Musselshell
RIVER BASIN WATER MANAGEMENT STUDY

U.S. Bureau of Reclamation
Billings, Montana

Montana Department of Natural
Resources and Conservation
Helena, Montana

Upper Musselshell Water
Users Association
Harlowton, Montana

Deadman's Basin Water
Users Association
Roundup, Montana

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ERRATA/UPDATES

Since this report was originally distributed to the public and other agencies in October 1997, a few errors have been brought to our attention and some of the facts have changed. The following list brings the report up to date.

Page	Originally	Revised To
i, 1st para., 2nd sent.	"(57,738 acres from the mainstem of the river...)"	"(57,816 acres from the mainstem of the river...)"
i, 2nd para., 2nd sent.	"In the 1940s..."	"In the 1930s..."
ii, 1st para., 1st sent.	"The Musselshell River Basin has three state projects along the mainstem of the river: the Upper Musselshell, Deadman's Basin, and Delphia-Melstone Projects."	The Delphia-Melstone Project was in fact privatized in 1996.
ii, 2nd para., 1st sent.	"DNRC controls..."	"DNRC owns..."
ii, 4th para., 3rd sent.	"... of which 25,563 ac-ft has been sold."	"... of which 26,842 ac-ft has been sold."
vii, Table R-1		Add footnote to bottom of table: "See Appendix 1 for details on increasing efficiency."
xii, 1st para., 3rd sent.	"After a problem reach has been identified..."	"Problem reaches have been identified;..."
2, 4th para., 1st sent.	"In the 1940s..."	"In the 1930s..."
5, 1st para., 2nd sent.	"Most users..."	"Some users..."
5, 3rd para., 3rd sent.	"In 1992, the LMCD(Lower Musselshell Conservation District)..."	"In 1992, the LMCD (Lower Musselshell Conservation District) and the DBWUA..."
5, 4th para., 1st sent.	"Part of the LMCD..."	"Part of the LMCD/DBWUA..."
9, 5th para., 1st sent.	"Five canals are part of the Upper Musselshell Project: *Checkerboard Canal*..."	This canal is slated to be abandoned by the state.

Page	Originally	Revised To
9, 6th para., 3rd sent.	"...gauges on the North Fork above Blair, on the South Fork above Martinsdale Supply Canal..."	Both of these gauges are now inactive.
11, 4th para., 2nd sent.	"Montana holds the water rights..."	"Montana owns the water rights..."
11, 7th para., 1st sent.	"The UMWUA is managed by a board of five elected directors who represent the five irrigation canals..."	"The UMWUA is managed by a board of five elected directors who represent the five irrigation regions ..."
26, Table 3.3		Add footnote to bottom of table: "See Appendix 1 for details on increasing efficiency."
80, Table 4.3, "Scenario: Increase On-farm Irrigation Efficiency by 5%"	"Remarks: Includes increased management through irrigation scheduling and some minor costs to facilitate management."	"Remarks: No data available for 5% costs, so costs predicated on 10% costs from NRCS; actual costs for 5% could be less."
80, Table 4.3, "Scenario: Increase On-farm Irrigation Efficiency by 10%"	"Remarks: See above."	"Remarks: Includes increased management through irrigation scheduling and some minor costs to facilitate management."
85, 2nd para., 2nd sent.	"The analysis locates reaches of the river with water quality problems, shows the magnitude of the problems, and encourages further detailed studies..."	"The analysis locates reaches of the river with water quality impairments, shows the magnitude of the impairments, and encourages further detailed studies..."
85, 2nd para., 2nd sent.		Add "Raw data on water quality can be found in Table WQ-2 at the end of Appendix 11)."
86, 2nd para., 6th sent.		Add to end: "Advisories could be issued through the local media if water quality impairments were observed."

Page	Originally	Revised To
86, 3rd para., 1st sent.	"Hardness is related to composition of TDS."	"Hardness is a physical property of the materials that makes up TDS."
86, 4th para., 1st sent.	"Alkalinity, the measure of ability to neutralize acids..."	"Alkalinity is the physical property that measures ability in equivalent milligrams/liter (mg/L) of the calcium carbonate necessary to neutralize a similar acid solution."
397, Appendix 9		Delete "Comparison of Average Return Flows at Harlowton, MT." (first two graphs).
429, Appendix 11, Figs. WQ-6 and WQ-7		Switch these two figures around.
429, Appendix 11		Add Table WQ-2 at the end.

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SUMMARY

WATER SUPPLY AND QUALITY PROBLEMS

Most years the Musselshell River in central Montana cannot meet all of the demands placed on it. Irrigation in the Musselshell River Basin totals 108,268 acres (57,816 acres from the mainstem of the river, 50,530 acres from the tributaries), while the towns of Ryegate, Roundup, and Melstone draw municipal water from the river to serve 2,177 people. Recreation is also important in the basin: yearly recreational use averages about 63,000 visitor-days at the three storage reservoirs in the basin, mainly in the form of fishing.

Like most snowmelt fed streams, the Musselshell has surplus flows in the spring until mid-June when flows taper off to a trickle during late summer and early fall. In the 1930s, three reservoirs were constructed to supply irrigation water: Bair and Martinsdale Reservoirs in the upper basin and Deadman's Basin Reservoir about two-thirds the way down the basin. Water delivery contracts were offered to irrigators from the three reservoirs. Users in the lower basin did not purchase enough contracts (from Deadman's Basin) to meet their needs, while upper basin users bought all available contracts (from Bair and Martinsdale).

Even with three storage reservoirs, however, water cannot be supplied for all uses during dry years. Most users in the upper basin receive enough irrigation water because they have first opportunity to divert stream flows into their systems. Most users irrigating along the river have a natural flow water right allowing them to divert water to apply to their crops. When users with delivery contracts call for water, the water has to flow past users with the natural flow rights. Thus, users sometimes take water they do not have a contract for. In the past 5 years, the DNRC (Montana Department of Natural Resources and Conservation) has started to work with the water users to help resolve this problem.

Another reason for water shortages in the basin is the fact that few users in the upper basin measure the water they divert, so they do not know what volume they are applying to their crops. Measuring water helps users divert only the water crops need, ensuring that salts and other undesirable constituents of the water are not leached through the root zone, creating water quality problems. In the early 1990s, users in the lower basin installed measuring devices as part of a water measurement study, but some of these meters have failed due to operations and maintenance problems. The Musselshell Basin has been declared a *Chronically Dewatered Stream* under the Montana Water Measurement Program Act of 1991, and is under a state ordered measurement program which should help users be more efficient.

Water quality as well as water supply is an issue in the basin. The total dissolved solids (TDS--dissolved inorganic elements which are mainly salts), sodium, sulfates, alkalinity, and heavy metals analyzed during this study all exceed limits set for certain water uses. Due to the irrigated acreage on the mainstem of the river and its tributaries, TDS raises to very high levels during late summer when natural flows are at a low point. In the lower basin, TDS is high throughout most of the irrigation season because irrigation water returns to the river as either surface or groundwater return flows. Excessive volumes of irrigation water flush salts out of the soils, depositing it into the river from return flows.

PRESENT OPERATIONS

The Musselshell River Basin has three state projects along the mainstem of the river: the Upper Musselshell, Deadman's Basin, and Delphia-Melstone Projects. The first, operated by the Upper Musselshell Water Users Association (UMWUA), provides water from Bair Reservoir (on the North Fork of the Musselshell) and Martinsdale Reservoir (an off-stream storage reservoir on the South Fork)) to users down to Deadman's Basin. Bair Reservoir has an active capacity of 7,010 acre feet (ac-ft), Martinsdale Reservoir 23,110 ac-ft. The second project, operated by the Deadman's Basin Water Users Association (DBWUA), provides water from Deadman's Basin for users from just upstream of the town of Barber down to Mosby by Fort Peck Reservoir. Deadman's Basin is an off stream storage reservoir with an active capacity of 76,900 ac-ft. The last project is operated by the Delphia- Melstone Water Users Association who have a contract for water from Deadman's Basin, as well as a water right for natural flows in the Musselshell.

DNRC owns the water rights for the reservoirs and maintains the dams for the users associations. The users association operate the reservoir and market shares of water to repay the costs of the projects with funds collected from water contracts. Each share is worth a certain volume of water depending on which project the contract is with.

The UMWUA is operated by a board of five elected directors who perform the day-to-day business, make water management decisions, maintain facilities, collect fees, hire needed workers, and manage operations. They operate the reservoirs to fulfill contracts sold from the firm annual yield, estimated to be 800 ac-ft for Bair Reservoir and 8,000 ac-ft for Martinsdale. Contracted water from the two reservoirs is 21,636 ac-ft.

The DBWUA is managed by a board of five directors who have hired a water manager to control the ordering and releases of water from Deadman's Basin Reservoir. The manager keeps records of the users and makes sure they are billed appropriately. They market water from the estimated firm annual yield of the reservoir of 34,000 ac-ft, of which 26,842 ac-ft has been sold.

Because the user associations have operated independently, occasional conflicts have developed over filling of the three reservoirs. Problems occurred when spring runoff is insufficient to satisfy both water rights. During periods of low flows, the UMWUA would divert their water right, leaving too little water in the river for the DBWUA. Since the senior water is with DBWUA, they could request upstream users to quit diverting until DBWUA needs were met. In 1994, the two associations agreed to meet every March to decide how to fill the reservoirs based on snow cover and runoff estimates. The associations also drew up an agreement to use as a fall-back position in case they could not reach a decision during the joint meeting. They continue to operate independently during the irrigation season.

Deadman's Basin Reservoir does not have enough storage to supply water for an extended drought. DBWUA has developed a water measurement program to help conserve water and make irrigation more efficient. It consists of tracking water down the river to see how long it takes to reach its destination, determining how much water is necessary to deliver the needed flow, and getting better estimates of needed water from irrigators. DBWUA got access to USGS (U.S. Geological Survey) gauging station data to accomplish the first two objectives and established

gauging stations of their own. Now, when water is released from Deadman's Basin as requested, DBWUA tracks its progress as it passes the different gauging stations on the river. They publish the flows at the gauges in the newspaper so users will know the water is coming and estimate when it will arrive.

In order to get better estimates of water use, DBWUA members had to install measuring devices on their diversions. The measuring devices gave users the information they needed to place accurate orders for water.

THIS REPORT

Because of water supply and water quality problems, the U.S. Bureau of Reclamation (Reclamation), DNRC, UMWUA, and Lower Musselshell Water Users Association developed a computer model for the Musselshell River Basin to help users make the best use of their limited water.

After some background information is presented (Chapters 1 and 2), the report describes the computer model and model results (Chapter 4 for water supply, Chapter 5 for water quality). Reclamation contracted with the U.S. Natural Resources Conservation Service (NRCS--formerly Soil Conservation Service) to study on-farm irrigation efficiencies of irrigation systems in the basin: NRCS's report is summarized in Chapter 3 (and included in Appendix 1).

Recommendations based on this report are listed below in their respective sections.

ON-FARM EFFICIENCY RECOMMENDATIONS

On-farm efficiency needed to be improved in the basin, in addition to managing water in the basin better. NRCS estimated seasonal irrigation efficiencies and developed cost estimates for increasing efficiencies, employing a method called the *Farm Irrigation Rating Index (FIRI)*. FIRI required information about irrigation systems and how they are managed. DNRC provided a list of 30 representative sites of irrigation practices and management occurring in the basin, and DNRC and DBWUA interviewed 22 basin irrigators to collect the information. FIRI analyzed the data gathered from the interviews, and, with the aid of a computer program, calculated irrigation efficiency for each site.

Before the FIRI procedure was run on the computer, crop water use was estimated using NRCS's *TR21 Blaney-Criddle* program for each field. TR21 requires information on carryover moisture and net irrigation application depth. Weather information was gathered from the closest weather station. Net irrigation application depth for TR21 was estimated based on the following conventions:

- Surface irrigation systems: 50% of the available water capacity (AWC).
- Lateral move sprinkler: Lesser of 3.0 inches or 50% of AWC.
- Pivot sprinkler: 1 inch.

The NRCS staff then applied their collective judgment to select management factors for the FIRI computations.

NRCS concluded that on-farm efficiency could be improved with a moderate commitment of irrigator management, maintenance, and capital investment. An overall average seasonal efficiency improvement of 5-10% would be a realistic goal. Beyond a 10% improvement would require a larger investment in irrigation facilities replacement.

NRCS recommended the following three things to improve on-farm irrigation efficiency.

- Implement Irrigation Conservation Plans–A program of preparing irrigation conservation plans on individual farms and ranches in the Musselshell Basin should be implemented. Such plans involve a detailed analysis of the irrigation operation and system in consultation with the owner/irrigator.

  Both short and long-range plans should be developed, detailing management actions and system modifications. We recommend the planning process detailed in NRCS's *Planning Handbook* and *Montana Irrigation Manual*. An irrigation plan is best completed as an integrated part of a farm-wide resource management plan.

  Practices and tools listed in Appendix 1 are examples of what might be included in a plan. A detailed resource inventory as part of the plan might involve obtaining on-site soils information, engineering surveys, and detailed irrigation system evaluations. As a result, plans are made based on accurate data.

  NRCS prepares such plans as part of their normal conservation program. Due to the high labor requirement and limited NRCS resources, however, only a few are done each year. An accelerated program would require additional trained staff, which might include employees of the Conservation District.

- Set up Conservation Demonstration Sites--Conservation practice demonstration sites should be set up at cooperating farms throughout the basin. New techniques–cablegation and automated ditches, scheduling methods, and other procedures--could be demonstrated and tried out at the sites. Tours and workshops should be set up to view and discuss the techniques. Much of this recommendation could be done under existing technical and cost share programs.

- Set Up A Demonstration Scheduling/Water Management Consultive Service--Set up a demonstration irrigator controlled management service. The service might include:

  Irrigation scheduling
  Water budget analysis on a field/farm basis
  Coordination with water district operations
  Other integrated crop/pest management services.

Such a service would require technical help and seed money to begin. The objective would be to ultimately make the service a self-supporting enterprise.

These three recommendations are the best ways to improve irrigation efficiency without incurring large initial investments. Other suggestions to improve irrigation efficiency are:

- Develop a Yearly Water Budget Based on Predicted Water Availability--Basin water managers and users make decisions based on the volume of water predicted to be available for the growing season. The users make decisions about types of crops, how thick to plant, and when to plant. Tools critical to this suggestion are: 1) A reservoir operating guide for the Musselshell River Basin; 2) A method to make reservoir and water supply forecasts; 3) A method to prepare farm/field level crop water budgets. The NRCS is developing this software and may have it available soon. Water supply forecasts can be made using NRCS's SNOTEL data, and using precipitation, crop evapotranspiration, and evaporation data obtained from AGRIMET stations installed in the basin. Reclamation may be able to help with installation of an AGRIMET station.

- Promote Moisture Conserving Farming Practices--To help keep available moisture in the soil, use conservation practices such as: 1) No Till; 2) Minimum Till; 3) Tillage equipment that does not turn the soil over; 4) Hay cutting at earliest stage consistent with high quality hay. Mature actively growing plants transpire at a high rate and thus use more moisture than freshly cut plants; 5) Crops that need the most water when it is available. Grain needs more water early which it is likely to be available where alfalfa requires water throughout a long season.

- Encourage Management by Flow Measurement--Install and use on-farm flow measurement as a management tool. The measuring devices being installed in the basin could be used to apply the correct volume of water after it was identified in a water management plan. By measuring water flow, maintenance problems could also be corrected at an early stage. Designation of the Musselshell River as chronically dewatered stream only requires that diversion from the river be measured and does not apply to diversion from canals or tributaries.

The NRCS also made suggestions about how to improve irrigation efficiency for specific types of water delivery systems (specifics can be found in Appendix 1).

Sprinkler systems could be improved by providing adequate intake screens, checking system operating pressure, installing flow control nozzles or sprinkler heads to improve distribution efficiency on rolling terrain, maintaining nozzles and couplings to minimize leaks, repairing nozzles if necessary, and by making sure center pivots applied water at an appropriate speed.

Surface systems could be improved by putting plastic or concrete lining in the supply ditches; using plastic pipe instead of ditches; using cablegation; automating ditches; installing pipelines and risers; using surge irrigation, gated pipe, layflat tubing, land

leveling, land smoothing between rotations, tailwater return systems, ripping of soil layers to improve infiltration; installing field corrugations; and using border dikes.

NRCS estimated costs to increase efficiencies in basin irrigation practices following the above suggestions. Table R-1 shows these costs based on the small sample of the basin taken for the FIRI process. Assumptions and background for the estimates can be found in Appendix 1.

WATER SUPPLY RECOMMENDATIONS

Reclamation's *Hydrologic River Operations Study* (HYDROSS) model was selected as the computerized model to set and run a water budget for the basin. HYDROSS is a hydrologic accounting model that operates over a period of record, simulating the effects of existing and proposed demands and features on historic naturalized flow. The period of record selected was 1929-1989, which included the drought of the 1930s.

Inputs to HYDROSS consisted of data files containing: 1) Natural flows (Appendix 2), 2) Operational parameters like reservoir operation rules and irrigation demands, and 3) Physical description of the basin like reservoir capacities and demand and inflow locations. HYDROSS operates in a time ordered sequence with results at one location depending on what happened at the previous location. It took into account the priority dates of water rights. USGS was contracted to produce historic naturalized flows for basin, simulating flows without the effects of development; in this way, the 1989 level of development with all the priority dates and water rights could be applied to what would have been the natural historic flows.

The HYDROSS model was calibrated to the end-of-month (EOM) contents at the three reservoirs as a test to ensure reliability. Except for Bair Reservoir in1961-1962, the model matched EOM contents very well. (This exception may be because of reservoir management decisions very difficult to model.) As another calibration test, HYDROSS results were compared to average monthly flows at USGS gauging stations in the basin. Peak modeled flows in May and June were about 20-30% higher at the Harlowton station when compared to historic flows because USGS assumed no agricultural depletions upstream of the gauge when developing historic flows, when in fact depletions were made. Modeled flows at Roundup, Musselshell, and Mosby closely matched historic naturalized flows, however.

After it was felt that the model could reflect actual water supply scenarios in the basin, it was used to evaluate increasing on-farm efficiency by 5%, 10%, and 20%, and operating the three reservoirs as one unit. To compare results of increasing on-farm efficiency, shortages of water--defined as the lack of water to supply a full season's irrigation for crops being produced in the basin--were used to illustrate potential savings. Shortages may be caused by lack of canal capacity to deliver the required crop water requirement or by the lack of water in the basin. Also, the diversion requirements were used to check for water savings.

The model shows about 110,000 ac-ft of shortages occur in the Musselshell River Basin annually. The 1980-1989 period was used to display how changing operation of the system could affect water supply. This 10 year period was chosen because it was in the recent past and it

Table R-1: First Year Costs of Increasing Irrigation Efficiency [1]

Acres	Irrigation Type	Existing Irrigation Efficiency (%)	Increased Management		Convert System to Automated Ditch Application		Convert System to Lateral Move Sprinkler System		Convert System to Improved Gated Pipe System	
			Efficiency	$/acre	Efficiency	$/acre	Efficiency	$/acre	Efficiency	$/acre
406	Graded Border	49	61	120	72	981	67.14	1050	[2]	596
43	Level Basin	47	67	120	[2]	981				
419	Contour Ditch, Controlled	34	52	120			54	1050	[2]	596
104	Uncontrolled	28	38	120				1050	[2]	596
16	Big gun	37	51	128						
494	Pivot	50	67	128						
309	Lateral Move	39	53	128						
1,791	Total Acres									

[1] See Appendix 1 for details on increasing efficiency.
[2] NRCS did not assign an efficiency to this type of irrigation practice.

included years of water surpluses as well as shortages. To alleviate these shortages, the 5%, 10%, and 20% increase in on-farm efficiency was put into the model. The 5% and 10% increases could be done with moderate initial investment, as mentioned, and an increase in irrigation scheduling and management. The 5% increase would reduce the average shortage about 30,000 ac-ft per year (Table R-2). This does not mean the water would be available for other uses; it means that more acreage would be getting its full crop water requirement. The 10% increase would reduce the shortage about 50,000 ac-ft, while increasing on-farm efficiency by 20% would reduce the shortage by 70,000 ac-ft. As mentioned, the 20% increase would involve significant investment to change irrigation practices, along with increased irrigation management and scheduling.

Changing operation of the basin from two separate systems to one would decrease the water shortages by about 5,000 ac-ft without any changes in on-farm efficiency. This option, coupled with increasing on-farm efficiency, should be part of any plan to improve water availability throughout the basin. Appendix 10 shows the volume and time water would be available for uses other than those already identified. Table R-3 shows the average volume available without making changes in current operations.

WATER QUALITY RECOMMENDATIONS

Quality of the Musselshell was analyzed for suitability for irrigation use, municipal and industrial (M&I) supplies, livestock use, and aquatic life. The objective was to locate reaches of the river with water quality problems, determine the magnitude, and encourage detailed studies of these areas in the future. Water quality properties analyzed included physical properties (including TDS), heavy metals, and inorganic constituents (all constituents of TDS). Samples were collected during the fall of 1993 on an almost monthly basis, in 1994 when there was open water, and one time in the spring of 1995. These samples were analyzed for physical properties and inorganic constituents. Three separate samples were taken for heavy metal analysis.

TDS is perceived as the most severe water quality problem in the basin. High levels of TDS in irrigation water adversely affects both plants and soil productivity. Depending on the makeup of the TDS, plants may receive a toxic dosage of TDS, and, if TDS were made up of much sodium, the soil may swell and become impermeable. High levels of TDS are also detrimental to livestock and to people. Alkalinity, the measure of the ability to neutralize acids, is not detrimental to people but can cause a relative increase in sodium which can be detrimental. Heavy metals are generally harmful to people, livestock, and wildlife when ingested above critical quantities.

Standards used to gauge the severity of water quality problems were developed by the Environmental Protection Agency, California Water Resource Board, U.S. Department of Agriculture, and some general "rules of thumb". A summary of the water quality findings are shown in Table R-4.

Table R-2: Water Savings With the Options

Alternatives	Irrigation Water Shortage (ac-ft)	Return Flows at Mosby	Remarks
Current Operation	110,000	----------	No action required.
Increase On-farm Irrigation Efficiency by 5%	70,000	Decrease return flows by ≈15%	Includes increased management through irrigation scheduling and some minor costs to facilitate management
Increase On-farm Irrigation Efficiency by 10%	50,000	Decrease return flows by ≈30%	See above
Increase On-farm Irrigation Efficiency by 20%	30,000	Decrease return flows by ≈ 70%	Includes adding concrete ditches or buried pipe with risers.
Operate Basin as One Unit	95,000	Decrease return flows by ≈ 10%	

Note: Since all the sprinkler systems studied pumped directly from the ditches or the river, no estimates were made for increasing on-farm irrigation efficiencies for them. It is believed that 5% or 10% increase in efficiency can be done with better irrigation management practices, but that to increase sprinkler efficiency by 20% would require substantial investment in the first year. Estimates were made to replace contour ditches with gated pipe but no estimates of increase in on-farm irrigation efficiency were made. It is believed that the efficiency increase would be between 10-20%, with higher increases possible in certain cases.

Table R-3: Water Available in the Musselshell (ac-ft)
(Monthly Avg. Water Available 1929-1989)

Location	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Harlowton	82	65	690	7008	30541	36531	2397	0	99	703	580	242	78942
Roundup	496	1063	6337	13867	36842	47329	3226	0	426	2334	1791	1056	114772
Musselshell	753	1554	7537	14444	37097	47589	3246	0	471	2833	2270	1446	119244
Mosby	1385	4439	17455	17977	42872	56775	6649	0	827	3772	3130	2065	157350

Table R-4: Water Quality Findings

TDS	Sodium	Chlorides	Sulfates	Alkalinity
		IRRIGATION USE		
River above Harlowton good, below Harlowton and above Musselshell permissible, somewhere below Musselshell doubtful.[1]	Sodium absorption ratio good for entire length of the river.[2]	Good for the entire length of the river.[1]	The river above Shawmut excellent, below Shawmut and above Musselshell permissible, below Musselshell doubtful.[1]	
		M&I USE		
River exceeds 250 mg/L the entire length and reaches unpalatable levels in some measurements at Mosby gauge.[3]	River of good quality for entire length; maximum levels exceeded standards, however.[1]	River very good for entire length.[1]	River above Shawmut excellent, below Shawmut and above Roundup permissible, and below Roundup exceeds 500 mg/L standard.[3]	River acceptable for entire length.[3]
		LIVESTOCK AND WILDLIFE USES		
River good quality for entire length.[1]	River of good quality for entire length.[1]	Entire river exceeds standard of 250 mg/L.[3]	River of good quality for entire length; however, maximum levels found exceeded standard.[1]	River exceeds 50 mg/L standard for entire length.[1]
		AQUATIC LIFE		
River of good quality for entire length.[1]	River of good quality for entire length.[1]	River of good quality for entire length.[1]	River of good quality for entire length; maximum levels found exceeded standard, however.[1]	River exceeds best range of 100-120 mg/L for entire length.[1]

[1] California Water Resource Board criteria.
[2] U.S. Department of Agriculture criteria.
[3] EPA Secondary Drinking Water criteria.

Reaches of the river with high levels of TDS also have many irrigated acres which probably contributes to TDS-laden return flows. Tributaries may also be large contributors to TDS levels in the mainstem: Sampling indicated that TDS levels were very high, but flows were usually small when compared to the river. Problem reaches have been identified; a more detailed analysis should be completed to determine the source of the TDS. Then, solutions could be formulated and implemented. DNRC and NRCS can help determine methods to reduce TDS levels, including improving range management, implementing best irrigation practices, and developing other ideas. The users in the basin should take the lead in making the water supply better. They could ask for help from many sources.

Another method of setting standards was introduced in 1994, when EPA mandated that states develop water quality standards based on the total maximum load (mass unit/day) of a water quality constituent that a water body can assimilate while still meeting water quality standards. The new method is called the *total maximum daily load* (TMDL). The new regulations require states to: 1) List water bodies that are limited by water quality; 2) Prioritize and target these water bodies; 3) Determine the TMDL allowable to meet water quality standards. The state's 1996 list included several reaches of the Musselshell and its tributaries (see Table WQ-2 in Appendix 11). All water bodies on the list have low priority for TMDL development, but the Musselshell overall had a moderate priority due to NRCS's Careless Creek Demonstration Project and because of the present study.

Recommendations to reduce levels of TDS and other constituents are listed below. Because of the different climates in the basin and different uses of water, several solutions were necessary.

- Reduce Subsurface Return Flows Caused by Irrigation--The major cause of TDS in the basin is subsurface return flows to the Musselshell River. Subsurface return flows are a combination of return flows from natural precipitation and from over-irrigated land. Since precipitation cannot be controlled, mitigation must focus on controlling subsurface return flows from irrigation. This form of mitigation would benefit all water user downstream by both reducing TDS levels and providing a larger source of water when the demand is greatest.

  Irrigators who presently use flood irrigation could easily reduce subsurface return flows by using more efficient irrigation methods (discussed at length in Appendix 1). Lining canals and ditches to reduce the water lost in the conveyance systems would also reduce subsurface return flows. This might be unrealistic because of the economic situation of farmers and ranchers in the basin.

  The second way to reduce subsurface return flows is through better management of the irrigation systems. As shown in Appendix 1, irrigation systems looked at basin-wide in this study could be made more efficient by improved management practices. Soil moisture monitoring, irrigation scheduling, and improved control of water during irrigation would provide some reduction in subsurface irrigation return flows.

Changes in water management could bring about substantial improvements in water quality with the only cost being a investment in education, and time. This would unquestionably be the most cost effective method of reducing TDS levels.

- Mitigate the Effects of Irrigating with Water with High Salt Concentrations--One method of mitigation would be more frequent irrigation, facilitating the leaching of salt through the root zone. Recommendations should be made on a field-by-field basis, which is beyond the scope of this report.

  Another method is to use spring runoff in the river for irrigation as much as possible. The Musselshell experiences two separate runoffs each year: A low elevation runoff occurring between the middle of February and the middle of March, and the late May-June high elevation runoff. At these times water quality in the Musselshell is at it's best. It's also the time when there is more water available to satisfy demand. This means irrigators could use water to help leach salts from the root zone soils without adversely effecting other water users.

- Implement a Water Quality Monitoring Plan and Make Public Announcements--While it would be unrealistic to monitor heavy metals by a monitoring plan, properties like electrical conductivity (EC) could be used to assess salt loading. After users were made aware by public announcements that a water quality problem existed, they might make changes in how they use their water.

  Using EC as a trigger for notification of water users could be set up at little expense. If users knew the EC of water available for irrigation and the condition of his soil, they would be able to assess potential damage the water could have on crops.

Chapter 1
INTRODUCTION

The Musselshell River in central Montana provides water for irrigation, municipal and industrial (M&I) supplies, livestock, recreation, and fish and wildlife, and occasionally for mining, well drilling, mineral exploration and other uses. Throughout the year, shortages occur because of the lack of water to meet all demands with a full water supply. These shortages have caused much discussion between users in the upper and lower Musselshell River Basin.

To help resolve the water shortage issue, the Lower Musselshell Conservation District asked the DNRC (Montana Department of Natural Resources and Conservation) and Reclamation (U.S. Bureau of Reclamation) to develop a system to manage the water supply. The DNRC and Reclamation, in cooperation with the UMWUA (Upper Musselshell Water Users Association), DBWUA (Deadman's Basin Water Users Association), and the NRCS (U.S. Natural Resources and Conservation Service) established the water management plan contained in this report. As part of the plan, a water supply computer model was developed to determine the best use for limited water supplies in the basin. The model does this by modeling senior water rights, land use, reservoir operations, M&I uses, irrigated acreage, crop consumptive use, irrigation practices, instream flow requirements, and historical stream flows, among other items (see Chapter 4). Hydrologic data--including climate data, water use data, and water flow data--was collected to input into the computer model. A 1989 level of development, called the *Baseline Development Level*, was used in the model.

Water users experience serious losses due to seepage, phreatophytes, evaporation, and because of poor irrigation practices like: 1) irrigation of unsuitable land because of salinity, slope, and lack of development; 2) dependence on low efficiency techniques like contour ditches and border dikes; 3) timing of irrigation and control of flows, such as irrigating before it is absolutely necessary or after crops experience shock, or not applying the correct volume of water for the irrigation cycle.

Several studies show the water available to various users can be significantly increased by implementing operating plans, increasing on-site efficiency, and structural changes to the delivery system. The present study shows how to change current operations, how to make the system deliver water more efficiently, and how irrigators can improve their irrigation practices.

Because of the large irrigated acreage and low river flows late in the irrigation season most years, water quality has also become an issue. Irrigation practices and soil types cause large salt volumes and other material to be returned to the river. During low flows, water is sometimes not of suitable quality for irrigation or livestock consumption.

STUDY AREA DESCRIPTION

The area studied for this report is the Musselshell River and its tributaries upstream of the high water level of Fort Peck Reservoir in Montana (fig. 1.1). The North Fork of the river, originating in the Little Belt Mountains, and the South Fork of the Musselshell, originating in the Crazy Mountains, converge near the town of Martinsdale to form the Musselshell River. The river flows easterly for about 120 miles to Melstone, where it turns and flows north about 80 miles into Fort Peck Reservoir just north of Mosby (fig.1.1). The 59-year average annual flow of the river at Mosby is 202,103 acre-feet. River flows range from 0-18,000 cubic-feet-per-second (cfs).

Above Fort Peck Reservoir, the drainage area of the Musselshell River includes approximately 8,550 square miles of mountains, valleys, and plains. The prairies and valleys are dominated by rangeland and cultivated lands, while forested lands are found primarily in the mountain and narrow strips bordering streams and rivers. Elevations range from about 2,000 feet in the plains near Fort Peck Reservoir to over 8,000 feet in the mountains.

Precipitation in the basin generally increases with elevation, ranging from less than 15 inches annually in the plains to over 50 inches annually in some of the mountains. Stream flows in the basin are dominated by mountain snowmelt and spring rains, peaking in May and June and gradually diminishing throughout the summer, fall, winter and early spring. However, reservoir operations and irrigation have altered natural flow patterns in the basin.

Irrigation is important in the basin, primarily for production of alfalfa, grasses, small grains, and some corn silage. Irrigation constitutes the largest diversionary use of water. Most irrigated acres are along the Musselshell River bottoms, with some along the major tributaries like Careless and Flat Willow creeks. Total acreage presently irrigated is 57,816 acres, of which the Upper Musselshell River Basin (from the headwaters to Deadman's Basin) has about 32,392. The Lower Musselshell River Basin (from Deadman's Basin to Fort Peck Reservoir) has 25,424 irrigated acres (excluding Flat Willow Creek). Water for irrigation is contracted for from one of the reservoirs, is claimed as a water right from natural river flows, or is a combination of these two. About 10 % of irrigation is supplied by claimed water right only, with no supplemental contract water. There are also several thousand acres which are irrigated solely with contract water. Every year, some of this acreage is not irrigated at all.

Three reservoirs were completed by the state in the 1930s to ease water shortages in the basin. Two--Martinsdale and Deadman's Basin--are off-stream storage reservoirs (fig.1.1). The third, Bair Reservoir, is an on-stream reservoir. Bair and Martinsdale Reservoirs have 7,010 ac-ft and 23,110 ac-ft of active storage, respectively. These two, operated by the Upper Musselshell Water Users Association, supply water for irrigation. The largest reservoir, Deadman's Basin, has an active storage capacity of 72,220 ac-ft. It is operated by the Deadman's Basin Water Users Association and supplies water for contract holders from the basin.

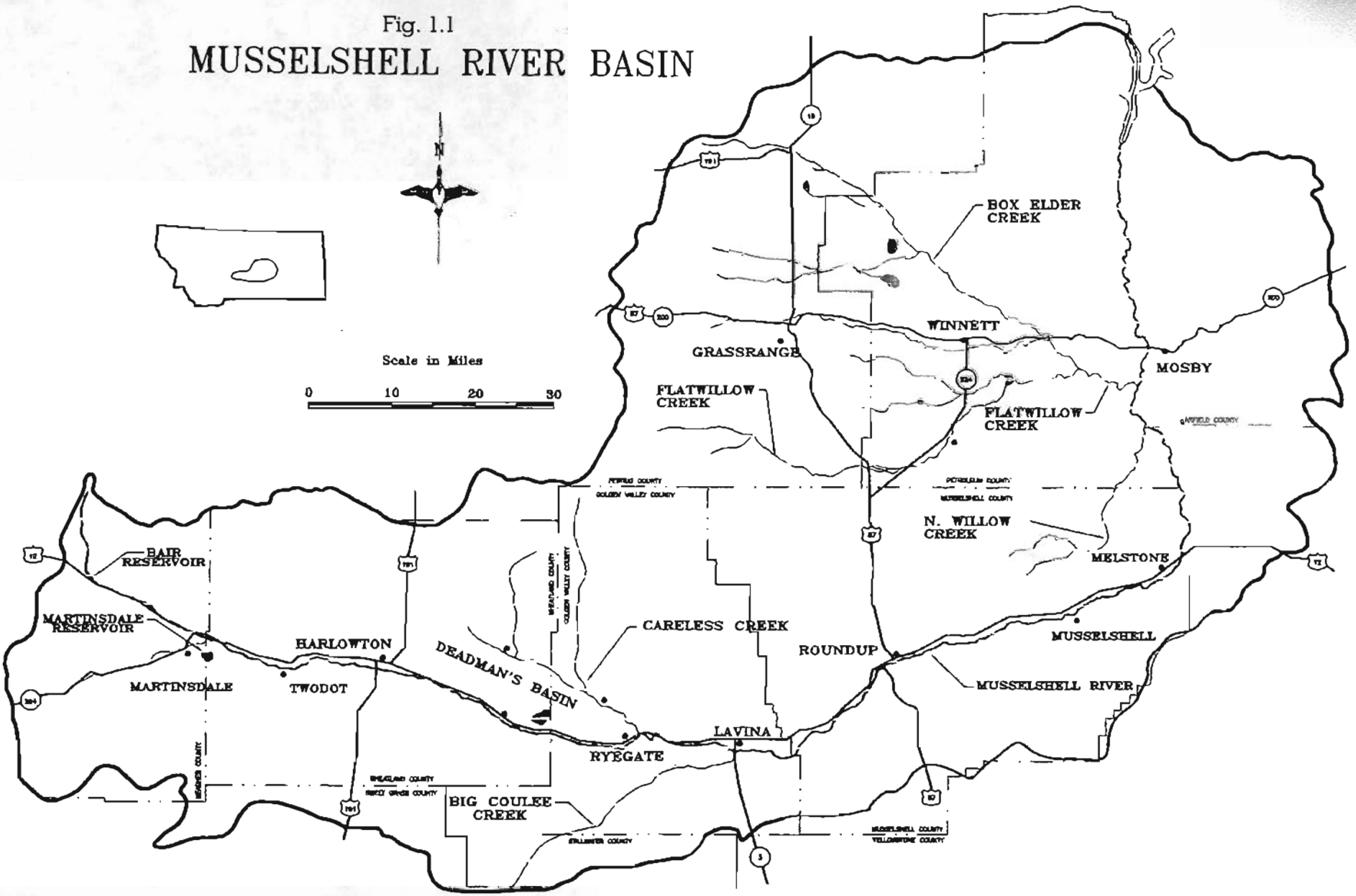
M&I supplies and recreation are the other important uses within the basin. The towns of Ryegate, Roundup, and Melstone draw water from the river to serve about 2,200 people. Recreational use averages about 93,000 visitor days per year at the three reservoirs, mainly fishing.

STUDY BACKGROUND

Like most snowmelt fed streams, the Musselshell floods in the spring until about mid-June, when flows tapers off to only a trickle in late summer and early fall. After the three reservoirs were constructed, water delivery contracts for stored water were offered to basin users. Upper basin water users bought contract water even though they have first chance to divert river flows into their storage reservoirs and irrigation systems. Bair Reservoir is almost always full, and the supply canal for Martinsdale Reservoir (upstream of any depletions) usually has sufficient flows for

Fig. 1.1

MUSSELSHELL RIVER BASIN



diversion needs. Some users in the lower basin did not buy enough contract water from Deadman's Basin Reservoir to satisfy their needs.

Contracts for stored water did not solve water shortage problems because most users have a natural flow or claimed water right allowing them to divert from the river. When users call for contract water from a reservoir, it must flow to them past users with natural flow rights. Since there is no way to differentiate between natural flows and contract water, water sometimes is diverted before it reaches the contract holder. Users did attempt to resolve this problem among themselves, but could not come up with a solution.

1992 Water Management/Accounting Program

Since most water contracts were sold to users along the Lower Musselshell and the users association counts an acre-foot of water as a single vote, the irrigators who experience the most water shortages also have the most votes. Lately, these users have begun to implement regulations on contract water to ensure they receive their fair share. In 1992, the LMCD (Lower Musselshell Conservation District) and DBWUA put together a plan funded by DNRC, Reclamation, and individual irrigators to begin a water measurement and accounting program. At the same time, DBWUA has begun to require that contract holders order water, so reservoir release flows can be better estimated. This should help reduce wastewater at the end of the system by releasing only water that is needed.

Part of the LMCD/DBWUA water measurement program included installation of real-time measuring devices at strategic points in the Deadman's Basin system. These devices, operated by the USGS (U.S. Geological Survey) and the water users, allow tracking water down the river. By ordering and tracking stored water, the users monitor water more wisely. In the past, few users actually measured the water they received. With the advent of the measurement program, irrigators now realize how much water is being applied, and hopefully will only use enough to prevent salts and other undesirable constituents from leaching through the root zone of their crops, thus creating water quality problems. Irrigators in the lower basin also installed measuring devices as part of the 1992 water measurement study, but some of the meters are malfunctioning because of maintenance problems.

Montana Water Measurement Program

The entire Musselshell River Basin is now under a measurement program because the river has been declared a chronically dewatered stream under the Montana Water Measurement Program Act of 1991. Nine factors guide DNRC when considering whether to declare a stream chronically dewatered:

- Extent, duration, and frequency of the dewatering.
- Impact of dewatering on fish, wildlife, or other natural resources.
- Particular species of fish and wildlife affected.
- Impact of dewatering on other off-stream uses, including agricultural, M&I, and recreational uses.

- The probable cause of dewatering.
- Existence of temporary or final decrees.
- History of conflict among water rights holders on the watercourse.
- Practicality and reasonableness of installing measuring device on diversions along the watercourse.
- Likelihood that installation of measuring devices will significantly help to solve the chronically dewatered condition of the watercourse, or resolve conflicts among water rights holders.

Public meetings were held as a first step. A draft report with DNRC's recommendations was then circulated for comment, followed by a final report including public comments and DNRC's final decision. Those diverting water had two years to install measuring devices after the decision to require them was made. The DNRC has the authority to help financially. Those diverting water are required to record and report to DNRC or their designees water measurements on a regular basis.

Water Rights Adjudication

About the time it was declared a chronically dewatered stream, the Musselshell Basin was issued a *Temporary Preliminary Decree* in the water rights adjudication process. The process was established in 1979 when the legislature modified the Montana Water Use Act which governs water rights originating before July 1, 1973. All owners of a water right had to file a claim with DNRC for that right before April 30, 1982.

The first stage of the adjudication process is issuance of the temporary preliminary decree, given to all effected parties, with a time set for filing objections. Temporary preliminary decrees are enforceable by the district court. The water judge assigned to the basin, with help of a water master, decides all objections to the water rights claims. After all objections have been resolved, the water judge issues a final decree. Then DNRC issues a *Certificate of Water Right* to each person decreed a water right. A temporary preliminary decree was issued for the Upper Musselshell Basin May 7, 1985, and the Lower Musselshell Basin February 6, 1990.

AUTHORITY

Reclamation's authority for this study is provided in Federal Reclamation Laws (Act of June 17, 1902, 32 Stat. 388, and acts amendatory thereof and supplementary thereto). Reclamation was directed to study the project and prepare suitable documentation by the Energy and Water Development Appropriations Bill of 1993.

Chapter 2
CURRENT BASIN OPERATIONS

This chapter of the report describes operations of the reservoirs in the Musselshell River Basin and operations of the water user associations and water contract holders.

RESERVOIR OPERATIONS

Three state projects--the Upper Musselshell, Deadman's Basin, and Delphia-Melstone Projects--have been constructed along the Musselshell River. Descriptions of the facilities and how they are operated make up this section.

Upper Musselshell Project

Bair Reservoir (fig. 1.1) is an impoundment of the North Fork of the Musselshell about 12 miles northeast of the town of Martinsdale. The earthfilled dam is 538 feet long and 100 feet high. The single 65-feet wide spillway has a capacity of 6,000 cfs (cubic-feet-per-second). Two gates, a 48-inch diameter slide gate and a 48-inch butterfly valve, control flows. Storage of the reservoir is 7,010 ac-ft (ac-ft). The dam, built in 1939, supplies water for irrigation and is operated by the UMWUA (Upper Musselshell Water Users Association).

Martinsdale Reservoir, 1 mile southeast of Martinsdale, is an off-stream storage reservoir. Two earthfilled dams were necessary at this site: the one on the north side is 1,000 feet long, on the east side 1, 635 feet long. Height of the dam on the north side is 96 feet, 49 feet on the east. A single 10-feet wide spillway serves the reservoir, with a capacity of 600 cfs. Two gates, a 54-inch slide gate and a 54-inch butterfly valve, control flows. Storage is 23,110 ac-ft. This dam, also built in 1939, supplies water for irrigation and is also operated by UMWUA.

Five canals are part of the Upper Musselshell Project:

- *Checkerboard Canal*--This 38-cfs, 2.9-mile long canal feeds Bair Reservoir from Checkerboard Creek (slated to be abandoned by the state).
- *North Fork Diversion Canal*--Of 105-cfs capacity, this 11.7 mile long canal carries water from the North Fork to the South Fork of the Musselshell (above Martinsdale Reservoir).
- *Martinsdale Supply Canal*--A 408-cfs, 2.41-mile long canal to carry water from the South Fork to Martinsdale Reservoir.
- *Martinsdale Outlet Canal*--This 333 cfs canal is 2.57 miles long and carries water from Martinsdale Reservoir back to the Musselshell.
- *Two Dot Canal*--A 122-cfs, 32.12-mile long canal carrying water from the river west of the town of Two Dot to Antelope Creek a mile east of Harlowton.

Monthly water surface elevations at Bair and Martinsdale Reservoirs are recorded by DNRC (Montana Department of Natural Resources and Conservation). The DNRC also maintains gauging stations below Bair Reservoir on the North Fork Diversion Canal, Martinsdale Supply Canal (2), Martinsdale Outlet Canal, and Two Dot Canal. The USGS (U.S. Geological Survey) has gauges on the North Fork above Bair and on the South Fork above Martinsdale Supply Canal (both now inactive), and on the Musselshell at Harlowton. Several turnouts on the canals also have measuring devices.

The DNRC reported the outlet gates on Bair and Martinsdale Dams to be eroded in 1974. These were repaired. Safety modifications have been made to the gate towers on both dams. Checkerboard Canal was rebuilt in 1974. Considerable damage was done to the Martinsdale Diversion Dam and part of the Martinsdale Supply Canal in 1975, but these have been repaired.

Deadman's Basin Project

The Deadman's Basin Project is downstream of the Upper Musselshell Project (fig. 1.1). Deadman's Basin Reservoir, about 3 miles northeast of the town of Shawmut, is also an off-stream storage reservoir. The earthfilled dam is 1,360 feet long and 63 feet high, with 2,950 feet of associated dike. The 1,000-cfs capacity spillway is 30 feet wide. Flows are controlled by two 60-inch by 60-inch slide gates. The reservoir can store 76,900 ac-ft of water. Built in 1941, the reservoir is operated by the DBWUA (Deadman's Basin Water Users.Association) and supplies water for Deadman's Basin contract holders.

Three canals serve the Deadman's Basin Project:

- *Supply Canal*–A 600-cfs, 11.49-mile long canal conveying water from the Musselshell to the reservoir. This canal has a concrete diversion and headgate.
- *Barber Canal*--This 200-cfs, 2.85-mile long canal conveys water from the reservoir back to the river. It has a concrete 5-feet by 14-feet radial headgate.
- *Careless Creek Canal*--A 344-cfs, 9.5 mile long canal conveying water from the reservoir back to the river via Careless Creek.

DNRC records the elevation at Deadman's Basin Reservoir every month. River flows are measured by USGS gauges at Ryegate, Roundup, Musselshell, and Mosby. Flows in the three canals are measured at each of four DNRC gauging stations. Water is turned into the river to be diverted by state and private canals and pumps. Because most of the diversions aren't measured, the extent of private rights in the river is unknown.

DNRC reported many structural deficiencies, which could lead to loss of use of parts of this project. Water leaking around the outlet canals has caused an accumulation of salts and permanent wetting of many acres below the dam.

Delphia-Melstone Project

The Delphia-Melstone Project, consisting of four canals, is downstream of the Deadman's Basin Project (fig.1.1). The Melstone Unit was completed in 1949, the Delphia Unit in 1955. The canals are:

- *Delphia Canal*–A 40-cfs, 9.5-mile long canal carrying water from the river west of the town of Delphia to Hawk Creek on the south side. The canal includes 4 siphons underneath the Musselshell, and has a concrete diversion and headgate.
- *Melstone Diversion Canal*–This 220-cfs capacity, 1.5-mile long canal splits into North and South canals about 0.5 miles from the town of Musselshell. It includes a concrete diversion and headgate and three 60-inch by 60-inch slide gates.
- *North Canal*–A 100-cfs, 15-mile long canal carrying water from near Musselshell to the town of Melstone on the north side of the river. This canal includes a concrete diversion and wooden headgate.
- *South Canal*–This 135 cfs canal is 33.4 miles long and carries water from near Musselshell to about six miles north of Melstone on the opposite side of the river from the North Canal. It too has a concrete diversion and wooden headgate.

Diversion from the river into the canals is measured by DNRC measuring stations. Water is divided by the users at turnouts without use of measuring devices.

DNRC reported several small maintenance items need attention to maintain this project in good condition.

Operation of the Projects

While the Montana State Water Board originally wanted to operate all basin facilities as one project, the water users associations wanted to operate independently. Montana owns the water rights for both UMWUA and DBWUA, but each sets it own operation.

Because UMWUA and DBWUA operate independently, occasional conflicts have developed over the filling of the reservoirs. Problems occurred when spring runoff is insufficient to satisfy both water rights. The UMWUA would divert their water right, not leaving enough water in the river for the DBWUA's water right downstream. Since the senior water right is with DBWUA, they could request upstream users to quit diverting until the needs of their association were met. In 1994, the two associations agreed to meet every March to decide how to fill the three reservoirs based on snow cover and runoff estimates. The associations also drew up an agreement as a fall-back position in case they couldn't reach a decision during the joint meeting.

The UMWUA are water users who have purchased shares from Bair and Martinsdale Reservoirs. Each share of water is equal to a specific volume varying from 1-1.5 ac-ft/yr. They market water from the reservoirs downstream to the inlet canal of Deadman's Basin Reservoir. The UMWUA operates Bair and Martinsdale Reservoirs together to fulfill contracts sold from the firm annual yield, estimated to be 800 ac-ft and 8,000 ac-ft, respectively. They market the yield to repay the initial investment by the state. Contracted water from the two reservoirs is 21,636 ac-ft.

The UMWUA is managed by a board of five elected directors who represent the five irrigation regions in the Upper Musselshell Project. The board performs day-to-day business, makes water management decisions, maintains facilities, collects fees, and hires any needed workers. They handle most of the operations themselves. They set the rate of flow at the diversion structures and determine how much water is released to downstream users. This works well as long as there is

plenty of water in the diversion points and demand for contract water remains constant. When changes in operation are required, the board has to make them. Problems sometimes occur when the board is unavailable to make necessary changes.

The UMWUA is concerned about the remaining yield in the reservoirs. They contend that the existing contracts take up most of the available water. They think the remaining water is needed to cover delivery system losses and to "push" contracted water to its destination. The contracts are for the water needed at the user's diversion point, not the volume to be released to get the water to that point. This means that the water required to get the contracted volume to the user seems available for marketing.

The DBWUA are water users who have purchased shares from Deadman's Basin Reservoir, each share equal to a specified volume each year. The DBWUA markets water from the reservoir downstream to Mosby. Estimated firm annual yield is 34,000 ac-ft, of which 25,563 ac-ft has been sold. A moratorium on water sales has been in effect since 1973.

The DBWUA is managed by a board of five directors who have hired a water manager to control ordering and releases from Deadman's Basin Reservoir. The manager also keeps records of the users who contract water, and he makes sure they are billed appropriately. The DBWUA has developed a water management plan to help manage facilities (which is discussed later).

Like the UMWUA, DBWUA has concerns about the state trying to market the remaining yield as unneeded water. They contend the unused volume is needed to cover delivery losses and to transport water to contract holders.

The Delphia-Melstone Project was constructed to use water from Deadman's Basin. This project has a contract for 6,687 ac-ft from the reservoir and a 250 cfs diversion right from the Musselshell River. It is managed by an association with a water marketing agreement with the state. The project collects payments and pays DBWUA for all users in the project. Each share in the Delphia-Melstone Project entitles the owner to 1.3 ac-ft from Deadman's Basin Reservoir and 0.6 ac-ft of natural flows from the Musselshell. Combined, these two sources provide less than 2 ac-ft/acre of irrigated land. Only 5,700 acres are currently irrigated in a project originally designed for 16,000 acres. Lack of water has discouraged further development.

DEADMAN"S BASIN WATER MANAGEMENT PLAN

During the extended drought of the 1980s, Deadman's Basin Reservoir at times wasn't able to adequately supply contract holders. The DBWUA in 1990 decided to implement practices that would help provide more water to members. They realized they needed to know where system water was going and when it got there. To supply this information, an active water measurement program was initiated. The program consisted of tracking water down the river to see how long it took to reach its destination, determining how much water it took to deliver the needed flow, and getting better estimates of needed water from irrigators. DBWUA got access to USGS gauging

station data for the first two objectives and established gauging stations of their own. Now, when water is released from Deadman's Basin as requested, DBWUA tracks its progress as it passes the different gauging stations on the river. They publish the flows at the gauges in the newspaper so users will know the water is coming and estimate when it will arrive.

In order to get better estimates of water use, DBWUA members had to install measuring devices on their diversions. The measuring devices gave users the information they needed to place accurate orders for water. The new measuring devices--both "real time" on the reservoir and the devices on private diversions--were made part of a Renewable Resource Grant Program.

System Measuring Devices

The Deadman's Basin Water Management Plan depends on knowing the whereabouts of available water in real time. Following is a list of "real time" gauges accessed by the water manager daily. With information from these locations and with the water orders, the manager can decide how much water to release from Deadman's Basin Reservoir and how much to divert into the basin.

- USGS Gauge at Harlowton--River flows measured here are used to predict runoff and to estimate the volume of claimed right water available to divert either into Deadman's Basin Reservoir or for use by irrigators or other water users. This gauge is voice-actuated and gives the present stage over the phone. With the use of a stage discharge table or relationship, a direct flow can be obtained at this station.

- USGS Gauge at Shawmut--This gauge measures river flows after they have been diverted into Deadman's Basin Inlet Canal, which represents natural flows available for users downstream if they have a right. This information is accessed through a satellite link in Helena, so data is about three hours old when accessed by phone.

- USGS Gauge at Lavina--This gauge below the outlet of Deadman's Basin measures a combination of contract water and claimed right water that passes this location in the river. The data is accessed like the Shawmut gauge.

- USGS Gauge at Roundup--The flows this gauge measures and the means of accessing information are like the Shawmut Gauge.

- USGS Gauge at Musselshell--Flows and the means of accessing information are like the Shawmut Gauge.

- Deadmans Basin Inlet Canal Gauge--This gauge measures flows for storage in Deadman's Basin Reservoir and for irrigation along the canal. The data is accessed through a radio link with the NRCS (U.S. Natural Resources Conservation Service) office in Roundup. That agency shared the costs of automating Deadman's Basin and has let DBWUA use their Roundup office as a data collection point.

- Stage of the Reservoir--This data is measured at the release tower on the dam. This data is accessed like inlet canal flow data at the NRCS office in Roundup.

- Height of the Reservoir Release Gate--This data is sent instantaneously to the NRCS office in Roundup, and, combined with stage of the reservoir data, can be used to accurately estimate the rate of release from the reservoir.

Individual Measuring Devices

All holders of Deadman's Basin contracts were required to install measuring devices with recording totalizers on any diversion used to divert contract water. This makes up approximately 90% of all diversions between Deadman's Basin and Melstone.

This requirement was made for several reasons: First, to allow water users to get a true measure of the volume they actually divert. This information was necessary if accurate water orders were to be placed. Second, measuring devices help keep track of the volume of contract water consumed at each diversion. This helped provide a more equitable distribution of the contract water when there wasn't enough to go around. Finally, measuring devices provide water right holders with a means of defending their claim. Without records, there is no evidence that a water right claim is accurate, that holders aren't diverting more water than is their due. While not part of the management plan, this benefit shouldn't be discounted.

Contract holders are also required to file maps with DBWUA indicating where they plan to use contract water. This helps manage development of new land using contract water in an already overdeveloped basin.

Water Ordering Program

DBWUA's water ordering program works like this. The lower Musselshell River Basin has been divided into five reaches determined by the number of days contract water takes to reach the leading edge of the reach.

The water ordering procedure differs according to what reach the water is needed in. If the water is to be used in Reach Number 5, for instance, then the order must be placed 5 days before the water is diverted. This gives time for the water released (or accounted for) to reach the diversion. The delay between ordering and diversion prevents shortages below where the water is diverted.

When an order is placed with the water manager, the user is requesting a flow, period of use , and a starting date. This information is loaded into a spreadsheet that accounts for travel time and predicts demands at each USGS gauge and at Deadman's Basin. Natural flows are then loaded into the spreadsheet. The difference between natural flows and the demand is equal to the volume of water to be released from Deadman's Basin Reservoir.

Tributary inflows can be accounted for along the river because there is real time capability at all the USGS gauges. These gauges also reveal unexpected diversions of water by users who either didn't order water, or users who have no contract but are diverting water anyway.

Water orders are also used to determine when to divert water into Deadman's Basin for storage. If--and only if--no demand is expressed does Deadman's Basin divert water for storage. If the orders for water are less than natural flows, the reservoir diverts only the water not needed downstream by senior water rights holders. If the orders exceed the water needed to satisfy the downstream demand, then all the water bypasses the diversion and is released from the reservoir at a rate to only satisfy the demand.

The Inlet Canal of Deadman's Basin is also used as a delivery system for water from Martinsdale Reservoir. The irrigators along the canal must place an order both with UMWUA and DBWUA. The UMWUA releases their contract water, and the DBWUA water manager ensures that the water is diverted into the canal to satisfy the demand.

Results of the Plan

The success of the Deadman's Basin Water Management Plan, only in effect for the 1995 and 1996 irrigation seasons, remains to be determined. After the 1995 season, however, about 30,000 ac-ft of water was left in Deadman's Basin Reservoir. The DBWUA board and water users believe that there would have been only a minimal volume of storage left if not for the plan. Users got most of the water they needed, and they felt confident they could irrigate the following year with the storage left over. By comparison, Martinsdale Reservoir upstream of Deadman's Basin was drawn very low in 1995, with hardly any carryover available for 1996.

Chapter 3
ON-FARM IRRIGATION EFFICIENCY ANALYSIS

Reclamation contracted with the U.S. Soil Conservation Service (now the National Resources Conservation Service--NRCS) to study the on-farm efficiencies of irrigation systems in the Musselshell River Basin. After some discussion, it was agreed that NRCS would estimate seasonal irrigation efficiencies based on irrigator interviews and a method of analysis called the *Farm Irrigation Rating Index* (FIRI). No on-site measurement or detailed system evaluations were to be performed.

FIRI requires collection of information about the irrigation system and how it is managed. Most of this information was gathered by interviewing basin irrigators. Interviews were done by Terri Hice, water manager for DBWUA (Deadman's Basin Water Users Association), and John Hunter of DNRC (Montana Department of Natural Resources and Conservation). The DNRC provided a list of 30 sites along the Musselshell representative of the types and management of irrigation in the basin. Interviews were held on 22 of these sites.

NRCS planning staff in Bozeman analyzed the data collected during the interviews using FIRI and other procedures. That analysis is summarized in this chapter; the complete NRCS report can be found in Appendix 1. Recommendations from NRCS's report are included at the beginning of the present report.

PROCEDURES

The basic method of estimating seasonal on-farm irrigation efficiency in this analysis is the FIRI procedure developed at NRCS's West National Technical Center. FIRI is detailed in Farm Irrigation Rating Index [FIRI] (NRCS, 1991). An associated computer program helps manipulate data.

FIRI is intended to be a uniform and objective evaluation for planning irrigation water conservation and identifying groundwater and surface water pollution potential. It compares improvements or changes to irrigation systems and management, but can't be used to establish a finite farm or field application efficiency or specific deep percolation and runoff volumes.

Data is usually gathered for FIRI by a combination of field observations and interviews with irrigators/managers. To facilitate the Musselshell FIRI analysis, a worksheet (Figure 1 in Appendix 1) was created to record data for entry into the computer. A trial run was made at two sites. John Dalton, NRCS, advised on how to use the worksheet and on the questions to ask during the interviews.

Information required by the process included soil data and a map (or aerial photo) on which ditches and field boundaries were marked. Since a soil survey is continuing in Musselshell County, not all sites had detailed soils information available. NRCS field office staff provided whatever information was available. Worksheets, soils information, and map data were provided to the NRCS planning staff as they were gathered.

Before the FIRI procedure was run on the computer, crop water use (ET) was estimated by running the NRCS's *TR21 Blaney-Criddle* computer program for each field. Data from the closest available weather station was used in the calculations. TR21 requires information on carryover moisture and net irrigation application depth. Since available water capacity (AWC) is required to estimate

these factors, AWC was estimated from available soil information and use of a *DM Soil* model or soil survey data, depending on availability.

Net irrigation application depth for TR21 was estimated based on the following conventions:

- Surface irrigation systems: 50% of AWC.
- Lateral move sprinkler: Lesser of 3.0 inches or 50% of AWC.
- Pivot sprinkler: 1 inch.

The NRCS staff then applied their collective judgment to select management factors for the FIRI computations. There is a considerable degree of judgment involved in selecting FIRI factors.

ANALYSIS

Table 3.1 shows the results of all analyzed sites, categorized into three major irrigation application methods: flood, sprinkler, and border. Estimated seasonal application efficiency for each site is shown, as is weighted average efficiency (weighted by the number of acres at each site) for each major type of irrigation. Net and gross seasonal irrigation requirements are also indicated for each site and a total for each method type.

On-farm irrigation conveyance system losses were estimated by totaling the number of miles of canals (or ditches) for each irrigation method and applying an average canal loss factor. Note that none of the sprinkler systems were associated with on-farm ditch or canal systems, since they all apparently pumped water directly from the community ditch or from the river. Based on an increased seasonal application efficiency of 10%, potential water conservation volumes for each method were estimated.

RESULTS

In general, the seasonal irrigation efficiencies summarized in Table 3.2 were higher than expected. This, in part, may be due to the following reasons:

- Since water availability has been such an issue on the Musselshell (particularly the lower basin), irrigators appear to pay more attention to water management than in other areas of the state. This fact was reflected in several factors in the FIRI process.

- Water measurement is being implemented in the basin, increasing one factor in the FIRI process and thus raising efficiency.

- The interview process and FIRI worksheet are limited in transmitting detailed information. Irrigation operation management can be complex. Some things were probably missed that would tend to change the results. To refine the process would have required spending more time at each site and possibly observing irrigation operations.

EXISTING IRRIGATION SYSTEM

Total flood irrigated acres	1588.4 acres
Existing weighted average irrigation application efficiency	32.1 percent (for flood irrigation throughout Musselshell)
Net seasonal irrigation water requirements	168.9 acre feet/year
Gross seasonal irrigation water requirements	526.1 acre feet/year

FACTOR	Contour Ditch	Contour Ditch	Contour Ditch	Contour Ditch	Uncontrol Flood	Uncontrol Flood	Control Flood	Contour Ditch	Contour Ditch	Contour Ditch	Contour Ditch	Contour Ditch	Control Flood	Contour Ditch
Farm	5	6	11	11	13	16	29	1	2	3	7	10	10	8
Field	2	1	2	3	8	8	283	2	1	1	1	2	1	1
Acres	80	81	120	130	13.1	21.4	70	300	32	60	30	173	400	69.9
Net Requirement (in)	8.04	11.13	14.64	14.35	14.77	13.96	16.76	11.21	5.74	9.16	11.56	11.26	13.07	13.21
Gross (ac ft)	160.5	261.9	356.6	531.2	67.0	109.2	328.7	818.9	43.6	119.6	63.3	776.5	1369.3	200.5
Potential efficiency	65	65	65	65	50	50	60	65	65	65	65	65	65	65
Seasonal Efficiency	38.73	28.69	41.05	29.27	24.05	22.80	29.74	34.22	35.08	38.28	45.65	20.90	31.14	38.38
Water measurement	0.90	0.94	0.96	0.90	0.96	0.96	0.90	0.90	0.90	0.90	0.96	0.90	0.90	0.90
Soil/moisture sched.	0.94	0.90	0.94	0.94	0.92	0.94	0.94	0.90	0.90	0.90	0.93	0.92	0.92	0.90
Irr. skills & action	0.80	0.80	0.95	0.80	0.90	0.80	0.92	0.90	0.92	0.92	0.98	0.92	0.95	0.90
System maintenance	0.98	0.94	0.94	0.94	0.95	0.94	0.94	0.98	0.94	0.96	0.98	0.98	0.98	0.98
Water Delivery	0.93	0.85	0.96	0.90	0.93	0.93	0.80	0.96	0.93	0.93	0.93	0.96	0.96	0.93
Soil condition	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Water control	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.95	0.98	0.98	0.98	0.98	0.98
Conveyance effic	0.95	0.92	0.98	0.92	0.91	0.96	0.93	0.85	0.87	0.94	0.94	0.53	0.86	0.96
Land leveling	0.82	0.82	0.77	0.79	0.80	0.80	0.86	0.80	0.67	0.77	0.83	0.75	0.80	0.82
Water reuse factor	1.25	1.15	1.15	1.15	1.00	1.00	1.10	1.20	1.20	1.30	1.20	1.20	1.00	1.20
Climate (Sprink)														
Sprinkler design														
Wind (Sprink)														

EXISTING IRRIGATION SYSTEM

Total sprinkler irrigated acres	1005.0 acres
Existing weighted average irrigation application efficiency	46.3 percent (for sprinklers throughout Musselshell)
Net seasonal irrigation water requirements	147.8 acre feet/year
Gross seasonal irrigation water requirements	319.3 acre feet/year

FACTOR	Pivot Sprinkler	Pivot Sprinkler	Big Gun	Pivot Sprinkler	Wheel Line	Hand Line	Wheel Line	Wheel Line	Pivot Sprinkler
Farm	5	12	13	16	19	19	22	28	1
Field	1	1	11	1	11	1	586	1	1
Acres	240	119	15.5	135	56.3	1.5	77.7	120	240
Net Requirement (in)	10.44	19.76	15	22.19	19.21	19.21	15.99	17.34	8.63
Gross (ac ft)	402.7	370.6	52.1	551.3	198.5	5.3	283.0	504.3	360.3
Potential efficiency	80	80	60	80	70	70	70	70	85
Seasonal Efficiency	51.85	52.88	37.22	45.27	45.40	45.40	36.58	34.38	47.91
Water measurement	1.00	1.00	1.00	0.94	0.94	0.94	1.00	0.90	0.90
Soil/moisture sched.	0.94	0.95	0.92	0.94	0.97	0.97	0.90	0.94	0.90
Irr. skills & action	0.92	0.90	0.90	0.92	0.92	0.92	0.92	0.92	0.90
System maintenance	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Water Delivery	0.93	0.98	0.93	0.93	0.98	0.98	0.80	0.80	0.93
Soil condition	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Water control	1.00	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00
Conveyance effic	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Land leveling									
Water reuse factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Climate (Sprink)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sprinkler design	0.95	0.93	0.93	0.93	0.95	0.95	0.93	0.93	0.98
Wind (Sprink)	0.94	0.94	0.96	0.91	0.96	0.94	0.94	0.94	0.96

EXISTING IRRIGATION SYSTEM

Total border irrigated acres	521.3 acres
Existing weighted average irrigation application efficiency	47.4 percent (for borders throughout Musselshell)
Net seasonal irrigation water requirements	256.0 acre feet/year
Gross seasonal irrigation water requirements	540.1 acre feet/year

FACTOR	Graded Border	Graded Border	Graded Border	Graded Border	Graded Border	Graded Border	Graded Border	Graded Border	Graded Border	Graded Border	Graded Border	Graded Border	Level Basin	Graded Border	Graded Border
Farm	11	12	13	14	16	18	19	20	22	25	25	26	26	28	29
Field	1	8	2	8	2	4	5	1	2	2	1	1	22	2	1
Acres	80	12	17.1	39.4	38	24.6	19.6	36.4	31.4	37	27	31	43	51	34
Net Requirement (in)	15.67	14.77	14.77	17.71	16.28	18.95	19.91	18.95	16.71	15.75	15.75	17.34	17.34	17.34	16.76
Gross (ac ft)	260.4	25.1	69.3	123.2	106.9	83.4	66.1	84.2	91.4	102.1	69.4	93.5	131.1	191.8	132.3
Potential efficiency	80	80	80	80	80	80	80	80	80	80	80	80	90	80	80
Seasonal Efficiency	40.12	58.90	42.68	47.20	54.17	46.58	49.18	68.24	47.82	47.58	51.07	47.92	47.40	38.46	42.21
Water measurement	0.90	0.96	0.96	0.96	0.94	0.94	0.94	0.94	1.00	0.96	0.96	0.90	0.90	0.90	0.90
Soil/moisture sched.	0.94	0.95	0.92	0.94	0.94	0.94	0.97	0.95	0.90	0.94	0.94	0.94	0.94	0.94	0.94
Irr. skills & action	0.80	0.92	0.90	0.92	0.92	0.92	0.92	0.95	0.92	0.98	1.00	0.98	0.98	0.92	0.95
System maintenance	0.94	0.94	0.95	0.94	0.94	0.94	0.94	0.95	0.94	0.98	0.98	0.98	0.94	0.94	0.98
Water Delivery	0.98	0.98	0.93	0.93	0.93	0.98	0.95	0.98	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Soil condition	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Water control	0.98	0.98	0.98	0.98	0.98	1.00	0.98	1.00	1.00	0.98	1.00	0.96	1.00	0.98	0.98
Conveyance effic	0.95	0.90	0.95	0.96	0.99	1.00	0.99	1.00	1.00	0.97	1.00	0.96	1.00	0.97	0.89
Land leveling	0.90	0.90	0.85	0.90	0.93	0.81	0.90	0.90	1.00	0.94	0.94	1.00	0.88	0.90	1.00
Water reuse factor	1.00	1.25	1.00	1.00	1.10	1.00	1.00	1.25	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Climate (Sprink)															
Sprinkler design															
Wind (Sprink)															

Table 3.2: Summary of the On-Farm Analysis

Irrigation Method	Total Acres	Weighted Avg. App. Eff.	Net Seasonal Water Require.	Gross Seasonal Water Require.
Flood	1,588.4	32.1%[1]	168.9 ac-ft/yr	526.1 ac-ft/yr
Sprinkler	1005	46.3%[1]	147.8 ac-ft/yr	319.3 ac-ft/yr
Border	521.5	47.4%[1]	256 ac-ft/yr	540.1 ac-ft/yr

[1] For this particular irrigation method throughout the Musselshell Basin.

According to NRCS, on-farm irrigation efficiency could be improved with a moderate commitment of irrigator management, maintenance, and capital investment. An overall average seasonal efficiency improvement of 5-10% would be a realistic goal. Beyond a 10% improvement would require a larger investment in irrigation facilities replacement.

RECOMMENDATIONS/SUGGESTIONS

The NRCS recommended the following to improve irrigation efficiency in the Musselshell River Basin. The first three would improve efficiency without incurring large initial investments. The six recommendations are followed by general suggestions to improve efficiency for specific types of irrigation systems (details in Appendix 1).

Recommendations

1. Prepare Irrigation Conservation Plans--Short and long term irrigation conservation plans for individual operations should be completed as detailed in the *Planning Handbook* (NRCS, 199_) and the *Montana Irrigation Manual* (NRCS, 199_). Developed in close consultation with the irrigator, the plan examines the operation and recommends specific practices. The NRCS prepares the plans as part of their normal conservation program, but they can only do a few each year because of limited resources. The water user associations could fund the training of additional staff (perhaps of the conservation districts) to develop these plans, offering them to the users at a nominal fee. Water conservation plans should also be encouraged for all users, including the towns.

2. Develop Conservation Demonstration Sites--Conservation practice demonstrations could be set up throughout the basin at cooperating farms. Workshops and tours could be set up to view and discuss new techniques like cablegation or automated ditches, scheduling methods, and other

procedures. Several programs may be able to help fund or share the costs of these activities. The NRCS, Reclamation, the state, or the extension service may be able to help.

3. Set up a Demonstration Scheduling/Water Management Consultive Service--The users associations and the state could cooperate in setting up a demonstration irrigator controlled management service, which could include:

- Irrigation scheduling.
- Water budget analysis on a field/farm basis.
- Coordination with water district operations.
- Other integrated crop/pest management services.

A service would required technical help and seed money to start. The objective would be to ultimately make the service a self-supporting enterprise without need for outside financial assistance. Help could come from the NRCS, Reclamation, the state, local government entities, organizations, or even individual irrigators. Groups like Montana Watercourse could help by searching information about these activities.

4. Establish a Water budget Based on Predicted Water Availability--This requires that the user and the associations look at the volume of water predicted to be available every year for the growing season. Tools critical to this recommendation are: 1) a reservoir operating guide for basin; 2) a method to make reservoir and water supply forecasts; 3) a computer program to prepare farm/field level crop water budgets. The NRCS is developing software for this purpose and may have it available. Water supply forecasts can be made using SNOTEL data from NRCS and using precipitation, crop evapotranspiration, and evaporation data obtainable from AGRIMET stations in the basin. Reclamation may be able to share the costs of installation of an AGRIMET station.

5. Use Moisture Conserving Farming Practices--To help keep available moisture in the soil, conservation practices should be used like: 1) No Till; 2) Minimum Till; 3) Tillage equipment that does not turn the soil over; 4) Cutting hay at earliest stage consistent with high quality (mature actively growing plants transpire at a high rate and thus use more moisture than freshly cut plants); 5) Planting crops that need the most water when it is available (grains need more water early when it is likely to be available, whereas alfalfa requires water throughout a long season). Changes in tillage would require the purchase of new farm equipment.

6. Manage by Flow Measurement--Install on-farm flow measurement as a management tool. The measuring devices could apply the correct volume of water identified by a water management plan. By measuring water flows, maintenance problems could also be noticed and corrected at an early stage.

Suggestions

Surface systems could be improved by lining ditches with plastic or concrete lining; replacing ditches with plastic pipe; using cablegation, automating ditches, installing pipelines, or risers; using surge irrigation, gated pipe, layflat tubing, land leveling, or land smoothing between rotations; installing tailwater return systems; ripping of soil layers to improve infiltration; install field corrugations; and using border dikes.

Sprinkler systems could be improved by providing adequate intake screens, checking system operating pressure, installing flow control nozzles or sprinkler heads to improve distribution efficiency on rolling terrain, maintaining nozzles and couplings to minimize leaks, repairing nozzles if necessary, and making sure center pivots applied water at an appropriate speed.

The NRCS estimated costs to increase irrigation efficiencies using current practices. Table 3.3 shows these costs on a small sample of the Musselshell Basin. Assumptions and background for the estimates can be found in Appendix 1.

Table 3.3: First Year Costs of Increasing Irrigation Efficiency [1]

Acres	Irrigation Type	Existing Irrigation Efficiency (%)	Increased Management		Convert System to Automated Ditch Application		Convert System to Lateral Move Sprinkler System		Convert System to Improved Gated Pipe System	
			Efficiency	$/acre	Efficiency	$/acre	Efficiency	$/acre	Efficiency	$/acre
406	Graded Border	49	61	120	72	981	67.14	1050	[2]	596
43	Level Basin	47	67	120	[2]	981				
419	Contour Ditch, Controlled	34	52	120			54	1050	[2]	596
104	Uncontrolled	28	38	120				1050	[2]	596
16	Big gun	37	51	128						
494	Pivot	50	67	128						
309	Lateral Move	39	53	128						

Total Acres Sampled: 1,791

[1] See Appendix 1 for details on increasing efficiency.

[2] NRCS did not assign an efficiency to this type irrigation practice.

Chapter 4
WATER SUPPLY ANALYSIS

Reclamation's *Hydrologic River Operations Study* (HYDROSS) model was selected as the mathematical computer model for this water supply analysis. HYDROSS is a surface water supply model developed to evaluate existing and proposed demands on a river system. It is intended to operate over a period of record, simulating the effects of existing and proposed demands and features on the historic naturalized flows. HYDROSS is a hydrologic accounting model which uses monthly water data. It is easy to conduct "what if" scenarios with the HYDROSS model.

The period of record selected for the model was 1929-1989. This period was selected primarily to include the drought of the 1930's so the impacts of present day development on that hydrologic period could be evaluated.

HYDROSS

Basin inputs to HYDROSS consists of three data files; natural flow data (Appendix 2), table data (Appendix 3), and network data (Appendix 4). The flow file contains the naturalized monthly flow data at selected river stations. The table file contains operational parameters such as reservoir operating rule curves and irrigation demands. The network file furnishes HYDROSS with a physical description of the study area, how stations connect, physical facilities and demand locations.

HYDROSS operates the data in strict sequential chronological order (results from one month depend on the system state at the end of the previous month), space (results at one station depend upon what is happening upstream and/or downstream), and priority (earlier priority dates are allowed water before later priority dates).

Nodes

In this HYDROSS model, a total of 13 nodes were used. A node is a river location where water use data is known or can be computed. HYDROSS uses the nodes as points where water diversions and inflows are gathered and input to the model. The diversions include irrigation, municipal, stock ponds while the inflows include return flows, tributary streams, and others. Nodes were located by consulting with DNRC (Montana Department of Natural Resources and Conservation). The nodes were selected to include USGS (U.S. Geology Survey) water quantity/quality stations where data has been recorded for an extended period of time. A schematic and a list of node basins used in the current hydrology model is shown in fig. 4.1

Naturalized stream flow was the main input at each node. Natural stream flows are flows that would have occurred if there were no human influences. Since most of the nodes were USGS stream flow gauging stations, Reclamation asked them to develop naturalized flows at each node throughout the basin. USGS responded with a report describing natural flows and detailing the procedure for arriving at them (the complete report is in Appendix 5).

USGS began computations of the naturalized flows at the North Fork of the Musselshell near Delpine, where recorded stream flows were essentially unaffected by irrigation and could thus be considered naturalized flows. The USGS then used statistical and/or regression techniques (record extension program developed) to simulate naturalized stream flows downstream to develop naturalized flows throughout the basin. At each node, the effects of human activities were calculated and removed from the data set to calculate the naturalized flows.

The 1989 baseline level of development was then imposed on the naturalized flow at each node for the period of record. The baseline level of development included all irrigated acres existing in 1989, municipal demands in 1989, and minimum instream flow requirements based upon DNRC's water reservation process. The demands were satisfied in order of priority water right dates. Three reservoirs (one on-stream and two off-stream) were also modeled in the analysis.

Priority Dates

Four basic dates were used in the model for distributing water. First priority went to natural and/or direct flow water rights for irrigation and municipal supply. Second priority went to contract flows out of the reservoirs for irrigation and municipal use. Third priority went to natural and/or direct flow water right with supplemental supply from contract water from the three reservoirs, while fourth priority went to reserved instream water rights within the basin. Natural or direct flow rights have a date before the reservoirs were constructed. The reserved instream water rights are for fishery flows, with a relatively late priority date of 1985.

Agricultural and Municipal Demands

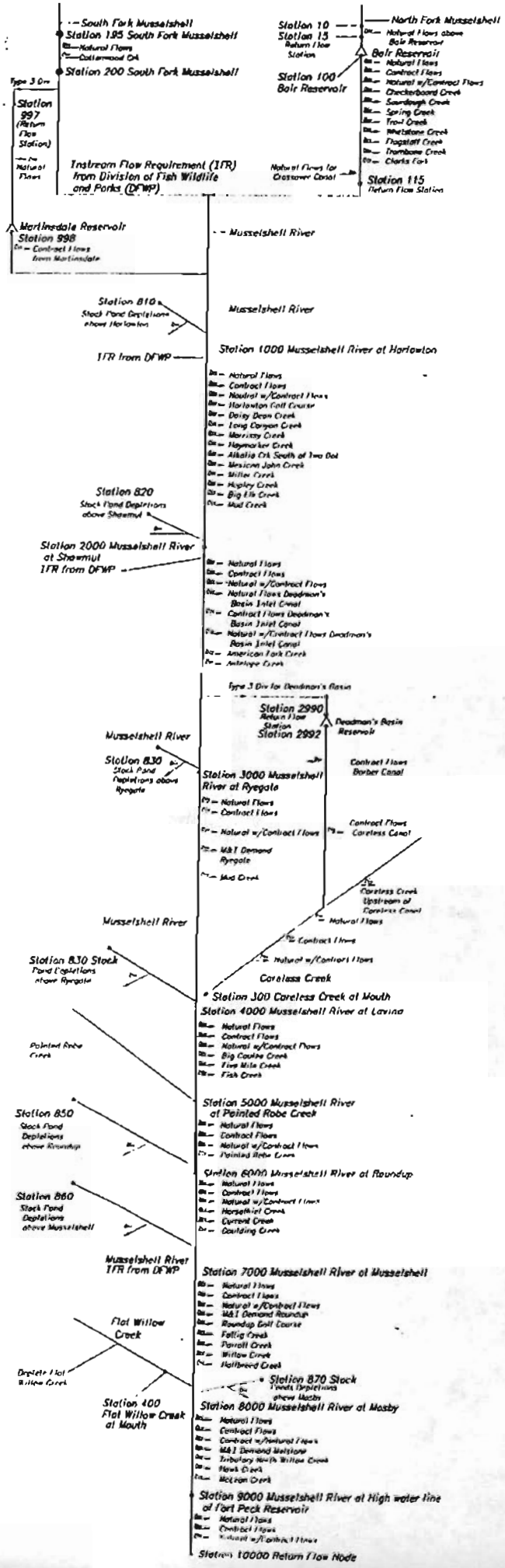
To represent basin water rights in the model, agricultural demands were calculated using crop irrigation requirements (CIR), irrigated acreage, delivery system efficiency, on-farm efficiency, and return flow data. Municipal demands were calculated using per capita water use requirement, population, efficiency, and return flow data.

Reservoir Operation

HYDROSS offers a relatively strong reservoir operating procedure. The three reservoirs in the basin (fig.1.1) were modeled and calibrated to actual end-of-month reservoir contents. Bair Reservoir, on the North Fork of the Musselshell, supplies the UMWUA (Upper Musselshell Water Users Association) and other contract holders. Martinsdale Reservoir, on the South Fork of the Musselshell River near Martinsdale, gets water from the South and North Forks. It also supplies the UMWUA and other contract holders. Deadman's Basin Reservoir, between the towns of Shawmut and Ryegate, is north of the Musselshell. It is the largest reservoir within the system and supplies the DBWUA (Deadman's Basin Water Users Association) and other contract holders from Ryegate to Fort Peck Reservoir.

Fig. 4.1

Diagram of the Musselshell River System



Irrigated Acres

An integral part of this analysis was the determination of acres of land irrigated within the Musselshell River Basin. DNRC, through the state's adjudication process, had delineated irrigated acres based upon aerial photographs and a working knowledge of the basin. Irrigated acres were then delineated for each node. Based on the water rights that serve them, irrigated acres at each node were divided into three categories : Direct and/or natural flow acres, contract flow acres, and direct and/or natural flow with supplemental contract flow acres. Also, any municipal and/or industrial demands were quantified at each node.

Crop Distribution Patterns

The NRCS (U.S. Natural Resource Conservation Service--formerly the Soil Conservation Service) was requested to provide on-farm efficiency in the basin and also to estimate the cropping patterns. They produced a report on-farm efficiency and other necessary information for the HYDROSS model (Appendix 1). The cropping pattern was alfalfa and/or native grass throughout the basin, with small grains used as starter crop for newly seeded alfalfa. There is a little corn grown for silage in the lower basin, but the percentage was so small that it was not included in the cropping pattern.

Crop Consumptive Use

CONUSE4, a computer program, was used to calculate crop consumptive water use. CONUSE4 can calculate crop consumptive use using either the Jensen-Haise or Blaney-Criddle methodology. The Blaney-Criddle method--requiring several types of data to determine how much and at what rate different plants consume water--was used in this study. Data for CONUSE4 are:

- Precipitation--The volume and rate of precipitation affects the volume of irrigation water consumed during any season. Precipitation can be in the form of frequent, light showers during a hot summer, which adds little to soil moisture for use by plants through transpiration (producing vapor through plant tissues), but may decrease withdrawal from stored moisture. Precipitation may also be lost in large part by evaporation directly from plant foliage and from the land surface. Some of the precipitation from heavy storms may be lost to surface runoff. When storms occur shortly after irrigation, much of the precipitation is lost to surface runoff, deep percolation, or both, since the soil is saturated. Other storms may be of an intensity and volume so that much of the precipitation enters the soil and becomes available for plant transpiration. Such a storm reduces the irrigation water needed.

- Temperature--Consumptive use of water by crops in any locality is probably affected more by temperature, which for long-time periods is a good measure of solar radiation, than by any other factor. Abnormally low temperature may retard plant growth and unusually high temperatures may produce dormancy. Consumptive use may vary even in years of average temperatures because of deviations from the normal seasonal distribution.

Transpiration is influenced not only by temperature but also by the leaf surface and the physiologic needs of the plant, both of which are related to stage of maturity.

- Growing Season--The growing season, which is tied rather closely to temperature, has a major effect on the use of water by plants. It is frequently considered to be the period between killing frosts, but for many annual crops it is shorter because crops are usually planted after frosts are past and mature before they recur. For most perennial crops, growth starts as soon as the maximum temperature stays well above freezing point for an extended period, continuing throughout the season despite later freezes. Sometimes growth persists even after the first killing frost in the fall. In the spring (and to a lesser extent in the fall), daily minimum temperatures may fluctuate several degrees above and below 32° F for several days before remaining generally above or below freezing point. Hardier crops survive these fluctuations and continue unharmed during a few hours of subfreezing temperature. In fact, many hardy crops, especially grasses, may mature even though growing season temperatures repeatedly drop below freezing. Although the frost-free season may be used as a guide for estimating consumptive use, actual dates of planting and crop maturity are important in determining the consumptive irrigation requirements of the crops.

- Latitude and Sunlight--Because of the earth's movement and axial inclination, the hours of daylight during the summer are much greater in the higher latitudes than at the equator. Since the sun is the source of all energy used in crop growth and evaporation of water, increased day light may allow plant transpiration to continue for a longer period each day and to produce an effect similar to that of lengthening the growing season.

- Carryover Soil Moisture--This is the moisture stored in soils within the root zone depths during the winter, at times when crop is dormant, or before the crop is planted. This moisture is available to help meet the consumptive water needs of the crop.

- Stage of Plant Growth--Other factors being equal, the stage of a crop's growth has a very considerable influence on its consumptive-use rate. This is particularly true for annual crops which generally have three rather distinct stages of growth. These are: (1) Emergence and development of complete vegetative cover when the consumptive-use rate increases rapidly from a low value and approaches its maximum; (2) Period of maximum vegetative cover when consumptive-use rates are near or at the maximum if abundant soil moisture is available; (3) Crop maturation when (for most crops), the consumptive-use rate begins to decrease. During the maturation period, the plant becomes the limiting factor in the transpiration rate.

- Other Climatic Factors

  Humidity--Evaporation and transpiration accelerate on days of low humidity and slow during high humidity. If the average relative humidity percentage is low during the growing season, a greater use of water by plants may be expected.

  Wind Movement--Evaporation from land and plant surfaces takes place more rapidly when there is moving air. Hot, dry winds and other unusual wind conditions

during the growing period will affect the water consumptively used. However, there is a limit in the water that can be used. As soon as the land surface is dry, evaporation practically stops and transpiration is limited by the ability to extract and convey the soil moisture through the plants.

Advection–Crops grown in irrigated areas surrounded by large arid or semi-arid areas can receive additional energy for vaporization of water by advection. A high percentage of net solar radiation received in arid areas is used in heating the atmosphere. As this warm air mass moves over generally cooler irrigated areas, energy contained in the air as sensible heat can evaporate water by vertical turbulent transfer. Thus an "oasis" effect is created. This evaporation of water by vertical turbulent transfer may cause a considerable increase in normal consumptive use in arid areas. It is not believed to be of significance in humid areas.

In order to initiate calculation of consumptive use for the model, it was necessary to select representative climatological stations. Within the Musselshell River Basin, there are three distinct climatology regions (fig. 1.1): Upper basin, the area above the town of Harlowton; Middle basin, between Harlowton and Roundup; and Lower basin, between Roundup and Fort Peck Reservoir. The climatological stations selected for the period of record for the upper, middle, and lower basin areas respectively were Harlowton, Roundup, and Musselshell. Each station has recorded data since the early 1920s.

Conveyance and On-Farm Efficiencies

Since the conveyance and on-farm efficiencies are not well documented in the Musselshell River Basin, Reclamation contracted NRCS to analyze the on-farm efficiency as mentioned above. NRCS used their *Farm Irrigation Rating Index* (FIRI) program which can be used for planning, evaluating, and improving irrigation management. The FIRI evaluation produces an overall seasonal efficiency. During HYDROSS calibration, it became apparent that the seasonal efficiencies were not in the correct level of detail for the model. Rather than use seasonal efficiencies, these were changed to monthly varying efficiencies based upon data from irrigation projects in Montana and Wyoming and NRCS's knowledge of the FIRI system. The monthly varying efficiencies were realistic and within acceptable data range.

NRCS also made an evaluation of conveyance efficiencies throughout the basin in consultation with DNRC. The range of conveyance efficiencies was found to be within acceptable limits for similar irrigation projects in Montana and Wyoming. Table 4.1 lists the efficiencies used throughout the basin.

Table 4.1: Efficiencies Used in the Study (percentage)

On-Farm Efficiency

	Apr	May	Jun	Jul	Aug	Sep	Oct
Upper Basin	28	28	42	51	37	22	22
Middle Basin	27	27	40	48	36	21	21
Lower Basin	27	27	41	49	36	21	21

Conveyance System Efficiency

	Apr	May	Jun	Jul	Aug	Sep	Oct
Upper Basin	40	60	60	60	60	60	40
Middle Basin	50	75	80	95	90	85	85
Lower Basin	50	75	80	95	90	85	85

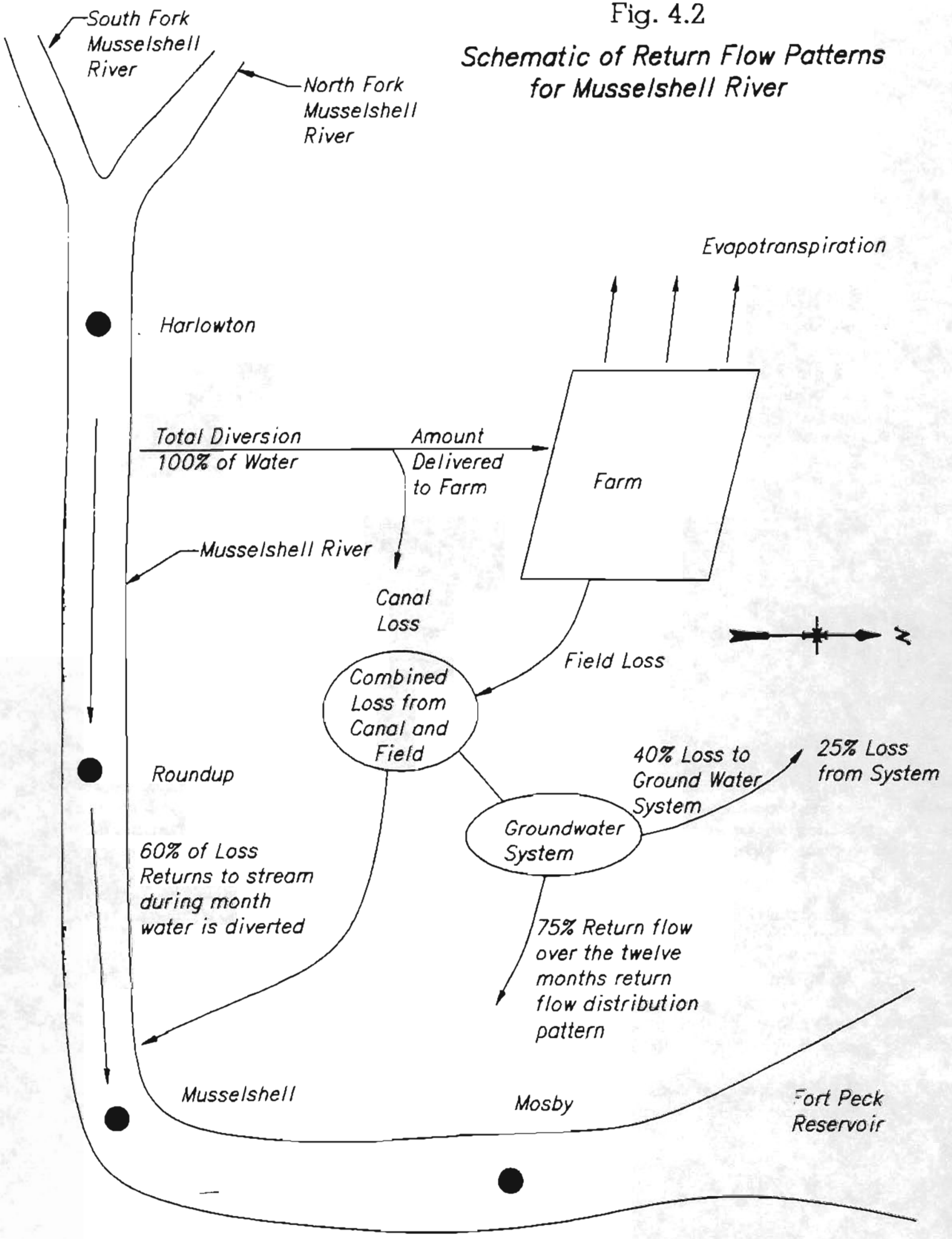
Return Flows Delay Patterns

No information is available on return flows delay patterns in the basin. Through discussions with NRCS and DNRC, return flow data developed for the *Upper Missouri River Study* (DNRC,1995) was used to estimate Musselshell River return flows delay patterns. In the Upper Missouri Study, DNRC did a detailed analysis of the return flows for each node basin in the study area and used Glover's method of predicting return flows. With this information and preliminary soil surveys for the counties in the basin, a return flow pattern was developed for the Musselshell River.

The return flows delay patterns are applied to that part of agricultural water losses--either from the on-farm or conveyance system loss--which enters into the subsurface. The HYDROSS model assumed that 60 % of any water lost and not non-beneficially consumptively used returns to the stream during the same month in which it was diverted via surface water returns. Surface water returns originate from sources such as field runoff, agricultural drains, and canal wasteways. The remainder of the loss (40 %) is assumed to percolate into the ground and return to stream via subsurface seepage over a 12 month period as defined by the return flows distribution pattern. Reclamation assumed that 25% of the potential return flow water was lost and did not return to the system. It was non-beneficially consumed. The remaining 75% (of the 40%) is assumed to percolate into groundwater and return over the 12 month distribution pattern. A schematic showing return flows delay patterns can be found in fig.4.2.

Fig. 4.2

Schematic of Return Flow Patterns for Musselshell River



Municipal and Industrial (M&I) Use

Municipal depletions were calculated for three towns in the basin: Ryegate, Roundup, and Melstone (fig. 1.1). Population figures were obtained for 1920-1990 from Census reports. Estimates of per capita day water use for each town were provided by DNRC and checked with information from Reclamation. Average annual withdrawals were calculated using current population figures and the per capita use figures.

Assumptions for return flows and depletion rates were supplied from DNRC. The assumptions include: all return flows were returned within the same month of diversion and the depletion rate was 45 % of the diversion, with the rest returning to the river.

After the depletions were calculated on an annual basis, a monthly depletion rate was required. A monthly distribution of the annual depletion was determined using information supplied by DNRC from a study completed in Lewistown in 1988. The Table 4.2 provides a breakdown for the monthly distribution.

Table 4.2: M&I Monthly Distribution

Month	Percentage	Month	Percentage
Jan	7	Jul	12
Feb	6	Aug	12
Mar	7	Sep	9
Apr	7	Oct	7
May	9	Nov	6
Jun	11	Dec	7

Calculation of Depletions

Any node could have a variety of depletions from agriculture and/or municipal use. The depletions at the node could be positive or negative. During the irrigation season, positive depletions indicated a withdrawal of water from the system which would not return. While in the non-irrigation season, depletions were negative if more water returned to the stream than leaving.

Depletions were calculated by summing all diversions at a node during a given month and then subtracting any returns to the node during the same month. Returns to a node during a given month could originate during that month or any of the previous 11 months.

An agricultural diversion value was calculated by multiplying the irrigated acreage by the CIR, then dividing by both the on-farm and conveyance system efficiencies. There is a possibility of three different types of agricultural diversions at each of the nodes--natural flows, contract water, or a combination of natural flows and contract water.

A municipal diversion was calculated by multiplying a population by the estimated water use per person per month. It was assumed that the depletion rate was 45% of the diversion requirement.

HYDROSS CALIBRATION

End-of-month (EOM) contents at Bair, Martinsdale, and Deadman's Basin Reservoirs, and information from the USGS gauging stations at Harlowton, Roundup, Musselshell, and Mosby were used to *calibrate* the HYDROSS model, that is, to try to reproduce historic patterns at the reservoirs and at the gauging stations. DNRC has recorded EOM at the reservoirs for 1960-1974 and for 1980-1989. USGS has had gauging stations in these locations mentioned since the early 1920s. The model was calibrated to a 1989 level of development in the basin for both agricultural and M&I water needs.

A comparison between the model results and the historic EOM (labeled *Bair EOM*) for 1980-1989 (selected as most representative) is shown in fig. 4.3. Comparisons of model results with historic EOM (*Martinsdale and Deadman's EOM*) for Martinsdale and Deadman's Basin for this period are shown in fig. 4.4 and 4.5, respectively. (Figures displaying the comparisons for 1960-1989 can be found in Appendix 6.) From these figures it can be seen that in most of the years when EOM reservoir contents have been recorded, HYDROSS results are either right on the historic EOM or very close to it. This implies that the model is calibrated to the historic EOM of the reservoirs. Individual historic and modeled flow data are shown in Appendix 7.

Another calibration done for the model concerned the average monthly flows for the period of record at the four gauging stations. A comparison of the historic mean monthly flows compared to modeled flows for the Harlowton station is shown in fig 4.6. The peak modeled flows in May and June shown in figs. 4.6-4.8 are about 20-30% higher when compared to historic flows because of the development of the natural flows by USGS. USGS assumed no agricultural depletions upstream of the gauging stations used to develop natural flows, when in fact depletions might have been made (see Appendix 5).

Historic mean monthly flows compared to modeled flows at Roundup are in fig. 4.7, at Musselshell in fig. 4.8, and at Mosby in fig. 4.9. The figures show how closely measured monthly flows match the modeled flows.

Appendix 8 shows monthly flows for the calibrated model and historic and natural flows at the Harlowton, Roundup, Musselshell, and Mosby stations for the period of record.

Fig. 4.3

Bair Reservoir

Comparison of End of Month Reservoir Content

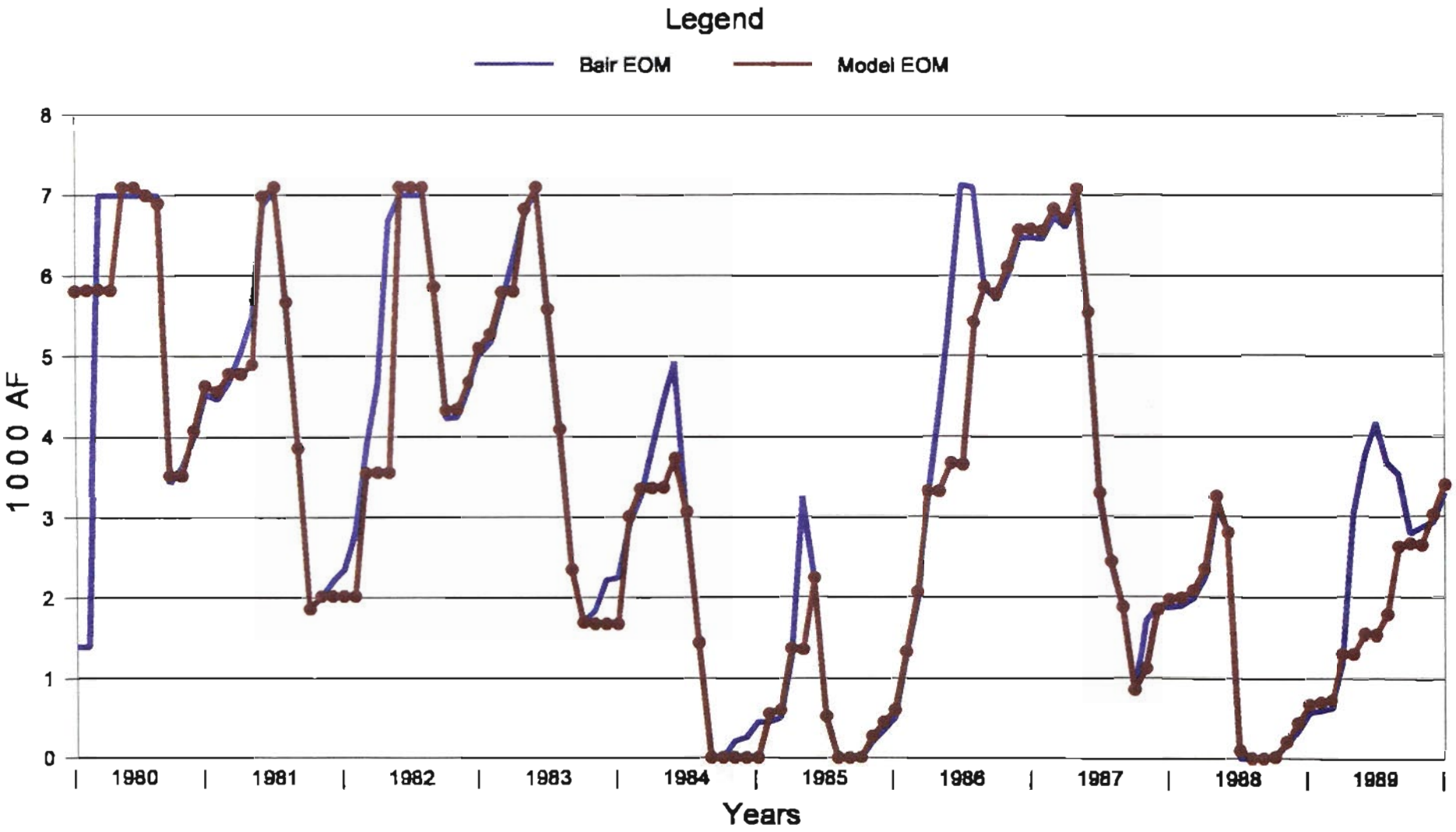


Fig. 4.4

Martinsdale Reservoir

Comparison of End of Month Reservoir Content

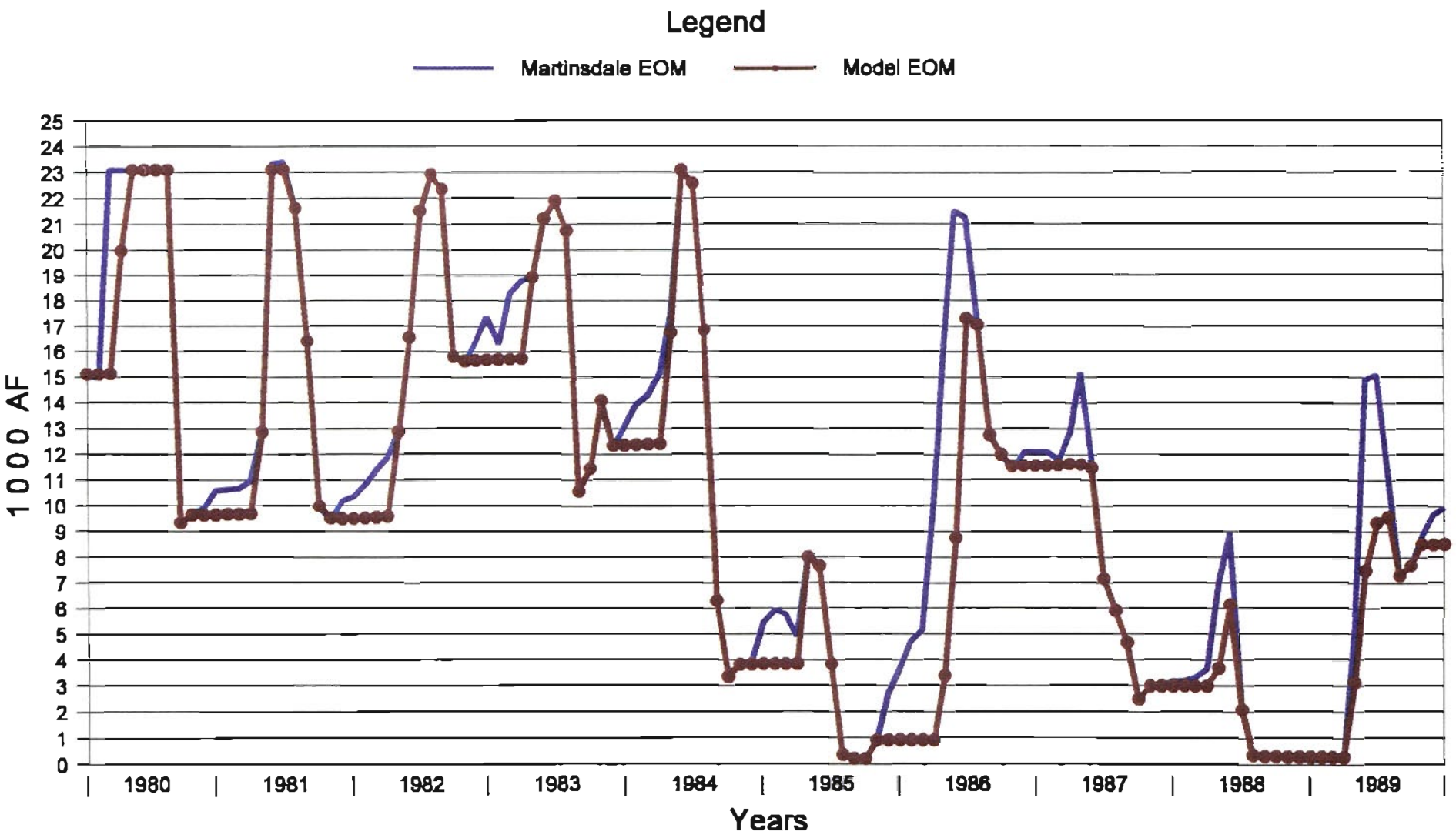


Fig. 4.5

Deadmans Basin Reservoir

Comparison of End of Month Reservoir Content

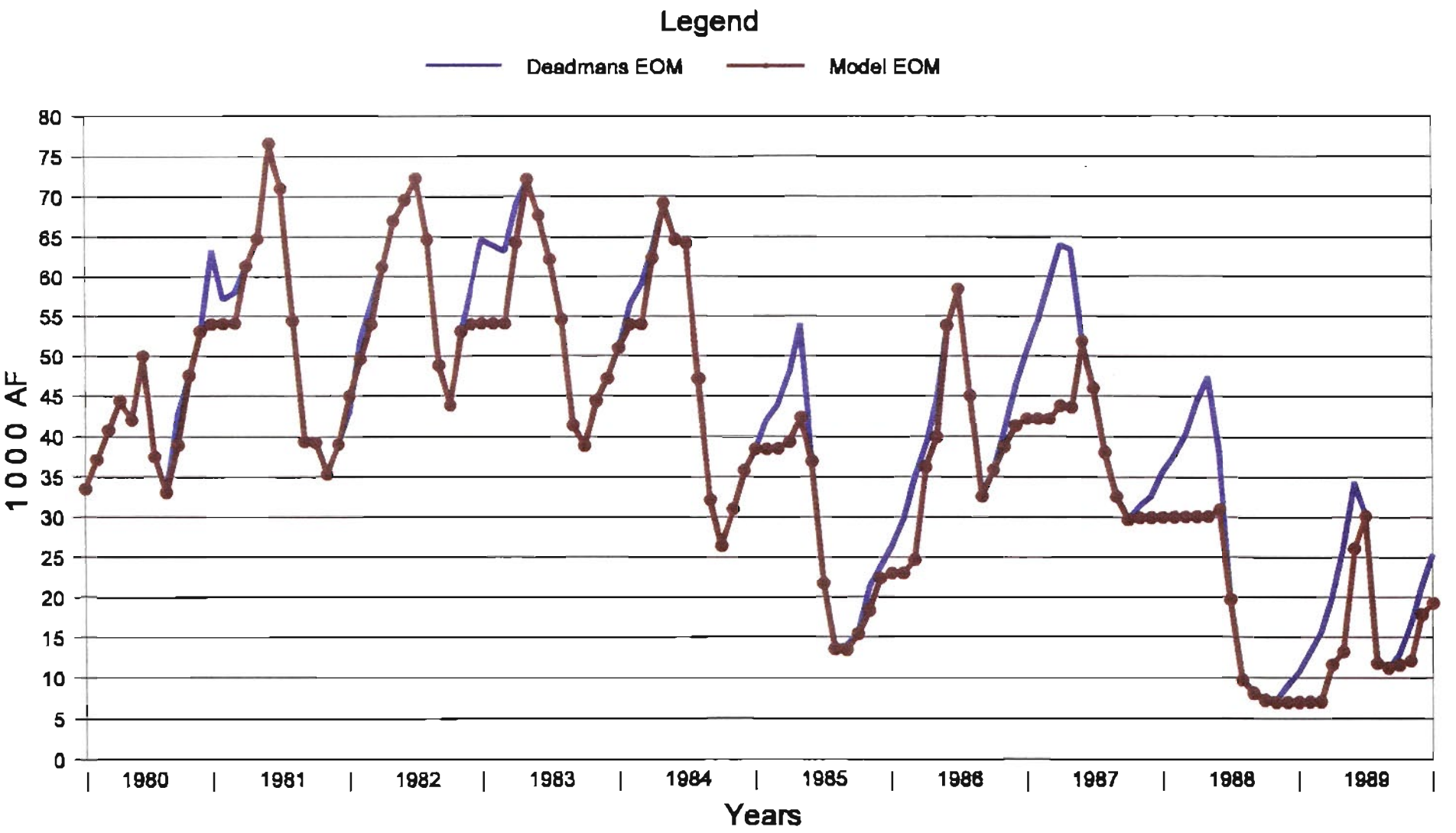
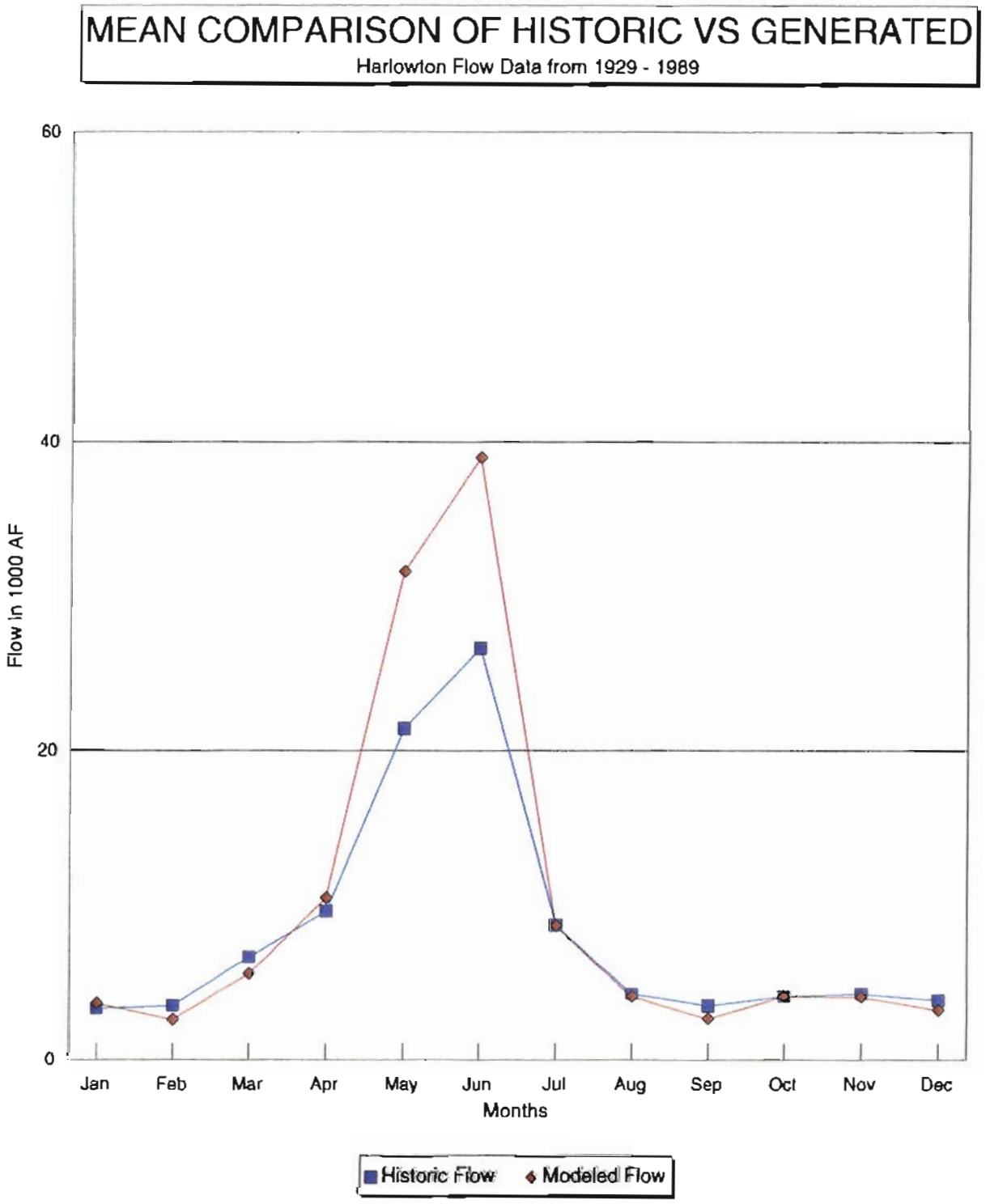


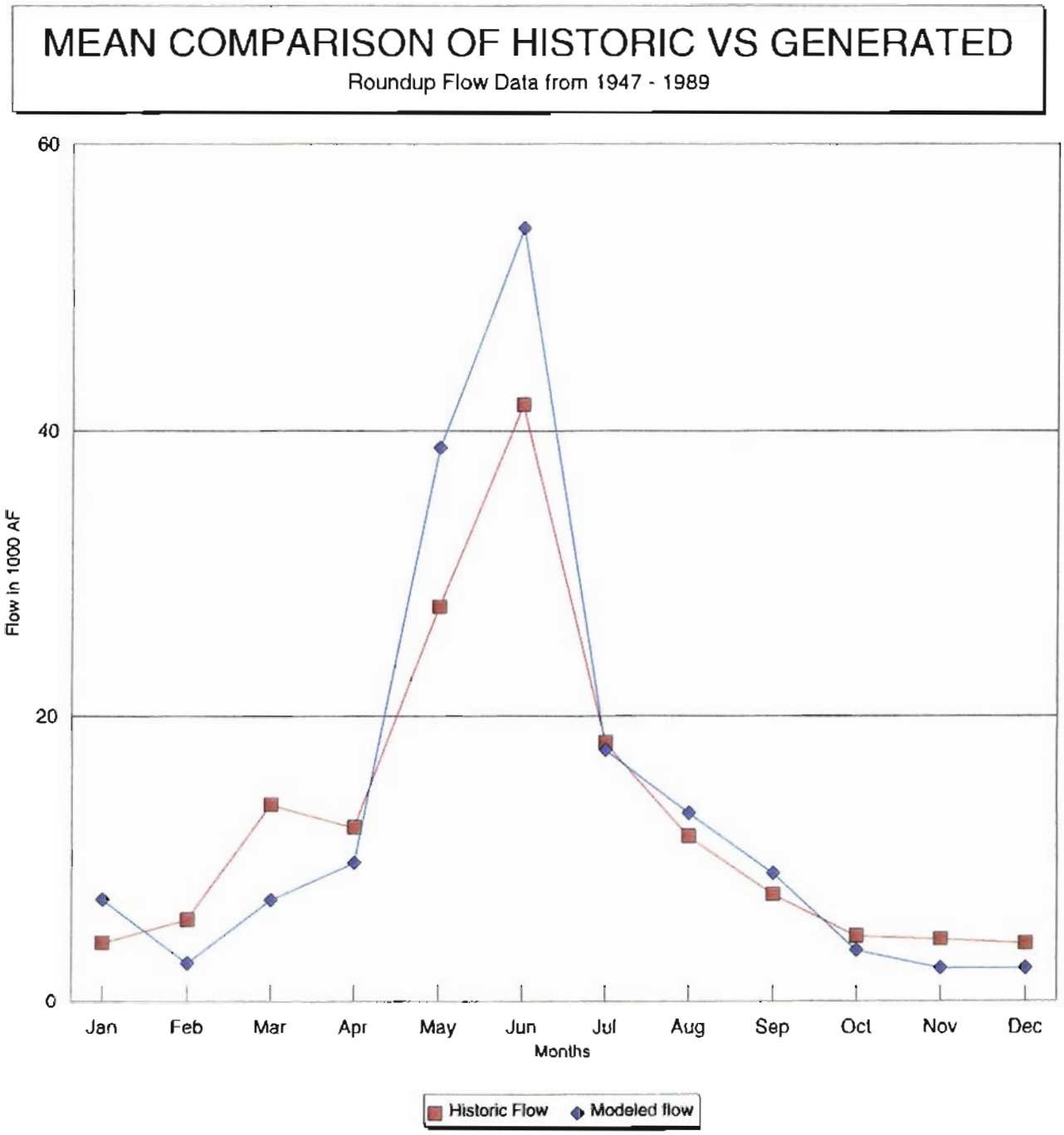
Fig. 4.6



Regression Output:

Constant	0
Std Err of Y Est	2.449
R Squared	0.959
No. of Observations	12
Degrees of Freedom	11
X Coefficient(s)	1.362
Std Err of Coef.	0.063

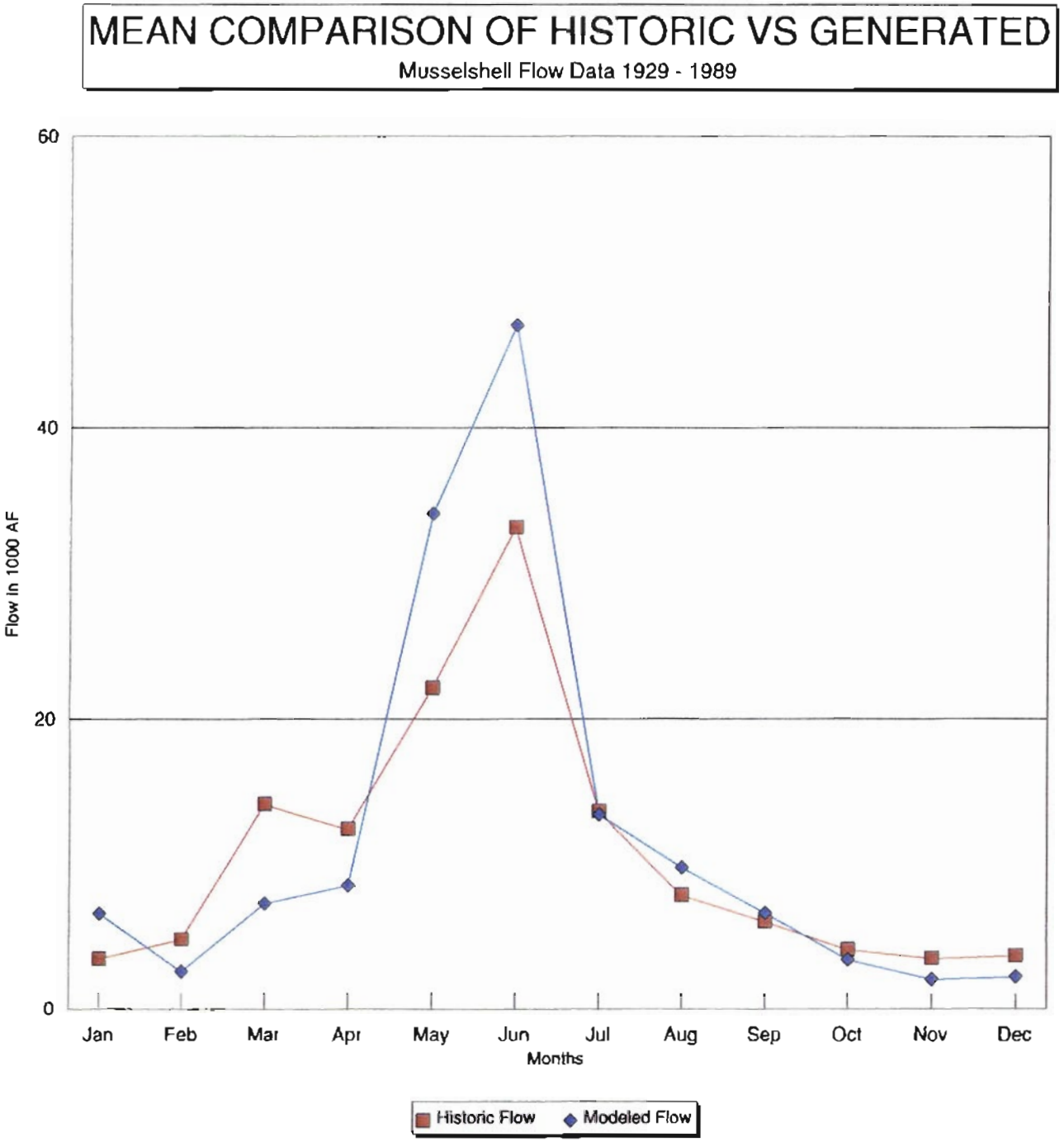
Fig. 4.7



Regression Output:

Constant		0
Std Err of Y Est		4.485
R Squared		0.923
No. of Observations		12
Degrees of Freedom		11
X Coefficient(s)	1.199	
Std Err of Coef.	0.076	

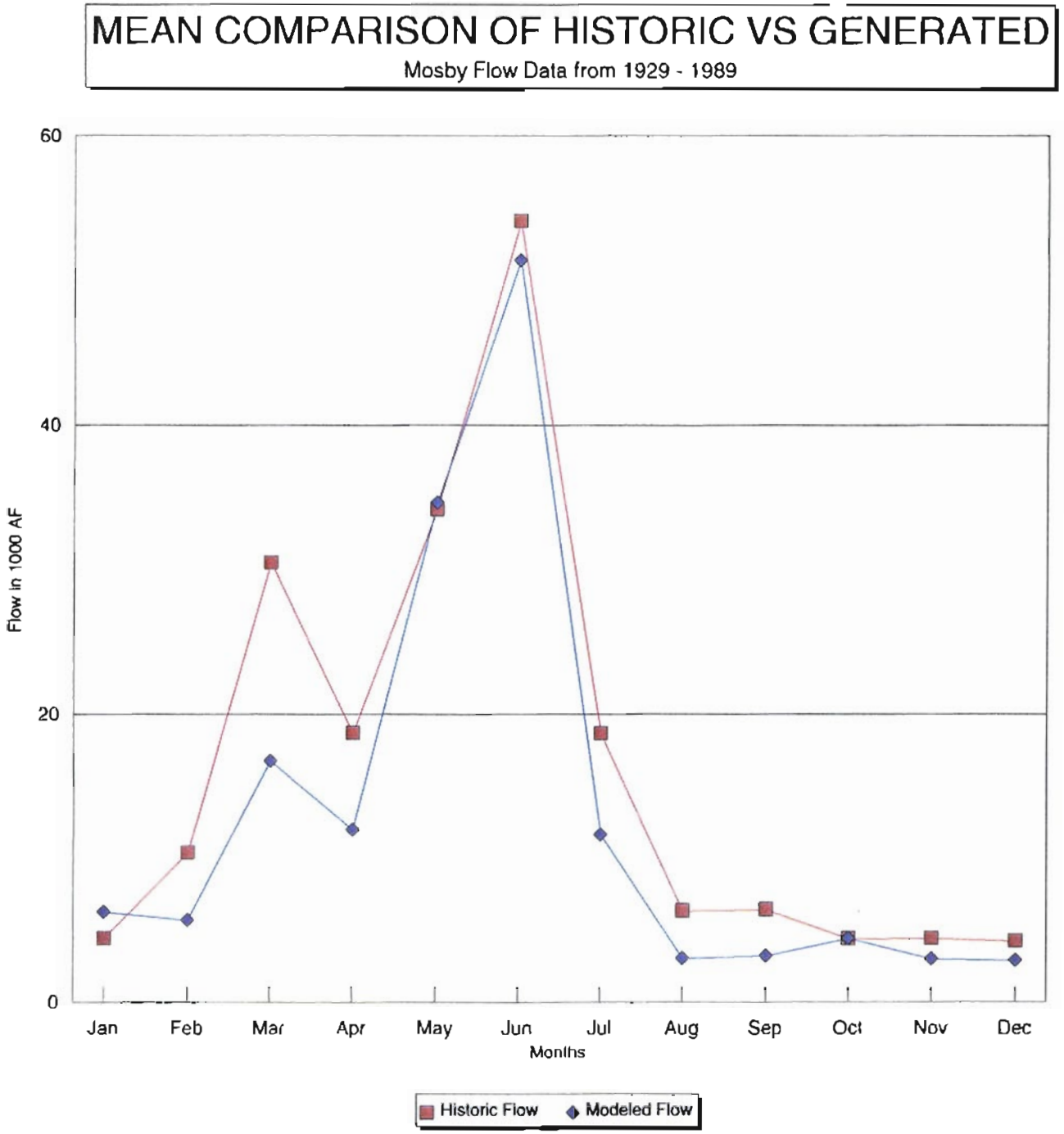
Fig. 4.8



Regression Output:

Constant		0
Std Err of Y Est		4.998
R Squared		0.873
No. of Observations		12.000
Degrees of Freedom		11
X Coefficient(s)	1.250	
Std Err of Coef.	0.104	

Fig. 4.9



Regression Output:

Constant		0
Std Err of Y Est		4.319
R Squared		0.919
No. of Observations		12
Degrees of Freedom		11
X Coefficient(s)	0.850	
Std Err of Coef.	0.056	

HYDROSS RESULTS

After establishing that HYDROSS represented the historic practices in the Musselshell River Basin, the model was made to evaluate different operational scenarios:

- Increasing on-farm efficiency by 5%, 10%, and 20%.
- Operating the three reservoirs as one unit.

For these evaluations, the table source file had to be modified to reflect changes discussed above. Monthly on-farm efficiencies for the three areas served by the different projects in the basin were increased by 5, 10, and 20% for each month of the irrigation season. It was necessary to review a vast number of outputs from HYDROSS to decide how to display results of the different scenarios .

The period 1981-1989 was selected to represent the entire 60-year study period because the period included wet, average, and drought years. To compare the results of increasing on-farm efficiencies, the parameters of shortages (water required for a full supply to satisfy the CIR along with the efficiencies of the systems) and diversion requirements for the calibrated model were used. Fig. 4.10 shows the 1981-1989 diversion requirements and the average diversion required for the whole study period. Fig. 4.11 shows the shortages and average shortages for 1929-1989. The average diversion for 1929-1989 was about 200,000 acre feet, while the average shortage was about 110,000 acre feet. Also displayed in these two figures is the breakdown between the natural flows, contract water, and natural flows with supplemental contract flow water rights.

Shortages occur when the water supply or delivery system can't provide enough water to meet the CIR. Shortage due to supply is caused from lack of flows in the river or lack of water stored to meet the CIR. Delivery system shortage results from the CIR for an area exceeding the capacity of the canal to deliver enough water, even when water is available. Shortages in fig. 4.11 are not differentiated as to whether they are caused by supply or delivery system.

Increasing Efficiency by 5%

Fig. 4.12 displays the agricultural diversion with a 5% on-farm efficiency increase, while fig. 4.13 shows shortages associated with the agricultural diversions in the basin. Reviewing these figures, it can be seen for 1929-1989 the shortages were about 70,000 ac-ft. Also, in fig. 4.13, 1982 was only short by about 5,000 ac-ft. Shortages associated with the 5% increase in efficiency drop from the calibrated model by about 30,000 ac-ft, decreasing the volume of water required for irrigation.

Increasing Efficiency by 10%

Fig. 4.14 shows shortages associated with the 10% increase on-farm efficiency. The average shortage for 1929-1989 was about 50,000 ac-ft, about 20,000 ac-ft less than with the 5% increase. Shortages in 1982 were about 5,000 ac-ft.

Increasing Efficiency by 20%

Fig.4.15 shows shortages with a 20% increase in on-farm efficiency. The decease in overall average shortage for 1929-1989 was about 30,000 ac-ft. When compared to the average shortages of 100,000 ac-ft predicted by HYDROSS, it can be seen that by improving on-farm efficiencies by 20% 70,000 ac-ft of water would not be required for irrigation.

Return Flows

Figs. 4.16-4.19 display average return flows at Harlowton, Roundup, Musselshell, and Mosby: Harlowton natural flow water right, Roundup contract flow water right, Musselshell natural flow with contract flow, and Mosby natural flow water right. (These stations with other of the water rights modeled [natural, contract, and natural with supplemental contract flow water rights] can be found in Appendix 9.) These figures show the calibrated model, and 5%, 10%, and 20% increases in on-farm efficiency. Return flows associated with different water rights show that as the on-farm efficiency increases, return flows decrease, except where flow rights have been overused and not enough water is available to satisfy all rights. In this case, the return flows increase with increasing on-farm efficiency.

Operation as One Unit

It was determined, after consultation with DNRC, to run the model with the Musselshell River Basin operating as one unit. In this eventuality, UMWUA and DBWUA would jointly fill and release water to contract holders from the outlet works of Bair Reservoir to the high water line of Fort Peck Reservoir. To do this with HYDROSS, the table source file was modified to reflect the change associated with calling stored water rights out of the different reservoirs in the basin. The physical limitations of this plan would be that water cannot flow upstream, so Deadman's Basin Reservoir could not be used to satisfy demands upstream of the Deadman's Basin Inlet Canal; the priority of water to satisfy the downstream rights below Deadman's Basin Reservoir would be to try to receive Deadman's Basin stored water rights first, next Martinsdale Reservoir water, and lastly, Bair Reservoir water. The principal reason behind this type of demand requirements on the three reservoirs was because Deadman's Basin was the largest reservoir and Bair Reservoir the smallest in volume stored, as previously discussed.

Fig.4.20 indicates shortages associated with the operation of the Musselshell River as one unit. Average shortages for 1929-1989 were about 95,000 ac-ft. With operation as one unit, there was about 5,000 ac-ft of water available for other uses.

Fig. 4.10

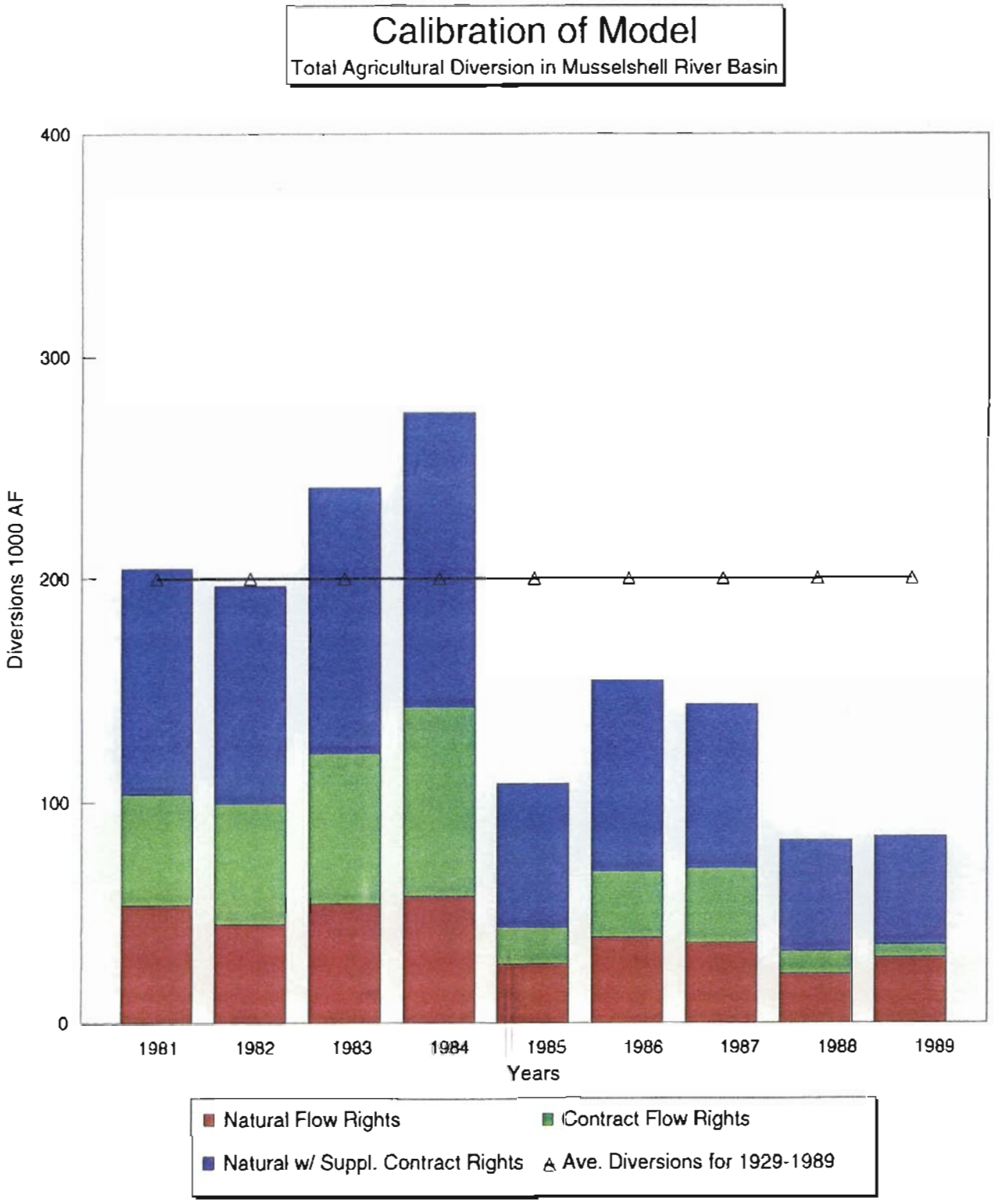

Calibration of Model
Total Agricultural Diversion in Musselshell River Basin
400
300
200
100
0
Diversions 1000 AF
1981
1982
1983
1984
1985
1986
1987
1988
1989
Years
Natural Flow Rights
Contract Flow Rights
Natural w/ Suppl. Contract Rights
Ave. Diversions for 1929-1989

Fig. 4.11

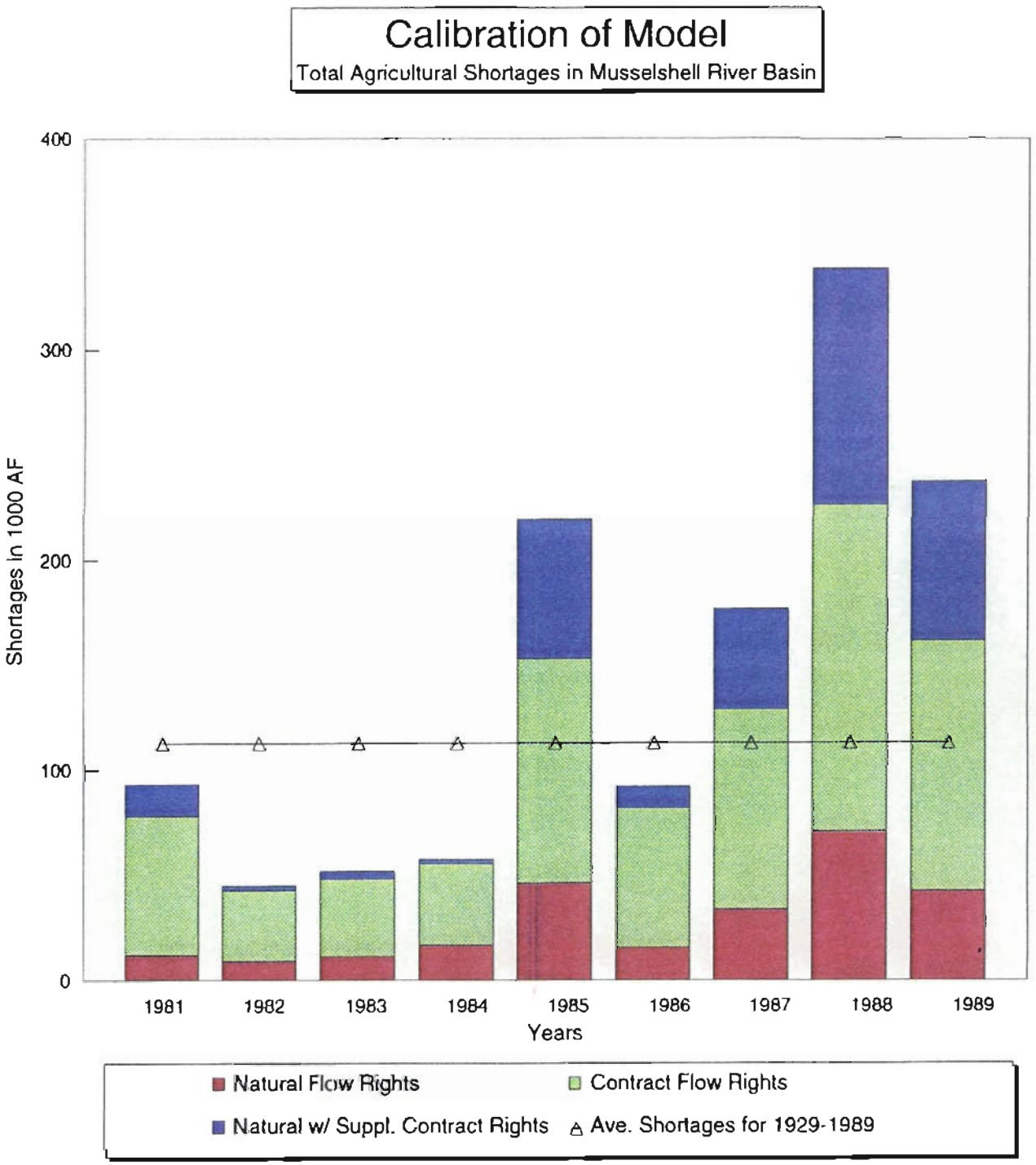

Calibration of Model
Total Agricultural Shortages in Musselshell River Basin
Shortages in 1000 AF
400
300
200
100
0
1981
1982
1983
1984
1985
1986
1987
1988
1989
Years
Natural Flow Rights
Contract Flow Rights
Natural w/ Suppl. Contract Rights
Ave. Shortages for 1929-1989

Fig. 4.12

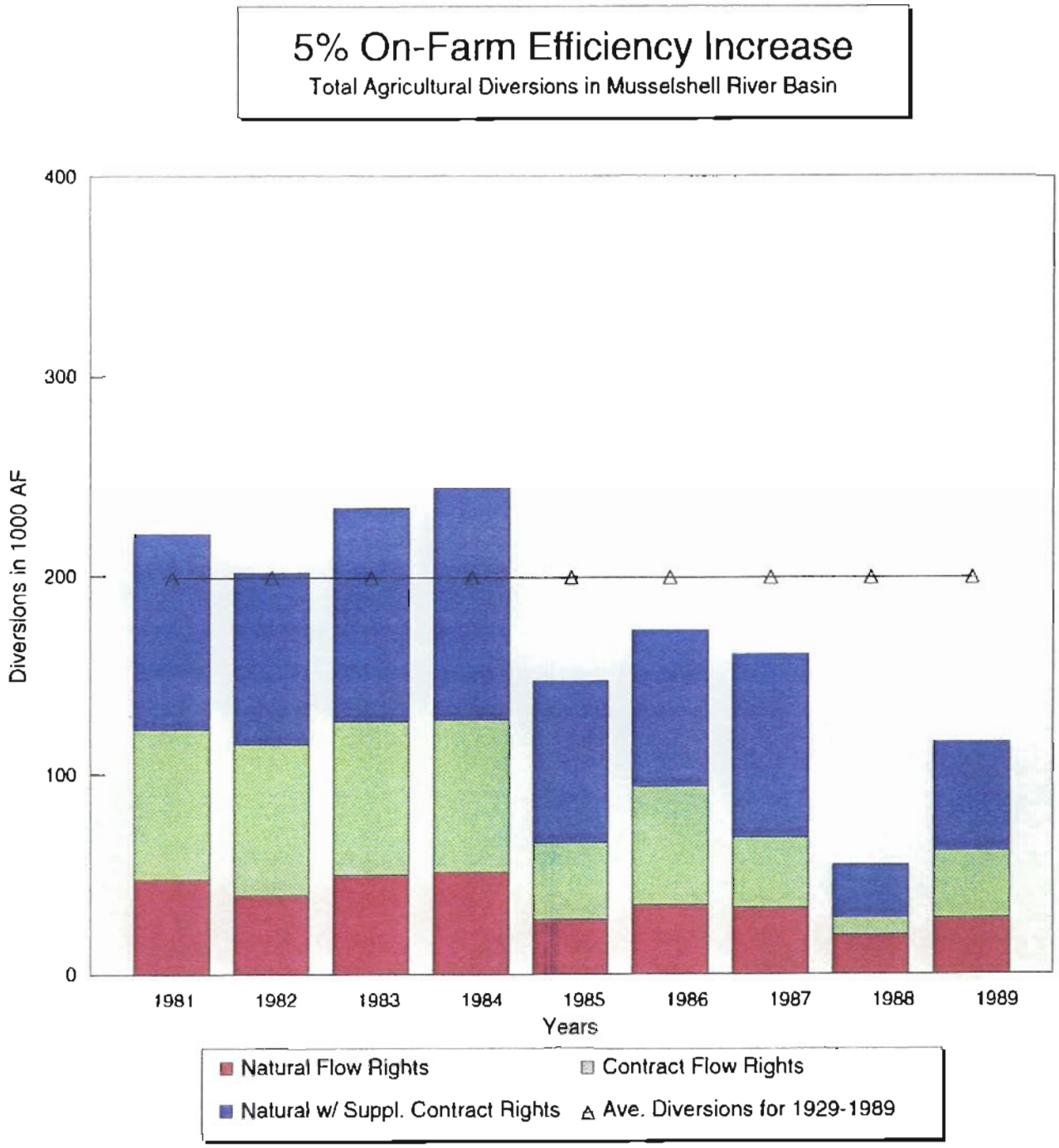

5% On-Farm Efficiency Increase
Total Agricultural Diversions in Musselshell River Basin
Diversions in 1000 AF
400
300
200
100
0
1981
1982
1983
1984
1985
1986
1987
1988
1989
Years
Natural Flow Rights
Contract Flow Rights
Natural w/ Suppl. Contract Rights
Ave. Diversions for 1929-1989

Fig. 4.13

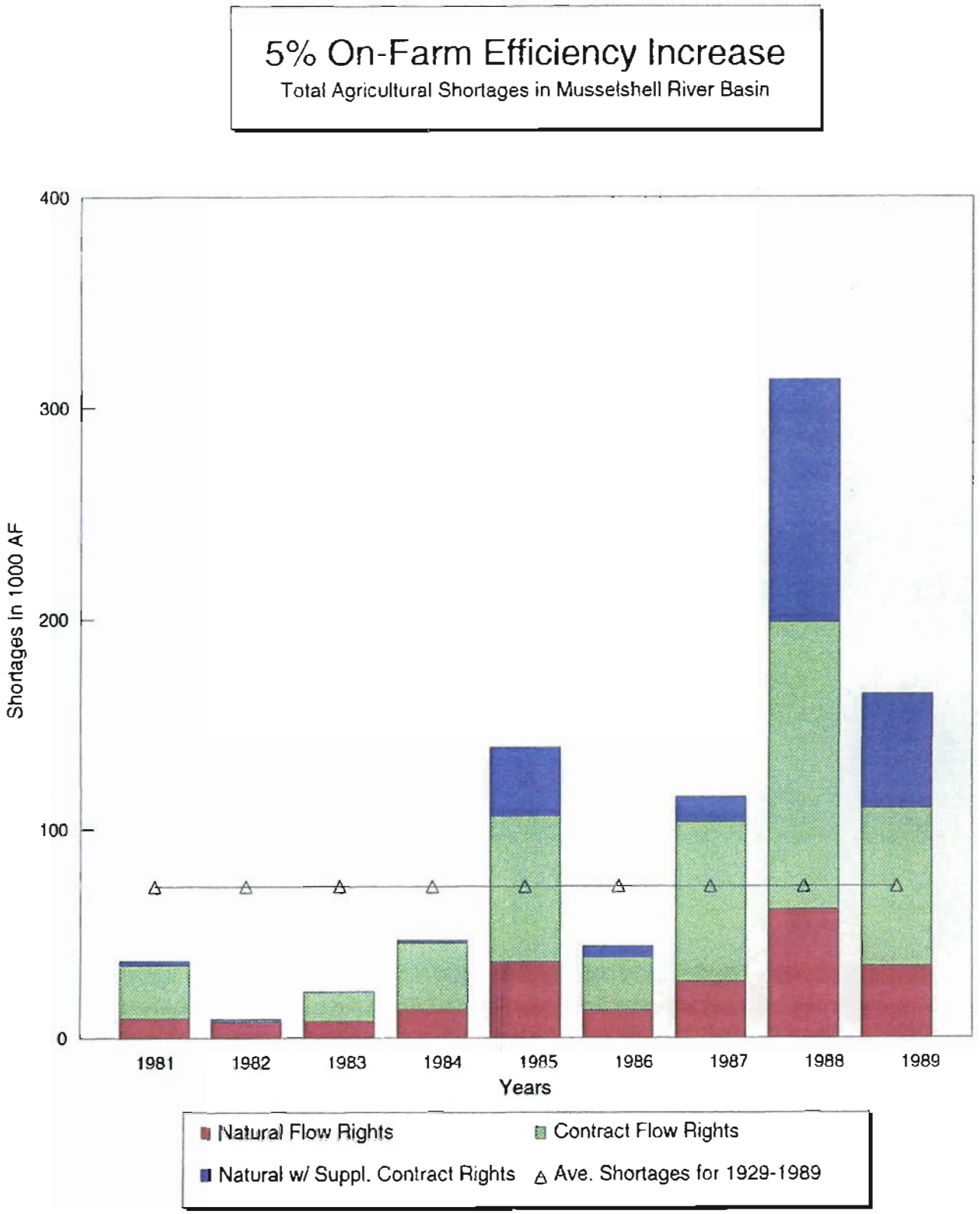

5% On-Farm Efficiency Increase
Total Agricultural Shortages in Musselshell River Basin
Shortages in 1000 AF
400
300
200
100
0
1981
1982
1983
1984
1985
1986
1987
1988
1989
Years
Natural Flow Rights
Contract Flow Rights
Natural w/ Suppl. Contract Rights
Ave. Shortages for 1929-1989

Fig. 4.14

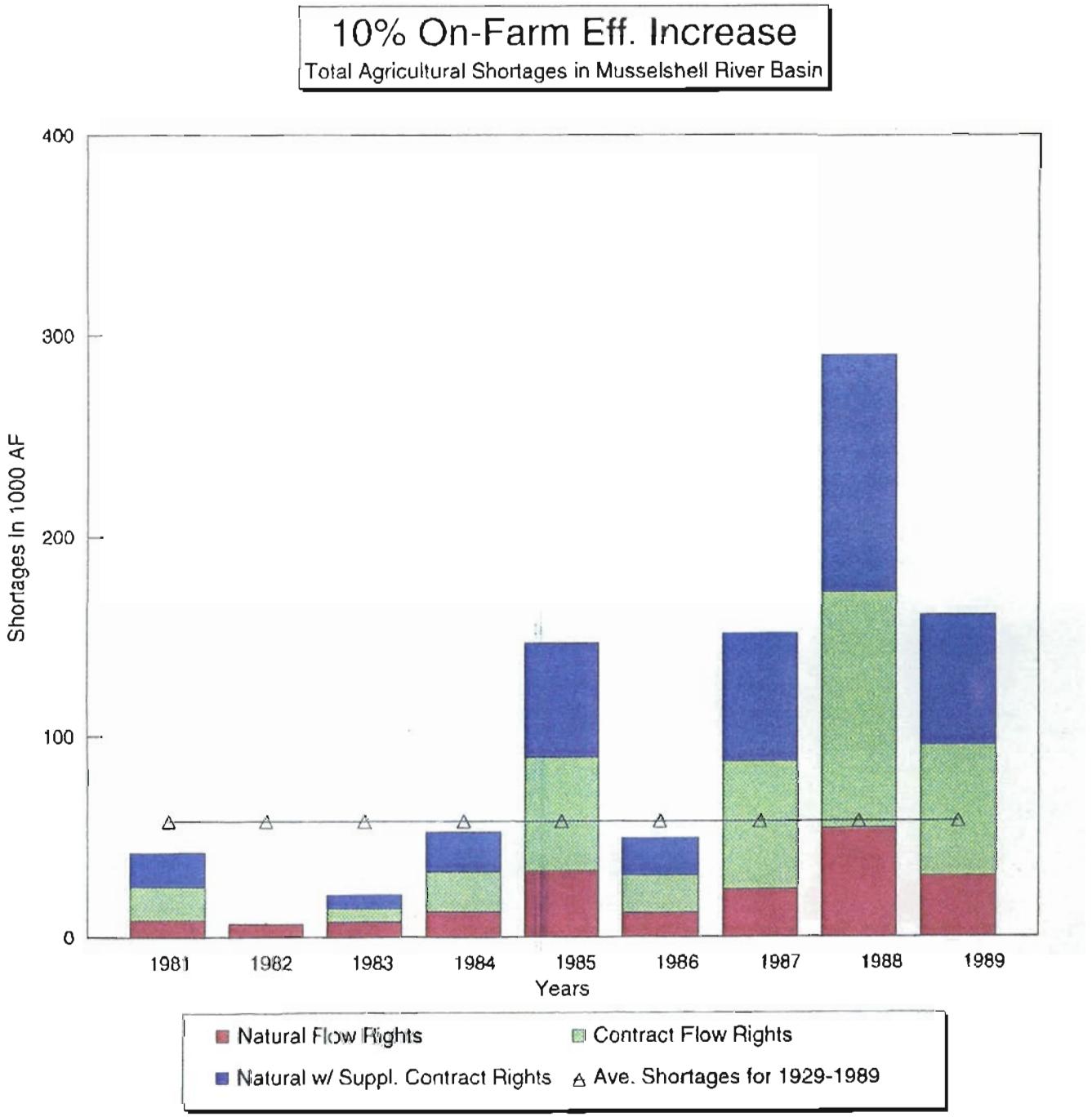

10% On-Farm Eff. Increase
Total Agricultural Shortages in Musselshell River Basin
Shortages In 1000 AF
400
300
200
100
0
1981
1982
1983
1984
1985
1986
1987
1988
1989
Years
Natural Flow Rights
Contract Flow Rights
Natural w/ Suppl. Contract Rights
Ave. Shortages for 1929-1989

Fig. 4.15

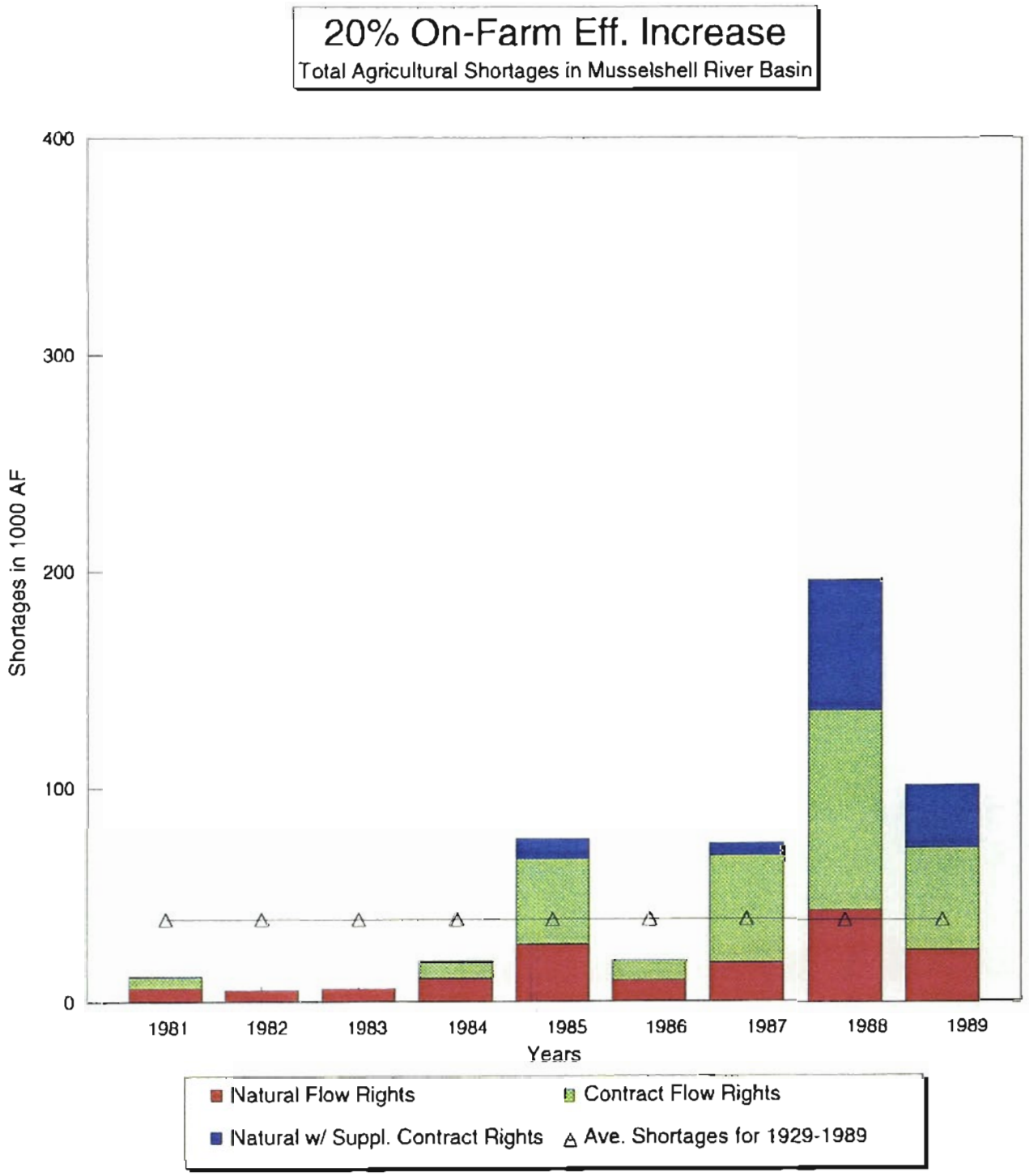

20% On-Farm Eff. Increase
Total Agricultural Shortages in Musselshell River Basin
Shortages in 1000 AF
400
300
200
100
0
1981
1982
1983
1984
1985
1986
1987
1988
1989
Years
Natural Flow Rights
Contract Flow Rights
Natural w/ Suppl. Contract Rights
Ave. Shortages for 1929-1989

Fig. 4.16

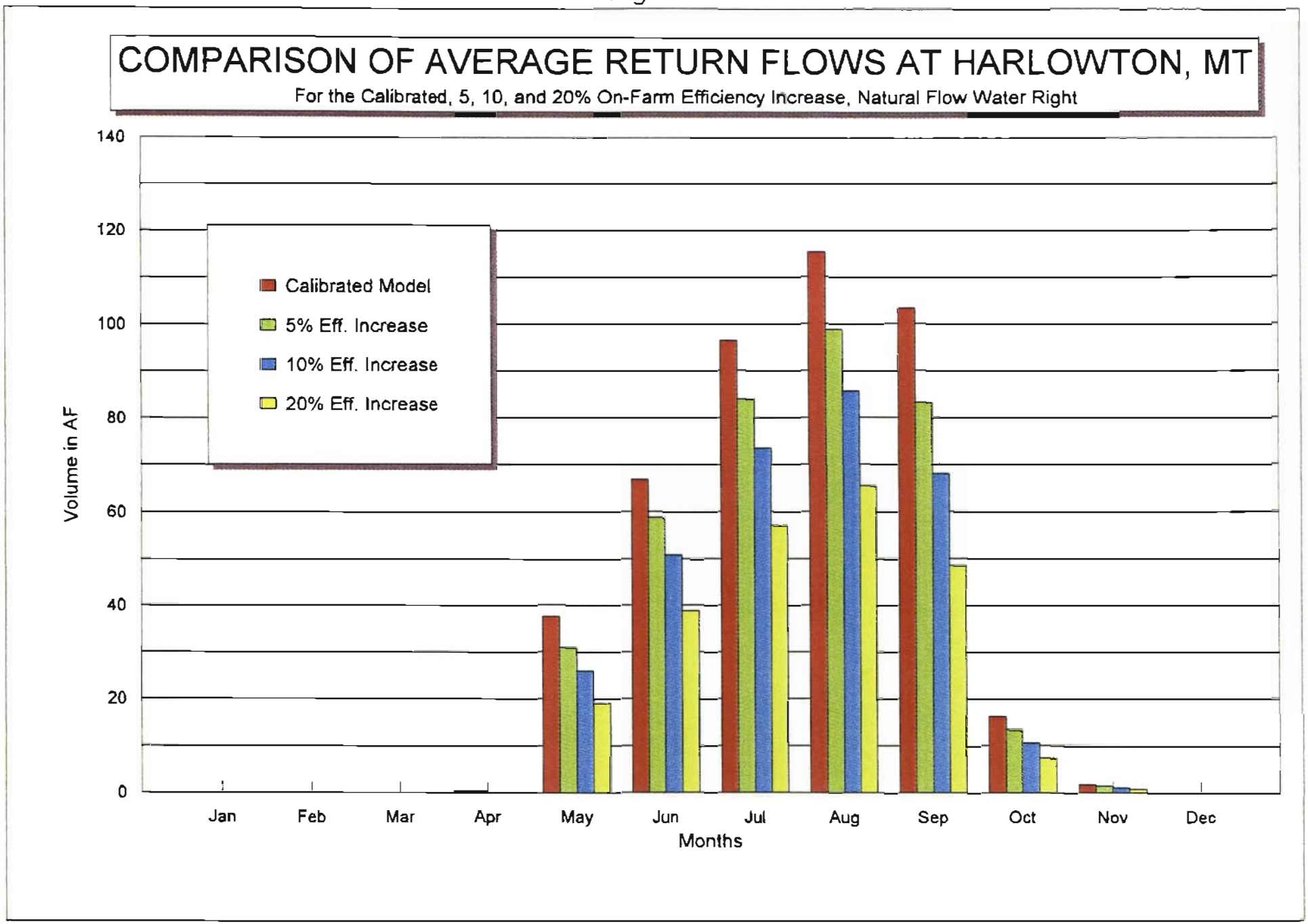

COMPARISON OF AVERAGE RETURN FLOWS AT HARLOWTON, MT
For the Calibrated, 5, 10, and 20% On-Farm Efficiency Increase, Natural Flow Water Right
Calibrated Model
5% Eff. Increase
10% Eff. Increase
20% Eff. Increase
Volume in AF
140
120
100
80
60
40
20
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Months

Fig. 4.17

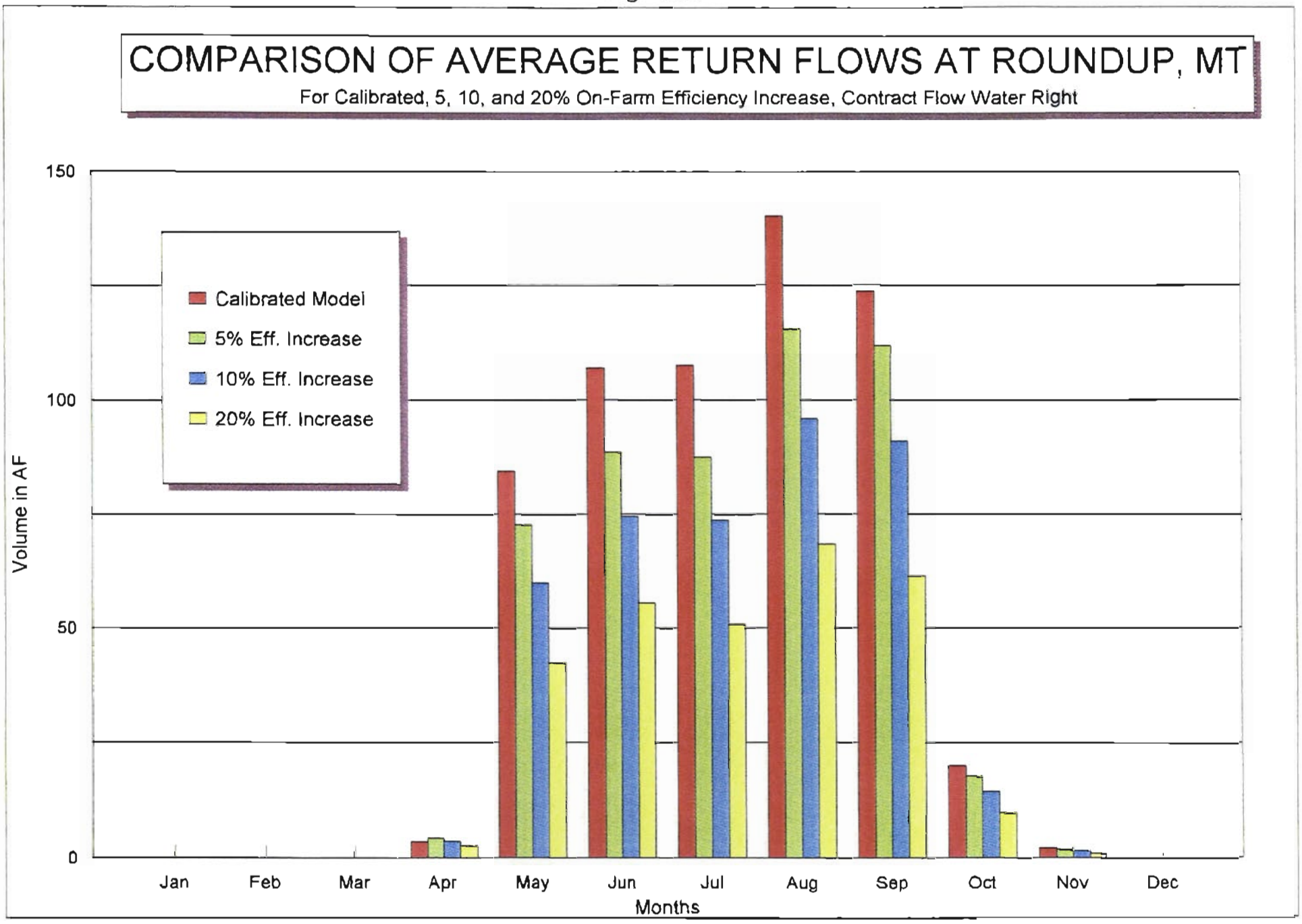

COMPARISON OF AVERAGE RETURN FLOWS AT ROUNDUP, MT
For Calibrated, 5, 10, and 20% On-Farm Efficiency Increase, Contract Flow Water Right
Calibrated Model
5% Eff. Increase
10% Eff. Increase
20% Eff. Increase
Volume in AF
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Months

Fig. 4.18

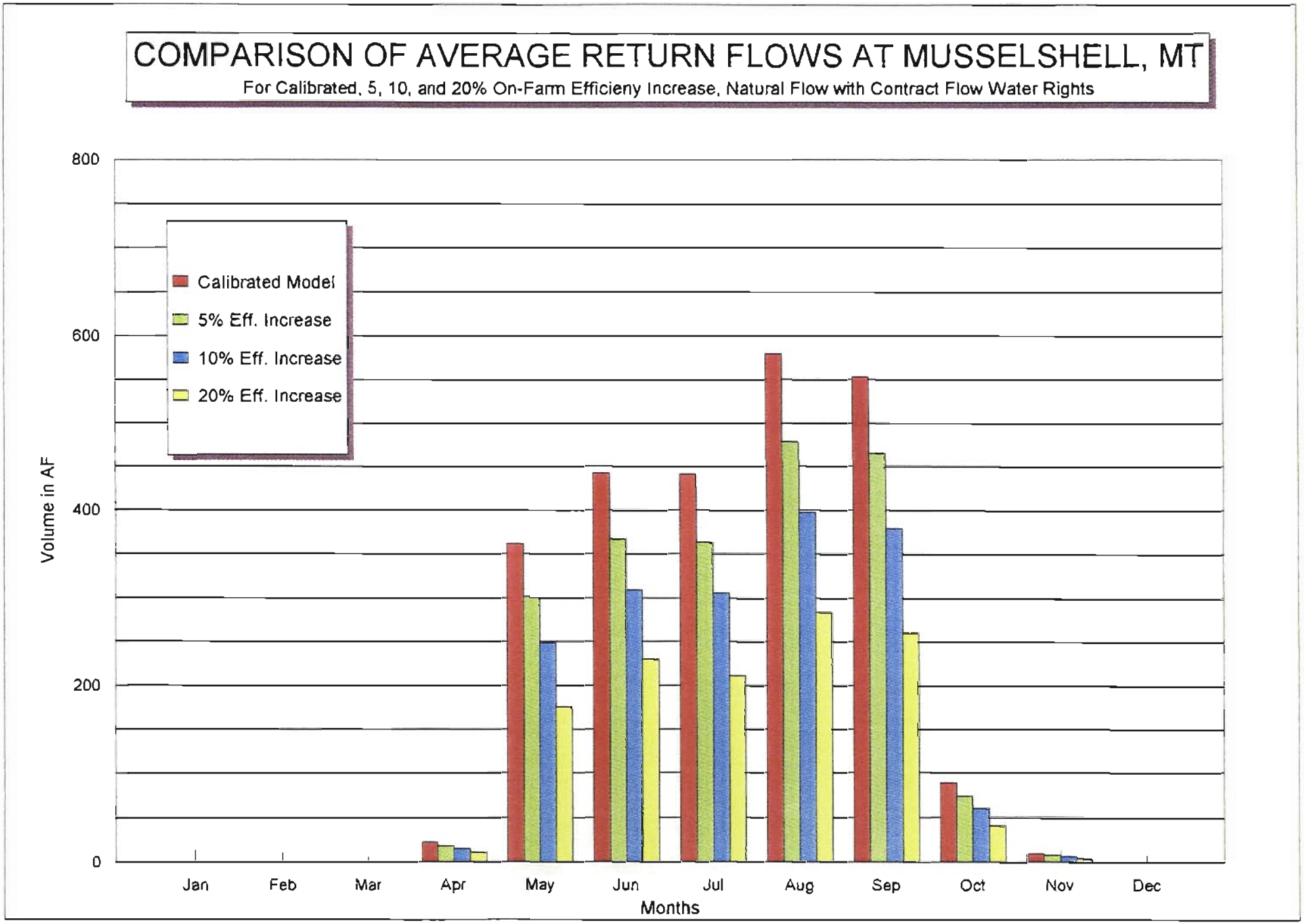

COMPARISON OF AVERAGE RETURN FLOWS AT MUSSELSHELL, MT
For Calibrated, 5, 10, and 20% On-Farm Efficieny Increase, Natural Flow with Contract Flow Water Rights
Calibrated Model
5% Eff. Increase
10% Eff. Increase
20% Eff. Increase
Volume in AF
800
600
400
200
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Months

Fig. 4.19

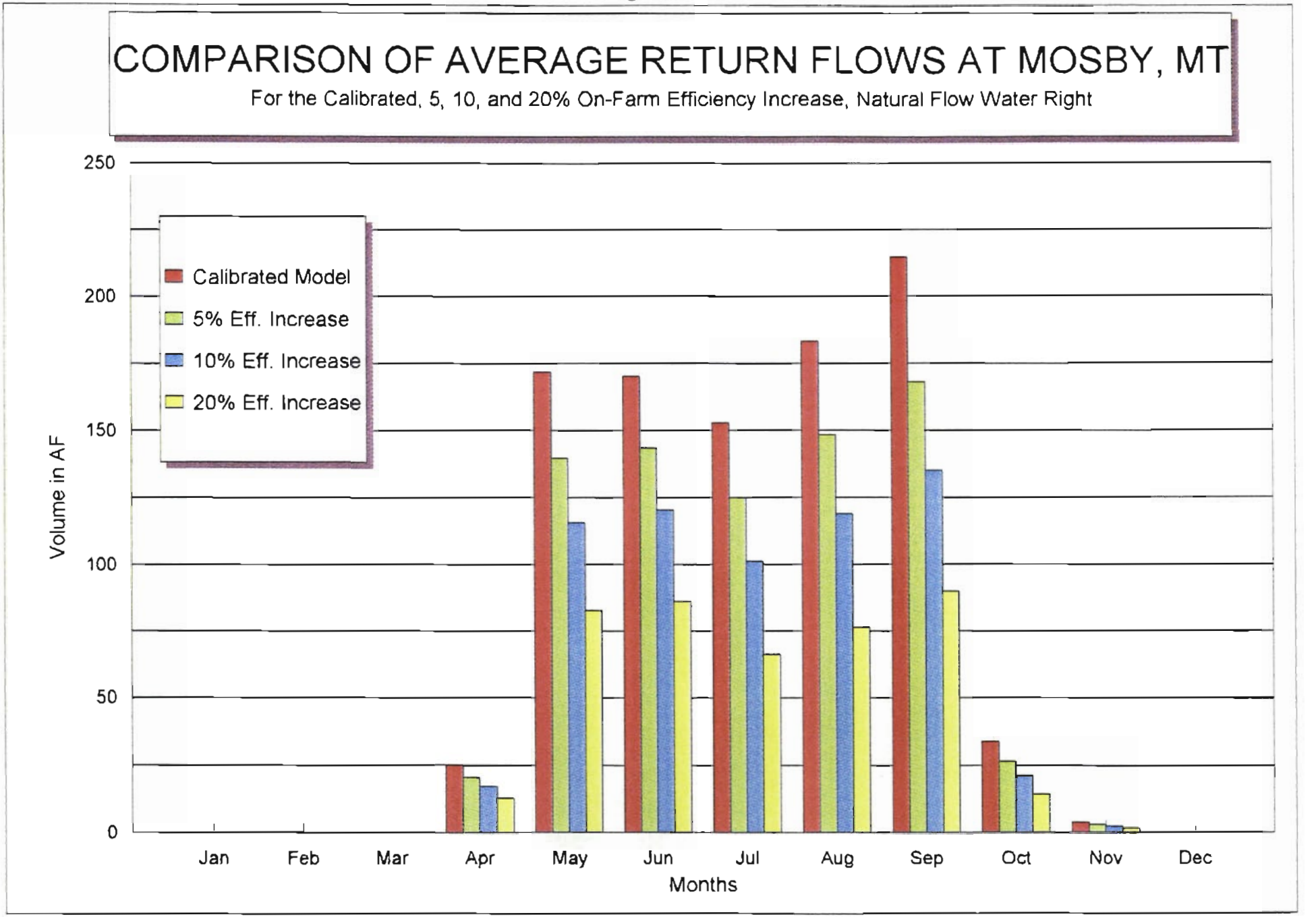
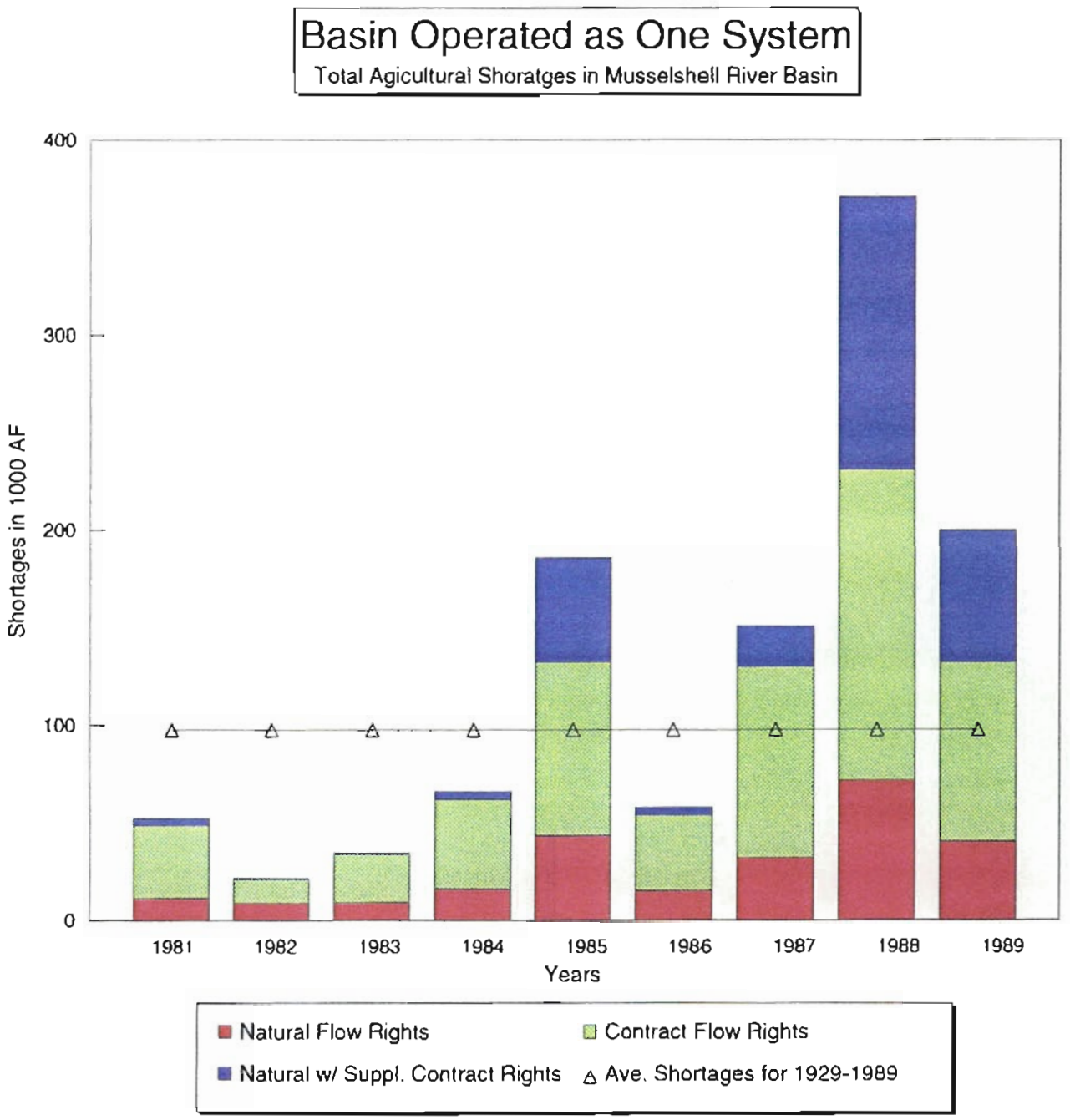

COMPARISON OF AVERAGE RETURN FLOWS AT MOSBY, MT
For the Calibrated, 5, 10, and 20% On-Farm Efficiency Increase, Natural Flow Water Right
Calibrated Model
5% Eff. Increase
10% Eff. Increase
20% Eff. Increase
Volume in AF
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Months

Fig. 4.20


Basin Operated as One System
Total Agicultural Shoratges in Musselshell River Basin
Shortages in 1000 AF
400
300
200
100
0
1981
1982
1983
1984
1985
1986
1987
1988
1989
Years
Natural Flow Rights
Contract Flow Rights
Natural w/ Suppl. Contract Rights
Ave. Shortages for 1929-1989

Costs/Changes in Return Flows of Scenarios

Table 4.3 lists estimated costs of increasing on-farm efficiency by 5%, 10%, and 20%, and operating the basin as one unit in comparison to current operation. Also included in the table are resultant return flows at the Mosby gauge (MB-1).

