	.7	.5
6	Narrows Creek at mouth, near Lakeview	.1	.1	.2	.2	.2	.1	.1	.2	.2	.2
7	Odell Creek near Lakeview	4	4	5	5	5	4	4	5	5	5
8	Jones Creek near Lakeview	.5	.5	.7	1	.8	.4	.4	.7	.9	.7
9	Red Rock River near Kennedy Ranch, near Lakeview	12	17	29	42	31	13	25	33	60	39
10	Peet Creek at county road, near Lakeview	.4	.5	.6	.9	.7	.4	.4	.6	1	.7
11	Long Creek near Lakeview	2	2	3	3	3	2	2	2	3	2
12	East Fork Clover Creek at mouth, near Monida	.6	.7	.9	1	1	.5	.6	.8	1	.8
13	Red Rock River below Lima Reservoir, near Monida	10	16	23	33	26	11	17	23	28	23
14	Cabin Creek above Simpson Creek, near Lima	.2	.3	.4	.5	.4	.2	.2	.3	.4	.3
15	Indian Creek above Simpson Creek, near Lima	.3	.4	.5	.7	.6	.3	.3	.5	.6	.5
16	Simpson Creek above Indian Creek, near Lima	.4	.4	.6	.8	.7	.3	.3	.5	.6	.5
17	Deadman Creek near Dell	3	3	4	5	4	2	3	3	4	3
18	Big Sheep Creek below Muddy Creek, near Dell	38	40	47	52	46	34	37	40	47	42
19	Red Rock River at Red Rock	180	190	210	240	230	130	150	170	180	180
20	Black Canyon Creek near Grant	1	1	2	2	2	1	1	1	2	1
21	Shennon Creek near mouth, near Grant	.3	.4	.5	.7	.6	.3	.3	.5	.6	.5
22	Frying Pan Creek near Grant	1	1	1	2	1	.8	1	1	1	1
23	Trapper Creek at mouth, near Grant	.3	.3	.4	.6	.5	.2	.3	.4	.5	.4
24	Bear Creek near Grant	2	2	3	3	3	2	2	3	3	3
25	Bloody Dick Creek near Grant	8	9	13	16	13	8	9	11	13	12
26	Horse Prairie Creek near Grant	21	23	31	40	33	21	24	28	33	29
27	Rape Creek above reservoir, near Grant	.2	.2	.3	.4	.3	.1	.2	.3	.3	.2
28	Painter Creek near Grant	1	2	2	3	2	1	1	2	2	2
29	Browns Canyon Creek near Grant	.8	1	1	2	1	.7	.8	1	2	1
30	Medicine Lodge Creek near Grant	3	4	6	9	7	3	4	6	8	6
32	Pole Creek near mouth, near Polaris	.5	.6	.8	1	.9	.4	.5	.7	1	.7
33	Reservoir Creek at mouth, near Polaris	.6	.7	1	1	1	.5	.6	1	1	1
34	East Fork Dyce Creek at mouth, near Polaris	.5	.6	.8	1	1	.4	.5	.7	1	.7
35	West Fork Dyce Creek at mouth, near Polaris	.3	.3	.4	.6	.5	.2	.3	.4	.5	.4
36	Grasshopper Creek near Dillon	18	21	30	38	30	19	20	23	32	25
37	Beaverhead River at Barretts	180	230	350	420	350	180	230	300	350	300
38	East Fork Blacktail Creek near Dillon	12	13	16	16	15	11	13	13	15	13
39	West Fork Blacktail Creek near Dillon	5	6	7	8	7	4	5	6	7	6
40	Blacktail Deer Creek near Dillon	26	27	32	38	32	23	25	30	33	30
41	Beaverhead River near Dillon	280	330	470	560	460	210	270	380	440	370

Table 5.--*Estimated monthly streamflow characteristics for December and January*--Continued

Site No.	Stream name	December					January				
		Q.90	Q.80	Q.50	Q.20	QM	Q.90	Q.80	Q.50	Q.20	QM
42	Beaverhead River near Twin Bridges	340	410	510	610	520	270	340	430	510	440
43	Corral Creek at mouth, near Alder	.4	.4	.6	.8	.6	.3	.4	.5	.7	.5
44	Coal Creek at mouth, near Alder	1	2	2	3	2	1	1	2	2	2
45	Ruby River above the forks, near Alder	5	6	7	9	8	4	5	7	8	7
46	East Fork Ruby River at mouth, near Alder	2	2	3	4	3	2	2	3	3	2
47	West Fork Ruby River at mouth, near Alder	2	3	3	4	4	2	2	3	4	3
48	Cottonwood Creek at mouth, near Alder	3	3	4	5	4	2	2	3	4	3
49	Warm Springs Creek at mouth, near Alder[1]	45	46	47	49	48	44	45	47	48	47
50	North Fork Greenhorn Creek at mouth, near Alder	1	2	2	2	2	1	1	2	2	2
51	Ruby River above reservoir, near Alder	93	97	110	130	110	76	90	100	120	100
52	Mill Creek at Forest Service boundary, near Sheridan	6	6	7	8	7	5	6	7	7	6
53	Wisconsin Creek at Forest Service boundary, near Sheridan	4	4	5	6	5	3	4	5	6	5
54	Ruby River near Twin Bridges	140	150	160	200	180	120	120	140	170	150
55	Big Hole River near Jackson	8	9	11	14	12	7	8	10	12	10
56	Andrus Creek near mouth, near Jackson	2	3	3	4	4	2	2	3	4	3
57	Fox Creek at mouth, near Jackson	1	2	2	3	2	1	1	2	3	2
58	Governor Creek near Jackson	10	11	15	17	15	10	11	13	15	13
59	Warm Springs Creek at Jackson	6	7	9	13	10	6	7	8	10	9
60	Miner Creek near Jackson	6	6	8	10	8	5	5	7	9	7
61	Big Lake Creek near mouth, near Wisdom	3	3	4	5	4	2	3	4	5	4
62	Steel Creek above Francis Creek, near Wisdom	1	2	2	3	2	1	2	2	2	2
63	Francis Creek at mouth, near Wisdom	2	2	3	4	3	2	2	3	4	3
64	Steel Creek near mouth, near Wisdom	4	4	6	7	6	4	4	5	6	5
65	Swamp Creek near mouth, near Wisdom	4	5	6	8	7	4	5	6	7	6
66	Joseph Creek at mouth, near Wisdom	2	2	3	4	3	2	2	3	4	3
67	Trail Creek near Wisdom	9	11	16	19	16	11	12	14	15	14
68	Ruby Creek at mouth, near Wisdom	3	4	5	7	6	3	4	5	6	5
69	Tie Creek at Forest Service boundary, near Wisdom	5	5	7	9	8	4	5	6	8	6
70	Johnson Creek near Wisdom	2	3	4	6	5	3	3	4	5	4
71	Mussigbrod Creek near Wisdom	2	2	3	3	3	2	2	3	3	3
72	North Fork Big Hole River near mouth, near Wisdom	19	23	32	40	33	20	23	28	33	28
73	Big Hole River below North Fork, near Wisdom	100	120	150	180	150	85	98	130	160	130
74	Pintlar Creek near Forest Service boundary, near Wisdom	3	4	5	7	6	3	4	5	6	5
75	Big Hole River below Mudd Creek, near Wisdom	110	120	160	200	170	90	110	140	180	140
76	Fishtrap Creek at mouth, near Wise River	4	5	7	10	8	4	5	7	8	7
77	Lamarche Creek near Wise River	8	9	11	14	12	7	8	10	12	10
78	Seymour Creek near Wise River	5	6	8	10	8	4	5	7	9	7
79	Tenmile Creek at mouth, near Wise River	2	2	3	3	3	1	2	2	3	2
80	Sevenmile Creek at mouth, near Wise River	.3	.4	.5	.7	.6	.3	.3	.5	.7	.5
81	Corral Creek at mouth, near Wise River	.4	.5	.7	1	.7	.3	.4	.6	.8	.6

Site No.	Stream name	December Q.90	December Q.80	December Q.50	December Q.20	December QM	January Q.90	January Q.80	January Q.50	January Q.20	January QM
82	Twelvemile Creek at mouth, near Wise River	1	1	2	3	2	1	1	2	2	2
83	Sullivan Creek at mouth, near Wise River	1	2	2	3	2	1	1	2	3	2
84	Oregon Creek near mouth, near Wise River	.1	.2	.2	.3	.3	.1	.1	.2	.3	.2
85	California Creek above American Creek, near Wise River	2	2	2	3	2	1	2	2	3	2
86	American Creek at mouth, near Wise River	.4	.5	.6	.8	.7	.3	.4	.6	.8	.6
87	Sixmile Creek at mouth, near Wise River	.3	.3	.4	.6	.5	.2	.3	.4	.5	.4
88	French Creek near mouth, near Wise River	3	3	4	5	5	2	3	4	5	4
89	Deep Creek near Wise River	15	17	22	23	21	15	17	19	21	18
90	Bear Creek near Wise River	.8	.9	1	1	1	.6	.7	1	1	.9
91	Bryant Creek at mouth, near Wise River	1	2	2	3	2	1	1	2	2	2
92	Big Hole River near Wise River	160	180	220	280	230	130	150	200	250	200
93	Johnson Creek at mouth, near Wise River	.7	.9	1	2	1	.6	.8	1	1	1
94	Meadow Creek near Wise River	1	2	2	3	2	1	1	2	3	2
95	Jacobson Creek at mouth, near Wise River	7	8	11	14	12	6	7	10	12	10
96	Mono Creek at mouth, near Wise River	.8	.9	1	2	1	.6	.7	1	1	1
97	Wyman Creek at mouth, near Wise River	4	4	6	7	6	3	4	5	7	5
98	Lacy Creek at mouth, near Wise River	2	3	4	5	4	2	2	3	4	3
99	Gold Creek at mouth, near Wise River	1	1	2	2	2	.9	1	2	2	2
100	Pattengail Creek at mouth, near Wise River	9	11	14	18	15	8	10	13	16	13
101	Sheep Creek at mouth, near Wise River	2	2	2	3	2	1	1	2	3	2
102	Wise River near Wise River	35	37	44	50	44	31	34	37	43	38
103	Adson Creek at mouth, near Wise River	1	1	1	2	2	.7	.9	1	2	1
104	Jerry Creek near Wise River	4	5	6	7	6	4	4	5	6	5
105	Divide Creek at Divide	2	2	3	5	4	2	2	3	4	3
106	Canyon Creek near Divide	2	3	4	6	5	2	3	4	5	4
107	Moose Creek near Divide	3	4	5	6	5	3	4	4	5	4
108	Trapper Creek near Melrose	3	4	4	6	5	3	3	4	5	4
109	Camp Creek at Melrose	.7	1	1	2	2	.7	.8	1	2	1
110	Big Hole River near Melrose	280	310	390	470	400	230	270	350	430	350
111	Willow Creek near Glen	5	6	7	8	7	5	6	7	8	7
112	Birch Creek near Glen	6	6	8	10	8	6	6	8	10	8
113	Hells Canyon Creek near Twin Bridges	2	2	2	3	2	2	2	2	3	2
114	Jefferson River near Twin Bridges	970	1000	1300	1500	1300	840	890	1000	1200	1100
115	Whitetail Creek near Whitehall	2	2	2	2	2	1	1	1	2	1
117	Boulder River above High Ore Creek, near Basin	16	19	23	30	24	13	17	24	28	23
118	Boulder River near Boulder	21	24	30	38	31	17	22	30	35	29
119	Little Boulder River near Boulder	6	6	8	10	8	5	5	8	9	8
120	Boulder River above Cabin Gulch, near Boulder	26	30	35	43	36	22	28	36	40	34
121	Boulder River near Cardwell	32	37	43	53	45	27	34	44	50	42
122	South Boulder River near Jefferson Island	8	9	11	15	12	8	9	11	14	11
123	Jefferson River at Sappington	1100	1200	1300	1600	1400	910	960	1100	1400	1200
124	South Willow Creek near Pony	8	11	16	19	15	6	9	11	15	12
125	North Willow Creek at Pony	7	9	11	13	11	6	7	8	11	9
126	Willow Creek near Harrison	18	23	30	35	29	15	20	24	29	24
127	Norwegian Creek near Harrison	5	5	5	6	5	3	3	4	5	4

Site No.	Stream name	December Q.90	December Q.80	December Q.50	December Q.20	December QM	January Q.90	January Q.80	January Q.50	January Q.20	January QM
129	Jefferson River near Three Forks	970	1100	1400	1800	1400	1000	1100	1300	1500	1300
130	Madison River near West Yellowstone	340	370	430	460	420	330	360	420	450	410
131	Duck Creek near West Yellowstone	18	19	21	22	20	16	18	19	21	19
132	Cougar Creek near West Yellowstone	6	7	9	14	11	6	7	10	12	10
133	Grayling Creek near West Yellowstone	12	13	16	19	17	10	12	15	18	15
134	Red Canyon Creek near West Yellowstone	.3	.5	.7	2	1	.4	.4	.8	1	1
135	South Fork Madison River near West Yellowstone	85	88	94	100	95	83	87	93	98	93
136	Watkins Creek near West Yellowstone	1	2	2	3	2	1	1	2	3	2
137	Trapper Creek near West Yellowstone	1	1	2	2	2	1	1	2	2	2
138	Madison River below Hebgen Lake, near Grayling	700	770	890	1100	970	690	760	910	1100	890
139	Cabin Creek near West Yellowstone	5	6	7	9	8	4	5	7	8	7
140	Beaver Creek near West Yellowstone	17	18	21	23	21	15	17	19	22	19
141	Elk River at mouth, near Cameron	10	12	15	20	17	8	10	13	17	14
142	Soap Creek at mouth, near Cameron	.6	.6	.8	1	1	.4	.5	.8	1	.8
143	Antelope Creek at mouth, near Cameron[2]	13	13	14	16	15	12	13	14	15	14
144	West Fork Madison River near Cameron	31	35	40	49	42	30	31	36	44	38
145	Squaw Creek near Cameron	5	5	6	7	6	4	5	6	7	6
146	Standard Creek near Cameron	4	4	5	5	5	3	4	4	5	4
147	Ruby Creek near Cameron	3	3	3	4	3	2	2	3	4	3
148	Indian Creek near Cameron	15	17	19	23	20	14	16	18	21	18
149	Madison River near Cameron	920	1000	1100	1300	1200	890	950	1100	1200	1100
150	Blaine Spring Creek near Cameron	21	21	23	25	23	21	22	23	24	23
151	O'Dell Creek near Ennis	99	100	100	100	100	95	97	100	100	99
152	Jack Creek near Ennis	14	15	16	17	16	11	12	14	16	14
153	Moore Creek at Ennis	.5	.6	.8	1	1	.5	.6	.8	1	.8
154	North Fork Meadow Creek at Forest Service boundary, near Ennis	3	4	6	7	6	3	4	5	6	5
155	North Fork Meadow Creek at Highway 287, near Ennis	2	3	4	5	4	2	2	3	4	3
156	Madison River below Ennis Lake, near McAllister	1200	1300	1500	1700	1500	1100	1200	1500	1600	1400
157	Hot Springs Creek near Norris	4	4	5	6	5	3	4	5	6	5
158	Cherry Creek near Norris	13	14	17	20	17	9	12	15	18	15
159	Madison River near Three Forks	1500	1500	1800	1900	1700	1100	1200	1500	1600	1400
160	Cache Creek at mouth, near West Yellowstone	2	2	3	4	3	2	2	3	3	3
161	Taylor Creek near Grayling	17	18	20	22	20	16	17	19	21	19
162	Porcupine Creek near Gallatin Gateway	4	4	5	6	5	3	4	5	6	5
163	Gallatin River above West Fork, near Big Sky	140	150	170	210	180	130	140	170	190	170
164	South Fork West Fork Gallatin River near Gallatin Gateway	8	9	12	15	12	7	9	11	14	11
165	Middle Fork West Fork Gallatin River near Gallatin Gateway	4	4	5	7	6	3	4	5	6	5
166	West Fork Gallatin River near Gallatin Gateway	17	18	23	28	24	15	17	21	25	21
167	Squaw Creek near Gallatin Gateway	12	12	14	17	14	10	11	13	15	13
168	Hellroaring Creek near Gallatin Gateway	13	14	17	20	17	12	13	15	18	15

Site No.	Stream name	December					January				
		Q.90	Q.80	Q.50	Q.20	QM	Q.90	Q.80	Q.50	Q.20	QM
169	South Fork Spanish Creek near Gallatin Gateway	8	9	10	12	10	7	8	10	11	9
170	Spanish Creek near Gallatin Gateway	17	18	22	27	22	15	17	20	24	20
171	Gallatin River near Gallatin Gateway	260	280	320	390	330	250	270	310	350	310
172	Big Bear Creek near Gallatin Gateway	3	3	4	5	4	3	3	4	4	4
173	South Cottonwood Creek near Gallatin Gateway	11	11	13	16	14	10	11	13	15	13
174	Baker Creek near Manhattan[3]	75	84	94	110	95	66	74	83	98	84
175	Rocky Creek near Bozeman	7	9	11	16	12	7	8	10	14	11
176	Bear Canyon Creek near Bozeman	.7	1	2	3	2	.6	1	1	2	2
177	Sourdough Creek near Bozeman	8	9	11	12	11	7	8	10	12	10
178	East Gallatin River at Bozeman	35	41	46	52	47	31	36	40	46	41
179	Bridger Creek near Bozeman	5	5	8	12	9	4	4	6	11	7
180	East Gallatin River near Belgrade	31	37	47	59	49	28	32	38	55	42
181	East Fork Hyalite Creek near Bozeman	2	3	3	5	4	2	2	3	4	4
182	West Fork Hyalite Creek near Bozeman	5	6	8	10	9	5	6	7	9	8
183	Hyalite Creek at Hyalite Ranger Station, near Bozeman	13	15	21	25	21	10	13	18	21	18
184	Hyalite Creek above Interstate 90, near Bozeman	4	4	6	7	6	3	4	5	7	5
185	Thompson Creek near Belgrade	24	26	30	32	29	24	27	31	34	30
186	Ben Hart Creek near Belgrade	29	29	30	32	30	28	28	29	30	30
187	Reese Creek near Belgrade	6	6	8	9	8	4	6	7	8	7
188	East Gallatin River near Manhattan	140	140	160	180	160	130	140	150	160	150
189	Gallatin River near Logan	650	730	790	910	800	580	650	710	830	720
190	Sixteenmile Creek near Ringling	2	2	4	6	4	.2	.8	3	5	3
191	Sixteenmile Creek near Maudlow	15	16	22	27	23	13	16	18	24	20
192	Sixteenmile Creek near Toston	18	21	29	40	33	17	20	25	35	28
193	Missouri River near Toston	3200	3300	3800	4300	3900	2700	3000	3400	3900	3400
194	Crow Creek near Radersburg	6	7	9	11	9	4	5	7	9	7
195	Dry Creek near Toston	2	2	3	3	3	1	2	2	3	2
196	Deep Creek below North Fork, near Townsend	5	6	8	11	9	4	5	7	9	7
197	Duck Creek near Townsend	2	3	3	4	3	2	2	3	3	3
198	Confederate Gulch near Winston	3	4	5	5	5	3	3	4	5	4
199	Beaver Creek near Winston	1	2	4	5	4	1	2	3	4	3
200	Avalanche Gulch near Winston	.8	1	2	3	2	1	1	2	2	2
201	Spokane Creek near East Helena	3	3	4	4	4	3	3	3	4	3
202	McGuire Creek at county road, near East Helena	6	6	7	7	7	6	6	7	7	7
203	Trout Creek at mouth, near East Helena	11	11	13	14	13	10	11	11	13	12
204	Prickly Pear Creek near Clancy	16	17	22	26	23	13	16	18	24	20
205	Prickly Pear Creek at mouth, near East Helena	21	22	26	30	27	19	21	23	28	25
206	Tenmile Creek near Rimini	.4	.6	1	2	2	.3	.5	1	2	1
207	Tenmile Creek near Helena	2	3	6	10	7	3	4	5	10	7
208	Sevenmile Creek near mouth, near Helena	1	1	2	3	2	1	1	2	3	2
209	Tenmile Creek at mouth, near East Helena	2	2	3	5	4	2	2	3	4	3
210	Silver Creek at Interstate 15, near Helena	8	8	9	10	10	7	8	8	10	9
211	Beaver Creek at mouth, near East Helena	5	6	7	9	8	5	5	6	8	7
212	Elkhorn Creek near mouth, near Wolf Creek	3	3	4	5	4	2	3	3	5	4
213	Willow Creek below Elkhorn Creek, near Wolf Creek	2	2	3	4	3	2	2	3	3	3