Since all the sprinkler systems studied pumped directly from community ditches or from the river, no estimate was made for increasing on-farm irrigation efficiencies for the sprinkler systems. It is believed that a 5% or 10% increase in efficiency can be done with better irrigation managment, but that to increase sprinkler efficiency by 20% would require substantial investment in the first year. Estimates were made to replace contour ditches with gated pipe, but no estimates of increase in on-farm irrigation efficiency. The efficiency increase is thought to be between 10-20%, with higher increases possible in certain cases.

Available Water in the Basin

At the request of DNRC, a model was run to show available water supply in the Musselshell Basin. The results, summarized in Table 4.4 and detailed in Appendix 10, display available water for new appropriations at Harlowton, Roundup, and Musselshell. This information reveals when and where water might be available for use. It should prove useful when applying for new water rights permits.

Table 4.4: Available Water in Basin (ac-ft)

	Minimum (vol/yr)	Maximum (vol/yr)	April Avg.	May Avg.	June Avg.
Harlowton	0 in 1931 & 1961	308,000 in 1975	7,000	30,500	36,500
Roundup	0 in 1931, 1961 & 1988	437,000 in 1967	13,800	36,800	47,300
Musselshell	0 in 1961	446,000 in 1975	14,400	37,100	47,600
Mosby	0 in 1961	429,000 in 1967	19,000	42,900	56,800

Table 4.3: Costs and Return Flows of the Scenarios

Scenario	Water Shortage (ac-ft)	Return Flows	First Year Cost	Remarks
Current Operation	110,000	---	$0	No action.
Increase On-farm Irrigation Efficiency by 5%	70,000	Decrease return flows by ≈15%.	$120/acre - Border and flood irrigation; $130/acre - Sprinkler.	No data available for 5% costs, so costs predicated on 10% costs from NRCS; actual costs for 5% could be less.
Increase On-farm Irrigation Efficiency by 10%	50,000	Decrease return flows by ≈30%.	$120/acre - Border and flood irrigation; $130/acre - Sprinkler.	Includes increased management through Irrigation scheduling and some minor costs to facilitate management.
Increase On-farm Irrigation Efficiency by 20%	30,000	Decrease return flows by ≈ 70%.	$1000/acre - Border; $1050/acre - Flood.	Includes adding concrete ditches or buried pipe with risers.
Operate Basin as One Unit	95,000	Decrease return flows by ≈ 10%.	$0	No change in on-farm efficiency.

Chapter 5
WATER QUALITY ANALYSIS

Water quality of the Musselshell River was analyzed in this report for suitability for the major uses: Irrigation, municipal and industrial (M&I) supplies, livestock, and aquatic life. This chapter focuses on water quality issues around irrigation (both by direct diversions from the river and water releases from Bair, Martinsdale and Deadman's Basin reservoirs); M&I use by Ryegate, Roundup, and Melstone (by direct diversions); and livestock watering (mainly by direct diversions). The river and reservoirs offer some recreation (camping, swimming, fishing), but specific analysis for recreational uses was not done.

Water quality analyses include physical properties, heavy metals, and inorganic constituents. The analysis locates reaches of the river with water quality impairments, shows the magnitude of the impairments, and encourages further detailed studies of these reaches. Raw data on water quality can be found in Table WQ-2 at the end of Appendix 11.

WATER QUALITY CONCERNS

A computer model was originally planned for this report to predict how management would affect water quality. After some discussion among the study partners, however, it was decided to develop water quality data without the model. DNRC (Montana Department of Natural Resources and Conservation) thought it would be useful to portray water quality problems in the basin and provide information to stimulate interest in pursuing solutions. That a model, which could only be developed using average monthly flows, would not adequately portray low flows in the river was also a concern. While a model couldn't show effects of specific actions, differences among low, medium, and high flows could be shown. A model could be developed in the future for specific reaches or for the whole river.

It was decided that this report would focus on the following, listed by the study partners as water quality concerns:

- River water quality and its suitability for major consumptive uses.
- River reaches that significantly contribute to water quality problems.
- Potential health risks Musselshell Basin residents might be exposed to from poor quality water.

Water quality properties and concerns are listed in Table 5.1.

Table 5.1: Properties and Constituents of Concern

Physical	Inorganics	Heavy Metals
temperature	calcium	arsenic
pH	potassium	chromium
hardness	chloride	lead
total dissolved solids	magnesium	mercury
electrical conductivity	sodium	cadmium
sodium absorption ratio	sulfate	iron
cation/anion balance		manganese
		selenium

The water quality problem perceived as having the greatest effect in the Musselshell Basin was *total dissolved solids* (TDS). Because the river supplies M&I water, too, the presence of *heavy metals* was also of concern. Of lesser concern, *inorganic elements and compounds* were also considered in the study.

TDS/Other Physical Characteristics

Levels of TDS, solids dissolved in the water (mainly salts), can be used to determine the suitability of water for a specific purpose. High TDS in irrigation water, for instance, affects both plants and soil productivity, depending on the character of the soil, type of crop, drainage, climate, and salts involved. High TDS in livestock water is detrimental to the stock, while high TDS in an M&I supply can affect the health of those who drink it and corrode water delivery systems, as well as tasting and smelling bad (Appendix 11). Measuring the electrical conductivity (EC) of water is one of the easier ways to estimate TDS; it can be used to assess TDS levels in a sample of water. The benefit of using EC is that it's easy and cheap to obtain accurate measurements. Water users could use this parameter to assess suitability of water for all uses on a daily basis. Advisories could be issued through the local media if water quality impairments were observed.

Hardness is a physical property of the material that makes up TDS. Calcium and magnesium are the major *cations* attributed to hardness, which is a measure of soap-neutralizing power.

Alkalinity is the physical property that measures ability in equivalent milligrams/liter (mg/L) of the calcium carbonate ($CaCO^3$) necessary to neutralize a similar acid solution. Like acids, alkalinity is related to pH, but high alkalinity shouldn't be confused with high pH. Alkalinity is not detrimental to people, but can cause a relative increase in sodium in solution, which will cause other problems. High alkalinity can also affect industrial and food processing and livestock.

Heavy Metals

The heavy metals considered in this study are generally harmful to people, livestock, and wildlife when ingested above critical quantities--some require relatively small doses ingested once, some large doses taken over many years. The Environmental Protection Agency (EPA) has established national standards on the levels of contaminates allowable in drinking water. These standards can be found in Appendix 11.

Inorganics

The inorganics tested for in this study (all constituents of TDS) could also be injurious to people and livestock, and are likewise governed by EPA standards (Appendix 11). Inorganics tend not to have the toxic--life threatening--properties associated with heavy metals.

High levels of sodium in irrigation water can be toxic to plants and damage the soil. Sodium salts tend to be very soluble in water, so sodium leached from soil or discharged into water will typically remain in solution.

When saturated with sodium, certain soils become less permeable to water as the colloids swell, thereby closing the soils pores. This adversely affects plant growth. The condition becomes worse with more efficient irrigation systems because of the reduced leaching effect. The poorer the drainage, the faster the sodium levels build up. Soils in the Musselshell River Basin have calcium and magnesium as their principal cations, with sodium generally representing less than 5% of the total exchangeable ions. Sodium will replace calcium and magnesium more readily than the reverse. This will eventually cause an increase in sodium levels of the soil solution.

The sodium absorption ratio (SAR) is a measure of relative activity of the sodium ion exchange reactions with the soil. This property of water assesses the potential hazard of using Musselshell water for irrigation.

The other major constituents of TDS in the Musselshell are chlorides and sulfates. Chlorides are found naturally or from industry in almost all water. They are toxic to most plants. Alfalfa, for example, is very sensitive to high chloride levels. Sulfates can be naturally occurring from gypsum or other common deposits, or from the leaching of abandoned mines, especially coal mines. Sulfates are less toxic than chlorides in irrigation water but can still cause problems.

REVIEW OF EXISTING DATA

As part of this analysis, the study partners reviewed existing data on inorganic (pesticides) and organic analyites (nutrients, major cation/anions and trace/metallic elements) in the basin. The objectives were to: 1) Determine if existing water quality data were available and reliable; 2) Avoid duplication of water sampling locations if gauging stations had enough data (three years or more); and 3) Evaluate constituents collected at existing and discontinued stations considered significant. The review was completed before selection of water sampling sites. The process involved retrieval and review of 158 EPA STORET stations, which were processed in hydrologic unit codes *10040201-10040205*. Most had only limited water quality data. The sample sites selected for this study filled in gaps where water quality information was unavailable.

SAMPLING

Locations

The USGS (U.S. Geological Survey) has recorded water quality information at several of their gauges, but Mosby is the only one with continuous data. It was thus necessary to collect water quality information at new sites for this study. Sampling sites (both new and USGS) and the designations used in this study were:

- *NFM-1*--North Fork of the Musselshell River (at the county bridge at Bair Ranch).
- *SFM-1*--South Fork of the Musselshell River (at the Martinsdale Diversion Dam).
- *HAR-1*--Harlowton USGS gauge.
- *SHAW-1*--Shawmut USGS gauge.
- *CC-1*--Careless Creek (200 yards upstream of the Route12 Bridge).

- CC-2--Careless Canal (350 yards downstream of the last drop structure).
- CC-3--Careless Creek (200 yards upstream of Careless Canal).
- *LAV-1*--Lavina USGS gauge.
- *PRC-1*--Painted Robe Creek (at first county road crossing south of the Musselshell).
- *RDP-1*--Roundup USGS gauge.
- *MS-1*--Musselshell USGS gauge.
- *FW-1*--Flatwillow Creek (200 yards upstream of the Musselshell).
- *MB-1*--Mosby USGS gauge.

Sites are indicated by dots in fig. 1.1

Measurements

Measurements were made at the sampling sites for heavy metals, soluble inorganic elements (salts), electrical conductivity (EC), pH, temperature, and flows after a process was established to assure the samples were not contaminated (see Appendix 11). Because the Musselshell provides M&I water, heavy metals concentrations were important. Lab work for heavy metals being expensive, it was decided that, unless a problem were found, three samples per site would be the limit for this study. A second constituent checked for was salts. Users in the basin identified salt loading and its effects on lands and crops as their primary water quality concern. It was decided to take monthly samples whenever possible.

EC measurements were taken by two different devices: a Yellow Spring Instrument Company Model 33 (from the Roundup office of the NRCS's [Natural Resource Conservation Service]), corrected for temperature and giving readings in μmhos/cm; and an Orion Model 124 (from Reclamation's Regional Office in Billings), a simple bridge unit which required temperature corrections at each sampling site. This unit gave readings like the Model 33. pH was measured with a Extech Instruments Oster PH/MV/TEMP meter (from DNRC), calibrated using known pH solutions. This probe was old, requiring an unusually long time to stabilize; it might have introduced some error into the data. During the sampling, two different instruments were used to take water temperature--the Model 33 used for EC measurements, and a simple glass stem thermometer with permanently fused graduations. The Model 33 had an accurate temperature probe; the thermometer was checked against a liquid of known temperature to assure accuracy.

Flow measurements and water quality samples were taken at the same time. Flows were measured by a pygmy meter equipped with a USGS digitizer at Flatwillow Creek, Painted Robe Creek, Careless Creek (#1), Careless Creek (#2), Careless Canal, and the North Fork of the Musselshell, using USGS standards for measurement. At USGS gauges, flows were obtained by using the equipment at the stations and the most current rating tables. Measurements on the South Fork were made at the Martinsdale Reservoir Diversion Dam, which contains a broad crested suppressed cipolleti weir. The stages over the crest were measured, and flows were calculated using an empirical formula (the rating table is included in Appendix 11).

Quality Assurance/Quality Control (QA/QC)

The objective of the QA/QC process was to provide the type and number of samples necessary to minimize effects of bias, and ensure precision in the sampling process. Consideration was given during the study to sampling sites, sampling containers, preservation of the samples, and analytical methods of the collected data.

Field QC samples, (*blanks*--samples that have negligible or unmeasurable levels of the target contaminates of interest; or *replicates*--duplicate but independent samples taken at the same site at the same time) were collected and handled exactly the same as the other water samples to provide the basis from which sampling bias (in most cases contamination) could be estimated, or sampling precision determined. Field blanks (distilled water carried to the site and exposed to the air) were collected once a day during every sampling operation, and then submitted for analysis as double blind samples. Any incidental contamination during the whole process could then be measured. During each sampling operation, 10% replicated samples were collected and submitted to the laboratory as double blind samples.

WATER QUALITY FOR IRRIGATION USE

TDS

The present study (and others by USGS) showed that TDS (mainly salts) in the Musselshell River were severe enough to affect irrigation use. The California Water Resource Board assesses TDS in irrigation water as shown in Table 5.2 (in mg/L--milligrams/liter).

Table 5.2: California Guidelines
for TDS in Irrigation Water

Water Quality	TDS Levels (mg/L)
Excellent	≤ 175
Good	176-525
Permissible	526-1,400
Doubtful	1,401-2,100
Not Acceptable	≥2,101

By comparing actual TDS levels found in the Musselshell shown in fig. 5.1 with the guidelines in Table 5.2, it is clear that irrigating with this water would be harmful to both plants and soils. Irrigated lands typically return salt laden water to the river, the amount being proportional to the area irrigated. For this reason, TDS levels typically increase downstream, as can be seen in fig. 5.1. It's also easy to determine reaches of the Musselshell where the most irrigation occurs, since these reaches show the greatest increases in TDS.

TDS levels are affected by the flows in the river, too. When river flows rise from surface runoff (rain, snowmelt, or reservoir releases), TDS levels are reduced through dilution. Fig. 5.2 shows the relationship of flows to TDS as measured at the Mosby gauge.

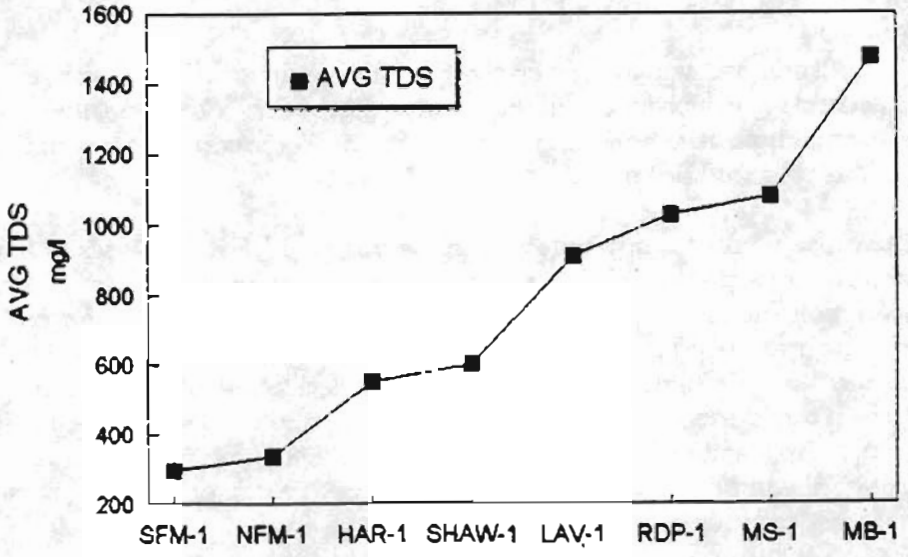


Fig. 5.1: TDS levels from the South Fork (SFM-1) to Mosby (MB-1). Note how TDS increases downstream.

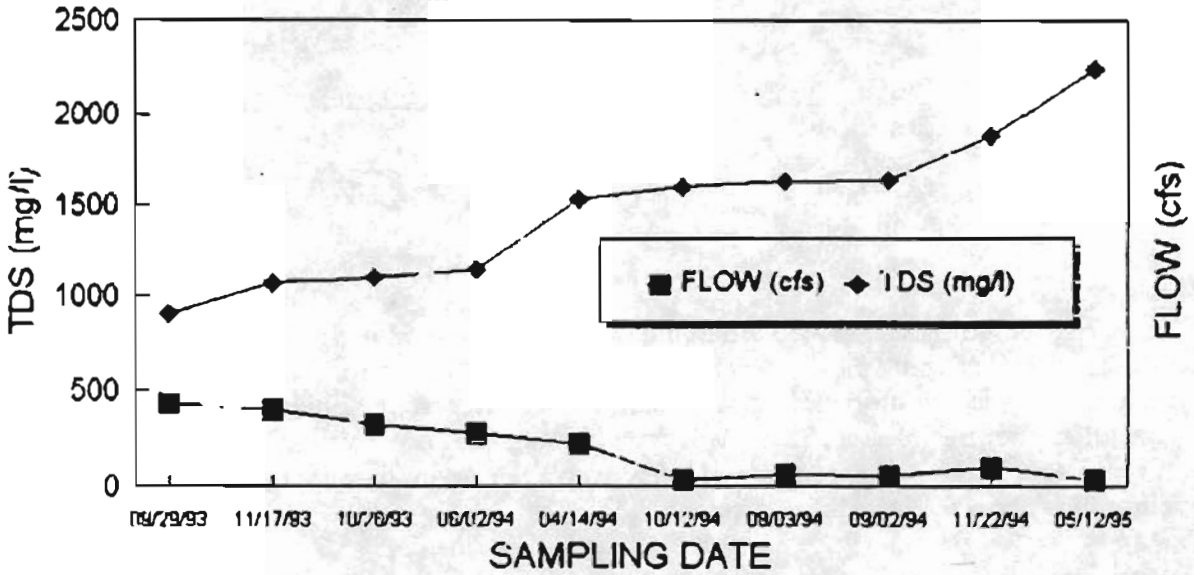


Fig. 5.2: Effects of River Flows on TDS Levels at the Mosby gauge.

As fig. 5.2 shows, irrigation water with high TDS levels can be improved by dilution with water of better quality. It has been suggested that releases from Deadman's Basin Reservoir could be used to reduce salt concentrations and generally improve water quality in the Musselshell. The highest TDS concentrations were found in fall and winter when river flows consist mainly of irrigation return flows. In the past, releases from Deadman's Basin have been made only in the summer when river flows are of fairly good quality.

To assess the impact of Deadman's Basin water on TDS concentrations, a sampling site was set up at the end of Careless Canal (CC-2), which conveys water from Deadman's Basin to Careless Creek for users along the canal and the creek, Careless Creek above the confluence of the canal and creek (CC-3), and at Careless Creek just before it empties into the Musselshell (CC-1). TDS concentrations at CC-1 were found to be typically higher, about 600 mg/L for every sample taken, than the river at Shawmut. Average TDS at Shawmut is slightly less than 600 mg/L and at Lavina the TDS averages slightly more than 900 mg/L.

Since the Lavina TDS average is higher than the Shawmut average even during the summer, it seems that Deadman's Basin did not improve water quality in the river. When the TDS levels of Careless Creek are analyzed, however, Deadman's Basin does keep them lower than without its flows. The TDS levels at various flows (in cfs--cubic-feet/second) for the gauging stations demonstrating this are shown in Table 5.3.

Table 5.3: TDS Levels and Dilution Potential
(Careless Creek and Deadman's Basin)

Location	TDS Levels/Flows (mg/L & cfs) (11/17/93)	TDS Levels/Flows (mg/L & cfs) (8/1/94)	TDS Levels/Flows (mg/L & cfs) (8/2/94)	TDS Levels/Flows (mg/L & cfs) (9/1/94)
Shawmut Gauge (SHAW-1)	494/NA (11/16/93)	445/134	575/34	739/10
Above Confluence of Careless Creek and Careless Canal (CC-3)	1047/NA	988/8.4	1782/0.4	2122/0.4
Careless Canal (CC-2)	600/28.3	572/32.0	—/11.5	626/36.8
Careless Creek Before Confluence with Musselshell River (CC-1)	893/36.7	838/40.4	926/12.0	799/36.1
Lavina Gauge (LAV-1)	624/317 (11/16/93)	620/261	743/174	752/193

From the sparse data gathered for this report, it appears that flows from Deadman's Basin does improve water quality through dilution, but only the water quality of Careless Creek. Deadman's Basin is filled with Musselshell water; thus, it should not be expected to have better quality than the river. It also appears that Careless Creek may be part of the reason TDS increases from Shawmut

to Lavina, however. This finding could probably be applied to the rest of the tributaries of the Musselshell as well. Tributaries do not have snowmelt from the mountains contributing to their flows, so the quality is heavily influenced by irrigation practices and return flows. Once the spring snowmelt is over, the only sources are springs, rainfall, and return flows. The tributaries are used extensively for irrigation, with the water probably being used more than once. Quality is not good by the time the water reaches the river. Tributaries in reaches of the Musselshell showing a sharp increase in TDS should be studied to find out which ones are big contributors to the problem and to see what could be done about it.

Sampling of river water quality indicated that the particular constituents of TDS are not a significant problem, except for sulphates. TDS levels in the lower Musselshell, however, are high enough to potentially harm irrigated lands. This can be observed by comparing the California standards with the levels shown in fig. 5.1. Reduction of TDS levels between Martinsdale and Harlowton, Shawmut and Lavina, and Musselshell and Mosby could help this situation.

Salts (Sodium/SAR, Chlorides, Sulfates)

Irrigation water with a high SAR causes soil to tighten up, affecting plant growth adversely. SAR for 8 of the 13 sampling sites during the study is shown in Table 5.4.

Table 5.4: Average and Maximum SAR

Site	Avg.	Max.
South Fork at Martinsdale Diversion Dam (SFM-1)	0.8	0.9
North Fork at Bair Ranch Bridge (NFM-1)	0.3	0.4
Harlowton (HAR-1)	1.3	2.0
Shawmut (SHAW-1)	1.4	1.9
Lavina (LAV-1)	2.7	4.1
Roundup (RDP-1)	2.9	4.5
Musselshell (MS-1)	3.1	4.6
Mosby (MB-1)	4.1	6.4

The U.S. Department of Agriculture classifies irrigation water in four classes as shown in fig. 5.3. Fig. 5.3, combined with the EC measurements listed in Appendix 11, can be used to assess the potential hazard from sodium in the water. This study indicated that sodium is not generally a problem in the Musselshell, although there are several infrequent indications of moderate hazard in the lower basin.

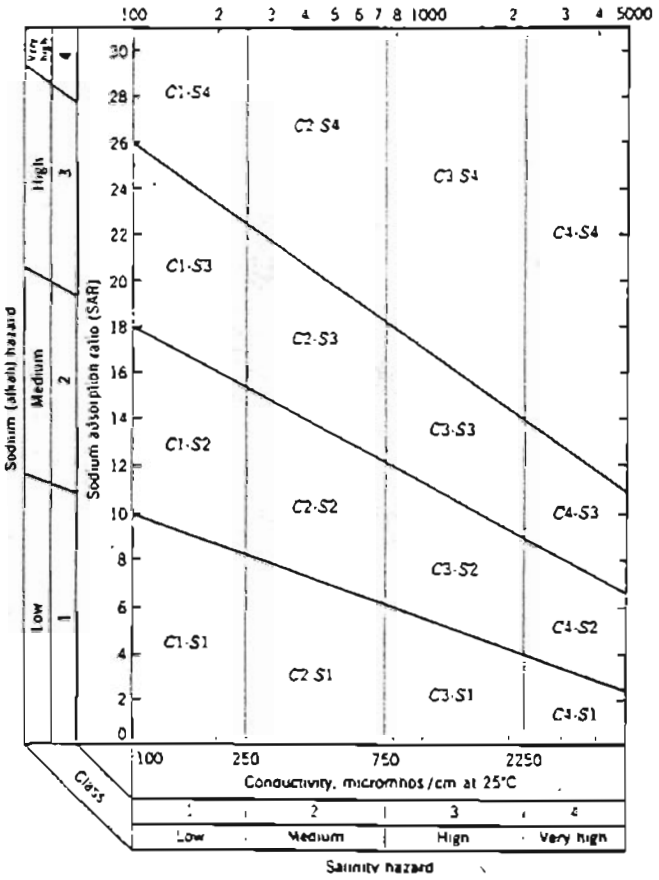


Fig. 5.3: USDA Irrigation Water Classifications

Table 5.5 shows average and maximum chloride levels found at eight sampling sites during the study.

Table 5.5: Chloride Levels in the Musselshell (mg/L)

Site	Avg.	Max.
South Fork (SFM-1)	3.5	5.1
North Fork (NFM-1)	2.3	2.7
Harlowton (HAR-1)	6.7	9.9
Shawmut (SHAW-1)	7.2	10.3
Lavina (LAV-1)	13.7	21.6
Roundup (RDP-1)	17.4	35.6
Musselshell (MS-1)	19.4	36.6
Mosby (MB-1)	22.7	39.7

Some sources state that levels less than 177 mg/L are safe to plants, while others say levels over 71 mg/L are injurious. Sampling indicates that chlorides are not a problem anywhere along the river.

The California Water Resource Board's assessment of sulfate levels in irrigation water is shown in Table 5.6. Average and maximum levels found during this study are shown in Table 5.7.

Table 5.6: California Guidelines for Sulfates in Irrigation Water

Water Quality	Sulfate Levels (mg/L)
Excellent	< 175
Good	193-336
Permissible	337-576
Doubtful	577-960
Not Acceptable	>961

Table 5.7: Sulfates Levels in the Musselshell (mg/L)

Site	Avg.	Max.
South Fork (SFM-1)	103	117
North Fork (NFM-1)	97	155
Harlowton (HAR-1)	105	630
Shawmut (SHAW-1)	134	346
Lavina (LAV-1)	462	768
Roundup (RDP-1)	542	1,026
Musselshell (MS-10	571	1,026
Mosby (MB-1)	839	1,302

Sampling shows that several reaches of the river typically exceed the acceptable limits for sulfate. Sulfates make calcium in water precipitate out, which could be detrimental to plants.

WATER QUALITY FOR M&I USE

Heavy Metals

Table 5.8 records the results in mg/L from three samples made for heavy metals in the Musselshell between September 29, 1993-May 12, 1995. Numbers with asterisks (*) indicate those that would rate at least a *health advisory* from EPA.

Three samples do not provide enough data to establish statistically valid conclusions. This information should be used to provide the basis for further investigation of heavy metals, particularly to isolate the origin to prevent further contamination of the river.

TDS

EPA's *Secondary Drinking Water Standard* for TDS is 500 mg/L. Levels greater than 500 mg/L are noticeable, and water with levels between 2,000-4,000 mg/L considered unpalatable, not able to quench thirst, and may act as a laxative on unaccustomed users. Water with TDS beyond 4,000 mg/L is unfit for human consumption.

The 500 mg/L standard is always exceeded at Ryegate, Roundup, and Melstone, the three towns using the Musselshell for an M&I supply. Average and maximum TDS levels at the sampling sites nearest the respective town's intake are shown in Table 5.9.

Table 5.9: TDS Levels Near the Intakes (mg/L)

Sample Site	Avg.	Max.
SHAW-1 (Ryegate)	600	779
RDP-1 (Roundup)	1,027	1,772
MS-1 (Musselshell)	1,079	1,784

Table 5.8: Average/Maximum Levels of Heavy Metals
(avg. first, then max. in micrograms/liter)

Site	Arsenic	Cadmium	Chromium	Copper	Iron
South Fork (SFM-1)	0.4/3.1	0.2/0.54	0.0/0	0.5/1.5*	129.0/253
North Fork (NFM-1)	1.2/2.3	0.7/1.3	1.0/1.8	2.1*/3.9*	346.7/578
Harlowton (HAR-1)	0.3/1.0	0.2/0.3	0.0/0.0	0.5/1.6*	110.7/163
Shawmut (SHAW-1)	0.4/1.3	0.3/0.5	0.0/0.0	2.2*/3.3*	188/292
Lavina (LAV-1)	0.9/1.7	0.0/0.0	0.9/2.6	1.6*/3.2*	554/1,186
Roundup (RDP-1)	0.9/1.6	0.1/0.3	1.2/3.5	1.6*/3.3*	579/1,189
Musselshell (MS-1)	0.9/1.6	0.1/0.3	1.2/3.5	1.6*/3.3*	579/1,189
Mosby (MB-1)	0.5/1.5	0.0/0.0	1.7/2.9	2.4*/3.5*	700/1,267

	Lead	Manganese	Mercury	Selenium	Zinc
South Fork (SFM-1)	0.0/0	26.3/36	0.0/0	0.0/0	0.3/1
North Fork (NFM-1)	0.4*/1.3*	52.7/62	0.3*/0.9*	0.0/0	12.3*/19*
Harlowton (HAR-1)	0.0/0	21/24	0.0/0	0.0/0	0.0/0
Shawmut (SHAW-1)	0.7*/1.1*	28.3/35	0.0/0	0.0/0	2/4
Lavina (LAV-1)	0.0/0	38.7/68	0.0/0	0.0/0	
Roundup (RDP-1)	0.0/0	36.7/66	0.4*/1.1*	0.3/1	5.3*/12*
Musselshell (MS-1)	0.0/0	36.7/66	0.4*/1.1*	0.3/1	5.3*/12*
Mosby (MB-10	0.8*/1.3*	54.7/86	0.1*/0.3*	0.0/0	6.3*/10

Management which limits irrigation return flows and reduces salt accumulation in the reservoirs would improve the quality of the water for M&I use.

Salts (Sodium, Chlorides, Sulfates)

Sodium in M&I water supplies can harm both humans and industrial machinery. Drinking sodium-rich water has been proven to adversely affect people with heart, kidney, and circulatory diseases. Consuming 200 milligrams/day of sodium in drinking water can be harmful. The taste of sodium is also a consideration in M&I supplies. Depending on the origin of the salt, detection levels vary from 34-290 mg/L. Table 5.10 indicates sodium levels for the sites nearest the towns' intakes.

Table 5.10: Sodium Levels Near the Intakes (mg/L)

Sample Site	Avg.	Max.
SHAW-1 (Ryegate)	65	91
RDP-1 (Roundup)	154	291
MS-1 (Musselshell)	167	296

While chloride levels as low as 100 mg/L may cause water to taste salty, the average threshold of taste is about 400 mg/L. Like sodium, chlorides can affect people with heart or kidney diseases. The California Water Resources Board set chloride levels for that state at 250 mg/L for drinking water, 50 mg/L for industrial water. Chloride levels at the sites nearest the intakes are shown in Table 5.11.

Table 5.11: Chloride Levels Near the Intakes (mg/L)

Sample Site	Avg.	Max.
SHAW-1 (Ryegate)	7.2	10.3
RDP-1 (Roundup)	17.4	35.2
MS-1 (Musselshell)	19.4	36.6

Sulfates affect people like chlorides, except much higher levels are required to produce the same toxicity. Taste threshold for sulfates vary, depending on the origin of the salt. Levels of 500 mg/L or higher are harmful to people, but this level varies depending on the sodium, calcium, and magnesium present in the water. Table 5.12 indicates the sulfate levels nearest the intakes.

Table 5.12: Sulfate Levels Near the Intakes (mg/L)

Sample Site	Avg.	Max.
SHAW-1 (Ryegate)	134	346
RDP-1 (Roundup)	542	1,025
MS-1 (Musselshell)	571	1,302

Physical Characteristics

While alkalinity is not usually detrimental to municipal water, it is associated with high pH, hardness, and high TDS levels. High alkalinity adversely affects many industrial uses, especially the food processing and carbonated beverage industries.

Hardness is caused by natural accumulation of salts through contact with soil or geologic formations, industrial discharges, or irrigation return flows. The major adverse effect is economic; greater quantities of detergents and soaps must be used, scale builds up inside pipes, and unwanted chemical reactions occur in industrial processes. While hardness has not been shown to cause health effects, controlling it through an ion exchange process introduces different ions (predominately sodium) that can cause health problems.

WATER QUALITY FOR LIVESTOCK AND WILDLIFE USE

TDS can have a harmful effect on cattle, sheep, and wildlife as it can for soil, plants, and people. The California Water Resources Board have found that water with TDS levels of 2,500 mg/L is of good quality for livestock, 2,500-3,500 mg/L fair quality, 3,500-4,500 poor, and greater than 4,500 mg/L unsuitable. Average and maximum levels of TDS, chlorides, sulfates, sodium, and alkalinity found at 8 sampling sites are shown in Table 5.13.

High chloride and sulfate levels can also be harmful to livestock and wildlife. Chloride levels of 1,500 mg/L are generally considered safe for cattle and sheep, while 1,000 mg/L represents the generally accepted limit for sulfate. Sulfate salts have an interesting side benefit, however: They partially offset the effects of high selenium in cattle.

High sodium salt levels are toxic to livestock and wildlife. Some studies suggest that 2,000 mg/L represents the upper limit for livestock. Levels greater than 2,000 mg/L would likely have harmful effects.

Alkalinity levels greater than 50 mg/L can cause adverse effects in livestock, but hardness in water may actually be beneficial. Studies of calves and chicks show that they develop somewhat better when supplied hard water in comparison to distilled water.

Table 5.13: Constituents Found at Sampling Sites

Location	TDS		Chlorides		Sulfates		Sodium		Alkalinity	
	Avg. (mg/L)	Max. (mg/L)	Avg. (mg/L)	Max. (mg/L)	Avg. (mg/L)	Max. (mg/L)	Avg. (mg/L)	Max. (mg/L)	Ave. (mg/L)	Max. (mg/L)
South Fork (SFM-1)	297	370	3.5	5.1	103	117	26	34	184	233
North Fork (NFM-1)	337	457	2.2	2.7	97	155	13	17	208	246
Harlowton (HAR-1)	553	752	6.7	9.9	105	630	55	92	235	298
Shawmut (SHAW-1)	600	780	7.2	10.3	134	346	65	91	250	308
Lavina (LAV-1)	912	1381	13.7	21.6	462	768	135	232	254	360
Roundup (RDP-1)	1028	1772	17.4	35.6	542	1,026	154	291	255	333
Musselshell (MS-1)	1079	1784	19.4	36.6	571	1,026	167	296	264	342
Mosby (MB-1)	1474	2242	22.7	39.7	839	1,302	248	440	260	349

WATER QUALITY FOR AQUATIC LIFE

TDS levels that create an osmotic pressure between fish and water greater than 6 atmospheres can be detrimental. Sodium can also have harmful effects, but the toxicity threshold varies depending on the type of salts and the species of fish. Sodium in moderate strength can buffer the effects of potassium and ammonium salts on fish.

Chlorides levels found by the California Water Resources Board to be harmful to aquatic life are listed in Table 5.14.

Table 5.14: Chloride Limits for Aquatic Life (mg/L)

Species	Upper Limit
Trout	400
Some other fish	2,000
Bass, Pike, Perch	4,000
Carp eggs	4,500-6,000
Small Bluegills	8,100-10,500

Alkalinity has a marked effect on aquatic life. The best conditions are water with a pH of 7-8 with a total alkalinity of 100-120 mg/L. Alkalinity does help buffer sudden changes in pH that could adversely affect aquatic life.

The growth of fish and other aquatic life may be inhibited by hardness, but softer water actually increases sensitivity of fish to toxic metals.

FINDINGS

The water quality study showed that the Musselshell River becomes more degraded the further downstream samples are obtained. Sampling showed reaches of the river where water quality criteria were exceeded and defined reaches that should be studied further to determine where the constituents originate and what can be done to lower the levels.

Findings of the water quality analysis for the various uses of the river can be found in Table 5.15. The source of the water quality criteria are included; some are from the California Water Resources Board, some EPA, some USDA, and some are just general "rule of thumb" criteria.

Table 5:15: Water Quality Findings

TDS	Sodium	Chlorides	Sulfates	Alkalinity
		IRRIGATION USE		
River above Harlowton good, below Harlowton and above Musselshell permissible, somewhere below Musselshell doubtful.[1]	Sodium absorption ratio good for entire length of the river.[2]	Good for the entire length of the river.[1]	The river above Shawmut excellent, below Shawmut and above Musselshell permissible, below Musselshell doubtful.[1]	
		M&I USE		
River exceeds 250 mg/L the entire length and reaches unpalatable levels in some measurements at Mosby gauge (MB-1).[3]	River of good quality for entire length; maximum levels exceeded standards, however.[1]	River very good for entire length.[1]	River above Shawmut excellent, below Shawmut and above Roundup permissible, and below Roundup exceeds 500 mg/L standard.[3]	River acceptable for entire length.[3]
		LIVESTOCK AND WILDLIFE USES		
River good quality for entire length.[1]	River of good quality for entire length.[1]	Entire river exceeds standard of 250 mg/L.[3]	River of good quality for entire length; however, maximum levels found exceeded standard.[1]	River exceeds 50 mg/L standard for entire length.[1]
		AQUATIC LIFE		
River of good quality for entire length.[1]	River of good quality for entire length.[1]	River of good quality for entire length.[1]	River of good quality for entire length; maximum levels found exceeded standard, however.[1]	River exceeds best range of 100-120 mg/L for entire length.[1]

[1] California Water Resource Board criteria.
[2] U.S. Department of Agriculture criteria.
[3] EPA Secondary Drinking Water criteria.

TDS

Since TDS seems to create the most water quality problems, sources should be identified and ways to reduce TDS should be developed. The few samples done this report showed the reaches of the river where TDS increased the most: 1) Above Harlowton, 2) Between the Shawmut and Lavina gauges , and 3) Between Musselshell and Mosby. These are all reaches where much irrigation takes place, resulting in return flows with high TDS. Tributaries which may contribute largely to TDS also need to be identified. TDS levels in conjunction with and flow volumes should be looked at: a stream with high TDS may not contribute much because of its small volume of flow.

Since TDS levels can be aggravated by many things, a solution to the problem may require cooperation among partners. Programs may be developed to help users irrigate more efficiently, to help livestock owners manage riparian areas better, and to help towns and industries do things differently. DNRC can help organize a sampling program to further identify problem areas. NRCS can help determine ways to reduce TDS levels--improving range management, implementing best irrigation practices, and others.

Another way to lower levels of most constituents is to keep more flows in the river. Ideas about how to increase flows should be analyzed for cost effectiveness and efficiency. Users in the Musselshell River Basin should take the lead in making the water supply better.

Total Maximum Daily Load

Water quality constituents were measured in mg/L until 1994, when §303(d) of the Clean Water Act and EPA's *Water Quality Planning and Management* mandated that water quality be based on how much of a constituent a body of water could assimilate, rather than a concentration at a particular time. This new measurement is called *Total Maximum Daily Load* (TMDL), defined as the total maximum load (mass unit/day) of a water quality constituent that a water body can assimilate and not violate water quality standards. Details can be found in Appendix 11.

The §303(d) listing process begins with identifying water bodies that do not fully meet water quality standards or are fully supporting uses but are threatened. After these water bodies have been identified, they are prioritized and targeted for TMDLs. Montana's 1996 §303(d) list includes several reaches of the Musselshell River and its tributaries (see Table WQ-2 in Appendix 11). All have low priority for TMDL development, but the Musselshell River overall had a moderate level, having been upgraded because of the Careless Creek Demonstration Project and because of the present study.

The "probable impaired uses" of the Musselshell River Basin are mainly aquatic life support and cold/warm water fisheries. Chicago Gulch, Collar Gulch, and Chippewa Creek, tributaries of Flat Willow Creek, have several probable impaired uses. Yet Flat Willow Creek itself is not listed. Painted Robe Creek is similar to the rest of the basin for probable impaired uses but includes silviculture as a probable cause. Careless Creek is the most significant water quality limited water body due to its probably not supporting aquatic life, swimmable and warm water fisheries uses. Samples taken during this study confirmed this listing, finding excessive TDS. The Musselshell River segment MT40C003-1 is listed as not supporting drinking water supply as a result of analysis of samples taken the Mosby gauge provided to the Montana Department of Environmental Quality

from DNRC. This analysis found arsenic and mercury levels above aquatic life and human health standards.

Probable causes related to the present study include flow alteration, siltation, nutrients, suspended solids, thermal modification and habitat alteration. Probable sources related to the study, not linked to the probable causes, include agriculture, range land, irrigated crop production, flow regulation/modification, streambank modification/destabilization and natural resources. The probable sources listed are non-point sources which can be improved using Best Management Practices.

REFERENCES CITED

Aquoneering, 1991. *Study of the Deadman's Basin Reservoir Careless Creek Release System*. Done for the Lower Musselshell Conservation District, Roundup, Montana.

Cawlfield, L., 1992. *Water Availability for the Musselshell River*. Done for the Montana Department of Natural Resources and Conservation, Helena, Montana.

Montana Department of Natural Reources and Conservation, 1984. *Hydropower Potential of Deadman's Basin Releases*. Helena, Montana.

Montana Department of Natural Reources and Conservation, 1988. *Lewistown Water Study*. Helena, Montana.

Montana Department of Natural Reources and Conservation, 1995. *Upper Missouri River Study*. Helena, Montana.

Natural Resources and Conservation Service, 1991. *Farm Irrigation Rating Index*. U.S. Department of the Interior, Washington, D. C.

Natural Resources and Conservation Service, 1979. *Planning Handbook*. Revised 1997. U.S. Department of the Interior, Washington, D. C.

Natural Resources and Conservation Service, 1984. *Montana Irrigation Manual*. Revised 1997. U.S. Department of the Interior, Washington, D. C.

Reller, M., 1990. *Water Availability Analysis for Proposed Musselshell Tributary Storage*. Done for the Montana Department of Natural Resources and Conservation, Helena, Montana.

Sundheim, S., 1982. *Water Availability in the Musselshell Basin*. Done for the Montana Department of Natural Resources and Conservation, Helena, Montana.

U.S. Army Corps of Engineers, 1990. *Seepage Losses in Deadman's Basin Inlet Canal*. Washington, D. C.

Vorozilchak, J.A., 1974. *Seepage Investigation:Deadman's Basin*. Done for the Montana Department of Natural Resources and Conservation, Helena, Montana.

Appendix 1
ON-FARM IRRIGATION REPORT

Musselshell River Water Management Study

On-Farm Irrigation

Report by:

U.S. Department of Agriculture
Soil Conservation Service

November 21, 1994

For

U.S. Department of the Interior
Bureau of Reclamation

In cooperation with

State of Montana
Department of Natural Resources and Conservation

Lower Musselshell Conservation District

Upper Musselshell Conservation District

MUSSELSHELL RIVER WATER MANAGEMENT STUDY

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SUPPORTING DATA INCLUDES

- Consumptive Use Data - TR-21 Computations
- Farm Irrigation Rating Index
- Table 7 - Wind River Study
- Table 7 Revised

INTRODUCTION

In FY 1993, the Bureau of Reclamation (Reclamation) received line-item funding under the General Investigation program to cooperatively undertake a 3-year study to formulate and recommend a basin-wide comprehensive water resource plan which will satisfy all of the established water uses in the Musselshell River Basin. The Study, a joint effort between Reclamation and the State of Montana Department of Natural Resources and Conservation (DNRC) will focus on water use efficiency, conservation, integrated reservoir operating and river management plans, rehabilitation needs, and irrigation scheduling programs.

In May, 1993 an interagency agreement was entered between Reclamation and the Soil Conservation Service (SCS) for the SCS to assist Reclamation in determining the on-farm irrigation efficiencies of irrigation systems in the Musselshell River Basin.

Based on discussions between the cooperating entities, it was agreed that the SCS would estimate seasonal irrigation efficiencies based on irrigator interviews and an SCS method of analysis called "Farm Irrigation Rating Index (FIRI)." No on-site measurement or detailed system evaluations were to be performed.

The FIRI procedure requires collection of various system data and information about how the system is managed. Most of this information was gathered by the method of irrigator interviews. The interviewers were performed by Terri Hice, water master for the Deadmans Water District, and John Hunter of the Montana Department of Natural Resources and Conservation. Funding for participation by Terri Hice was provided by the Deadmans Basin Water User's Association.

John Hunter provided a list of 30 representative sites along the Musselshell. These sites are intended to be representative of the types and management of irrigation along the Musselshell. Interviews were actually completed for 22 sites.

The SCS planning staff at Bozeman analyzed the collected data using the FIRI process and other tools. The results of that analysis, and recommendations are contained in this report.

PROCEDURE

The basic method of estimating seasonal on-farm irrigation efficiency is the SCS Farm Irrigation Rating Index (FIRI) procedure. This method of analysis was developed at the SCS West National Technical Center in Portland, Oregon. The procedure is detailed in the SCS publication "Farm Irrigation Rating Index (FIRI)," dated June, 1991. A computer program is available which aids in manipulation of data.

FIRI is a method for planning, evaluating, and improving irrigation management. It is intended to be a uniform and objective evaluation method for planning irrigation water conservation and identifying ground water and surface water pollution potential. FIRI is a procedure for comparing improvements or changes to irrigation systems and management in the planning process, and cannot be used to establish a finite farm or field application efficiency, or specific deep percolation and runoff amounts.

This process has been used in several recent studies in the west to analyze the potential for making changes in irrigation systems and on-farm management for the improvement of irrigation efficiency.

Data is usually gathered for the FIRI process by a combination of field observations of a site and interviews with the irrigator/manager. To facilitate performing the Musselshell FIRI analysis, a worksheet (Figure 1) was created that systematically allows recording data for entry in the FIRI process.

A trial run was made at two sites. John Dalton, SCS Agricultural Engineer, Bozeman, Montana provided guidance on how to use the worksheet and the type of questions to ask.

Supplemental information needed included soils data and a map or aerial photo on which ditches and field boundaries were marked. Since a soil survey is ongoing in Musselshell County, not all sites had detailed soils information available. The SCS field office staff provided whatever soil information that was available.

The worksheet, soils, and map data was provided to the SCS planning staff in Bozeman as data was gathered.

Prior to performing the FIRI procedure, crop seasonal water use (ET) was estimated by running the SCS TR21 Blaney Criddle computer program for each field. Closest available weather station data was used in the calculations. TR21 requires information on carryover moisture and net irrigation application depth. Since available water capacity (AWC) is required to estimate these factors, AWC was estimated based on available soil information and use of a "DM Soil" model or soil survey based data depending on the availability of soil information.

Net irrigation application depth for TR21 was estimated based on the following conventions:

- Surface irrigation systems:
  50% of AWC
- Lateral move sprinkler:
  Lessor of 3.0 inches or 50% of AWC
- Pivot sprinkler:
  1 inch

The collective judgment of the SCS staff was then applied to select management factors for the FIRI computations. There is a considerable degree of educated judgment involved in selecting FIRI factors.

SUMMARY OF ANALYSIS

Appendix C shows the tabulated results of all sites that were analyzed. The sites were categorized into three major irrigation application methods: sprinkler, border and flood.

The estimated seasonal application efficiency for each site is shown in the tabulation. The weighted average efficiency for each major type of irrigation is also shown. The weighted average is weighted by the number of acres at each site.

The net and gross seasonal irrigation requirements are shown for each site and a total for each method type.

On farm irrigation conveyance system losses are estimated by totaling the number of miles of canals or ditches for each method type and applying an average canal loss factor. Note that none of the sprinkler systems were associated with on-farm ditch or canal systems, since they all apparently pumped water directly from the community ditch or from the river.

Based on an increased seasonal application efficiency of ten percent, the potential water conservation amount for each method type was estimated.

CONCLUSIONS

In general the seasonal efficiencies tabulated (Appendix C) are higher than expected. This, in part, may be due to the following reasons:

- Since water availability has been such an issue on the Musselshell, particularly the lower reaches, irrigators appear to in general pay more attention to management of water than in comparable irrigated areas of the state. This is reflected in several factors in the FIRI process.

- Water measurement is being implemented in the basin. This increases one factor in the FIRI process and thus raises efficiency.

- The interview process and FIRI worksheet have their limitations in transmitting detailed information. Management of irrigation operations can be complex. We have probably missed some things that would tend to change the results. To refine the process would have required spending more time at each site and possibly observing an irrigation process.

There can be improvements in on-farm irrigation efficiency with a moderate commitment of irrigator management, maintenance, and capital investment. In our judgment, an overall average seasonal efficiency improvement of 10 percent would be a realistic goal. Beyond that would require increasing investment in irrigation system type and facilities replacement.

RECOMMENDATIONS

1. Irrigation Conservation Plans

Implement a program of preparing irrigation conservation plans on individual farms and ranches in the Musselshell Basin. Such plans involve a detailed analysis of the irrigation operation and system, and in close consultation with the owner/irrigator. A short and long-range plan is developed which details management actions and system modifications. We recommend the planning process detailed in the SCS Planning Handbook and the SCS Montana Irrigation Manual. An irrigation plan is best completed as an integrated part of a farm-wide resource management plan.

The advantage of a plan is that it allows a close look at each individual irrigation system and, as a result, very specific practices can be recommended and worked out with the owner/irrigator. The practices and tools listed in Appendix B are examples of what may be included in a plan. A detailed resource inventory performed as part of planning may involve obtaining on-site soils information, engineering surveys and detailed irrigation system evaluations. As a result, plans are made based on accurate data.

The SCS prepares such plans as part of their normal conservation program. Due to the high labor requirement, and limited SCS resources, only a few are accomplished each year. An accelerated program would require funding additional trained staff. Staff may be employees of the Conservation District. Irrigation related planning can be complicated, so experienced planners are essential.

2. Conservation Demonstration Sites

Conservation practice demonstrations should be set up at various cooperating farms, at various locations throughout the length of basin. Workshops and tours would be set up to view and discuss these techniques. New techniques, such as cablegation and automated ditches, scheduling methods, and other appropriate procedures could be demonstrated and tried out in the area. Much of this may be done under existing technical and cost share programs.

3. Set Up A Demonstration Scheduling/Water Management Consultive Service

Set up a demonstration irrigator controlled management service. The service might include:

- Irrigation scheduling
- Water budget analysis on a field/farm basis
- Coordination with water district operations
- Other integrated crop/pest management services.

Such a service would need technical help and seed money to get started. The objective would be to ultimately make the service a self-supporting enterprise.

APPENDIX

APPENDIX A

MUSSELSHELL WATER MANAGEMENT
Tools Which May be Used to Improve Irrigation Water Use Efficiency

by John Dalton, Agricultural Engineer, Bozeman, MT

The following are a list of water management tools that we believe may be useful in the Musselshell basin irrigated areas. Whether or not any tool will fit a site or an operator's objectives will depend on the operator and the site. Additional information about any of the listed tools are available through the Soil Conservation Service.

GENERAL

- Irrigation Water Management Plan

  A plan prepared with the help of the Soil Conservation Service or other consultant. The plan provides information on management actions and system operation and maintenance procedures that can improve irrigation management and productivity. The plan is detailed and is tailored to the needs of the irrigator.

- Irrigation System Evaluations

  Irrigation system evaluations are performed by the Soil Conservation Service, a Resource Conservation District, power company or another entity. An evaluation involves measuring and observing what takes place during a single irrigation at one location in a field. Recommendations are made as to improvements in the irrigation system and management of the system. Evaluation procedures are described in the SCS Montana Irrigation Manual. Some districts have obtained grants to help implement an evaluation program.

- Community Scheduling Service

  A community-wide irrigation scheduling service may provided by some means. The scheduling could be implemented as part of an integrated crop and pest management program. The service might be provided by a consultant, the Conservation District, a group of irrigators, or some other entity. The method of scheduling can be based on weather station/computer models, neutron probe soil moisture monitoring, capacitance probe soil moisture monitoring, infrared monitoring, or some other technically advanced method or combination of methods. A trained, experienced technician is essential to make this work. An irrigation water management education program is usually part of the service. Such services often are initiated using grant funds. For long-term success they must ultimately become self supporting.

- Water Budget Based on Predicted Water Availability

Annual management of an irrigation enterprise can be enhanced by a seasonal water budget planning process. Such a process would allow irrigators to make decisions early in the season, based on predicted water availability. Such items as whether or not to plant a particular crop, whether to tear out and re-establish hayland, where to concentrate water and similar factors can be managed. The data used for predicting water availability is obtained from the SCS snow survey and water supply forecasting program. Reservoir operation must be done in a coordinated, planned way.

Some tools are critical to making the system work: (1) A reservoir operating guide for the reservoirs along the Musselshell must be prepared and implemented. This has been talked about but not initiated. Such a plan would take some time to prepare. (2) A method of making available reservoir and water supply forecast information must be implemented. (3) A computer program for preparing farm/field level crop water budgets (seasonal water use and availability) must be available. The SCS is presently developing such software which should be available by the end of 1994.

This process would take time and some pioneering work and effort to implement but once implemented should be easy to maintain.

- Moisture Conserving Farming Practices

Use moisture conserving practices such as:

- No till
- Minimum till
- Use tillage equipment that does not turn over soil
- In conjunction with carefully scheduled irrigations, cut hay at the earliest stage consistent with high quality hay. (Mature actively growing plants transpire at a high rate. After cutting, transpiration is drastically reduced)
- Grow crops that need the most water when it is available. For example, grain needs more water early when it is more likely to be available, in comparison to alfalfa which requires water through a long season.

- Management by Flow Measurement

On-farm flow measurement can be used as a water management tool. The measuring devices being installed in the Musselshell basin can be used to better manage water application. The addition of supplemental on-farm measuring devices should be considered. By knowing how much water to apply, based on a water management plan, the proper amount can be measured. Measuring is also an advantage to help spot maintenance problems. Clogged screens, worn pumps, leaks and other problems can be spotted by monitoring flow rates and volumes.

SPRINKLER SYSTEM

- Adequate Intake Screens

Clogged nozzles are a major cause of poor performance by sprinkler systems. A carefully designed, properly maintained screen system can solve the problem. There are modern screen designs that can even keep out weed seeds and do not require electric power.

- Pressure is at Design Pressure

System operating pressure should be regularly checked. Irrigation uniformity and amount will not be correct if the pressure is not as designed. If the system was not properly designed in the first place, have a design done and make appropriate modifications to the system.

Side Roll/Hand Move Sprinklers

- Flow Control Devices at Sprinkler Heads

Flow control nozzles or sprinkler heads can do much to improve sprinkler system distribution efficiency on rolling terrain. The cost of retrofitting a system is not high, but requires proper design.

- Nozzle and coupling Maintenance

Leaking couplings can disrupt the entire system. Worn and leaking sprinkler heads and nozzles are a very common cause of poor sprinkler distribution uniformity. A regular program of maintenance is a low cost, highly effective way to maintain the design efficiency of the system.

Pivot Sprinklers

- Repair Nozzles/ Replace Nozzles

If flow control devices and/or sprinklers are worn or malfunctioning, repair or replace them. Occasionally check flow from selected nozzles and compare to pivot design information.

- Speed Control Set to Appropriate Value

The pivot speed will determine how much water is applied during each application. It is usually most efficient to run a pivot as slow as possible without causing major runoff. Use the chart that came with the pivot which indicates how much is applied at various speed settings. Get a chart if one is not available.

SURFACE

- Plastic Lined Supply Ditches

Ditch loss is one of the major water losses associated with Musselshell irrigation. A long-term, economical way to line off-farm and on-farm supply ditches is with plastic lining material. Since the ditch must be shaped and the lining carefully designed and installed, the cost is moderate.

- Plastic Pipe Supply System

Large diameter plastic pipe now makes replacement of larger off-farm and on-farm supply ditches economically feasible. Advantages include no leakage and the ability to use available head to drive irrigation systems with no pump or a smaller pump. This type of system can make cablegation and surge automation more feasible. A properly designed system requires little maintenance and should last in excess of 25 years. Group projects have many advantages including significant government cost share potential.

- Cablegation

Consider cablegation as an automated method of applying water on furrows and graded borders. For border irrigation, buried pipes with carefully set risers may be used. Cablegation can generally be used on roughly rectangular fields with a cross slope of 0.04 ft/100ft or greater. It is a labor saving, adjustable, highly effective way to automate surface irrigation. The increase in efficiency of irrigation can be substantial. Initial investment is moderate.

- Automated Ditches

Surface system automation can be used in both lined and unlined ditches but is most successful in concrete lined ditches. The method has been used very successfully on the Fairfield Bench in Montana. This type of system reduces labor and conserves water. Initial investment is low to moderate.

- Concrete Lined Ditch

Lining of on-farm ditches with concrete enhances the potential for automation, as well as allowing turnouts that result in accurate control of water. Automation forms include ported ditch and timer operated gate-type turnouts. Maintenance and labor costs are reduced. Installation costs are moderate.

- Pipeline and Risers

A pipeline distribution system permanently installed at the head end of a field with riser valves at every one or two borders. This type of system allows good control of water and little or no ditch loss. Portable automated valve controllers may be available commercially which would allow automating the system.

- Surge Irrigation

Surge irrigation can be used in conjunction with border dikes to improve and automate water application. This procedure is particularly effective on moderate to high intake rate soils. Pipelines can be buried or portable. Controllers are widely available and highly automated. Installation cost is moderate.

- Gated Pipe

Gated pipe is increasingly used for furrow irrigation. It can also be used for graded border and contour type flood irrigation. The advantage of gated pipe is the lack of ditch loss and better water distribution. Outflow can be accurately controlled. A key to successful use of gated pipe is a good screening system at the inlet. Since the pipe is portable, it can be moved around in rotations. Cost of a gated pipe system is moderate.

- Layflat Tubing

Layflat tubing is used like gated pipe except that it is low cost an lasts only one or two years. In addition to low initial cost, an advantage is that turnouts are punched in the pipe where needed and to the size needed. This allows accurate, customized distribution. Simple holes in the pipe or inserted gates can be used. The ground should be prepared where the pipe lays.

- Land Leveling

Land leveling to a designed plane will dramatically improve flood irrigation distribution uniformity and reduce deep percolation and runoff, if properly managed. The disadvantages are the cost and removal of topsoil from cut areas. In general, soil productivity will be reduced due to the leveling process.

- Land Smoothing Between Rotations

Land smoothing and/or planing between rotations can significantly improve water distribution uniformity. This is usually done with a land plane. Perhaps a community owned land plane or rental of some kind would lower the cost.

- Tailwater Return System

Where water is short, tailwater return systems can be economically feasible. Such systems can take many forms and require careful design and management. Cost is highly variable but in the Musselshell area would need to be low to be feasible.

- Ripping/Renovation

Carefully executed ripping/renovation of irrigated pasture and hayland can enhance production and the way water enters the soil. Ripping must be performed under the proper moisture conditions.

- Corrugations

Corrugations may be used to improve water distribution uniformity on unleveled flood irrigated land. A commercially or specially built corrugator creates good corrugations, which are a key to the method. Such an implement has adjustable widths and presses down the spoil from corrugations when they are made. This is a relatively low cost way to improve irrigation efficiency.

- Border Dikes

border dikes that are constructed properly are essential to successful, efficient graded border or guide border type irrigation. The best borders are those that equipment can operate on or over. Construction techniques vary, but it is worth the effort to do them right. Community owned special equipment or rental equipment may be an option for economical construction of borders.

APPENDIX B

MUSSELSHELL WATER MANAGEMENT
Monthly Irrigation Application Efficiency Estimates
by John Dalton, Agricultural Engineer, Bozeman, MT

There are no known Montana based studies that provide information on irrigation application efficiencies on a monthly basis. Such a study would involve considerable field measurement data and analysis. We do know that efficiencies throughout the season vary from overall seasonal efficiencies.

Our approach in estimating monthly efficiencies is to adjust the calculated seasonal irrigation efficiency by a percentage factor based on the following analysis. Table 1 displays our estimated monthly adjustment factors.

Table 1
Application Efficiency Monthly Adjustments
(Multiply seasonal application efficiency by the factor)

Month	Adjustment Factor
April	0.65
May	0.65
June	0.95
July	1.15
August	0.85
September	0.50
October	0.50

The Wind River Basin Water Supply Study, in Wyoming, tied monthly efficiencies to monthly irrigation diversions. Months with greatest diversions had proportionally higher monthly efficiency values. Table 7 in the Wind River report displays the monthly efficiency values derived by analysis of net irrigation requirements compared to diversions for each month. (See Table 7 of Wind River Report in Supporting Data)

We believe that irrigation procedures and conditions are enough alike to compare Musselshell efficiencies to Wind River efficiencies. We studied the wind river monthly efficiencies and compared each monthly value to the seasonal. An adjustment factor for each month for each study area was thus calculated. The average of these values were used as a partial basis for our estimated Musselshell factors. (See Revised Table 7 in Supporting Data)

In general, monthly efficiencies will depend on the following factors:

Early in season

Early in the season, most of stored carryover moisture is used. Most irrigators do not carefully determine status of soil moisture before irrigating. Typically, irrigation is started more by when water is available than what the specific soil moisture need is. Scheduling between irrigation may be erratic. This is when most natural precipitation occurs. It is hard to predict precipitation, so an

irrigation may take place just before a major rain. These factors tend to lower monthly irrigation efficiency values.

In many cases, surface irrigation is only performed one or two times in a season. If there are two irrigations, the first is probably in mid to late June.

Mid Season

By mid season (late June, July), irrigations are fairly regularly scheduled, assuming there are more than one or two irrigations during the season. Since irrigations probably barely keep up with needs, and irrigators are watching water fairly closely, this is the time for maximum application efficiency. If there is only one irrigation during a season, this is when the second irrigation is probably applied. Because of these factors, efficiencies at this time are probably higher than seasonal efficiencies.

A factor tending to lower efficiencies during this time is that there is fierce competition for the water. Everyone can't have water when it is optimally needed. We believe that because of this, the efficiency factor during this period would tend to be lower than Wind River.

Late Season

Sometimes there is no water during late season (August, September, October) and crops often suffer. Even though consumptive use calculations show a water need, water may not be available. If water is available, there is fierce competition for it. Who gets it and when will depend on location along the river, water rights, share ownership and other factors. In general, the user has much less control on when and how much to irrigate. We believe irrigation efficiencies are relatively low during this period.

We used all the factors described above, and a healthy dose of judgment based on experience, in our analysis to determine monthly efficiency adjustment factors. We tried to adjust the factors so the total gross seasonal irrigation requirements, based on monthly efficiencies, are close to gross needs calculated based on seasonal net irrigation requirements and seasonal efficiency.

Weighted Monthly Efficiency
Husselshell Project
Upper Husselshell

Site Location	Field	Acres	Seasonal Efficiency
5	1	240	51.85
5	2	88	36.73
6	1	81	28.69
1	1	240	47.91
1	2	300	34.22
2	1	32	35.08
3	1	60	38.28
10	1	400	31.14
10	2	173	20.90
7	1	30	45.65
8	1	70	38.38

Total Acres 1714

Monthly Net Irrigation Requirements

Apr	May	Jun	Jul	Aug	Sep	Oct
0.00	0.08	3.88	5.52	0.97	0.00	0.00
0.00	0.00	2.68	5.21	0.16	0.00	0.00
0.00	0.49	3.80	5.45	1.39	0.00	0.00
0.00	0.00	2.98	5.24	0.41	0.00	0.00
0.00	0.00	2.47	4.21	3.66	0.87	0.00
0.00	0.00	1.46	4.28	0.00	0.00	0.00
0.00	0.00	1.47	4.14	3.55	0.00	0.00
0.00	0.00	2.72	5.95	4.40	0.00	0.00
0.00	0.00	2.07	4.80	4.08	0.30	0.00
0.00	0.00	2.18	4.88	4.15	0.35	0.00
0.00	0.00	2.77	5.99	4.45	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00

% of Seasonal Efficiency (average)

Apr	May	Jun	Jul	Aug	Sep	Oct
65.00	65.00	95.00	115.00	85.00	50.00	50.00

Adjusted Monthly Efficiency

Apr	May	Jun	Jul	Aug	Sep	Oct
33.70	33.70	49.26	59.63	44.07	25.93	25.93
23.87	23.87	34.89	42.24	31.22	18.37	18.37
18.65	18.65	27.26	32.99	24.39	14.35	14.35
31.14	31.14	45.51	55.10	40.72	23.96	23.96
22.24	22.24	32.51	39.35	29.09	17.11	17.11
22.80	22.80	33.33	40.34	29.82	17.54	17.54
24.88	24.88	36.37	44.02	32.54	19.14	19.14
20.24	20.24	29.58	35.81	26.47	15.57	15.57
13.59	13.59	19.86	24.04	17.77	10.45	10.45
29.67	29.67	43.37	52.50	38.80	22.83	22.83
24.95	24.95	36.46	44.14	32.62	19.19	19.19
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00

Seasonal Net Requirements	Gross Per Adjustd Effic.	Gross Per Seasonal Effic.
10.45	19.57	20.15
8.05	20.53	21.92
11.13	38.79	38.79
8.63	17.06	18.01
11.21	35.96	32.76
5.74	14.99	16.36
9.16	24.36	23.93
13.07	42.43	41.97
11.25	56.23	53.83
11.56	26.55	25.32
13.21	34.81	34.42
0.00	0.00	0.00
0.00	0.00	0.00

Monthly Gross Irrigation Water Requirements

Apr	May	Jun	Jul	Aug	Sep	Oct
0.00	0.24	7.88	9.26	2.20	0.00	0.00
0.00	0.00	7.68	12.33	0.51	0.00	0.00
0.00	2.63	13.94	16.52	5.70	0.00	0.00
0.00	0.00	6.55	9.51	1.01	0.00	0.00
0.00	0.00	7.60	10.70	12.58	5.08	0.00
0.00	0.00	4.38	10.61	0.00	0.00	0.00
0.00	0.00	4.04	9.40	10.91	0.00	0.00
0.00	0.00	9.19	16.62	16.62	0.00	0.00
0.00	0.00	10.43	19.97	22.97	2.87	0.00
0.00	0.00	5.03	9.30	10.70	1.53	0.00
0.00	0.00	7.60	13.57	13.64	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00

Weighted Monthly Efficiency --> 24.0 24.0 35.1 42.5 31.4 18.5 18.5
Weighted season efficiency --> 36.9 % for upper reach of river
(Weighted by acres)

Weighted Efficiency
Adjusted Monthly Efficiency x Acres

Apr	May	Jun	Jul	Aug	Sep	Oct	Season
8089	8089	11822	14311	10577	6222	6222	12444
2101	2101	3071	3717	2747	1616	1616	3232
1511	1511	2208	2672	1975	1162	1162	2324
7474	7474	10923	13223	9774	5749	5749	11498
6673	6673	9753	11806	8726	5133	5133	10266
730	730	1066	1291	954	561	561	1123
1493	1493	2182	2641	1952	1148	1148	2297
8096	8096	11833	14324	10588	6228	6228	12456
2350	2350	3435	4158	3073	1808	1808	3616
890	890	1301	1575	1164	685	685	1370
1744	1744	2549	3085	2280	1341	1341	2683
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
Total 41150	41150	60142	72804	53812	31654	31654	63308

Weighted Monthly Efficiency
Husselshell Project
Central Husselshell

% of Seasonal Efficiency (average)
65.00 65.00 95.00 115.00 85.00 50.00 50.00

Site Location	Field	Acres	Seasonal Efficiency	Monthly Net Irrigation Requirements Apr	May	Jun	Jul	Aug	Sep	Oct	Adjusted Monthly Efficiency Apr	May	Jun	Jul	Aug	Sep	Oct
11	1	80.0	39.99	0.00	0.07	3.96	6.27	5.05	0.34	0.00	25.99	25.99	37.99	45.99	33.99	20.00	20.00
11	2	120.0	41.05	0.00	0.00	3.51	6.25	4.88	0.00	0.00	26.68	26.68	39.00	47.21	34.89	20.53	20.53
11	3	130.0	29.27	0.00	0.00	3.36	6.25	4.74	0.00	0.00	19.03	19.03	27.81	33.66	24.88	14.64	14.64
12	1	119.0	52.88	0.00	1.69	4.42	6.55	5.30	1.80	0.00	34.37	34.37	50.24	60.81	44.95	26.44	26.44
12	8	12.0	58.76	0.00	0.00	3.57	6.25	4.94	0.00	0.00	38.19	38.19	55.82	67.57	49.95	29.38	29.38
13	2	17.1	42.68	0.00	0.00	3.57	6.25	4.94	0.00	0.00	27.74	27.74	40.55	49.08	36.28	21.34	21.34
13	11	15.5	37.22	0.00	0.00	3.69	6.30	5.01	0.00	0.00	24.19	24.19	35.36	42.80	31.64	18.61	18.61
13	8	13.1	24.05	0.00	0.00	3.57	6.25	4.94	0.00	0.00	15.63	15.63	22.85	27.66	20.44	12.03	12.03
14	8	39.4	47.21	0.00	0.96	4.10	6.36	5.12	1.18	0.00	30.69	30.69	44.85	54.29	40.13	23.61	23.61
14	11	21.4	22.80	0.00	0.00	3.17	6.25	4.55	0.00	0.00	14.82	14.82	21.66	26.22	19.38	11.40	11.40
16	1	135.0	45.27	0.00	1.76	5.12	7.58	6.25	1.47	0.00	29.43	29.43	43.01	52.06	38.48	22.64	22.64
16	2	38.0	53.95	0.00	0.23	4.62	7.27	6.01	0.15	0.00	35.07	35.07	51.25	62.04	45.86	26.98	26.98
17	1	90.0	38.27	0.00	0.63	4.63	7.28	6.02	0.54	0.00	24.88	24.88	36.36	44.01	32.53	19.14	19.14
18	4	24.6	46.58	0.00	0.56	4.63	7.27	6.02	0.47	0.00	30.28	30.28	44.25	53.57	39.59	23.29	23.29
				0.00	0.00					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				0.00	0.00				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Total Acres 855.1

Seasonal Net Requirements	Gross Per Adjustd Effic.	Gross Per Seasonal Effic.	Monthly Gross Irrigation Water Requirements Apr	May	Jun	Jul	Aug	Sep	Oct	Weighted Efficiency Adjusted Monthly Efficiency x Acres Apr	May	Jun	Jul	Aug	Sep	Oct	Season
15.69	40.88	39.23	0.00	0.27	10.42	13.63	14.86	1.70	0.00	2079	2079	3039	3679	2719	1600	1600	3199
14.64	36.23	35.66	0.00	0.00	9.00	13.24	13.99	0.00	0.00	3202	3202	4680	5665	4187	2463	2463	4926
14.35	49.70	49.03	0.00	0.00	12.08	18.57	19.05	0.00	0.00	2473	2473	3615	4376	3234	1903	1903	3805
19.76	43.09	37.37	0.00	4.92	8.80	10.77	11.79	6.81	0.00	4090	4090	5978	7237	5349	3146	3146	6293
14.76	25.54	25.12	0.00	0.00	6.40	9.25	9.89	0.00	0.00	458	458	670	811	599	353	353	705
14.76	35.16	34.58	0.00	0.00	8.80	12.73	13.62	0.00	0.00	474	474	693	839	620	365	365	730
15.00	40.99	40.30	0.00	0.00	10.44	14.72	15.84	0.00	0.00	375	375	548	663	490	288	288	577
14.76	62.39	61.37	0.00	0.00	15.63	22.60	24.17	0.00	0.00	205	205	299	362	268	158	158	315
17.72	41.74	37.53	0.00	3.13	9.14	11.71	12.76	5.00	0.00	1209	1209	1767	2139	1581	930	930	1860
13.97	61.95	61.27	0.00	0.00	14.64	23.84	23.48	0.00	0.00	317	317	464	561	415	244	244	488
22.18	55.18	48.99	0.00	5.98	11.91	14.56	16.24	6.49	0.00	3972	3972	5806	7028	5195	3056	3056	6111
18.28	35.05	33.88	0.00	0.66	9.01	11.72	13.11	0.56	0.00	1333	1333	1948	2358	1743	1025	1025	2050
19.10	53.14	53.14	0.00	2.53	12.73	16.54	18.51	2.82	0.00	2239	2239	3272	3961	2928	1722	1722	3444
18.95	43.11	40.68	0.00	1.85	10.46	13.57	15.20	2.02	0.00	745	745	1089	1318	974	573	573	1146
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0
										-----	-----	-----	-----	-----	-----	-----	-----
Weighted Monthly Efficiency -->			27.1	27.1	39.6	47.9	35.4	20.8	20.8	Total 23172	23172	33867	40997	30302	17825	17825	35650

Weighted season efficiency --> 41.7 % for central reach of river
(Weighted by acres)

Weighted Monthly Efficiency
Musselshell Project
Lower Musselshell

Site Location	Field	Acres	Seasonal Efficiency	Monthly Net Irrigation Requirements Apr	May	Jun	Jul	Aug	Sep	Oct
			% of Seasonal Efficiency (average)	65.00	65.00	95.00	115.00	85.00	50.00	50.00
19	11	56.3	45.40	0.00	0.62	4.71	7.32	6.05	0.50	0.00
19	5	19.6	49.18	0.00	1.02	4.65	7.29	6.03	0.93	0.00
19	A	1.5	45.40	0.00	0.62	4.71	7.32	6.05	0.50	0.00
20	1	36.4	68.24	0.00	0.56	4.63	7.27	6.02	0.47	0.00
20	11	45.2	48.37	0.00	2.03	4.82	7.39	0.22	0.12	0.00
20	10	8.0	39.90	0.00	2.03	4.82	7.39	6.11	1.87	0.00
22	2	31.4	47.82	0.05	0.61	4.64	7.22	0.23	0.17	0.00
22	586	77.7	36.58	0.00	0.21	4.71	7.25	3.82	0.00	0.00
25	2	37.0	47.59	0.00	0.15	4.63	7.20	3.78	0.00	0.00
25	1	27.0	51.70	0.00	0.15	4.63	7.20	3.78	0.00	0.00
26	1	31.0	47.81	0.00	0.91	4.67	7.23	4.53	0.00	0.00
26	2	43.0	47.40	0.00	0.91	4.67	7.23	4.53	0.00	0.00
28	1	120.0	34.38	0.00	0.91	4.67	7.23	4.53	0.00	0.00
29	1	34.0	42.10	0.00	0.63	4.65	7.22	4.26	0.00	0.00
29	283	70.0	29.68	0.00	0.63	4.65	7.22	4.26	0.00	0.00
Total Acres		638.1								

Site Location	Field	Adjusted Monthly Efficiency Apr	May	Jun	Jul	Aug	Sep	Oct
19	11	29.51	29.51	43.13	52.21	38.59	22.70	22.70
19	5	31.97	31.97	46.72	56.56	41.80	24.59	24.59
19	A	29.51	29.51	43.13	52.21	38.59	22.70	22.70
20	1	44.36	44.36	64.83	78.48	58.00	34.12	34.12
20	11	31.44	31.44	45.95	55.63	41.11	24.19	24.19
20	10	25.94	25.94	37.91	45.89	33.92	19.95	19.95
22	2	31.08	31.08	45.43	54.99	40.65	23.91	23.91
22	586	23.78	23.78	34.75	42.07	31.09	18.29	18.29
25	2	30.93	30.93	45.21	54.73	40.45	23.80	23.80
25	1	33.61	33.61	49.12	59.46	43.95	25.85	25.85
26	1	31.08	31.08	45.42	54.98	40.64	23.91	23.91
26	2	30.81	30.81	45.03	54.51	40.29	23.70	23.70
28	1	22.35	22.35	32.66	39.54	29.22	17.19	17.19
29	1	27.37	27.37	40.00	48.42	35.78	21.05	21.05
29	283	19.29	19.29	28.20	34.13	25.23	14.84	14.84

Site Location	Field	Seasonal Net Requirements	Gross Per Adjustd Effic.	Gross Per Seasonal Effic.	Monthly Gross Irrigation Water Requirements Apr	May	Jun	Jul	Aug	Sep	Oct
19	11	19.20	44.92	42.29	0.00	2.10	10.92	14.02	15.68	2.20	0.00
19	5	19.92	44.24	40.50	0.00	3.19	9.95	12.89	14.42	3.78	0.00
19	A	19.20	44.92	42.29	0.00	2.10	10.92	14.02	15.68	2.20	0.00
20	1	18.95	29.42	27.77	0.00	1.26	7.14	9.26	10.38	1.38	0.00
20	11	14.58	31.26	30.14	0.00	6.46	10.49	13.29	0.54	0.50	0.00
20	10	22.22	64.04	55.69	0.00	7.83	12.72	16.11	18.02	9.37	0.00
22	2	12.92	26.74	27.02	0.16	1.96	10.21	13.13	0.57	0.71	0.00
22	586	15.99	43.96	43.71	0.00	0.88	13.55	17.23	12.29	0.00	0.00
25	2	15.76	33.23	33.12	0.00	0.48	10.24	13.16	9.34	0.00	0.00
25	1	15.76	30.58	30.48	0.00	0.45	9.43	12.11	8.60	0.00	0.00
26	1	17.34	37.51	36.27	0.00	2.93	10.28	13.15	11.15	0.00	0.00
26	2	17.34	37.83	36.58	0.00	2.95	10.37	13.26	11.24	0.00	0.00
28	1	17.34	52.16	50.44	0.00	4.07	14.30	18.29	15.50	0.00	0.00
29	1	16.76	40.75	39.81	0.00	2.30	11.63	14.91	11.90	0.00	0.00
29	283	16.76	57.80	56.47	0.00	3.27	16.49	21.15	16.89	0.00	0.00
Weighted Monthly Efficiency -->					27.7	27.7	40.5	49.1	36.3	21.3	21.3
Weighted season efficiency -->					42.7 % for lower reach of river						
(Weighted by acres)											

Site Location	Field	Weighted Efficiency Adjusted Monthly Efficiency x Acres Apr	May	Jun	Jul	Aug	Sep	Oct	Season
19	11	1661	1661	2428	2939	2173	1278	1278	2556
19	5	627	627	916	1109	819	482	482	964
19	A	44	44	65	78	58	34	34	68
20	1	1615	1615	2360	2857	2111	1242	1242	2484
20	11	1421	1421	2077	2514	1858	1093	1093	2186
20	10	207	207	303	367	271	160	160	319
22	2	976	976	1426	1727	1276	751	751	1502
22	586	1847	1847	2700	3269	2416	1421	1421	2842
25	2	1145	1145	1673	2025	1497	880	880	1761
25	1	907	907	1326	1605	1187	698	698	1396
26	1	963	963	1408	1704	1260	741	741	1482
26	2	1325	1325	1936	2344	1732	1019	1019	2038
28	1	2682	2682	3919	4744	3507	2063	2063	4126
29	1	930	930	1360	1646	1217	716	716	1431
29	283	1350	1350	1974	2389	1766	1039	1039	2078
		17701	17701	25871	31318	23148	13616	13616	27233

APPENDIX C

MUSSELSHELL WATER MANAGEMENT
Existing System Seasonal Efficiencies
by System Type

MUSSELSHELL WATER MANAGEMENT STUDY
BORDER IRRIGATION SUMMARY
4/14/94

EXISTING IRRIGATION SYSTEM

Total border irrigated acres	521.5 acres
Existing weighted average irrigation application efficiency	47.4 percent (For borders throughout Musselshell)
Net seasonal irrigation water requirements	256.0 acre feet/year
Gross seasonal irrigation water requirements	540.1 acre feet/year

FACTOR	Graded Border	Graded Border	Graded Border	Graded Border	Graded Border	Graded Border	Graded Border	Graded Border	Graded Border	Graded Border	Graded Border	Graded Border	Level Basin	Graded Border	Graded Border
Farm	11	12	13	14	16	18	19	20	22	25	25	26	26	28	29
Field	1	8	2	8	2	4	5	1	2	2	1	1	22	2	1
Acres	80	12	17.1	39.4	38	24.6	19.6	36.4	31.4	37	27	31	43	51	34
Net Requirement (in)	15.67	14.77	14.77	17.71	18.28	18.95	19.91	18.95	16.71	15.75	15.75	17.34	17.34	17.34	16.76
Gross (ac ft)	260.4	25.1	49.3	123.2	106.9	83.4	66.1	84.2	91.4	102.1	69.4	93.5	131.1	191.6	112.5
Potential efficiency	80	80	80	80	80	80	80	80	80	80	80	80	90	80	80
Seasonal Efficiency	40.12	58.90	42.68	47.20	54.17	46.58	49.18	68.24	47.82	47.58	51.07	47.92	47.40	38.46	42.21
Water measurement	0.90	0.96	0.96	0.96	0.94	0.94	0.94	0.94	1.00	0.96	0.96	0.90	0.90	0.90	0.90
Soil/moisture sched.	0.94	0.95	0.92	0.94	0.94	0.94	0.97	0.95	0.90	0.94	0.94	0.94	0.94	0.94	0.94
Irr. skills & action	0.80	0.92	0.90	0.92	0.92	0.92	0.92	0.95	0.92	0.98	1.00	0.98	0.98	0.92	0.95
System maintenance	0.94	0.94	0.95	0.94	0.94	0.94	0.94	0.95	0.94	0.98	0.98	0.98	0.94	0.94	0.98
Water Delivery	0.98	0.98	0.93	0.93	0.93	0.98	0.93	0.98	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Soil condition	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Water control	0.98	0.98	0.98	0.98	0.98	1.00	0.98	1.00	1.00	0.98	1.00	1.00	1.00	0.98	0.98
Conveyance effic	0.95	0.90	0.95	0.96	0.99	1.00	0.99	1.00	1.00	0.97	1.00	0.96	1.00	0.97	0.89
Land leveling	0.90	0.90	0.85	0.90	0.93	0.81	0.90	0.90	1.00	0.94	0.94	1.00	0.88	0.90	1.00
Water reuse factor	1.00	1.25	1.00	1.00	1.10	1.00	1.00	1.25	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Climate (Sprink)															
Sprinkler design															
Wind (Sprink)															

HUSSELSHELL WATER MANAGEMENT STUDY
SPRINKLER IRRIGATION SUMMARY
4/14/94

EXISTING IRRIGATION SYSTEM

Total sprinkler irrigated acres	1005.0	acres
Existing weighted average irrigation application efficiency	46.3	percent (for sprinklers throughout Musselshell)
Net seasonal irrigation water requirements	147.8	acre feet/year
Gross seasonal irrigation water requirements	319.3	acre feet/year

FACTOR	Pivot Sprinkler	Pivot Sprinkler	Big Gun	Pivot Sprinkler	Wheel Line	Hand Line	Wheel Line	Wheel Line	Pivot Sprinkler
Farm	5	12	13	16	19	19	22	28	1
Field	1	1	11	1	11	A	586	1	1
Acres	240	119	15.5	135	56.3	1.5	77.7	120	240
Net Requirement (in)	10.44	19.76	15	22.19	19.21	19.21	15.99	17.34	8.63
Gross (ac ft)	402.7	370.6	52.1	551.5	198.5	5.3	283.0	504.3	360.3
Potential efficiency	80	80	60	80	70	70	70	70	85
Seasonal Efficiency	51.85	52.88	37.22	45.27	45.40	45.40	36.58	34.38	47.91
Water measurement	1.00	1.00	1.00	0.94	0.94	0.94	1.00	0.90	0.90
Soil/moisture sched.	0.94	0.95	0.92	0.94	0.97	0.97	0.90	0.94	0.90
Irr. skills & action	0.92	0.90	0.90	0.92	0.92	0.92	0.92	0.92	0.90
System maintenance	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Water Delivery	0.93	0.98	0.93	0.93	0.98	0.98	0.80	0.80	0.93
Soil condition	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Water control	1.00	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00
Conveyance effic	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Land leveling									
Water reuse factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Climate (Sprink)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sprinkler design	0.95	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.98
Wind (Sprink)	0.94	0.94	0.96	0.91	0.94	0.94	0.94	0.94	0.94

MUSSELSHELL WATER MANAGEMENT STUDY
FLOOD IRRIGATION SUMMARY

EXISTING IRRIGATION SYSTEM

Total flood irrigated acres	1588.4	acres
Existing weighted average irrigation application efficiency	32.1	percent (For flood irrigation throughout Musselshell)
Net seasonal irrigation water requirements	168.9	acre feet/year
Gross seasonal irrigation water requirements	526.1	acre feet/year

FACTOR	Contour Ditch	Contour Ditch	Contour Ditch	Contour Ditch	Uncontrol Flood	Uncontrol Flood	Control Flood	Contour Ditch	Contour Ditch	Contour Ditch	Contour Ditch	Contour Ditch	Control Flood	Contour Ditch
Farm	5	6	11	11	13	14	29	1	2	3	7	10	10	8
Field	2	1	2	3	8	8	283	2	1	1	1	2	1	1
Acres	88	81	120	130	13.1	21.4	70	300	32	60	30	173	400	69.9
Net Requirement (in)	8.04	11.13	14.64	14.35	14.77	13.96	16.76	11.21	5.74	9.16	11.56	11.26	13.07	13.21
Gross (ac ft)	160.5	261.9	356.6	531.2	67.0	109.2	328.7	818.9	43.6	119.6	63.3	776.5	1399.3	200.5
Potential efficiency	65	65	65	65	50	50	60	65	65	65	65	65	65	65
Seasonal Efficiency	36.73	28.69	41.05	29.27	24.05	22.80	29.74	34.22	35.08	38.28	45.65	20.90	31.14	38.38
Water measurement	0.90	0.94	0.96	0.90	0.96	0.96	0.90	0.90	0.90	0.90	0.96	0.90	0.90	0.90
Soil/moisture sched.	0.94	0.90	0.94	0.94	0.92	0.94	0.94	0.90	0.90	0.90	0.93	0.92	0.92	0.90
Irr. skills & action	0.80	0.80	0.95	0.80	0.90	0.80	0.92	0.90	0.92	0.92	0.98	0.92	0.95	0.90
System maintenance	0.98	0.94	0.94	0.94	0.95	0.94	0.94	0.98	0.94	0.96	0.98	0.98	0.98	0.98
Water Delivery	0.93	0.85	0.96	0.90	0.93	0.93	0.80	0.96	0.93	0.93	0.93	0.96	0.96	0.93
Soil condition	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Water control	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.95	0.98	0.98	0.98	0.98	0.98
Conveyance effic	0.95	0.92	0.98	0.92	0.91	0.96	0.93	0.85	0.87	0.94	0.94	0.53	0.86	0.96
Land leveling	0.82	0.82	0.77	0.79	0.80	0.80	0.88	0.80	0.87	0.77	0.83	0.75	0.80	0.82
Water reuse factor	1.25	1.15	1.15	1.15	1.00	1.00	1.10	1.20	1.20	1.30	1.20	1.20	1.00	1.20
Climate (Sprink)														
Sprinkler design														
Wind (Sprink)														

APPENDIX D
COST ESTIMATES

Improvement Cost Summary
Musselshell Study

Acres	Irrigation Type	Existing Seasonal Efficiency	With Increased Management 1st Year Cost Efficiency	$/40 A	$/1 A	Convert System to: Automated Ditch Application Efficiency	$/40 A	$/1 A	Convert System to: Lateral Move Sprinkler System Efficiency	$/40 A	$/1 A	Convert System to: Improved Gated Pipe System Efficiency	$/40 A	$/1 A
	Border													
406.5	Graded border	48.65	61.44	$4,808.00	$120.20	71.52	$39,240.00	$981.00	67.14	$41,880.00	$1,047.00	?	$23,838.00	$595.95
43.0	Level basin	47.40	67.05	$4,808.00	$120.20	?	$39,240.00	$981.00						
0.0	Surge													
	Flood													
419.0	Cont Ditch, Controll	34.15	52.17	$4,808.00	$120.20				54.31	$41,880.00	$1,047.00	?	$23,838.00	$595.95
104.5	Uncontrolled (wild)	27.57	37.66	$4,808.00	$120.20				?	$41,880.00	$1,047.00	?	$23,838.00	$595.95
	Furrow													
0.0	Corrugation													
	Sprinkler													
15.5	Big gun	37.22	51.43	$5,110.00	$127.75									
494.0	Pivot	50.30	67.44	$5,110.00	$127.75									
308.7	Lateral Move	39.19	52.62	$5,110.00	$127.75									
1791.2	Total Acres Sampled													

Conservation Irrigation Practices Cost Analysis
by John C. Dalton

The following scenarios are typical of what might be done to improve some on-farm irrigation systems in the Musselshell basin. The costs are capital costs for improved irrigation system only and do not include costs to re-establish the crop or operation and maintenance costs.

The existing system consists of 40 acres of contour ditch flooded ground. The ground is reasonably level and has had some smoothing done. Water supply is from a main ditch through an earth farm supply ditch.

The rectangular field is 1450 feet wide by 1200 feet in the direction of irrigation. The principal crop is grass hay. The proposed crop is alfalfa with periodic rotations of small grain used in the alfalfa reestablishment process.

Cost figures are generally based on the Montana SCS 1993 Cost List for the Great Plains Conservation Program.

There is actually no "typical" irrigated field. Each field is unique and requires careful analysis to come up with satisfactory irrigation system improvements. In particular, the length of the on farm water conveyance system and the volume of land leveling earthwork will vary greatly between sites. We will use quantities 1,000 feet of on farm water conveyance system to get to the field and 300 CY per acre landleveling earthwork which should give a fair basis for comparison of scenarios.

(NOTE: The figures used in these improvement cost summaries are on the high side of a range that could be expected when converting from one system to another. Individual systems should be evaluated on a case by case basis. The local SCS office can be contacted for help with this information.)

SURFACE SYSTEMS

1. Surface System Using Automated Surge Valve and Gated Pipe

A complete land leveling job will be performed to bring the entire 40 acre field into a single plane with a slope of 0.004 in the direction of irrigation. The field will be converted to a graded border system using a surge gated pipe application system. A new on-farm delivery system will consist of 1000 feet of plastic underground conveyance pipe from the main ditch to the center of the upper edge of the field. A new concrete turnout with gate and fountain type screen, will be constructed at the main ditch. The application system will consist of 12 inch plastic gated pipe controlled by a surge valve. Based on 4 hr sets, 80 ft wide borders, and 3.5 cfs delivery, it will take just over 3 days to irrigate the field. The irrigator will have to visit the field every 8 hours during irrigation.

Land leveling	300 CY/A @ $.90/CY	$10,800
Turnout Structure w/gate, screen	1 ea @ $5,000	5,000
Underground 15" PIP Pipe	1000 ft @ $7.50/ft	7,500
Trenching for pipe	1000 ft @ $0.60/ft	600
Flow meter 12"	1 ea @ $960	960
Air valve	1 ea @ $170	170
12" hydrant and alfalfa valve	1 ea @ $600	600
Plastic 12" gated pipe	1450 ft @ $4.44/ft	6,438
12" Surge Valve	1 ea @ $2,160	2,160
Prepare borders & seedbed	job	2,000
	Total	$36,228

Capital cost per acre = $905/acre

2. Surface System Using Automated Concrete Lined Ditch System

The existing ditch between the turnout and field will not be changed. A concrete ditch with automated turnouts at each 80 ft wide border will be used to apply water to graded borders. The field will be leveled to a single plane.

Land leveling	300 CY/A @ $.90/CY	$10,800
Flow meter 12"	1 ea @ $960	960
Construct ditch pad	1450 ft @ $1.40/ft	2,030
Install concrete ditch lining	1450ft x 0.065CY/ft x $200/CY	18,850
Turnout/check gate install	18 ea @ 200	3,600
Portable check gate and timer	5 ea @ 200	1,000
Prepare borders & seedbed	job	2,000
	Total	$39,240

Capital cost per acre = $981/acre

3. Surface System With Buried Pipe and Riser/Alfalfa Valves

A new turnout w/o screen and buried plastic pipe conveyance system will be installed between the turnout and field. The field will be leveled to a single plane. A buried plastic pipe with alfalfa valve risers every 160 feet will be installed along the upper edge of the field.

Land leveling	300 CY/A @ $.90/CY	$10,800
Turnout Structure w/gate	1 ea @ $4,000	4,000
Underground 15" PIP Pipe	2400 ft @ $7.50/ft	18,000
Trenching for pipe	2400 ft @ $0.60/ft	1,440
Flow meter 12"	1 ea @ $960	960
Air valve	1 ea @ $170	170
12" riser and alfalfa valve	9 ea @ $320	2,880
Prepare borders & seedbed	job	2,000
	Total	$40,250

Capital cost per acre = $1,006/acre

4. Surface System, Gated Pipe and Land Smoothing

Gated pipe will be used to replace a contour ditch to apply water. Gated pipe will also be used as a conveyance system to the field. Perform land smoothing on the field (The field will be smoothed but not taken to a true single plane.

Land smoothing (based on 150 CY/A)	150 CY/A @ $1.00/C	$6,000
Turnout Structure w/gate, screen	1 ea @ $5,000	5,000
Plastic 12" gated pipe	2450 ft @ $4.44/ft	10,878
Flow meter 12"	1 ea @ $960	960
Prepare seedbed	job	1,000
	Total	$23,838

Capital cost per acre = $596/acre

5. Surface System, Land Leveling Only

Use existing conveyance system. Land level the field and install graded borders.

Land leveling	300 CY/A @ $.90/CY	$10,800
Prepare borders & seedbed	job	2,000
	Total	$12,800

Capital cost per acre = $320/acre

6. Surface System, Management and Minor Improvements Only

Concentrate on upgrading management of the existing system. Make minor system improvements to facilitate management.

Number of irrigations per year 2

Action	Replications	Hourly Cost	Hours /time	Unit Cost	15 yr Cost	1st Cost
Less cost of part time irrigator	-15	7.00	8	112	-1680	-112
Cost of full time irrigator	15	7.00	40	560	8400	560
Irrigation management training	2	15.00	24	360	720	360
Purchase probes and auger	1			200	200	200
Smoothing at re-planting	3			800	2400	800
Flow measuring device to field	1			1500	1500	1500
New or repair water control struct	1			1000	1000	1000
Additional maintenance--ditches	15			400	6000	400
Control or burrowing varmints	15			100	1500	100
				Total	20,040	4,808

Annual cost $1,336.00
First year cost $4,808.00

(Note: Annual costs do not include interest of inflation)

6. Convert to a Side Roll Sprinkler System

Convert from a surface system to a side roll sprinkler irrigation system. An electric booster pump will be installed at the canal turnout. The new turnout/pump structure will include a fountain type screen. An underground plastic pipe will be installed between the turnout and field and underground pipe with risers every 60 feet will be installed along the upper edge of the field. One side roll sprinkler lateral, 1200 feet long will cover the field in 12 days using 11-1/2 hour sets.

Pump/turnout structure w/screen	1 ea @ $4,000	$4,000
Power line installation	job	5,000
Electric 30 HP Centrifugal pump	1 ea	5,000
Underground 10" PIP Pipe (100 psi)	2400 ft @ $5.00	12,000
Trenching for pipe	2400 ft @ $0.60	1,440
Flow meter 10"	1 ea @ $800	800
Air valve	1 ea @ $170	170
Pressure relief valve	1 ea @ $170	170
Risers	24 @ $200	4,800
Side roll sprinkler, 1200 ft	1 ea @$8,500	8,500
	Total	$41,880

Capital cost per acre = $1,047/acre

7. Convert to a Pivot Sprinkler System

Combine the above field in a larger reorganization of fields. Convert to a low pressure, 1/4 mile pivot sprinkler system with end gun, covering 141 acres. Use the unirrigated corners for dryland hay.

Pump/turnout structure w/screen	1 ea @ $4,000	$4,000
Power line installation	job	10,000
Electric 30 HP Centrifugal pump	1 ea	5,000
Underground 10" PIP Pipe (100 psi)	3,320 ft @ $5.00	16,600
Trenching for pipe	3,320 ft @ $0.60	1,992
Flow meter 10"	1 ea @ $800	800
Shutoff valve 10"	1 ea @ $600	600
Air valve	1 ea @ $170	170
Pressure relief valve	1 ea @ $170	170
Low pressure pivot, 1300 ft	1 ea @ $42,000	42,000
	Total	$81,332

Capital cost per acre = $576/acre (based on 141 irrigated acres)

8. Sprinkler System Using Traveling Gun Sprinkler

Convert the same field as above to a high pressure gun traveling sprinkler irrigation system. An electric booster pump will be installed at the canal turnout. The new turnout will include a fountain type screen. An underground plastic pipe will be installed between the turnout and down the center of the field. 100 ft wide lanes will require risers ar 200 ft intervals. Two travelers will be used at 450 gpm each. Note that this type of system is usually not used on this type of field as they usually are used on odd shaped fields.

Pump/turnout Structure w/screen	1 ea @ $4,000	$4,000
Power line installation	job	5,000
Electric 60 HP Centrifugal pump	1 ea	7,000
Underground 10" PIP Pipe (125 psi)	2100 ft @ $6.00	12,600
Trenching for pipe	2100 ft @ $0.60	1,260
Flow meter 10"	1 ea @ $800	800
Air valve	1 ea @ $170	170
Pressure relief valve	1 ea @ $170	170
Risers	6 @ $200	1,200
Water power traveler sprinkler (Traveler prices = $9,000-$20,000)	2 ea @$12,000	24,000
	Total	$56,200

Capital cost per acre = $1,405/acre

9. Sprinkler System, Management and Minor Improvements Only

Concentrate on upgrading management of the existing sprinkler system. Make minor improvements in the system to facilitate management.

Number of irrigations per year 6

	Replic-ations	Hourly Cost	Hours /irrig	Unit Cost	15 yr Cost	1st Cost
Less maint. costs now done	15			-100	-1500	-100
Irrigation management training	2	15.00	24	360	720	360
Purchase p. gauge, probes, auger	1			250	250	250
New sprinkler Heads	2			1000	2000	1000
Flow measuring device to field	1			1500	1500	1500
New or repair screen intake struct	1			1000	1000	1000
Additional maintenance--pipe, hds	13			100	1300	100
Pump maintenance	3			1000	3000	1000
Note: Assume power costs remain the same				Total	8,270	5,110
				Annual cost		$551.33
				First year cost		$5,110.00

(Note: Annual costs do not include interest or inflation)

APPENDIX E
INTERVIEW FORMS AND SITE LOCATIONS

Figure 1
FIRI Worksheet

Musselshell Study Farm No. _____ Field No. _____ page 1

MUSSELSHELL BASIN WATER SUPPLY STUDY
QUESTIONNAIRE & WORKSHEET
(For one field)

County: _____ Study sub-area: _____
Farm number: _____ Field number: _____
Location: T ____ N, R ____ E, Sec. ____
By: _____ Date: _____
FIRI analysis by: _____ Date: _____

Acres irrigated in field: _____ Irrigated acres in farm: _____

TYPE OF IRRIGATION SYSTEM:

Borders: [ ] Graded border [ ] Level basin [ ] Guide border
[ ] Contour border [ ] Border ditch [ ] Surge

Flood: [ ] Controlled [ ] Uncontrolled (wild)
[ ] Contour ditch

Furrow: [ ] Graded [ ] Corrugations [ ] Surge

Sprinklers: [ ] Big gun [ ] Hand line [ ] Wheel line
[ ] Pivot

Approximate typical field slope: ____ %

SOILS: (Select the major controlling soil component for the field)

Map Unit number: _____ Series name: _____
Approximate percentage of field covered by selected soil: _____ %
Intake: Furrow intake: Low ___ Medium ___ High ___ Selected ___
Cylinder intake: Low ___ Medium ___ High ___ Selected ___
Sprinkler group: Low __ Medium __ High __ Selected __

Cumulative available water capacity, by foot:
1 ____ 2 ____ 3 ____ 4 ____ 5 ____

CROPS (Rotation)

Rotation	Description
1	
2	
3	

CROP WATER USE

Climatic station: _____
Planting/start growth date: _____ Harvest/end growth date: _____
Management crop: _____
Management root depth: ____ ft Management allowed depletion: ____ %
Available water capacity: ____ inches Net application: ____ inches
Annual net irrigation requirement _____ inches
Peak consumptive use _____ inch/day

WATER MEASUREMENT

[ ] None [ ] Farm delivery point [ ] Each field or set
Comments: _____

Figure 1 (cont)
FIRI Worksheet

Musselshell Study Farm No. _____ Field No. _____ page-2

SOIL MOISTURE MONITORING AND SCHEDULING

[ ] Whenever convenient [ ] Plant indicators [ ] Probe, feel & appearance
[ ] Water budget program [ ] Soil moisture monitoring [ ] Other
Comments: _____

IRRIGATION ACTION

[ ] Changes when can get to it [ ] Changes in morning and evening
[ ] Changes when water gets to certain point in field
[ ] Has full time irrigator who watches water and adjusts timing, flow
[ ] Automated irrigation [ ] Other
Comments: _____

MAINTENANCE

Turnouts: [ ] Good [ ] Needs some work [ ] Not working well
Runoff control: [ ] Controlled [ ] Needs work [ ] A problem

Border:
[ ] Border not controlling water [ ] Borders can use some work
[ ] Borders work and regularly maintained
[ ] Land smoothed between crop rotations

Flood:
[ ] Ditches well maintained and laid out to grade
[ ] Ditches need work [ ] Lots of problem with ditches
[ ] Land smoothing before replanting

Furrow:
[ ] Shovel clean furrow clogs [ ] Fix the worst clogs [ ] Let it go
[ ] Land smoothing before planting

Sprinklers:
[ ] Clean nozzle clogs every day [ ] Once a week +/- [ ] When really bad
[ ] Repair nozzles, leaks when they occur [ ] Periodically [ ] Each season
[ ] Check nozzle wear each season

Comments: _____

WATER DELIVERY

[ ] Direct diversion from river [ ] Pumped diversion from river
[ ] Diversion from main canal [ ] Diversion from lateral with other users

[ ] Can get all the water needed as long as there is water in river/canal
[ ] Can get water by scheduling with neighbors, ditch rider.
[ ] Hardly ever get water when wanted. Get it when available. Use or loose
Comments: _____

SOIL CONDITION

[ ] If hardpan, is subsoiling and chiseling used?
Tillage: [ ] Notill [ ] Minimum till [ ] Chisel [ ] Disk/plow
Residue: [ ] Conservation tillage [ ] Meets FSA requirements
          [ ] Clean tilled
Comments: _____

Figure 1 (cont)
FIRI Worksheet

Musselshell Study Farm No. _____ Field No. _____ page-3

WATER DISTRIBUTION CONTROL

[ ] Temporary dams in ditches [ ] Poorly maintained flow control structures
[ ] Well maintained flow control structures [ ] Pipeline from canal
Comments: _____

CONVEYANCE LOSSES

Reach No.	Length (ft)	Bottom width (ft)	Soil Type	Growth in ditch (description)

LAND LEVELING

Does length of run appear: [ ] Good [ ] Short [ ] Long

[ ] Unleveled [ ] Smoothed [ ] Leveled years ago [ ] Recent laser leveled
Comments: _____

SPRINKLER DESIGN

[ ] New system, designed for field [ ] Old system, designed for field
[ ] System moved in from somewhere else.
[ ] System does not appear to apply enough water
Comments: _____

WIND FACTOR (Sprinkler)

Average wind speed: ____ MPH
Spray type: [ ] Fine [ ] Medium [ ] Coarse

TAILWATER REUSE

[ ] Tailwater not re-used, returns to main water course
[ ] Tailwater re-used by neighbors
[ ] Tailwater re-used on farm
[ ] Tailwater re-used on same field
Percentage of tailwater re-used on farm: _____

Comments: _____

Musselshell Study
LIST OF EVALUATION FIELDS

Farm Number	T	R	Sec	Fld	System Type	Acres	Weather Station
UPPER SECTION							
1	8	11	15,16	1	Pivot	240	Martinsdale
	8	11	15	2	Cont ditch	320	Martinsdale
2	8	10	29	1	Cont ditch	32	Lennup 6WSW
3	8	12	5	1	Cont ditch	60	Martinsdale
4	No Data Collected						
5	8	11	9	1	Pivot	240	Martinsdale
	8	11	14,15	2	Cont ditch	88	Martinsdale
6	8	12	14	1	Cont ditch	81	Martinsdale
7	8	13	20	1	Cont ditch	30	Harlowton
8	8	15	20	1	Cont ditch	69.9	Harlowton
9	No Data Collected						
10	7	16	6	1	Controlled	400	Harlowton
	7	16	1,2,12	2	Cont ditch	173	Harlowton
CENTRAL SECTION							
11	7	18	30	1	Grd border	80	Barber
	7	17	22	2	Cont ditch	120	Barber
	7	18	36	3	Cont ditch	130	Barber
12	6	19	5	12	Pivot	119	Barber
	6	19	5	8	Grd border	12	Barber
13	6	20	3	2	Grd border	17.1	Barber
	6	20	4	11	Big gun	15.5	Barber
	6	20	4	8	Wild flood	13.1	Barber
14	6	21	1	B	Grd border	39.4	Barber
	6	21	1	H	Wild flood	21.4	Barber
15	No Data Collected						
16	6	22	1	1	Pivot	135	Roundup
	6	22	1,12	2	Grd border	38	Roundup
17	7	25	8	1	Grd border	90	Roundup
18	8	25	23	4	Grd border	24.6	Roundup
LOEWER SECTION							
19	8	27	6	11	Wheel line	56.3	Roundup
	8	26	10	5	Grd border	19.6	Roundup
	8	27	6	6	Hand line	1.5	Roundup
20	8	27	1	1	Grd border	36.4	Roundup
	8	27	1	11	Wheel line	45.2	Roundup
	8	27	1	10	Hand line	8.0	Roundup
21	No Data Collected						

Farm Number	T	R	Sec	Fld	System Type	Acres	Weather Station
22	9	30	9	2	Grd border	31.4	Melstone
	9	30	9	5,6	Wheel line	77.7	Melstone
23	No Data Collected						
24	No Data Collected						
25	11	31	4	1	Grd border	27.0	Melstone
	11	31	4	2	Grd border	140	Melstone
26	14	30	32	1	Grd border	31	Melstone
	13	30	4	2	Level Basin	43	Melstone
27	No Data Collected						
28	15/16	30	32/5	1	Wheel line	120	Melstone
	15	30	30	2	Grd border	51	Melstone
29	16	30	8	2,3	Controlled	70	Melstone
	17	29	24	24	Grd border	34	Melstone
30	No Data Collected						

Appendix 2
NATURAL FLOW DATA FILES

```
TITL MUSSELSHELL RIVER WATER MGNT STUDY
OPTION:UNIT=KAF;
* Station 10, N.F. Musselshell River above Bair Reservoir
*  jan   feb   mar   apr   may   jun   jul   aug   sep   oct   nov   dec   stayr
  0.30  0.33  0.78  0.71  1.72  1.46  0.54  0.39  0.32  0.34  0.42  0.3600001029
  0.20  0.35  0.36  2.34  1.11  0.79  0.46  0.31  0.27  0.30  0.38  0.2900001030
  0.23  0.23  0.46  0.64  0.51  0.50  0.47  0.20  0.27  0.29  0.42  0.2600001031
  0.22  0.14  0.33  0.46  1.33  1.17  0.76  0.28  0.32  0.31  0.40  0.3400001032
  0.28  0.22  0.34  0.52  1.37  1.53  0.72  0.22  0.21  0.21  0.38  0.3500001033
  0.29  0.32  0.42  1.68  0.95  1.84  0.47  0.18  0.29  0.30  0.51  0.3500001034
  0.28  0.16  0.37  0.60  0.76  0.61  0.76  0.20  0.27  0.30  0.36  0.2800001035
  0.18  0.26  0.72  0.65  1.35  0.59  0.46  0.22  0.27  0.29  0.32  0.2700001036
  0.14  0.31  0.31  0.46  1.05  0.80  0.74  0.14  0.27  0.39  0.29  0.2700001037
  0.20  0.32  0.50  0.71  1.40  1.61  1.08  0.78  0.28  0.31  0.48  0.3800001038
  0.38  0.26  0.54  1.34  1.38  0.63  0.72  0.24  0.28  0.29  0.27  0.3300001039
  0.23  0.26  0.42  0.74  0.91  0.61  0.42  0.20  0.24  0.28  0.29  0.3000001040
  0.23  0.19  0.45  0.33  0.32  0.81  0.54  0.26  0.39  0.39  0.38  0.3400001041
  0.28  0.23  0.27  1.48  1.43  2.61  0.96  0.65  0.46  0.43  0.42  0.3800001042
  0.36  0.27  1.13  1.87  1.76  2.34  1.05  0.80  0.46  0.46  0.46  0.3600001043
  0.28  0.24  0.30  0.51  0.75  1.39  1.06  0.70  0.49  0.44  0.39  0.3500001044
  0.36  0.28  0.49  0.41  0.57  1.68  0.75  0.58  0.41  0.41  0.38  0.3100001045
  0.31  0.22  0.84  0.95  1.46  1.43  1.36  0.77  0.60  0.58  0.53  0.5400001046
  0.42  0.45  1.76  1.65  2.67  2.13  1.02  0.88  0.68  0.64  0.58  0.5300001047
  0.50  0.35  0.42  2.14  3.03  3.27  1.68  0.86  0.49  0.44  0.36  0.2800001048
  0.30  0.30  0.31  1.52  2.18  2.16  0.94  0.84  0.63  0.60  0.52  0.3700001049
  0.22  0.83  0.66  1.32  1.73  2.21  1.24  0.98  0.60  0.57  0.46  0.3900001050
  0.26  0.39  0.57  1.00  2.03  1.70  0.70  0.54  0.52  0.36  0.48  0.4100001051
  0.35  0.32  0.33  1.84  2.64  1.51  0.74  0.72  0.54  0.50  0.40  0.3400001052
  0.33  0.34  0.52  0.52  0.95  3.08  1.01  0.64  0.46  0.28  0.46  0.4400001053
  0.31  0.33  0.31  0.66  0.62  0.73  0.40  0.46  0.28  0.39  0.39  0.2600001054
  0.26  0.17  0.15  0.40  0.68  1.10  0.74  0.46  0.23  0.26  0.42  0.3600001055
  0.31  0.28  0.53  1.17  1.49  1.00  0.47  0.41  0.24  0.24  0.33  0.3300001056
  0.27  0.33  0.42  0.80  1.52  1.65  0.95  0.63  0.49  0.47  0.41  0.2900001057
  0.34  0.32  0.63  1.12  1.33  1.04  0.68  0.61  0.47  0.31  0.42  0.4300001058
  0.36  0.29  0.39  0.86  1.23  2.21  1.05  0.62  0.49  0.52  0.42  0.3500001059
  0.31  0.28  0.62  1.01  1.29  1.27  0.49  0.26  0.18  0.18  0.42  0.4100001060
  0.37  0.32  0.40  0.43  0.49  0.49  0.31  0.20  0.18  0.19  0.23  0.2800001061
  0.26  0.31  0.42  0.90  1.21  1.70  0.66  0.38  0.26  0.25  0.39  0.4000001062
  0.26  0.37  0.47  0.71  1.21  1.26  0.72  0.31  0.21  0.22  0.36  0.3600001063
  0.41  0.36  0.31  0.69  2.25  2.46  1.01  0.44  0.33  0.28  0.36  0.4300001064
  0.46  0.38  0.39  1.82  2.44  2.67  1.40  0.74  0.95  0.97  0.77  0.6400001065
  0.42  0.46  1.08  0.90  1.35  0.89  0.38  0.30  0.23  0.31  0.41  0.3700001066
  0.37  0.34  0.38  0.94  2.80  3.88  1.48  0.66  0.66  0.81  0.69  0.5600001067
  0.54  0.67  1.18  0.98  1.67  2.28  1.14  0.79  0.76  0.74  0.63  0.4300001068
  0.39  0.41  0.47  2.44  1.27  0.62  0.47  0.33  0.30  0.33  0.30  0.3400001069
  0.39  0.38  0.40  1.35  3.11  2.02  0.79  0.40  0.32  0.49  0.47  0.4200001070
  0.41  0.36  0.40  1.48  1.99  1.51  0.57  0.34  0.27  0.43  0.43  0.2800001071
  0.30  0.39  1.12  1.01  1.64  1.95  0.88  0.54  0.60  0.62  0.43  0.3600001072
  0.41  0.35  0.44  0.44  0.45  0.32  0.20  0.16  0.18  0.26  0.41  0.3300001073
  0.44  0.30  0.74  1.12  1.47  1.77  0.58  0.49  0.56  0.33  0.49  0.4400001074
  0.36  0.37  0.41  0.55  2.58  3.31  1.76  1.03  0.64  0.51  0.68  0.7500001075
  0.55  0.52  0.66  1.40  2.40  1.36  0.58  0.34  0.27  0.24  0.47  0.3900001076
  0.38  0.38  0.60  1.52  0.62  0.48  0.29  0.22  0.18  0.39  0.49  0.3300001077
  0.36  0.43  0.92  2.45  3.03  2.29  1.39  0.78  0.61  0.70  0.50  0.3800001078
  0.33  0.40  0.65  1.56  2.53  2.65  1.56  0.89  0.63  0.36  0.45  0.4100001079
  0.30  0.33  0.42  2.17  1.14  2.56  1.85  1.04  0.99  0.42  0.53  0.4500001080
  0.37  0.42  0.77  1.60  2.76  2.17  2.30  1.18  0.84  0.30  0.50  0.3800001081
  0.39  0.46  0.75  0.83  1.63  2.86  1.88  0.18  0.96  0.56  0.50  0.4400001082
  0.45  0.43  0.73  0.85  1.41  1.09  1.60  0.73  0.62  0.27  0.52  0.4600001083
  0.48  0.44  0.50  1.13  1.60  1.34  0.73  0.11  0.40  0.40  0.41  0.3300001084
  0.33  0.39  0.48  1.91  0.97  0.39  0.21  0.20  0.42  0.42  0.52  0.4100001085
  0.40  0.39  0.89  1.02  1.44  1.43  0.81  0.46  0.67  0.28  0.46  0.3900001086
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0.26	0.33	0.57	0.92	0.74	0.58	0.57	0.24	0.39	0.33	0.34	0.2700001087
0.22	0.31	0.36	0.75	0.59	0.53	0.24	0.11	0.27	0.25	0.33	0.2900001088
0.25	0.30	0.70	1.33	1.26	0.73	0.59	0.42	0.46	0.33	0.46	0.4200001089

* Station 15, RETURN FLOW STATION, NO NATURAL FLOWS AT THIS STATION

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
0.30	0.33	0.78	0.71	1.72	1.46	0.54	0.39	0.32	0.34	0.42	0.3600001529
0.20	0.35	0.36	2.34	1.11	0.79	0.46	0.31	0.27	0.30	0.38	0.2900001530
0.23	0.23	0.46	0.64	0.51	0.50	0.47	0.20	0.27	0.29	0.42	0.2600001531
0.22	0.14	0.33	0.46	1.33	1.17	0.76	0.28	0.32	0.31	0.40	0.3400001532
0.28	0.22	0.34	0.52	1.37	1.53	0.72	0.22	0.21	0.21	0.38	0.3500001533
0.29	0.32	0.42	1.68	0.95	1.84	0.47	0.18	0.29	0.30	0.51	0.3500001534
0.28	0.16	0.37	0.60	0.76	0.61	0.76	0.20	0.27	0.30	0.36	0.2800001535
0.18	0.26	0.72	0.65	1.35	0.59	0.46	0.22	0.27	0.29	0.32	0.2700001536
0.14	0.31	0.31	0.46	1.05	0.80	0.74	0.14	0.27	0.39	0.29	0.2700001537
0.20	0.32	0.50	0.71	1.40	1.61	1.08	0.78	0.28	0.31	0.48	0.3800001538
0.38	0.26	0.54	1.34	1.38	0.63	0.72	0.24	0.28	0.29	0.27	0.3300001539
0.23	0.26	0.42	0.74	0.91	0.61	0.42	0.20	0.24	0.28	0.29	0.3000001540
0.23	0.19	0.45	0.33	0.32	0.81	0.54	0.26	0.39	0.39	0.38	0.3400001541
0.28	0.23	0.27	1.48	1.43	2.61	0.96	0.65	0.46	0.43	0.42	0.3800001542
0.36	0.27	1.13	1.87	1.76	2.34	1.05	0.80	0.46	0.46	0.46	0.3600001543
0.28	0.24	0.30	0.51	0.75	1.39	1.06	0.70	0.49	0.44	0.39	0.3500001544
0.36	0.28	0.49	0.41	0.57	1.68	0.75	0.58	0.41	0.41	0.38	0.3100001545
0.31	0.22	0.84	0.95	1.46	1.43	1.36	0.77	0.60	0.58	0.53	0.5400001546
0.42	0.45	1.76	1.65	2.67	2.13	1.02	0.88	0.68	0.64	0.58	0.5300001547
0.50	0.35	0.42	2.14	3.03	3.27	1.68	0.86	0.49	0.44	0.36	0.2800001548
0.30	0.30	0.31	1.52	2.18	2.16	0.94	0.84	0.63	0.60	0.52	0.3700001549
0.22	0.83	0.66	1.32	1.73	2.21	1.24	0.98	0.60	0.57	0.46	0.3900001550
0.26	0.39	0.57	1.00	2.03	1.70	0.70	0.54	0.52	0.36	0.48	0.4100001551
0.35	0.32	0.33	1.84	2.64	1.51	0.74	0.72	0.54	0.50	0.40	0.3400001552
0.33	0.34	0.52	0.52	0.95	3.08	1.01	0.64	0.46	0.28	0.46	0.4400001553
0.31	0.33	0.31	0.66	0.62	0.73	0.40	0.46	0.28	0.39	0.39	0.2600001554
0.26	0.17	0.15	0.40	0.68	1.10	0.74	0.46	0.23	0.26	0.42	0.3600001555
0.31	0.28	0.53	1.17	1.49	1.00	0.47	0.41	0.24	0.24	0.33	0.3300001556
0.27	0.33	0.42	0.80	1.52	1.65	0.95	0.63	0.49	0.47	0.41	0.2900001557
0.34	0.32	0.63	1.12	1.33	1.04	0.68	0.61	0.47	0.31	0.42	0.4300001558
0.36	0.29	0.39	0.86	1.23	2.21	1.05	0.62	0.49	0.52	0.42	0.3500001559
0.31	0.28	0.62	1.01	1.29	1.27	0.49	0.26	0.18	0.18	0.42	0.4100001560
0.37	0.32	0.40	0.43	0.49	0.49	0.31	0.20	0.18	0.19	0.23	0.2800001561
0.26	0.31	0.42	0.90	1.21	1.70	0.66	0.38	0.26	0.25	0.39	0.4000001562
0.26	0.37	0.47	0.71	1.21	1.26	0.72	0.31	0.21	0.22	0.36	0.3600001563
0.41	0.36	0.31	0.69	2.25	2.46	1.01	0.44	0.33	0.28	0.36	0.4300001564
0.46	0.38	0.39	1.82	2.44	2.67	1.40	0.74	0.95	0.97	0.77	0.6400001565
0.42	0.46	1.08	0.90	1.35	0.89	0.38	0.30	0.23	0.31	0.41	0.3700001566
0.37	0.34	0.38	0.94	2.80	3.88	1.48	0.66	0.66	0.81	0.69	0.5600001567
0.54	0.67	1.18	0.98	1.67	2.28	1.14	0.79	0.76	0.74	0.63	0.4300001568
0.39	0.41	0.47	2.44	1.27	0.62	0.47	0.33	0.30	0.33	0.30	0.3400001569
0.39	0.38	0.40	1.35	3.11	2.02	0.79	0.40	0.32	0.49	0.47	0.4200001570
0.41	0.36	0.40	1.48	1.99	1.51	0.57	0.34	0.27	0.43	0.43	0.2800001571
0.30	0.39	1.12	1.01	1.64	1.95	0.88	0.54	0.60	0.62	0.43	0.3600001572
0.41	0.35	0.44	0.44	0.45	0.32	0.20	0.16	0.18	0.26	0.41	0.3300001573
0.44	0.30	0.74	1.12	1.47	1.77	0.58	0.49	0.56	0.33	0.49	0.4400001574
0.36	0.37	0.41	0.55	2.58	3.31	1.76	1.03	0.64	0.51	0.68	0.7500001575
0.55	0.52	0.66	1.40	2.40	1.36	0.58	0.34	0.27	0.24	0.47	0.3900001576
0.38	0.38	0.60	1.52	0.62	0.48	0.29	0.22	0.18	0.39	0.49	0.3300001577
0.36	0.43	0.92	2.45	3.03	2.29	1.39	0.78	0.61	0.70	0.50	0.3800001578
0.33	0.40	0.65	1.56	2.53	2.65	1.56	0.89	0.63	0.36	0.45	0.4100001579
0.30	0.33	0.42	2.17	1.14	2.56	1.85	1.04	0.99	0.42	0.53	0.4500001580
0.37	0.42	0.77	1.60	2.76	2.17	2.30	1.18	0.84	0.30	0.50	0.3800001581
0.39	0.46	0.75	0.83	1.63	2.86	1.88	0.18	0.96	0.56	0.50	0.4400001582
0.45	0.43	0.73	0.85	1.41	1.09	1.60	0.73	0.62	0.27	0.52	0.4600001583
0.48	0.44	0.50	1.13	1.60	1.34	0.73	0.11	0.40	0.40	0.41	0.3300001584
0.33	0.39	0.48	1.91	0.97	0.39	0.21	0.20	0.42	0.42	0.52	0.4100001585

0.40	0.39	0.89	1.02	1.44	1.43	0.81	0.46	0.67	0.28	0.46	0.3900001586
0.26	0.33	0.57	0.92	0.74	0.58	0.57	0.24	0.39	0.33	0.34	0.2700001587
0.22	0.31	0.36	0.75	0.59	0.53	0.24	0.11	0.27	0.25	0.33	0.2900001588
0.25	0.30	0.70	1.33	1.26	0.73	0.59	0.42	0.46	0.33	0.46	0.4200001589
* Station 100, N.F. Musselshell River above diversion canal to S.F.											
* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec stayr
1.32	0.76	2.31	3.46	10.40	13.50	1.32	0.74	0.80	1.67	1.89	0.7100010029
0.36	1.19	1.09	6.26	4.20	2.87	0.92	0.54	0.50	0.56	0.73	0.5200010030
0.41	0.59	0.95	1.49	1.59	1.84	0.95	0.34	0.47	0.55	0.74	0.5000010031
0.38	0.25	0.64	1.15	4.67	11.60	1.49	0.51	0.53	0.60	0.81	0.6400010032
0.49	0.41	0.65	1.73	6.85	7.79	1.51	0.47	0.42	0.44	0.71	0.6800010033
0.56	0.59	0.89	3.76	2.83	8.26	0.94	0.32	0.47	0.62	0.88	0.6400010034
0.50	0.28	0.70	1.40	2.22	2.16	2.05	0.35	0.45	0.61	0.64	0.5000010035
0.35	0.46	2.01	2.28	5.85	2.86	0.93	0.39	0.47	0.53	0.56	0.4800010036
0.24	0.56	0.66	1.62	4.05	3.41	1.82	0.26	0.46	1.33	0.52	0.4600010037
0.35	0.72	0.95	1.85	6.99	7.62	4.94	1.43	0.52	0.60	1.52	0.6900010038
0.67	0.47	1.61	3.69	5.19	4.11	1.86	0.43	0.50	0.58	0.52	0.5400010039
0.41	0.46	0.97	1.81	2.84	2.43	0.95	0.35	0.41	0.60	0.61	0.5100010040
0.41	0.41	0.90	0.88	1.76	4.47	1.20	0.49	1.98	1.30	1.21	1.7800010041
1.34	0.80	0.99	6.49	13.50	16.20	3.50	2.11	1.94	2.13	1.99	2.2600010042
1.97	2.24	2.98	8.04	9.86	17.90	4.40	2.39	1.63	2.00	2.48	2.1600010043
1.46	0.79	1.08	2.99	4.11	13.20	5.32	2.85	2.03	2.01	1.96	2.1300010044
2.00	1.00	1.35	1.31	2.48	8.15	1.93	0.99	0.69	0.81	0.79	0.5800010045
0.57	0.45	1.62	2.84	5.67	5.20	2.98	1.32	1.03	1.19	1.03	1.2500010046
0.76	0.87	3.26	4.43	11.50	9.34	2.56	1.63	1.32	1.48	1.16	1.0600010047
0.94	0.68	0.87	5.27	12.50	16.20	4.63	1.85	1.01	0.99	0.76	0.5900010048
0.56	0.60	0.83	4.28	8.86	7.31	2.10	1.41	1.07	1.17	0.97	0.6600010049
0.40	1.39	1.17	3.21	7.04	10.00	3.49	1.98	1.17	1.27	0.93	0.7800010050
0.50	0.76	1.19	2.58	8.65	6.74	1.96	1.17	1.06	0.89	0.94	0.7900010051
0.65	0.61	0.67	5.34	13.90	6.91	2.08	1.40	1.00	0.97	0.73	0.6100010052
0.60	0.65	1.04	1.35	4.91	17.10	2.80	1.15	0.74	0.50	0.81	0.7700010053
0.55	0.95	0.70	1.89	2.84	3.38	0.96	0.95	0.46	0.87	0.74	0.4600010054
0.45	0.30	0.33	3.36	3.78	5.25	2.06	0.84	0.40	0.51	0.77	0.7000010055
0.57	0.52	1.43	3.27	7.01	4.16	1.07	0.87	0.42	0.47	0.62	0.5900010056
0.47	0.56	0.81	1.85	7.04	8.16	2.69	1.23	0.96	1.00	0.79	0.5700010057
0.61	0.61	1.26	2.67	5.62	3.71	1.59	1.13	0.82	0.63	0.76	0.7700010058
0.65	0.54	1.60	2.37	4.77	9.82	2.44	1.11	0.89	1.11	0.90	0.7400010059
0.57	0.52	1.84	2.94	5.02	4.46	1.12	0.51	0.36	0.42	0.77	0.7400010060
0.65	0.58	0.76	0.95	1.79	1.76	0.64	0.35	0.32	0.40	0.45	0.5000010061
0.45	0.71	0.91	2.39	6.96	8.97	1.99	1.21	0.57	0.69	0.75	0.7800010062
0.47	1.40	1.19	1.93	6.13	5.77	1.75	0.58	0.44	0.54	0.70	0.6600010063
0.71	0.64	0.61	1.68	9.47	11.20	2.82	1.07	0.62	0.63	0.68	0.8600010064
0.93	1.30	1.11	5.98	10.10	10.90	3.76	1.47	2.08	2.27	1.51	1.3500010065
0.85	0.85	2.61	2.82	6.73	3.40	1.05	0.57	0.45	0.66	0.77	0.6800010066
0.66	0.78	0.94	2.47	10.50	17.30	3.90	1.26	1.20	1.61	1.33	0.9900010067
0.95	1.35	2.28	2.30	5.89	10.40	3.05	1.52	1.41	1.52	1.23	0.7900010068
0.71	0.76	1.63	6.70	4.70	2.90	2.27	0.67	0.59	0.76	0.63	0.6300010069
0.68	0.81	0.90	3.21	14.80	10.10	2.17	0.80	0.69	1.06	0.89	0.7700010070
0.92	1.90	1.47	4.30	7.91	6.00	1.59	0.65	0.59	1.00	0.89	0.5700010071
0.57	0.81	3.03	3.11	7.00	7.31	2.24	1.22	1.22	1.38	0.86	0.6400010072
0.69	0.64	0.88	1.17	2.10	2.32	0.73	0.43	0.49	0.74	0.91	0.6800010073
0.92	0.61	1.59	3.29	6.69	9.62	2.03	1.24	1.24	0.89	0.98	0.8200010074
0.64	0.67	0.83	1.82	10.60	19.90	6.52	2.36	1.45	1.40	1.41	1.5400010075
1.06	0.96	1.36	3.80	13.20	7.00	2.13	1.07	0.85	0.80	1.02	0.7500010076
0.71	0.75	1.13	3.57	3.48	2.69	0.89	0.51	0.43	0.84	0.93	0.6600010077
0.65	0.78	2.34	6.08	13.30	10.70	4.51	1.64	1.43	1.58	1.06	0.7500010078
0.57	0.75	1.83	3.68	11.10	13.00	4.04	1.74	1.15	0.90	0.85	0.7900010079
0.57	0.66	0.84	4.87	6.29	11.30	4.32	2.07	1.87	1.01	1.07	0.9200010080
0.68	0.79	1.58	3.92	12.30	9.84	5.06	2.26	1.52	1.04	1.49	1.4800010081
2.06	1.52	1.83	2.66	9.94	18.30	6.60	1.30	2.55	2.69	2.28	2.0000010082
2.21	1.25	1.88	4.23	7.69	6.00	4.81	2.15	2.03	2.02	1.48	2.0200010083
1.51	0.95	1.20	3.35	7.49	7.43	2.00	0.61	0.99	1.12	0.89	0.6500010084

0.60	0.63	0.96	4.20	3.70	1.78	0.52	0.52	1.01	1.12	1.17	0.8700010085
0.73	0.81	2.11	2.48	6.05	6.65	2.11	0.98	1.40	0.85	0.97	0.8300010086
0.49	0.60	1.16	2.08	3.40	2.30	1.45	0.66	0.83	0.84	0.71	0.5800010087
0.38	0.55	0.74	1.71	2.99	2.40	0.59	0.29	0.54	0.60	0.67	0.5900010088
0.44	0.50	1.53	2.82	4.82	3.35	1.45	0.80	1.01	0.87	1.12	0.9300010089

* Station 115, Return flow station for the North Fork

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
1.32	0.76	2.31	3.46	10.40	13.50	1.32	0.74	0.80	1.67	1.89	0.7100011529
0.36	1.19	1.09	6.26	4.20	2.87	0.92	0.54	0.50	0.56	0.73	0.5200011530
0.41	0.59	0.95	1.49	1.59	1.84	0.95	0.34	0.47	0.55	0.74	0.5000011531
0.38	0.25	0.64	1.15	4.67	11.60	1.49	0.51	0.53	0.60	0.81	0.6400011532
0.49	0.41	0.65	1.73	6.85	7.79	1.51	0.47	0.42	0.44	0.71	0.6800011533
0.56	0.59	0.89	3.76	2.83	8.26	0.94	0.32	0.47	0.62	0.88	0.6400011534
0.50	0.28	0.70	1.40	2.22	2.16	2.05	0.35	0.45	0.61	0.64	0.5000011535
0.35	0.46	2.01	2.28	5.85	2.86	0.93	0.39	0.47	0.53	0.56	0.4800011536
0.24	0.56	0.66	1.62	4.05	3.41	1.82	0.26	0.46	1.33	0.52	0.4600011537
0.35	0.72	0.95	1.85	6.99	7.62	4.94	1.43	0.52	0.60	1.52	0.6900011538
0.67	0.47	1.61	3.69	5.19	4.11	1.86	0.43	0.50	0.58	0.52	0.5400011539
0.41	0.46	0.97	1.81	2.84	2.43	0.95	0.35	0.41	0.60	0.61	0.5100011540
0.41	0.41	0.90	0.88	1.76	4.47	1.20	0.49	1.98	1.30	1.21	1.7800011541
1.34	0.80	0.99	6.49	13.50	16.20	3.50	2.11	1.94	2.13	1.99	2.2600011542
1.97	2.24	2.98	8.04	9.86	17.90	4.40	2.39	1.63	2.00	2.48	2.1600011543
1.46	0.79	1.08	2.99	4.11	13.20	5.32	2.85	2.03	2.01	1.96	2.1300011544
2.00	1.00	1.35	1.31	2.48	8.15	1.93	0.99	0.69	0.81	0.79	0.5800011545
0.57	0.45	1.62	2.84	5.67	5.20	2.98	1.32	1.03	1.19	1.03	1.2500011546
0.76	0.87	3.26	4.43	11.50	9.34	2.56	1.63	1.32	1.48	1.16	1.0600011547
0.94	0.68	0.87	5.27	12.50	16.20	4.63	1.85	1.01	0.99	0.76	0.5900011548
0.56	0.60	0.83	4.28	8.86	7.31	2.10	1.41	1.07	1.17	0.97	0.6600011549
0.40	1.39	1.17	3.21	7.04	10.00	3.49	1.98	1.17	1.27	0.93	0.7800011550
0.50	0.76	1.19	2.58	8.65	6.74	1.96	1.17	1.06	0.89	0.94	0.7900011551
0.65	0.61	0.67	5.34	13.90	6.91	2.08	1.40	1.00	0.97	0.73	0.6100011552
0.60	0.65	1.04	1.35	4.91	17.10	2.80	1.15	0.74	0.50	0.81	0.7700011553
0.55	0.95	0.70	1.89	2.84	3.38	0.96	0.95	0.46	0.87	0.74	0.4600011554
0.45	0.30	0.33	3.36	3.78	5.25	2.06	0.84	0.40	0.51	0.77	0.7000011555
0.57	0.52	1.43	3.27	7.01	4.16	1.07	0.87	0.42	0.47	0.62	0.5900011556
0.47	0.56	0.81	1.85	7.04	8.16	2.69	1.23	0.96	1.00	0.79	0.5700011557
0.61	0.61	1.26	2.67	5.62	3.71	1.59	1.13	0.82	0.63	0.76	0.7700011558
0.65	0.54	1.60	2.37	4.77	9.82	2.44	1.11	0.89	1.11	0.90	0.7400011559
0.57	0.52	1.84	2.94	5.02	4.46	1.12	0.51	0.36	0.42	0.77	0.7400011560
0.65	0.58	0.76	0.95	1.79	1.76	0.64	0.35	0.32	0.40	0.45	0.5000011561
0.45	0.71	0.91	2.39	6.96	8.97	1.99	1.21	0.57	0.69	0.75	0.7800011562
0.47	1.40	1.19	1.93	6.13	5.77	1.75	0.58	0.44	0.54	0.70	0.6600011563
0.71	0.64	0.61	1.68	9.47	11.20	2.82	1.07	0.62	0.63	0.68	0.8600011564
0.93	1.30	1.11	5.98	10.10	10.90	3.76	1.47	2.08	2.27	1.51	1.3500011565
0.85	0.85	2.61	2.82	6.73	3.40	1.05	0.57	0.45	0.66	0.77	0.6800011566
0.66	0.78	0.94	2.47	10.50	17.30	3.90	1.26	1.20	1.61	1.33	0.9900011567
0.95	1.35	2.28	2.30	5.89	10.40	3.05	1.52	1.41	1.52	1.23	0.7900011568
0.71	0.76	1.63	6.70	4.70	2.90	2.27	0.67	0.59	0.76	0.63	0.6300011569
0.68	0.81	0.90	3.21	14.80	10.10	2.17	0.80	0.69	1.06	0.89	0.7700011570
0.92	1.90	1.47	4.30	7.91	6.00	1.59	0.65	0.59	1.00	0.89	0.5700011571
0.57	0.81	3.03	3.11	7.00	7.31	2.24	1.22	1.22	1.38	0.86	0.6400011572
0.69	0.64	0.88	1.17	2.10	2.32	0.73	0.43	0.49	0.74	0.91	0.6800011573
0.92	0.61	1.59	3.29	6.69	9.62	2.03	1.24	1.24	0.89	0.98	0.8200011574
0.64	0.67	0.83	1.82	10.60	19.90	6.52	2.36	1.45	1.40	1.41	1.5400011575
1.06	0.96	1.36	3.80	13.20	7.00	2.13	1.07	0.85	0.80	1.02	0.7500011576
0.71	0.75	1.13	3.57	3.48	2.69	0.89	0.51	0.43	0.84	0.93	0.6600011577
0.65	0.78	2.34	6.08	13.30	10.70	4.51	1.64	1.43	1.58	1.06	0.7500011578
0.57	0.75	1.83	3.68	11.10	13.00	4.04	1.74	1.15	0.90	0.85	0.7900011579
0.57	0.66	0.84	4.87	6.29	11.30	4.32	2.07	1.87	1.01	1.07	0.9200011580
0.68	0.79	1.58	3.92	12.30	9.84	5.06	2.26	1.52	1.04	1.49	1.4800011581
2.06	1.52	1.83	2.66	9.94	18.30	6.60	1.30	2.55	2.69	2.28	2.0000011582
2.21	1.25	1.88	4.23	7.69	6.00	4.81	2.15	2.03	2.02	1.48	2.0200011583

1.51	0.95	1.20	3.35	7.49	7.43	2.00	0.61	0.99	1.12	0.89	0.6500011584
0.60	0.63	0.96	4.20	3.70	1.78	0.52	0.52	1.01	1.12	1.17	0.8700011585
0.73	0.81	2.11	2.48	6.05	6.65	2.11	0.98	1.40	0.85	0.97	0.8300011586
0.49	0.60	1.16	2.08	3.40	2.30	1.45	0.66	0.83	0.84	0.71	0.5800011587
0.38	0.55	0.74	1.71	2.99	2.40	0.59	0.29	0.54	0.60	0.67	0.5900011588
0.44	0.50	1.53	2.82	4.82	3.35	1.45	0.80	1.01	0.87	1.12	0.9300011589

* Station 195, S.F. Musselshell River above diversion canal from N.F.

jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
1.18	1.39	6.37	8.41	27.80	30.20	0.93	1.46	2.15	1.15	2.22	2.1400019529
0.66	1.38	2.11	14.90	17.80	13.50	0.79	0.46	0.99	0.69	1.60	1.1200019530
0.80	0.90	2.09	1.67	4.17	8.69	0.64	0.34	0.45	0.92	1.11	1.3900019531
0.71	0.48	1.49	4.23	20.40	30.80	0.08	0.53	0.28	1.08	1.57	1.6300019532
1.18	1.10	0.79	11.00	48.50	37.90	0.29	1.04	1.31	1.32	1.65	1.9000019533
1.90	1.32	3.46	8.95	8.77	36.00	0.81	0.43	0.29	1.65	0.90	1.3900019534
1.12	0.56	1.46	3.68	6.52	9.79	1.42	0.37	0.24	1.45	0.89	0.8500019535
1.27	0.88	1.43	9.50	39.00	21.60	0.99	0.49	0.45	0.52	0.97	0.9400019536
0.37	1.25	1.17	11.40	23.60	15.40	0.47	0.58	0.39	2.60	0.77	0.5800019537
0.66	1.19	1.46	7.61	51.00	39.90	22.00	2.70	1.32	1.10	2.83	1.6000019538
1.72	1.01	5.18	8.33	24.40	16.80	2.00	0.66	0.91	1.34	1.41	0.4800019539
0.82	0.87	2.43	5.73	9.72	11.80	2.55	0.44	0.44	1.67	2.81	0.7500019540
0.89	1.49	2.67	3.82	15.00	27.50	2.89	1.14	2.61	8.31	5.34	3.5700019541
2.39	1.93	2.41	13.80	44.80	46.50	2.70	1.20	1.77	2.58	2.30	1.8900019542
1.45	1.74	3.83	36.60	46.90	58.90	6.48	1.93	1.12	1.73	2.17	1.6600019543
1.01	0.78	1.43	4.49	19.70	38.40	13.30	1.76	1.22	1.78	1.91	1.3500019544
1.42	1.13	1.34	1.46	15.00	33.50	3.83	0.61	0.75	1.67	2.63	1.5700019545
1.86	1.29	3.62	13.00	24.40	13.60	2.94	0.57	1.11	2.71	2.94	5.1900019546
1.82	2.29	4.07	19.20	51.20	42.60	4.43	1.06	2.51	4.45	3.75	3.3900019547
2.71	1.86	2.81	18.40	63.80	78.60	18.80	5.42	2.42	2.81	3.04	2.4300019548
2.02	1.88	4.58	19.50	43.80	24.30	3.26	0.08	0.79	2.18	2.04	1.3100019549
1.01	1.28	0.44	9.73	39.10	60.20	12.70	3.96	2.16	3.58	2.82	2.1100019550
1.40	2.02	3.73	10.20	47.40	29.80	7.22	3.22	2.96	3.49	2.89	2.2300019551
1.87	1.48	1.62	25.70	80.60	31.40	7.10	1.59	1.49	1.66	1.49	1.1500019552
1.40	1.27	2.41	5.29	20.00	75.20	5.32	1.74	0.03	0.37	1.13	1.2500019553
1.10	1.34	1.78	5.45	19.80	21.00	3.33	0.56	0.24	1.01	1.44	0.8400019554
0.68	0.60	0.94	3.47	11.20	22.60	7.78	1.30	0.61	0.94	1.58	1.9900019555
1.54	1.33	3.44	10.40	49.20	25.90	3.02	0.73	0.51	0.86	1.17	1.1400019556
0.73	0.71	1.88	4.25	41.50	46.80	10.70	2.33	1.71	2.40	2.16	1.8300019557
1.24	1.61	3.64	8.21	25.30	8.75	2.98	1.23	0.80	1.30	1.31	1.4100019558
1.69	1.17	2.53	6.93	27.60	65.40	6.98	1.44	1.44	3.08	3.10	1.9400019559
1.60	1.08	7.66	9.43	25.70	19.50	2.02	1.13	1.22	1.72	1.73	1.3800019560
1.23	1.07	1.59	1.99	9.14	8.09	0.54	0.18	0.43	1.19	1.15	0.9700019561
0.82	1.05	1.94	9.18	35.00	35.00	8.58	3.07	2.40	3.76	2.50	2.2700019562
1.17	2.28	3.41	5.02	37.10	35.00	5.92	1.31	1.44	2.26	2.18	1.5000019563
1.33	1.14	1.38	5.03	35.70	57.00	8.06	1.47	1.10	1.89	1.79	2.4500019564
2.20	2.01	1.25	14.90	39.70	56.00	12.60	4.03	8.80	8.66	4.70	3.3200019565
2.17	1.63	4.81	11.50	46.20	18.00	4.75	1.31	1.01	1.67	1.87	1.5300019566
1.36	1.27	3.80	9.98	50.70	96.80	13.80	2.60	1.82	2.97	2.78	1.6800019567
1.74	3.01	4.42	6.05	26.50	49.50	11.50	3.46	2.89	3.42	3.00	1.5900019568
1.54	1.65	2.73	21.20	19.40	11.20	8.49	1.89	1.50	2.41	2.49	1.3400019569
1.24	1.56	2.07	6.09	62.40	64.30	9.74	1.99	2.41	2.90	1.81	1.7100019570
2.20	3.20	4.01	12.80	42.30	32.80	7.90	1.17	2.04	3.52	2.75	2.0000019571
1.90	2.64	10.20	10.40	35.80	34.20	5.58	3.32	2.18	2.64	1.84	1.0600019572
0.81	1.26	2.32	4.25	4.77	9.69	1.80	1.77	1.44	2.92	3.15	2.3500019573
4.53	1.86	6.41	15.90	37.80	57.80	9.71	4.75	3.48	3.41	3.15	1.9800019574
1.36	1.35	2.35	9.98	55.60	159.00	39.70	7.42	4.20	4.75	4.31	4.7500019575
2.74	1.84	4.18	15.60	92.30	36.40	10.60	5.84	3.80	3.63	2.67	2.2000019576
2.07	1.99	2.12	8.84	24.40	14.80	4.24	2.15	2.16	2.43	1.98	2.1600019577
1.67	1.44	7.66	19.50	78.40	61.20	24.00	3.79	4.21	4.32	3.27	2.5400019578
0.65	1.69	7.18	11.10	64.20	88.50	14.50	3.93	2.03	3.66	2.06	2.3100019579
1.60	2.04	2.14	9.84	41.10	65.20	9.96	4.96	3.40	3.94	3.51	3.1200019580
1.60	1.88	5.19	12.90	69.20	52.60	7.45	4.61	2.09	3.39	2.82	2.3600019581
0.96	2.16	5.84	15.50	43.90	74.70	22.70	4.81	3.05	3.49	3.34	2.5500019582

2.77	2.32	5.62	25.10	28.50	22.40	8.64	4.15	3.85	3.07	2.01	1.2400019583
4.10	2.13	4.67	8.93	24.50	28.90	4.65	5.98	2.11	3.78	2.56	2.0600019584
1.43	0.43	2.75	6.47	11.40	6.65	0.78	2.89	4.97	5.24	6.38	3.5000019585
1.93	2.44	11.50	6.00	26.90	31.40	6.86	3.45	3.32	4.33	4.30	3.1900019586
1.00	1.26	3.71	3.31	16.40	10.30	4.37	3.41	3.35	3.97	2.94	2.4000019587
0.70	0.98	2.34	3.31	11.80	9.39	1.33	2.06	1.82	2.71	2.80	2.1300019588
0.88	0.45	5.88	3.74	18.60	13.70	3.41	1.27	4.32	4.33	7.69	4.1200019589

* Station 200, Natural flows South Fork Musselshell Martinsdale Inlet Canal

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
1.18	1.39	6.37	8.41	27.80	30.20	0.93	1.46	2.15	1.15	2.22	2.1400020029
0.66	1.38	2.11	14.90	17.80	13.50	0.79	0.46	0.99	0.69	1.60	1.1200020030
0.80	0.90	2.09	1.67	4.17	8.69	0.64	0.34	0.45	0.92	1.11	1.3900020031
0.71	0.48	1.49	4.23	20.40	30.80	0.08	0.53	0.28	1.08	1.57	1.6300020032
1.18	1.10	0.79	11.00	48.50	37.90	0.29	1.04	1.31	1.32	1.65	1.9000020033
1.90	1.32	3.46	8.95	8.77	36.00	0.81	0.43	0.29	1.65	0.90	1.3900020034
1.12	0.56	1.46	3.68	6.52	9.79	1.42	0.37	0.24	1.45	0.89	0.8500020035
1.27	0.88	1.43	9.50	39.00	21.60	0.99	0.49	0.45	0.52	0.97	0.9400020036
0.37	1.25	1.17	11.40	23.60	15.40	0.47	0.58	0.39	2.60	0.77	0.5800020037
0.66	1.19	1.46	7.61	51.00	39.90	22.00	2.70	1.32	1.10	2.83	1.6000020038
1.72	1.01	5.18	8.33	24.40	16.80	2.00	0.66	0.91	1.34	1.41	0.4800020039
0.82	0.87	2.43	5.73	9.72	11.80	2.55	0.44	0.44	1.67	2.81	0.7500020040
0.89	1.49	2.67	3.82	15.00	27.50	2.89	1.14	2.61	8.31	5.34	3.5700020041
2.39	1.93	2.41	13.80	44.80	46.50	2.70	1.20	1.77	2.58	2.30	1.8900020042
1.45	1.74	3.83	36.60	46.90	58.90	6.48	1.93	1.12	1.73	2.17	1.6600020043
1.01	0.78	1.43	4.49	19.70	38.40	13.30	1.76	1.22	1.78	1.91	1.3500020044
1.42	1.13	1.34	1.46	15.00	33.50	3.83	0.61	0.75	1.67	2.63	1.5700020045
1.86	1.29	3.62	13.00	24.40	13.60	2.94	0.57	1.11	2.71	2.94	5.1900020046
1.82	2.29	4.07	19.20	51.20	42.60	4.43	1.06	2.51	4.45	3.75	3.3900020047
2.71	1.86	2.81	18.40	63.80	78.60	18.80	5.42	2.42	2.81	3.04	2.4300020048
2.02	1.88	4.58	19.50	43.80	24.30	3.26	0.08	0.79	2.18	2.04	1.3100020049
1.01	1.28	0.44	9.73	39.10	60.20	12.70	3.96	2.16	3.58	2.82	2.1100020050
1.40	2.02	3.73	10.20	47.40	29.80	7.22	3.22	2.96	3.49	2.89	2.2300020051
1.87	1.48	1.62	25.70	80.60	31.40	7.10	1.59	1.49	1.66	1.49	1.1500020052
1.40	1.27	2.41	5.29	20.00	75.20	5.32	1.74	0.03	0.37	1.13	1.2500020053
1.10	1.34	1.78	5.45	19.80	21.00	3.33	0.56	0.24	1.01	1.44	0.8400020054
0.68	0.60	0.94	3.47	11.20	22.60	7.78	1.30	0.61	0.94	1.58	1.9900020055
1.54	1.33	3.44	10.40	49.20	25.90	3.02	0.73	0.51	0.86	1.17	1.1400020056
0.73	0.71	1.88	4.25	41.50	46.80	10.70	2.33	1.71	2.40	2.16	1.8300020057
1.24	1.61	3.64	8.21	25.30	8.75	2.98	1.23	0.80	1.30	1.31	1.4100020058
1.69	1.17	2.53	6.93	27.60	65.40	6.98	1.44	1.44	3.08	3.10	1.9400020059
1.60	1.08	7.66	9.43	25.70	19.50	2.02	1.13	1.22	1.72	1.73	1.3800020060
1.23	1.07	1.59	1.99	9.14	8.09	0.54	0.18	0.43	1.19	1.15	0.9700020061
0.82	1.05	1.94	9.18	35.00	35.00	8.58	3.07	2.40	3.76	2.50	2.2700020062
1.17	2.28	3.41	5.02	37.10	35.00	5.92	1.31	1.44	2.26	2.18	1.5000020063
1.33	1.14	1.38	5.03	35.70	57.00	8.06	1.47	1.10	1.89	1.79	2.4500020064
2.20	2.01	1.25	14.90	39.70	56.00	12.60	4.03	8.80	8.66	4.70	3.3200020065
2.17	1.63	4.81	11.50	46.20	18.00	4.75	1.31	1.01	1.67	1.87	1.5300020066
1.36	1.27	3.80	9.98	50.70	96.80	13.80	2.60	1.82	2.97	2.78	1.6800020067
1.74	3.01	4.42	6.05	26.50	49.50	11.50	3.46	2.89	3.42	3.00	1.5900020068
1.54	1.65	2.73	21.20	19.40	11.20	8.49	1.89	1.50	2.41	2.49	1.3400020069
1.24	1.56	2.07	6.09	62.40	64.30	9.74	1.99	2.41	2.90	1.81	1.7100020070
2.20	3.20	4.01	12.80	42.30	32.80	7.90	1.17	2.04	3.52	2.75	2.0000020071
1.90	2.64	10.20	10.40	35.80	34.20	5.58	3.32	2.18	2.64	1.84	1.0600020072
0.81	1.26	2.32	4.25	4.77	9.69	1.80	1.77	1.44	2.92	3.15	2.3500020073
4.53	1.86	6.41	15.90	37.80	57.80	9.71	4.75	3.48	3.41	3.15	1.9800020074
1.36	1.35	2.35	9.98	55.60	159.00	39.70	7.42	4.20	4.75	4.31	4.7500020075
2.74	1.84	4.18	15.60	92.30	36.40	10.60	5.84	3.80	3.63	2.67	2.2000020076
2.07	1.99	2.12	8.84	24.40	14.80	4.24	2.15	2.16	2.43	1.98	2.1600020077
1.67	1.44	7.66	19.50	78.40	61.20	24.00	3.79	4.21	4.32	3.27	2.5400020078
0.65	1.69	7.18	11.10	64.20	88.50	14.50	3.93	2.03	3.66	2.06	2.3100020079
1.60	2.04	2.14	9.84	41.10	65.20	9.96	4.96	3.40	3.94	3.51	3.1200020080
1.60	1.88	5.19	12.90	69.20	52.60	7.45	4.61	2.09	3.39	2.82	2.3600020081

0.96	2.16	5.84	15.50	43.90	74.70	22.70	4.81	3.05	3.49	3.34	2.5500020082
2.77	2.32	5.62	25.10	28.50	22.40	8.64	4.15	3.85	3.07	2.01	1.2400020083
4.10	2.13	4.67	8.93	24.50	28.90	4.65	5.98	2.11	3.78	2.56	2.0600020084
1.43	0.43	2.75	6.47	11.40	6.65	0.78	2.89	4.97	5.24	6.38	3.5000020085
1.93	2.44	11.50	6.00	26.90	31.40	6.86	3.45	3.32	4.33	4.30	3.1900020086
1.00	1.26	3.71	3.31	16.40	10.30	4.37	3.41	3.35	3.97	2.94	2.4000020087
0.70	0.98	2.34	3.31	11.80	9.39	1.33	2.06	1.82	2.71	2.80	2.1300020088
0.88	0.45	5.88	3.74	18.60	13.70	3.41	1.27	4.32	4.33	7.69	4.1200020089

* Station 997, RETURN FLOW STATION, NO NATURAL FLOWS AT THIS STATION

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
												00099729
												00099730
												00099731
												00099732
												00099733
												00099734
												00099735
												00099736
												00099737
												00099738
												00099739
												00099740
												00099741
												00099742
												00099743
												00099744
												00099745
												00099746
												00099747
												00099748
												00099749
												00099750
												00099751
												00099752
												00099753
												00099754
												00099755
												00099756
												00099757
												00099758
												00099759
												00099760
												00099761
												00099762
												00099763
												00099764
												00099765
												00099766
												00099767
												00099768
												00099769
												00099770
												00099771
												00099772
												00099773
												00099774
												00099775
												00099776
												00099777
												00099778
												00099779
												00099780

00099781
00099782
00099783
00099784
00099785
00099786
00099787
00099788
00099789

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* Station  998, MARTINSDALE RESERVOIR
*  jan   feb   mar   apr   may   jun   jul   aug   sep   oct   nov   dec   stayr
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00099829
00099830
00099831
00099832
00099833
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00099842
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00099875
00099876
00099877
00099878
00099879

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                                                                                                                                00099880
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                                                                                                                                00099886
                                                                                                                                00099887
                                                                                                                                00099888
                                                                                                                                00099889
*Station   810, STOCK POND DEPLETIONS ABOVE HARLOWTON
*  jan    feb    mar    apr    may    jun    jul    aug    sep    oct    nov    dec    stayr
  0.65   0.84   1.82   1.93   2.40   2.10   0.81   0.33   0.27   0.51   0.59   0.6400081029
  0.46   0.92   1.55   1.94   1.90   0.83   0.25   0.33   0.41   0.50   0.61   0.4500081030
  0.36   0.45   0.56   0.73   1.09   0.57   0.31   0.31   0.29   0.56   0.56   0.3000081031
  0.31   0.40   0.64   0.75   1.73   2.30   0.64   0.30   0.26   0.52   0.59   0.3600081032
  0.40   0.40   0.70   0.97   1.55   2.31   0.59   0.43   0.43   0.52   0.43   0.4600081033
  0.48   0.68   0.97   1.69   1.10   1.64   0.40   0.20   0.25   0.36   0.39   0.3300081034
  0.31   0.34   0.55   0.97   1.36   0.85   0.69   0.27   0.25   0.27   0.46   0.4500081035
  0.42   0.40   1.41   1.62   1.55   1.04   0.28   0.24   0.28   0.32   0.35   0.3600081036
  0.32   0.39   0.68   0.78   1.55   1.49   0.55   0.24   0.26   0.33   0.28   0.3300081037
  0.35   0.62   1.04   1.14   2.91   3.38   2.76   0.41   0.35   0.68   0.80   0.6700081038
  0.47   0.35   1.64   1.88   2.61   1.79   0.46   0.27   0.21   0.43   0.46   0.4200081039
  0.37   0.45   0.91   1.00   1.44   0.87   0.40   0.23   0.22   0.74   0.58   0.5300081040
  0.39   0.46   0.70   0.76   0.94   2.23   0.40   0.25   0.76   1.09   1.03   1.2300081041
  0.63   0.83   1.72   3.61   5.20   7.00   1.83   0.87   0.42   0.88   0.96   1.3200081042
  0.91   1.56   2.29   4.06   4.04   8.10   2.82   1.19   0.64   0.91   0.96   1.2900081043
  0.80   0.64   1.05   1.25   1.39   6.90   3.28   1.52   0.73   0.77   0.80   1.1700081044
  0.98   0.83   1.26   0.96   1.42   3.05   0.89   0.33   0.42   0.55   0.77   0.5300081045
  0.52   0.59   1.22   1.66   2.23   1.70   1.00   0.23   0.91   1.34   1.01   1.2300081046
  0.77   0.98   3.07   2.77   4.80   4.06   1.19   0.61   0.71   1.22   1.04   1.4600081047
  1.41   0.77   1.41   2.23   5.30   8.20   2.17   0.87   0.65   1.03   1.14   0.9800081048
  0.64   0.53   1.23   2.72   3.64   2.49   0.50   0.27   0.48   0.80   0.77   0.5900081049
  0.47   1.44   1.49   1.46   1.66   4.20   1.61   0.68   0.72   1.09   0.94   0.9300081050
  0.75   1.04   2.17   1.72   3.95   3.06   1.02   0.67   0.73   0.90   0.90   0.6400081051
  0.49   0.85   1.44   2.86   4.70   2.39   1.02   0.44   0.46   0.49   0.61   0.5200081052
  0.69   0.55   0.83   0.72   0.99   6.30   1.45   0.38   0.36   0.52   0.68   0.6800081053
  0.54   0.89   0.82   0.88   1.16   1.02   1.07   0.54   0.24   0.32   0.51   0.5300081054
  0.58   0.42   0.57   1.86   0.72   3.45   1.66   0.51   0.32   0.54   0.48   0.7200081055
  0.67   0.68   1.78   1.23   5.79   2.84   0.34   0.22   0.12   0.08   0.13   0.1000081056
  0.16   0.15   0.32   0.38   4.16   3.14   0.51   0.27   0.29   0.39   0.28   0.3400081057
  0.34   0.32   0.50   0.42   4.28   2.04   0.53   0.20   0.16   0.14   0.16   0.1500081058
  0.15   0.14   2.29   0.80   2.23   4.68   1.08   0.27   0.30   0.36   0.26   0.1900081059
  0.19   0.19   0.80   0.73   1.98   2.54   0.30   0.14   0.10   0.10   0.10   0.5300081060
  0.10   0.19   0.19   0.17   1.47   1.95   0.18   0.04   0.11   0.08   0.10   0.0600081061
  0.07   0.13   0.62   0.93   2.84   3.73   0.63   0.25   0.27   0.26   0.22   0.2600081062
  0.12   0.63   0.36   0.44   3.37   3.73   0.86   0.19   0.27   0.18   0.14   0.0700081063
  0.12   0.16   0.14   0.45   3.03   7.40   1.42   0.41   0.32   0.27   0.22   0.3300081064
  0.31   0.46   0.49   1.62   3.70   6.70   1.24   0.44   0.72   0.57   0.33   0.2500081065
  0.27   0.29   1.36   0.78   1.57   0.80   0.40   0.09   0.15   0.17   0.11   0.0900081066
  0.15   0.18   0.25   0.35   3.20  14.90   2.10   0.73   0.56   0.86   0.70   0.3900081067
  0.57   0.96   1.22   1.11   3.11   4.40   1.55   0.77   0.70   0.73   0.70   0.5100081068
  0.54   0.45   3.12   2.10   4.60   2.40   1.04   0.39   0.32   0.47   0.38   0.2000081069
  0.24   0.38   0.62   0.58   5.90   6.10   1.39   0.51   0.69   0.73   0.54   0.4500081070
  0.68   1.21   1.02   1.40   5.79   4.80   0.71   0.24   0.42   0.37   0.40   0.1900081071
  0.30   1.24   2.17   0.89   4.20   7.79   1.04   0.56   0.40   1.79   1.69   0.6100081072
  0.76   0.71   1.02   1.37   2.09   1.89   0.59   0.21   0.74   0.88   1.31   0.8000081073
  0.75   0.92   1.22   1.91   3.01   8.48   1.26   0.82   1.18   1.03   1.20   0.8900081074
  0.61   0.65   1.16   2.30   6.30  12.10   8.38   2.02   1.72   1.82   2.53   2.0000081075
  1.33   1.11   2.19   3.10  12.50   7.10   1.87   1.10   1.37   1.74   1.83   1.3200081076
  0.78   0.99   0.96   1.29   0.82   1.11   0.23   0.22   0.59   1.03   1.01   0.7500081077
  0.68   0.77   4.00   3.22   5.50   5.20   2.99   0.82   1.79   1.61   1.35   1.0200081078
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0.60	0.87	4.79	2.02	4.90	3.50	0.96	0.65	0.64	0.74	0.90	0.5800081079
0.53	0.94	1.39	1.79	4.21	5.90	1.32	0.65	1.03	1.16	1.19	1.0400081080
0.90	0.93	1.03	1.08	7.50	9.16	1.39	0.61	0.53	1.03	1.07	0.9000081081
0.72	1.27	1.79	1.94	4.86	10.00	4.20	0.71	1.38	1.73	1.59	1.1200081082
1.25	1.26	1.46	1.47	2.91	4.80	3.25	0.93	1.31	1.79	1.80	0.7700081083
1.27	1.23	1.32	1.72	5.21	9.97	3.01	1.23	1.52	1.70	1.74	0.7500081084
0.82	0.80	1.06	2.23	2.10	0.84	0.10	0.23	0.73	1.24	0.73	0.5300081085
0.70	1.33	1.49	1.62	2.55	5.05	0.86	0.38	2.48	1.30	1.05	0.6600081086
0.69	0.63	0.81	0.94	0.70	0.50	0.60	0.37	0.58	0.77	0.67	0.4100081087
0.37	0.46	0.60	0.87	1.71	0.81	0.07	0.08	0.23	0.28	0.45	0.4300081088
0.32	0.27	1.12	1.46	1.88	1.35	0.28	0.23	0.47	0.61	0.88	0.4900081089

* Station 1000, Musselshell River at Harlowton

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
3.15	2.99	10.50	13.80	40.60	45.80	3.06	2.53	3.22	3.33	4.70	3.4900100029
1.48	3.49	4.75	23.10	23.90	17.20	1.96	1.33	1.90	1.75	2.94	2.0900100030
1.57	1.94	3.60	3.89	6.85	11.10	1.90	0.99	1.21	2.03	2.41	2.1900100031
1.40	1.13	2.77	6.13	26.80	44.70	2.21	1.34	1.07	2.20	2.97	2.6300100032
2.07	1.91	2.14	13.70	56.90	48.00	2.39	1.94	2.16	2.28	2.79	3.0400100033
2.94	2.59	5.32	14.40	12.70	45.90	2.15	0.95	1.01	2.63	2.17	2.3600100034
1.93	1.18	2.71	6.05	10.10	12.80	4.16	0.99	0.94	2.33	1.99	1.8000100035
2.04	1.74	4.85	13.40	46.40	25.50	2.20	1.12	1.20	1.37	1.88	1.7800100036
0.93	2.20	2.51	13.80	29.20	20.30	2.84	1.08	1.11	4.26	1.57	1.3700100037
1.36	2.53	3.45	10.60	60.90	50.90	29.70	4.54	2.19	2.38	5.15	2.9600100038
2.86	1.83	8.43	13.90	32.20	22.70	4.32	1.36	1.62	2.35	2.39	1.4400100039
1.60	1.78	4.31	8.54	14.00	15.10	3.90	1.02	1.07	3.01	4.00	1.7900100040
1.69	2.36	4.27	5.46	17.70	34.20	4.49	1.88	5.35	10.70	7.58	6.5800100041
4.36	3.56	5.12	23.90	63.50	69.70	8.03	4.18	4.13	5.59	5.25	5.4700100042
4.33	5.54	9.10	48.70	60.80	84.90	13.70	5.51	3.39	4.64	5.61	5.1100100043
3.27	2.21	3.56	8.73	25.20	58.50	21.90	6.13	3.98	4.56	4.67	4.6500100044
4.40	2.96	3.95	3.73	18.90	44.70	6.65	1.93	1.86	3.03	4.19	2.6800100045
2.95	2.33	6.46	17.50	32.30	20.50	6.92	2.12	3.05	5.24	4.98	7.6700100046
3.35	4.14	10.40	26.40	67.50	56.00	8.18	3.30	4.54	7.15	5.95	5.9100100047
5.06	3.31	5.09	25.90	81.60	103.00	25.60	8.14	4.08	4.83	4.94	4.0000100048
3.22	3.01	6.64	26.50	56.30	34.10	5.86	1.76	2.34	4.15	3.78	2.5600100049
1.88	4.11	3.10	14.40	47.80	74.40	17.80	6.62	4.05	5.94	4.69	3.8200100050
2.65	3.82	7.09	14.50	60.00	39.60	10.20	5.06	4.75	5.28	4.73	3.6600100051
3.01	2.94	3.73	33.90	99.20	40.70	10.20	3.43	2.95	3.12	2.83	2.2800100052
2.69	2.47	4.28	7.36	25.90	98.60	9.57	3.27	1.13	1.39	2.62	2.7000100053
2.19	3.18	3.30	8.22	23.80	25.40	5.36	2.05	0.94	2.20	2.69	1.8300100054
1.71	1.32	1.84	8.69	15.70	31.30	11.50	2.65	1.33	1.99	2.83	3.4100100055
2.78	2.53	6.65	14.90	62.00	32.90	4.43	1.82	1.05	1.41	1.92	1.8300100056
1.36	1.42	3.01	6.48	52.70	58.10	13.90	3.83	2.96	3.79	3.23	2.7400100057
2.19	2.54	5.40	11.30	35.20	14.50	5.10	2.56	1.78	2.07	2.23	2.3300100058
2.49	1.85	6.42	10.10	34.60	79.90	10.50	2.82	2.63	4.55	4.26	2.8700100059
2.36	1.79	10.30	13.10	32.70	26.50	3.44	1.78	1.68	2.24	2.60	2.6500100060
1.98	1.84	2.54	3.11	12.40	11.80	1.36	0.57	0.86	1.67	1.70	1.5300100061
1.34	1.89	3.47	12.50	44.80	47.70	11.20	4.53	3.24	4.71	3.47	3.3100100062
1.76	4.31	4.96	7.39	46.60	44.50	8.53	2.08	2.15	2.98	3.02	2.2300100063
2.16	1.94	2.13	7.16	48.20	75.60	12.30	2.95	2.04	2.79	2.69	3.6400100064
3.44	3.77	2.85	22.50	53.50	73.60	17.60	5.94	11.60	11.50	6.54	4.9200100065
3.29	2.77	8.78	15.10	54.50	22.20	6.20	1.97	1.61	2.50	2.75	2.3000100066
2.17	2.23	4.99	12.80	64.40	129.00	19.80	4.59	3.58	5.44	4.81	3.0600100067
3.26	5.32	7.92	9.46	35.50	64.30	16.10	5.75	5.00	5.67	4.93	2.8900100068
2.79	2.86	7.48	30.00	28.70	16.50	11.80	2.95	2.41	3.64	3.50	2.1700100069
2.16	2.75	3.59	9.88	83.10	80.50	13.30	3.30	3.79	4.69	3.24	2.9300100070
3.80	6.31	6.50	18.50	56.00	43.60	10.20	2.06	3.05	4.89	4.04	2.7600100071
2.77	4.69	15.40	14.40	47.00	49.30	8.86	5.10	3.80	5.81	4.39	2.3100100072
2.26	2.61	4.22	6.79	8.96	13.90	3.12	2.41	2.67	4.54	5.37	3.8300100073
6.20	3.39	9.22	21.10	47.50	75.90	13.00	6.81	5.90	5.33	5.33	3.6900100074
2.61	2.67	4.34	14.10	72.50	191.00	54.60	11.80	7.37	7.97	8.25	8.2900100075
5.13	3.91	7.73	22.50	118.00	50.50	14.60	8.01	6.02	6.17	5.52	4.2700100076
3.56	3.73	4.21	13.70	28.70	18.60	5.36	2.88	3.18	4.30	3.92	3.5700100077

3.00	2.99	14.00	28.80	97.20	77.10	31.50	6.25	7.43	7.51	5.68	4.3100100078
1.82	3.31	13.80	16.80	80.20	105.00	19.50	6.32	3.82	5.30	3.81	3.6800100079
2.70	3.64	4.37	16.50	51.60	82.40	15.60	7.68	6.30	6.11	5.77	5.0800100080
3.18	3.60	7.80	17.90	89.00	71.60	13.90	7.48	4.14	5.46	5.38	4.7400100081
3.74	4.95	9.46	20.10	58.70	103.00	33.50	6.82	6.98	7.91	7.21	5.6700100082
6.23	4.83	8.96	30.80	39.10	33.20	16.70	7.23	7.19	6.88	5.29	4.0300100083
6.88	4.31	7.19	14.00	37.20	46.30	9.66	7.82	4.62	6.60	5.19	3.4600100084
2.85	1.86	4.77	12.90	17.20	9.27	1.40	3.64	6.71	7.60	8.28	4.9000100085
3.36	4.58	15.10	10.10	35.50	43.10	9.83	4.81	7.20	6.48	6.32	4.6800100086
2.18	2.49	5.68	6.33	20.50	13.10	6.42	4.44	4.76	5.58	4.32	3.3900100087
1.45	1.99	3.68	5.89	16.50	12.60	1.99	2.43	2.59	3.59	3.92	3.1500100088
1.64	1.22	8.53	8.02	25.30	18.40	5.14	2.30	5.80	5.81	9.69	5.5400100089

*Station 820, STOCK POND DEPLETIONS ABOVE SHAWMUT

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
1.23	1.07	1.80	1.50	2.80	3.20	0.26	0.35	2.11	0.83	0.89	0.8000082029
0.65	0.61	2.66	2.10	1.30	0.30	0.01	0.31	0.05	0.74	0.73	0.5200082030
0.67	0.51	0.84	0.76	0.11	0.70	0.00	0.12	0.63	1.01	0.89	0.5500082031
0.37	0.22	0.85	0.74	1.70	3.00	0.04	0.28	0.36	0.82	0.81	0.7400082032
0.37	0.64	0.59	1.60	6.60	5.70	0.08	0.74	0.69	0.86	0.65	1.1700082033
1.05	0.85	0.77	1.40	0.40	0.90	0.01	0.43	0.01	0.64	0.49	0.4700082034
1.12	0.25	0.85	0.97	0.30	0.50	0.43	0.20	0.01	0.48	0.34	0.4000082035
0.41	0.38	1.93	1.00	4.70	2.40	0.01	0.14	0.02	0.56	0.37	0.4500082036
0.49	0.75	0.77	1.70	2.10	1.50	0.16	0.15	0.01	0.57	0.28	0.5000082037
1.10	0.30	1.14	0.80	7.10	7.90	5.20	0.67	0.10	0.99	1.32	1.0400082038
1.01	0.56	3.77	1.60	2.30	1.80	0.57	0.16	0.01	0.59	0.57	1.2500082039
0.61	0.27	1.23	0.49	0.50	0.70	0.69	0.12	0.01	0.55	1.27	0.3600082040
0.76	0.25	0.57	0.56	1.00	3.40	0.78	0.30	1.03	1.50	1.23	1.3900082041
1.40	1.31	1.73	2.20	9.80	11.90	1.67	0.66	0.57	0.70	0.92	1.4500082042
1.11	2.25	4.10	4.00	8.20	12.80	1.90	1.54	0.71	0.91	0.93	1.3300082043
1.11	0.50	1.77	1.00	1.00	8.90	4.50	1.52	0.76	1.02	0.87	1.3800082044
1.28	0.85	1.99	0.63	1.20	5.60	1.24	0.60	0.72	0.85	1.24	0.8700082045
1.01	1.04	1.89	1.80	2.10	2.40	0.65	0.27	0.49	1.34	1.32	1.7300082046
1.23	1.46	2.90	2.10	9.00	3.00	0.71	0.39	0.52	1.13	1.11	1.3900082047
1.98	0.94	1.93	1.10	8.90	24.00	8.60	1.43	0.73	0.92	1.10	0.8100082048
0.43	0.32	2.10	3.90	4.60	2.70	1.29	0.71	0.82	0.81	0.85	0.4800082049
0.52	2.23	1.34	1.30	6.90	14.40	3.90	1.75	1.13	1.50	1.77	2.0300082050
1.65	1.48	3.71	2.10	4.80	4.90	2.40	1.31	1.82	2.05	1.80	1.5400082051
1.41	1.52	1.95	3.10	9.80	4.50	2.10	1.26	1.01	0.96	0.80	0.6400082052
0.76	0.71	1.31	1.13	1.30	12.40	0.83	0.71	0.72	0.66	0.71	0.9800082053
0.98	1.12	1.03	1.15	0.50	1.00	0.50	0.43	0.37	0.42	0.58	0.5000082054
0.41	0.39	0.65	1.25	1.00	2.10	1.20	0.46	0.38	0.30	0.54	0.7500082055
0.66	1.06	2.69	1.70	7.30	4.20	0.61	0.44	0.33	0.29	0.54	0.6400082056
0.44	0.55	1.01	0.94	7.10	11.40	2.30	0.69	0.73	1.20	1.19	1.0200082057
1.11	1.18	1.48	1.40	4.80	3.10	1.31	0.31	0.30	0.19	1.02	0.9000082058
0.90	0.69	1.94	1.40	2.30	7.70	1.40	0.33	0.37	1.40	1.26	0.9900082059
0.81	0.79	1.40	1.10	2.70	2.90	0.97	0.42	0.13	0.47	0.84	0.8600082060
0.82	0.76	0.71	0.58	0.30	0.50	0.27	0.13	0.12	0.22	0.58	0.5600082061
0.31	0.57	0.81	0.50	3.20	6.10	1.60	0.70	0.96	0.40	0.50	0.9600082062
0.65	1.32	1.24	0.82	1.80	9.70	1.57	0.33	0.52	0.70	0.62	0.6300082063
0.83	0.85	0.87	0.81	1.30	8.60	2.20	0.39	0.36	0.34	0.37	0.6000082064
0.99	1.02	1.36	2.00	3.70	7.00	2.00	0.99	3.30	2.50	1.61	0.9800082065
0.78	0.73	1.42	1.50	4.10	1.00	0.61	0.33	0.22	0.37	0.79	0.8600082066
0.80	0.64	1.09	1.00	6.30	33.00	4.70	0.94	0.71	0.61	0.81	1.0600082067
1.10	2.03	0.92	0.84	3.40	7.80	1.80	0.99	0.83	1.18	0.66	1.4500082068
1.21	1.30	1.42	1.70	2.00	2.20	3.10	0.82	0.58	1.29	0.99	0.9700082069
0.76	1.20	0.96	1.12	11.20	8.70	1.70	1.70	0.71	1.48	0.86	1.0500082070
0.80	2.25	1.37	1.50	5.50	3.40	0.90	1.00	0.58	2.54	1.23	0.8800082071
0.82	2.52	1.40	1.50	3.90	3.80	1.08	1.74	1.13	1.56	1.12	0.7100082072
0.81	0.63	1.07	0.99	0.44	1.00	0.48	1.19	0.81	0.74	0.83	0.9600082073
1.31	0.95	1.28	1.30	2.50	7.90	1.40	1.40	0.99	0.48	1.17	1.0900082074
0.75	0.85	1.77	2.50	13.20	23.00	6.70	2.50	1.19	2.93	1.95	1.9100082075
1.80	2.58	2.10	1.50	16.00	5.90	1.70	0.72	0.99	2.70	1.25	1.1200082076

1.27	1.71	1.26	0.90	1.60	1.60	0.52	0.79	0.19	0.68	0.78	1.0700082077
0.94	1.12	4.20	1.60	13.80	8.70	3.40	1.20	1.20	1.23	1.22	1.8900082078
1.34	1.43	3.60	2.30	9.10	12.00	3.20	0.84	0.63	0.40	0.87	1.4200082079
1.15	1.33	1.83	1.60	5.10	11.00	2.60	1.53	1.05	1.17	1.12	0.9300082080
1.30	1.48	1.28	1.20	12.00	8.70	2.00	1.68	1.21	0.95	0.93	1.1800082081
0.82	1.33	2.04	1.50	5.60	13.00	5.30	1.80	1.85	2.59	1.26	1.2900082082
1.55	0.83	1.44	0.80	2.90	2.60	2.20	1.81	1.35	1.10	0.72	0.7400082083
1.76	1.12	1.34	1.40	2.30	3.60	1.24	1.31	1.20	0.86	0.87	0.6900082084
0.56	1.10	1.06	1.10	0.60	0.45	0.22	0.34	0.54	0.89	0.45	0.6000082085
0.73	1.72	1.60	0.90	2.70	4.10	1.77	0.90	1.29	1.43	0.91	1.0800082086
0.80	1.06	1.04	0.95	1.20	0.90	1.15	0.45	0.42	0.60	0.44	0.7500082087
0.65	0.72	0.91	0.66	0.70	0.80	0.37	0.01	0.02	0.05	0.23	0.4000082088
0.41	0.20	1.14	1.17	1.50	1.30	0.91	0.70	0.44	0.63	0.81	0.8300082089

* Station 2000, Musselshell River at Shawmut

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
4.38	4.06	12.30	15.30	43.40	49.00	3.32	2.88	5.33	4.16	5.59	4.2900200029
2.13	4.10	7.41	25.20	25.20	17.50	1.97	1.64	1.95	2.49	3.67	2.6100200030
2.24	2.45	4.44	4.65	6.96	11.80	1.90	1.11	1.84	3.04	3.30	2.7400200031
1.77	1.35	3.62	6.87	28.50	47.70	2.25	1.62	1.43	3.02	3.78	3.3700200032
2.44	2.55	2.73	15.30	63.50	53.70	2.47	2.68	2.85	3.14	3.44	4.2100200033
3.99	3.44	6.09	15.80	13.10	46.80	2.16	1.38	1.02	3.27	2.66	2.8300200034
3.05	1.43	3.56	7.02	10.40	13.30	4.59	1.19	0.95	2.81	2.33	2.2000200035
2.45	2.12	6.78	14.40	51.10	27.90	2.21	1.26	1.22	1.93	2.25	2.2300200036
1.42	2.95	3.28	15.50	31.30	21.80	3.00	1.23	1.12	4.83	1.85	1.8700200037
2.46	2.83	4.59	11.40	68.00	58.80	34.90	5.21	2.29	3.37	6.47	4.0000200038
3.87	2.39	12.20	15.50	34.50	24.50	4.89	1.52	1.63	2.94	2.96	2.6900200039
2.21	2.05	5.54	9.03	14.50	15.80	4.59	1.14	1.08	3.56	5.27	2.1500200040
2.45	2.61	4.84	6.02	18.70	37.60	5.27	2.18	6.38	12.20	8.81	7.9700200041
5.76	4.87	6.85	26.10	73.30	81.60	9.70	4.84	4.70	6.29	6.17	6.9200200042
5.44	7.79	13.20	52.70	69.00	97.70	15.60	7.05	4.10	5.55	6.54	6.4400200043
4.38	2.71	5.33	9.73	26.20	67.40	26.40	7.65	4.74	5.58	5.54	6.0300200044
5.68	3.81	5.94	4.36	20.10	50.30	7.89	2.53	2.58	3.88	5.43	3.5500200045
3.96	3.37	8.35	19.30	34.40	22.90	7.57	2.39	3.54	6.58	6.30	9.4000200046
4.58	5.60	13.30	28.50	76.50	59.00	8.89	3.69	5.06	8.28	7.06	7.3000200047
7.04	4.25	7.02	27.00	90.50	127.00	34.20	9.57	4.81	5.75	6.04	4.8100200048
3.65	3.33	8.74	30.40	60.90	36.80	7.15	2.47	3.16	4.96	4.63	3.0400200049
2.40	6.34	4.44	15.70	54.70	88.80	21.70	8.37	5.18	7.44	6.46	5.8500200050
4.30	5.30	10.80	16.60	64.80	44.50	12.60	6.37	6.57	7.33	6.53	5.2000200051
4.42	4.46	5.68	37.00	109.00	45.20	12.30	4.69	3.96	4.08	3.63	2.9200200052
3.45	3.18	5.59	8.49	27.20	111.00	10.40	3.98	1.85	2.05	3.33	3.6800200053
3.17	4.30	4.33	9.37	24.30	26.40	5.86	2.48	1.31	2.62	3.27	2.3300200054
2.12	1.71	2.49	9.94	16.70	33.40	12.70	3.11	1.71	2.29	3.37	4.1600200055
3.44	3.59	9.34	16.60	69.30	37.10	5.04	2.26	1.38	1.70	2.46	2.4700200056
1.80	1.97	4.02	7.42	59.80	69.50	16.20	4.52	3.69	4.99	4.42	3.7600200057
3.30	3.72	6.88	12.70	40.00	17.60	6.41	2.87	2.08	2.26	3.25	3.2300200058
3.39	2.54	8.36	11.50	36.90	87.60	11.90	3.15	3.00	5.95	5.52	3.8600200059
3.17	2.58	11.70	14.20	35.40	29.40	4.41	2.20	1.81	2.71	3.44	3.5100200060
2.80	2.60	3.25	3.69	12.70	12.30	1.63	0.70	0.98	1.89	2.28	2.0900200061
1.65	2.46	4.28	13.00	48.00	53.80	12.80	5.23	4.20	5.11	3.97	4.2700200062
2.41	5.63	6.20	8.21	48.40	54.20	10.10	2.41	2.67	3.68	3.64	2.8600200063
2.99	2.79	3.00	7.97	49.50	84.20	14.50	3.34	2.40	3.13	3.06	4.2400200064
4.43	4.79	4.21	24.50	57.20	80.60	19.60	6.93	14.90	14.00	8.15	5.9000200065
4.07	3.50	10.20	16.60	58.60	23.20	6.81	2.30	1.83	2.87	3.54	3.1600200066
2.97	2.87	6.08	13.80	70.70	162.00	24.50	5.53	4.29	6.05	5.62	4.1200200067
4.36	7.35	8.84	10.30	38.90	72.10	17.90	6.74	5.83	6.85	5.59	4.3400200068
4.00	4.16	8.90	31.70	30.70	18.70	14.90	3.77	2.99	4.93	4.49	3.1400200069
2.92	3.95	4.55	11.00	94.30	89.20	15.00	5.00	4.50	6.17	4.10	3.9800200070
4.60	8.56	7.87	20.00	61.50	47.00	11.10	3.06	3.63	7.43	5.27	3.6400200071
3.59	7.21	16.80	15.90	50.90	53.10	9.94	6.84	4.93	7.37	5.51	3.0200200072
3.07	3.24	5.29	7.78	9.40	14.90	3.60	3.60	3.48	5.28	6.20	4.7900200073
7.51	4.34	10.50	22.40	50.00	83.80	14.40	8.21	6.89	5.81	6.50	4.7800200074
3.36	3.52	6.11	16.60	85.70	214.00	61.30	14.30	8.56	10.90	10.20	10.2000200075

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  6.93  6.49  9.83 24.00134.00 56.40 16.30  8.73  7.01  8.87  6.77  5.3900200076
  4.83  5.44  5.47 14.60 30.30 20.20  5.88  3.67  3.37  4.98  4.70  4.6400200077
  3.94  4.11 18.20 30.40111.00 85.80 34.90  7.45  8.63  8.74  6.90  6.2000200078
  3.16  4.74 17.40 19.10 89.30117.00 22.70  7.16  4.45  5.70  4.68  5.1000200079
  3.85  4.97  6.20 18.10 56.70 93.40 18.20  9.21  7.35  7.28  6.89  6.0100200080
  4.48  5.08  9.08 19.10101.00 80.30 15.90  9.16  5.35  6.41  6.31  5.9200200081
  4.56  6.28 11.50 21.60 64.30116.00 38.80  8.62  8.83 10.50  8.47  6.9600200082
  7.78  5.66 10.40 31.60 42.00 35.80 18.90  9.04  8.54  7.98  6.01  4.7700200083
  8.64  5.43  8.53 15.40 39.50 49.90 10.90  9.13  5.82  7.46  6.06  4.1500200084
  3.41  2.96  5.83 14.00 17.80  9.72  1.62  3.98  7.25  8.49  8.73  5.5000200085
  4.09  6.30 16.70 11.00 38.20 47.20 11.60  5.71  8.49  7.91  7.23  5.7600200086
  2.98  3.55  6.72  7.28 21.70 14.00  7.57  4.89  5.18  6.18  4.76  4.1400200087
  2.10  2.71  4.59  6.55 17.20 13.40  2.36  2.44  2.61  3.64  4.15  3.5500200088
  2.05  1.42  9.67  9.19 26.80 19.70  6.05  3.00  6.24  6.44 10.50  6.3700200089
* Station 2990, RETURN FLOW STATION, NO NATURAL FLOWS AT THIS STATION
*  jan   feb   mar   apr   may   jun   jul   aug   sep   oct   nov   dec   stayr
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* Station 2992, DEADMANS BASIN RESERVOIR
*  jan   feb   mar   apr   may   jun   jul   aug   sep   oct   nov   dec   stayr
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* Station 2995, NODE FOR DIVERSION SPLIT
*  jan    feb    mar    apr    may    jun    jul    aug    sep    oct    nov    dec    stayr
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* Station 295, CARLESS CANAL RESERVOIR
* jan   feb   mar   apr   may   jun   jul   aug   sep   oct   nov   dec   stayr
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*Station 830, STOCK POND DEPLETIONS ABOVE RYEGATE

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr	
0.17	0.04	1.60	2.60	1.00	1.00	0.03	0.19	0.01	0.06	0.08	0.0700083029		00029572
0.04	0.05	1.31	2.70	0.40	0.20	0.00	0.03	0.04	0.11	0.14	0.1000083030		00029573
0.00	0.09	0.15	0.75	0.32	0.20	0.01	0.00	0.00	0.00	0.04	0.0500083031		00029574
0.05	0.09	0.15	0.18	0.50	1.40	0.12	0.01	0.01	0.10	0.14	0.0700083032		00029575
0.02	0.04	0.15	0.90	0.60	1.20	0.27	0.00	0.00	0.07	0.01	0.0000083033		00029576
0.01	0.17	0.34	0.40	0.00	4.20	0.00	0.00	0.00	0.00	0.03	0.0000083034		00029577
0.01	0.00	0.18	0.42	0.00	0.00	0.31	0.00	0.00	0.00	0.04	0.0100083035		00029578
0.00	0.00	0.83	2.30	2.00	1.00	0.00	0.00	0.01	0.00	0.00	0.0000083036		00029579
0.00	0.00	0.42	1.00	0.50	4.30	0.26	0.01	0.00	0.00	0.00	0.0000083037		00029580
0.01	0.08	0.73	0.80	2.80	7.70	1.30	0.25	0.20	0.12	0.12	0.2500083038		00029581
0.05	0.04	1.50	1.30	0.90	3.50	0.14	0.00	0.08	0.14	0.02	0.0000083039		00029582
0.00	0.01	0.39	0.45	0.00	0.20	0.00	0.00	0.07	0.08	0.00	0.0500083040		00029583
0.00	0.15	0.14	0.30	0.10	2.70	0.08	0.00	0.05	0.20	0.04	0.3600083041		00029584
0.00	0.34	1.49	1.70	6.50	12.40	0.60	0.59	0.02	0.19	0.29	0.3300083042		00029585
0.00	0.25	1.80	4.10	4.80	11.30	0.60	0.24	0.06	0.25	0.13	0.3600083043		00029586
0.16	0.02	0.89	0.87	0.90	11.90	1.20	0.53	0.04	0.04	0.15	0.3900083044		00029587
0.07	0.14	0.93	0.84	0.60	4.30	0.21	0.12	0.11	0.06	0.08	0.0700083045		00029588
0.09	0.10	0.81	1.30	0.70	0.60	0.07	0.03	0.03	0.17	0.05	0.3000083046		00029589
0.27	0.43	3.10	2.90	1.60	1.60	0.11	0.16	0.07	0.10	0.13	0.7000083047		
0.16	0.12	0.95	1.60	2.30	3.00	0.30	0.22	0.07	0.24	0.31	0.4100083048		
0.26	0.00	0.23	3.00	1.40	1.20	0.04	0.02	0.02	0.14	0.12	0.0700083049		
0.15	1.07	1.29	1.00	0.80	1.50	0.20	0.13	0.04	0.15	0.11	0.2100083050		
0.15	0.47	2.80	1.10	1.60	1.70	0.10	0.11	0.05	0.06	0.14	0.1300083051		
0.07	0.41	1.24	4.00	2.00	1.10	0.10	0.07	0.00	0.03	0.06	0.0600083052		
0.10	0.06	0.33	0.36	0.70	2.00	0.10	0.08	0.01	0.05	0.04	0.0800083053		
0.16	0.21	0.21	0.63	0.70	0.20	0.41	0.39	0.04	0.07	0.08	0.0400083054		
0.19	0.00	0.09	2.06	1.10	1.30	0.30	0.11	0.01	0.05	0.01	0.1100083055		
0.17	0.21	1.66	1.00	2.00	1.50	0.08	0.08	0.01	0.00	0.03	0.0400083056		
0.16	0.01	0.25	0.36	2.00	2.00	0.10	0.30	0.11	0.18	0.28	0.3600083057		
0.33	0.23	0.50	0.60	0.40	0.60	0.11	0.07	0.03	0.05	0.06	0.0500083058		
0.05	0.04	3.14	1.40	2.90	3.50	0.60	0.15	0.10	0.07	0.11	0.0500083059		
0.12	0.09	0.70	1.00	1.00	0.50	0.06	0.06	0.02	0.04	0.02	0.0200083060		
0.05	0.07	0.08	0.16	0.30	0.20	0.04	0.03	0.02	0.03	0.04	0.0300083061		
0.01	0.01	1.02	0.40	0.40	8.60	0.20	0.11	0.05	0.08	0.11	0.1500083062		
0.05	0.32	0.24	0.48	1.30	0.70	0.00	0.06	0.04	0.05	0.06	0.0300083063		
0.04	0.05	0.10	0.81	0.40	2.90	0.20	0.18	0.07	0.10	0.10	0.0600083064		
0.10	0.17	0.30	2.20	1.20	1.00	0.20	0.11	0.10	0.20	0.13	0.1700083065		
0.18	0.13	1.60	1.90	1.20	0.80	0.33	0.07	0.04	0.06	0.05	0.0800083066		
0.10	0.06	0.20	0.80	3.90	87.00	2.00	1.05	0.40	0.67	0.62	0.4800083067		
0.54	0.88	1.26	2.70	3.50	8.00	1.50	1.01	0.38	0.54	0.70	0.6200083068		
0.47	0.34	5.90	3.00	1.70	6.30	0.70	0.48	0.18	0.35	0.43	0.2500083069		
0.16	0.28	0.96	1.40	16.70	11.80	0.60	0.57	0.42	0.62	0.58	0.5800083070		

0.69	1.12	1.52	2.70	2.00	1.70	0.10	0.11	0.12	0.22	0.33	0.2100083071
0.25	1.40	2.50	2.30	2.20	0.90	0.36	0.59	0.16	0.52	0.59	0.0500083072
0.24	0.08	0.49	1.69	1.50	1.00	0.20	0.13	0.15	0.06	0.21	0.1500083073
0.10	0.31	0.40	0.80	1.20	4.10	0.30	0.64	0.68	0.11	0.58	0.2100083074
0.10	0.11	0.75	4.60	13.10	21.00	2.70	1.20	0.78	0.20	1.70	0.8000083075
0.31	0.27	2.17	1.80	15.00	6.90	0.60	0.59	0.16	0.05	0.37	0.7100083076
0.14	0.37	0.57	1.00	1.30	0.80	0.06	0.17	0.16	0.16	0.21	0.1700083077
0.11	0.13	0.60	4.80	10.00	9.30	1.40	0.59	0.78	0.43	0.35	0.6500083078
0.18	0.24	3.50	2.20	7.40	10.00	0.60	0.69	0.28	0.24	0.24	0.0800083079
0.16	0.39	1.39	1.50	1.40	5.20	0.20	0.35	0.17	0.18	0.11	0.2400083080
0.27	0.33	0.43	0.40	9.00	7.90	0.40	0.43	0.16	0.16	0.18	0.3500083081
0.32	0.49	1.50	2.60	3.40	10.00	1.00	0.47	0.19	0.40	0.30	0.4200083082
0.42	0.66	0.80	1.10	2.60	1.90	0.30	0.47	0.16	0.31	0.15	0.0800083083
0.20	0.44	0.61	0.90	1.30	2.50	0.20	0.36	0.16	0.23	0.22	0.0400083084
0.24	0.24	0.29	0.80	0.70	0.48	0.01	0.03	0.27	0.22	0.24	0.0300083085
0.19	0.67	0.70	1.00	0.90	2.00	0.30	0.28	1.61	0.14	0.20	0.0800083086
0.26	0.08	0.22	0.77	0.60	0.60	0.33	0.11	0.16	0.25	0.13	0.0800083087
0.06	0.00	0.21	0.32	0.40	0.70	0.00	0.01	0.15	0.00	0.02	0.0000083088
0.00	0.00	0.43	1.31	0.90	0.40	0.11	0.11	0.16	0.06	0.10	0.0500083089

* Station 3000, Musselshell River at Ryegate

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	sta yr
4.55	4.10	13.90	17.90	44.40	50.00	3.35	3.07	5.34	4.22	5.67	4.3600300029
2.17	4.15	8.72	27.90	25.60	17.70	1.97	1.67	1.99	2.60	3.81	2.7100300030
2.24	2.54	4.59	5.40	7.28	12.00	1.91	1.11	1.84	3.04	3.34	2.7900300031
1.82	1.44	3.77	7.05	29.00	49.10	2.37	1.63	1.44	3.12	3.92	3.4400300032
2.46	2.59	2.88	16.20	64.10	54.90	2.74	2.68	2.85	3.21	3.45	4.2100300033
4.00	3.61	6.43	16.20	13.10	51.00	2.16	1.38	1.02	3.27	2.69	2.8300300034
3.06	1.43	3.74	7.44	10.40	13.30	4.90	1.19	0.95	2.81	2.37	2.2100300035
2.45	2.12	7.61	16.70	53.10	28.90	2.21	1.26	1.23	1.93	2.25	2.2300300036
1.41	2.95	3.70	16.50	31.80	26.10	3.26	1.24	1.12	4.83	1.85	1.8700300037
2.47	2.91	5.32	12.20	70.80	66.50	36.20	5.46	2.49	3.49	6.59	4.2500300038
3.92	2.43	13.70	16.80	35.40	28.00	5.03	1.52	1.71	3.08	2.98	2.6900300039
2.21	2.06	5.93	9.48	14.50	16.00	4.59	1.14	1.15	3.64	5.27	2.2000300040
2.45	2.76	4.98	6.32	18.80	40.30	5.35	2.18	6.43	12.40	8.85	8.3300300041
5.76	5.21	8.34	27.80	79.80	94.00	10.30	5.43	4.72	6.48	6.46	7.2500300042
5.44	8.04	15.00	56.80	73.80	109.00	16.20	7.29	4.16	5.80	6.67	6.8000300043
4.54	2.73	6.22	10.60	27.10	79.30	27.60	8.18	4.78	5.62	5.69	6.4200300044
5.75	3.95	6.87	5.20	20.70	54.60	8.10	2.65	2.69	3.94	5.51	3.6200300045
4.05	3.47	9.16	20.60	35.10	23.50	7.64	2.42	3.57	6.75	6.35	9.7000300046
4.85	6.03	16.40	31.40	78.10	60.60	9.00	3.85	5.13	8.38	7.19	8.0000300047
7.20	4.37	7.97	28.60	92.80	130.00	34.50	9.79	4.88	5.99	6.35	5.2200300048
3.91	3.33	8.97	33.40	62.30	38.00	7.19	2.49	3.18	5.10	4.75	3.1100300049
2.55	7.41	5.73	16.70	55.50	90.30	21.90	8.50	5.22	7.59	6.57	6.0600300050
4.45	5.77	13.60	17.70	66.40	46.20	12.70	6.48	6.62	7.39	6.67	5.3300300051
4.49	4.87	6.92	41.00	111.00	46.30	12.40	4.76	3.96	4.11	3.69	2.9800300052
3.55	3.24	5.92	8.85	27.90	113.00	10.50	4.06	1.86	2.10	3.37	3.7600300053
3.33	4.51	4.54	10.00	25.00	26.60	6.27	2.87	1.35	2.69	3.35	2.3700300054
2.31	1.71	2.58	12.00	17.80	34.70	13.00	3.22	1.72	2.34	3.38	4.2700300055
3.61	3.80	11.00	17.60	71.30	38.60	5.12	2.34	1.39	1.70	2.49	2.5100300056
1.96	1.98	4.27	7.78	61.80	71.50	16.30	4.82	3.80	5.17	4.70	4.1200300057
3.63	3.95	7.38	13.30	40.40	18.20	6.52	2.94	2.11	2.31	3.31	3.2800300058
3.44	2.58	11.50	12.90	39.80	91.10	12.50	3.30	3.10	6.02	5.63	3.9100300059
3.29	2.67	12.40	15.20	36.40	29.90	4.47	2.26	1.83	2.75	3.46	3.5300300060
2.85	2.67	3.33	3.85	13.00	12.50	1.67	0.73	1.00	1.92	2.32	2.1200300061
1.66	2.47	5.30	13.40	48.40	62.40	13.00	5.34	4.25	5.19	4.08	4.4200300062
2.46	5.95	6.44	8.69	49.70	54.90	10.10	2.47	2.71	3.73	3.70	2.8900300063
3.03	2.84	3.10	8.78	49.90	87.10	14.70	3.52	2.47	3.23	3.16	4.3000300064
4.53	4.96	4.51	26.70	58.40	81.60	19.80	7.04	15.00	14.20	8.28	6.0700300065
4.25	3.63	11.80	18.50	59.80	24.00	7.14	2.37	1.87	2.93	3.59	3.2400300066
3.07	2.93	6.28	14.60	74.60	249.00	26.50	6.58	4.69	6.72	6.24	4.6000300067
4.90	8.23	10.10	13.00	42.40	80.10	19.40	7.75	6.21	7.39	6.29	4.9600300068
4.47	4.50	14.80	34.70	32.40	25.00	15.60	4.25	3.17	5.28	4.92	3.3900300069

3.08	4.23	5.51	12.40	111.00	101.00	15.60	5.57	4.92	6.79	4.68	4.56	00300070
5.29	9.68	9.39	22.70	63.50	48.70	11.20	3.17	3.75	7.65	5.60	3.85	00300071
3.84	8.61	19.30	18.20	53.10	54.00	10.30	7.43	5.09	7.89	6.10	3.07	00300072
3.31	3.32	5.78	9.47	10.90	15.90	3.80	3.73	3.63	5.34	6.41	4.94	00300073
7.61	4.65	10.90	23.20	51.20	87.90	14.70	8.85	7.57	5.92	7.08	4.99	00300074
3.46	3.63	6.86	21.20	98.80	235.00	64.00	15.50	9.34	11.10	11.90	11.00	00300075
7.24	6.76	12.00	25.80	149.00	63.30	16.90	9.32	7.17	8.92	7.14	6.10	00300076
4.97	5.81	6.04	15.60	31.60	21.00	5.94	3.84	3.53	5.14	4.91	4.81	00300077
4.05	4.24	18.80	35.20	121.00	95.10	36.30	8.04	9.41	9.17	7.25	6.85	00300078
3.34	4.98	20.90	21.30	96.70	127.00	23.30	7.85	4.73	5.94	4.92	5.18	00300079
4.01	5.36	7.59	19.60	58.10	98.60	18.40	9.56	7.52	7.46	7.00	6.25	00300080
4.75	5.41	9.51	19.50	110.00	88.20	16.30	9.59	5.51	6.57	6.49	6.27	00300081
4.88	6.77	13.00	24.20	67.70	126.00	39.80	9.09	9.02	10.90	8.77	7.38	00300082
8.20	6.32	11.20	32.70	44.60	37.70	19.20	9.51	8.70	8.29	6.16	4.85	00300083
8.84	5.87	9.14	16.30	40.80	52.40	11.10	9.49	5.98	7.69	6.28	4.19	00300084
3.65	3.20	6.12	14.80	18.50	10.20	1.63	4.01	7.52	8.71	8.97	5.53	00300085
4.28	6.97	17.40	12.00	39.10	49.20	11.90	5.99	10.10	8.05	7.43	5.84	00300086
3.24	3.63	6.94	8.05	22.30	14.60	7.90	5.00	5.34	6.43	4.89	4.22	00300087
2.16	2.71	4.80	6.87	17.60	14.10	2.36	2.45	2.76	3.63	4.17	3.55	00300088
2.05	1.42	10.10	10.50	27.70	20.10	6.16	3.11	6.40	6.50	10.60	6.42	00300089

* Station 300, Careless Creek at mouth

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
0.04	0.29	1.30	1.11	1.07	0.49	1.22	0.06	0.00	0.00	0.00	0.09	00300029
0.01	0.54	0.77	0.32	0.37	0.02	0.00	0.00	0.00	0.01	0.13	0.00	00300030
0.02	0.15	0.00	0.02	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	00300031
0.00	0.00	0.00	0.05	0.06	4.90	0.39	0.10	0.04	0.01	0.01	0.00	00300032
0.00	0.03	1.64	0.16	0.48	3.72	0.20	0.16	0.00	0.00	0.01	0.07	00300033
0.12	0.19	0.15	0.01	0.00	1.07	0.00	0.00	0.00	0.00	0.00	0.00	00300034
0.00	0.00	0.02	0.16	0.00	0.03	1.09	0.00	0.00	0.00	0.00	0.00	00300035
0.00	0.00	1.87	0.80	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	00300036
0.00	0.00	0.12	0.08	0.01	0.00	0.10	0.00	0.00	0.02	0.00	0.00	00300037
0.00	0.76	0.65	0.02	0.19	2.59	1.56	0.01	0.00	0.01	0.00	0.00	00300038
0.01	0.00	1.28	0.16	0.23	0.33	0.55	0.00	0.00	0.00	0.00	0.00	00300039
0.00	0.02	0.42	0.01	0.02	0.20	0.00	0.00	0.02	0.02	0.00	0.00	00300040
0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.00	0.01	0.38	0.74	00300041
0.42	0.24	2.01	3.05	3.21	4.94	1.32	0.72	0.09	0.44	0.11	1.35	00300042
0.79	2.49	1.82	1.61	1.25	11.20	3.22	0.71	0.34	0.38	0.16	1.27	00300043
0.52	0.36	0.09	1.25	0.48	9.64	4.27	1.32	0.51	0.39	0.08	1.32	00300044
0.84	0.50	0.68	0.25	0.07	1.67	0.23	0.00	0.00	0.02	0.17	0.00	00300045
0.04	0.24	0.49	0.21	0.25	0.33	0.35	0.02	0.13	0.19	0.09	0.74	00300046
0.09	0.20	2.35	0.39	0.68	0.59	0.24	0.15	0.08	0.12	0.12	0.11	00300047
0.13	0.18	0.31	0.17	0.74	1.23	0.98	0.28	0.12	0.12	0.15	0.02	00300048
0.04	0.11	2.87	0.52	0.29	0.49	0.23	0.03	0.11	0.08	0.08	0.02	00300049
0.00	0.13	1.21	0.62	0.26	0.86	0.50	0.25	0.22	0.19	0.18	0.24	00300050
0.11	0.21	1.41	0.17	0.34	0.57	0.21	0.22	0.40	0.34	0.11	0.00	00300051
0.07	0.21	1.47	0.29	0.89	0.50	0.31	0.16	0.16	0.07	0.00	0.04	00300052
0.11	0.03	0.12	0.02	0.62	5.44	0.55	0.01	0.00	0.00	0.00	0.01	00300053
0.01	0.33	0.04	0.16	0.04	0.14	0.01	0.10	0.00	0.04	0.00	0.00	00300054
0.00	0.00	0.00	1.86	0.68	0.86	0.15	0.02	0.00	0.00	0.00	0.00	00300055
0.00	0.00	0.77	0.21	0.09	0.01	0.00	0.10	0.00	0.01	0.07	0.07	00300056
0.02	0.11	0.10	0.36	0.42	0.77	0.41	0.09	0.28	0.23	0.04	0.00	00300057
0.03	0.18	0.21	0.11	0.18	0.50	0.23	0.12	0.16	0.14	0.01	0.02	00300058
0.07	0.11	5.42	0.14	0.06	0.52	0.28	0.14	0.18	0.16	0.08	0.21	00300059
0.04	0.16	1.00	0.14	0.18	0.20	0.08	0.14	0.06	0.04	0.00	0.07	00300060
0.03	0.09	0.00	0.08	0.05	0.04	0.09	0.00	0.07	0.00	0.06	0.01	00300061
0.03	0.08	0.14	0.68	0.75	0.79	0.52	0.10	0.18	0.15	0.00	0.12	00300062
0.05	0.47	0.26	0.07	0.18	0.58	0.23	0.03	0.18	0.10	0.01	0.01	00300063
0.03	0.08	0.01	0.04	0.55	1.05	0.59	0.13	0.29	0.17	0.05	0.28	00300064
0.25	0.58	0.93	0.29	0.24	0.69	0.48	0.24	0.43	0.39	0.13	0.10	00300065
0.05	0.17	1.67	0.22	0.39	0.06	0.41	0.08	0.17	0.18	0.01	0.00	00300066
0.05	0.14	0.18	0.14	0.20	1.71	0.83	0.24	0.31	0.27	0.31	0.01	00300067
0.17	0.28	0.90	0.43	0.46	1.13	0.55	0.25	0.31	0.25	0.27	0.11	00300068

0.13	0.21	2.78	0.70	0.38	0.54	0.71	0.20	0.23	0.23	0.13	0.0000030069
0.08	0.18	0.40	0.13	1.33	0.98	0.34	0.22	0.27	0.22	0.16	0.0700030070
0.16	0.98	1.54	0.56	0.57	0.39	0.26	0.15	0.33	0.23	0.24	0.0500030071
0.10	0.47	4.26	0.02	0.50	0.52	0.23	0.34	0.28	0.23	0.12	0.0700030072
0.04	0.16	0.14	0.40	0.47	0.27	0.14	0.00	0.14	0.14	0.30	0.0700030073
0.26	0.19	0.12	0.33	0.41	0.62	0.24	0.24	0.29	0.20	0.11	0.0700030074
0.07	0.15	0.37	0.87	1.54	1.43	1.17	0.42	0.40	0.42	0.10	0.5900030075
0.56	0.41	0.68	0.42	1.03	0.66	0.38	0.26	0.30	0.23	0.39	0.0000030076
0.18	0.27	0.25	0.05	0.26	0.18	0.14	0.08	0.18	0.16	0.15	0.0000030077
0.04	0.14	19.50	0.89	1.29	0.94	0.98	0.34	0.66	0.42	0.41	0.0000030078
0.15	0.27	18.50	0.00	0.98	0.21	0.43	0.11	0.29	0.25	0.09	0.0300030079
0.13	0.24	0.74	0.32	0.33	0.76	0.30	0.27	0.21	0.29	0.14	0.1900030080
0.13	0.27	0.18	0.06	1.22	1.02	0.42	0.10	0.22	0.22	0.11	0.0900030081
0.05	0.57	0.84	0.55	0.62	1.23	0.76	0.13	0.41	0.39	0.24	0.0700030082
0.29	0.38	0.36	0.56	0.42	0.26	0.17	0.00	0.23	0.23	0.08	0.0000030083
0.49	0.28	0.20	0.01	0.25	0.33	0.06	0.14	0.28	0.17	0.15	0.0200030084
0.08	0.02	0.09	0.40	0.07	0.10	0.10	0.06	0.07	0.13	0.02	0.0000030085
0.06	0.57	0.58	0.42	0.73	0.32	0.25	0.00	0.68	0.31	0.01	0.0900030086
0.15	0.06	0.12	0.33	0.36	0.17	0.23	0.19	0.12	0.17	0.07	0.0000030087
0.00	0.09	0.08	0.08	0.38	0.01	0.07	0.02	0.00	0.00	0.00	0.0000030088
0.05	0.03	1.44	0.23	0.42	0.09	0.01	0.01	0.11	0.14	0.00	0.0100030089

*Station 840, STOCK POND DEPLETIONS ABOVE LAVINA

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
0.00	0.01	0.00	0.00	0.03	0.01	0.01	0.01	0.00	0.01	0.01		0.0100084029
0.01	0.01	0.02	0.00	0.03	0.00	0.00	0.01	0.01	0.01	0.01		0.0000084030
0.00	0.00	0.01	0.01	0.02	0.00	0.00	0.01	0.00	0.02	0.01		0.0000084031
0.01	0.00	0.01	0.02	0.00	0.00	0.01	0.01	0.00	0.01	0.01		0.0000084032
0.01	0.00	0.01	0.00	0.02	0.00	0.00	0.01	0.01	0.01	0.01		0.0100084033
0.01	0.01	0.02	0.00	0.10	0.00	0.00	0.01	0.01	0.01	0.01		0.0000084034
0.00	0.00	0.01	0.02	0.00	0.07	0.01	0.00	0.01	0.01	0.01		0.0000084035
0.01	0.01	0.01	0.00	0.06	0.09	0.00	0.01	0.01	0.01	0.01		0.0100084036
0.01	0.01	0.01	0.02	0.09	0.00	0.01	0.00	0.00	0.00	0.01		0.0000084037
0.00	0.00	0.01	0.00	0.01	0.01	0.04	0.01	0.00	0.02	0.01		0.0100084038
0.00	0.00	0.00	0.00	0.07	0.07	0.00	0.01	0.00	0.01	0.01		0.0100084039
0.00	0.01	0.01	0.02	0.08	0.10	0.00	0.00	0.00	0.02	0.01		0.0100084040
0.00	0.01	0.01	0.01	0.00	0.06	0.00	0.00	0.01	0.00	0.02		0.0100084041
0.01	0.02	0.05	0.05	0.00	0.06	0.08	0.00	0.00	0.00	0.01		0.0000084042
0.01	0.00	0.08	0.09	0.00	0.00	0.08	0.02	0.01	0.00	0.01		0.0100084043
0.01	0.01	0.00	0.00	0.00	0.06	0.03	0.01	0.01	0.02	0.01		0.0000084044
0.01	0.01	0.02	0.01	0.03	0.03	0.02	0.01	0.01	0.00	0.01		0.0100084045
0.01	0.01	0.01	0.00	0.05	0.07	0.01	0.00	0.01	0.02	0.02		0.0000084046
0.01	0.01	0.05	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.02		0.0100084047
0.01	0.01	0.02	0.03	0.06	0.77	0.02	0.03	0.01	0.02	0.01		0.0100084048
0.01	0.01	0.06	0.08	0.01	0.01	0.01	0.00	0.00	0.01	0.01		0.0000084049
0.00	0.00	0.02	0.00	0.04	0.04	0.00	0.01	0.01	0.02	0.02		0.0100084050
0.00	0.01	0.00	0.03	0.06	0.03	0.09	0.01	0.01	0.02	0.02		0.0100084051
0.01	0.01	0.02	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01		0.0000084052
0.00	0.00	0.01	0.01	0.00	0.56	0.05	0.01	0.01	0.01	0.01		0.0100084053
0.01	0.02	0.01	0.04	0.00	0.00	0.01	0.00	0.00	0.01	0.00		0.0000084054
0.01	0.01	0.02	0.04	0.02	0.04	0.00	0.01	0.01	0.01	0.01		0.0100084055
0.01	0.01	0.00	0.00	0.11	0.00	0.00	0.00	0.01	0.00	0.00		0.0000084056
0.00	0.00	0.00	0.00	0.08	0.03	0.00	0.00	0.00	0.01	0.00		0.0000084057
0.00	0.01	0.00	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.00		0.0100084058
0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.00		0.0000084059
0.00	0.00	0.00	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.00		0.0100084060
0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.0000084061
0.00	0.00	0.00	0.02	0.05	0.01	0.00	0.00	0.00	0.01	0.01		0.0000084062
0.00	0.00	0.00	0.00	0.02	0.02	0.07	0.00	0.00	0.00	0.00		0.0000084063
0.00	0.00	0.00	0.00	0.05	0.05	0.01	0.00	0.00	0.00	0.01		0.0100084064
0.00	0.00	0.00	0.01	0.06	0.11	0.00	0.00	0.07	0.01	0.00		0.0000084065
0.00	0.00	0.00	0.00	0.01	0.04	0.00	0.00	0.00	0.00	0.00		0.0000084066
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01		0.0000084067

0.00	0.00	0.00	0.00	0.04	0.07	0.00	0.00	0.00	0.00	0.00	0.0000084068
0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.0000084069
0.00	0.00	0.00	0.00	0.67	1.02	0.06	0.00	0.00	0.00	0.00	0.0000084070
0.00	0.04	0.00	0.04	0.03	0.11	0.04	0.01	0.00	0.00	0.00	0.0000084071
0.00	0.01	0.04	0.00	0.10	0.08	0.00	0.01	0.00	0.03	0.02	0.0100084072
0.02	0.01	0.01	0.02	0.03	0.03	0.00	0.00	0.01	0.02	0.02	0.0100084073
0.02	0.01	0.00	0.07	0.00	0.08	0.00	0.00	0.00	0.02	0.02	0.0100084074
0.02	0.00	0.02	0.03	0.00	0.57	0.13	0.00	0.01	0.08	0.00	0.0100084075
0.01	0.02	0.12	0.00	0.00	0.04	0.02	0.02	0.03	0.04	0.02	0.0100084076
0.00	0.01	0.01	0.05	0.00	0.02	0.00	0.00	0.00	0.02	0.01	0.0100084077
0.01	0.01	0.00	0.01	0.71	0.00	0.02	0.02	0.03	0.02	0.02	0.0100084078
0.01	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.01	0.0100084079
0.00	0.01	0.02	0.00	0.00	0.04	0.00	0.01	0.01	0.02	0.03	0.0100084080
0.01	0.00	0.01	0.04	0.00	0.08	0.00	0.00	0.01	0.01	0.01	0.0000084081
0.01	0.01	0.00	0.00	0.08	0.00	0.04	0.01	0.01	0.01	0.03	0.0200084082
0.01	0.01	0.04	0.00	0.08	0.04	0.13	0.01	0.01	0.04	0.03	0.0100084083
0.02	0.01	0.02	0.09	0.05	0.07	0.04	0.02	0.02	0.03	0.03	0.0100084084
0.01	0.01	0.02	0.00	0.03	0.00	0.00	0.00	0.00	0.02	0.02	0.0100084085
0.01	0.01	0.02	0.00	0.00	0.08	0.05	0.00	0.02	0.03	0.02	0.0000084086
0.01	0.00	0.02	0.02	0.04	0.00	0.01	0.00	0.01	0.00	0.01	0.0000084087
0.01	0.00	0.01	0.03	0.02	0.00	0.00	0.00	0.00	0.01	0.01	0.0100084088
0.01	0.00	0.00	0.00	0.08	0.01	0.01	0.00	0.00	0.01	0.00	0.0000084089

* Station 4000, Musselshell River at Lavina

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
4.59	4.40	15.20	19.00	45.50	50.50	4.58	3.14	5.34	4.23	5.68	4.4600400029
2.19	4.70	9.51	28.20	26.00	17.70	1.97	1.68	2.00	2.62	3.95	2.7100400030
2.26	2.69	4.60	5.43	7.33	12.00	1.91	1.12	1.84	3.06	3.35	2.7900400031
1.83	1.44	3.78	7.12	29.00	54.00	2.77	1.74	1.48	3.14	3.94	3.4400400032
2.47	2.62	4.53	16.30	64.60	58.60	2.94	2.85	2.86	3.22	3.47	4.2900400033
4.13	3.81	6.60	16.20	13.20	52.00	2.16	1.39	1.03	3.28	2.70	2.8300400034
3.06	1.43	3.77	7.62	10.40	13.40	6.00	1.19	0.96	2.82	2.38	2.2100400035
2.46	2.13	9.49	17.50	53.20	29.00	2.21	1.27	1.24	1.94	2.26	2.2400400036
1.42	2.96	3.83	16.60	31.90	26.10	3.37	1.24	1.12	4.85	1.86	1.8700400037
2.47	3.67	5.98	12.20	71.00	69.10	37.80	5.48	2.49	3.52	6.60	4.2600400038
3.93	2.43	14.90	16.90	35.70	28.40	5.58	1.53	1.71	3.09	2.99	2.7000400039
2.21	2.09	6.36	9.51	14.60	16.30	4.59	1.14	1.17	3.68	5.28	2.2100400040
2.45	2.77	4.99	6.33	18.80	40.40	5.36	2.18	6.44	12.40	9.25	9.0800400041
6.19	5.47	10.40	30.90	83.00	99.00	11.70	6.15	4.81	6.92	6.58	8.6000400042
6.24	10.50	16.90	58.50	75.00	120.00	19.50	8.02	4.51	6.18	6.84	8.0800400043
5.07	3.10	6.31	11.80	27.50	89.00	31.90	9.51	5.30	6.03	5.78	7.7400400044
6.60	4.46	7.57	5.46	20.80	56.30	8.35	2.66	2.70	3.96	5.69	3.6300400045
4.10	3.72	9.66	20.80	35.40	23.90	8.00	2.44	3.71	6.96	6.46	10.4000400046
4.95	6.24	18.80	31.80	78.80	61.20	9.26	4.01	5.22	8.52	7.33	8.1200400047
7.34	4.56	8.30	28.80	93.60	132.00	35.50	10.10	5.01	6.13	6.51	5.2500400048
3.96	3.45	11.90	34.00	62.60	38.50	7.43	2.52	3.29	5.19	4.84	3.1300400049
2.55	7.54	6.96	17.30	55.80	91.20	22.40	8.76	5.45	7.80	6.77	6.3100400050
4.56	5.99	15.00	17.90	66.80	46.80	13.00	6.71	7.03	7.75	6.80	5.3400400051
4.57	5.09	8.41	41.30	112.00	46.80	12.70	4.93	4.12	4.19	3.70	3.0200400052
3.66	3.27	6.05	8.88	28.50	119.00	11.10	4.08	1.87	2.11	3.38	3.7800400053
3.35	4.86	4.59	10.20	25.00	26.70	6.29	2.97	1.35	2.74	3.35	2.3700400054
2.32	1.72	2.60	13.90	18.50	35.60	13.10	3.25	1.73	2.35	3.39	4.2800400055
3.62	3.81	11.70	17.80	71.50	38.60	5.12	2.44	1.40	1.71	2.56	2.5700400056
1.97	2.09	4.37	8.14	62.30	72.30	16.70	4.91	4.08	5.41	4.73	4.1200400057
3.66	4.14	7.59	13.50	40.60	18.70	6.75	3.06	2.27	2.44	3.32	3.3100400058
3.51	2.68	16.90	13.00	39.80	91.60	12.80	3.44	3.28	6.19	5.71	4.1200400059
3.33	2.82	13.40	15.40	36.60	30.10	4.55	2.39	1.89	2.79	3.46	3.6100400060
2.88	2.76	3.33	3.94	13.00	12.50	1.76	0.73	1.07	1.92	2.38	2.1200400061
1.69	2.55	5.44	14.10	49.20	63.20	13.50	5.44	4.43	5.35	4.09	4.5300400062
2.51	6.42	6.70	8.76	49.90	55.50	10.40	2.50	2.89	3.83	3.71	2.8900400063
3.06	2.92	3.11	8.82	50.50	88.20	15.30	3.65	2.76	3.40	3.22	4.5900400064
4.78	5.53	5.44	27.00	58.70	82.40	20.20	7.28	15.50	14.60	8.41	6.1700400065
4.30	3.80	13.40	18.70	60.20	24.10	7.54	2.45	2.04	3.11	3.60	3.2400400066

3.12	3.07	6.46	14.70	74.80	250.00	27.30	6.83	5.00	6.99	6.56	4.6100400067
5.07	8.51	11.00	13.40	42.90	81.30	19.90	8.00	6.52	7.64	6.56	5.0700400068
4.60	4.71	17.50	35.40	32.80	25.50	16.30	4.45	3.40	5.51	5.04	3.3900400069
3.16	4.41	5.91	12.50	113.00	103.00	16.00	5.79	5.19	7.01	4.84	4.6300400070
5.45	10.70	10.90	23.30	64.10	49.20	11.50	3.33	4.08	7.88	5.84	3.9000400071
3.94	9.09	23.60	18.20	53.70	54.60	10.50	7.78	5.37	8.15	6.24	3.1500400072
3.37	3.49	5.93	9.89	11.40	16.20	3.94	3.73	3.78	5.50	6.73	5.0200400073
7.89	4.85	11.00	23.60	51.60	88.60	14.90	9.09	7.86	6.14	7.21	5.0700400074
3.55	3.78	7.25	22.10	100.00	237.00	65.30	15.90	9.75	11.60	12.00	11.6000400075
7.81	7.19	12.80	26.20	150.00	64.00	17.30	9.60	7.50	9.19	7.55	6.1100400076
5.15	6.09	6.30	15.70	31.80	21.20	6.08	3.92	3.71	5.32	5.07	4.8200400077
4.10	4.39	38.30	36.10	123.00	96.00	37.30	8.40	10.10	9.61	7.68	6.8600400078
3.50	5.26	39.40	21.30	97.70	127.00	23.70	7.96	5.02	6.20	5.02	5.2200400079
4.14	5.61	8.35	19.90	58.40	99.40	18.70	9.84	7.74	7.77	7.17	6.4500400080
4.89	5.68	9.70	19.60	111.00	89.30	16.70	9.69	5.74	6.80	6.61	6.3600400081
4.94	7.35	13.80	24.70	68.40	127.00	40.60	9.23	9.44	11.30	9.04	7.4700400082
8.50	6.71	11.60	33.20	45.10	38.00	19.50	9.52	8.94	8.56	6.27	4.8600400083
9.35	6.16	9.36	16.40	41.10	52.80	11.20	9.65	6.28	7.89	6.46	4.2200400084
3.74	3.23	6.23	15.20	18.60	10.30	1.73	4.07	7.59	8.86	9.01	5.5400400085
4.35	7.55	18.00	12.40	39.80	49.60	12.20	5.99	10.80	8.39	7.46	5.9300400086
3.40	3.69	7.08	8.40	22.70	14.70	8.14	5.19	5.47	6.60	4.97	4.2200400087
2.17	2.80	4.89	6.98	18.00	14.10	2.43	2.47	2.76	3.64	4.18	3.5600400088
2.11	1.45	11.50	10.70	28.20	20.20	6.18	3.12	6.51	6.65	10.60	6.4300400089

* Station 5000, Musselshell River below Painted Robe Creek

jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
4.72	4.74	17.00	19.90	46.30	51.20	4.79	3.33	5.39	4.33	5.79	4.5500500029
2.22	5.06	10.70	29.50	26.40	18.00	2.12	1.74	2.07	2.76	4.09	2.8100500030
2.29	2.97	5.22	5.80	7.56	12.20	2.07	1.14	1.88	3.10	3.42	2.8500500031
1.88	1.64	4.26	7.29	29.60	54.70	3.15	1.78	1.52	3.25	4.09	3.5300500032
2.51	2.85	5.01	16.70	65.20	59.40	3.45	2.87	2.88	3.30	3.51	4.3300500033
4.16	4.23	7.28	16.80	13.50	53.50	2.32	1.41	1.06	3.31	2.78	2.8700500034
3.09	1.58	4.31	7.89	10.70	13.60	6.58	1.22	0.99	2.85	2.46	2.2500500035
2.48	2.37	10.80	18.20	54.00	29.40	2.36	1.29	1.29	1.97	2.29	2.2700500036
1.44	3.25	4.44	16.90	32.30	27.30	3.89	1.26	1.16	4.90	1.89	1.9100500037
2.49	4.02	6.98	12.60	72.00	71.20	39.50	5.77	2.77	3.66	6.75	4.4800500038
3.99	2.70	16.40	17.60	36.30	29.30	5.95	1.56	1.84	3.25	3.03	2.7400500039
2.24	2.34	7.06	9.83	14.80	16.50	4.73	1.17	1.28	3.78	5.31	2.2800500040
2.48	3.06	5.59	6.49	18.90	41.20	5.62	2.21	6.54	12.60	9.32	9.3800500041
6.22	5.92	11.50	31.80	85.00	102.00	12.60	6.68	4.89	7.14	6.85	8.8800500042
6.29	11.00	19.20	60.00	76.70	123.00	20.40	8.30	4.65	6.46	6.99	8.3700500043
5.19	3.34	7.17	12.20	28.00	91.90	33.40	10.00	5.41	6.12	5.94	8.0600500044
6.68	4.82	8.66	5.79	21.10	57.70	8.82	2.82	2.89	4.06	5.79	3.7100500045
4.18	3.99	11.10	21.40	36.00	24.50	8.51	2.56	3.83	7.18	6.56	10.7000500046
5.16	6.96	22.60	33.00	80.00	62.30	9.72	4.24	5.39	8.69	7.50	8.6700500047
7.49	4.97	9.34	29.80	95.10	133.00	36.30	10.40	5.14	6.38	6.79	5.5700500048
4.14	3.72	12.40	35.20	63.60	39.50	7.78	2.63	3.39	5.40	5.00	3.2200500049
2.66	9.06	8.46	17.90	56.50	92.30	23.00	8.97	5.58	7.99	6.90	6.5100500050
4.68	6.68	17.30	18.40	67.80	47.70	13.30	6.86	7.15	7.85	6.95	5.4800500051
4.64	5.69	9.49	42.80	113.00	47.60	13.10	5.06	4.19	4.28	3.80	3.1000500052
3.75	3.63	6.85	9.11	29.00	120.00	11.60	4.22	1.94	2.20	3.46	3.9000500053
3.47	5.31	5.07	10.50	25.40	27.00	6.85	3.32	1.44	2.84	3.46	2.4300500054
2.46	1.87	2.82	14.50	19.00	36.20	13.70	3.38	1.76	2.43	3.45	4.4000500055
3.75	4.21	13.30	18.40	72.40	39.30	5.36	2.56	1.44	1.74	2.62	2.6400500056
2.09	2.41	5.00	8.45	63.20	73.30	17.10	5.23	4.26	5.63	4.99	4.4000500057
3.89	4.59	8.61	13.90	41.10	19.20	7.10	3.19	2.36	2.52	3.42	3.3900500058
3.57	2.98	19.10	13.60	40.90	93.10	13.80	3.62	3.47	6.31	5.85	4.2000500059
3.43	3.15	14.50	15.90	37.20	30.60	4.77	2.46	1.93	2.84	3.52	3.6700500060
2.95	3.11	3.85	4.09	13.20	12.70	1.90	0.78	1.12	1.98	2.44	2.1700500061
1.72	2.84	6.50	14.50	49.60	65.60	14.00	5.57	4.53	5.45	4.22	4.6800500062
2.56	6.99	7.39	9.06	50.60	56.10	10.70	2.58	2.96	3.91	3.79	2.9500500063
3.12	3.29	3.53	9.21	51.30	89.70	15.80	3.84	2.88	3.52	3.33	4.6800500064
4.89	6.01	6.06	28.10	59.70	83.50	20.90	7.46	15.70	14.80	8.60	6.3600500065

4.45	4.32	15.60	19.50	60.90	24.60	8.00	2.53	2.11	3.19	3.69	3.3400500066
3.21	3.43	7.02	15.20	76.60	269.00	29.80	7.74	5.60	7.69	7.11	5.0100500067
5.44	9.75	13.20	14.40	44.20	83.70	21.80	8.89	7.10	8.20	7.17	5.5600500068
4.91	5.33	21.40	36.90	33.60	27.00	17.10	4.88	3.68	5.87	5.40	3.6000500069
3.29	4.97	6.92	13.20	117.00	106.00	16.90	6.29	5.76	7.63	5.33	5.0900500070
5.89	11.80	12.30	24.40	65.20	50.00	11.80	3.45	4.28	8.12	6.15	4.0800500071
4.11	10.40	26.30	19.10	54.70	55.50	11.20	8.30	5.64	8.69	6.73	3.2300500072
3.55	3.87	6.72	10.40	11.90	16.50	4.22	3.85	4.01	5.59	6.93	5.1700500073
8.00	5.35	12.10	24.10	52.30	90.10	15.40	9.65	8.81	6.27	7.71	5.2600500074
3.65	4.20	8.16	23.50	104.00	242.00	68.60	17.00	10.80	11.90	13.40	12.3000500075
8.05	7.87	14.80	27.10	154.00	65.90	18.10	10.10	7.75	9.26	7.89	6.6500500076
5.27	6.71	7.32	16.40	32.30	21.50	6.24	4.08	3.94	5.50	5.28	4.9700500077
4.19	4.89	39.80	38.00	126.00	98.70	39.10	8.95	11.10	10.10	8.00	7.3600500078
3.64	5.80	42.20	22.30	100.00	130.00	24.90	8.60	5.44	6.45	5.25	5.3200500079
4.26	6.19	9.63	20.90	59.10	101.00	19.60	10.20	8.07	7.98	7.32	6.6700500080
5.08	6.30	10.80	20.20	114.00	91.60	17.90	10.20	6.04	6.98	6.81	6.6500500081
5.17	8.11	15.50	25.60	69.70	130.00	42.20	9.63	9.79	11.70	9.34	7.8100500082
8.79	7.57	12.80	33.80	46.10	38.80	20.30	9.97	9.22	8.87	6.44	4.9600500083
9.51	6.88	10.30	16.90	41.90	53.80	11.70	9.95	6.53	8.13	6.67	4.2800500084
3.92	3.77	6.96	15.90	19.10	10.60	1.80	4.12	7.99	9.10	9.25	5.6000500085
4.51	8.38	19.40	12.90	40.50	50.50	12.70	6.26	13.00	8.54	7.66	6.0300500086
3.58	4.06	7.87	8.84	23.00	15.00	8.67	5.31	5.72	6.86	5.11	4.3100500087
2.22	3.09	5.43	7.24	18.30	14.40	2.51	2.50	3.00	3.67	4.23	3.5900500088
2.14	1.73	12.60	11.40	28.80	20.50	6.49	3.26	6.77	6.74	10.70	6.5200500089

*Station 850, STOCK POND DEPLETIONS ABOVE ROUNDUP

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
0.17	0.40	1.30	0.70	1.20	1.00	0.26	0.16	0.15	0.13	0.18		0.1500085029
0.08	0.35	0.80	1.80	0.80	0.50	0.19	0.15	0.13	0.13	0.19		0.1100085030
0.10	0.25	0.64	0.47	0.36	0.40	0.20	0.10	0.11	0.09	0.19		0.1000085031
0.10	0.14	0.46	0.34	0.90	0.80	0.34	0.15	0.13	0.12	0.20		0.1200085032
0.12	0.22	0.47	0.50	1.00	1.00	0.33	0.10	0.10	0.08	0.16		0.1300085033
0.11	0.36	0.65	1.20	0.60	1.20	0.19	0.06	0.12	0.10	0.21		0.1300085034
0.12	0.16	0.55	0.46	0.50	0.30	0.36	0.07	0.10	0.09	0.17		0.0800085035
0.07	0.24	1.20	0.60	1.00	0.40	0.20	0.08	0.12	0.10	0.15		0.1000085036
0.05	0.29	0.54	0.40	0.80	0.50	0.35	0.05	0.10	0.13	0.13		0.0900085037
0.12	0.32	0.84	0.60	1.10	1.10	0.60	0.33	0.16	0.14	0.27		0.2100085038
0.18	0.26	1.10	1.10	1.00	0.50	0.35	0.08	0.13	0.13	0.13		0.1200085039
0.09	0.25	0.67	0.57	0.70	0.40	0.18	0.07	0.18	0.17	0.14		0.1200085040
0.09	0.21	0.62	0.31	0.20	0.60	0.25	0.14	0.25	0.20	0.26		0.2600085041
0.18	0.33	0.70	1.20	1.30	2.00	0.60	0.38	0.28	0.28	0.32		0.2700085042
0.22	0.40	1.90	1.60	1.30	2.00	0.60	0.37	0.23	0.21	0.29		0.2400085043
0.19	0.24	0.62	0.40	0.60	1.20	0.70	0.40	0.23	0.18	0.25		0.2400085044
0.22	0.31	0.89	0.36	0.40	1.20	0.36	0.23	0.19	0.15	0.22		0.1600085045
0.17	0.25	1.30	0.80	1.00	0.90	0.64	0.32	0.33	0.30	0.32		0.3000085046
0.29	0.55	2.90	1.40	1.90	1.40	0.58	0.41	0.35	0.31	0.35		0.4100085047
0.44	0.43	0.86	1.60	2.10	3.00	0.80	0.40	0.31	0.29	0.29		0.2600085048
0.24	0.37	0.50	1.30	1.60	1.30	0.45	0.33	0.31	0.28	0.30		0.2000085049
0.18	0.94	1.13	1.10	1.20	1.50	0.60	0.43	0.34	0.30	0.30		0.2400085050
0.23	0.49	1.30	0.80	1.50	1.10	0.40	0.27	0.29	0.21	0.30		0.2200085051
0.21	0.42	0.71	1.50	2.00	1.00	0.40	0.33	0.28	0.24	0.25		0.1900085052
0.21	0.39	0.79	0.40	0.60	2.00	0.50	0.30	0.25	0.16	0.28		0.2300085053
0.21	0.40	0.50	0.60	0.40	0.50	0.28	0.26	0.18	0.19	0.24		0.1700085054
0.20	0.22	0.26	0.50	0.50	0.80	0.40	0.24	0.16	0.18	0.28		0.2100085055
0.20	0.34	1.00	0.90	1.10	0.60	0.26	0.19	0.17	0.15	0.23		0.1800085056
0.19	0.36	0.66	0.59	1.20	1.10	0.50	0.32	0.31	0.28	0.30		0.2400085057
0.25	0.38	0.96	0.90	1.00	0.70	0.38	0.28	0.27	0.19	0.26		0.2100085058
0.20	0.32	1.10	0.70	0.90	1.50	0.60	0.29	0.28	0.28	0.28		0.2000085059
0.20	0.33	1.00	0.80	1.00	0.80	0.27	0.17	0.15	0.15	0.25		0.2000085060
0.20	0.37	0.59	0.34	0.40	0.40	0.18	0.10	0.15	0.14	0.19		0.1600085061
0.16	0.36	0.80	0.60	0.90	1.20	0.40	0.24	0.25	0.20	0.27		0.2200085062
0.17	0.47	0.72	0.54	0.80	0.80	0.40	0.19	0.22	0.16	0.24		0.1900085063
0.22	0.40	0.49	0.54	1.50	1.60	0.60	0.26	0.24	0.20	0.26		0.2200085064

0.26	0.46	0.63	1.40	1.70	1.70	0.70	0.35	0.50	0.40	0.36	0.3000085065
0.24	0.51	1.70	0.70	1.00	0.50	0.29	0.12	0.16	0.17	0.19	0.1700085066
0.18	0.38	0.60	0.70	2.00	4.00	0.90	0.42	0.41	0.44	0.41	0.2900085067
0.33	0.85	1.80	0.80	1.30	1.60	0.80	0.40	0.45	0.41	0.39	0.2900085068
0.28	0.49	1.70	1.80	1.00	0.50	0.40	0.21	0.22	0.24	0.20	0.1900085069
0.20	0.45	0.75	1.10	3.00	1.00	0.50	0.26	0.32	0.33	0.29	0.2500085070
0.31	0.50	0.80	1.10	1.50	1.00	0.40	0.19	0.24	0.24	0.24	0.1500085071
0.20	0.60	1.90	0.80	1.20	1.20	0.50	0.30	0.36	0.40	0.30	0.1800085072
0.26	0.38	0.71	0.50	0.40	0.30	0.18	0.09	0.18	0.18	0.24	0.2100085073
0.25	0.38	1.10	0.80	1.10	1.20	0.40	0.28	0.42	0.16	0.34	0.2400085074
0.31	0.41	0.76	0.70	2.00	3.00	1.60	0.60	0.60	0.30	0.60	0.4000085075
0.36	0.62	1.30	1.10	2.00	1.00	0.40	0.30	0.26	0.13	0.31	0.2900085076
0.22	0.48	0.94	1.10	0.50	0.40	0.19	0.16	0.17	0.20	0.28	0.1800085077
0.21	0.49	1.40	1.90	2.00	1.30	0.90	0.41	0.50	0.40	0.35	0.3000085078
0.24	0.49	1.60	1.20	2.00	2.00	0.80	0.45	0.37	0.25	0.31	0.2300085079
0.22	0.45	0.87	1.60	0.90	2.00	0.90	0.50	0.51	0.26	0.33	0.2600085080
0.26	0.50	1.20	1.20	2.00	1.60	1.10	0.50	0.41	0.19	0.29	0.2200085081
0.25	0.61	1.30	0.70	1.20	2.00	1.00	0.15	0.51	0.30	0.30	0.2400085082
0.29	0.53	1.20	0.60	1.10	0.70	0.70	0.33	0.36	0.20	0.27	0.1800085083
0.26	0.52	0.80	0.80	1.10	0.80	0.30	0.05	0.24	0.19	0.22	0.1200085084
0.17	0.41	0.71	1.40	0.70	0.20	0.10	0.10	0.24	0.19	0.27	0.1500085085
0.21	0.51	1.40	0.80	1.00	1.00	0.50	0.21	0.60	0.17	0.25	0.2100085086
0.19	0.35	0.82	0.69	0.60	0.40	0.30	0.12	0.23	0.18	0.20	0.1300085087
0.11	0.33	0.59	0.56	0.50	0.40	0.11	0.04	0.15	0.11	0.15	0.1100085088
0.10	0.30	1.00	1.00	0.90	0.50	0.26	0.16	0.22	0.13	0.20	0.1600085089

* Station 6000, Musselshell River at Roundup

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
4.89	5.14	18.30	20.60	47.50	52.20	5.05	3.49	5.54	4.46	5.97	4.7000600029
2.30	5.41	11.50	31.30	27.20	18.50	2.31	1.89	2.20	2.89	4.28	2.9200600030
2.39	3.22	5.86	6.27	7.92	12.60	2.27	1.24	1.99	3.19	3.61	2.9500600031
1.98	1.78	4.72	7.63	30.50	55.50	3.49	1.93	1.65	3.37	4.29	3.6500600032
2.63	3.07	5.48	17.20	66.20	60.40	3.78	2.97	2.98	3.38	3.67	4.4600600033
4.27	4.59	7.93	18.00	14.10	54.70	2.51	1.47	1.18	3.41	2.99	3.0000600034
3.21	1.74	4.86	8.35	11.20	13.90	6.94	1.29	1.09	2.94	2.63	2.3300600035
2.55	2.61	12.00	18.80	55.00	29.80	2.56	1.37	1.41	2.07	2.44	2.3700600036
1.49	3.54	4.98	17.30	33.10	27.80	4.24	1.31	1.26	5.03	2.02	2.0000600037
2.61	4.34	7.82	13.20	73.10	72.30	40.10	6.10	2.93	3.80	7.02	4.6900600038
4.17	2.96	17.50	18.70	37.30	29.80	6.30	1.64	1.97	3.38	3.16	2.8600600039
2.33	2.59	7.73	10.40	15.50	16.90	4.91	1.24	1.46	3.95	5.45	2.4000600040
2.57	3.27	6.21	6.80	19.10	41.80	5.87	2.35	6.79	12.80	9.58	9.6400600041
6.40	6.25	12.20	33.00	86.30	104.00	13.20	7.06	5.17	7.42	7.17	9.1500600042
6.51	11.40	21.10	61.60	78.00	125.00	21.00	8.67	4.88	6.67	7.28	8.6100600043
5.38	3.58	7.79	12.60	28.60	93.10	34.10	10.40	5.64	6.30	6.19	8.3000600044
6.90	5.13	9.55	6.15	21.50	58.90	9.18	3.05	3.08	4.21	6.01	3.8700600045
4.35	4.24	12.40	22.20	37.00	25.40	9.15	2.88	4.16	7.48	6.88	11.0000600046
5.45	7.51	25.50	34.40	81.90	63.70	10.30	4.65	5.74	9.00	7.85	9.0800600047
7.93	5.40	10.20	31.40	97.20	136.00	37.10	10.80	5.45	6.67	7.08	5.8300600048
4.38	4.09	12.90	36.50	65.20	40.80	8.23	2.96	3.70	5.68	5.30	3.4200600049
2.84	10.00	9.59	19.00	57.70	93.80	23.60	9.40	5.92	8.29	7.20	6.7500600050
4.91	7.17	18.60	19.20	69.30	48.80	13.70	7.13	7.44	8.06	7.25	5.7000600051
4.85	6.11	10.20	44.30	115.00	48.60	13.50	5.39	4.47	4.52	4.05	3.2900600052
3.96	4.02	7.64	9.51	29.60	122.00	12.10	4.52	2.19	2.36	3.74	4.1300600053
3.68	5.71	5.57	11.10	25.80	27.50	7.13	3.58	1.62	3.03	3.70	2.6000600054
2.66	2.09	3.08	15.00	19.50	37.00	14.10	3.62	1.92	2.61	3.73	4.6100600055
3.95	4.55	14.30	19.30	73.50	39.90	5.62	2.75	1.61	1.89	2.85	2.8200600056
2.28	2.77	5.66	9.04	64.40	74.40	17.60	5.55	4.57	5.91	5.29	4.6400600057
4.14	4.97	9.57	14.80	42.10	19.90	7.48	3.47	2.63	2.71	3.68	3.6000600058
3.77	3.30	20.20	14.30	41.80	94.60	14.40	3.91	3.75	6.59	6.13	4.4000600059
3.63	3.48	15.50	16.70	38.20	31.40	5.04	2.63	2.08	2.99	3.77	3.8700600060
3.15	3.48	4.44	4.43	13.60	13.10	2.08	0.88	1.27	2.12	2.63	2.3300600061
1.88	3.20	7.30	15.10	50.50	66.80	14.40	5.81	4.78	5.65	4.49	4.9000600062
2.73	7.46	8.11	9.60	51.40	56.90	11.10	2.77	3.18	4.07	4.03	3.1400600063

3.34	3.69	4.02	9.75	52.80	91.30	16.40	4.10	3.12	3.72	3.59	4.9000600064
5.15	6.47	6.69	29.50	61.40	85.20	21.60	7.81	16.20	15.20	8.96	6.6600600065
4.69	4.83	17.30	20.20	61.90	25.10	8.29	2.65	2.27	3.36	3.88	3.5100600066
3.39	3.81	7.62	15.90	78.60	273.00	30.70	8.16	6.01	8.13	7.52	5.3000600067
5.77	10.60	15.00	15.20	45.50	85.30	22.60	9.29	7.55	8.61	7.56	5.8500600068
5.19	5.82	23.10	38.70	34.60	27.50	17.50	5.09	3.90	6.11	5.60	3.7900600069
3.49	5.42	7.67	14.30	120.00	107.00	17.40	6.55	6.08	7.96	5.62	5.3400600070
6.20	12.30	13.10	25.50	66.70	51.00	12.20	3.64	4.52	8.36	6.39	4.2300600071
4.31	11.00	28.20	19.90	55.90	56.70	11.70	8.60	6.00	9.09	7.03	3.4100600072
3.81	4.25	7.43	10.90	12.30	16.80	4.40	3.94	4.19	5.77	7.17	5.3800600073
8.25	5.73	13.20	24.90	53.40	91.30	15.80	9.93	9.23	6.43	8.05	5.5000600074
3.96	4.61	8.92	24.20	106.00	245.00	70.20	17.60	11.40	12.20	14.00	12.7000600075
8.41	8.49	16.10	28.20	156.00	66.90	18.50	10.40	8.01	9.39	8.20	6.9400600076
5.49	7.19	8.26	17.50	32.80	21.90	6.43	4.24	4.11	5.70	5.56	5.1500600077
4.40	5.38	41.20	39.90	128.00	100.00	40.00	9.36	11.60	10.50	8.35	7.6600600078
3.88	6.29	43.80	23.50	102.00	132.00	25.70	9.05	5.81	6.70	5.56	5.5500600079
4.48	6.64	10.50	22.50	60.00	103.00	20.50	10.70	8.58	8.24	7.65	6.9300600080
5.34	6.80	12.00	21.40	116.00	93.20	19.00	10.70	6.45	7.17	7.10	6.8700600081
5.42	8.72	16.80	26.30	70.90	132.00	43.20	9.78	10.30	12.00	9.64	8.0500600082
9.08	8.10	14.00	34.40	47.20	39.50	21.00	10.30	9.58	9.07	6.71	5.1400600083
9.77	7.40	11.10	17.70	43.00	54.60	12.00	10.00	6.77	8.32	6.89	4.4000600084
4.09	4.18	7.67	17.30	19.80	10.80	1.90	4.22	8.23	9.29	9.52	5.7500600085
4.72	8.89	20.80	13.70	41.50	51.50	13.20	6.47	13.60	8.71	7.91	6.2400600086
3.77	4.41	8.69	9.53	23.60	15.40	8.97	5.43	5.95	7.04	5.31	4.4400600087
2.33	3.42	6.02	7.80	18.80	14.80	2.62	2.54	3.15	3.78	4.38	3.7000600088
2.24	2.03	13.60	12.40	29.70	21.00	6.75	3.42	6.99	6.87	10.90	6.6800600089

*Station 860, STOCK POND DEPLETIONS ABOVE MUSSELSHELL

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
0.10	0.51	1.80	1.20	0.40	0.40	0.04	0.05	0.04	0.01	0.02	0.1100086029
0.01	0.07	1.10	0.80	0.20	0.10	0.00	0.00	0.01	0.03	0.03	0.0300086030
0.01	0.15	0.15	0.21	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.0000086031
0.01	0.15	0.12	0.06	0.10	0.70	0.14	0.03	0.01	0.03	0.03	0.0200086032
0.01	0.06	0.16	0.20	0.20	0.20	0.27	0.00	0.00	0.02	0.03	0.0200086033
0.02	0.28	0.25	0.10	0.00	0.70	0.00	0.00	0.00	0.01	0.01	0.0000086034
0.00	0.00	0.14	0.12	0.00	0.00	0.33	0.00	0.00	0.01	0.02	0.0100086035
0.00	0.00	1.40	0.70	0.50	0.10	0.00	0.00	0.00	0.00	0.00	0.0000086036
0.00	0.00	0.35	0.30	0.10	0.60	0.28	0.01	0.00	0.05	0.00	0.0000086037
0.00	0.13	0.53	0.20	0.60	1.10	1.50	0.06	0.08	0.03	0.08	0.0600086038
0.01	0.06	1.50	0.40	0.30	0.60	0.14	0.00	0.04	0.04	0.00	0.0100086039
0.00	0.01	0.37	0.10	0.00	0.00	0.00	0.00	0.03	0.02	0.00	0.0100086040
0.00	0.22	0.09	0.07	0.10	0.40	0.08	0.00	0.09	0.10	0.03	0.2100086041
0.07	0.52	1.50	1.10	2.90	3.00	0.80	0.38	0.07	0.20	0.19	0.2800086042
0.13	0.80	2.40	1.50	1.40	3.00	0.80	0.29	0.06	0.19	0.21	0.2800086043
0.10	0.08	1.15	0.60	0.20	2.50	1.40	0.60	0.08	0.15	0.16	0.2900086044
0.14	0.27	1.15	0.29	0.10	0.70	0.23	0.03	0.04	0.02	0.07	0.1500086045
0.06	0.25	0.70	0.40	0.20	0.10	0.07	0.01	0.02	0.10	0.13	0.2000086046
0.11	0.63	2.50	1.40	0.50	0.30	0.20	0.08	0.03	0.07	0.11	0.5500086047
1.12	0.22	1.40	0.60	0.70	0.00	0.30	0.00	0.04	0.06	0.19	0.3000086048
0.12	0.01	0.20	1.10	1.10	0.30	0.04	0.00	0.01	0.04	0.06	0.0200086049
0.04	1.60	0.91	0.50	0.50	0.60	0.10	0.04	0.02	0.05	0.09	0.1000086050
0.20	0.66	2.10	0.40	1.10	0.40	0.10	0.04	0.03	0.03	0.03	0.0500086051
0.03	0.65	1.00	1.30	1.00	0.20	0.10	0.03	0.00	0.01	0.05	0.0100086052
0.03	0.08	0.25	0.11	0.30	1.00	0.10	0.02	0.01	0.02	0.01	0.0200086053
0.02	0.34	0.21	0.20	0.20	0.00	0.40	0.12	0.02	0.03	0.02	0.0100086054
0.02	0.00	0.08	1.00	0.40	0.20	0.30	0.03	0.01	0.02	0.01	0.0300086055
0.02	0.29	1.50	0.30	0.40	0.20	0.08	0.05	0.01	0.00	0.05	0.0000086056
0.02	0.01	0.30	0.14	0.40	0.30	0.10	0.08	0.04	0.12	0.15	0.2000086057
0.06	0.32	0.43	0.20	0.10	0.10	0.11	0.01	0.01	0.01	0.07	0.0100086058
0.01	0.04	2.80	0.30	0.60	0.40	0.60	0.04	0.05	0.07	0.07	0.0200086059
0.04	0.12	0.80	0.30	0.20	0.10	0.06	0.01	0.01	0.03	0.04	0.0000086060
0.01	0.09	0.06	0.05	0.00	0.00	0.03	0.02	0.01	0.01	0.03	0.0100086061
0.00	0.03	0.78	0.10	0.30	1.30	0.20	0.10	0.13	0.07	0.08	0.0600086062

0.01	0.54	0.30	0.15	0.40	0.10	0.00	0.01	0.10	0.05	0.06	0.0000086063
0.03	0.07	0.07	0.22	0.30	0.40	0.20	0.08	0.03	0.09	0.08	0.0200086064
0.05	0.31	0.46	0.80	0.40	0.20	0.10	0.03	0.30	0.10	0.11	0.0500086065
0.03	0.18	1.50	0.60	0.30	0.10	0.32	0.01	0.01	0.01	0.06	0.0200086066
0.02	0.08	0.15	0.20	1.20	11.00	2.00	0.26	0.18	0.18	0.16	0.1100086067
0.08	1.20	0.90	0.80	1.10	1.20	1.40	0.25	0.23	0.14	0.15	0.1400086068
0.08	0.49	4.30	1.00	1.00	0.90	0.70	0.13	0.09	0.09	0.10	0.0500086069
0.03	0.40	0.69	0.30	4.00	2.00	0.70	0.16	0.30	0.17	0.14	0.1300086070
0.11	1.60	1.10	0.80	0.40	0.50	0.10	0.03	0.17	0.05	0.08	0.0500086071
0.04	2.00	1.80	0.60	1.10	0.60	0.30	0.13	0.08	0.21	0.18	0.0100086072
0.04	0.11	0.42	0.50	0.40	0.10	0.21	0.02	0.11	0.06	0.10	0.0900086073
0.03	0.53	0.60	0.30	0.50	0.50	0.30	0.27	0.29	0.04	0.20	0.1300086074
0.04	0.18	0.66	1.60	3.00	3.00	4.20	0.40	0.30	0.20	0.50	0.4000086075
0.07	0.45	1.70	0.50	3.00	0.90	0.60	0.30	0.24	0.09	0.17	0.2800086076
0.11	0.60	0.42	0.30	0.30	0.10	0.07	0.05	0.06	0.08	0.08	0.1100086077
0.07	0.25	1.60	1.30	3.00	2.00	1.80	0.23	0.40	0.20	0.19	0.1900086078
0.10	0.39	2.70	0.70	2.00	1.00	0.60	0.20	0.11	0.14	0.14	0.0200086079
0.04	0.61	1.10	0.50	0.60	1.00	0.30	0.30	0.11	0.13	0.11	0.1200086080
0.11	0.53	0.50	0.30	5.00	1.90	0.50	0.30	0.08	0.10	0.12	0.0800086081
0.04	0.74	1.40	0.80	0.80	0.00	1.00	0.12	0.20	0.30	0.16	0.1000086082
0.06	0.93	0.60	0.30	0.60	0.20	0.40	0.10	0.24	0.15	0.10	0.0200086083
0.03	0.64	0.50	0.30	0.30	0.40	0.20	0.10	0.20	0.11	0.09	0.0100086084
0.04	0.38	0.32	0.20	0.10	0.10	0.01	0.01	0.14	0.10	0.08	0.0000086085
0.04	1.08	0.80	0.30	0.50	0.30	0.30	0.08	0.70	0.13	0.10	0.1800086086
0.09	0.14	0.32	0.33	0.20	0.10	0.33	0.04	0.20	0.12	0.09	0.0200086087
0.00	0.00	0.20	0.10	0.10	0.10	0.00	0.00	0.06	0.00	0.02	0.0100086088
0.00	0.01	0.30	0.50	0.40	0.10	0.12	0.04	0.07	0.07	0.10	0.0700086089

* Station 7000, Musselshell River at Musselshell

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
4.99	5.65	20.10	21.80	47.90	52.60	5.09	3.54	5.58	4.47	5.99	4.8100700029
2.31	5.48	12.60	32.10	27.40	18.60	2.31	1.89	2.21	2.92	4.31	2.9500700030
2.40	3.37	6.01	6.48	8.00	12.60	2.27	1.24	1.99	3.19	3.61	2.9500700031
1.99	1.93	4.84	7.69	30.60	56.20	3.63	1.96	1.66	3.40	4.32	3.6700700032
2.64	3.13	5.64	17.40	66.40	60.60	4.05	2.97	2.98	3.40	3.70	4.4800700033
4.29	4.87	8.18	18.10	14.10	55.40	2.51	1.47	1.17	3.42	3.00	3.0000700034
3.20	1.74	5.00	8.47	11.20	13.90	7.27	1.29	1.09	2.95	2.65	2.3400700035
2.55	2.61	13.40	19.50	55.50	29.90	2.56	1.37	1.41	2.07	2.44	2.3700700036
1.49	3.54	5.33	17.60	33.20	28.40	4.52	1.32	1.26	5.08	2.02	2.0000700037
2.61	4.47	8.35	13.40	73.70	73.40	41.60	6.16	3.01	3.83	7.10	4.7500700038
4.18	3.02	19.00	19.10	37.60	30.40	6.44	1.64	2.01	3.42	3.16	2.8700700039
2.33	2.60	8.10	10.50	15.50	16.90	4.91	1.24	1.49	3.97	5.45	2.4100700040
2.57	3.49	6.30	6.87	19.20	42.20	5.95	2.35	6.88	12.90	9.61	9.8500700041
6.47	6.77	13.70	34.10	89.20	107.00	14.00	7.44	5.24	7.62	7.36	9.4300700042
6.64	12.20	23.50	63.10	79.40	128.00	21.80	8.96	4.94	6.86	7.49	8.8900700043
5.48	3.66	8.94	13.20	28.80	95.60	35.50	11.00	5.72	6.45	6.35	8.5900700044
7.04	5.40	10.70	6.44	21.60	59.60	9.41	3.08	3.12	4.23	6.08	4.0200700045
4.41	4.49	13.10	22.60	37.20	25.50	9.22	2.89	4.18	7.58	7.01	11.2000700046
5.56	8.14	28.00	35.80	82.40	64.00	10.50	4.73	5.77	9.07	7.96	9.6300700047
9.05	5.62	11.60	32.00	97.90	136.00	37.40	10.80	5.49	6.73	7.27	6.1300700048
4.50	4.10	13.10	37.60	66.30	41.10	8.27	2.96	3.71	5.72	5.36	3.4400700049
2.88	11.60	10.50	19.50	58.20	94.40	23.70	9.44	5.94	8.34	7.29	6.8500700050
5.11	7.83	20.70	19.60	70.40	49.20	13.80	7.17	7.47	8.09	7.28	5.7500700051
4.88	6.76	11.20	45.60	116.00	48.80	13.60	5.42	4.47	4.53	4.10	3.3000700052
3.99	4.10	7.89	9.62	29.90	123.00	12.20	4.54	2.20	2.38	3.75	4.1500700053
3.70	6.05	5.78	11.30	26.00	27.50	7.53	3.70	1.64	3.06	3.72	2.6100700054
2.68	2.09	3.16	16.00	19.90	37.20	14.40	3.65	1.93	2.63	3.74	4.6400700055
3.97	4.84	15.80	19.60	73.90	40.10	5.70	2.80	1.62	1.89	2.90	2.8200700056
2.30	2.78	5.96	9.18	64.80	74.70	17.70	5.63	4.61	6.03	5.44	4.8400700057
4.20	5.29	10.00	15.00	42.20	20.00	7.59	3.48	2.64	2.72	3.75	3.6100700058
3.78	3.34	23.00	14.60	42.40	95.00	15.00	3.95	3.80	6.66	6.20	4.4200700059
3.67	3.60	16.30	17.00	38.40	31.50	5.10	2.64	2.09	3.02	3.81	3.8700700060
3.16	3.57	4.50	4.48	13.60	13.10	2.11	0.90	1.28	2.13	2.66	2.3400700061

	1.88	3.23	8.08	15.20	50.80	68.10	14.60	5.91	4.91	5.72	4.57	4.9600700062
	2.74	8.00	8.41	9.75	51.80	57.00	11.10	2.78	3.28	4.12	4.09	3.1400700063
	3.37	3.76	4.09	9.97	53.10	91.70	16.60	4.18	3.15	3.81	3.67	4.9200700064
	5.20	6.78	7.15	30.30	61.80	85.40	21.70	7.84	16.50	15.30	9.07	6.7100700065
	4.72	5.01	18.80	20.80	62.20	25.20	8.61	2.66	2.28	3.37	3.94	3.5300700066
	3.41	3.89	7.77	16.10	79.80	284.00	32.70	8.42	6.19	8.31	7.68	5.4100700067
	5.85	11.80	15.90	16.00	46.60	86.50	24.00	9.54	7.78	8.75	7.71	5.9900700068
	5.27	6.31	27.40	39.70	35.60	28.40	18.20	5.22	3.99	6.20	5.70	3.8400700069
	3.52	5.82	8.36	14.60	124.00	109.00	18.10	6.71	6.38	8.13	5.76	5.4700700070
	6.31	13.90	14.20	26.30	67.10	51.50	12.30	3.67	4.69	8.41	6.47	4.2800700071
	4.35	13.00	30.00	20.50	57.00	57.30	12.00	8.73	6.08	9.30	7.21	3.4200700072
	3.85	4.36	7.85	11.40	12.70	16.90	4.61	3.96	4.30	5.83	7.27	5.4700700073
	8.28	6.26	13.80	25.20	53.90	91.80	16.10	10.20	9.52	6.47	8.25	5.6300700074
	4.00	4.79	9.58	25.80	109.00	248.00	74.40	18.00	11.70	12.40	14.50	13.1000700075
	8.48	8.94	17.80	28.70	159.00	67.80	19.10	10.70	8.25	9.48	8.37	7.2200700076
	5.60	7.79	8.68	17.80	33.10	22.00	6.50	4.29	4.17	5.78	5.64	5.2600700077
	4.47	5.63	42.80	41.20	131.00	102.00	41.80	9.59	12.00	10.70	8.54	7.8500700078
	3.98	6.68	46.50	24.20	104.00	133.00	26.30	9.25	5.92	6.84	5.70	5.5700700079
	4.52	7.25	11.60	23.00	60.60	104.00	20.80	11.00	8.69	8.37	7.76	7.0500700080
	5.45	7.33	12.50	21.70	121.00	95.10	19.50	11.00	6.53	7.27	7.22	6.9500700081
	5.46	9.46	18.20	27.10	71.70	134.00	44.20	9.90	10.50	12.30	9.80	8.1500700082
	9.14	9.03	14.60	34.70	47.80	39.70	21.40	10.40	9.82	9.22	6.81	5.1600700083
	9.80	8.04	11.60	18.00	43.30	55.00	12.20	10.10	6.97	8.43	6.98	4.4100700084
	4.13	4.56	7.99	17.50	19.90	10.90	1.91	4.23	8.37	9.39	9.60	5.7500700085
	4.76	9.97	21.60	14.00	42.00	51.80	13.50	6.55	14.30	8.84	8.01	6.4200700086
	3.86	4.55	9.01	9.86	23.80	15.50	9.30	5.47	6.15	7.16	5.40	4.4600700087
	2.33	3.42	6.22	7.90	18.90	14.90	2.62	2.54	3.21	3.78	4.40	3.7100700088
	2.24	2.04	13.90	12.90	30.10	21.10	6.87	3.46	7.06	6.94	11.00	6.7500700089

* Station 400, Flat Willow Creek at mouth

*	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
	0.32	0.48	3.89	2.83	2.31	1.95	0.33	0.00	0.00	0.00	0.00	0.2400040029	
	0.35	2.83	2.70	2.81	1.35	0.02	0.14	0.34	0.01	0.01	0.00	0.0000040030	
	0.08	0.37	0.18	0.02	0.00	0.22	0.00	0.15	0.00	0.00	0.00	0.0000040031	
	0.00	0.00	0.00	0.13	0.19	4.11	1.08	0.62	0.33	0.03	0.15	0.0300040032	
	0.14	0.21	2.21	1.58	5.19	3.81	0.01	0.11	0.07	0.04	0.09	0.0300040033	
	0.06	0.64	0.89	0.26	0.00	3.37	0.02	0.00	0.00	0.00	0.00	0.0000040034	
	0.00	0.02	0.54	0.26	0.10	0.01	0.84	0.01	0.00	0.00	0.00	0.0000040035	
	0.00	0.00	8.07	2.15	1.84	0.58	0.00	0.00	0.00	0.00	0.00	0.0000040036	
	0.00	0.00	1.12	0.72	0.38	3.53	0.70	0.00	0.00	0.17	0.00	0.0500040037	
	0.28	1.94	1.93	0.53	2.75	7.88	5.46	0.36	0.08	0.22	0.50	0.2400040038	
	0.22	0.47	4.23	1.00	0.74	2.70	0.32	0.00	0.00	0.00	0.00	0.0000040039	
	0.00	0.13	1.00	0.28	0.09	0.17	0.00	0.00	0.00	0.00	0.00	0.0000040040	
	0.00	0.06	0.31	0.03	0.09	1.92	0.19	0.01	0.78	0.41	0.27	0.4000040041	
	0.46	0.80	4.20	1.51	8.91	15.50	2.10	0.98	0.39	0.47	0.70	0.4000040042	
	0.23	6.60	5.16	5.35	5.76	13.60	1.91	0.34	0.14	0.21	0.54	0.3400040043	
	0.24	0.44	0.68	0.57	0.65	14.70	4.67	0.85	0.18	0.25	0.47	0.3600040044	
	0.33	1.12	2.46	0.57	0.41	3.52	0.54	0.09	0.02	0.02	0.28	0.1400040045	
	0.21	0.98	1.93	1.03	0.49	1.31	0.89	0.06	0.12	0.22	0.22	0.4100040046	
	0.32	0.71	6.28	3.15	4.37	2.74	0.45	0.18	0.06	0.11	0.20	0.3600040047	
	0.27	0.56	1.42	1.43	3.72	11.80	6.38	0.57	0.11	0.11	0.35	0.2300040048	
	0.12	0.27	7.35	3.49	3.63	1.91	0.49	0.03	0.09	0.06	0.20	0.0900040049	
	0.05	0.35	3.78	2.66	4.27	5.75	1.73	0.45	0.28	0.22	0.36	0.7500040050	
	0.48	0.77	4.25	2.73	2.85	2.59	0.37	0.35	0.80	0.59	0.80	0.4000040051	
	0.28	0.78	4.37	5.14	6.66	2.01	0.74	0.18	0.16	0.06	0.15	0.1500040052	
	0.18	0.33	0.81	0.21	1.36	7.54	0.39	0.19	0.05	0.01	0.06	0.1200040053	
	0.05	0.67	0.49	0.42	0.79	0.33	0.01	0.85	0.06	0.04	0.15	0.0500040054	
	0.03	0.09	0.26	1.94	0.55	0.47	0.21	0.03	0.02	0.01	0.04	0.1200040055	
	0.11	0.16	2.69	0.78	2.48	1.70	0.24	0.21	0.08	0.01	0.15	0.1000040056	
	0.06	0.27	0.71	0.27	1.75	4.59	1.18	0.06	0.42	0.31	0.63	0.2600040057	
	0.28	0.60	1.10	0.57	0.41	0.81	0.48	0.10	0.17	0.13	0.24	0.1300040058	
	0.10	0.25	12.10	0.98	0.74	2.17	0.60	0.15	0.20	0.17	0.21	0.2000040059	
	0.12	0.45	3.27	0.65	0.58	0.25	0.09	0.13	0.04	0.03	0.11	0.0800040060	

0.05	0.20	0.13	0.12	0.08	0.05	0.00	0.00	0.05	0.00	0.07	0.0200040061
0.01	0.17	0.88	0.24	5.27	7.41	1.83	0.22	0.20	0.16	0.33	0.2100040062
0.06	2.32	1.26	0.44	1.29	2.70	0.44	0.24	0.21	0.08	0.18	0.0900040063
0.06	0.17	0.35	0.31	2.87	8.66	2.37	0.83	0.44	0.19	0.29	0.1500040064
0.50	3.51	3.10	4.76	5.76	3.76	1.58	0.42	0.93	0.76	0.57	0.3700040065
0.34	0.51	4.84	1.85	1.55	0.40	0.54	0.23	0.19	0.20	0.17	0.1400040066
0.15	0.39	0.99	0.66	2.87	23.00	4.62	0.61	0.50	0.40	0.54	0.2500040067
0.27	1.27	3.04	1.66	2.10	9.92	2.05	0.90	0.51	0.34	0.85	0.4900040068
0.35	0.77	7.15	4.19	1.40	1.82	3.35	0.28	0.31	0.31	0.35	0.2100040069
0.11	0.60	1.68	0.88	16.60	7.49	0.86	0.34	0.41	0.29	0.37	0.2500040070
0.19	9.88	4.54	2.79	3.12	1.25	0.52	0.18	0.55	0.30	0.39	0.1700040071
0.19	2.28	9.99	1.17	2.45	2.19	0.42	0.87	0.41	0.30	0.32	0.1100040072
0.13	0.47	0.85	1.46	2.16	0.64	0.19	0.05	0.14	0.14	0.29	0.1900040073
0.50	0.68	0.80	0.53	1.62	3.04	0.46	0.42	0.45	0.23	0.43	0.2400040074
0.15	0.43	1.59	6.52	22.40	15.90	9.08	1.47	0.79	0.91	1.15	0.7600040075
0.89	1.80	2.47	1.60	9.92	3.40	1.01	0.51	0.49	0.31	0.55	0.5800040076
0.34	1.19	1.22	0.72	0.74	0.32	0.10	0.06	0.20	0.17	0.17	0.2300040077
0.18	0.42	33.10	6.74	15.60	6.83	6.39	0.92	2.05	0.88	1.12	0.8400040078
0.56	1.19	31.80	9.82	9.05	5.51	1.29	0.72	0.45	0.36	0.66	0.4700040079
0.30	0.90	2.63	1.21	1.11	4.50	0.69	0.54	0.27	0.46	0.60	0.1700040080
0.41	1.17	1.00	0.29	14.00	8.15	1.24	0.68	0.28	0.27	0.53	0.3100040081
0.15	3.37	2.87	2.64	3.63	11.70	3.82	0.76	0.81	0.77	0.66	0.3800040082
0.63	1.55	1.56	0.82	1.77	0.68	0.27	0.33	0.31	0.32	0.37	0.1200040083
1.06	1.21	1.09	0.63	0.67	0.91	0.06	0.15	0.42	0.19	0.20	0.1000040084
0.05	0.04	0.68	0.51	0.10	0.13	0.00	0.27	0.05	0.12	0.10	0.0800040085
0.28	3.37	2.19	0.69	5.05	1.12	0.48	0.29	2.20	0.52	0.32	0.2100040086
0.12	0.11	0.80	0.51	1.36	0.31	0.58	0.27	0.11	0.18	0.29	0.1200040087
0.08	0.19	0.66	0.19	1.49	0.02	0.00	0.01	0.00	0.00	0.03	0.0300040088
0.03	0.06	4.32	1.04	1.81	0.47	0.02	0.01	0.09	0.13	0.20	0.1300040089

*Station 870, STOCK POND DEPLETIONS ABOVE MOSBY

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
4.41	15.27	25.37	11.37	21.59	35.65	1.64	3.15	6.68	1.71	4.13		3.7500087029
0.00	2.69	11.12	23.09	0.00	0.00	0.00	0.00	0.00	17.73	0.00		0.0000087030
0.00	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.60		0.2300087031
0.00	0.04	0.00	0.00	17.01	105.4	1.43	5.30	0.46	0.49	0.00		1.5300087032
0.30	0.15	7.10	11.63	49.01	21.69	0.00	0.91	0.00	0.00	0.00		0.0000087033
0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.0000087034
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.0000087035
0.00	0.00	27.16	8.65	27.66	0.00	0.00	0.00	0.00	0.00	0.00		0.0000087036
0.00	0.00	0.00	12.09	12.12	0.00	0.32	0.00	0.00	1.43	0.00		0.0000087037
0.00	0.89	9.47	0.00	39.55	51.82	51.93	3.74	0.93	0.00	1.10		0.0000087038
0.00	0.00	16.87	0.00	0.00	1.90	0.00	0.00	0.00	0.00	0.00		0.0000087039
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.0000087040
0.00	0.00	0.00	0.00	0.00	10.78	0.00	0.00	4.77	7.59	4.83		7.5800087041
4.39	0.00	13.24	24.39	55.59	50.20	13.70	1.05	0.69	1.21	1.60		4.1900087042
3.03	18.42	27.54	51.75	16.94	120.7	40.69	4.60	0.00	0.43	2.09		4.6800087043
1.55	0.00	22.83	0.00	0.00	91.70	69.03	11.39	3.99	3.26	3.68		6.9400087044
4.44	4.11	11.09	0.00	0.00	0.00	0.00	0.00	1.27	2.15	3.18		0.8900087045
1.40	2.62	11.10	13.07	12.71	0.00	3.16	0.00	2.80	5.33	4.67		9.8600087046
3.94	7.38	45.50	30.05	66.03	31.66	2.05	3.05	4.18	7.28	5.72		8.0400087047
13.78	4.09	10.58	16.37	28.88	106.9	36.76	8.57	4.40	5.19	5.99		4.8100087048
3.25	2.08	24.85	33.96	15.27	0.00	0.00	0.00	0.00	0.20	0.71		0.0000087049
0.00	8.86	4.11	8.64	22.43	86.05	18.87	6.56	3.76	6.31	4.65		4.1000087050
3.04	13.35	7.75	8.47	41.15	0.00	1.53	3.83	4.21	2.13	1.98		1.8200087051
1.69	5.72	17.03	33.56	93.14	21.39	9.79	3.20	2.57	1.97	0.93		0.0000087052
1.40	1.38	4.56	6.30	19.44	127.8	12.81	3.80	1.10	0.68	1.34		2.0300087053
2.16	5.23	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.0000087054
0.25	0.00	1.56	13.80	0.00	0.00	4.69	2.32	0.00	0.00	0.00		1.7900087055
1.09	1.91	23.78	11.71	24.12	0.00	0.00	0.00	0.00	0.00	0.00		0.0000087056
0.00	0.00	9.13	0.00	5.75	0.00	0.00	0.00	0.00	0.00	0.00		0.0000087057
0.00	1.39	0.00	0.00	0.00	0.00	1.18	1.05	0.57	0.00	0.50		0.3000087058
0.59	0.00	39.28	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.30		0.0000087059

0.00	0.00	11.83	4.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000087060
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000087061
0.00	0.00	2.60	2.06	0.00	12.59	0.00	4.29	1.01	0.00	0.00	0.1900087062
0.00	5.58	0.00	0.00	0.00	8.40	0.00	0.00	0.38	0.00	0.00	0.0000087063
0.00	0.00	0.00	0.00	14.93	49.84	8.53	0.00	0.00	0.00	0.00	1.9100087064
2.42	10.02	8.68	36.84	67.34	72.04	19.90	4.18	15.86	11.55	3.30	2.7800087065
0.00	0.00	19.56	0.00	11.05	0.00	0.00	0.00	0.00	0.00	0.00	0.0000087066
0.00	0.44	0.34	0.00	0.00	64.00	0.00	0.00	0.00	0.00	0.00	0.0000087067
0.00	4.66	1.86	0.00	0.00	40.18	7.15	0.00	1.47	0.35	0.30	0.0000087068
0.21	0.00	34.83	28.21	13.80	11.78	22.31	1.43	0.37	0.90	0.64	0.0000087069
0.00	1.46	0.00	0.00	50.40	22.81	0.00	0.00	0.00	0.00	0.00	0.0000087070
3.79	27.32	0.00	7.11	0.00	0.00	0.00	0.00	1.20	2.07	1.35	0.0000087071
0.20	7.33	30.08	2.33	9.25	0.00	0.00	0.00	0.00	2.42	0.60	0.0000087072
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.01	0.0000087073
3.48	1.09	2.50	0.07	0.00	0.00	0.00	1.75	0.66	0.00	0.00	0.0000087074
0.00	0.00	0.00	0.00	74.50	211.3	119.6	10.26	4.29	4.92	10.61	9.5800087075
0.00	8.72	9.83	14.80	119.2	19.00	7.99	2.14	4.58	2.26	2.57	4.0100087076
2.58	7.04	2.42	2.88	14.96	12.68	5.04	0.36	0.00	0.00	0.00	0.2700087077
0.65	0.00	46.50	31.96	103.9	58.67	54.41	4.52	12.35	3.38	2.12	2.7400087078
1.20	4.61	47.73	24.94	89.95	122.5	18.84	4.47	0.54	1.00	1.42	1.4700087079
2.58	6.31	8.24	19.25	47.59	99.10	20.80	9.86	6.42	5.51	4.64	4.2600087080
4.49	8.00	2.40	13.11	127.2	99.35	16.77	9.56	0.04	1.42	0.00	0.5500087081
6.12	11.53	24.03	29.96	73.07	137.3	46.28	10.14	13.19	13.63	11.04	8.6600087082
0.00	9.75	15.74	35.18	49.13	39.92	23.33	10.57	12.59	10.28	7.82	5.2400087083
10.34	9.09	12.71	18.47	43.73	57.39	12.64	10.25	9.19	9.26	7.73	4.5900087084
0.00	1.44	0.00	0.00	0.00	0.00	0.00	0.81	3.37	5.40	4.03	1.0600087085
2.88	16.62	20.91	0.00	21.35	36.58	12.31	4.88	13.80	7.09	4.30	4.6600087086
2.07	3.01	6.04	5.42	19.82	3.89	7.65	4.40	6.33	4.79	2.30	1.6200087087
0.39	1.73	2.39	0.50	0.00	0.00	0.00	0.61	1.66	0.41	0.22	0.2900087088
0.00	0.00	10.90	0.00	0.00	0.00	3.34	0.66	4.60	3.96	7.93	2.8600087089

* Station 8000, Musselshell River at Mosby

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
6.17	19.00	33.70	31.10	56.20	64.90	5.86	4.41	7.84	6.61	6.02	5.9000800029
2.68	9.54	20.80	38.50	34.50	18.60	2.45	3.58	2.51	21.40	4.44	3.0400800030
2.51	4.37	6.95	6.80	8.08	12.80	2.28	1.38	1.99	3.19	3.63	2.9700800031
2.04	2.38	5.17	8.10	32.00	126.00	7.24	7.09	2.07	4.30	4.87	3.8400800032
2.92	3.42	14.90	19.70	73.10	66.70	4.21	3.23	3.14	3.73	4.08	4.7600800033
4.55	6.78	9.32	20.20	14.10	79.20	2.83	1.47	1.18	3.45	3.03	3.0100800034
3.21	1.77	5.86	9.28	15.60	15.80	10.70	3.28	1.09	2.98	2.70	2.3600800035
2.56	2.65	42.40	23.00	57.50	30.50	2.56	1.37	1.42	2.07	2.44	2.3800800036
1.49	3.54	7.56	18.60	33.60	51.00	9.84	1.43	1.26	5.66	2.02	2.1700800037
2.90	6.82	22.50	14.30	78.30	84.20	65.90	6.66	4.84	4.16	8.16	5.2200800038
4.47	3.51	43.70	21.80	39.50	66.90	8.92	1.72	2.07	3.49	3.17	2.9800800039
2.34	2.86	10.30	11.20	15.80	17.70	4.94	1.30	1.54	4.01	5.45	2.4300800040
2.63	3.65	6.66	7.11	19.30	52.20	6.26	2.43	8.94	13.40	10.10	11.2000800041
7.51	9.49	25.90	43.80	121.00	158.00	38.80	11.00	6.66	9.67	9.20	11.1000800042
7.94	31.70	50.00	75.50	90.50	182.00	55.90	11.80	5.80	8.49	9.58	10.5000800043
6.43	5.62	33.00	18.00	38.60	154.00	86.80	17.30	8.36	7.79	7.95	10.4000800044
8.52	8.86	20.40	8.03	22.50	67.80	11.60	3.34	3.23	4.37	6.92	4.9300800045
5.08	8.91	18.10	24.60	38.60	27.80	10.90	3.12	4.36	8.39	8.35	12.7000800046
6.72	9.96	54.60	47.70	89.40	70.60	16.20	6.61	6.00	9.82	9.37	12.8000800047
17.80	8.86	25.30	36.20	105.00	158.00	48.50	11.70	5.95	7.04	8.96	7.6800800048
5.46	4.76	37.20	45.90	82.10	47.40	9.31	3.10	3.85	5.89	5.90	3.5600800049
3.18	13.80	16.50	25.20	67.80	111.00	27.70	10.20	6.40	9.05	8.43	8.2400800050
7.09	17.10	31.10	24.80	84.90	55.70	15.70	7.80	8.48	9.03	8.63	6.4200800051
5.40	9.65	35.90	54.60	137.00	54.00	15.30	5.84	4.66	4.87	4.60	3.7000800052
4.53	4.82	9.22	10.60	34.00	148.00	15.10	4.77	2.27	2.67	3.84	4.3200800053
3.93	8.74	7.13	12.40	27.00	28.90	7.77	6.19	1.76	3.26	3.94	2.7400800054
2.84	2.21	9.21	24.80	27.50	41.80	15.60	4.93	1.96	2.66	3.79	4.8600800055
4.32	5.36	30.00	21.70	77.90	42.70	6.59	3.39	1.71	2.22	3.45	3.0000800056
2.44	3.09	15.90	10.50	67.20	79.80	19.70	5.79	5.13	7.29	6.90	5.9600800057
4.71	6.31	12.90	17.60	43.20	20.80	9.66	3.68	2.85	3.17	4.43	3.7700800058

3.90	3.60	58.40	16.90	43.50	97.30	15.80	4.14	4.10	7.30	7.62	5.2100800059
4.01	4.08	28.30	19.70	39.70	31.80	5.52	2.83	2.18	3.23	4.18	3.9600800060
3.24	3.80	4.66	4.62	13.70	13.10	2.22	1.09	1.48	2.17	2.96	2.3600800061
1.98	4.55	10.40	15.50	71.30	126.00	17.60	10.80	6.97	6.62	5.66	5.4900800062
2.91	19.70	13.20	11.30	57.50	61.10	11.60	3.04	4.87	4.52	4.64	3.2400800063
3.60	3.95	4.54	10.60	72.50	114.00	22.10	7.53	3.76	4.50	4.47	5.2900800064
6.47	17.40	18.50	52.00	85.00	92.30	25.70	8.45	20.80	17.90	10.80	8.3200800065
5.64	5.71	36.50	24.40	64.90	25.80	9.26	2.91	2.51	3.60	4.54	3.8100800066
3.73	5.03	9.49	17.00	90.30	329.00	39.00	9.42	7.15	9.16	8.74	5.8200800067
6.41	13.80	19.70	18.20	53.90	116.00	27.30	10.90	9.73	9.95	9.04	6.7500800068
5.83	7.21	49.30	48.80	47.50	35.10	31.90	5.79	4.62	6.71	6.27	4.1900800069
3.74	6.95	11.00	16.40	193.00	129.00	19.40	7.52	9.21	8.81	6.49	6.3400800070
7.62	43.00	29.40	32.20	71.10	60.70	13.20	3.98	7.19	8.82	6.99	4.5200800071
4.65	15.80	49.70	24.40	70.80	72.00	12.70	9.79	6.87	10.70	8.24	3.6700800072
4.29	4.99	10.00	14.40	15.70	19.10	4.97	4.05	5.24	6.39	8.11	6.0900800073
9.15	9.88	18.80	26.20	58.90	95.60	20.00	11.80	10.90	6.85	9.49	6.5000800074
4.59	6.16	12.90	39.60	143.00	266.00	149.00	21.70	14.30	14.70	18.20	15.3000800075
9.98	17.40	22.60	33.30	171.00	76.20	20.70	12.60	11.60	10.70	9.79	8.8700800076
6.84	12.00	10.60	19.50	34.80	23.60	6.94	4.54	4.61	6.36	6.25	6.1000800077
5.34	7.72	99.00	51.60	160.00	116.00	73.50	11.70	27.40	12.80	10.90	9.6100800078
5.34	9.86	87.40	43.60	122.00	143.00	28.80	10.50	6.71	8.22	7.19	6.2500800079
5.10	10.30	16.30	27.70	67.00	118.00	24.00	12.90	9.69	9.64	9.47	8.0200800080
7.04	10.90	16.00	24.80	170.00	128.00	24.50	13.50	7.09	8.43	8.61	7.3800800081
6.27	14.90	26.90	32.60	76.70	149.00	50.10	10.90	14.00	14.40	11.70	9.0400800082
10.60	11.30	17.30	36.00	50.90	40.60	23.60	10.90	12.90	10.60	8.19	5.3600800083
11.40	10.30	13.80	19.10	44.40	58.30	12.70	10.40	9.61	9.45	7.93	4.6900800084
4.36	6.62	10.20	18.50	20.20	11.10	1.91	4.57	8.96	9.98	10.10	5.8400800085
5.46	25.40	34.60	15.80	53.60	56.20	15.10	7.06	18.20	10.50	8.90	7.7900800086
4.58	6.34	12.70	12.20	29.10	16.80	10.50	5.91	8.43	8.16	6.20	4.6900800087
2.45	3.70	7.77	8.32	20.60	14.90	2.62	2.55	3.31	3.78	4.54	3.9700800088
2.26	2.29	20.70	16.40	36.40	23.40	7.14	3.64	7.67	7.47	11.80	7.4500800089

* station 9000, Ft. Peck high water level Flows

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
6.60	25.40	38.53	34.32	59.18	70.05	6.08	4.84	8.96	7.68	6.03	6.3200900029
2.69	10.15	23.54	40.29	37.36	18.60	2.45	4.25	2.65	30.59	4.50	3.0800900030
2.52	4.68	7.33	6.95	8.12	12.80	2.28	1.38	1.99	3.19	3.64	2.9800900031
2.06	2.60	5.33	8.24	32.60	158.69	8.50	9.33	2.11	4.73	5.07	3.9100900032
2.99	3.46	18.41	20.06	73.85	67.84	4.28	3.30	3.18	3.87	4.22	4.8800900033
4.65	7.41	9.44	21.12	14.10	89.37	2.98	1.47	1.18	3.46	3.04	3.0100900034
3.21	1.77	6.02	9.55	17.74	16.74	11.99	4.27	1.09	2.99	2.72	2.3700900035
2.56	2.67	52.82	23.67	57.58	30.51	2.56	1.37	1.42	2.07	2.44	2.3800900036
1.49	3.54	8.11	18.74	33.61	60.49	12.14	1.48	1.26	5.86	2.02	2.2300900037
2.90	7.02	28.58	14.48	79.22	85.65	75.28	6.73	5.71	4.21	8.44	5.3500900038
4.50	3.52	53.89	22.65	40.08	83.72	9.99	1.76	2.10	3.52	3.17	3.0300900039
2.34	2.92	10.90	11.41	15.90	18.01	4.95	1.33	1.56	4.03	5.45	2.4400900040
2.66	3.70	6.68	7.21	19.30	56.22	6.32	2.46	9.58	13.44	10.21	11.6700900041
7.80	10.45	29.88	47.88	132.39	175.67	50.10	12.28	7.17	10.46	9.77	11.7300900042
8.74	38.12	60.62	79.01	93.16	202.11	71.92	13.04	6.16	9.20	10.35	11.1300900043
6.78	6.38	44.64	20.11	43.15	175.75	110.01	20.01	9.58	8.33	8.51	11.1200900044
9.09	10.02	24.00	8.54	22.74	70.13	12.42	3.42	3.27	4.43	7.20	5.3100900045
5.31	10.62	19.63	25.08	39.05	28.29	11.29	3.20	4.39	8.68	8.91	13.2400900046
7.14	10.51	64.71	52.05	90.71	72.52	18.81	7.46	6.08	10.14	9.97	14.2000900047
22.02	10.19	31.41	37.58	106.68	163.08	50.08	11.86	6.12	7.14	9.63	8.3400900048
5.88	4.95	45.54	48.29	88.16	49.58	9.58	3.15	3.87	5.94	6.07	3.5700900049
3.30	14.72	17.60	26.71	70.45	116.40	28.83	10.35	6.49	9.29	8.82	8.5600900050
7.84	21.33	34.16	26.03	90.70	57.65	16.46	7.94	8.58	9.20	8.90	6.5500900051
5.52	10.70	46.02	56.52	144.14	55.59	15.78	5.96	4.67	5.01	4.77	3.8200900052
4.71	5.01	9.48	10.98	35.36	156.69	16.35	4.79	2.28	2.81	3.85	4.3400900053
4.02	9.75	7.56	12.74	27.10	29.43	7.88	7.01	1.79	3.34	3.97	2.7800900054
2.90	2.22	12.09	28.21	31.01	43.86	16.09	5.55	1.96	2.67	3.79	4.9100900055
2.44	5.54	35.73	22.36	78.66	43.15	6.91	3.58	1.71	2.38	3.65	3.0400900056
2.48	3.11	20.49	11.02	67.52	80.05	20.11	5.84	5.18	7.76	7.31	6.3900900057

4.82	6.52	13.80	18.61	43.49	20.80	10.45	3.73	2.87	3.33	4.65	3.7800900058
3.91	3.60	70.00	17.56	43.68	97.36	15.90	4.16	4.15	7.53	8.22	5.5000900059
4.12	4.09	32.64	20.72	40.06	31.82	5.68	2.86	2.20	3.32	4.31	3.9600900060
3.25	3.81	4.67	4.63	13.71	13.10	2.27	1.18	1.55	2.19	3.07	2.3600900061
2.02	5.12	11.12	15.53	78.88	151.13	18.18	13.12	7.90	6.99	6.04	5.6500900062
2.96	24.37	14.96	11.85	59.69	61.80	11.63	3.05	5.56	4.68	4.82	3.2400900063
3.68	3.96	4.59	10.76	80.73	120.79	23.66	8.78	3.84	4.75	4.72	5.4000900064
6.85	20.94	22.61	60.43	93.68	93.86	26.90	8.54	22.48	18.82	11.38	8.9400900065
5.93	5.80	42.90	25.27	65.47	25.90	9.31	2.92	2.53	3.61	4.75	3.8800900066
3.81	5.40	9.85	17.12	94.10	339.95	39.84	9.61	7.38	9.38	9.00	5.9000900067
6.55	14.16	20.08	18.47	56.49	125.74	27.92	11.13	10.45	10.38	9.28	6.8800900068
5.93	7.27	56.64	51.24	52.73	37.53	37.05	5.93	4.78	6.81	6.38	4.2600900069
3.79	7.21	11.48	16.86	219.08	135.23	19.62	7.75	10.41	9.00	6.67	6.6500900070
8.18	52.57	34.71	33.75	71.54	64.66	13.39	4.04	8.16	8.87	7.05	4.5500900071
4.70	16.06	54.53	25.76	76.45	78.23	12.84	9.88	7.06	11.25	8.59	3.7400900072
4.44	5.07	10.65	15.17	16.12	19.88	5.05	4.07	5.64	6.60	8.38	6.3000900073
9.33	11.34	20.89	26.43	60.58	95.98	21.71	12.39	11.36	6.92	9.89	6.8100900074
4.81	6.63	13.76	43.22	148.77	267.05	181.61	22.81	15.20	15.39	19.47	16.0200900075
10.28	20.71	23.76	34.79	172.04	78.69	20.99	13.29	13.02	11.15	10.22	9.40000900076
7.29	13.50	10.95	19.99	35.28	24.24	7.11	4.63	4.73	6.56	6.47	6.4000900077
5.68	8.55	110.50	53.42	166.67	119.57	86.10	12.29	34.04	13.41	11.52	10.0700900078
5.74	10.85	91.93	48.37	126.45	145.23	29.40	10.76	6.88	8.73	7.60	6.3500900079
5.24	11.37	17.33	29.44	69.63	122.73	25.25	13.58	10.05	10.04	10.02	8.4200900080
7.63	12.09	17.24	26.02	187.42	140.32	26.37	14.41	7.23	8.87	9.04	7.4400900081
6.60	15.93	29.80	34.02	77.70	150.64	51.14	11.02	15.34	15.06	12.32	9.2900900082
11.01	11.66	17.87	36.24	51.56	40.71	24.56	10.98	14.28	11.13	8.69	5.4000900083
11.67	10.82	14.35	19.33	44.61	59.49	12.92	10.47	10.71	9.86	8.30	4.7800900084
4.45	7.63	10.96	18.74	20.30	11.13	1.91	4.60	9.23	10.21	10.30	5.8400900085
5.67	31.40	39.98	16.35	56.86	57.83	15.66	7.17	19.05	11.07	9.18	8.3700900086
4.88	7.18	14.14	13.11	31.06	17.29	10.81	5.99	9.51	8.57	6.45	4.7400900087
2.47	3.74	8.21	8.43	20.70	14.90	2.62	2.55	3.36	3.78	4.59	4.0800900088
2.26	2.38	21.93	17.62	38.63	24.31	7.26	3.72	7.93	7.67	12.10	7.7300900089

* station 10000, Return Flow Node for Ft. Peck high water level flows

* jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	stayr
6.60	25.40	38.53	34.32	59.18	70.05	6.08	4.84	8.96	7.68	6.03	6.3201000029
2.69	10.15	23.54	40.29	37.36	18.60	2.45	4.25	2.65	30.59	4.50	3.0801000030
2.52	4.68	7.33	6.95	8.12	12.80	2.28	1.38	1.99	3.19	3.64	2.9801000031
2.06	2.60	5.33	8.24	32.60	158.69	8.50	9.33	2.11	4.73	5.07	3.9101000032
2.99	3.46	18.41	20.06	73.85	67.84	4.28	3.30	3.18	3.87	4.22	4.8801000033
4.65	7.41	9.44	21.12	14.10	89.37	2.98	1.47	1.18	3.46	3.04	3.0101000034
3.21	1.77	6.02	9.55	17.74	16.74	11.99	4.27	1.09	2.99	2.72	2.3701000035
2.56	2.67	52.82	23.67	57.58	30.51	2.56	1.37	1.42	2.07	2.44	2.3801000036
1.49	3.54	8.11	18.74	33.61	60.49	12.14	1.48	1.26	5.86	2.02	2.2301000037
2.90	7.02	28.58	14.48	79.22	85.65	75.28	6.73	5.71	4.21	8.44	5.3501000038
4.50	3.52	53.89	22.65	40.08	83.72	9.99	1.76	2.10	3.52	3.17	3.0301000039
2.34	2.92	10.90	11.41	15.90	18.01	4.95	1.33	1.56	4.03	5.45	2.4401000040
2.66	3.70	6.68	7.21	19.30	56.22	6.32	2.46	9.58	13.44	10.21	11.6701000041
7.80	10.45	29.88	47.88	132.39	175.67	50.10	12.28	7.17	10.46	9.77	11.7301000042
8.74	38.12	60.62	79.01	93.16	202.11	71.92	13.04	6.16	9.20	10.35	11.1301000043
6.78	6.38	44.64	20.11	43.15	175.75	110.01	20.01	9.58	8.33	8.51	11.1201000044
9.09	10.02	24.00	8.54	22.74	70.13	12.42	3.42	3.27	4.43	7.20	5.3101000045
5.31	10.62	19.63	25.08	39.05	28.29	11.29	3.20	4.39	8.68	8.91	13.2401000046
7.14	10.51	64.71	52.05	90.71	72.52	18.81	7.46	6.08	10.14	9.97	14.2001000047
22.02	10.19	31.41	37.58	106.68	163.08	50.08	11.86	6.12	7.14	9.63	8.3401000048
5.88	4.95	45.54	48.29	88.16	49.58	9.58	3.15	3.87	5.94	6.07	3.5701000049
3.30	14.72	17.60	26.71	70.45	116.40	28.83	10.35	6.49	9.29	8.82	8.5601000050
7.84	21.33	34.16	26.03	90.70	57.65	16.46	7.94	8.58	9.20	8.90	6.5501000051
5.52	10.70	46.02	56.52	144.14	55.59	15.78	5.96	4.67	5.01	4.77	3.8201000052
4.71	5.01	9.48	10.98	35.36	156.69	16.35	4.79	2.28	2.81	3.85	4.3401000053
4.02	9.75	7.56	12.74	27.10	29.43	7.88	7.01	1.79	3.34	3.97	2.7801000054
2.90	2.22	12.09	28.21	31.01	43.86	16.09	5.55	1.96	2.67	3.79	4.9101000055
2.44	5.54	35.73	22.36	78.66	43.15	6.91	3.58	1.71	2.38	3.65	3.0401000056

2.48	3.11	20.49	11.02	67.52	80.05	20.11	5.84	5.18	7.76	7.31	6.3901000057
4.82	6.52	13.80	18.61	43.49	20.80	10.45	3.73	2.87	3.33	4.65	3.7801000058
3.91	3.60	70.00	17.56	43.68	97.36	15.90	4.16	4.15	7.53	8.22	5.5001000059
4.12	4.09	32.64	20.72	40.06	31.82	5.68	2.86	2.20	3.32	4.31	3.9601000060
3.25	3.81	4.67	4.63	13.71	13.10	2.27	1.18	1.55	2.19	3.07	2.3601000061
2.02	5.12	11.12	15.53	78.88	151.13	18.18	13.12	7.90	6.99	6.04	5.6501000062
2.96	24.37	14.96	11.85	59.69	61.80	11.63	3.05	5.56	4.68	4.82	3.2401000063
3.68	3.96	4.59	10.76	80.73	120.79	23.66	8.78	3.84	4.75	4.72	5.4001000064
6.85	20.94	22.61	60.43	93.68	93.86	26.90	8.54	22.48	18.82	11.38	8.9401000065
5.93	5.80	42.90	25.27	65.47	25.90	9.31	2.92	2.53	3.61	4.75	3.8801000066
3.81	5.40	9.85	17.12	94.10	339.95	39.84	9.61	7.38	9.38	9.00	5.9001000067
6.55	14.16	20.08	18.47	56.49	125.74	27.92	11.13	10.45	10.38	9.28	6.8801000068
5.93	7.27	56.64	51.24	52.73	37.53	37.05	5.93	4.78	6.81	6.38	4.2601000069
3.79	7.21	11.48	16.86	219.08	135.23	19.62	7.75	10.41	9.00	6.67	6.6501000070
8.18	52.57	34.71	33.75	71.54	64.66	13.39	4.04	8.16	8.87	7.05	4.5501000071
4.70	16.06	54.53	25.76	76.45	78.23	12.84	9.88	7.06	11.25	8.59	3.7401000072
4.44	5.07	10.65	15.17	16.12	19.88	5.05	4.07	5.64	6.60	8.38	6.3001000073
9.33	11.34	20.89	26.43	60.58	95.98	21.71	12.39	11.36	6.92	9.89	6.8101000074
4.81	6.63	13.76	43.22	148.77	267.05	181.61	22.81	15.20	15.39	19.47	16.0201000075
10.28	20.71	23.76	34.79	172.04	78.69	20.99	13.29	13.02	11.15	10.22	9.40001000076
7.29	13.50	10.95	19.99	35.28	24.24	7.11	4.63	4.73	6.56	6.47	6.4001000077
5.68	8.55	110.50	53.42	166.67	119.57	86.10	12.29	34.04	13.41	11.52	10.0701000078
5.74	10.85	91.93	48.37	126.45	145.23	29.40	10.76	6.88	8.73	7.60	6.3501000079
5.24	11.37	17.33	29.44	69.63	122.73	25.25	13.58	10.05	10.04	10.02	8.4201000080
7.63	12.09	17.24	26.02	187.42	140.32	26.37	14.41	7.23	8.87	9.04	7.4401000081
6.60	15.93	29.80	34.02	77.70	150.64	51.14	11.02	15.34	15.06	12.32	9.2901000082
11.01	11.66	17.87	36.24	51.56	40.71	24.56	10.98	14.28	11.13	8.69	5.4001000083
11.67	10.82	14.35	19.33	44.61	59.49	12.92	10.47	10.71	9.86	8.30	4.7801000084
4.45	7.63	10.96	18.74	20.30	11.13	1.91	4.60	9.23	10.21	10.30	5.8401000085
5.67	31.40	39.98	16.35	56.86	57.83	15.66	7.17	19.05	11.07	9.18	8.3701000086
4.88	7.18	14.14	13.11	31.06	17.29	10.81	5.99	9.51	8.57	6.45	4.7401000087
2.47	3.74	8.21	8.43	20.70	14.90	2.62	2.55	3.36	3.78	4.59	4.0801000088
2.26	2.38	21.93	17.62	38.63	24.31	7.26	3.72	7.93	7.67	12.10	7.7301000089

Appendix 3
TABLE DATA FILES

```
TITL MUSSELSHELL RIVER WATER MGNT STUDY
*
***THE FOLLOWING SECTIONS IS FOR RESERVOIR INFORMATION*******
*
TR10 1 34 BAIR RESERVOIR CONTENTS AF
     0.0  24.0  98.0 192.0 332.0 520.0 753.01043.01400.01830.0+
  2351.02985.03752.04672.05760.07100.0
*
TR11 1 14 BAIR RESERVOIR ELEVATION FT
  5247.55253.25260.05265.05270.05275.05280.05285.05290.05295.0+
  5300.05305.05310.05315.05320.05325.0
*
TR12 1 25 BAIR RESERVOIR RESERVOIR AREA ACRES
     0.0   7.1  15.7  23.4  32.9  42.2  52.3  64.7  78.7  95.1+
   115.5 140.1 168.7 200.8 235.7 273.2
*
TR13 1 47 BAIR RESERVOIR MAXIMUM DISCHARGE CAPACITY CFS
   117.0 117.0 117.0 117.0 117.0 117.0 117.0 117.0 117.0 117.0+
   117.0 117.0 117.0 117.0 117.0 117.0
*
TR14 0 13 BAIR RESERVOIR EVAPORATION INCHES
* BAIR RESERVOIR, NET EVAPORATION IN INCHES
*    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
28 -0.65 -0.58 -0.14  0.38   2.2  0.34   1.3   4.1   4.6   2.0   1.3 -0.79
29 -0.58 -0.30 -0.03 -0.06   1.5   2.3   6.0   7.5   2.7   2.9  0.10  -1.1
30 -0.44 -0.36  -1.5  0.50   1.0   2.9   4.5   4.4   2.6   1.4 -0.25  0.05
31  0.09  0.28 -0.81  0.91   1.6   3.4   4.3   6.1   4.1   2.6 -0.87 -0.32
32 -0.34 -0.62 -0.63 -0.17   1.6   1.7   5.1   5.1   3.9   1.6  0.13 -0.66
33 -0.39 -0.34 -0.10 -0.14  0.41   3.6   7.0   3.8   4.2   2.7  0.82 -0.51
34 -0.51 -0.33  -1.3  0.94   2.4  0.33   5.8   6.6   2.1   2.1   1.3 -0.83
35 -0.59 -0.40 -0.67  -1.3  0.86   2.9   5.1   6.9   5.5   3.1 -0.31 -0.39
36 -0.42 -0.73 -0.77 -0.10   2.0   3.3   6.6   6.1   4.0   2.1   1.2 -0.73
37 -0.97 -0.65  -1.1  0.51   2.4  0.05   3.5   5.6   3.3   2.9 -0.37 -0.80
38 -0.51 -0.90  -1.1  0.07 -0.90   1.3   2.4   4.6   4.7   1.2 -0.62 -0.37
39 -0.48 -0.45 -0.39  0.51   1.2   1.6   4.9   5.5   3.3   1.7   2.2 -0.28
40 -0.54  -1.1 -0.55  -2.2   1.9   1.8   2.4   5.7   2.7   2.0 -0.70 -0.30
41 -0.48 -0.64 -0.27 -0.73  0.68   1.2   1.3   3.9  0.20   2.6 -0.03 -0.75
42 -0.37 -0.77 -0.97  0.84  -2.2   1.5   2.8   4.8   1.9   1.4 -0.88 -0.53
43  -1.3  -1.1 -0.92 -0.94  0.42  -1.2   4.3   3.9   2.9   2.6  0.91 -0.26
44 -0.30 -0.48 -0.81  0.90  0.71  0.59   3.7   2.4   2.4   2.3 -0.35 -0.43
45 -0.30 -0.45 -0.46  0.29  0.77 -0.23   3.7   4.3   2.1   2.2  0.53 -0.82
46  0.07 -0.15 -0.02  0.94  0.01   1.7   3.3   4.6   1.8 -0.02 -0.50 -0.90
47 -0.33 -0.34 -0.53  0.48   1.6  -1.3   2.8   2.1  0.69   1.0 -0.80 -0.40
48 -0.58 -0.46 -0.61  0.06  -1.5  -4.0   1.5   2.8   2.5   4.8 -0.30 -0.57
49 -0.89 -0.74 -0.68  0.87  -1.0 -0.53   3.1   3.8  0.71  0.95   2.6 -0.29
50 -0.73  0.00  -1.6  0.05   1.3  0.18   3.4   3.4   2.7   3.5  -1.2 -0.45
51 -0.34 -0.68 -0.93  -1.1  0.75  0.06   4.4   3.3   1.7  0.94 -0.26  -1.3
52 -0.24 -0.54 -0.75   1.4  -1.2   2.6   4.8   4.7   4.5   2.5  -1.7 -0.07
53 -0.43  -1.0 -0.19 -0.31  -3.8 -0.09   5.4   4.4   2.2   4.8   2.1 -0.44
54  -1.9  0.23 -0.52   1.1   1.6  -1.7   4.7   4.3   3.6   1.7   2.2  0.50
55 -0.18 -0.64 -0.61 -0.52 -0.30   2.5 -0.29   6.6   4.5   3.0 -0.87  -1.1
56 -0.46 -0.18 -0.63  0.87  0.61   2.8   3.9   5.3   4.7   3.4   1.2 -0.39
57 -0.69 -0.42 -0.35  0.30 -0.69  0.95   4.6   4.8   3.2  0.89 -0.66 -0.13
58 -0.25 -0.31  -1.2 -0.10   1.3 -0.63   2.8   4.6   4.0   1.7  -1.1 -0.64
59 -0.59 -0.83  0.16  0.92 -0.45   1.7   6.0   4.9   2.9   1.1  -1.1 -0.26
60 -0.26 -0.18 -0.22  0.31 -0.03   4.6   5.9   2.9   3.6   2.8 -0.13 -0.11
61 -0.07  0.02 -0.30  0.11  0.71   4.9   5.4   5.9   1.3   2.6 -0.45 -0.26
62 -0.66 -0.65 -0.45  0.40  -1.2   2.1   3.4   4.5   3.4  0.80  0.25 -0.09
63  -1.0 -0.18  0.19 -0.07   1.0  0.10   4.9   6.9   2.3   2.2  0.37 -0.96
64 -0.41 -0.26 -0.54  0.15  -2.4 -0.06   4.6   3.6   3.2   3.1 -0.55 -0.89
65 -0.14 -0.34 -0.64  -1.5  0.11  0.29   2.9   3.0  0.32   3.0 -0.30 -0.20
66 -0.65 -0.20  0.03  0.42   1.7   1.9   4.5   5.1   4.5   1.4  0.03 -0.37
67 -0.09 -0.62 -0.77  -1.3  0.46  -1.6   5.6   6.3   3.5   1.8 -0.46  -1.8
68 -0.50 -0.18 -0.39  0.42  -1.0 -0.40   6.0   3.4  0.19   3.2 -0.69 -0.57
69  -1.0 -0.21 -0.38 -0.96 -0.01  -1.6   3.1   5.9   3.3  0.41  0.48 -0.28
70 -0.25 -0.05 -0.66 -0.45  0.68  0.89   4.4   7.3   3.3   1.9 -0.17 -0.17
71 -0.66 -0.25 -0.09 -0.04 -0.87   2.7   6.0   5.1   3.2   2.7  0.18 -0.48
72 -0.89 -0.19  0.03  0.40  0.53   4.0   4.4   3.5   4.3   2.4 -0.05 -0.43
73 -0.09 -0.01 -0.25 -0.06   1.6   3.7   6.5   6.0   1.5   3.6 -0.95 -0.44
```

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74  -1.0 -0.25 -0.17  0.67 -0.64   4.8   6.4   1.4   3.3   2.7  0.23 -0.39
75 -0.65 -0.84 -0.44  -3.2 -0.61   1.1   2.9   3.3   3.8 -0.38 -0.67 -0.21
76 -0.09 -0.34 -0.12 -0.70   1.8  0.93   5.1   3.9   3.6   2.9  0.15 -0.18
77 -0.50 -0.06 -0.70   1.0 -0.87   3.7   3.7   4.0   1.2   2.5 -0.53 -0.47
78 -0.73 -0.25 -0.03 -0.82  -2.0   3.0   2.4   4.5   1.7   3.5 -0.76 -0.50
79 -0.45 -0.19 -0.39  -1.8   1.6   3.2   4.6   5.3   4.8   2.6 -0.05 -0.31
80 -0.69 -0.41 -0.40  0.43  -3.1 -0.55   4.5   4.4   2.9  0.26  0.20 -0.29
81 -0.36 -0.19 -0.23  0.87  -4.4   2.4   2.7   4.9   3.9   1.9  0.54 -0.12
82 -0.46 -0.35 -0.84 -0.11  -1.3  0.72   4.3   6.6   1.0   1.2 -0.27 -0.57
83 -0.10 -0.13 -0.31 -0.04  -1.2   1.6   1.3   3.5   2.3   2.1 -0.29 -0.21
84 -0.44 -0.20 -0.39 -0.82   1.4   1.3   5.7   4.9   2.9   1.1 -0.38 -0.37
85 -0.05 -0.25 -0.41  0.86   1.2   4.3   6.4  0.81 -0.10   1.5 -0.50 -0.56
86 -0.23 -0.64  0.27 -0.20  0.84   2.2   3.1   5.2 -0.37   1.8 -0.37 -0.15
87 -0.02 -0.10 -0.71   1.1  0.16   3.8  0.68   4.3   4.4   3.8  0.13 -0.33
88 -0.21 -0.31 -0.25  0.18  0.46   4.3   6.2   6.2   1.9   3.4 -0.18 -0.25
89 -0.43 -0.76 -0.68 -0.62 -0.01   2.5   4.0   1.0   3.2   1.8  0.12 -0.35
*
TR15 0 35 BAIR RESERVOIR TARGET CONTENT (KAF)
* Jan    Feb    Mar    Apr    May    Jun    Jul    Aug    Sep    Oct    Nov    Dec
291.4   1.4    7.0    7.0    7.0    7.0    7.0    7.0    7.0    1.4    1.4    1.4
*601.4   1.4    7.0    7.0    7.0    7.0    7.0    7.0   2.86   2.76   3.1   3.425
*613.65  4.047  4.32   4.7    5.2    2.75   0.0    0.1   5.86   5.542  5.627  5.282
*625.412 6.47   7.0    7.0    7.0    7.0    6.623  4.69  5.86   5.542  5.627  5.282
*635.412 6.47   7.0    7.0    7.0    7.0    6.623  4.69  2.769  2.934  3.282  3.63
*643.899 4.23   4.525  5.629  7.0    7.0    6.039  4.01  4.175  4.488  4.781  5.26
*655.564 6.319  6.838  7.0    7.0    7.0    7.0    6.065 5.81   5.67   6.876  6.8
*665.963 5.434  6.116  7.0    7.0    7.0    6.724  2.6   1.805  2.205  2.529  2.833
*673.138 4.028  4.267  5.81   6.62   7.0    7.0    4.2   2.278  2.909  3.583  4.414
*684.672 5.542  7.0    7.0    7.0    7.0    6.851  4.562 4.654  5.379  5.887  5.989
*696.241 6.319  6.039  7.0    7.0    6.344  6.562  2.731 1.744  2.351  2.478  2.820
*703.245 3.583  3.991  5.836  7.0    7.0    7.0    3.5   2.858  3.354  3.85   4.287
*714.725 5.303  6.141  6.993  6.979  7.0    4.912  2.174 1.161  1.55   1.954  2.216
*722.731 3.077  4.424  5.651  7.0    6.832  7.0    5.06  1.64   2.705  3.058  3.33
*733.72  4.18   4.51   5.1    4.47   2.26   0.27   0.335 0.027  0.641  0.733  0.804
*742.247 2.65   3.431  4.424  6.169  7.0    7.0    5.059 7.0    1.4    1.4    1.4
*801.4   1.4    7.0    7.0    7.0    7.0    7.0    7.0   3.43   3.63   3.982  4.528
*814.457 4.681  5.052  5.491  6.878  7.0    5.574  3.862 1.86   2.01   2.2    2.34
*822.82  3.88   4.66   6.67   7.0    7.0    7.0    5.86  4.23   4.24   4.57   5.0
*835.17  5.69   6.22   6.78   7.06   5.48   3.99   2.35  1.685  1.844  2.216  2.247
*842.91  3.25   3.845  4.438  4.932  2.966  1.438  0.0   0.0    0.2    0.25   0.45
*850.45  0.5    1.265  3.249  2.243  0.5    0.0    0.0   0.0    0.2    0.35   0.5
*861.312 1.957  3.221  4.34   5.615  7.0    7.0    5.855 5.695  5.995  6.463  6.465
*876.454 6.719  6.585  6.973  5.43   3.189  2.413  1.866 0.85   1.706  1.88   1.87
*881.886 1.978  2.25   3.15   2.795  0.0    0.0    0.0   0.023  0.165  0.336  0.567
*890.597 0.625  1.2    3.03   3.737  4.156  3.646  3.51  2.78   2.86   2.92   3.29
*
TR16 0 35 BAIR RESERVOIR MAXIMUM CONTENT (KAF)
*     Jan    Feb    Mar    Apr    May    Jun    Jul    Aug    Sep    Oct    Nov    Dec
29    7.0    7.0    7.0    7.0    7.0    7.0    7.0    7.0    7.0    7.0    7.0    7.0
*601.5   1.5    7.1    7.1    7.1    7.1    7.1    7.1   2.96   2.86   3.2   3.525
*613.75  4.147  4.42   4.8    5.3    2.85   0.1    0.2   5.96   5.642  5.727  5.382
*625.512 6.57   7.1    7.1    7.1    7.1    6.723  4.79  5.96   5.642  5.727  5.382
*635.512 6.57   7.1    7.1    7.1    7.1    6.723  4.79  2.869  3.034  3.382  3.73
*643.999 4.33   4.625  5.729  7.1    7.1    6.139  4.11  4.275  4.588  4.881  5.36
*655.664 6.419  6.938  7.1    7.1    7.1    7.1    6.165 5.91   5.77   6.976  6.9
*666.063 5.534  6.216  7.1    7.1    7.1    6.824  2.7   1.905  2.305  2.629  2.933
*673.238 4.128  4.367  5.91   6.72   7.1    7.1    4.3   2.378  3.009  3.683  4.514
*684.772 5.642  7.1    7.1    7.1    7.1    6.951  4.662 4.754  5.479  5.987  6.089
*696.341 6.419  6.139  7.1    7.1    6.444  6.662  2.831 1.844  2.451  2.578  2.920
*703.345 3.683  4.091  5.936  7.1    7.1    7.1    3.6   2.958  3.454  3.95   4.387
*714.825 5.403  6.241  7.093  7.079  7.1    5.012  2.274 1.261  1.65   2.054  2.316
*722.831 3.177  4.524  5.751  7.1    6.932  7.1    5.16  1.74   2.805  3.158  3.43
*733.82  4.28   4.61   5.2    4.57   2.36   0.37   0.435 0.127  0.741  0.833  0.904
*742.347 2.75   3.531  4.524  6.269  7.1    7.1    5.159 7.1    7.1    7.1    7.1
*807.1   7.1    7.1    7.1    7.1    7.1    7.1    4.0   3.53   3.73   4.082  4.628
*814.557 4.781  5.152  5.591  6.978  7.1    5.674  3.962 1.96   2.11   2.3    2.44
*822.92  3.98   4.76   6.77   7.1    7.1    7.1    5.96  4.33   4.34   4.67   5.1
*835.27  5.79   6.32   6.88   7.1    5.58   4.09   2.45  1.785  1.944  2.316  2.347
*843.01  3.35   3.945  4.538  5.032  3.066  1.538  0.1   0.1    0.3    0.35   0.55
```

```
*850.55  0.6    1.365 3.349 2.343 0.6    0.1    0.1    0.1    0.3    0.45  0.6
*861.412 2.057  3.321 4.44  5.715 7.1    7.1    5.955  5.795  6.095  6.563 6.565
*876.554 6.819  6.685 7.073 5.53  3.289  2.513  1.966  0.95   1.806  1.98  1.97
*881.986 2.078  2.35  3.25  2.895 0.1    0.1    0.1    0.123  0.265  0.436 0.667
*890.697 0.725  1.3   3.13  3.837 4.256  3.746  3.61   2.88   2.96   3.02  3.39
*
TR17 0 35 BAIR RESERVOIR MINIMUM CONTENT (KAF)
* Jan    Feb    Mar    Apr    May    Jun    Jul    Aug    Sep    Oct    Nov    Dec
290.52  0.52   0.52   0.52   0.52   0.52   0.52   0.52   0.52   0.52   0.52   0.52
*601.4   1.4    7.0    7.0    7.0    7.0    7.0    7.0    2.86   2.76   3.1    3.425
*613.65  4.047  4.32   4.7    5.2    2.75   0.0    0.1    5.86   5.542  5.627  5.282
*625.412 6.47   7.0    7.0    7.0    7.0    6.623  4.69   5.86   5.542  5.627  5.282
*635.412 6.47   7.0    7.0    7.0    7.0    6.623  4.69   2.769  2.934  3.282  3.63
*643.899 4.23   4.525  5.629  7.0    7.0    6.039  4.01   4.175  4.488  4.781  5.26
*655.564 6.319  6.838  7.0    7.0    7.0    7.0    6.065  5.81   5.67   6.876  6.8
*665.963 5.434  6.116  7.0    7.0    7.0    6.724  2.6    1.805  2.205  2.529  2.833
*673.138 4.028  4.267  5.81   6.62   7.0    7.0    4.2    2.278  2.909  3.583  4.414
*684.672 5.542  7.0    7.0    7.0    7.0    6.851  4.562  4.654  5.379  5.887  5.989
*696.241 6.319  6.039  7.0    7.0    6.344  6.562  2.731  1.744  2.351  2.478  2.820
*703.245 3.583  3.991  5.836  7.0    7.0    7.0    3.5    2.858  3.354  3.85   4.287
*714.725 5.303  6.141  6.993  6.979  7.0    4.912  2.174  1.161  1.55   1.954  2.216
*722.731 3.077  4.424  5.651  7.0    6.832  7.0    5.06   1.64   2.705  3.058  3.33
*733.72  4.18   4.51   5.1    4.47   2.26   0.27   0.335  0.027  0.641  0.733  0.804
*742.247 2.65   3.431  4.424  6.169  7.0    7.0    5.059  7.0    1.4    1.4    1.4
*801.4   1.4    7.0    7.0    7.0    7.0    7.0    7.0    3.43   3.63   3.982  4.528
*814.457 4.681  5.052  5.491  6.878  7.0    5.574  3.862  1.86   2.01   2.2    2.34
*822.82  3.88   4.66   6.67   7.0    7.0    7.0    5.86   4.23   4.24   4.57   5.0
*835.17  5.69   6.22   6.78   7.0    5.48   3.99   2.35   1.685  1.844  2.216  2.247
*842.91  3.25   3.845  4.438  4.932  2.966  1.438  0.0    0.0    0.2    0.25   0.45
*850.45  0.5    1.265  3.249  2.243  0.5    0.0    0.0    0.0    0.2    0.35   0.5
*861.312 1.957  3.221  4.34   5.615  7.0    7.0    5.855  5.695  5.995  6.463  6.465
*876.454 6.719  6.585  6.973  5.43   3.189  2.413  1.866  0.85   1.706  1.88   1.87
*881.886 1.978  2.25   3.15   2.795  0.0    0.0    0.0    0.023  0.165  0.336  0.567
*890.597 0.625  1.2    3.03   3.737  4.156  3.646  3.51   2.78   2.86   2.92   3.29
*
*
*
TR20 1 35 MARTINSDALE RESERVOIR CONTENT (KAF)
     0.0  0.02  0.07  0.18  0.36  0.87  1.17  1.90  2.93  4.30  6.14+
    8.83 11.72  15.3 19.41 23.10 23.19
*
TR21 1 14 MARTINSDALE RESERVOIR ELEVATION (FT)
    4704  4710  4715  4720  4725  4730  4735  4740  4745  4750  4755+
    4760  4765  4770  4775  4778  4789
*
TR22 1 25 MARTINSDALE RESERVOIR AREA (ACRES)
     0.0     7    14    27    47    77   120   174   238   309   429+
     588   668   767   875   973  1005
*
TR23 1 47 MARTINSDALE RESERVOIR MAXIMUM DISCHARGE CAPACITY (CFS)
     272   272   272   272   272   272   272   272   272   272   272+
     272   272   272   272   272   272
*
TR24 0 13 MARTINSDALE RESERVOIR EVAPORATION INCHES
* MARTINSDALE RESERVOIR, NET EVAPORATION IN INCHES
*    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
28 -0.65 -0.58 -0.14  0.38   2.2  0.34   1.3   4.1   4.6   2.0   1.3 -0.79
29 -0.58 -0.30 -0.03 -0.06   1.5   2.3   6.0   7.5   2.7   2.9  0.10  -1.1
30 -0.44 -0.36  -1.5  0.50   1.0   2.9   4.5   4.4   2.6   1.4 -0.25  0.05
31  0.09  0.28 -0.81  0.91   1.6   3.4   4.3   6.1   4.1   2.6 -0.87 -0.32
32 -0.34 -0.62 -0.63 -0.17   1.6   1.7   5.1   5.1   3.9   1.6  0.13 -0.66
33 -0.39 -0.34 -0.10 -0.14  0.41   3.6   7.0   3.8   4.2   2.7  0.82 -0.51
34 -0.51 -0.33  -1.3  0.94   2.4  0.33   5.8   6.6   2.1   2.1   1.3 -0.83
35 -0.59 -0.40 -0.67  -1.3  0.86   2.9   5.1   6.9   5.5   3.1 -0.31 -0.39
36 -0.42 -0.73 -0.77 -0.10   2.0   3.3   6.6   6.1   4.0   2.1   1.2 -0.73
37 -0.97 -0.65  -1.1  0.51   2.4  0.05   3.5   5.6   3.3   2.9 -0.37 -0.80
38 -0.51 -0.90  -1.1  0.07 -0.90   1.3   2.4   4.6   4.7   1.2 -0.62 -0.37
39 -0.48 -0.45 -0.39  0.51   1.2   1.6   4.9   5.5   3.3   1.7   2.2 -0.28
40 -0.54  -1.1 -0.55  -2.2   1.9   1.8   2.4   5.7   2.7   2.0 -0.70 -0.30
```