Site No.	Stream name	December Q.90	December Q.80	December Q.50	December Q.20	December QM	January Q.90	January Q.80	January Q.50	January Q.20	January QM
214	Cottonwood Creek above Beartooth Ranch, near Wolf Creek	.4	.5	.7	1	.9	.4	.4	.7	1	.7
217	Virginia Creek at mouth, near Canyon Creek	4	6	9	11	8	3	4	6	7	6
218	Canyon Creek below Cottonwood Creek, near Canyon Creek	6	8	13	19	14	4	5	9	12	9
219	Little Prickly Pear Creek near Canyon Creek	15	20	27	33	26	12	14	19	24	20
220	Lyons Creek near Wolf Creek	5	5	6	8	7	4	5	5	7	6
221	Wolf Creek at mouth, at Wolf Creek	2	2	3	4	4	2	2	3	4	3
222	Little Prickly Pear Creek near Wolf Creek	45	50	57	67	58	32	38	50	61	51
223	Wegner Creek near Craig[4]	0	0	0	0	0	0	0	0	0	0
224	Stickney Creek near Craig[5]	0	0	0	0	0	0	0	0	0	0
226	Middle Fork Dearborn River at Highway 200, near Wolf Creek	6	7	9	11	9	5	6	8	9	8
227	South Fork Dearborn River at Highway 434, near Wolf Creek	5	6	8	9	8	4	5	7	8	6
228	Dearborn River near Craig	40	47	62	83	67	36	41	53	67	56
229	Flat Creek above Slew Creek, near Craig	6	8	11	14	11	6	7	9	11	9
230	Sheep Creek at mouth, near Cascade	8	9	12	13	11	6	8	11	12	10
232	North Fork Smith River at Highway 89, near White Sulphur Springs	2	3	4	6	4	2	3	4	5	4
233	South Fork Smith River at mouth, near White Sulphur Springs	7	7	10	12	10	6	7	9	12	9
234	Smith River below forks, near White Sulphur Springs	8	9	12	16	13	7	8	11	13	11
235	Big Birch Creek at mouth, near White Sulphur Springs	13	14	21	27	20	10	12	17	26	18
236	Newlan Creek below Charcoal Gulch, near White Sulphur Springs	3	4	5	6	5	3	3	4	5	4
237	Camas Creek near mouth, near White Sulphur Springs	3	4	5	7	6	3	3	5	6	5
238	Smith River near Fort Logan	79	84	98	110	99	73	80	95	110	95
239	Sheep Creek near White Sulphur Springs	7	8	11	12	11	6	7	10	11	9
240	Sheep Creek near mouth, near White Sulphur Springs	10	13	18	24	20	10	12	17	22	17
241	Eagle Creek near mouth, near White Sulphur Springs	1	2	2	3	3	1	2	3	3	2
242	Rock Creek below Buffalo Canyon, near White Sulphur Springs	5	6	8	11	9	5	6	8	10	8
243	Tenderfoot Creek below South Fork, near White Sulphur Springs	9	10	13	15	13	7	9	12	14	11
244	Smith River near Eden	54	66	110	150	120	51	61	93	140	100
245	Hound Creek near mouth, near Cascade	8	11	15	20	16	9	10	14	18	15
246	Missouri River near Ulm	4000	4500	5300	6100	5400	3700	4200	5300	6400	5300
247	North Fork Sun River near Augusta	59	63	71	94	79	50	54	65	74	66
248	Sun River near Augusta	41	99	180	260	200	26	92	170	240	180
249	Sun River below diversion dam, near Augusta	73	85	130	170	130	75	82	110	160	120
250	Willow Creek near Anderson Lake, near Augusta	2	2	2	3	3	1	2	2	3	2
251	North Fork Willow Creek below Cutrock Creek, near Augusta	2	3	3	3	3	2	2	3	3	3
254	Smith Creek near Augusta	5	6	8	12	10	4	5	7	10	7
255	Ford Creek near Augusta	4	6	10	13	10	4	6	8	10	8
256	Elk Creek near Augusta	18	19	23	27	24	12	17	26	37	31
257	Sun River at Simms	130	140	180	210	190	120	140	180	240	190
260	Missouri River near Great Falls	4300	4800	5800	6800	5800	3800	4600	5400	7100	5700
261	Dry Fork at mouth, at Monarch	5	5	8	11	9	4	5	7	9	7

Site No.	Stream name	December Q.90	December Q.80	December Q.50	December Q.20	December QM	January Q.90	January Q.80	January Q.50	January Q.20	January QM
262	Tillinghast Creek above Joice Creek, near Monarch	4	5	7	8	7	3	4	6	7	6
263	Pilgrim Creek at mouth, near Monarch	4	4	5	7	6	3	4	6	8	6
264	Logging Creek at Logging Creek Campground, near Monarch	5	5	6	7	6	4	4	6	6	5
265	Belt Creek near Monarch	18	22	37	47	35	14	17	29	38	29
266	Big Otter Creek above Never Sweat Creek, near Raynesford	4	5	5	6	6	4	4	5	6	5
267	Belt Creek near Portage	10	12	22	34	24	7	9	17	27	17
268	Highwood Creek below Smith Creek, near Highwood	4	4	5	6	5	3	4	5	6	5
269	Missouri River at Fort Benton	3800	4300	5400	6900	5600	4000	5000	5600	7200	6000
270	Shonkin Creek below Bishop Creek, near Highwood	2	3	3	3	3	2	3	3	4	3
271	South Fork Two Medicine River near East Glacier	9	10	14	19	15	8	9	12	14	12
273	South Fork Badger Creek near Browning	10	11	14	19	16	8	9	12	16	13
274	North Fork Badger Creek near Browning	9	10	13	18	15	7	8	11	15	12
278	Birch Creek at Swift Dam, near Valier	.0	1	7	17	13	.6	1	8	13	8
279	South Fork Dupuyer Creek near Dupuyer	2	2	3	4	3	2	2	3	3	3
280	North Fork Dupuyer Creek near Dupuyer	2	3	3	5	4	2	2	3	4	3
281	Dupuyer Creek below Scoffin Creek, near Dupuyer	7	9	13	16	13	6	7	9	12	10
282	Birch Creek near Valier	34	37	39	51	44	18	25	34	45	35
283	Cut Bank Creek near Browning	13	22	36	59	42	5	17	31	49	33
284	Cut Bank Creek at Cut Bank	17	23	35	61	44	17	23	33	50	38
285	Marias River at Sullivan Bridge, near Cut Bank	150	170	240	360	280	120	150	210	300	230
286	Marias River near Shelby	150	170	250	370	290	120	150	210	310	240
287	Marias River at "F" Bridge, above Tiber Reservoir, near Shelby	170	190	290	440	340	140	180	240	360	280
288	Marias River near Loma	110	180	370	650	390	110	160	300	500	330
290	Teton River near Strabane	8	15	19	23	19	7	14	16	20	16
291	McDonald Creek near Strabane	8	9	9	11	10	8	9	9	10	10
292	North Fork Deep Creek near Choteau	3	3	4	6	5	2	3	4	5	4
293	South Fork Deep Creek near Choteau	3	3	4	6	5	2	3	4	5	4
294	Deep Creek near Choteau	7	7	9	10	9	6	7	7	9	8
295	Teton River near Dutton	30	39	58	94	68	37	42	55	66	55
296	Missouri River at Virgelle	4600	5200	6500	7400	6400	4100	4900	6000	7700	6300
297	Lost Creek at mouth, near Utica	5	5	7	9	7	4	5	6	8	6
298	Yogo Creek at mouth, near Utica	.4	.7	1	3	2	.7	.7	2	2	2
299	Middle Fork Judith River, near Utica	.3	.5	2	3	2	.0	.0	.1	.3	0
301	South Fork Judith River at Indian Hill Campground, near Utica	1	1	2	2	2	1	1	2	2	2
303	Judith River above Courtneys Creek, at Utica	5	7	9	12	10	5	6	8	10	8
306	East Fork Big Spring Creek at mouth, near Lewistown	3	4	6	9	7	4	4	6	8	6
307	Big Spring Creek above Cottonwood Creek, near Hanover	92	100	110	120	110	96	98	100	110	110
309	Cottonwood Creek at Highway 200, near Lewistown	2	2	3	4	3	2	2	3	4	3
310	Beaver Creek at county road, near Lewistown	6	7	9	10	9	5	6	7	10	8
311	Big Spring Creek at mouth, near Lewistown	70	82	96	110	98	76	80	89	100	92

Site No.	Stream name	December					January				
		Q.90	Q.80	Q.50	Q.20	QM	Q.90	Q.80	Q.50	Q.20	QM
312	Warm Springs Creek above Meadow Creek, near Hilger	96	100	100	110	100	96	100	110	110	100
313	Judith River near Winifred	240	250	470	590	420	240	240	490	600	430
315	Cow Creek below forks, near Cleveland	2	3	3	4	4	2	2	3	3	3
316	Missouri River near Landusky	4900	5600	6900	7900	6900	4600	5200	6600	8300	6700
317	North Fork Musselshell River near Delpine	5	5	6	7	6	4	4	6	7	6
318	Checkerboard Creek near Checkerboard	.7	.9	1	2	1	.7	.8	1	2	1
319	Spring Creek below Whitetail Creek, near Checkerboard	2	3	3	4	4	2	2	3	4	3
320	North Fork Musselshell River near mouth, near Martinsdale	5	6	8	9	8	5	5	7	9	7
321	Alabaugh Creek at mouth, near Lennep	1	2	2	3	3	1	2	2	3	2
322	Cottonwood Creek below Loco Creek, near Martinsdale	7	8	10	11	10	6	7	9	11	8
323	South Fork Musselshell River above Martinsdale	11	14	21	27	22	8	11	17	23	18
324	Big Elk Creek at mouth, at Twodot	.2	.6	8	11	7	.1	.3	6	8	5
325	Musselshell River at Harlowton	37	47	67	91	72	31	43	56	74	61
326	American Fork near Harlowton	1	2	3	5	3	.8	1	2	3	2
330	Careless Creek below Little Careless Creek, near Hedgesville	.5	.6	.8	1	1	.4	.5	.8	1	.8
331	Swimming Woman Creek below Dry Coulee, near Franklin	.4	.5	.6	.8	.7	.4	.4	.6	.8	.6
333	Musselshell River near Roundup	16	25	57	110	71	24	34	52	110	69
335	Flatwillow Creek below the forks, near Grass Range	2	3	5	11	8	3	3	6	9	7
338	Musselshell River near Mosby	17	31	67	130	82	11	21	70	120	86
339	Big Dry Creek above Little Dry Creek, near Van Norman	.0	.0	.4	.8	1	.0	.0	.0	.8	1
340	Little Dry Creek near Van Norman	.0	.2	.8	2	2	.0	.0	.1	1	2
341	Big Dry Creek near Van Norman	.0	.2	1	2	3	.0	.0	.1	2	3

[1]Includes estimated spring flow of about 40 cubic feet per second, based on information provided by Montana Department of Fish, Wildlife and Parks.

[2]Includes estimated spring flow of about 10 cubic feet per second, based on information provided by Montana Department of Fish, Wildlife and Parks.

[3]Estimated long-term monthly streamflow characteristics may not reflect the current flow regime because of upstream streamflow regulation.

[4]Stream is known to be dry except for periods of runoff. Calculated flows were adjusted by subtracting 7 cubic feet per second.

[5]Stream is known to be dry except for periods of runoff. Calculated flows were adjusted by subtracting 8 cubic feet per second.

Table 5.-- Estimated monthly streamflow characteristics for December and January.

[Q.XX, monthly mean streamflow for specified month exceeded XX percent of the years, in cubic feet per second; QM, mean montnly streamflow for specified month, in cubic feet per second]

Site no.	Stream name	December Q.90	Q.80	Q.50	Q.20	QM	January Q.90	Q.80	Q.50	Q.20	QM
366	ROCK CREEK AT MOUTH NEAR WISDOM	3	4	5	6	5	3	3	5	6	5
367	DELANO CREEK AT MOUTH NEAR WISE RIVER	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.2
368	HALFWAY CREEK AT MOUTH NEAR WHITEHALL	1	1	2	2	2	0.8	1	1	2	1
369	N.F DEEP CREEK AT MOUTH NR MILLIGAN	0.7	0.8	1	2	1	0.6	0.7	1	1	1
370	COLLAR GULCH AT MOUTH NEAR MAIDEN	0.2	0.2	0.3	0.4	0.4	0.2	0.2	0.3	0.4	0.3
371	BADGER CREEK BEL FORKS NR BROWNING	18	20	27	36	30	15	18	23	30	24

PROVISIONAL

Table 6.--*Estimated monthly streamflow characteristics for February and March*

[Q.XX, monthly mean streamflow for specified month exceeded XX percent of the years, in cubic feet per second; QM, mean monthly streamflow for specified month, in cubic feet per second]

Site No.	Stream name	February Q.90	February Q.80	February Q.50	February Q.20	February QM	March Q.90	March Q.80	March Q.50	March Q.20	March QM
1	Hellroaring Creek near Lakeview	4	4	5	7	5	4	4	4	5	4
2	Corral Creek near Lakeview	.5	.5	.6	.8	.7	.5	.5	.5	.6	.5
3	Antelope Creek near Lakeview	.1	.1	.2	.2	.2	.2	.2	.2	.2	.2
4	Red Rock Creek near Lakeview	8	9	10	12	10	8	8	9	10	9
5	Tom Creek near Lakeview	.2	.3	.4	.5	.4	.2	.3	.4	.4	.4
6	Narrows Creek at mouth, near Lakeview	.1	.1	.2	.2	.2	.1	.1	.2	.3	.2
7	Odell Creek near Lakeview	3	4	5	6	5	3	4	4	4	4
8	Jones Creek near Lakeview	.4	.5	.6	.9	.7	.4	.5	.8	1	.9
9	Red Rock River near Kennedy Ranch, near Lakeview	16	31	47	63	49	26	42	56	98	67
10	Peet Creek at county road, near Lakeview	.4	.5	.7	1	.7	.5	.6	.8	1	1
11	Long Creek near Lakeview	2	2	2	3	2	2	2	2	2	2
12	East Fork Clover Creek at mouth, near Monida	.5	.6	.8	1	.9	.6	.7	1	2	1
13	Red Rock River below Lima Reservoir, near Monida	8	14	22	31	22	7	13	21	28	21
14	Cabin Creek above Simpson Creek, near Lima	.2	.2	.3	.4	.3	.2	.2	.4	.6	.4
15	Indian Creek above Simpson Creek, near Lima	.3	.3	.4	.5	.4	.3	.3	.5	.7	.6
16	Simpson Creek above Indian Creek, near Lima	.3	.3	.4	.6	.5	.3	.4	.6	.8	.6
17	Deadman Creek near Dell	2	2	3	4	3	3	3	4	5	5
18	Big Sheep Creek below Muddy Creek, near Dell	32	35	39	46	41	36	39	46	53	48
19	Red Rock River at Red Rock	140	140	160	180	170	120	140	170	200	190
20	Black Canyon Creek near Grant	1	1	2	2	2	1	2	2	3	2
21	Shennon Creek near mouth, near Grant	.3	.4	.5	.7	.5	.3	.4	.6	1	.7
22	Frying Pan Creek near Grant	.8	1	1	2	1	1	1	2	3	2
23	Trapper Creek at mouth, near Grant	.2	.3	.4	.5	.4	.3	.3	.5	.8	.6
24	Bear Creek near Grant	2	2	2	4	3	2	2	3	4	3
25	Bloody Dick Creek near Grant	7	8	10	16	12	8	9	12	17	13
26	Horse Prairie Creek near Grant	21	25	30	41	32	29	31	39	63	47
27	Rape Creek above reservoir, near Grant	.1	.2	.2	.3	.3	.2	.2	.3	.5	.4
28	Painter Creek near Grant	1	1	2	2	2	1	2	2	3	2
29	Browns Canyon Creek near Grant	.7	.9	1	2	1	.8	1	1	2	2
30	Medicine Lodge Creek near Grant	2	4	6	8	6	5	6	9	13	11
32	Pole Creek near mouth, near Polaris	.4	.5	.7	1	.8	.5	.6	.9	1	1
33	Reservoir Creek at mouth, near Polaris	.6	.7	1	1	1	.7	.8	1	2	2
34	East Fork Dyce Creek at mouth, near Polaris	.4	.5	.6	.9	.7	.5	.6	.8	1	1
35	West Fork Dyce Creek at mouth, near Polaris	.2	.3	.3	.5	.4	.2	.3	.5	.7	.5
36	Grasshopper Creek near Dillon	19	21	27	33	27	27	32	44	73	53
37	Beaverhead River at Barretts	180	230	310	360	300	200	270	330	420	340
38	East Fork Blacktail Creek near Dillon	11	11	13	19	15	12	13	14	20	15
39	West Fork Blacktail Creek near Dillon	4	5	6	8	6	5	6	8	10	9
40	Blacktail Deer Creek near Dillon	20	27	34	40	34	31	36	41	53	44
41	Beaverhead River near Dillon	260	300	380	470	380	280	320	410	520	420

Table 6.--*Estimated monthly streamflow characteristics for February and March*--Continued

Site No.	Stream name	February Q.90	Q.80	Q.50	Q.20	QM	March Q.90	Q.80	Q.50	Q.20	QM
42	Beaverhead River near Twin Bridges	340	380	450	520	450	360	400	500	590	500
43	Corral Creek at mouth, near Alder	.3	.4	.5	.7	.6	.4	.4	.7	1	.8
44	Coal Creek at mouth, near Alder	1	1	2	3	2	1	2	2	3	3
45	Ruby River above the forks, near Alder	5	5	7	9	7	5	6	8	12	9
46	East Fork Ruby River at mouth, near Alder	2	2	2	3	3	2	2	3	4	3
47	West Fork Ruby River at mouth, near Alder	2	2	3	4	3	2	3	4	5	4
48	Cottonwood Creek at mouth, near Alder	2	3	3	4	4	2	3	4	6	4
49	Warm Springs Creek at mouth, near Alder[1]	44	45	47	49	47	45	46	48	51	49
50	North Fork Greenhorn Creek at mouth, near Alder	1	1	2	2	2	1	1	2	3	2
51	Ruby River above reservoir, near Alder	84	90	100	110	100	89	94	110	120	110
52	Mill Creek at Forest Service boundary, near Sheridan	5	5	6	8	7	5	5	5	6	5
53	Wisconsin Creek at Forest Service boundary, near Sheridan	3	4	5	6	5	3	3	4	4	4
54	Ruby River near Twin Bridges	110	120	130	150	130	110	120	150	210	170
55	Big Hole River near Jackson	7	8	10	13	11	8	9	11	15	12
56	Andrus Creek near mouth, near Jackson	2	2	3	4	3	2	3	4	6	4
57	Fox Creek at mouth, near Jackson	1	1	2	3	2	1	2	2	3	3
58	Governor Creek near Jackson	9	10	12	18	13	9	10	13	18	15
59	Warm Springs Creek at Jackson	5	6	8	12	9	6	7	10	13	11
60	Miner Creek near Jackson	5	6	7	9	7	5	6	8	10	8
61	Big Lake Creek near mouth, near Wisdom	2	3	4	5	4	3	3	4	6	5
62	Steel Creek above Francis Creek, near Wisdom	1	1	2	3	2	1	1	2	3	2
63	Francis Creek at mouth, near Wisdom	2	2	3	4	3	2	2	3	4	3
64	Steel Creek near mouth, near Wisdom	3	4	5	7	5	3	4	5	7	6
65	Swamp Creek near mouth, near Wisdom	4	4	5	8	5	3	4	5	7	5
66	Joseph Creek at mouth, near Wisdom	2	2	3	4	3	2	2	3	4	3
67	Trail Creek near Wisdom	9	9	12	21	14	9	10	13	20	15
68	Ruby Creek at mouth, near Wisdom	3	3	4	7	5	3	3	5	7	6
69	Tie Creek at Forest Service boundary, near Wisdom	4	5	6	8	6	5	5	7	10	8
70	Johnson Creek near Wisdom	2	3	3	5	4	2	3	4	6	5
71	Mussigbrod Creek near Wisdom	1	2	2	3	2	1	1	2	2	2
72	North Fork Big Hole River near mouth, near Wisdom	17	20	26	41	28	18	20	28	40	32
73	Big Hole River below North Fork, near Wisdom	100	110	130	180	140	120	130	160	210	180
74	Pintlar Creek near Forest Service boundary, near Wisdom	3	3	4	6	4	2	3	4	5	4
75	Big Hole River below Mudd Creek, near Wisdom	110	120	140	190	150	130	140	170	230	190
76	Fishtrap Creek at mouth, near Wise River	3	4	6	8	6	3	4	6	7	6
77	Lamarche Creek near Wise River	6	8	10	12	10	7	8	10	13	11
78	Seymour Creek near Wise River	4	5	7	9	7	5	6	8	10	9
79	Tenmile Creek at mouth, near Wise River	1	2	2	3	2	2	2	3	3	3
80	Sevenmile Creek at mouth, near Wise River	.3	.4	.5	.7	.5	.3	.4	.6	1	.7
81	Corral Creek at mouth, near Wise River	.4	.5	.6	.9	.7	.4	.5	.8	1	.9

Site No.	Stream name	February Q.90	February Q.80	February Q.50	February Q.20	February QM	March Q.90	March Q.80	March Q.50	March Q.20	March QM
82	Twelvemile Creek at mouth, near Wise River	1	1	2	2	2	1	2	2	3	2
83	Sullivan Creek at mouth, near Wise River	1	1	2	2	2	1	2	2	3	2
84	Oregon Creek near mouth, near Wise River	.1	.2	.2	.3	.3	.1	.2	.3	.5	.4
85	California Creek above American Creek, near Wise River	1	2	2	3	2	2	2	3	4	3
86	American Creek at mouth, near Wise River	.4	.4	.6	.8	.6	.4	.5	.8	1	.9
87	Sixmile Creek at mouth, near Wise River	.2	.3	.4	.6	.4	.3	.3	.5	.8	.6
88	French Creek near mouth, near Wise River	3	3	4	6	4	3	4	5	8	6
89	Deep Creek near Wise River	14	15	18	27	20	14	15	17	26	19
90	Bear Creek near Wise River	.6	.7	.9	1	.9	.6	.6	.7	1	.8
91	Bryant Creek at mouth, near Wise River	1	1	2	3	2	1	2	2	3	3
92	Big Hole River near Wise River	160	170	200	270	210	180	200	240	320	280
93	Johnson Creek at mouth, near Wise River	.7	.8	1	2	1	.8	1	1	2	2
94	Meadow Creek near Wise River	1	2	2	3	2	1	2	2	3	3
95	Jacobson Creek at mouth, near Wise River	6	7	9	12	10	7	8	10	14	11
96	Mono Creek at mouth, near Wise River	.7	.8	1	2	1	.7	1	1	2	1
97	Wyman Creek at mouth, near Wise River	3	4	5	7	5	4	5	6	8	7
98	Lacy Creek at mouth, near Wise River	2	2	3	4	3	2	3	4	5	4
99	Gold Creek at mouth, near Wise River	1	1	1	2	2	1	1	2	2	2
100	Pattengail Creek at mouth, near Wise River	8	10	13	16	13	10	12	15	20	16
101	Sheep Creek at mouth, near Wise River	1	1	2	3	2	1	2	2	3	3
102	Wise River near Wise River	31	32	36	40	36	30	34	40	45	40
103	Adson Creek at mouth, near Wise River	.8	1	1	2	1	.9	1	2	2	2
104	Jerry Creek near Wise River	4	4	5	7	5	4	4	5	7	6
105	Divide Creek at Divde	1	2	3	3	3	2	2	4	4	4
106	Canyon Creek near Divide	2	3	4	4	4	2	3	4	5	5
107	Moose Creek near Divide	3	3	4	6	5	4	4	5	7	5
108	Trapper Creek near Melrose	3	3	4	5	4	3	4	5	6	5
109	Camp Creek at Melrose	.5	1	2	2	1	1	2	2	5	3
110	Big Hole River near Melrose	280	290	340	450	370	320	350	420	550	470
111	Willow Creek near Glen	5	6	6	8	7	5	6	7	8	7
112	Birch Creek near Glen	5	6	7	8	7	5	6	7	9	7
113	Hells Canyon Creek near Twin Bridges	1	2	2	3	2	2	2	2	3	3
114	Jefferson River near Twin Bridges	880	970	1100	1300	1100	910	1000	1200	1500	1200
115	Whitetail Creek near Whitehall	1	1	2	3	2	1	1	2	3	2
117	Boulder River above High Ore Creek, near Basin	15	19	26	33	26	23	26	34	48	39
118	Boulder River near Boulder	19	25	33	42	33	30	34	43	62	50
119	Little Boulder River near Boulder	5	6	8	10	8	7	8	10	15	11
120	Boulder River above Cabin Gulch, near Boulder	25	30	38	47	39	35	39	47	65	54
121	Boulder River near Cardwell	30	37	47	58	48	43	48	58	79	67
122	South Boulder River near Jefferson Island	7	8	11	14	11	4	9	10	14	11
123	Jefferson River at Sappington	960	1000	1200	1400	1300	1100	1300	1400	1600	1400
124	South Willow Creek near Pony	7	9	12	17	14	12	13	16	23	17
125	North Willow Creek at Pony	7	7	9	12	11	10	11	12	16	13
126	Willow Creek near Harrison	17	20	25	31	27	25	26	30	36	31
127	Norwegian Creek near Harrison	4	4	5	5	5	5	6	7	7	7

Site No.	Stream name	February Q.90	February Q.80	February Q.50	February Q.20	February QM	March Q.90	March Q.80	March Q.50	March Q.20	March QM
129	Jefferson River near Three Forks	880	1100	1400	1700	1400	1300	1400	1700	1900	1600
130	Madison River near West Yellowstone	340	370	410	440	410	340	380	410	430	410
131	Duck Creek near West Yellowstone	17	18	20	23	21	18	19	20	24	20
132	Cougar Creek near West Yellowstone	5	7	9	10	8	5	6	9	9	9
133	Grayling Creek near West Yellowstone	9	12	14	17	14	8	9	11	11	11
134	Red Canyon Creek near West Yellowstone	.2	.4	.6	.7	.6	.3	.4	.8	.8	1
135	South Fork Madison River near West Yellowstone	82	87	93	98	92	84	87	92	100	93
136	Watkins Creek near West Yellowstone	1	1	2	2	2	1	1	2	2	2
137	Trapper Creek near West Yellowstone	1	1	1	2	2	1	1	1	2	1
138	Madison River below Hebgen Lake, near Grayling	570	680	790	950	820	390	550	800	1100	810
139	Cabin Creek near West Yellowstone	4	5	6	7	6	3	3	4	4	4
140	Beaver Creek near West Yellowstone	14	16	19	24	20	14	15	17	18	17
141	Elk River at mouth, near Cameron	8	10	13	16	13	10	11	14	18	15
142	Soap Creek at mouth, near Cameron	.5	.5	.7	1	.8	.5	.6	1	1	1
143	Antelope Creek at mouth, near Cameron[2]	13	13	14	15	14	13	14	15	17	16
144	West Fork Madison River near Cameron	28	31	38	45	39	32	34	42	53	45
145	Squaw Creek near Cameron	4	5	6	7	6	5	5	6	6	6
146	Standard Creek near Cameron	3	4	4	5	5	3	3	4	5	4
147	Ruby Creek near Cameron	2	2	3	4	3	2	3	3	4	3
148	Indian Creek near Cameron	13	15	18	22	19	13	13	15	17	16
149	Madison River near Cameron	780	880	1000	1200	1000	710	810	1000	1300	1100
150	Blaine Spring Creek near Cameron	21	21	22	24	23	21	22	23	24	23
151	O'Dell Creek near Ennis	94	95	98	99	98	94	95	99	100	98
152	Jack Creek near Ennis	11	12	13	14	13	11	11	14	15	13
153	Moore Creek at Ennis	.4	.6	.7	.8	.7	.4	.5	.9	.9	1
154	North Fork Meadow Creek at Forest Service boundary, near Ennis	3	3	5	6	5	2	3	4	6	4
155	North Fork Meadow Creek at Highway 287, near Ennis	2	2	3	4	3	2	2	3	3	3
156	Madison River below Ennis Lake, near McAllister	1000	1200	1400	1600	1400	980	1200	1400	1700	1400
157	Hot Springs Creek near Norris	3	4	5	6	5	3	4	5	6	6
158	Cherry Creek near Norris	14	15	17	20	18	14	15	18	24	20
159	Madison River near Three Forks	1100	1200	1400	1600	1400	990	1200	1400	1800	1500
160	Cache Creek at mouth, near West Yellowstone	2	2	2	3	3	2	2	3	4	3
161	Taylor Creek near Grayling	14	16	19	24	20	14	14	16	18	17
162	Porcupine Creek near Gallatin Gateway	3	4	5	6	5	3	3	4	4	4
163	Gallatin River above West Fork, near Big Sky	130	140	170	190	160	130	150	160	200	170
164	South Fork West Fork Gallatin River near Gallatin Gateway	7	9	11	13	10	7	8	10	12	10
165	Middle Fork West Fork Gallatin River near Gallatin Gateway	3	4	5	6	5	4	4	5	6	5
166	West Fork Gallatin River near Gallatin Gateway	15	17	21	25	21	14	16	19	24	20
167	Squaw Creek near Gallatin Gateway	11	12	13	16	14	12	13	14	17	15
168	Hellroaring Creek near Gallatin Gateway	12	13	16	19	16	13	14	15	20	16

Table 6.--*Estimated monthly streamflow characteristics for February and March*--Continued

Site No.	Stream name	February Q.90	February Q.80	February Q.50	February Q.20	February QM	March Q.90	March Q.80	March Q.50	March Q.20	March QM
169	South Fork Spanish Creek near Gallatin Gateway	7	8	9	11	9	7	7	8	11	8
170	Spanish Creek near Gallatin Gateway	15	17	21	25	21	16	18	20	27	21
171	Gallatin River near Gallatin Gateway	240	270	310	350	310	250	270	310	370	310
172	Big Bear Creek near Gallatin Gateway	3	3	3	4	3	3	3	3	4	4
173	South Cottonwood Creek near Gallatin Gateway	10	11	12	15	13	10	11	13	16	13
174	Baker Creek near Manhattan[3]	68	75	85	99	88	81	87	100	110	100
175	Rocky Creek near Bozeman	6	9	11	14	12	10	11	15	22	17
176	Bear Canyon Creek near Bozeman	.5	1	2	3	2	1	2	3	5	4
177	Sourdough Creek near Bozeman	7	8	10	11	10	8	8	10	12	11
178	East Gallatin River at Bozeman	31	37	45	51	44	43	51	56	66	60
179	Bridger Creek near Bozeman	5	5	7	10	8	7	8	11	24	15
180	East Gallatin River near Belgrade	27	33	46	59	49	42	52	61	90	69
181	East Fork Hyalite Creek near Bozeman	2	2	3	4	3	2	3	3	4	3
182	West Fork Hyalite Creek near Bozeman	5	6	7	9	7	5	5	7	8	7
183	Hyalite Creek at Hyalite Ranger Station, near Bozeman	12	13	17	21	17	11	14	17	23	18
184	Hyalite Creek above Interstate 90, near Bozeman	3	4	5	6	5	3	3	4	5	5
185	Thompson Creek near Belgrade	21	25	30	35	29	20	23	30	34	29
186	Ben Hart Creek near Belgrade	27	28	29	32	29	27	28	29	32	30
187	Reese Creek near Belgrade	5	5	7	8	7	6	6	7	9	8
188	East Gallatin River near Manhattan	140	140	160	180	170	150	160	170	210	180
189	Gallatin River near Logan	600	650	740	840	750	700	740	860	950	850
190	Sixteenmile Creek near Ringling	.8	2	4	6	5	2	3	11	32	26
191	Sixteenmile Creek near Maudlow	16	17	21	29	24	20	23	28	41	31
192	Sixteenmile Creek near Toston	18	22	28	37	31	26	31	41	58	47
193	Missouri River near Toston	3100	3400	3800	4200	3800	3200	3500	3900	4800	4100
194	Crow Creek near Radersburg	8	8	9	10	9	7	7	9	12	10
195	Dry Creek near Toston	2	2	2	3	3	2	2	3	5	3
196	Deep Creek below North Fork, near Townsend	6	6	8	9	8	6	7	9	10	10
197	Duck Creek near Townsend	2	3	3	3	3	2	2	3	4	3
198	Confederate Gulch near Winston	4	4	4	5	5	4	4	4	6	5
199	Beaver Creek near Winston	1	1	3	4	3	1	2	4	6	4
200	Avalanche Gulch near Winston	.7	1	2	2	2	1	2	2	3	3
201	Spokane Creek near East Helena	3	3	4	4	4	3	3	4	5	5
202	McGuire Creek at county road, near East Helena	6	7	7	8	7	7	7	7	8	8
203	Trout Creek at mouth, near East Helena	11	11	12	14	13	13	14	15	18	16
204	Prickly Pear Creek near Clancy	16	18	21	28	24	20	23	27	38	30
205	Prickly Pear Creek at mouth, near East Helena	21	22	25	31	28	26	28	32	39	34
206	Tenmile Creek near Rimini	.3	.6	1	2	1	.6	.9	2	3	2
207	Tenmile Creek near Helena	3	4	6	7	6	3	5	7	11	8
208	Sevenmile Creek near mouth, near Helena	1	1	2	2	2	2	2	3	4	3
209	Tenmile Creek at mouth, near East Helena	2	2	3	5	4	3	3	5	9	6
210	Silver Creek at Interstate 15, near Helena	8	8	9	11	10	9	9	11	13	11
211	Beaver Creek at mouth, near East Helena	5	6	7	9	8	6	7	8	10	9
212	Elkhorn Creek near mouth, near Wolf Creek	3	3	4	4	4	3	4	4	5	5
213	Willow Creek below Elkhorn Creek, near Wolf Creek	1	2	2	2	2	1	2	3	3	3

Site No.	Stream name	February Q.90	February Q.80	February Q.50	February Q.20	February QM	March Q.90	March Q.80	March Q.50	March Q.20	March QM
214	Cottonwood Creek above Beartooth Ranch, near Wolf Creek	.3	.4	.6	.6	.5	.3	.4	.7	.7	.8
217	Virginia Creek at mouth, near Canyon Creek	4	6	7	10	8	7	9	15	28	17
218	Canyon Creek below Cottonwood Creek, near Canyon Creek	6	8	11	15	12	10	14	26	49	30
219	Little Prickly Pear Creek near Canyon Creek	16	19	23	28	24	22	26	39	56	43
220	Lyons Creek near Wolf Creek	5	5	6	7	6	5	6	8	10	9
221	Wolf Creek at mouth, at Wolf Creek	2	2	3	4	3	2	3	4	5	4
222	Little Prickly Pear Creek near Wolf Creek	41	49	62	77	65	44	60	79	100	81
223	Wegner Creek near Craig[4]	0	0	0	0	0	0	0	0	0	0
224	Stickney Creek near Craig[5]	0	0	0	0	0	0	0	0	0	0
226	Middle Fork Dearborn River at Highway 200, near Wolf Creek	6	6	8	10	8	5	7	9	12	10
227	South Fork Dearborn River at Highway 434, near Wolf Creek	5	5	7	9	7	4	6	8	12	9
228	Dearborn River near Craig	42	46	57	71	61	42	54	77	100	84
229	Flat Creek above Slew Creek, near Craig	7	7	10	13	11	7	10	15	22	16
230	Sheep Creek at mouth, near Cascade	7	8	10	13	10	7	8	9	12	9
232	North Fork Smith River at Highway 89, near White Sulphur Springs	2	2	3	3	3	1	2	2	2	2
233	South Fork Smith River at mouth, near White Sulphur Springs	6	8	11	17	12	9	12	16	25	19
234	Smith River below forks, near White Sulphur Springs	6	7	9	10	9	5	6	8	8	8
235	Big Birch Creek at mouth, near White Sulphur Springs	12	15	26	57	33	20	31	49	100	60
236	Newlan Creek below Charcoal Gulch, near White Sulphur Springs	3	4	5	7	5	4	5	7	13	9
237	Camas Creek near mouth, near White Sulphur Springs	3	4	5	6	5	4	5	7	10	8
238	Smith River near Fort Logan	77	88	110	150	120	93	110	140	180	150
239	Sheep Creek near White Sulphur Springs	7	7	9	11	9	7	8	9	11	9
240	Sheep Creek near mouth, near White Sulphur Springs	9	12	16	18	15	10	12	16	18	17
241	Eagle Creek near mouth, near White Sulphur Springs	1	2	2	2	2	1	1	2	2	2
242	Rock Creek below Buffalo Canyon, near White Sulphur Springs	5	6	8	9	7	6	6	8	10	9
243	Tenderfoot Creek below South Fork, near White Sulphur Springs	8	9	11	14	11	7	8	10	11	10
244	Smith River near Eden	66	88	130	190	150	82	110	160	240	170
245	Hound Creek near mouth, near Cascade	9	12	14	16	14	8	11	17	23	19
246	Missouri River near Ulm	3200	4400	5100	6500	5300	3700	4500	5700	6800	5700
247	North Fork Sun River near Augusta	47	52	64	74	65	48	53	61	80	68
248	Sun River near Augusta	29	140	180	260	220	58	150	200	310	230
249	Sun River below diversion dam, near Augusta	63	89	120	160	120	61	98	120	190	140
250	Willow Creek near Anderson Lake, near Augusta	2	2	2	3	2	2	2	3	4	3
251	North Fork Willow Creek below Cutrock Creek, near Augusta	2	3	3	4	3	3	3	4	5	4
254	Smith Creek near Augusta	4	5	8	16	10	8	10	13	17	17
255	Ford Creek near Augusta	5	6	8	11	9	7	7	9	15	12
256	Elk Creek near Augusta	18	22	30	46	33	18	19	28	53	34
257	Sun River at Simms	120	130	180	250	190	48	84	140	250	170
260	Missouri River near Great Falls	3700	4700	5900	7500	5900	4300	5100	6100	8100	6500
261	Dry Fork at mouth, at Monarch	4	5	7	9	7	5	6	8	9	8

Site No.	Stream name	February Q.90	Q.80	Q.50	Q.20	QM	March Q.90	Q.80	Q.50	Q.20	QM
262	Tillinghast Creek above Joice Creek, near Monarch	4	5	6	8	6	5	5	6	8	7
263	Pilgrim Creek at mouth, near Monarch	4	5	6	8	7	5	5	7	10	8
264	Logging Creek at Logging Creek Campground, near Monarch	4	5	6	7	6	5	5	6	7	6
265	Belt Creek near Monarch	15	21	29	41	31	19	24	31	43	35
266	Big Otter Creek above Never Sweat Creek, near Raynesford	4	5	6	8	7	3	6	9	15	13
267	Belt Creek near Portage	8	11	17	28	19	9	13	24	37	27
268	Highwood Creek below Smith Creek, near Highwood	3	4	4	5	4	3	3	3	4	4
269	Missouri River at Fort Benton	3700	4700	6000	7600	6100	4300	5300	6300	8000	6600
270	Shonkin Creek below Bishop Creek, near Highwood	2	3	3	3	3	1	2	2	2	2
271	South Fork Two Medicine River near East Glacier	6	7	9	11	9	6	7	8	10	9
273	South Fork Badger Creek near Browning	8	9	12	15	12	9	10	13	16	14
274	North Fork Badger Creek near Browning	7	8	11	14	11	8	9	12	15	12
278	Birch Creek at Swift dam, near Valier	.2	2	8	43	27	2	2	4	36	16
279	South Fork Dupuyer Creek near Dupuyer	2	2	2	3	3	2	2	3	4	3
280	North Fork Dupuyer Creek near Dupuyer	2	2	3	4	3	2	3	3	5	4
281	Dupuyer Creek below Scoffin Creek, near Dupuyer	7	9	11	14	12	10	12	20	32	22
282	Birch Creek near Valier	38	41	51	65	55	22	29	71	210	160
283	Cut Bank Creek near Browning	11	24	35	62	51	21	38	71	200	120
284	Cut Bank Creek at Cut Bank	16	25	35	91	57	37	44	94	250	150
285	Marias River at Sullivan Bridge, near Cut Bank	130	160	260	490	310	230	260	390	830	570
286	Marias River near Shelby	130	160	260	510	320	230	260	400	900	610
287	Marias River at "F" Bridge, above Tiber Reservoir, near Shelby	150	190	310	600	370	270	310	470	1000	710
288	Marias River near Loma	140	220	420	630	420	130	220	390	750	480
290	Teton River near Strabane	7	14	17	21	17	4	6	14	18	13
291	McDonald Creek near Strabane	8	9	9	11	10	10	10	11	14	12
292	North Fork Deep Creek near Choteau	3	3	4	5	4	3	3	5	6	5
293	South Fork Deep Creek near Choteau	2	3	4	5	4	3	3	4	6	5
294	Deep Creek near Choteau	7	7	8	11	9	8	9	10	14	11
295	Teton River near Dutton	40	47	67	95	86	62	72	120	200	170
296	Missouri River at Virgelle	3900	5200	6700	8400	6600	4600	5700	7200	9100	7600
297	Lost Creek at mouth, near Utica	4	5	6	8	6	5	6	7	10	8
298	Yogo Creek at mouth, near Utica	.3	.8	1	2	1	.6	.9	3	3	3
299	Middle Fork Judith River near Utica	.0	.0	.1	.8	.5	.0	.2	.7	2	1
301	South Fork Judith River at Indian Hill Campground, near Utica	1	1	2	2	1	.7	.8	1	1	1
303	Judith River above Courtneys Creek, at Utica	4	5	7	8	6	3	4	6	6	6
306	East Fork Big Spring Creek at mouth, near Lewistown	4	5	6	6	6	3	5	7	9	8
307	Big Spring Creek above Cottonwood Creek, near Hanover	100	100	110	110	110	90	99	110	130	110
309	Cottonwood Creek at Highway 200, near Lewistown	1	2	3	3	2	1	2	2	3	3
310	Beaver Creek at county road, near Lewistown	5	8	11	17	15	3	10	26	61	47
311	Big Spring Creek at mouth, near Lewistown	83	88	95	100	94	68	81	98	130	110

Site No.	Stream name	February Q.90	February Q.80	February Q.50	February Q.20	February QM	March Q.90	March Q.80	March Q.50	March Q.20	March QM
312	Warm Springs Creek above Meadow Creek, near Hilger	95	100	100	110	100	97	100	110	110	110
313	Judith River near Winifred	240	250	530	640	480	260	310	590	710	540
315	Cow Creek below forks, near Cleveland	2	2	3	3	3	2	3	4	5	4
316	Missouri River near Landusky	4200	5500	7200	9300	7300	5500	6600	8400	11000	8900
317	North Fork Musselshell River, near Delpine	4	5	6	7	6	5	6	8	12	9
318	Checkerboard Creek near Checkerboard	.6	.8	1	1	1	.6	.8	1	1	1
319	Spring Creek below Whitetail Creek, near Checkerboard	2	3	3	4	3	2	2	3	5	4
320	North Fork Musselshell River near mouth, near Martinsdale	5	6	7	9	8	6	7	9	14	11
321	Alabaugh Creek at mouth, near Lennep	1	2	2	2	2	1	1	2	2	2
322	Cottonwood Creek below Loco Creek, near Martinsdale	6	7	9	10	8	5	5	6	7	6
323	South Fork Musselshell River above Martinsdale	11	14	20	26	21	14	17	29	53	37
324	Big Elk Creek at mouth, at Twodot	.1	.3	7	9	6	.3	.7	8	12	7
325	Musselshell River at Harlowton	36	46	65	97	70	53	62	87	150	110
326	American Fork near Harlowton	.1	.3	1	2	2	.0	.0	1	5	2
330	Careless Creek below Little Careless Creek, near Hedgesville	.4	.6	1	2	1	.2	.6	4	20	13
331	Swimming Woman Creek below Dry Coulee, near Franklin	.3	.4	.5	.6	.5	.2	.3	.5	.5	.6
333	Musselshell River near Roundup	24	37	93	160	110	50	80	140	290	220
335	Flatwillow Creek below the forks, near Grass Range	2	3	5	5	4	3	4	7	7	8
338	Musselshell River near Mosby	25	48	120	280	220	72	120	270	630	550
339	Big Dry Creek above Little Dry Creek, near Van Norman	.0	.0	1	50	34	.3	3	30	400	190
340	Little Dry Creek near Van Norman	.0	.0	2	42	28	2	4	32	210	110
341	Big Dry Creek near Van Norman	.0	.0	3	98	62	3	7	73	640	300

[1]Includes estimated spring flow of about 40 cubic feet per second, based on information provided by Montana Department of Fish, Wildlife and Parks.

[2]Includes estimated spring flow of about 10 cubic feet per second, based on information provided by Montana Department of Fish, Wildlife and Parks.

[3]Estimated long-term monthly streamflow characteristics may not reflect the current flow regime because of upstream streamflow regulation.

[4]Stream is known to be dry except for periods of runoff. Calculated flows were adjusted by subtracting 7 cubic feet per second.

[5]Stream is known to be dry except for periods of runoff. Calculated flows were adjusted by subtracting 8 cubic feet per second.

Table 6.-- Estimated monthly streamflow characteristics for February and March.