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41 -0.48 -0.64 -0.27 -0.73  0.68   1.2   1.3   3.9  0.20   2.6 -0.03 -0.75
42 -0.37 -0.77 -0.97  0.84  -2.2   1.5   2.8   4.8   1.9   1.4 -0.88 -0.53
43  -1.3  -1.1 -0.92 -0.94  0.42  -1.2   4.3   3.9   2.9   2.6  0.91 -0.26
44 -0.30 -0.48 -0.81  0.90  0.71  0.59   3.7   2.4   2.4   2.3 -0.35 -0.43
45 -0.30 -0.45 -0.46  0.29  0.77 -0.23   3.7   4.3   2.1   2.2  0.53 -0.82
46  0.07 -0.15 -0.02  0.94  0.01   1.7   3.3   4.6   1.8 -0.02 -0.50 -0.90
47 -0.33 -0.34 -0.53  0.48   1.6  -1.3   2.8   2.1  0.69   1.0 -0.80 -0.40
48 -0.58 -0.46 -0.61  0.06  -1.5  -4.0   1.5   2.8   2.5   4.8 -0.30 -0.57
49 -0.89 -0.74 -0.68  0.87  -1.0 -0.53   3.1   3.8  0.71  0.95   2.6 -0.29
50 -0.73  0.00  -1.6  0.05   1.3  0.18   3.4   3.4   2.7   3.5  -1.2 -0.45
51 -0.34 -0.68 -0.93  -1.1  0.75  0.06   4.4   3.3   1.7  0.94 -0.26  -1.3
52 -0.24 -0.54 -0.75   1.4  -1.2   2.6   4.8   4.7   4.5   2.5  -1.7 -0.07
53 -0.43  -1.0 -0.19 -0.31  -3.8 -0.09   5.4   4.4   2.2   4.8   2.1 -0.44
54  -1.9  0.23 -0.52   1.1   1.6  -1.7   4.7   4.3   3.6   1.7   2.2  0.50
55 -0.18 -0.64 -0.61 -0.52 -0.30   2.5 -0.29   6.6   4.5   3.0 -0.87  -1.1
56 -0.46 -0.18 -0.63  0.87  0.61   2.8   3.9   5.3   4.7   3.4   1.2 -0.39
57 -0.69 -0.42 -0.35  0.30 -0.69  0.95   4.6   4.8   3.2  0.89 -0.66 -0.13
58 -0.25 -0.31  -1.2 -0.10   1.3 -0.63   2.8   4.6   4.0   1.7  -1.1 -0.64
59 -0.59 -0.83  0.16  0.92 -0.45   1.7   6.0   4.9   2.9   1.1  -1.1 -0.26
60 -0.26 -0.18 -0.22  0.31 -0.03   4.6   5.9   2.9   3.6   2.8 -0.13 -0.11
61 -0.07  0.02 -0.30  0.11  0.71   4.9   5.4   5.9   1.3   2.6 -0.45 -0.26
62 -0.66 -0.65 -0.45  0.40 -1.2    2.1   3.4   4.5   3.4  0.80  0.25 -0.09
63  -1.0 -0.18  0.19 -0.07   1.0  0.10   4.9   6.9   2.3   2.2  0.37 -0.96
64 -0.41 -0.26 -0.54  0.15 -2.4 -0.06   4.6   3.6   3.2   3.1 -0.55 -0.89
65 -0.14 -0.34 -0.64  -1.5  0.11  0.29   2.9   3.0  0.32   3.0 -0.30 -0.20
66 -0.65 -0.20  0.03  0.42   1.7   1.9   4.5   5.1   4.5   1.4  0.03 -0.37
67 -0.09 -0.62 -0.77  -1.3  0.46  -1.6   5.6   6.3   3.5   1.8 -0.46  -1.8
68 -0.50 -0.18 -0.39  0.42  -1.0 -0.40   6.0   3.4  0.19   3.2 -0.69 -0.57
69  -1.0 -0.21 -0.38 -0.96 -0.01  -1.6   3.1   5.9   3.3  0.41  0.48 -0.28
70 -0.25 -0.05 -0.66 -0.45  0.68  0.89   4.4   7.3   3.3   1.9 -0.17 -0.17
71 -0.66 -0.25 -0.09 -0.04 -0.87   2.7   6.0   5.1   3.2   2.7  0.18 -0.48
72 -0.89 -0.19  0.03  0.40  0.53   4.0   4.4   3.5   4.3   2.4 -0.05 -0.43
73 -0.09 -0.01 -0.25 -0.06   1.6   3.7   6.5   6.0   1.5   3.6 -0.95 -0.44
74  -1.0 -0.25 -0.17  0.67 -0.64   4.8   6.4   1.4   3.3   2.7  0.23 -0.39
75 -0.65 -0.84 -0.44  -3.2 -0.61   1.1   2.9   3.3   3.8 -0.38 -0.67 -0.21
76 -0.09 -0.34 -0.12 -0.70   1.8  0.93   5.1   3.9   3.6   2.9  0.15 -0.18
77 -0.50 -0.06 -0.70   1.0 -0.87   3.7   3.7   4.0   1.2   2.5 -0.53 -0.47
78 -0.73 -0.25 -0.03 -0.82  -2.0   3.0   2.4   4.5   1.7   3.5 -0.76 -0.50
79 -0.45 -0.19 -0.39  -1.8   1.6   3.2   4.6   5.3   4.8   2.6 -0.05 -0.31
80 -0.69 -0.41 -0.40  0.43  -3.1 -0.55   4.5   4.4   2.9  0.26  0.20 -0.29
81 -0.36 -0.19 -0.23  0.87  -4.4   2.4   2.7   4.9   3.9   1.9  0.54 -0.12
82 -0.46 -0.35 -0.84 -0.11  -1.3  0.72   4.3   6.6   1.0   1.2 -0.27 -0.57
83 -0.10 -0.13 -0.31 -0.04  -1.2   1.6   1.3   3.5   2.3   2.1 -0.29 -0.21
84 -0.44 -0.20 -0.39 -0.82   1.4   1.3   5.7   4.9   2.9   1.1 -0.38 -0.37
85 -0.05 -0.25 -0.41  0.86   1.2   4.3   6.4  0.81 -0.10   1.5 -0.50 -0.56
86 -0.23 -0.64  0.27 -0.20  0.84   2.2   3.1   5.2 -0.37   1.8 -0.37 -0.15
87 -0.02 -0.10 -0.71   1.1  0.16   3.8  0.68   4.3   4.4   3.8  0.13 -0.33
88 -0.21 -0.31 -0.25  0.18  0.46   4.3   6.2   6.2   1.9   3.4 -0.18 -0.25
89 -0.43 -0.76 -0.68 -0.62 -0.01   2.5   4.0   1.0   3.2   1.8  0.12 -0.35
*
TR25 0 35 MARTINSDALE RESERVOIR TARGET CONTENT (KAF)
*  Jan    Feb    Mar    Apr    May    Jun    Jul    Aug    Sep    Oct    Nov    Dec
2915.0  15.0  23.1  23.1  23.1  23.1  23.1  23.1  23.1  15.0  15.0  15.0
*6015.0  15.0  23.1  23.1  23.1  23.1  23.1  23.1   4.2   3.9   3.9   3.675
*61 3.6   3.85  3.9   4.3   3.98  2.25  0.0   0.0   0.0   0.0   1.077 1.342
*62 1.24  1.548 2.21  7.64 12.79417.60418.52513.72613.40612.00411.099 8.888
*63 8.693 8.693 9.48212.43419.40919.40916.782 9.371 8.184 8.283 8.532 8.233
*64 8.233 8.034 7.686 8.18413.72518.01313.582 7.338 6.89  7.586 7.686 7.686
*65 7.636 7.586 7.38810.66720.49522.99418.58812.93612.65012.86412.72112.434
*6612.14711.86012.43416.78222.71319.32715.196 7.089 7.636 7.537 6.940 7.338
*67 7.736 7.487 7.437 9.24815.01720.44719.24510.72910.60510.23510.050 9.927
*68 9.865 9.988 9.49510.35914.80219.97518.58812.07511.03711.16110.85210.790
*6910.66710.60510.35913.83318.01313.43812.86412.864 5.222 4.852 4.852 4.852
*70 4.852 4.852 5.258 7.63615.71420.44710.17411.16110.235 9.757 9.279 9.364
*71 9.450 9.346 9.18611.93118.50619.88111.654 8.034 8.333 8.283 8.183 8.083
*72 7.984 7.885 7.785 9.12515.21117.38115.060 9.125 8.88  9.526 9.199 9.063
*73 9.460 9.81010.31011.42014.220 5.220 0.862 0.169 0.649 1.656 3.686 4.926
*74 6.611 7.532 9.12510.59321.55623.0  18.58515.84323.1  15.0  15.0  15.0
*8015.0  15.0  23.1  23.1  23.1  23.1  23.1  23.1   9.336 9.640 9.92410.616
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*8110.64210.69210.95612.86823.1  23.1  21.61816.410 9.980 9.42010.19010.360
*8210.84011.40011.86012.89016.55021.51022.92022.36015.81015.64016.38017.370
*8316.30018.27018.76018.93021.22021.89020.75010.59011.46414.06712.25013.105
*8413.92614.29215.13617.56323.1  22.58316.849 6.299 3.374 3.830 3.970 5.446
*85 5.915 5.770 4.926 8.132 7.656 3.845 0.364 0.200 0.200 0.900 2.684 3.640
*86 4.722 5.150 9.93916.25621.48021.24317.04512.76812.04011.48712.14212.154
*8712.13711.80912.83915.16611.490 7.167 5.900 4.659 2.500 2.988 2.956 3.160
*88 3.200 3.328 3.640 7.010 8.950 2.085 0.345 0.365 0.320 0.309 0.221 0.208
*89 0.195 0.200 0.267 5.27014.88615.08011.220 7.310 7.700 8.842 9.680 9.960
*
TR26 0 35 MARTINSDALE RESERVOIR MAXIMUM CONTENT (KAF)
*    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
2923.11223.11223.11223.11223.11223.11223.11223.11223.11223.11223.11223.112
*6015.0  15.0  23.1  23.1  23.1  23.1  23.1  23.1   4.1   4.0   4.0   3.775
*61 3.7   3.95  4.0   4.4   4.08  2.35  0.1   0.1   0.1   0.1   1.177 1.442
*62 1.34  1.648 2.31  7.74 12.89417.70418.62513.82613.50612.10411.199 8.988
*63 8.793 8.793 9.58212.53419.50919.50916.882 9.471 8.284 8.383 8.632 8.333
*64 8.333 8.134 7.786 8.28413.82518.11313.682 7.438 6.99  7.686 7.786 7.786
*65 7.736 7.686 7.48810.76720.59523.09418.68813.03612.75012.96412.82112.534
*6612.24711.96012.53416.88222.81319.42715.296 7.189 7.736 7.637 7.040 7.438
*67 7.836 7.587 7.537 9.34815.11720.54719.34510.82910.70510.33510.15010.027
*68 9.96510.088 9.59510.45914.90220.07518.68812.17511.13711.26110.95210.890
*6910.76710.70510.45913.93318.11313.53812.96412.964 5.322 4.952 4.952 4.952
*70 4.952 4.952 5.358 7.73615.81420.54710.27411.26110.335 9.857 9.379 9.464
*71 9.550 9.446 9.28612.03118.60619.98111.754 8.134 8.433 8.383 8.283 8.183
*72 8.084 7.985 7.885 9.22515.31117.48115.160 9.225 8.98  9.626 9.299 9.163
*73 9.560 9.91010.41011.52014.320 5.320 0.962 0.269 0.749 1.756 3.786 5.026
*74 6.711 7.632 9.22510.69321.65623.1  18.68515.94323.1  15.1  15.1  15.1
*8015.1  15.1  23.1  23.1  23.1  23.1  20.1  20.1   9.436 9.74010.02410.716
*8110.74210.79211.05612.96823.1  23.1  21.71816.51010.080 9.52010.29010.460
*8210.94011.50011.96012.99016.65021.61023.02022.46015.91015.74016.48017.470
*8316.40018.37018.86019.03021.32021.99020.85010.69011.56414.16712.35013.205
*8414.02614.39215.23617.66323.10022.68316.949 6.399 3.474 3.910 4.070 5.546
*85 6.015 5.870 5.026 8.232 7.756 3.945 0.464 0.300 0.300 1.000 2.784 3.740
*86 4.822 5.25010.03916.35621.58021.34317.14512.86812.14011.58712.24212.254
*8712.23711.90912.93915.26611.590 7.267 6.000 4.759 2.600 3.088 3.056 3.260
*88 3.300 3.428 3.740 7.110 9.050 2.185 0.445 0.465 0.420 0.409 0.321 0.308
*89 0.295 0.300 0.367 5.37014.98615.18011.320 7.410 7.800 8.942 9.78010.060
*
TR27 0 35 MARTINSDALE RESERVOIR MINIMUM CONTENT (KAF)
*    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 0.4   0.4   0.4   0.4   0.4   0.4   0.4   0.4   0.4   0.4   0.4   0.4
*6015.0  15.0  23.1  23.1  23.1  23.1  23.1  23.1   4.2   3.9   3.9   3.675
*61 3.6   3.85  3.9   4.3   3.98  2.25  0.0   0.0   0.0   0.0   1.077 1.342
*62 1.24  1.548 2.21  7.64 12.79417.60418.52513.72613.40612.00411.099 8.888
*63 8.693 8.693 9.48212.43419.40919.40916.782 9.371 8.184 8.283 8.532 8.233
*64 8.233 8.034 7.686 8.18413.72518.01313.582 7.338 6.89  7.586 7.686 7.686
*65 7.636 7.586 7.38810.66720.49522.99418.58812.93612.65012.86412.72112.434
*6612.14711.86012.43416.78222.71319.32715.196 7.089 7.636 7.537 6.940 7.338
*67 7.736 7.487 7.437 9.24815.01720.44719.24510.72910.60510.23510.050 9.927
*68 9.865 9.988 9.49510.35914.80219.97518.58812.07511.03711.16110.85210.790
*6910.66710.60510.35913.83318.01313.43812.86412.864 5.222 4.852 4.852 4.852
*70 4.852 4.852 5.258 7.63615.71420.44710.17411.16110.235 9.757 9.279 9.364
*71 9.450 9.346 9.18611.93118.50619.88111.654 8.034 8.333 8.283 8.183 8.083
*72 7.984 7.885 7.785 9.12515.21117.38115.060 9.125 8.88  9.526 9.199 9.063
*73 9.460 9.81010.31011.42014.220 5.220 0.862 0.169 0.649 1.656 3.686 4.926
*74 6.611 7.532 9.12510.59321.55623.0  18.58515.84323.1  15.0  15.0  15.0
*8015.0  15.0  23.1  23.1  23.1  23.1  23.1  23.1   9.336 9.640 9.92410.616
*8110.64210.69210.95612.86823.1  23.1  21.61816.410 9.980 9.42010.19010.360
*8210.84011.40011.86012.89016.55021.51022.92022.36015.81015.64016.38017.370
*8316.30018.27018.76018.93021.22021.89020.75010.59011.46414.06712.25013.105
*8413.92614.29215.13617.56323.11222.58316.849 6.299 3.374 3.830 3.970 5.446
*85 5.915 5.770 4.926 8.132 7.656 3.845 0.364 0.200 0.200 0.900 2.684 3.640
*86 4.722 5.150 9.93916.25621.48021.24317.04512.76812.04011.48712.14212.154
*8712.13711.80912.83915.16611.490 7.167 5.900 4.659 2.500 2.988 2.956 3.160
*88 3.200 3.328 3.640 7.010 8.950 2.085 0.345 0.365 0.320 0.309 0.221 0.208
*89 0.195 0.200 0.267 5.27014.88615.08011.220 7.310 7.700 8.842 9.680 9.960
*
*
```

```
*
TR30 1 35 DEADMANS BASIN RESERVOIR CONTENTS (KAF)
     0.0   5.0  10.0  15.0  20.0  25.0  30.0  35.0  40.0  45.0  50.0+
    55.0  60.0  62.0  65.0  76.9
*
TR31 1 14 DEADMANS BASIN RESERVOIR ELEVATION (FT)
    3854  3873  3879  3884  3888  3892  3895  3898  3901  3904  3907+
    3910  3913  3914  3915  3921
*
TR32 1 25 DEADMANS BASIN RESERVOIR AREA (ACRES)
     0.0   680   960  1120  1280  1400  1480  1560  1660  1710  1800+
    1880  1920  1948  1990  2175
*
TR33 1 47 DEADMANS BASIN RESERVOIR MAXIMUM DISCHARGE (CFS)
     320   320   320   320   320   320   320   320   320   320   320+
     320   320   320   320   320
*
TR34 0 13 DEADMAN'S BASIN RESERVOIR EVAPORATION INCHES
*DEADMAN'S BASIN RESERVOIR, NET EVAPORATION IN INCHES
*     Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
28 -0.65 -0.58 -0.08  0.51  3.36  0.54  1.80  5.16  5.76  2.52  1.30 -0.79
29 -0.58 -0.30  0.03  0.05  2.52  3.00  7.56  9.24  3.48  3.72  0.09 -1.10
30 -0.44 -0.36 -1.50  0.66  1.92  3.72  5.76  5.40  3.36  1.80 -0.27  0.04
31  0.09  0.28 -0.81  1.10  2.52  4.32  5.52  7.56  5.16  3.24 -0.87 -0.32
32 -0.34 -0.62 -0.63 -0.09  2.52  2.28  6.48  6.36  4.92  2.04  0.12 -0.66
33 -0.39 -0.34 -0.05 -0.04  1.00  4.56  8.88  4.80  5.28  3.36  0.80 -0.51
34 -0.51 -0.33 -1.30  1.10  3.72  0.61  7.32  8.16  2.76  2.64  1.20 -0.83
35 -0.59 -0.40 -0.67 -1.30  1.56  3.72  6.48  8.52  6.96  3.96 -0.31 -0.39
36 -0.42 -0.73 -0.77 -0.03  3.12  4.08  8.40  7.56  5.04  2.64  1.20 -0.73
37 -0.97 -0.65 -1.10  0.60  3.60  0.23  4.56  6.96  4.20  3.60 -0.37 -0.80
38 -0.51 -0.90 -1.10  0.15 -0.42  1.68  3.12  5.76  6.00  1.56 -0.62 -0.37
39 -0.48 -0.45 -0.37  0.63  2.04  2.16  6.24  6.72  4.20  2.16  2.10 -0.29
40 -0.54 -1.10 -0.54 -2.20  3.00  2.40  3.24  7.08  3.36  2.52 -0.70 -0.30
41 -0.48 -0.64 -0.25 -0.61  1.32  1.68  1.92  4.80  0.38  3.36 -0.05 -0.75
42 -0.37 -0.77 -0.97  0.96 -1.44  1.92  3.72  6.00  2.40  1.80 -0.88 -0.53
43 -1.30 -1.10 -0.92 -0.80  0.85 -0.88  5.40  4.92  3.60  3.24  0.89 -0.26
44 -0.30 -0.48 -0.81  1.00  1.32  0.84  4.68  3.00  3.00  2.88 -0.35 -0.43
45 -0.30 -0.45 -0.44  0.38  1.32 -0.09  4.68  5.40  2.64  2.76  0.51 -0.82
46  0.07 -0.15  0.05  1.10  0.41  2.16  4.20  5.76  2.28  0.07 -0.50 -0.90
47 -0.33 -0.34 -0.53  0.57  2.52 -0.96  3.60  2.64  0.98  1.32 -0.80 -0.40
48 -0.58 -0.46 -0.61  0.14 -0.96 -3.20  1.92  3.48  3.12  6.00 -0.30 -0.57
49 -0.89 -0.74 -0.68  1.00 -0.58 -0.34  3.96  4.80  0.96  1.20  2.50 -0.29
50 -0.73  0.00 -1.60  0.18  2.04  0.37  4.44  4.32  3.36  4.44 -1.20 -0.45
51 -0.34 -0.68 -0.93 -0.97  1.56  0.25  5.64  4.08  2.16  1.20 -0.26 -1.30
52 -0.24 -0.54 -0.75  1.60 -0.62  3.36  6.12  5.76  5.64  3.12 -1.70 -0.07
53 -0.43 -1.00 -0.17 -0.17 -2.72  0.08  6.84  5.52  2.76  6.00  2.10 -0.44
54 -1.90  0.23 -0.52  1.30  2.64 -1.28  6.00  5.28  4.56  2.16  2.10  0.49
55 -0.18 -0.64 -0.61 -0.44  0.13  3.24 -0.02  8.16  5.64  3.72 -0.87 -1.10
56 -0.46 -0.18 -0.63  1.00  1.20  3.60  5.04  6.60  5.88  4.32  1.20 -0.39
57 -0.69 -0.42 -0.35  0.41 -0.19  1.32  5.88  6.00  4.08  1.18 -0.66 -0.13
58 -0.25 -0.31 -1.20  0.04  2.16 -0.38  3.72  5.76  5.04  2.16 -1.10 -0.64
59 -0.59 -0.83  0.18  1.10 -0.10  2.16  7.56  6.00  3.72  1.44 -1.10 -0.26
60 -0.26 -0.18 -0.22  0.43  0.40  5.76  7.44  3.72  4.56  3.48 -0.13 -0.11
61 -0.07  0.02 -0.26  0.18  1.32  6.12  6.84  7.32  1.68  3.24 -0.45 -0.26
62 -0.66 -0.65 -0.45  0.53 -0.74  2.76  4.44  5.64  4.32  1.07  0.24 -0.09
63 -1.00 -0.18  0.22  0.01  1.80  0.29  6.24  8.64  3.00  2.76  0.36 -0.96
64 -0.41 -0.26 -0.54  0.26 -1.60  0.08  5.88  4.56  4.08  3.84 -0.55 -0.89
65 -0.14 -0.34 -0.64 -1.40  0.56  0.52  3.84  3.84  0.53  3.72 -0.30 -0.20
66 -0.65 -0.20  0.05  0.53  2.64  2.40  5.88  6.24  5.64  1.80  0.02 -0.37
67 -0.09 -0.62 -0.77 -1.30  1.04 -1.20  7.08  7.80  4.44  2.28 -0.46 -1.80
68 -0.50 -0.18 -0.33  0.54 -0.50 -0.21  7.56  4.20  0.41  3.96 -0.69 -0.57
69 -1.00 -0.21 -0.38 -0.84  0.55 -1.20  4.08  7.32  4.20  0.56  0.47 -0.28
70 -0.25 -0.05 -0.66 -0.40  1.32  1.32  5.64  9.00  4.08  2.40 -0.17 -0.17
71 -0.66 -0.25 -0.09  0.04 -0.35  3.36  7.56  6.36  4.08  3.36  0.18 -0.48
72 -0.89 -0.19  0.10  0.53  1.13  5.04  5.64  4.32  5.28  3.00 -0.05 -0.43
73 -0.09 -0.01 -0.23  0.02  2.64  4.68  8.28  7.44  2.04  4.44 -0.95 -0.44
74 -1.00 -0.25 -0.17  0.79 -0.19  6.00  8.04  1.92  4.20  3.48  0.22 -0.39
75 -0.65 -0.84 -0.44 -3.20 -0.18  1.56  3.84  4.08  4.80 -0.21 -0.67 -0.21
76 -0.09 -0.34 -0.12 -0.60  2.88  1.32  6.48  4.92  4.56  3.72  0.14 -0.18
```

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77 -0.50 -0.06 -0.70  1.10 -0.42  4.68  4.68  5.04  1.56  3.12 -0.53 -0.47
78 -0.73 -0.25 -0.01 -0.73 -1.36  3.84  3.24  5.64  2.16  4.32 -0.76 -0.50
79 -0.45 -0.19 -0.39 -1.70  2.40  3.96  5.88  6.48  6.00  3.36 -0.05 -0.31
80 -0.69 -0.41 -0.40  0.56 -2.16 -0.33  5.64  5.52  3.72  0.41  0.20 -0.29
81 -0.36 -0.19 -0.18  0.96 -3.28  3.00  3.48  6.12  4.92  2.40  0.53 -0.12
82 -0.46 -0.35 -0.84 -0.05 -0.69  1.01  5.40  8.16  1.44  1.56 -0.27 -0.57
83 -0.10 -0.13 -0.28  0.04 -0.67  2.04  1.80  4.44  3.00  2.64 -0.29 -0.21
84 -0.44 -0.20 -0.38 -0.74  2.28  1.80  7.20  6.12  3.72  1.44 -0.38 -0.37
85 -0.05 -0.25 -0.41  0.98  2.16  5.40  8.16  1.14  0.02  1.80 -0.50 -0.56
86 -0.23 -0.64  0.34 -0.11  1.44  2.88  3.96  6.48 -0.20  2.28 -0.37 -0.15
87 -0.02 -0.10 -0.67  1.30  0.72  4.80  1.12  5.40  5.52  4.68  0.12 -0.33
88 -0.21 -0.31 -0.23  0.30  1.12  5.40  7.92  7.68  2.52  4.32 -0.18 -0.25
89 -0.43 -0.76 -0.68 -0.54  0.40  3.24  5.16  1.32  3.96  2.28  0.11 -0.35
*
TR35 0 35 DEADMANS BASIN RESERVOIR TARGET CONTENT (KAF)
*  Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
2956.7  56.7  76.9  76.9  76.9  76.9  76.9  76.9  76.9  56.7  56.7  56.7
*6054.0  54.0  76.9  76.9  76.9  76.9  76.9  76.9  32.85035.90039.86041.550
*6145.25050.25050.10048.75071.75027.50013.400 3.437 3.270 3.185 3.687 4.687
*62 7.43714.50013.18714.93720.93744.18738.43031.49030.57033.80036.95042.075
*6347.45052.50057.45060.80065.96070.68556.12041.90041.00038.10040.30045.120
*6448.17051.55054.98059.20064.17069.46057.64039.92040.10036.78036.45038.760
*6542.98048.00052.70059.20070.18071.00063.77552.12052.70058.20063.37564.960
*6666.15067.35068.75066.65067.75062.38051.36031.49026.60026.91030.72534.162
*6737.60041.00045.84055.93068.15072.22067.95054.03050.03052.12056.50059.000
*6860.40060.20061.00058.21053.45062.58054.60044.23038.51542.98046.74047.100
*6946.56046.56049.17556.50048.70039.26044.95030.72518.61023.88026.91028.290
*7028.29028.90033.80036.95055.36064.96044.76029.20032.30041.00049.70052.550
*7155.40059.48063.50068.27564.50061.19042.93034.62031.72037.63042.27041.000
*7243.70046.38056.22058.60063.97056.69041.72038.27036.10040.46047.10050.030
*7352.31055.36061.78069.15052.12032.63030.12018.20020.14022.22026.00029.810
*7433.46037.10040.82044.40042.07550.03037.48033.13042.76047.63053.07556.310
*8033.46037.10040.82044.40042.07550.03037.48033.13042.76047.63053.07556.310
*8157.12057.93061.32064.76076.62071.02054.41039.43039.35035.29039.10046.040
*8252.08056.65061.20066.98069.56072.22064.66048.85043.87053.11059.04064.710
*8363.91063.18068.95072.08067.64062.18054.62041.54038.93044.40047.17051.000
*8456.50059.00063.57569.15064.66564.17047.17032.17226.45031.02035.78038.430
*8542.15044.05048.00054.03036.99521.84213.64014.00015.59021.25023.88026.450
*8629.65034.80038.93044.40053.84058.38145.10332.68735.95040.82046.38050.600
*8754.41059.20063.97363.35651.97046.09238.08432.68729.81031.49032.63035.780
*8837.77040.30044.40047.45038.08019.790 9.77  8.19  7.35  7.35  9.14 10.720
*8913.15015.61020.14026.15034.37530.22011.88311.30012.97016.60021.52025.390
*
TR36 0 35 DEADMANS BASIN RESERVOIR MAXIMUM CONTENT (KAF)
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
*  72.23072.23072.23072.23072.23072.23072.23072.23072.23072.23072.23072.230
2972.23072.23072.23072.23072.23072.23072.23072.23072.23072.23072.23072.230
*6054.0  54.0  76.9  76.9  76.9  76.9  76.9  76.9  32.85035.90039.86041.550
*6145.25050.25050.10048.75071.75027.50013.400 3.437 3.270 3.185 3.687 4.687
*62 7.43714.50013.18714.93720.93744.18738.43031.49030.57033.80036.95042.075
*6347.45052.50057.45060.80065.96070.68556.12041.90041.00038.10040.30045.120
*6448.17051.55054.98059.20064.17069.46057.64039.92040.10036.78036.45038.760
*6542.98048.00052.70059.20070.18071.00063.77552.12052.70058.20063.37564.960
*6666.15067.35068.75066.65067.75062.38051.36031.49026.60026.91030.72534.162
*6737.60041.00045.84055.93068.15072.22067.95054.03050.03052.12056.50059.000
*6860.40060.20061.00058.21053.45062.58054.60044.23038.51542.98046.74047.100
*6946.56046.56049.17556.50048.70039.26044.95030.72518.61023.88026.91028.290
*7028.29028.90033.80036.95055.36064.96044.76029.20032.30041.00049.70052.550
*7155.40059.48063.50068.27564.50061.19042.93034.62031.72037.63042.27041.000
*7243.70046.38056.22058.60063.97056.69041.72038.27036.10040.46047.10050.030
*7352.31055.36061.78069.15052.12032.63030.12018.20020.14022.22026.00029.810
*7433.46037.10040.82044.40042.07550.03037.48033.13042.76047.63053.07556.310
*8033.46037.10040.82044.40042.07550.03037.48033.13042.76047.63053.07556.310
*8157.12057.93061.32064.76076.62071.02054.41039.43039.35035.29039.10046.040
*8252.08056.65061.20066.98069.56072.22064.66048.85043.87053.11059.04064.710
*8363.91063.18068.95072.08067.64062.18054.62041.54038.93044.40047.17051.000
*8456.50059.00063.57569.15064.66564.17047.17032.17226.45031.02035.78038.430
*8542.15044.05048.00054.03036.99521.84213.64014.00015.59021.25023.88026.450
*8629.65034.80038.93044.40053.84058.38145.10332.68735.95040.82046.38050.600
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*8754.41059.20063.97363.35651.97046.09238.08432.68729.81031.49032.63035.780
*8837.77040.30044.40047.45038.08019.790 9.77  8.19  7.35  7.35  9.14 10.720
*8913.15015.61020.14026.15034.37530.22011.88311.30012.97016.60021.52025.390
*
TR37 0 35 DEADMANS BASIN RESERVOIR MINIMUM CONTENT (KAF)
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
*   12.0  12.0  12.0  12.0  12.0  12.0  12.0  12.0  12.0  12.0  12.0  12.0
2912.0  12.0  12.0  12.0  12.0  12.0  12.0  12.0  12.0  12.0  12.0  12.0
*6053.9  53.9  76.8  76.8  76.8  76.8  76.8  76.8  32.75035.80039.76041.450
*6145.15050.15050.00048.65071.65027.40013.300 3.337 3.170 3.085 3.587 4.587
*62 7.33714.40013.08714.83720.83744.08738.33031.39030.47033.70036.85041.975
*6347.35052.40057.35060.70065.86070.58556.02041.80040.90038.00040.20045.020
*6448.07051.45054.88059.10064.07069.36057.54039.82040.00036.68036.30038.660
*6542.88047.90052.60059.10070.08070.90063.67552.02052.60058.10063.27564.860
*6666.05067.25068.65066.55067.65062.28051.26031.39026.50026.81030.62534.062
*6737.50040.90045.74055.83068.05072.12067.85053.93049.93052.02056.40058.900
*6860.30060.10060.90058.11053.35062.48054.50044.13038.41542.88046.64047.000
*6946.46046.46049.07556.40048.60039.16044.85030.62518.51023.78026.81028.190
*7028.19028.80033.70036.85055.26064.86044.66029.10032.20040.90049.60052.450
*7155.30059.38063.40068.17564.40061.09042.83034.52031.62037.53042.17040.900
*7243.60046.28056.12058.50063.87056.59041.62038.17036.00040.36047.00049.930
*7352.21055.26061.68069.05052.02032.53030.02018.10020.04022.12025.90029.710
*7433.36037.00040.72044.30041.97549.93037.38033.03042.66047.53052.97556.210
*8033.36037.00040.72044.30041.97549.93037.38033.03042.66047.53052.97556.210
*8157.02057.83061.22064.66076.52070.92054.31039.33039.25035.19039.00045.940
*8251.98056.55061.10066.88069.46072.12064.56048.75043.77053.01058.94064.610
*8363.81063.08068.85071.98067.54062.08054.52041.44038.83044.30047.07050.900
*8456.40058.90063.47569.05064.56564.07047.07032.07226.35030.92035.68038.330
*8542.05043.95047.90053.93036.89521.74213.54013.90015.49021.15023.78026.350
*8629.55034.70038.83044.30053.74058.28145.00332.58735.85040.72046.28050.500
*8754.31059.10063.87363.25651.87045.99237.98432.58729.71031.39032.53035.680
*8837.67040.20044.30047.35037.98019.690 9.67  8.09  7.25  7.25  9.04 10.620
*8913.05015.51020.04026.05034.27530.12011.78311.20012.87016.50021.42025.290
*
*
*
*
**********CANAL EFFICIENCIES**********
*
TE02 0 60 CANAL EFFICIENCY TABLE FOR D002, TYPE3 DIVERSION TO MARTINSDALE
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
  100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0
TE03 0 60 CANAL EFFICIENCY TABLE FOR D003, TYPE3 DIV. TO DEADMAN'S BASIN
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
   82.0  82.0  82.0  82.0  82.0  82.0  82.0  82.0  82.0  82.0  82.0  82.0
TE04 0 60 CANAL EFFICIENCY TABLE FOR UPPER BASIN
* 60 percent canal efficiency used in calibration
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
   60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0
*   40.0  40.0  40.0  50.0  75.0  80.0  95.0  90.0  85.0  85.0  45.0  45.0
TE05 0 60 CANAL EFFICIENCY TABLE FOR MIDDLE BASIN
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
   40.0  40.0  40.0  50.0  75.0  80.0  95.0  90.0  85.0  85.0  45.0  45.0
TE06 0 60 CANAL EFFICIENCY TABLE FOR LOWER BASIN
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
   40.0  40.0  40.0  50.0  75.0  80.0  95.0  90.0  85.0  85.0  45.0  45.0
TE45 0 60 45 PERCENT EFFICIENCY TABLE FOR M&I
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
   45.0  45.0  45.0  45.0  45.0  45.0  45.0  45.0  45.0  45.0  45.0  45.0
TE75 0 60 75 PERCENT EFFICIENCY TABLE FOR M&I
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
   75.0  75.0  75.0  75.0  75.0  75.0  75.0  75.0  75.0  75.0  75.0  75.0
TE99 0 60 100 PERCENT EFFICIENCY TABLE FOR M&I
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
  100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0
*
**********SITE EFFICIENCIES**********
*
TF02 0 60 SITE EFFICIENCY TABLE FOR TYPE 3 DIVERSION TO MARTINSDALE RES.
```

```
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
    0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
*
TF03 0 60 SITE EFFICIENCY TABLE FOR TYPE 3 DIVERSION TO DEADMAN'S BASIN
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
    0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
*
TF04 0 60 ON FARM EFFICIENCY TABLE FOR UPPER BASIN FROM SCS REPORT PRELIM.
* On Farm Efficiency 1st line from SCS report Increase by 5% each add. line
* 5 percent, 10, 15 and 20 percent.
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
    0.0   0.0   0.0  28.6  28.6  41.8  50.6  37.4  22.0  22.0   0.0   0.0
*    0.0   0.0   0.0  33.6  33.6  46.8  55.6  42.4  27.0  22.0   0.0   0.0
*    0.0   0.0   0.0  38.6  38.6  51.8  60.6  47.4  32.0  32.0   0.0   0.0
*    0.0   0.0   0.0  43.6  43.6  56.8  65.6  52.4  37.0  37.0   0.0   0.0
*    0.0   0.0   0.0  48.6  48.6  61.8  70.6  57.4  42.0  42.0   0.0   0.0
*
TF05 0 60 ON FARM EFFICIENCY TABLE FOR MIDDLE BASIN FROM SCS REPORT PRELIM
* On Farm Efficiency 1st line from SCS report Increase by 5% each add. line
* 5 percent, 10, 15 and 20 percent.
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
    0.0   0.0   0.0  27.4  27.4  40.0  48.4  35.8  21.1  21.1   0.0   0.0
*    0.0   0.0   0.0  32.4  32.4  45.0  53.4  40.8  26.1  26.1   0.0   0.0
*    0.0   0.0   0.0  37.4  37.4  50.0  58.4  45.8  31.1  31.1   0.0   0.0
*    0.0   0.0   0.0  42.4  42.4  55.0  63.4  50.8  36.1  36.1   0.0   0.0
*    0.0   0.0   0.0  47.4  47.4  60.0  68.4  55.8  41.1  41.1   0.0   0.0
*
TF06 0 60 ON FARM EFFICIENCY TABLE FOR LOWER BASIN FROM SCS REPORT PRELIM.
* On Farm Efficiency 1st line from SCS report Increase by 5% each add. line
* 5 percent, 10, 15 and 20 percent.
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
    0.0   0.0   0.0  27.4  27.4  40.5  49.1  36.3  21.3  21.3   0.0   0.0
*    0.0   0.0   0.0  32.4  32.4  45.5  54.1  41.3  26.3  26.3   0.0   0.0
*    0.0   0.0   0.0  37.4  37.4  50.5  59.1  46.3  31.3  31.3   0.0   0.0
*    0.0   0.0   0.0  42.4  42.4  55.5  64.1  51.3  36.3  36.3   0.0   0.0
*    0.0   0.0   0.0  47.4  47.4  60.5  69.1  56.3  41.3  41.3   0.0   0.0
*
TF75 0 60 EFFICIENCY TABLE FOR 75 PERCENT EFFICIENT FOR GOLF COURSES
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
    0.0   0.0   0.0  75.0  75.0  75.0  75.0  75.0  75.0  75.0   0.0   0.0
*
TF99 0 60 EFFICIENCY TABLE FOR 100 PERCENT EFFICIENT FOR MUNICIPALITIES
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
  100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0
*

**********RETURN FLOW PATTERNS**********
*
TR02 0 60 RETURN FLOW DELAY TABLE FOR d002 TYPE 3 DIVERSION
  100.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
*
TR03 0 60 RETURN FLOW DELAY TABLE FOR d003 TYPE 3 DIVERSION
  100.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
*
TR04 0 60 RETURN FLOW DELAY TABLE FOR UPPER BASIN
   86.68  12.0  1.32  0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
*
TR05 0 60 RETURN FLOW DELAY TABLE FOR MIDDLE BASIN
   86.68  12.0  1.32  0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
*
TR06 0 60 RETURN FLOW DELAY TABLE FOR LOWER BASIN
   86.68  12.0  1.32  0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
*
TR09 0 60 RETURN FLOW FOR M&I DEMANDS
  100.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
*
**********DIVERSION CAPACITY LIMITS TYPE 3 DIVERSIONS********
*
* THIS LIMITS TOTAL DIVERSION CAPACITY FOR MARTINSDALE RESERVOIR(150 CFS)
```

```
TP02 0 47 DIVERSION CAPACITY LIMITS FOR MARTINSDALE INLET (CFS)
*    Jan    Feb    Mar    Apr    May    Jun    Jul    Aug    Sep    Oct    Nov    Dec
     0.0    0.0  150.0  150.0  150.0  150.0  150.0  150.0  150.0  150.0    0.0    0.0
*
* THIS LIMITS TOTAL TO DIVERSION CAPACITY FOR DEADMANS BASIN (450 CFS)
TP03 0 47 DIVERSION CAPACITY LIMITS FOR DEADMANS BASIN INLET
*    Jan    Feb    Mar    Apr    May    Jun    Jul    Aug    Sep    Oct    Nov    Dec
   450.0  450.0  450.0  450.0  450.0  450.0  450.0  450.0  450.0  450.0  450.0  450.0
*
* THIS LIMITS TOTAL DIVERSION FROM NORTH FORK TO SOUTH FORK MUSSELSHELL
* OF 100 CFS DIVERSIONS THROUGH STATE LINE CANAL THEN
* WATER IS DIVERTED INTO MARTINSDALE RESERVOIR BY INLET CANAL
TP04 0 47 DIVERSION CAPACITY LIMITS FROM NF TO SF MARTIN (CFS)
*    Jan    Feb    Mar    Apr    May    Jun    Jul    Aug    Sep    Oct    Nov    Dec
     0.0    0.0  105.0  105.0  105.0  105.0  105.0  105.0  105.0  105.0    0.0    0.0
*
********************** POPULATION NUMBERS*********************************
*
TP10 0 60 RYEGATE POPULATION - UNITS THOUSANDS OF PEOPLE
*    Jan    Feb    Mar    Apr    May    Jun    Jul    Aug    Sep    Oct    Nov    Dec
29  0.29   0.29   0.29   0.29   0.29   0.29   0.29   0.29   0.29   0.29   0.29   0.29
30  0.29   0.29   0.29   0.29   0.29   0.29   0.29   0.29   0.29   0.29   0.29   0.29
40  0.35   0.35   0.35   0.35   0.35   0.35   0.35   0.35   0.35   0.35   0.35   0.35
50  0.34   0.34   0.34   0.34   0.34   0.34   0.34   0.34   0.34   0.34   0.34   0.34
60  0.31   0.31   0.31   0.31   0.31   0.31   0.31   0.31   0.31   0.31   0.31   0.31
70  0.26   0.26   0.26   0.26   0.26   0.26   0.26   0.26   0.26   0.26   0.26   0.26
80  0.27   0.27   0.27   0.27   0.27   0.27   0.27   0.27   0.27   0.27   0.27   0.27
89  0.26   0.26   0.26   0.26   0.26   0.26   0.26   0.26   0.26   0.26   0.26   0.26
*
TP11 0 60 POPULATION NUMBERS FOR ROUNDUP - UNITS THOUSANDS OF PEOPLE
*    Jan    Feb    Mar    Apr    May    Jun    Jul    Aug    Sep    Oct    Nov    Dec
29  2.43   2.43   2.43   2.43   2.43   2.43   2.43   2.43   2.43   2.43   2.43   2.43
30  2.58   2.58   2.58   2.58   2.58   2.58   2.58   2.58   2.58   2.58   2.58   2.58
40  2.64   2.64   2.64   2.64   2.64   2.64   2.64   2.64   2.64   2.64   2.64   2.64
50  2.86   2.86   2.86   2.86   2.86   2.86   2.86   2.86   2.86   2.86   2.86   2.86
60  2.84   2.84   2.84   2.84   2.84   2.84   2.84   2.84   2.84   2.84   2.84   2.84
70  2.12   2.12   2.12   2.12   2.12   2.12   2.12   2.12   2.12   2.12   2.12   2.12
80  2.12   2.12   2.12   2.12   2.12   2.12   2.12   2.12   2.12   2.12   2.12   2.12
89  1.81   1.81   1.81   1.81   1.81   1.81   1.81   1.81   1.81   1.81   1.81   1.81
*
TP12 0 60 MELSTONE POPULATION - UNITS THOUSANDS OF PEOPLE
*    Jan    Feb    Mar    Apr    May    Jun    Jul    Aug    Sep    Oct    Nov    Dec
29  0.48   0.48   0.48   0.48   0.48   0.48   0.48   0.48   0.48   0.48   0.48   0.48
30  0.22   0.22   0.22   0.22   0.22   0.22   0.22   0.22   0.22   0.22   0.22   0.22
40  0.20   0.20   0.20   0.20   0.20   0.20   0.20   0.20   0.20   0.20   0.20   0.20
50  0.20   0.20   0.20   0.20   0.20   0.20   0.20   0.20   0.20   0.20   0.20   0.20
60  0.27   0.27   0.27   0.27   0.27   0.27   0.27   0.27   0.27   0.27   0.27   0.27
70  0.23   0.23   0.23   0.23   0.23   0.23   0.23   0.23   0.23   0.23   0.23   0.23
80  0.24   0.24   0.24   0.24   0.24   0.24   0.24   0.24   0.24   0.24   0.24   0.24
89  0.17   0.17   0.17   0.17   0.17   0.17   0.17   0.17   0.17   0.17   0.17   0.17
*
**********************CONSUMPTIVE USE DEMANDS FOR M&I**********************
*
TM01 0 52 RYEGATE CONSUMPTIVE USE - AF/1000 POPULATION/MONTH
*    Jan    Feb    Mar    Apr    May    Jun    Jul    Aug    Sep    Oct    Nov    Dec
29   2.32   1.99   2.32   2.32   2.98   3.64   3.97   3.97   2.98   2.32   1.99   2.32
40   4.95   4.24   4.95   4.95   6.36   7.77   8.48   8.48   6.36   4.95   4.24   4.95
50   6.27   5.37   6.27   6.27   8.06   9.85  10.74  10.74   8.06   6.27   5.37   6.27
60   7.58   6.49   7.58   7.58   9.74  11.91  12.99  12.99   9.74   7.58   6.49   7.58
70   8.90   7.62   8.90   8.90  11.44  13.98  15.25  15.25  11.44   8.90   7.62   8.90
80  10.21   8.75  10.21  10.21  13.12  16.04  17.50  17.50  13.12  10.21   8.75  10.21
89  11.60   9.94  11.60  11.60  14.91  18.23  19.89  19.89  14.91  11.60   9.94  11.60
*
TM02 0 52 ROUNDUP CONSUMPTIVE USE - AF/1000 POPULATION/MONTH
*    Jan    Feb    Mar    Apr    May    Jun    Jul    Aug    Sep    Oct    Nov    Dec
29   2.32   1.99   2.32   2.32   2.98   3.64   3.97   3.97   2.98   2.32   1.99   2.32
40   4.95   4.24   4.95   4.95   6.36   7.77   8.48   8.48   6.36   4.95   4.24   4.95
50   6.27   5.37   6.27   6.27   8.06   9.85  10.74  10.74   8.06   6.27   5.37   6.27
60   7.58   6.49   7.58   7.58   9.74  11.91  12.99  12.99   9.74   7.58   6.49   7.58
```

```
70  8.90  7.62  8.90  8.90 11.44 13.98 15.25 15.25 11.44  8.90  7.62  8.90
80 10.21  8.75 10.21 10.21 13.12 16.04 17.50 17.50 13.12 10.21  8.75 10.21
89 11.60  9.94 11.60 11.60 14.91 18.23 19.89 19.89 14.91 11.60  9.94 11.60
*
TM03 0 52 MELSTONE CONSUMPTIVE USE - AF/1000 POPULATION/MONTH
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29  2.32  1.99  2.32  2.32  2.98  3.64  3.97  3.97  2.98  2.32  1.99  2.32
40  4.95  4.24  4.95  4.95  6.36  7.77  8.48  8.48  6.36  4.95  4.24  4.95
50  6.27  5.37  6.27  6.27  8.06  9.85 10.74 10.74  8.06  6.27  5.37  6.27
60  7.58  6.49  7.58  7.58  9.74 11.91 12.99 12.99  9.74  7.58  6.49  7.58
70  8.90  7.62  8.90  8.90 11.44 13.98 15.25 15.25 11.44  8.90  7.62  8.90
80 10.21  8.75 10.21 10.21 13.12 16.04 17.50 17.50 13.12 10.21  8.75 10.21
89 11.60  9.94 11.60 11.60 14.91 18.23 19.89 19.89 14.91 11.60  9.94 11.60
*
**********INSTREAM FLOW REQUIREMENTS**********
*
TI01 0 47 DFWP IFR RESERVATION FROM MARTINSDALE TO MUSSELSHELL 80 CFS
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
85  80.0  80.0  80.0  80.0  80.0  80.0  80.0  80.0  80.0  80.0  80.0  80.0
*
TI02 0 47 DFWP IFR RESERVATION FROM MUSSELSHELL TO FORT PECK 70 CFS
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
85  70.0  70.0  70.0  70.0  70.0  70.0  70.0  70.0  70.0  70.0  70.0  70.0
*
**********STOCKWATER PONDS**********
*
TS01 0 52 STOCKWATER PONDS ABOVE HARLOWTON TO HEADWATERS
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   0.0 188.0 188.0   0.0   0.0 377.0   0.0   0.0   0.0   0.0   0.0   0.0
*
TS02 0 52 STOCKWATER PONDS FROM HARLOWTON TO SHAWMUT
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   0.0 107.0 107.0   0.0   0.0 213.0   0.0   0.0   0.0   0.0   0.0   0.0
*
TS03 0 52 STOCKWATER PONDS FROM SHAWMUT TO RYEGATE
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   0.0  64.0  64.0   0.0   0.0 128.0   0.0   0.0   0.0   0.0   0.0   0.0
*
TS04 0 52 STOCKWATER PONDS FROM RYEGATE TO LAVINA
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   0.0 292.0 292.0   0.0   0.0 583.0   0.0   0.0   0.0   0.0   0.0   0.0
*
TS05 0 52 STOCKWATER PONDS FROM LAVINA TO ROUNDUP
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   0.0 396.0 396.0   0.0   0.0 792.0   0.0   0.0   0.0   0.0   0.0   0.0
*
TS06 0 52 STOCKWATER PONDS FROM ROUNDUP TO MUSSELSHELL
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   0.0 192.0 192.0   0.0   0.0 384.0   0.0   0.0   0.0   0.0   0.0   0.0
*
TS07 0 52 STOCKWATER PONDS FROM MUSSELSHELL TO MOSBYE
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   0.0 530.0 530.0   0.0   0.01060.0   0.0   0.0   0.0   0.0   0.0   0.0
*
**********IRRIGATED ACRES**********
*
* TA01 IRRIGATED ACRES NATURAL FLOWS ABOVE BAIR RESERVOIR
TA01 0 25 IRRIGATED ACRES ABOVE BAIR RESERVOIR N
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 616.0 616.0 616.0 616.0 616.0 616.0 616.0 616.0 616.0 616.0 616.0 616.0
*
* TA02 IRRIGATED ACRES NATURAL FLOWS BETWEEN BAIR AND STATION 100
TA02 0 25 IRRIGATED ACRES BETWEEN BAIR AND S L N
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 229.0 229.0 229.0 229.0 229.0 229.0 229.0 229.0 229.0 229.0 229.0 229.0
*
* TA03 IRRIGATED ACRES CONTRACT FLOWS BETWEEN BAIR AND STATION 100
```

```
*TA03 0 25 IRRIGATED ACRES BETWEEN BAIR & S L C
**   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
*29 203.0 203.0 203.0 203.0 203.0 203.0 203.0 203.0 203.0 203.0 203.0 203.0
*
*
*
* TA03 IRRIGATED ACRES CONTRACT FLOWS BETWEEN BAIR AND STATION 100
TA03 0 25 IRRIGATED ACRES BETWEEN BAIR & S L C
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 1000. 1000. 1000. 1000. 1000. 1000. 1000. 1000. 1000. 1000. 1000. 1000.

*
*
*
* TA04 IRRIGATED ACRES NATURAL & CONTRACT FLOWS BETWEEN BAIR & STATION 100
TA04 0 25 IRRIGATED ACRES BETWEEN BAIR & S L NC
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
291118.01118.01118.01118.01118.01118.01118.01118.01118.01118.01118.0
*
* TA05 IRRIGATED ACRES NATURAL FLOWS HEADWATERS SF TO STATE LINE
TA05 0 25 IRRIGATED ACRES FROM HW SF TO S L N
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
291983.01983.01983.01983.01983.01983.01983.01983.01983.01983.01983.0
*
* TA06 IRRIGATED ACRES CONTRACT FLOWS FROM MARTINSDALE RES BELOW MARTINS
TA06 0 25 IRRIGATED ACRES FROM MARTINSDALE
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 12951 12951 12951 12951 12951 12951 12951 12951 12951 12951 12951 12951
*
* TA07 IRRIGATED ACRES NATURAL FLOWS FROM STATELINE TO HARLOW
TA07 0 25 IRRIGATED ACRES FROM NF&SF TO HARLOW N
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
291593.01593.01593.01593.01593.01593.01593.01593.01593.01593.01593.0
*
* TA08 IRRIGATED ACRES CONTRACT FLOWS FROM STATELINE TO HARLOW
TA08 0 25 IRRIGATED ACRES FROM NF&SF TO HARLOW C
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29     0     0     0     0     0     0     0     0     0     0     0     0
*
* TA09 IRRIGATED ACRES NATURAL AND CONTRACT FLOWS FROM STATELINE TO HARLOW
TA09 0 25 IRRIGATED ACRES FROM NF&SF TO HARLOW NC
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 1700. 1700. 1700. 1700. 1700. 1700. 1700. 1700. 1700. 1700. 1700. 1700.
*
* TA11 IRRIGATED ACRES NATURAL FLOWS FROM HARLOW TO SHAWMUT
TA11 0 25 IRRIGATED ACRES HARLOW TO SHAWMUT N
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 317.  317.  317.  317.  317.  317.  317.  317.  317.  317.  317.  317.
*
* TA12 IRRIGATED ACRES CONTRACT FLOWS FROM HARLOW TO SHAWMUT
TA12 0 25 IRRIGATED ACRES HARLOW TO SHAWMUT N
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 2826. 2826. 2826. 2826. 2826. 2826. 2826. 2826. 2826. 2826. 2826. 2826.
*
* TA13 IRRIGATED ACRES NATURAL AND CONTRACT FLOWS FROM HARLOW TO SHAWMUT
TA13 0 25 IRRIGATED ACRES HARLOW TO SHAWMUT NC
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29    54    54    54    54    54    54    54    54    54    54    54    54
*
* TA14 IRRIGATED ACRES NATURAL FLOWS FROM SHAWMUT TO RYEGATE
TA14 0 25 IRRIGATED ACRES SHAWMUT TO RYEGATE N
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
291159. 1159. 1159. 1159. 1159. 1159. 1159. 1159. 1159. 1159. 1159. 1159.
*
* TA15 IRRIGATED ACRES CONTRACT FLOWS FROM SHAWMUT TO RYEGATE
TA15 0 25 IRRIGATED ACRES SHAWMUT TO RYEGATE C
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
292752. 2752. 2752. 2752. 2752. 2752. 2752. 2752. 2752. 2752. 2752. 2752.
*
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* TA16 IRRIGATED ACRES NATURAL AND CONTRACT FLOWS FROM SHAWMUT TO RYEGATE
TA16 0 25 IRRIGATED ACRES SHAWMUT TO RYEGATE NC
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 562.  562.  562.  562.  562.  562.  562.  562.  562.  562.  562.  562.
*
* TA17 IRRIGATED ACRES NATURAL FLOWS ON DEADMANS INLET
TA17 0 25 IRRIGATED ACRES ON DEADMANS INLET N
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29    0     0     0     0     0     0     0     0     0     0     0     0
*
* TA18 IRRIGATED ACRES CONTRACT FLOWS ON DEADMANS INLET
TA18 0 25 IRRIGATED ACRES ON DEADMANS INLET C
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29    0     0     0     0     0     0     0     0     0     0     0     0
*
* TA19 IRRIGATED ACRES NATURAL AND CONTRACT FLOWS ON DEADMANS INLET
TA19 0 25 IRRIGATED ACRES ON DEADMANS INLET NC
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29    0     0     0     0     0     0     0     0     0     0     0     0
*
* TA20 IRRGATED ACRES CONTRACT FLOWS ON BARBER CANAL
TA20 0 25 IRRIGATED ACRES ON BARBER CANAL C
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29  728   728   728   728   728   728   728   728   728   728   728   728
*
* TA21 IRRIGATED ACRES CONTRACT FLOWS ON CARLESS CANAL
TA21 0 25 IRRIGATED ACRES ON CARLESS CANAL C
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 1468  1468  1468  1468  1468  1468  1468  1468  1468  1468  1468  1468
*
* TA22 IRRIGATED ACRES NATURAL FLOWS ON CARLESS CREEK
TA22 0 25 IRRIGATED ACRES ON CARLESS CREEK N
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29    0     0     0     0     0     0     0     0     0     0     0     0
*
* TA23 IRRIGATED ACRES CONTRACT FLOWS ON CARLESS CREEK
TA23 0 25 IRRIGATED ACRES ON CARLESS CREEK C
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 578.  578.  578.  578.  578.  578.  578.  578.  578.  578.  578.  578.
*
* TA24 IRRIGATED ACRES NATURAL AND CONTRACT FLOWS ON CARLESS CREEK
TA24 0 25 IRRIGATED ACRES ON CARLESS CREEK NC
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 920.  920.  920.  920.  920.  920.  920.  920.  920.  920.  920.  920.
*
* TA25 IRRIGATED ACRES NATURAL FLOWS FROM RYEGATE TO LAVINA
TA25 0 25 IRRIGATED ACRES RYEGATE TO LAVINA N
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29108.0 108.0 108.0 108.0 108.0 108.0 108.0 108.0 108.0 108.0 108.0 108.0
*
* TA26 IRRIGATED ACRES CONTRACT FLOWS FROM RYEGATE TO LAVINA
TA26 0 25 IRRIGATED ACRES RYEGATE TO LAVINA C
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29261.0 261.0 261.0 261.0 261.0 261.0 261.0 261.0 261.0 261.0 261.0 261.0
*
* TA27 IRRIGATED ACRES NATURAL AND CONTRACT FLOWS FROM RYEGATE TO LAVINA
TA27 0 25 IRRIGATED ACRES RYEGATE TO LAVINA NC
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 2353  2353  2353  2353  2353  2353  2353  2353  2353  2353  2353  2353
*
* TA28 IRRIGATED ACRES NATURAL FLOWS FROM LAVINA TO PAINTED ROBE
TA28 0 25 IRRIGATED ACRES FROM LAVINA TO PR N
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 41.0  41.0  41.0  41.0  41.0  41.0  41.0  41.0  41.0  41.0  41.0  41.0
*
* TA29 IRRIGATED ACRES CONTRACT FLOWS FROM LAVINA TO PAINTED ROBE
TA29 0 25 IRRIGATED ACRES FROM LAVINA TO PR C
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 412.  412.  412.  412.  412.  412.  412.  412.  412.  412.  412.  412.
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*
* TA30 IRRIGATED ACRES NATURAL AND CONTRACT FLOWS FROM LAVINA TO PR CRREK
TA30 0 25 IRRIGATED ACRES FROM LAVINA TO PR NC
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 688.  688.  688.  688.  688.  688.  688.  688.  688.  688.  688.  688.
*
* TA31 IRRIGATED ACRES NATURAL FLOWS PAINTED ROBE CK TO ROUNDUP
TA31 0 25 IRRIGATED ACRES PR CK TO ROUNDUP N
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 333.  333.  333.  333.  333.  333.  333.  333.  333.  333.  333.  333.
*
* TA32 IRRIGATED ACRES CONTRACT FLOWS PAINTED ROBE CK TO ROUNDUP
TA32 0 25 IRRIGATED ACRES PR CK TO ROUNDUP N
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 606.  606.  606.  606.  606.  606.  606.  606.  606.  606.  606.  606.
*
* TA33 IRRIGATED ACRES NATURAL AND CONTRACT FLOWS PR CK TO ROUNDUP
TA33 0 25 IRRIGATED ACRES PR CK TO ROUNDUP NC
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
291707. 1707. 1707. 1707. 1707. 1707. 1707. 1707. 1707. 1707. 1707. 1707.
*
* TA34 IRRIGATED ACRES NATURAL FLOWS ROUNDUP TO MUSSELSHELL
TA34 0 25 IRRIGATED ACRES ROUNDUP TO MUSSELSHELL N
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 486.  486.  486.  486.  486.  486.  486.  486.  486.  486.  486.  486.
*
* TA35 IRRIGATED ACRES CONTRACT FLOWS ROUNDUP TO MUSSELSHELL
TA35 0 25 IRRIGATED ACRES ROUNDUP TO MUSSELSHELL C
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 828.  828.  828.  828.  828.  828.  828.  828.  828.  828.  828.  828.
*
* TA36 IRRIGATED ACRES NATURAL AND CONTRACT FLOWS ROUNDUP TO MUSSELSHELL
TA36 0 25 IRRIGATED ACRES ROUNDUP TO MUSSELSHELL NC
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 3795. 3795. 3795. 3795. 3795. 3795. 3795. 3795. 3795. 3795. 3795. 3795.
*
* TA37 IRRIGATED ACRES NATURAL FLOWS MUSSELSHELL TO MOSBY
TA37 0 25 IRRIGATED ACRES MUSSSELSHELL TO MOSBY N
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 691.  691.  691.  691.  691.  691.  691.  691.  691.  691.  691.  691.
*
* TA38 IRRIGATED ACRES CONTRACT FLOWS MUSSELSHELL TO MOSBY
TA38 0 25 IRRIGATED ACRES MUSSSELSHELL TO MOSBY C
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 359.  359.  359.  359.  359.  359.  359.  359.  359.  359.  359.  359.
*
* TA39 IRRIGATED ACRES NATURAL AND CONTRACT FLOWS MUSSELSHELL TO MOSBY
TA39 0 25 IRRIGATED ACRES MUSSSELSHELL TO MOSBY NC
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 8332. 8332. 8332. 8332. 8332. 8332. 8332. 8332. 8332. 8332. 8332. 8332.
*
* TA40 IRRIGATED ACRES NATURAL FLOWS MOSBY TO FORT PECK
TA40 0 25 IRRIGATED ACRES MOSBY TO FORT PECK N
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
294165. 4165. 4165. 4165. 4165. 4165. 4165. 4165. 4165. 4165. 4165. 4165.
*
* TA41 IRRIGATED ACRES CONTRACT FLOWS MOSBY TO FORT PECK
TA41 0 25 IRRIGATED ACRES MOSBY TO FORT PECK C
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29    0     0     0     0     0     0     0     0     0     0     0     0
*
* TA42 IRRIGATED ACRES NATURAL AND CONTRACT FLOWS MOSBY TO FORT PECK
TA42 0 25 IRRIGATED ACRES MOSBY TO FORT PECK NC
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 324.  324.  324.  324.  324.  324.  324.  324.  324.  324.  324.  324.
*
* TA43 IRRIGATED ACRES NATURAL FLOWS MARTINSDALE INLET CANAL
TA43 0 25 IRRIGATED ACRES MARTINSDALE INLET CANAL
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
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29 497.0 497.0 497.0 497.0 497.0 497.0 497.0 497.0 497.0 497.0 497.0 497.0
*********SUB SECTION OF DIVERSION TO DEPLETE FLOWS ON TRIBUTARIES*********
*
************************DEPLETIONS UPPER BASIN*****************************
*
* TA50 IRRIGATED ACRES TO DEPLETE FLOWS ON COTTONWOOD CREEK
TA50 0 25 IRRIGATED ACRES COTTONWOOD CK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29  3100  3100  3100  3100  3100  3100  1550     0     0     0  3100  3100
*
* TA51 IRRIGATED ACRES TO DEPLETE FLOWS ON CHECKERBOARD CREEK
TA51 0 25 IRRIGATED ACRES CHECKERBOARD
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   155   155   155   155   155   155     0     0     0     0   155   155
*
* TA52 IRRIGATED ACRES TO DEPLETE FL WS ON SOURDOUGH CREEK
TA52 0 25 IRRIGATED ACRES SOURDOUGH CK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   140   140   140   140   140   140     0     0     0     0   140   140
*
* TA53 IRRIGATED ACRES TO DEPLETE FLOWS ON SPRING CREEK
TA53 0 25 IRRIGATED ACRES SPRING CREEK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29    80    80    80    80    80    80     0     0     0     0    80    80
*
* TA54 IRRIGATED ACRES TO DEPLETE FLOWS ON TRAIL CREEK
TA54 0 25 IRRIGATED ACRES TRAIL CREEK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   670   670   670   670   670   670     0     0     0     0   670   670
*
* TA55 IRRIGATED ACRES TO DEPLETE FLOWS ON WHETSONE CREEK
TA55 0 25 IRRIGATED ACRES WHESTONE CK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29    10    10    10    10    10    10     0     0     0     0    10    10
*
* TA57 IRRIGATED ACRES TO DEPLETE FLOWS ON FLAGSTAFF CREEK
TA57 0 25 IRRIGATED ACRES FLAGSTAFF CK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   250   250   250   250   125     0     0     0     0     0   250   250
*
* TA58 IRRIGATED ACRES TO DEPLETE FLOWS ON DAISY DEAN CREEK
TA58 0 25 IRRIGATED ACRES DAISY DEAN CK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29  1110  1110  1110  1110   555     0     0     0     0     0  1110  1110
*
* TA59 IRRIGATED ACRES TO DEPLETE FLOWS ON LONG CANYON CK, ALKALI CK
TA59 0 25 IRRIGATED ACRES LCCK, ALKALI
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   270   270   270   270   135     0     0     0     0     0   270   270
*
* TA60 IRRIGATED ACRES TO DEPLETE FLOWS ON MORRISSY CREEK
TA60 0 25 IRRIGATED ACRES MORRISSY CK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   350   350   350   350   175     0     0     0     0     0   350   350
*
* TA61 IRRIGATED ACRES TO DEPLETE FLOWS ON HAYMAKER CREEK
TA61 0 25 IRRIGATED ACRES HAYMAKER CK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   430   430   430   430   215     0     0     0     0     0   430   430
*
* TA62 IRRIGATED ACRES TO DEPLETE FLOWS ON ALKALI CK SOUTH OF TWO DOT
TA62 0 25 IRRIGATED ACRES ALK S TWO DOT
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   860   860   860   860   430     0     0     0     0     0   860   860
*
* TA63 IRRIGATED ACRES TO DEPLETE FLOWS ON TROMBONE CREEK
TA63 0 25 IRRIGATED ACRES TROMBONE CREEK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   250   250   250   250   125     0     0     0     0     0   250   250
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*
* TA64 IRRIGATED ACRES TO DEPLETE FLOWS ON CLARKS FORK
TA64 0 25 IRRIGATED ACRES CLARKS FORK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29    30    30    30    30    15     0     0     0     0     0    30    30
*
* TA65 IRRIGATED ACRES TO DEPLETE FLOWS ON MEXICAN JOHN CREEK
TA65 0 25 IRRIGATED ACRES MEXICAN JOHN
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29    45    45    45    45    22     0     0     0     0     0    45    45
*
* TA66 IRRIGATED ACRES TO DEPLETE FLOWS ON MILLER CREEK
TA66 0 25 IRRIGATED ACRES MILLER CREEK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29  1198  1198  1198  1198   599     0     0     0     0     0  1198  1198
*
* TA67 IRRIGATED ACRES TO DEPLETE FLOWS ON HOPLEY CREEK
TA67 0 25 IRRIGATED ACRES HOPLEY CREEK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   274   274   274   274   137     0     0     0     0     0   274   274
*
* TA68 IRRIGATED ACRES TO DEPLETE FLOWS ON BIG ELK CREEK
TA68 0 25 IRRIGATED ACRES BIG ELK CREEK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29  4403  4403  4403  4403  4403  2201     0     0     0     0  4403  4403
*
* TA85 IRRIGATED ACRES TO DEPLETE FLOWS ON MUD CREEK LOWER
TA85 0 25 IRRIGATED ACRES MUD CREEK L
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29    33    33    33    33    16     0     0     0     0     0    33    33
*
**********DEPLETIONS MIDDLE BASIN**********
*
* TA56 IRRIGATED ACRES TO DEPLETE FLOWS ON MUD CREEK
TA56 0 25 IRRIGATED ACRES MUD CREEK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   770   770   770   770     0     0     0     0     0     0   770   770
*
* TA69 IRRIGATED ACRES TO DEPLETE FLOWS ON HORSETHIEF CREEK
TA69 0 25 IRRIGATED ACRES HORSETHIEF CK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29  1732  1732  1732  1732     0     0     0     0     0     0  1732  1732
*
* TA70 IRRIGATED ACRES TO DEPLETE FLOWS ON CURRENT CREEK
TA70 0 25 IRRIGATED ACRES CURRENT CREEK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   511   511   511   511     0     0     0     0     0     0   511   511
*
* TA71 IRRIGATED ACRES TO DEPLETE FLOWS ON AMERICAN FORK
TA71 0 25 IRRIGATED ACRES AMERICAN FORK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 11565 11565 11565 11565  5782     0     0     0     0     0 11565 11565
*
* TA72 IRRIGATED ACRES TO DEPLETE FLOWS ON BIG COULEE CREEK
TA72 0 25 IRRIGATED ACRES B COULEE CK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29  1348  1348  1348  1348     0     0     0     0     0     0  1348  1348
*
* TA73 IRRIGATED ACRES TO DEPLETE FLOWS ON CARLESS CK UPSTREAM CARLESS CAN
TA73 0 25 IRRIGATED ACRES CCK UP C CANAL
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29 12058 12058 12058 12058     0     0     0     0     0     0 12058 12058
*
* TA74 IRRIGATED ACRES TO DEPLETE FLOWS ON FIVE MILE CREEK
TA74 0 25 IRRIGATED ACRES FIVE MILE CK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29    70    70    70    70     0     0     0     0     0     0    70    70
*
* TA75 IRRIGATED ACRES TO DEPLETE FLOWS ON FISH CREEK
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TA75 0 25 IRRIGATED ACRES FISH CREEK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29  2106  2106  2106  2106     0     0     0     0     0     0  2106  2106
*
* TA76 IRRIGATED ACRES TO DEPLETE FLOWS ON PAINTED ROBE CREEK
TA76 0 25 IRRIGATED ACRES PAINTED ROBE CK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   904   904   904   904     0     0     0     0     0     0   904   904
*
* TA77 IRRIGATED ACRES TO DEPLETE FLOWS ON ANTELOPE CREEK
TA77 0 25 IRRIGATED ACRES ANTELOPE CREEK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29    11    11    11    11     0     0     0     0     0     0    11    11
*
* TA78 IRRIGATED ACRES TO DEPLETE FLOWS ON GOULDING CREEK
TA78 0 25 IRRIGATED ACRES GOULDING CK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   160   160   160   160     0     0     0     0     0     0   160   160
*
**********DEPLETIONS LOWER BASIN**********
*
* TA79 IRRIGATED ACRES TO DEPLETE FLOWS ON NORTH WILLOW CREEK
TA79 0 25 IRRIGATED ACRES N WILLOW CK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   506   506   506   506     0     0     0     0     0     0   506   506
*
* TA80 IRRIGATED ACRES TO DEPLETE FLOWS ON HAWK CREEK
TA80 0 25 IRRIGATED ACRES HAWK CREEK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   387   387   387   387     0     0     0     0     0     0   387   387
*
* TA81 IRRIGATED ACRES TO DEPLETE FLOWS ON FATTIG CREEK
TA81 0 25 IRRIGATED ACRES FATTIG CREEK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   165   165   165   165     0     0     0     0     0     0   165   165
*
* TA82 IRRIGATED ACRES TO DEPLETE FLOWS ON PARROTT CREEK
TA82 0 25 IRRIGATED ACRES PARROTT CREEK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   130   130   130   130     0     0     0     0     0     0   130   130
*
* TA83 IRRIGATED ACRES TO DEPLETE FLOWS ON WILLOW CREEK
TA83 0 25 IRRIGATED ACRES WILLOW CREEK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29  4260  4260  4260  4260     0     0     0     0     0     0  4260  4260
*
* TA84 IRRIGATED ACRES TO DEPLETE FLOWS ON HALFBREED CREEK
TA84 0 25 IRRIGATED ACRES HALFBREED CREEK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29   168   168   168   168     0     0     0     0     0     0   168   168
*
* TA86 IRRIGATED ACRES TO DEPLETE FLOWS ON MCLEAN CREEK
TA86 0 25 IRRIGATED ACRES MCLEAN CREEK
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29    21    21    21    21     0     0     0     0     0     0    21    21
*
**********LAWN GRASS ACRES**********
*
* TA90 IRRIGATED ACRES HARLOWTON GOLF COURSE
TA90 0 25 IRRIGATED ACRES HARLOW GOLF
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29     0     0     0     0     0     0     0     0     0     0     0     0
80    40    40    40    40    40    40    40    40    40    40    40    40
*
* TA91 IRRIGATED ACRES ROUNDUP GOLF COURSE
TA91 0 25 IRRIGATED ACRES ROUNDUP GOLF
*   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
29     0     0     0     0     0     0     0     0     0     0     0     0
80    60    60    60    60    60    60    60    60    60    60    60    60
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*
**********DEPLETE FLOWS FLAT WILLOW**********
*
TW01 0 52 DEPLETE FLOWS FLAT WILLOW
* Station 400, Depletions Flat Willow Creek at mouth
*     Jan    Feb    Mar    Apr    May    Jun    Jul    Aug    Sep    Oct    Nov    Dec
29   1.31   1.96  15.87  11.55   9.43   7.96   1.35   0.00   0.00   0.00   0.00   0.98
30   1.43  11.55  11.02  11.47   5.51   0.08   0.57   1.39   0.04   0.04   0.00   0.00
31   0.33   1.51   0.73   0.08   0.00   0.90   0.00   0.61   0.00   0.00   0.00   0.00
32   0.00   0.00   0.00   0.53   0.78  16.77   4.41   2.53   1.35   0.12   0.61   0.12
33   0.57   0.86   9.02   6.45  21.18  15.55   0.04   0.45   0.29   0.16   0.37   0.12
34   0.24   2.61   3.63   1.06   0.00  13.75   0.08   0.00   0.00   0.00   0.00   0.00
35   0.00   0.08   2.20   1.06   0.41   0.04   3.43   0.04   0.00   0.00   0.00   0.00
36   0.00   0.00  32.93   8.77   7.51   2.37   0.00   0.00   0.00   0.00   0.00   0.00
37   0.00   0.00   4.57   2.94   1.55  14.40   2.86   0.00   0.00   0.69   0.00   0.20
38   1.14   7.92   7.88   2.16  11.22  32.15  22.28   1.47   0.33   0.90   2.04   0.98
39   0.90   1.92  17.26   4.08   3.02  11.02   1.31   0.00   0.00   0.00   0.00   0.00
40   0.00   0.53   4.08   1.14   0.37   0.69   0.00   0.00   0.00   0.00   0.00   0.00
41   0.00   0.24   1.26   0.12   0.37   7.83   0.78   0.04   3.18   1.67   1.10   1.63
42   1.88   3.26  17.14   6.16  36.36  63.25   8.57   4.00   1.59   1.92   2.86   1.63
43   0.94  26.93  21.06  21.83  23.50  55.50   7.79   1.39   0.57   0.86   2.20   1.39
44   0.98   1.80   2.77   2.33   2.65  59.98  19.06   3.47   0.73   1.02   1.92   1.47
45   1.35   4.57  10.04   2.33   1.67  14.36   2.20   0.37   0.08   0.08   1.14   0.57
46   0.86   4.00   7.88   4.20   2.00   5.35   3.63   0.24   0.49   0.90   0.90   1.67
47   1.31   2.90  25.63  12.85  17.83  11.18   1.84   0.73   0.24   0.45   0.82   1.47
48   1.10   2.29   5.79   5.84  15.18  48.15  26.03   2.33   0.45   0.45   1.43   0.94
49   0.49   1.10  29.99  14.24  14.81   7.79   2.00   0.12   0.37   0.24   0.82   0.37
50   0.20   1.43  15.42  10.85  17.42  23.46   7.06   1.84   1.14   0.90   1.47   3.06
51   1.96   3.14  17.34  11.14  11.63  10.57   1.51   1.43   3.26   2.41   3.26   1.63
52   1.14   3.18  17.83  20.97  27.18   8.20   3.02   0.73   0.65   0.24   0.61   0.61
53   0.73   1.35   3.31   0.86   5.55  30.77   1.59   0.78   0.20   0.04   0.24   0.49
54   0.20   2.73   2.00   1.71   3.22   1.35   0.04   3.47   0.24   0.16   0.61   0.20
55   0.12   0.37   1.06   7.92   2.24   1.92   0.86   0.12   0.08   0.04   0.16   0.49
56   0.45   0.65  10.98   3.18  10.12   6.94   0.98   0.86   0.33   0.04   0.61   0.41
57   0.24   1.10   2.90   1.10   7.14  18.73   4.82   0.24   1.71   1.26   2.57   1.06
58   1.14   2.45   4.49   2.33   1.67   3.31   1.96   0.41   0.69   0.53   0.98   0.53
59   0.41   1.02  49.37   4.00   3.02   8.85   2.45   0.61   0.82   0.69   0.86   0.82
60   0.49   1.84  13.34   2.65   2.37   1.02   0.37   0.53   0.16   0.12   0.45   0.33
61   0.20   0.82   0.53   0.49   0.33   0.20   0.00   0.00   0.20   0.00   0.29   0.08
62   0.04   0.69   3.59   0.98  21.50  30.24   7.47   0.90   0.82   0.65   1.35   0.86
63   0.24   9.47   5.14   1.80   5.26  11.02   1.80   0.98   0.86   0.33   0.73   0.37
64   0.24   0.69  -0.25   0.31  22.45  47.47  12.59   2.20   1.19   1.26   1.25   0.99
65   1.36   8.77   7.13  22.22  22.79   5.89   3.74   1.11  -0.51  -0.22   0.21   0.36
66   0.14  -0.19  11.10   2.64  -0.11  -0.14  -0.32   0.68  -0.19   0.82   0.69   0.57
67   0.61   1.59   4.04   2.69  11.71  93.85  18.85   2.49   2.04   1.63   2.20   1.02
68   1.10   5.18  12.40   6.77   8.57  40.48   8.37   3.67   2.08   1.39   3.47   2.00
69   1.43   3.14  29.18  17.10   5.71   7.43  13.67   1.14   1.26   1.26   1.43   0.86
70   0.45   2.45   6.86   3.59  67.74  30.56   3.51   1.39   1.67   1.18   1.51   1.02
71   0.78  40.32  18.53  11.38  12.73   5.10   2.12   0.73   2.24   1.22   1.59   0.69
72   0.78   9.30  40.76   4.77  10.00   8.94   1.71   3.55   1.67   1.22   1.31   0.45
73   0.53   1.92   3.47   5.96   8.81   2.61   0.78   0.20   0.57   0.57   1.18   0.78
74   2.04   2.77   3.26   2.16   6.61  12.40   1.88   1.71   1.84   0.94   1.75   0.98
75   0.61   1.75   6.49  26.61  91.40  64.88  37.05   6.00   3.22   3.71   4.69   3.10
76   3.63   7.35  10.08   6.53  40.48  13.87   4.12   2.08   2.00   1.26   2.24   2.37
77   1.39   4.86   4.98   2.94   3.02   1.31   0.41   0.24   0.82   0.69   0.69   0.94
78   0.73   1.71 135.1  27.50  63.66  27.87  26.07   3.75   8.37   3.59   4.57   3.43
79   2.29   4.86 129.8  40.07  36.93  22.48   5.26   2.94   1.84   1.47   2.69   1.92
80   1.22   3.67  10.73   4.94   4.53  18.36   2.82   2.20   1.10   1.88   2.45   0.69
81   1.67   4.77   4.08   1.18  57.13  33.26   5.06   2.77   1.14   1.10   2.16   1.26
82   0.61  13.75  11.71  10.77  14.81  47.74  15.59   3.10   3.31   3.14   2.69   1.55
83   2.57   6.32   6.37   3.35   7.22   2.77   1.10   1.35   1.26   1.31   1.51   0.49
84   4.33   4.94   4.45   2.57   2.73   3.71   0.24   0.61   1.71   0.78   0.82   0.41
85   0.20   0.16   2.77   2.08   0.41   0.53   0.00   1.10   0.20   0.49   0.41   0.33
86   1.14  13.75   8.94   2.82  20.61   4.57   1.96   1.18   8.98   2.12   1.31   0.86
87   0.49   0.45   3.26   2.08   5.55   1.26   2.37   1.10   0.45   0.73   1.18   0.49
88   0.33   0.78   2.69   0.78   6.08   0.08   0.00   0.04   0.00   0.00   0.12   0.12
89   0.12   0.24  17.63   4.24   7.39   1.92   0.08   0.04   0.37   0.53   0.82   0.53
*
**********CIR VALUES**********
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* THE CIR WERE CALCULATED BY BLANEY CRIDDLE WITH AVERAGE TEMPERATURE
* AND PRECIPITATION FOR THE 3 CLIMATE REGIONS. 1929 THROUGH 1948
* COMPLETED 6-10-94. LAWN GRASS WAS COMPLETED 12-28-94 AT END OF FILE.
* THE CROPPPING PATTERN WAS 100 % ALFALFA FOR EACH REGION
*
* CIR VALUES FOR UPPER BASIN 100 PERCENT ALFALA
TC01 0 13 CIR VALUES FOR THE UPPER MUSSELSHELL BASIN (INCHES)

*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
29	0.00	0.00	0.00	0.00	0.90	2.32	7.20	6.92	0.92	0.06	0.00	0.00
30	0.00	0.00	0.00	0.35	3.47	5.68	6.90	5.58	1.93	0.00	0.00	0.00
31	0.00	0.00	0.00	0.00	2.04	4.40	6.25	5.67	0.91	0.07	0.00	0.00
32	0.00	0.00	0.00	0.00	1.68	2.38	4.88	4.70	3.42	0.03	0.00	0.00
33	0.00	0.00	0.00	0.00	1.42	4.49	7.71	2.03	2.22	0.02	0.00	0.00
34	0.00	0.00	0.00	0.00	2.82	0.29	4.68	4.67	0.90	0.04	0.00	0.00
35	0.00	0.00	0.00	0.00	0.04	2.62	5.11	3.49	1.91	0.00	0.00	0.00
36	0.00	0.00	0.00	0.00	1.66	1.80	6.28	3.68	1.45	0.04	0.00	0.00
37	0.00	0.00	0.00	0.00	1.14	2.65	4.12	3.96	1.11	0.06	0.00	0.00
38	0.00	0.00	0.00	0.00	0.00	3.12	4.73	3.75	2.81	0.05	0.00	0.00
39	0.00	0.00	0.00	0.33	3.63	1.60	6.65	5.02	2.44	0.03	0.00	0.00
40	0.00	0.00	0.00	0.00	2.50	3.81	6.46	5.92	1.88	0.06	0.00	0.00
41	0.00	0.00	0.00	0.00	1.73	1.87	4.88	3.19	0.34	0.04	0.00	0.00
42	0.00	0.00	0.00	0.00	0.00	2.17	5.33	4.16	2.18	0.04	0.00	0.00
43	0.00	0.00	0.00	0.00	0.00	2.26	5.23	3.95	2.70	0.04	0.00	0.00
44	0.00	0.00	0.00	0.00	0.91	0.00	4.70	3.24	1.79	0.07	0.00	0.00
45	0.00	0.00	0.00	0.00	0.00	0.76	5.37	3.84	0.70	0.04	0.00	0.00
46	0.00	0.00	0.00	0.00	0.00	1.93	4.15	4.48	0.00	0.01	0.00	0.00
47	0.00	0.00	0.00	0.00	1.61	0.55	5.74	3.95	0.11	0.05	0.00	0.00
48	0.00	0.00	0.00	0.00	1.75	0.54	3.52	4.02	2.47	0.06	0.00	0.00
49	0.00	0.00	0.00	0.00	1.74	2.31	4.03	5.06	1.08	0.04	0.00	0.00
50	0.00	0.00	0.00	0.00	0.08	2.55	4.01	3.31	1.60	0.06	0.00	0.00
51	0.00	0.00	0.00	0.00	0.08	2.54	4.35	1.95	1.79	0.02	0.00	0.00
52	0.00	0.00	0.00	0.00	0.68	3.14	4.19	3.55	2.63	0.07	0.00	0.00
53	0.00	0.00	0.00	0.00	0.12	3.15	6.01	4.30	3.11	0.08	0.00	0.00
54	0.00	0.00	0.00	0.00	0.33	2.43	6.52	3.89	2.02	0.05	0.00	0.00
55	0.00	0.00	0.00	0.00	0.62	3.01	4.35	5.56	2.34	0.07	0.00	0.00
56	0.00	0.00	0.00	0.00	1.21	3.55	5.18	4.03	2.79	0.06	0.00	0.00
57	0.00	0.00	0.00	0.00	0.98	1.42	4.79	3.62	2.27	0.03	0.00	0.00
58	0.00	0.00	0.00	0.00	3.84	2.47	3.98	5.19	2.59	0.07	0.00	0.00
59	0.00	0.00	0.00	0.00	0.19	2.97	5.20	4.19	1.18	0.03	0.00	0.00
60	0.00	0.00	0.00	0.00	0.36	3.15	5.69	2.35	2.32	0.05	0.00	0.00
61	0.00	0.00	0.00	0.00	1.01	4.94	4.82	5.07	0.89	0.03	0.00	0.00
62	0.00	0.00	0.00	0.00	0.00	2.84	2.71	2.56	1.98	0.03	0.00	0.00
63	0.00	0.00	0.00	0.00	0.20	1.32	4.06	4.24	2.00	0.06	0.00	0.00
64	0.00	0.00	0.00	0.00	0.18	1.28	5.25	2.96	2.14	0.05	0.00	0.00
65	0.00	0.00	0.00	0.00	0.07	1.60	4.25	2.64	0.00	0.05	0.00	0.00
66	0.00	0.00	0.00	0.00	0.94	2.32	4.85	3.85	2.58	0.05	0.00	0.00
67	0.00	0.00	0.00	0.00	0.10	1.33	5.04	4.50	2.14	0.02	0.00	0.00
68	0.00	0.00	0.00	0.00	0.04	1.83	4.66	3.28	1.17	0.05	0.00	0.00
69	0.00	0.00	0.00	0.00	1.42	1.86	4.32	4.63	2.42	0.01	0.00	0.00
70	0.00	0.00	0.00	0.00	0.84	3.23	4.31	4.00	1.24	0.03	0.00	0.00
71	0.00	0.00	0.00	0.00	0.84	2.90	4.63	4.72	1.34	0.03	0.00	0.00
72	0.00	0.00	0.00	0.00	0.78	2.97	3.56	3.21	1.61	0.03	0.00	0.00
73	0.00	0.00	0.00	0.00	0.96	3.76	4.89	3.97	1.21	0.04	0.00	0.00
74	0.00	0.00	0.00	0.00	0.33	4.54	5.43	1.40	1.76	0.04	0.00	0.00
75	0.00	0.00	0.00	0.00	0.00	1.29	4.09	2.80	1.87	0.00	0.00	0.00
76	0.00	0.00	0.00	0.00	1.45	2.07	4.86	3.05	1.19	0.03	0.00	0.00
77	0.00	0.00	0.00	0.00	0.64	3.58	3.87	2.78	1.24	0.05	0.00	0.00
78	0.00	0.00	0.00	0.00	0.39	2.63	2.61	3.69	0.97	0.06	0.00	0.00
79	0.00	0.00	0.00	0.00	0.59	2.05	4.13	3.77	2.92	0.05	0.00	0.00
80	0.00	0.00	0.00	0.00	0.42	1.89	4.45	3.52	1.43	0.05	0.00	0.00
81	0.00	0.00	0.00	0.00	0.04	2.46	3.50	4.27	2.53	0.03	0.00	0.00
82	0.00	0.00	0.00	0.00	0.00	1.38	3.09	4.27	1.04	0.04	0.00	0.00
83	0.00	0.00	0.00	0.00	0.22	2.05	3.03	4.68	0.97	0.04	0.00	0.00
84	0.00	0.00	0.00	0.00	1.03	2.59	5.05	4.00	1.18	0.03	0.00	0.00
85	0.00	0.00	0.00	0.00	2.24	4.09	5.73	2.68	0.11	0.03	0.00	0.00
86	0.00	0.00	0.00	0.00	0.97	3.38	2.78	3.53	0.62	0.05	0.00	0.00
87	0.00	0.00	0.00	0.00	1.17	4.05	2.60	3.45	2.64	0.07	0.00	0.00
88	0.00	0.00	0.00	0.00	2.07	5.01	5.72	4.85	1.73	0.06	0.00	0.00
89	0.00	0.00	0.00	0.00	0.65	3.64	5.28	3.23	2.09	0.04	0.00	0.00

*
*CIR VALUES FOR MIDDLE BASIN 100 PERCENT ALFALFA
TC02 0 13 CIR VALUES FOR THE MIDDLE MUSSELSHELL BASIN (INCHES)

*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
29	0.00	0.00	0.00	0.00	0.00	1.68	5.56	5.17	0.94	0.04	0.00	0.00
30	0.00	0.00	0.00	0.00	0.09	3.68	4.60	4.52	1.49	0.00	0.00	0.00
31	0.00	0.00	0.00	0.00	1.90	4.40	5.17	5.24	2.02	0.06	0.00	0.00
32	0.00	0.00	0.00	0.00	0.28	2.62	4.85	3.94	2.47	0.01	0.00	0.00
33	0.00	0.00	0.00	0.00	1.78	4.80	7.83	3.32	2.34	0.04	0.00	0.00
34	0.00	0.00	0.00	0.00	2.95	2.30	5.42	4.03	1.28	0.04	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00	2.32	4.84	4.05	2.24	0.04	0.00	0.00
36	0.00	0.00	0.00	0.00	3.55	3.21	7.18	3.87	2.14	0.06	0.00	0.00
37	0.00	0.00	0.00	0.00	2.75	3.35	3.72	4.30	1.60	0.07	0.00	0.00
38	0.00	0.00	0.00	0.00	0.43	2.61	4.20	4.31	3.20	0.03	0.00	0.00
39	0.00	0.00	0.00	0.00	2.98	0.64	5.13	4.65	2.20	0.03	0.00	0.00
40	0.00	0.00	0.00	0.00	2.88	3.84	4.81	5.22	2.14	0.03	0.00	0.00
41	0.00	0.00	0.00	0.00	2.47	0.83	6.41	3.18	0.17	0.02	0.00	0.00
42	0.00	0.00	0.00	0.00	0.33	2.51	4.78	3.96	1.38	0.05	0.00	0.00
43	0.00	0.00	0.00	0.00	0.49	3.32	4.20	3.91	2.43	0.05	0.00	0.00
44	0.00	0.00	0.00	0.47	3.48	0.00	6.06	4.04	2.34	0.09	0.00	0.00
45	0.00	0.00	0.00	0.00	1.62	2.59	7.02	6.16	1.83	0.05	0.00	0.00
46	0.00	0.00	0.00	0.00	0.61	2.07	5.29	4.54	0.99	0.01	0.00	0.00
47	0.00	0.00	0.00	0.00	2.04	2.79	6.78	4.42	1.07	0.06	0.00	0.00
48	0.00	0.00	0.00	0.00	0.00	1.08	2.84	4.78	3.41	0.10	0.00	0.00
49	0.00	0.00	0.00	0.41	2.08	3.01	5.38	5.22	2.31	0.04	0.00	0.00
50	0.00	0.00	0.00	0.00	1.09	3.06	4.64	4.41	1.50	0.06	0.00	0.00
51	0.00	0.00	0.00	0.00	1.76	2.84	5.41	3.35	1.70	0.02	0.00	0.00
52	0.00	0.00	0.00	0.49	1.66	3.79	5.46	5.05	2.98	0.07	0.00	0.00
53	0.00	0.00	0.00	0.00	0.48	3.02	6.84	4.43	2.99	0.07	0.00	0.00
54	0.00	0.00	0.00	0.00	1.70	2.28	7.69	4.49	2.39	0.06	0.00	0.00
55	0.00	0.00	0.00	0.00	1.22	2.32	6.00	6.41	2.55	0.07	0.00	0.00
56	0.00	0.00	0.00	0.00	1.69	5.24	6.28	4.05	3.02	0.07	0.00	0.00
57	0.00	0.00	0.00	0.00	1.46	2.02	6.46	5.01	2.50	0.04	0.00	0.00
58	0.00	0.00	0.00	0.16	4.26	1.80	3.94	6.20	3.00	0.08	0.00	0.00
59	0.00	0.00	0.00	0.00	0.71	4.11	6.11	5.31	1.18	0.04	0.00	0.00
60	0.00	0.00	0.00	0.00	1.57	4.29	6.90	3.70	2.79	0.07	0.00	0.00
61	0.00	0.00	0.00	0.00	2.29	5.77	6.35	5.68	0.79	0.03	0.00	0.00
62	0.00	0.00	0.00	0.00	1.03	2.92	4.19	4.07	2.56	0.06	0.00	0.00
63	0.00	0.00	0.00	0.00	1.46	3.28	6.25	5.83	3.00	0.09	0.00	0.00
64	0.00	0.00	0.00	0.00	1.49	1.45	6.93	3.54	2.68	0.07	0.00	0.00
65	0.00	0.00	0.00	0.00	1.08	1.81	5.48	3.59	0.00	0.05	0.00	0.00
66	0.00	0.00	0.00	0.00	2.06	3.88	6.36	4.52	2.92	0.06	0.00	0.00
67	0.00	0.00	0.00	0.00	0.64	0.24	5.69	5.52	2.50	0.06	0.00	0.00
68	0.00	0.00	0.00	0.00	0.57	1.49	5.21	3.67	2.15	0.06	0.00	0.00
69	0.00	0.00	0.00	0.35	3.12	1.63	5.20	5.75	3.10	0.04	0.00	0.00
70	0.00	0.00	0.00	0.00	0.82	4.66	6.10	6.01	1.07	0.04	0.00	0.00
71	0.00	0.00	0.00	0.00	1.82	3.30	5.63	5.51	1.88	0.03	0.00	0.00
72	0.00	0.00	0.00	0.00	1.44	4.39	3.87	3.75	1.52	0.04	0.00	0.00
73	0.00	0.00	0.00	0.00	1.90	3.81	5.91	4.63	1.41	0.04	0.00	0.00
74	0.00	0.00	0.00	0.00	0.69	5.03	5.76	2.20	1.80	0.05	0.00	0.00
75	0.00	0.00	0.00	0.00	0.61	1.81	5.49	4.16	2.61	0.02	0.00	0.00
76	0.00	0.00	0.00	0.00	2.78	2.54	6.32	4.80	2.24	0.06	0.00	0.00
77	0.00	0.00	0.00	0.00	2.44	4.64	4.95	2.91	1.47	0.06	0.00	0.00
78	0.00	0.00	0.00	0.00	0.91	3.63	4.16	4.31	1.22	0.06	0.00	0.00
79	0.00	0.00	0.00	0.00	1.22	4.20	5.53	4.42	3.62	0.07	0.00	0.00
80	0.00	0.00	0.00	0.34	1.60	3.27	6.25	3.92	2.27	0.04	0.00	0.00
81	0.00	0.00	0.00	0.00	0.00	3.29	4.49	5.36	3.12	0.05	0.00	0.00
82	0.00	0.00	0.00	0.00	0.75	1.62	4.42	5.16	1.57	0.05	0.00	0.00
83	0.00	0.00	0.00	0.00	1.32	3.32	5.39	5.89	1.40	0.04	0.00	0.00
84	0.00	0.00	0.00	0.00	2.17	3.88	6.47	5.35	1.49	0.04	0.00	0.00
85	0.00	0.00	0.00	0.36	3.00	4.56	6.42	2.44	1.32	0.04	0.00	0.00
86	0.00	0.00	0.00	0.00	1.66	4.09	3.69	4.36	0.59	0.06	0.00	0.00
87	0.00	0.00	0.00	0.50	2.03	4.31	3.10	3.15	2.92	0.07	0.00	0.00
88	0.00	0.00	0.00	0.21	2.38	6.84	6.90	5.54	2.09	0.07	0.00	0.00
89	0.00	0.00	0.00	0.00	1.26	3.67	6.35	3.24	2.59	0.04	0.00	0.00

*
*CIR VALUES FOR LOWER BASIN 100 PERCENT ALFALFA
TC03 0 13 CIR VALUES FOR THE LOWER MUSSELSHELL BASIN (INCHES)

*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

29	0.00	0.00	0.00	0.00	2.08	4.32	7.74	7.01	1.77	0.06	0.00	0.00
30	0.00	0.00	0.00	0.29	3.60	5.69	8.60	6.35	2.78	0.04	0.00	0.00
31	0.00	0.00	0.00	0.43	4.03	6.73	7.19	6.07	3.20	0.08	0.00	0.00
32	0.00	0.00	0.00	0.25	3.48	3.38	7.38	5.51	3.27	0.03	0.00	0.00
33	0.00	0.00	0.00	0.00	1.83	6.62	8.32	4.75	3.35	0.05	0.00	0.00
34	0.00	0.00	0.00	0.59	5.92	4.33	6.69	5.86	2.14	0.08	0.00	0.00
35	0.00	0.00	0.00	0.00	1.55	4.70	7.10	5.63	2.99	0.05	0.00	0.00
36	0.00	0.00	0.00	0.45	5.25	6.69	9.37	6.60	3.37	0.08	0.00	0.00
37	0.00	0.00	0.00	0.45	4.94	4.36	7.92	6.86	2.75	0.05	0.00	0.00
38	0.00	0.00	0.00	0.28	1.62	2.62	6.82	5.48	4.46	0.07	0.00	0.00
39	0.00	0.00	0.00	0.48	2.28	1.38	7.91	5.76	3.61	0.07	0.00	0.00
40	0.00	0.00	0.00	0.20	4.36	3.86	7.86	7.24	4.39	0.07	0.00	0.00
41	0.00	0.00	0.00	0.37	4.00	3.76	6.44	5.28	0.00	0.06	0.00	0.00
42	0.00	0.00	0.00	0.28	0.21	2.05	4.23	5.56	2.33	0.07	0.00	0.00
43	0.00	0.00	0.00	0.37	2.90	2.21	6.95	4.71	3.24	0.04	0.00	0.00
44	0.00	0.00	0.00	0.48	3.89	1.25	5.76	4.61	3.31	0.09	0.00	0.00
45	0.00	0.00	0.00	0.00	1.07	2.23	6.62	6.00	2.19	0.05	0.00	0.00
46	0.00	0.00	0.00	0.45	2.84	4.24	6.61	6.39	1.33	0.03	0.00	0.00
47	0.00	0.00	0.00	0.00	3.72	2.59	8.88	5.68	2.39	0.09	0.00	0.00
48	0.00	0.00	0.00	0.45	2.71	3.95	5.91	5.69	4.07	0.09	0.00	0.00
49	0.00	0.00	0.00	0.56	4.15	4.45	6.59	7.03	2.74	0.05	0.00	0.00
50	0.00	0.00	0.00	0.00	1.98	3.34	5.58	5.60	2.22	0.08	0.00	0.00
51	0.00	0.00	0.00	0.00	2.77	3.19	7.32	4.42	2.40	0.05	0.00	0.00
52	0.00	0.00	0.00	0.56	2.60	5.75	6.89	5.91	3.57	0.09	0.00	0.00
53	0.00	0.00	0.00	0.00	0.94	3.43	7.47	5.92	4.07	0.09	0.00	0.00
54	0.00	0.00	0.00	0.00	2.24	3.15	8.65	4.77	2.86	0.06	0.00	0.00
55	0.00	0.00	0.00	0.00	1.54	4.45	5.69	7.19	3.00	0.07	0.00	0.00
56	0.00	0.00	0.00	0.00	2.36	6.05	6.98	3.87	3.54	0.08	0.00	0.00
57	0.00	0.00	0.00	0.00	2.66	2.99	8.09	4.93	2.73	0.05	0.00	0.00
58	0.00	0.00	0.00	0.47	5.39	2.66	4.39	6.95	3.52	0.07	0.00	0.00
59	0.00	0.00	0.00	0.00	1.53	5.04	7.07	5.81	1.87	0.06	0.00	0.00
60	0.00	0.00	0.00	0.00	3.05	5.07	8.01	5.25	3.54	0.09	0.00	0.00
61	0.00	0.00	0.00	0.07	3.85	7.47	7.81	7.63	0.74	0.05	0.00	0.00
62	0.00	0.00	0.00	0.47	0.99	4.67	4.59	4.80	2.70	0.06	0.00	0.00
63	0.00	0.00	0.00	0.00	2.19	4.02	6.70	5.77	2.96	0.09	0.00	0.00
64	0.00	0.00	0.00	0.19	2.08	2.52	7.19	3.54	3.17	0.08	0.00	0.00
65	0.00	0.00	0.00	0.00	2.55	3.91	5.21	4.94	0.52	0.07	0.00	0.00
66	0.00	0.00	0.00	0.08	3.67	5.34	7.63	5.83	4.32	0.08	0.00	0.00
67	0.00	0.00	0.00	0.00	1.80	1.39	7.76	6.51	2.82	0.08	0.00	0.00
68	0.00	0.00	0.00	0.00	1.55	0.92	6.32	3.94	2.59	0.07	0.00	0.00
69	0.00	0.00	0.00	0.39	3.60	2.26	5.30	6.74	3.73	0.05	0.00	0.00
70	0.00	0.00	0.00	0.00	2.18	4.84	7.56	7.15	2.00	0.05	0.00	0.00
71	0.00	0.00	0.00	0.36	3.50	5.25	7.41	7.13	2.67	0.03	0.00	0.00
72	0.00	0.00	0.00	0.28	2.22	6.12	5.74	4.78	2.24	0.04	0.00	0.00
73	0.00	0.00	0.00	0.00	2.78	4.13	7.32	6.02	1.94	0.05	0.00	0.00
74	0.00	0.00	0.00	0.31	1.07	5.71	7.75	3.24	2.11	0.06	0.00	0.00
75	0.00	0.00	0.00	0.00	1.05	3.46	6.00	5.37	3.29	0.02	0.00	0.00
76	0.00	0.00	0.00	0.32	3.90	3.18	7.32	6.38	3.07	0.06	0.00	0.00
77	0.00	0.00	0.00	0.54	2.72	6.04	7.38	4.16	1.83	0.07	0.00	0.00
78	0.00	0.00	0.00	0.27	0.05	4.77	5.78	5.10	0.61	0.09	0.00	0.00
79	0.00	0.00	0.00	0.00	1.89	5.28	7.04	5.67	4.10	0.09	0.00	0.00
80	0.00	0.00	0.00	0.55	3.31	4.92	7.65	4.17	3.03	0.05	0.00	0.00
81	0.00	0.00	0.00	0.49	0.44	3.68	6.05	6.34	3.36	0.06	0.00	0.00
82	0.00	0.00	0.00	0.00	1.45	3.09	6.36	6.30	2.13	0.05	0.00	0.00
83	0.00	0.00	0.00	0.00	2.22	5.34	7.16	7.15	2.02	0.05	0.00	0.00
84	0.00	0.00	0.00	0.29	3.30	4.86	8.45	7.11	1.47	0.06	0.00	0.00
85	0.00	0.00	0.00	0.57	4.01	5.56	7.28	3.69	2.01	0.06	0.00	0.00
86	0.00	0.00	0.00	0.00	2.14	4.96	4.72	5.72	0.38	0.06	0.00	0.00
87	0.00	0.00	0.00	0.56	1.41	5.50	3.84	4.25	3.57	0.09	0.00	0.00
88	0.00	0.00	0.00	0.47	3.23	8.15	8.29	6.71	2.02	0.07	0.00	0.00
89	0.00	0.00	0.00	0.05	2.26	4.33	7.81	5.47	3.18	0.06	0.00	0.00

*

*CIR VALUES FOR LOWER BASIN LAWN GRASS

TC10 0 13 CIR VALUES FOR THE LOWER MUSSELSHELL BASIN LG (INCHES)

*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
29	0.00	0.00	0.00	0.63	2.09	3.33	6.37	5.95	1.45	0.73	0.00	0.00
30	0.00	0.00	0.00	0.53	2.93	4.53	7.01	5.28	2.37	0.29	0.00	0.00
31	0.00	0.00	0.00	0.92	3.29	5.38	5.89	5.10	2.76	0.84	0.00	0.00
32	0.00	0.00	0.00	0.57	2.79	2.34	6.03	4.58	2.86	0.10	0.00	0.00

33	0.00	0.00	0.00	0.37	1.19	5.21	6.83	3.89	2.94	0.49	0.00	0.00
34	0.00	0.00	0.00	1.27	4.89	3.27	5.38	4.96	1.80	0.94	0.00	0.00
35	0.00	0.00	0.00	0.50	1.60	3.69	5.78	4.74	2.58	0.44	0.00	0.00
36	0.00	0.00	0.00	0.88	4.28	5.32	7.66	5.56	2.88	0.85	0.00	0.00
37	0.00	0.00	0.00	0.94	4.07	3.30	6.51	5.83	2.32	0.38	0.00	0.00
38	0.00	0.00	0.00	1.06	1.04	1.64	5.56	4.57	3.91	0.61	0.00	0.00
39	0.00	0.00	0.00	1.04	1.56	0.60	6.49	4.83	3.16	0.65	0.00	0.00
40	0.00	0.00	0.00	0.55	3.57	2.80	6.45	6.15	3.83	0.61	0.00	0.00
41	0.00	0.00	0.00	0.69	3.19	2.73	5.16	4.36	0.00	0.59	0.00	0.00
42	0.00	0.00	0.00	0.78	0.00	1.26	3.18	4.67	1.96	0.69	0.00	0.00
43	0.00	0.00	0.00	0.82	2.32	1.37	5.68	3.84	2.85	0.33	0.00	0.00
44	0.00	0.00	0.00	1.04	3.10	0.47	4.64	3.80	2.87	1.04	0.00	0.00
45	0.00	0.00	0.00	0.56	1.34	1.46	5.42	5.08	1.87	0.54	0.00	0.00
46	0.00	0.00	0.00	1.05	2.23	3.20	5.31	5.43	0.97	0.14	0.00	0.00
47	0.00	0.00	0.00	0.75	3.11	1.71	7.37	4.71	1.99	0.98	0.00	0.00
48	0.00	0.00	0.00	0.97	2.00	2.92	4.74	4.76	3.57	0.99	0.00	0.00
49	0.00	0.00	0.00	1.29	3.34	3.40	5.34	5.95	2.33	0.47	0.00	0.00
50	0.00	0.00	0.00	0.56	1.89	2.43	4.49	4.69	1.84	0.91	0.00	0.00
51	0.00	0.00	0.00	0.78	2.23	2.38	6.00	3.59	2.05	0.40	0.00	0.00
52	0.00	0.00	0.00	1.31	1.91	4.56	5.66	4.94	3.08	0.99	0.00	0.00
53	0.00	0.00	0.00	0.39	0.34	2.47	6.14	4.95	3.56	0.89	0.00	0.00
54	0.00	0.00	0.00	0.55	1.95	2.26	7.17	3.91	2.44	0.59	0.00	0.00
55	0.00	0.00	0.00	0.55	0.95	3.44	4.51	6.11	2.60	0.81	0.00	0.00
56	0.00	0.00	0.00	0.80	1.70	4.76	5.71	3.07	3.10	0.82	0.00	0.00
57	0.00	0.00	0.00	0.57	1.97	2.06	6.67	4.02	2.33	0.47	0.00	0.00
58	0.00	0.00	0.00	0.94	4.45	1.79	3.39	5.90	3.07	0.74	0.00	0.00
59	0.00	0.00	0.00	0.44	1.41	3.91	5.79	4.87	1.50	0.59	0.00	0.00
60	0.00	0.00	0.00	0.67	2.39	3.96	6.56	4.36	3.09	0.98	0.00	0.00
61	0.00	0.00	0.00	0.54	3.11	6.01	6.41	6.47	0.45	0.59	0.00	0.00
62	0.00	0.00	0.00	1.10	0.43	3.60	3.56	3.95	2.32	0.65	0.00	0.00
63	0.00	0.00	0.00	0.27	1.84	3.03	5.49	4.86	2.49	1.06	0.00	0.00
64	0.00	0.00	0.00	0.32	1.43	1.61	5.85	2.76	2.79	0.98	0.00	0.00
65	0.00	0.00	0.00	0.33	1.93	2.91	4.06	4.05	0.29	0.97	0.00	0.00
66	0.00	0.00	0.00	0.71	2.92	4.24	6.21	4.89	3.79	0.82	0.00	0.00
67	0.00	0.00	0.00	0.60	1.40	0.59	6.40	5.49	2.36	0.77	0.00	0.00
68	0.00	0.00	0.00	0.70	1.09	0.13	5.12	3.15	2.18	0.73	0.00	0.00
69	0.00	0.00	0.00	0.80	2.88	1.39	4.18	5.70	3.25	0.30	0.00	0.00
70	0.00	0.00	0.00	0.26	1.51	3.68	6.20	6.06	1.63	0.49	0.00	0.00
71	0.00	0.00	0.00	0.71	2.78	4.13	6.14	5.98	2.28	0.21	0.00	0.00
72	0.00	0.00	0.00	0.70	1.57	4.85	4.64	3.86	1.91	0.33	0.00	0.00
73	0.00	0.00	0.00	0.12	2.16	3.06	6.02	5.01	1.55	0.48	0.00	0.00
74	0.00	0.00	0.00	0.62	0.54	4.49	6.38	2.52	1.74	0.58	0.00	0.00
75	0.00	0.00	0.00	0.35	0.50	2.54	4.77	4.50	2.87	0.00	0.00	0.00
76	0.00	0.00	0.00	0.53	3.11	2.24	5.96	5.37	2.61	0.55	0.00	0.00
77	0.00	0.00	0.00	1.26	2.01	4.77	6.07	3.38	1.45	0.76	0.00	0.00
78	0.00	0.00	0.00	0.68	0.00	3.68	4.63	4.24	0.23	0.95	0.00	0.00
79	0.00	0.00	0.00	0.54	1.53	4.14	5.76	4.73	3.58	0.94	0.00	0.00
80	0.00	0.00	0.00	1.23	2.53	3.78	6.27	3.38	2.59	0.36	0.00	0.00
81	0.00	0.00	0.00	1.12	0.00	2.73	4.84	5.33	2.88	0.56	0.00	0.00
82	0.00	0.00	0.00	0.49	0.93	2.15	5.18	5.28	1.76	0.38	0.00	0.00
83	0.00	0.00	0.00	0.79	1.73	4.23	5.84	6.01	1.66	0.54	0.00	0.00
84	0.00	0.00	0.00	0.74	2.61	3.77	7.01	6.00	1.14	0.65	0.00	0.00
85	0.00	0.00	0.00	1.29	3.17	4.42	5.90	2.91	1.71	0.68	0.00	0.00
86	0.00	0.00	0.00	0.94	1.53	3.76	3.67	4.79	0.09	0.71	0.00	0.00
87	0.00	0.00	0.00	1.27	0.72	4.29	2.83	3.47	3.11	0.95	0.00	0.00
88	0.00	0.00	0.00	0.99	2.45	6.53	6.84	5.69	1.63	0.79	0.00	0.00
89	0.00	0.00	0.00	0.26	1.63	3.31	6.41	4.57	2.77	0.60	0.00	0.00

*CIR VALUES FOR MIDDLE BASIN LAWN GRASS

TC11 0 13 CIR VALUES FOR THE MIDDLE MUSSELSHELL BASIN LG (INCHES)

*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
29	0.00	0.00	0.00	0.36	1.52	1.93	5.54	4.89	0.77	0.54	0.00	0.00
30	0.00	0.00	0.00	0.78	1.97	3.60	4.57	4.26	1.25	0.00	0.00	0.00
31	0.00	0.00	0.00	0.90	2.44	4.29	5.14	4.96	1.73	0.69	0.00	0.00
32	0.00	0.00	0.00	0.61	2.28	2.54	4.82	3.71	2.22	0.00	0.00	0.00
33	0.00	0.00	0.00	0.23	2.39	4.67	7.79	3.07	2.05	0.29	0.00	0.00
34	0.00	0.00	0.00	1.01	3.56	2.23	5.39	3.80	1.10	0.50	0.00	0.00
35	0.00	0.00	0.00	0.22	1.01	2.79	4.82	3.83	1.98	0.30	0.00	0.00
36	0.00	0.00	0.00	0.60	3.72	3.11	7.14	3.63	1.87	0.61	0.00	0.00
37	0.00	0.00	0.00	0.67	3.52	3.25	3.69	4.06	1.30	0.82	0.00	0.00

38	0.00	0.00	0.00	0.92	0.20	2.51	4.18	4.07	2.85	0.13	0.00	0.00
39	0.00	0.00	0.00	1.08	3.24	0.57	5.10	4.40	1.92	0.11	0.00	0.00
40	0.00	0.00	0.00	0.31	3.57	3.73	4.78	4.94	1.81	0.17	0.00	0.00
41	0.00	0.00	0.00	0.72	2.64	0.75	6.38	2.94	0.00	0.14	0.00	0.00
42	0.00	0.00	0.00	0.73	0.33	2.43	4.76	3.72	1.13	0.56	0.00	0.00
43	0.00	0.00	0.00	0.67	1.18	3.23	4.18	3.67	2.15	0.54	0.00	0.00
44	0.00	0.00	0.00	1.24	3.56	0.00	6.03	3.77	2.02	1.03	0.00	0.00
45	0.00	0.00	0.00	0.83	2.10	2.50	6.98	5.83	1.56	0.55	0.00	0.00
46	0.00	0.00	0.00	1.17	1.23	1.98	5.26	4.29	0.72	0.00	0.00	0.00
47	0.00	0.00	0.00	0.86	2.78	2.70	6.75	4.16	0.81	0.75	0.00	0.00
48	0.00	0.00	0.00	0.39	0.41	1.02	2.82	4.53	3.03	1.15	0.00	0.00
49	0.00	0.00	0.00	1.11	2.14	2.91	5.35	4.92	2.01	0.38	0.00	0.00
50	0.00	0.00	0.00	0.48	2.28	2.97	4.62	4.15	1.25	0.67	0.00	0.00
51	0.00	0.00	0.00	0.64	2.43	2.76	5.39	3.12	1.46	0.01	0.00	0.00
52	0.00	0.00	0.00	1.37	1.73	3.68	5.43	4.76	2.64	0.73	0.00	0.00
53	0.00	0.00	0.00	0.45	0.99	2.93	6.81	4.16	2.66	0.78	0.00	0.00
54	0.00	0.00	0.00	0.48	2.72	2.20	7.65	4.23	2.09	0.58	0.00	0.00
55	0.00	0.00	0.00	0.44	1.56	2.23	5.97	6.08	2.25	0.80	0.00	0.00
56	0.00	0.00	0.00	0.59	1.82	5.11	6.25	3.79	2.68	0.73	0.00	0.00
57	0.00	0.00	0.00	0.37	1.61	1.92	6.43	4.72	2.19	0.27	0.00	0.00
58	0.00	0.00	0.00	0.92	4.35	1.71	3.92	5.87	2.68	0.88	0.00	0.00
59	0.00	0.00	0.00	0.44	0.98	3.99	6.08	5.03	0.93	0.35	0.00	0.00
60	0.00	0.00	0.00	0.52	1.97	4.18	6.87	3.45	2.48	0.81	0.00	0.00
61	0.00	0.00	0.00	0.55	2.52	5.63	6.32	5.35	0.58	0.32	0.00	0.00
62	0.00	0.00	0.00	1.24	1.03	2.82	4.17	3.81	2.28	0.70	0.00	0.00
63	0.00	0.00	0.00	0.70	1.61	3.18	6.22	5.53	2.62	0.94	0.00	0.00
64	0.00	0.00	0.00	0.63	1.74	1.36	6.90	3.30	2.41	0.79	0.00	0.00
65	0.00	0.00	0.00	0.39	2.08	1.72	5.45	3.35	0.00	0.70	0.00	0.00
66	0.00	0.00	0.00	0.56	2.55	3.78	6.33	4.27	2.57	0.58	0.00	0.00
67	0.00	0.00	0.00	0.46	1.08	0.16	5.66	5.22	2.17	0.57	0.00	0.00
68	0.00	0.00	0.00	0.61	0.87	1.40	5.18	3.44	1.86	0.59	0.00	0.00
69	0.00	0.00	0.00	1.18	3.18	1.54	5.17	5.44	2.76	0.19	0.00	0.00
70	0.00	0.00	0.00	0.31	0.76	4.55	6.07	5.70	0.84	0.44	0.00	0.00
71	0.00	0.00	0.00	0.63	2.32	3.20	5.61	5.18	1.63	0.23	0.00	0.00
72	0.00	0.00	0.00	0.70	1.84	4.28	3.84	3.49	1.29	0.33	0.00	0.00
73	0.00	0.00	0.00	0.32	2.71	3.70	5.88	4.35	1.15	0.43	0.00	0.00
74	0.00	0.00	0.00	0.94	0.85	4.91	5.73	2.00	1.53	0.54	0.00	0.00
75	0.00	0.00	0.00	0.23	1.07	1.73	5.46	3.92	2.32	0.00	0.00	0.00
76	0.00	0.00	0.00	0.33	3.09	2.45	6.29	4.53	1.93	0.56	0.00	0.00
77	0.00	0.00	0.00	1.16	2.50	4.52	4.92	2.69	1.20	0.61	0.00	0.00
78	0.00	0.00	0.00	0.56	1.02	3.53	4.14	4.06	0.93	0.69	0.00	0.00
79	0.00	0.00	0.00	0.60	1.90	4.09	5.50	4.15	3.25	0.79	0.00	0.00
80	0.00	0.00	0.00	1.16	1.66	3.17	6.22	3.68	1.98	0.38	0.00	0.00
81	0.00	0.00	0.00	0.87	0.00	3.20	4.47	5.07	2.79	0.42	0.00	0.00
82	0.00	0.00	0.00	0.31	1.15	1.53	4.39	4.87	1.31	0.44	0.00	0.00
83	0.00	0.00	0.00	0.66	2.20	3.22	5.36	5.56	1.14	0.38	0.00	0.00
84	0.00	0.00	0.00	0.70	2.86	3.78	6.44	5.04	1.27	0.42	0.00	0.00
85	0.00	0.00	0.00	1.21	3.07	4.46	6.39	2.22	1.11	0.45	0.00	0.00
86	0.00	0.00	0.00	0.54	1.96	3.97	3.67	4.09	0.38	0.66	0.00	0.00
87	0.00	0.00	0.00	1.37	2.10	4.19	3.08	2.93	2.59	0.83	0.00	0.00
88	0.00	0.00	0.00	0.83	2.45	6.68	6.86	5.25	1.81	0.79	0.00	0.00
89	0.00	0.00	0.00	0.39	1.62	3.57	6.32	3.00	2.29	0.34	0.00	0.00

*CIR VALUES FOR UPPER BASIN LAWN GRASS

TC12 0 13 CIR VALUES FOR THE UPPER MUSSELSHELL BASIN LG (INCHES)

*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
29	0.00	0.00	0.00	0.60	1.89	2.23	7.16	6.56	0.68	0.05	0.00	0.00
30	0.00	0.00	0.00	0.90	3.54	5.55	6.86	5.26	1.64	0.00	0.00	0.00
31	0.00	0.00	0.00	0.89	2.16	4.27	6.22	5.37	0.64	0.07	0.00	0.00
32	0.00	0.00	0.00	0.40	1.79	2.27	4.85	4.40	3.08	0.02	0.00	0.00
33	0.00	0.00	0.00	0.00	1.74	4.36	7.68	1.80	1.94	0.02	0.00	0.00
34	0.00	0.00	0.00	0.78	3.39	0.22	4.65	4.43	0.73	0.04	0.00	0.00
35	0.00	0.00	0.00	0.10	0.13	2.54	5.08	3.25	1.62	0.00	0.00	0.00
36	0.00	0.00	0.00	0.58	2.38	1.71	6.25	3.45	1.22	0.04	0.00	0.00
37	0.00	0.00	0.00	0.40	2.90	2.57	4.10	3.73	0.86	0.05	0.00	0.00
38	0.00	0.00	0.00	0.62	2.15	3.31	4.71	3.54	2.50	0.05	0.00	0.00
39	0.00	0.00	0.00	1.08	3.70	1.51	6.62	4.74	2.14	0.03	0.00	0.00
40	0.00	0.00	0.00	0.51	2.94	3.70	6.43	5.61	1.56	0.06	0.00	0.00
41	0.00	0.00	0.00	0.54	2.14	1.78	4.85	2.94	0.15	0.03	0.00	0.00
42	0.00	0.00	0.00	0.81	0.10	2.08	5.30	3.91	1.90	0.04	0.00	0.00

43	0.00	0.00	0.00	0.53	1.38	2.18	5.20	3.69	2.42	0.04	0.00	0.00
44	0.00	0.00	0.00	0.39	1.23	0.00	4.67	3.02	1.53	0.06	0.00	0.00
45	0.00	0.00	0.00	0.26	0.25	0.61	5.35	3.60	0.50	0.04	0.00	0.00
46	0.00	0.00	0.00	0.71	0.90	1.91	4.12	4.23	0.00	0.01	0.00	0.00
47	0.00	0.00	0.00	0.60	2.65	0.48	5.71	3.71	0.00	0.04	0.00	0.00
48	0.00	0.00	0.00	0.52	2.13	0.46	3.50	3.79	2.21	0.05	0.00	0.00
49	0.00	0.00	0.00	0.80	2.20	2.22	4.01	4.79	0.83	0.03	0.00	0.00
50	0.00	0.00	0.00	0.12	1.47	2.46	3.99	3.10	1.34	0.06	0.00	0.00
51	0.00	0.00	0.00	0.42	2.20	2.46	4.32	1.75	1.56	0.02	0.00	0.00
52	0.00	0.00	0.00	1.07	0.80	3.05	4.16	3.32	2.32	0.06	0.00	0.00
53	0.00	0.00	0.00	0.32	0.79	3.06	5.99	4.05	2.78	0.08	0.00	0.00
54	0.00	0.00	0.00	0.61	2.03	2.35	6.49	3.65	1.75	0.05	0.00	0.00
55	0.00	0.00	0.00	0.68	1.33	2.92	4.32	5.27	2.07	0.07	0.00	0.00
56	0.00	0.00	0.00	0.45	1.79	3.45	5.16	3.79	2.49	0.05	0.00	0.00
57	0.00	0.00	0.00	0.70	1.17	1.34	4.76	3.38	1.99	0.02	0.00	0.00
58	0.00	0.00	0.00	0.56	4.19	2.39	3.96	4.91	2.30	0.07	0.00	0.00
59	0.00	0.00	0.00	0.00	0.32	2.87	5.18	3.97	0.96	0.02	0.00	0.00
60	0.00	0.00	0.00	0.38	1.40	3.06	5.66	2.15	2.04	0.05	0.00	0.00
61	0.00	0.00	0.00	0.40	1.53	4.83	4.80	4.79	0.72	0.02	0.00	0.00
62	0.00	0.00	0.00	0.86	0.00	2.75	2.69	2.36	1.75	0.03	0.00	0.00
63	0.00	0.00	0.00	0.40	0.30	1.25	4.04	4.01	1.71	0.05	0.00	0.00
64	0.00	0.00	0.00	0.72	1.18	1.21	5.23	2.77	1.92	0.05	0.00	0.00
65	0.00	0.00	0.00	0.23	1.18	1.52	4.23	2.43	0.00	0.05	0.00	0.00
66	0.00	0.00	0.00	0.40	1.66	2.24	4.82	3.63	2.28	0.04	0.00	0.00
67	0.00	0.00	0.00	0.12	0.61	1.26	5.01	4.25	1.85	0.01	0.00	0.00
68	0.00	0.00	0.00	0.56	0.27	1.75	4.63	3.08	0.93	0.04	0.00	0.00
69	0.00	0.00	0.00	0.84	2.30	1.79	4.30	4.37	2.13	0.01	0.00	0.00
70	0.00	0.00	0.00	0.25	1.66	3.13	4.28	3.75	1.04	0.03	0.00	0.00
71	0.00	0.00	0.00	0.50	1.72	2.81	4.61	4.43	1.13	0.03	0.00	0.00
72	0.00	0.00	0.00	0.63	1.72	2.87	3.54	2.98	1.39	0.03	0.00	0.00
73	0.00	0.00	0.00	0.40	2.35	3.66	4.86	3.72	0.98	0.03	0.00	0.00
74	0.00	0.00	0.00	0.70	0.54	4.43	5.40	1.22	1.52	0.03	0.00	0.00
75	0.00	0.00	0.00	0.00	0.81	1.23	4.06	2.61	1.63	0.00	0.00	0.00
76	0.00	0.00	0.00	0.27	2.43	1.99	4.83	2.83	0.96	0.03	0.00	0.00
77	0.00	0.00	0.00	0.95	1.12	3.48	3.85	2.58	0.99	0.04	0.00	0.00
78	0.00	0.00	0.00	0.59	1.00	2.54	2.59	3.48	0.72	0.05	0.00	0.00
79	0.00	0.00	0.00	0.38	1.58	1.96	4.10	3.53	2.62	0.05	0.00	0.00
80	0.00	0.00	0.00	0.87	0.40	1.81	4.42	3.31	1.16	0.04	0.00	0.00
81	0.00	0.00	0.00	0.71	0.00	2.38	3.48	4.03	2.25	0.03	0.00	0.00
82	0.00	0.00	0.00	0.27	0.79	1.33	3.07	4.02	0.82	0.04	0.00	0.00
83	0.00	0.00	0.00	0.42	1.51	1.97	3.01	4.41	0.76	0.04	0.00	0.00
84	0.00	0.00	0.00	0.52	2.52	2.51	5.03	3.74	1.00	0.03	0.00	0.00
85	0.00	0.00	0.00	0.87	2.89	3.99	5.70	2.48	0.00	0.02	0.00	0.00
86	0.00	0.00	0.00	0.20	1.73	3.28	2.76	3.29	0.43	0.05	0.00	0.00
87	0.00	0.00	0.00	1.10	1.20	3.95	2.57	3.25	2.34	0.06	0.00	0.00
88	0.00	0.00	0.00	0.58	2.42	4.88	5.69	4.59	1.47	0.05	0.00	0.00
89	0.00	0.00	0.00	0.44	1.57	3.54	5.25	3.01	1.83	0.04	0.00	0.00

Appendix 4
NETWORK DATA FILES

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TITL MUSSELSHELL RIVER WATER MGNT STUDY
*************************************************************************
STA 000010     000015                NF MUSSELSHELL ABOVE BAIR RESERVOIR
DV1 d101 2 1800      TE04 IRRIGATED LANDS ABOVE BAIR RES.
DV2 100   100 TF04 1TC01TA01
RFL 2 100  000015 TR04
RFL 4 100  000015 TR04
*************************************************************************
STA 000015     000100                RETURN FLOW NODE
*************************************************************************
STA 000100     000115                NF MUSSELSHELL ABOVE DIVERSION CANAL SF
ST2                              TP04
RES TR10 TR14 TR15 TR16 TR17 357.1
DV1 d003 2 1856      TE02 NAF TO MARTINSDALE DIV FROM NF MUSSEL
DV2 100   100 TF02 3 000998
RFL 3 100  000998 TR02
RFL 5 100  000998 TR02
DV1 d102 2 1855      TE04 NAF IRRIGATED LANDS FROM BAIR TO SLC
DV2 100   100 TF04 1TC01TA02
RFL 2 100  000115 TR04
RFL 4 100  000115 TR04
*DV1 d201 1 1935      TE04 COF IRRIGATED LANDS FROM BAIR TO SLC
*DV2 100   100 TF04 1TC01TA03
*RFL 2 100  000115 TR04
*RFL 4 100  000115 TR04
*CRS 000100
*
DV1 d201 1 1935      TE04 To determine Firm Yield out of Bair Res.
DV2 100   100 TF04 1TC01TA03
RFL 2 100  000115 TR04
RFL 4 100  000115 TR04
CRS 000100
*
*DV1 d301 2 1860 1936 TE04 NCF IRRIGATED LANDS FROM BAIR TO SLC
*DV2 100   100 TF04 1TC01TA04
*RFL 2 100  000115 TR04
*RFL 4 100  000115 TR04
*CRS 000100
DV1 d501 2 1850      TE04 IRRIGATED LANDS TRIB. CHECKERBOARD CK
DV2  80    80 TF04 1TC01TA51
RFL 2 100  000100 TR04
RFL 4 100  000100 TR04
DV1 d502 2 1850      TE04 IRRIGATED LANDS TRIB. SOURDOUGH CK
DV2  80    80 TF04 1TC01TA52
RFL 2 100  000100 TR04
RFL 4 100  000100 TR04
DV1 d503 2 1850      TE04 IRRIGATED LANDS TRIB SPRING CREEK
DV2  80    80 TF04 1TC01TA53
RFL 2 100  000100 TR04
RFL 4 100  000100 TR04
DV1 d504 2 1850      TE04 IRRIGATED LANDS TRIB TRAIL CREEK
DV2  80    80 TF04 1TC01TA54
RFL 2 100  000100 TR04
RFL 4 100  000100 TR04
DV1 d505 2 1850      TE04 IRRIGATED LANDS TRIB WHETSTONE CK
DV2  80    80 TF04 1TC01TA55
RFL 2 100  000100 TR04
RFL 4 100  000100 TR04
DV1 d506 2 1850      TE04 IRRIGATED LANDS TRIB FLAGSTAFF CK
DV2  80    80 TF04 1TC01TA57
RFL 2 100  000100 TR04
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RFL 4 100  000100 TR04
DV1 d507 2 1850      TE04 IRRIGATED LANDS TRIB TROMBONE CK
DV2  80    80 TF04 1TC01TA63
RFL 2 100  000100 TR04
RFL 4 100  000100 TR04
DV1 d508 2 1850      TE04 IRRIGATED LANDS TRIB CLARKS FORK
DV2  80    80 TF04 1TC01TA64
RFL 2 100  000100 TR04
RFL 4 100  000100 TR04
*********************************************************************************
STA 000115     001000                RETURN FLOW STATION ON NORTH FORK
*********************************************************************************
STA 000195     000200                SF MUSSELSHELL ABOVE MARINSDALE INLET
DV1 d103 2 1855      TE04 NAF IRRIGATED LANDS SOUTH FORK TO SLC
DV2 100   100 TF04 1TC01TA05
RFL 2 100  000195 TR04
RFL 4 100  000195 TR04
DV1 d509 2 1850      TE04 IRRIGATED LANDS TRIB COTTONWOOD CK
DV2  80    80 TF04 1TC01TA50
RFL 2 100  000195 TR04
RFL 4 100  000195 TR04
*********************************************************************************
STA 000200     001000                SF MUSSELSHELL ABOVE DIVERSION CANAL NF
ST2                          TP02
IFR 0 0785 TI01 MIMINUM FLOWS FROM DFWP
DV1 d004 1 1856      TE02 MARTINSDALE CANAL TYPE 3 DIVERSION
DV2 100   100 TF02 3 000998
RFL 3 100  000998 TR02
RFL 5 100  000998 TR02
*********************************************************************************
STA 000997     000998                STATION FOR RETURN FLOWS TO MARTINSDALE
DV1 d104 2 1850 1900 TE04 NAF IRRIGATED LANDS OFF MARTINSDALE INLET CANAL
DV2 100   100 TF04 1TC01TA43
RFL 2 100  000998 TR04
RFL 4 100  000998 TR04
*********************************************************************************
STA 000998     001000                MARTINSDALE RESERVOIR
RES TR20 TR24 TR25 TR26 TR27 3523.19
DV1 d202 1 1936      TE04 CONTRACT FLOWS MARTINSADLE RES. C
DV2 100   100 TF04 1TC01TA06
RFL 2 100  001000 TR04
RFL 4 100  001000 TR04
CRS 000998
*********************************************************************************
STA 000810     001000                STOCK DEPLETION AB HARLOWTON
DV1 d801 2 1820      TE99 STOCKWATER PONDS AB HARLOWTON
DV2           TF99 2TS01                    34 753
*********************************************************************************
STA 001000     002000                MUSSELSHELL RIVER AT HARLOWTOWN
IFR 0 0785 TI01 MIMINUM FLOWS FROM DFWP
DV1 d105 2 1857      TE04 NAF FROM STATE LINE TO HARLOW
DV2 100   100 TF04 1TC02TA07
RFL 2 100  002000 TR04
RFL 4 100  002000 TR04
DV1 d203 1 1937      TE04 COF FROM STATE LINE TO HARLOW
DV2 100   100 TF04 1TC02TA08
RFL 2 100  002000 TR04
RFL 4 100  002000 TR04
CRS 000998
DV1 d302 2 1858 1938 TE04 NCF FROM STATE LINE TO HARLOW
DV2 100   100 TF04 1TC02TA09
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RFL 2 100  002000 TR04
RFL 4 100  002000 TR04
CRS 000998
DV1 d900 1 1936      TE75 HARLOW GOLF COURSE
DV2 100   100 TF75 1TC11TA90
RFL 2 100  002000 TR04
RFL 4 100  002000 TR04
CRS 000998
DV1 d510 2 1850      TE04 IRRIGATED LANDS TRIB. DAISY DEAN CK
DV2  80    80 TF04 1TC02TA58
RFL 2 100  001000 TR04
RFL 4 100  001000 TR04
DV1 d511 2 1850      TE04 IRRIGATED LANDS TRIB. LONG CANYON CK
DV2  80    80 TF04 1TC02TA59
RFL 2 100  001000 TR04
RFL 4 100  001000 TR04
DV1 d512 2 1850      TE04 IRRIGATED LANDS TRIB. MORRISSY CK
DV2  80    80 TF04 1TC02TA60
RFL 2 100  001000 TR04
RFL 4 100  001000 TR04
DV1 d513 2 1850      TE04 IRRIGATED LANDS TRIB. HAYMAKER CK
DV2  80    80 TF04 1TC02TA61
RFL 2 100  001000 TR04
RFL 4 100  001000 TR04
DV1 d514 2 1850      TE04 IRRIGATED LANDS TRIB. ALKALIA CK S TD
DV2  80    80 TF04 1TC02TA62
RFL 2 100  001000 TR04
RFL 4 100  001000 TR04
DV1 d515 2 1850      TE04 IRRIGATED LANDS TRIB. MEX. JOHN CK
DV2  80    80 TF04 1TC02TA65
RFL 2 100  001000 TR04
RFL 4 100  001000 TR04
DV1 d516 2 1850      TE04 IRRIGATED LANDS TRIB. MILLER CK
DV2  80    80 TF04 1TC02TA66
RFL 2 100  001000 TR04
RFL 4 100  001000 TR04
DV1 d517 2 1850      TE04 IRRIGATED LANDS TRIB. HOPLEY CK
DV2  80    80 TF04 1TC02TA67
RFL 2 100  001000 TR04
RFL 4 100  001000 TR04
DV1 d518 2 1850      TE04 IRRIGATED LANDS TRIB. BIG ELK CK
DV2  80    80 TF04 1TC02TA68
RFL 2 100  001000 TR04
RFL 4 100  001000 TR04
DV1 d519 2 1850      TE04 IRRIGATED LANDS TRIB. MUD CREEK UPP
DV2  80    80 TF04 1TC02TA85
RFL 2 100  001000 TR04
RFL 4 100  001000 TR04
*********************************************************************************
STA 000820     002000                STOCK DEPLETION AB SHAWMUT
DV1 d802 2 1820      TE99 STOCKWATER PONDS HARLOWTON TO SHAWMUT
DV2           TF99 2TS02                      34 426
*********************************************************************************
STA 002000     003000                MUSSELSHELL RIVER AT SHAWMUT
ST2                              TP03
IFR 0 0785 TI01 MIMINUM FLOWS FROM DFWP
DV1 d005 2 1859      TE03 DEADMANS BASIN INLET TYPE 3 DIV.
DV2 100   100 TF03 3 002992
RFL 2 100  002990 TR03
RFL 4 100  002990 TR03
DV1 d106 2 1861      TE05 NAF FROM HARLOW TO SHAWMUT
```

```
DV2 100   100 TF05 1TC02TA11
RFL 2 100  003000 TR05
RFL 4 100  003000 TR05
DV1 d204 1 1936      TE05 COF FROM HARLOW TO SHAWMUT
DV2 100   100 TF05 1TC02TA12
RFL 2 100  003000 TR05
RFL 4 100  003000 TR05
CRS 000998
DV1 d303 2 1862 1936 TE05 NCF FROM HARLOW TO SHAWMUT
DV2 100   100 TF05 1TC02TA13
RFL 2 100  003000 TR05
RFL 4 100  003000 TR05
CRS 000998
DV1 d107 2 1863      TE05 NAF DEADMANS BASIN INLET CANAL
DV2 100   100 TF05 1TC02TA17
RFL 2 100  003000 TR05
RFL 4 100  003000 TR05
DV1 d205 1 1936      TE05 COF DEADMANS BASIN INLET CANAL
DV2 100   100 TF05 1TC02TA18
RFL 2 100  003000 TR05
RFL 4 100  003000 TR05
CRS 000998
DV1 d304 2 1864 1936 TE05 NCF DEADMANS BASIN INLET CANAL
DV2 100   100 TF05 1TC02TA19
RFL 2 100  003000 TR05
RFL 4 100  003000 TR05
CRS 000998
DV1 d520 2 1850      TE05 IRRIGATED LANDS TRIB. AMERICAN FK
DV2  80    80 TF05 1TC02TA71
RFL 2 100  002000 TR05
RFL 4 100  002000 TR05
DV1 d521 2 1850      TE05 IRRIGATED LANDS TRIB. ANTELOPE CK
DV2  80    80 TF05 1TC02TA77
RFL 2 100  002000 TR05
RFL 4 100  002000 TR05
*******************************************************************************
STA 002990     002992                STATION FOR RETURN FLOWS DEADMANS BASIN
*******************************************************************************
STA 002992     002995                DEADMANS BASIN RESERVOIR
RES TR30 TR34 TR35 TR36 TR37 3576.9
*******************************************************************************
STA 002995     000295                DIVERSION SPLIT CARLESS AND BARBER CS.
DV1 d206 1 1936      TE05 COF BARBER CANAL
DV2 100   100 TF05 1TC02TA20
RFL 2 100  003000 TR05
RFL 4 100  003000 TR05
CRS 002992
*******************************************************************************
STA 000295     000300                CARLESS CANAL FLOWS INTO CARLESS CREEK
DV1 d207 1 1937      TE05 COF CARLESS CANAL
DV2 100   100 TF05 1TC02TA21
RFL 2 100  000300 TR05
RFL 4 100  000300 TR05
CRS 002992
*******************************************************************************
STA 000300     004000                CARLESS CK. AT MOUTH
DV1 d108 2 1862      TE05 NAF ON CARLESS CREEK
DV2 100   100 TF05 1TC02TA22
RFL 2 100  000300 TR05
RFL 4 100  000300 TR05
DV1 d209 1 1938      TE05 COF ON CARLESS CREEK FROM DEADMANS
```

```
DV2 100   100 TF05 1TC02TA23
RFL 2 100  000300 TR05
RFL 4 100  000300 TR05
CRS 002992
DV1 d306 2 1863 1935 TE05 NCF ON CARLESS CREEK
DV2 100   100 TF05 1TC02TA24
RFL 2 100  000300 TR05
RFL 4 100  000300 TR05
CRS 002992
DV1 d522 2 1850      TE05 IRRIGATED LANDS CARLESS CK UP CC
DV2  80    80 TF05 1TC02TA73
RFL 2 100  000300 TR05
RFL 4 100  000300 TR05
*********************************************************************************
STA 000830     003000                STOCK DEPLETION AB RYEGATE
DV1 d803 2 1820      TE99 STOCKWATER PONDS SHAWMUT TO RYEGATE
DV2           TF99 2TS03                       34 255
*********************************************************************************
STA 003000     004000                MUSSELSHELL RIVER AT RYEGATE
IFR 0 0785 TI01 MIMINUM FLOWS FROM DFWP
DV1 d109 2 1864      TE05 NAF FROM SHAWMUT TO RYEGATE
DV2 100   100 TF05 1TC02TA14
RFL 2 100  004000 TR05
RFL 4 100  004000 TR05
DV1 d208 1 1936      TE05 COF FROM SHAWMUT TO RYEGATE
DV2 100   100 TF05 1TC02TA15
RFL 2 100  004000 TR05
RFL 4 100  004000 TR05
CRS 000998
DV1 d305 2 1864 1936 TE05 NCF FROM SHAWMUT TO RYEGATE
DV2 100   100 TF05 1TC02TA16
RFL 2 100  004000 TR05
RFL 4 100  004000 TR05
CRS 000998
DV1 d400 4 1864 1936 TE99 RYEGATE M&I DEMAND
DV2 100   100 TE45 4TM01TP10
RFL 2 100  004000 TR09
RFL 4 100  004000 TR09
CRS 000998
DV1 d523 2 1850      TE05 IRRIGATED LANDS TRIB. MUD CK.
DV2  80    80 TF05 1TC02TA56
RFL 2 100  003000 TR05
RFL 4 100  003000 TR05
*********************************************************************************
STA 000840     004000                STOCK DEPLETION AB LAVINA
DV1 d804 2 1820      TE99 STOCKWATER PONDS RYEGATE TO LAVINA
DV2           TF99 2TS04                       34 1167
*********************************************************************************
STA 004000     005000                MUSSELSHELL RIVER AT LAVINA
IFR 0 0785 TI01 MIMINUM FLOWS FROM DFWP
DV1 d110 2 1865      TE05 NAF FROM RYEGATE TO LAVINA
DV2 100   100 TF05 1TC02TA25
RFL 2 100  005000 TR05
RFL 4 100  005000 TR05
DV1 d210 1 1936      TE05 COF FROM RYEGATE TO LAVINA
DV2 100   100 TF05 1TC02TA26
RFL 2 100  005000 TR05
RFL 4 100  005000 TR05
CRS 000998
DV1 d307 2 1865 1936 TE05 NCF FROM RYEGATE TO LAVINA
DV2 100   100 TF05 1TC02TA27
```

```
RFL 2 100  005000 TR05
RFL 4 100  005000 TR05
CRS 000998
DV1 d524 2 1850      TE05 IRRIGATED LANDS TRIB. BIG COULEE
DV2  80    80 TF05 1TC02TA72
RFL 2 100  004000 TR05
RFL 4 100  004000 TR05
DV1 d525 2 1850      TE05 IRRIGATED LANDS TRIB. FIVE MILE
DV2  80    80 TF05 1TC02TA74
RFL 2 100  004000 TR05
RFL 4 100  004000 TR05
DV1 d526 2 1850      TE05 IRRIGATED LANDS TRIB. FISH CK
DV2  80    80 TF05 1TC02TA75
RFL 2 100  004000 TR05
RFL 4 100  004000 TR05
*********************************************************************
STA 005000     006000                MUSSELSHELL RIVER AT PAINTED ROBE CK
IFR 0 0785 TI01 MIMINUM FLOWS FROM DFWP
DV1 d111 2 1866      TE05 NAF FROM LAVINA TO PAINTED ROBE CK
DV2 100   100 TF05 1TC02TA28
RFL 2 100  006000 TR05
RFL 4 100  006000 TR05
DV1 d211 1 1936      TE05 COF FROM LAVINA TO PAINTED ROBE CK
DV2 100   100 TF05 1TC02TA29
RFL 2 100  006000 TR05
RFL 4 100  006000 TR05
CRS 002992
DV1 d308 2 1866 1936 TE05 NCF FROM LAVINA TO PAINTED ROBE CK
DV2 100   100 TF05 1TC02TA30
RFL 2 100  006000 TR05
RFL 4 100  006000 TR05
CRS 002992
DV1 d527 2 1850      TE05 IRRIGATED LANDS TRIB. PAINTED ROBE
DV2  80    80 TF05 1TC02TA76
RFL 2 100  005000 TR05
RFL 4 100  005000 TR05
*********************************************************************
STA 000850     006000                STOCK DEPLETION AB ROUNDUP
DV1 d805 2 1820      TE99 STOCKWATER PONDS LAVINA TO ROUNDUP
DV2           TF99 2TS05                    34 1584
*********************************************************************
STA 006000     007000                MUSSELSHELL RIVER AT ROUNDUP
IFR 0 0785 TI01 MIMINUM FLOWS FROM DFWP
DV1 d112 2 1867      TE05 NAF FROM PAINTED ROBE CK TO ROUNDUP
DV2 100   100 TF05 1TC02TA31
RFL 2 100  007000 TR05
RFL 4 100  007000 TR05
DV1 d212 1 1936      TE05 COF FROM PAINTED ROBE CK TO ROUNDUP
DV2 100   100 TF05 1TC02TA32
RFL 2 100  007000 TR05
RFL 4 100  007000 TR05
CRS 002992
DV1 d309 2 1867 1936 TE05 NCF FROM PAINTED ROBE CK TO ROUNDUP
DV2 100   100 TF05 1TC02TA33
RFL 2 100  007000 TR05
RFL 4 100  007000 TR05
CRS 002992
DV1 d528 2 1850      TE05 IRRIGATED LANDS TRIB. HORSETHIEF CK
DV2  80    80 TF05 1TC02TA69
RFL 2 100  006000 TR05
RFL 4 100  006000 TR05
```

```
DV1 d529 2 1850      TE05 IRRIGATED LANDS TRIB. CURRENT CK
DV2  80     80 TF05 1TC02TA70
RFL 2 100  006000 TR05
RFL 4 100  006000 TR05
DV1 d530 2 1850      TE05 IRRIGATED LANDS TRIB. GOULDING CK
DV2  80     80 TF05 1TC02TA78
RFL 2 100  006000 TR05
RFL 4 100  006000 TR05
*********************************************************************************
STA 000860     007000                STOCK DEPLETION AB MUSSELSHELL
DV1 d806 2 1820      TE99 STOCKWATER PONDS ROUNDUP TO MUSSELSHELL
DV2           TF99 2TS06                        34 768
*********************************************************************************
STA 007000     008000                MUSSELSHELL RIVER AT MUSSELSHELL
IFR 0 0785 TI02 MIMINUM FLOWS FROM DFWP
DV1 d113 2 1868      TE06 NAF FROM ROUNDUP TO MUSSELSHELL
DV2 100   100 TF06 1TC03TA34
RFL 2 100  008000 TR06
RFL 4 100  008000 TR06
DV1 d213 1 1936      TE06 COF FROM ROUNDUP TO MUSSELSHELL
DV2 100   100 TF06 1TC03TA35
RFL 2 100  008000 TR06
RFL 4 100  008000 TR06
CRS 002992
DV1 d310 2 1868 1936 TE06 NCF FROM ROUNDUP TO MUSSELSHELL
DV2 100   100 TF06 1TC03TA36
RFL 2 100  008000 TR06
RFL 4 100  008000 TR06
CRS 002992
DV1 d401 4 1900 1936 TE99 ROUNDUP M&I DEMAND
DV2 100    45 TE99 4TM01TP11
RFL 2 100  007000 TR09
RFL 4 100  007000 TR09
CRS 002992
DV1 d901 1 1936      TE75 ROUNDUP GOLF COURSE
DV2 100   100 TF75 1TC10TA91
RFL 2 100  007000 TR06
RFL 4 100  007000 TR06
CRS 002992
DV1 d532 2 1850      TE06 IRRIGATED LANDS TRIB. FATTIG CK
DV2  80     80 TF06 1TC02TA81
RFL 2 100  007000 TR06
RFL 4 100  007000 TR06
DV1 d533 2 1850      TE06 IRRIGATED LANDS TRIB. PARROTT CK
DV2  80     80 TF06 1TC02TA82
RFL 2 100  007000 TR06
RFL 4 100  007000 TR06
DV1 d534 2 1850      TE06 IRRIGATED LANDS TRIB. WILLOW CK
DV2  80     80 TF06 1TC02TA83
RFL 2 100  007000 TR06
RFL 4 100  007000 TR06
DV1 d535 2 1850      TE06 IRRIGATED LANDS TRIB. HALFBREED CK
DV2  80     80 TF06 1TC02TA84
RFL 2 100  007000 TR06
RFL 4 100  007000 TR06
*********************************************************************************
STA 000400     008000                FLATWILLOW CK. AT MOUTH
DV1 d600 2 1850      TE99 DEPLETE WIILOW CREEK FLOWS
DV2 100   100 TF99 2TW01
RFL 2 100  000400 TR09
RFL 4 100  000400 TR09
```

```
*********************************************************************************
STA 000870     008000                STOCK DEPLETION AB MOSBY
DV1 d807 2 1820      TE99 STOCKWATER PONDS MUSSELSHELL TO MOSBY
DV2           TF99 2TS07                    34 2118
*********************************************************************************
STA 008000     009000                MUSSELSHELL RIVER AT MOSBY
IFR 0 0785 TI02 MIMINUM FLOWS FROM DFWP
DV1 d114 2 1869      TE06 NAF FROM MUSSELSHELL TO MOSBY
DV2 100   100 TF06 1TC03TA37
RFL 2 100  009000 TR06
RFL 4 100  009000 TR06
DV1 d214 1 1936      TE06 COF FROM MUSSELSHELL TO MOSBY
DV2 100   100 TF06 1TC03TA38
RFL 2 100  009000 TR06
RFL 4 100  009000 TR06
CRS 002992
DV1 d311 2 1869 1936 TE06 NCF FROM MUSSELSHELL TO MOSBY
DV2 100   100 TF06 1TC03TA39
RFL 2 100  009000 TR06
RFL 4 100  009000 TR06
CRS 002992
DV1 d402 4 1870 1936 TE99 MELSTONE M&I DEMAND
DV2 100   100 TE45 4TM03TP12
RFL 2 100  009000 TR09
RFL 4 100  009000 TR09
CRS 002992
DV1 d537 2 1850      TE06 IRRIGATED LANDS TRIB. N. WILLOW CK
DV2  80    80 TF06 1TC02TA79
RFL 2 100  008000 TR06
RFL 4 100  008000 TR06
DV1 d536 2 1850      TE06 IRRIGATED LANDS TRIB. MCLEAN CK
DV2  80    80 TF06 1TC02TA86
RFL 2 100  008000 TR06
RFL 4 100  008000 TR06
DV1 d531 2 1850      TE06 IRRIGATED LANDS TRIB. HAWK CK
DV2  80    80 TF06 1TC02TA80
RFL 2 100  008000 TR06
RFL 4 100  008000 TR06
*********************************************************************************
STA 009000     010000                FT PECK HIGH WATER LEVEL FLOWS
IFR 0 0785 TI02 MIMINUM FLOWS FROM DFWP
DV1 d115 2 1890      TE06 NAF FROM MOSBY TO FORT PECK
DV2 100   100 TF06 1TC03TA40
RFL 2 100  010000 TR06
RFL 4 100  010000 TR06
DV1 d215 1 1936      TE06 COF FROM MOSBY TO FORT PECK
DV2 100   100 TF06 1TC03TA41
RFL 2 100  010000 TR06
RFL 4 100  010000 TR06
CRS 002992
DV1 d312 2 1890 1936 TE06 NCF FROM MOSBY TO FORT PECK
DV2 100   100 TF06 1TC03TA42
RFL 2 100  010000 TR06
RFL 4 100  010000 TR06
CRS 002992
*********************************************************************************
STA 010000                           RETURN FLOW NODE
```

Appendix 5
USGS NATURAL FLOW PROCEDURE

SYNTHESIS OF MONTHLY NATURAL FLOWS FOR SELECTED SITES IN THE MUSSELSHELL RIVER BASIN, MONTANA, BASE PERIOD 1929-89

By Kevin C. Vining, Dave R. Johnson, and Charles Parrett

U.S. GEOLOGICAL SURVEY

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BUREAU OF RECLAMATION

Helena, Montana
June 1996

U.S. DEPARTMENT OF THE INTERIOR

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U.S. GEOLOGICAL SURVEY

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
acre	0.407	hectare
acre-foot	1,233	cubic meter
inch (in.)	25.4	millimeter
square mile (mi^2)	2.59	square kilometer

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

SYNTHESIS OF MONTHLY NATURAL FLOWS FOR SELECTED SITES IN THE MUSSELSHELL RIVER BASIN, MONTANA, BASE PERIOD 1929-89

By Kevin C. Vining, Dave R. Johnson, *and* Charles Parrett

Abstract

Synthesized monthly natural streamflows were required at 13 sites for use in a streamflow-accounting model to evaluate the effects of various water-allocation schemes on water availability in the Musselshell River Basin in central Montana. Records of monthly streamflow at 14 streamflow-gaging stations were used to synthesize monthly natural flows at tributaries and the 13 synthesis sites. A streamflow-record extension program was used to extend flow records at the 14 gaged sites to a common base period, 1929-89.

To synthesize monthly natural flows at 10 sites on the Musselshell River mainstem, synthesized monthly natural flows at all significant tributary streams were required. Results from a previous study were used to synthesize tributary natural flows. Monthly natural flows at each mainstem site downstream from the first site were synthesized by successively adding monthly natural flows from intervening tributaries to the next upstream mainstem site. Special methods using extended-record flows from gaged tributaries were used to synthesize monthly natural flows at three tributary sites.

Synthesized mean annual natural flows were found to be greater than mean annual extended-record flows at three selected comparison sites on the Musselshell River. The differences between mean natural and extended-record flows (depletions) at Harlowton and Musselshell were considered to be reasonable given the amount of irrigated acreage upstream from the two sites. The differences at Mosby, the site farthest downstream, was less than at Musselshell, the next upstream site, indicating that the methods of synthesis had error. The synthesis error generally was attributed to the larger natural variability of tributary flows in the lower portion of the Musselshell River Basin.

INTRODUCTION

The Bureau of Reclamation (BOR) is developing a monthly water-accounting model of the Musselshell River Basin in Montana to evaluate the effects of various water-allocation alternatives on water availability at selected sites. To allow comparisons among schemes, a reference data base of monthly natural flows (unaffected by human use) is required at each site. Although recorded streamflow data are available at many of the sites, monthly flows for most sites are affected by irrigation and reservoir storage and cannot be directly used as natural flows. Accordingly, the BOR requested the U.S. Geological Survey (USGS) to synthesize monthly natural flows for the 1929-89 base period at 13 sites in the Musselshell River Basin.

Purpose and Scope

This report, prepared in cooperation with the BOR, presents the synthesized monthly natural flows for 13 selected sites and describes the methods used for synthesis. The methods required the use of streamflow records from 14 USGS streamflow-gaging stations in the basin and monthly streamflow estimates for 48 tributary streams. Seven of the 13 synthesis sites are at USGS streamflow-gaging stations but, for reasons indicated above, data from only 2 stations were directly used to synthesize monthly natural flows. The natural-flow synthesis sites, tributary sites for which monthly natural streamflows were synthesized, and selected streamflow-gaging stations are listed in table 1, and their locations are shown on figure 1. (All tables are presented at the back of the report in the Supplemental Information section.)