[Q.XX, monthly mean streamflow for specified month exceeded XX percent of the years, in cubic feet per second; QM, mean monthly streamflow for specified month, in cubic feet per second]

Site no.	Stream name	February Q.90	February Q.80	February Q.50	February Q.20	February QM	March Q.90	March Q.80	March Q.50	March Q.20	March QM
366	ROCK CREEK AT MOUTH NEAR WISDOM	3	4	5	6	5	3	4	6	8	7
367	DELANO CREEK AT MOUTH NEAR WISE RIVER	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.2	0.3	0.2
368	HALFWAY CREEK AT MOUTH NEAR WHITEHALL	0.9	1	1	2	2	1	1	2	3	2
369	N.F DEEP CREEK AT MOUTH NR MILLIGAN	0.6	0.7	1	1	1	0.7	0.9	1	2	1
370	COLLAR GULCH AT MOUTH NEAR MAIDEN	0.2	0.2	0.3	0.4	0.3	0.2	0.3	0.4	0.6	0.4
371	BADGER CREEK BEL FORKS NR BROWNING	15	17	22	28	23	17	20	24	31	26

Table 7.--*Estimated monthly streamflow characteristics for April and May*

[Q.XX, monthly mean streamflow for specified month exceeded XX percent of the years, in cubic feet per second; QM, mean monthly streamflow for specified month, in cubic feet per second]

Site No.	Stream name	April					May				
		Q.90	Q.80	Q.50	Q.20	QM	Q.90	Q.80	Q.50	Q.20	QM
1	Hellroaring Creek near Lakeview	5	7	13	25	16	41	52	70	93	71
2	Corral Creek near Lakeview	.6	.9	2	3	2	4	5	7	10	8
3	Antelope Creek near Lakeview	.3	.3	.5	1	.7	2	2	2	3	2
4	Red Rock Creek near Lakeview	10	13	21	39	26	58	75	97	130	98
5	Tom Creek near Lakeview	.5	1	2	5	3	9	11	11	16	12
6	Narrows Creek at mouth, near Lakeview	.4	.6	1	1	1	2	2	3	5	3
7	Odell Creek near Lakeview	5	6	12	22	15	35	44	56	75	57
8	Jones Creek near Lakeview	1	2	3	4	3	5	7	9	13	10
9	Red Rock River near Kennedy Ranch, near Lakeview	190	220	350	520	350	170	240	360	490	380
10	Peet Creek at county road, near Lakeview	1	2	3	5	3	5	7	11	15	11
11	Long Creek near Lakeview	3	4	7	13	9	17	23	29	40	30
12	East Fork Clover Creek at mouth, near Monida	2	2	4	5	4	6	8	12	17	13
13	Red Rock River below Lima Reservoir, near Monida	16	21	40	73	55	180	220	290	450	330
14	Cabin Creek above Simpson Creek, near Lima	.5	.7	1	2	1	2	3	3	5	4
15	Indian Creek above Simpson Creek, near Lima	.7	1	2	2	2	4	4	5	7	6
16	Simpson Creek above Indian Creek, near Lima	.8	1	2	3	2	4	5	6	8	6
17	Deadman Creek near Dell	5	7	9	14	10	15	19	21	31	22
18	Big Sheep Creek below Muddy Creek, near Dell	49	62	79	100	86	31	40	63	99	72
19	Red Rock River at Red Rock	170	190	270	370	280	78	100	250	470	310
20	Black Canyon Creek near Grant	3	4	5	8	6	9	11	15	22	16
21	Shennon Creek near mouth, near Grant	.9	1	2	3	2	3	4	6	9	6
22	Frying Pan Creek near Grant	3	3	5	7	5	6	8	13	19	14
23	Trapper Creek at mouth, near Grant	.7	1	2	3	2	3	4	5	7	6
24	Bear Creek near Grant	4	6	9	14	10	12	16	31	43	33
25	Bloody Dick Creek near Grant	17	25	42	65	47	72	90	160	210	160
26	Horse Prairie Creek near Grant	64	70	100	160	110	100	130	210	340	250
27	Rape Creek above reservoir, near Grant	.4	.6	1	2	1	2	2	3	4	3
28	Painter Creek near Grant	3	5	7	11	8	16	20	28	37	29
29	Browns Canyon Creek near Grant	2	3	5	7	5	10	13	18	25	19
30	Medicine Lodge Creek near Grant	9	11	18	33	23	39	49	55	85	59
32	Pole Creek near mouth, near Polaris	1	2	3	5	4	7	9	12	16	13
33	Reservoir Creek at mouth, near Polaris	2	2	4	6	4	5	7	11	16	12
34	East Fork Dyce Creek at mouth, near Polaris	1	1	2	4	3	5	6	8	11	9
35	West Fork Dyce Creek at mouth, near Polaris	.6	.8	1	2	2	3	4	5	7	5
36	Grasshopper Creek near Dillon	54	62	71	91	74	42	57	100	160	110
37	Beaverhead River at Barretts	220	270	370	590	420	200	300	580	830	570
38	East Fork Blacktail Creek near Dillon	19	26	37	50	38	48	64	110	140	110
39	West Fork Blacktail Creek near Dillon	9	11	15	20	16	17	23	28	42	30
40	Blacktail Deer Creek near Dillon	39	42	54	67	55	45	63	78	120	88
41	Beaverhead River near Dillon	210	270	380	650	430	36	98	180	460	270

Table 7.--*Estimated monthly streamflow characteristics for April and May*--Continued

Site No.	Stream name	April Q.90	April Q.80	April Q.50	April Q.20	April QM	May Q.90	May Q.80	May Q.50	May Q.20	May QM
42	Beaverhead River near Twin Bridges	290	360	490	710	520	62	140	240	560	340
43	Corral Creek at mouth, near Alder	1	2	3	4	3	5	6	8	12	9
44	Coal Creek at mouth, near Alder	3	4	7	11	8	13	17	25	34	26
45	Ruby River above the forks, near Alder	11	14	23	35	25	40	50	75	100	79
46	East Fork Ruby River at mouth, near Alder	4	6	9	14	10	20	24	34	46	36
47	West Fork Ruby River at mouth, near Alder	5	7	11	17	12	22	28	40	55	42
48	Cottonwood Creek at mouth, near Alder	6	8	12	19	14	27	32	46	63	49
49	Warm Springs Creek at mouth, near Alder[1]	51	54	63	75	65	81	91	117	150	121
50	North Fork Greenhorn Creek at mouth, near Alder	3	4	6	9	7	11	14	19	27	21
51	Ruby River above reservoir, near Alder	110	120	160	220	170	260	300	410	530	430
52	Mill Creek at Forest Service boundary, near Sheridan	7	9	17	31	21	54	66	90	120	94
53	Wisconsin Creek at Forest Service bounday, near Sheridan	5	7	13	26	17	52	62	74	100	77
54	Ruby River near Twin Bridges	92	100	190	290	200	63	120	250	360	250
55	Big Hole River near Jackson	13	15	22	43	29	85	96	130	170	140
56	Andrus Creek near mouth, near Jackson	5	7	12	18	13	20	25	38	53	40
57	Fox Creek at mouth, near Jackson	3	5	8	11	8	15	18	26	36	28
58	Governor Creek near Jackson	18	28	46	72	51	74	95	170	230	180
59	Warm Springs Creek at Jackson	13	19	31	47	34	50	62	110	150	110
60	Miner Creek near Jackson	15	18	23	29	24	43	50	75	110	82
61	Big Lake Creek near mouth, near Wisdom	6	8	13	20	15	26	32	47	64	50
62	Steel Creek above Francis Creek, near Wisdom	3	5	8	13	9	11	14	32	45	35
63	Francis Creek at mouth, near Wisdom	4	6	12	20	14	21	29	48	66	50
64	Steel Creek near mouth, near Wisdom	7	12	20	34	24	34	44	78	110	82
65	Swamp Creek near mouth, near Wisdom	7	14	28	50	33	52	68	150	210	160
66	Joseph Creek at mouth, near Wisdom	5	7	11	16	12	28	33	45	59	47
67	Trail Creek near Wisdom	20	35	63	110	73	230	270	370	480	380
68	Ruby Creek at mouth, near Wisdom	7	12	21	35	24	40	50	90	130	97
69	Tie Creek at Forest Service boundary, near Wisdom	10	13	21	33	24	51	61	86	110	89
70	Johnson Creek near Wisdom	6	10	17	29	20	38	45	74	110	79
71	Mussigbrod Creek near Wisdom	3	6	15	32	19	38	47	160	260	170
72	North Fork Big Hole River near mouth, near Wisdom	40	69	120	200	140	190	250	570	810	610
73	Big Hole River below North Fork, near Wisdom	260	410	570	920	670	820	1000	1500	2400	1700
74	Pintlar Creek near Forest Service boundary, near Wisdom	6	13	31	58	36	60	73	280	460	310
75	Big Hole River below Mudd Creek, near Wisdom	280	450	620	1000	720	890	1100	1700	2700	1900
76	Fishtrap Creek at mouth, near Wise River	8	14	30	60	39	95	110	190	270	200
77	Lamarche Creek near Wise River	10	15	29	58	38	99	120	160	230	170
78	Seymour Creek near Wise River	11	15	24	36	26	58	69	95	130	99
79	Tenmile Creek at mouth, near Wise River	4	5	9	13	10	24	29	39	50	40
80	Sevenmile Creek at mouth, near Wise River	1	1	2	4	3	5	6	8	11	9
81	Corral Creek at mouth, near Wise River	1	2	3	4	3	5	7	10	14	10

Table 7.--*Estimated monthly streamflow characteristics for April and May*--Continued

Site No.	Stream name	April Q.90	April Q.80	April Q.50	April Q.20	April QM	May Q.90	May Q.80	May Q.50	May Q.20	May QM
82	Twelvemile Creek at mouth, near Wise River	3	4	7	10	7	16	20	28	36	29
83	Sullivan Creek at mouth, near Wise River	3	5	7	11	8	19	23	31	40	32
84	Oregon Creek near mouth, near Wise River	.5	.7	1	2	1	2	3	4	6	5
85	California Creek above American Creek, near Wise River	4	5	8	12	9	11	15	23	33	25
86	American Creek at mouth, near Wise River	1	2	3	4	3	4	6	9	12	9
87	Sixmile Creek at mouth, near Wise River	.8	1	2	3	2	4	5	7	9	7
88	French Creek near mouth, near Wise River	7	9	14	22	16	20	26	41	59	44
89	Deep Creek near Wise River	25	40	66	99	71	100	130	250	330	260
90	Bear Creek near Wise River	.8	1	3	7	4	9	12	17	23	17
91	Bryant Creek at mouth, near Wise River	3	4	7	11	8	13	16	24	33	25
92	Big Hole River near Wise River	400	630	870	1400	1000	1200	1500	2300	3600	2600
93	Johnson Creek at mouth, near Wise River	2	3	5	7	5	7	9	14	20	15
94	Meadow Creek near Wise River	4	5	8	12	8	15	19	27	37	29
95	Jacobson Creek at mouth, near Wise River	15	20	32	50	36	95	110	150	190	150
96	Mono Creek at mouth, near Wise River	2	3	5	7	5	10	12	17	23	18
97	Wyman Creek at mouth, near Wise River	8	11	18	28	20	39	47	67	91	70
98	Lacy Creek at mouth, near Wise River	6	7	12	18	13	28	33	47	62	49
99	Gold Creek at mouth, near Wise River	3	4	6	9	7	15	18	25	32	26
100	Pattengail Creek at mouth, near Wise River	20	26	41	64	46	88	110	150	210	160
101	Sheep Creek at mouth, near Wise River	4	5	8	12	8	19	22	31	41	32
102	Wise River near Wise River	45	56	75	110	83	260	300	500	780	530
103	Adson Creek at mouth, near Wise River	2	3	5	8	6	11	14	20	27	21
104	Jerry Creek near Wise River	5	8	15	29	19	37	49	72	99	74
105	Divide Creek at Divide	4	5	9	20	13	24	31	40	60	43
106	Canyon Creek near Divide	5	6	12	27	18	46	54	65	96	69
107	Moose Creek near Divide	7	9	13	18	14	17	22	37	51	39
108	Trapper Creek near Melrose	5	6	10	18	13	30	35	41	58	43
109	Camp Creek at Melrose	2	3	7	13	8	13	17	24	51	29
110	Big Hole River near Melrose	660	1000	1300	2100	1500	1900	2300	3300	5000	3600
111	Willow Creek near Glen	7	8	10	15	11	23	26	37	48	37
112	Birch Creek near Glen	8	9	11	17	12	26	33	45	69	51
113	Hells Canyon Creek near Twin Bridges	3	3	5	10	7	13	17	21	30	22
114	Jefferson River near Twin Bridges	1300	1600	2100	3000	2300	2000	2400	3700	5300	4000
115	Whitetail Creek near Whitehall	3	3	4	5	4	8	13	23	37	25
117	Boulder River above High Ore Creek, near Basin	46	62	110	190	130	220	260	410	550	420
118	Boulder River near Boulder	59	79	140	240	160	280	330	520	700	530
119	Little Boulder River near Boulder	9	11	17	27	20	51	55	68	85	71
120	Boulder River above Cabin Gulch, near Boulder	62	79	120	200	140	230	260	380	490	390
121	Boulder River near Cardwell	76	98	150	240	180	280	320	470	600	480
122	South Boulder River near Jefferson Island	6	10	15	25	17	33	36	41	49	44
123	Jefferson River at Sappington	1500	1800	2300	3300	2600	2200	2700	4000	5700	4400
124	South Willow Creek near Pony	14	19	30	45	31	61	74	90	140	94
125	North Willow Creek at Pony	11	13	18	23	18	31	38	44	63	46
126	Willow Creek near Harrison	25	30	41	54	42	21	33	58	99	63
127	Norwegian Creek near Harrison	8	8	10	12	10	7	9	12	14	12

Table 7.--*Estimated monthly streamflow characteristics for April and May*--Continued

Site No.	Stream name	April Q.90	April Q.80	April Q.50	April Q.20	April QM	May Q.90	May Q.80	May Q.50	May Q.20	May QM
129	Jefferson River near Three Forks	1500	2100	2700	3300	2700	1800	2300	4300	6200	4400
130	Madison River near West Yellowstone	410	430	460	540	480	640	680	800	990	830
131	Duck Creek near West Yellowstone	22	26	35	59	41	90	110	140	190	140
132	Cougar Creek near West Yellowstone	10	14	28	63	41	130	150	160	220	170
133	Grayling Creek near West Yellowstone	13	21	44	96	61	190	230	290	400	300
134	Red Canyon Creek near West Yellowstone	1	2	3	8	5	21	23	23	28	21
135	South Fork Madison River near West Yellowstone	94	100	110	130	110	170	190	210	240	220
136	Watkins Creek near West Yellowstone	2	3	6	13	9	33	37	37	50	38
137	Trapper Creek near West Yellowstone	2	2	4	8	6	19	21	22	29	22
138	Madison River below Hebgen Lake, near Grayling	260	400	800	1400	920	230	310	590	1200	730
139	Cabin Creek near West Yellowstone	5	10	23	54	33	120	140	180	250	180
140	Beaver Creek near West Yellowstone	20	26	45	82	55	160	190	230	310	240
141	Elk River at mouth, near Cameron	21	27	44	68	49	140	160	210	270	220
142	Soap Creek at mouth, near Cameron	2	2	3	5	4	8	10	14	18	14
143	Antelope Creek at mouth, near Cameron[2]	17	19	24	32	26	36	42	58	76	60
144	West Fork Madison River near Cameron	45	53	79	110	84	160	180	250	330	250
145	Squaw Creek near Cameron	7	8	13	22	15	47	54	57	76	59
146	Standard Creek near Cameron	5	6	10	17	12	25	32	46	62	48
147	Ruby Creek near Cameron	4	4	7	12	9	18	22	26	36	27
148	Indian Creek near Cameron	19	25	45	87	58	170	200	250	330	260
149	Madison River near Cameron	510	750	1200	1700	1200	790	1000	1500	2000	1600
150	Blaine Spring Creek near Cameron	23	23	25	29	26	31	34	38	43	38
151	O'Dell Creek near Ennis	99	100	110	120	110	130	140	150	160	150
152	Jack Creek near Ennis	14	17	23	35	25	55	70	93	130	98
153	Moore Creek at Ennis	1	1	3	6	4	8	10	12	17	12
154	North Fork Meadow Creek at Forest Service boundary, near Ennis	5	8	16	30	19	47	58	83	120	88
155	North Fork Meadow Creek at Highway 287, near Ennis	3	5	10	21	14	34	41	52	75	54
156	Madison River below Ennis Lake, near McAllister	900	1000	1500	2100	1600	1100	1300	1900	2500	1900
157	Hot Springs Creek near Norris	6	7	11	20	14	23	30	39	55	41
158	Cherry Creek near Norris	21	25	38	61	43	72	93	140	200	150
159	Madison River near Three Forks	940	1100	1500	2100	1600	1100	1300	2000	2500	2000
160	Cache Creek at mouth, near West Yellowstone	4	6	10	15	10	28	33	43	55	45
161	Taylor Creek near Grayling	19	22	32	45	34	120	160	210	280	230
162	Porcupine Creek near Gallatin Gateway	5	7	13	26	17	51	60	70	96	73
163	Gallatin River above West Fork, near Big Sky	170	200	230	340	260	580	740	960	1200	970
164	South Fork West Fork Gallatin River near Gallatin Gateway	11	17	30	64	41	110	140	190	260	190
165	Middle Fork West Fork Gallatin River near Gallatin Gateway	6	8	12	23	15	39	47	63	87	66
166	West Fork Gallatin River near Gallatin Gateway	21	31	54	110	70	180	220	320	430	320
167	Squaw Creek near Gallatin Gateway	16	18	25	43	30	72	86	100	130	100
168	Hellroaring Creek near Gallatin Gateway	17	22	32	56	38	98	120	150	200	150

Table 7.--*Estimated monthly streamflow characteristics for April and May*--Continued

Site No.	Stream name	April Q.90	April Q.80	April Q.50	April Q.20	April QM	May Q.90	May Q.80	May Q.50	May Q.20	May QM
169	South Fork Spanish Creek near Gallatin Gateway	9	14	24	48	31	81	100	140	190	150
170	Spanish Creek near Gallatin Gateway	22	30	46	85	57	120	150	230	320	240
171	Gallatin River near Gallatin Gateway	320	370	440	640	490	1100	1400	1800	2200	1800
172	Big Bear Creek near Gallatin Gateway	4	4	6	11	8	19	26	33	50	38
173	South Cottonwood Creek near Gallatin Gateway	13	16	19	27	20	45	57	72	89	73
174	Baker Creek near Manhattan	89	110	130	170	140	130	190	270	350	280
175	Rocky Creek near Bozeman	24	28	45	72	50	52	68	100	140	110
176	Bear Canyon Creek near Bozeman	5	6	11	20	13	16	20	30	43	32
177	Sourdough Creek near Bozeman	11	13	19	28	23	41	45	63	93	69
178	East Gallatin River at Bozeman	84	98	160	220	170	140	180	260	350	270
179	Bridger Creek near Bozeman	24	32	59	90	62	63	96	140	220	160
180	East Gallatin River near Belgrade	86	110	160	250	190	150	230	360	460	370
181	East Fork Hyalite Creek near Bozeman	6	6	7	9	8	22	26	30	38	31
182	West Fork Hyalite Creek near Bozeman	9	9	12	15	13	38	44	55	69	56
183	Hyalite Creek at Hyalite Ranger Station, near Bozeman	19	23	35	52	39	92	100	130	170	140
184	Hyalite Creek above Interstate 90, near Bozeman	5	8	16	34	22	57	68	82	120	85
185	Thompson Creek near Belgrade	21	27	32	41	33	26	30	40	44	37
186	Ben Hart Creek near Belgrade	27	29	31	33	31	29	30	35	37	34
187	Reese Creek near Belgrade	7	8	13	18	13	22	26	40	54	42
188	East Gallatin River near Manhattan	180	200	240	350	260	440	570	780	1000	780
189	Gallatin River near Logan	780	900	1100	1400	1100	1100	1500	2100	2700	2200
190	Sixteenmile Creek near Ringling	7	9	30	75	49	4	8	19	69	34
191	Sixteenmile Creek near Maudlow	34	37	56	83	58	58	72	120	170	130
192	Sixteenmile Creek near Toston	48	51	77	130	91	130	160	210	310	230
193	Missouri River near Toston	3700	4000	5600	7200	5700	4600	5200	8700	12000	8800
194	Crow Creek near Radersburg	10	13	20	34	23	79	88	120	160	130
195	Dry Creek near Toston	4	5	9	15	10	19	24	31	44	33
196	Deep Creek below North Fork, near Townsend	10	12	20	37	26	54	66	80	110	83
197	Duck Creek near Townsend	3	4	8	14	10	21	26	33	45	34
198	Confederate Gulch near Winston	5	7	12	21	14	30	38	50	68	52
199	Beaver Creek near Winston	4	7	16	30	18	27	32	51	80	55
200	Avalanche Gulch near Winston	3	3	6	11	8	19	23	23	30	22
201	Spokane Creek near East Helena	3	5	9	15	10	16	21	28	39	29
202	McGuire Creek at county road, near East Helena	8	8	9	10	9	9	10	11	12	12
203	Trout Creek at mouth, near East Helena	16	16	18	23	19	29	35	40	56	42
204	Prickly Pear Creek near Clancy	33	34	50	71	52	52	63	100	130	110
205	Prickly Pear Creek at mouth, near East Helena	35	36	48	74	55	83	110	130	190	140
206	Tenmile Creek near Rimini	3	6	13	24	16	37	54	79	100	84
207	Tenmile Creek near Helena	9	14	30	44	33	42	53	89	120	97
208	Sevenmile Creek near mouth, near Helena	3	4	6	10	7	12	15	16	24	17
209	Tenmile Creek at mouth, near East Helena	7	8	14	24	15	22	28	48	73	53
210	Silver Creek at Interstate 15, near Helena	12	12	15	19	16	16	17	23	27	24
211	Beaver Creek at mouth, near East Helena	9	11	15	20	16	18	20	25	29	28
212	Elkhorn Creek near mouth, near Wolf Creek	5	5	8	11	8	13	16	20	27	21
213	Willow Creek below Elkhorn Creek, near Wolf Creek	3	4	7	15	10	27	31	34	50	36