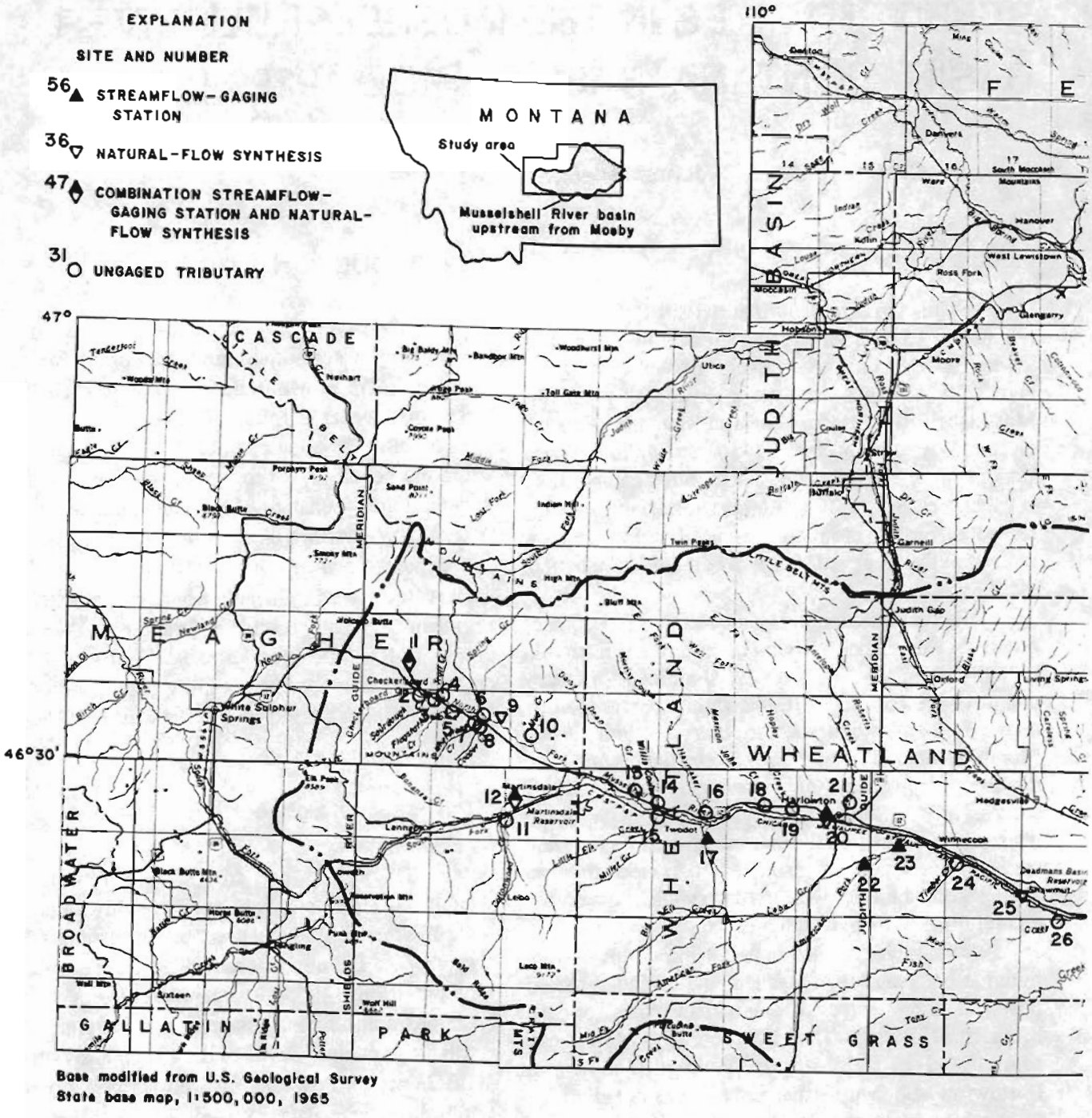
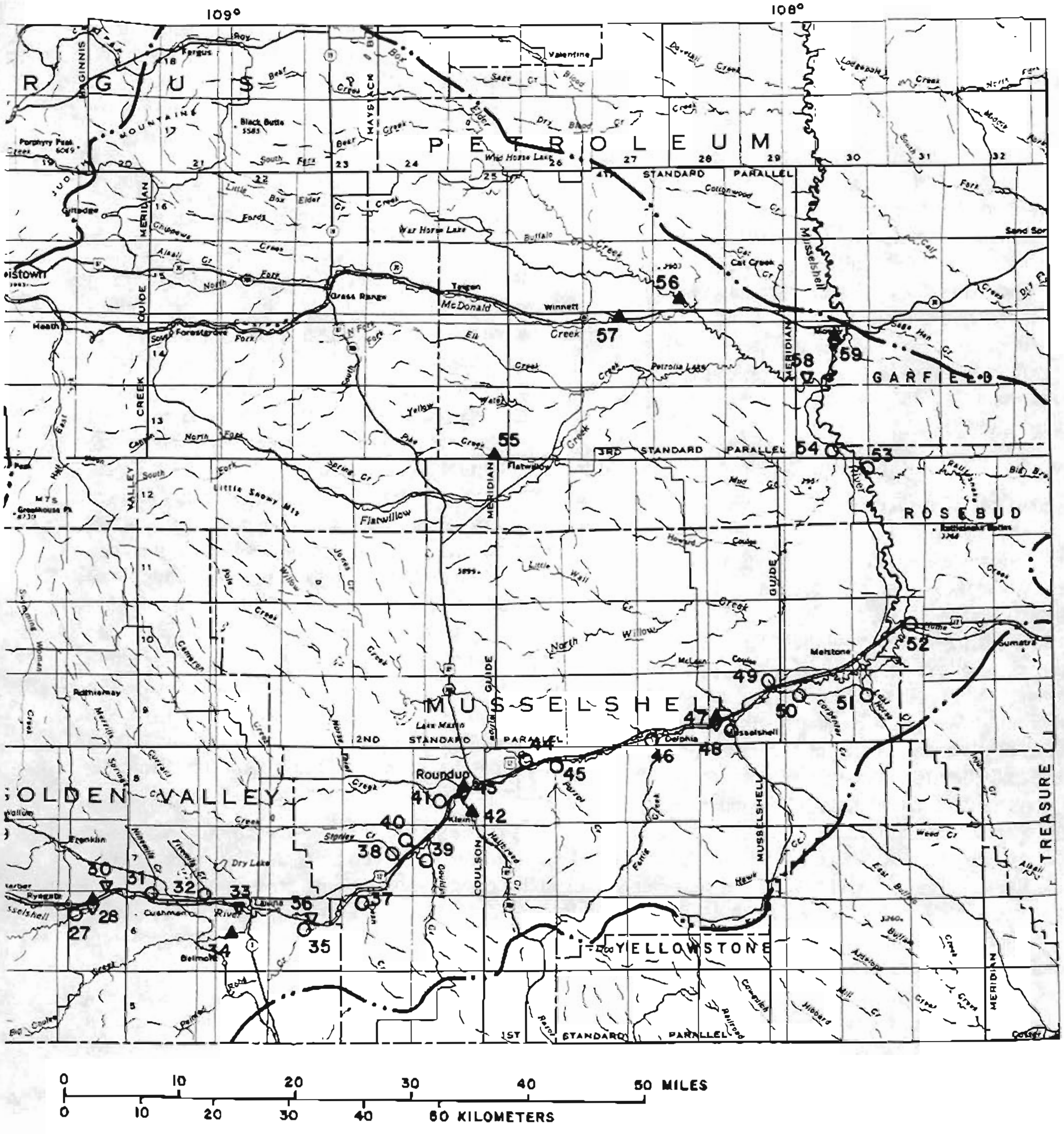


Figure 1. Location of Musselshell River Basin, Montana, selected streamflow-gaging



stations, natural-flow synthesis sites, and ungaged tributary sites.

A streamflow-record extension program was used to extend streamflow records where necessary to the 1929-89 base period. In general, monthly natural flows at mainstem sites were synthesized by successively adding estimates of intervening tributary flows to synthesized monthly natural flows at each mainstem site, beginning with the mainstem site farthest upstream, North Fork Musselshell River near Delpine (site 1). Although the Musselshell River mainstem commonly is considered to begin at the confluence of the North Fork Musselshell and South Fork Musselshell Rivers, for purposes of clarity in this report, the mainstem of the Musselshell River includes the North Fork Musselshell River. Special methods were used to synthesize monthly natural flows for sites on tributary streams South Fork Musselshell River above Martinsdale (site 12), Careless Creek at mouth, near Ryegate (site 30), and Flatwillow Creek at mouth, near Mosby (site 58).

Description of Study Area

The Musselshell River arises in the Little Belt Mountains where the North Fork Musselshell River has its headwaters and in the Castle and Crazy Mountains where the South Fork Musselshell River has its headwaters. These mountain areas receive approximately 30 in. of precipitation annually (U.S. Soil Conservation Service, 1981), mostly in the form of snow. Most of the streams draining the mountains are perennial. Irrigation is the major use of water in the sparsely populated basin (less than 10,000 inhabitants). Irrigation withdrawals substantially reduce flows of Cottonwood Creek, a major tributary to the South Fork Musselshell River. Irrigation withdrawals from other tributary streams in the basin above the confluence of the North Fork Musselshell River and South Fork Musselshell River are presumed to be relatively minor.

The South Fork Musselshell River joins the North Fork Musselshell River near Martinsdale. Downstream from Martinsdale, the Musselshell River traverses a broad, flat plains area where annual precipitation is about 13 in. (U.S. Soil Conservation Service, 1981). Tributary streams draining the plains are mostly intermittent, and subject to large variations in flow as a result of sporadic, but intense, rainstorms. Irrigation withdrawals from these plains tributary streams, except for Flatwillow Creek, the largest tributary in the plains, are presumed to be minor.

The drainage area of the Musselshell River is about 8,000 mi^2. The river is an important source of water for irrigation of about 47,000 acres of cropland. Although the water supply is marginally adequate in most years, serious shortages of water for irrigation do occur. Shortages occur despite the presence of four State-managed water-storage projects and are reflective of the large natural variability of streamflows.

STREAMFLOW-RECORD EXTENSION

Records from selected streamflow-gaging stations in the Musselshell River Basin were used for various purposes in the natural-flow synthesis process (table 2). Recorded monthly flows at one station were used as synthesized monthly natural flows at one mainstem estimation site (site 1), whereas recorded monthly flows at nine stations were used to synthesize monthly natural flows at tributary sites (sites 12, 17, 23, 29, 34, 42, 55, 56, and 57). Recorded monthly flows at three stations (sites 55, 56, and 57) were added together to synthesize monthly natural flows for one ungaged tributary site (site 58), whereas recorded monthly flows at eight stations (sites 1, 12, 17, 22, 29, 34, 56, and 57) were used to synthesize monthly natural flows at other ungaged tributaries. Records from three mainstem sites (sites 20, 47, and 59) were used to make comparisons between synthesized natural flows and recorded flows. The 14 streamflow-gaging stations whose records were used in the natural-flow synthesis process had various record lengths.

A streamflow record-extension program developed by Alley and Burns (1983) was used to extend short-term and seasonal streamflow records for the 14 gaging stations with various periods of missing record during the 1929-89 base period. This program selects the best nearby base station from all those available to estimate each month of missing record at a gaging station using a regression technique. Thus, if a gaging station has several months of missing record, several base stations may be used for estimating missing flows. The criterion for selection is to use the base station that results in the smallest standard error of prediction for that month. Only gaging stations with flow records for a particular month and year were used to estimate missing flows at other gaging stations for that month and year. Previously estimated flows were not used to estimate other missing flows.

The regression technique used in the streamflow record-extension program is the MOVE.1 (Maintenance of Variance Extension, Type 1) curve-fitting technique described by Hirsch (1982). This technique is analogous to ordinary least-squares regression, but unlike ordinary least-squares regression, MOVE.1 results in an extended flow record with a variance comparable to that of the unextended flow record.

The extension procedure was based on a previous study (Parrett and Johnson, 1989) that used MOVE.1 to extend the records of the same 14 gaging stations to the base period water years 1937-86. In that study, 157 streamflow-gaging stations were used as potential base stations for MOVE.1 (Parrett and Johnson, 1989, table 3). The 157 base stations used in the previous study were used in this study. To permit inclusion of data from stations discontinued before 1929, the procedure was used to estimate all missing monthly streamflow data for the years 1906-1992. After the records were extended, all data prior to 1937 and after 1989 were excluded from the data base. At one gaging station, Flatwillow Creek near Flatwillow (station 06127900), the streamflow regimen changed in about 1930 as a result of substantially increased irrigation diversions. Flow records after 1930 at this site were not used in the streamflow-record extension program to ensure that estimated flows for the 1929-89 base period would be consistent and more representative of natural-flow conditions. Monthly flows for the 1929-89 base period for the 14 gaging stations are hereinafter referred to as extended-record flows.

SYNTHESIS OF NATURAL FLOWS

Synthesized monthly natural flows were required for 10 mainstem sites and 3 tributary sites. Different methods were used to synthesize natural flows at mainstem and tributary sites and are described below.

Mainstem Sites

The method used to synthesize monthly natural flows for sites on the mainstem makes use of a previous study (Parrett and Johnson, 1989) that provided estimates of long-term mean monthly flows for selected Musselshell River tributaries for the base period 1937-86. These estimates of long-term mean monthly flows were used to synthesize monthly natural flows for the 1929-89 base period for most ungaged tributary streams. Natural flows for each mainstem synthesis site downstream from North Fork Musselshell River near Delpine (site 1) were synthesized by successively adding synthesized natural flows on intervening tributary streams to the synthesized natural flows at the closest upstream mainstem site. This method is based on the assumptions that (1) extended-record flows for the uppermost mainstem site, North Fork Musselshell River near Delpine, were equivalent to natural flows, and (2) long-term mean monthly tributary flows estimated by Parrett and Johnson (1989) are equivalent to natural flows. Although the second assumption probably is not true for some tributaries that have significant irrigation, it is considered to be a reasonable assumption overall.

Although this method of estimation required synthesized tributary natural flows, the method did not require estimates of mainstem irrigation withdrawals and return flows. The error involved in the estimation of mainstem irrigation withdrawals and return flows was considered to be greater than the error associated with flow estimation of tributary streams and the assumption that estimated tributary flow is equivalent to natural flow.

Table 3 lists each mainstem synthesis site and the tributary sites whose synthesized monthly natural flows were added to synthesized monthly natural flows at the mainstem site to synthesize monthly natural flows at the next downstream mainstem site. For example, monthly natural flows at Musselshell River near Shawmut (site 25) were synthesized by adding synthesized monthly tributary natural flows for Antelope Creek above Alkali Creek, near Harlowton (site 21); American Fork below Lebo Creek, near Harlowton (site 23); and Timber Creek at mouth, near Harlowton (site 24) to natural flows for the synthesis site, Musselshell River at Harlowton (site 20).

Tributary Sites

Monthly natural flows for each ungaged tributary for the 1929-89 base period were determined from the estimated mean monthly natural flows for each tributary and extended-record flows at a nearby gaged site by use of the following equation:

$$q_{trib\,(i,j)} = \left(\frac{\bar{q}_{trib\,(j)}}{\bar{q}_{gage\,(j)}} \right) \times q_{gage\,(i,j)} \qquad (1)$$

where $q_{trib\,(i,j)}$ is synthesized monthly natural flow of the ungaged tributary for month j in year i of the base period 1929-89;

$\bar{q}_{trib\,(j)}$ is the estimated long-term mean flow for 1937-86 of the ungaged tributary for month j;

$\bar{q}_{gage\,(j)}$ is the long-term mean flow for 1937-86 for the gaged site for month j; and

$q_{gage\,(i,j)}$ is the extended-record flow at the gaged site for month j in year i of the base period 1929-89.

Table 4 lists the Musselshell River tributaries and the corresponding gaged sites used to synthesize tributary monthly natural flows.

Special methods were used to synthesize monthly natural flows for tributary sites on South Fork Musselshell River (site 12), Careless Creek (site 30), and Flatwillow Creek (site 58). For South Fork Musselshell River, irrigation withdrawals from Cottonwood Creek substantially reduce flows past the South Fork Musselshell above Martinsdale (site 12) streamflow-gaging station. Equation 1 was used to synthesize monthly natural flows for Cottonwood Creek at mouth (site 11), because previously estimated mean monthly flows for Cottonwood Creek were considered to be equivalent to natural flows based on a previous study by Parrett and Johnson (1989). The synthesized monthly natural flows for site 11 were added to the extended-record flows at site 12 to synthesize monthly natural flows for South Fork Musselshell River (site 12).

Flows at the mouth of Careless Creek are significantly increased during the irrigation season by flow releases from Deadman's Basin Reservoir, an off-stream reservoir that stores water diverted from the Musselshell River. Water in Deadman's Basin Reservoir is returned to lower reaches of the Musselshell River via the Careless Creek channel. Natural flows at the mouth of Careless Creek (site 30) were assumed to be equivalent to extended-record flows for Careless Creek at Wallum (site 29), a site upstream from the inflow from Deadman's Basin Reservoir.

Flows at the mouth of Flatwillow Creek are significantly reduced during the irrigation season by irrigation withdrawals from the upper reaches of Flatwillow Creek. Extended-record flows for Flatwillow Creek near Flatwillow (site 55) were considered to be equivalent to natural flows. Monthly natural flows at the mouth of Flatwillow Creek (site 58) were synthesized by adding extended-record flows for Flatwillow Creek near Flatwillow (site 55) to extended-record flows for Box Elder Creek near Winnett (site 56) and McDonald Creek at Winnett (site 57), tributaries of Flatwillow Creek downstream from the gage at Flatwillow.

RELIABILITY OF SYNTHESIZED FLOWS

Synthesized monthly natural flows for the 1929-89 base period at the 13 synthesis sites are shown in tables 7-19. Water withdrawals for irrigation from the Musselshell River have occurred for many years prior to the establishment of most streamflow-gaging stations. Lack of streamflow information prior to irrigation activities has resulted in a lack of natural streamflow data for comparison purposes. In general, the synthesized natural flows probably are most reliable in the upper, mountainous portions of the Musselshell River Basin where streamflows generally are more uniform than in the plains. The reliability of synthesis likely decreases downstream because of the increased variability of flow in the Musselshell River and its tributaries, and the increased number of tributaries for which synthesized natural flows were required.

Comparisons were made between synthesized natural flows and extended-record flows at three sites having streamflow-gaging stations: Musselshell River at Harlowton (site 20), Musselshell River at Musselshell (site 47), and Musselshell River at Mosby (site 59). The comparisons were used to make inferences about the overall reliability of the synthesized natural flows.

Values of mean annual flow were calculated from the synthesized monthly natural flows and the extended-record flows at the three comparison sites and are shown in table 5. Also shown in table 5 is the calculated mean annual depletion (difference between mean annual flows calculated from the monthly natural

flows and the extended record flows) at each site and the irrigated acreage upstream from each site. Mean values shown in table 5 are all based on the 1929-89 base period.

The depletions at Harlowton and Musselshell appear reasonable given the amount of irrigated acreage upstream from each site. At Mosby, mean annual depletion is less than that at Musselshell. Because depletion represents water that is consumed and unavailable at downstream sites, depletion must increase, or at least remain constant, in the downstream direction. Also, because irrigated acreage increases from Musselshell to Mosby, the depletion should increase. Thus, the decrease in depletion from Musselshell to Mosby shown in table 5 is anomalous and indicates error in the estimation method.

To help explain the anomalous decrease in depletion shown in table 5, plots of annual synthesized natural flows and extended-record flows were made for the three comparison sites (fig. 2). Figures 2A and 2B show that synthesized natural flows were greater than extended-record flows for all years in the base period at the Harlowton and Musselshell sites. For the site at Mosby, figure 2C shows that synthesized natural flows were greater than extended-record flows for all years except 1942, 1975, 1978, and 1979. Extended-record flows for those 4 years were greater than synthesized natural flows, indicating that the method of synthesis did not provide adequate estimates of tributary flows to match the actual tributary flows that occurred between Musselshell and Mosby. To ascertain the effect that the 4 years of large tributary flows had on the synthesis results, depletions were re-calculated at the three comparison sites excluding all data from 1942, 1975, 1978, and 1979 (table 6). The re-calculated mean annual depletion at Mosby shown in table 6 is greater than the mean annual depletion at Mosby shown in table 5 and greater than the re-calculated depletion at Musselshell shown in table 6. Thus, elimination of 4 years of generally large tributary flow removes the anomalous decrease in depletion between Musselshell and Mosby.

Because the methods for synthesizing monthly natural flows in the Musselshell River depend heavily upon synthesized natural flows in tributaries, errors in synthesis of natural flows in the mainstem are a function primarily of errors in synthesis of natural flows in tributaries. The errors in synthesis of tributary natural flows is greater in the lower portion of the basin where tributary streams generally are intermittent and have monthly flows that are much more variable than monthly flows from tributaries higher in the basin (Parrett and Johnson, 1989, p.14). In addition, many tributary streams are affected by irrigation withdrawals, and the assumption that estimated tributary flows are equivalent to natural flows may result in additional error.

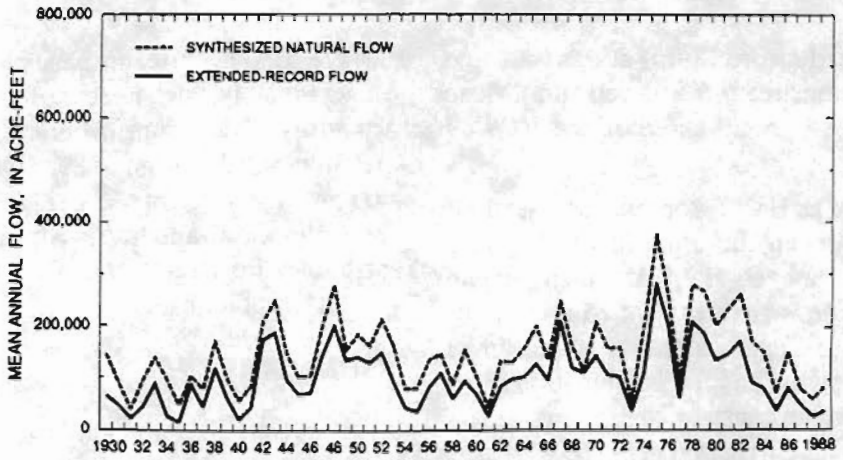
SUMMARY

Synthesized monthly natural streamflows for the base period 1929-89 at 13 selected sites were needed to evaluate various water-allocation alternatives on water availability in the Musselshell River Basin in central Montana. Streamflow records at 14 streamflow-gaging stations were used in the natural-flow synthesis process.

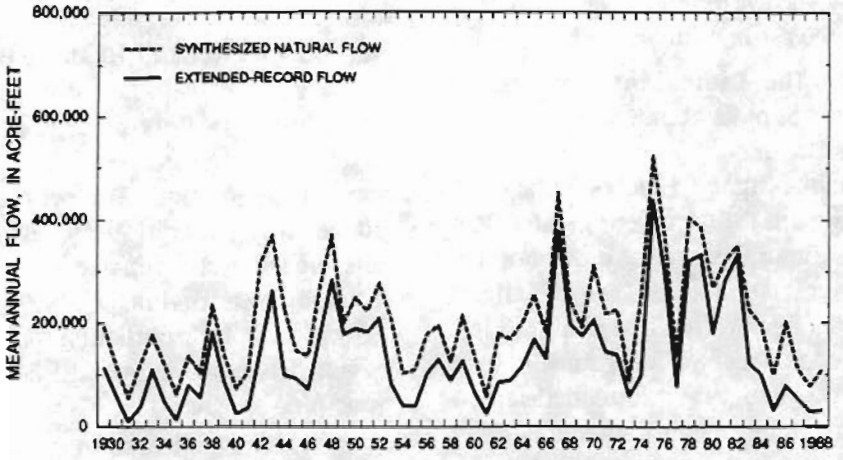
Monthly flow records at 14 gaged sites were extended to the base period using a streamflow record-extension program. The program used the MOVE.1 curve-fitting technique to estimate each month of missing record at each gaged site from recorded data at a nearby base station. Only those base stations with flow records for a particular month and year were used to estimate extended-record flows for that month and year at gaged sites.

The method used to synthesize monthly natural flows at the mainstem sites required the use of synthesized monthly natural flows for Musselshell River tributaries. Estimated long-term mean monthly flows from a previous study (Parrett and Johnson, 1989) were used together with monthly flow data from nearby gaged sites to synthesize monthly natural flows for the base period at tributary sites. Natural flows for each mainstem synthesis site were synthesized by successively adding tributary natural flows to the synthesized natural flows at the closest upstream synthesis site. Monthly natural flows at the mainstem site farthest upstream were considered to be equivalent to the extended-record flows.

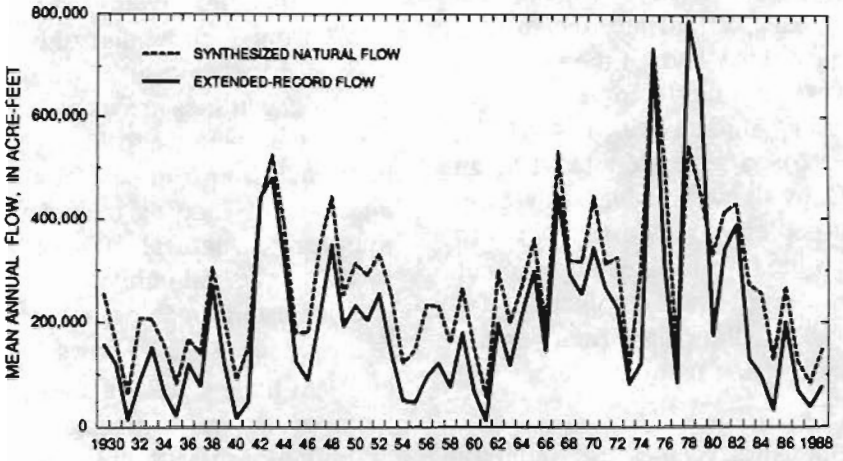
At three synthesis sites on tributaries, different methods for synthesizing natural flows were used. For South Fork Musselshell River above Martinsdale (site 12), monthly natural flows were synthesized by adding monthly natural flows for Cottonwood Creek at mouth, near Martinsdale (site 11) to the extended-record flows at the streamflow-gaging station, South Fork Musselshell River above Martinsdale (site 12). Monthly natural flows at the mouth of Careless Creek



2A. MUSSELSHELL RIVER AT HARLOWTON (SITE 20)



2B. MUSSELSHELL RIVER AT MUSSELSHELL (SITE 47)



2C. MUSSELSHELL RIVER AT MOSBY (SITE 59)

Figure 2. Comparison of extended-record flows with synthesized natural flows for the Musselshell River (2A) at Harlowton, (2B) at Musselshell, (2C) at Mosby.

near Ryegate (site 30) were considered to be equivalent to extended-record flows at Careless Creek at Wallum (site 29), a streamflow-gaging station upstream from the outflow from Deadman's Basin Reservoir. Extended-record flows for three sites (sites 55, 56, and 57) were added together to calculate monthly natural flows for Flatwillow Creek at mouth, near Mosby (site 58).

Comparisons were made between mean annual natural flows calculated from the synthesized monthly natural flows and mean annual flows calculated from monthly flows based on the extended-record at three sites that had streamflow-gaging stations. Annual irrigation depletions at the three sites, calculated as the difference between mean annual natural flows and mean annual extended-record flows, also were compared. Synthesized annual natural flows were greater than annual extended-record flows for all years in the base period at the Harlowton and Musselshell sites, and for all years but 1942, 1975, 1978, and 1979 at the Mosby site. Mean annual depletions at Harlowton and Musselshell appeared reasonable, given the amount of irrigated acreages upstream from each site. At Mosby, however, mean annual depletions were less than at Musselshell. The decreased mean annual depletion from Musselshell to Mosby indicated the presence of error in the synthesis of tributary flow. Depletions at the three comparison sites were recalculated excluding all data from 1942, 1975, 1978, and 1979, and the results showed an increase in mean annual depletions from Musselshell to Mosby.

REFERENCES CITED

Alley, W.M., and Burns, A.W., 1983, Mixed-station extension of monthly streamflow records: American Society of Civil Engineers, Journal of Hydraulic Engineering, v. 109, no. 10, p. 1,272-1,284.

Hirsch, R.M., 1982, A comparison of four streamflow record extension techniques: Water Resources Research, v. 18, no. 4, p. 1,081-1,088.

Parrett, Charles, and Johnson, D.R., 1989, Estimates of mean monthly streamflow for selected sites in the Musselshell River Basin, Montana, base period water years 1937-86: U.S. Geological Survey Water-Resources Investigations Report 89-4165, 31 p.

U.S. Soil Conservation Service, 1981, Average annual precipitation, Montana, based on 1941-70 base period: Bozeman, Mont., 13 p.

Supplemental Information

Table 1. Natural-flow synthesis and tributary sites, and selected streamflow-gaging stations, Musselshell River Basin, Montana

[–, not applicable]

Site no.	Stream name	Streamflow-gaging station no.	Natural-flow synthesis site	Tributary site
1	North Fork Musselshell River near Delpine	06115500	X	–
2	Checkerboard Creek at Checkerboard	–	–	X
3	Sourdough Creek at mouth, near Checkerboard	–	–	X
4	Trail Creek at mouth, near Checkerboard	–	–	X
5	Flagstaff Creek at mouth, near Checkerboard	–	–	X
6	Spring Creek at mouth, near Checkerboard	–	–	X
7	Whetstone Creek at mouth, near Checkerboard	–	–	X
8	Cooper Creek at mouth, near Checkerboard	–	–	X
9	North Fork Musselshell River above North Fork Diversion Canal, near Checkerboard	–	X	–
10	Mud Creek at mouth, near Martinsdale	–	–	X
11	Cottonwood Creek at mouth, near Martinsdale	–	–	X
12	South Fork Musselshell River above Martinsdale	06118500	X	X
13	Daisy Dean Creek at mouth, near Twodot	–	–	X
14	Willis Coulee at mouth, near Twodot	–	–	X
15	Miller Creek near mouth, near Twodot	–	–	X
16	Haymaker Creek at mouth, near Twodot	–	–	X
17	Big Elk Creek at Twodot	06120000	–	X
18	Mexican John Creek at mouth, near Harlowton	–	–	X
19	Hopley Creek at mouth, near Harlowton	–	–	X
20	Musselshell River at Harlowton	06120500	X	–
21	Antelope Creek above Alkali Creek, near Harlowton	–	–	X
22	American Fork near Harlowton	06121000	–	–
23	American Fork below Lebo Creek, near Harlowton	06122000	–	X
24	Timber Creek at mouth, near Harlowton	–	–	X
25	Musselshell River near Shawmut	–	X	–
26	Mud Creek near mouth, near Shawmut	–	–	X
27	Fish Creek near mouth, near Ryegate	–	–	X
28	Musselshell River near Ryegate	06123500[1]	X	–
29	Careless Creek at Wallum	06125500	–	X
30	Careless Creek at mouth, near Ryegate	–	X	X

Table 1. Natural-flow synthesis and tributary sites, and selected streamflow-gaging stations, Musselshell River Basin, Montana (Continued)

Site no.	Stream name	Streamflow-gaging station no.	Natural-flow synthesis site	Tributary site
31	Ninemile Creek at mouth, near Cushman	--	--	X
32	Fivemile Creek at mouth, near Lavina	--	--	X
33	Musselshell River near Lavina	--	X	--
34	Big Coulee Creek near Lavina	06125700	--	X
35	Painted Robe Creek at mouth, near Lavina	--	--	X
36	Musselshell River below Painted Robe Creek, near Lavina	--	X	--
37	Dean Creek near mouth, near Lavina	--	--	X
38	Stanley Creek at mouth, near Roundup	--	--	X
39	Goulding Creek at mouth, near Roundup	--	--	X
40	Currant Creek near Roundup	--	--	X
41	Horse Thief Creek at mouth, near Roundup	--	--	X
42	Halfbreed Creek near Klein	06126470	--	X
43	Musselshell River near Roundup	06126500[1]	X	--
44	Willow Creek at mouth, near Roundup	--	--	X
45	Parrot Creek at mouth, near Roundup	--	--	X
46	Fattig Creek at mouth, near Delphia	--	--	X
47	Musselshell River at Musselshell	06127500	X	--
48	Hawk Creek at Musselshell	--	--	X
49	McLean Coulee at mouth, near Musselshell	--	--	X
50	Carpenter Creek at mouth, near Musselshell	--	--	X
51	Lost Horse Creek at mouth, near Melstone	--	--	X
52	Home Creek near mouth, near Melstone	--	--	X
53	Rattlesnake Creek at mouth, near Mosby	--	--	X
54	North Willow Creek at mouth, near Mosby	--	--	X
55	Flatwillow Creek near Flatwillow	06127900	--	X
56	Box Elder Creek near Winnett	06129000	--	X
57	McDonald Creek at Winnett	06129500	--	X
58	Flatwillow Creek at mouth, near Mosby	--	X	X
59	Musselshell River at Mosby	06130500	X	--
	Total	16	13	48

[1]Recorded streamflow not used for natural flow synthesis.

Table 2. Streamflow-gaging stations whose records were used for various purposes, Musselshell River Basin, Montana

[–, not applicable]

Site no.	Stream name	Stream-flow-gaging station no.	Period of record	Gaging-station record used for indicated purpose			
				Monthly natural-flow synthesis at mainstem site	Monthly natural-flow synthesis at tributary site	Cor-relation	Com-parison
1	North Fork Musselshell River near Delpine	06115500	1940-79	X	–	X	–
12	South Fork Musselshell River above Martinsdale	06118500	1941-79	–	X	X	–
17	Big Elk Creek at Twodot	06120000	1953-56	–	X	X	–
20	Musselshell River at Harlowton	06120500	1907-29; 1930-32; 1933-33; 1934-90	–	–	–	X
22	American Fork near Harlowton	06121000	1907-11; 1913-13; 1924-29; 1930-30; 1931-32	-	–	X	–
23	American Fork below Lebo Creek, near Harlowton	06122000	1946-67	–	X	–	–
29	Careless Creek at Wallum	06125500	1934-42	–	X	X	–
34	Big Coulee Creek near Lavina	06125700	1957-72	–	X	X	–
42	Halfbreed Creek near Klein	06126470	1977-86; 1987-91	–	X	–	–
47	Musselshell River at Musselshell	06127500	1929-32; 1945-79; 1982-89	–	–	–	X
55	Flatwillow Creek near Flatwillow	06127900[1]	1911-32; 1934-56	–	[2]X	–	–
56	Box Elder Creek near Winnett	06129000	1930-32; 1934-38 1958-72	–	[2]X	X	–
57	McDonald Creek at Winnett	06129500	1930-32; 1934-45 1953-56	–	[2]X	X	–
59	Musselshell River at Mosby	06130500	1929-32; 1934-90	–	–	–	X
	Total	14	–	1	9	8	3

[1]Record after 1930 not used because of significantly increased irrigation diversions beginning about 1930.

[2]Records added together to synthesize tributary flows for Flatwillow Creek at mouth, near Mosby (site 58).

Table 3. Mainstem synthesis and tributary sites whose flows are added together to synthesize natural flows, Musselshell River Basin, Montana

[For sites shown between horizontal lines, monthly flows at tributary sites are added to monthly natural flows at mainstem site to calculate monthly natural flows at next downstream site; --, not applicable]

Site no.	Mainstem synthesis site	Site no.	Tributary site
1	North Fork Musselshell River near Delpine		--
	--	2	Checkerboard Creek at Checkerboard
	--	3	Sourdough Creek at mouth, near Checkerboard
	--	4	Trail Creek at mouth, near Checkerboard
	--	5	Flagstaff Creek at mouth, near Checkerboard
	--	6	Spring Creek at mouth, near Checkerboard
	--	7	Whetstone Creek at mouth, near Checkerboard
	--	8	Cooper Creek at mouth, near Checkerboard
9	North Fork Musselshell River above North Fork Diversion Canal, near Checkerboard		--
	--	10	Mud Creek at mouth, near Martinsdale
	--	11	[1]Cottonwood Creek at mouth, near Martinsdale
	--	12	South Fork Musselshell River above Martinsdale
	--	13	Daisy Dean Creek at mouth, near Twodot
	--	14	Willis Coulee at mouth, near Twodot
	--	15	Miller Creek near mouth, near Twodot
	--	16	Haymaker Creek at mouth, near Twodot
	--	17	Big Elk Creek at Twodot
	--	18	Mexican John Creek at mouth, near Harlowton
	--	19	Hopley Creek at mouth, near Harlowton
20	Musselshell River at Harlowton		--
	--	21	Antelope Creek above Alkali Creek, near Harlowton
	--	23	American Fork below Lebo Creek, near Harlowton
	--	24	Timber Creek at mouth, near Harlowton
25	Musselshell River near Shawmut		--
	--	26	Mud Creek near mouth, near Shawmut
	--	27	Fish Creek near mouth, near Ryegate
28	Musselshell River near Ryegate		--
	--	30	[2]Careless Creek at mouth, near Ryegate
	--	31	Ninemile Creek at mouth, near Cushman
	--	32	Fivemile Creek at mouth, near Lavina
33	Musselshell River near Lavina		--
	--	34	Big Coulee Creek near Lavina
	--	35	Painted Robe Creek at mouth, near Lavina

Table 3. Mainstem synthesis and tributary sites whose flows are added together to synthesize natural flows, Musselshell River Basin, Montana (Continued)

Site no.	Mainstem synthesis site	Site no.	Tributary site
36	Musselshell River below Painted Robe Creek, near Lavina		–
	–	37	Dean Creek near mouth, near Lavina
	–	38	Stanley Creek at mouth, near Roundup
	–	39	Goulding Creek at mouth, near Roundup
	–	40	Currant Creek near Roundup
	–	41	Horse Thief Creek at mouth, near Roundup
	–	42	Halfbreed Creek near Klein
43	Musselshell River near Roundup		–
	–	44	Willow Creek at mouth, near Roundup
	–	45	Parrot Creek at mouth, near Roundup
	–	46	Fattig Creek at mouth, near Delphia
47	Musselshell River at Musselshell		–
	–	48	Hawk Creek at Musselshell
	–	49	McLean Coulee at mouth, near Musselshell
	–	50	Carpenter Creek at mouth, near Musselshell
	–	51	Lost Horse Creek at mouth, near Melstone
	–	52	Home Creek near mouth, near Melstone
	–	53	Rattlesnake Creek at mouth, near Mosby
	–	54	North Willow Creek at mouth, near Mosby
	–	58	[3]Flatwillow Creek at mouth, near Mosby
59	Musselshell River at Mosby		–

[1]Tributary to South Fork Musselshell River above Martinsdale (site 12).

[2]Based on extended-record flows for Careless Creek at Wallum (site 29).

[3]Includes extended-record flows for Flatwillow Creek near Flatwillow (site 55), Box Elder Creek near Winnett (site 56), and McDonald Creek at Winnett (site 57).

Table 4. Ungaged tributary sites with corresponding gaged sites used for synthesis, Musselshell River Basin, Montana

Site no.	Tributary site	Site no.	Gaged site used for synthesis	Stream-flow-gaging station no.
2	Checkerboard Creek at Checkerboard	1	North Fork Musselshell River near Delpine	06115500
3	Sourdough Creek at mouth, near Checkerboard	29	Careless Creek at Wallum	06125500
4	Trail Creek at mouth, near Checkerboard	22	American Fork near Harlowton	06121000
5	Flagstaff Creek at mouth, near Checkerboard	22	American Fork near Harlowton	06121000
6	Spring Creek at mouth, near Checkerboard	12	South Fork Musselshell River above Martinsdale	06118500
7	Whetstone Creek at mouth, near Checkerboard	1	North Fork Musselshell River near Delpine	06115500
8	Cooper Creek at mouth, near Checkerboard	1	North Fork Musselshell River near Delpine	06115500
10	Mud Creek at mouth, near Martinsdale	29	Careless Creek at Wallum	06125500
11	Cottonwood Creek at mouth, near Martinsdale	12	South Fork Musselshell River above Martinsdale	06118500
13	Daisy Dean Creek at mouth, near Twodot	29	Careless Creek at Wallum	06125500
14	Willis Coulee at mouth, near Twodot	57	McDonald Creek at Winnett	06129500
15	Miller Creek near mouth, near Twodot	34	Big Coulee Creek near Lavina	06125700
16	Haymaker Creek at mouth, near Twodot	34	Big Coulee Creek near Lavina	06125700
18	Mexican John Creek at mouth, near Harlowton	1	North Fork Musselshell River near Delpine	06115500
19	Hopley Creek at mouth, near Harlowton	34	Big Coulee Creek near Lavina	06125700
21	Antelope Creek above Alkali Creek, near Harlowton	1	North Fork Musselshell River near Delpine	06115500
24	Timber Creek at mouth, near Harlowton	57	McDonald Creek at Winnett	06129500
26	Mud Creek near mouth, near Shawmut	34	Big Coulee Creek near Lavina	06125700
27	Fish Creek near mouth, near Ryegate	34	Big Coulee Creek near Lavina	06125700
31	Ninemile Creek at mouth, near Cushman	17	Big Elk Creek at Twodot	06120000
32	Fivemile Creek at mouth, near Lavina	34	Big Coulee Creek near Lavina	06125700
35	Painted Robe Creek at mouth, near Lavina	1	North Fork Musselshell River near Delpine	06115500
37	Dean Creek near mouth, near Lavina	34	Big Coulee Creek near Lavina	06125700
38	Stanley Creek at mouth, near Roundup	57	McDonald Creek at Winnett	06129500
39	Goulding Creek at mouth, near Roundup	57	McDonald Creek at Winnett	06129500
40	Currant Creek near Roundup	1	North Fork Musselshell River near Delpine	06115500
41	Horse Thief Creek at mouth, near Roundup	34	Big Coulee Creek near Lavina	06125700
44	Willow Creek at mouth, near Roundup	57	McDonald Creek at Winnett	06129500
45	Parrot Creek at mouth, near Roundup	34	Big Coulee Creek near Lavina	06125700
46	Fattig Creek at mouth, near Delphia	34	Big Coulee Creek near Lavina	06125700
48	Hawk Creek at Musselshell	34	Big Coulee Creek near Lavina	06125700
49	McLean Coulee at mouth, near Musselshell	34	Big Coulee Creek near Lavina	06125700
50	Carpenter Creek at mouth, near Musselshell	34	Big Coulee Creek near Lavina	06125700
51	Lost Horse Creek at mouth, near Melstone	34	Big Coulee Creek near Lavina	06125700
52	Home Creek near mouth, near Melstone	34	Big Coulee Creek near Lavina	06125700
53	Rattlesnake Creek at mouth, near Mosby	57	McDonald Creek at Winnett	06129500
54	North Willow Creek at mouth, near Mosby	56	Box Elder Creek near Winnett	06129000

Table 5. Mean annual extended-record and synthesized natural flows, depletions, and irrigated acreage for three sites on the Musselshell River, Montana, base period 1929-89

Site no.	Stream name	Mean annual flow, in acre-feet		Mean annual depletion, in acre-feet	Irrigated acreage upstream from site
		Extended-record	Synthesized natural		
20	Musselshell River at Harlowton	101,000	150,000	49,000	30,100
47	Musselshell River at Musselshell	134,000	206,000	72,000	44,600
59	Musselshell River at Mosby	199,000	268,000	69,000	47,000

Table 6. Mean annual extended-record and synthesized natural flows, depletions, and irrigated acreage for three sites on the Musselshell River, Montana, base period 1929-41, 1943-74,1976-77, 1980-89

Site no.	Stream name	Mean annual flow, in acre-feet		Mean annual depletion, in acre-feet	Irrigated acreage upstream from site
		Extended-record	Natural		
20	Musselshell River at Harlowton	93,000	141,000	48,000	30,100
47	Musselshell River at Musselshell	121,000	191,000	70,000	44,600
59	Musselshell River at Mosby	166,000	249,000	83,000	47,000

Table 7. Synthesized monthly natural flows for North Fork Musselshell River near Delpine, Montana, in acre-feet

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1929	300	330	780	710	1,700	1,500	540	390	320	340	420	360	7,700
1930	200	350	360	2,300	1,100	790	460	310	270	300	380	290	7,100
1931	230	230	460	640	510	500	470	200	270	290	420	260	4,500
1932	220	140	330	460	1,300	1,200	760	280	320	310	400	340	6,100
1933	280	220	340	520	1,400	1,500	720	220	210	210	380	350	6,400
1934	290	320	420	1,700	950	1,800	470	180	290	300	510	350	7,600
1935	280	160	370	600	760	610	760	200	270	300	360	280	5,000
1936	180	260	720	650	1,400	590	460	220	270	290	320	270	5,600
1937	140	310	310	460	1,000	800	740	140	270	390	290	270	5,100
1938	200	320	500	710	1,400	1,600	1,100	780	280	310	480	380	8,100
1939	380	260	530	1,300	1,400	630	720	240	280	290	270	330	6,600
1940	230	260	420	740	910	610	420	200	240	280	290	300	4,900
1941	230	190	450	330	320	810	530	260	390	390	370	340	4,600
1942	280	230	270	1,500	1,400	2,600	960	650	460	430	420	380	9,600
1943	360	270	1,100	1,900	1,800	2,300	1,000	800	460	460	460	360	11,300
1944	280	240	300	510	750	1,400	1,100	700	490	440	390	350	7,000
1945	360	280	490	410	570	1,700	750	580	400	410	380	310	6,600
1946	310	220	840	950	1,500	1,400	1,400	770	600	580	530	530	9,600
1947	420	450	1,800	1,700	2,700	2,100	1,000	880	680	640	580	530	13,500
1948	500	350	420	2,100	3,000	3,300	1,700	850	490	440	360	280	13,800
1949	300	300	310	1,500	2,200	2,200	940	840	630	600	520	370	10,700
1950	220	830	660	1,300	1,700	2,200	1,200	980	600	570	460	390	11,100
1951	260	390	570	1,000	2,000	1,700	700	540	520	360	480	410	8,900
1952	350	320	330	1,800	2,600	1,500	740	720	540	500	400	340	10,100
1953	330	340	520	520	950	3,100	1,000	640	460	280	460	440	9,000
1954	310	330	310	660	610	730	400	460	280	390	390	260	5,100
1955	260	170	150	400	680	1,100	740	460	230	260	420	360	5,200
1956	310	280	530	1,200	1,500	1,000	470	410	240	240	330	330	6,800
1957	270	330	420	800	1,500	1,700	950	630	490	470	410	290	8,300
1958	340	320	630	1,100	1,300	1,000	680	610	470	310	420	430	7,600
1959	360	290	390	860	1,200	2,200	1,000	610	490	520	420	350	8,700
1960	310	280	610	1,000	1,300	1,300	490	260	180	180	420	410	6,700
1961	370	320	400	430	490	490	310	200	180	190	230	280	3,900
1962	260	310	420	900	1,200	1,700	660	380	260	250	390	400	7,100
1963	260	370	470	710	1,200	1,300	720	310	210	220	360	360	6,500
1964	410	360	310	690	2,300	2,500	1,000	440	330	280	360	430	9,400
1965	460	380	390	1,800	2,400	2,700	1,400	740	950	970	770	640	13,600
1966	420	460	1,100	900	1,400	890	380	300	230	310	410	370	7,200
1967	370	340	380	940	2,800	3,900	1,500	660	660	810	690	560	13,600
1968	530	670	1,200	980	1,700	2,300	1,100	790	760	740	620	430	11,800
1969	390	410	470	2,400	1,300	620	470	330	300	330	300	340	7,700
1970	390	380	400	1,400	3,100	2,000	790	400	320	490	470	420	10,600
1971	410	360	400	1,500	2,000	1,500	570	340	270	430	430	280	8,500
1972	300	390	1,100	1,000	1,600	1,900	880	540	600	610	430	360	9,700
1973	410	350	440	440	450	320	200	160	180	260	400	330	3,900
1974	440	300	740	1,100	1,500	1,800	580	490	570	330	490	440	8,800
1975	360	370	410	550	2,600	3,300	1,800	1,000	640	510	680	750	13,000
1976	550	520	660	1,400	2,400	1,400	580	340	270	240	470	390	9,200
1977	380	380	600	1,500	610	480	290	220	180	390	490	330	5,900
1978	360	430	920	2,400	3,000	2,300	1,400	780	610	700	500	380	13,800
1979	330	400	650	1,600	2,500	2,600	1,600	890	620	360	450	410	12,400
1980	300	330	420	2,200	1,100	2,600	1,900	1,000	990	420	530	450	12,200

Table 7. Synthesized monthly natural flows for North Fork Musselshell River near Delpine, Montana, in acre-feet (Continued)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1981	370	420	770	1,600	2,800	2,200	2,300	1,200	840	300	500	380	13,700
1982	390	460	750	830	1,600	2,900	1,900	180	960	560	500	440	11,500
1983	450	430	730	840	1,400	1,100	1,600	730	620	270	520	460	9,200
1984	480	440	500	1,100	1,600	1,300	730	100	400	400	400	330	7,800
1985	330	390	480	1,900	970	390	210	200	420	420	520	410	6,600
1986	400	390	890	1,000	1,400	1,400	810	460	670	280	460	390	8,600
1987	260	330	570	920	740	580	570	240	390	330	340	270	5,500
1988	220	300	360	750	590	530	240	110	270	250	330	290	4,200
1989	250	300	700	1,300	1,300	730	590	420	460	330	460	420	7,300

[1]Values may not total due to rounding.

Table 8. Synthesized monthly natural flows for North Fork Musselshell River above North Fork Diversion Canal near Checkerboard, Montana, in acre-feet

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1929	1,300	760	2,300	3,500	10,400	13,500	1,300	740	800	1,700	1,900	710	38,900
1930	360	1,200	1,100	6,300	4,200	2,900	920	540	500	560	730	520	19,800
1931	410	580	950	1,500	1,600	1,800	950	340	460	550	740	500	10,400
1932	380	250	640	1,100	4,700	11,600	1,500	510	530	600	810	640	23,300
1933	490	410	650	1,700	6,900	7,800	1,500	470	420	440	710	680	22,200
1934	560	590	890	3,800	2,800	8,300	940	320	470	620	880	640	20,800
1935	500	280	700	1,400	2,200	2,200	2,000	350	450	610	640	500	11,800
1936	350	460	2,000	2,300	5,800	2,900	930	390	460	530	560	480	17,200
1937	240	560	660	1,600	4,000	3,400	1,800	260	460	1,300	520	460	15,300
1938	350	720	950	1,800	7,000	7,600	4,900	1,400	520	600	1,500	690	28,000
1939	670	470	1,600	3,700	5,200	4,100	1,900	430	500	580	520	540	20,200
1940	410	460	970	1,800	2,800	2,400	950	350	410	600	610	510	12,300
1941	410	410	900	880	1,800	4,500	1,200	490	2,000	1,300	1,200	1,800	16,900
1942	1,300	800	990	6,500	13,500	16,200	3,500	2,100	1,900	2,100	2,000	2,300	53,200
1943	2,000	2,200	3,000	8,000	9,900	17,900	4,400	2,400	1,600	2,000	2,500	2,200	58,100
1944	1,500	790	1,100	3,000	4,100	13,200	5,300	2,900	2,000	2,000	2,000	2,100	40,000
1945	2,000	1,000	1,300	1,300	2,500	8,100	1,900	990	690	810	790	580	22,000
1946	570	450	1,600	2,800	5,700	5,200	3,000	1,300	1,000	1,200	1,000	1,200	25,000
1947	760	870	3,300	4,400	11,500	9,300	2,600	1,600	1,300	1,500	1,200	1,100	39,400
1948	940	680	870	5,300	12,500	16,200	4,600	1,900	1,000	990	760	590	46,300
1949	560	600	830	4,300	8,900	7,300	2,100	1,400	1,100	1,200	970	660	29,900
1950	400	1,400	1,200	3,200	7,000	10,000	3,500	2,000	1,200	1,300	920	780	32,900
1951	490	760	1,200	2,600	8,600	6,700	2,000	1,200	1,100	890	940	790	27,300
1952	650	610	670	5,300	13,900	6,900	2,100	1,400	1,000	970	730	610	34,800
1953	600	650	1,000	1,300	4,900	17,100	2,800	1,100	740	500	810	770	32,300
1954	550	950	700	1,900	2,800	3,400	960	950	460	870	740	460	14,700
1955	450	300	330	3,400	3,800	5,300	2,100	840	400	510	770	690	18,900
1956	570	520	1,400	3,300	7,000	4,200	1,100	870	420	470	620	590	21,100
1957	470	560	810	1,800	7,000	8,200	2,700	1,200	960	1,000	780	570	26,100
1958	610	610	1,300	2,700	5,600	3,700	1,600	1,100	820	630	760	770	20,200
1959	650	540	1,600	2,400	4,800	9,800	2,400	1,100	890	1,100	900	740	26,900
1960	570	520	1,800	2,900	5,000	4,500	1,100	510	360	420	770	740	19,200
1961	650	580	760	950	1,800	1,800	640	340	320	400	450	500	9,200
1962	450	710	910	2,400	7,000	9,000	2,000	1,200	570	690	750	780	26,500
1963	470	1,400	1,200	1,900	6,100	5,800	1,800	580	440	540	700	660	21,600
1964	710	640	610	1,700	9,500	11,200	2,800	1,100	620	630	680	860	31,100
1965	930	1,300	1,100	6,000	10,100	10,900	3,800	1,500	2,100	2,300	1,500	1,300	42,800
1966	850	850	2,600	2,800	6,700	3,400	1,100	570	450	660	760	680	21,400
1967	660	780	940	2,500	10,500	17,300	3,900	1,300	1,200	1,600	1,300	990	43,000
1968	950	1,300	2,300	2,300	5,900	10,400	3,000	1,500	1,400	1,500	1,200	790	32,500
1969	710	760	1,600	6,700	4,700	2,900	2,300	670	590	760	630	630	23,000
1970	680	810	900	3,200	14,800	10,100	2,200	800	690	1,100	890	770	36,900
1971	920	1,900	1,500	4,300	7,900	6,000	1,600	650	590	1,000	890	570	27,800
1972	570	810	3,000	3,100	7,000	7,300	2,200	1,200	1,200	1,400	860	640	29,300
1973	690	640	880	1,200	2,100	2,300	730	430	490	740	910	680	11,800
1974	920	610	1,600	3,300	6,700	9,600	2,000	1,200	1,200	890	980	820	29,800
1975	640	670	830	1,800	10,600	19,900	6,500	2,400	1,500	1,400	1,400	1,500	49,100
1976	1,100	960	1,400	3,800	13,200	7,000	2,100	1,100	850	800	1,000	750	34,100
1977	710	750	1,100	3,600	3,500	2,700	890	510	430	840	930	660	16,600
1978	650	780	2,300	6,100	13,300	10,700	4,500	1,600	1,400	1,600	1,100	750	44,800
1979	570	750	1,800	3,700	11,100	13,000	4,000	1,700	1,200	900	850	790	40,400
1980	570	660	840	4,900	6,300	11,300	4,300	2,100	1,900	1,000	1,100	920	35,900

Table 8. Synthesized monthly natural flows for North Fork Musselshell River above North Fork Diversion Canal near Checkerboard, Montana, in acre-feet (Continued)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1981	670	790	1,600	3,900	12,300	9,800	5,100	2,300	1,500	1,000	1,500	1,500	42,000
1982	2,100	1,500	1,800	2,700	9,900	18,300	6,600	1,300	2,600	2,700	2,300	2,000	53,800
1983	2,200	1,300	1,900	4,200	7,700	6,000	4,800	2,200	2,000	2,000	1,500	2,000	37,800
1984	1,500	950	1,200	3,300	7,500	7,400	2,000	610	990	1,100	890	650	28,100
1985	600	630	960	4,200	3,700	1,800	520	520	1,000	1,100	1,200	870	17,100
1986	730	810	2,100	2,500	6,100	6,600	2,100	980	1,400	850	970	830	26,000
1987	490	600	1,200	2,100	3,400	2,300	1,500	660	830	840	710	580	15,200
1988	370	540	740	1,700	3,000	2,400	590	290	540	600	670	590	12,000
1989	440	500	1,500	2,800	4,800	3,400	1,500	800	1,000	870	1,100	920	19,600

[1]Values may not total due to rounding.

Table 9. Synthesized monthly natural flows for South Fork Musselshell River above Martinsdale, Montana, in acre-feet

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1929	1,200	1,400	6,400	8,400	27,800	30,200	930	1,500	2,200	1,200	2,200	2,100	85,500
1930	660	1,400	2,100	14,900	17,800	13,500	790	460	990	680	1,600	1,100	56,000
1931	800	900	2,100	1,700	4,200	8,700	640	340	450	920	1,100	1,400	23,300
1932	710	480	1,500	4,200	20,400	30,800	75	530	280	1,100	1,600	1,600	63,300
1933	1,200	1,100	790	11,000	48,500	37,900	290	1,000	1,300	1,300	1,700	1,900	108,000
1934	1,900	1,300	3,500	9,000	8,800	36,000	800	430	280	1,700	900	1,400	66,000
1935	1,100	560	1,500	3,700	6,500	9,800	1,400	370	240	1,500	890	850	28,400
1936	1,300	880	1,400	9,500	39,000	21,600	990	490	450	520	970	940	78,000
1937	370	1,300	1,200	11,400	23,600	15,400	470	580	390	2,600	770	580	58,700
1938	660	1,200	1,500	7,600	51,000	39,900	22,000	2,700	1,300	1,100	2,800	1,600	133,000
1939	1,700	1,000	5,200	8,300	24,400	16,800	2,000	660	900	1,300	1,400	480	64,100
1940	820	870	2,400	5,700	9,700	11,800	2,600	440	440	1,700	2,800	750	40,000
1941	890	1,500	2,700	3,800	15,000	27,500	2,900	1,100	2,600	8,300	5,300	3,600	75,200
1942	2,400	1,900	2,400	13,800	44,800	46,500	2,700	1,200	1,800	2,600	2,300	1,900	124,000
1943	1,500	1,700	3,800	36,600	46,900	58,900	6,500	1,900	1,100	1,700	2,200	1,700	165,000
1944	1,000	780	1,400	4,500	19,700	38,400	13,300	1,800	1,200	1,800	1,900	1,300	87,100
1945	1,400	1,100	1,300	1,500	15,000	33,500	3,800	610	750	1,700	2,600	1,600	64,900
1946	1,900	1,300	3,600	13,000	24,400	13,600	2,900	570	1,100	2,700	2,900	5,200	73,200
1947	1,800	2,300	4,100	19,200	51,200	42,600	4,400	1,100	2,500	4,400	3,700	3,400	141,000
1948	2,700	1,900	2,800	18,400	63,800	78,600	18,800	5,400	2,400	2,800	3,000	2,400	203,000
1949	2,000	1,900	4,600	19,500	43,800	24,300	3,300	82	790	2,200	2,000	1,300	106,000
1950	1,000	1,300	440	9,700	39,100	60,200	12,700	4,000	2,200	3,600	2,800	2,100	139,000
1951	1,400	2,000	3,700	10,200	47,400	29,800	7,200	3,200	3,000	3,500	2,900	2,200	117,000
1952	1,900	1,500	1,600	25,700	80,600	31,400	7,100	1,600	1,500	1,700	1,500	1,200	157,000
1953	1,400	1,300	2,400	5,300	20,000	75,200	5,300	1,700	34	370	1,100	1,300	115,000
1954	1,100	1,300	1,800	5,500	19,800	21,000	3,300	560	240	1,000	1,400	840	57,800
1955	680	600	940	3,500	11,200	22,600	7,800	1,300	610	940	1,600	2,000	53,800
1956	1,500	1,300	3,400	10,400	49,200	25,900	3,000	730	510	860	1,200	1,100	99,100
1957	730	710	1,900	4,200	41,500	46,800	10,700	2,300	1,700	2,400	2,200	1,800	117,000
1958	1,200	1,600	3,600	8,200	25,300	8,800	3,000	1,200	800	1,300	1,300	1,400	57,700
1959	1,700	1,200	2,500	6,900	27,600	65,400	7,000	1,400	1,400	3,100	3,100	1,900	123,000
1960	1,600	1,100	7,700	9,400	25,700	19,500	2,000	1,100	1,200	1,700	1,700	1,400	74,100
1961	1,200	1,100	1,600	2,000	9,100	8,100	540	180	430	1,200	1,100	970	27,500
1962	820	1,000	1,900	9,200	35,000	35,000	8,600	3,100	2,400	3,800	2,500	2,300	106,000
1963	1,200	2,300	3,400	5,000	37,100	35,000	5,900	1,300	1,400	2,300	2,200	1,500	98,600
1964	1,300	1,100	1,400	5,000	35,700	57,000	8,100	1,500	1,100	1,900	1,800	2,400	118,000
1965	2,200	2,000	1,300	14,900	39,700	56,000	12,600	4,000	8,800	8,700	4,700	3,300	158,000
1966	2,200	1,600	4,800	11,500	46,200	18,000	4,800	1,300	1,000	1,700	1,900	1,500	96,500
1967	1,400	1,300	3,800	10,000	50,700	96,800	13,800	2,600	1,800	3,000	2,800	1,700	190,000
1968	1,700	3,000	4,400	6,000	26,500	49,500	11,500	3,500	2,900	3,400	3,000	1,600	117,000
1969	1,500	1,700	2,700	21,200	19,400	11,200	8,500	1,900	1,500	2,400	2,500	1,300	75,800
1970	1,200	1,600	2,100	6,100	62,400	64,300	9,700	2,000	2,400	2,900	1,800	1,700	158,000
1971	2,200	3,200	4,000	12,800	42,300	32,800	7,900	1,200	2,000	3,500	2,700	2,000	117,000
1972	1,900	2,600	10,200	10,400	35,800	34,200	5,600	3,300	2,200	2,600	1,800	1,100	112,000
1973	810	1,300	2,300	4,200	4,800	9,700	1,800	1,800	1,400	2,900	3,100	2,400	36,500
1974	4,500	1,900	6,400	15,900	37,800	57,800	9,700	4,800	3,500	3,400	3,100	2,000	151,000
1975	1,400	1,400	2,300	10,000	55,600	159,000	39,700	7,400	4,200	4,700	4,300	4,800	295,000
1976	2,700	1,800	4,200	15,600	92,300	36,400	10,600	5,800	3,800	3,600	2,700	2,200	182,000
1977	2,100	2,000	2,100	8,800	24,400	14,800	4,200	2,200	2,200	2,400	2,000	2,200	69,400
1978	1,700	1,400	7,700	19,500	78,400	61,200	24,000	3,800	4,200	4,300	3,300	2,500	212,000
1979	650	1,700	7,200	11,100	64,200	88,500	14,500	3,900	2,000	3,700	2,100	2,300	202,000
1980	1,600	2,000	2,100	9,800	41,100	65,200	10,000	5,000	3,400	3,900	3,500	3,100	151,000

Table 9. Synthesized monthly natural flows for South Fork Musselshell River above Martinsdale, Montana, in acre-feet (Continued)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1981	1,600	1,900	5,200	12,900	69,200	52,600	7,400	4,600	2,100	3,400	2,800	2,400	166,000
1982	960	2,200	5,800	15,500	43,900	74,700	22,700	4,800	3,000	3,500	3,300	2,500	183,000
1983	2,800	2,300	5,600	25,100	28,500	22,400	8,600	4,200	3,900	3,100	2,000	1,200	110,000
1984	4,100	2,100	4,700	8,900	24,500	28,900	4,600	6,000	2,100	3,800	2,600	2,100	94,400
1985	1,400	430	2,800	6,500	11,400	6,600	780	2,900	5,000	5,200	6,400	3,500	52,900
1986	1,900	2,400	11,500	6,000	26,900	31,400	6,900	3,500	3,300	4,300	4,300	3,200	106,000
1987	1,000	1,300	3,700	3,300	16,400	10,300	4,400	3,400	3,400	4,000	2,900	2,400	56,500
1988	700	980	2,300	3,300	11,800	9,400	1,300	2,100	1,800	2,700	2,800	2,100	41,300
1989	880	450	5,900	3,700	18,600	13,700	3,400	1,300	4,300	4,300	7,700	4,100	68,300

[1]Values may not total due to rounding.

Table 10. Synthesized monthly natural flows for Musselshell River at Harlowton, Montana, in acre-feet

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1929	3,100	3,000	10,500	13,800	40,600	45,800	3,100	2,500	3,200	3,300	4,700	3,500	137,000
1930	1,500	3,500	4,800	23,100	23,900	17,200	2,000	1,300	1,900	1,700	2,900	2,100	85,900
1931	1,600	1,900	3,600	3,900	6,900	11,100	1,900	990	1,200	2,000	2,400	2,200	39,700
1932	1,400	1,100	2,800	6,100	26,800	44,700	2,200	1,300	1,100	2,200	3,000	2,600	95,300
1933	2,100	1,900	2,100	13,700	56,900	48,000	2,400	1,900	2,200	2,300	2,800	3,000	139,000
1934	2,900	2,600	5,300	14,400	12,700	45,900	2,100	950	1,000	2,600	2,200	2,400	95,100
1935	1,900	1,200	2,700	6,000	10,100	12,800	4,200	990	940	2,300	2,000	1,800	46,900
1936	2,000	1,700	4,900	13,400	46,400	25,500	2,200	1,100	1,200	1,400	1,900	1,800	104,000
1937	930	2,200	2,500	13,800	29,200	20,300	2,800	1,100	1,100	4,300	1,600	1,400	81,200
1938	1,400	2,500	3,400	10,600	60,900	50,900	29,700	4,500	2,200	2,400	5,200	3,000	177,000
1939	2,900	1,800	8,400	13,900	32,200	22,700	4,300	1,400	1,600	2,300	2,400	1,400	95,300
1940	1,600	1,800	4,300	8,500	14,000	15,100	3,900	1,000	1,100	3,000	4,000	1,800	60,100
1941	1,700	2,400	4,300	5,500	17,700	34,200	4,500	1,900	5,400	10,700	7,600	6,600	103,000
1942	4,400	3,600	5,100	23,900	63,500	69,700	8,000	4,200	4,100	5,600	5,200	5,500	203,000
1943	4,300	5,500	9,100	48,700	60,800	84,900	13,700	5,500	3,400	4,600	5,600	5,100	251,000
1944	3,300	2,200	3,600	8,700	25,200	58,500	21,900	6,100	4,000	4,600	4,700	4,600	147,000
1945	4,400	3,000	3,900	3,700	18,900	44,700	6,600	1,900	1,900	3,000	4,200	2,700	98,900
1946	3,000	2,300	6,500	17,500	32,300	20,500	6,900	2,100	3,100	5,200	5,000	7,700	112,000
1947	3,400	4,100	10,400	26,400	67,500	56,000	8,200	3,300	4,500	7,100	6,000	5,900	203,000
1948	5,100	3,300	5,100	25,900	81,600	103,000	25,600	8,100	4,100	4,800	4,900	4,000	276,000
1949	3,200	3,000	6,600	26,500	56,300	34,100	5,900	1,800	2,300	4,100	3,800	2,600	150,000
1950	1,900	4,100	3,100	14,400	47,800	74,400	17,800	6,600	4,000	5,900	4,700	3,800	189,000
1951	2,600	3,800	7,100	14,500	60,000	39,600	10,200	5,100	4,800	5,300	4,700	3,700	161,000
1952	3,000	2,900	3,700	33,900	99,200	40,700	10,200	3,400	2,900	3,100	2,800	2,300	208,000
1953	2,700	2,500	4,300	7,400	25,900	98,600	9,600	3,300	1,100	1,400	2,600	2,700	162,000
1954	2,200	3,200	3,300	8,200	23,800	25,400	5,400	2,100	940	2,200	2,700	1,800	81,200
1955	1,700	1,300	1,800	8,700	15,700	31,300	11,500	2,600	1,300	2,000	2,800	3,400	84,100
1956	2,800	2,500	6,600	14,900	62,000	32,900	4,400	1,800	1,100	1,400	1,900	1,800	134,000
1957	1,400	1,400	3,000	6,500	52,700	58,100	13,900	3,800	3,000	3,800	3,200	2,700	154,000
1958	2,200	2,500	5,400	11,300	35,200	14,500	5,100	2,600	1,800	2,100	2,200	2,300	87,200
1959	2,500	1,800	6,400	10,100	34,600	79,900	10,500	2,800	2,600	4,600	4,300	2,900	163,000
1960	2,400	1,800	10,300	13,100	32,700	26,500	3,400	1,800	1,700	2,200	2,600	2,600	101,000
1961	2,000	1,800	2,500	3,100	12,400	11,800	1,400	570	860	1,700	1,700	1,500	41,300
1962	1,300	1,900	3,500	12,500	44,800	47,700	11,200	4,500	3,200	4,700	3,500	3,300	142,000
1963	1,800	4,300	5,000	7,400	46,600	44,500	8,500	2,100	2,100	3,000	3,000	2,200	131,000
1964	2,200	1,900	2,100	7,200	48,200	75,600	12,300	2,900	2,000	2,800	2,700	3,600	164,000
1965	3,400	3,800	2,800	22,500	53,500	73,600	17,600	5,900	11,600	11,500	6,500	4,900	218,000
1966	3,300	2,800	8,800	15,100	54,500	22,200	6,200	2,000	1,600	2,500	2,700	2,300	124,000
1967	2,200	2,200	5,000	12,800	64,400	129,000	19,800	4,600	3,600	5,400	4,800	3,100	257,000
1968	3,300	5,300	7,900	9,500	35,500	64,300	16,100	5,800	5,000	5,700	4,900	2,900	166,000
1969	2,800	2,900	7,500	30,000	28,700	16,500	11,800	3,000	2,400	3,600	3,500	2,200	115,000
1970	2,200	2,800	3,600	9,900	83,100	80,500	13,300	3,300	3,800	4,700	3,200	2,900	213,000
1971	3,800	6,300	6,500	18,500	56,000	43,600	10,200	2,100	3,100	4,900	4,000	2,800	162,000
1972	2,800	4,700	15,400	14,400	47,000	49,300	8,900	5,100	3,800	5,800	4,400	2,300	164,000
1973	2,300	2,600	4,200	6,800	9,000	13,900	3,100	2,400	2,700	4,500	5,400	3,800	60,700
1974	6,200	3,400	9,200	21,100	47,500	75,900	13,000	6,800	5,900	5,300	5,300	3,700	203,000
1975	2,600	2,700	4,300	14,100	72,500	191,000	54,600	11,800	7,400	8,000	8,200	8,300	386,000
1976	5,100	3,900	7,700	22,500	118,000	50,500	14,600	8,000	6,000	6,200	5,500	4,300	252,000
1977	3,600	3,700	4,200	13,700	28,700	18,600	5,400	2,900	3,200	4,300	3,900	3,600	95,800
1978	3,000	3,000	14,000	28,800	97,200	77,100	31,500	6,300	7,400	7,500	5,700	4,300	286,000
1979	1,800	3,300	13,800	16,800	80,200	105,000	19,500	6,300	3,800	5,300	3,800	3,700	263,000
1980	2,700	3,600	4,400	16,500	51,600	82,400	15,600	7,700	6,300	6,100	5,800	5,100	208,000

Table 10. Synthesized monthly natural flows for Musselshell River at Harlowton, Montana, in acre-feet (Continued)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1981	3,200	3,600	7,800	17,900	89,000	71,600	13,900	7,500	4,100	5,500	5,400	4,700	234,000
1982	3,700	5,000	9,500	20,100	58,700	103,000	33,500	6,800	7,000	7,900	7,200	5,700	268,000
1983	6,200	4,800	9,000	30,800	39,100	33,200	16,700	7,200	7,200	6,900	5,300	4,000	170,000
1984	6,900	4,300	7,200	14,000	37,200	46,300	9,700	7,800	4,600	6,600	5,200	3,500	153,000
1985	2,900	1,900	4,800	12,900	17,200	9,300	1,400	3,600	6,700	7,600	8,300	4,900	81,500
1986	3,400	4,600	15,100	10,100	35,500	43,100	9,800	4,800	7,200	6,500	6,300	4,700	151,000
1987	2,200	2,500	5,700	6,300	20,500	13,100	6,400	4,400	4,800	5,600	4,300	3,400	79,200
1988	1,400	2,000	3,700	5,900	16,500	12,600	2,000	2,400	2,600	3,600	3,900	3,100	59,700
1989	1,600	1,200	8,500	8,000	25,300	18,400	5,100	2,300	5,800	5,800	9,700	5,500	97,200

[1]Values may not total due to rounding.

Table 11. Synthesized monthly natural flows for Musselshell River near Shawmut, Montana, in acre-feet

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1929	4,400	4,100	12,300	15,300	43,400	49,000	3,300	2,900	5,300	4,200	5,600	4,300	154,000
1930	2,100	4,100	7,400	25,200	25,200	17,500	2,000	1,600	2,000	2,500	3,700	2,600	95,900
1931	2,200	2,500	4,400	4,700	7,000	11,800	1,900	1,100	1,800	3,000	3,300	2,700	46,400
1932	1,800	1,300	3,600	6,900	28,500	47,700	2,200	1,600	1,400	3,000	3,800	3,400	105,000
1933	2,400	2,500	2,700	15,300	63,500	53,700	2,500	2,700	2,900	3,100	3,400	4,200	159,000
1934	4,000	3,400	6,100	15,800	13,100	46,800	2,200	1,400	1,000	3,300	2,700	2,800	103,000
1935	3,100	1,400	3,600	7,000	10,400	13,300	4,600	1,200	950	2,800	2,300	2,200	52,900
1936	2,500	2,100	6,800	14,400	51,100	27,900	2,200	1,300	1,200	1,900	2,300	2,200	116,000
1937	1,400	3,000	3,300	15,500	31,300	21,800	3,000	1,200	1,100	4,800	1,900	1,900	90,200
1938	2,500	2,800	4,600	11,400	68,000	58,800	34,900	5,200	2,300	3,400	6,500	4,000	204,000
1939	3,900	2,400	12,200	15,500	34,500	24,500	4,900	1,500	1,600	2,900	3,000	2,700	110,000
1940	2,200	2,000	5,500	9,000	14,500	15,800	4,600	1,100	1,100	3,600	5,300	2,200	66,900
1941	2,400	2,600	4,800	6,000	18,700	37,600	5,300	2,200	6,400	12,200	8,800	8,000	115,000
1942	5,800	4,900	6,800	26,100	73,300	81,600	9,700	4,800	4,700	6,300	6,200	6,900	237,000
1943	5,400	7,800	13,200	52,700	69,000	97,700	15,600	7,100	4,100	5,500	6,500	6,400	291,000
1944	4,400	2,700	5,300	9,700	26,200	67,400	26,400	7,700	4,700	5,600	5,500	6,000	172,000
1945	5,700	3,800	5,900	4,400	20,100	50,300	7,900	2,500	2,600	3,900	5,400	3,600	116,000
1946	4,000	3,400	8,400	19,300	34,400	22,900	7,600	2,400	3,500	6,600	6,300	9,400	128,000
1947	4,600	5,600	13,300	28,500	76,500	59,000	8,900	3,700	5,100	8,300	7,100	7,300	228,000
1948	7,000	4,300	7,000	27,000	90,500	127,000	34,200	9,600	4,800	5,800	6,000	4,800	328,000
1949	3,700	3,300	8,700	30,400	60,900	36,800	7,200	2,500	3,200	5,000	4,600	3,000	169,000
1950	2,400	6,300	4,400	15,700	54,700	88,800	21,700	8,400	5,200	7,400	6,500	5,900	227,000
1951	4,300	5,300	10,800	16,600	64,800	44,500	12,600	6,400	6,600	7,300	6,500	5,200	191,000
1952	4,400	4,500	5,700	37,000	109,000	45,200	12,300	4,700	4,000	4,100	3,600	2,900	237,000
1953	3,400	3,200	5,600	8,500	27,200	111,000	10,400	4,000	1,900	2,000	3,300	3,700	184,000
1954	3,200	4,300	4,300	9,400	24,300	26,400	5,900	2,500	1,300	2,600	3,300	2,300	89,800
1955	2,100	1,700	2,500	9,900	16,700	33,400	12,700	3,100	1,700	2,300	3,400	4,200	93,700
1956	3,400	3,600	9,300	16,600	69,300	37,100	5,000	2,300	1,400	1,700	2,500	2,500	155,000
1957	1,800	2,000	4,000	7,400	59,800	69,500	16,200	4,500	3,700	5,000	4,400	3,800	182,000
1958	3,300	3,700	6,900	12,700	40,000	17,600	6,400	2,900	2,100	2,300	3,200	3,200	104,000
1959	3,400	2,500	8,400	11,500	36,900	87,600	11,900	3,200	3,000	5,900	5,500	3,900	184,000
1960	3,200	2,600	11,700	14,200	35,400	29,400	4,400	2,200	1,800	2,700	3,400	3,500	115,000
1961	2,800	2,600	3,200	3,700	12,700	12,300	1,600	700	980	1,900	2,300	2,100	46,900
1962	1,600	2,500	4,300	13,000	48,000	53,800	12,800	5,200	4,200	5,100	4,000	4,300	159,000
1963	2,400	5,600	6,200	8,200	48,400	54,200	10,100	2,400	2,700	3,700	3,600	2,900	150,000
1964	3,000	2,800	3,000	8,000	49,500	84,200	14,500	3,300	2,400	3,100	3,100	4,200	181,000
1965	4,400	4,800	4,200	24,500	57,200	80,600	19,600	6,900	14,900	14,000	8,200	5,900	245,000
1966	4,100	3,500	10,200	16,600	58,600	23,200	6,800	2,300	1,800	2,900	3,500	3,200	137,000
1967	3,000	2,900	6,100	13,800	70,700	162,000	24,500	5,500	4,300	6,000	5,600	4,100	309,000
1968	4,400	7,300	8,800	10,300	38,900	72,100	17,900	6,700	5,800	6,900	5,600	4,300	189,000
1969	4,000	4,200	8,900	31,700	30,700	18,700	14,900	3,800	3,000	4,900	4,500	3,100	132,000
1970	2,900	3,900	4,500	11,000	94,300	89,200	15,000	5,000	4,500	6,200	4,100	4,000	245,000
1971	4,600	8,600	7,900	20,000	61,500	47,000	11,100	3,100	3,600	7,400	5,300	3,600	184,000
1972	3,600	7,200	16,800	15,900	50,900	53,100	9,900	6,800	4,900	7,400	5,500	3,000	185,000
1973	3,100	3,200	5,300	7,800	9,400	14,900	3,600	3,600	3,500	5,300	6,200	4,800	70,700
1974	7,500	4,300	10,500	22,400	50,000	83,800	14,400	8,200	6,900	5,800	6,500	4,800	225,000
1975	3,400	3,500	6,100	16,600	85,700	214,000	61,300	14,300	8,600	10,900	10,200	10,200	445,000
1976	6,900	6,500	9,800	24,000	134,000	56,400	16,300	8,700	7,000	8,900	6,800	5,400	291,000
1977	4,800	5,400	5,500	14,600	30,300	20,200	5,900	3,700	3,400	5,000	4,700	4,600	108,000
1978	3,900	4,100	18,200	30,400	111,000	85,800	34,900	7,400	8,600	8,700	6,900	6,200	326,000
1979	3,200	4,700	17,400	19,100	89,300	117,000	22,700	7,200	4,500	5,700	4,700	5,100	301,000
1980	3,900	5,000	6,200	18,100	56,700	93,400	18,200	9,200	7,400	7,300	6,900	6,000	238,000

Table 11. Synthesized monthly natural flows for Musselshell River near Shawmut, Montana, in acre-feet (Continued)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1981	4,500	5,100	9,100	19,100	101,000	80,300	15,900	9,200	5,300	6,400	6,300	5,900	268,000
1982	4,600	6,300	11,500	21,600	64,300	116,000	38,800	8,600	8,800	10,500	8,500	7,000	307,000
1983	7,800	5,700	10,400	31,600	42,000	35,800	18,900	9,000	8,500	8,000	6,000	4,800	189,000
1984	8,600	5,400	8,500	15,400	39,500	49,900	10,900	9,100	5,800	7,500	6,100	4,200	171,000
1985	3,400	3,000	5,800	14,000	17,800	9,700	1,600	4,000	7,200	8,500	8,700	5,500	89,200
1986	4,100	6,300	16,700	11,000	38,200	47,200	11,600	5,700	8,500	7,900	7,200	5,800	170,000
1987	3,000	3,500	6,700	7,300	21,700	14,000	7,600	4,900	5,200	6,200	4,800	4,100	89,000
1988	2,100	2,700	4,600	6,500	17,200	13,400	2,400	2,400	2,600	3,600	4,200	3,600	65,300
1989	2,100	1,400	9,700	9,200	26,800	19,700	6,000	3,000	6,200	6,400	10,500	6,400	107,000

[1]Values may not total due to rounding.

Table 12. Synthesized monthly natural flows for Musselshell River near Ryegate, Montana, in acre-feet

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1929	4,500	4,100	13,900	17,900	44,400	50,000	3,400	3,100	5,300	4,200	5,700	4,400	161,000
1930	2,200	4,100	8,700	27,900	25,600	17,700	2,000	1,700	2,000	2,600	3,800	2,700	101,000
1931	2,200	2,500	4,600	5,400	7,300	12,000	1,900	1,100	1,800	3,000	3,300	2,800	47,900
1932	1,800	1,400	3,800	7,100	29,000	49,100	2,400	1,600	1,400	3,100	3,900	3,400	108,000
1933	2,500	2,600	2,900	16,200	64,100	54,900	2,700	2,700	2,900	3,200	3,400	4,200	162,000
1934	4,000	3,600	6,400	16,200	13,100	51,000	2,200	1,400	1,000	3,300	2,700	2,800	108,000
1935	3,100	1,400	3,700	7,400	10,400	13,300	4,900	1,200	950	2,800	2,400	2,200	53,800
1936	2,500	2,100	7,600	16,700	53,100	28,900	2,200	1,300	1,200	1,900	2,200	2,200	122,000
1937	1,400	3,000	3,700	16,500	31,800	26,100	3,300	1,200	1,100	4,800	1,900	1,900	96,700
1938	2,500	2,900	5,300	12,200	70,800	66,500	36,200	5,500	2,500	3,500	6,600	4,300	219,000
1939	3,900	2,400	13,700	16,800	35,400	28,000	5,000	1,500	1,700	3,100	3,000	2,700	117,000
1940	2,200	2,100	5,900	9,500	14,500	16,000	4,600	1,100	1,100	3,600	5,300	2,200	68,100
1941	2,400	2,800	5,000	6,300	18,800	40,300	5,300	2,200	6,400	12,400	8,900	8,300	119,000
1942	5,800	5,200	8,300	27,800	79,800	94,000	10,300	5,400	4,700	6,500	6,500	7,200	262,000
1943	5,400	8,000	15,000	56,800	73,800	109,000	16,200	7,300	4,200	5,800	6,700	6,800	315,000
1944	4,500	2,700	6,200	10,600	27,100	79,300	27,600	8,200	4,800	5,600	5,700	6,400	189,000
1945	5,800	3,900	6,900	5,200	20,700	54,600	8,100	2,700	2,700	3,900	5,500	3,600	124,000
1946	4,100	3,500	9,200	20,600	35,100	23,500	7,600	2,400	3,600	6,700	6,300	9,700	132,000
1947	4,900	6,000	16,400	31,400	78,100	60,600	9,000	3,900	5,100	8,400	7,200	8,000	239,000
1948	7,200	4,400	8,000	28,600	92,800	130,000	34,500	9,800	4,900	6,000	6,300	5,200	338,000
1949	3,900	3,300	9,000	33,400	62,300	38,000	7,200	2,500	3,200	5,100	4,700	3,100	176,000
1950	2,500	7,400	5,700	16,700	55,500	90,300	21,900	8,500	5,200	7,600	6,600	6,100	234,000
1951	4,400	5,800	13,600	17,700	66,400	46,200	12,700	6,500	6,600	7,400	6,700	5,300	199,000
1952	4,500	4,900	6,900	41,000	111,000	46,300	12,400	4,800	4,000	4,100	3,700	3,000	247,000
1953	3,500	3,200	5,900	8,800	27,900	113,000	10,500	4,100	1,900	2,100	3,400	3,800	188,000
1954	3,300	4,500	4,500	10,000	25,000	26,600	6,300	2,900	1,300	2,700	3,300	2,400	92,800
1955	2,300	1,700	2,600	12,000	17,800	34,700	13,000	3,200	1,700	2,300	3,400	4,300	99,000
1956	3,600	3,800	11,000	17,600	71,300	38,600	5,100	2,300	1,400	1,700	2,500	2,500	161,000
1957	2,000	2,000	4,300	7,800	61,800	71,500	16,300	4,800	3,800	5,200	4,700	4,100	188,000
1958	3,600	4,000	7,400	13,300	40,400	18,200	6,500	2,900	2,100	2,300	3,300	3,300	107,000
1959	3,400	2,600	11,500	12,900	39,800	91,100	12,500	3,300	3,100	6,000	5,600	3,900	196,000
1960	3,300	2,700	12,400	15,200	36,400	29,900	4,500	2,300	1,800	2,700	3,500	3,500	118,000
1961	2,900	2,700	3,300	3,900	13,000	12,500	1,700	730	1,000	1,900	2,300	2,100	48,000
1962	1,700	2,500	5,300	13,400	48,400	62,400	13,000	5,300	4,300	5,200	4,100	4,400	170,000
1963	2,500	5,900	6,400	8,700	49,700	54,900	10,100	2,500	2,700	3,700	3,700	2,900	154,000
1964	3,000	2,800	3,100	8,800	49,900	87,100	14,700	3,500	2,500	3,200	3,200	4,300	186,000
1965	4,500	5,000	4,500	26,700	58,400	81,600	19,800	7,000	15,000	14,200	8,300	6,100	251,000
1966	4,300	3,600	11,800	18,500	59,800	24,000	7,100	2,400	1,900	2,900	3,600	3,200	143,000
1967	3,100	2,900	6,300	14,600	74,600	249,000	26,500	6,600	4,700	6,700	6,200	4,600	406,000
1968	4,900	8,200	10,100	13,000	42,400	80,100	19,400	7,700	6,200	7,400	6,300	5,000	211,000
1969	4,500	4,500	14,800	34,700	32,400	25,000	15,600	4,300	3,200	5,300	4,900	3,400	153,000
1970	3,100	4,200	5,500	12,400	111,000	101,000	15,600	5,600	4,900	6,800	4,700	4,600	279,000
1971	5,300	9,700	9,400	22,700	63,500	48,700	11,200	3,200	3,800	7,600	5,600	3,800	195,000
1972	3,800	8,600	19,300	18,200	53,100	54,000	10,300	7,400	5,100	7,900	6,100	3,100	197,000
1973	3,300	3,300	5,800	9,500	10,900	15,900	3,800	3,700	3,600	5,300	6,400	4,900	76,400
1974	7,600	4,600	10,900	23,200	51,200	87,900	14,700	8,800	7,600	5,900	7,100	5,000	235,000
1975	3,500	3,600	6,900	21,200	98,800	235,000	64,000	15,500	9,300	11,100	11,900	11,000	492,000
1976	7,200	6,800	12,000	25,800	149,000	63,300	16,900	9,300	7,200	8,900	7,100	6,100	320,000
1977	5,000	5,800	6,000	15,600	31,600	21,000	5,900	3,800	3,500	5,100	4,900	4,800	113,000
1978	4,000	4,200	18,800	35,200	121,000	95,100	36,300	8,000	9,400	9,200	7,200	6,800	355,000
1979	3,300	5,000	20,900	21,300	96,700	127,000	23,300	7,800	4,700	5,900	4,900	5,200	326,000
1980	4,000	5,400	7,600	19,600	58,100	98,600	18,400	9,600	7,500	7,500	7,000	6,200	250,000

Table 12. Synthesized monthly natural flows for Musselshell River near Ryegate, Montana, in acre-feet (Continued)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1981	4,800	5,400	9,500	19,500	110,000	88,200	16,300	9,600	5,500	6,600	6,500	6,300	288,000
1982	4,900	6,800	13,000	24,200	67,700	126,000	39,800	9,100	9,000	10,900	8,800	7,400	328,000
1983	8,200	6,300	11,200	32,700	44,600	37,700	19,200	9,500	8,700	8,300	6,200	4,800	197,000
1984	8,800	5,900	9,100	16,300	40,800	52,400	11,100	9,500	6,000	7,700	6,300	4,200	178,000
1985	3,700	3,200	6,100	14,800	18,500	10,200	1,600	4,000	7,500	8,700	9,000	5,500	92,800
1986	4,300	7,000	17,400	12,000	39,100	49,200	11,900	6,000	10,100	8,100	7,400	5,800	178,000
1987	3,200	3,600	6,900	8,100	22,300	14,600	7,900	5,000	5,300	6,400	4,900	4,200	92,400
1988	2,200	2,700	4,800	6,900	17,600	14,100	2,400	2,400	2,800	3,600	4,200	3,600	67,300
1989	2,100	1,400	10,100	10,500	27,700	20,100	6,200	3,100	6,400	6,500	10,600	6,400	111,000

[1]Values may not total due to rounding.

Table 13. Synthesized monthly natural flows for Careless Creek at mouth, near Ryegate, Montana, in acre-feet

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL
1929	37	290	1,300	1,100	1,100	490	1,200	61	0	0	0	92	5,700
1930	12	540	770	320	370	24	0	0	0	6	130	0	2,200
1931	18	150	0	24	31	12	0	0	0	0	0	0	240
1932	0	0	0	54	61	4,900	390	98	36	12	12	0	5,600
1933	0	28	1,600	160	480	3,700	200	160	0	0	12	74	6,400
1934	120	190	150	12	0	1,100	0	0	0	0	0	0	1,600
1935	0	0	18	160	0	30	1,100	0	0	0	0	0	1,300
1936	0	0	1,900	800	43	6	0	0	0	0	0	0	2,700
1937	0	0	120	83	6	0	98	0	0	18	0	0	330
1938	0	760	650	18	190	2,600	1,600	6	0	12	0	0	5,800
1939	6	0	1,300	150	230	330	550	0	0	0	0	0	2,600
1940	0	23	420	12	18	200	0	0	18	18	0	0	710
1941	0	0	0	0	0	36	6	0	0	6	380	740	1,200
1942	420	240	2,000	3,100	3,200	4,900	1,300	720	89	440	110	1,300	17,800
1943	790	2,500	1,800	1,600	1,300	11,200	3,200	710	340	380	150	1,300	25,300
1944	520	360	86	1,200	480	9,600	4,300	1,300	510	390	77	1,300	20,100
1945	840	510	680	250	68	1,700	230	0	0	18	170	0	4,500
1946	43	240	490	210	250	330	350	25	120	190	89	740	3,100
1947	92	200	2,300	390	680	590	240	150	77	120	120	110	5,100
1948	130	180	310	170	740	1,200	980	280	120	120	150	25	4,400
1949	43	110	2,900	520	290	490	230	31	110	80	83	18	4,900
1950	0	130	1,200	620	260	860	500	250	220	190	180	240	4,700
1951	100	210	1,400	170	340	570	210	220	400	340	110	0	4,100
1952	74	210	1,500	290	890	500	310	160	150	74	0	37	4,200
1953	100	28	120	24	620	5,400	550	6	0	0	0	12	6,900
1954	6	330	37	150	43	140	12	98	0	43	0	0	860
1955	0	0	0	1,900	680	860	150	18	0	0	0	0	3,600
1956	0	0	770	210	92	6	0	98	0	6	71	68	1,300
1957	18	110	98	360	420	770	410	86	280	230	36	0	2,800
1958	31	180	210	110	180	500	230	120	160	140	6	25	1,900
1959	74	110	5,400	140	55	520	280	140	180	160	83	210	7,400
1960	37	160	1,000	140	180	200	80	140	60	43	0	68	2,100
1961	31	89	0	83	49	36	92	0	65	0	60	6	510
1962	31	78	140	680	750	790	520	98	180	150	0	120	3,500
1963	49	470	260	65	180	580	230	31	180	98	12	6	2,200
1964	31	81	6	36	550	1,100	590	130	290	170	54	280	3,300
1965	250	580	930	290	240	690	480	240	430	390	130	98	4,700
1966	49	170	1,700	220	390	60	410	80	170	180	6	0	3,400
1967	49	140	180	140	200	1,700	830	240	310	270	310	12	4,400
1968	170	280	900	430	460	1,100	550	250	310	250	270	110	5,100
1969	130	210	2,800	700	380	540	710	200	230	230	120	0	6,300
1970	80	180	400	130	1,300	980	340	220	270	220	160	68	4,300
1971	160	980	1,500	570	570	390	260	150	330	230	240	49	5,400
1972	98	470	4,300	24	500	520	230	340	280	230	120	68	7,200
1973	43	160	140	400	470	270	140	0	140	140	300	74	2,300
1974	260	190	120	330	410	620	240	240	290	200	110	74	3,100
1975	74	150	370	870	1,500	1,400	1,200	420	400	420	95	590	7,500
1976	560	410	680	420	1,000	650	380	260	300	230	390	0	5,300
1977	180	270	250	54	260	180	140	80	180	160	150	0	1,900
1978	37	140	19,500	890	1,300	940	980	340	650	420	410	0	25,600
1979	150	270	18,500	0	980	210	430	100	290	250	89	31	21,300
1980	130	240	740	320	330	760	300	270	210	290	140	190	3,900

Table 13. Synthesized monthly natural flows for Careless Creek at mouth, near Ryegate, Montana, in acre-feet (Continued)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1981	130	270	180	60	1,200	1,000	420	98	220	220	110	86	4,000
1982	49	570	840	550	610	1,200	760	130	400	390	240	74	5,800
1983	290	380	360	560	420	260	170	0	230	230	77	0	3,000
1984	490	280	200	6	250	330	55	140	280	170	150	18	2,400
1985	80	22	86	400	68	95	98	61	65	130	24	0	1,100
1986	61	570	580	420	730	320	250	0	680	310	12	86	4,000
1987	150	56	120	330	360	170	230	190	120	170	65	0	2,000
1988	0	86	80	77	380	6	68	25	0	0	0	0	720
1989	49	28	1,400	230	420	89	12	6	110	140	0	6	2,500

[1]Values may not total due to rounding.

Table 14. Synthesized monthly natural flows for Musselshell River near Lavina, Montana, in acre-feet

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1929	4,600	4,400	15,200	19,000	45,500	50,500	4,600	3,100	5,300	4,200	5,700	4,500	167,000
1930	2,200	4,700	9,500	28,200	26,000	17,700	2,000	1,700	2,000	2,600	3,900	2,700	103,000
1931	2,300	2,700	4,600	5,400	7,300	12,000	1,900	1,100	1,800	3,100	3,300	2,800	48,300
1932	1,800	1,400	3,800	7,100	29,000	54,000	2,800	1,700	1,500	3,100	3,900	3,400	114,000
1933	2,500	2,600	4,500	16,300	64,600	58,600	2,900	2,800	2,900	3,200	3,500	4,300	169,000
1934	4,100	3,800	6,600	16,200	13,200	52,000	2,200	1,400	1,000	3,300	2,700	2,800	109,000
1935	3,100	1,400	3,800	7,600	10,400	13,400	6,000	1,200	960	2,800	2,400	2,200	55,300
1936	2,500	2,100	9,500	17,500	53,200	29,000	2,200	1,300	1,200	1,900	2,300	2,200	125,000
1937	1,400	3,000	3,800	16,600	31,900	26,100	3,400	1,200	1,100	4,900	1,900	1,900	97,200
1938	2,500	3,700	6,000	12,200	71,000	69,100	37,800	5,500	2,500	3,500	6,600	4,300	225,000
1939	3,900	2,400	15,000	16,900	35,700	28,400	5,600	1,500	1,700	3,100	3,000	2,700	120,000
1940	2,200	2,100	6,400	9,500	14,600	16,300	4,600	1,100	1,200	3,700	5,300	2,200	69,200
1941	2,500	2,800	5,000	6,300	18,800	40,400	5,400	2,200	6,400	12,400	9,300	9,100	121,000
1942	6,200	5,500	10,400	30,900	83,000	99,000	11,700	6,200	4,800	6,900	6,600	8,600	280,000
1943	6,200	10,500	16,900	58,500	75,000	120,000	19,500	8,000	4,500	6,200	6,800	8,100	340,000
1944	5,100	3,100	6,300	11,800	27,500	89,000	31,900	9,500	5,300	6,000	5,800	7,700	209,000
1945	6,600	4,500	7,600	5,500	20,800	56,300	8,300	2,700	2,700	4,000	5,700	3,600	128,000
1946	4,100	3,700	9,700	20,800	35,400	23,900	8,000	2,400	3,700	7,000	6,500	10,400	136,000
1947	5,000	6,200	18,800	31,800	78,800	61,200	9,300	4,000	5,200	8,500	7,300	8,100	244,000
1948	7,300	4,600	8,300	28,800	93,600	132,000	35,500	10,100	5,000	6,100	6,500	5,200	343,000
1949	4,000	3,400	11,900	34,000	62,600	38,500	7,400	2,500	3,300	5,200	4,800	3,100	181,000
1950	2,600	7,500	7,000	17,300	55,800	91,200	22,400	8,800	5,500	7,800	6,800	6,300	239,000
1951	4,600	6,000	15,000	17,900	66,800	46,800	13,000	6,700	7,000	7,700	6,800	5,300	204,000
1952	4,600	5,100	8,400	41,300	112,000	46,800	12,700	4,900	4,100	4,200	3,700	3,000	251,000
1953	3,700	3,300	6,100	8,900	28,500	119,000	11,100	4,100	1,900	2,100	3,400	3,800	196,000
1954	3,300	4,900	4,600	10,200	25,000	26,700	6,300	3,000	1,400	2,700	3,400	2,400	93,900
1955	2,300	1,700	2,600	13,900	18,500	35,600	13,100	3,200	1,700	2,400	3,400	4,300	103,000
1956	3,600	3,800	11,700	17,800	71,500	38,600	5,100	2,400	1,400	1,700	2,600	2,600	163,000
1957	2,000	2,100	4,400	8,100	62,300	72,300	16,700	4,900	4,100	5,400	4,700	4,100	191,000
1958	3,700	4,100	7,600	13,500	40,600	18,700	6,800	3,100	2,300	2,400	3,300	3,300	109,000
1959	3,500	2,700	16,900	13,000	39,800	91,600	12,800	3,400	3,300	6,200	5,700	4,100	203,000
1960	3,300	2,800	13,400	15,400	36,600	30,100	4,600	2,400	1,900	2,800	3,500	3,600	120,000
1961	2,900	2,800	3,300	3,900	13,000	12,500	1,800	730	1,100	1,900	2,400	2,100	48,400
1962	1,700	2,500	5,400	14,100	49,200	63,200	13,500	5,400	4,400	5,400	4,100	4,500	173,000
1963	2,500	6,400	6,700	8,800	49,900	55,500	10,400	2,500	2,900	3,800	3,700	2,900	156,000
1964	3,100	2,900	3,100	8,800	50,500	88,200	15,300	3,700	2,800	3,400	3,200	4,600	190,000
1965	4,800	5,500	5,400	27,000	58,700	82,400	20,200	7,300	15,500	14,600	8,400	6,200	256,000
1966	4,300	3,800	13,400	18,700	60,200	24,100	7,500	2,400	2,000	3,100	3,600	3,200	146,000
1967	3,100	3,100	6,500	14,700	74,800	250,000	27,300	6,800	5,000	7,000	6,600	4,600	410,000
1968	5,100	8,500	11,000	13,400	42,900	81,300	19,900	8,000	6,500	7,600	6,600	5,100	216,000
1969	4,600	4,700	17,500	35,400	32,800	25,500	16,300	4,500	3,400	5,500	5,000	3,400	159,000
1970	3,200	4,400	5,900	12,500	113,000	103,000	16,000	5,800	5,200	7,000	4,800	4,600	285,000
1971	5,400	10,700	10,900	23,300	64,100	49,200	11,500	3,300	4,100	7,900	5,800	3,900	200,000
1972	3,900	9,100	23,600	18,200	53,700	54,600	10,500	7,800	5,400	8,200	6,200	3,100	204,000
1973	3,400	3,500	5,900	9,900	11,400	16,200	3,900	3,700	3,800	5,500	6,700	5,000	78,900
1974	7,900	4,900	11,000	23,600	51,600	88,600	14,900	9,100	7,900	6,100	7,200	5,100	238,000
1975	3,500	3,800	7,200	22,100	100,000	237,000	65,300	15,900	9,700	11,600	12,000	11,600	500,000
1976	7,800	7,200	12,800	26,200	150,000	64,000	17,300	9,600	7,500	9,200	7,600	6,100	325,000
1977	5,200	6,100	6,300	15,700	31,800	21,200	6,100	3,900	3,700	5,300	5,100	4,800	115,000
1978	4,100	4,400	38,300	36,100	123,000	96,000	37,300	8,400	10,100	9,600	7,700	6,900	382,000
1979	3,500	5,300	39,400	21,300	97,700	127,000	23,700	8,000	5,000	6,200	5,000	5,200	347,000
1980	4,100	5,600	8,300	19,900	58,400	99,400	18,700	9,800	7,700	7,800	7,200	6,400	253,000

Table 14. Synthesized monthly natural flows for Musselshell River near Lavina, Montana, in acre-feet (Continued)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1981	4,900	5,700	9,700	19,600	111,000	89,300	16,700	9,700	5,700	6,800	6,600	6,400	292,000
1982	4,900	7,300	13,800	24,700	68,400	127,000	40,600	9,200	9,400	11,300	9,000	7,500	333,000
1983	8,500	6,700	11,600	33,200	45,100	38,000	19,500	9,500	8,900	8,600	6,300	4,900	201,000
1984	9,300	6,200	9,400	16,400	41,100	52,800	11,200	9,700	6,300	7,900	6,500	4,200	181,000
1985	3,700	3,200	6,200	15,200	18,600	10,300	1,700	4,100	7,600	8,900	9,000	5,500	94,000
1986	4,400	7,600	18,000	12,400	39,800	49,600	12,200	6,000	10,800	8,400	7,500	5,900	183,000
1987	3,400	3,700	7,100	8,400	22,700	14,700	8,100	5,200	5,500	6,600	5,000	4,200	94,600
1988	2,200	2,800	4,900	7,000	18,000	14,100	2,400	2,500	2,800	3,600	4,200	3,600	68,100
1989	2,100	1,400	11,500	10,700	28,200	20,200	6,200	3,100	6,500	6,600	10,600	6,400	114,000

[1]Values may not total due to rounding.

Table 15. Synthesized monthly natural flows for Musselshell River below Painted Robe Creek, near Lavina, Montana, in acre-feet

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1929	4,700	4,700	17,000	19,900	46,300	51,200	4,800	3,300	5,400	4,300	5,800	4,500	172,000
1930	2,200	5,100	10,700	29,500	26,400	18,000	2,100	1,700	2,100	2,800	4,100	2,800	108,000
1931	2,300	3,000	5,200	5,800	7,600	12,200	2,100	1,100	1,900	3,100	3,400	2,900	50,600
1932	1,900	1,600	4,300	7,300	29,600	54,700	3,100	1,800	1,500	3,300	4,100	3,500	117,000
1933	2,500	2,900	5,000	16,700	65,200	59,400	3,400	2,900	2,900	3,300	3,500	4,300	172,000
1934	4,200	4,200	7,300	16,800	13,500	53,500	2,300	1,400	1,100	3,300	2,800	2,900	113,000
1935	3,100	1,600	4,300	7,900	10,700	13,600	6,600	1,200	990	2,900	2,500	2,200	57,600
1936	2,500	2,400	10,800	18,200	54,000	29,400	2,400	1,300	1,300	2,000	2,300	2,300	129,000
1937	1,400	3,200	4,400	16,900	32,300	27,300	3,900	1,300	1,200	4,900	1,900	1,900	101,000
1938	2,500	4,000	7,000	12,600	72,000	71,200	39,500	5,800	2,800	3,700	6,700	4,500	232,000
1939	4,000	2,700	16,400	17,600	36,300	29,300	6,000	1,600	1,800	3,300	3,000	2,700	125,000
1940	2,200	2,300	7,100	9,800	14,800	16,500	4,700	1,200	1,300	3,800	5,300	2,300	71,300
1941	2,500	3,100	5,600	6,500	18,900	41,200	5,600	2,200	6,500	12,600	9,300	9,400	123,000
1942	6,200	5,900	11,500	31,800	85,000	102,000	12,600	6,700	4,900	7,100	6,900	8,900	290,000
1943	6,300	11,000	19,200	60,000	76,700	123,000	20,400	8,300	4,700	6,500	7,000	8,400	352,000
1944	5,200	3,300	7,200	12,200	28,000	91,900	33,400	10,000	5,400	6,100	5,900	8,100	217,000
1945	6,700	4,800	8,700	5,800	21,100	57,700	8,800	2,800	2,900	4,100	5,800	3,700	133,000
1946	4,200	4,000	11,100	21,400	36,000	24,500	8,500	2,600	3,800	7,200	6,600	10,700	141,000
1947	5,200	7,000	22,600	33,000	80,000	62,300	9,700	4,200	5,400	8,700	7,500	8,700	254,000
1948	7,500	5,000	9,300	29,800	95,100	133,000	36,300	10,300	5,100	6,400	6,800	5,600	350,000
1949	4,100	3,700	12,400	35,200	63,600	39,500	7,800	2,600	3,400	5,400	5,000	3,200	186,000
1950	2,700	9,100	8,500	17,900	56,500	92,300	23,000	9,000	5,600	8,000	6,900	6,500	246,000
1951	4,700	6,700	17,300	18,400	67,800	47,700	13,300	6,900	7,100	7,900	7,000	5,500	210,000
1952	4,600	5,700	9,500	42,800	113,000	47,600	13,100	5,100	4,200	4,300	3,800	3,100	257,000
1953	3,800	3,600	6,800	9,100	29,000	120,000	11,600	4,200	1,900	2,200	3,500	3,900	200,000
1954	3,500	5,300	5,100	10,500	25,400	27,000	6,800	3,300	1,400	2,800	3,500	2,400	97,000
1955	2,500	1,900	2,800	14,500	19,000	36,200	13,700	3,400	1,800	2,400	3,500	4,400	106,000
1956	3,800	4,200	13,300	18,400	72,400	39,300	5,400	2,600	1,400	1,700	2,600	2,600	168,000
1957	2,100	2,400	5,000	8,400	63,200	73,300	17,100	5,200	4,300	5,600	5,000	4,400	196,000
1958	3,900	4,600	8,600	13,900	41,100	19,200	7,100	3,200	2,400	2,500	3,400	3,400	113,000
1959	3,600	3,000	19,100	13,600	40,900	93,100	13,800	3,600	3,500	6,300	5,800	4,200	211,000
1960	3,400	3,100	14,500	15,900	37,200	30,600	4,800	2,500	1,900	2,800	3,500	3,700	124,000
1961	3,000	3,100	3,900	4,100	13,200	12,700	1,900	780	1,100	2,000	2,400	2,200	50,400
1962	1,700	2,800	6,500	14,500	49,600	65,600	14,000	5,600	4,500	5,500	4,200	4,700	179,000
1963	2,600	7,000	7,400	9,100	50,600	56,100	10,700	2,600	3,000	3,900	3,800	2,900	160,000
1964	3,100	3,300	3,500	9,200	51,300	89,700	15,800	3,800	2,900	3,500	3,300	4,700	194,000
1965	4,900	6,000	6,100	28,100	59,700	83,500	20,900	7,500	15,700	14,800	8,600	6,400	262,000
1966	4,500	4,300	15,600	19,500	60,900	24,600	8,000	2,500	2,100	3,200	3,700	3,300	152,000
1967	3,200	3,400	7,000	15,200	76,600	269,000	29,800	7,700	5,600	7,700	7,100	5,000	437,000
1968	5,400	9,800	13,200	14,400	44,200	83,700	21,800	8,900	7,100	8,200	7,200	5,600	230,000
1969	4,900	5,300	21,400	36,900	33,600	27,000	17,100	4,900	3,700	5,900	5,400	3,600	170,000
1970	3,300	5,000	6,900	13,200	117,000	106,000	16,900	6,300	5,800	7,600	5,300	5,100	298,000
1971	5,900	11,800	12,300	24,400	65,200	50,000	11,800	3,500	4,300	8,100	6,200	4,100	208,000
1972	4,100	10,400	26,300	19,100	54,700	55,500	11,200	8,300	5,600	8,700	6,700	3,200	214,000
1973	3,600	3,900	6,700	10,500	11,900	16,500	4,200	3,800	4,000	5,600	6,900	5,200	82,800
1974	8,000	5,300	12,100	24,100	52,300	90,100	15,400	9,700	8,800	6,300	7,700	5,300	245,000
1975	3,600	4,200	8,200	23,500	104,000	242,000	68,600	17,000	10,800	11,900	13,400	12,300	520,000
1976	8,100	7,900	14,800	27,100	154,000	65,900	18,100	10,100	7,700	9,300	7,900	6,600	338,000
1977	5,300	6,700	7,300	16,400	32,300	21,600	6,200	4,100	3,900	5,500	5,300	5,000	120,000
1978	4,200	4,900	39,800	38,000	126,000	98,700	39,100	9,000	11,100	10,100	8,000	7,400	396,000
1979	3,600	5,800	42,200	22,300	100,000	130,000	24,900	8,600	5,400	6,400	5,300	5,300	360,000
1980	4,300	6,200	9,600	20,900	59,100	101,000	19,600	10,200	8,100	8,000	7,300	6,700	261,000

Table 15. Synthesized monthly natural flows for Musselshell River below Painted Robe Creek, near Lavina, Montana, in acre-feet (Continued)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1981	5,100	6,300	10,800	20,200	114,000	91,600	17,900	10,200	6,000	7,000	6,800	6,700	303,000
1982	5,200	8,100	15,500	25,600	69,700	130,000	42,200	9,600	9,800	11,700	9,300	7,800	345,000
1983	8,800	7,600	12,800	33,800	46,100	38,800	20,300	10,000	9,200	8,900	6,400	5,000	208,000
1984	9,500	6,900	10,300	16,900	41,900	53,800	11,700	9,900	6,500	8,100	6,700	4,300	187,000
1985	3,900	3,800	7,000	15,900	19,100	10,600	1,800	4,100	8,000	9,100	9,300	5,600	98,200
1986	4,500	8,400	19,400	12,900	40,500	50,500	12,700	6,300	13,000	8,500	7,700	6,000	190,000
1987	3,600	4,100	7,900	8,800	23,000	15,000	8,700	5,300	5,700	6,900	5,100	4,300	98,400
1988	2,200	3,100	5,400	7,200	18,300	14,400	2,500	2,500	3,000	3,700	4,200	3,600	70,100
1989	2,100	1,700	12,600	11,400	28,800	20,500	6,500	3,300	6,800	6,700	10,700	6,500	118,000

[1]Values may not total due to rounding.

Table 16. Synthesized monthly natural flows for Musselshell River near Roundup, Montana, in acre-feet

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1929	4,900	5,100	18,300	20,600	47,500	52,200	5,100	3,500	5,500	4,500	6,000	4,700	178,000
1930	2,300	5,400	11,500	31,300	27,200	18,500	2,300	1,900	2,200	2,900	4,300	2,900	113,000
1931	2,400	3,200	5,900	6,300	7,900	12,600	2,300	1,200	2,000	3,200	3,600	2,900	53,500
1932	2,000	1,800	4,700	7,600	30,500	55,500	3,500	1,900	1,700	3,400	4,300	3,700	121,000
1933	2,600	3,100	5,500	17,200	66,200	60,400	3,800	3,000	3,000	3,400	3,700	4,500	176,000
1934	4,300	4,600	7,900	18,000	14,100	54,700	2,500	1,500	1,200	3,400	3,000	3,000	118,000
1935	3,200	1,700	4,900	8,400	11,200	13,900	6,900	1,300	1,100	2,900	2,600	2,300	60,400
1936	2,500	2,600	12,000	18,800	55,000	29,800	2,600	1,400	1,400	2,100	2,400	2,400	133,000
1937	1,500	3,500	5,000	17,300	33,100	27,800	4,200	1,300	1,300	5,000	2,000	2,000	104,000
1938	2,600	4,300	7,800	13,200	73,100	72,300	40,100	6,100	2,900	3,800	7,000	4,700	238,000
1939	4,200	3,000	17,500	18,700	37,300	29,800	6,300	1,600	2,000	3,400	3,200	2,900	130,000
1940	2,300	2,600	7,700	10,400	15,500	16,900	4,900	1,200	1,500	3,900	5,400	2,400	74,700
1941	2,600	3,300	6,200	6,800	19,100	41,800	5,900	2,300	6,800	12,800	9,600	9,600	127,000
1942	6,400	6,300	12,200	33,000	86,300	104,000	13,200	7,100	5,200	7,400	7,200	9,200	298,000
1943	6,500	11,400	21,100	61,600	78,000	125,000	21,000	8,700	4,900	6,700	7,300	8,600	361,000
1944	5,400	3,600	7,800	12,600	28,600	93,100	34,100	10,400	5,600	6,300	6,200	8,300	222,000
1945	6,900	5,100	9,500	6,100	21,500	58,900	9,200	3,000	3,100	4,200	6,000	3,900	137,000
1946	4,400	4,200	12,400	22,200	37,000	25,400	9,200	2,900	4,200	7,500	6,900	11,000	147,000
1947	5,400	7,500	25,500	34,400	81,900	63,700	10,300	4,600	5,700	9,000	7,800	9,100	265,000
1948	7,900	5,400	10,200	31,400	97,200	136,000	37,100	10,800	5,400	6,700	7,100	5,800	361,000
1949	4,400	4,100	12,900	36,500	65,200	40,800	8,200	3,000	3,700	5,700	5,300	3,400	193,000
1950	2,800	10,000	9,600	19,000	57,700	93,800	23,600	9,400	5,900	8,300	7,200	6,700	254,000
1951	4,900	7,200	18,600	19,200	69,300	48,800	13,700	7,100	7,400	8,100	7,300	5,700	217,000
1952	4,800	6,100	10,200	44,300	115,000	48,600	13,500	5,400	4,500	4,500	4,100	3,300	264,000
1953	4,000	4,000	7,600	9,500	29,600	122,000	12,100	4,500	2,200	2,400	3,700	4,100	206,000
1954	3,700	5,700	5,600	11,100	25,800	27,500	7,100	3,600	1,600	3,000	3,700	2,600	101,000
1955	2,700	2,100	3,100	15,000	19,500	37,000	14,100	3,600	1,900	2,600	3,700	4,600	110,000
1956	4,000	4,500	14,300	19,300	73,500	39,900	5,600	2,700	1,600	1,900	2,900	2,800	173,000
1957	2,300	2,800	5,700	9,000	64,400	74,400	17,600	5,600	4,600	5,900	5,300	4,600	202,000
1958	4,100	5,000	9,600	14,800	42,100	19,900	7,500	3,500	2,600	2,700	3,700	3,600	119,000
1959	3,800	3,300	20,200	14,300	41,800	94,500	14,400	3,900	3,700	6,600	6,100	4,400	217,000
1960	3,600	3,500	15,500	16,700	38,200	31,400	5,000	2,600	2,100	3,000	3,800	3,900	129,000
1961	3,200	3,500	4,400	4,400	13,600	13,100	2,100	880	1,300	2,100	2,600	2,300	53,500
1962	1,900	3,200	7,300	15,100	50,500	66,800	14,400	5,800	4,800	5,600	4,500	4,900	185,000
1963	2,700	7,500	8,100	9,600	51,400	56,900	11,100	2,800	3,200	4,100	4,000	3,100	165,000
1964	3,300	3,700	4,000	9,800	52,800	91,300	16,400	4,100	3,100	3,700	3,600	4,900	201,000
1965	5,100	6,500	6,700	29,500	61,400	85,200	21,600	7,800	16,200	15,200	9,000	6,700	271,000
1966	4,700	4,800	17,300	20,200	61,900	25,100	8,300	2,700	2,300	3,400	3,900	3,500	158,000
1967	3,400	3,800	7,600	15,900	78,600	273,000	30,700	8,200	6,000	8,100	7,500	5,300	448,000
1968	5,800	10,600	15,000	15,200	45,500	85,300	22,600	9,300	7,600	8,600	7,600	5,900	239,000
1969	5,200	5,800	23,100	38,700	34,600	27,500	17,500	5,100	3,900	6,100	5,600	3,800	177,000
1970	3,500	5,400	7,700	14,300	120,000	107,000	17,400	6,500	6,100	8,000	5,600	5,300	307,000
1971	6,200	12,300	13,100	25,500	66,700	51,000	12,200	3,600	4,500	8,400	6,400	4,200	214,000
1972	4,300	11,000	28,200	19,900	55,900	56,700	11,700	8,600	6,000	9,100	7,000	3,400	222,000
1973	3,800	4,300	7,400	10,900	12,300	16,800	4,400	3,900	4,200	5,800	7,200	5,400	86,400
1974	8,200	5,700	13,200	24,900	53,400	91,300	15,800	9,900	9,200	6,400	8,100	5,500	252,000
1975	3,900	4,600	8,900	24,200	106,000	245,000	70,200	17,600	11,300	12,200	14,000	12,700	531,000
1976	8,400	8,500	16,100	28,200	156,000	66,900	18,500	10,400	8,000	9,400	8,200	6,900	346,000
1977	5,500	7,200	8,300	17,500	32,800	21,900	6,400	4,200	4,100	5,700	5,600	5,200	124,000
1978	4,400	5,400	41,200	39,900	128,000	100,000	40,000	9,400	11,600	10,500	8,300	7,700	406,000
1979	3,900	6,300	43,800	23,500	102,000	132,000	25,700	9,100	5,800	6,700	5,600	5,500	370,000
1980	4,500	6,600	10,500	22,500	60,000	103,000	20,500	10,700	8,600	8,200	7,700	6,900	270,000

Table 16. Synthesized monthly natural flows for Musselshell River near Roundup, Montana, in acre-feet (Continued)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1981	5,300	6,800	12,000	21,400	116,000	93,200	19,000	10,700	6,500	7,200	7,100	6,900	312,000
1982	5,400	8,700	16,800	26,300	70,900	132,000	43,200	9,800	10,300	12,000	9,600	8,100	353,000
1983	9,100	8,100	14,000	34,400	47,200	39,500	21,000	10,300	9,600	9,100	6,700	5,100	214,000
1984	9,800	7,400	11,100	17,800	43,000	54,600	12,000	10,000	6,800	8,300	6,900	4,400	192,000
1985	4,100	4,200	7,700	17,300	19,800	10,800	1,900	4,200	8,200	9,300	9,500	5,700	103,000
1986	4,700	8,900	20,800	13,700	41,500	51,500	13,200	6,500	13,600	8,700	7,900	6,200	197,000
1987	3,800	4,400	8,700	9,500	23,600	15,400	9,000	5,400	6,000	7,000	5,300	4,400	103,000
1988	2,300	3,400	6,000	7,800	18,800	14,800	2,600	2,500	3,100	3,800	4,400	3,700	73,200
1989	2,200	2,000	13,600	12,400	29,700	21,000	6,700	3,400	7,000	6,900	11,000	6,700	123,000

[1]Values may not total due to rounding.

Table 17. Synthesized monthly natural flows for Musselshell River at Musselshell, Montana, in acre-feet

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1929	5,000	5,600	20,100	21,800	47,900	52,600	5,100	3,500	5,600	4,500	6,000	4,800	183,000
1930	2,300	5,500	12,600	32,100	27,400	18,600	2,300	1,900	2,200	2,900	4,300	3,000	115,000
1931	2,400	3,400	6,000	6,500	8,000	12,600	2,300	1,200	2,000	3,200	3,600	3,000	54,200
1932	2,000	1,900	4,800	7,700	30,600	56,200	3,600	2,000	1,700	3,400	4,300	3,700	122,000
1933	2,600	3,100	5,600	17,400	66,400	60,500	4,000	3,000	3,000	3,400	3,700	4,500	177,000
1934	4,300	4,900	8,200	18,100	14,100	55,400	2,500	1,500	1,200	3,400	3,000	3,000	120,000
1935	3,200	1,700	5,000	8,500	11,200	13,900	7,300	1,300	1,100	2,900	2,600	2,300	61,000
1936	2,600	2,600	13,400	19,500	55,500	29,900	2,600	1,400	1,400	2,100	2,400	2,400	136,000
1937	1,500	3,500	5,300	17,600	33,200	28,400	4,500	1,300	1,300	5,100	2,000	2,000	106,000
1938	2,600	4,500	8,300	13,400	73,700	73,400	41,600	6,200	3,000	3,800	7,100	4,700	242,000
1939	4,200	3,000	19,000	19,100	37,600	30,400	6,400	1,600	2,000	3,400	3,200	2,900	133,000
1940	2,300	2,600	8,100	10,500	15,500	16,900	4,900	1,200	1,500	4,000	5,500	2,400	75,400
1941	2,600	3,500	6,300	6,900	19,200	42,200	6,000	2,300	6,900	12,900	9,600	9,800	128,000
1942	6,500	6,800	13,700	34,100	89,200	107,000	14,000	7,400	5,200	7,600	7,400	9,400	308,000
1943	6,600	12,200	23,500	63,100	79,400	128,000	21,800	9,000	4,900	6,900	7,500	8,900	372,000
1944	5,500	3,700	8,900	13,200	28,800	95,600	35,500	11,000	5,700	6,400	6,400	8,600	229,000
1945	7,000	5,400	10,700	6,400	21,600	59,600	9,400	3,100	3,100	4,200	6,100	4,000	141,000
1946	4,400	4,500	13,100	22,600	37,200	25,500	9,200	2,900	4,200	7,600	7,000	11,200	149,000
1947	5,600	8,100	28,000	35,800	82,400	64,000	10,500	4,700	5,800	9,100	8,000	9,600	272,000
1948	9,100	5,600	11,600	32,000	97,900	136,000	37,400	10,800	5,500	6,700	7,300	6,100	366,000
1949	4,500	4,100	13,100	37,600	66,300	41,100	8,300	3,000	3,700	5,700	5,400	3,400	196,000
1950	2,900	11,600	10,500	19,500	58,200	94,400	23,700	9,400	5,900	8,300	7,300	6,800	259,000
1951	5,100	7,800	20,700	19,600	70,400	49,200	13,800	7,200	7,500	8,100	7,300	5,700	222,000
1952	4,900	6,800	11,200	45,600	116,000	48,800	13,600	5,400	4,500	4,500	4,100	3,300	269,000
1953	4,000	4,100	7,900	9,600	29,900	123,000	12,200	4,500	2,200	2,400	3,700	4,100	208,000
1954	3,700	6,100	5,800	11,300	26,000	27,500	7,500	3,700	1,600	3,100	3,700	2,600	103,000
1955	2,700	2,100	3,200	16,000	19,900	37,200	14,400	3,700	1,900	2,600	3,700	4,600	112,000
1956	4,000	4,800	15,800	19,600	73,900	40,100	5,700	2,800	1,600	1,900	2,900	2,800	176,000
1957	2,300	2,800	6,000	9,200	64,800	74,700	17,700	5,600	4,600	6,000	5,400	4,800	204,000
1958	4,200	5,300	10,000	15,000	42,200	20,000	7,600	3,500	2,600	2,700	3,700	3,600	120,000
1959	3,800	3,300	23,000	14,600	42,400	95,000	15,000	3,900	3,800	6,700	6,200	4,400	222,000
1960	3,700	3,600	16,300	17,000	38,400	31,500	5,100	2,600	2,100	3,000	3,800	3,900	131,000
1961	3,200	3,600	4,500	4,500	13,600	13,100	2,100	900	1,300	2,100	2,700	2,300	53,900
1962	1,900	3,200	8,100	15,200	50,800	68,100	14,600	5,900	4,900	5,700	4,600	5,000	188,000
1963	2,700	8,000	8,400	9,800	51,800	57,000	11,100	2,800	3,300	4,100	4,100	3,100	166,000
1964	3,400	3,800	4,100	10,000	53,100	91,700	16,600	4,200	3,200	3,800	3,700	4,900	203,000
1965	5,200	6,800	7,200	30,300	61,800	85,400	21,700	7,800	16,500	15,300	9,100	6,700	274,000
1966	4,700	5,000	18,800	20,800	62,200	25,200	8,600	2,700	2,300	3,400	3,900	3,500	161,000
1967	3,400	3,900	7,800	16,100	79,800	284,000	32,700	8,400	6,200	8,300	7,700	5,400	464,000
1968	5,900	11,800	15,900	16,000	46,600	86,500	24,000	9,500	7,800	8,800	7,700	6,000	247,000
1969	5,300	6,300	27,400	39,700	35,600	28,400	18,200	5,200	4,000	6,200	5,700	3,800	186,000
1970	3,500	5,800	8,400	14,600	124,000	109,000	18,100	6,700	6,400	8,100	5,800	5,500	316,000
1971	6,300	13,900	14,200	26,300	67,100	51,500	12,300	3,700	4,700	8,400	6,500	4,300	219,000
1972	4,300	13,000	30,000	20,500	57,000	57,300	12,000	8,700	6,100	9,300	7,200	3,400	229,000
1973	3,800	4,400	7,900	11,400	12,700	16,900	4,600	4,000	4,300	5,800	7,300	5,500	88,600
1974	8,300	6,300	13,800	25,200	53,900	91,800	16,100	10,200	9,500	6,500	8,300	5,600	256,000
1975	4,000	4,800	9,600	25,800	109,000	248,000	74,400	18,000	11,700	12,400	14,500	13,100	545,000
1976	8,500	8,900	17,800	28,700	159,000	67,800	19,100	10,700	8,200	9,500	8,400	7,200	354,000
1977	5,600	7,800	8,700	17,800	33,100	22,000	6,500	4,300	4,200	5,800	5,600	5,300	127,000
1978	4,500	5,600	42,800	41,200	131,000	102,000	41,800	9,600	12,000	10,700	8,500	7,900	418,000
1979	4,000	6,700	46,500	24,200	104,000	133,000	26,300	9,300	5,900	6,800	5,700	5,600	378,000
1980	4,500	7,200	11,600	23,000	60,600	104,000	20,800	11,000	8,700	8,400	7,800	7,100	275,000

Table 17. Synthesized monthly natural flows for Musselshell River at Musselshell, Montana, in acre-feet (Continued)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1981	5,500	7,300	12,500	21,700	121,000	95,100	19,500	11,000	6,500	7,300	7,200	7,000	322,000
1982	5,500	9,500	18,200	27,100	71,700	134,000	44,200	9,900	10,500	12,200	9,800	8,200	361,000
1983	9,100	9,000	14,600	34,700	47,800	39,700	21,400	10,400	9,800	9,200	6,800	5,200	218,000
1984	9,800	8,000	11,600	18,000	43,300	55,000	12,200	10,100	7,000	8,400	7,000	4,400	195,000
1985	4,100	4,600	8,000	17,500	19,900	10,900	1,900	4,200	8,400	9,400	9,600	5,800	104,000
1986	4,800	10,000	21,600	14,000	42,000	51,800	13,500	6,600	14,300	8,800	8,000	6,400	202,000
1987	3,900	4,600	9,000	9,900	23,800	15,500	9,300	5,500	6,200	7,200	5,400	4,500	105,000
1988	2,300	3,400	6,200	7,900	18,900	14,800	2,600	2,500	3,200	3,800	4,400	3,700	73,700
1989	2,200	2,000	13,900	12,900	30,100	21,100	6,900	3,500	7,100	6,900	11,000	6,700	124,000

[1]Values may not total due to rounding.

Table 18. Synthesized monthly natural flows for Flatwillow Creek at mouth, near Mosby, Montana, in acre-feet

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1929	1,000	4,700	5,100	6,900	8,800	10,900	470	500	1,500	1,100	830	1,100	42,900
1930	610	1,800	3,500	5,700	6,400	290	49	380	260	1,000	740	560	21,300
1931	490	580	730	660	410	200	270	410	340	950	900	280	6,200
1932	310	580	1,000	1,500	1,300	47,700	2,600	1,500	260	740	890	360	58,700
1933	580	470	5,300	1,800	5,700	5,400	460	630	760	760	750	720	23,300
1934	730	1,200	1,400	4,600	2,300	15,900	770	150	200	480	460	420	28,600
1935	380	470	700	1,900	6,200	3,000	2,100	810	200	260	670	730	17,400
1936	670	520	10,400	2,300	2,500	1,900	220	210	290	370	460	490	20,300
1937	420	450	1,100	1,100	3,400	15,300	3,900	230	210	490	320	430	27,400
1938	440	540	9,500	2,000	8,200	7,500	17,900	870	1,200	950	1,500	1,100	51,700
1939	1,100	610	13,800	3,800	4,600	25,800	2,900	300	300	410	460	540	54,600
1940	570	650	1,100	2,100	3,300	2,700	540	200	300	360	370	470	12,700
1941	520	520	520	1,300	2,800	8,000	1,600	400	1,500	1,600	1,400	1,700	21,900
1942	1,200	1,500	4,300	7,400	20,000	25,200	18,800	1,300	910	930	1,200	1,500	84,200
1943	1,500	5,100	9,900	8,000	9,500	30,500	27,000	1,500	720	1,100	1,700	1,400	97,900
1944	1,100	1,100	14,400	3,200	10,200	33,500	39,400	3,000	1,700	1,300	1,400	1,500	112,000
1945	1,700	1,600	3,300	1,900	5,600	9,100	2,500	410	610	770	1,200	1,200	29,900
1946	1,300	2,000	2,000	2,400	3,700	2,300	1,300	250	660	2,000	2,400	2,300	22,600
1947	2,000	1,600	14,600	7,500	8,400	8,500	5,400	1,500	760	1,200	1,900	2,300	55,700
1948	6,700	2,300	5,100	4,400	9,700	12,900	7,100	1,300	710	1,300	1,900	1,800	55,200
1949	1,200	990	13,300	5,200	11,300	5,700	1,600	220	710	900	980	800	42,900
1950	830	1,400	2,300	3,400	9,900	15,100	3,700	1,200	920	1,600	1,600	1,600	43,600
1951	2,000	6,400	5,700	3,900	14,300	9,600	3,900	1,300	1,600	1,700	1,400	1,400	53,200
1952	1,400	1,600	15,600	6,000	14,300	3,900	1,800	370	210	610	930	720	47,400
1953	1,000	890	1,100	2,300	6,400	19,300	3,300	530	400	380	650	820	37,100
1954	790	1,700	1,100	1,700	3,000	3,800	1,200	650	160	200	370	360	15,000
1955	230	230	4,300	3,400	5,300	4,200	2,100	870	170	280	1,400	1,300	23,800
1956	650	580	7,000	3,300	15,400	16,900	1,500	660	240	330	1,500	850	48,900
1957	330	290	6,500	1,600	2,900	1,200	1,900	870	1,600	710	920	2,600	21,400
1958	1,200	1,800	2,800	2,500	6,800	9,400	4,000	1,100	480	2,100	730	2,900	35,800
1959	1,100	1,000	14,400	1,600	180	3,000	2,100	420	220	1,100	3,500	1,600	30,200
1960	700	460	4,900	2,800	1,000	1,200	980	200	400	220	730	480	14,100
1961	290	260	330	65	280	120	350	470	280	86	370	140	3,000
1962	590	690	980	2,800	13,800	57,300	1,400	2,100	1,800	1,100	1,500	1,600	85,700
1963	200	7,200	2,600	1,200	3,600	1,200	2,200	580	1,500	610	2,400	830	24,100
1964	560	370	440	2,100	13,600	9,800	22,000	1,900	1,100	1,300	1,600	1,900	56,700
1965	360	3,800	4,300	9,500	13,000	8,800	8,500	1,000	5,300	3,300	1,500	1,800	61,200
1966	1,200	1,100	7,300	1,700	5,100	1,400	470	330	250	160	370	960	20,300
1967	1,900	2,500	2,500	1,200	5,500	17,900	15,600	1,400	1,500	330	690	650	51,700
1968	750	1,300	3,200	4,100	19,800	13,800	5,400	1,400	2,500	3,600	2,100	1,900	59,900
1969	1,200	2,200	17,200	24,900	14,700	4,500	38,900	1,600	740	2,700	3,400	2,600	115,000
1970	1,100	960	970	1,100	61,800	17,700	11,300	1,900	2,500	1,100	1,900	1,600	104,000
1971	1,900	16,000	10,700	11,000	7,600	9,400	11,900	1,300	2,300	1,800	1,300	1,200	76,400
1972	1,900	2,000	10,100	7,000	32,900	11,200	4,200	1,900	2,000	2,600	2,200	1,900	79,900
1973	500	1,200	830	2,900	1,600	2,400	1,000	220	1,100	310	1,100	1,300	14,500
1974	280	1,400	2,100	7,600	13,300	3,900	8,700	2,200	2,800	250	770	1,200	44,500
1975	1,800	1,800	2,900	3,300	12,600	46,900	53,000	5,500	3,400	4,500	7,500	6,200	149,000
1976	3,000	7,000	4,000	9,000	11,000	76,500	8,300	3,100	3,800	1,800	2,100	2,100	132,000
1977	1,600	1,500	860	560	1,800	880	340	310	180	570	1,100	380	10,100
1978	440	640	9,200	2,900	10,400	9,300	36,800	2,600	7,700	1,400	1,300	760	83,400
1979	680	880	5,600	6,400	29,500	9,300	1,500	720	540	570	690	540	56,900
1980	1,100	1,400	1,300	1,900	9,500	6,800	9,000	1,300	650	3,100	1,900	3,300	41,300

Table 18. Synthesized monthly natural flows for Flatwillow Creek at mouth, near Mosby, Montana, in acre-feet (Continued)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1981	1,800	1,500	1,000	1,800	24,300	18,700	7,600	1,700	410	570	610	320	60,300
1982	600	1,400	2,500	2,700	18,900	12,200	6,600	2,000	2,700	2,300	2,100	1,400	55,400
1983	1,800	1,600	3,600	2,300	12,500	10,300	3,700	2,000	2,700	1,900	4,500	1,400	48,300
1984	2,400	2,300	5,200	4,200	17,500	3,700	1,100	2,700	8,300	3,600	2,100	1,600	54,700
1985	1,600	4,100	980	1,800	3,800	820	170	300	470	1,800	2,200	1,600	19,600
1986	1,500	8,000	5,600	590	9,800	13,600	2,200	870	860	1,900	1,500	1,600	48,000
1987	1,400	1,200	1,300	1,300	3,300	840	660	290	1,700	390	580	280	13,200
1988	380	350	470	400	1,000	300	170	4,500	150	110	180	200	8,200
1989	250	480	3,300	2,800	4,200	3,100	440	1,700	460	470	730	910	18,800

[1]Values may not total due to rounding.

Table 19. Synthesized monthly natural flows for Musselshell River at Mosby, Montana, in acre-feet

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1929	6,500	19,000	32,900	32,400	58,500	67,600	5,700	4,700	8,200	7,600	6,900	6,400	256,000
1930	2,900	7,800	19,200	39,700	35,500	18,900	2,400	3,300	2,600	22,000	5,200	3,600	163,000
1931	2,900	4,400	7,300	7,300	8,500	12,800	2,500	1,600	2,300	4,100	4,500	3,200	61,400
1932	2,300	2,800	6,000	9,300	32,300	125,000	6,800	6,700	2,000	5,000	5,500	4,200	208,000
1933	3,300	3,700	13,200	19,500	72,700	66,800	4,600	3,700	3,800	4,500	4,600	5,400	206,000
1934	5,100	6,800	9,800	23,500	16,500	77,800	3,300	1,600	1,400	3,900	3,500	3,400	157,000
1935	3,600	2,200	5,800	10,700	18,700	17,400	10,100	3,500	1,300	3,200	3,400	3,100	83,000
1936	3,200	3,200	35,000	22,600	58,100	31,900	2,800	1,600	1,700	2,400	2,900	2,900	168,000
1937	1,900	4,000	7,100	18,800	36,600	49,600	9,500	1,600	1,500	5,800	2,300	2,500	141,000
1938	3,100	5,300	21,400	15,600	82,700	82,100	64,200	7,100	5,200	4,900	8,900	6,000	307,000
1939	5,300	3,700	41,300	23,800	42,600	66,800	9,900	2,000	2,400	3,900	3,600	3,500	209,000
1940	2,900	3,300	10,200	12,800	18,900	19,800	5,500	1,500	1,800	4,400	5,800	2,900	89,800
1941	3,100	4,100	6,900	8,200	21,900	52,800	7,600	2,800	8,900	14,600	11,100	12,100	154,000
1942	7,900	9,400	22,700	46,100	118,000	147,000	38,000	10,300	6,500	9,600	9,100	11,500	436,000
1943	8,500	25,900	46,700	75,100	91,100	175,000	56,200	11,900	6,000	9,000	9,900	10,900	526,000
1944	6,900	5,800	33,300	18,800	41,800	146,000	85,500	17,400	8,600	8,400	8,200	10,900	392,000
1945	9,200	8,600	19,100	8,900	27,400	70,700	12,300	3,600	3,800	5,100	7,600	5,600	182,000
1946	5,900	8,800	17,300	25,600	41,200	28,100	10,700	3,300	4,900	10,000	9,900	14,200	180,000
1947	8,000	10,500	50,100	48,200	91,800	74,000	17,400	7,400	6,600	10,800	10,600	13,400	349,000
1948	18,800	9,400	25,000	38,000	109,000	153,000	45,600	12,300	6,400	8,200	9,800	8,500	444,000
1949	6,100	5,300	31,000	45,500	82,000	48,600	10,000	3,300	4,500	6,700	6,500	4,300	254,000
1950	3,900	14,200	13,700	24,600	70,000	114,000	28,000	10,900	7,000	10,300	9,400	8,800	315,000
1951	7,700	17,700	28,500	24,900	88,900	60,500	18,100	8,700	9,200	10,100	9,200	7,400	291,000
1952	6,400	9,800	32,900	53,800	136,000	54,100	15,600	6,000	4,700	5,400	5,200	4,200	334,000
1953	5,200	5,200	9,300	12,300	37,300	150,000	16,200	5,100	2,600	3,000	4,400	5,000	256,000
1954	4,700	9,000	7,500	13,400	29,100	31,700	8,900	5,500	1,900	3,400	4,100	3,000	122,000
1955	3,000	2,300	9,100	23,300	27,500	43,000	16,800	5,400	2,100	2,900	5,100	6,000	147,000
1956	4,800	5,600	28,300	23,600	89,900	57,300	7,400	3,700	1,900	2,500	4,600	3,700	233,000
1957	2,700	3,100	15,800	11,300	68,100	76,200	19,800	6,600	6,300	7,400	6,800	7,900	232,000
1958	5,600	7,300	14,200	18,400	49,200	29,400	11,900	4,700	3,100	5,200	4,700	6,500	160,000
1959	4,900	4,400	48,100	16,900	42,900	98,200	17,300	4,400	4,100	8,000	10,600	6,500	266,000
1960	4,500	4,100	25,500	20,800	39,700	32,700	6,200	2,900	2,500	3,300	4,600	4,400	151,000
1961	3,500	3,900	4,800	4,600	13,900	13,200	2,500	1,500	1,600	2,200	3,100	2,500	57,300
1962	2,500	4,500	10,000	18,100	69,200	141,000	16,400	11,300	7,500	7,300	6,500	6,800	301,000
1963	3,000	19,600	12,800	11,500	56,800	58,600	13,400	3,400	5,300	4,900	6,600	4,000	200,000
1964	4,000	4,200	4,600	12,300	71,600	106,000	39,400	7,800	4,300	5,400	5,500	7,000	272,000
1965	6,000	13,900	15,500	47,700	80,100	95,300	30,900	9,000	23,100	19,900	11,200	9,600	362,000
1966	6,400	6,200	32,200	23,400	67,700	26,700	9,200	3,000	2,500	3,600	4,500	4,600	190,000
1967	5,500	6,700	10,500	17,400	88,100	313,000	49,200	10,200	8,000	9,000	8,700	6,200	533,000
1968	6,900	13,600	19,700	20,500	68,400	107,000	30,100	11,300	11,000	13,200	10,300	8,100	320,000
1969	6,700	8,600	49,700	67,200	54,200	34,700	59,400	7,000	4,900	9,000	9,300	6,600	317,000
1970	4,700	7,000	9,800	16,200	203,000	132,000	29,600	9,000	9,900	9,600	7,900	7,700	446,000
1971	9,100	37,600	28,100	38,800	75,100	64,400	24,300	5,000	7,800	10,300	7,900	5,500	314,000
1972	6,400	15,500	43,200	28,900	93,900	73,800	16,400	10,800	8,300	12,700	9,900	5,400	325,000
1973	4,600	5,600	9,600	15,200	14,700	19,800	5,700	4,200	5,700	6,400	8,700	7,000	107,000
1974	8,800	9,600	19,000	33,100	68,400	96,100	25,600	13,200	13,000	6,800	9,500	7,200	310,000
1975	6,100	7,300	13,900	33,100	126,000	296,000	149,000	25,000	16,100	17,800	23,900	20,200	734,000
1976	11,900	19,100	23,500	39,300	172,000	146,000	27,700	14,700	13,200	11,900	10,900	9,900	500,000
1977	7,700	11,200	9,900	18,900	35,400	23,500	7,000	4,700	4,500	6,600	6,900	6,000	142,000
1978	5,300	7,400	66,300	46,100	146,000	113,000	86,400	12,900	27,000	12,900	10,500	9,300	543,000
1979	5,100	8,900	56,100	35,000	137,000	145,000	28,200	10,400	6,700	8,100	6,800	6,300	454,000
1980	5,800	10,000	14,500	26,700	72,100	115,000	30,700	13,100	9,700	11,900	10,300	10,900	331,000

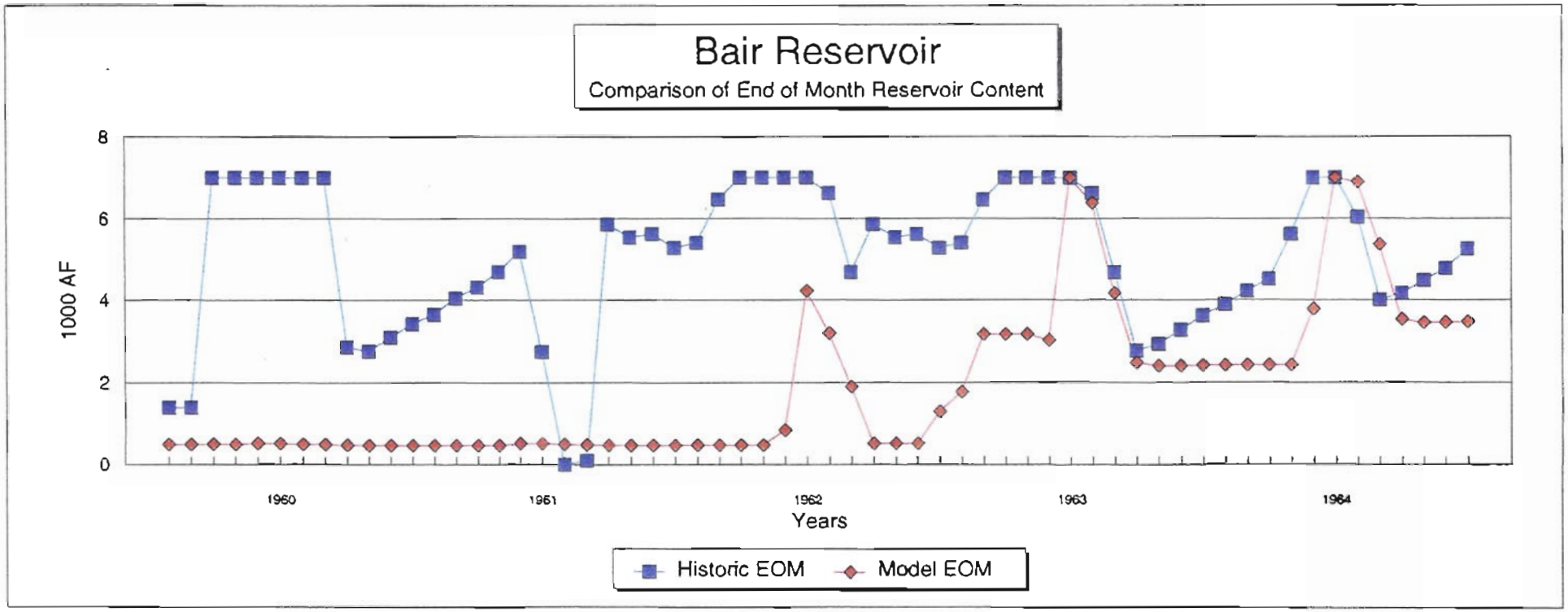
Table 19. Synthesized monthly natural flows for Musselshell River at Mosby, Montana, in acre-feet (Continued)

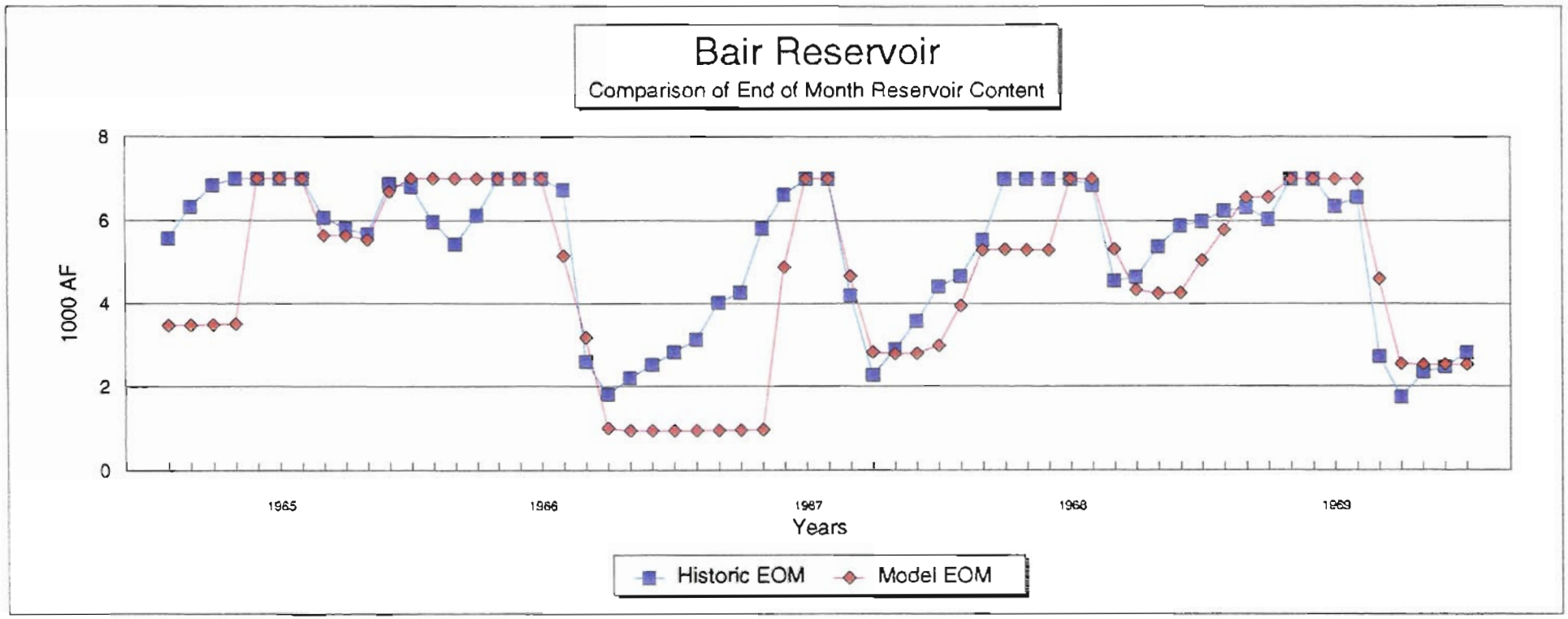
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL[1]
1981	8,000	10,300	15,500	25,100	158,000	124,000	28,400	13,800	7,100	8,500	8,300	7,400	414,000
1982	6,600	12,200	24,600	31,200	91,200	148,000	51,500	12,100	14,300	15,500	12,700	10,000	430,000
1983	11,600	11,100	18,900	37,300	60,800	50,200	25,800	12,500	13,600	11,900	11,900	6,700	272,000
1984	12,600	11,100	17,800	22,500	61,000	59,500	13,500	12,900	16,100	12,600	9,600	6,200	255,000
1985	5,900	9,700	10,100	19,600	23,800	11,700	2,100	4,600	9,100	11,500	12,000	7,400	128,000
1986	6,600	23,800	32,500	15,200	54,200	66,600	16,000	7,600	16,400	11,500	9,800	8,600	269,000
1987	5,600	6,600	12,200	12,100	28,300	16,700	10,200	5,900	8,700	8,200	6,200	4,800	126,000
1988	2,700	3,800	7,300	8,400	20,000	15,200	2,800	7,100	3,500	3,900	4,600	4,100	83,400
1989	2,500	2,700	18,200	17,100	35,800	24,900	7,400	5,300	7,800	7,600	12,100	8,000	149,000

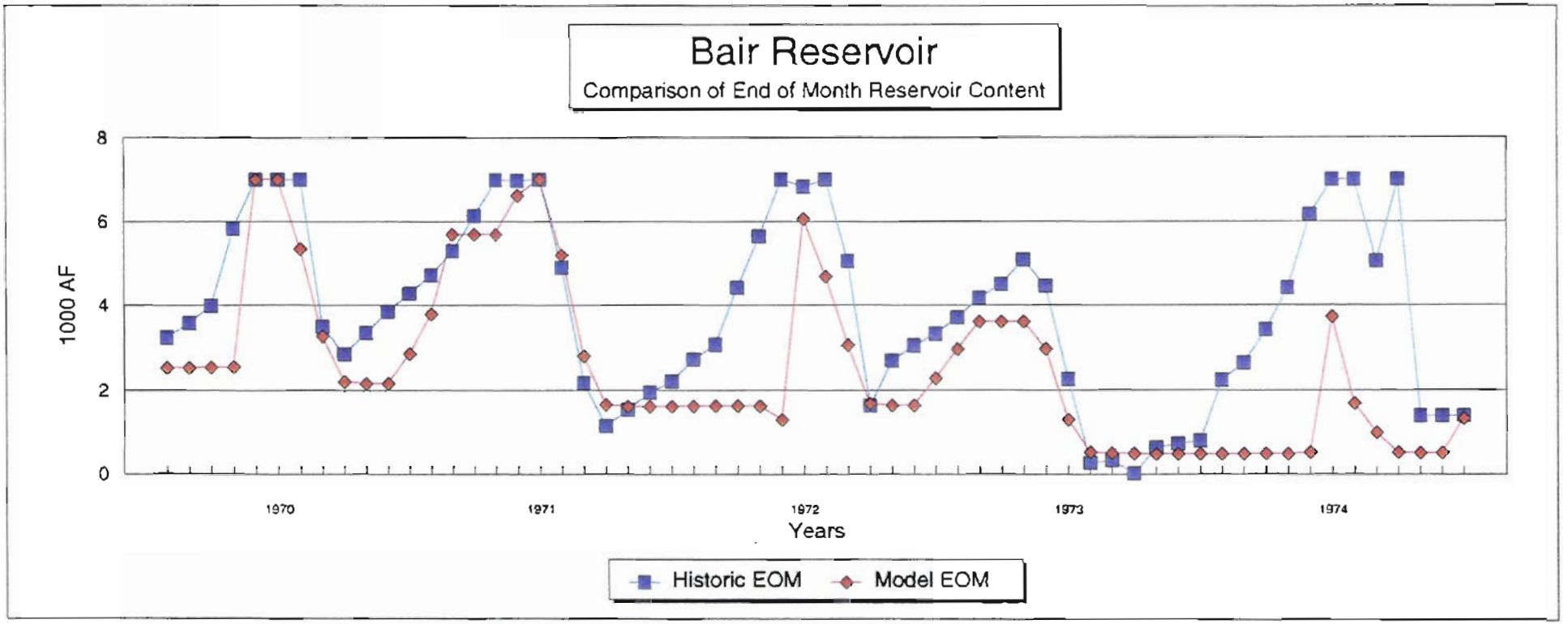
[1]Values may not total due to rounding.

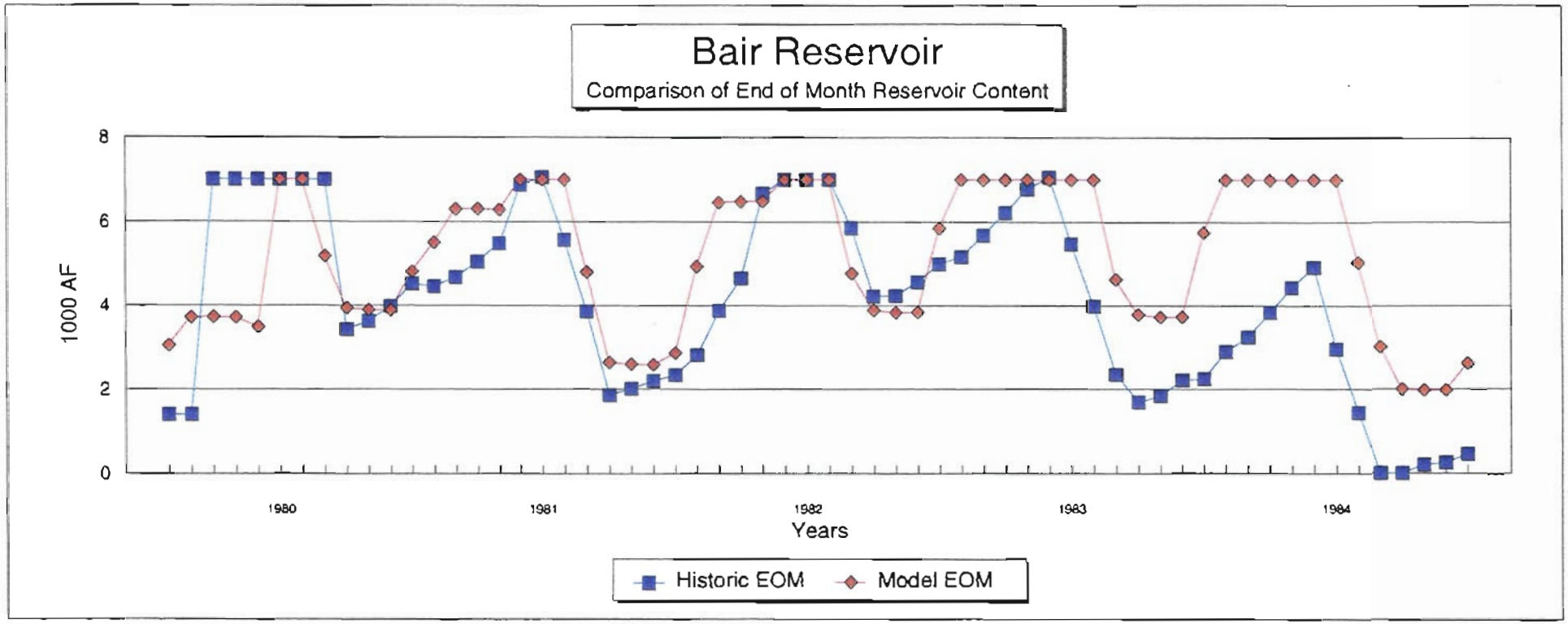
• U.S. GOVERNMENT PRINTING OFFICE: 1996-776-180/45056

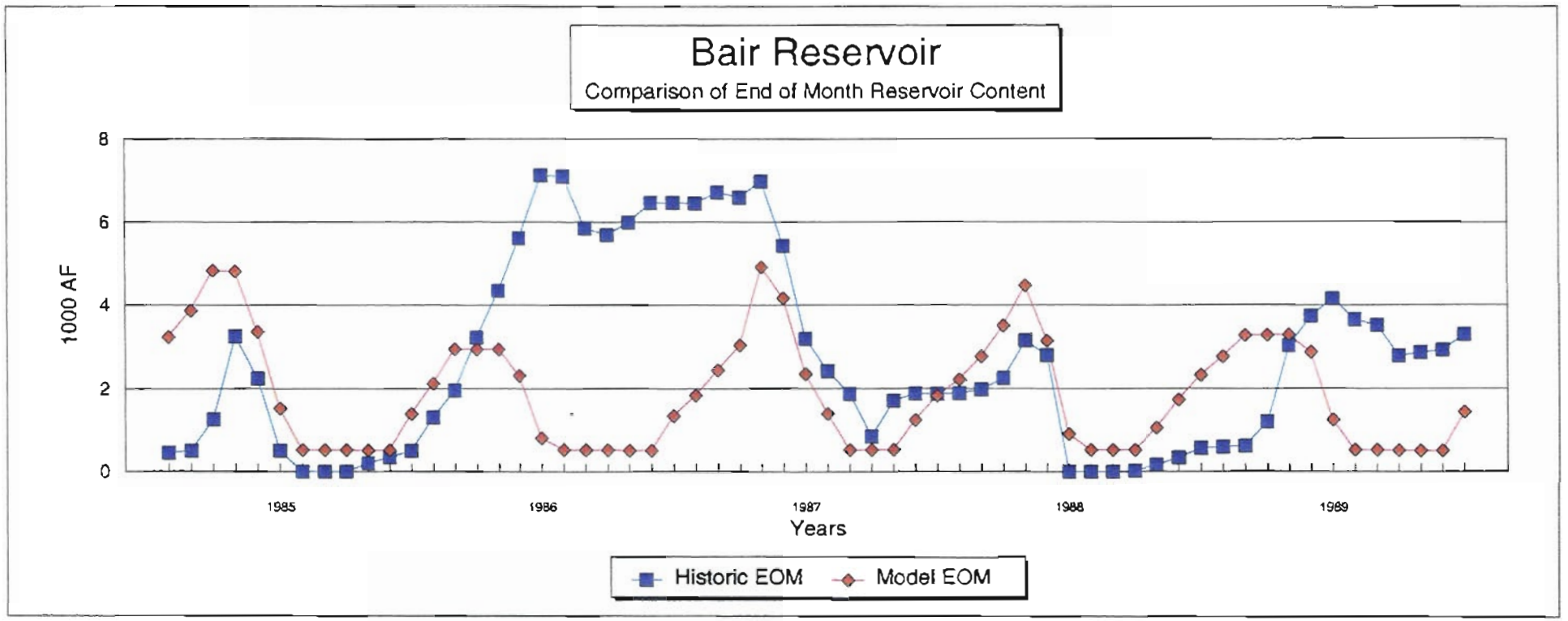
Appendix 6
MODEL RESULTS COMPARED TO HISTORIC EOM

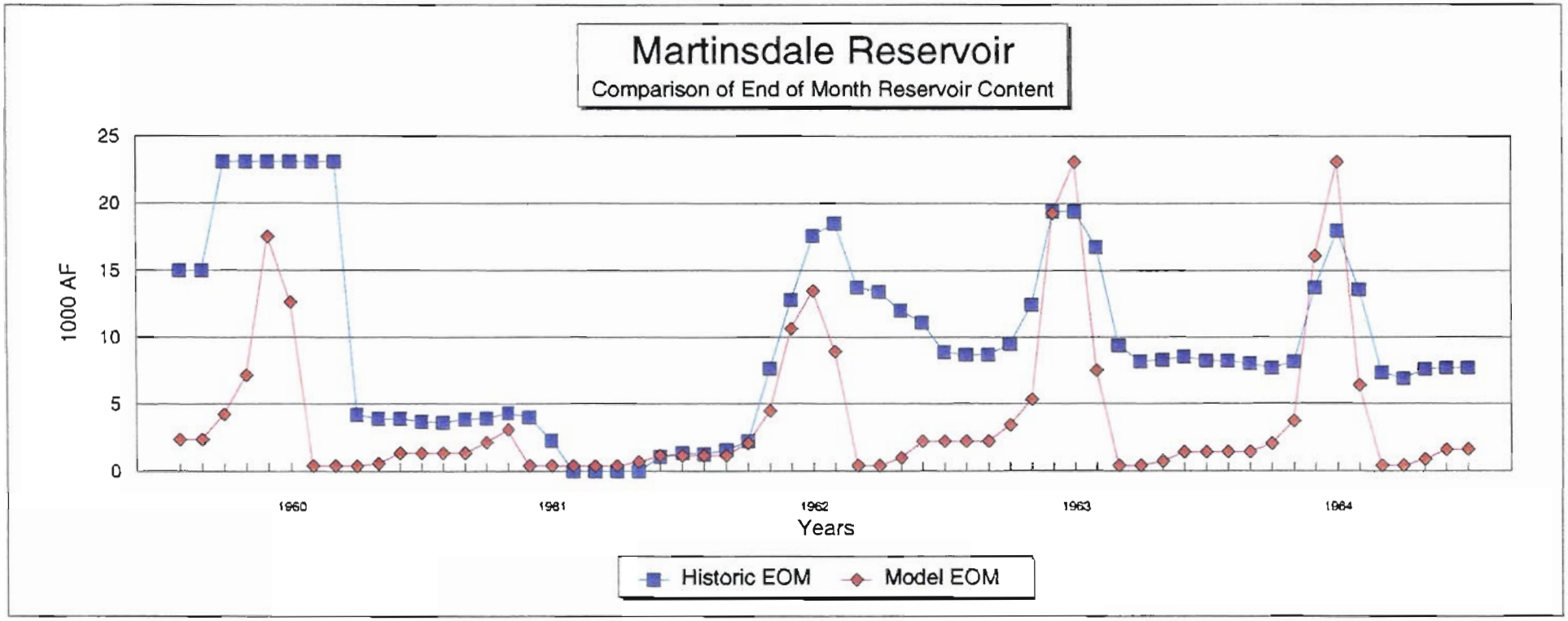

Bair Reservoir
Comparison of End of Month Reservoir Content
1000 AF
8
6
4
2
0
1960
1961
1962
1963
1964
Years
Historic EOM
Model EOM

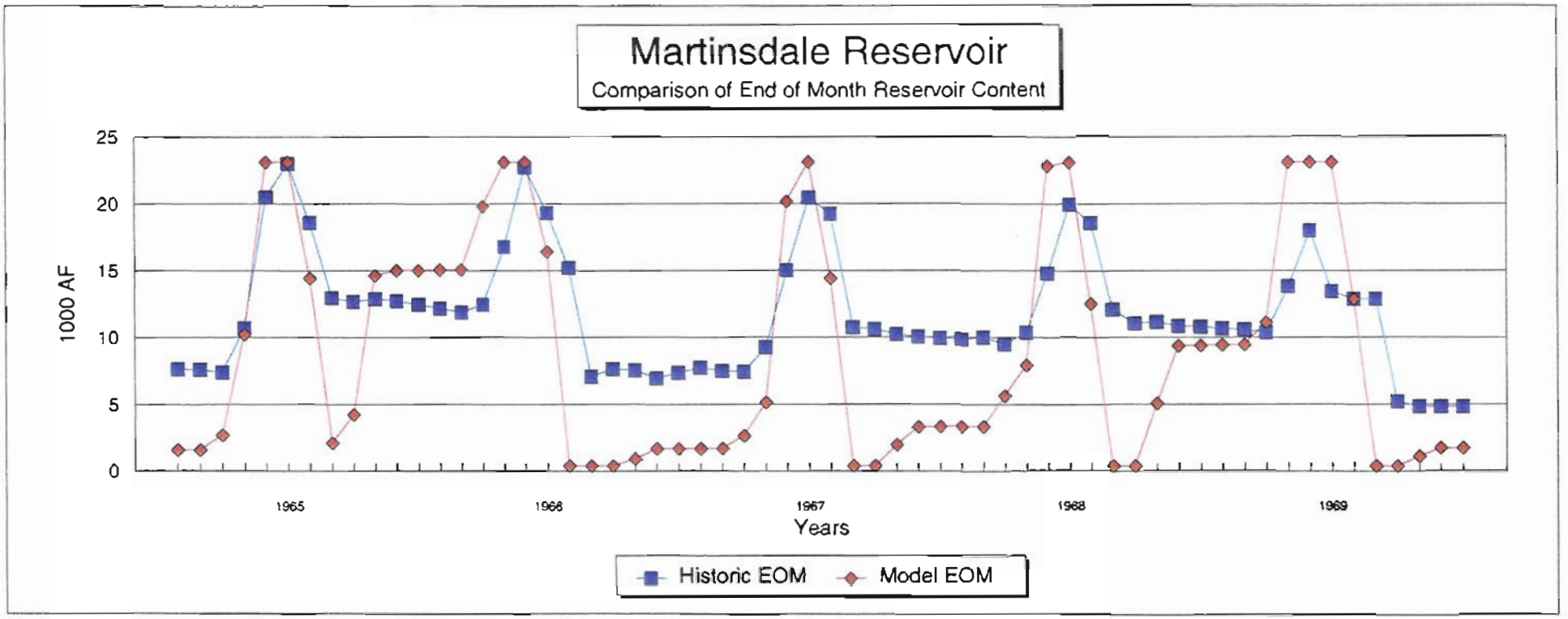

Bair Reservoir
Comparison of End of Month Reservoir Content
1000 AF
8
6
4
2
0
1965
1966
1967
1968
1969
Years
Historic EOM
Model EOM

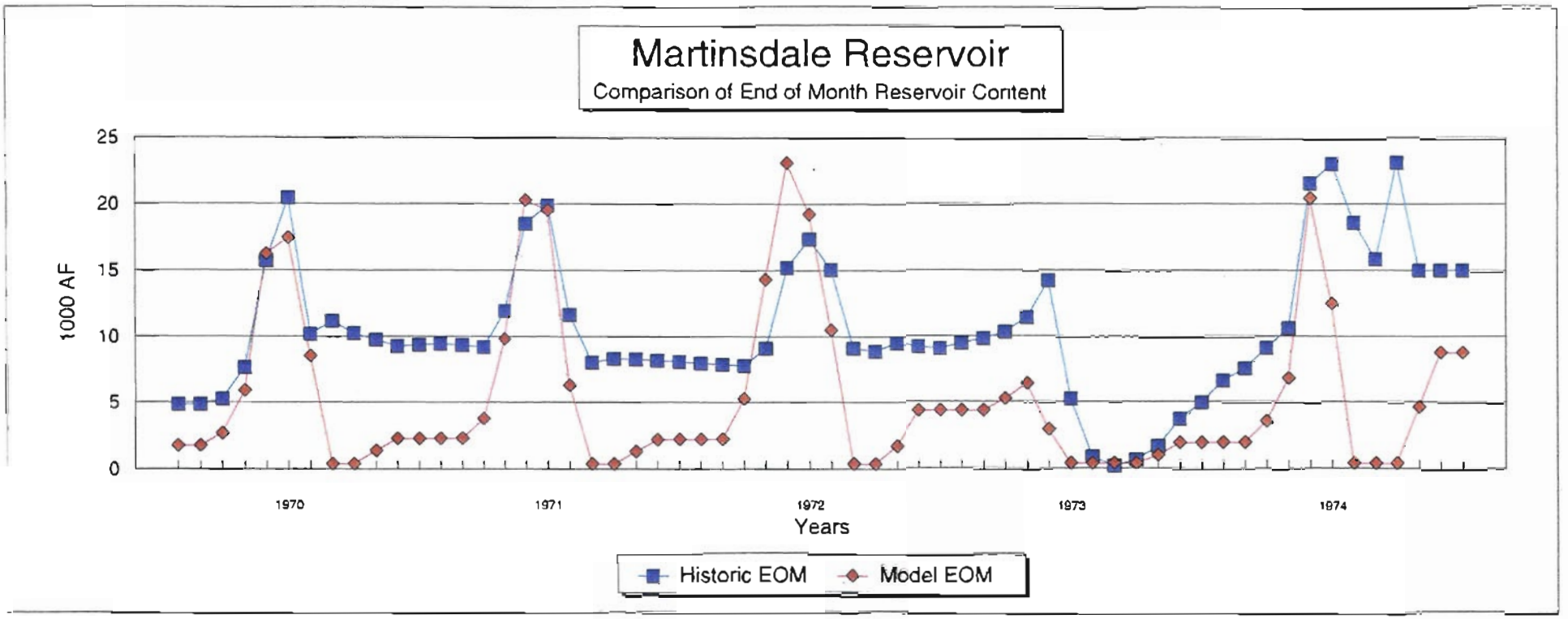

Bair Reservoir
Comparison of End of Month Reservoir Content
1000 AF
8
6
4
2
0
1970
1971
1972
1973
1974
Years
Historic EOM
Model EOM

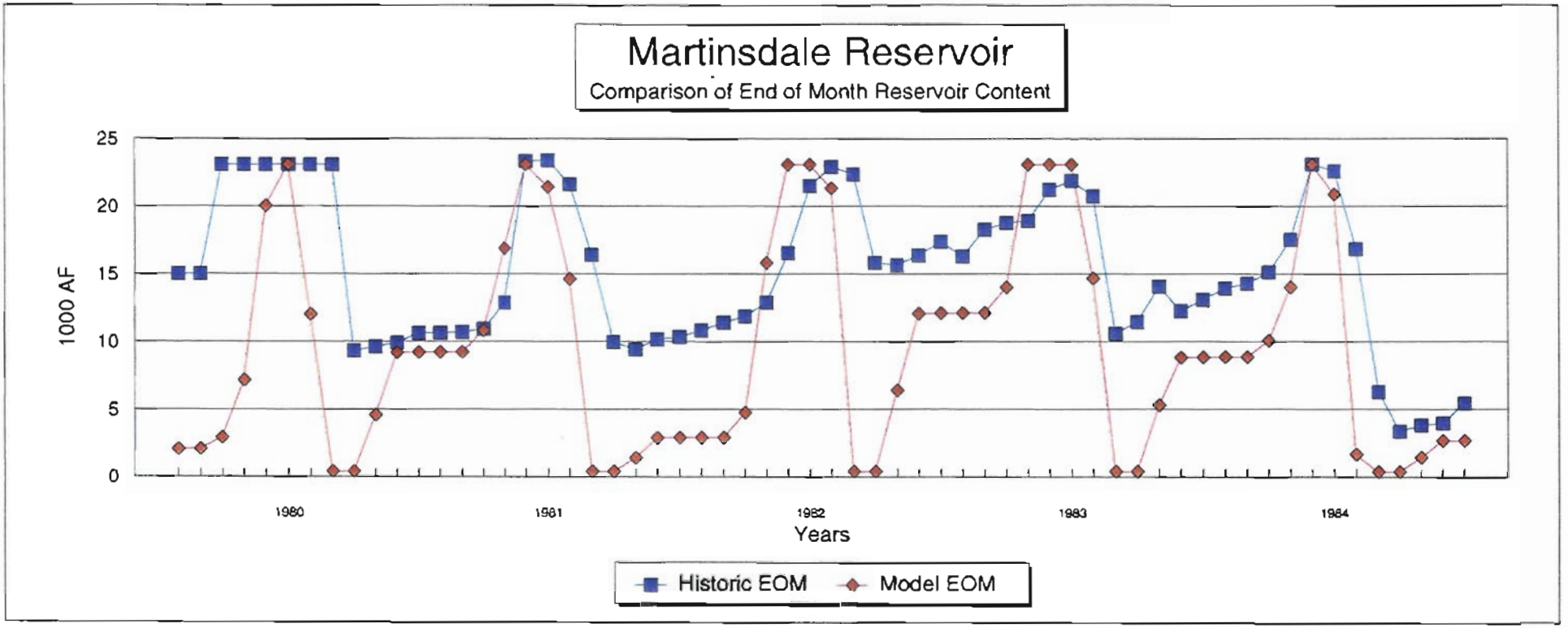

Bair Reservoir
Comparison of End of Month Reservoir Content
1000 AF
8
6
4
2
0
1980
1981
1982
1983
1984
Years
Historic EOM
Model EOM

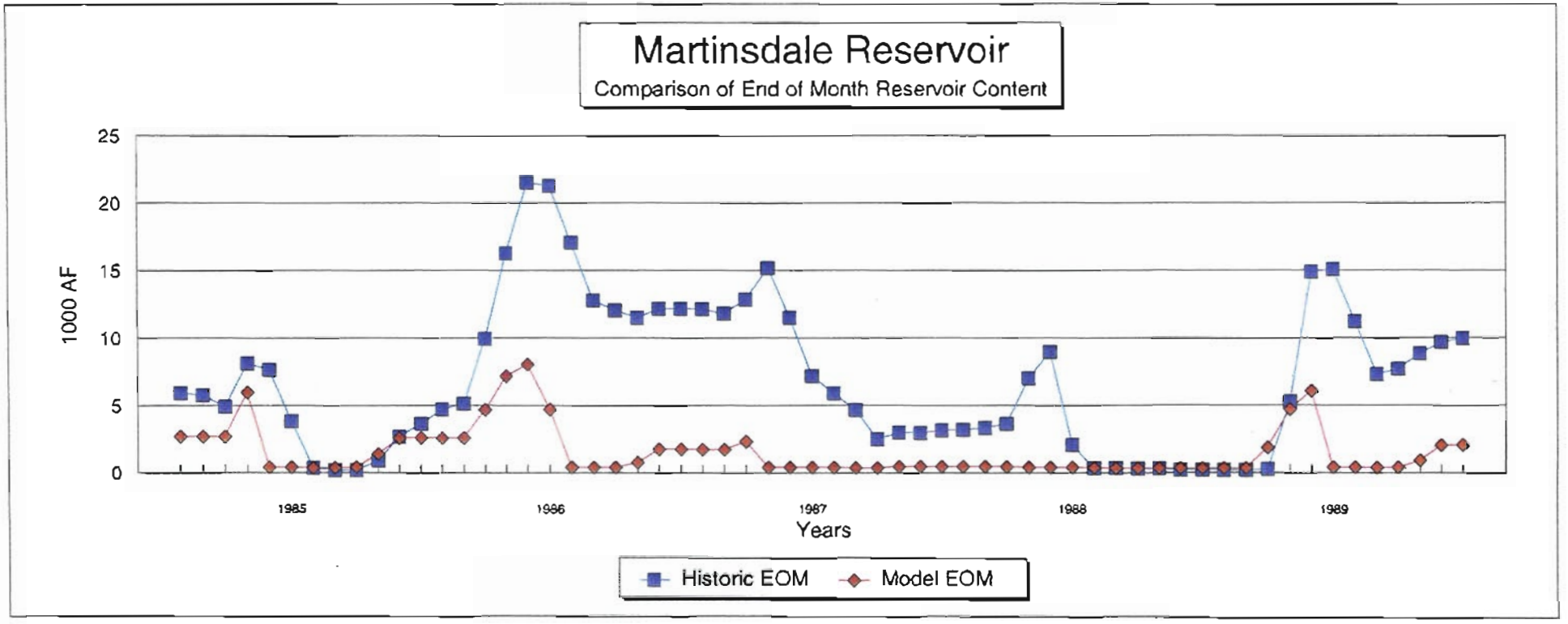

Bair Reservoir
Comparison of End of Month Reservoir Content
1000 AF
8
6
4
2
0
1985
1986
1987
1988
1989
Years
Historic EOM
Model EOM

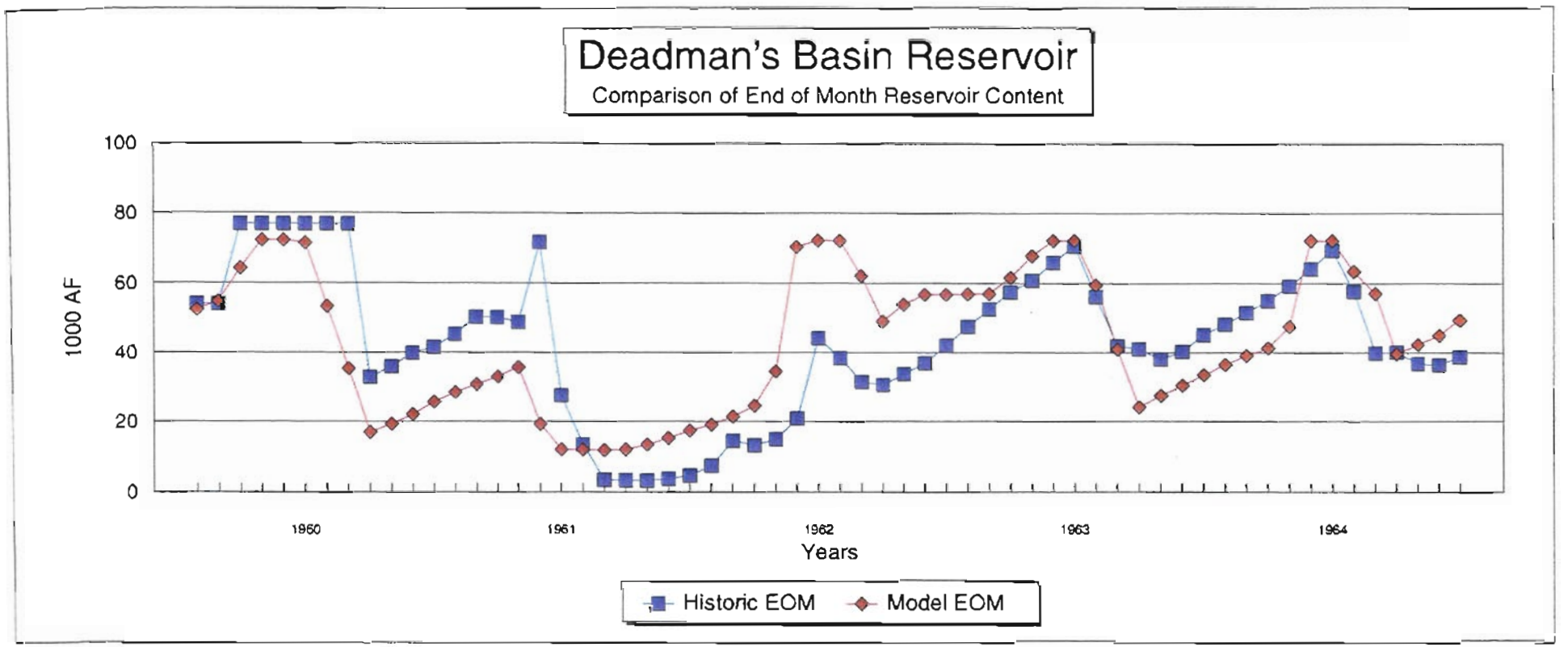

Martinsdale Reservoir
Comparison of End of Month Reservoir Content
1000 AF
25
20
15
10
5
0
1960
1961
1962
1963
1964
Years
Historic EOM
Model EOM

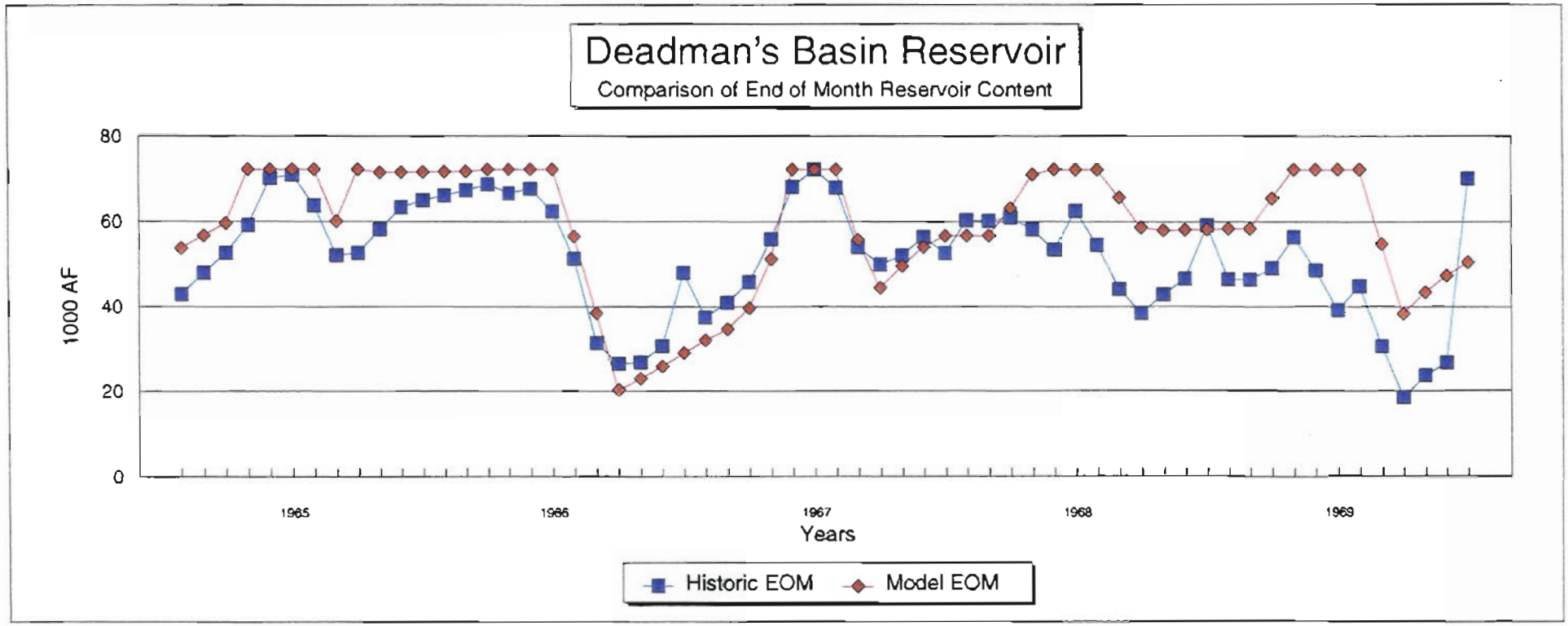

Martinsdale Reservoir
Comparison of End of Month Reservoir Content
1000 AF
25
20
15
10
5
0
1965
1966
1967
1968
1969
Years
Historic EOM
Model EOM

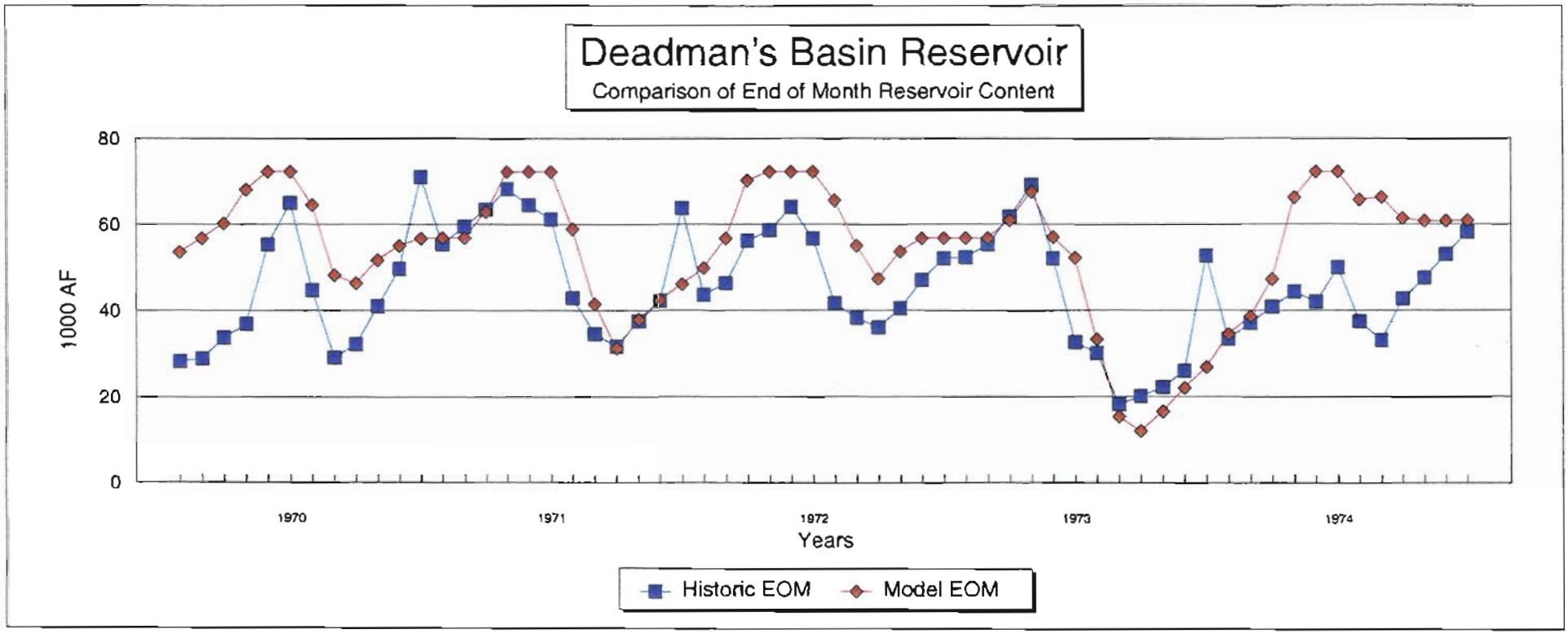

Martinsdale Reservoir
Comparison of End of Month Reservoir Content
1000 AF
25
20
15
10
5
0
1970
1971
1972
1973
1974
Years
Historic EOM
Model EOM

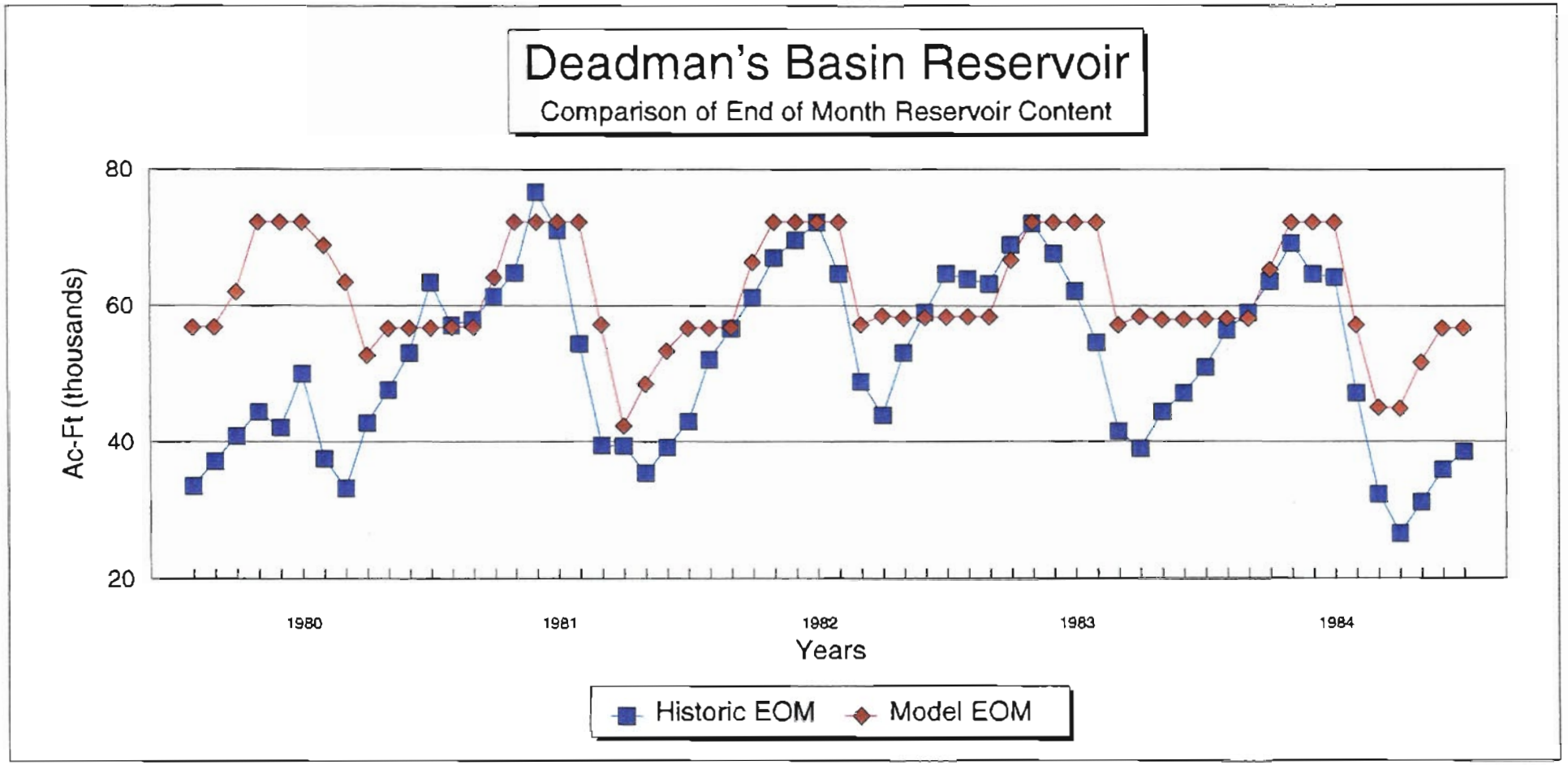

Martinsdale Reservoir
Comparison of End of Month Reservoir Content
1000 AF
25
20
15
10
5
0
1980
1981
1982
1983
1984
Years
Historic EOM
Model EOM

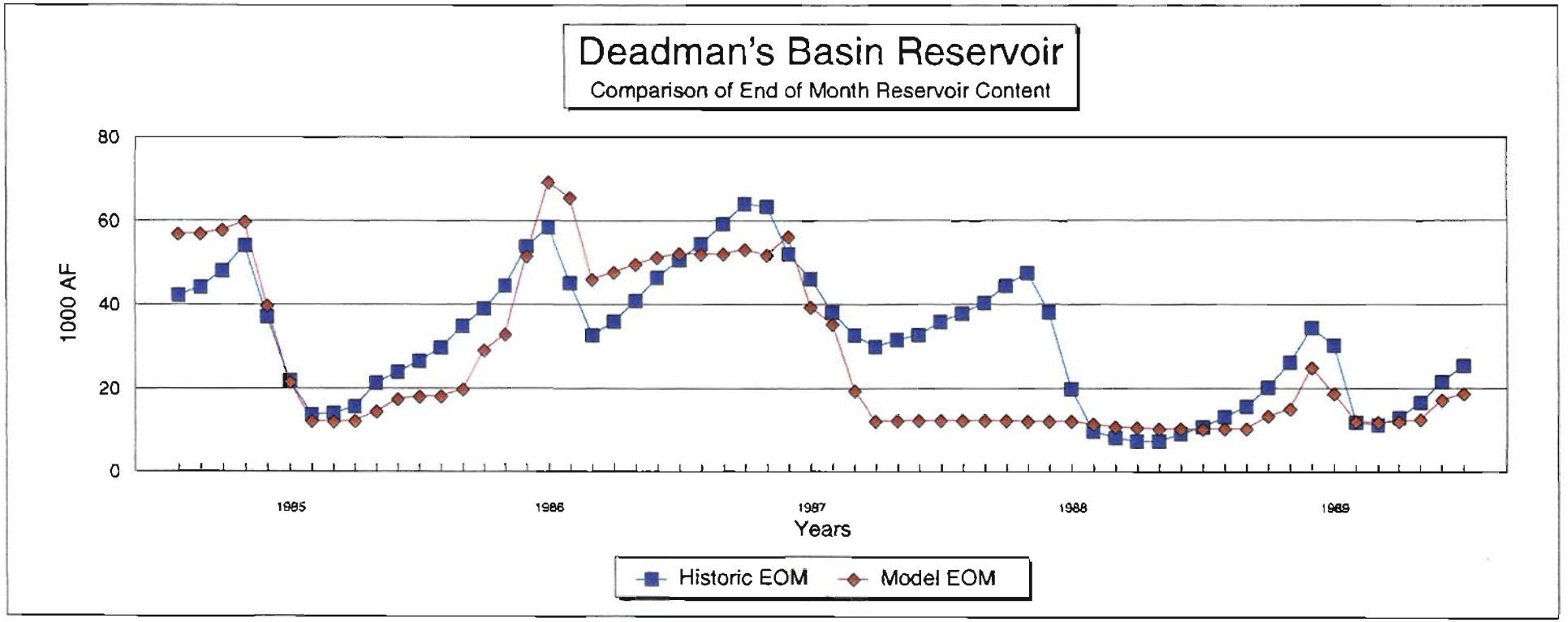

Martinsdale Reservoir
Comparison of End of Month Reservoir Content
1000 AF
25
20
15
10
5
0
1985
1986
1987
1988
1989
Years
Historic EOM
Model EOM


Deadman's Basin Reservoir
Comparison of End of Month Reservoir Content
1000 AF
100
80
60
40
20
0
1960
1961
1962
1963
1964
Years
Historic EOM
Model EOM


Deadman's Basin Reservoir
Comparison of End of Month Reservoir Content
1000 AF
80
60
40
20
0
1965
1966
1967
1968
1969
Years
Historic EOM
Model EOM


Deadman's Basin Reservoir
Comparison of End of Month Reservoir Content
1000 AF
80
60
40
20
0
1970
1971
1972
1973
1974
Years
Historic EOM
Model EOM


Deadman's Basin Reservoir
Comparison of End of Month Reservoir Content
Ac-Ft (thousands)
80
60
40
20
1980
1981
1982
1983
1984
Years
Historic EOM
Model EOM


Deadman's Basin Reservoir
Comparison of End of Month Reservoir Content
1000 AF
80
60
40
20
0
1985
1986
1987
1988
1989
Years
Historic EOM
Model EOM

Appendix 7
HISTORIC AND MODELED FLOW DATA

Name: MUSSELSHELL RIVER AT HARLOWTON, MT. Coverage : 98%
Model Results that match end-of-month reservoir contains at Bair and Martinsdale

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
29	3.15	2.80	10.31	10.34	28.96	38.55	14.00	2.33	2.15	1.87	4.78	3.50
30	1.48	3.30	4.56	16.55	21.13	6.54	0.53	0.01	0.18	1.50	2.97	2.09
31	1.57	1.75	3.41	2.40	3.94	1.10	0.53	0.00	0.25	1.61	2.50	2.20
32	1.40	0.94	2.58	4.98	20.31	27.23	5.06	1.29	0.00	1.87	3.03	2.63
33	2.07	1.72	1.95	11.97	40.75	35.29	5.25	0.29	0.06	2.15	2.85	3.04
34	2.94	2.40	5.13	10.64	6.33	27.11	8.95	0.17	0.25	2.15	2.23	2.37
35	1.93	0.99	2.52	4.65	7.85	8.27	1.52	0.04	0.11	1.97	2.02	1.80
36	2.04	1.55	4.66	11.12	32.10	21.97	0.42	0.03	0.20	1.06	1.95	1.79
37	0.94	2.01	2.32	12.18	21.38	13.51	1.40	0.00	0.22	3.10	1.65	1.38
38	1.36	2.34	3.26	8.75	43.41	37.81	22.91	10.89	0.11	2.31	5.25	2.97
39	2.19	1.17	8.24	9.37	19.98	14.77	6.16	0.00	0.07	2.13	2.46	1.44
40	1.60	1.60	4.12	6.73	4.42	6.95	0.54	0.00	0.07	2.68	4.10	1.80
41	1.69	2.17	4.08	4.58	9.44	24.89	4.94	0.17	3.54	9.74	7.66	6.58
42	4.36	2.57	4.93	14.15	46.16	60.27	14.18	4.78	2.91	2.89	3.36	3.46
43	4.36	5.38	8.93	33.55	55.07	74.68	13.60	9.23	2.89	3.35	3.24	3.22
44	3.28	2.03	3.39	5.61	16.76	43.87	11.28	11.30	2.84	1.39	2.83	2.53
45	3.51	2.78	3.77	2.42	15.59	27.06	9.83	1.79	1.01	2.39	4.26	2.69
46	2.95	2.14	6.27	14.66	15.59	11.34	11.95	4.42	1.54	4.07	4.99	6.42
47	2.59	3.08	10.21	13.04	47.37	49.28	14.57	2.38	3.14	5.69	6.01	4.86
48	4.12	2.58	4.92	14.84	71.26	96.25	19.43	16.34	2.52	4.58	4.84	3.42
49	2.66	2.22	6.45	11.88	39.37	20.96	11.65	7.62	1.57	3.24	3.86	2.57
50	1.88	3.92	2.91	11.19	28.62	57.87	11.00	14.19	3.93	1.85	3.87	3.05
51	2.15	2.87	6.90	9.63	40.36	30.91	10.91	9.06	2.89	4.90	3.86	2.87
52	2.36	2.14	3.54	17.94	83.53	31.96	10.87	7.66	2.19	2.78	2.98	2.29
53	2.69	2.29	4.09	6.01	17.46	78.34	10.35	2.07	1.75	1.33	2.75	2.71
54	2.19	2.99	3.11	6.33	19.78	20.07	0.48	0.50	0.13	1.57	2.77	1.84
55	1.71	1.14	1.65	5.33	9.70	23.51	7.55	0.27	0.04	1.80	2.94	3.42
56	2.78	2.34	6.46	11.63	45.19	24.70	4.97	0.43	0.00	1.35	2.03	1.84
57	1.36	1.27	2.62	4.63	35.74	42.35	10.05	6.85	0.56	3.18	3.30	2.74
58	2.19	2.35	5.21	8.36	17.76	10.68	1.20	0.54	0.38	1.83	2.95	2.34
59	2.49	1.71	6.23	7.73	20.93	62.32	13.51	0.62	0.66	3.61	4.32	2.87
60	2.36	1.08	10.11	10.16	13.48	11.62	0.00	0.00	11.80	4.12	2.88	2.14
61	2.06	1.65	2.35	2.41	4.29	1.98	4.51	0.00	0.17	1.60	1.29	1.03
62	1.34	1.76	3.28	4.76	35.75	31.38	4.14	3.83	0.38	5.61	4.22	5.53
63	2.00	4.13	4.77	4.96	31.22	32.00	4.30	7.50	2.58	2.89	2.59	2.31
64	2.18	1.99	2.36	6.66	34.95	64.78	5.74	4.59	0.60	2.05	2.09	3.01
65	3.23	3.65	2.89	19.30	36.25	66.68	9.68	6.11	12.26	9.91	7.59	5.31
66	4.47	3.41	7.91	9.57	39.31	14.38	3.56	6.56	0.13	2.63	3.45	2.31
67	2.17	2.05	4.80	10.63	51.17	117.09	10.24	6.05	2.17	6.14	3.79	2.48
68	3.10	4.27	6.68	8.57	27.05	53.16	6.82	7.06	2.46	5.38	4.12	2.76
69	2.74	2.67	7.85	22.33	13.18	16.39	5.62	2.48	7.78	4.64	2.98	1.63
70	1.74	2.23	3.40	7.13	66.39	62.34	11.35	1.75	2.75	5.28	3.80	2.93
71	3.80	6.12	4.99	15.76	40.80	30.65	7.78	5.37	0.74	4.98	3.52	2.40
72	2.40	4.27	13.96	13.04	33.91	33.48	5.00	4.51	3.90	5.32	4.80	2.47
73	2.26	2.42	4.03	5.62	0.00	7.33	5.42	0.75	0.03	3.48	4.63	3.77
74	5.28	2.76	7.77	12.18	32.19	56.30	6.94	7.11	1.51	6.62	5.41	3.71
75	13.98	2.48	3.32	10.32	55.29	183.79	46.57	8.49	1.48	8.53	7.82	8.31
76	18.28	3.32	6.76	18.57	92.50	40.21	7.62	4.84	1.26	6.85	4.55	3.63
77	16.74	3.14	3.25	9.70	9.55	7.12	2.77	2.32	0.00	4.72	4.03	3.61
78	13.58	2.59	12.84	24.87	78.74	64.39	28.05	3.80	4.15	7.61	5.35	4.36
79	14.99	2.72	12.84	12.93	60.83	91.41	11.91	3.94	0.00	6.23	3.92	3.71
80	2.17	2.82	3.65	7.31	46.56	75.76	7.26	1.53	15.20	7.13	5.44	4.54
81	3.26	3.19	7.25	14.66	77.36	63.27	7.76	4.51	7.63	6.89	5.07	4.74
82	3.74	4.76	7.44	16.70	44.30	95.94	24.36	1.48	9.39	9.11	7.04	5.25
83	6.06	4.12	8.25	23.43	33.78	25.49	10.02	7.75	4.24	4.60	6.58	4.01
84	6.22	3.78	6.41	8.81	22.84	37.02	6.70	8.86	4.26	6.79	4.95	3.27
85	2.85	1.81	4.01	7.46	8.41	10.13	6.15	3.92	5.74	6.65	7.86	4.76
86	2.63	3.72	13.64	7.62	18.40	23.83	8.42	9.27	6.47	6.77	5.41	3.86
87	1.69	2.17	5.64	4.81	14.06	9.96	6.50	6.23	7.54	5.03	3.65	2.97
88	1.44	1.90	3.41	3.86	4.92	11.70	5.26	2.57	2.55	3.39	3.71	2.93
89	1.62	1.20	7.77	5.20	16.18	7.32	4.65	3.75	5.18	4.94	9.45	5.18

Model Flow	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	3.678	2.603	5.617	10.533	31.638	38.972	8.765	4.134	2.664	4.129	4.098	3.239
Min	0.942	0.942	1.652	2.400	0.000	1.096	0.000	0.000	0.000	1.060	1.294	1.033
Maximum	18.278	6.122	13.963	33.548	92.499	183.795	46.574	16.341	15.202	9.908	9.445	8.308
Median	2.190	2.089	4.960	9.357	29.280	31.712	9.460	4.811	1.612	2.757	3.831	2.820
Variance	13.934	1.129	8.821	35.199	458.704	1056.532	56.244	14.595	10.776	5.228	2.881	1.865
Stand Dev	3.733	1.063	2.970	5.933	21.417	32.504	7.500	3.820	3.283	2.286	1.697	1.366

Name: MUSSELSHELL RIVER AT HARLOWTON, MT. Coverage : 98%
ID : 06120500 Gage Datum: 4171.40 Rec Years: 67
PO : MT Site: SW Well Depth: --- Begin-End: 1927-1993

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1929	2.459	2.221	7.991	7.793	13.716	14.944	1.556	0.015	0.265	1.925	2.360	0.000
1930	0.000	0.000	0.000	14.670	6.935	1.657	0.107	0.666	0.439	2.249	2.975	2.769
1931	3.074	2.221	2.709	1.312	0.725	3.633	0.122	0.000	0.000	0.000	0.000	0.000
1932	0.000	1.194	17.206	3.659	8.545	13.357	0.277	0.000	0.000	0.168	1.618	0.000
1933	0.000	0.000	0.000	10.462	32.006	26.103	0.614	0.000	0.000	0.000	0.000	0.000
1934	0.000	3.262	4.236	4.162	2.326	4.187	0.075	0.001	0.000	0.005	0.617	1.089
1935	1.089	1.380	1.253	3.141	1.466	2.857	2.219	0.124	0.000	0.093	1.998	2.152
1936	1.824	0.575	17.292	29.412	22.916	12.162	0.092	0.000	0.019	0.283	1.434	2.370
1937	2.439	3.093	5.225	10.903	10.885	7.748	0.900	0.014	0.000	0.069	1.646	1.537
1938	1.844	1.527	5.398	7.014	34.597	38.456	25.103	2.362	0.804	3.392	5.424	3.827
1939	2.913	2.459	12.015	9.992	11.176	8.761	2.984	0.109	0.114	0.802	0.919	1.311
1940	1.366	1.467	2.983	1.852	2.735	3.569	3.898	0.280	0.033	1.127	1.344	1.937
1941	1.634	1.396	2.199	2.304	5.307	16.786	4.119	1.476	4.906	10.224	10.494	7.758
1942	6.012	4.565	5.860	12.846	45.750	54.400	7.839	5.501	4.405	4.039	4.519	5.604
1943	3.669	5.741	15.414	37.616	39.390	57.820	6.640	3.556	3.062	3.139	4.014	3.579
1944	2.852	2.076	3.482	3.984	5.263	39.955	21.174	4.816	3.292	4.634	4.864	3.161
1945	3.791	3.084	3.766	2.532	8.439	27.084	6.392	1.959	1.959	3.095	4.315	2.717
1946	4.055	3.530	6.415	12.803	10.236	12.140	7.096	1.468	3.439	5.560	6.308	10.774
1947	4.616	5.057	17.343	18.166	37.007	27.829	4.610	3.561	3.706	7.266	6.629	6.034
1948	4.462	2.836	5.360	13.532	43.933	75.642	26.816	5.981	2.721	5.503	7.916	6.195
1949	2.998	2.221	16.245	27.520	34.235	20.792	3.726	2.808	3.807	4.993	4.208	3.294
1950	2.832	3.940	5.340	11.670	32.162	45.589	13.304	6.919	6.221	8.851	8.295	6.614
1951	5.731	6.425	11.158	11.378	29.852	20.980	8.091	5.196	6.736	7.710	7.514	4.660
1952	4.166	3.793	5.047	24.482	56.230	19.312	9.088	4.166	4.285	3.131	3.129	3.288
1953	3.415	3.157	4.840	4.166	6.935	47.080	7.922	5.158	2.941	1.820	3.718	4.509
1954	1.727	3.974	3.264	4.942	7.789	4.852	2.967	3.469	2.257	3.185	2.320	1.931
1955	1.749	1.571	2.973	4.107	3.807	6.010	5.011	2.157	2.064	2.754	3.300	4.353
1956	3.371	3.068	7.868	9.992	30.376	12.277	3.704	2.405	2.453	2.744	3.782	3.109
1957	2.471	2.284	3.879	4.246	22.914	42.837	13.881	5.203	4.527	5.293	5.082	3.956
1958	3.381	4.462	5.089	7.853	12.533	5.364	4.777	3.621	1.891	2.413	3.212	3.867
1959	4.531	3.331	6.639	4.360	8.442	36.399	9.923	6.548	5.614	5.259	4.761	4.720
1960	3.401	3.004	7.793	5.221	16.161	11.037	4.630	3.780	1.906	3.823	3.932	3.847
1961	3.801	3.197	2.893	1.943	1.436	1.777	1.323	0.264	0.281	0.288	2.041	2.342
1962	2.302	2.568	3.314	2.560	23.841	30.233	8.283	5.445	3.970	5.909	5.467	5.609
1963	3.012	5.269	4.676	3.885	18.269	29.604	10.712	5.469	3.512	2.784	4.404	4.273
1964	3.411	2.788	3.357	4.670	15.029	45.312	10.651	6.992	2.140	2.039	2.213	4.531
1965	5.495	5.578	4.819	13.899	21.956	35.805	12.554	7.724	15.112	11.723	7.791	6.478
1966	4.563	4.394	9.318	7.327	21.349	9.604	6.812	5.405	2.358	2.909	4.067	3.746
1967	3.173	2.677	5.027	10.149	38.793	109.600	21.109	8.725	5.404	5.429	6.564	5.344
1968	4.541	7.218	8.208	7.660	18.405	37.116	10.774	9.344	5.572	6.074	6.476	3.337
1969	3.867	4.263	16.334	31.597	9.558	11.016	12.737	6.437	2.350	4.174	5.221	4.386
1970	3.159	3.292	3.435	6.300	53.511	41.567	11.672	5.100	5.664	5.810	4.478	5.592
1971	4.339	6.867	5.917	13.992	28.854	16.082	8.668	5.676	6.068	6.750	6.290	3.008
1972	3.389	4.224	14.416	10.016	16.704	17.244	5.727	9.223	7.071	5.765	5.632	2.887
1973	2.540	2.522	4.067	3.325	2.382	5.136	2.169	1.364	1.806	3.351	4.146	4.115
1974	5.739	3.292	5.816	7.401	12.231	38.318	11.902	11.783	4.942	4.317	5.810	3.649
1975	3.034	3.212	7.288	17.437	63.742	109.270	46.146	11.589	6.155	9.108	9.138	12.652
1976	9.013	7.773	8.142	18.398	77.825	28.825	11.089	10.585	5.467	7.062	6.143	5.156
1977	4.618	5.509	4.232	5.378	8.311	7.827	4.228	4.198	3.508	3.924	3.958	4.745
1978	4.008	3.928	20.365	21.615	68.714	42.578	24.089	8.191	8.571	8.029	5.868	5.186
1979	4.194	4.827	15.313	16.717	43.585	58.774	14.194	8.434	4.882	4.283	4.325	4.785
1980	3.873	4.576	5.100	9.092	24.885	52.540	12.342	7.839	5.001	5.848	5.461	5.703
1981	3.881	4.928	4.321	4.357	55.157	39.523	9.532	5.116	6.018	6.078	4.561	4.067
1982	2.590	5.439	7.113	12.792	27.492	62.877	25.846	7.892	6.269	8.594	8.175	5.424
1983	6.038	5.778	5.882	8.409	14.280	12.731	10.881	8.866	5.808	5.368	3.583	2.837
1984	8.329	3.827	4.599	8.337	11.289	17.869	8.286	6.732	5.354	4.160	4.420	3.024
1985	3.129	2.156	4.121	5.844	3.508	2.546	1.341	1.935	3.034	4.432	2.407	2.237
1986	2.828	8.969	5.921	5.368	13.056	20.003	8.872	4.822	6.282	6.881	4.547	4.216
1987	3.992	3.514	4.484	2.798	6.101	4.559	5.923	2.437	1.557	2.946	2.261	1.816
1988	1.325	2.284	3.012	2.798	3.702	4.029	2.098	0.058	0.077	0.408	1.364	1.319
1989	1.410	1.170	4.081	3.195	7.375	6.865	4.765	3.837	2.580	3.119	4.180	3.175

Historic Flow	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	3.333	3.523	8.740	9.890	21.438	28.614	8.791	4.299	3.515	4.142	4.292	3.878
Minimum	0.000	0.000	0.000	1.312	0.725	1.657	0.052	0.000	0.000	0.000	0.000	0.000
Maximum	9.013	8.969	20.365	37.616	77.825	109.600	46.146	11.783	15.112	11.723	10.494	12.652
Median	3.371	3.292	5.100	7.401	18.029	19.312	7.839	4.166	3.292	4.039	4.315	3.827
Variance	2.975	3.303	22.071	60.477	330.811	560.765	66.573	10.223	7.905	7.427	4.829	5.039
Stand Dev	1.725	1.817	4.698	7.777	18.188	23.680	8.178	3.197	2.812	2.725	2.197	2.245

Name: MUSSELSHELL RIVER NEAR ROUNDUP MT
Model Rsesults based on end-of-month contents for Bair, Martinsdale, and Deadman

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
47	4.69	5.87	11.69	15.91	55.41	53.42	22.28	15.88	12.89	1.29	0.89	2.25
48	6.99	4.09	2.71	9.07	87.03	126.36	27.06	27.24	17.53	1.69	1.18	5.26
49	3.82	2.81	3.64	8.79	43.30	23.77	20.14	19.21	14.59	1.72	0.80	0.38
50	0.44	3.20	4.67	3.30	27.26	72.13	10.92	25.78	11.92	1.82	6.56	5.98
51	4.41	5.64	7.34	7.27	44.28	35.97	19.35	17.02	12.49	1.59	2.87	4.91
52	4.20	4.73	4.04	11.72	95.71	33.71	17.50	19.40	17.75	1.14	0.53	0.37
53	0.51	0.39	1.58	1.02	6.25	95.62	17.20	18.18	16.49	0.86	0.51	0.45
54	0.51	0.93	0.77	1.73	11.74	8.88	15.92	12.12	15.43	1.08	0.54	0.27
55	0.54	0.15	0.24	5.06	3 51	10.27	10.91	14.91	15.41	0.71	0.45	0.45
56	0.51	0.54	4.50	2.70	30.83	23.90	14.64	11.15	15.36	0.58	0.47	0.35
57	0.48	0.43	1.18	1.62	16.84	51.29	17.87	17.50	13.97	2.02	1.00	0.88
58	0.84	0.79	2.23	1.65	21.72	5.65	7.25	15.16	15.69	0.80	0.52	0.37
59	0.38	0.40	11.38	2.80	8.59	69.56	20.28	16.72	9.22	1.09	0.69	0.54
60	0.46	1.60	3.34	2.50	14.69	12.23	0.00	0.00	49.90	3.67	0.59	1.45
61	0.42	0.44	0.73	4.61	0.37	21.49	13.57	4.83	0.03	2.21	1.76	0.85
62	0.23	0.37	2.56	5.03	32.89	22.57	7.70	8.13	0.47	4.24	2.17	2.85
63	0.56	1.38	1.45	1.39	26.90	35.14	13.09	14.03	0.43	7.62	1.57	0.36
64	0.37	0.66	0.93	2.95	29.79	73.22	11.57	19.34	0.00	6.62	3.56	2.09
65	0.74	1.28	2.24	18.85	30.31	74.52	13.27	15.56	17.74	7.65	4.88	5.50
66	4.78	3.74	14.45	16.68	39.82	16.78	11.62	21.08	2.25	3.94	1.06	0.35
67	0.42	0.50	1.08	3.27	51.37	256.27	16.27	17.12	6.76	7.80	2.32	2.50
68	4.29	9.21	12.45	17.02	40.23	62.40	13.32	16.27	9.31	5.14	3.27	5.45
69	5.82	5.09	20.34	20.74	18.47	36.52	2.32	12.15	14.70	3.89	1.98	1.90
70	3.10	3.72	2.66	7.89	82.61	71.58	27.95	14.86	1.82	3.55	2.08	1.36
71	1.60	3.24	6.45	17.97	50.05	35.95	20.57	8.54	3.93	3.08	1.30	5.21
72	1.37	7.34	16.30	16.08	33.54	40.20	18.53	6.59	7.37	4.84	1.95	0.55
73	0.74	0.55	1.67	3.12	13.03	23.75	3.09	9.21	0.00	2.62	2.81	1.56
74	3.80	0.93	7.49	12.28	38.44	55.57	15.92	12.61	0.47	1.89	1.61	0.73
75	37.71	0.63	3.35	17.29	89.37	226.05	67.13	13.58	0.42	6.04	8.33	9.52
76	44.42	3.72	10.74	20.77	124.60	46.30	16.82	8.27	0.00	1.59	1.84	3.09
77	41.59	2.39	3.10	9.76	9.08	0.95	12.31	5.08	0.00	1.13	0.95	0.54
78	31.77	0.80	35.75	32.49	109.42	73.57	44.17	7.89	1.28	3.63	2.76	4.56
79	39.97	1.51	38.60	16.28	81.08	104.44	23.64	7.89	0.00	1.78	0.96	0.47
80	22.45	1.65	5.53	7.01	53.58	84.42	18.32	7.44	10.63	2.27	1.60	3.21
81	4.66	5.04	7.50	14.57	93.07	83.45	24.00	16.08	6.22	14.12	3.15	0.95
82	0.86	1.97	8.85	17.12	52.14	119.35	35.10	15.46	16.47	5.31	3.74	2.06
83	9.73	7.57	6.96	23.89	42.61	31.72	15.58	17.43	8.76	2.45	5.41	1.32
84	3.68	3.83	5.22	7.05	26.45	41.03	17.60	20.41	11.27	5.32	2.09	1.61
85	4.09	4.13	5.51	6.33	9.41	18.52	9.50	4.89	5.09	6.06	5.15	5.02
86	3.99	5.84	7.27	7.46	6.53	21.58	20.80	16.55	10.75	7.09	4.54	4.57
87	3.28	4.09	6.56	4.50	5.99	9.39	13.69	8.78	5.68	6.51	4.71	4.03
88	2.32	3.33	5.35	4.28	4.92	14.27	10.72	3.71	3.70	3.66	4.18	3.47
89	2.22	2.01	7.82	7.97	5.93	4.76	19.09	4.05	4.76	5.42	4.93	4.86

Model Flow	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	7.202	2.757	7.167	9.761	38.817	54.151	17.641	13.258	9.045	3.663	2.424	2.429
Minimum	0.228	0.152	0.244	1.018	0.365	0.948	0.000	0.000	0.000	0.578	0.451	0.272
Maximum	44.419	9.205	38.600	32.489	124.595	256.274	67.133	27.239	49.901	14.118	8.331	9.516
Median	3.118	2.989	4.171	6.967	28.841	35.654	12.790	16.744	12.833	1.762	1.219	3.110
Variance	149.282	5.118	63.689	53.874	995.45	2701.81	120.293	35.353	78.181	7.270	3.399	4.597
Stand Dev	12.218	2.262	7.981	7.340	31.551	51.979	10.968	5.946	8.842	2.696	1.844	2.144

Name: MUSSELSHELL RIVER NEAR ROUNDUP MT Coverage : 99%
ID : 06126500 Gage Datum: 3188.10 Rec Years: 48
PO : MT Site: SW Well Depth: --- Begin-End: 1946-1993
Flow cfs /Mean --- Value Mask OFF

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1947	6.683	6.534	30.393	22.025	44.110	33.644	5.422	4.059	1.927	2.459	4.164	6.762
1948	5.225	4.601	10.450	14.873	43.031	113.031	55.326	11.065	4.759	3.688	5.354	4.918
1949	3.074	2.221	30.737	38.669	43.031	25.581	6.147	3.688	2.380	2.372	2.320	2.865
1950	2.893	5.794	8.535	15.190	42.168	57.967	19.729	11.085	7.129	6.677	5.178	12.850
1951	7.010	7.178	24.994	19.981	32.305	28.520	7.611	17.335	11.503	12.170	11.051	6.334
1952	5.939	6.831	12.792	36.263	67.285	23.824	15.513	8.648	3.986	2.544	2.580	3.177
1953	3.700	2.881	5.227	2.052	2.808	48.611	6.544	7.014	3.702	0.916	1.908	1.049
1954	1.803	5.229	3.014	2.713	6.010	2.858	8.190	10.050	2.390	1.392	1.850	1.033
1955	0.597	0.823	2.064	8.977	5.307	6.833	8.505	5.646	3.246	0.688	0.956	2.304
1956	2.237	1.452	14.430	6.734	32.955	21.878	7.010	8.261	2.798	1.048	2.534	1.997
1957	1.110	1.432	3.498	2.066	20.207	61.281	18.605	6.262	10.750	7.629	9.665	5.572
1958	5.037	5.086	7.420	6.252	11.319	11.914	11.069	8.227	7.202	2.576	3.472	2.215
1959	2.072	2.806	25.894	4.499	7.323	33.907	12.148	11.079	6.260	3.224	3.147	3.212
1960	2.332	3.833	7.894	5.927	10.665	9.154	12.878	9.193	3.490	1.467	1.789	1.358
1961	1.580	1.527	1.171	3.290	4.000	8.358	7.091	3.002	0.483	0.517	0.886	0.652
1962	0.406	1.797	4.872	1.726	15.352	35.204	12.233	7.867	5.412	4.166	4.991	3.756
1963	1.491	5.757	3.901	2.263	9.566	34.867	12.193	12.188	3.754	3.629	2.717	1.567
1964	1.777	2.060	2.360	2.235	6.889	61.021	20.090	17.891	6.760	3.205	2.534	1.775
1965	6.637	9.469	7.182	19.269	18.716	45.462	19.953	15.216	21.527	13.869	6.734	6.881
1966	6.207	6.118	16.098	15.192	20.262	11.767	14.482	12.112	8.160	4.131	2.437	3.421
1967	3.242	2.935	7.585	5.291	28.295	256.680	47.072	18.771	11.390	7.407	7.180	4.402
1968	8.011	13.653	17.754	17.349	23.110	56.978	19.987	18.127	11.214	5.523	9.175	6.911
1969	6.237	6.871	34.792	32.932	13.770	23.152	13.252	12.596	10.191	6.125	4.470	4.252
1970	2.336	3.673	8.224	9.469	54.277	48.296	19.499	14.341	9.919	5.104	4.035	3.625
1971	2.913	23.013	10.988	18.115	28.460	20.472	17.458	11.656	11.682	5.554	5.221	3.109
1972	3.113	10.914	26.308	6.538	19.665	17.750	15.005	16.393	11.039	4.817	3.641	1.779
1973	1.828	3.000	5.880	4.876	11.210	8.469	10.667	6.465	3.230	2.156	3.490	3.072
1974	7.069	4.938	5.106	4.123	9.602	26.314	12.872	17.853	8.386	4.361	5.221	3.665
1975	2.399	3.163	9.380	46.854	84.145	155.471	80.403	29.342	15.834	14.305	12.717	17.391
1976	13.643	14.119	15.414	15.378	111.320	41.010	20.153	16.647	13.453	6.092	8.279	9.417
1977	6.933	8.636	6.613	4.944	11.069	7.639	5.427	7.597	3.437	1.705	2.120	3.113
1978	3.530	3.750	78.751	30.401	68.178	56.863	44.286	16.328	14.232	10.901	9.681	8.777
1979	6.996	7.835	73.321	43.342	49.638	65.370	23.263	19.743	9.629	5.765	7.113	7.577
1980	5.741	7.744	13.703	9.657	23.955	61.858	19.253	12.009	7.143	5.469	3.901	4.959
1981	6.520	6.788	5.447	2.834	107.211	77.121	22.680	20.344	8.122	4.652	7.315	5.344
1982	2.998	9.120	14.359	16.945	36.596	123.583	59.175	21.575	20.225	9.534	5.511	6.127
1983	10.133	11.490	8.571	7.405	19.860	15.097	14.520	15.003	10.151	5.473	4.248	2.142
1984	12.481	8.483	7.081	6.397	10.926	17.841	12.917	12.449	12.096	2.873	2.447	1.497
1985	0.986	0.323	4.207	3.268	9.873	6.429	3.550	1.450	1.087	2.078	1.444	1.408
1986	2.374	11.676	7.767	3.631	6.927	16.512	13.260	10.891	9.072	5.253	2.812	2.142
1987	2.312	2.957	3.583	2.146	7.121	6.611	13.883	7.896	3.510	3.918	2.832	2.090
1988	0.712	1.695	3.363	1.571	5.404	9.598	3.357	1.798	0.325	0.311	0.275	0.372
1989	0.361	0.359	5.144	4.775	6.252	4.755	8.668	1.979	2.790	2.552	1.991	1.797

Historic Flow	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	4.202	5.827	13.867	12.289	27.632	41.850	18.171	11.654	7.576	4.658	4.451	4.155
Minimum	0.361	0.323	1.171	1.571	2.808	2.858	3.357	1.450	0.325	0.311	0.275	0.372
Maximum	13.643	23.013	78.751	46.854	111.320	256.680	80.403	29.342	21.527	14.305	12.717	17.391
Median	3.074	5.086	7.894	6.538	19.665	26.314	13.260	11.085	7.143	4.131	3.641	3.177
Variance	9.574	19.489	258.685	144.802	694.149	2173.36	246.672	36.019	24.501	11.199	8.259	10.954
Stand Dev	3.094	4.415	16.084	12.033	26.347	46.619	15.706	6.002	4.950	3.346	2.874	3.310

Name: MUSSELSHELL RIVER AT MUSSELSHELL MT
Model Results based on end-of-month contents for Bair, Martinsdale, and Deadmans
C:\-MUSSEL\MODELVFLOW\MUSSELSH.WK3
23-Aug-95

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
29	0.60	0.95	7.14	6.49	9.38	35.60	21.85	12.12	3.98	0.72	0.48	0.52
30	0.17	0.90	4.51	10.41	16.64	10.33	11.50	10.02	6.44	0.75	0.68	0.33
31	0.16	0.45	0.94	1.14	12.04	1.15	0.00	0.00	0.00	0.24	0.37	0.21
32	0.21	0.22	0.62	0.44	9.53	4.63	9.30	7.28	11.12	0.98	0.61	0.29
33	0.19	0.28	2.27	2.09	16.52	32.10	12.04	10.01	10.85	0.75	0.35	0.27
46	0.44	0.59	4.07	2.28	13.20	7.21	15.68	12.31	4.24	1.59	0.77	5.31
47	4.79	8.30	13.98	17.30	49.89	51.33	16.08	10.54	8.49	1.35	1.01	2.79
48	8.10	4.11	3.91	8.28	82.10	121.59	22.65	21.82	11.89	2.06	1.42	5.54
49	3.93	2.80	3.83	8.15	37.49	19.38	15.54	12.57	10.47	1.97	0.88	0.39
50	0.46	4.59	5.37	3.78	24.46	89.28	7.12	20.43	8.27	1.92	6.66	6.06
51	4.59	6.10	9.23	7.65	40.92	33.10	14.13	12.80	8.54	1.73	2.91	4.95
52	4.21	5.18	4.83	11.28	92.72	27.85	12.74	13.98	12.24	1.37	0.62	0.37
53	0.52	0.38	1.62	1.11	4.94	92.98	12.16	12.47	12.84	1.10	0.56	0.46
54	0.51	1.06	0.77	1.91	8.53	5.81	11.05	6.06	11.07	1.32	0.58	0.27
55	0.54	0.14	0.23	6.04	1.80	5.46	7.46	11.63	10.95	0.95	0.49	0.47
56	0.51	0.63	5.79	2.98	27.58	18.23	10.05	7.99	10.38	0.82	0.55	0.34
57	0.48	0.42	1.27	1.74	12.78	48.31	12.14	13.35	10.05	2.38	1.18	1.06
58	0.86	0.91	2.45	0.38	13.84	3.30	4.35	11.92	10.39	1.10	0.62	0.37
59	0.37	0.39	13.97	3.06	8.53	84.87	16.01	11.51	6.20	1.22	0.76	0.54
60	0.46	1.58	3.92	2.78	9.70	7.43	0.00	0.00	44.33	3.87	0.66	1.43
61	0.41	0.43	0.71	4.42	0.00	14.09	9.37	5.21	0.00	2.24	1.79	0.84
62	0.21	0.35	3.12	3.65	31.87	18.81	4.79	3.94	0.00	4.54	2.28	2.89
63	0.55	1.71	1.53	1.52	23.81	31.30	8.54	9.04	0.52	7.91	1.66	0.34
64	0.38	0.85	0.91	2.58	26.85	70.64	6.82	18.42	0.00	6.81	3.65	2.09
65	0.77	1.38	2.49	19.83	28.20	70.19	9.92	10.74	17.01	7.63	4.96	5.53
66	4.79	3.72	15.74	17.01	34.02	11.52	8.80	15.49	1.89	4.18	1.15	0.35
67	0.42	0.48	1.06	3.45	49.28	265.19	12.45	11.28	3.45	8.16	2.51	2.59
68	4.34	10.20	13.13	17.79	38.52	62.84	10.18	12.99	5.52	5.42	3.44	5.57
69	5.86	5.37	24.42	20.52	14.43	35.02	0.00	12.03	9.04	4.29	2.11	1.93
70	3.11	3.92	3.14	8.17	82.67	66.78	23.36	12.28	0.18	3.79	2.22	1.47
71	1.89	4.63	7.34	17.84	44.52	30.86	15.35	8.32	1.58	3.33	1.40	5.24
72	1.39	9.14	17.89	15.79	31.08	34.28	14.89	4.81	3.73	5.18	2.14	0.54
73	0.76	0.54	1.68	3.60	9.05	20.04	2.70	6.91	0.00	2.73	2.91	1.63
74	3.81	1.26	7.68	11.60	37.21	50.28	10.69	9.72	0.00	1.99	1.82	0.84
75	37.73	0.61	3.80	18.87	90.62	224.89	67.17	8.80	0.00	6.46	6.64	9.90
76	44.47	3.96	12.23	20.28	121.55	43.92	12.30	3.21	0.00	1.73	2.02	3.35
77	41.68	2.78	3.31	6.37	5.53	0.00	9.95	3.72	0.00	1.18	1.03	0.63
78	31.82	0.84	37.14	32.93	112.96	70.46	41.81	4.55	1.54	3.83	2.95	4.73
79	40.05	1.89	41.09	16.97	80.04	99.82	19.27	4.06	0.00	1.90	1.11	0.47
80	22.47	2.05	6.41	5.79	48.80	80.02	13.17	4.07	6.60	2.59	1.73	3.30
81	4.75	5.36	7.79	13.32	97.13	81.41	20.11	10.36	4.73	14.51	3.30	1.01
84	3.69	4.26	5.51	6.43	21.46	36.41	11.71	13.56	9.61	5.52	2.18	1.59
85	4.13	4.30	5.62	4.96	8.68	13.32	9.77	4.27	4.17	6.13	5.22	5.00
86	4.01	6.71	7.86	7.73	4.30	16.81	17.81	13.81	11.30	7.20	4.63	4.73
87	3.37	4.07	6.66	3.75	4.92	8.15	11.42	8.21	5.87	6.83	4.83	4.03
88	2.32	3.33	5.34	3.26	4.30	14.32	10.23	3.96	3.79	3.66	4.18	3.48
89	2.22	2.02	7.90	6.29	4.30	4.17	14.35	3.51	4.17	5.46	6.03	4.91

Model Flow	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	6.839	2.629	7.315	8.577	34.121	47.072	13.417	9.789	6.841	3.428	2.089	2.279
Minimum	0.155	0.137	0.226	0.381	0.000	0.000	0.000	0.000	0.000	0.244	0.346	0.208
Maximum	44.470	10.195	41.089	32.931	121.545	265.192	67.166	21.818	44.331	14.607	6.844	9.897
Median	0.880	2.311	4.579	5.678	18.685	30.285	9.538	11.699	9.068	1.774	1.178	1.378
Variance	148.872	6.202	73.378	62.337	1012.570	2711.466	114.987	21.371	54.116	7.982	3.289	5.077
Stand Dev	12.119	2.490	8.568	7.234	31.821	52.072	10.722	4.623	7.358	2.825	1.808	2.253

Name: MUSSELSHELL RIVER AT MUSSELSHELL MT Coverage: 66%
ID : 06127500 Gage Datum: 2984.70 Rec Years: 52
PO : MT Site: SW Well Depth: --- Begin–End: 1926–1993
---------- Flow cfs /Mean --- Value Mask OFF ---------

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1929	8.15	3.89	17.27	19.04	18.21	19.24	1.66	0.07	0.00	0.03	0.59	0.00
1930	0.00	0.00	15.07	16.35	15.79	0.09	0.00	7.01	0.37	0.56	1.76	0.00
1931	0.00	0.00	1.23	0.63	0.02	0.03	0.00	0.00	0.00	0.00	0.14	0.00
1932	0.00	0.00	0.82	1.09	2.62	29.68	2.00	1.05	0.23	0.00	0.00	0.00
1933	4.28	4.49	9.89	10.90	6.06	13.58	11.71	1.31	3.15	3.76	2.84	10.03
1946	4.28	4.49	9.89	10.90	6.06	13.58	11.71	1.31	3.15	3.76	2.84	10.03
1947	8.43	6.98	33.36	23.11	43.83	33.52	6.72	5.49	2.17	2.63	3.76	6.89
1948	5.27	5.33	11.28	15.58	39.57	118.44	61.00	10.71	4.62	3.85	6.04	4.79
1949	2.84	2.41	40.61	41.74	40.94	25.29	5.56	2.64	2.57	2.04	2.41	2.91
1950	2.90	5.55	14.78	16.23	43.21	63.41	20.67	9.54	6.84	4.87	5.32	14.06
1951	8.11	8.13	30.68	22.11	30.44	28.55	7.13	12.55	13.77	11.92	10.94	7.23
1952	5.97	7.06	14.29	36.26	65.55	24.64	13.95	7.03	3.75	2.40	2.55	3.15
1953	3.70	2.76	4.74	2.03	1.82	46.87	4.93	5.80	3.02	0.75	1.72	1.37
1954	1.53	5.49	3.45	2.85	6.53	2.63	5.00	8.63	1.76	1.58	1.85	1.12
1955	0.72	0.81	2.02	9.51	4.56	5.99	5.90	3.12	1.90	0.77	0.92	2.38
1956	2.32	1.56	16.18	8.00	28.95	24.16	5.97	6.79	2.92	0.85	2.77	2.02
1957	1.22	1.51	3.92	2.31	18.98	61.84	20.04	5.06	10.73	6.98	9.42	6.20
1958	5.57	5.06	7.82	6.53	9.83	10.93	9.37	5.84	6.46	2.80	3.79	2.48
1959	2.17	2.81	46.04	5.24	6.52	31.26	10.37	8.30	5.91	3.66	2.96	3.36
1960	2.39	4.27	9.55	6.67	9.14	7.03	6.50	6.78	2.72	1.47	1.71	1.59
1961	1.36	1.58	1.15	2.44	2.45	5.40	3.84	1.55	0.35	0.52	0.95	0.76
1962	0.53	2.57	6.81	2.12	14.19	36.76	10.78	5.02	5.16	3.82	4.49	3.58
1963	1.19	7.36	3.91	2.33	7.94	31.86	10.44	8.90	3.51	2.95	2.69	1.58
1964	1.64	1.69	2.17	2.36	5.93	57.91	16.54	12.69	6.92	2.84	2.57	2.00
1965	8.53	12.21	8.27	18.75	20.03	40.98	21.46	11.72	19.97	14.10	7.51	8.16
1966	6.74	5.53	17.57	15.46	19.04	9.79	11.76	9.34	6.61	3.85	2.26	3.24
1967	3.28	3.00	6.55	5.42	23.71	251.25	50.47	16.21	10.91	7.52	6.56	4.14
1968	5.99	12.84	18.63	17.01	22.80	57.94	19.76	16.40	10.53	5.95	8.34	6.67
1969	6.31	7.24	36.94	35.32	13.50	21.92	14.94	9.52	6.93	6.59	4.34	4.05
1970	2.67	4.14	8.90	9.23	69.98	61.72	15.28	11.71	9.00	5.06	3.92	4.06
1971	3.30	25.52	11.29	17.84	24.67	17.18	13.14	8.67	11.66	5.85	4.95	3.11
1972	3.34	12.97	30.73	7.28	20.17	16.21	11.51	14.47	10.05	5.06	3.84	2.24
1973	2.15	3.16	6.40	4.41	11.04	6.81	7.14	4.09	3.66	2.80	3.49	3.14
1974	7.17	5.37	5.38	4.37	6.79	25.55	9.65	15.45	8.81	4.77	5.40	3.72
1975	2.97	3.54	12.55	51.12	91.01	136.78	84.57	27.53	16.46	15.98	14.08	16.51
1976	13.67	14.16	16.52	16.24	102.68	42.60	16.20	14.40	12.52	6.20	8.37	9.51
1977	7.25	8.84	7.24	5.01	9.13	6.05	3.07	5.00	3.60	2.19	2.26	3.31
1978	3.86	3.87	77.21	32.97	70.24	56.66	40.80	14.49	15.00	11.25	10.13	9.15
1979	7.35	8.17	83.34	46.70	50.68	61.78	19.79	16.77	9.59	3.38	0.00	0.00
1980	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.87	5.89	6.22
1981	10.56	11.46	9.23	7.56	18.23	12.27	10.92	11.65	8.85	0.00	0.00	0.00
1984	0.00	0.00	0.00	6.36	9.36	15.23	7.52	8.87	10.39	3.41	0.00	0.00
1985	0.00	0.00	0.00	3.83	5.32	4.05	1.55	1.97	1.14	2.22	0.00	0.00
1986	0.00	0.00	0.00	3.82	6.84	13.03	9.53	7.29	9.06	6.07	0.00	0.00
1987	0.00	0.00	0.00	2.31	5.15	4.39	10.86	7.07	3.32	4.02	0.00	0.00
1988	0.00	0.00	0.00	1.82	3.99	5.00	1.11	1.61	0.23	0.25	0.10	0.00
1989	0.00	0.00	1.29	4.94	7.13	3.37	4.81	1.04	2.87	2.81	0.00	0.00

Historic Flow	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	3.528	4.848	14.180	12.486	22.167	33.221	13.882	7.935	6.066	4.143	3.542	3.723
Minimum	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Maximum	13.673	25.515	83.336	51.118	102.678	251.246	84.575	27.528	19.967	15.975	14.083	16.508
Median	2.905	3.867	8.900	7.280	13.502	21.916	10.357	7.073	4.620	3.411	2.788	3.105
Variance	9.935	23.981	320.907	161.386	569.113	1839.304	249.160	31.788	23.270	13.284	10.732	14.661
Stand Dev	3.152	4.897	17.914	12.704	23.856	42.887	15.786	5.638	4.824	3.645	3.276	3.829

Mosby Flows in 1000 Acre Feet
Model Results based on end-of-month contents for Blair, Martinsdale, and Deadman
C:\-MUSSELMODEL\FLOW\MOSGAG.WK3
23-Aug-95

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
29	1.78	13.77	20.20	15.78	12.73	40.14	13.12	1.15	2.19	3.17	0.57	1.61
30	0.54	4.41	12.17	15.81	16.26	1.71	1.35	1.64	0.00	19.35	0.83	0.42
31	0.26	0.92	1.88	0.00	3.04	0.00	0.00	0.00	0.00	0.11	0.42	0.23
32	0.26	0.63	0.95	0.00	2.73	66.49	4.09	3.74	3.40	2.61	1.24	0.46
34	0.55	2.49	2.55	0.58	0.00	20.42	7.33	2.33	1.48	0.74	0.50	0.18
35	0.15	0.18	1.66	2.25	1.08	3.39	2.10	0.00	0.00	0.15	0.42	0.18
36	0.10	0.28	34.39	5.66	4.62	3.07	0.00	0.78	0.00	0.36	0.30	0.15
37	0.07	0.29	3.61	0.17	2.13	17.76	2.20	0.31	0.00	1.26	0.29	0.30
38	0.43	2.93	16.70	1.07	25.45	51.59	40.42	9.96	0.21	2.18	1.89	1.22
39	2.63	2.36	30.29	7.84	11.16	54.22	3.70	2.11	1.59	1.56	0.36	0.29
40	0.12	0.52	4.06	0.86	2.42	2.73	0.00	0.00	0.00	0.29	0.23	0.27
41	0.17	0.55	1.24	0.01	3.10	5.41	2.73	3.15	3.92	1.15	1.32	3.22
42	1.74	6.92	17.79	20.53	102.30	138.83	30.93	4.28	3.87	4.80	7.56	9.06
43	7.95	30.21	36.52	53.41	70.73	159.85	36.76	7.96	5.13	5.15	4.07	8.60
44	6.42	4.97	26.49	4.09	6.53	127.75	58.29	10.43	5.08	6.86	6.44	8.27
45	7.61	7.45	13.24	3.65	3.03	39.16	7.20	2.11	3.30	1.80	1.68	1.37
46	1.10	4.48	8.53	2.73	7.96	3.11	9.56	2.54	1.60	2.70	2.15	6.81
47	5.94	7.59	40.03	29.16	47.83	53.34	10.97	3.70	3.04	2.48	2.50	5.96
48	16.84	6.81	17.07	10.93	82.86	136.54	26.79	13.82	1.66	3.09	3.23	7.09
49	4.86	2.93	27.17	14.45	43.60	19.16	6.86	1.82	4.11	2.72	1.50	0.51
50	0.76	6.26	10.82	9.47	29.33	79.70	4.51	12.41	3.47	3.00	7.87	7.45
51	8.57	14.83	19.05	12.84	48.82	34.89	7.25	6.87	3.70	3.14	4.33	5.61
52	4.73	7.53	26.98	16.26	107.72	23.07	6.46	5.18	3.64	2.37	1.23	0.77
53	1.06	0.56	2.41	2.09	6.79	111.44	6.06	3.51	0.60	1.86	0.74	0.63
54	0.74	3.22	1.96	3.01	4.20	2.47	0.49	3.25	4.17	2.07	0.89	0.40
55	0.70	0.26	5.74	14.83	5.53	3.05	2.05	0.00	3.56	1.54	0.83	0.69
56	0.66	0.62	19.45	5.08	25.04	11.34	2.86	2.73	1.33	1.76	1.20	0.52
57	0.62	0.73	10.67	3.08	8.85	49.00	4.36	6.97	3.91	4.19	2.71	2.18
58	1.39	1.39	5.34	1.35	2.18	0.80	1.31	0.00	1.77	2.23	1.41	0.53
59	0.49	0.65	48.79	5.38	3.98	58.98	8.51	2.66	2.20	2.19	2.24	1.33
60	0.81	2.08	15.38	5.47	3.75	0.00	0.00	0.00	35.51	4.83	1.13	1.52
61	0.49	0.65	0.86	4.32	0.00	2.48	0.00	0.00	0.00	2.27	2.11	0.85
62	0.30	1.67	4.91	2.36	50.15	67.95	2.55	1.19	0.00	5.83	3.41	3.42
63	0.72	12.87	6.32	3.08	24.30	28.15	1.11	0.32	0.00	6.43	2.28	0.44
64	0.60	0.83	1.36	2.55	41.34	86.10	3.80	14.43	0.00	7.51	4.49	2.45
65	2.03	11.46	13.30	41.30	43.31	70.10	7.85	3.64	20.48	10.22	6.74	7.13
66	5.71	4.42	32.90	20.34	28.01	4.07	0.00	6.59	0.00	4.57	1.80	0.83
67	0.73	1.16	2.43	4.34	55.49	307.11	9.18	2.10	0.00	9.46	3.64	3.00
68	4.90	11.85	16.39	19.99	42.12	59.83	5.67	5.30	1.06	7.06	4.85	6.33
69	6.43	6.27	46.76	28.20	17.90	37.67	6.99	0.00	0.03	5.55	2.76	2.28
70	3.33	4.51	6.77	9.97	146.42	60.17	15.74	0.00	0.00	4.70	3.00	2.34
71	3.00	33.16	22.52	22.31	40.30	31.93	7.59	0.00	0.00	4.12	1.97	5.46
72	1.69	11.40	37.02	16.73	39.69	39.36	8.86	0.00	0.00	7.03	3.23	0.79
73	1.20	1.16	4.02	6.59	5.43	15.99	0.00	0.00	0.00	3.31	3.76	2.25
74	4.66	4.34	12.34	11.55	39.75	44.89	5.50	6.54	0.00	2.46	3.10	1.71
75	38.31	1.96	7.11	32.64	122.03	236.25	134.59	4.11	0.00	9.03	12.57	12.09
76	45.95	11.88	16.49	23.77	124.33	46.80	5.14	0.00	0.00	2.99	3.46	5.00
77	42.91	6.45	4.89	8.23	0.93	0.00	0.02	0.00	0.00	1.66	1.66	1.47
78	32.69	2.93	92.67	42.39	141.86	75.65	66.74	0.00	15.80	5.86	5.34	6.49
79	41.40	4.33	61.33	36.32	93.51	100.54	13.54	0.00	0.00	3.22	2.83	1.15
80	23.04	4.57	10.57	8.54	47.31	85.53	7.37	0.00	0.00	4.39	3.51	4.27
81	6.34	8.39	10.76	14.75	145.16	107.28	17.92	2.90	0.00	16.03	4.75	1.44
82	1.66	7.39	18.20	23.39	51.99	127.06	29.59	0.65	11.85	8.26	5.87	3.02
83	11.22	10.02	9.50	25.46	37.36	17.63	4.62	0.00	4.31	4.49	6.95	1.52
84	5.26	5.96	7.17	8.54	14.62	31.32	2.19	2.80	9.15	6.80	3.18	1.87
85	4.36	5.83	7.83	4.17	4.30	4.71	4.27	4.27	4.17	6.75	5.76	5.09
86	4.71	21.59	20.31	9.53	10.30	12.35	14.06	4.21	14.59	8.83	5.54	6.10
87	4.09	5.33	9.82	3.75	6.96	4.17	8.09	4.27	4.14	7.89	5.68	4.26
88	2.44	3.81	8.36	3.26	4.30	4.17	4.27	4.15	3.90	3.86	4.32	3.74
89	2.24	2.27	14.15	11.61	4.30	4.17	4.62	3.44	4.17	6.96	5.85	5.61

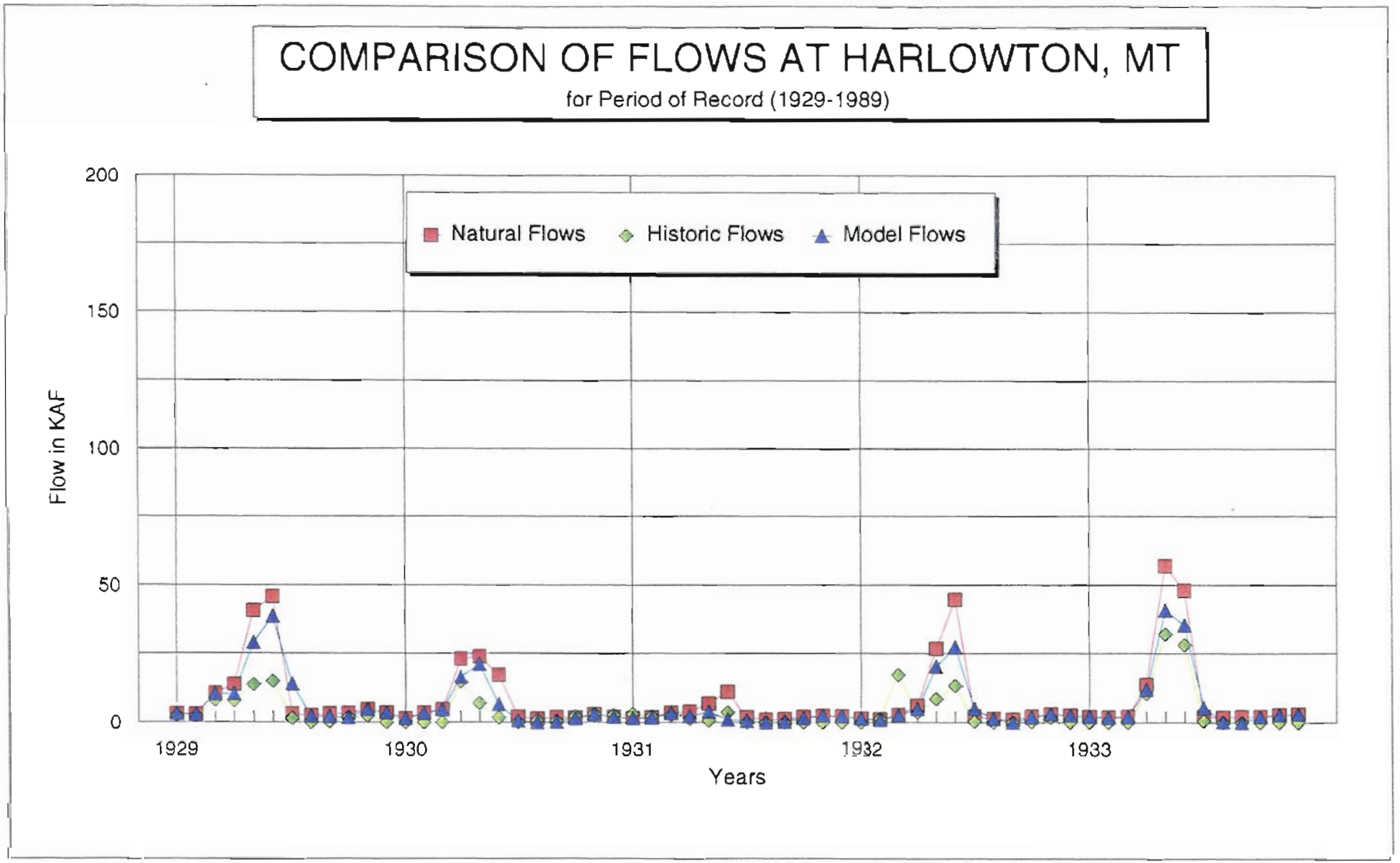
Model Flow	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	6.346	5.781	16.764	11.996	34.857	51.412	11.667	3.135	3.302	4.495	3.102	3.001
Minimum	0.074	0.175	0.864	0.000	0.000	0.000	0.000	0.000	0.000	0.105	0.228	0.180
Maximum	45.984	33.16	92.67	53.41	146.42	307.11	134.59	14.429	35.514	19.349	12.572	12.092
Median	1.761	3.599	11.856	6.469	15.312	34.592	3.486	3.457	3.127	3.069	2.249	2.182
Variance	122.133	42.36	309.5	141.37	1624.8	3469.1	426.26	12.583	34.007	12.603	5.880	7.988
Stand Dev	11.051	6.510	17.592	11.890	40.309	58.899	20.648	3.547	5.832	3.550	2.383	2.828

Historic Mosby Gaged Flows in Thousand Acre Feet

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1929	0.00	0.00	0.00	0.00	23.92	25.08	4.82	0.00	0.00	0.00	0.00	0.00
1930	0.00	0.00	23.30	32.63	14.02	0.26	2.08	6.49	0.31	0.26	0.06	0.00
1931	1.82	3.84	1.59	0.19	0.00	2.82	0.01	2.87	0.00	0.00	0.00	0.00
1932	0.00	0.00	0.00	1.45	1.94	52.94	15.77	11.97	7.00	0.00	0.00	0.00
1934	0.00	6.66	7.70	2.99	0.01	43.36	0.27	0.00	0.00	0.00	0.00	0.00
1935	0.00	0.20	4.70	3.05	1.04	0.11	12.29	0.10	0.00	0.00	0.00	0.00
1936	0.00	0.00	69.79	25.02	19.13	7.51	0.08	0.02	0.00	0.00	0.00	0.00
1937	0.00	0.00	9.73	8.33	3.91	45.46	10.28	0.00	0.05	3.47	0.00	1.06
1938	6.10	20.29	16.70	6.15	28.58	101.45	79.68	7.04	1.76	4.54	7.28	4.99
1939	4.73	4.87	36.60	11.68	7.66	34.80	4.63	0.02	0.00	0.00	0.00	0.00
1940	0.00	1.40	6.61	3.27	0.92	2.12	0.01	0.00	0.00	0.01	0.00	0.00
1941	0.00	0.67	2.89	0.37	0.94	24.67	2.83	0.26	18.58	8.43	3.97	6.15
1942	9.93	8.41	36.30	17.48	92.45	200.11	30.63	19.15	8.33	9.64	10.22	8.25
1943	4.96	68.94	44.60	62.11	59.76	175.60	27.52	6.64	2.98	4.32	7.87	6.64
1944	5.23	4.60	5.84	6.65	6.72	168.80	68.10	16.54	3.84	5.03	6.77	7.36
1945	7.07	11.68	21.29	6.65	4.26	45.31	7.79	1.67	0.47	0.37	4.07	2.75
1946	4.55	10.25	16.71	11.97	5.06	16.63	12.95	1.19	2.48	4.61	3.16	6.28
1947	6.81	7.44	54.31	36.63	45.33	35.22	6.57	3.43	1.29	2.17	2.92	7.33
1948	5.75	5.86	12.29	16.61	38.64	151.82	93.11	11.11	2.30	2.23	5.14	4.65
1949	2.48	2.65	63.54	40.59	37.84	24.55	7.16	0.60	1.89	1.28	2.91	1.88
1950	1.06	3.63	32.73	30.85	44.29	74.09	25.28	8.61	5.93	4.53	5.19	15.27
1951	10.25	6.04	38.78	31.74	29.56	33.36	5.37	6.71	17.01	12.09	11.62	6.17
1952	6.10	6.11	37.65	59.67	69.07	25.94	10.81	3.45	3.41	1.24	2.16	3.14
1953	3.86	3.40	7.02	2.48	14.17	97.12	5.66	3.60	1.06	0.11	0.92	2.51
1954	1.11	7.01	4.24	4.67	8.26	4.21	0.13	16.51	1.16	0.84	2.12	1.04
1955	0.66	0.91	2.26	22.56	5.66	6.00	3.01	0.51	0.39	0.20	0.56	2.34
1956	2.37	1.62	23.25	9.04	25.68	21.88	3.46	4.06	1.73	0.22	2.17	2.06
1957	1.29	2.80	6.17	3.17	18.15	59.07	17.27	1.23	8.94	6.42	9.24	5.39
1958	5.90	6.21	9.45	6.84	4.26	10.41	7.00	1.99	3.60	2.61	3.45	2.73
1959	2.20	2.61	104.42	11.38	7.67	27.94	8.77	2.89	4.24	3.55	2.99	3.99
1960	2.50	4.71	28.28	7.52	5.99	3.23	1.28	2.55	0.94	0.89	1.53	1.59
1961	1.09	2.04	1.16	1.37	0.79	0.60	0.00	0.00	1.00	0.07	1.06	0.37
1962	0.13	1.72	7.59	2.82	54.67	95.44	26.67	4.27	4.15	3.37	4.77	4.36
1963	1.35	24.25	10.91	5.07	13.35	34.76	6.42	4.71	4.42	1.73	2.57	1.82
1964	1.27	1.79	3.05	3.64	29.73	111.53	34.88	16.14	9.30	3.88	4.21	3.04
1965	10.71	36.84	28.53	55.34	59.70	46.45	23.07	6.04	19.70	16.51	8.31	7.62
1966	7.27	5.36	41.62	21.52	16.07	5.16	7.86	4.46	4.01	4.13	2.42	2.75
1967	3.17	4.11	8.52	7.62	29.74	295.53	67.35	11.95	10.64	8.19	7.94	5.09
1968	5.84	13.29	26.23	19.26	21.63	127.74	29.91	17.53	10.83	6.98	12.29	9.98
1969	7.42	6.03	61.28	48.70	14.55	23.44	48.90	5.51	6.62	6.27	5.01	4.26
1970	2.45	6.27	14.51	10.25	171.89	96.43	12.47	6.57	6.66	5.96	5.31	5.01
1971	3.99	103.16	39.27	32.44	32.41	16.08	7.54	3.42	11.70	6.19	5.67	3.52
1972	4.01	23.76	66.35	13.56	25.39	26.18	6.06	17.00	6.81	6.17	4.59	2.20
1973	2.80	4.86	7.35	17.01	22.39	8.23	2.73	0.87	3.03	2.83	4.20	3.62
1974	10.62	7.13	6.97	6.13	16.67	39.16	6.70	6.06	9.46	4.80	6.32	4.92
1975	3.16	4.50	13.70	76.73	231.93	205.37	132.37	28.59	16.76	16.67	16.66	15.49
1976	19.08	16.72	21.31	16.61	102.66	43.74	14.72	9.96	10.33	6.36	7.94	11.72
1977	7.29	12.47	10.52	8.31	7.66	4.15	1.49	1.25	4.25	3.53	2.62	4.76
1978	3.93	4.37	288.42	78.26	161.94	67.88	93.24	17.81	43.59	18.02	16.25	17.09
1979	11.95	12.45	274.84	114.09	93.66	70.97	16.61	13.89	9.49	7.36	9.57	9.57
1980	6.46	9.35	22.74	14.09	11.52	57.91	10.09	10.42	5.75	9.42	6.74	3.50
1981	6.81	12.14	6.66	3.37	145.30	104.98	18.01	13.26	5.67	5.60	7.67	6.40
1982	3.24	35.20	24.67	30.72	37.64	150.66	55.62	14.77	17.24	15.82	9.60	7.77
1983	13.50	16.21	13.53	9.49	18.31	6.78	3.99	6.34	6.55	6.48	5.31	2.37
1984	22.75	12.59	9.40	7.31	6.93	11.65	0.61	2.84	6.93	3.90	2.89	2.07
1985	1.13	0.47	5.65	5.92	1.02	1.71	0.00	5.22	1.05	2.50	1.40	1.58
1986	5.96	35.20	18.97	8.05	52.36	14.39	7.00	5.55	48.65	10.55	4.61	4.27
1987	2.50	1.16	6.95	5.96	14.10	3.92	6.46	5.19	2.29	3.68	4.15	2.47
1988	1.69	1.94	5.73	2.23	15.44	0.24	0.00	0.26	0.06	0.02	0.44	0.64
1989	0.55	0.58	37.39	12.10	18.78	6.02	0.27	0.10	1.90	2.63	2.85	2.73

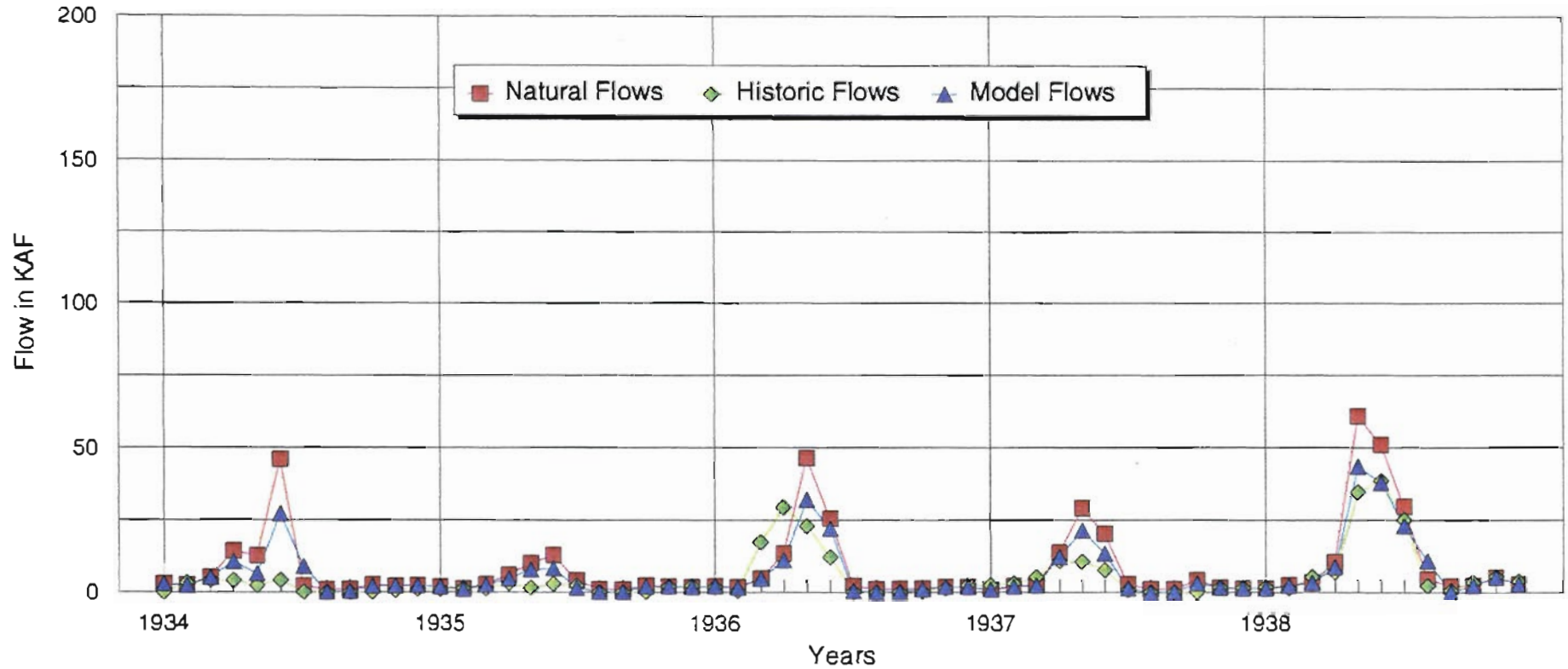
Historic Flow	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	4.514	10.446	30.530	18.712	34.231	54.089	16.657	6.423	6.516	4.492	4.527	4.349
Minimum	0.000	0.000	0.000	0.000	0.009	0.114	0.000	0.000	0.000	0.000	0.000	0.000
Maximum	22.750	103.16	288.42	114.09	231.93	295.53	132.37	28.594	46.650	18.666	16.659	17.088
Median	3.166	4.869	13.698	9.043	18.147	28.175	7.543	4.459	3.838	3.560	3.973	3.136
Variance	20.849	280.14	2916.7	498.66	2090.6	3919.5	728.61	39.817	77.040	20.396	15.394	15.450
Stand Dev	4.566	16.737	51.154	22.331	45.723	62.606	26.993	6.310	8.777	4.516	3.924	3.931

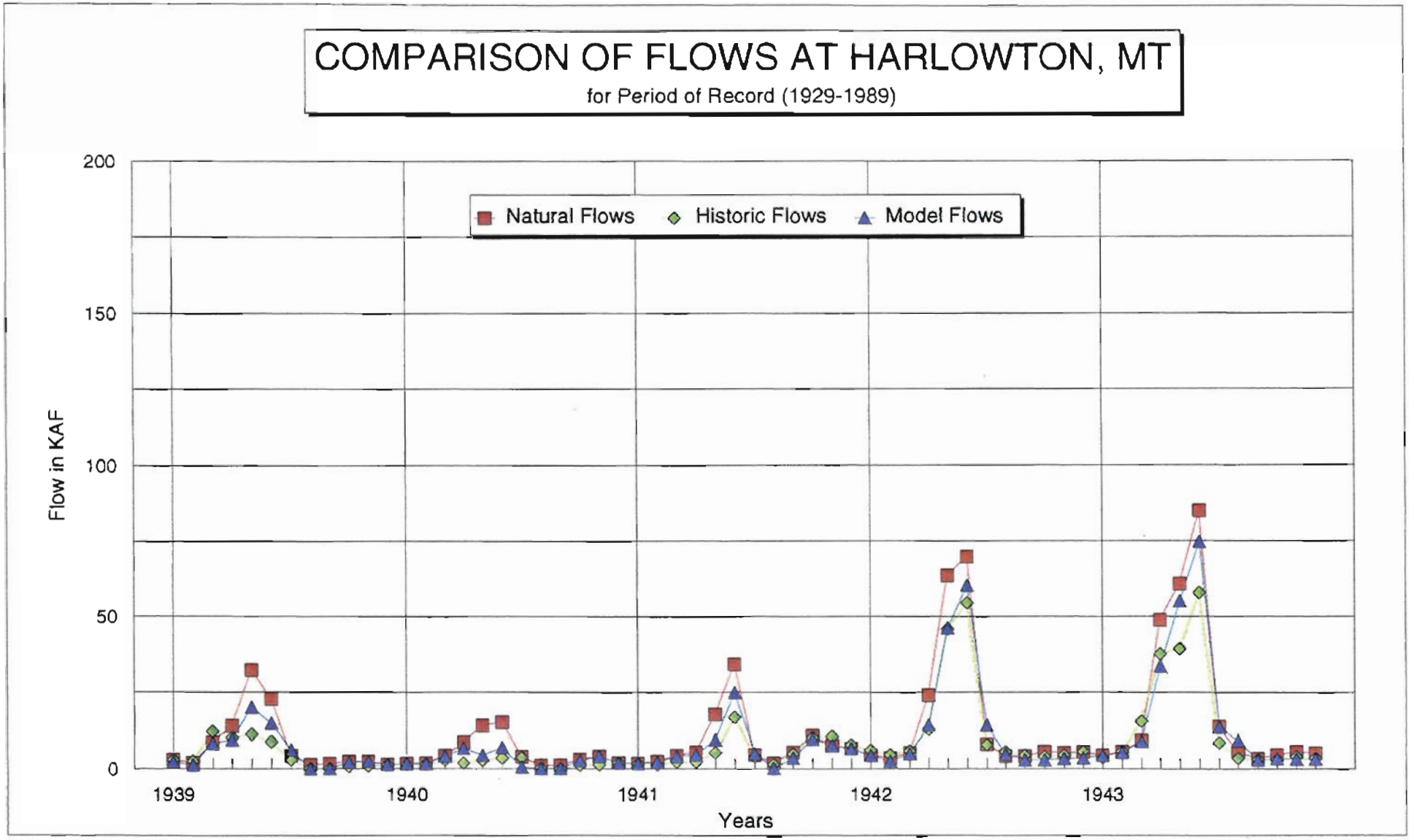
Appendix 8
CALIBRATED MODEL, HISTORIC, AND NATURAL FLOWS FOR THE PERIOD OF RECORD


COMPARISON OF FLOWS AT HARLOWTON, MT
for Period of Record (1929-1989)
Natural Flows
Historic Flows
Model Flows
Flow in KAF
200
150
100
50
0
1929
1930
1931
1932
1933
Years

COMPARISON OF FLOWS AT HARLOWTON, MT

for Period of Record (1929-1989)

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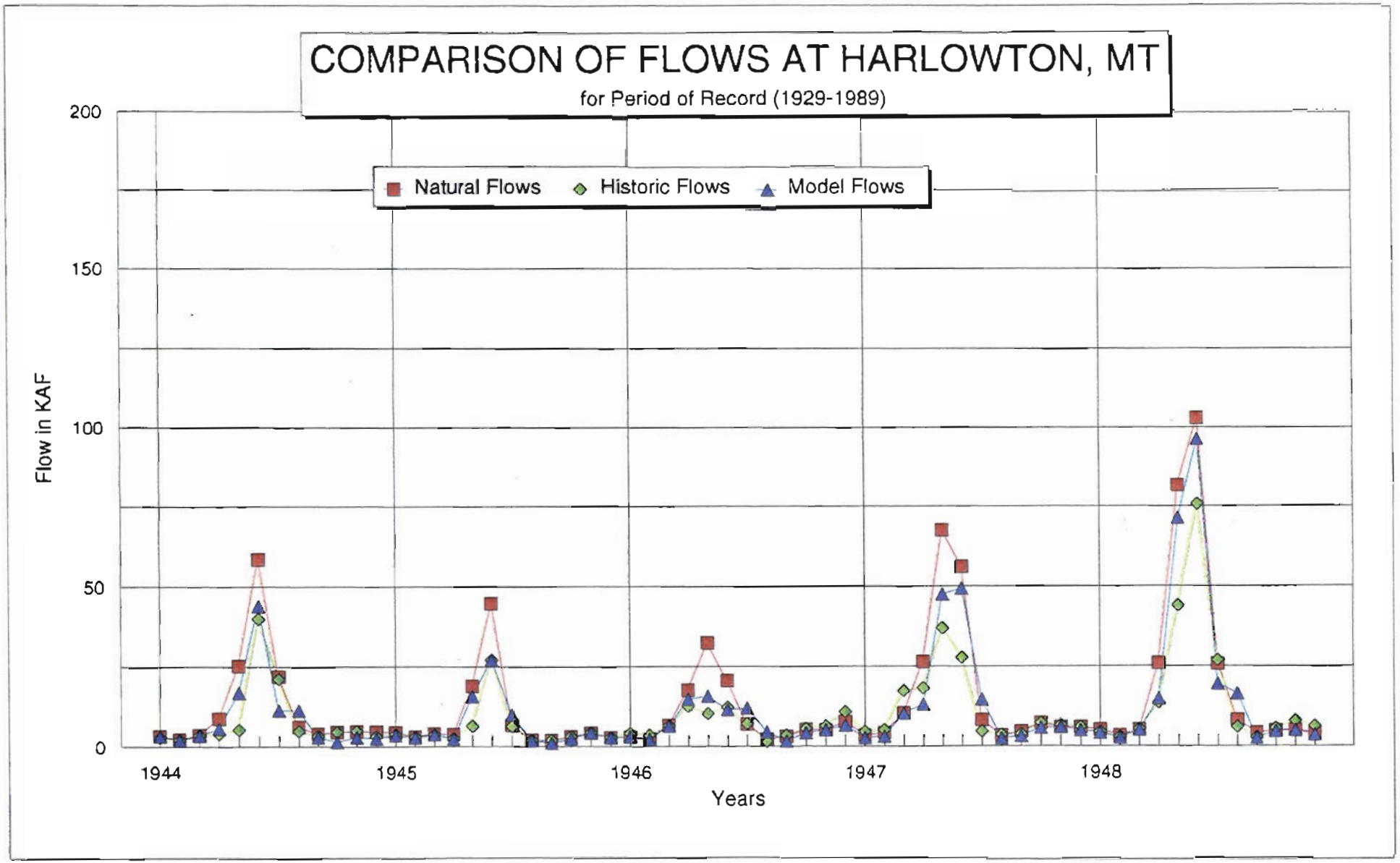
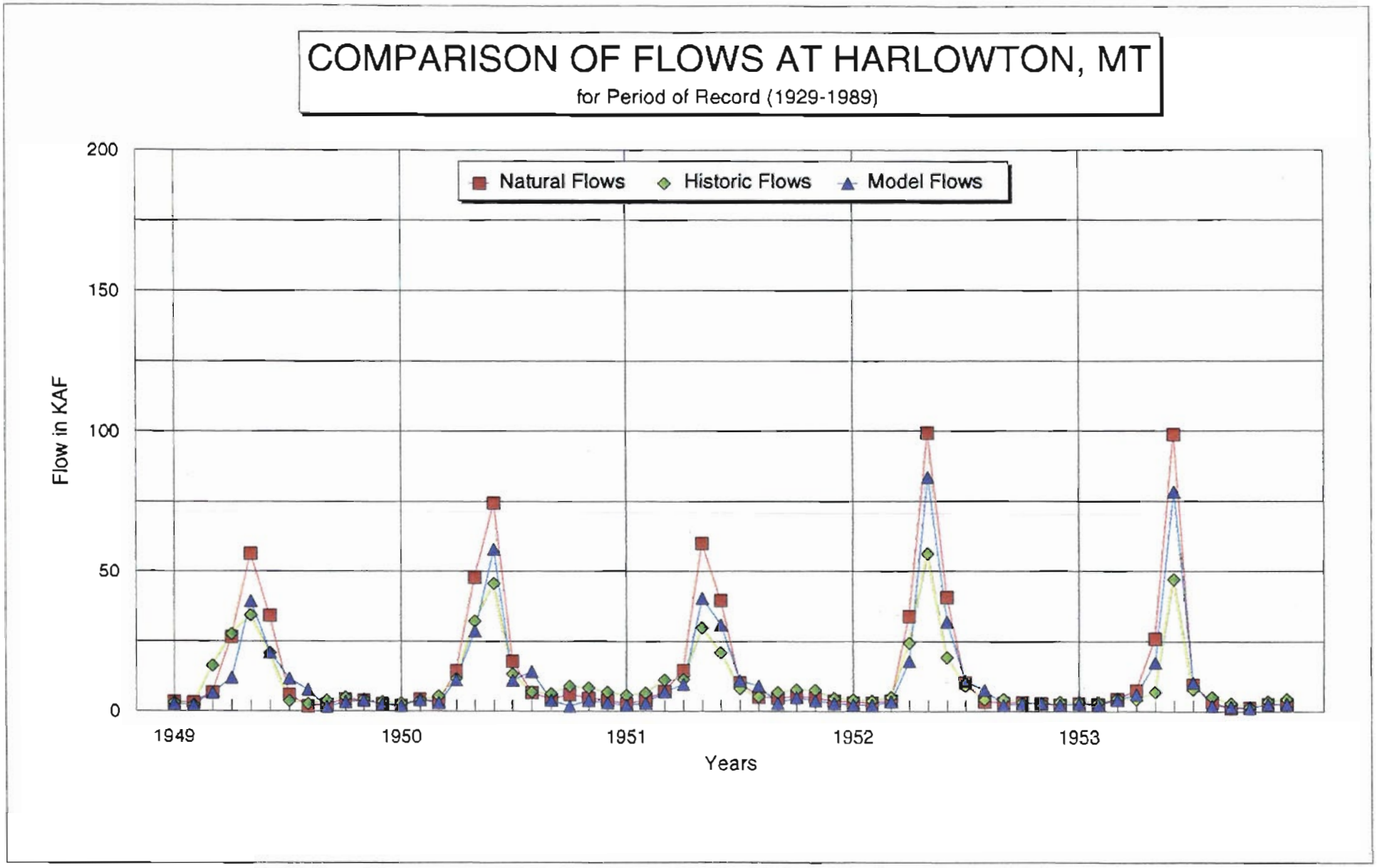
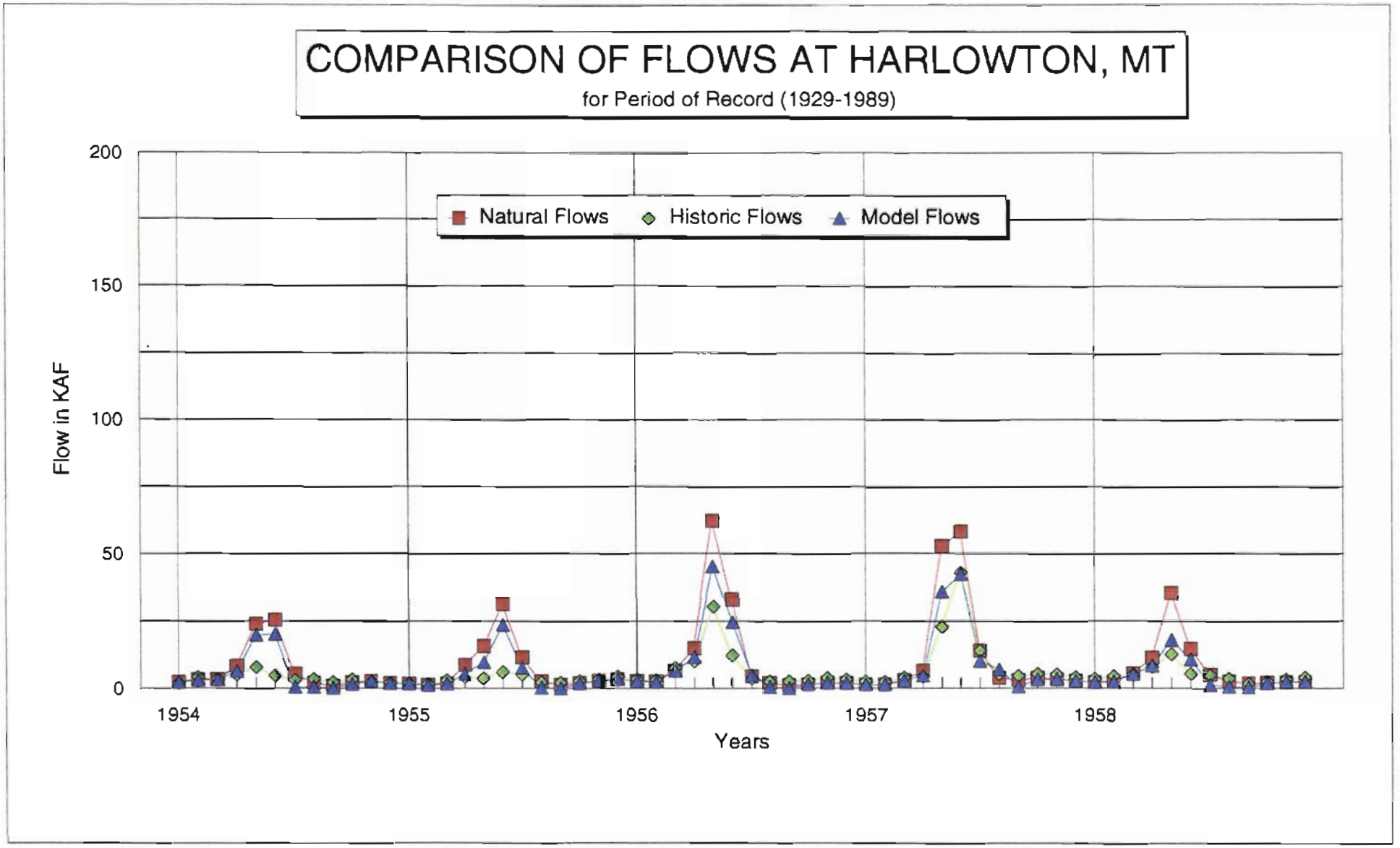
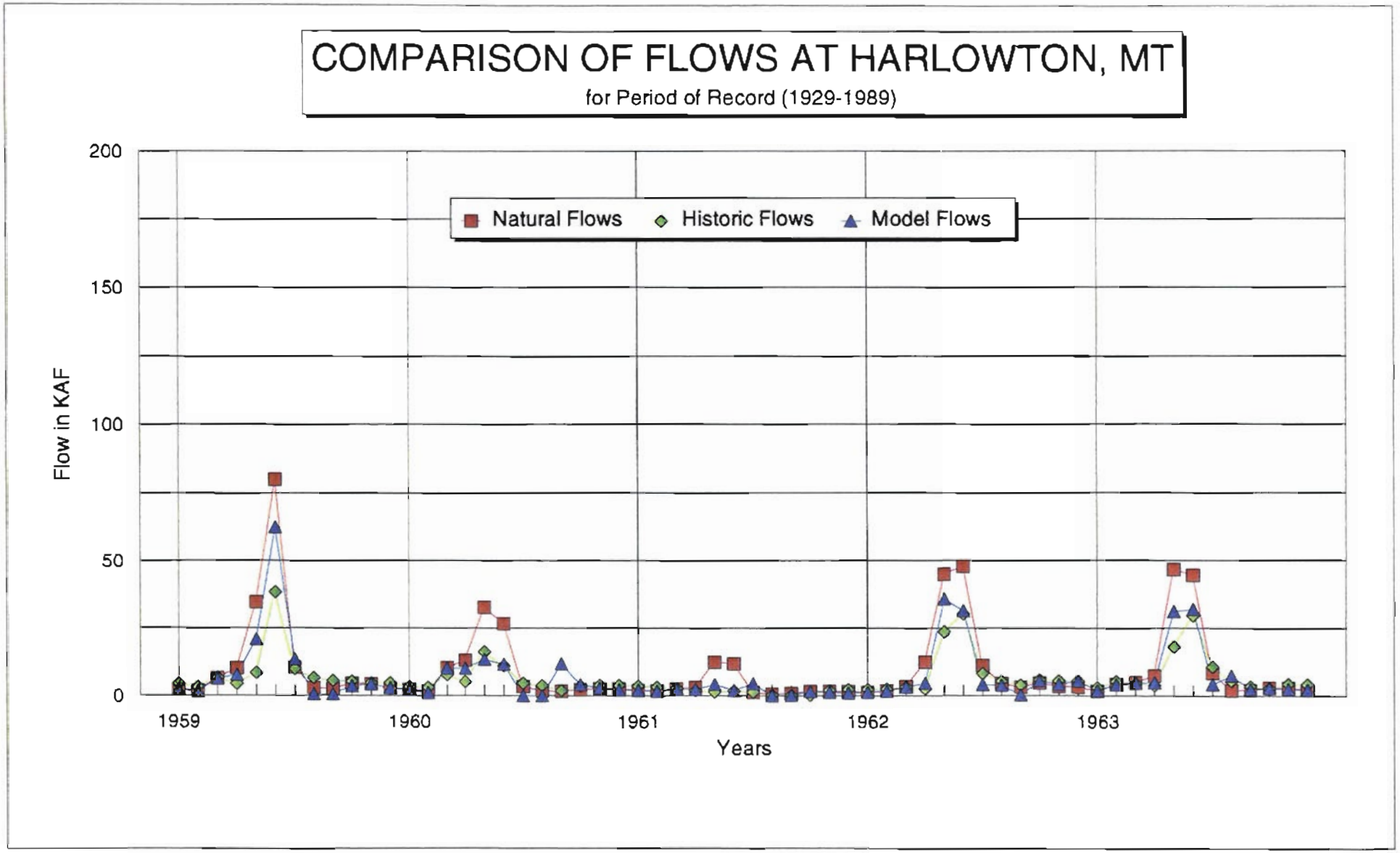
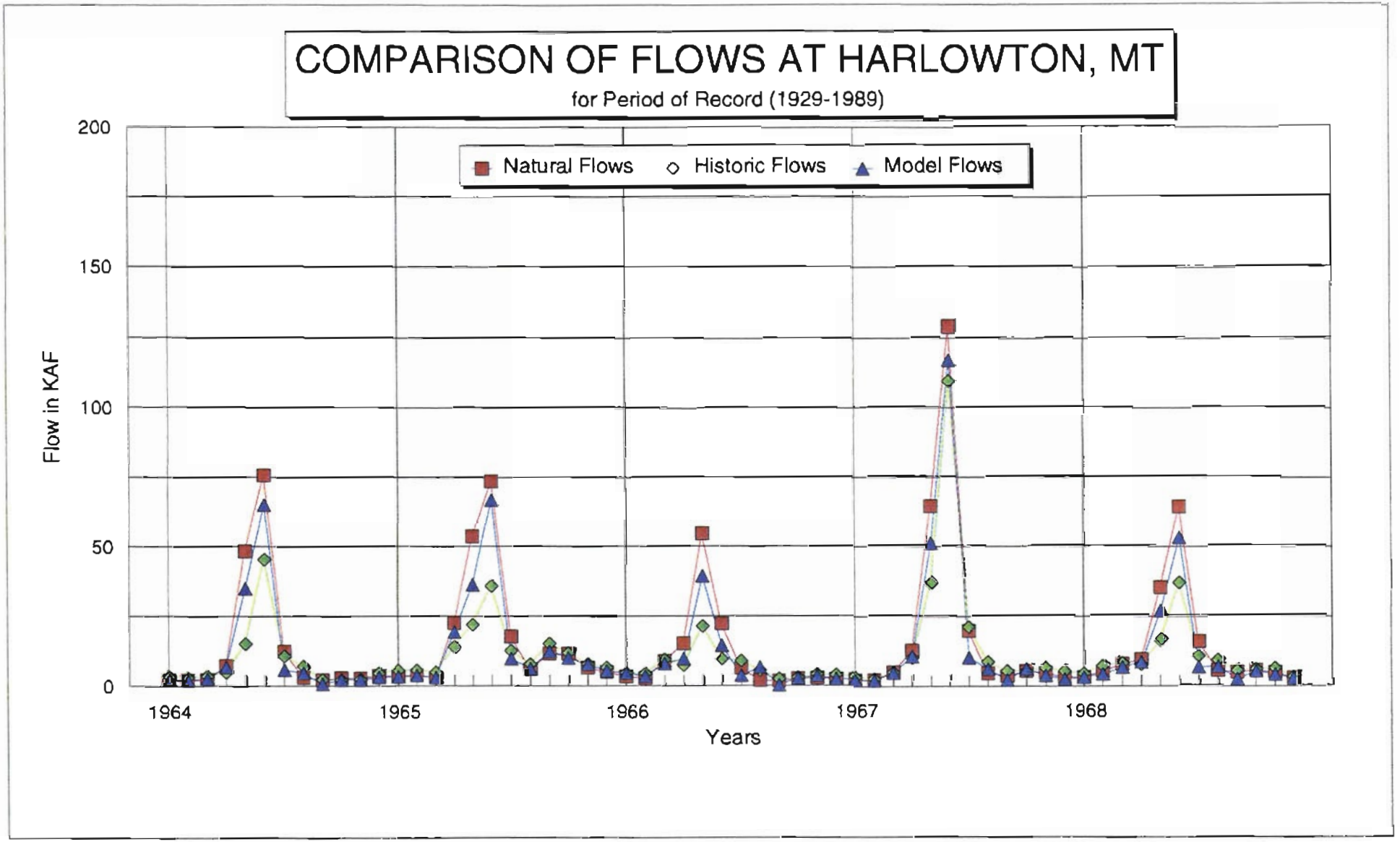
for Period of Record (1929-1989)
Natural Flows
Historic Flows
Model Flows
Flow in KAF
200
150
100
50
0
1939
1940
1941
1942
1943
Years

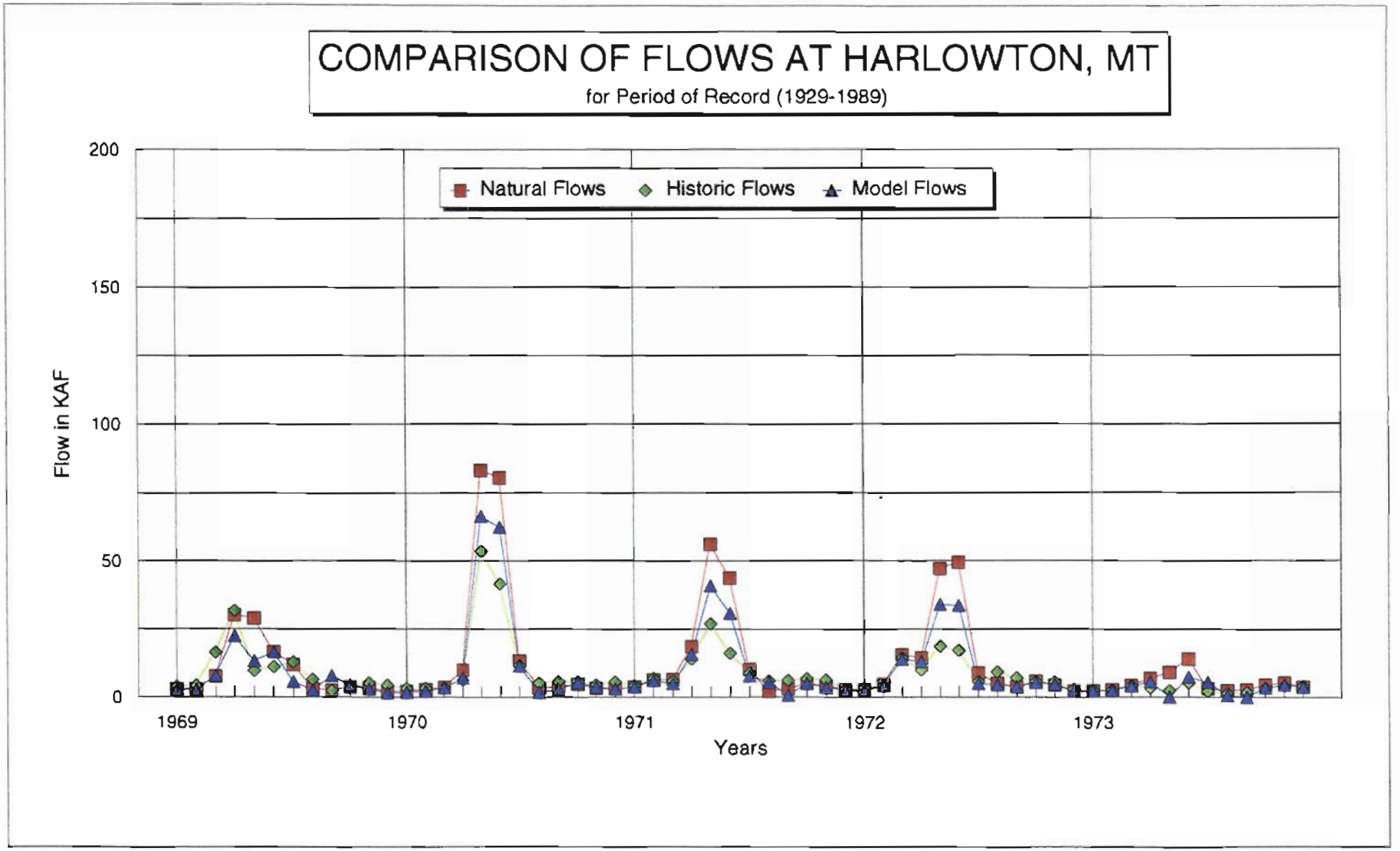

COMPARISON OF FLOWS AT HARLOWTON, MT
for Period of Record (1929-1989)
Natural Flows
Historic Flows
Model Flows
200
150
100
50
0
Flow in KAF
1944
1945
1946
1947
1948
Years


COMPARISON OF FLOWS AT HARLOWTON, MT
for Period of Record (1929-1989)
Natural Flows
Historic Flows
Model Flows
Flow in KAF
200
150
100
50
0
1949
1950
1951
1952
1953
Years


COMPARISON OF FLOWS AT HARLOWTON, MT
for Period of Record (1929-1989)
Natural Flows
Historic Flows
Model Flows
Flow in KAF
200
150
100
50
0
1954
1955
1956
1957
1958
Years

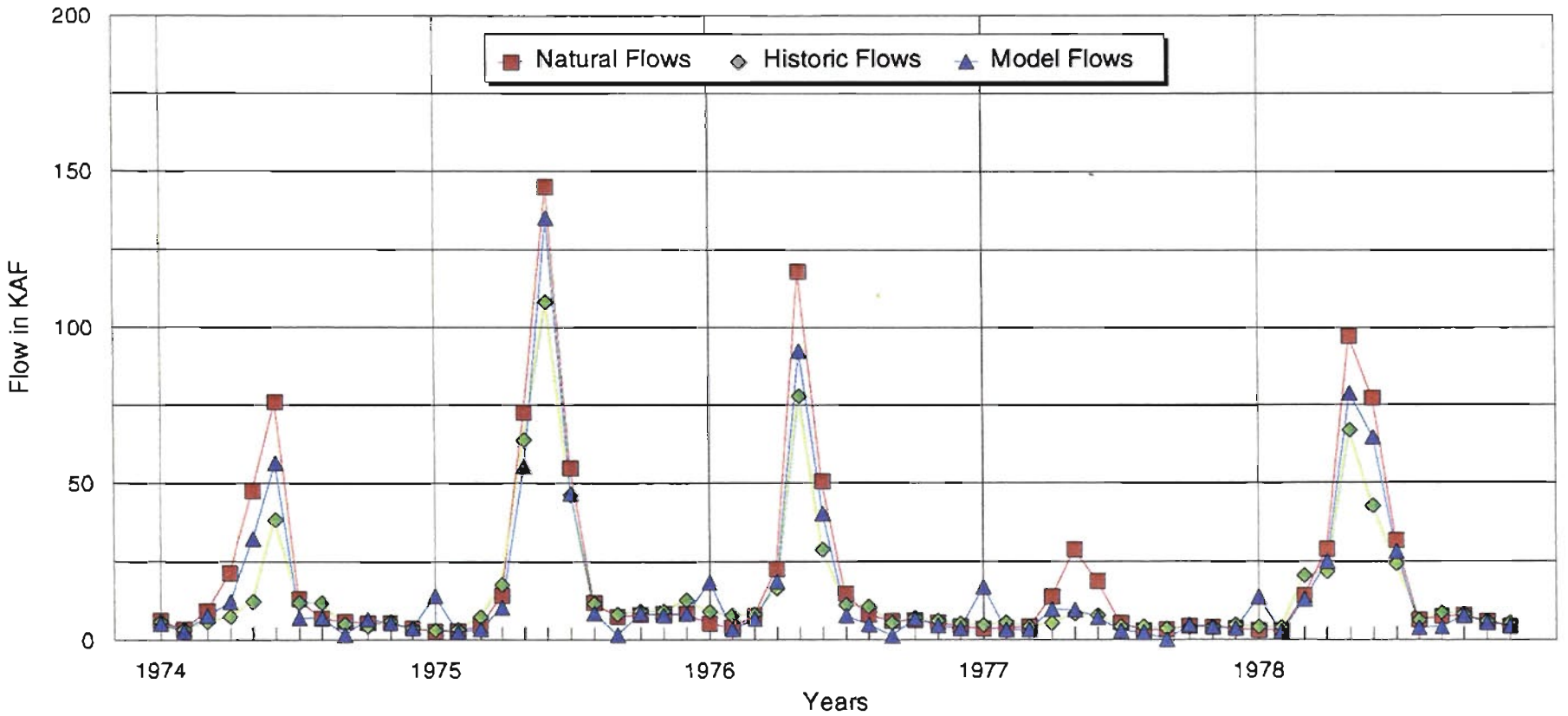

COMPARISON OF FLOWS AT HARLOWTON, MT
for Period of Record (1929-1989)
Natural Flows
Historic Flows
Model Flows
Flow in KAF
200
150
100
50
0
1959
1960
1961
1962
1963
Years

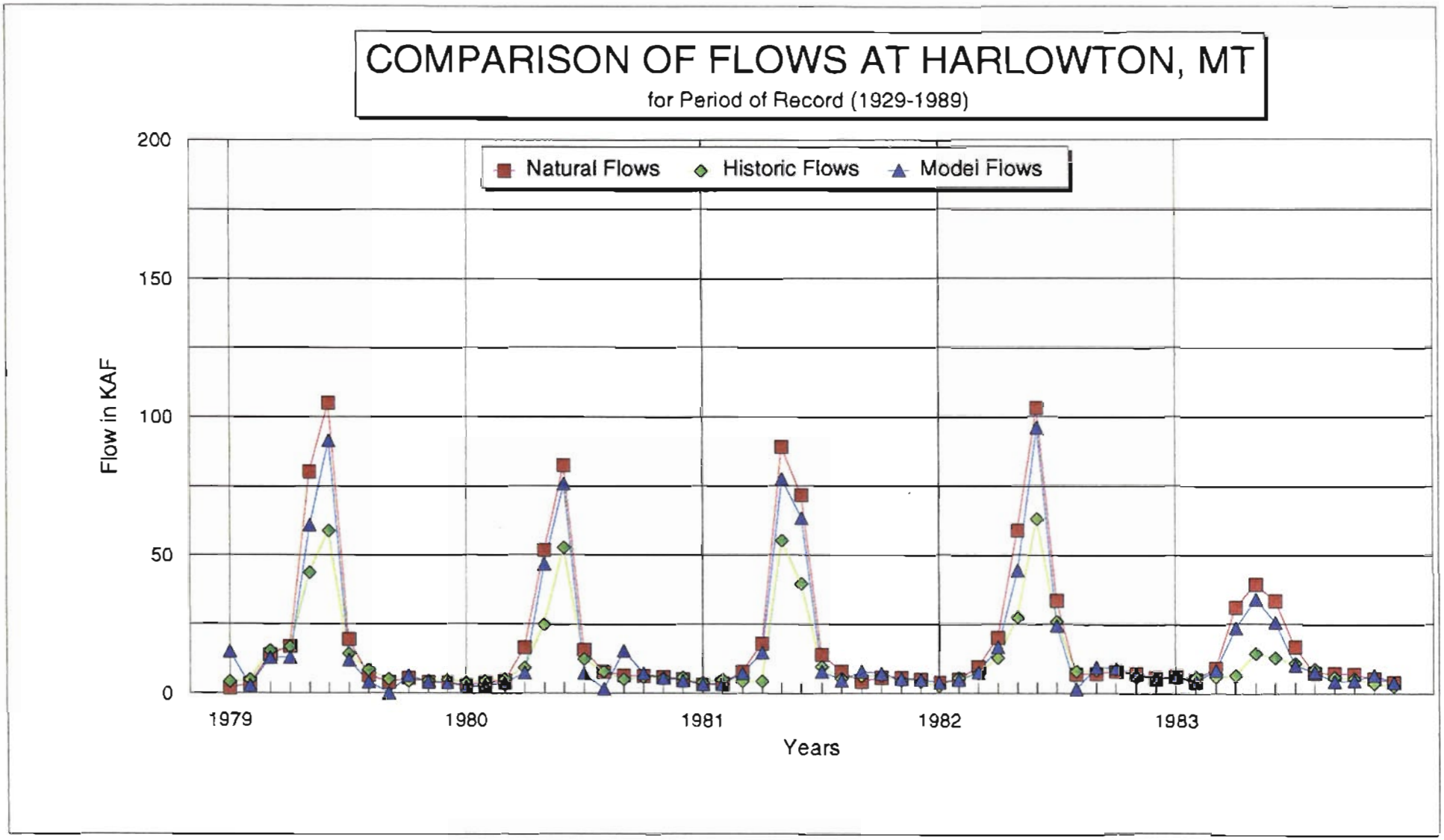

COMPARISON OF FLOWS AT HARLOWTON, MT
for Period of Record (1929-1989)
Natural Flows
Historic Flows
Model Flows
Flow in KAF
200
150
100
50
0
1964
1965
1966
1967
1968
Years


COMPARISON OF FLOWS AT HARLOWTON, MT
for Period of Record (1929-1989)
Natural Flows
Historic Flows
Model Flows
Flow in KAF
200
150
100
50
0
1969
1970
1971
1972
1973
Years

COMPARISON OF FLOWS AT HARLOWTON, MT

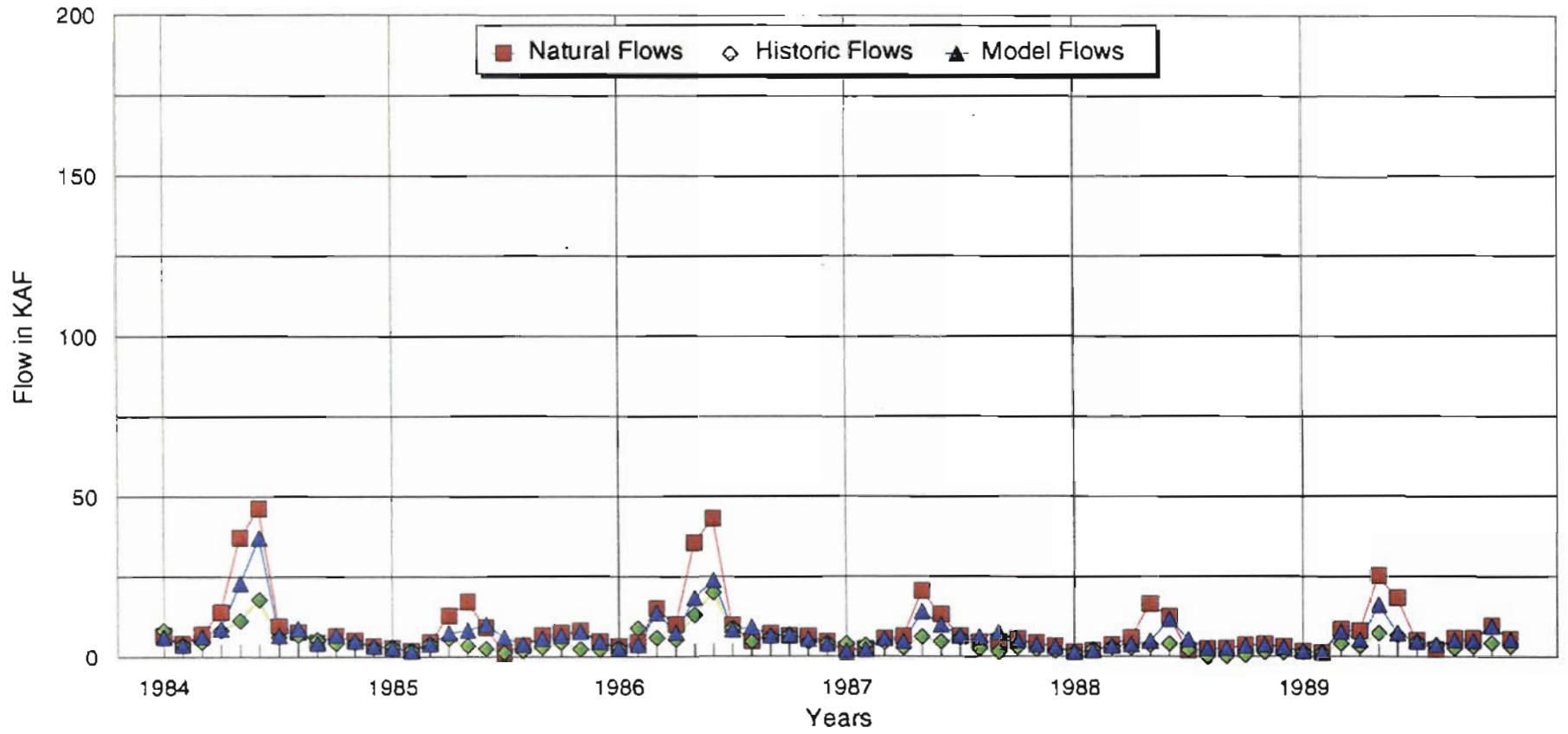
for Period of Record (1929-1989)

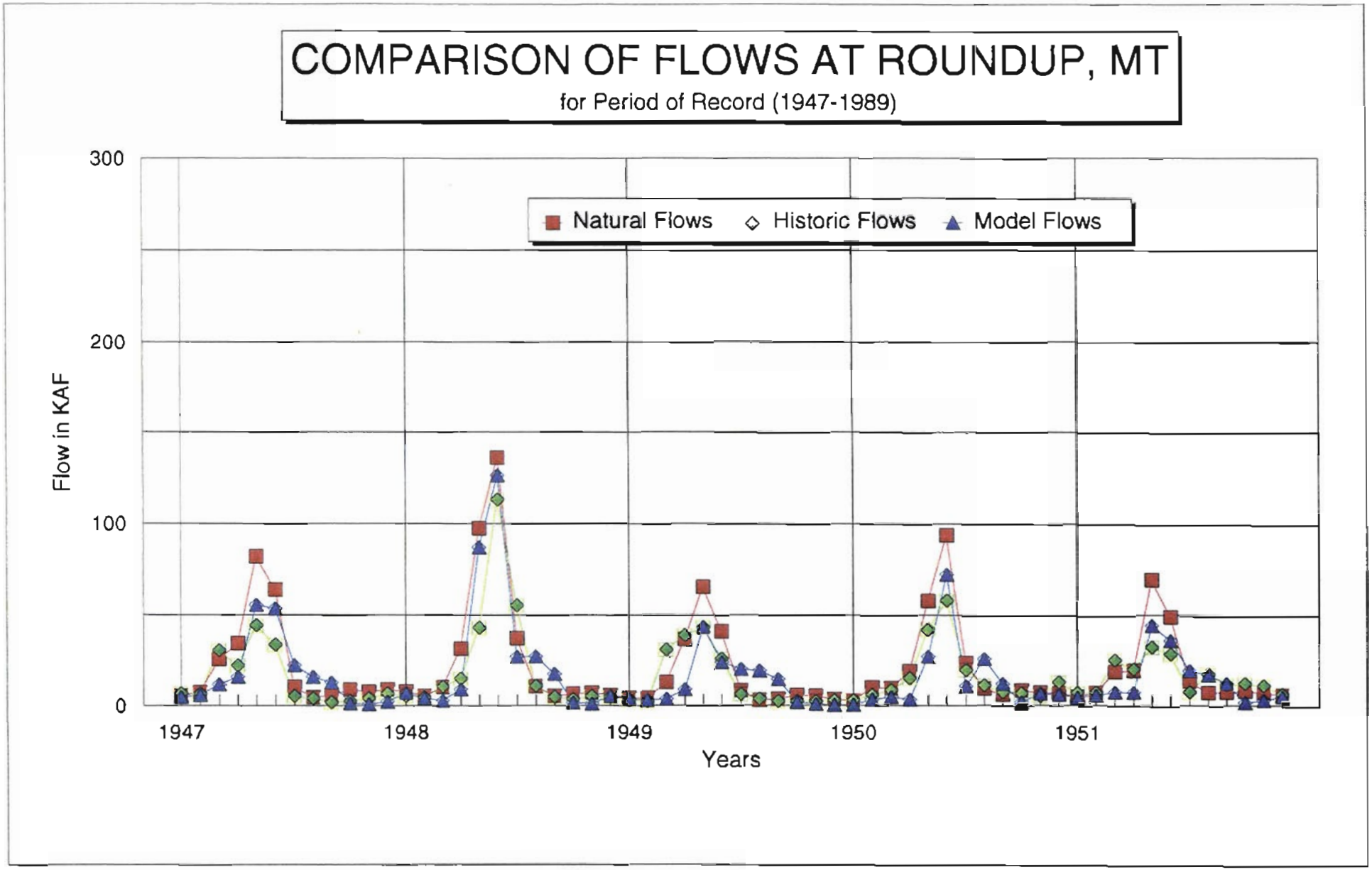


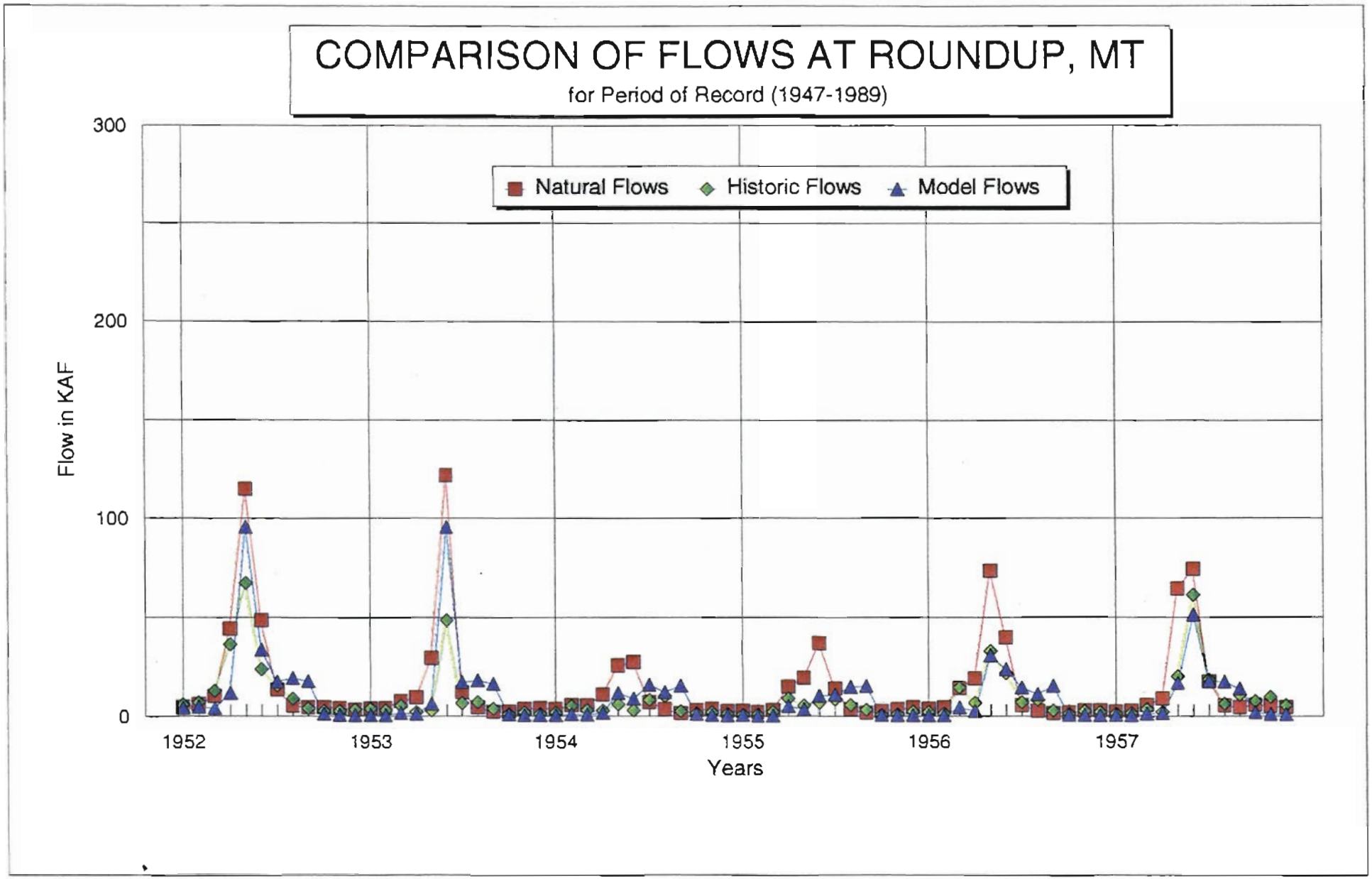

COMPARISON OF FLOWS AT HARLOWTON, MT
for Period of Record (1929-1989)
Natural Flows
Historic Flows
Model Flows
Flow in KAF
200
150
100
50
0
1979
1980
1981
1982
1983
Years

COMPARISON OF FLOWS AT HARLOWTON, MT

for Period of Record (1929-1989)

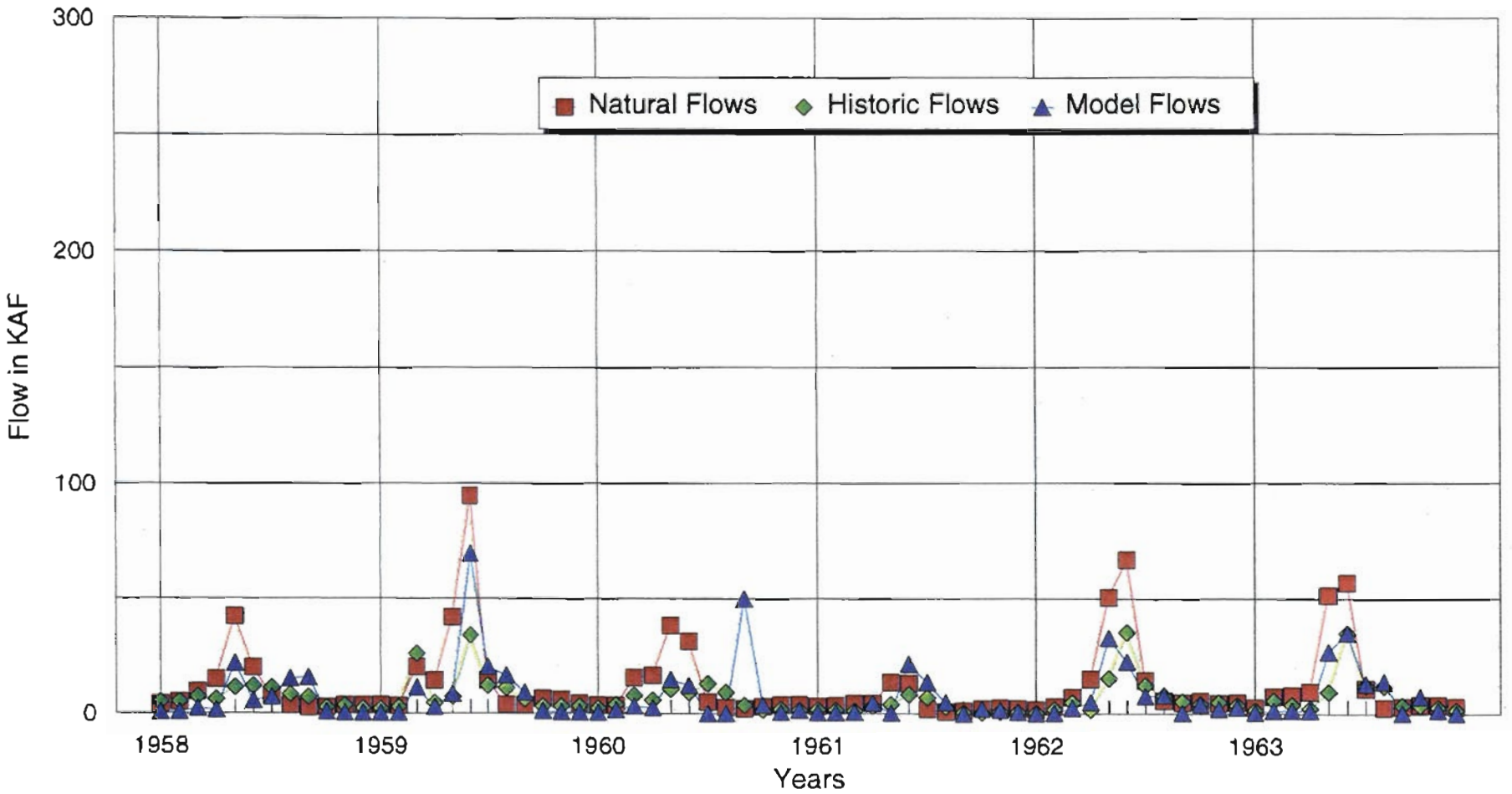



COMPARISON OF FLOWS AT ROUNDUP, MT
for Period of Record (1947-1989)
Natural Flows
Historic Flows
Model Flows
300
200
100
0
Flow in KAF
1947
1948
1949
1950
1951
Years


COMPARISON OF FLOWS AT ROUNDUP, MT
for Period of Record (1947-1989)
Natural Flows
Historic Flows
Model Flows
300
200
100
0
Flow in KAF
1952
1953
1954
1955
1956
1957
Years

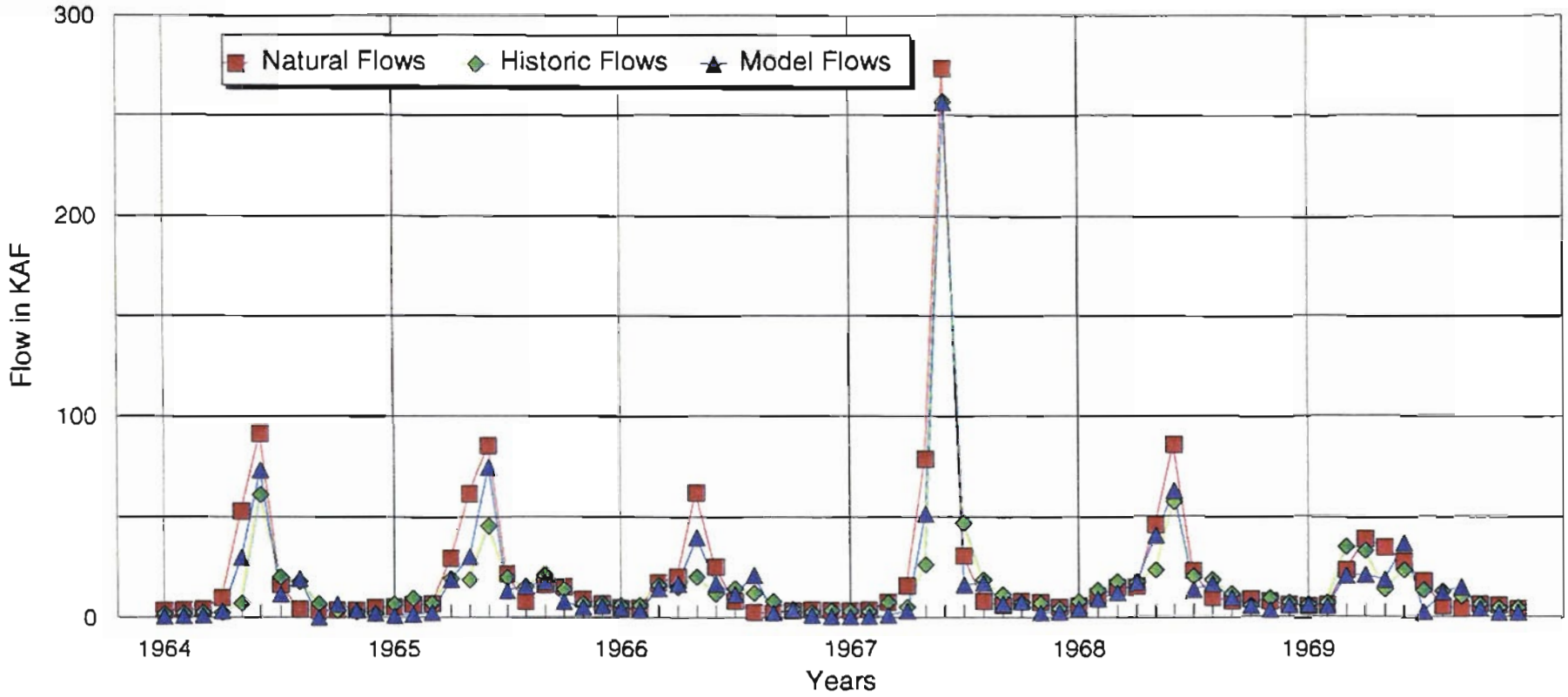
COMPARISON OF FLOWS AT ROUNDUP, MT

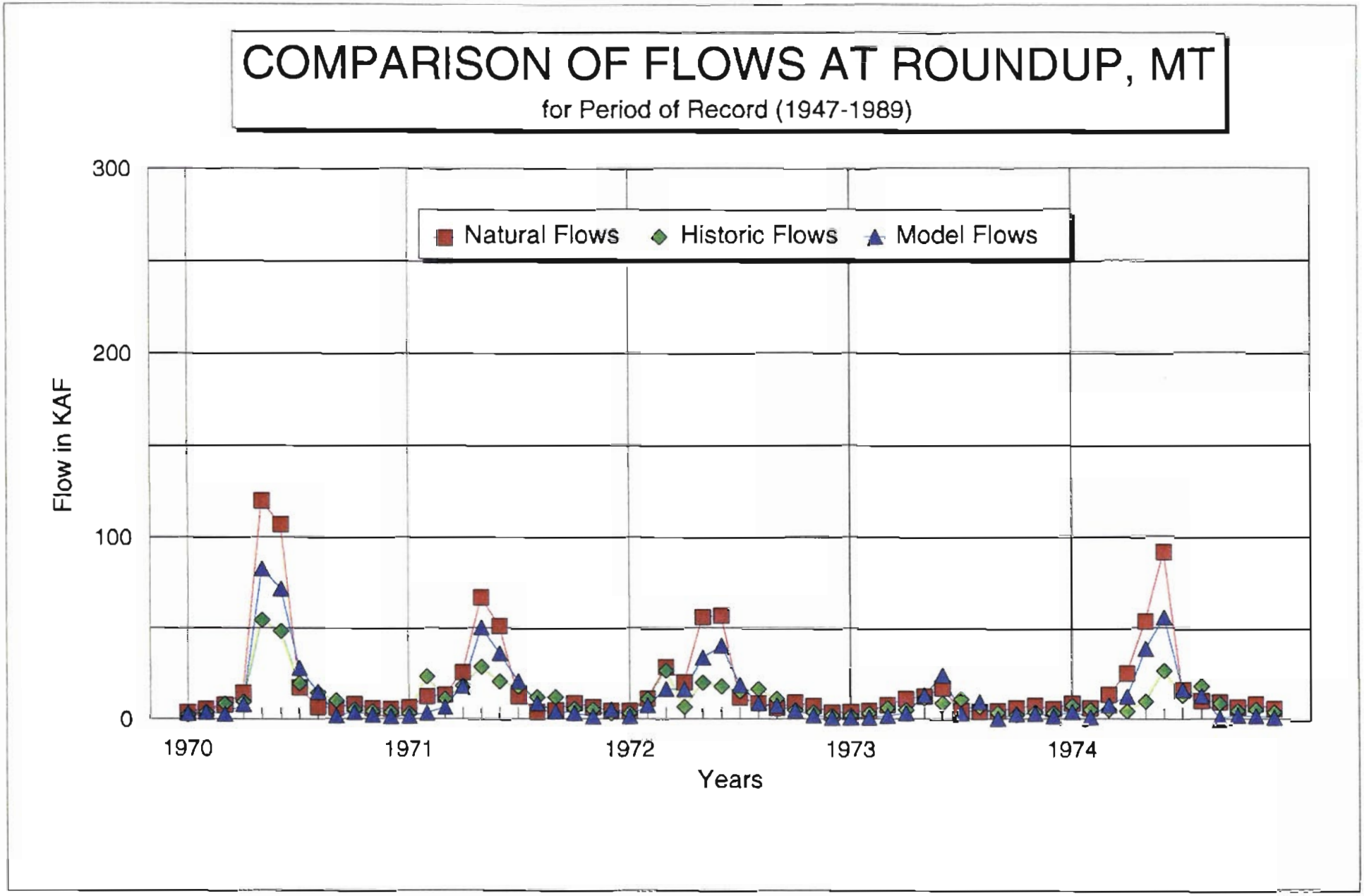
for Period of Record (1947-1989)



COMPARISON OF FLOWS AT ROUNDUP, MT

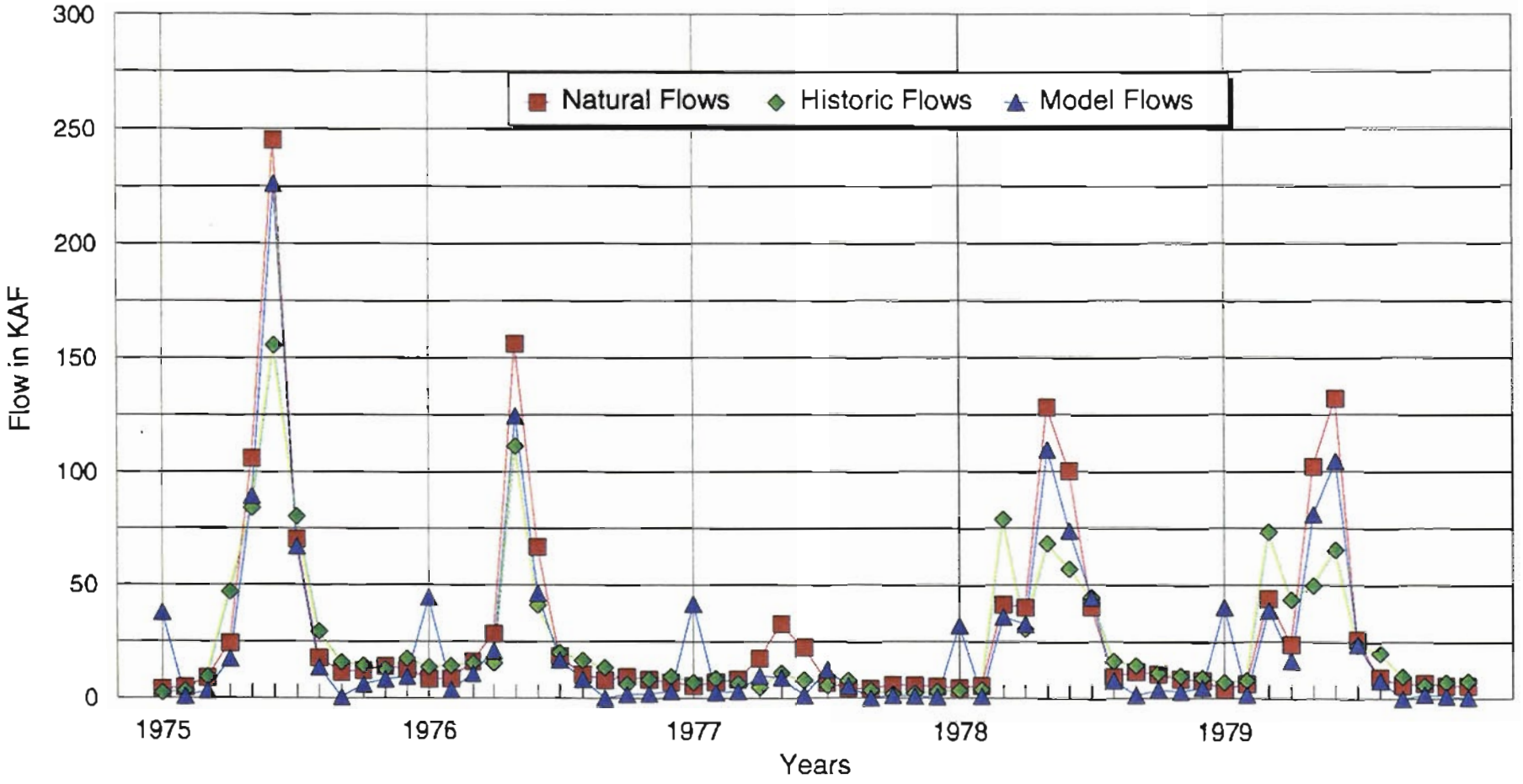
for Period of Record (1947-1989)

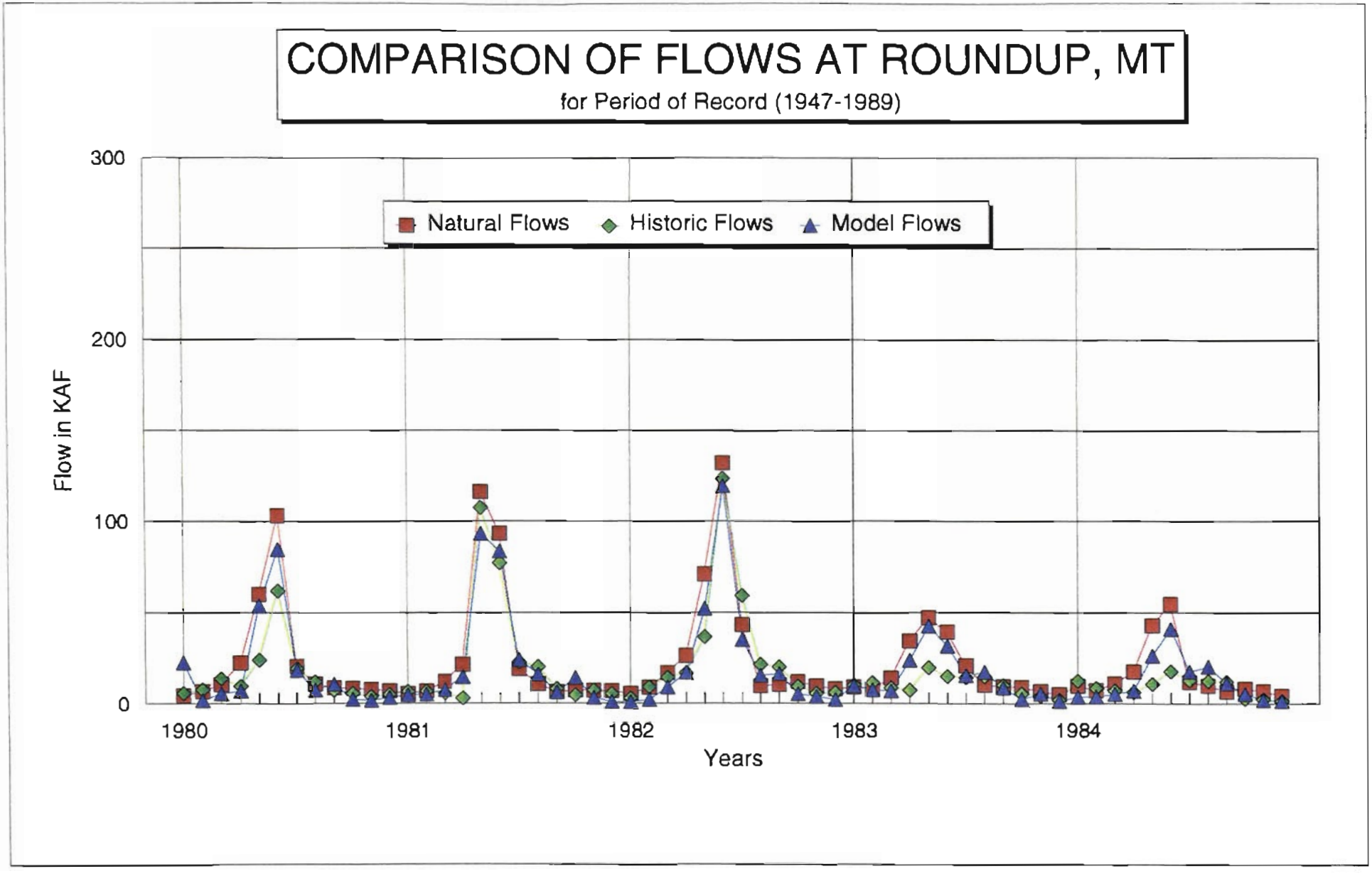



COMPARISON OF FLOWS AT ROUNDUP, MT
for Period of Record (1947-1989)
Natural Flows
Historic Flows
Model Flows
300
200
100
0
Flow in KAF
1970
1971
1972
1973
1974
Years