Site No.	Stream name	April					May				
		Q.90	Q.80	Q.50	Q.20	QM	Q.90	Q.80	Q.50	Q.20	QM
214	Cottonwood Creek above Beartooth Ranch, near Wolf Creek	.8	1	3	6	4	9	11	15	24	17
217	Virginia Creek at mouth, near Canyon Creek	7	12	25	38	25	25	31	54	94	62
218	Canyon Creek below Cottonwood Creek, near Canyon Creek	12	20	45	76	48	49	59	98	190	120
219	Little Prickly Pear Creek near Canyon Creek	20	32	60	110	67	28	43	100	180	120
220	Lyons Creek near Wolf Creek	6	9	13	19	14	24	28	34	49	37
221	Wolf Creek at mouth, at Wolf Creek	5	6	11	20	13	29	36	41	58	42
222	Little Prickly Pear Creek near Wolf Creek	76	92	150	230	180	130	170	330	560	380
223	Wegner Creek near Craig[4]	0	2	7	15	8	15	23	39	59	41
224	Stickney Creek near Craig[5]	0	1	5	12	7	12	17	31	46	34
226	Middle Fork Dearborn River at Highway 200, near Wolf Creek	5	13	27	50	32	64	82	120	160	120
227	South Fork Dearborn River at Highway 434, near Wolf Creek	4	12	27	50	31	51	66	120	180	120
228	Dearborn River near Craig	31	91	180	350	200	270	360	670	1000	680
229	Flat Creek above Slew Creek near Craig	7	18	34	53	35	31	41	100	160	110
230	Sheep Creek at mouth, near Cascade	11	15	31	56	36	57	77	190	310	210
232	North Fork Smith River at Highway 89, near White Sulphur Springs	3	5	11	24	16	47	80	330	820	410
233	South Fork Smith River at mouth, near White Sulphur Springs	15	18	27	42	30	38	49	67	100	73
234	Smith River below forks, near White Sulphur Springs	9	14	27	59	39	110	140	240	380	260
235	Big Birch Creek at mouth, near White Sulphur Springs	43	51	81	100	76	39	49	130	250	170
236	Newlan Creek below Charcoal Gulch, near White Sulphur Springs	7	11	16	22	17	16	20	30	48	33
237	Camas Creek near mouth, near White Sulphur Springs	7	10	16	29	20	38	47	52	76	54
238	Smith River near Fort Logan	130	140	190	260	210	160	200	270	380	320
239	Sheep Creek near White Sulphur Springs	10	12	18	30	21	55	64	89	130	96
240	Sheep Creek near mouth, near White Sulphur Springs	18	25	51	110	69	150	190	290	460	320
241	Eagle Creek near mouth, near White Sulphur Springs	3	4	8	19	12	29	37	47	71	50
242	Rock Creek below Buffalo Canyon, near White Sulphur Springs	9	11	20	37	25	51	63	83	120	88
243	Tenderfoot Creek below South Fork, near White Sulphur Springs	11	17	36	73	46	110	140	210	310	220
244	Smith River near Eden	180	210	360	560	420	360	460	860	1500	990
245	Hound Creek near mouth, near Cascade	24	31	61	100	70	99	130	270	430	300
246	Missouri River near Ulm	3800	4200	6700	8800	6800	5200	6300	9200	13000	9800
247	North Fork Sun River near Augusta	67	88	160	300	200	810	960	1200	1500	1300
248	Sun River near Augusta	140	230	520	940	600	1300	1900	2900	3800	2800
249	Sun River below diversion dam, near Augusta	57	110	230	420	290	290	340	770	1400	910
250	Willow Creek near Anderson Lake, near Augusta	4	4	7	13	9	21	25	27	38	28
251	North Fork Willow Creek below Cutrock Creek, near Augusta	4	4	5	7	6	10	12	13	18	14
254	Smith Creek near Augusta	6	7	17	34	25	42	52	70	100	75
255	Ford Creek near Augusta	8	9	18	23	17	29	37	61	89	64
256	Elk Creek near Augusta	21	25	36	66	45	55	86	220	330	220
257	Sun River at Simms	100	150	300	610	390	160	330	790	1700	1100
260	Missouri River near Great Falls	4600	5000	7600	10000	7700	6100	7600	11000	16000	12000
261	Dry Fork at mouth, at Monarch	9	12	23	44	30	62	76	100	150	110

Site No.	Stream name	April Q.90	April Q.80	April Q.50	April Q.20	April QM	May Q.90	May Q.80	May Q.50	May Q.20	May QM
262	Tillinghast Creek above Joice Creek, near Monarch	7	9	15	24	17	30	38	53	74	56
263	Pilgrim Creek at mouth, near Monarch	12	16	26	40	28	46	61	93	130	96
264	Logging Creek at Logging Creek Campground, near Monarch	7	8	12	20	14	25	32	44	59	45
265	Belt Creek near Monarch	34	46	88	180	120	230	340	550	950	630
266	Big Otter Creek above Never Sweat Creek, near Raynesford	7	9	12	18	14	21	26	30	42	31
267	Belt Creek near Portage	30	46	100	270	140	260	320	540	1200	770
268	Highwood Creek below Smith Creek, near Highwood	4	7	15	33	21	55	70	84	110	85
269	Missouri River at Fort Benton	4800	5100	7700	10000	7900	6700	8000	12000	18000	12000
270	Shonkin Creek below Bishop Creek, near Highwood	2	5	13	29	18	43	57	79	110	81
271	South Fork Two Medicine River near East Glacier	10	15	28	61	39	130	150	300	520	340
273	South Fork Badger Creek near Browning	19	26	41	64	45	150	170	210	270	220
274	North Fork Badger Creek near Browning	18	24	38	59	42	140	150	200	240	200
278	Birch Creek at Swift Dam, near Valier	6	7	13	110	54	63	150	240	370	250
279	South Fork Dupuyer Creek near Dupuyer	4	6	10	15	10	22	27	38	50	39
280	North Fork Dupuyer Creek near Dupuyer	5	7	11	17	12	32	38	50	65	52
281	Dupuyer Creek below Scoffin Creek, near Dupuyer	11	18	35	57	39	63	77	100	150	110
282	Birch Creek near Valier	17	23	71	150	100	22	32	68	140	94
283	Cut Bank Creek near Browning	67	83	120	150	120	340	360	410	430	400
284	Cut Bank Creek at Cut Bank	80	94	200	360	240	280	360	550	670	520
285	Marias River at Sullivan Bridge, near Cut Bank	400	500	960	1300	970	1300	1600	2300	3200	2400
286	Marias River near Shelby	420	520	1100	1500	1100	1400	1800	2600	3700	2700
287	Marias River at "F" Bridge, above Tiber Reservoir, near Shelby	490	610	1200	1700	1200	1700	2100	3000	4300	3200
288	Marias River near Loma	400	490	830	1300	890	1000	1100	1400	1700	1400
290	Teton River near Strabane	6	11	25	47	30	26	46	86	120	87
291	McDonald Creek near Strabane	11	11	13	15	14	14	15	16	16	16
292	North Fork Deep Creek near Choteau	7	9	15	23	16	40	47	63	82	65
293	South Fork Deep Creek near Choteau	7	9	14	22	15	37	44	60	78	62
294	Deep Creek near Choteau	12	13	18	25	19	19	22	34	43	36
295	Teton River near Dutton	73	100	150	250	180	59	110	340	440	330
296	Missouri River at Virgelle	5300	6200	8500	12000	9100	7100	9900	13000	19000	14000
297	Lost Creek at mouth, near Utica	10	13	21	33	23	46	55	79	110	83
298	Yogo Creek at mouth, near Utica	2	3	6	14	9	25	29	29	39	28
299	Middle Fork Judith River near Utica	6	8	12	18	14	71	96	130	160	130
301	South Fork Judith River at Indian Hill Campground, near Utica	1	3	6	15	9	27	32	37	52	37
303	Judith River above Courtneys Creek, at Utica	5	10	26	60	39	100	120	170	230	170
306	East Fork Big Spring Creek at mouth, near Lewistown	10	12	23	38	27	44	54	89	140	98
307	Big Spring Creek above Cottonwood Creek, near Hanover	130	140	180	220	190	220	260	320	380	330
309	Cottonwood Creek at Highway 200, near Lewistown	3	5	11	23	14	31	40	66	120	75
310	Beaver Creek at county road, near Lewistown	15	20	28	39	33	30	39	50	71	55
311	Big Spring Creek at mouth, near Lewistown	130	150	230	330	250	350	460	690	900	710

Site No.	Stream name	April Q.90	April Q.80	April Q.50	April Q.20	April QM	May Q.90	May Q.80	May Q.50	May Q.20	May QM
312	Warm Springs Creek above Meadow Creek, near Hilger	95	100	110	110	110	92	98	100	110	100
313	Judith River near Winifred	260	290	500	730	520	280	360	530	720	540
315	Cow Creek below forks, near Cleveland	4	5	8	12	9	12	15	21	31	23
316	Missouri River near Landusky	6000	7000	9200	14000	10000	7700	10000	14000	21000	16000
317	North Fork Musselshell River near Delpine	7	11	17	27	19	10	16	24	40	26
318	Checkerboard Creek near Checkerboard	1	2	4	9	6	13	16	20	31	22
319	Spring Creek below Whitetail Creek, near Checkerboard	5	8	16	27	18	28	35	78	130	87
320	North Fork Musselshell River near mouth, near Martinsdale	9	14	23	38	27	48	57	68	100	70
321	Alabaugh Creek at mouth, near Lennep	2	4	8	17	11	23	30	43	68	47
322	Cottonwood Creek below Loco Creek, near Martinsdale	7	13	30	64	40	94	120	190	290	200
323	South Fork Musselshell River above Martinsdale	43	54	99	160	110	100	170	310	430	320
324	Big Elk Creek at mouth, at Twodot	2	5	14	25	15	15	21	40	62	43
325	Musselshell River at Harlowton	45	71	130	240	170	64	130	300	630	390
326	American Fork near Harlowton	.0	.3	3	7	4	.1	.8	3	10	7
330	Careless Creek below Little Careless Creek, near Hedgesville	1	3	5	13	9	10	12	13	20	15
331	Swimming Woman Creek below Dry Coulee, near Franklin	.5	1	3	6	4	10	12	14	21	15
333	Musselshell River near Roundup	38	55	110	320	200	93	120	310	700	440
335	Flatwillow Creek below the forks, near Grass Range	8	11	21	49	33	87	100	120	170	130
338	Musselshell River near Mosby	54	88	180	540	350	64	100	360	960	630
339	Big Dry Creek above Little Dry Creek, near Van Norman	.2	1	4	27	58	.1	1	3	17	18
340	Little Dry Creek near Van Norman	2	2	6	23	42	1	2	5	17	17
341	Big Dry Creek near Van Norman	3	4	10	50	100	1	3	8	34	35

[1]Includes estimated spring flow of about 40 cubic feet per second, based on information provided by Montana Department of Fish, Wildlife and Parks.

[2]Includes estimated spring flow of about 10 cubic feet per second, based on information provided by Montana Department of Fish, Wildlife and Parks.

[3]Estimated long-term monthly streamflow characteristics may not reflect the current flow regime because of upstream streamflow regulation.

[4]Stream is known to be dry except for periods of runoff. Calculated flows were adjusted by subtracting 7 cubic feet per second.

[5]Stream is known to be dry except for periods of runoff. Calculated flows were adjusted by subtracting 8 cubic feet per second.

Table 7.-- Estimated monthly streamflow characteristics for April and May.

[Q.XX, monthly mean streamflow for specified month exceeded XX percent of the years, in cubic feet per second; QM, mean monthly streamflow for specified month, in cubic feet per second]

Site no.	Stream name	April Q.90	April Q.80	April Q.50	April Q.20	April QM	May Q.90	May Q.80	May Q.50	May Q.20	May QM
366	ROCK CREEK AT MOUTH NEAR WISDOM	8	10	16	25	18	25	31	49	69	52
367	DELANO CREEK AT MOUTH NEAR WISE RIVER	0.4	0.5	1	1	1	2	2	4	5	4
368	HALFWAY CREEK AT MOUTH NEAR WHITEHALL	3	3	6	9	6	9	12	18	25	19
369	N.F DEEP CREEK AT MOUTH NR MILLIGAN	2	3	4	7	5	9	11	16	21	17
370	COLLAR GULCH AT MOUTH NEAR MAIDEN	0.6	1	2	2	2	3	4	5	7	6
371	BADGER CREEK BEL FORKS NR BROWNING	35	46	72	110	81	250	280	370	460	370

PROVISIONAL

Table 8.--*Estimated monthly streamflow characteristics for June and July*

[Q.XX, monthly mean streamflow for specified month exceeded XX percent of the years, in cubic feet per second; QM, mean monthly streamflow for specified month, in cubic feet per second

Site No.	Stream name	June					July			
		Q.90	Q.80	Q.50	Q.20	QM	Q.90	Q.80	Q.50	Q.20
1	Hellroaring Creek near Lakeview	39	51	77	100	80	18	24	34	43
2	Corral Creek near Lakeview	4	5	8	10	8	2	3	4	4
3	Antelope Creek near Lakeview	1	1	3	4	3	.3	.3	.6	1
4	Red Rock Creek near Lakeview	48	63	95	140	100	24	30	41	52
5	Tom Creek near Lakeview	7	9	14	21	15	2	3	4	7
6	Narrows Creek at mouth, near Lakeview	1	1	3	4	3	.4	.5	.8	1
7	Odell Creek near Lakeview	30	39	60	85	64	13	18	25	33
8	Jones Creek near Lakeview	4	5	10	14	10	2	2	3	5
9	Red Rock River near Kennedy Ranch, near Lakeview	120	170	270	350	280	40	57	110	170
10	Peet Creek at county road, near Lakeview	4	5	10	14	10	2	2	3	4
11	Long Creek near Lakeview	15	19	32	46	34	7	9	12	18
12	East Fork Clover Creek at mouth, near Monida	5	6	11	16	12	2	2	4	5
13	Red Rock River below Lima Reservoir, near Monida	280	380	460	590	470	250	270	330	410
14	Cabin Creek above Simpson Creek, near Lima	2	2	4	6	5	.7	1	2	2
15	Indian Creek above Simpson Creek, near Lima	3	4	7	9	7	1	2	2	3
16	Simpson Creek above Indian Creek, near Lima	3	4	7	10	8	1	2	2	4
17	Deadman Creek near Dell	10	12	24	39	26	4	5	8	13
18	Big Sheep Creek below Muddy Creek, near Dell	45	51	91	140	94	41	47	64	80
19	Red Rock River at Red Rock	90	120	190	420	250	150	180	240	290
20	Black Canyon Creek near Grant	6	8	15	22	16	3	3	6	8
21	Shennon Creek near mouth, near Grant	2	3	6	9	7	1	1	2	3
22	Frying Pan Creek near Grant	4	7	11	17	13	2	3	5	6
23	Trapper Creek at mouth, near Grant	2	3	5	8	6	.9	1	2	3
24	Bear Creek near Grant	11	17	29	40	31	5	7	9	12
25	Bloody Dick Creek near Grant	62	92	150	220	160	23	29	44	66
26	Horse Prairie Creek near Grant	83	130	220	330	240	42	58	100	140
27	Rape Creek above reservoir, near Grant	1	2	3	5	3	.5	.7	1	2
28	Painter Creek near Grant	12	15	26	38	29	4	5	8	13
29	Browns Canyon Creek near Grant	7	10	17	24	18	3	3	5	8
30	Medicine Lodge Creek near Grant	33	41	75	120	83	8	10	24	47
32	Pole Creek near mouth, near Polaris	5	6	11	16	12	2	2	3	5
33	Reservoir Creek at mouth, near Polaris	4	5	10	15	11	2	2	4	5
34	East Fork Dyce Creek at mouth, near Polaris	5	6	10	13	10	2	2	3	5
35	West Fork Dyce Creek at mouth, near Polaris	3	3	6	8	6	1	1	2	3
36	Grasshopper Creek near Dillon	37	52	120	200	140	12	18	42	69
37	Beaverhead River at Barretts	350	480	840	1100	830	290	340	580	870
38	East Fork Blacktail Creek near Dillon	42	63	97	140	100	25	30	40	47
39	West Fork Blacktail Creek near Dillon	13	17	32	51	35	6	8	13	19
40	Blacktail Deer Creek near Dillon	70	85	120	160	120	40	48	77	100
41	Beaverhead River near Dillon	27	110	230	610	370	28	80	160	330

Site No.	Stream name	June Q.90	June Q.80	June Q.50	June Q.20	June QM	July Q.90	July Q.80	July Q.50	July Q.20	July QM
42	Beaverhead River near Twin Bridges	49	160	300	680	430	49	120	230	400	300
43	Corral Creek at mouth, near Alder	3	4	8	11	8	1	2	2	4	3
44	Coal Creek at mouth, near Alder	10	13	24	34	26	4	5	8	12	9
45	Ruby River above the forks, near Alder	33	44	77	110	83	12	16	26	40	29
46	East Fork Ruby River at mouth, near Alder	15	19	33	48	36	5	7	11	16	12
47	West Fork Ruby River at mouth, near Alder	17	22	39	57	42	6	8	13	19	14
48	Cottonwood Creek at mouth, near Alder	20	26	45	66	49	7	9	15	22	16
49	Warm Springs Creek at mouth, near Alder[1]	74	85	118	160	125	52	56	66	80	69
50	North Fork Greenhorn Creek at mouth, near Alder	9	12	21	30	22	3	4	7	10	8
51	Ruby River above reservoir, near Alder	240	280	440	650	480	98	110	180	260	200
52	Mill Creek at Forest Service boundary, near Sheridan	62	80	120	150	120	25	36	53	70	58
53	Wisconsin Creek at Forest Service boundary, near Sheridan	51	63	96	130	99	17	24	38	54	41
54	Ruby River near Twin Bridges	84	170	340	550	380	89	120	240	350	240
55	Big Hole River near Jackson	140	160	200	240	200	24	40	78	110	85
56	Andrus Creek near mouth, near Jackson	16	21	37	55	40	6	8	12	19	14
57	Fox Creek at mouth, near Jackson	11	14	25	37	27	4	5	8	12	9
58	Governor Creek near Jackson	63	95	160	230	170	27	33	49	69	51
59	Warm Springs Creek at Jackson	46	66	110	160	120	16	19	30	50	33
60	Miner Creek near Jackson	100	110	140	160	140	28	36	57	93	70
61	Big Lake Creek near mouth, near Wisdom	20	27	46	68	50	7	9	15	23	17
62	Steel Creek above Francis Creek, near Wisdom	10	17	29	40	31	4	5	8	11	9
63	Francis Creek at mouth, near Wisdom	16	24	42	63	45	6	7	12	18	12
64	Steel Creek near mouth, near Wisdom	28	43	73	110	78	11	14	21	31	22
65	Swamp Creek near mouth, near Wisdom	41	70	130	180	130	16	20	30	43	32
66	Joseph Creek at mouth, near Wisdom	21	26	43	61	47	7	9	13	20	15
67	Trail Creek near Wisdom	87	170	270	410	280	36	40	57	73	58
68	Ruby Creek at mouth, near Wisdom	34	50	88	130	94	11	13	21	35	23
69	Tie Creek at Forest Service boundary, near Wisdom	40	51	85	120	93	13	17	27	42	30
70	Johnson Creek near Wisdom	31	43	75	110	80	8	10	17	30	19
71	Mussigbrod Creek near Wisdom	28	53	120	190	120	8	9	16	27	17
72	North Fork Big Hole River near mouth, near Wisdom	180	300	520	740	550	66	83	130	190	140
73	Big Hole River below North Fork, near Wisdom	710	1200	1900	3100	2100	170	290	590	920	650
74	Pintlar Creek near Forest Service boundary, near Wisdom	53	100	220	330	230	15	18	32	49	34
75	Big Hole River below Mudd Creek, near Wisdom	770	1300	2200	3500	2300	180	320	650	1000	710
76	Fishtrap Creek at mouth, near Wise River	70	99	170	270	190	16	19	34	64	38
77	Lamarche Creek near Wise River	87	130	210	290	210	26	37	67	94	71
78	Seymour Creek near Wise River	45	57	95	140	100	14	19	30	47	34
79	Tenmile Creek at mouth, near Wise River	18	22	36	52	39	6	7	11	17	12
80	Sevenmile Creek at mouth, near Wise River	3	4	8	11	8	1	2	2	4	3
81	Corral Creek at mouth, near Wise River	4	5	9	13	10	1	2	3	4	3

Site No.	Stream name	June Q.90	June Q.80	June Q.50	June Q.20	June QM	July Q.90	July Q.80	July Q.50	July Q.20	July QM
82	Twelvemile Creek at mouth, near Wise River	12	15	26	37	28	4	5	8	12	9
83	Sullivan Creek at mouth, near Wise River	14	17	29	41	31	5	6	9	13	10
84	Oregon Creek near mouth, near Wise River	2	2	4	5	4	.6	.7	1	2	1
85	California Creek above American Creek, near Wise River	9	12	23	34	25	4	5	8	12	9
86	American Creek at mouth, near Wise River	3	4	8	12	9	1	2	3	4	3
87	Sixmile Creek at mouth, near Wise River	3	3	6	9	7	1	1	2	3	2
88	French Creek near mouth, near Wise River	16	22	41	62	45	6	8	14	22	16
89	Deep Creek near Wise River	84	130	210	300	230	43	53	73	89	74
90	Bear Creek near Wise River	6	10	17	24	18	3	4	6	7	6
91	Bryant Creek at mouth, near Wise River	10	13	23	34	25	4	5	8	11	8
92	Big Hole River near Wise River	1100	1800	2900	4700	3200	260	450	900	1400	990
93	Johnson Creek at mouth, near Wise River	5	7	13	19	14	2	3	4	7	5
94	Meadow Creek near Wise River	11	15	26	38	28	4	5	8	13	9
95	Jacobson Creek at mouth, near Wise River	74	92	150	210	160	22	30	46	71	51
96	Mono Creek at mouth, near Wise River	7	9	16	23	17	3	3	5	7	6
97	Wyman Creek at mouth, near Wise River	30	39	67	97	73	10	14	22	33	24
98	Lacy Creek at mouth, near Wise River	21	26	45	65	49	7	9	14	22	16
99	Gold Creek at mouth, near Wise River	11	13	23	33	25	4	5	7	11	8
100	Pattengail Creek at mouth, near Wise River	73	95	160	230	170	23	32	52	82	59
101	Sheep Creek at mouth, near Wise River	13	17	29	42	32	5	6	9	14	10
102	Wise River near Wise River	330	580	830	1200	860	93	140	240	350	260
103	Adson Creek at mouth, near Wise River	8	10	18	27	20	3	4	6	9	6
104	Jerry Creek near Wise River	31	46	76	110	80	13	18	29	36	30
105	Divide Creek at Divide	21	29	52	78	55	6	8	15	26	17
106	Canyon Creek near Divide	38	51	88	130	93	8	12	24	41	26
107	Moose Creek near Divide	15	22	37	52	39	8	9	13	18	14
108	Trapper Creek near Melrose	24	30	50	73	53	8	10	17	25	18
109	Camp Creek at Melrose	12	19	49	97	54	3	4	15	32	18
110	Big Hole River near Melrose	1600	2700	4200	6400	4400	440	730	1400	2100	1500
111	Willow Creek near Glen	36	46	63	81	64	16	19	28	39	30
112	Birch Creek near Glen	69	79	100	140	110	37	46	63	81	66
113	Hells Canyon Creek near Twin Bridges	13	16	26	37	27	5	7	10	15	11
114	Jefferson River near Twin Bridges	2000	3100	5400	7800	5500	550	910	2000	3100	2100
115	Whitetail Creek near Whitehall	22	24	39	51	39	19	22	25	28	25
117	Boulder River above High Ore Creek, near Basin	120	180	360	600	380	20	38	66	150	94
118	Boulder River near Boulder	160	230	460	770	490	26	48	84	190	120
119	Little Boulder River near Boulder	25	37	59	91	66	8	13	19	27	20
120	Boulder River above Cabin Gulch, near Boulder	140	190	340	530	360	31	52	83	170	110
121	Boulder River near Cardwell	170	240	420	650	450	38	64	100	210	140
122	South Boulder River near Jefferson Island	110	120	150	170	150	49	55	71	86	71
123	Jefferson River at Sappington	2000	3300	5800	8700	6000	600	930	2100	3400	2400
124	South Willow Creek near Pony	42	60	110	180	130	10	12	46	80	50
125	North Willow Creek at Pony	23	31	53	80	59	5	8	23	36	25
126	Willow Creek near Harrison	30	55	96	150	110	7	13	58	96	62
127	Norwegian Creek near Harrison	6	7	10	13	10	3	4	6	10	7

Site No.	Stream name	June Q.90	June Q.80	June Q.50	June Q.20	June QM	July Q.90	July Q.80	July Q.50	July Q.20	July QM
129	Jefferson River near Three Forks	2600	3600	6200	10000	6900	630	1000	1900	3200	2300
130	Madison River near West Yellowstone	530	630	850	1000	850	360	420	520	670	530
131	Duck Creek near West Yellowstone	72	91	140	210	150	34	43	58	75	61
132	Cougar Creek near West Yellowstone	120	140	210	320	230	27	36	63	120	73
133	Grayling Creek near West Yellowstone	210	280	430	540	430	63	94	160	230	170
134	Red Canyon Creek near West Yellowstone	16	18	30	43	31	2	3	6	14	8
135	South Fork Madison River near West Yellowstone	220	230	280	320	280	140	150	190	220	190
136	Watkins Creek near West Yellowstone	28	32	51	70	53	6	9	15	27	18
137	Trapper Creek near West Yellowstone	14	16	26	38	28	4	5	8	13	9
138	Madison River below Hebgen Lake, near Grayling	220	590	1200	1800	1200	660	780	1000	1300	1000
139	Cabin Creek near West Yellowstone	140	180	300	370	300	31	47	88	150	100
140	Beaver Creek near West Yellowstone	160	200	290	390	300	60	84	120	170	130
141	Elk River at mouth, near Cameron	110	140	210	300	230	31	44	66	100	73
142	Soap Creek at mouth, near Cameron	6	7	12	18	13	2	2	4	6	4
143	Antelope Creek at mouth, near Cameron[2]	30	37	58	80	62	17	20	26	34	28
144	West Fork Madison River near Cameron	150	180	270	380	280	70	100	140	180	140
145	Squaw Creek near Cameron	39	45	68	99	73	13	17	25	38	28
146	Standard Creek near Cameron	31	40	60	75	61	14	20	29	37	31
147	Ruby Creek near Cameron	17	20	32	47	34	7	9	13	19	14
148	Indian Creek near Cameron	170	220	320	430	330	61	87	130	190	140
149	Madison River near Cameron	1300	1600	2500	3500	2600	1100	1300	1600	2000	1600
150	Blaine Spring Creek near Cameron	36	41	47	51	45	30	33	39	43	38
151	O'Dell Creek near Ennis	150	150	160	170	160	120	130	140	140	140
152	Jack Creek near Ennis	92	110	150	190	150	40	54	71	87	71
153	Moore Creek at Ennis	6	7	13	21	14	2	2	4	7	4
154	North Fork Meadow Creek at Forest Service boundary, near Ennis	54	71	110	140	110	21	34	56	70	58
155	North Fork Meadow Creek at highway, near Ennis	33	42	67	97	71	11	17	28	41	30
156	Madison River below Ennis Lake, near McAllister	1500	1800	2900	3900	3000	1200	1400	1700	2400	1900
157	Hot Springs Creek near Norris	20	26	42	63	45	10	13	19	25	20
158	Cherry Creek near Norris	75	110	160	220	170	34	46	67	94	77
159	Madison River near Three Forks	1600	1800	3000	4100	3100	1100	1300	1700	2500	1900
160	Cache Creek at mouth, near West Yellowstone	20	25	40	57	44	6	8	12	19	14
161	Taylor Creek near Grayling	290	330	440	500	420	98	130	190	280	200
162	Porcupine Creek near Gallatin Gateway	48	58	90	120	94	16	22	34	50	37
163	Gallatin River above West Fork, near Big Sky	1000	1100	1700	2200	1700	390	480	710	1000	760
164	South Fork West Fork Gallatin River near Gallatin Gateway	120	160	290	380	290	34	48	87	140	97
165	Middle Fork West Fork Gallatin River near Gallatin Gateway	43	54	94	120	94	13	19	32	48	36
166	West Fork Gallatin River near Gallatin Gateway	200	260	450	600	460	61	88	150	220	170
167	Squaw Creek near Gallatin Gateway	61	72	110	170	120	23	29	43	62	46
168	Hellroaring Creek near Gallatin Gateway	89	110	170	240	180	34	45	68	93	73

Site No.	Stream name	June Q.90	June Q.80	June Q.50	June Q.20	June QM	July Q.90	July Q.80	July Q.50	July Q.20	July QM
169	South Fork Spanish Creek near Gallatin Gateway	84	110	190	250	190	29	40	66	94	72
170	Spanish Creek near Gallatin Gateway	140	190	320	410	320	54	78	120	170	130
171	Gallatin River near Gallatin Gateway	2000	2100	3200	4000	3100	730	900	1300	1900	1400
172	Big Bear Creek near Gallatin Gateway	28	44	64	82	62	12	15	21	33	24
173	South Cottonwood Creek near Gallatin Gateway	76	86	120	150	120	31	38	53	75	57
174	Baker Creek near Manhattan[3]	160	210	410	590	410	37	54	110	230	140
175	Rocky Creek near Bozeman	35	47	80	120	87	9	17	29	44	31
176	Bear Canyon Creek near Bozeman	10	13	23	37	26	2	4	7	13	8
177	Sourdough Creek near Bozeman	42	47	73	100	76	18	21	34	44	34
178	East Gallatin River at Bozeman	97	110	190	270	200	41	45	67	94	74
179	Bridger Creek near Bozeman	40	54	98	150	100	15	18	28	56	38
180	East Gallatin River near Belgrade	120	150	300	530	330	36	44	91	170	110
181	East Fork Hyalite Creek near Bozeman	43	50	61	71	61	15	17	27	40	30
182	West Fork Hyalite Creek near Bozeman	80	88	100	110	100	25	33	55	84	62
183	Hyalite Creek at Hyalite Ranger Station, near Bozeman	150	170	210	260	220	69	91	130	170	130
184	Hyalite Creek above Interstate 90, near Bozeman	50	62	99	150	110	17	24	39	57	41
185	Thompson Creek near Belgrade	27	32	38	41	37	30	31	35	37	35
186	Ben Hart Creek near Belgrade	31	32	35	38	35	30	32	34	36	34
187	Reese Creek near Belgrade	17	25	44	75	50	6	8	14	23	16
188	East Gallatin River near Manhattan	430	560	830	1200	900	220	290	390	500	410
189	Gallatin River near Logan	1300	1700	3200	4400	3200	340	480	990	1800	1100
190	Sixteenmile Creek near Ringling	7	13	38	78	46	.0	.5	6	16	10
191	Sixteenmile Creek near Maudlow	44	72	150	260	170	18	29	52	110	64
192	Sixteenmile Creek near Toston	110	140	260	420	290	28	41	78	160	96
193	Missouri River near Toston	5400	7100	12000	18000	12000	1800	2700	4600	7000	5100
194	Crow Creek near Radersburg	81	120	160	230	170	27	34	53	93	65
195	Dry Creek near Toston	13	17	32	53	36	4	5	9	17	11
196	Deep Creek below North Fork, near Townsend	45	57	92	140	100	14	18	29	51	34
197	Duck Creek near Townsend	15	21	33	50	36	6	8	12	17	13
198	Confederate Gulch near Winston	24	33	51	76	56	10	12	18	28	21
199	Beaver Creek near Winston	23	43	68	110	74	6	10	19	30	21
200	Avalanche Gulch near Winston	14	15	28	46	31	2	2	5	15	7
201	Spokane Creek near East Helena	11	15	27	42	29	5	6	9	14	10
202	McGuire Creek at county road, near East Helena	9	10	12	14	12	7	8	9	11	9
203	Trout Creek at mouth, near East Helena	25	30	48	74	53	13	15	20	29	22
204	Prickly Pear Creek near Clancy	41	63	120	200	130	18	28	47	88	57
205	Prickly Pear Creek at mouth, near East Helena	66	85	140	230	160	27	35	51	83	57
206	Tenmile Creek near Rimini	16	25	70	110	76	1	2	8	19	12
207	Tenmile Creek near Helena	18	27	85	150	97	5	7	13	22	17
208	Sevenmile Creek near mouth, near Helena	9	11	21	35	24	2	2	5	12	6
209	Tenmile Creek at mouth, near East Helena	16	25	61	110	69	5	7	14	36	19
210	Silver Creek at Interstate 15, near Helena	13	17	26	35	27	8	11	15	21	16
211	Beaver Creek at mouth, near East Helena	15	17	23	31	27	7	9	11	18	13
212	Elkhorn Creek near mouth, near Wolf Creek	12	14	24	36	26	4	5	9	14	10
213	Willow Creek below Elkhorn Creek, near Wolf Creek	19	21	39	63	43	4	4	8	19	10

Table 8.--*Estimated monthly streamflow characteristics for June and July*--Continued

Site No.	Stream name	June Q.90	June Q.80	June Q.50	June Q.20	June QM	July Q.90	July Q.80	July Q.50	July Q.20	July QM
214	Cottonwood Creek above Beartooth Ranch, near Wolf Creek	6	7	14	24	16	1	2	3	6	4
217	Virginia Creek at mouth, near Canyon Creek	22	30	77	130	85	5	7	15	31	20
218	Canyon Creek below Cottonwood Creek, near Canyon Creek	44	58	170	330	190	6	8	24	64	35
219	Little Prickly Pear Creek near Canyon Creek	48	61	160	310	180	6	13	31	69	43
220	Lyons Creek near Wolf Creek	19	23	41	61	45	6	8	13	23	16
221	Wolf Creek at mouth, at Wolf Creek	20	25	45	74	51	5	6	11	24	14
222	Little Prickly Pear Creek near Wolf Creek	70	95	190	300	220	51	62	92	160	110
223	Wegner Creek near Craig[4]	8	15	34	56	38	0	0	6	13	8
224	Stickney Creek near Craig[5]	8	14	31	51	35	0	0	6	13	7
226	Middle Fork Dearborn River at Highway 200, near Wolf Creek	42	61	110	170	130	15	19	33	53	36
227	South Fork Dearborn River at Highway 434, near Wolf Creek	34	56	120	170	130	13	17	31	53	36
228	Dearborn River near Craig	140	300	710	1100	810	56	89	180	340	210
229	Flat Creek above Slew Creek, near Craig	28	52	120	160	130	11	17	34	61	42
230	Sheep Creek at mouth, near Cascade	68	110	220	310	230	33	53	80	97	84
232	North Fork Smith River at Highway 89, near White Sulphur Springs	31	48	160	340	190	9	13	23	40	25
233	South Fork Smith River at mouth, near White Sulphur Springs	28	39	82	130	88	10	13	25	42	29
234	Smith River below forks, near White Sulphur Springs	72	98	190	330	220	23	31	49	76	51
235	Big Birch Creek at mouth, near White Sulphur Springs	37	65	270	410	260	14	23	63	100	79
236	Newlan Creek below Charcoal Gulch, near White Sulphur Springs	13	18	35	52	38	5	7	13	23	16
237	Camas Creek near mouth, near White Sulphur Springs	27	32	58	96	65	7	8	15	32	19
238	Smith River near Fort Logan	120	180	390	540	390	81	100	170	230	190
239	Sheep Creek near White Sulphur Springs	49	63	100	160	110	22	30	41	55	43
240	Sheep Creek near mouth, near White Sulphur Springs	130	190	350	530	380	41	62	100	160	110
241	Eagle Creek near mouth, near White Sulphur Springs	22	28	53	84	58	6	8	13	24	15
242	Rock Creek below Buffalo Canyon, near White Sulphur Springs	42	54	94	140	100	15	21	31	49	35
243	Tenderfoot Creek below South Fork, near White Sulphur Springs	85	120	220	330	240	33	48	72	99	76
244	Smith River near Eden	360	530	920	1400	1100	96	190	370	740	450
245	Hound Creek near mouth, near Cascade	83	120	220	360	260	27	41	75	120	82
246	Missouri River near Ulm	4500	7200	12000	18000	13000	3100	4000	6600	10000	7300
247	North Fork Sun River near Augusta	720	830	1300	2000	1400	260	310	460	700	500
248	Sun River near Augusta	1300	1900	3000	4700	3300	390	680	1000	1700	1200
249	Sun River below diversion dam, near Augusta	360	690	1300	2900	1800	71	160	250	480	330
250	Willow Creek near Anderson Lake, near Augusta	14	17	30	48	33	3	4	8	15	9
251	North Fork Willow Creek below Cutrock Creek, near Augusta	8	9	16	24	17	3	3	5	8	6
254	Smith Creek near Augusta	34	43	69	110	86	25	30	47	59	48
255	Ford Creek near Augusta	29	45	62	110	81	27	31	40	56	44
256	Elk Creek near Augusta	98	190	310	490	340	32	52	78	150	100
257	Sun River at Simms	420	710	1400	3200	2100	66	96	270	600	420
260	Missouri River near Great Falls	6300	8500	15000	21000	16000	3900	4900	7800	12000	8500
261	Dry Fork at mouth, at Monarch	51	66	110	170	130	15	21	37	60	42

Site No.	Stream name	June Q.90	June Q.80	June Q.50	June Q.20	June QM	July Q.90	July Q.80	July Q.50	July Q.20	July QM
262	Tillinghast Creek above Joice Creek, near Monarch	26	33	54	80	60	11	15	22	30	24
263	Pilgrim Creek at mouth, near Monarch	31	45	79	120	88	11	14	23	37	27
264	Logging Creek at Logging Creek Campground, near Monarch	19	25	40	60	44	10	13	17	21	18
265	Belt Creek near Monarch	250	330	570	1000	700	75	110	200	320	220
266	Big Otter Creek above Never Sweat Creek, near Raynesford	14	17	29	50	33	6	7	10	14	11
267	Belt Creek near Portage	250	390	710	1700	1100	57	85	150	330	220
268	Highwood Creek below Smith Creek, near Highwood	36	47	78	130	88	12	15	23	36	25
269	Missouri River at Fort Benton	6800	9000	16000	23000	17000	3900	5200	7900	12000	8800
270	Shonkin Creek below Bishop Creek, near Highwood	25	35	61	100	70	10	12	18	26	18
271	South Fork Two Medicine River near East Glacier	92	120	240	380	260	25	35	59	95	63
273	South Fork Badger Creek near Browning	120	140	210	300	230	31	43	65	100	71
274	North Fork Badger Creek near Browning	100	130	190	270	210	28	39	59	91	65
278	Birch Creek at Swift Dam, near Valier	110	270	370	630	500	150	170	240	430	300
279	South Fork Dupuyer Creek near Dupuyer	17	21	36	52	39	6	7	11	17	13
280	North Fork Dupuyer Creek near Dupuyer	23	29	48	68	52	7	10	15	22	16
281	Dupuyer Creek below Scoffin Creek, near Dupuyer	47	60	120	200	130	10	13	27	55	34
282	Birch Creek near Valier	31	55	99	220	140	19	25	43	97	62
283	Cut Bank Creek near Browning	310	370	470	680	530	74	130	170	260	190
284	Cut Bank Creek at Cut Bank	280	350	510	810	600	78	110	190	350	230
285	Marias River at Sullivan Bridge, near Cut Bank	1100	1300	2200	3600	2800	310	460	730	1300	950
286	Marias River near Shelby	1200	1500	2500	4300	3200	320	490	790	1500	1000
287	Marias River at "F" Bridge, above Tiber Reservoir, near Shelby	1400	1700	2900	5000	3800	370	570	920	1700	1200
288	Marias River near Loma	570	750	1500	2600	1900	460	680	1300	2000	1300
290	Teton River near Strabane	36	59	99	140	100	21	32	48	82	61
291	McDonald Creek near Strabane	14	15	16	17	16	11	12	13	15	13
292	North Fork Deep Creek near Choteau	30	37	61	87	66	9	12	19	29	21
293	South Fork Deep Creek near Choteau	28	35	57	83	63	9	12	18	27	20
294	Deep Creek near Choteau	15	22	39	60	43	7	11	17	30	20
295	Teton River near Dutton	64	140	320	560	420	32	64	140	270	170
296	Missouri River at Virgelle	7800	12000	18000	26000	20000	4400	5600	10000	14000	10000
297	Lost Creek at mouth, near Utica	36	47	79	120	86	12	16	26	40	29
298	Yogo Creek at mouth, near Utica	18	20	36	59	41	3	4	8	20	10
299	Middle Fork Judith River near Utica	120	160	220	350	250	25	34	66	90	69
301	South Fork Judith River at Indian Hill Campground, near Utica	18	24	42	74	48	5	5	9	15	10
303	Judith River above Courtneys Creek, at Utica	77	100	190	300	210	23	33	62	100	67
306	East Fork Big Spring Creek at mouth, near Lewistown	35	46	83	130	96	10	14	26	45	30
307	Big Spring Creek above Cottonwood Creek, near Hanover	170	210	260	320	280	140	160	190	210	190
309	Cottonwood Creek at Highway 200, near Lewistown	27	37	73	120	87	7	10	20	35	23
310	Beaver Creek at county road, near Lewistown	21	27	49	79	56	9	11	16	25	18
311	Big Spring Creek at mouth, near Lewistown	220	310	460	680	540	150	190	260	330	270

Table 8.--*Estimated monthly streamflow characteristics for June and July*--Continued

Site No.	Stream name	June Q.90	June Q.80	June Q.50	June Q.20	June QM	July Q.90	July Q.80	July Q.50	July Q.20	July QM
312	Warm Springs Creek above Meadow Creek, near Hilger	94	100	110	120	110	98	100	110	110	110
313	Judith River near Winifred	250	300	550	720	550	260	320	560	670	550
315	Cow Creek below forks, near Cleveland	12	16	28	40	30	5	6	11	16	12
316	Missouri River near Landusky	8400	13000	20000	29000	22000	5000	6200	11000	15000	12000
317	North Fork Musselshell River near Delpine	10	14	27	41	29	6	8	13	23	15
318	Checkerboard Creek near Checkerboard	10	12	23	36	25	3	4	6	11	7
319	Spring Creek below Whitetail Creek, near Checkerboard	21	30	58	93	68	8	11	20	29	21
320	North Fork Musselshell River near mouth, near Martinsdale	31	39	70	120	78	11	14	22	37	25
321	Alabaugh Creek at mouth, near Lennep	18	25	49	76	54	6	8	14	22	15
322	Cottonwood Creek below Loco Creek, near Martinsdale	73	110	200	310	220	28	40	61	85	65
323	South Fork Musselshell River above Martinsdale	94	140	290	510	340	19	28	66	120	78
324	Big Elk Creek at mouth, at Twodot	16	29	55	98	62	3	5	11	23	15
325	Musselshell River at Harlowton	87	150	460	770	510	48	67	140	210	170
326	American Fork near Harlowton	.1	2	11	70	56	.0	.3	2	9	5
330	Careless Creek below Little Careless Creek, near Hedgesville	6	7	13	24	15	2	2	3	5	3
331	Swimming Woman Creek below Dry Coulee, near Franklin	7	9	17	27	19	2	3	4	8	5
333	Musselshell River near Roundup	130	200	520	1000	720	94	120	220	330	290
335	Flatwillow Creek below the forks, near Grass Range	90	120	200	300	220	12	17	43	89	51
338	Musselshell River near Mosby	70	150	590	1800	1000	14	51	140	500	350
339	Big Dry Creek above Little Dry Creek, near Van Norman	.1	1	14	80	43	.0	.5	4	25	31
340	Little Dry Creek near Van Norman	1	2	14	55	34	.3	1	5	22	26
341	Big Dry Creek near Van Norman	2	3	28	140	77	.4	1	9	47	57

[1]Includes estimated spring flow of about 40 cubic feet per second, based on information provided by Montana Department of Fish, Wildlife and Parks.

[2]Includes estimated spring flow of about 10 cubic feet per second, based on information provided by Montana Department of Fish, Wildlife and Parks.

[3]Estimated long-term monthly streamflow characteristics may not reflect the current flow regime because of upstream streamflow regulation.

[4]Stream is known to be dry except for periods of runoff. Calculated flows were adjusted by subtracting 7 cubic feet per second.

[5]Stream is known to be dry except for periods of runoff. Calculated flows were adjusted by subtracting 8 cubic feet per second.

Table 8.-- Estimated monthly streamflow characteristics for June and July.