COMPARISON OF FLOWS AT ROUNDUP, MT

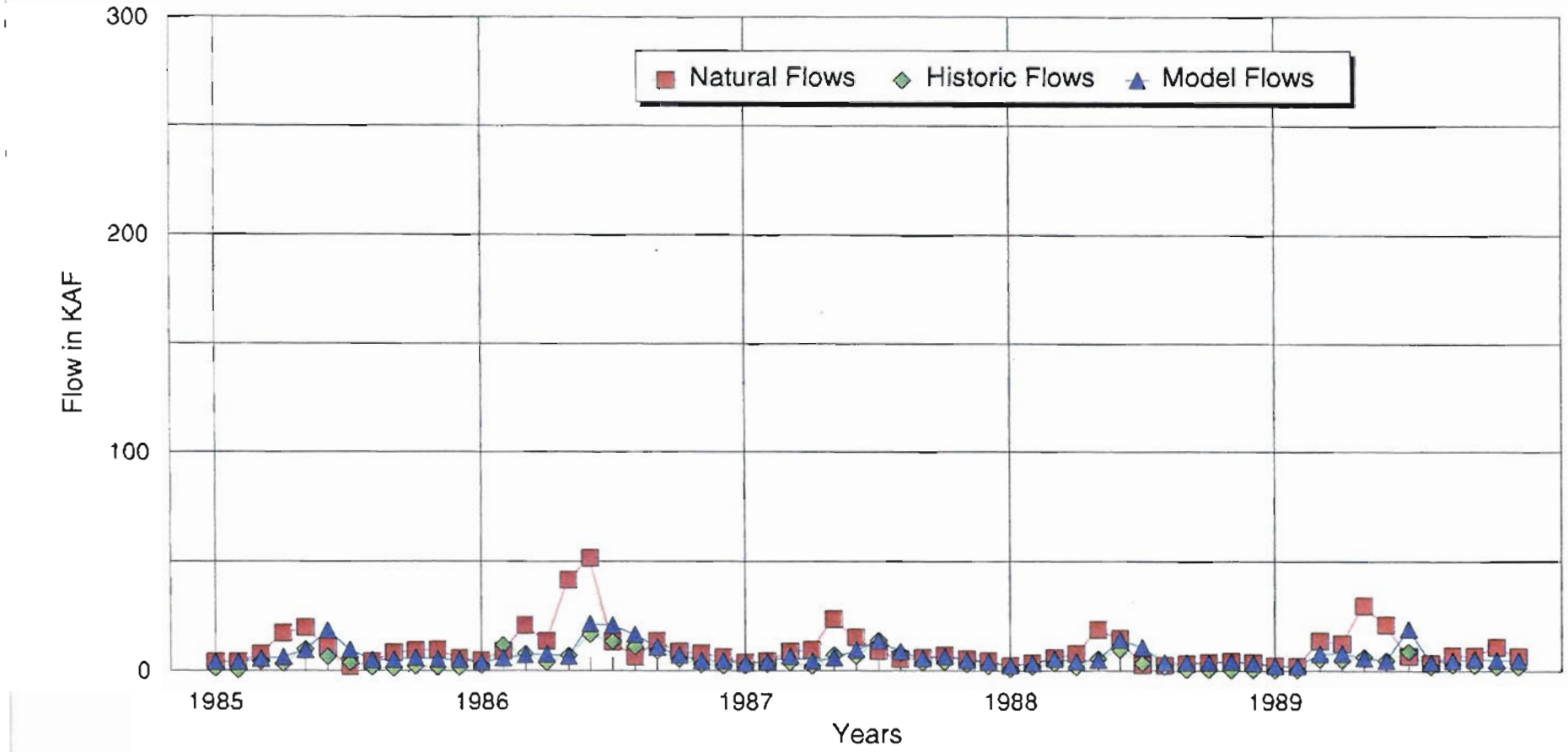
for Period of Record (1947-1989)




COMPARISON OF FLOWS AT ROUNDUP, MT
for Period of Record (1947-1989)
Natural Flows
Historic Flows
Model Flows
300
200
100
0
Flow in KAF
1980
1981
1982
1983
1984
Years

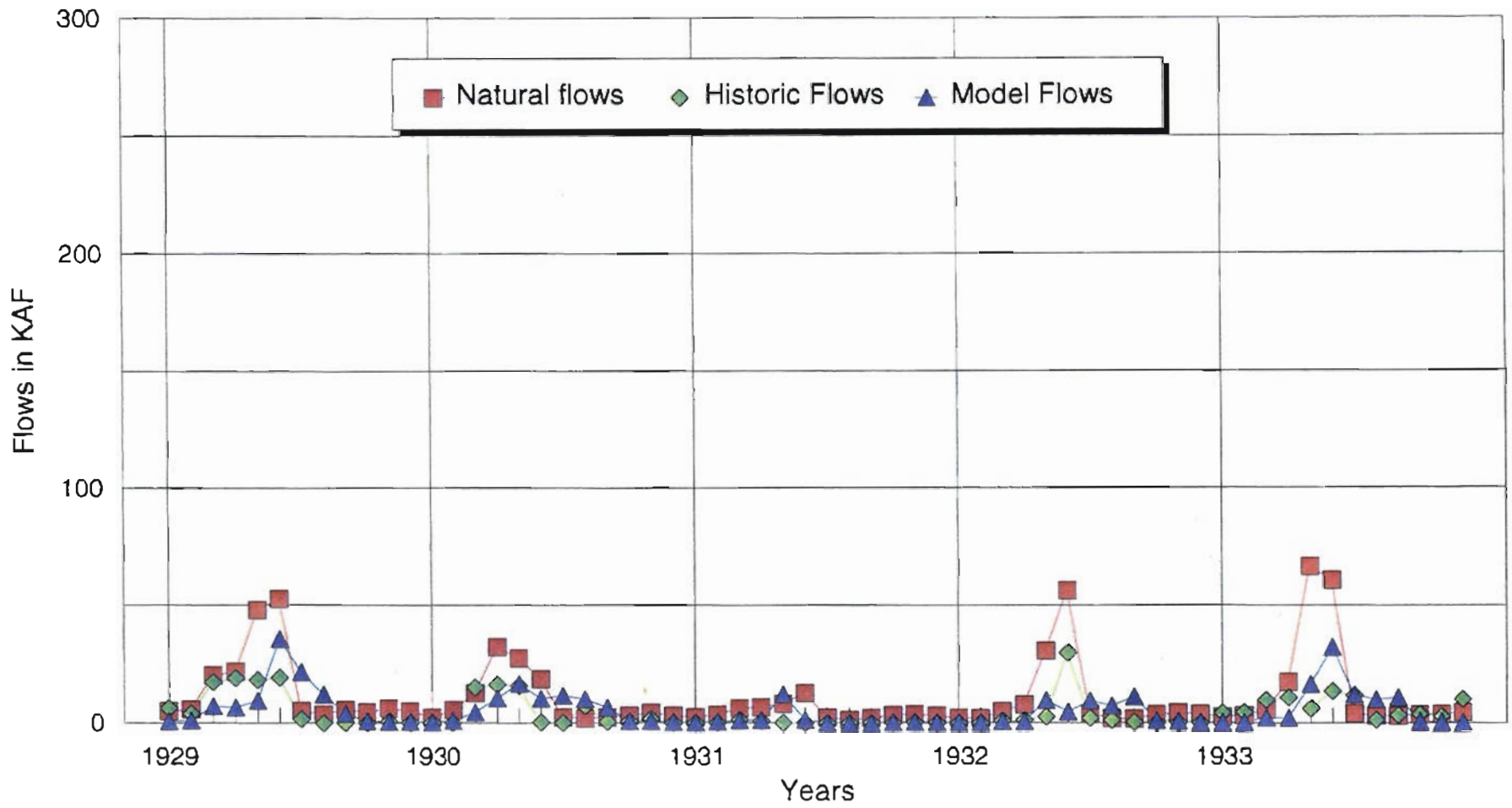
COMPARISON OF FLOWS AT ROUNDUP, MT

for Period of Record (1947-1989)



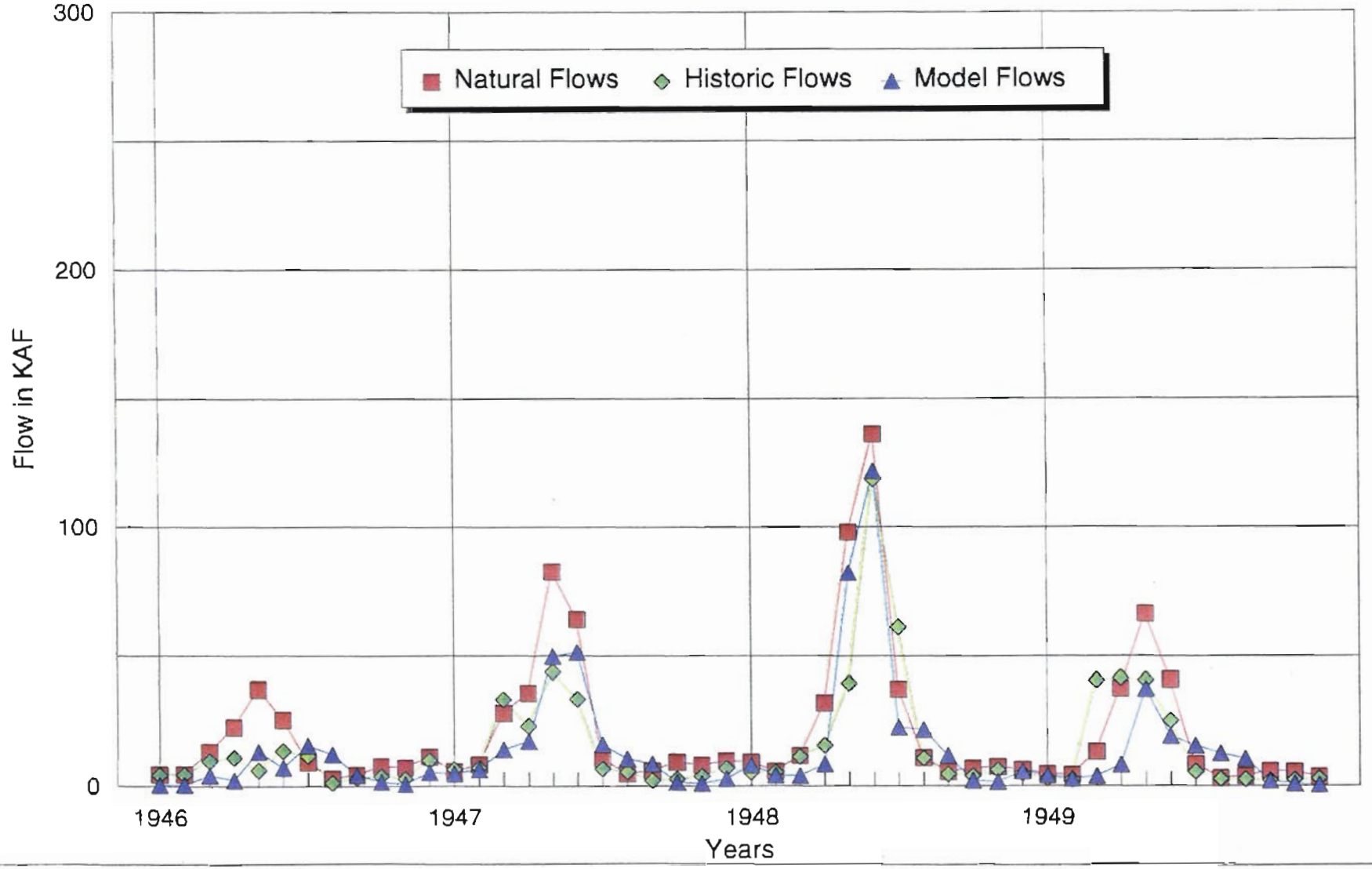
COMPARISON OF FLOWS AT MUSSELSHELL, MT

for period of record (1929 -1989)



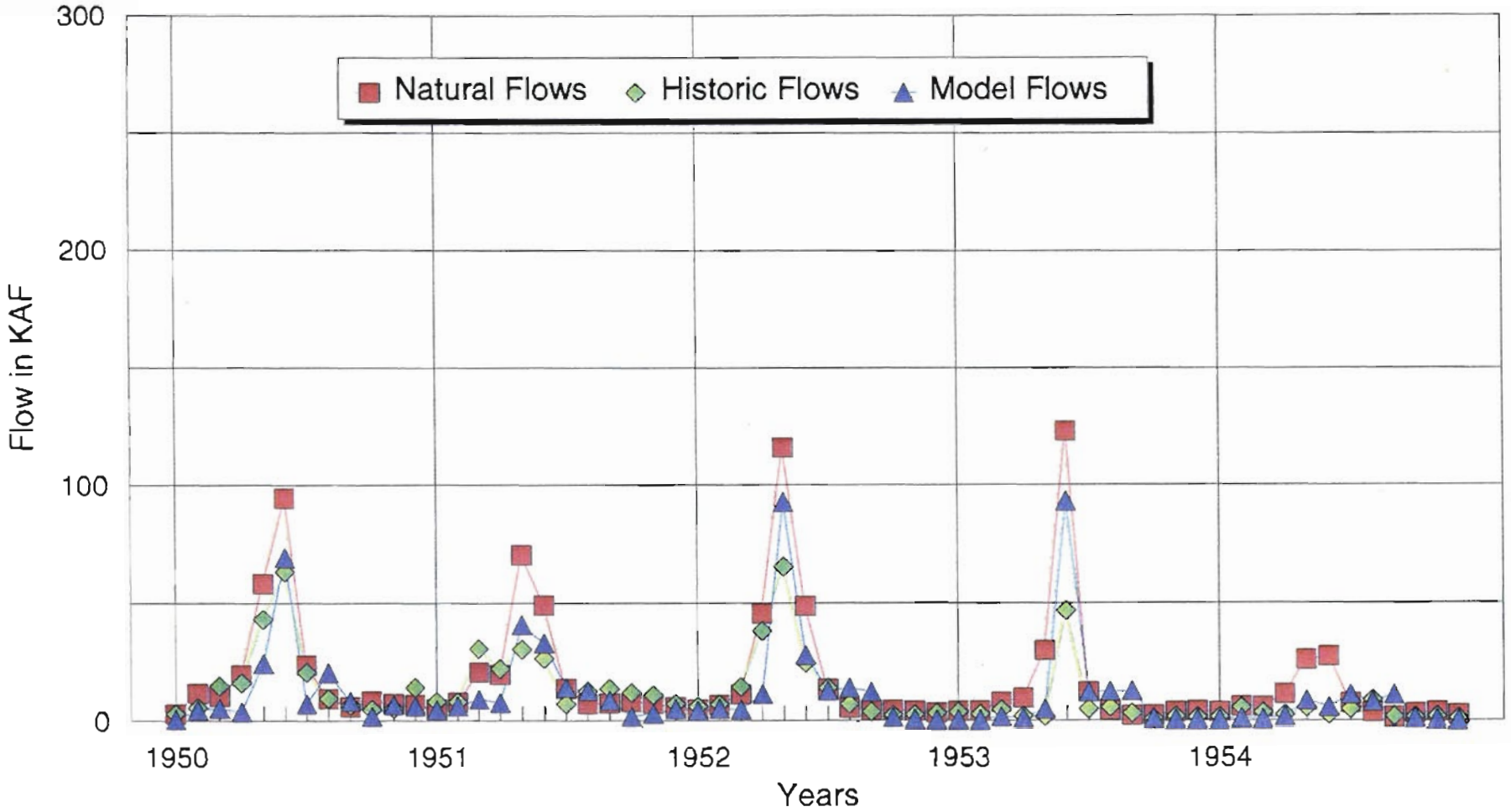
COMPARISON OF FLOWS AT MUSSELSHELL, MT

for Period of Record (1929-1989)



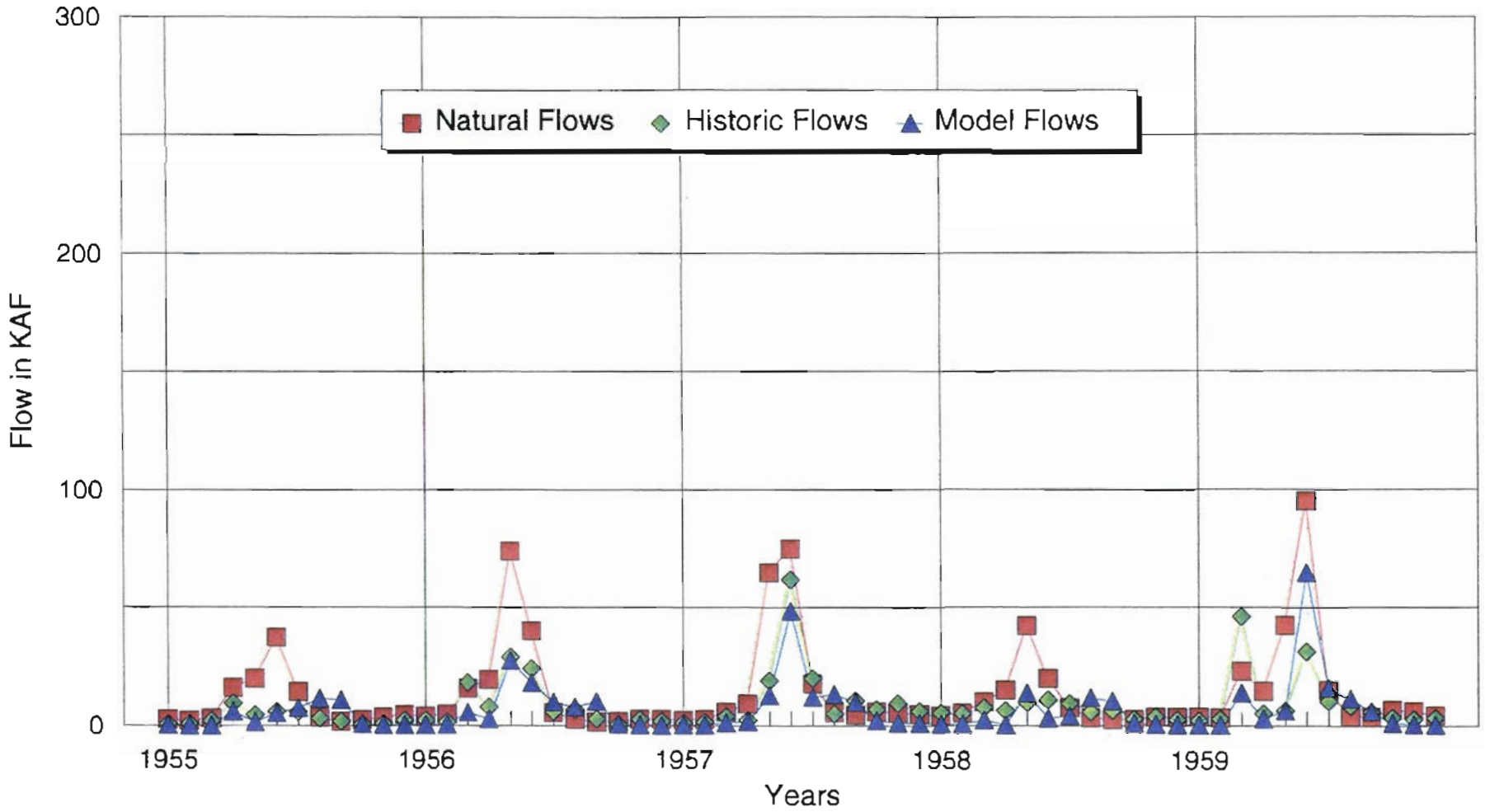
COMPARISON OF FLOWS AT MUSSELSHELL, MT

for Period of Record (1929-1989)



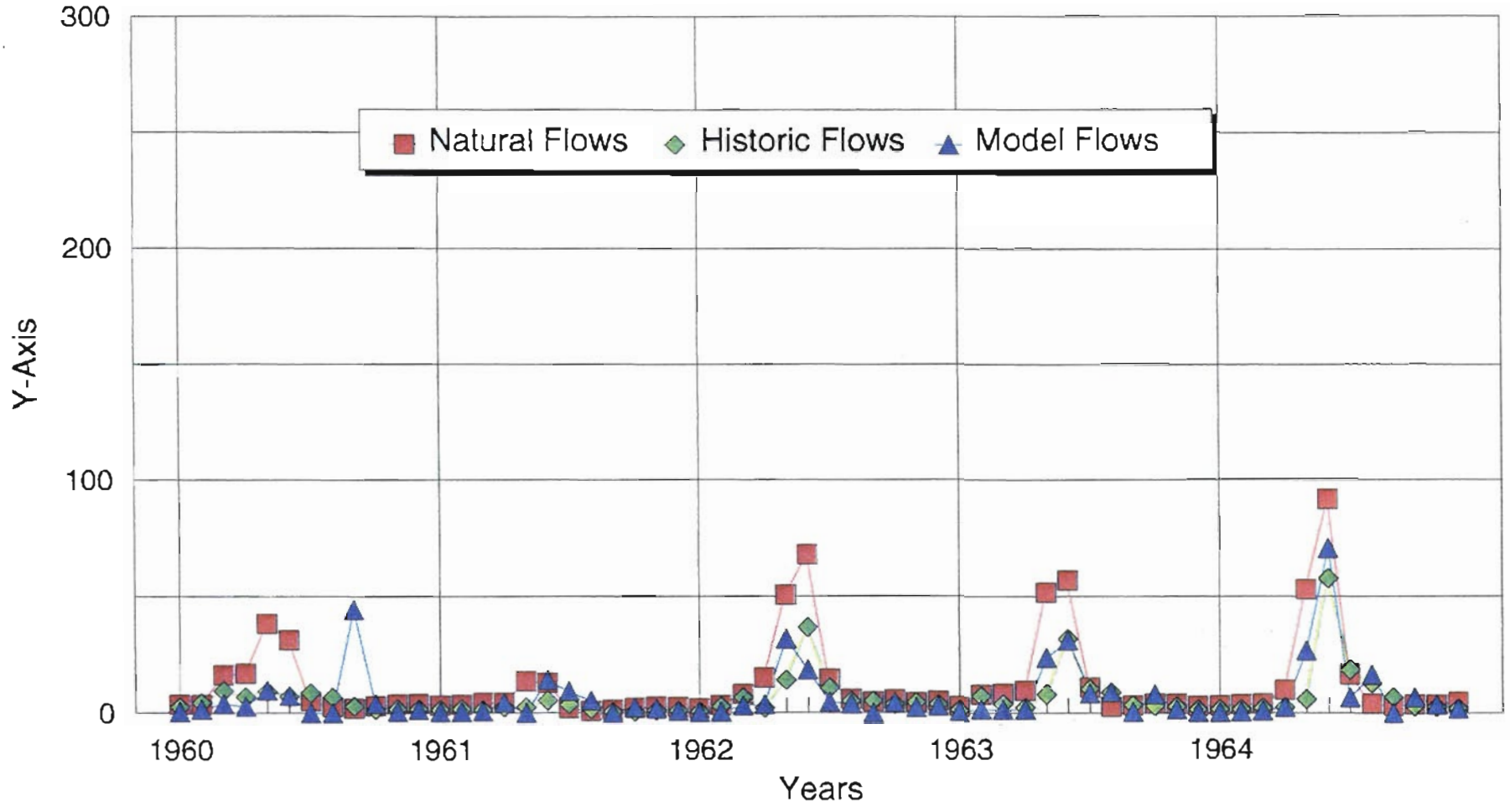
COMPARISON OF FLOWS AT MUSSELSHELL, MT

for Period of Record (1929-1989)



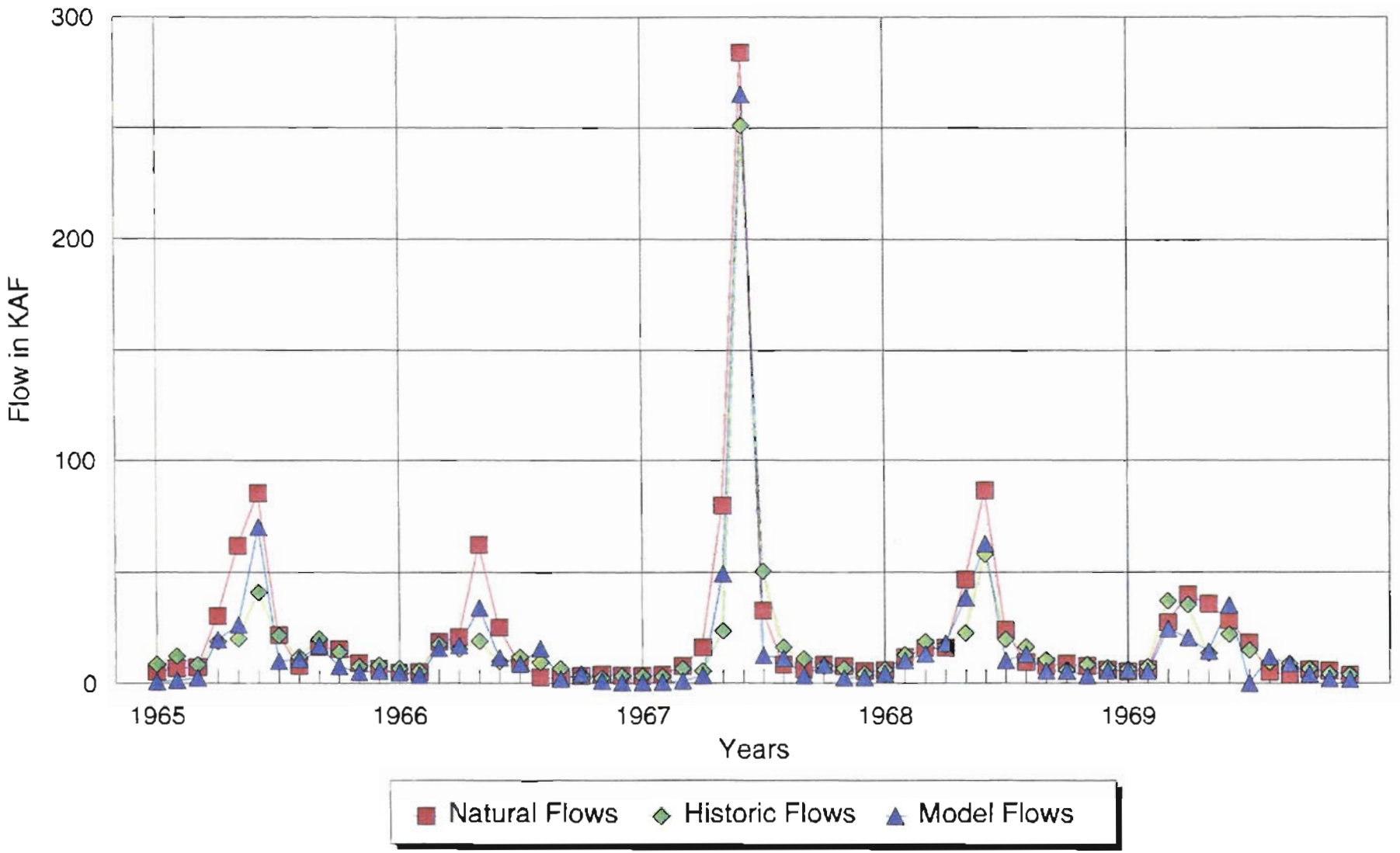
COMPARISON OF FLOWS AT MUSSELSHELL, MT

for Period of Record (1929-1989)



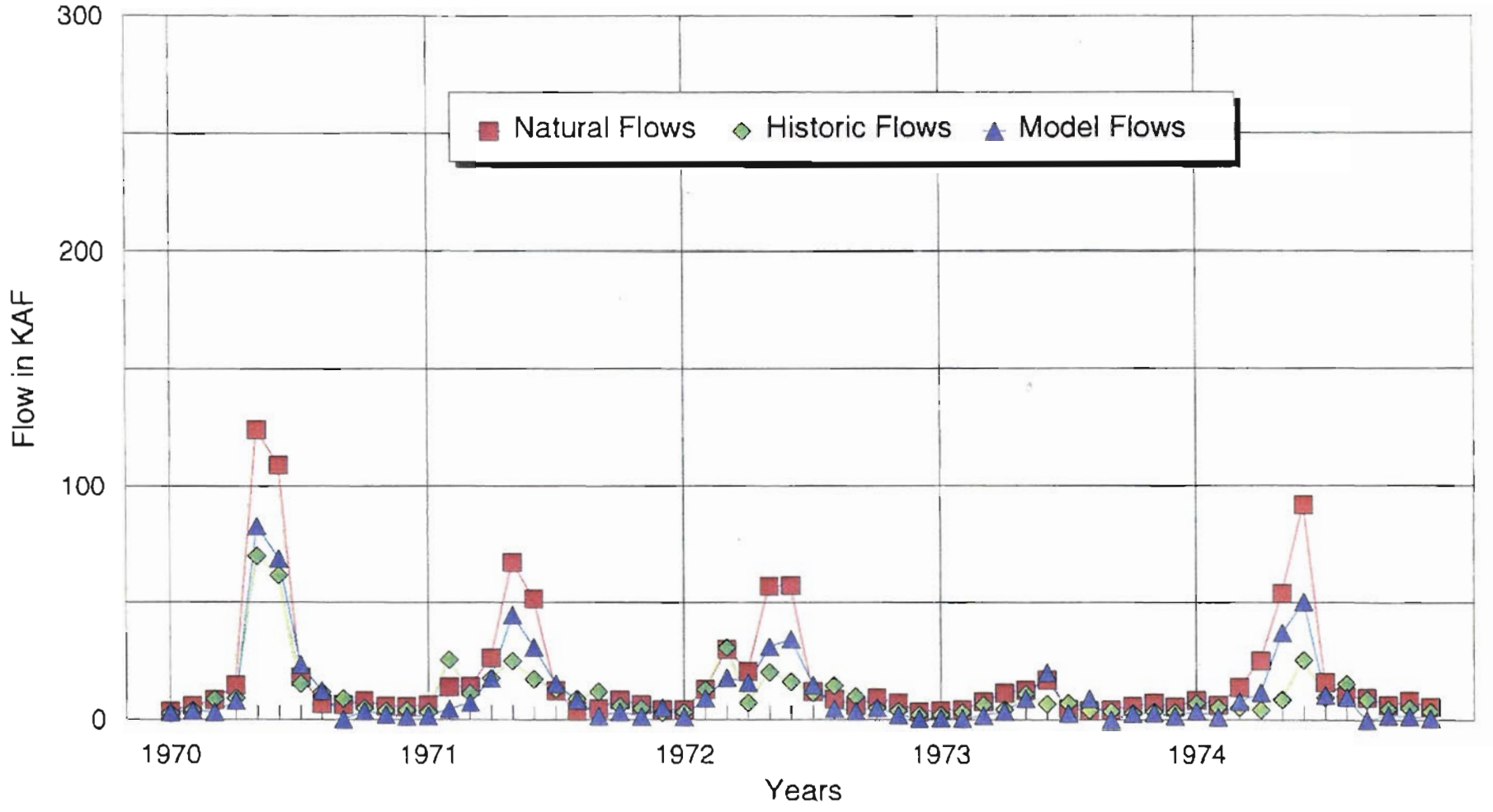
COMPARISON OF FLOWS AT MUSSELSHELL, MT

for Period of Record (1929-1989)



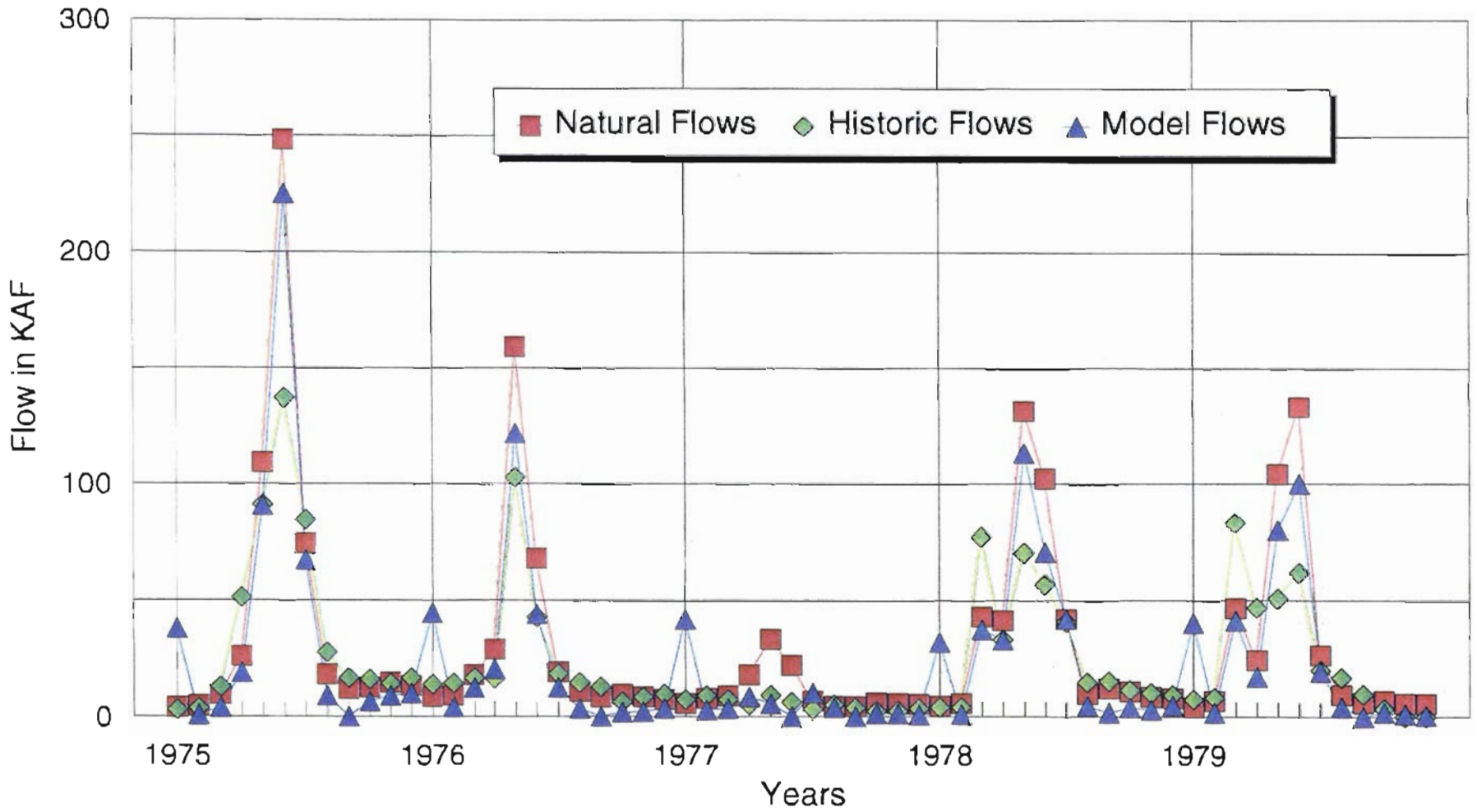
COMPARISON OF FLOWS AT MUSSELSHELL, MT

for Period of Record (1929-1989)



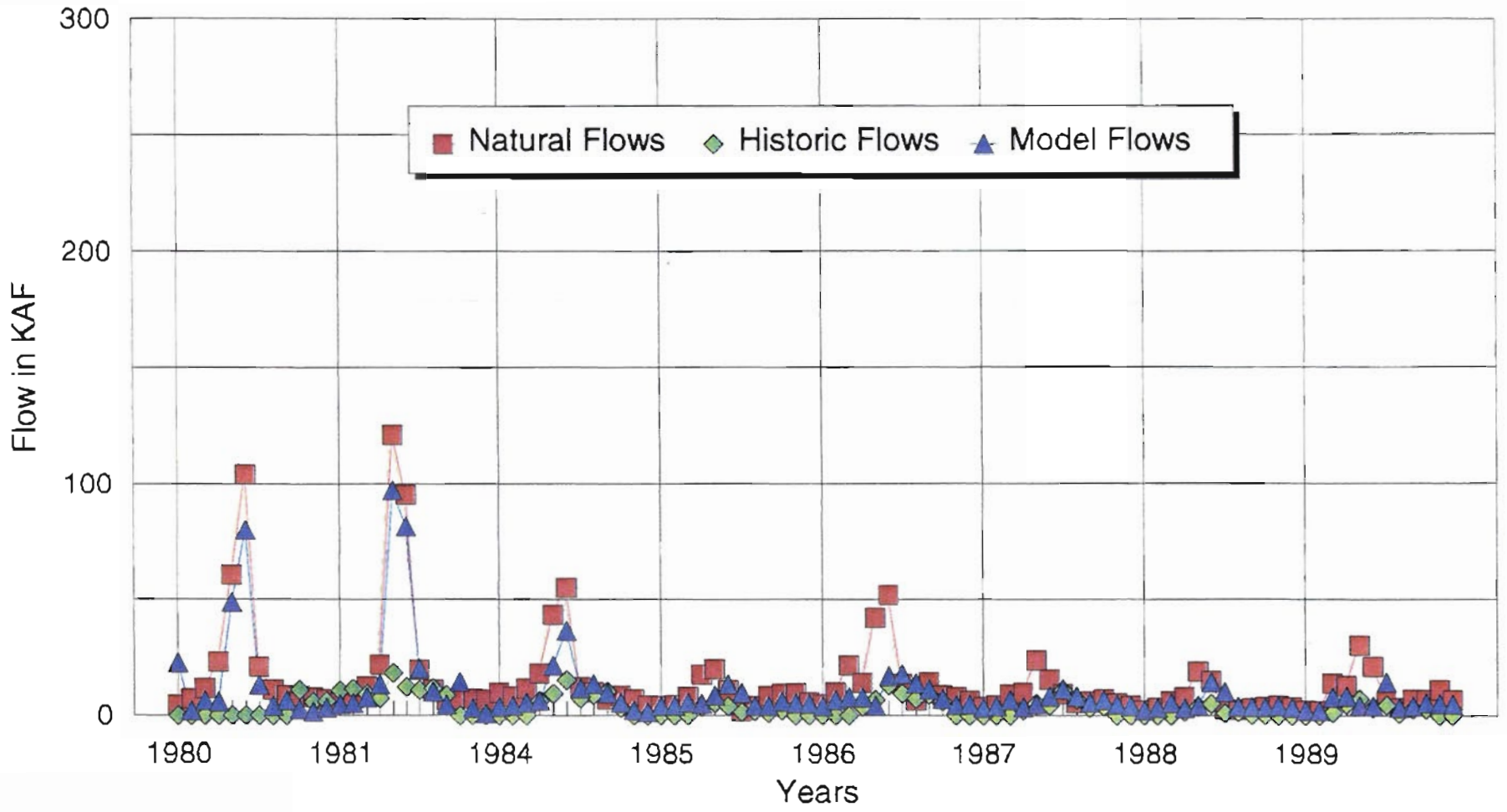
COMPARISON OF FLOWS AT MUSSELSHELL, MT

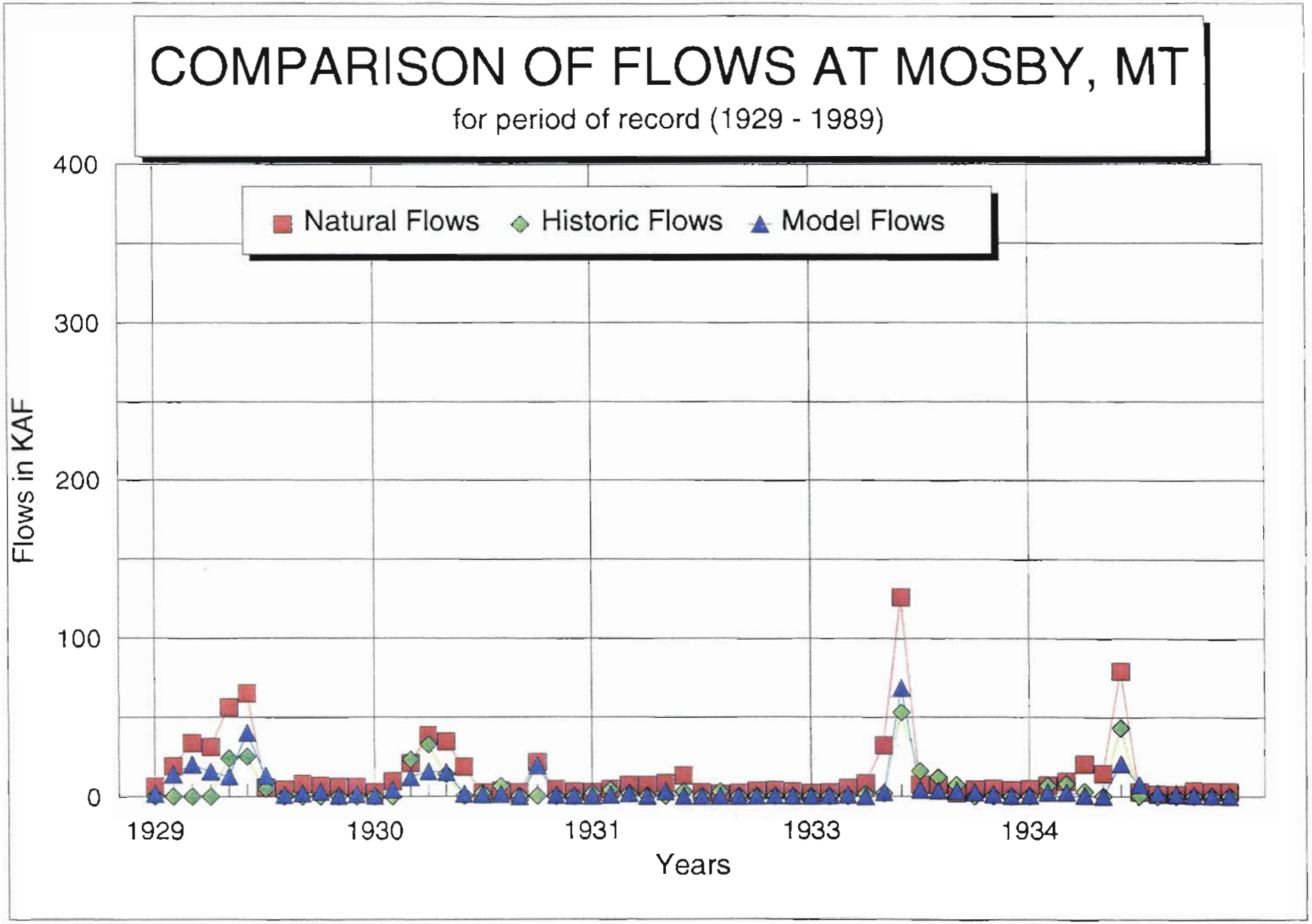
for Period of Record (1929-1989)



COMPARISON OF FLOWS AT MUSSELSHELL, MT

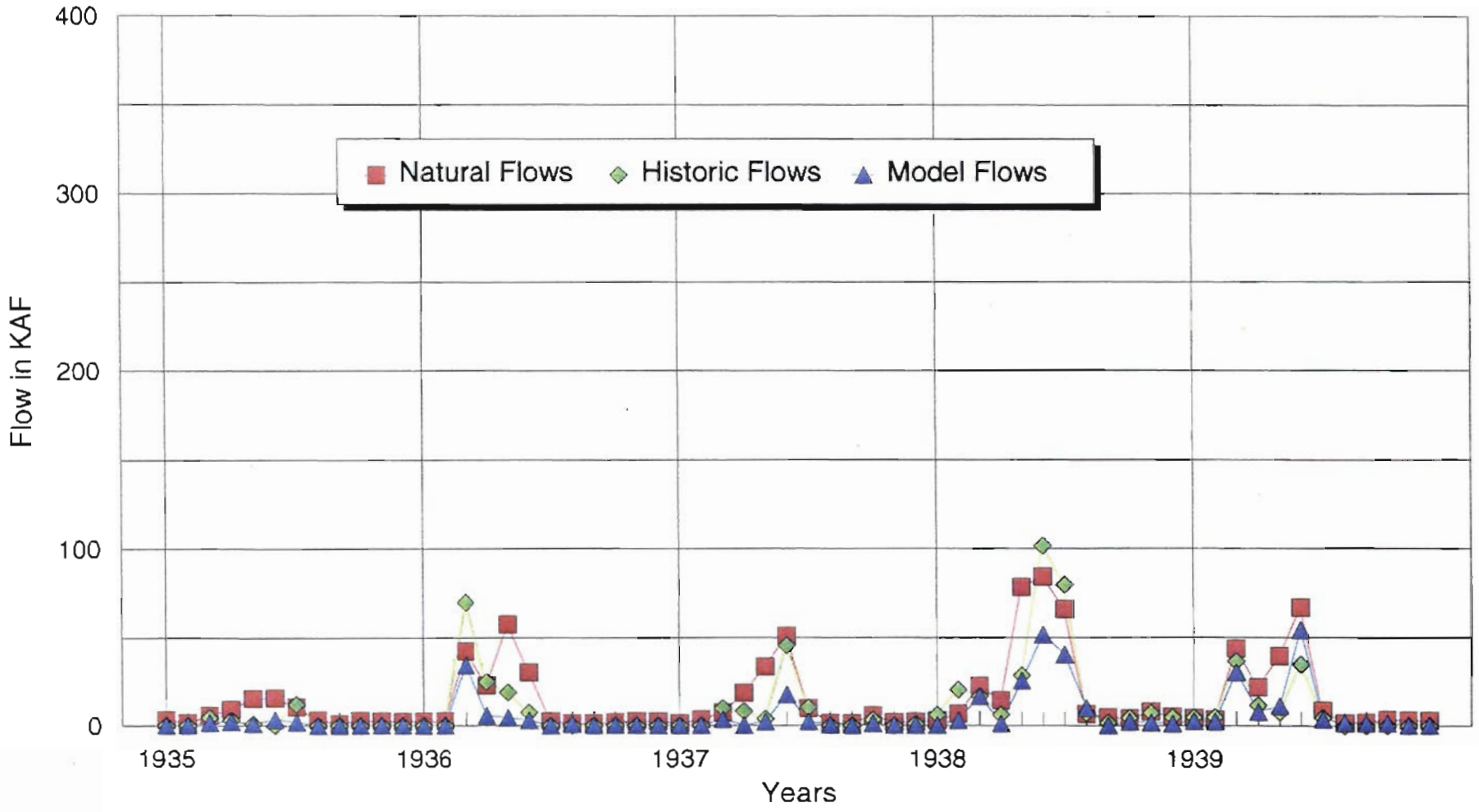
for Period of Record (1929-1989)




COMPARISON OF FLOWS AT MOSBY, MT
for period of record (1929 - 1989)
Natural Flows
Historic Flows
Model Flows
400
300
200
100
0
Flows in KAF
1929
1930
1931
1933
1934
Years

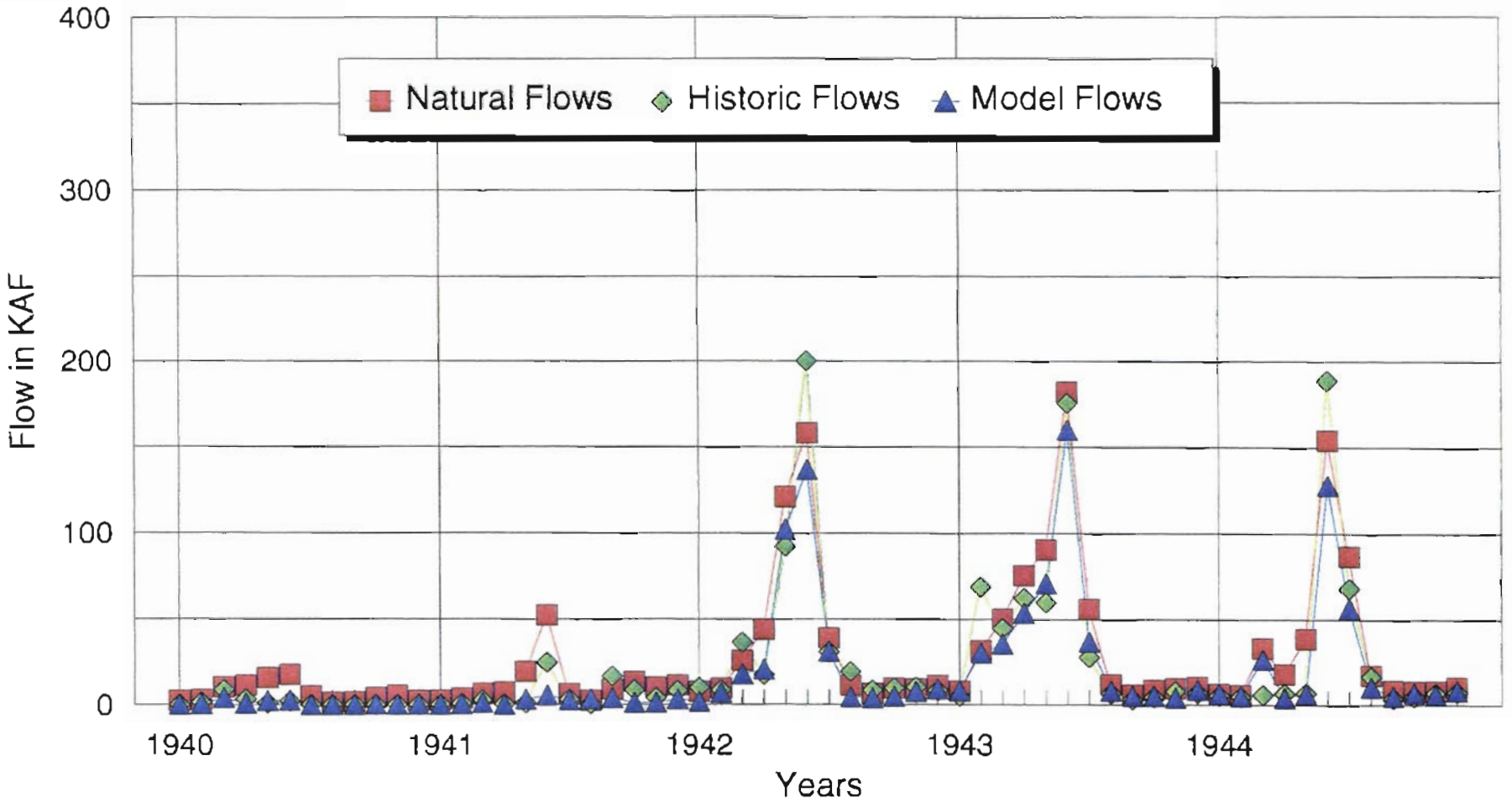
COMPARISON OF FLOWS AT MOSBY, MT

for Period of Record (1929-1989)



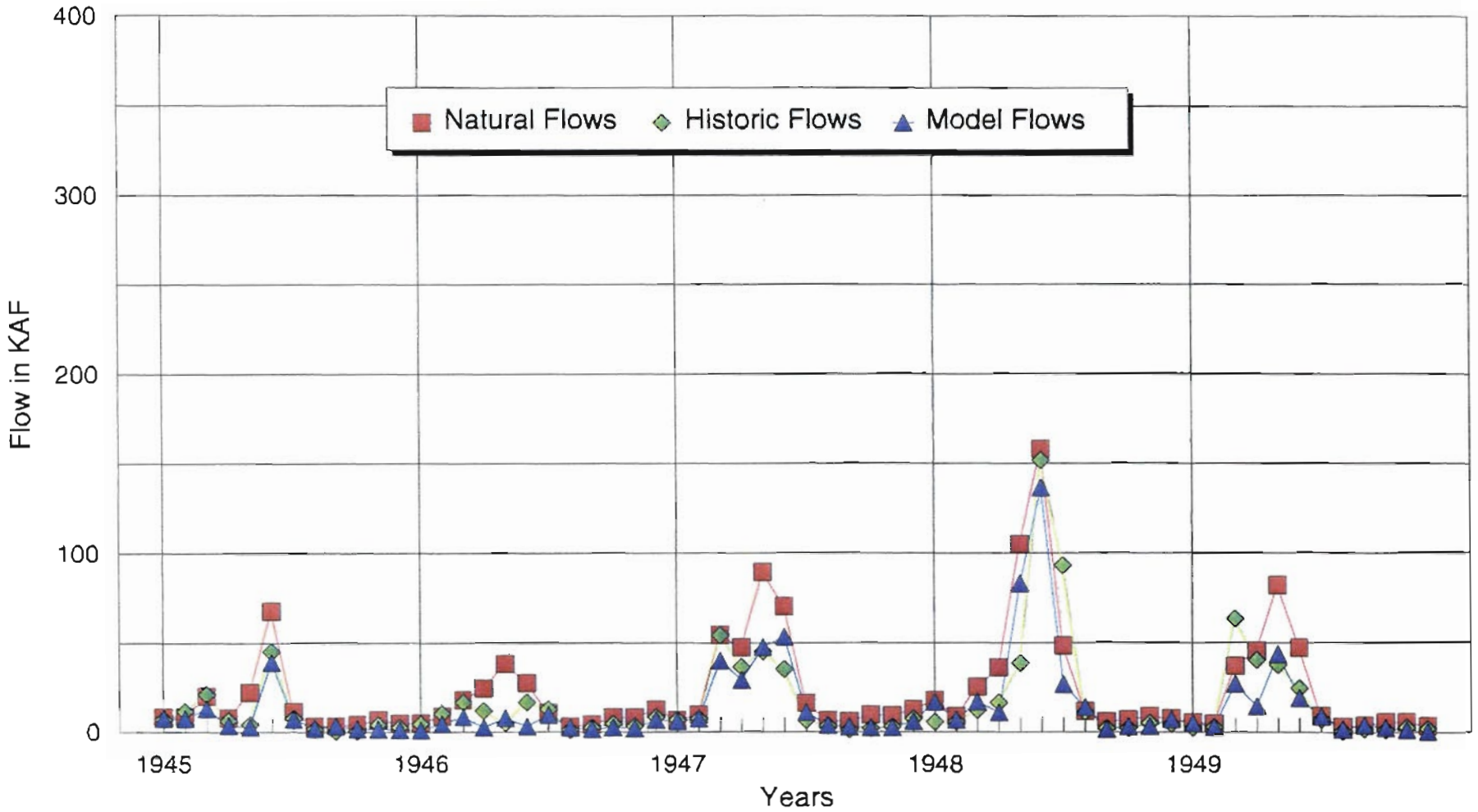
COMPARISON OF FLOWS AT MOSBY, MT

for Period of Record (1929-1989)



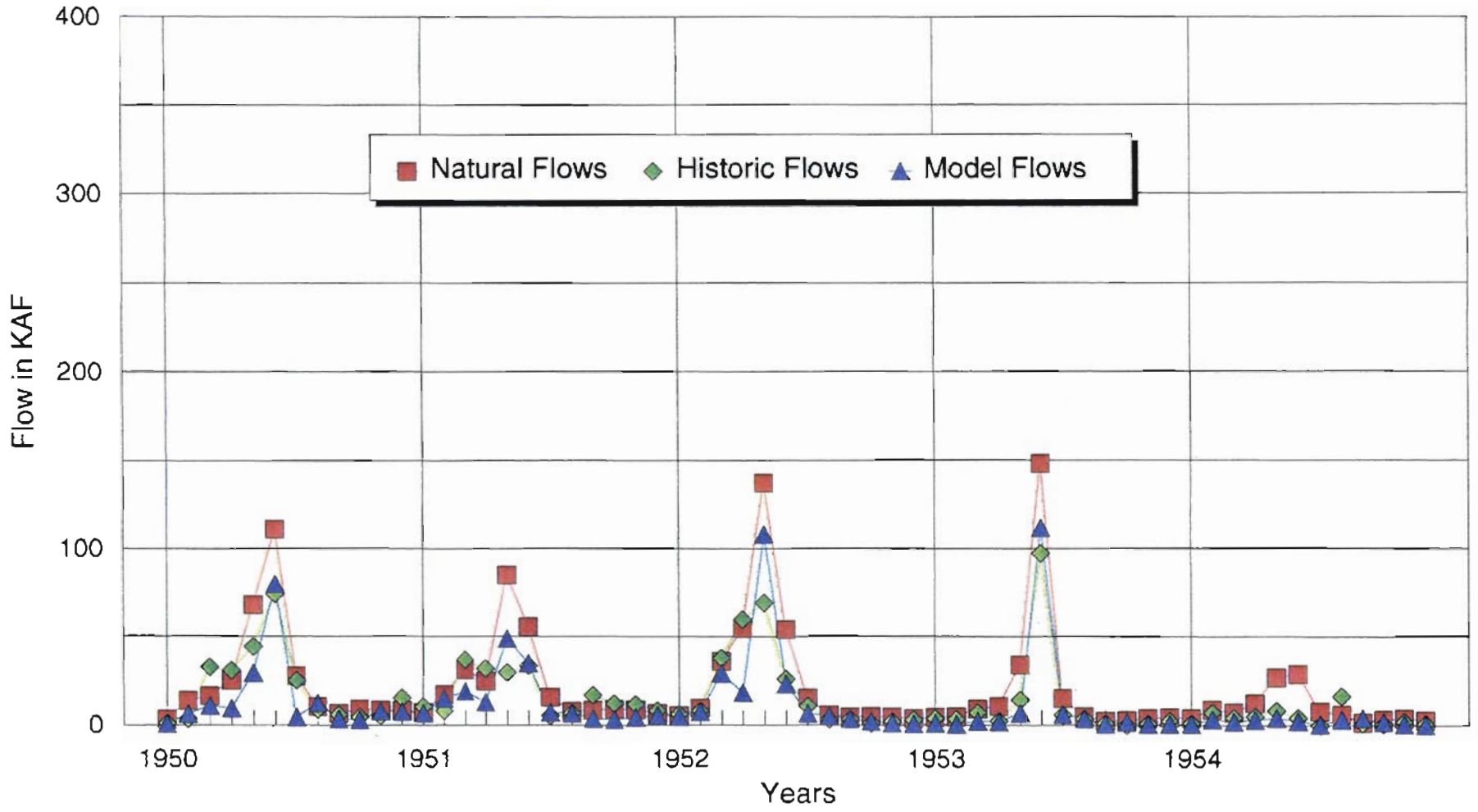
COMPARISON OF FLOWS AT MOSBY, MT

for Period of Record (1929-1989)



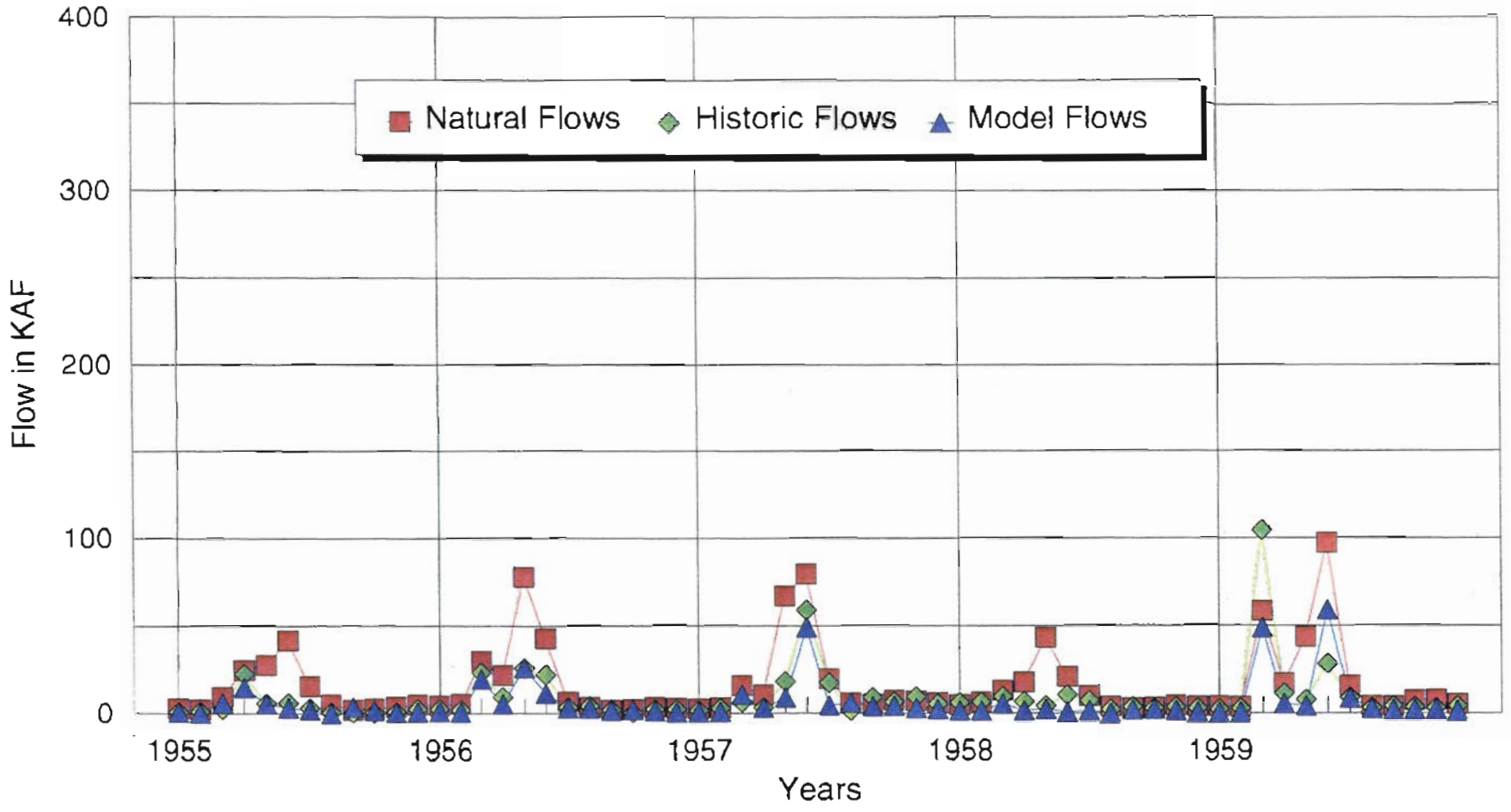
COMPARISON OF FLOWS AT MOSBY, MT

for Period of Record (1929-1989)



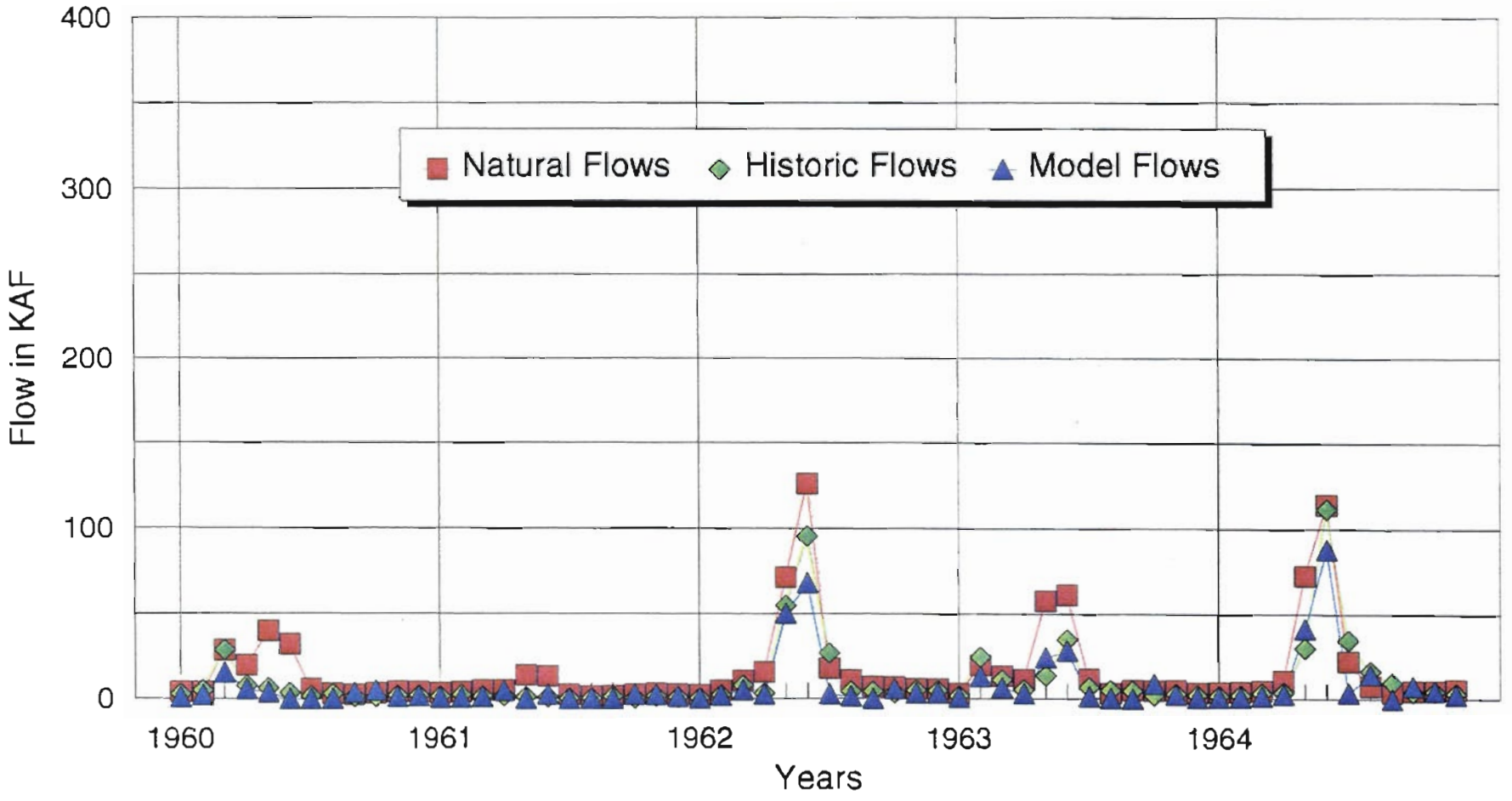
COMPARISON OF FLOWS AT MOSBY, MT

for Period of Record (1929-1989)



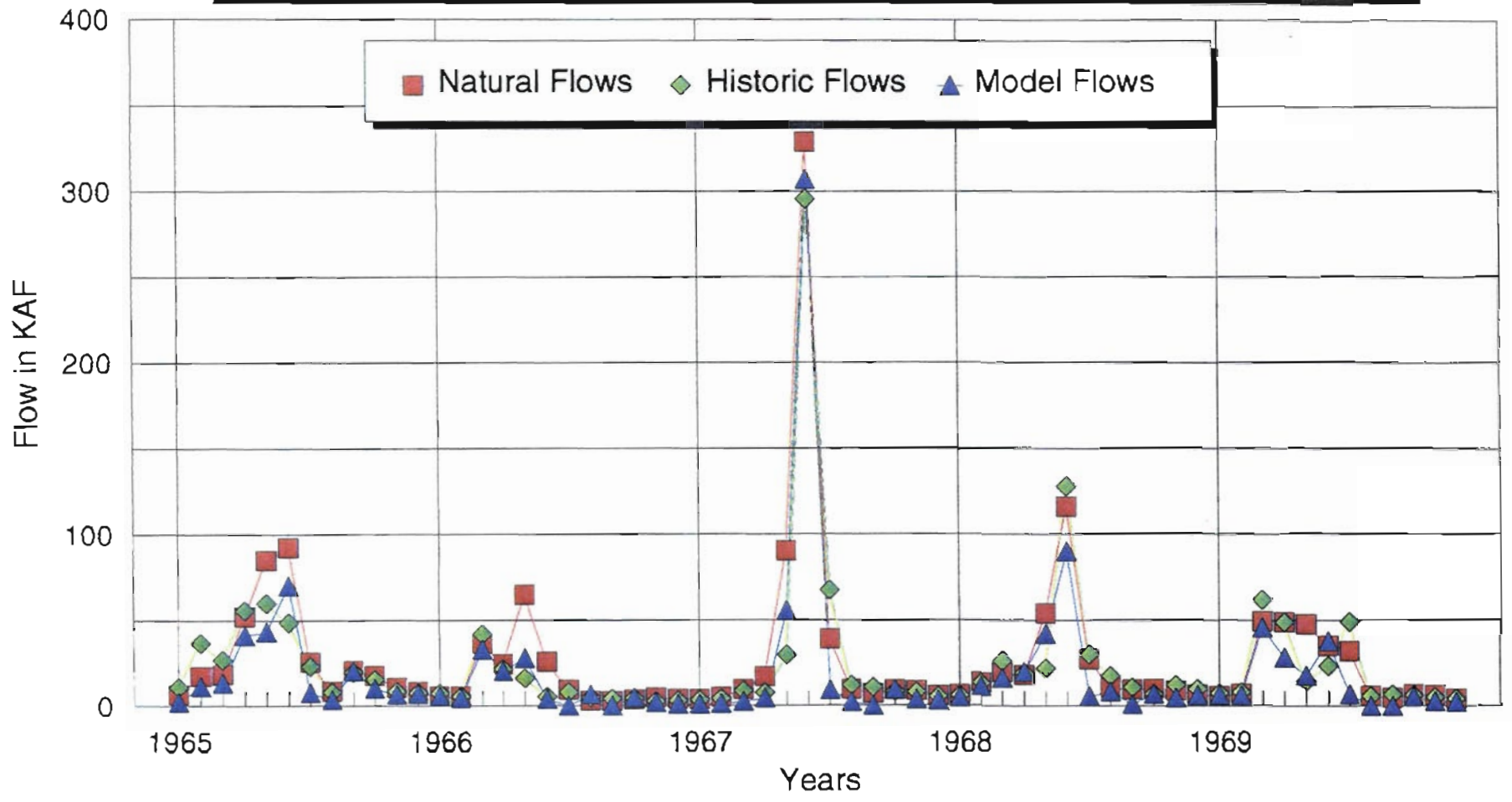
COMPARISON OF FLOWS AT MOSBY, MT

for Period of Record (1929-1989)



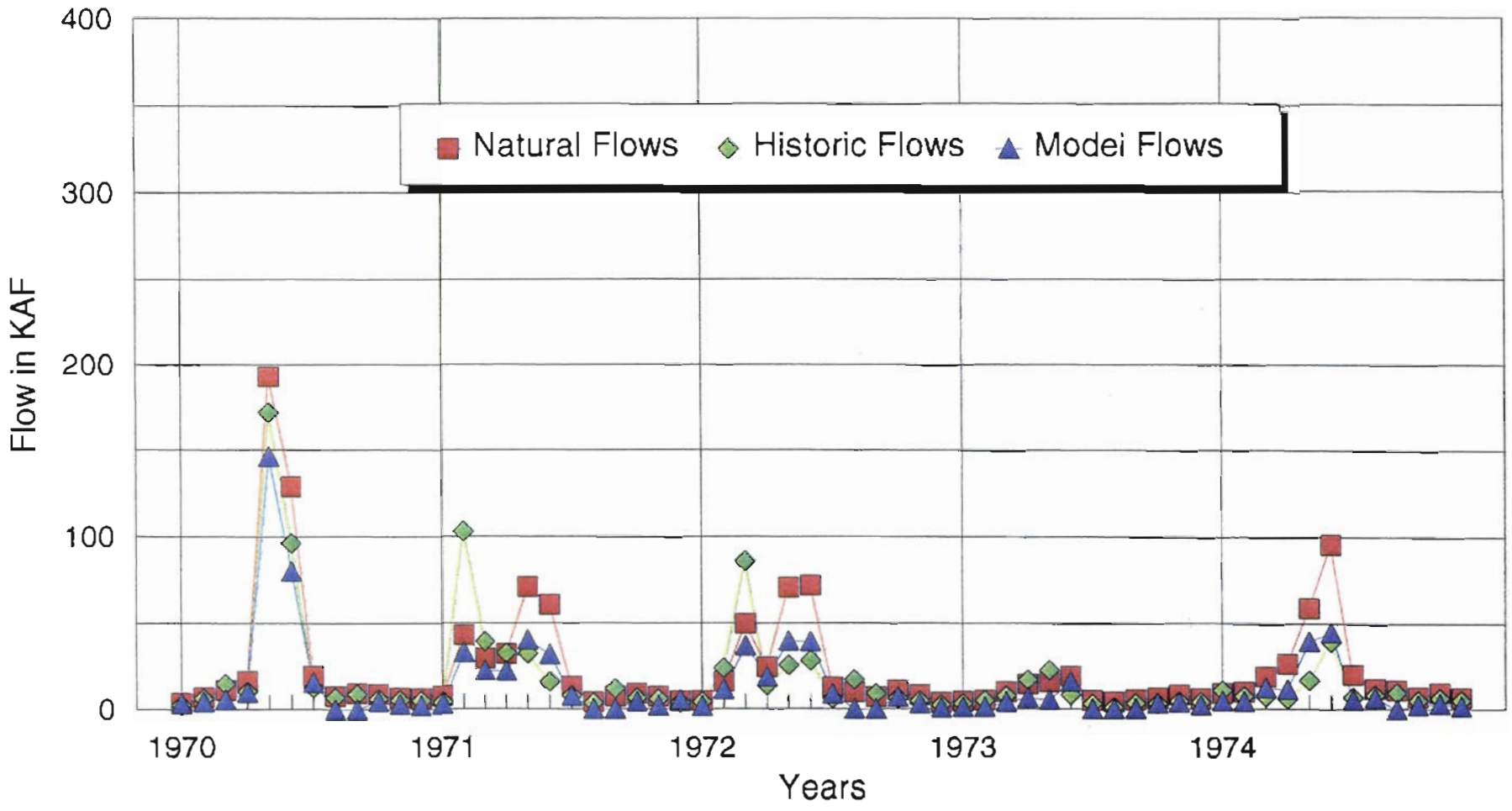
COMPARISON OF FLOWS AT MOSBY, MT

for Period of Record (1929-1989)



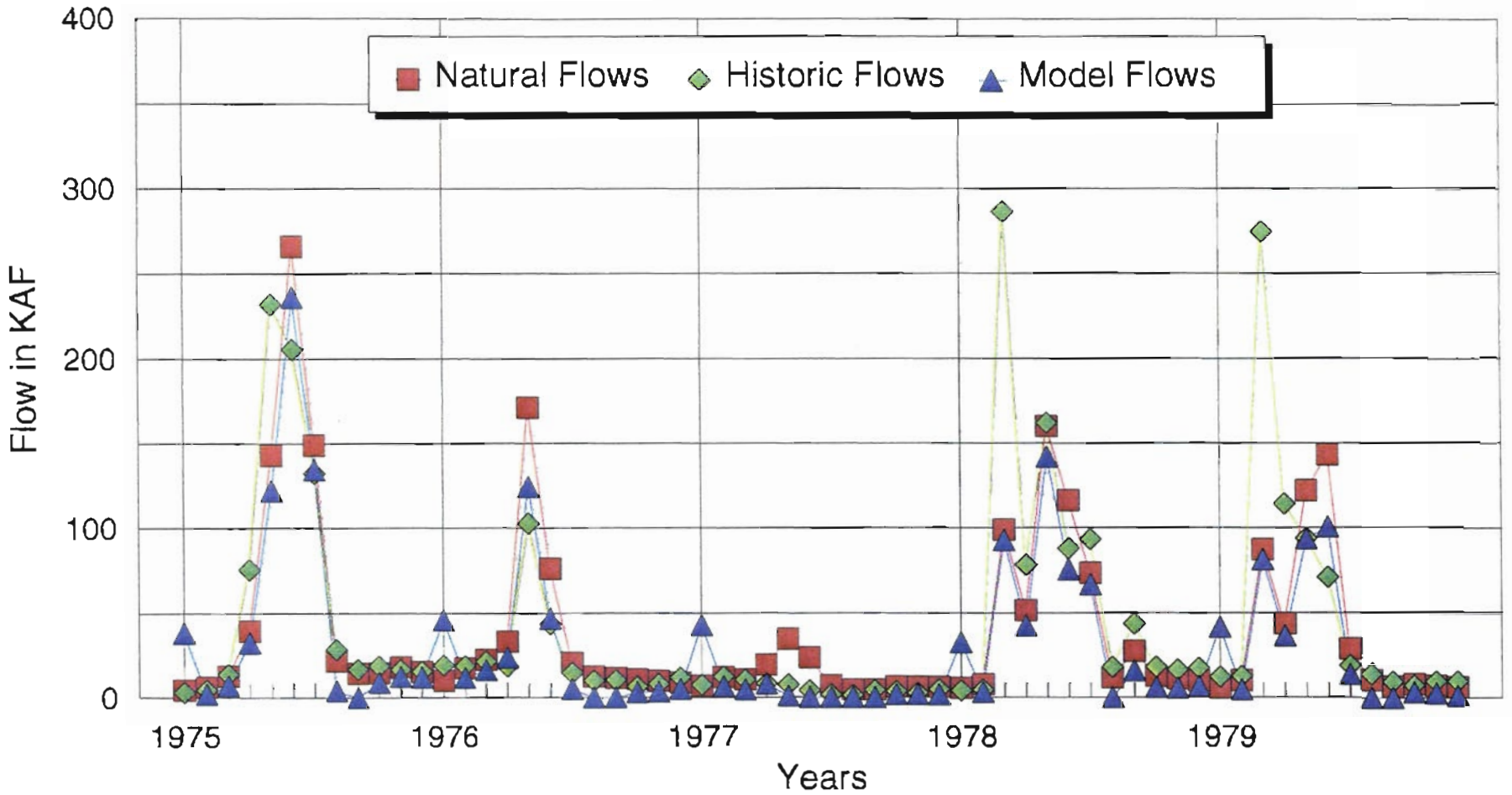
COMPARISON OF FLOWS AT MOSBY, MT

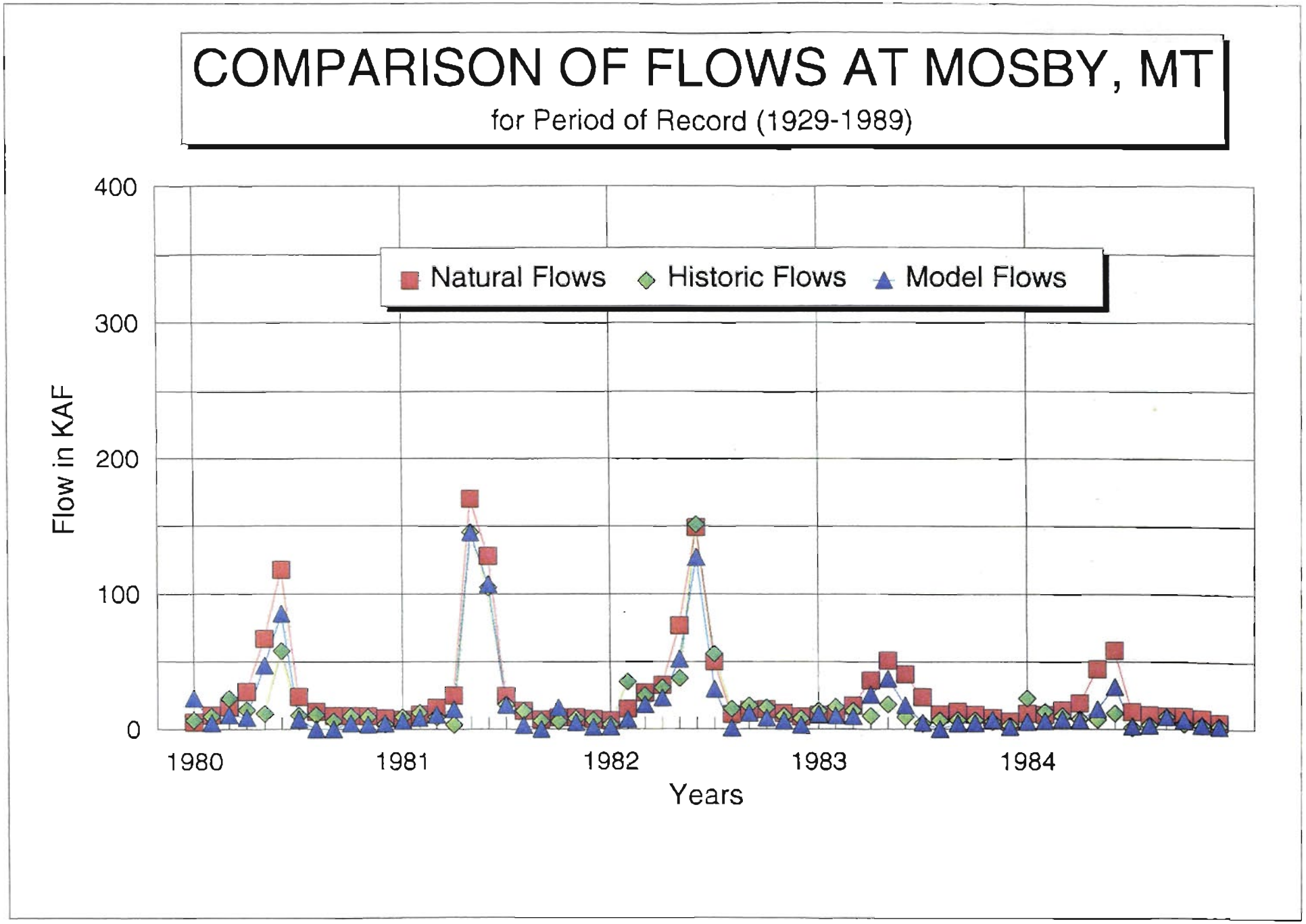
for Period of Record (1929-1989)



COMPARISON OF FLOWS AT MOSBY, MT

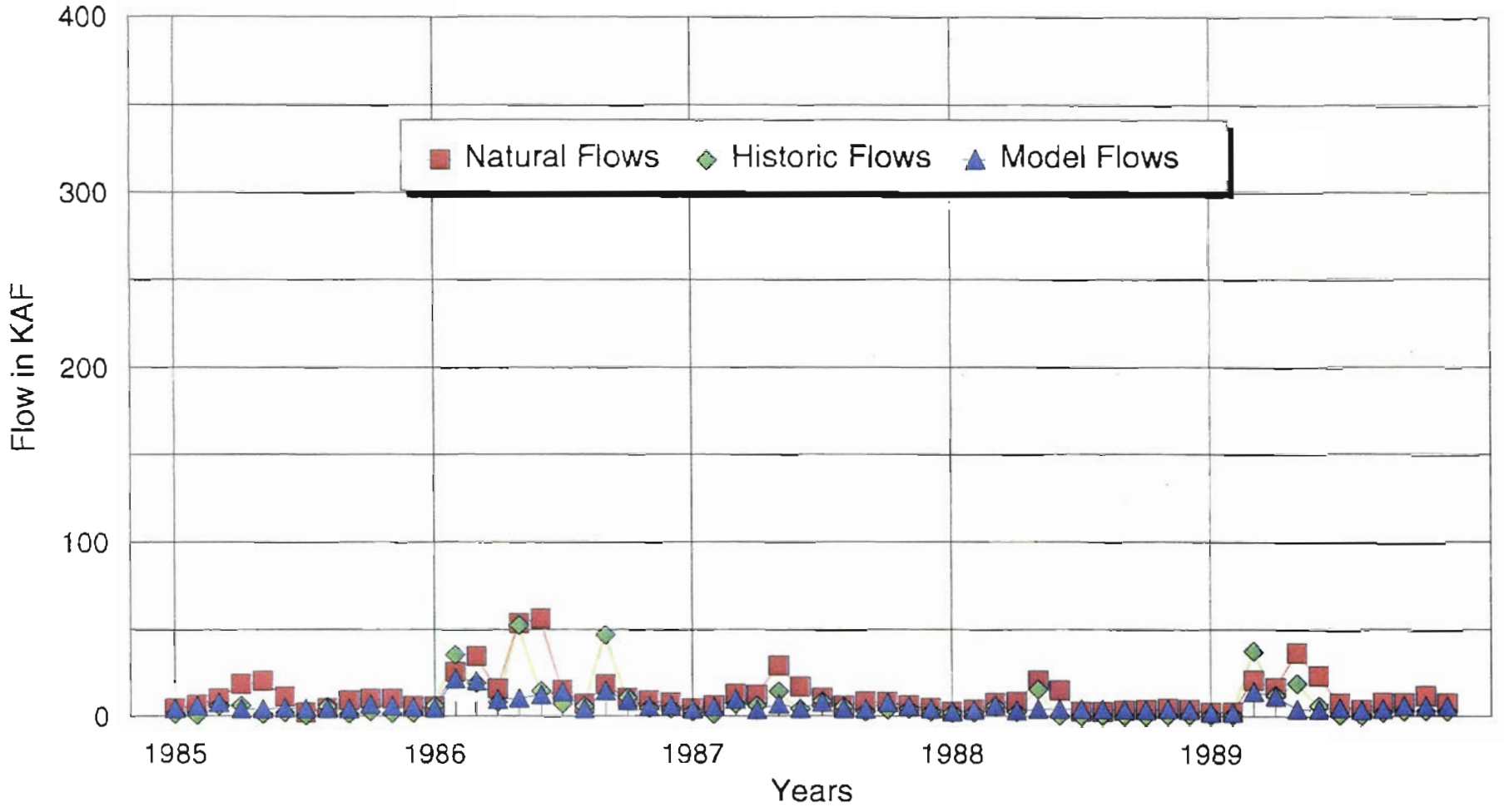
for Period of Record (1929-1989)




COMPARISON OF FLOWS AT MOSBY, MT
for Period of Record (1929-1989)
Natural Flows
Historic Flows
Model Flows
Flow in KAF
400
300
200
100
0
1980
1981
1982
1983
1984
Years

COMPARISON OF FLOWS AT MOSBY, MT

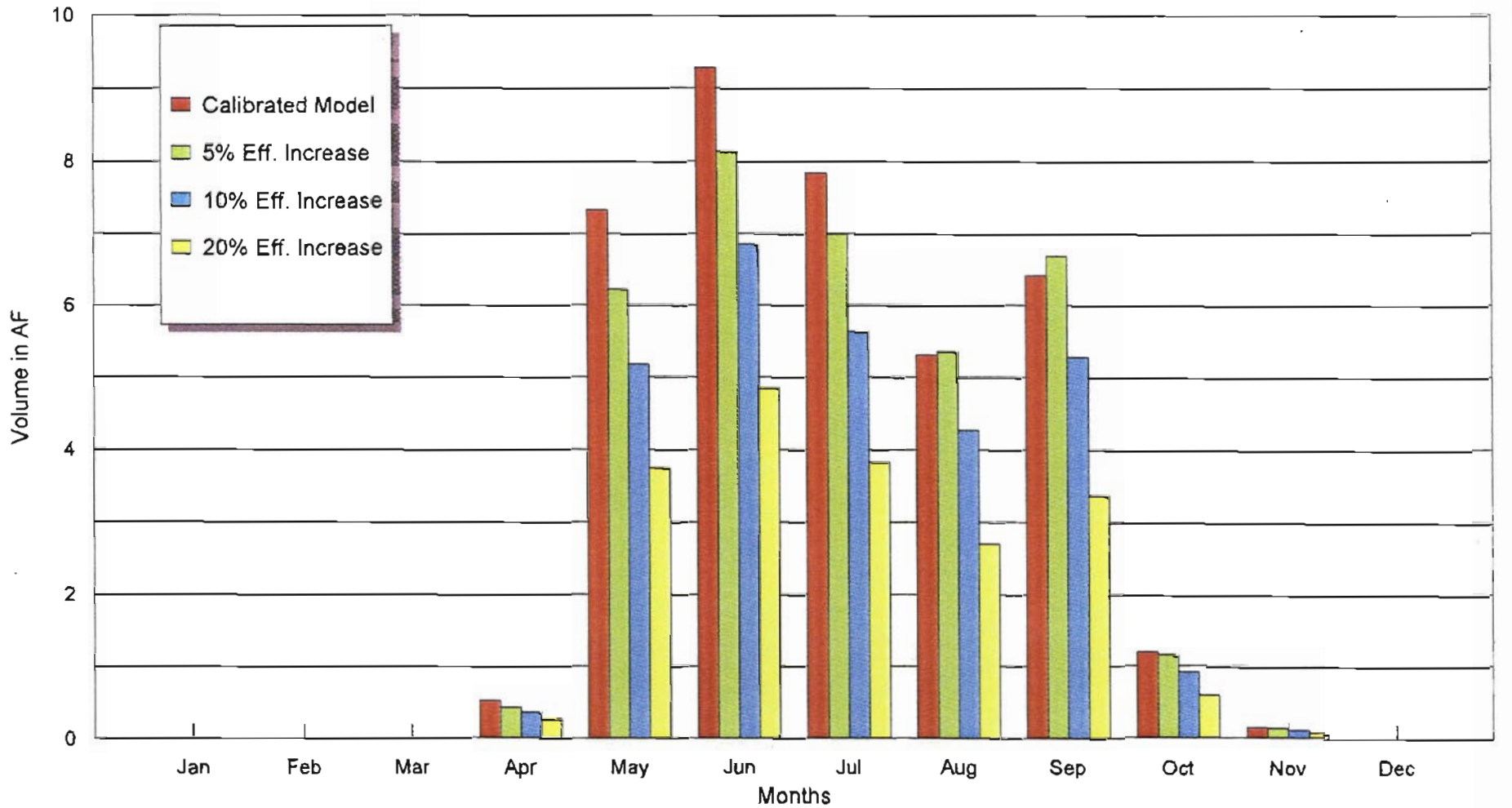
for Period of Record (1929-1989)



Appendix 9
MODELED WATER RIGHT FLOWS

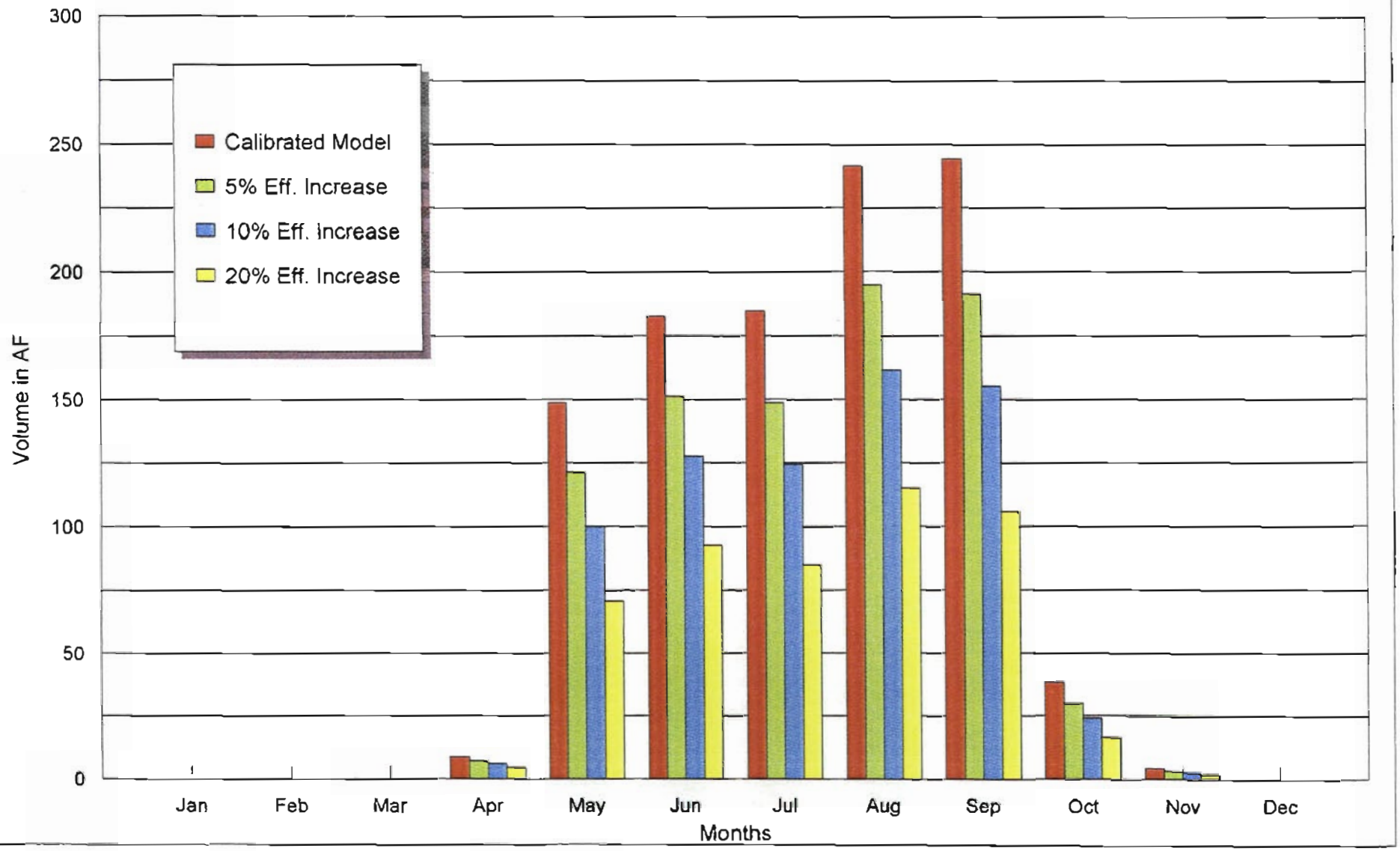
COMPARISON OF AVERAGE RETURN FLOWS AT ROUNDUP, MT

For Calibrated, 5, 10, and 20% On-Farm Efficiency Increase, Natural Flow Water Right



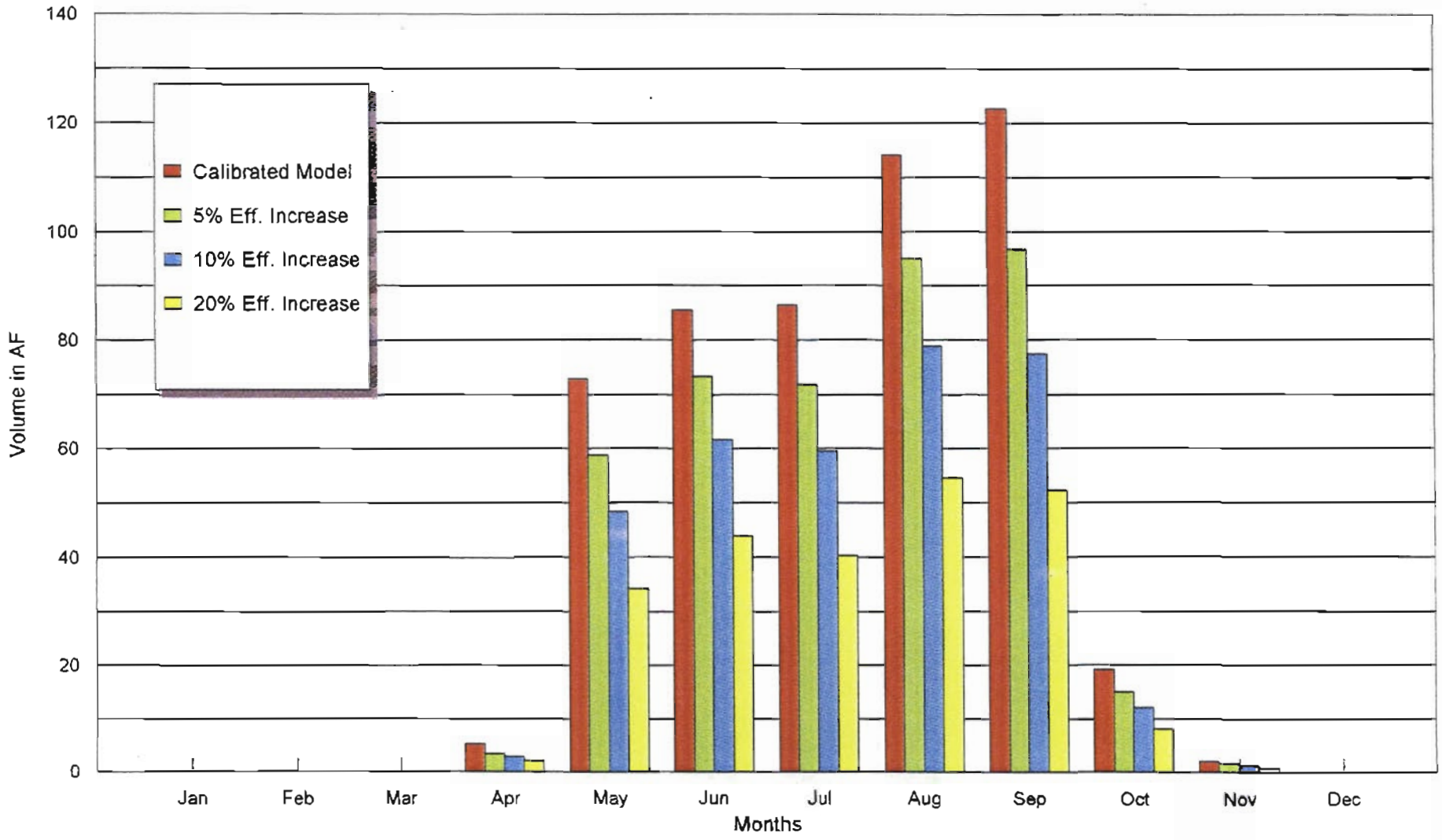
COMPARISON OF AVERAGE RETURN FLOWS AT ROUNDUP, MT

For Calibarted, 5, 10, and 20% On-Farm Efficiency Increase, Natural Flow with Contract Flow Water Rights



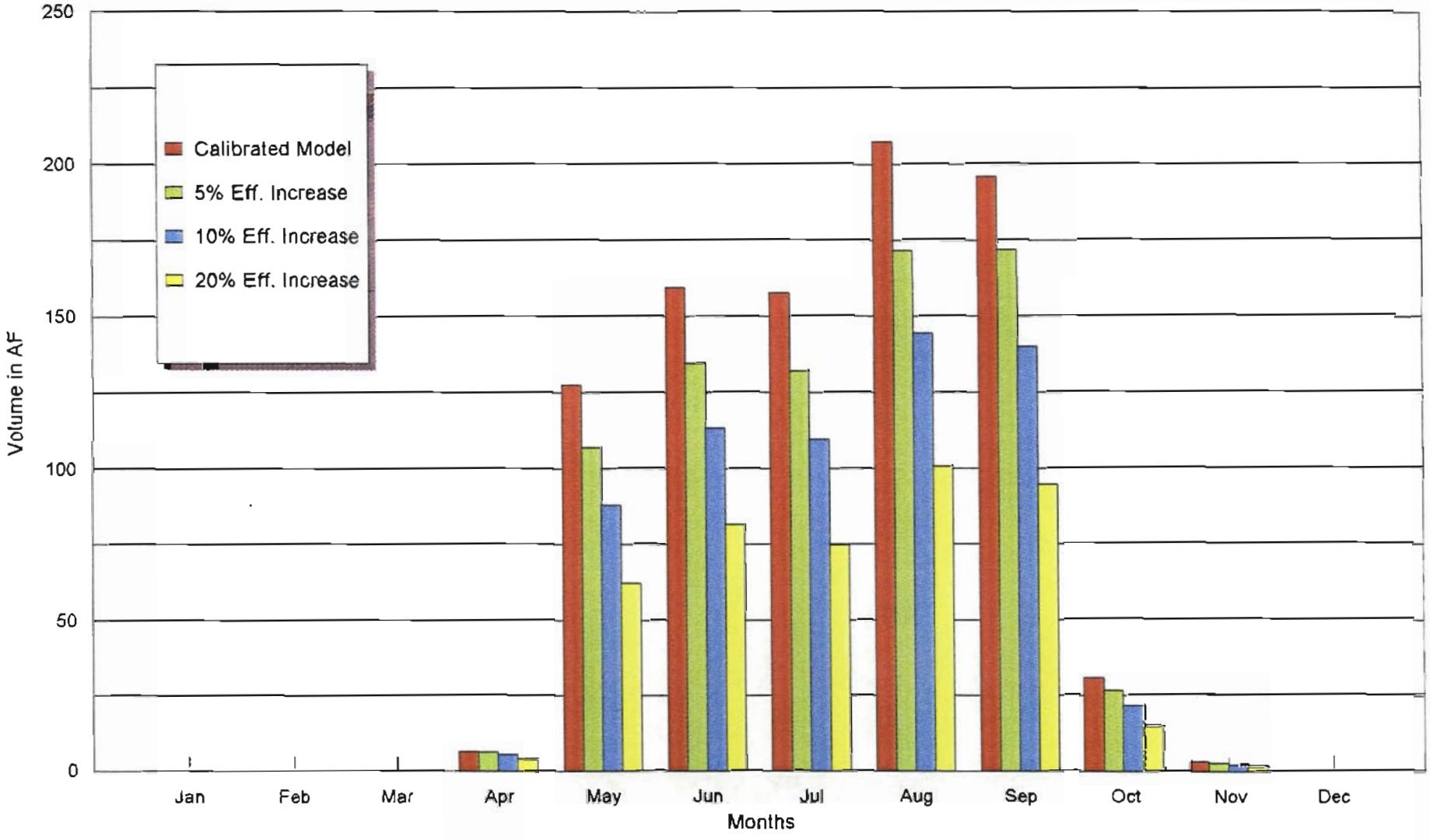
COMPARISON OF AVERAGE RETURN FLOWS AT MUSSELSHELL, MT

For Calibrated, 5, 10, and 20% On-Farm Efficiency Increase, Natural Flow Water Right



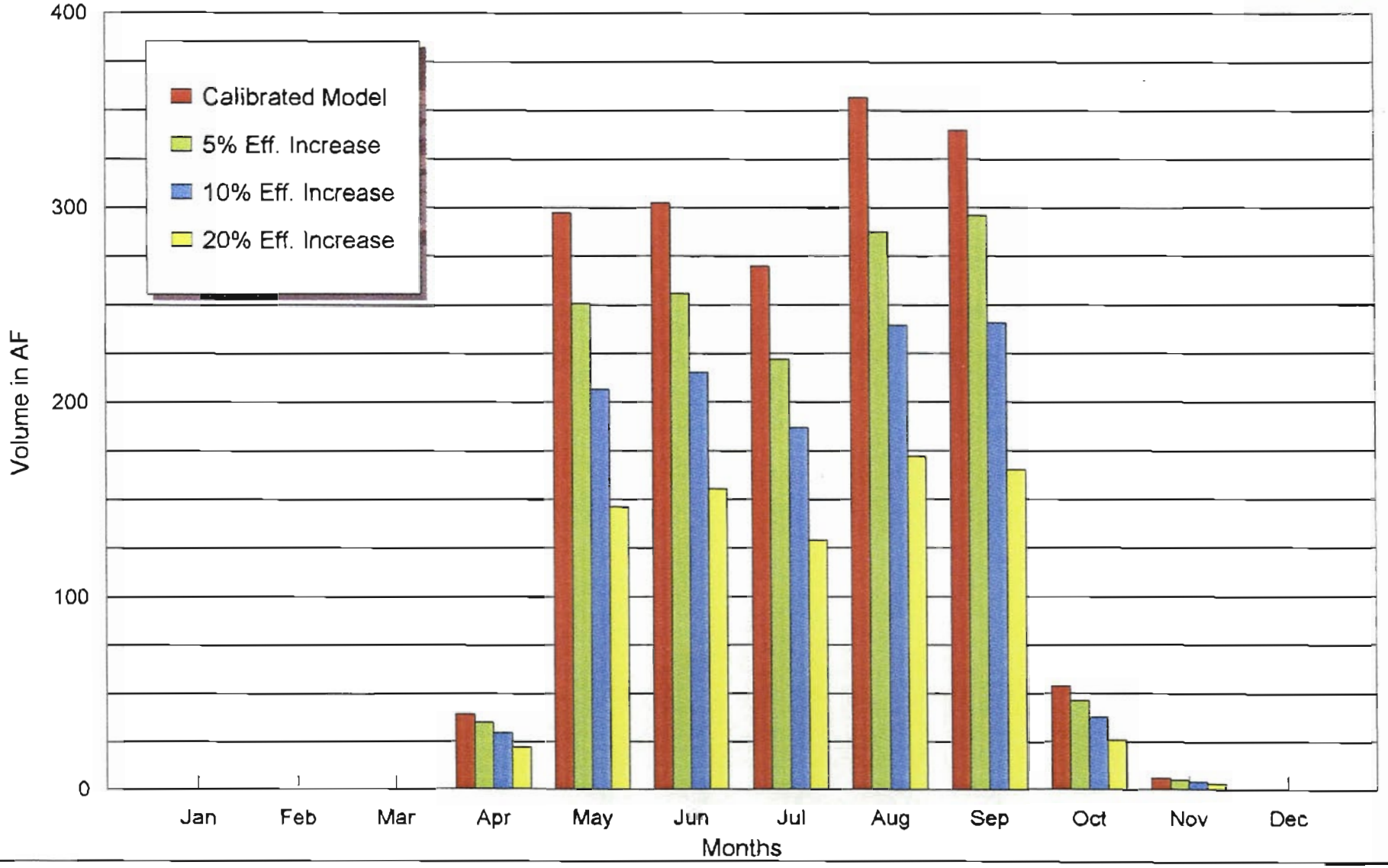
COMPARISON OF AVERAGE RETURN FLOWS AT MUSSELSHELL, MT

For Calibrated 5, 10, and 20% On-Farm Efficiency Increase, Contract Flow Water Right



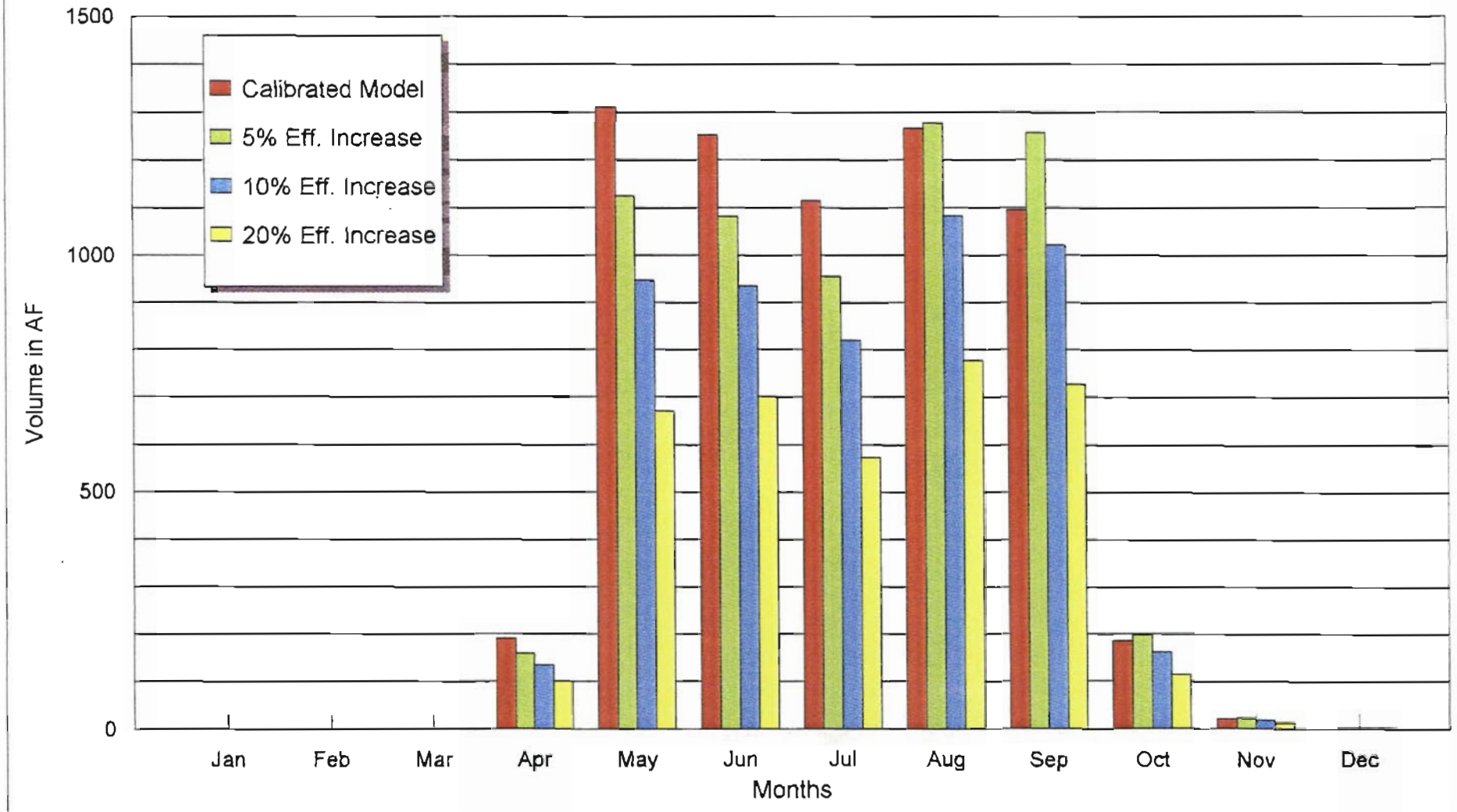
COMPARISON OF AVERAGE RETURN FLOWS AT MOSBY, MT

For Calibrated, 5, 10, and 20% On-Farm Efficiency Increase, Contract Flow Water Right



COMPARISON OF AVERAGE RETURN FLOWS AT MOSBY, MT

For Calibrated, 5, 10, and 20% On-Farm Efficiency Increase, Natural Flow with Contract Flow Water Rights



Appendix 10
MODEL RUNS SHOWING WATER AVAILABILITY

sta 001000 MUSSELSHELL RIVER AT HARLOWTOWN
Avail Flow Units=af option =Plan

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1929					8021	39299				3016	4731	3516	58585
1930				15074	9432								24507
1931													
1932					9001	33027							42028
1933				5879	44579	29828							80287
1934				6079		36972							43051
1935					400								400
1936				4977	14155	2900							22032
1937				5911		7970							13882
1938				1936	54780	38474	18491				464		114147
1939			2223	5408	8401	14708							30741
1940				201									201
1941						26433				5773	2840	1679	36727
1942				16426	57813	58438				706	560	564	134509
1943		1023	3572	43507	54388	72664					888	197	176242
1944					3738	54546	8203						66488
1945					4907	35395							40302
1946				9579	19999	5125				118	263	2844	37931
1947			3563	18931	53993	47443				1998	1223	1005	128160
1948	201			17543	74287	96743	15928				247		204951
1949				18507	42884	23253							84645
1950				6232	39380	62267	4977			986	4		113850
1951			789	7450	49411	27982				472	21		86128
1952				24530	88626	22900							136057
1953					16850	85736							102587
1954					5473	10754							16228
1955				585	2501	17141							20229
1956				6904	50220	9174							66299
1957					42063	49092							91155
1958				2415		6504							8919
1959				1781	24931	65573							92286
1960			1877	4674	15791	2019							24363
1961													
1962				3435	35307	35212							73954
1963					33674	33577							67251
1964					35150	67385							102535
1965				15458	44129	64326	2199		6044	6406	1799	6	140371
1966				7033	35075								42109
1967				4720	57391	122377	6219			550	107		191366
1968		707		743	27701	55156	365			657	231		85565
1969				20629	9720	8027							38377
1970				1674	74456	65422							141553
1971		1684		10563	43925	30940							87114
1972		63	6336	6335	35552	34261				794			83343
1973											662		662
1974	1303			12761	37924	58204				350	613		111158
1975				8050	65825	181852	42155			3339	3605	3392	308222
1976	220			14747	102510	40511				1035	790		159816
1977				4873	8824								13697
1978			8079	21170	89209	63838	21680			2641	980		207599
1979			7071	10142	70632	91685	2108			452			182093
1980				6700	41718	71029				1228	1058	168	121904
1981				9419	84467	58702	1428			678	665		155362
1982		326	1377	12179	51670	94093	22514			2970	2495	764	188393
1983	1313	201	488	22164	28317	12285				1943	574		67289
1984	1970			6169	15700	30819				1501	469		56630
1985				2387						2316	3541		8245
1986			6740	1595	21731	26315				1556	1598		59538
1987					4021					546			4567
1988													
1989					12365					886	4976	630	18858
Mean	82	65	690	7008	30541	36531	2397		99	703	580	242	78942
Median				4977	27701	30940							67251

The Maximum Value 181852 Occurred In Jun Of 1975
The Minimum Value Occurred In Jan Of 1929

Sta 001000 Musselshell River At Harlowtown
Avail Flow Units=af option =Plan

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Minimum													
Maximum	1970	1684	8079	43507	102510	181852	42155		6044	6406	4976	3516	308222
Mean	82	65	690	7008	30541	36531	2397		99	703	580	242	78942
Std Dev	338	264	1848	8274	27209	35320	7175		767	1315	1143	742	65498
Skewness	4	4	2	1	0	1	3		7	2	2	3	0
Kurtosis	18	23	7	4	0	3	14		56	7	5	11	0
10 Pctile													3005
25 Pctile					5332	6159							23780
50 Pctile				4977	27701	30940							67251
75 Pctile				10247	49614	58504				817	626		116086
90 Pctile		25	2759	18677	72094	77893	7013			2446	2077	684	178583

Sta 001000 Musselshell River At Harlowtown
Avail Flow Units-af option -Plan

Year	# Months	Total	Minimum	Maximum	Mean	Median
1929	12	58585	39299	4882		
1930	12	24507	15074	2042		
1931	12					
1932	12	42028	33027	3502		
1933	12	80287	44579	6690		
1934	12	43051	36972	3587		
1935	12	400	400	33		
1936	12	22032	14155	1836		
1937	12	13882	7970	1156		
1938	12	114147	54780	9512		
1939	12	30741	14708	2561		
1940	12	201	201	16		
1941	12	36727	26433	3060		
1942	12	134509	58438	11209	280	
1943	12	176242	72664	14686	543	
1944	12	66488	54546	5540		
1945	12	40302	35395	3358		
1946	12	37931	19999	3160	59	
1947	12	128160	53993	10680	1114	
1948	12	204951	96743	17079	100	
1949	12	84645	42884	7053		
1950	12	113850	62267	9487	2	
1951	12	86128	49411	7177	10	
1952	12	136057	88626	11338		
1953	12	102587	85736	8548		
1954	12	16228	10754	1352		
1955	12	20229	17141	1685		
1956	12	66299	50220	5524		
1957	12	91155	49092	7596		
1958	12	8919	6504	743		
1959	12	92286	65573	7690		
1960	12	24363	15791	2030		
1961	12					
1962	12	73954	35307	6162		
1963	12	67251	33674	5604		
1964	12	102535	67385	8544		
1965	12	140371	64326	11697	1999	
1966	12	42109	35075	3509		
1967	12	191366	122377	15947	53	
1968	12	85565	55156	7130	298	
1969	12	38377	20629	3198		
1970	12	141553	74456	11796		
1971	12	87114	43925	7259		
1972	12	83343	35552	6945	31	
1973	12	662	662	55		
1974	12	111158	58204	9263	175	
1975	12	308222	181852	25685	3366	
1976	12	159816	102510	13318	110	
1977	12	13697	8824	1141		
1978	12	207599	89209	17299	1810	
1979	12	182093	91685	15174	226	
1980	12	121904	71029	10158	84	
1981	12	155362	84467	12946	332	
1982	12	188393	94093	15699	1936	
1983	12	67289	28317	5607	531	
1984	12	56630	30819	4719	234	
1985	12	8245	3541	687		
1986	12	59538	26315	4961	778	
1987	12	4567	4021	380		
1988	12					
1989	12	18858	12365	1571		

sta 006000 MUSSELSHELL RIVER AT ROUNDUP
Avail Flow Units=af option =Plan

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1929	509	634	5539	5299	11704	40170				4530	6062	4728	79178
1930		269	5688	25843	9432								41234
1931													
1932				2411	9001	39790							51203
1933				12449	49651	29828							91928
1934			1664	12101		43084							56850
1935				3939	3787								7727
1936			3778	14046	14155	2900							34880
1937				11500		12260							23760
1938			1103	8370	65041	56691	24933				2383		158523
1939			11733	13017	8401	23708							56860
1940			681	6239							779		7700
1941				824		31100			1620	7972	4858	4738	51114
1942	1487	1113	6428	27994	80363	90185				3152	2564	4245	217535
1943	1872	6507	15601	57075	67938	110461	4160			2491	2639	3699	272447
1944	466		1599	1830	3738	89921	15911			2193	1618	3395	120675
1945	1986	16	3680	1297	7000	47504					1320		62805
1946			6144	16957	19999	5125				2773	2286	6331	59618
1947	621	2395	19922	29500	58476	52753				4351	3204	4177	175403
1948	3150	318	4674	26612	86647	124627	23050			2435	2501	929	274947
1949			6555	27188	45290	25029				1068	572		105705
1950		4800	3665	14200	45544	77726	4977			4038	2610	1844	159408
1951		1975	12797	14717	53895	33714				4062	2631	911	124707
1952		1050	4713	34335	101023	22900							164024
1953			2003	4809	22750	104632							134196
1954		485		5995	5473	10754							22709
1955				10313	7201	17141							34656
1956			8037	14272	54977	9174							86461
1957				4174	44624	61884				1474	659		112817
1958			4228	7979		8333							20541
1959			14487	9249	29726	67653				2000	1496		124614
1960			9885	11841	15791	2019							39538
1961													
1962			483	8283	40944	49196				1124			100030
1963		2264	2369	4837	37226	37954							84652
1964				4926	39559	80418						3	124908
1965	231	1277	760	25126	48595	70946	2199		12373	10173	4242	1747	177674
1966			11063	15300	35075								61440
1967			1465	11488	69464	265705	7881			4010	2923	448	363387
1968	984	5450	9422	10311	37457	74597	365			4594	2991	946	147121
1969	291	624	17209	30258	11530	19230	1387			1742	934		83210
1970		221	1748	9642	109880	86568				3335	965	425	212786
1971	1293	7065	7194	20731	43925	32039				3785	1727		117763
1972		5794	21904	15003	41774	34261				4771	2397		125907
1973			1239	6135						1002	2537	471	11385
1974	3351	541	6881	19894	44609	59726				2293	3444	591	141335
1975			2942	20318	98430	233338	55218			9013	9624	7838	436722
1976	3513	3364	10337	23615	134195	54477				5364	3608	2026	240504
1977	579	1981	2036	11691	8824					1100	936	244	27394
1978		175	35286	35338	118865	81837	27595		4131	6324	3745	2754	316055
1979		1084	37679	19210	90160	112309	2108			2503	963	640	266660
1980		1438	4489	13706	43517	86829				4489	3071	2018	159561
1981	436	1652	6368	15978	112038	76017	1483			3180	2484	1954	221596
1982	508	3517	10884	21547	62146	121147	25532			7929	5035	3144	261394
1983	4160	2892	8256	29631	31950	12285				4938	2089	226	96429
1984	4858	2194	5169	13137	15700	30819				3958	2255		78092
1985			2003	6673						4697	4872	843	19090
1986		3739	15027	8962	25679	26315			7906	4124	3249	1326	96331
1987			2815		8337					2623	708		14484
1988													
1989			6910	7782	15865					2790	6294	1769	41412
Mean	496	1063	6337	13867	36842	47329	3226		426	2334	1791	1056	114772
Median			4228	11841	31950	33714				2000	1320		96331

The Maximum Value 265705 Occurred In Jun Of 1967
The Minimum Value Occurred In Jul Of 1929

ta 006000 Musselshell River At Roundup
vail Flow Units=af option =Plan

tatistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
inimum													
aximum	4858	7065	37679	57075	134195	265705	55218		12373	10173	9624	7838	436722
ean	496	1063	6337	13867	36842	47329	3226		426	2334	1791	1056	114772
td Dev	1097	1768	7689	10717	34792	51714	9366		1917	2525	1974	1739	95134
kewness	2	1	2	1	0	2	3		5	1	1	1	1
urtosis	5	2	5	2	0	5	14		25	0	2	3	1
0 Pctile				1617									13245
5 Pctile			1017	6100	8053	7531							40810
0 Pctile			4228	11841	31950	33714				2000	1320		96331
5 Pctile	444	1492	8547	20000	54166	74952				4044	2710	1752	159446
0 Pctile	1917	3606	15257	28596	93468	106964	11093			5108	4488	3890	263500

Sta 006000 Musselshell River At Roundup
Avail Flow Units=af option =Plan

Year	# Months	Total	Minimum	Maximum	Mean	Median
1929	12	79178	40170	6598	4629	
1930	12	41234	25843	3436		
1931	12					
1932	12	51203	39790	4266		
1933	12	91928	49651	7660		
1934	12	56850	43084	4737		
1935	12	7727	3939	643		
1936	12	34880	14155	2906		
1937	12	23760	12260	1980		
1938	12	158523	65041	13210	551	
1939	12	56860	23708	4738		
1940	12	7700	6239	641		
1941	12	51114	31100	4259	412	
1942	12	217535	90185	18127	2858	
1943	12	272447	110461	22703	3929	
1944	12	120675	89921	10056	1724	
1945	12	62805	47504	5233	657	
1946	12	59618	19999	4968	2529	
1947	12	175403	58476	14616	3691	
1948	12	274947	124627	22912	2825	
1949	12	105705	45290	8808	286	
1950	12	159408	77726	13284	3852	
1951	12	124707	53895	10392	2303	
1952	12	164024	101023	13668		
1953	12	134196	104632	11183		
1954	12	22709	10754	1892		
1955	12	34656	17141	2888		
1956	12	86461	54977	7205		
1957	12	112817	61884	9401		
1958	12	20541	8333	1711		
1959	12	124614	67653	10384	748	
1960	12	39538	15791	3294		
1961	12					
1962	12	100030	49196	8335		
1963	12	84652	37954	7054		
1964	12	124908	80418	10409		
1965	12	177674	70946	14806	3220	
1966	12	61440	35075	5120		
1967	12	363387	265705	30282	2194	
1968	12	147121	74597	12260	3792	
1969	12	83210	30258	6934	1161	
1970	12	212786	109880	17732	695	
1971	12	117763	43925	9813	2756	
1972	12	125907	41774	10492	3584	
1973	12	11385	6135	948		
1974	12	141335	59726	11777	2822	
1975	12	436722	233338	36393	8425	
1976	12	240504	134195	20042	3561	
1977	12	27394	12691	2282	758	
1978	12	316055	118865	26337	5227	
1979	12	266660	112309	22221	1596	
1980	12	159561	86829	13296	2544	
1981	12	221596	112038	18466	2219	
1982	12	261394	121147	21782	6482	
1983	12	96429	31950	8035	3526	
1984	12	78092	30819	6507	3106	
1985	12	19090	6673	1590		
1986	12	96331	26315	8027	3932	
1987	12	14484	8337	1207		
1988	12					
1989	12	41412	15865	3451	884	

sta 007000 MUSSELSHELL RIVER AT MUSSELSHELL
Avail Flow Units=af option =Plan

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1929	603	947	7141	6493	11704	40170				4535	6091	4832	82520
1930		819	7204	26477	9432						203		44138
1931			193										193
1932				2411	9001	39790					203		51407
1933				13238	49651	29828						183	92901
1934		63	2331	12101		43084							57580
1935				4648	3787								8436
1936			5594	14163	14155	2900							36814
1937				11500		12260				500			24261
1938			2050	8370	65041	56691	24933				3061	450	160599
1939			13649	13017	8401	23708							58777
1940			1461	6389							1368		9219
1941				824		31100			2429	8586	5475	5550	53968
1942	2159	1986	8338	28947	80685	91930				3997	3357	5127	229529
1943	2604	7659	18410	58194	67938	112297	4160			3483	3462	4581	282792
1944	1167		3159	1830	3738	91529	15911			3066	2394	4288	127086
1945	2727	638	5240	2169	7000	47504				94	1995		67371
1946	89		7254	16957	19999	5125				3519	3011	7133	63091
1947	1333	3377	22832	31482	58476	52753				5005	3915	5329	184506
1948	4871	891	6484	26622	86647	124627	23050			3327	3319	1832	281674
1949	201		7165	27319	45290	25029				1859	1243		108109
1950		6748	4980	15277	45544	77726	4977			4728	3301	2541	165827
1951	793	2983	15302	15695	53895	33714				4779	3260	1558	131983
1952	622	2048	6118	34643	101023	22900				563	120		168042
1953			2658	5496	22750	104632							135538
1954		1173		6772	5473	10754							24174
1955				11890	7201	17141						347	36580
1956		25	9942	15149	54977	9174							89269
1957				4891	44624	61884				2372	1418	522	115713
1958		506	5063	7979		8333							21882
1959			17692	10126	29726	67653				2694	2162	114	130169
1960			11086	12715	15791	2019							41613
1961													
1962			1664	8283	40944	49196				1967	529	638	103224
1963		3149	3070	5560	37226	37954					47		87009
1964				5177	39559	80418						618	125774
1965	875	1932	1621	26499	48595	70946	2199		12384	10779	4933	2391	183159
1966	406	171	12965	16266	35075								64885
1967			2058	12261	69464	275478	7881			4926	3691	1152	376913
1968	1658	6995	10723	11684	37457	75473	365			5448	3745	1680	155232
1969	964	1459	21910	30737	11530	19230	1387			2549	1635		91406
1970		968	2842	10518	111153	86568				4150	1698	1151	219052
1971	1999	9012	8698	21169	43925	32039				4574	2408		123829
1972	44	8141	24108	15450	41774	34261				5685	3176		132642
1973			2063	7211						1722	3234	1158	15389
1974	3977	1418	7885	19894	44609	59726				3023	4246	1317	146100
1975			4006	22494	100545	233338	56445			10046	10731	8834	446443
1976	4179	4162	12441	23858	134195	54477				6204	4386	2903	246808
1977	1285	2928	2860	11691	8824					1829	1615	950	31987
1978	161	772	37290	36511	122888	81837	27595		4918	7117	4532	3541	327167
1979		1821	40783	20486	90165	112309	2108			3420	1720	1257	274072
1980	207	2393	5991	13706	43517	86829				5369	3784	2732	164531
1981	1139	2527	7269	15978	116862	76017	1483			4103	3217	2628	231228
1982	1141	4602	12686	22917	62146	121147	25532			8927	5792	3838	268733
1983	4813	4167	9257	30500	31950	12285				5766	2784	839	102364
1984	5481	3178	6071	13251	15700	30819				4730	2941	93	82268
1985			2724	6673						5430	5546	1437	21811
1986	436	5164	16228	9831	25679	26315			9014	4841	3937	2100	103549
1987			3536		8337					3467	1409	145	16896
1988			61								353		415
1989			7612	8724	15865					3616	7002	2433	45255
Mean	753	1554	7537	14444	37097	47589	3246		471	2833	2270	1446	119244
Median		171	5594	12261	31950	33714				2694	1995	522	102364

The Maximum Value 275478 Occurred In Jun Of 1967
The Minimum Value Occurred In Jul Of 1929

Sta 007000 Musselshell River At Musselshell
Avail Flow Units=af option =Plan

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Minimum													
Maximum	5481	9012	40783	58194	134195	275478	56445		12384	10779	10731	8834	446443
Mean	753	1554	7537	14444	37097	47589	3246		471	2833	2270	1446	119244
Std Dev	1356	2297	8399	10901	35301	52491	9478		2029	2805	2206	1996	97706
Skewness	2	1	1	1	0	2	3		4	0	1	1	1
Kurtosis	3	2	4	2	0	5	15		22	0	1	2	1
10 Pctile				2034									16294
25 Pctile			1953	6628	8053	7531							43507
50 Pctile		171	5594	12261	31950	33714				2694	1995	522	102364
75 Pctile	1008	2427	10137	20657	54166	75609				4742	3519	2401	164855
90 Pctile	2653	4827	17979	29568	94317	107698	11093			5941	5150	4681	270869

Sta 007000 Musselshell River At Musselshell
Avail Flow Units=af option =Plan

Year	# Months	Total	Minimum	Maximum	Mean	Median
1929	12	82520	40170	6876	4684	
1930	12	44138	26477	3678		
1931	12	193	193	16		
1932	12	51407	39790	4283		
1933	12	92901	49651	7741		
1934	12	57580	43084	4798		
1935	12	8436	4648	703		
1936	12	36814	14163	3067		
1937	12	24261	12260	2021		
1938	12	160599	65041	13383	1250	
1939	12	58777	23708	4898		
1940	12	9219	6389	768		
1941	12	53968	31100	4497	412	
1942	12	229529	91930	19127	3677	
1943	12	282792	112297	23566	4371	
1944	12	127086	91529	10590	2730	
1945	12	67371	47504	5614	1317	
1946	12	63091	19999	5257	3265	
1947	12	184506	58476	15375	4460	
1948	12	281674	124627	23472	4099	
1949	12	108109	45290	9009	722	
1950	12	165827	77726	13818	4853	
1951	12	131983	53895	10998	3122	
1952	12	168042	101023	14003	593	
1953	12	135538	104632	11294		
1954	12	24174	10754	2014		
1955	12	36580	17141	3048		
1956	12	89269	54977	7439		
1957	12	115713	61884	9642	261	
1958	12	21882	8333	1823		
1959	12	130169	67653	10847	1138	
1960	12	41613	15791	3467		
1961	12					
1962	12	103224	49196	8602	584	
1963	12	87009	37954	7250	23	
1964	12	125774	80418	10481		
1965	12	183159	70946	15263	3662	
1966	12	64885	35075	5407		
1967	12	376913	275478	31409	2875	
1968	12	155232	75473	12936	4597	
1969	12	91406	30737	7617	1547	
1970	12	219052	111153	18254	1425	
1971	12	123829	43925	10319	3491	
1972	12	132642	41774	11053	4430	
1973	12	15389	7211	1282		
1974	12	146100	59726	12175	3500	
1975	12	446443	233338	37203	9440	
1976	12	246808	134195	20567	4282	
1977	12	31987	11691	2665	1450	
1978	12	327167	122888	27263	6018	
1979	12	274072	112309	22839	1965	
1980	12	164531	86829	13710	3258	
1981	12	231228	116862	19269	2922	
1982	12	268733	121147	22394	7360	
1983	12	102364	31950	8530	4490	
1984	12	82268	30819	6855	3954	
1985	12	21811	6673	1817		
1986	12	103549	26315	8629	5003	
1987	12	16896	8337	1408		
1988	12	415	353	34		
1989	12	45255	15865	3771	1216	

sta 008000 MUSSELSHELL RIVER AT MOSBY
Avail Flow Units=af option =Plan

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1929	1779	13763	20193	15779	14868	44507				6535	6133	5920	129480
1930		4337	14862	31838	9432					17147	342		77960
1931			1131										1131
1932				2411	9001	103432					759		115604
1933			8174	15530	51820	29828					0	463	105817
1934	249	1749	3466	12110		59687							77263
1935				5456	4367								9824
1936			34030	16060	14155	2900							67147
1937			133	11500		28369				955			40960
1938		1599	15661	8370	65713	62285	40890			186	4139	920	199767
1939	167		37801	14012	8401	57215							117598
1940			3654	6389							1383		11427
1941			319	824		33967			4504	8919	5974	6897	61406
1942	3195	4700	19989	37647	115004	138411	18348			5925	5213	6795	355232
1943	3901	26600	44357	69260	71967	161968	29754			5077	5563	6188	424640
1944	2114	1081	26684	4821	4101	147371	60123			4250	4016	6096	260663
1945	4204	3562	14397	3755	7000	52126				137	2846	632	88663
1946	756	3666	11714	17358	19999	5125				4291	4359	8630	75900
1947	2489	4662	48874	43367	58476	54556				5579	5347	8497	231853
1948	13618	3596	19646	29220	87174	139361	27086			3470	5032	3380	331589
1949	1158		30703	33529	51020	25029				1929	1794		145165
1950		8414	10432	20964	50246	87972	4977			5297	4461	3927	196693
1951	2768	11718	25152	20881	61556	35313				5657	4623	2224	169896
1952	1138	4403	30267	41527	115761	22900				705	640		217346
1953	211		3452	6473	24526	122948						11	157622
1954		3327	416	7868	5473	10754							27841
1955			2736	20679	11002	17141						565	52125
1956		25	23598	17243	54977	9174							105019
1957			8600	6207	44624	62391				3563	2890	1639	129918
1958	387	991	7956	8874		8333					426		26970
1959			52510	12419	29726	67653				3227	3596	901	170036
1960			22538	15408	15791	2019					130		55888
1961													
1962		15	3446	8283	59105	98351				2762	1632	1164	174761
1963		14305	7851	7104	37520	37954				73	614		105425
1964				5177	53858	97731				243	452	984	158447
1965	2139	12009	12430	48173	65485	70946	2199		15320	13288	6684	3997	252673
1966	1321	867	30119	19575	35075						485		87446
1967			3430	13154	75512	317285	7881			5696	4775	1558	429294
1968	2212	8456	13976	13873	40924	102582	365			6604	5097	2435	196527
1969	1518	2352	43247	38357	14672	21678	8664			2985	2216		135693
1970		1562	5471	12310	174709	97721				4851	2450	2017	301094
1971	3304	37538	23875	25779	43925	33020				4966	2936	203	175551
1972	339	10398	43233	18349	50164	39066				7071	4218		172842
1973		219	4205	10200						2189	4084	1774	22673
1974	4840	4502	12347	19894	47045	59726				3439	5511	2183	159491
1975	274	1332	7315	36263	131861	244582	123779			12605	14456	11027	583498
1976	5671	12080	16696	27314	136628	57124				7389	5825	4547	273278
1977	2520	6599	4240	11691	8824					2270	2240	1786	40174
1978	1025	2857	92821	45923	151768	86766	52415		18734	9088	6914	5295	473611
1979	1017	4462	81019	39841	103466	112687	2108			4659	3232	1933	354429
1980	780	4905	10144	16372	43517	92066				6635	5511	3697	183632
1981	2722	5558	10230	17336	164846	101738	1483			5200	4623	3052	316794
1982	1945	9493	20839	28401	63552	130095	25532			11299	7740	4722	303623
1983	6265	5896	11415	31791	31950	12285				7400	4210	1035	112250
1984	7071	4899	7731	13316	15700	30819				5726	3913	368	89547
1985	26	1225	4926	6673						6065	6076	1523	26516
1986	1130	20046	28684	11622	31979	26315			11920	6406	4841	3465	146412
1987	245	1049	6687		10326					4290	2229	371	25199
1988			1073								506		1579
1989			13860	12038	16599					4036	7815	3129	57480
Mean	1385	4439	17455	17977	42872	56775	6649		827	3772	3130	2065	157350
Median	249	1599	11714	14012	31979	37954				3470	2936	984	129918

The Maximum Value 317285 Occurred In Jun Of 1967
The Minimum Value Occurred In Jul Of 1929

Sta 008000 Musselshell River At Mosby
Avail Flow Units=af option =Plan

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Minimum													
Maximum	13618	37538	92821	69260	174709	317285	123779		18734	17147	14456	11027	583498
Mean	1385	4439	17455	17977	42872	56775	6649		827	3772	3130	2065	157350
Std Dev	2317	6819	18574	14107	44059	61419	19602		3402	3804	2792	2607	126761
Skewness	2	2	1	1	1	1	4		4	1	1	1	1
Kurtosis	11	8	4	1	1	4	19		16	1	2	1	1
10 Pctile			377	3217									24189
25 Pctile			4067	7677	8718	7531					446		60425
50 Pctile	249	1599	11714	14012	31979	37954				3470	2936	984	129918
75 Pctile	2120	5068	24194	26163	59718	93480	91			5776	5048	3402	204162
90 Pctile	4022	12038	43238	38951	115307	133422	26154			8008	6099	6133	340725

Sta 008000 Musselshell River At Mosby
Avail Flow Units=af option =Plan

Year	# Months	Total	Minimum	Maximum	Mean	Median
1929	12	129480	44507	10790	6334	
1930	12	77960	31838	6496	171	
1931	12	1131	1131	94		
1932	12	115604	103432	9633		
1933	12	105817	51820	8818	0	
1934	12	77263	59687	6438		
1935	12	9824	5456	818		
1936	12	67147	34030	5595		
1937	12	40960	28369	3413		
1938	12	199767	65713	16647	2869	
1939	12	117598	57215	9799		
1940	12	11427	6389	952		
1941	12	61406	33967	5117	571	
1942	12	355232	138411	29602	6360	
1943	12	424640	161968	35386	16394	
1944	12	260663	147371	21721	4175	
1945	12	88663	52126	7388	3204	
1946	12	75900	19999	6325	4325	
1947	12	231853	58476	19321	5463	
1948	12	331589	139361	27632	9325	
1949	12	145165	51020	12097	1476	
1950	12	196693	87972	16391	5137	
1951	12	169896	61556	14158	5140	
1952	12	217346	115761	18112	922	
1953	12	157622	122948	13135	5	
1954	12	27841	10754	2320		
1955	12	52125	20679	4343		
1956	12	105019	54977	8751		
1957	12	129918	62391	10826	2264	
1958	12	26970	8874	2247	193	
1959	12	170036	67653	14169	2064	
1960	12	55888	22538	4657		
1961	12					
1962	12	174761	98351	14563	1398	
1963	12	105425	37954	8785	344	
1964	12	158447	97731	13203	121	
1965	12	252673	70946	21056	12219	
1966	12	87446	35075	7287	242	
1967	12	429294	317285	35774	4102	
1968	12	196527	102582	16377	5850	
1969	12	135693	43247	11307	2669	
1970	12	301094	174709	25091	2233	
1971	12	175551	43925	14629	4135	
1972	12	172842	50164	14403	5645	
1973	12	22673	10200	1889	109	
1974	12	159491	59726	13290	4671	
1975	12	583498	244582	48624	11816	
1976	12	273278	136628	22773	6607	
1977	12	40174	11691	3347	2255	
1978	12	473611	151768	39467	13911	
1979	12	354429	112687	29535	3847	
1980	12	183632	92066	15302	5208	
1981	12	316794	164846	26399	4911	
1982	12	303623	130095	25301	10396	
1983	12	112250	31950	9354	6081	
1984	12	89547	30819	7462	5313	
1985	12	26516	6673	2209	626	
1986	12	146412	31979	12201	9014	
1987	12	25199	10326	2099	308	
1988	12	1579	1073	131		
1989	12	57480	16599	4790	1564	

Appendix 11
WATER QUALITY DATA

TOTAL DISSOLVED SOLIDS

Total dissolved solids (TDS) are defined as the total sum of inorganic salts, organic matter, and dissolved materials in a body of water. TDS concentrations affect the chemical, physical, physiological, and toxicological properties of water, and can be used as an indicator of water's suitability for many beneficial uses.

TDS can be used to assess suitability to irrigate crops. Water with characteristically high TDS will generally not be suitable as irrigation water. Salts that already exist in the soil solution determine this hazard. When irrigation water high in TDS is applied to soil, it adds salts, and, in time, the capacity of the soil to raise crops will be adversely affected. Free drainage of the soil allows the downward movement of the salts, preventing accumulation in the root zone. Over-irrigating with water of low TDS serves to mitigate salt accumulation in the root zone of most soils.

The present study looked at TDS concentrations in the Musselshell, some of the tributaries, and storage facilities to assess the potential of improving water quality through dilution. Water user associations in the basin could mix water from their reservoirs with river water to adjust TDS concentrations. The study determined that TDS concentrations of the river could not be substantially changed by mixing with reservoir water, however. Water quality in the reservoirs is not good enough.

Several possible causes of elevated salts in reservoirs in the basin can be offered: A significant percentage of water is diverted into reservoirs from the river during winter, when salt-laden return flows dominate; evaporation from Bair, Martinsdale, and Deadman's Basin Reservoirs tends to concentrate salts; and, finally, return flows from irrigation adjoining the conveyance systems around the reservoirs add salts.

Electrical conductivity (EC) of river water can be used to estimate TDS concentrations. This is a very inexpensive method of determining the salts carried down the Musselshell. This is accomplished with the following relationship:

$$TDS = 0.55 \text{ to } 0.7 \times EC \text{ (electrical conductivity)}$$

where: TDS is measured in mg/L
EC is measured in μmhos/cm

TDS concentrations have considerable effects on potable water systems. TDS concentrations greater than 500 mg/L are detectable by taste. TDS concentrations between 2,000 mg/L and 4,000 mg/L are considered not palatable, will not quench thirst, and may have a laxative action on new users. Water containing a TDS concentration greater than 4,000 mg/L are generally considered unfit for human use. Just for a point of reference the EPA has set a threshold of 250 mg/L for domestic water systems.

Just as TDS have a deleterious effect on humans it can have just as harmful effect on livestock. Beef cattle and sheep are the primary livestock users of the water. As reported by the California State Water Resource Control board concentrations of 2,500 mg/L have no effect on livestock, 2,500 to 3,500 mg/L are considered fair, 3,500 to 4,500 mg/L are considered poor, and any concentration greater than 4,500 mg/L is considered unsatisfactory.

High concentrations of TDS have an adverse effect on plants directly, and indirectly through their effects on the soils. Their harmfulness is by a number of variables: Specifically crop type, character of the soil,

drainage conditions, climate, and the types of salts involved. The following classifications are used by California to assess the quality of the water with respect to irrigation:

Classification	TDS concentration (mg/L)
Excellent	≤ 175
Good	176 to 525
Permissible	526 to 1,400
Doubtful	1,401 to 2,100
Not acceptable	≥ 2,101

The effect of TDS on fish and wildlife can also be detrimental. The effects on wildlife is similar to that of livestock. Fish are also affected by elevated levels of TDS. TDS levels that create an osmotic pressure between the fish and water greater than 6 atmospheres may be expected to be detrimental to the fish.

Figs. WQ1-WQ8 show TDS at the sampling locations for eight samples taken in 1993-1995.

SODIUM

Sodium as a metal doesn't occur as a free element naturally, though sodium compounds make up approximately 2.83% of the earth's crust. Sodium salts tend to be very soluble in water, and any sodium that is leached from the soil or is discharged into surface water will typically remain in solution.

Sodium in potable or municipal water systems can have harmful effects on both humans and industrial uses. Drinking sodium laden water has been proven to have harmful effects on individuals with cardiac, renal, and circulatory diseases. Consumption of 200 mg/day of sodium from drinking water may be injurious to humans.

The taste threshold of sodium is also a consideration in a potable water system. Depending on the associated element creating the salt, detection thresholds vary from 34 mg/L on the low side, to 290 mg/L on the high side.

Sodium in irrigation water can also be toxic. Plants need only very limited amounts of sodium for optimum growth. In high concentrations sodium is not only toxic to plants but will also damage the soil.

Normally the soils in Central Montana have calcium and magnesium as their principal cations, with sodium generally representing less than 5% of the total exchangeable ions. If the sodium percentage in the soil is increased to 10% or more the aggregation of the soil grains break down and the soil becomes less

permeable, crusts when dry, and its pH increases. Magnesium and calcium replace sodium more readily than the reverse. Irrigation water with a low sodium absorption ratio is also less damaging to soils.

The sodium absorption ratio (SAR) is defined as:

$$SAR = \frac{Na^{+}}{\sqrt[2]{(Ca^{2+} + Mg^{2+})/2}}$$

where the concentration of ions is expressed in equivalents per million (EPM). EPM is determined by dividing the concentration of the salt in milligrams per liter (ppm) by the combining weight. The SAR is a measure of the relative activity of the sodium ion exchange reactions with the soil. Irrigation water with a high SAR will cause the soil to tighten up. The U. S. Department of Agriculture's classification of irrigation water is shown in fig. WQ-9 .

Soils saturated with sodium become less permeable to water. Sodium soil colloids swell which closes the pores and create the impervious condition. This condition becomes worse the more efficient the irrigation becomes because of the reduced leaching effect. The worse the drainage properties of the soil, the faster the concentration of sodium increases. One way to reverse the process is the application of low sodium concentration water in the quantities necessary to leach the sodium from the soil.

High sodium salt concentrations are toxic to stock, and wildlife. There has been some studies that suggest a threshold of 2,000 mg/L as the high limit for livestock. Concentrations that exceed 2,000 mg/L will likely have deleterious effects on most livestock.

The toxicity threshold for fish and aquatic life varies considerably with the type of sodium salts and the species of fish. Thresholds for fish vary so widely that it extends beyond the scope of this report. One benefit is that moderate amounts of sodium in the water reduces the toxicity of potassium and ammonium salts towards fish.

Figs. WQ-10-WQ-15 show sodium concentrations at the sampling stations for samples taken from 1993-1995.

CHLORIDES

Chlorides are found in nearly all natural water. The origin could be natural, industrial effluent, salts spread on fields for agricultural purposes, or from human or animal waste that somehow enters the system.

A summary of chloride concentration considered not harmful for the intended uses are as follows (California State Water Resources Control Board):

Potable water supply	250 mg/L
Industrial water supply	50 mg/L
Irrigation	100 mg/L
Stock, and wildlife	1,500 mg/L

For potable water systems the following classification could be used:

Classification	Concentration (mg/L)
Acceptable	< 125
Doubtful	126 to 250
Unsatisfactory	> 251

Chlorides in water at concentration levels as low as 100 mg/L may cause the water to taste salty. For the average individual the taste threshold is around 400 mg/L. Chlorides may also adversely effect individuals with preexisting heart or kidney conditions.

Chloride is one of the most problematic anions in irrigation water. It is more toxic than sulfides to most plants. Alfalfa is very sensitive to elevated chloride concentrations. Concentrations exceeding 177 mg/L in irrigation water are considered injurious to plants.

Livestock watering from sources with elevated levels of chlorides can experience harmful effects. Chloride concentrations exceeding 1,500 mg/L are generally considered unsafe for cattle, sheep, hogs, and poultry.

Chlorides have a harmful effect on fish and aquatic live. The following table list the concentration levels that have been found to cause harm to aquatic life (California State Water Resources Control Board):

Fish type	Concentration (mg/L)
Trout	400
Some fish	2,000
Bass, Pike, Perch	4,000
Carp eggs	4,500 to 6,000
Small Bluegills	8,100 to 10,500

Fig. WQ-16 shows average chlorides concentrations from September 1993-1995, and figs. WQ-17-WQ-24 concentrations found at the sampling locations during 1993-1994.

SULFATES

Sulfates in water is natural occurring, especially in the western United States. The natural concentration could be the result of leaching from gypsum and other common deposits. Sulfides can also be the result of leaching from abandoned mines, especially coal mines.

The summary of sulfate concentrations that will not cause any impacts to the following water uses (California State Water Resources Control Board):

Water use	Concentration (mg/L)
Potable water supply	500
Irrigation	200
Stock water	500

Sulfates affect humans in a similar fashion as chlorides except much higher concentrations are required to obtain the same level of toxicity. The taste threshold for sulfate salts vary widely depending on the salt. The

concentration level for not adversely affecting humans is 500 mg/L, but this varies with the other elements that are present (sodium, calcium, and magnesium).

Sulfates and salts of sulfates typically are less toxic to plants than chlorides. Irrigation water that contains high enough sulfate concentrations will still be toxic to most plants, however.

If high enough concentrations of sulfates are present calcium could be precipitated out. This would also be toxic to some plants. The following table is included to help rank water with respect to different concentrations of sulfates:

Characteristics	Concentrations (mg/L)
Excellent	< 192
Good	193 to 336
Permissible	337 to 576
Doubtful	577 to 960
Unsuitable	>961

The effects of sulfate salts on stock and wildlife watering is similar to that of chlorides. A maximum threshold of 1,000 mg/L is the general accepted higher limit before stock will experience toxic effect. Sulfate salts do possess a interesting benefit by partially offsetting the effects of selenium in cattle.

Figs. WQ-25-WQ-32 show the sulfates concentrations at the sampling locations from 1993-1995.

ALKALINITY

Another property of the Musselshell's water that we measured and recorded is the alkalinity. Alkalinity is not a contaminate that can be isolated but is a measure of the ability of a solution to neutralize hydrogen ions. Alkalinity is caused by the total constituent composition of a sample. Like acidity, alkalinity is related to the pH but high alkalinities should not be confused with high pH values.

Alkalinity is expressed in the milligrams of calcium carbonate ($CaCo_3$) per liter that would neutralize the equivalent acid solution.

Generally alkalinity is not detrimental to potable, or municipal water systems, but is associated with high pH values, hardness, and excessive TDS levels. High levels of alkalinity are very detrimental to many industrial uses. This is especially true in the food processing and carbonated beverages industries.

Irrigation water that has excessively high levels of alkalinity is detrimental in that it adds to the total salinity (TDS) and is frequently accompanied by high pH values. This is a general statement and is solely dependent on the source of the alkalinity.

Stock and wildlife watering from a source that has high alkalinities will develop adverse effects. Generally alkalinity levels greater than 50 mg/L will begin to cause deleterious effects to livestock.

The alkalinity of water has a marked effect on the fish and aquatic life. It is generally accepted that the best conditions to support aquatic life is water with a pH of between 7 and 8 with a total alkalinity of 100 to 120 mg/L.

The one benefit of alkalinity is that it helps serve as a buffer to prevent any sudden changes in pH which might adversely effect the aquatic life.

Fig. WQ-33 shows average alkalinity in the Musselshell, while figs. WQ-34-WQ-43 show alkalinity at the sampling locations during 1993-1995.

HARDNESS

Hardness is a property that relates to the soap neutralizing power of a sample of water. Any substance that will form a insoluble curd with soap is a indication of hardness. Hardness is only caused by cations like calcium and magnesium and is independent of the anions in solution.

Hardness is caused by natural accumulation of salts through contact with soil or geologic formations. It also can be caused by industrial discharges, and irrigation return flows.

The major detrimental effect of hardness in potable/municipal water systems is economic. Excessive use of detergents and soaps, scale on interior of piping systems, miscellaneous effects in industrial applications due to unwanted chemical reactions are the major economic impacts.

There has been no conclusive proof that hard water causes harmful effects upon the health of human consumers. Many studies have shown that water softened through a ion exchange process introduce different ions (predominantly sodium) that cause health problems such as high blood pressure, and associated conditions.

Irrigating with hard water generally has no effect on crops. Only under very specific soil conditions will crops be adversely by being irrigated by hard water.

Stock and wildlife use of hard water may actually be beneficial. Studies of calves and chicks that when given hard water seemed to develop somewhat better than those supplied with distilled water.

The growth of fish and aquatic life may be inhibited by the hardness of the water. Softer water actually increases fish sensitivity to toxic metals.

TOTAL MAXIMUM DAILY LOAD

Water quality constituents were measured in mg/L until 1994, when §303(d) of the Clean Water Act and EPA's *Water Quality Planning and Management* mandated that water quality be based on how much of a constituent a body of water could assimilate, rather than a concentration at a particular time. This new measurement is called *Total Maximum Daily Load* (TMDL). It is defined as the total maximum load (mass unit/day) of a water quality constituent that a water body can assimilate and not violate water quality standards. TMDL consists of three general components: waste load allocations (WLAs) for the point sources of pollution, load allocations (LAs) for nonpoint sources of pollution, and a margin of safety (MOS) incorporating the uncertainty in making the other allocations.

The §303(d) listing process begins with identifying water bodies that do not fully meet water quality standards or are fully supporting uses but are threatened. These are referred to as "water quality limited" in need of TMDLs. After these water bodies have been identified, they are prioritized and targeted for TMDLs. This latter process includes input from industry and local organizations.

High-priority water bodies may be severely out of compliance with standards, be a human health risk, have technology and resources available to address the water quality problem with reasonable certainty in a two-year time frame, been nominated through public input or have strong public support for establishment and implementation of the control measures required by a TMDL. Moderate-priority bodies may be less severely degraded, have nonpoint source demonstration projects in the watershed, or be the process of implementing water quality controls requiring more than two years to complete. Moderate priority includes water bodies where significant development is planned and controls in addition to established technology may be necessary to meet water quality standards. Low-priority bodies include those not high or moderate priority. As TMDL projects are completed and other factors change, selected water bodies in this category could be upgraded or targeted for TMDLs.

After the draft priority list has been developed, a 30-day public notice period follows with EPA giving final approval.

Montana's 1996 §303(d) list includes several reaches of the Musselshell River and its tributaries (Table WQ-1). All have low priority for TMDL development, but the Musselshell River overall had a moderate level, having been upgraded because of the Careless Creek Demonstration Project and because of the present study.

Samples taken during the course of the present study are noted in the table in italics under the water body name to relate results to each water body segment. The "probable impaired uses" of the basin are mainly aquatic life support and cold/warm water fisheries. Chicago Gulch, Collar Gulch, and Chippewa Creek, tributaries of Flat Willow Creek, have several probable impaired uses. Yet Flat Willow Creek itself is not listed. Painted Robe Creek is similar to the rest of the Musselshell Basin for probable impaired uses but includes silviculture as a probable cause.

Careless Creek is the most significant water quality limited water body due to its probably not supporting aquatic life, swimmable and warm water fisheries uses. Samples taken during this study confirmed this listing, finding excessive TDS. The Musselshell River segment MT40C003-1 is listed as not supporting drinking water supply as a result of analysis of samples taken a the Mosby gauge provided to the Montana Department of Environmental Quality from DNRC. This analysis found arsenic and mercury levels above aquatic life and human health standards.

Probable causes related to the present study include flow alteration, siltation, nutrients, suspended solids, thermal modification and habitat alteration. Probable sources related to the study, not linked to the probable causes, include agriculture, range land, irrigated crop production, flow regulation/modification, streambank modification/destabilization and natural resources. The probable sources listed are non-point sources which can be improved using Best Management Practices (BMPs).

The Careless Creek Demonstration project is an example of BMP application. The project identified the following six tasks:

1. Reduce sediment delivery to the Musselshell River.
2. Re-establish riparian vegetation.
3. Improve fisheries.

4. Reduce peak flows.
5. Reduce salt concentrations.
6. Provide information to watershed residents.

For more information concerning this project, contact Alice Sellers, Lower Musselshell Conservation District, Roundup, MT. (406) 323-2103 or Stuart Lehman, DEQ, (406) 444-5319.