[Q.XX, monthly mean streamflow for specified month exceeded XX percent of the years, in cubic feet per second; QM, mean monthly streamflow for specified month, in cubic feet per second]

Site no.	Stream name	June Q.90	June Q.80	June Q.50	June Q.20	June QM	July Q.90	July Q.80	July Q.50	July Q.20	July QM
366	ROCK CREEK AT MOUTH NEAR WISDOM	20	27	49	73	53	8	10	17	26	19
367	DELANO CREEK AT MOUTH NEAR WISE RIVER	1	2	3	4	3	0.5	0.6	0.9	1	1
368	HALFWAY CREEK AT MOUTH NEAR WHITEHALL	7	9	17	25	18	3	3	6	8	6
369	N.F DEEP CREEK AT MOUTH NR MILLIGAN	6	8	15	21	16	2	3	5	7	5
370	COLLAR GULCH AT MOUTH NEAR MAIDEN	2	3	5	7	5	0.7	1	2	2	2
371	BADGER CREEK BEL FORKS NR BROWNING	200	250	370	540	410	54	77	120	180	130

PROVISIONAL

Table 9.--*Estimated monthly streamflow characteristics for August and September*

[Q.XX, monthly mean streamflow for specified month exceeded XX percent of the years, in cubic feet per second; QM, mean monthly streamflow for specified month, in cubic feet per second]

Site No.	Stream name	August					September				
		Q.90	Q.80	Q.50	Q.20	QM	Q.90	Q.80	Q.50	Q.20	QM
1	Hellroaring Creek near Lakeview	10	11	16	21	16	8	9	11	14	12
2	Corral Creek near Lakeview	1	1	2	3	2	1	1	1	2	1
3	Antelope Creek near Lakeview	.2	.2	.3	.4	.3	.2	.2	.2	.3	.2
4	Red Rock Creek near Lakeview	14	17	22	28	23	12	14	16	20	18
5	Tom Creek near Lakeview	1	1	2	2	2	.6	.7	1	1	1
6	Narrows Creek at mouth, near Lakeview	.3	.3	.6	.8	.6	.2	.2	.4	.5	.4
7	Odell Creek near Lakeview	8	9	12	16	13	6	7	8	11	9
8	Jones Creek near Lakeview	1	1	2	3	2	.7	1	1	2	1
9	Red Rock River near Kennedy Ranch, near Lakeview	20	27	46	76	53	20	32	47	69	49
10	Peet Creek at county road, near Lakeview	1	1	2	2	2	.7	1	1	2	1
11	Long Creek near Lakeview	4	5	6	8	6	3	3	4	5	5
12	East Fork Clover Creek at mouth, near Monida	1	1	2	3	2	.9	1	2	2	2
13	Red Rock River below Lima Reservoir, near Monida	110	160	260	310	240	33	52	140	250	150
14	Cabin Creek above Simpson Creek, near Lima	.6	.6	1	1	1	.3	.4	.6	.9	.7
15	Indian Creek above Simpson Creek, near Lima	.9	1	2	2	1	.5	.6	.8	1	1
16	Simpson Creek above Indian Creek, near Lima	1	1	2	2	2	.6	.7	1	1	1
17	Deadman Creek near Dell	3	4	6	9	6	2	3	4	6	5
18	Big Sheep Creek below Muddy Creek, near Dell	34	51	63	81	65	32	40	51	64	52
19	Red Rock River at Red Rock	100	120	150	240	180	170	190	230	290	250
20	Black Canyon Creek near Grant	2	2	3	4	3	2	2	2	3	3
21	Shennon Creek near mouth, near Grant	.7	.8	1	2	1	.5	.6	1	1	1
22	Frying Pan Creek near Grant	2	2	3	3	3	1	1	2	3	2
23	Trapper Creek at mouth, near Grant	.6	.7	1	2	1	.4	.5	.7	1	.9
24	Bear Creek near Grant	3	4	5	6	5	3	3	4	5	4
25	Bloody Dick Creek near Grant	13	16	20	26	21	10	13	16	21	17
26	Horse Prairie Creek near Grant	30	34	44	55	45	26	28	36	50	39
27	Rape Creek above reservoir, near Grant	.4	.5	.8	1	.8	.3	.3	.5	.8	.6
28	Painter Creek near Grant	3	3	5	6	5	2	2	3	4	4
29	Browns Canyon Creek near Grant	2	2	3	4	3	1	2	2	3	2
30	Medicine Lodge Creek near Grant	5	6	9	13	10	4	6	7	11	8
32	Pole Creek near mouth, near Polaris	1	1	2	3	2	.8	1	1	2	2
33	Reservoir Creek at mouth, near Polaris	1	1	2	3	2	1	1	2	3	2
34	East Fork Dyce Creek at mouth, near Polaris	1	1	2	3	2	.8	1	1	2	1
35	West Fork Dyce Creek at mouth, near Polaris	.7	.8	1	2	1	.5	.5	.7	1	.8
36	Grasshopper Creek near Dillon	12	16	26	38	28	11	12	17	28	20
37	Beaverhead River at Barretts	230	290	440	740	530	180	240	360	510	410
38	East Fork Blacktail Creek near Dillon	16	18	23	29	24	14	16	20	24	20
39	West Fork Blacktail Creek near Dillon	5	7	11	16	11	4	6	8	11	8
40	Blacktail Deer Creek near Dillon	30	40	46	58	48	32	37	43	52	44
41	Beaverhead River near Dillon	49	65	150	260	210	130	150	330	450	360

Table 9.--*Estimated monthly streamflow characteristics for August and September*--Continued

Site No.	Stream name	August Q.90	August Q.80	August Q.50	August Q.20	August QM	September Q.90	September Q.80	September Q.50	September Q.20	September QM
42	Beaverhead River near Twin Bridges	80	100	200	330	260	190	220	410	570	440
43	Corral Creek at mouth, near Alder	.8	1	2	2	2	.6	.7	1	2	1
44	Coal Creek at mouth, near Alder	2	3	4	6	5	2	2	3	4	4
45	Ruby River above the forks, near Alder	7	9	14	19	14	6	8	10	15	12
46	East Fork Ruby River at mouth, near Alder	3	4	6	8	6	3	3	4	6	5
47	West Fork Ruby River at mouth, near Alder	4	5	7	9	7	3	4	5	7	6
48	Cottonwood Creek at mouth, near Alder	4	5	8	11	8	4	4	6	8	6
49	Warm Springs Creek at mouth, near Alder[1]	47	49	54	59	54	46	48	50	54	51
50	North Fork Greenhorn Creek at mouth, near Alder	2	3	4	5	4	2	2	3	4	3
51	Ruby River above reservoir, near Alder	76	97	120	150	120	84	91	110	140	110
52	Mill Creek at Forest Service boundary, near Sheridan	12	14	21	29	22	9	10	13	17	14
53	Wisconsin Creek at Forest Service boundary, near Sheridan	8	10	14	20	15	6	7	9	12	10
54	Ruby River near Twin Bridges	66	100	140	190	140	140	150	190	280	210
55	Big Hole River near Jackson	14	17	22	29	23	13	14	17	23	18
56	Andrus Creek near mouth, near Jackson	4	4	7	10	7	3	4	5	7	6
57	Fox Creek at mouth, near Jackson	3	3	5	6	5	2	2	3	5	4
58	Governor Creek near Jackson	16	19	23	30	25	12	15	19	25	20
59	Warm Springs Creek at Jackson	9	10	14	18	14	7	8	11	14	11
60	Miner Creek near Jackson	13	14	17	22	19	6	7	9	13	10
61	Big Lake Creek near mouth, near Wisdom	5	5	8	11	8	4	4	6	8	7
62	Steel Creek above Francis Creek, near Wisdom	3	3	4	5	4	2	2	3	4	3
63	Francis Creek at mouth, near Wisdom	4	4	6	8	6	3	3	5	6	5
64	Steel Creek near mouth, near Wisdom	7	8	10	13	10	5	6	8	10	8
65	Swamp Creek near mouth, near Wisdom	9	11	13	17	14	6	8	10	14	11
66	Joseph Creek at mouth, near Wisdom	4	5	7	9	7	3	4	5	6	5
67	Trail Creek near Wisdom	19	21	24	32	26	13	16	20	25	20
68	Ruby Creek at mouth, near Wisdom	6	7	9	12	9	4	5	7	9	7
69	Tie Creek at Forest Service boundary, near Wisdom	8	9	14	18	14	6	7	10	13	11
70	Johnson Creek near Wisdom	4	5	7	9	7	3	4	5	7	6
71	Mussigbrod Creek near Wisdom	4	5	6	8	7	3	4	5	6	5
72	North Fork Big Hole River near mouth, near Wisdom	34	41	52	71	55	25	32	41	56	44
73	Big Hole River below North Fork, near Wisdom	86	130	190	280	210	83	93	130	200	160
74	Pintlar Creek near Forest Service boundary, near Wisdom	7	9	11	15	12	5	6	8	11	9
75	Big Hole River below Mudd Creek, near Wisdom	93	140	200	300	220	93	100	140	240	170
76	Fishtrap Creek at mouth, near Wise River	8	10	12	16	13	6	7	9	13	10
77	Lamarche Creek near Wise River	13	18	24	32	25	11	13	17	23	19
78	Seymour Creek near Wise River	9	10	15	20	15	7	8	11	14	12
79	Tenmile Creek at mouth, near Wise River	4	4	6	8	6	3	3	4	5	4
80	Sevenmile Creek at mouth, near Wise River	.8	1	2	2	2	.6	.7	1	1	1
81	Corral Creek at mouth, near Wise River	1	1	2	2	2	.7	.8	1	2	1

Table 9.--*Estimated monthly streamflow characteristics for August and September*--Continued

Site No.	Stream name	August Q.90	August Q.80	August Q.50	August Q.20	August QM	September Q.90	September Q.80	September Q.50	September Q.20	September QM
82	Twelvemile Creek at mouth, near Wise River	3	3	5	6	5	2	2	3	4	3
83	Sullivan Creek at mouth, near Wise River	3	3	5	6	5	2	2	3	4	4
84	Oregon Creek near mouth, near Wise River	.4	.5	.8	1	.8	.3	.3	.5	.7	.6
85	California Creek above American Creek, near Wise River	2	3	5	7	5	2	3	4	5	4
86	American Creek at mouth, near Wise River	.8	1	2	2	2	.6	.8	1	2	1
87	Sixmile Creek at mouth, near Wise River	.6	.7	1	2	1	.5	.6	.8	1	1
88	French Creek near mouth, near Wise River	4	5	8	12	9	4	5	7	9	7
89	Deep Creek near Wise River	25	29	36	47	39	20	24	30	39	32
90	Bear Creek near Wise River	2	2	3	4	3	1	2	2	3	2
91	Bryant Creek at mouth, near Wise River	2	3	4	6	5	2	2	3	4	4
92	Big Hole River near Wise River	130	190	290	420	310	130	140	190	300	240
93	Johnson Creek at mouth, near Wise River	1	2	3	4	3	1	1	2	3	2
94	Meadow Creek near Wise River	3	3	5	7	5	2	3	3	5	4
95	Jacobson Creek at mouth, near Wise River	13	15	21	28	22	10	12	14	19	16
96	Mono Creek at mouth, near Wise River	2	2	3	4	3	1	1	2	3	2
97	Wyman Creek at mouth, near Wise River	6	8	11	15	12	5	6	8	11	9
98	Lacy Creek at mouth, near Wise River	4	5	8	10	8	3	4	5	7	6
99	Gold Creek at mouth, near Wise River	2	3	4	5	4	2	2	3	4	3
100	Pattengail Creek at mouth, near Wise River	14	17	25	35	26	12	14	19	26	21
101	Sheep Creek at mouth, near Wise River	3	3	5	7	5	2	3	3	5	4
102	Wise River near Wise River	56	72	89	120	93	44	50	63	86	69
103	Adson Creek at mouth, near Wise River	2	2	3	4	3	1	2	2	3	3
104	Jerry Creek near Wise River	8	10	13	17	14	6	8	10	12	10
105	Divide Creek at Divide	3	4	5	7	6	3	3	4	5	4
106	Canyon Creek near Divide	4	6	8	10	8	3	4	5	7	6
107	Moose Creek near Divide	5	6	7	9	7	4	5	6	7	6
108	Trapper Creek near Melrose	5	6	8	10	8	4	5	6	7	6
109	Camp Creek at Melrose	2	3	4	7	4	1	2	3	5	3
110	Big Hole River near Melrose	240	340	490	700	520	240	260	340	560	410
111	Willow Creek near Glen	10	14	17	21	17	8	10	12	15	12
112	Birch Creek near Glen	13	18	28	37	28	8	10	12	16	13
113	Hells Canyon Creek near Twin Bridges	3	3	5	6	5	2	3	3	4	4
114	Jefferson River near Twin Bridges	310	520	770	1100	840	580	710	1000	1300	1000
115	Whitetail Creek near Whitehall	20	22	28	33	27	10	13	17	21	18
117	Boulder River above High Ore Creek, near Basin	9	12	20	35	24	10	13	20	33	24
118	Boulder River near Boulder	12	15	25	45	31	12	17	26	42	30
119	Little Boulder River near Boulder	4	5	8	12	10	5	6	9	16	11
120	Boulder River above Cabin Gulch, near Boulder	16	20	30	50	36	17	22	32	47	36
121	Boulder River near Cardwell	20	25	38	61	45	21	27	39	58	44
122	South Boulder River near Jefferson Island	25	28	32	37	32	15	17	23	29	23
123	Jefferson River at Sappington	250	410	690	1200	790	560	710	1100	1800	1200
124	South Willow Creek near Pony	5	7	8	14	10	4	5	8	21	12
125	North Willow Creek at Pony	3	4	6	10	7	3	3	6	13	8
126	Willow Creek near Harrison	3	4	8	18	11	4	5	13	34	20
127	Norwegian Creek near Harrison	3	4	7	9	8	5	5	7	10	7

Site No.	Stream name	August Q.90	August Q.80	August Q.50	August Q.20	August QM	September Q.90	September Q.80	September Q.50	September Q.20	September QM
129	Jefferson River near Three Forks	450	540	850	1400	1000	790	890	1300	1800	1300
130	Madison River near West Yellowstone	330	370	440	510	440	340	380	420	490	430
131	Duck Creek near West Yellowstone	23	27	33	41	35	22	24	29	35	30
132	Cougar Creek near West Yellowstone	12	15	21	29	22	9	11	14	18	15
133	Grayling Creek near West Yellowstone	26	33	46	69	50	19	23	30	40	33
134	Red Canyon Creek near West Yellowstone	.9	1	2	2	2	.5	.6	.8	1	1
135	South Fork Madison River near West Yellowstone	110	120	130	140	130	100	110	120	130	120
136	Watkins Creek near West Yellowstone	3	4	5	7	5	2	2	3	4	3
137	Trapper Creek near West Yellowstone	2	3	4	5	4	2	2	3	3	3
138	Madison River below Hebgen Lake, near Grayling	800	910	1100	1200	1100	690	890	1200	1400	1200
139	Cabin Creek near West Yellowstone	12	16	21	32	23	8	11	13	18	15
140	Beaver Creek near West Yellowstone	30	36	51	70	54	25	28	35	44	37
141	Elk River at mouth, near Cameron	19	21	29	38	30	14	16	20	25	21
142	Soap Creek at mouth, near Cameron	1	2	2	3	2	1	1	1	2	2
143	Antelope Creek at mouth, near Cameron[2]	15	16	19	22	19	14	15	16	19	17
144	West Fork Madison River near Cameron	44	55	67	84	69	43	46	57	64	56
145	Squaw Creek near Cameron	8	9	12	16	13	7	7	9	11	9
146	Standard Creek near Cameron	7	9	12	17	13	6	6	8	10	9
147	Ruby Creek near Cameron	4	5	6	8	6	3	4	4	6	5
148	Indian Creek near Cameron	29	36	50	70	53	24	27	34	43	36
149	Madison River near Cameron	1000	1200	1300	1500	1300	1000	1200	1400	1600	1400
150	Blaine Spring Creek near Cameron	25	26	29	35	30	23	25	26	28	26
151	O'Dell Creek near Ennis	110	110	120	120	120	110	110	110	120	110
152	Jack Creek near Ennis	23	26	33	41	34	21	22	27	32	27
153	Moore Creek at Ennis	1	1	2	2	2	.8	1	1	2	1
154	North Fork Meadow Creek at Forest Service boundary, near Ennis	10	13	31	43	29	8	10	15	21	16
155	North Fork Meadow Creek at Highway 287, near Ennis	6	8	15	20	14	4	6	8	11	9
156	Madison River below Ennis Lake, near McAllister	1200	1400	1600	1800	1600	1200	1300	1700	2000	1700
157	Hot Springs Creek near Norris	6	8	13	15	12	6	7	8	11	9
158	Cherry Creek near Norris	20	23	35	48	36	19	22	28	36	29
159	Madison River near Three Forks	1000	1200	1500	1700	1500	1200	1300	1600	1800	1600
160	Cache Creek at mouth, near West Yellowstone	4	4	6	8	6	3	3	4	5	5
161	Taylor Creek near Grayling	42	49	65	89	68	30	32	40	49	42
162	Porcupine Creek near Gallatin Gateway	8	9	13	18	14	6	7	9	11	9
163	Gallatin River above West Fork, near Big Sky	250	270	320	390	330	210	220	280	320	280
164	South Fork West Fork Gallatin River near Gallatin Gateway	17	21	28	40	31	14	16	22	30	24
165	Middle Fork West Fork Gallatin River near Gallatin Gateway	7	9	12	17	13	6	7	9	12	10
166	West Fork Gallatin River near Gallatin Gateway	32	39	52	72	56	27	31	42	55	44
167	Squaw Creek near Gallatin Gateway	15	18	23	28	24	15	16	19	23	20
168	Hellroaring Creek near Gallatin Gateway	21	24	32	41	33	19	21	26	33	27

Site No.	Stream name	August					September				
		Q.90	Q.80	Q.50	Q.20	QM	Q.90	Q.80	Q.50	Q.20	QM
169	South Fork Spanish Creek near Gallatin Gateway	16	19	25	34	27	13	15	20	26	21
170	Spanish Creek near Gallatin Gateway	30	36	49	67	52	26	30	40	51	41
171	Gallatin River near Gallatin Gateway	460	510	600	730	620	390	420	520	610	520
172	Big Bear Creek near Gallatin Gateway	6	8	9	13	10	5	6	7	8	7
173	South Cottonwood Creek near Gallatin Gateway	19	21	25	31	26	17	18	21	25	21
174	Baker Creek near Manhattan[3]	36	43	55	78	60	53	64	86	110	87
175	Rocky Creek near Bozeman	7	10	14	21	16	9	10	13	18	15
176	Bear Canyon Creek near Bozeman	.8	2	3	5	4	1	2	3	4	3
177	Sourdough Creek near Bozeman	12	14	20	25	20	10	12	17	19	16
178	East Gallatin River at Bozeman	27	29	45	60	49	35	42	52	60	52
179	Bridger Creek near Bozeman	7	8	12	18	14	5	7	9	12	11
180	East Gallatin River near Belgrade	25	27	44	66	51	32	35	50	71	55
181	East Fork Hyalite Creek near Bozeman	6	6	10	12	9	5	6	8	10	8
182	West Fork Hyalite Creek near Bozeman	11	13	17	23	18	10	12	15	17	14
183	Hyalite Creek at Hyalite Ranger Station, near Bozeman	35	45	84	100	78	29	34	46	60	50
184	Hyalite Creek above Interstate 90, near Bozeman	9	11	21	27	20	7	8	11	16	13
185	Thompson Creek near Belgrade	28	30	32	35	32	27	29	32	35	32
186	Ben Hart Creek near Belgrade	29	30	32	34	32	29	29	31	33	31
187	Reese Creek near Belgrade	5	6	8	11	9	5	6	7	11	8
188	East Gallatin River near Manhattan	160	180	220	280	230	160	170	200	240	200
189	Gallatin River near Logan	330	390	480	670	530	470	560	740	920	740
190	Sixteenmile Creek near Ringling	.0	.0	.8	5	3	.0	1	3	4	3
191	Sixteenmile Creek near Maudlow	12	14	30	48	32	15	16	24	40	28
192	Sixteenmile Creek near Toston	17	21	36	57	39	18	21	29	46	33
193	Missouri River near Toston	1400	1800	2400	3300	2600	2400	2600	3400	4600	3500
194	Crow Creek near Radersburg	13	15	23	32	24	12	14	17	23	18
195	Dry Creek near Toston	3	3	5	7	5	2	3	3	6	4
196	Deep Creek below North Fork, near Townsend	8	10	14	18	15	8	9	11	14	12
197	Duck Creek near Townsend	4	5	7	8	7	3	4	5	7	5
198	Confederate Gulch near Winston	6	7	10	13	10	5	6	8	10	8
199	Beaver Creek near Winston	2	4	6	8	6	2	2	4	6	4
200	Avalanche Gulch near Winston	1	1	2	3	2	.8	1	1	2	2
201	Spokane Creek near East Helena	3	4	5	7	5	3	3	4	5	5
202	McGuire Creek at county road, near East Helena	6	6	8	9	8	6	6	7	8	8
203	Trout Creek at mouth, near East Helena	11	11	15	17	15	12	12	14	15	13
204	Prickly Pear Creek near Clancy	13	15	29	44	30	16	17	24	37	27
205	Prickly Pear Creek at mouth, near East Helena	19	22	32	40	33	21	22	28	35	29
206	Tenmile Creek near Rimini	.4	.5	1	3	2	.3	.5	1	3	2
207	Tenmile Creek near Helena	.3	.6	2	8	5	.8	1	3	7	5
208	Sevenmile Creek near mouth, near Helena	1	1	2	3	2	1	1	2	3	2
209	Tenmile Creek at mouth, near East Helena	3	4	6	12	7	2	3	5	9	6
210	Silver Creek at Interstate 15, near Helena	7	7	11	14	11	8	8	10	13	11
211	Beaver Creek at mouth, near East Helena	4	4	7	11	8	4	5	6	12	8
212	Elkhorn Creek near mouth, near Wolf Creek	2	3	5	7	5	2	3	4	5	4
213	Willow Creek below Elkhorn Creek, near Wolf Creek	3	3	4	6	4	2	2	3	4	3

Site No.	Stream name	August Q.90	August Q.80	August Q.50	August Q.20	August QM	September Q.90	September Q.80	September Q.50	September Q.20	September QM
214	Cottonwood Creek above Beartooth Ranch, near Wolf Creek	1	1	2	2	2	.6	.8	1	2	1
217	Virginia Creek at mouth, near Canyon Creek	3	3	4	7	5	4	5	7	11	8
218	Canyon Creek below Cottonwood Creek, near Canyon Creek	3	4	5	8	6	5	6	10	15	10
219	Little Prickly Pear Creek near Canyon Creek	2	3	5	13	8	13	15	21	27	21
220	Lyons Creek near Wolf Creek	3	4	7	9	7	3	4	6	7	6
221	Wolf Creek at mouth, at Wolf Creek	3	3	5	8	6	2	3	4	6	5
222	Little Prickly Pear Creek near Wolf Creek	20	27	54	97	76	30	36	59	84	63
223	Wegner Creek near Craig[4]	0	0	0	0	0	0	0	0	0	0
224	Stickney Creek near Craig[5]	0	0	0	0	0	0	0	0	0	0
226	Middle Fork Dearborn River at Highway 200, near Wolf Creek	8	10	14	20	15	6	8	11	15	12
227	South Fork Dearborn River at Highway 434, near Wolf Creek	7	9	13	18	14	5	7	9	14	11
228	Dearborn River near Craig	17	33	68	100	70	20	32	52	75	56
229	Flat Creek above Slew Creek, near Craig	5	7	13	21	14	4	6	9	14	10
230	Sheep Creek at mouth, near Cascade	17	24	36	56	38	14	19	26	36	28
232	North Fork Smith River at Highway 89, near White Sulphur Springs	6	8	12	21	13	4	6	9	13	9
233	South Fork Smith River at mouth, near White Sulphur Springs	5	7	12	16	11	8	9	11	14	12
234	Smith River below forks, near White Sulphur Springs	15	19	27	39	29	11	15	22	29	22
235	Big Birch Creek at mouth, near White Sulphur Springs	5	8	22	40	20	16	18	25	32	25
236	Newlan Creek below Charcoal Gulch, near White Sulphur Springs	3	3	8	13	8	3	3	6	9	6
237	Camas Creek near mouth, near White Sulphur Springs	4	5	8	11	8	3	4	6	9	7
238	Smith River near Fort Logan	41	55	100	130	95	90	98	110	120	110
239	Sheep Creek near White Sulphur Springs	14	18	23	30	23	12	14	18	22	18
240	Sheep Creek near mouth, near White Sulphur Springs	21	29	41	62	44	17	23	30	42	33
241	Eagle Creek near mouth, near White Sulphur Springs	3	4	6	8	6	2	3	4	6	5
242	Rock Creek below Buffalo Canyon, near White Sulphur Springs	9	12	16	22	17	8	10	12	16	13
243	Tenderfoot Creek below South Fork, near White Sulphur Springs	18	24	33	47	35	15	19	25	34	27
244	Smith River near Eden	58	83	140	230	160	62	85	120	190	150
245	Hound Creek near mouth, near Cascade	16	22	36	49	37	15	17	25	33	26
246	Missouri River near Ulm	2300	2700	4100	5900	4300	2500	3100	4200	5300	4300
247	North Fork Sun River near Augusta	100	130	160	210	160	90	95	110	140	120
248	Sun River near Augusta	760	840	1100	1300	1100	240	260	370	540	390
249	Sun River below diversion dam, near Augusta	64	73	86	140	110	54	64	100	130	110
250	Willow Creek near Anderson Lake, near Augusta	2	3	4	5	4	2	2	3	4	3
251	North Fork Willow Creek below Cutrock Creek, near Augusta	2	2	3	4	3	2	3	3	3	3
254	Smith Creek near Augusta	6	8	12	17	13	4	6	9	16	11
255	Ford Creek near Augusta	12	15	19	27	20	12	14	17	21	18
256	Elk Creek near Augusta	20	26	37	49	38	20	23	30	38	31
257	Sun River at Simms	55	87	150	240	170	49	68	120	180	130
260	Missouri River near Great Falls	3200	3800	5100	7200	5400	3300	3800	4900	6300	5100
261	Dry Fork at mouth, at Monarch	8	11	16	23	17	7	9	12	19	14

Site No.	Stream name	August Q.90	August Q.80	August Q.50	August Q.20	August QM	September Q.90	September Q.80	September Q.50	September Q.20	September QM
312	Warm Springs Creek above Meadow Creek, near Hilger	100	100	110	110	110	100	110	110	110	110
313	Judith River near Winifred	240	250	480	670	470	240	240	470	640	440
315	Cow Creek below forks, near Cleveland	3	4	6	9	7	3	3	4	6	5
316	Missouri River near Landusky	3900	4700	6600	8700	6800	4300	4600	5900	7700	6400
317	North Fork Musselshell River near Delpine	3	4	9	13	9	4	4	8	11	8
318	Checkerboard Creek near Checkerboard	2	2	3	4	3	1	2	2	3	2
319	Spring Creek below Whitetail Creek, near Checkerboard	5	6	10	14	10	4	5	7	9	7
320	North Fork Musselshell River near mouth, near Martinsdale	6	8	13	18	13	5	7	10	14	11
321	Alabaugh Creek at mouth, near Lennep	3	4	6	9	6	2	3	4	6	5
322	Cottonwood Creek below Loco Creek, near Martinsdale	15	20	27	39	29	12	15	20	28	22
323	South Fork Musselshell River above Martinsdale	6	12	21	44	27	5	10	21	36	25
324	Big Elk Creek at mouth, at Twodot	.9	1	3	7	4	.5	1	5	10	6
325	Musselshell River at Harlowton	22	36	84	130	83	13	35	65	100	70
326	American Fork near Harlowton	.0	.0	.5	2	1	.0	.0	.7	2	.9
330	Careless Creek below Little Careless Creek, near Hedgesville	1	1	2	2	2	.7	1	1	2	1
331	Swimming Woman Creek below Dry Coulee, near Franklin	1	1	2	2	2	.7	1	1	2	2
333	Musselshell River near Roundup	32	70	180	270	170	40	48	110	190	120
335	Flatwillow Creek below the forks, near Grass Range	4	5	8	16	10	3	4	6	10	7
338	Musselshell River near Mosby	5	20	87	220	120	9	20	73	180	130
339	Big Dry Creek above Little Dry Creek, near Van Norman	.0	.0	2	6	7	.0	.0	.5	4	9
340	Little Dry Creek near Van Norman	.1	.3	2	8	9	.0	.1	1	5	10
341	Big Dry Creek near Van Norman	.1	.3	4	14	16	.0	.1	2	9	19

[1]Includes estimated spring flow of about 40 cubic feet per second, based on information provided by Montana Department of Fish, Wildlife and Parks.

[2]Includes estimated spring flow of about 10 cubic feet per second, based on information provided by Montana Department of Fish, Wildlife and Parks.

[3]Estimated long-term monthly streamflow characteristics may not reflect the current flow regime because of upstream streamflow regulation.

[4]Stream is known to be dry except for periods of runoff. Calculated flows were adjusted by subtracting 7 cubic feet per second.

[5]Stream is known to be dry except for periods of runoff. Calculated flows were adjusted by subtracting 8 cubic feet per second.

Table 9.-- Estimated monthly streamflow characteristics for August and September.

[Q.XX, monthly mean streamflow for specified month exceeded XX percent of the years, in cubic feet per second; QM, mean monthly streamflow for specified month, in cubic feet per second]

Site no.	Stream name	August Q.90	August Q.80	August Q.50	August Q.20	August QM	September Q.90	September Q.80	September Q.50	September Q.20	September QM
366	ROCK CREEK AT MOUTH NEAR WISDOM	5	6	9	13	10	4	5	7	10	8
367	DELANO CREEK AT MOUTH NEAR WISE RIVER	0.3	0.3	0.6	0.8	0.6	0.2	0.3	0.3	0.5	0.4
368	HALFWAY CREEK AT MOUTH NEAR WHITEHALL	2	2	3	5	4	1	2	2	4	3
369	N.F DEEP CREEK AT MOUTH NR MILLIGAN	2	2	3	4	3	1	1	2	3	2
370	COLLAR GULCH AT MOUTH NEAR MAIDEN	0.5	0.6	1	1	1	0.3	0.4	0.6	1	0.7
371	BADGER CREEK BEL FORKS NR BROWNING	31	36	48	64	49	24	27	33	42	36

Site No.	Stream name	August					September				
		Q.90	Q.80	Q.50	Q.20	QM	Q.90	Q.80	Q.50	Q.20	QM
262	Tillinghast Creek above Joice Creek, near Monarch	7	9	12	16	13	6	8	10	14	11
263	Pilgrim Creek at mouth, near Monarch	6	7	11	16	12	5	7	9	13	10
264	Logging Creek at Logging Creek Campground, near Monarch	7	8	11	14	11	6	7	9	12	10
265	Belt Creek near Monarch	36	56	79	120	87	36	47	63	100	74
266	Big Otter Creek above Never Sweat Creek, near Raynesford	2	4	6	8	7	1	2	5	6	5
267	Belt Creek near Portage	16	27	54	91	59	14	18	35	60	42
268	Highwood Creek below Smith Creek, near Highwood	7	9	11	15	12	6	7	9	12	10
269	Missouri River at Fort Benton	3200	3800	5200	6900	5400	3300	3700	4900	6300	5200
270	Shonkin Creek below Bishop Creek, near Highwood	6	7	9	11	10	4	5	7	9	8
271	South Fork Two Medicine River near East Glacier	17	22	34	52	36	13	17	28	36	27
273	South Fork Badger Creek near Browning	19	21	28	36	28	14	15	18	23	20
274	North Fork Badger Creek near Browning	17	19	26	33	26	13	14	17	22	18
278	Birch Creek at Swift Dam, near Valier	9	21	98	160	100	53	59	91	170	110
279	South Fork Dupuyer Creek near Dupuyer	4	4	6	8	6	3	3	4	6	5
280	North Fork Dupuyer Creek near Dupuyer	5	5	8	10	8	3	4	5	7	5
281	Dupuyer Creek below Scoffin Creek, near Dupuyer	6	7	8	12	10	7	8	12	16	13
282	Birch Creek near Valier	12	14	20	33	23	13	16	28	50	37
283	Cut Bank Creek near Browning	38	49	63	90	69	24	36	44	60	55
284	Cut Bank Creek at Cut Bank	29	35	66	110	77	26	40	51	100	67
285	Marias River at Sullivan Bridge, near Cut Bank	150	190	310	480	350	130	190	280	480	330
286	Marias River near Shelby	150	190	320	510	360	130	190	290	500	340
287	Marias River at "F" Bridge, above Tiber Reservoir, near Shelby	180	220	370	590	420	150	220	330	590	400
288	Marias River near Loma	350	540	980	1600	1100	330	420	720	1100	880
290	Teton River near Strabane	17	22	30	43	33	19	20	24	29	25
291	McDonald Creek near Strabane	9	9	11	12	11	9	10	10	12	11
292	North Fork Deep Creek near Choteau	6	7	10	13	10	4	5	6	9	7
293	South Fork Deep Creek near Choteau	6	6	9	12	9	4	5	6	8	7
294	Deep Creek near Choteau	5	6	11	16	12	6	7	9	14	11
295	Teton River near Dutton	16	45	67	120	80	26	39	59	90	69
296	Missouri River at Virgelle	3500	4300	5800	8100	6200	3900	4300	5400	7100	5900
297	Lost Creek at mouth, near Utica	7	9	13	18	14	6	7	10	13	11
298	Yogo Creek at mouth, near Utica	1	2	2	3	2	.5	.7	2	3	2
299	Middle Fork Judith River near Utica	4	5	14	31	18	2	3	11	19	12
301	South Fork Judith River at Indian Hill Campground, near Utica	3	4	4	5	4	2	2	3	4	4
303	Judith River above Courtneys Creek, at Utica	12	16	23	34	25	9	12	16	24	19
306	East Fork Big Spring Creek at mouth, near Lewistown	6	8	13	18	13	6	6	9	12	10
307	Big Spring Creek above Cottonwood Creek, near Hanover	120	130	160	170	160	120	120	140	150	140
309	Cottonwood Creek at Highway 200, near Lewistown	4	5	7	11	8	3	4	5	9	7
310	Beaver Creek at county road, near Lewistown	3	5	8	13	10	2	3	6	8	7
311	Big Spring Creek at mouth, near Lewistown	120	140	180	210	180	110	120	150	170	150

APPENDIX B

Blue light paper Front

Costs of Obtaining Stream Gauging Data
at Various Levels of Intensity

Compiled by Systems Technology, Inc.,
Helena, Montana,
December 1987

Front

Print
Front &
Back pgs
B-1 thru B-10

ALTERNATIVES FOR STREAM GAGING AND ESTIMATED INSTALLATION AND OPERATION COSTS

Prepared for

Montana Department of Fish, Wildlife and Parks

By

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December 4, 1987

GAGING STATION COSTS

A number of the stream reaches identified for inclusion in the reservation request are ungaged. Thus, there is little or no flow data available upon which to quantify the requested flow. Therefore, a plan is needed to estimate the necessary flow and/or gather flow data upon which to quantify the required flow. Continued data collection may also be valuable after sufficient data has been collected or even for those streams which already have quantified instream flow. This would be for detection of minimum flow violations. Because the gathering of necessary flow data may take several years, it may be instructive to estimate required flows using accepted hydrologic modelling techniques (e.g., Riggs method, Basin characteristics). This would provide a quantified value until sufficient data could be collected to replace the estimated value. The cost of employing hydrologic modelling techniques to generate stream flow statistics, upon which to base the reservation, is estimated to average about $500 - $1000 per stream reach. There is the possibility of economy of scale, in that, the more stream reaches that need to be analyzed, particularly within a common area, the lower the unit cost.

The cost associated with gathering flow data depends upon the level of data collection desired. And the level of data collection deemed necessary depends on the severity of the threat from future depletion. Where the threat is expected to be minimal in the near future, some time is afforded in the collection. However, where significant water rights applications are pending or possibly where a stream reach may already be over appropriated, a more intensive data collection facility may well be warranted. Also of consideration in the choice of the level of data collection is the feasibility of installing and maintaining the equipment.

Five data collection levels are presented along with their associated costs.

Level 1. This level is the lowest in regards to the flow data collected and the timeliness of the data for responding to critical conditions. This level consists of the installation of a staff gage, and crest gage surveyed in along with a stream cross section. Staff gage and crest gage measurements are obtained monthly by a local observer. Seasonally, stream flows are measured (at least five measurements) at significantly different staff gage levels to develop a stream flow versus staff gage relationship. Depending upon the stability of the stream reach, installation of staff gages and re-surveying may be required periodically (e.g., annually). The annual cost for installation, monitoring and data reporting for this type of station is estimated at $1700/yr. (See Level 1. Costs).

Level 2. This level includes the equipment and monitoring described in Level 1. However, in addition continuous recording of stage is also provided. This includes the installation of a stilling well and strip chart recorder (e.g., Steven Type F - 32 day). It should be noted that recent technological advances provide alternatives to the strip chart recorders, which encode level data into digital storage devices. These devices are then read periodically (e.g., monthly) to retrieve the level data. Digital storage devises are comparable in costs.

Besides taking monthly staff gage readings, the local observer changes chart paper and sends them into the department. In addition, during seasonal streamflow measurements, personnel service the chart recorder (e.g., charge batteries, check mechanics). The installation cost is estimated at $3240 and the annual cost for monitoring and data reporting for this type of station is estimated at $1200/yr (See Level 2 Costs). These costs are somewhat similar to that charged by the U.S. Geological Survey ($2600) through their loan cooperative agreements for a similar level of data gathering on ephemeral streams. For a site with continuous flow, the U.S. Geological Survey estimates installation costs to range from $2500 to $3000 and annual operation (i.e., monitoring and data reporting) costs at $4200. The large operating costs are a result of increased monitoring (i.e., 12 trips vs. 5 trips) and data reporting.

Level 3. This level involves the establishment of a gaging house with telephone hook-up (e.g., Stevens Telemark) and seasonal monitoring. Besides the fact that the frequency, quality and resolution of the data is better from this type of facility, it also provides for obtaining information on a more timely basis. The station can be called over a telephone line to obtain the current water level. The recording transmitter equipment normally used (e.g., Stevens type AP) also produces a strip chart or can be configured with a digital storage device. Alternatively, a bubble water level gage can be used instead of the float gage. The bubble gages are generally employed where installation of stilling wells are impossible or too expensive. For purposes of costing out this level it has been assumed that the cost of float gage plus stilling well installation equalls the cost of the bubble gage. The same seasonal flow measuring and monthly monitoring is still required. The estimated installation cost is $11,000 and the annual cost for monitoring and data reporting is approximately $2200/yr (See Level 3. Costs).

Level 4. This level is basically the same as level 3 with the exception that radio telemetry is employed rather than the telephone hook-up. Radio telemetry is generally used where phone-line installation is impractical. The cost of installation is estimated at $14,000 and the annual cost of monitoring and reporting is estimated at $2600/yr. The major difference in annual costs between Level 3 and Level 4 is the phone service versus the increased number of trips (See Level 4. Costs).

Level 5. This level is basically the same as Levels 3 and 4, with the exception that Satellite telemetry (GOES) is utilized instead of telephone or radio transmission. The major advantage of GOES (Geostationary Operational Environmental Satellites) is the "real-time" access to gaging stations. Generally, the data is accessed from a central receiving station (e.g., Wallops Island, VA) via computer terminal. The costs are: installation $17,600 and operation $5500. It should be pointed out that currently, the GOES system is saturated with users. Thus the addition of new sites and/or users may be difficult.

Through the U.S. Geological Survey's loan cooperative agreement, Levels 3, 4 and 5 can be operated at an annual cost of $6000 per year. This does not include installation. This is an average value the Survey has determined for numerous sites. Actual costs range from $1000 to $10,000 per year. This is a little more than the estimates derived for these levels. However, it should be noted that these level costs were determined on the basis of a group of accessible sites. In addition, the survey provides a rigorous amount of data verification in their reporting.

LEVEL 1. COSTS

Installation:		
[1] Labor		
Tech 24 hrs @ $25/hr	600.00	
Subtotal Labor		600.00
Expenses		
Mileage 100 @ $.30	30.00	
Per diem 2 @ $50	100.00	
Staff Gage	35.00	
Crest Gage	75.00	
Misc. Supplies	50.00	
Subtotal Expenses		290.00
[2] Monitoring		
Labor - Local Resident (lump sum)	75.00	
Tech-3hrs @ $25 * 5 trps	375.00	
Subtotal Labor		450.00
Expenses		
Mileage 30 mi @ $.30 * 5 trps	45.00	
Per diem $15/trp * 5 trps	75.00	
Misc. $5/trp * 5 trps	25.00	
Subtotal Expenses		145.00
Data Work-up & Reporting		
Labor - Tech 8 hrs @ $25/hr		200.00
Expenses - Misc. Copying, printing, etc.		10.00
Total Annual Level 1. Costs		$1695.00

Note 1 - Labor includes travel & preparation time; rate includes overhead.
2 - Monitoring assumes this is one of at least four sites in close proximity.

LEVEL 2. COSTS

Installation			
[1]Labor			
Tech 32 hrs @ $25/hr	800.00		
Subtotal Labor		800.00	
Expenses			
Mileage 100 @ $.30	30.00		
Per diem 2 @ $50	100.00		
Staff gage/Crest gage	110.00		
Continuous Recorder	2000.00		
Equipment Rental (drill, trench)	100.00		
Misc. (posts, well pipe, PCV)	100.00		
Subtotal Expenses		2440.00	
Total Installation Costs			$3240.00
[2]Monitoring			
Labor			
Local Resident (lump sum)	100.00		
Tech 4 hrs @ $25/hr * 5 trps	500.00		
Subtotal Labor		600.00	
Expenses			
Mileage 30 mi @ $.30/mi * 5 trp	45.00		
Per diem $20/trp * 5 trps	100.00		
Misc $6/trp * 5 trps	30.00		
Subtotal Expenses		175.00	
Data Reporting			
Labor			
Tech 16 hrs @ $25/hr		400.00	
Expenses misc (copying, printing)		20.00	
Total Annual Level 2. Costs (Monitoring & Data Reporting)			$1195.00

Note 1. Labor includes preparation & travel time; the rate includes overhead.
2. Monitoring assumes this is one of at least four sites in close proximity.

LEVEL 3 COSTS

Installation			
[1]Labor			
Tech 48 hrs @ $25/hr	1200.00		
Subtotal Labor		1200.00	
Expenses			
Mileage 100 @$.30/mi	30.00		
Per diem 3 @ $50	150.00		
Staff & wire weight	500.00		
Bubble gage	6000.00		
All Weather House	1500.00		
Telephone Line Installation	1000.00		
Telephone w/ adaptor	200.00		
Misc.	200.00		
Subtotal Expenses		9580.00	
Total Installation Costs			$10,780.00
[2]Monitoring			
Labor			
Tech. 8 hrs @ 25 * 5 trps	1000.00		
Subtotal Labor		1000.00	
Expenses			
Mileage 40 mi @ $.30 * 5 trps	60.00		
Per diem $20/trp * 5 trps	100.00		
Phone service $50/mon * 12	600.00		
Misc. $6/trp * 5 trps	30.00		
Subtotal Expenses		790.00	
Data Reporting			
Labor - Tech 16 hrs @ $25/hr		400.00	
Expenses - misc.		20.00	
Total Annual Level 3. Costs (Monitoring & Data Reporting)			$2210.00

Notes - 1. Labor includes preparation & travel time; rate includes overhead.

2. Monitoring assumes this is one of at least four sites in close proximity.

LEVEL 4. COSTS

Installation			
[1]Labor			
Tech 48 hrs @ $25/hr	1200.00		
Subtotal Labor		1200.00	
Expenses			
Mileage 100 mi @ $.30/mi	30.00		
Per diem 3 @ $50	150.00		
Staff & wire weight gages	500.00		
Bubble gage	6000.00		
Transceiver	4500.00		
All Weather House	1500.00		
Misc.	200.00		
Subtotal Expenses		12,880.00	
Total Installation Cost			$14,080.00
[2]Monitoring			
Labor			
Tech 8 hrs @ $25/hr * 9 trp	1800.00		
Subtotal Labor		1800.00	
Expenses			
Mileage 40 mi @ $.30/mi * 9 tps	108.00		
Per diem $20/trp * 9 trps	180.00		
Misc. $6/trp * 9 trps	54.00		
Subtotal Expenses		342.00	
Data Reporting			
Labor - Tech. 16 hrs @ $25/hr		400.00	
Expenses - misc.		20.00	
Total Annual Level 4. Cost (Monitoring & Data Reporting)			$2562.00

Notes: 1. Labor includes preperation and travel time; rate includes overhead.

2. Monitoring assumes this is one of at least four sites in close proximity.

LEVEL 5. COSTS

Installation			
[1]Labor			
Tech 48 hrs @ $25/hr	1200.00		
Subtotal Labor		1200.00	
Expenses			
Mileage 100 mi @ $.30/mi	30.00		
Per diem 3 day @ $50/day	150.00		
Staff & wire weight gages	500.00		
Bubble gage	6000.00		
Data Collection Platform (DCP)	8000.00		
All weather house	1500.00		
Misc.	200.00		
Subtotal Expenses		16,380.00	
Total Installation Costs			$17,580.00
[2]Monitoring			
Labor			
Tech 8 hrs @ $25/hr * 12 trps	2400.00		
Subtotal Labor		2400.00	
Expenses			
Mileage 40 mi @ $.30/mi * 12 trps	144.00		
Per diem $20/trp * 12 trps	240.00		
Misc. $10/trp * 12 trps	120.00		
Subtotal Expenses		504.00	
Data Reporting			
Labor			
Tech 65 hrs @ $25/hr	1625.00		
Subtotal Labor		1625.00	
Expenses			
Remote terminal service		1000.00	
Total Annual Level 5. Cost (Monitoring & Data Reporting)			$5520.00

Notes:
1. Labor includes preparation and travel time; rate includes overhead.
2. Monitoring assumes this is one of at least four sites in close proximity.