Table WQ-1: Montana 1996 Water Quality Limited Waterbodies													
Waterbody Number	USGS Hydrologic Number	Assess Date yr/mo	Waterbody Name (Streams) *(SAMPLE SITE)*	Est. Size (mi..)	TMDL Development Priority	Probable Impaired Uses	Probable Use Support (Miles)				(Causes and sources of impairment are not linked)	
							Fully	Threat	Partial	Not Supporting	Probable Cause	Probable Source
MT 40A001-1	10040201	9604	Musselshell River *(SHAW-1)* *(HAR-1)*	39	LOW	Aquatic life support Cold water fishery-trout			39 39		Flow alteration Nutrients Other inorganics Salinity/TDS/ chlorides Siltation Thermal mod.	Agriculture Highway/Road/Bridge Construction Irrigated Crop Production Range land Streambed Modification / Destabilization
MT 40A002-1	10040201	9312	N. Fork *(NFM-1)* Musselshell River	31	LOW	Cold water fishery-trout		31			Nutrients	Agriculture Irrigated Crop Production
MT 40A002-4	10040201	9310	Mill Creek	3	LOW	Aquatic Life Support Cold water fishery-trout			3 3		Siltation	Agriculture Range land Silviculture
MT 40A003-1	10040201	9105	Careless Creek *(CC-1)* *(CC-2)* *(CC-3)*	9	LOW	Aquatic Life Support Swimmable Warm Water Fishery				9 9 9	Flow alteration Nutrients Other Habitat alterations Suspended solids	Flow Regulation /Mod. Irrigated Crop Production Streambed Modification / Destabilization
MT 40A003-2	10040201	8912	Musselshell River *(LAV-1)* *(RDP-1)*	68	LOW	Aquatic Life Support Warm Water Fishery			68 68		Flow alteration Nutrients Siltation	Flow Regulation / Mod. Irrigated Crop Production Streambed Modification / Destabilization
MT 40A004-1	10040201	8912	Halfbreed Creek	9	LOW	Warm Water Fishery		9			Flow Alteration Nutrients	Animal Operation Irrigated Crop Production
MT 40A004-4	10040201	9312	Painted Robe Creek *(PRC-1)*	29	LOW	Aquatic Life Support Warm Water Fishery			29 29		Flow Alteration Nutrients Salinity/TDS/ chlorides	Agriculture Irrigated Crop Production Range Land Silviculture
MT 40B001-3	10040203	9604	Snoose Creek	4	LOW	Aquatic Life Support			4		Other habitat alterations	Agriculture Range Land
MT 40B002-1	10040204	8912	McDonald Creek	38	LOW	Aquatic Life Support Warm Water Fishery			38 38		Siltation	Agriculture

Table WQ-1: Montana 1996 Water Quality Limited Waterbodies

Waterbody Number	USGS Hydrologic Number	Assess Date yr/mo	Waterbody Name (Streams) *(SAMPLE SITE)*	Est. Size (mi..)	TMDL Development Priority	Probable Impaired Uses	Probable Use Support (Miles)				(Causes and sources of impairment are not linked)	
							Fully	Threat	Partial	Not Supporting	Probable Cause	Probable Source
MT 40B002-2	10040204	9012	Chicago Gulch	2	LOW	Aquatic Life Support Drinking Water Supply Recreation Swimmable Warm Water Fishery			 2 2 2	2 2	Metals pH	Resource Extraction Subsurface Mining
MT 40B002-3	10040204	9012	Collar Gulch	2	LOW	Agriculture Aquatic Life Support Drinking Water Supply Recreation Swimmable Warm Water Fishery			2 2 2 2	 2 2	Metals pH	Resource Extraction Subsurface Mining
MT 40B002-4	10040204	9101	Chippewa Creek	1	LOW	Aquatic Life Support Drinking Water Supply Warm Water Fishery			1 1 1		Metals Nonpriority Organics Siltation	Agriculture Resource Extraction Subsurface Mining
MT 40C001-1	10040202	9101	Musselshell River *(MS-1)*	84	LOW	Aquatic Life Support Drinking Water Supply Warm Water Fishery			84 84	 84	Flow Alteration Metals Other habitat alterations Siltation Thermal modification	Agriculture Channelization Flow Regulation / Mod. Irrigated Crop Production Natural Resources Range Land Stream Bank modification / Destabilization
MT 40C002-1	10040202	9604	North Willow Creek	70	LOW	Aquatic Life Support Warm Water Fishery			70 70		Siltation Suspended Solids	Agriculture Range Land
MT 40C003-1	10040205	9210	Musselshell River *(MB-1)*	47	LOW	Aquatic Life Support Warm Water Fishery			47 47		Flow Alteration Siltation	Agriculture Flow Regulation / Mod. Irrigated Crop Production Range Land Streambank Modification / Destabilization
MT 40C004-1	10040205	8912	Calf Creek	37	LOW	Aquatic Life Support Warm Water Fishery		37 37			Flow Alteration Other habitat alteration Thermal mod.	Agriculture Irrigated Crop production Range Land

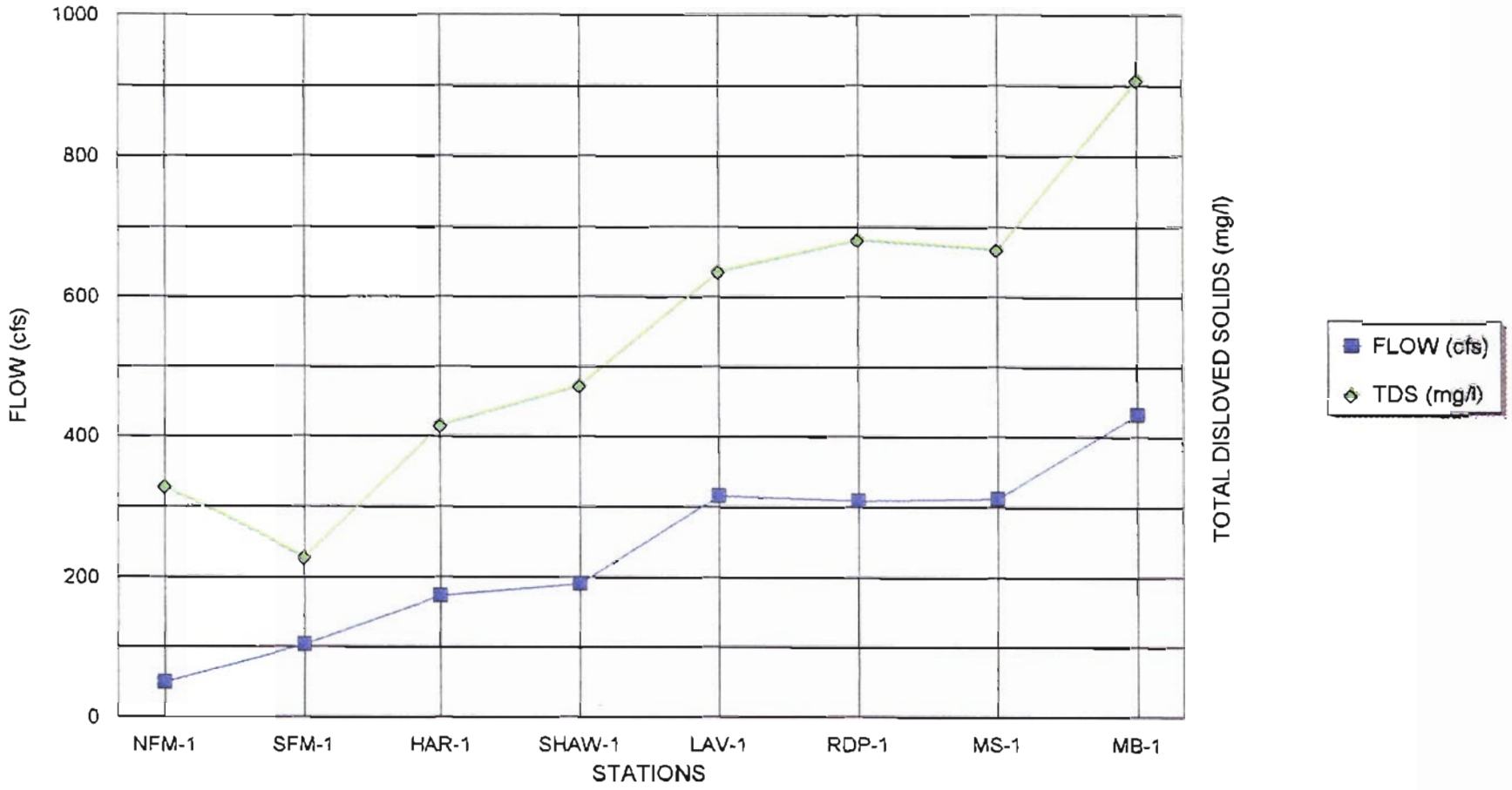
Table WQ-1: Montana 1996 Water Quality Limited Waterbodies

Waterbody Number	USGS Hydrologic Number	Assess Date yr/mo	Waterbody Name (Streams) *(SAMPLE SITE)*	Est. Size (mi..)	TMDL Development Priority	Probable Impaired Uses	Probable Use Support (Miles)				(Causes and sources of impairment are not linked)	
							Fully	Threat	Partial	Not Supporting	Probable Cause	Probable Source
MT 40C004-2	10040205	8912	Lodgepole Creek	17	LOW	Aquatic Life Support Warm Water Fishery		17 17			Flow Alteration Other habitat alteration Thermal modification	Agriculture Construction Highway / Road / Bridge Construction Irrigated Crop Production Range Land
MT 40C004-3	10040205	9605	Blood Creek	10	LOW	Aquatic Life Support	8		2		Other Habitat alterations	Agriculture Range Land
LAKES				(Ac.)								
MT 40A005-1	10040201	9403	Deadmans Basin Reservior	1903	LOW	Aquatic Life Support Cold Water Fisheries			1903 1903		Flow Alteration Other Habitat alterations	Agriculture Irrigated Crop Production Natural Sources
MT 40A005-2	10040201	9403	Lebo Lake	314	LOW	Aquatic Life Support			314		Flow Alteration Other Habitat alterations	Agriculture Irrigated Crop Production Natural Sources
MT 40A005-3	10040201	9403	Martinsdale Reservior	985	LOW	Aquatic Life Support Cold Water Fisheries			985		Flow Alteration	Agriculture

Fig. WQ-1

TOTAL DISSOLVED SOLID CONCENTRATION ALONG MUSSELSHELL RIVER

SEPTEMBER 29,1993



USE THE SAME SCALE FOR BOTH TDS, AND FLOW

Fig. WQ-2

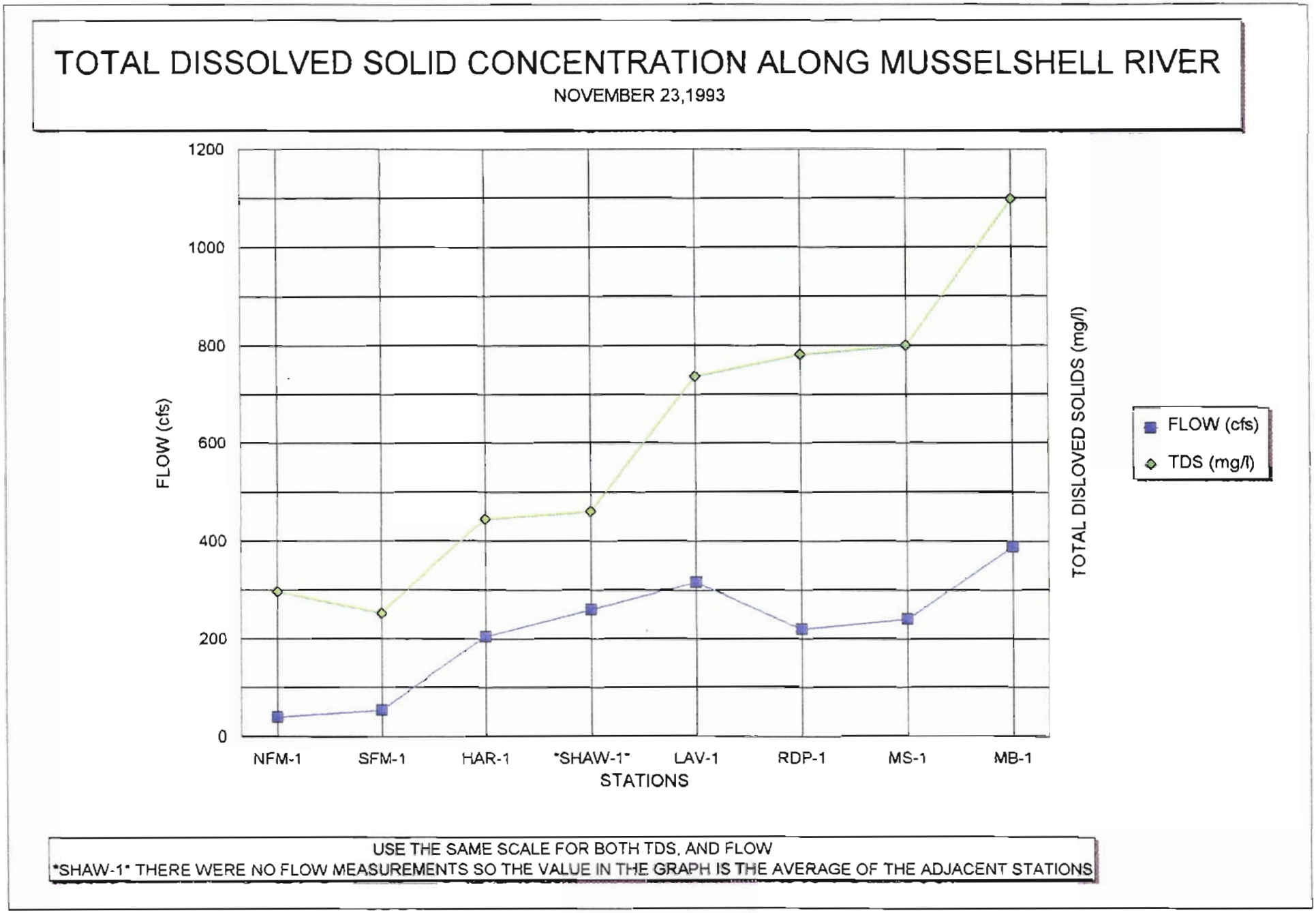
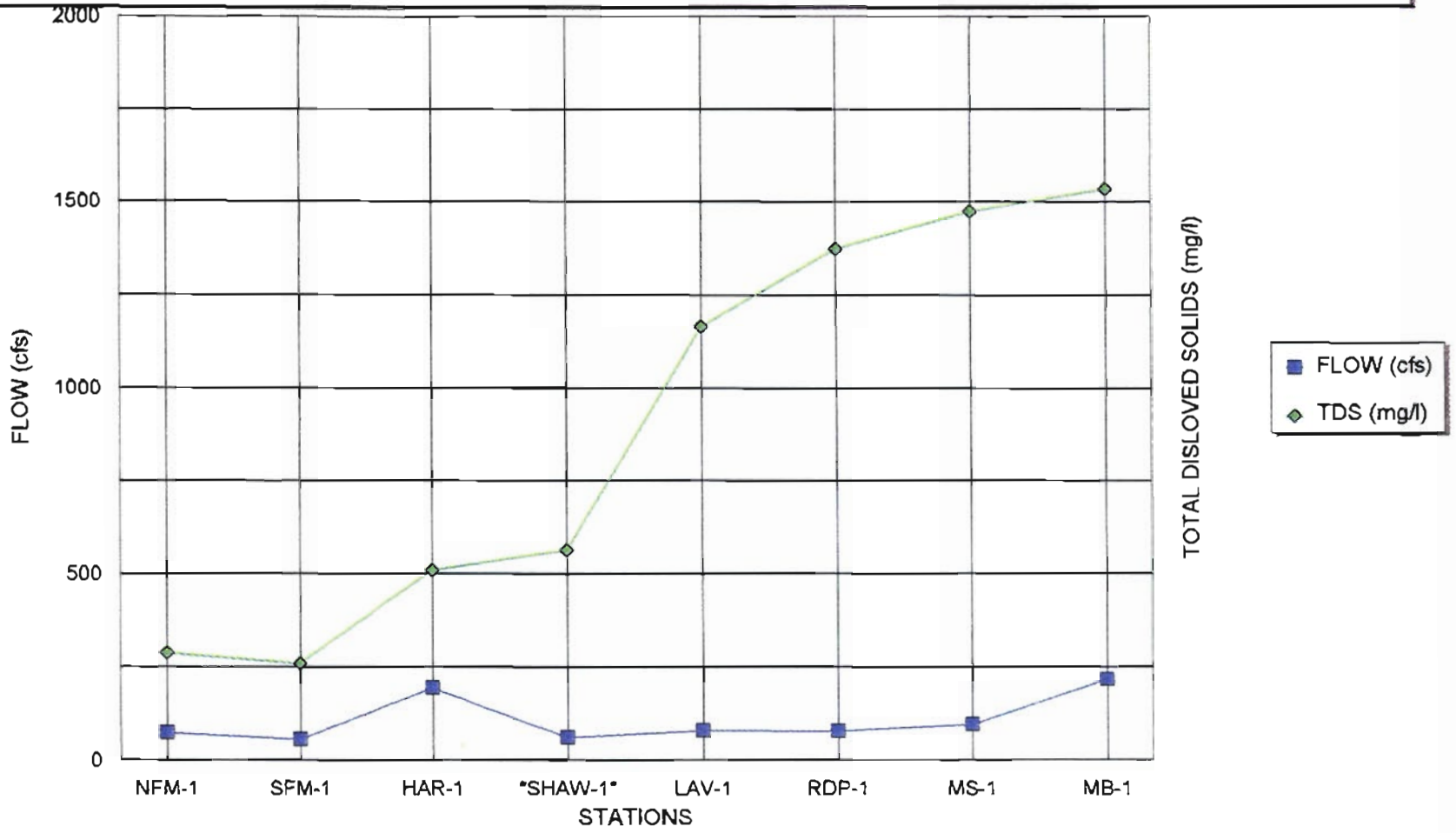

TOTAL DISSOLVED SOLID CONCENTRATION ALONG MUSSELSHELL RIVER
NOVEMBER 23,1993
1200
1000
800
600
400
200
0
FLOW (cfs)
TOTAL DISLOVED SOLIDS (mg/l)
NFM-1
SFM-1
HAR-1
"SHAW-1"
LAV-1
RDP-1
MS-1
MB-1
STATIONS
FLOW (cfs)
TDS (mg/l)
USE THE SAME SCALE FOR BOTH TDS, AND FLOW
"SHAW-1" THERE WERE NO FLOW MEASUREMENTS SO THE VALUE IN THE GRAPH IS THE AVERAGE OF THE ADJACENT STATIONS

Fig. WQ-3

TOTAL DISSOLVED SOLID CONCENTRATION ALONG MUSSELSHELL RIVER

APRIL 14 ,1994



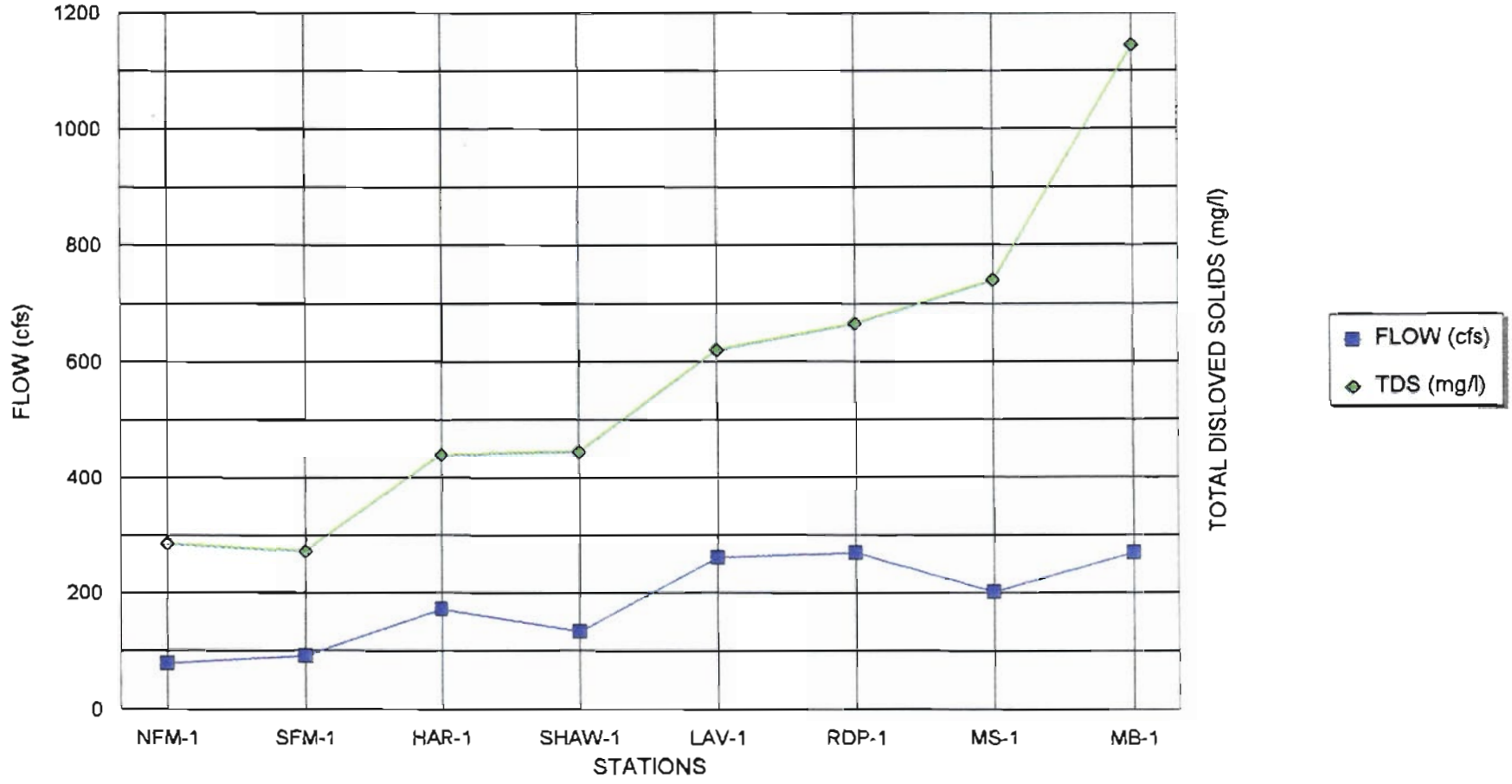
USE THE SAME SCALE FOR BOTH TDS, AND FLOW

"SHAW-1" THERE WERE NO FLOW MEASUREMENTS, DEADMANS BASIN WAS DIVERTING WATER. THE VALUE IS ESTIMATED FROM PREVIOUS RECORDS

Fig. WQ-4

TOTAL DISSOLVED SOLID CONCENTRATION ALONG MUSSELSHELL RIVER

JUNE 1,1994



USE THE SAME SCALE FOR BOTH TDS, AND FLOW

Fig. WQ-5

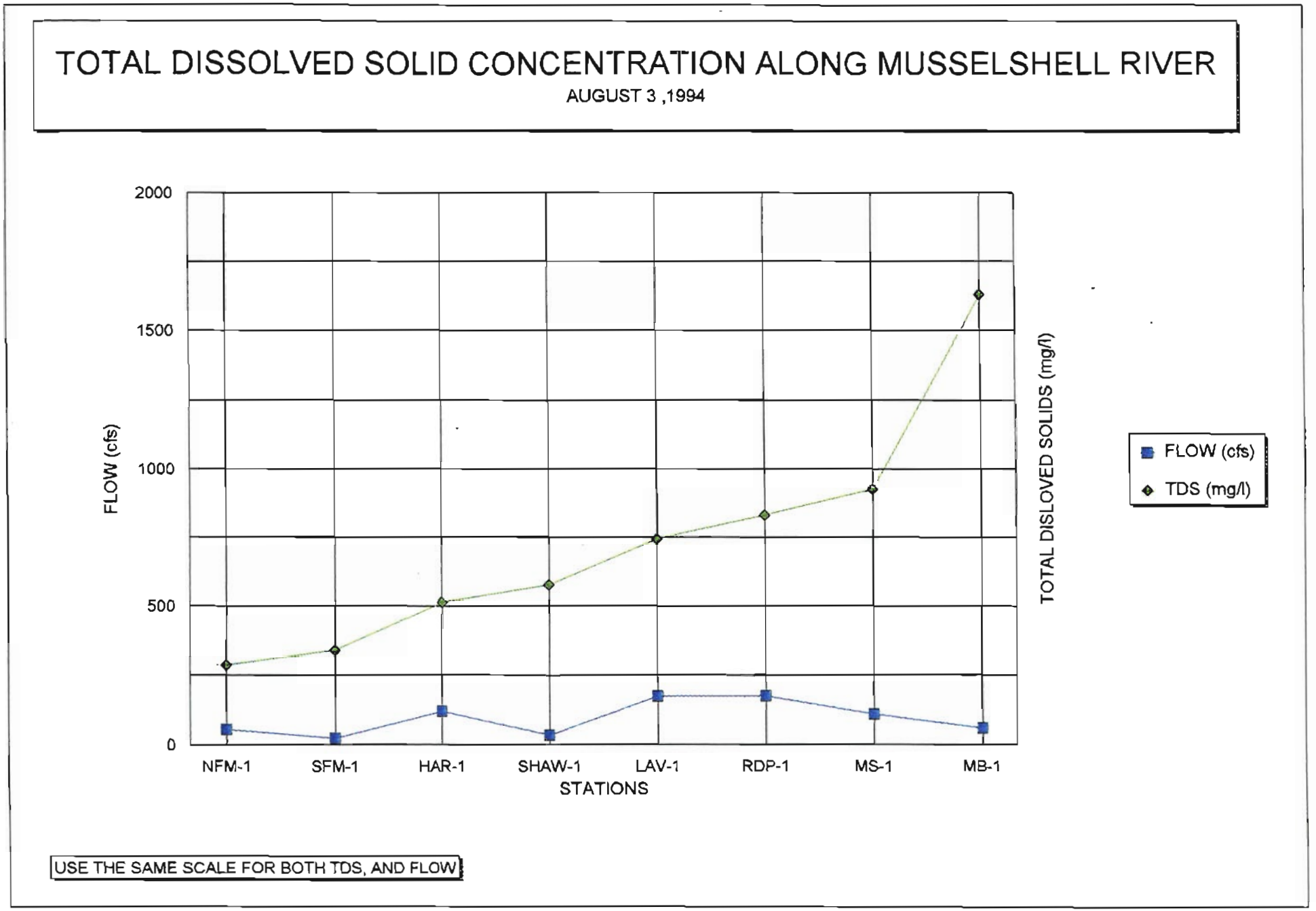
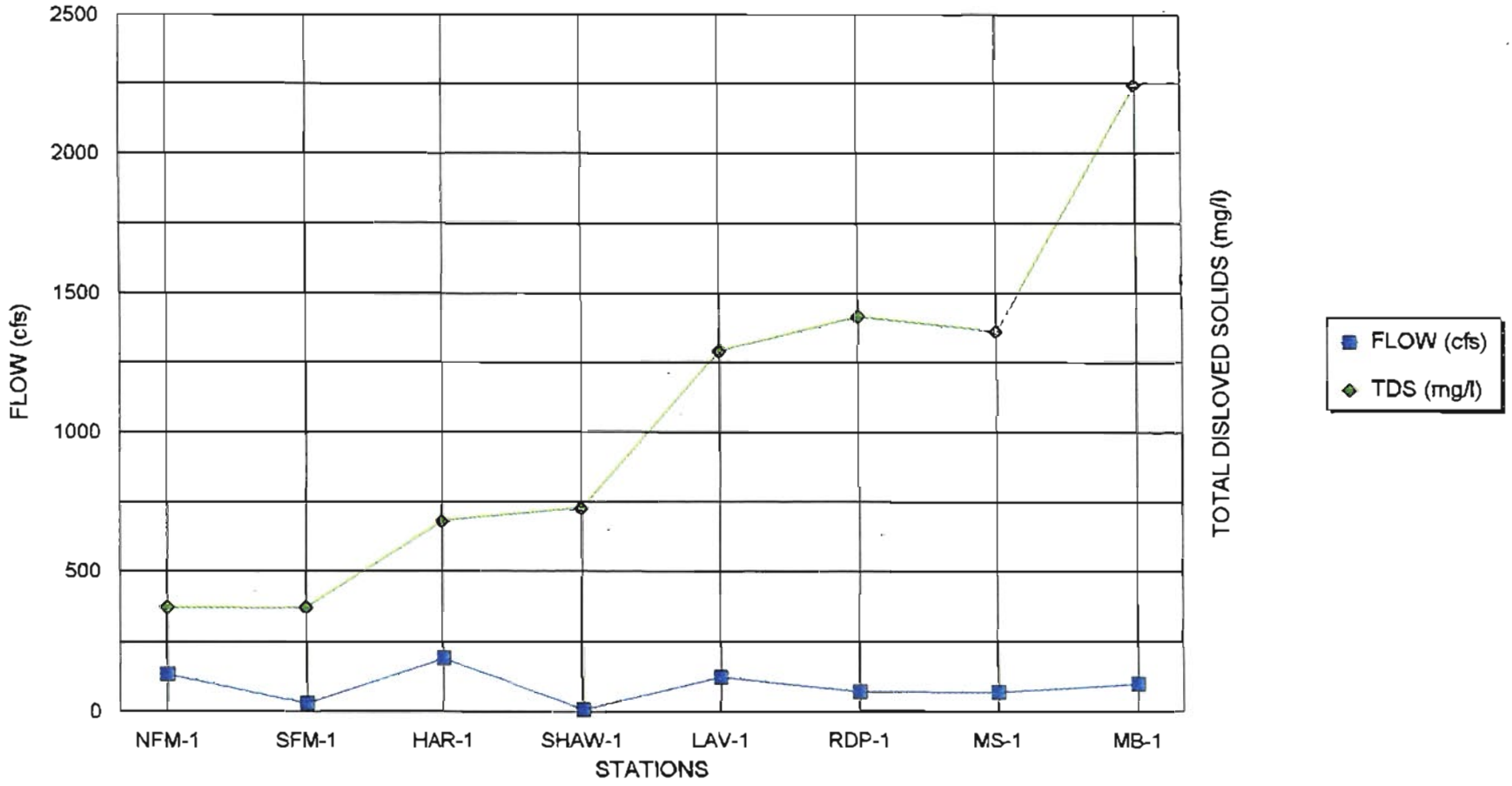

TOTAL DISSOLVED SOLID CONCENTRATION ALONG MUSSELSHELL RIVER
AUGUST 3 ,1994
2000
1500
1000
500
0
FLOW (cfs)
TOTAL DISLOVED SOLIDS (mg/l)
NFM-1
SFM-1
HAR-1
SHAW-1
LAV-1
RDP-1
MS-1
MB-1
STATIONS
FLOW (cfs)
TDS (mg/l)
USE THE SAME SCALE FOR BOTH TDS, AND FLOW

Fig. WQ-6

TOTAL DISSOLVED SOLID CONCENTRATION ALONG MUSSELSHELL RIVER

NOVEMBER 11 ,1994

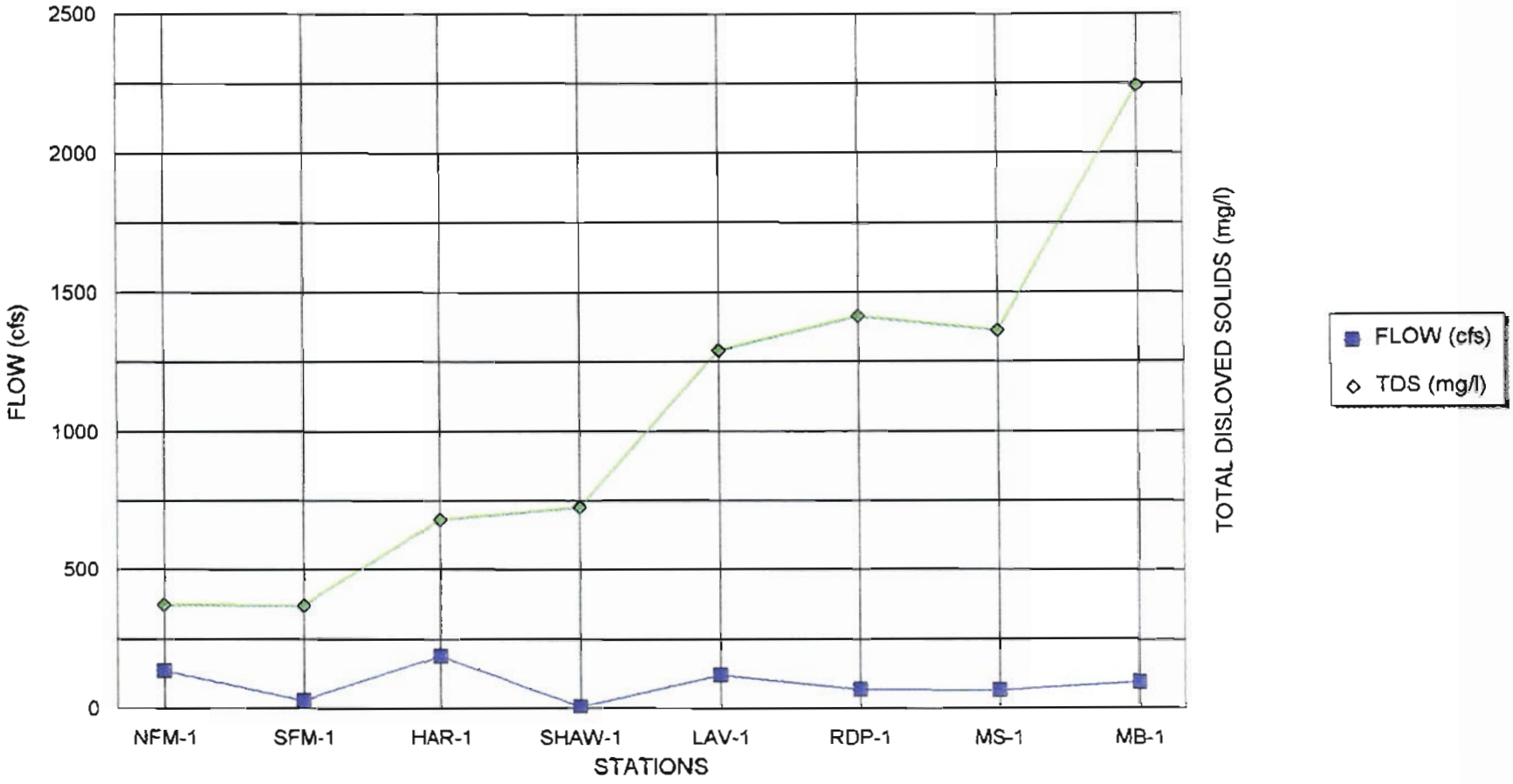


USE THE SAME SCALE FOR BOTH TDS, AND FLOW

Fig. WQ-7

TOTAL DISSOLVED SOLID CONCENTRATION ALONG MUSSELSHELL RIVER

NOVEMBER 11 ,1994

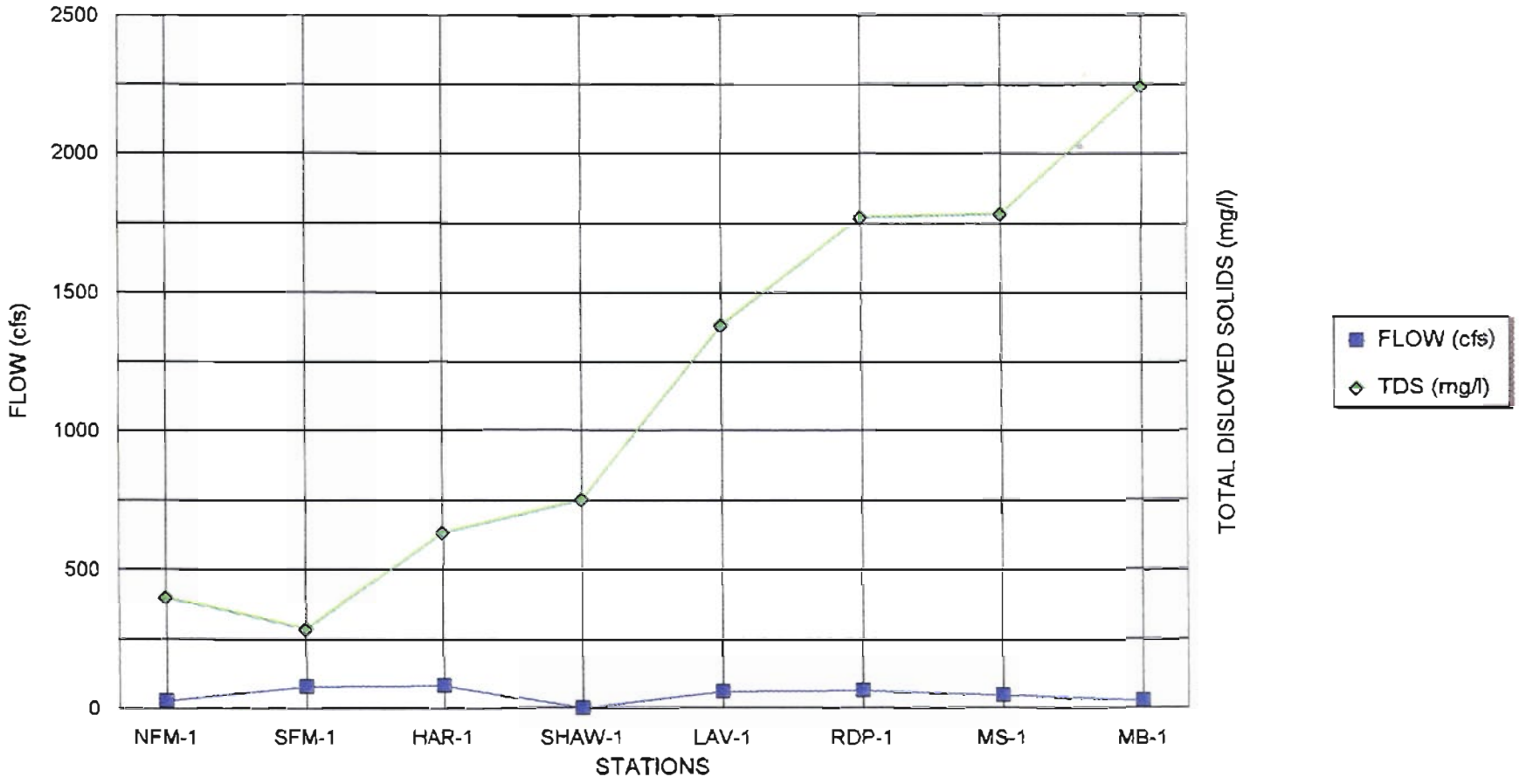


USE THE SAME SCALE FOR BOTH TDS, AND FLOW

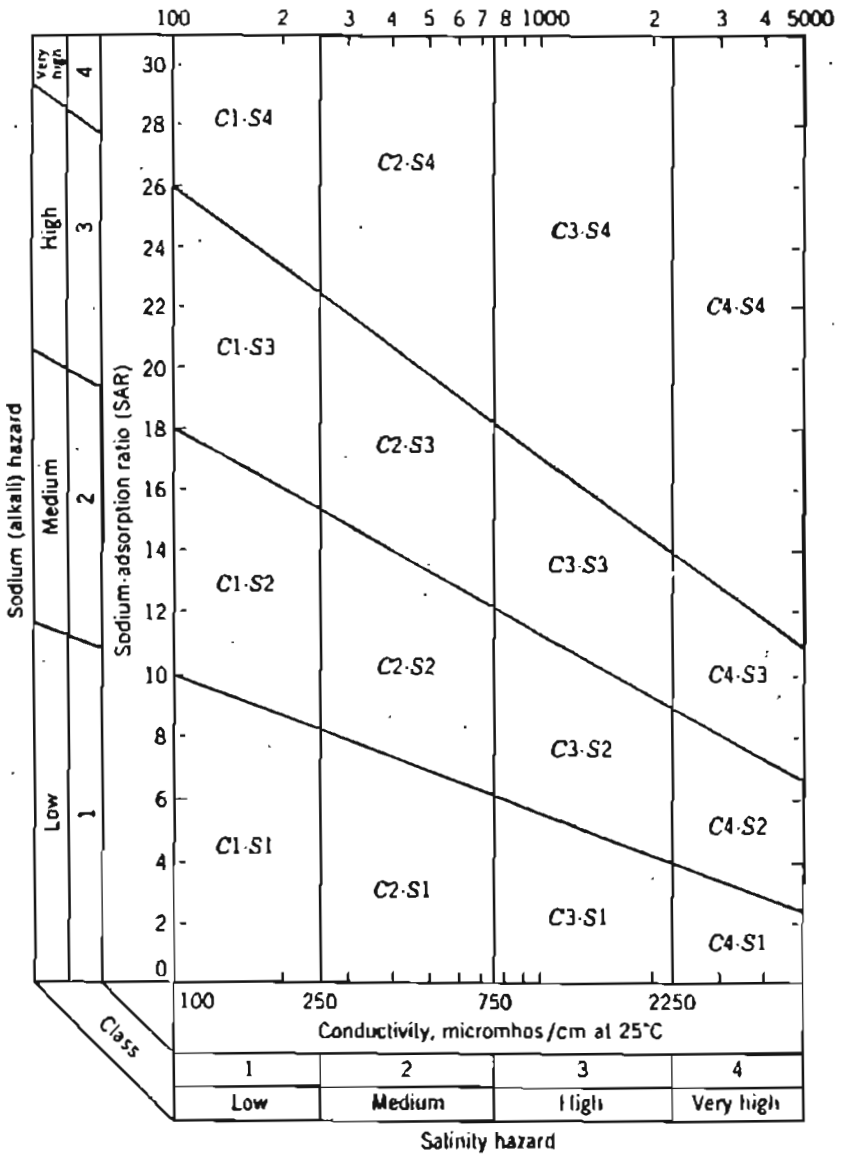
Fig. WQ-8

TOTAL DISSOLVED SOLID CONCENTRATION ALONG MUSSELSHELL RIVER

MAY 12 ,1995



USE THE SAME SCALE FOR BOTH TDS, AND FLOW



Source: Wilcox, 1955.

Fig. WQ-9: USDA Classification per Sodium Absorption Ratio

Fig. WQ-10

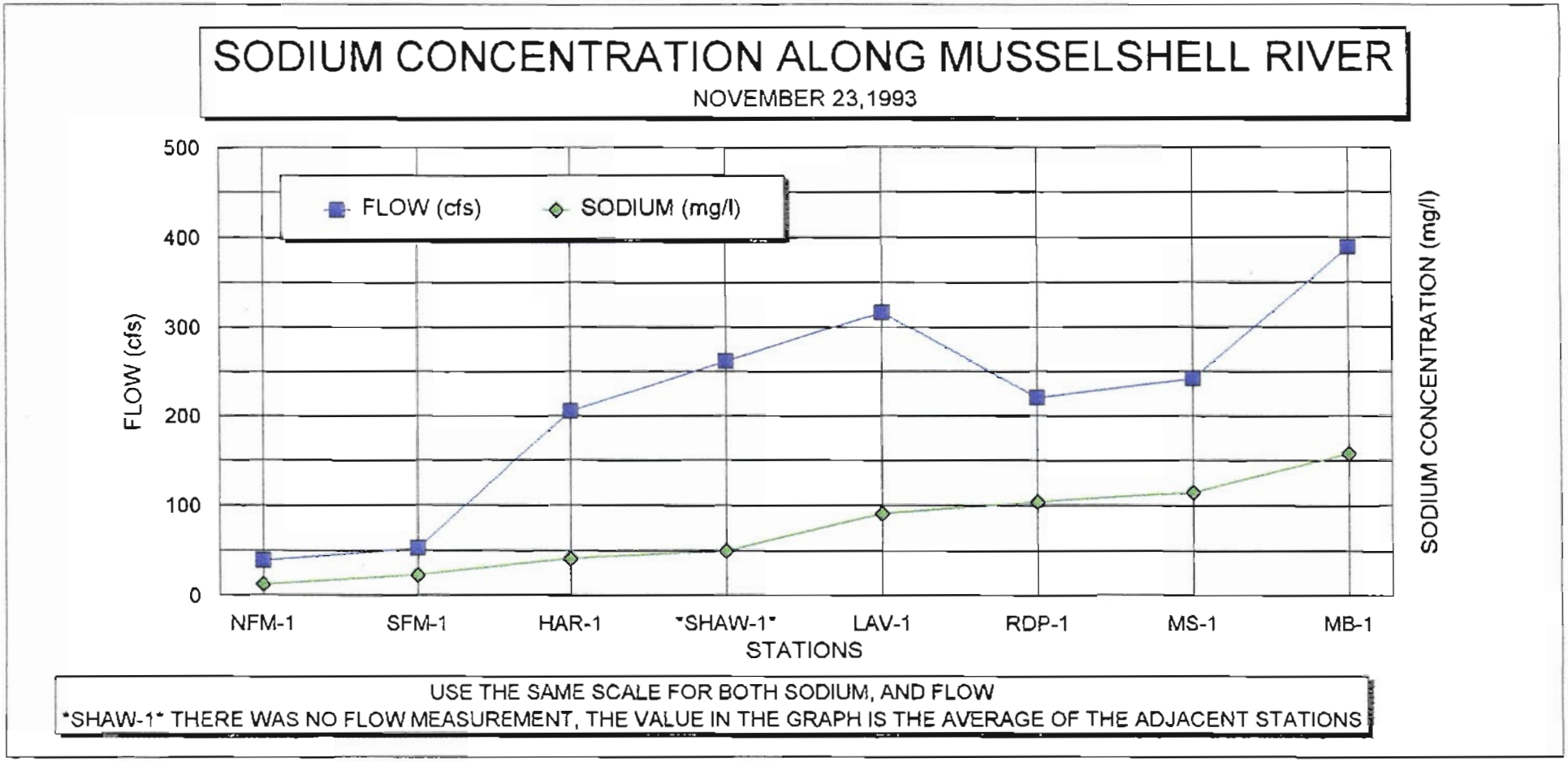
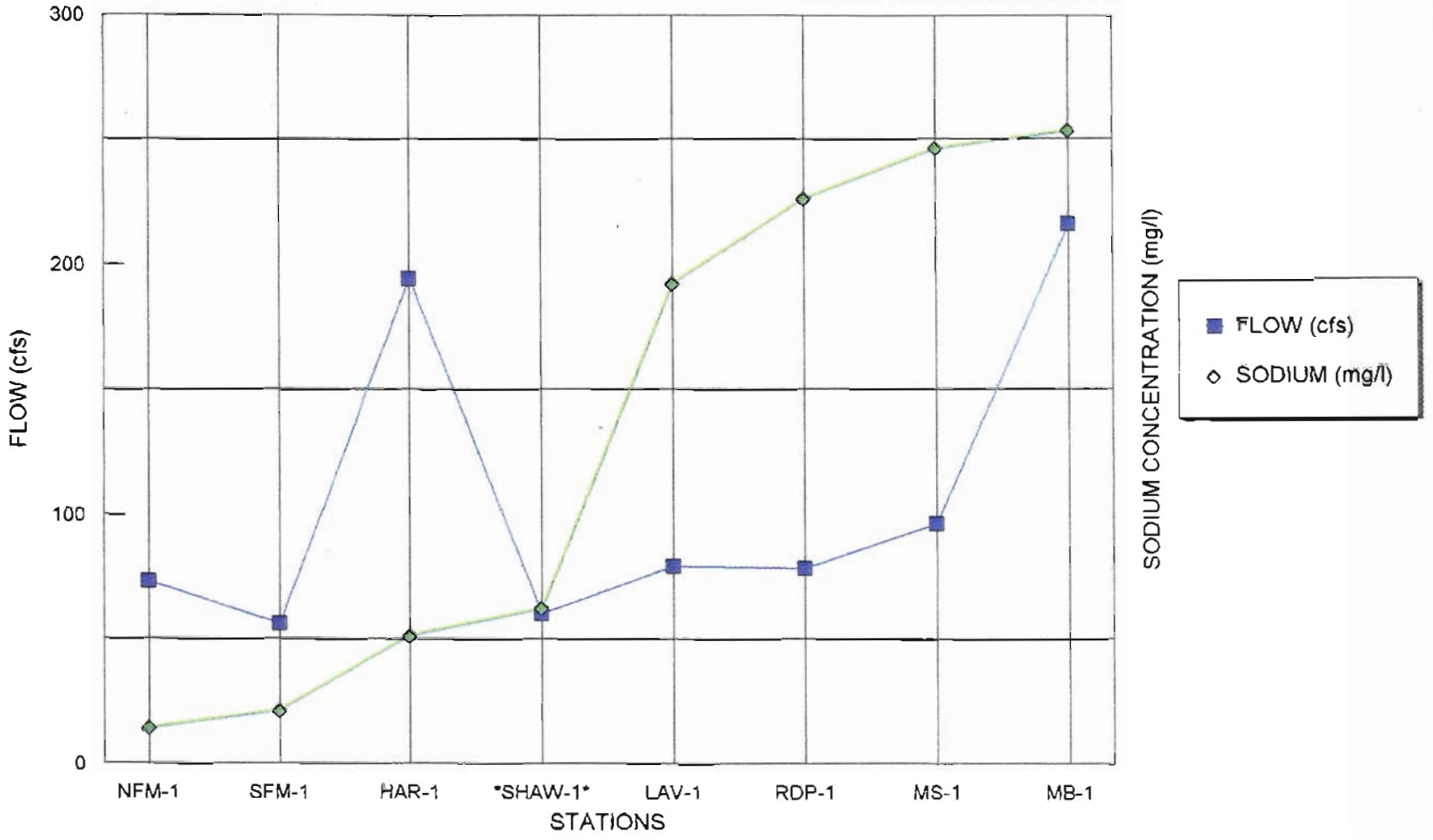

SODIUM CONCENTRATION ALONG MUSSELSHELL RIVER
NOVEMBER 23,1993
FLOW (cfs)
SODIUM (mg/l)
500
400
300
200
100
0
FLOW (cfs)
SODIUM CONCENTRATION (mg/l)
NFM-1
SFM-1
HAR-1
"SHAW-1"
LAV-1
RDP-1
MS-1
MB-1
STATIONS
USE THE SAME SCALE FOR BOTH SODIUM, AND FLOW
"SHAW-1" THERE WAS NO FLOW MEASUREMENT, THE VALUE IN THE GRAPH IS THE AVERAGE OF THE ADJACENT STATIONS

Fig. WQ-11

SODIUM CONCENTRATION ALONG MUSSELSHELL RIVER

APRIL 14 ,1994



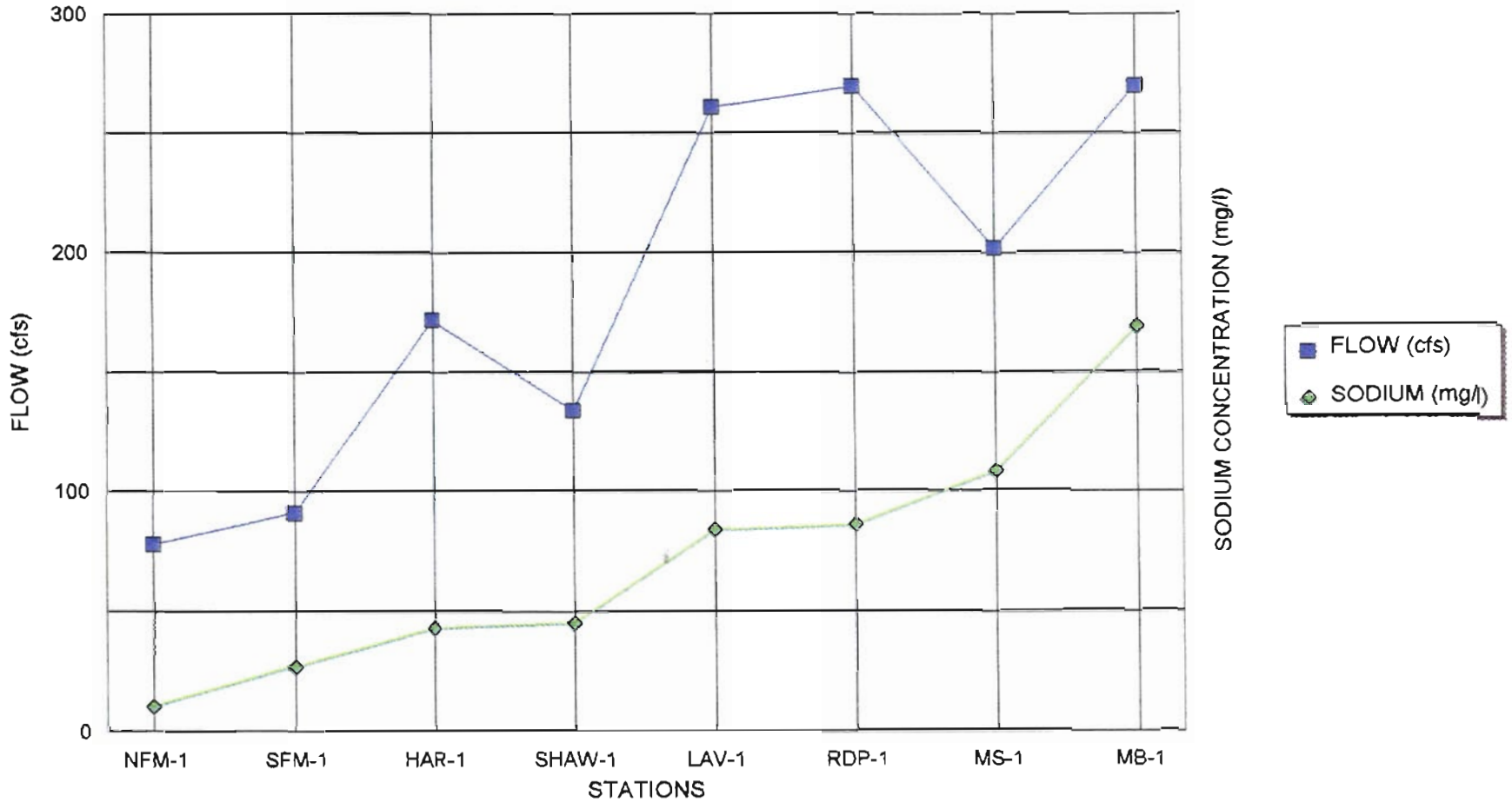
USE THE SAME SCALE FOR BOTH SODIUM, AND FLOW

SHAW-1 THERE WAS NO FLOW MEASUREMENT, DEADMANS BASIN WAS DIVERTING WATER, THE VALUE IS ESTIMATED FROM PREVIOUS RECORDS

Fig. WQ-12

SODIUM CONCENTRATION ALONG MUSSELSHELL RIVER

JUNE 1,1994

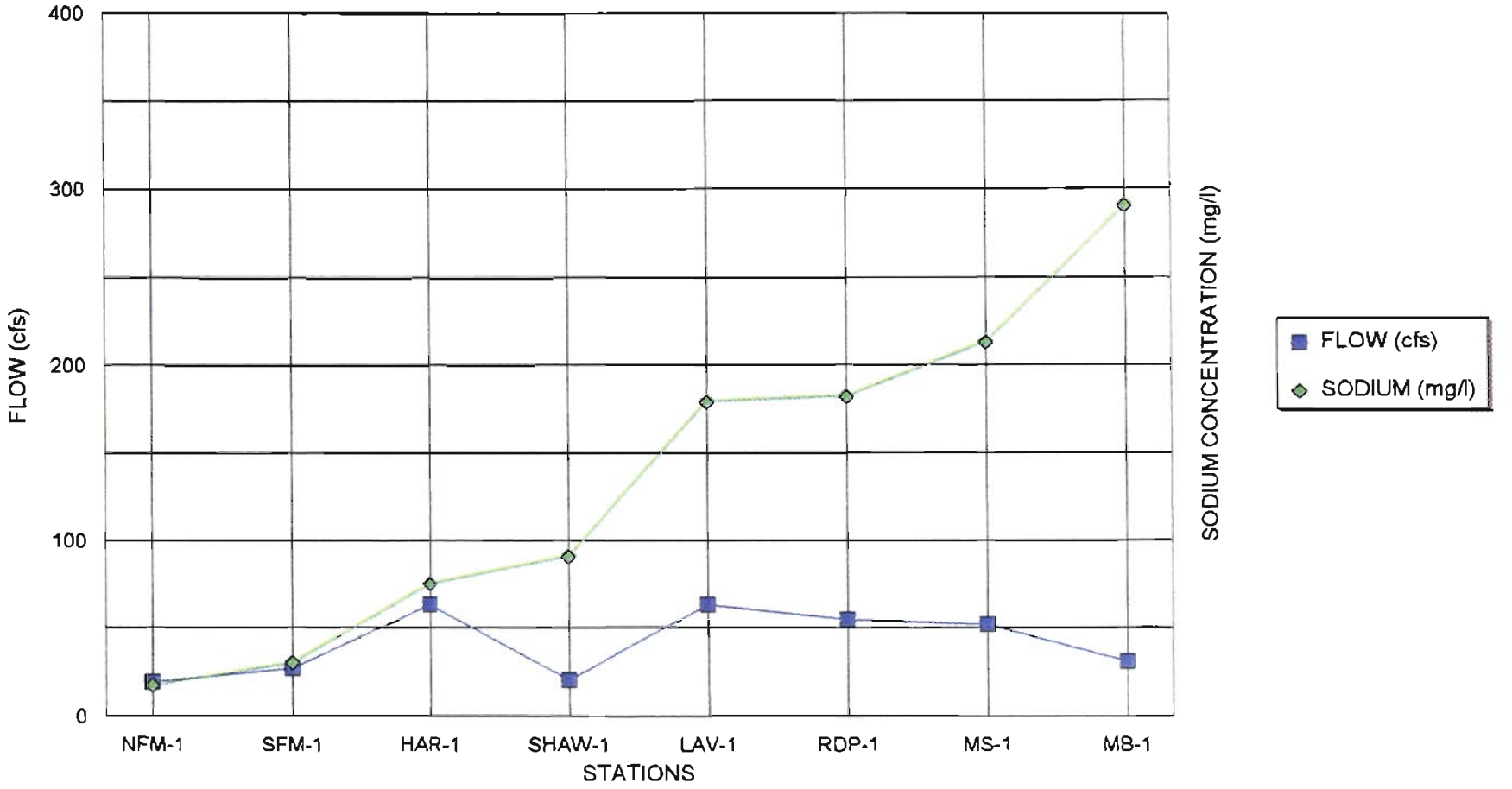


USE THE SAME SCALE FOR BOTH SODIUM, AND FLOW

Fig. WQ-13

SODIUM CONCENTRATION ALONG MUSSELSHELL RIVER

OCTOBER 12 ,1994



USE THE SAME SCALE FOR BOTH SODIUM, AND FLOW

Fig. WQ-14

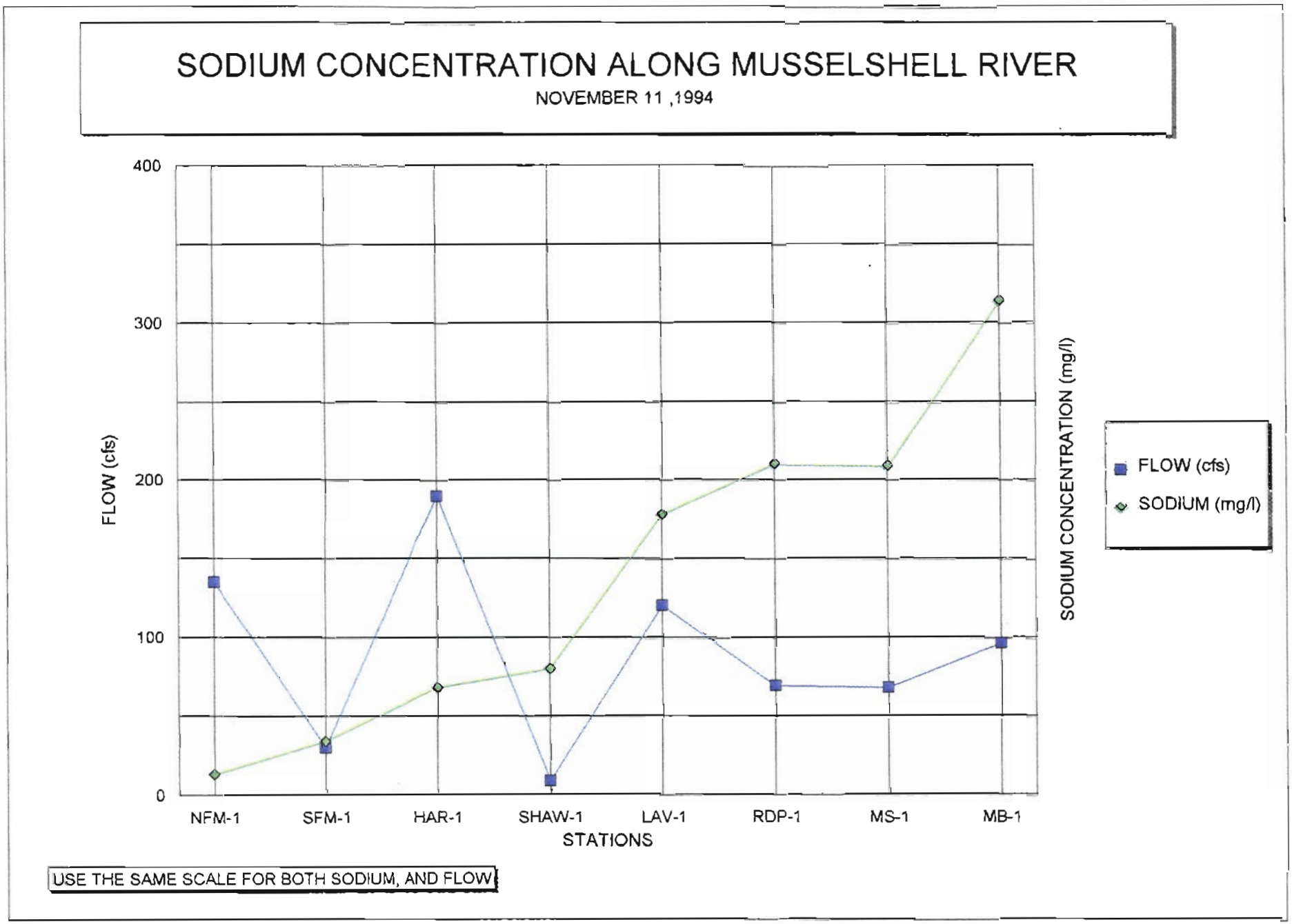
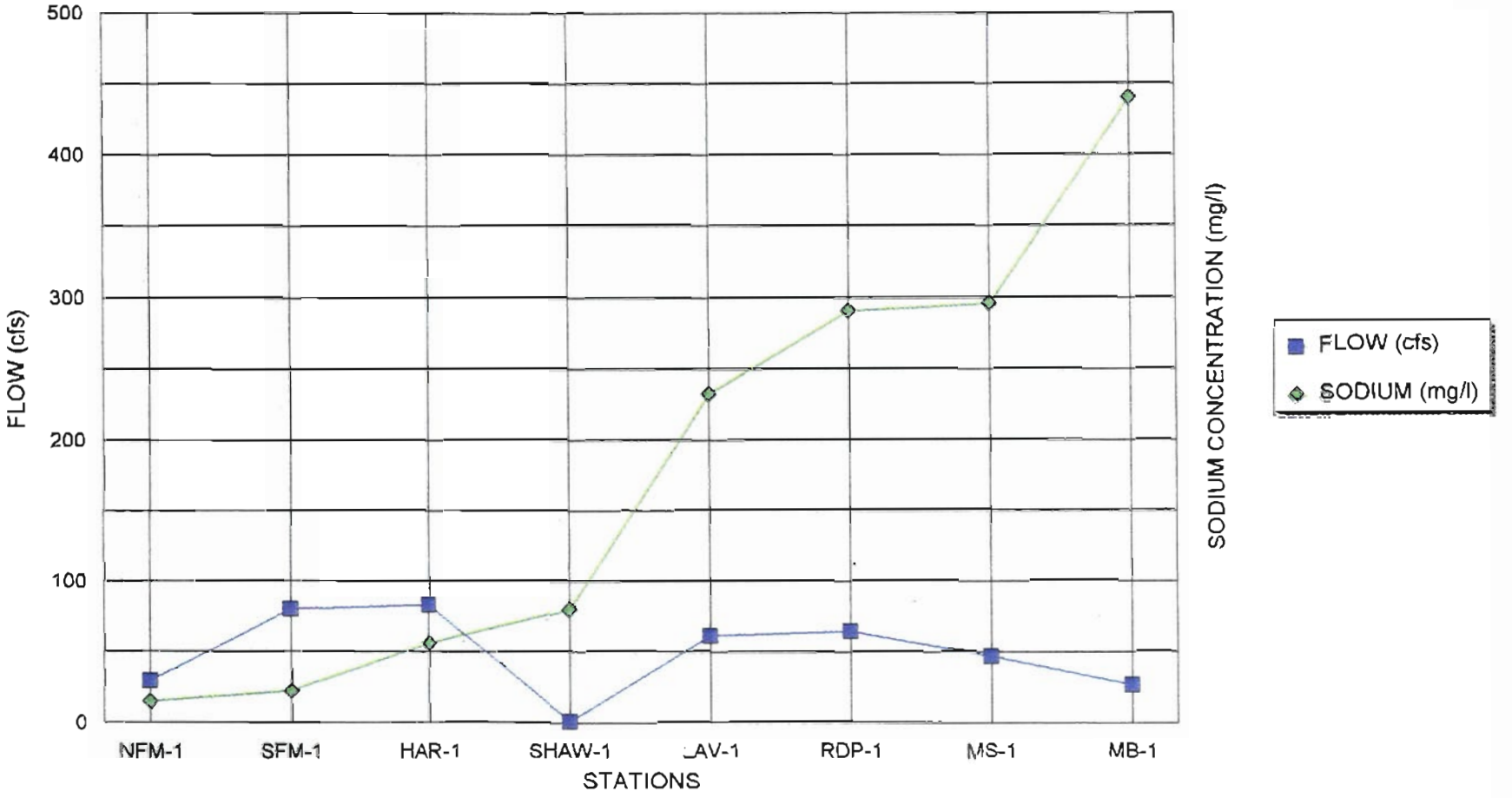

SODIUM CONCENTRATION ALONG MUSSELSHELL RIVER
NOVEMBER 11 ,1994
400
300
200
100
0
FLOW (cfs)
SODIUM CONCENTRATION (mg/l)
NFM-1
SFM-1
HAR-1
SHAW-1
LAV-1
RDP-1
MS-1
MB-1
STATIONS
FLOW (cfs)
SODIUM (mg/l)
USE THE SAME SCALE FOR BOTH SODIUM, AND FLOW

Fig. WQ-15

SODIUM CONCENTRATION ALONG MUSSELSHELL RIVER

MAY 12 ,1995



USE THE SAME SCALE FOR BOTH SODIUM, AND FLOW
DEADMANS BASIN IS DIVERING 90% OF FLOW BETWEEN HAR-1 AND SHAW-1

Fig. WQ-16

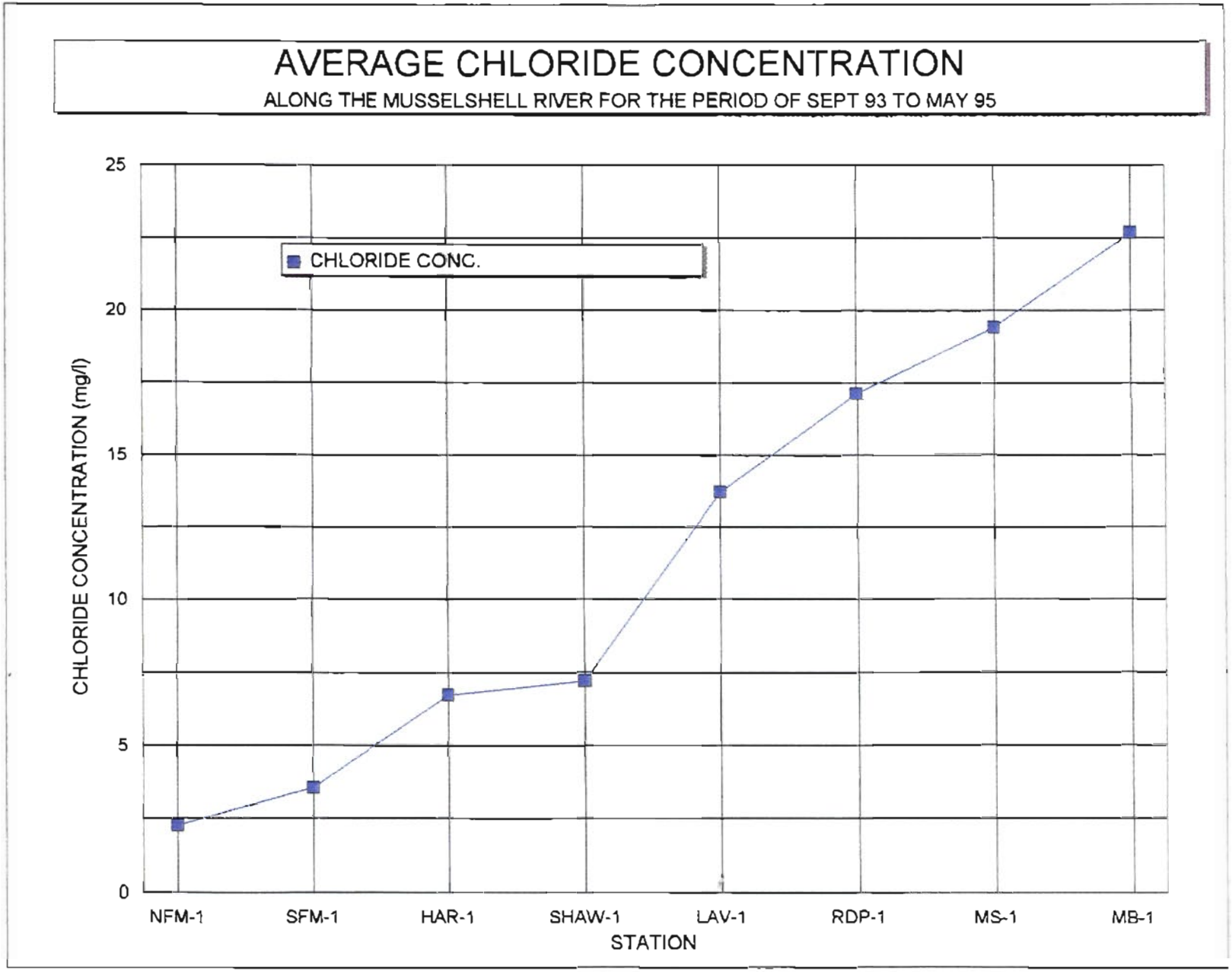

AVERAGE CHLORIDE CONCENTRATION
ALONG THE MUSSELSHELL RIVER FOR THE PERIOD OF SEPT 93 TO MAY 95
CHLORIDE CONC.
CHLORIDE CONCENTRATION (mg/l)
25
20
15
10
5
0
NFM-1
SFM-1
HAR-1
SHAW-1
LAV-1
RDP-1
MS-1
MB-1
STATION

Fig. WQ-17

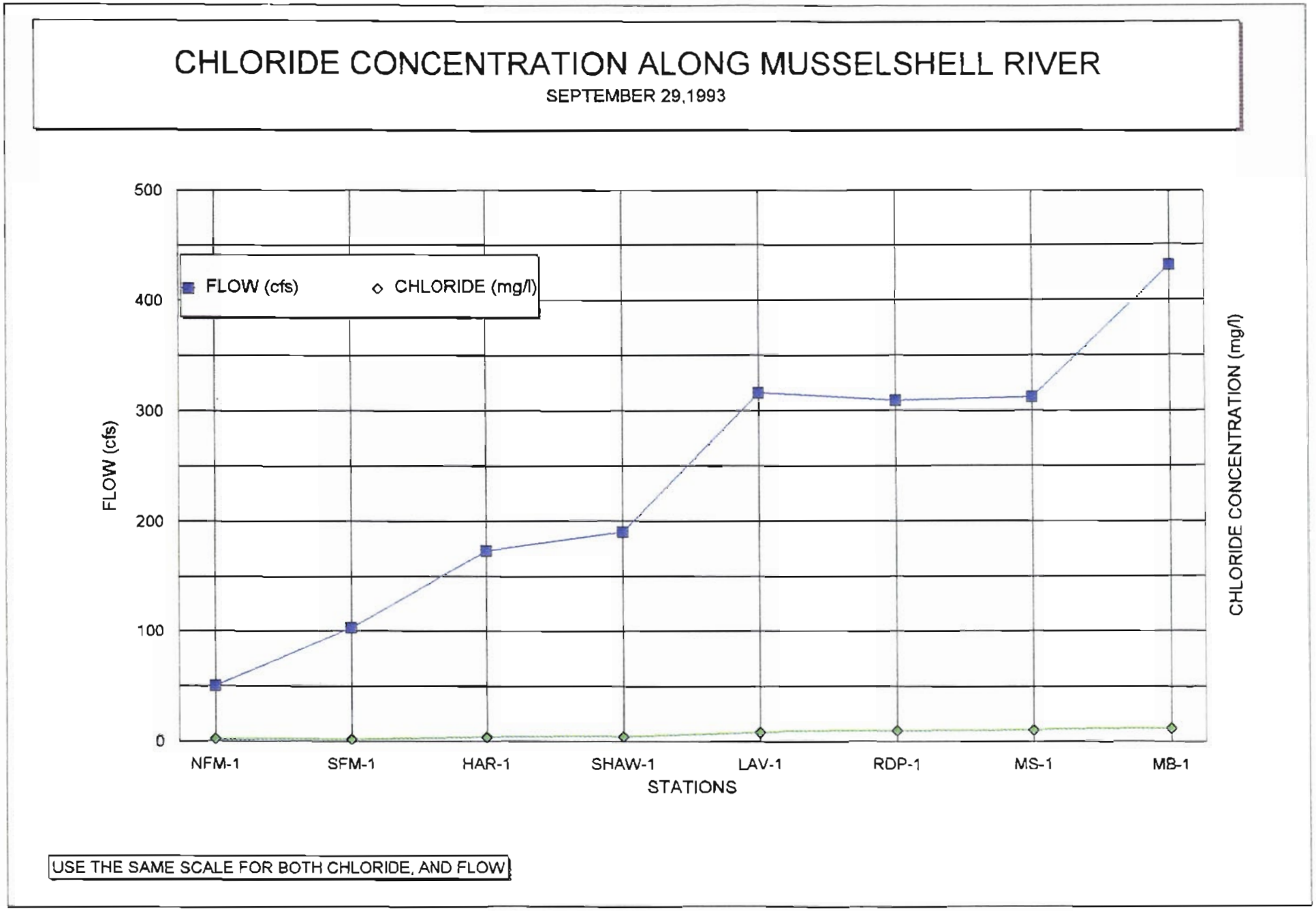

CHLORIDE CONCENTRATION ALONG MUSSELSHELL RIVER
SEPTEMBER 29,1993
FLOW (cfs)
CHLORIDE (mg/l)
500
400
300
200
100
0
FLOW (cfs)
CHLORIDE CONCENTRATION (mg/l)
NFM-1
SFM-1
HAR-1
SHAW-1
LAV-1
RDP-1
MS-1
MB-1
STATIONS
USE THE SAME SCALE FOR BOTH CHLORIDE, AND FLOW

Fig. WQ-18

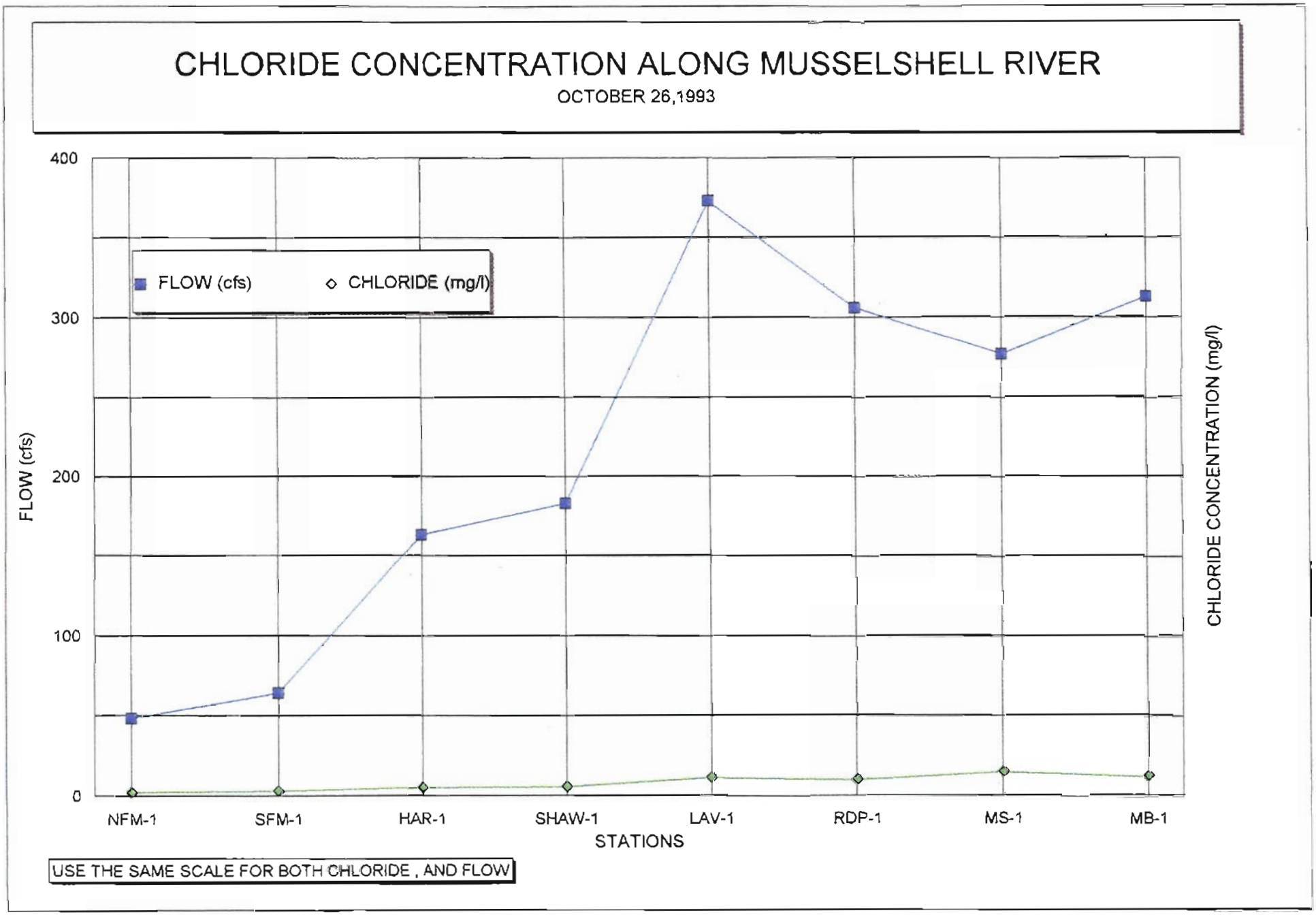

CHLORIDE CONCENTRATION ALONG MUSSELSHELL RIVER
OCTOBER 26,1993
FLOW (cfs)
CHLORIDE (mg/l)
400
300
200
100
0
FLOW (cfs)
CHLORIDE CONCENTRATION (mg/l)
NFM-1
SFM-1
HAR-1
SHAW-1
LAV-1
RDP-1
MS-1
MB-1
STATIONS
USE THE SAME SCALE FOR BOTH CHLORIDE , AND FLOW

Fig. WQ-19

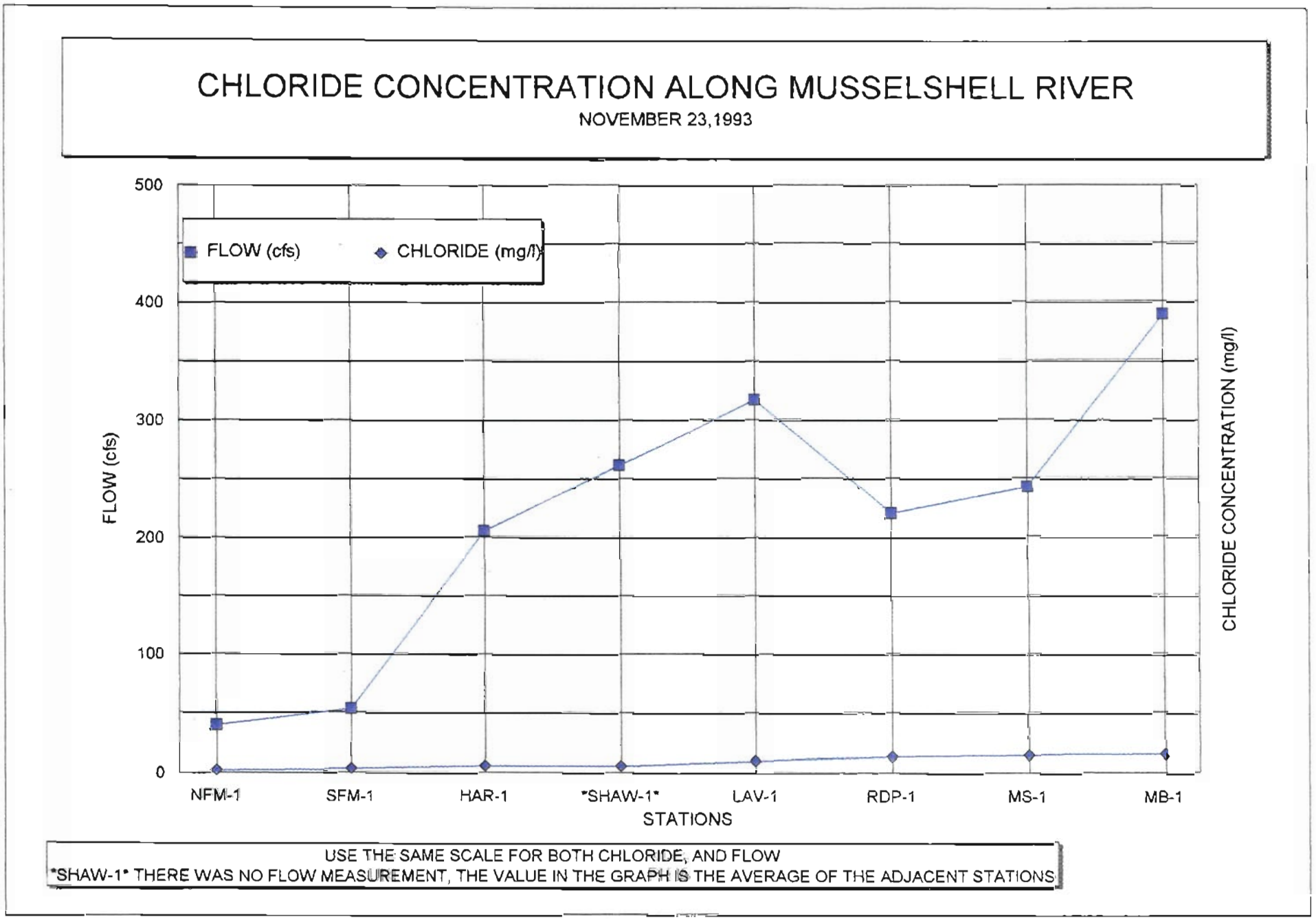
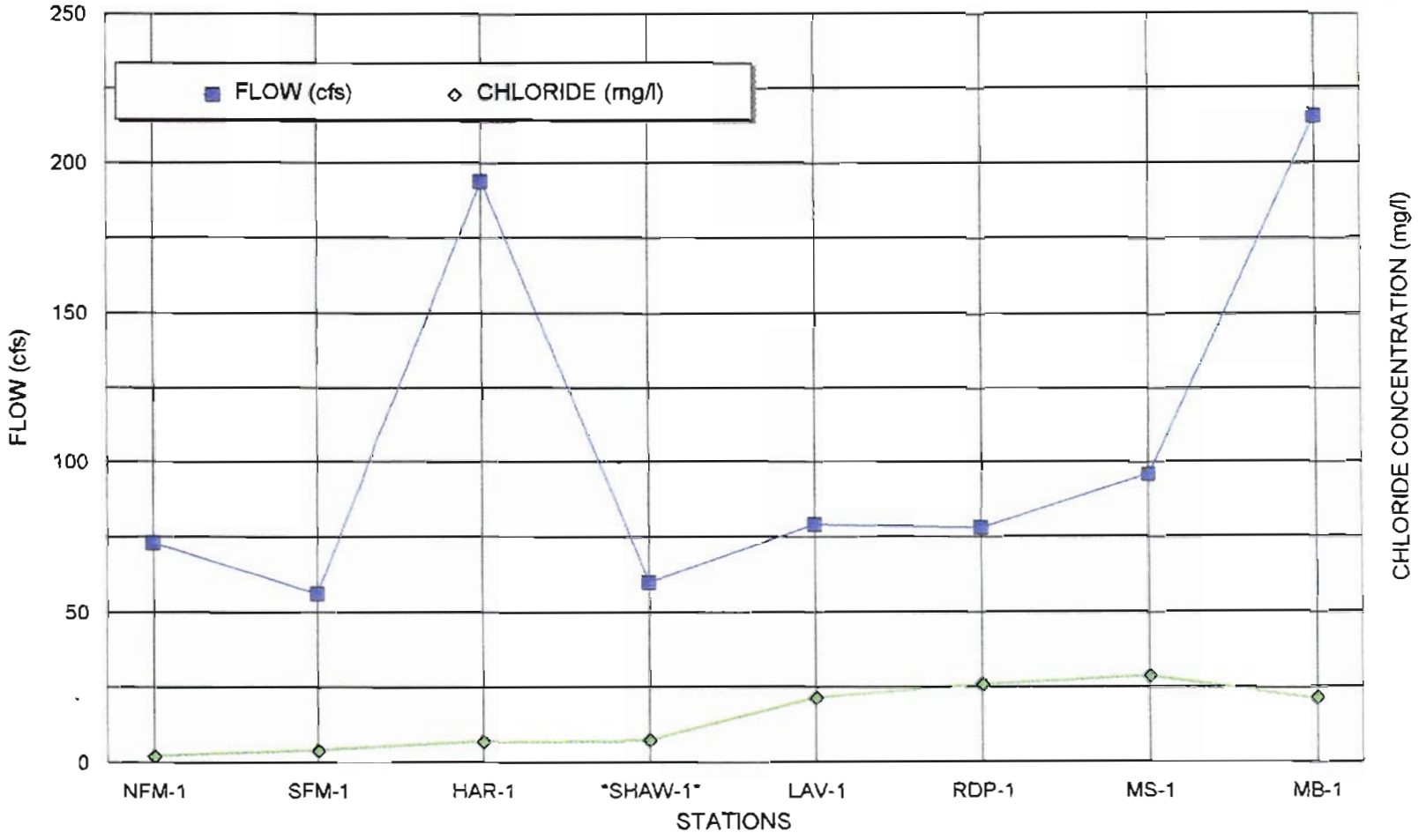

CHLORIDE CONCENTRATION ALONG MUSSELSHELL RIVER
NOVEMBER 23,1993
FLOW (cfs)
CHLORIDE (mg/l)
500
400
300
200
100
0
FLOW (cfs)
CHLORIDE CONCENTRATION (mg/l)
NFM-1
SFM-1
HAR-1
"SHAW-1"
LAV-1
RDP-1
MS-1
MB-1
STATIONS
USE THE SAME SCALE FOR BOTH CHLORIDE, AND FLOW
"SHAW-1" THERE WAS NO FLOW MEASUREMENT, THE VALUE IN THE GRAPH IS THE AVERAGE OF THE ADJACENT STATIONS

Fig. WQ-20

CHLORIDE CONCENTRATION ALONG MUSSELSHELL RIVER

APRIL 14 ,1994



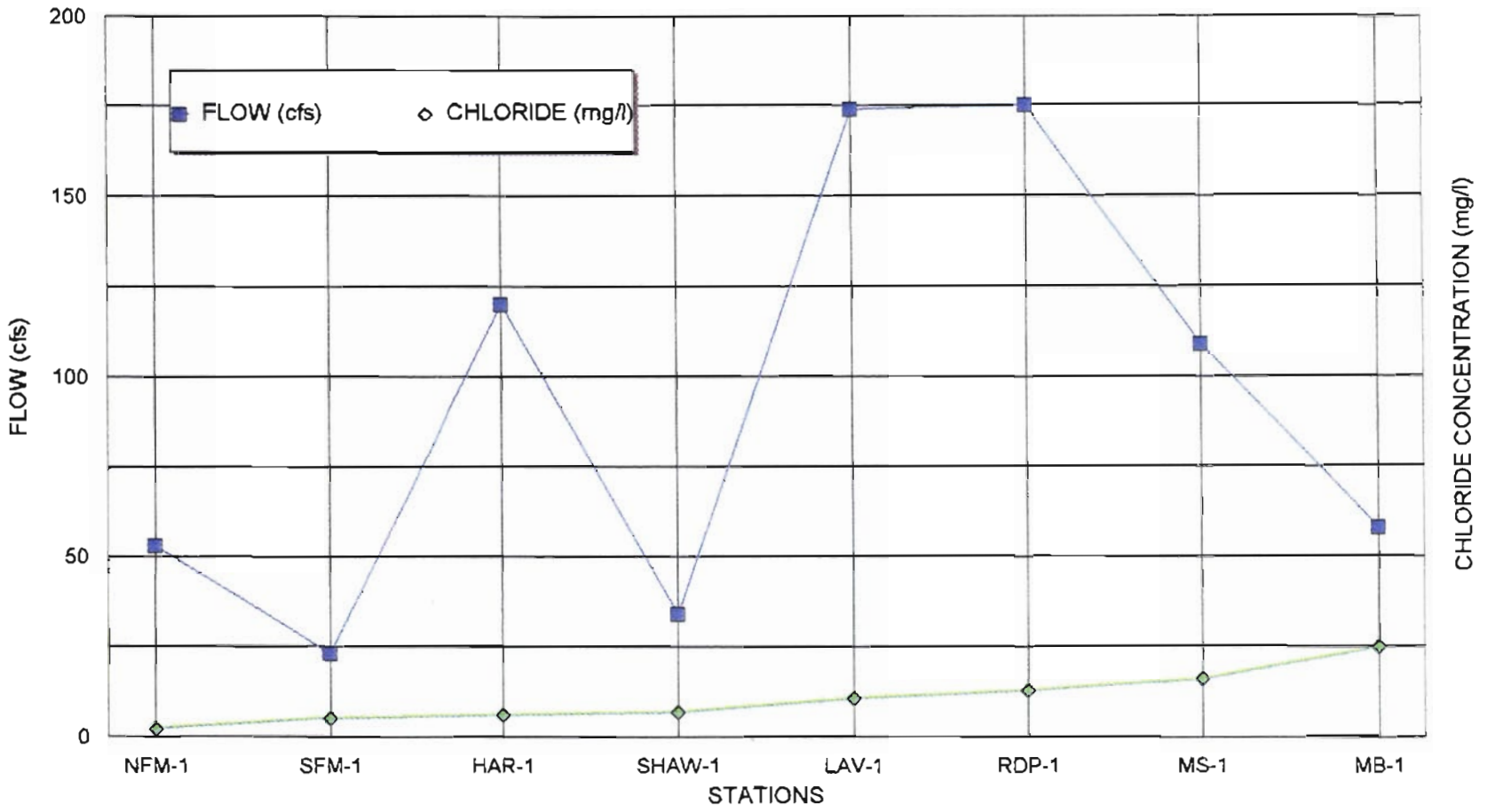
USE THE SAME SCALE FOR BOTH CHLORIDE, AND FLOW

"SHAW-1" THERE WAS NO FLOW MEASUREMENT, DEADMANS BASIN WAS DIVERTING FLOW. THE VALUE IS ESTIMATED FROM PREVIOUS RECORDS

Fig. WQ-21

CHLORIDE CONCENTRATION ALONG MUSSELSHELL RIVER

AUGUST 3 ,1994

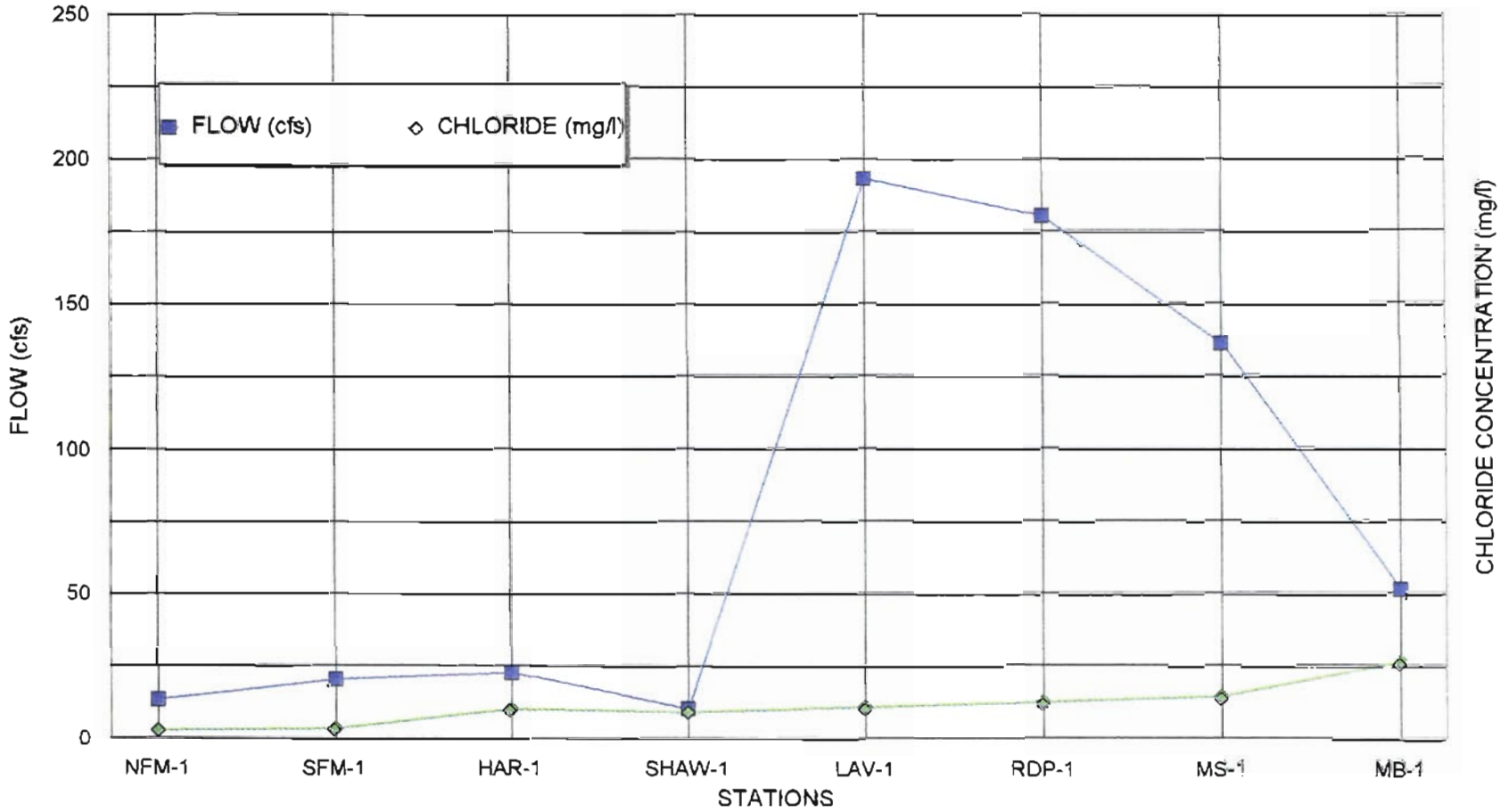


USE THE SAME SCALE FOR BOTH CHLORIDE, AND FLOW

Fig. WQ-22

CHLORIDE CONCENTRATION ALONG MUSSELSHELL RIVER

SEPTEMBER 2 ,1994

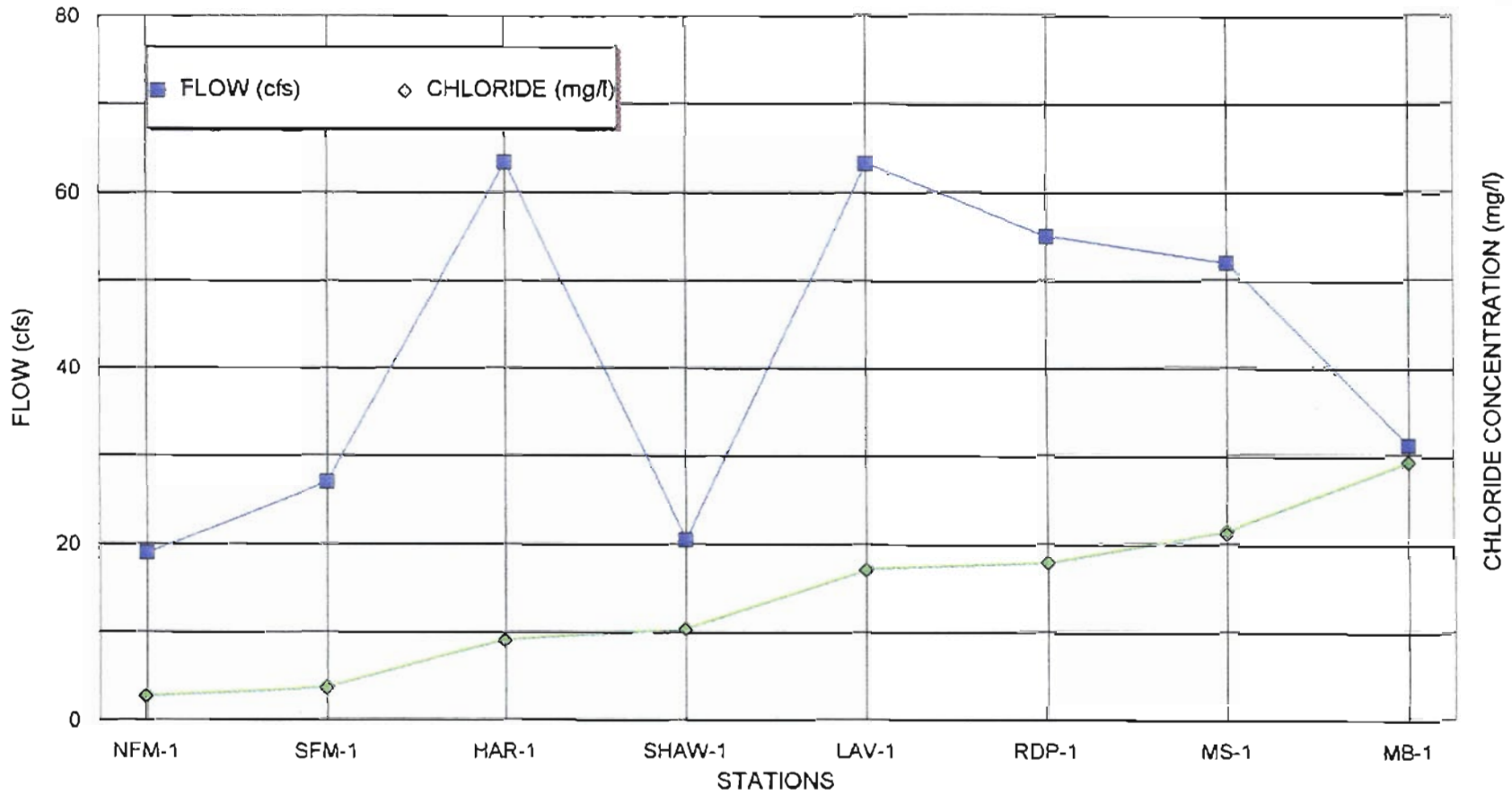


USE THE SAME SCALE FOR BOTH CHLORIDE, AND FLOW

Fig. WQ-23

CHLORIDE CONCENTRATION ALONG MUSSELSHELL RIVER

OCTOBER 12 ,1994



USE THE SAME SCALE FOR BOTH CHLORIDE, AND FLOW

Fig. WQ-24

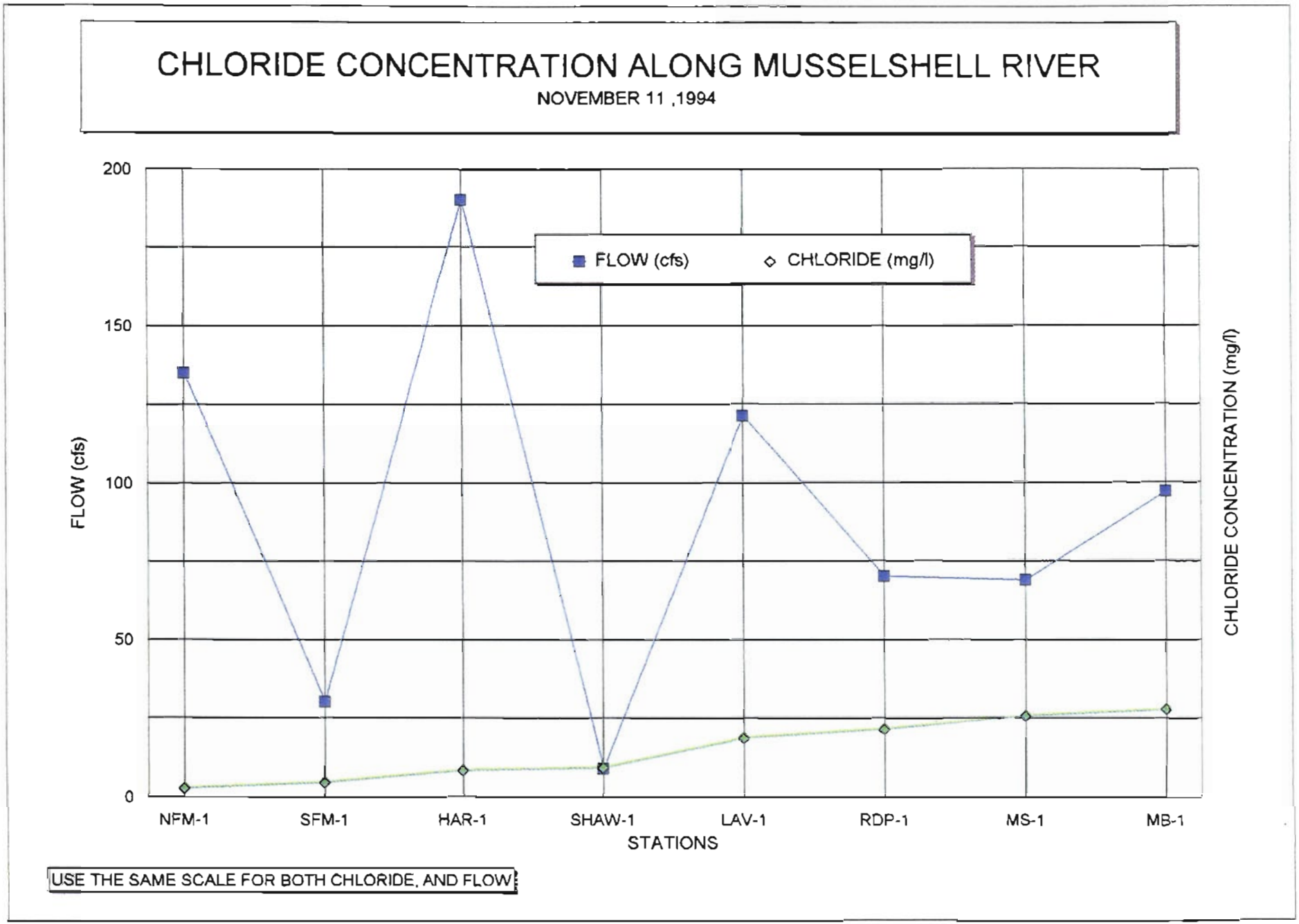
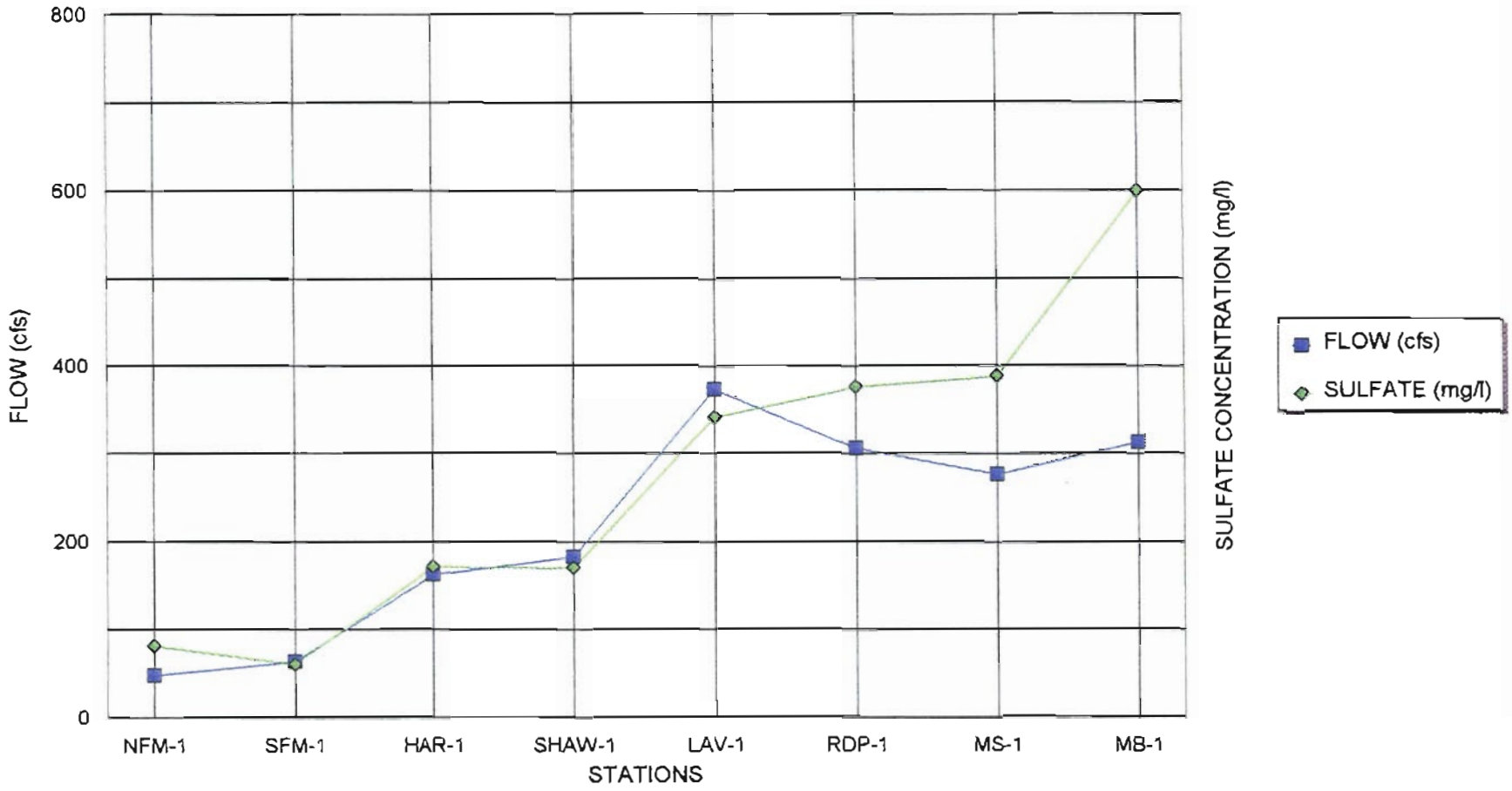

CHLORIDE CONCENTRATION ALONG MUSSELSHELL RIVER
NOVEMBER 11 ,1994
FLOW (cfs)
CHLORIDE (mg/l)
200
150
100
50
0
FLOW (cfs)
CHLORIDE CONCENTRATION (mg/l)
NFM-1
SFM-1
HAR-1
SHAW-1
LAV-1
RDP-1
MS-1
MB-1
STATIONS
USE THE SAME SCALE FOR BOTH CHLORIDE, AND FLOW

Fig. WQ-25

SULFATE CONCENTRATION ALONG MUSSELSHELL RIVER

SEPTEMBER 29,1993



USE THE SAME SCALE FOR BOTH SULFATE, AND FLOW

Fig. WQ-26

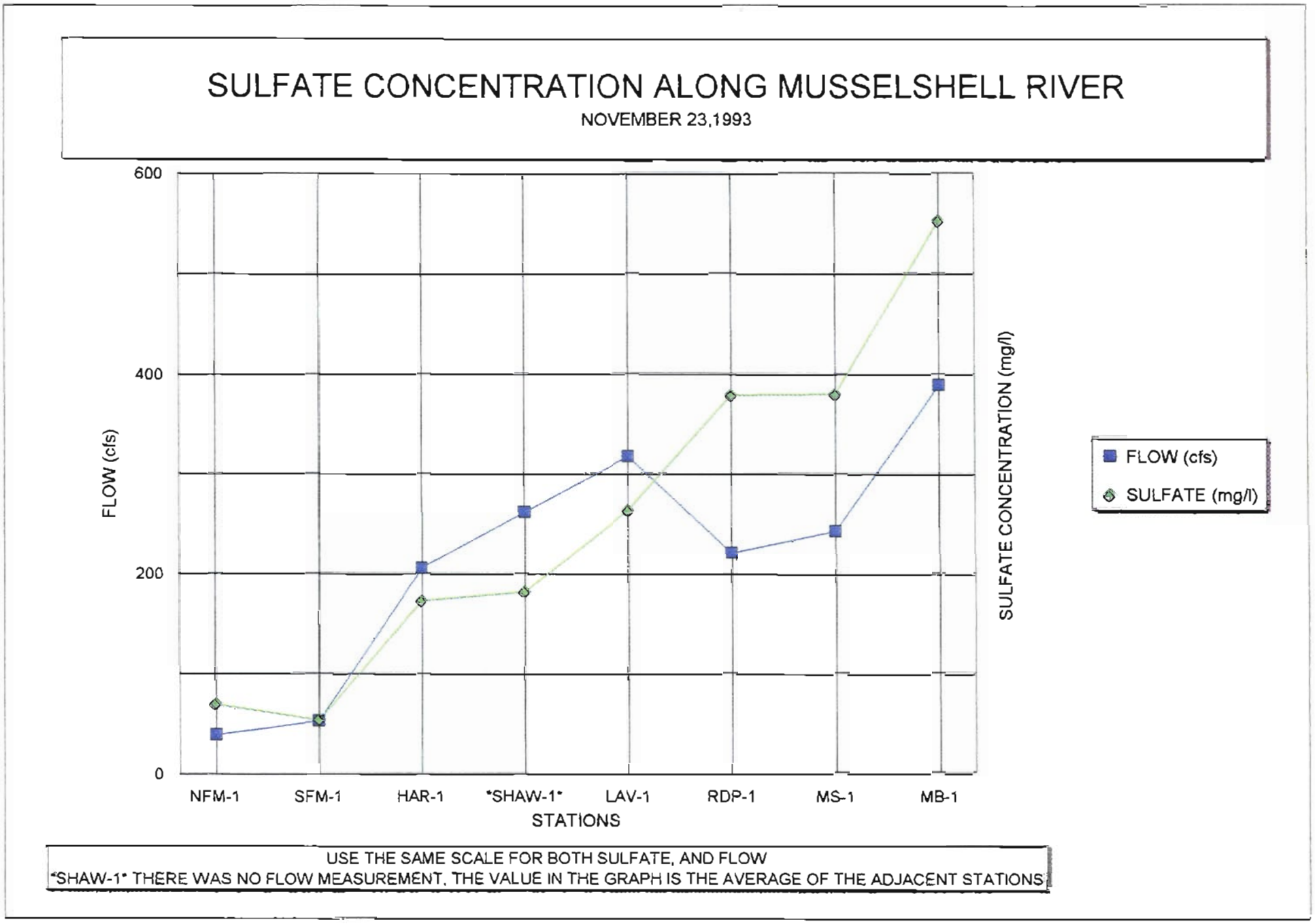
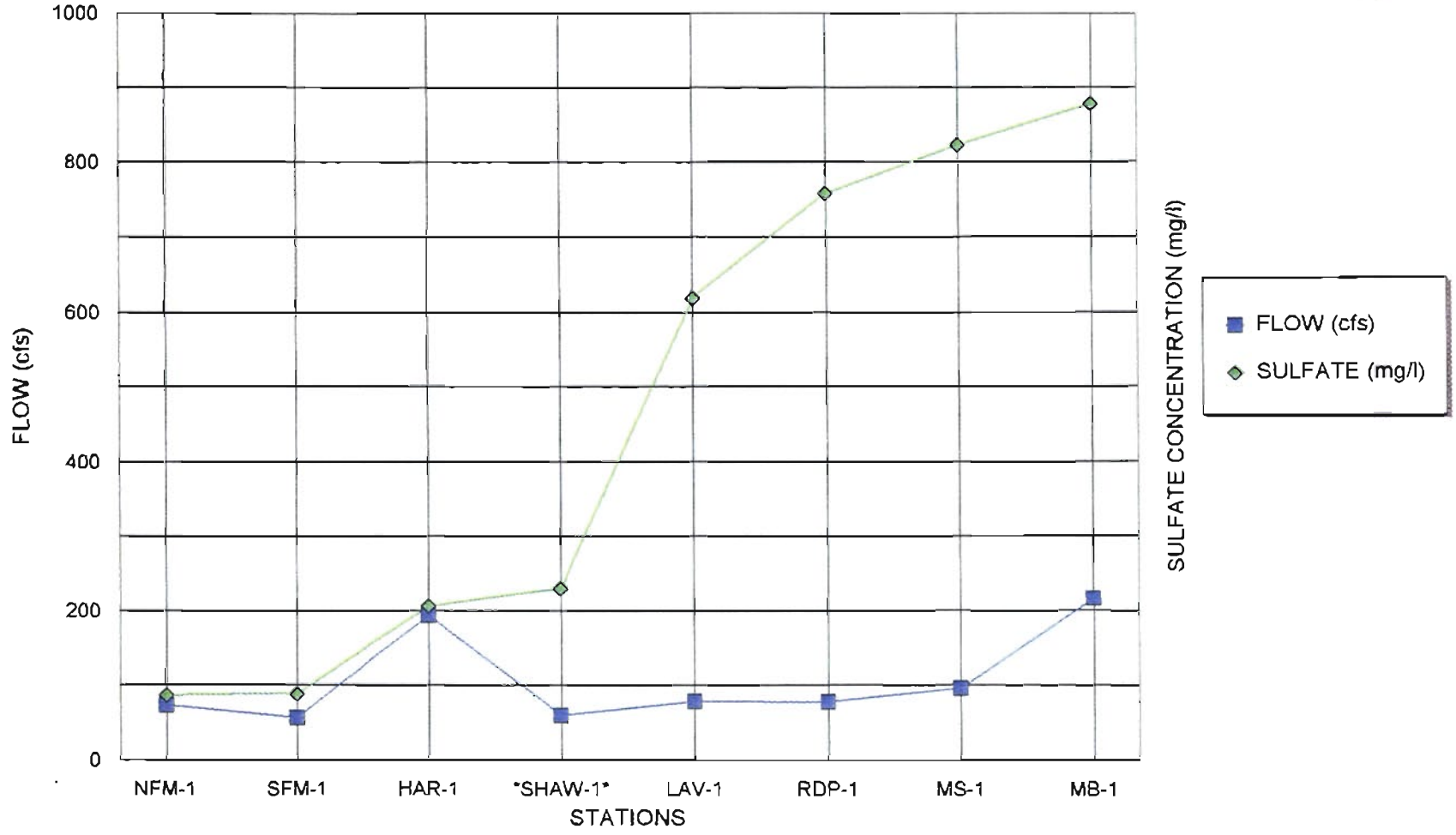

SULFATE CONCENTRATION ALONG MUSSELSHELL RIVER
NOVEMBER 23,1993
600
400
200
0
FLOW (cfs)
SULFATE CONCENTRATION (mg/l)
NFM-1
SFM-1
HAR-1
"SHAW-1"
LAV-1
RDP-1
MS-1
MB-1
STATIONS
FLOW (cfs)
SULFATE (mg/l)
USE THE SAME SCALE FOR BOTH SULFATE, AND FLOW
"SHAW-1" THERE WAS NO FLOW MEASUREMENT. THE VALUE IN THE GRAPH IS THE AVERAGE OF THE ADJACENT STATIONS

Fig. WQ-27

SULFATE CONCENTRATION ALONG MUSSELSHELL RIVER

APRIL 14 ,1994



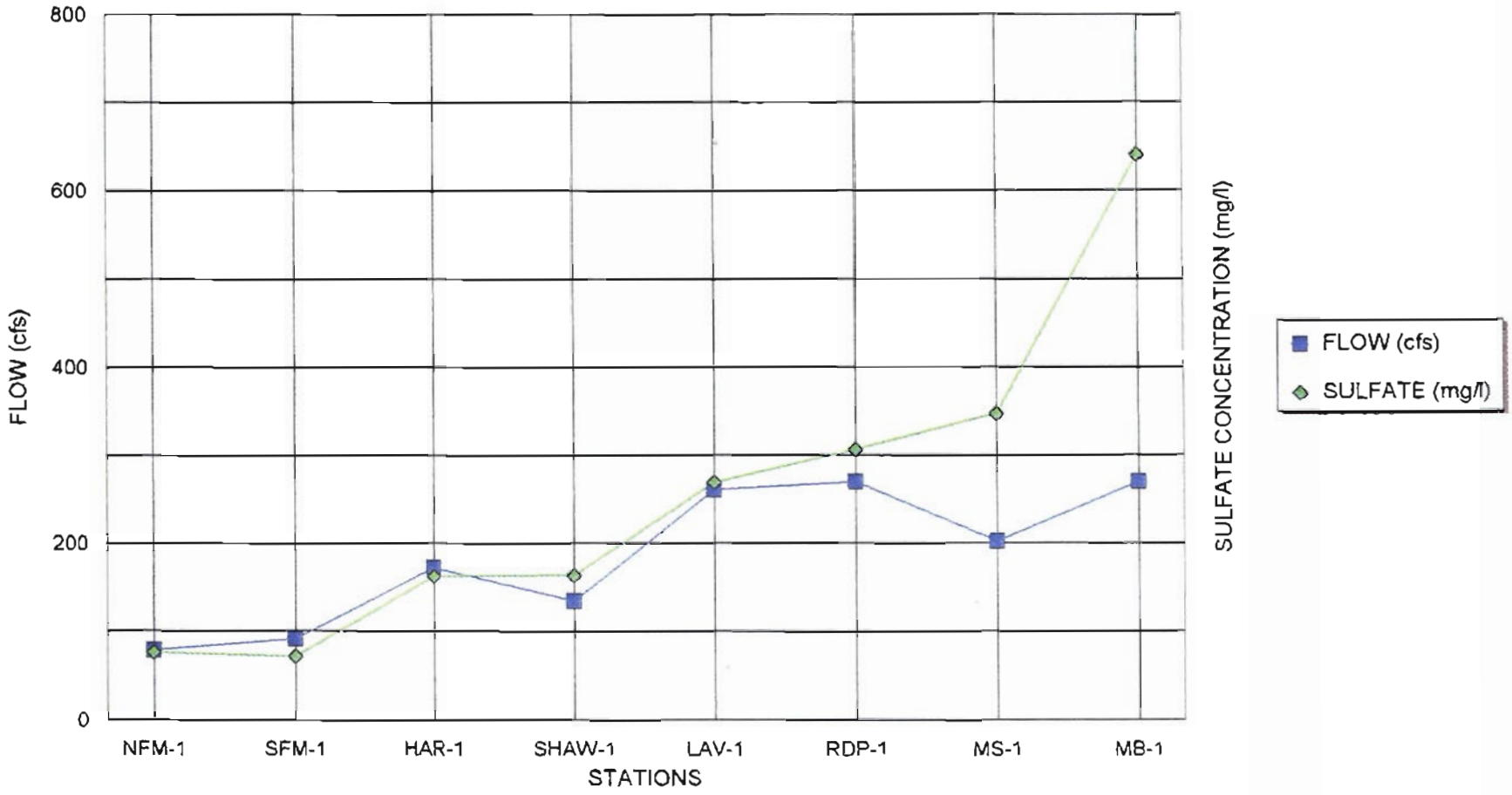
USE THE SAME SCALE FOR BOTH SULFATE, AND FLOW

SHAW-1 THERE WAS NO FLOW MEASUREMENT, DEADMANS BASIN WAS DIVERTING WATER. THE VALUE IS ESTIMATED FROM PREVIOUS RECORDS

Fig. WQ-28

SULFATE CONCENTRATION ALONG MUSSELSHELL RIVER

JUNE 1,1994

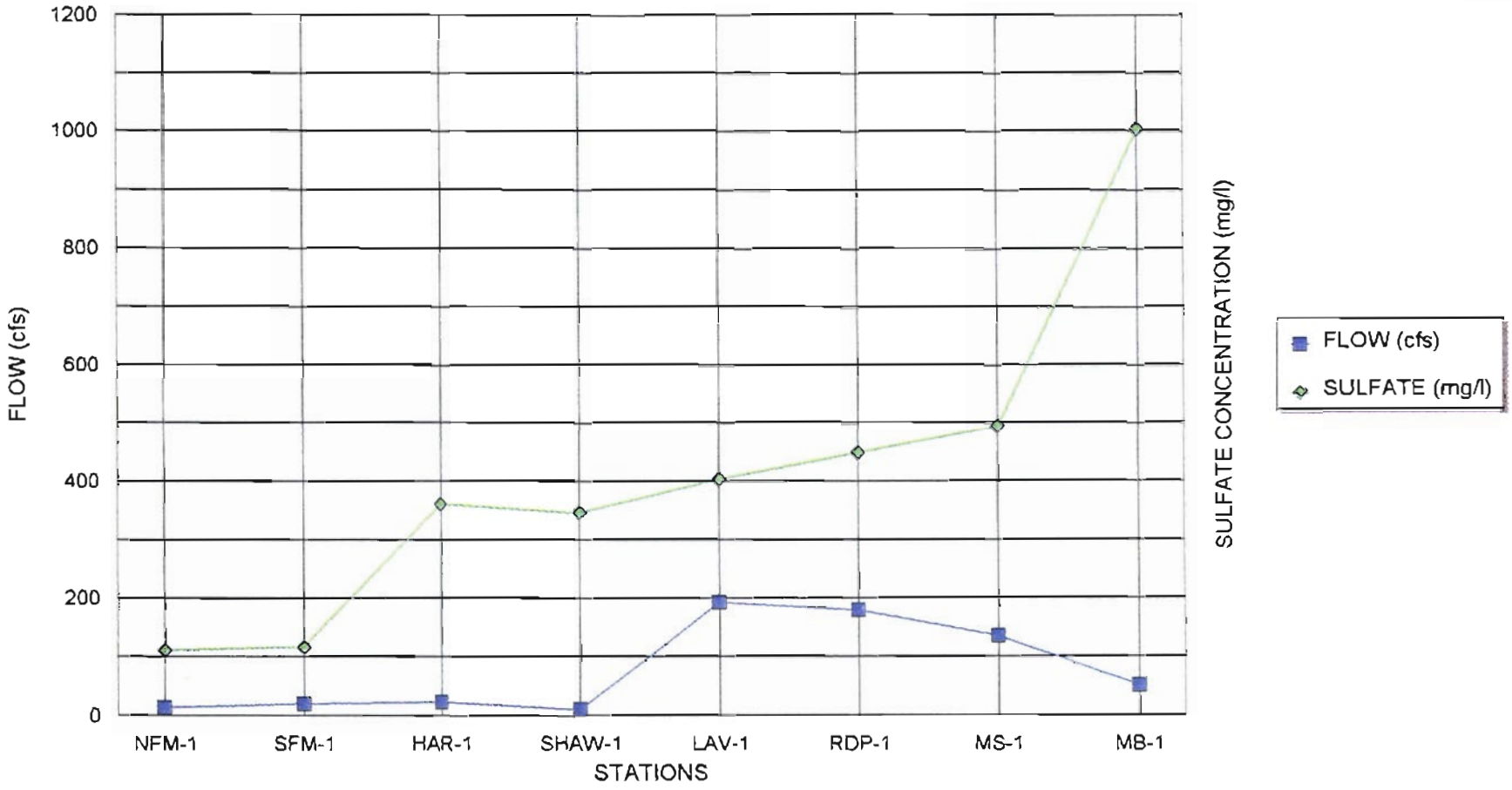


USE THE SAME SCALE FOR BOTH SULFATE, AND FLOW

Fig. WQ-29

SULFATE CONCENTRATION ALONG MUSSELSHELL RIVER

SEPTEMBER 2 ,1994

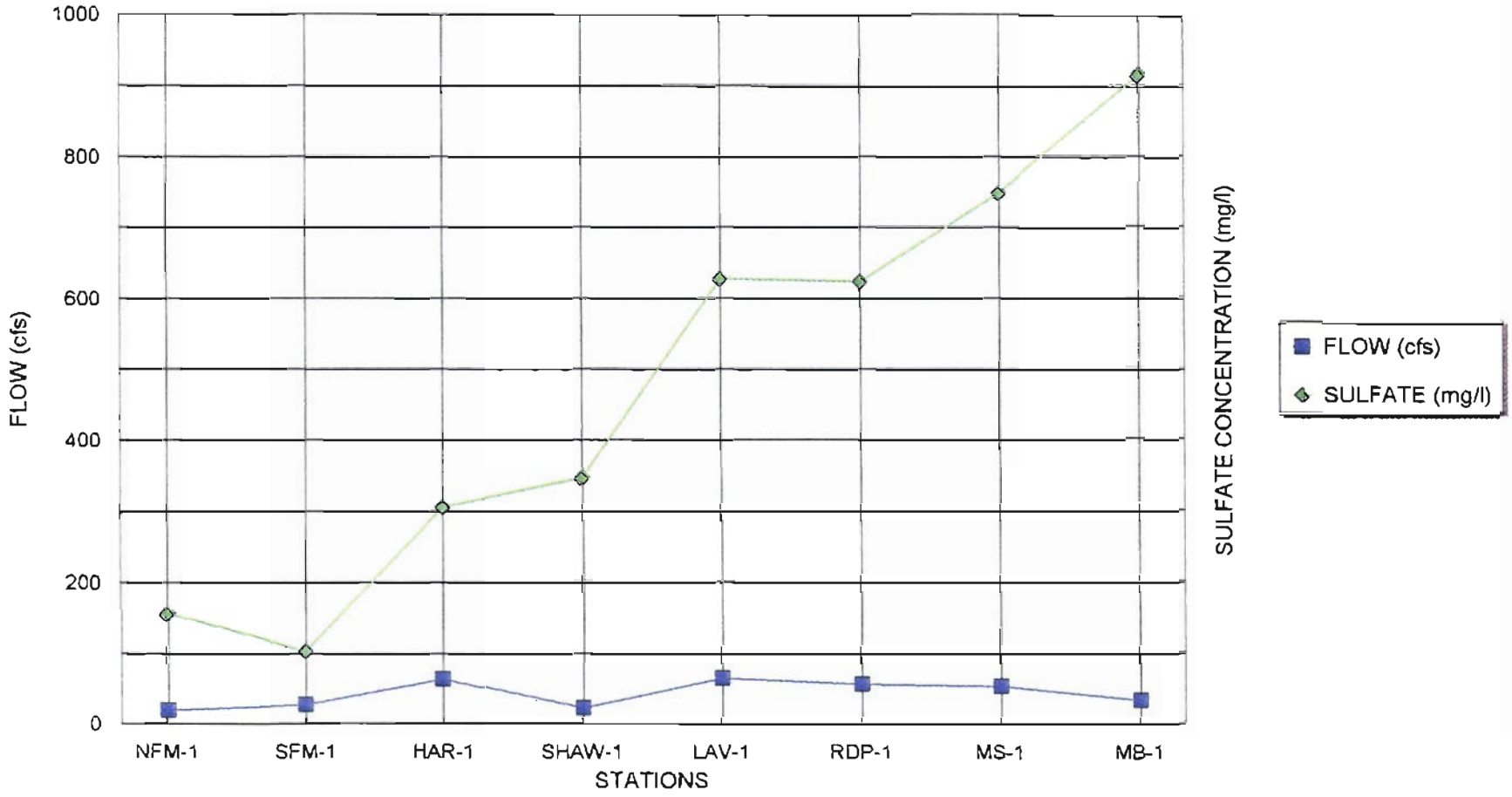


USE THE SAME SCALE FOR BOTH SULFATE, AND FLOW

Fig. WQ-30

SULFATE CONCENTRATION ALONG MUSSELSHELL RIVER

OCTOBER 12 ,1994



USE THE SAME SCALE FOR BOTH SULFATE, AND FLOW

Fig. WQ-31

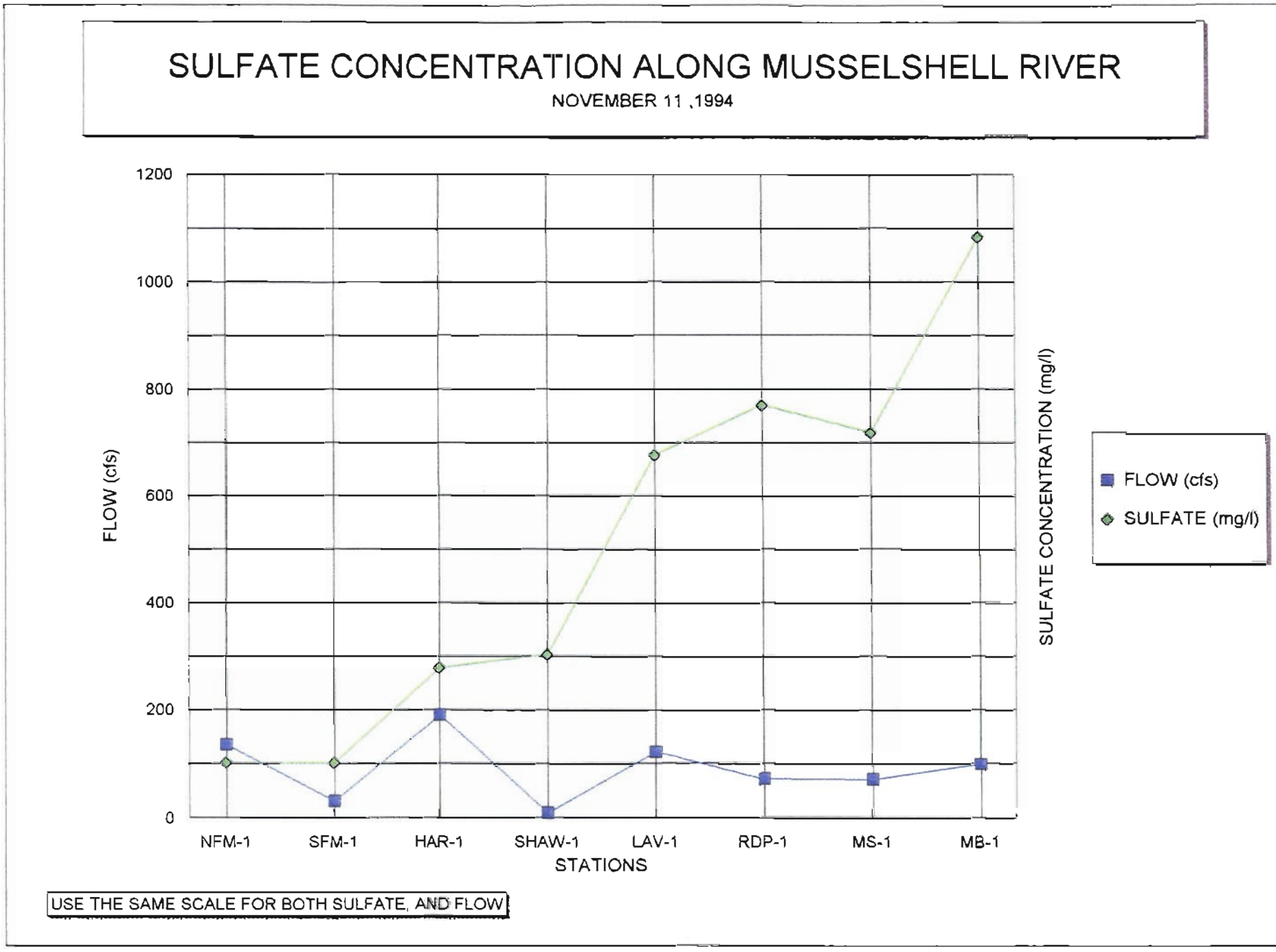

SULFATE CONCENTRATION ALONG MUSSELSHELL RIVER
NOVEMBER 11 ,1994
1200
1000
800
600
400
200
0
FLOW (cfs)
SULFATE CONCENTRATION (mg/l)
NFM-1
SFM-1
HAR-1
SHAW-1
LAV-1
RDP-1
MS-1
MB-1
STATIONS
FLOW (cfs)
SULFATE (mg/l)
USE THE SAME SCALE FOR BOTH SULFATE, AND FLOW

Fig. WQ-33

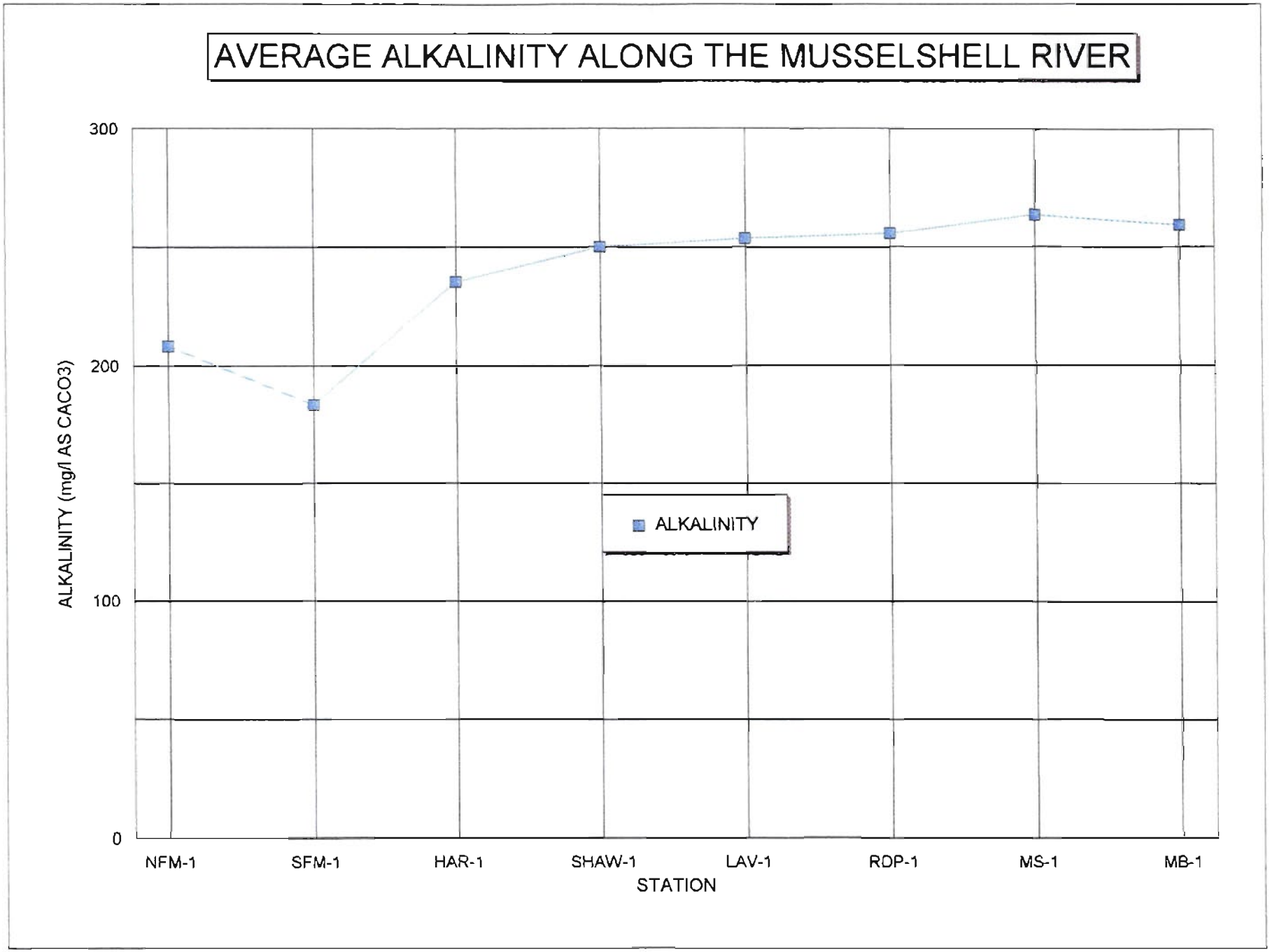
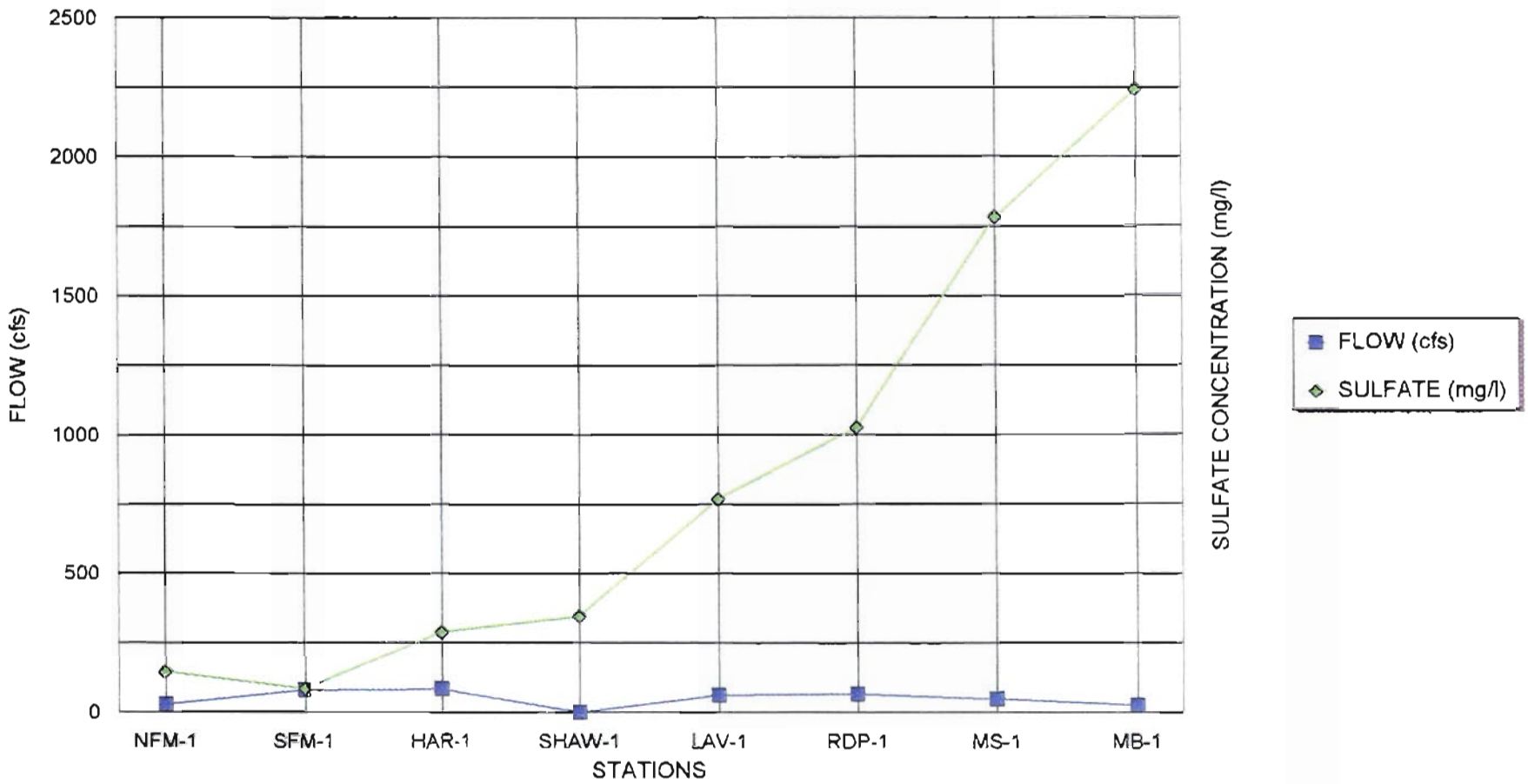

AVERAGE ALKALINITY ALONG THE MUSSELSHELL RIVER
300
200
100
0
ALKALINITY (mg/l AS CACO3)
ALKALINITY
NFM-1
SFM-1
HAR-1
SHAW-1
LAV-1
RDP-1
MS-1
MB-1
STATION

Fig. WQ-32

SULFATE CONCENTRATION ALONG MUSSELSHELL RIVER

MAY 12 ,1995

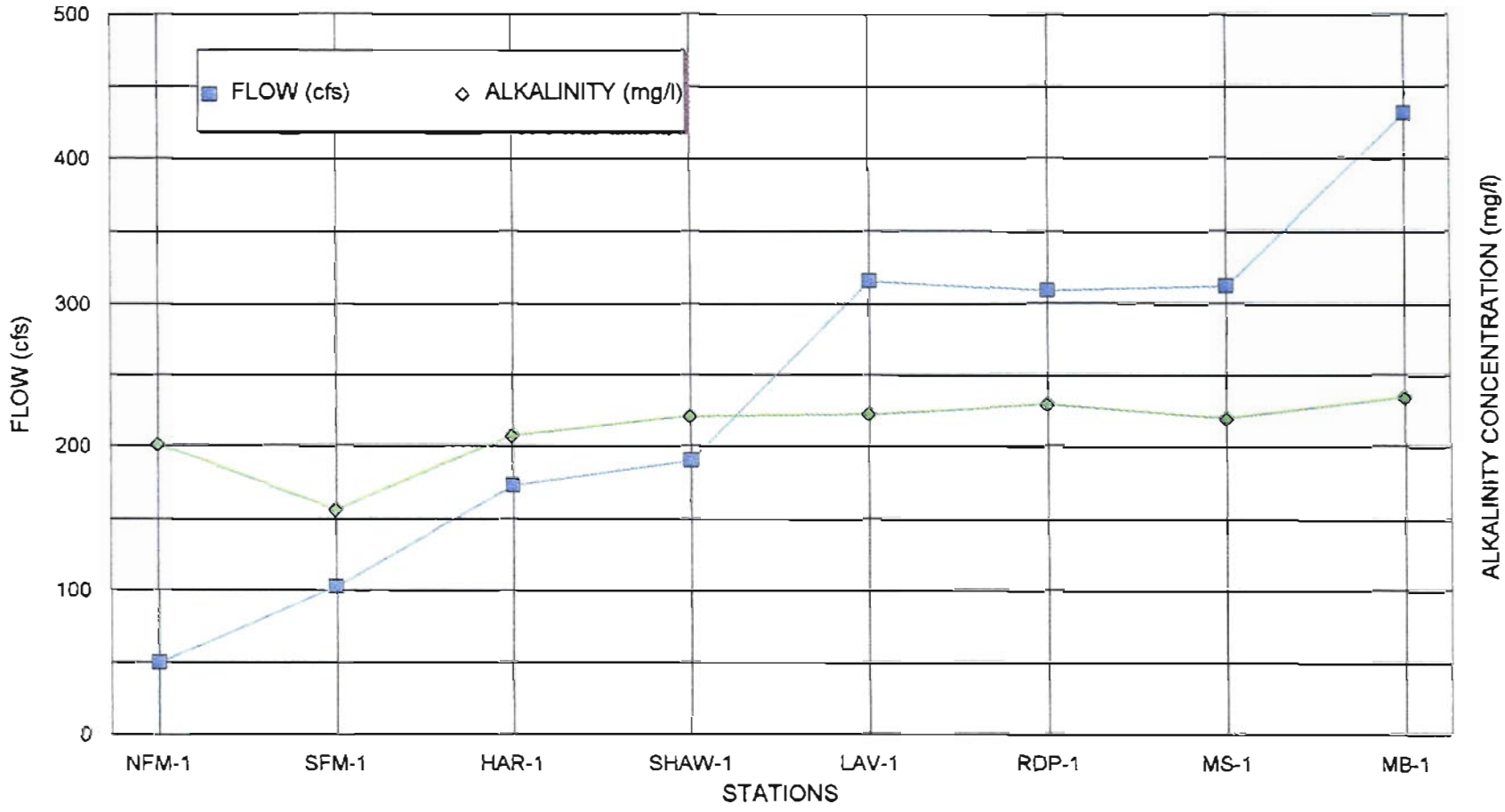


USE THE SAME SCALE FOR BOTH SULFATE, AND FLOW
DEADMANS BASIN IS DIVERING ALMOST ALL FLOW BETWEEN HAR-1 AND SHAW-1

Fig. WQ-34

ALKALINAITY ALONG MUSSELSHELL RIVER

SEPTEMBER 29,1993



USE THE SAME SCALE FOR BOTH ALKALINITY, AND FLOW

Fig. WQ-35

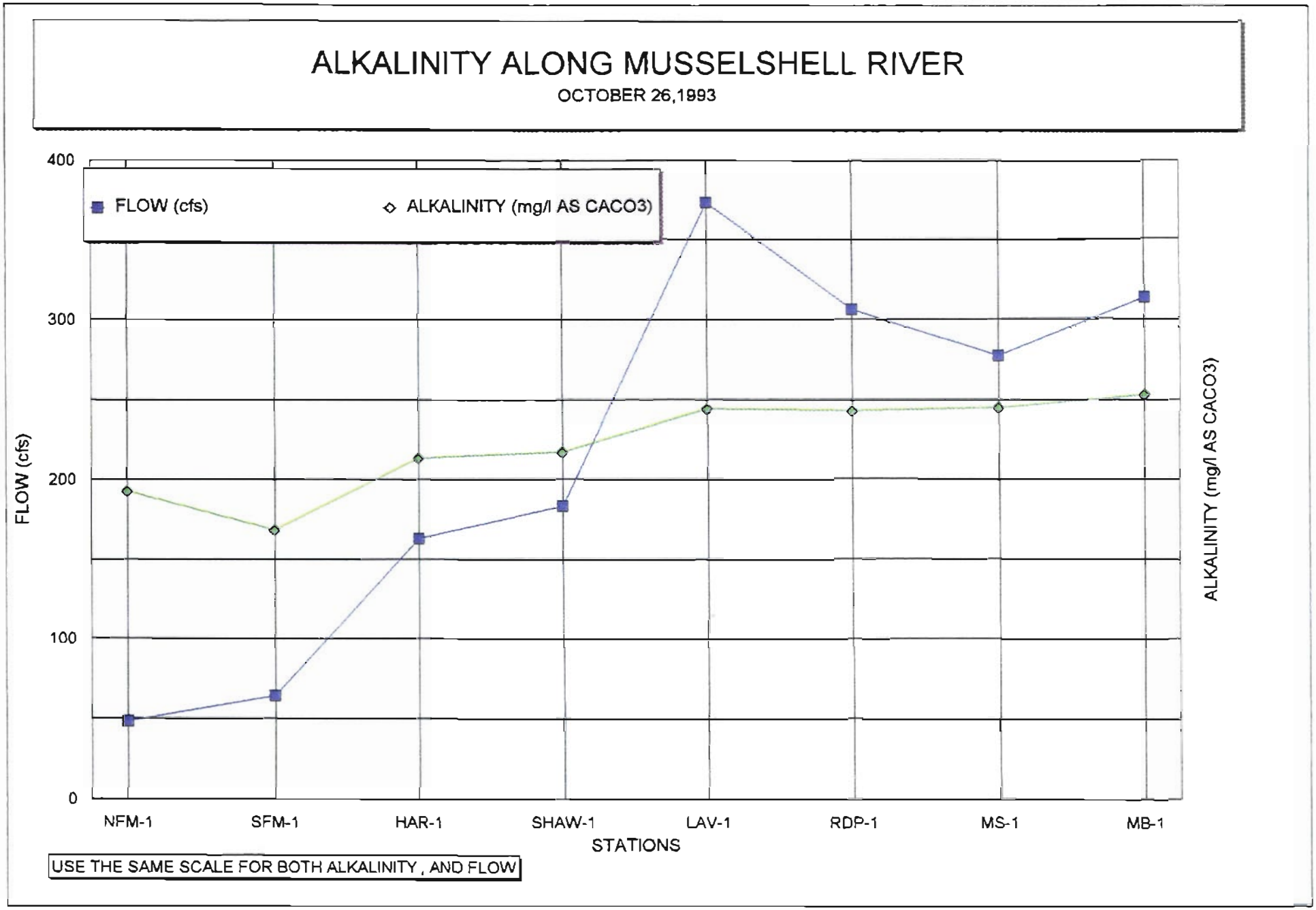
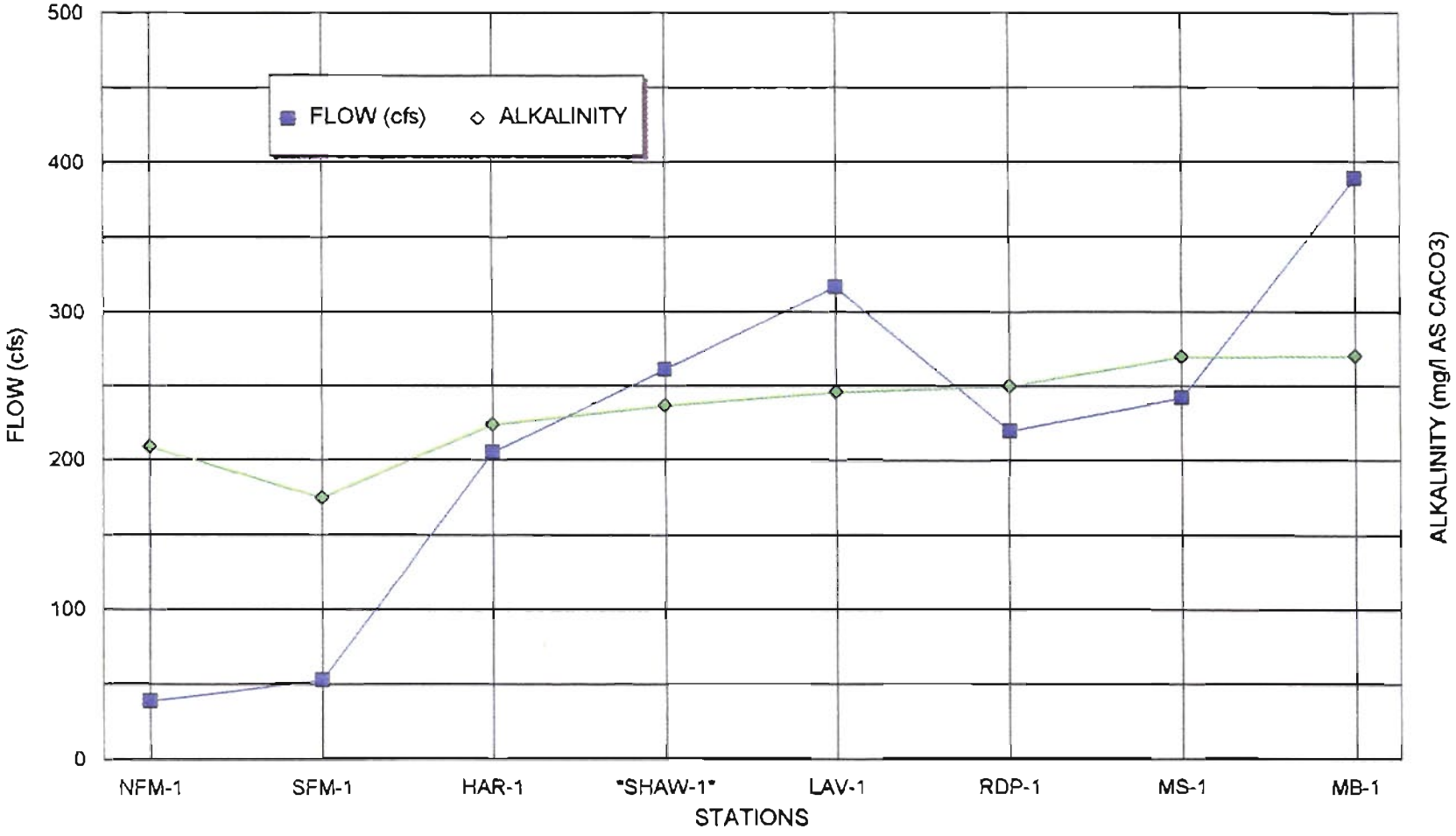

ALKALINITY ALONG MUSSELSHELL RIVER
OCTOBER 26,1993
FLOW (cfs)
ALKALINITY (mg/l AS CACO3)
400
300
200
100
0
FLOW (cfs)
ALKALINITY (mg/l AS CACO3)
NFM-1
SFM-1
HAR-1
SHAW-1
LAV-1
RDP-1
MS-1
MB-1
STATIONS
USE THE SAME SCALE FOR BOTH ALKALINITY , AND FLOW

Fig. WQ-36

ALKALINITY ALONG MUSSELSHELL RIVER

NOVEMBER 23,1993



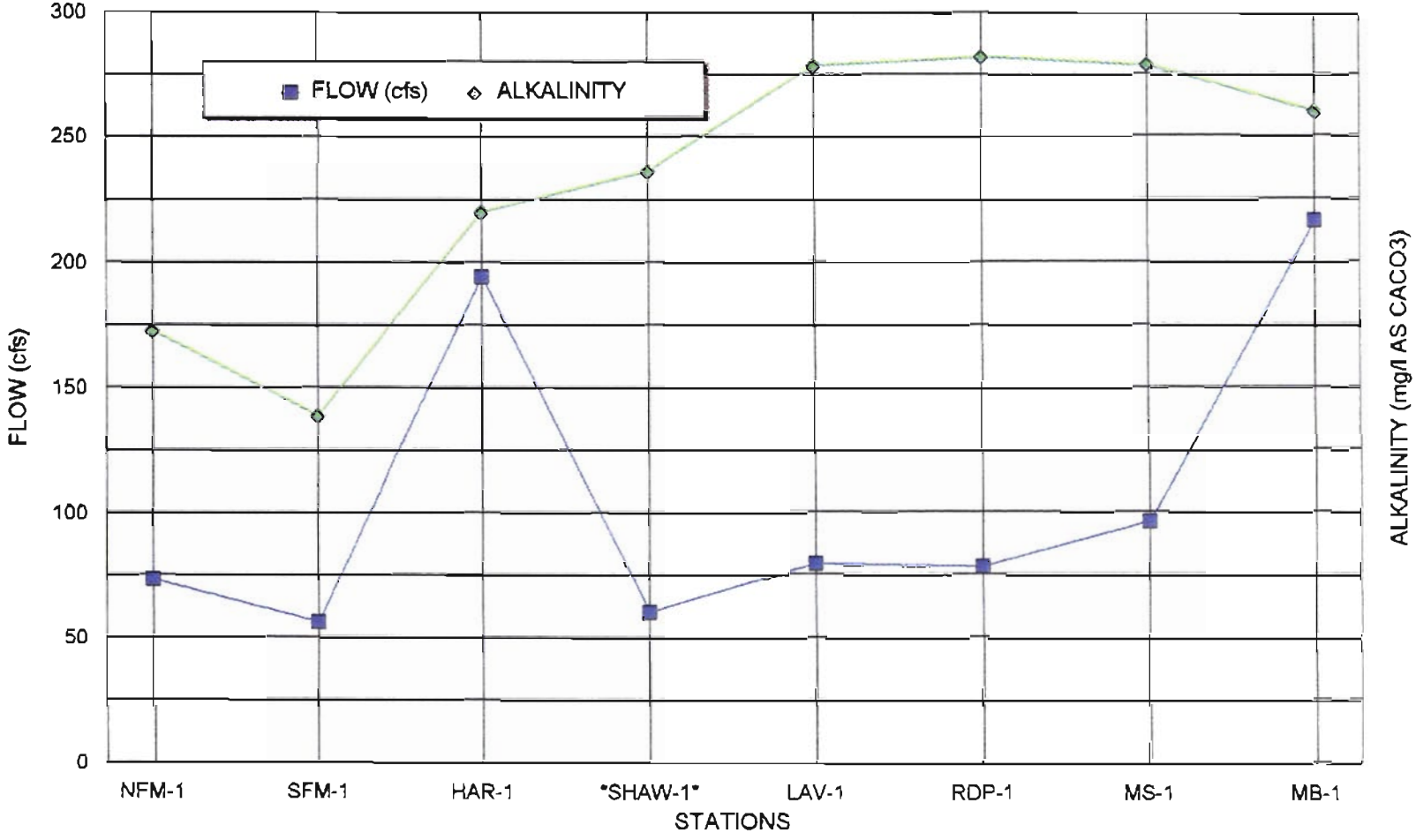
USE THE SAME SCALE FOR BOTH ALKALINITY, AND FLOW

"SHAW-1" THERE WERE NO FLOW MEASUREMENTS SO THE VALUE IN THE GRAPH IS THE AVERAGE OF THE ADJACENT STATIONS

Fig. WQ-37

ALKALINITY ALONG MUSSELSHELL RIVER

APRIL 14 ,1994



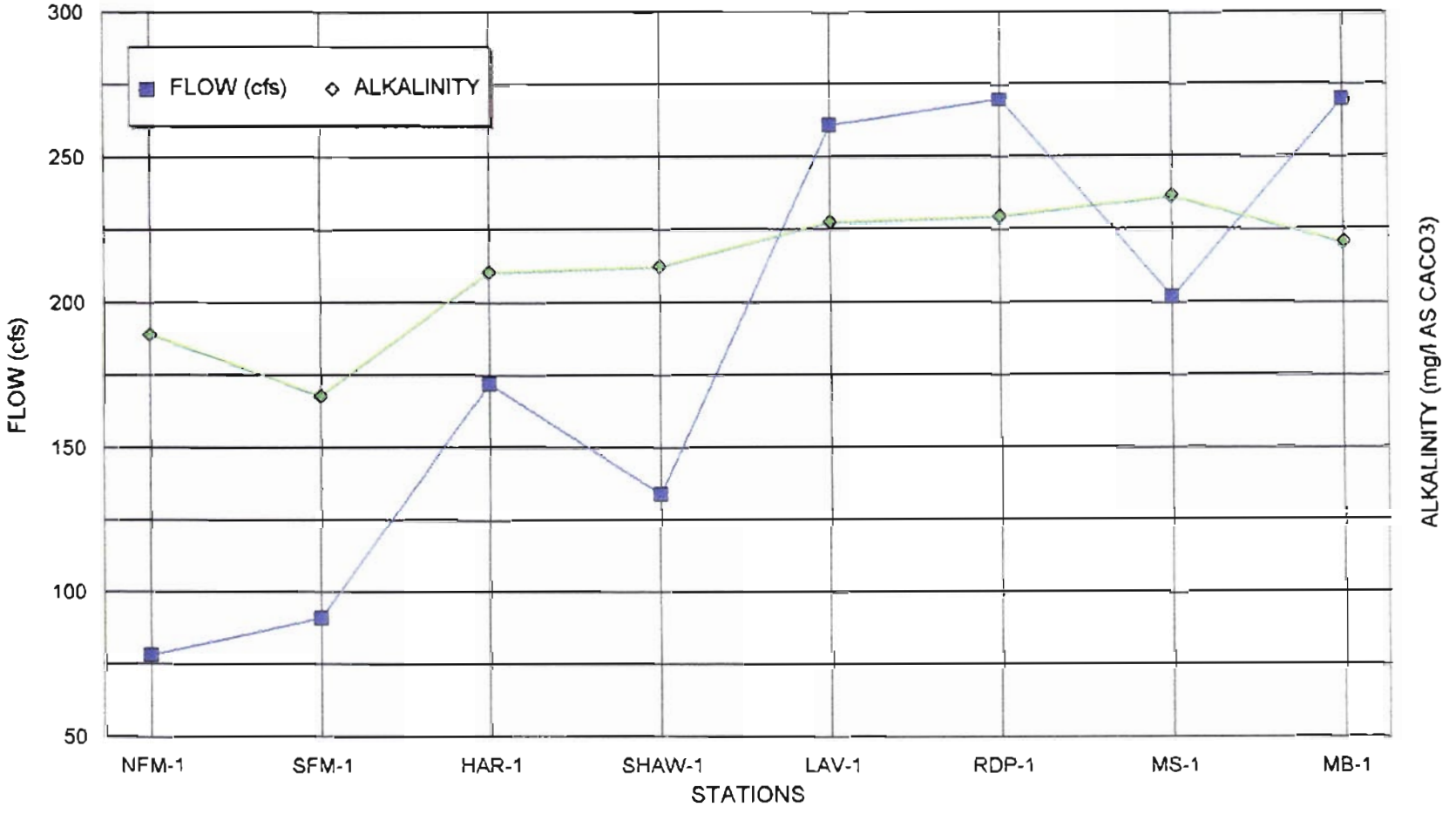
USE THE SAME SCALE FOR BOTH ALKALINITY, AND FLOW

"SHAW-1" THERE WAS NO FLOW MEASUREMENT, DEADMANS BASIN WAS DIVERTING WATER. THE VALUE IS ESTIMATED FROM PREVIOUS RECORDS

Fig. WQ-38

ALKALINITY ALONG MUSSELSHELL RIVER

JUNE 1,1994

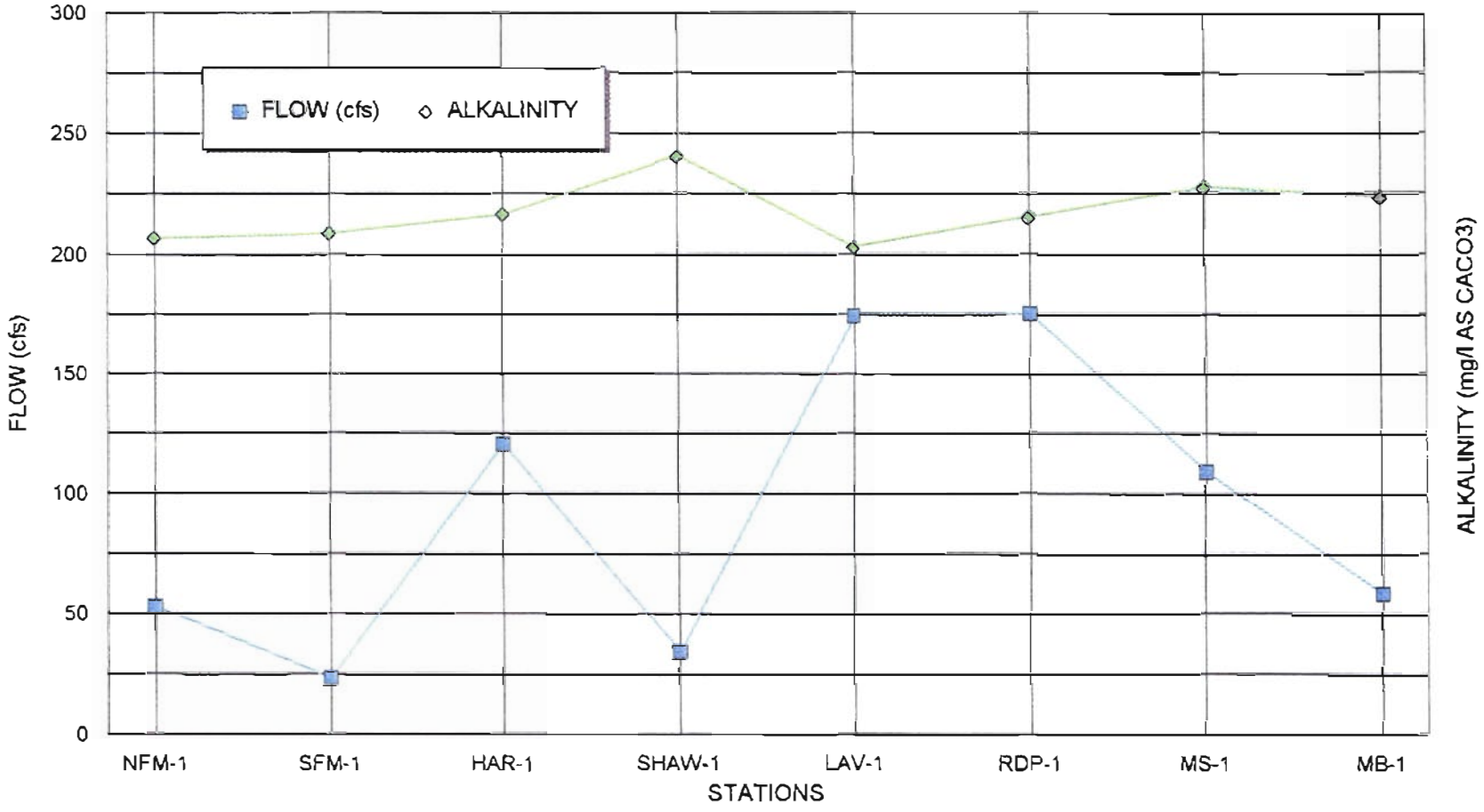


USE THE SAME SCALE FOR BOTH ALKALIINITY, AND FLOW

Fig. WQ-39

ALKALINITY ALONG MUSSELSHELL RIVER

AUGUST 3 ,1994

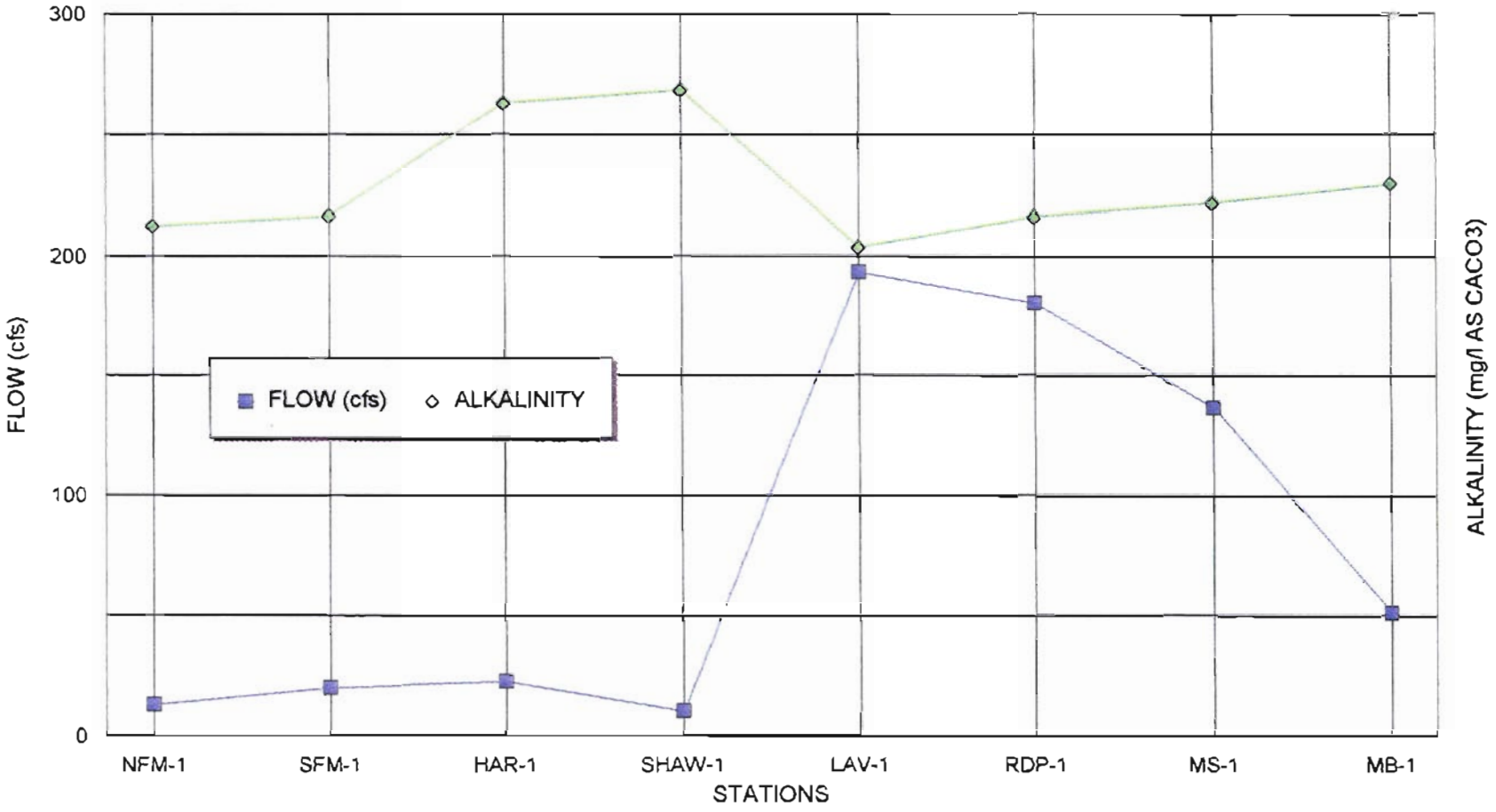


USE THE SAME SCALE FOR BOTH ALKALINITY, AND FLOW

Fig. WQ-40

ALKALINITY ALONG MUSSELSHELL RIVER

SEPTEMBER 2 ,1994

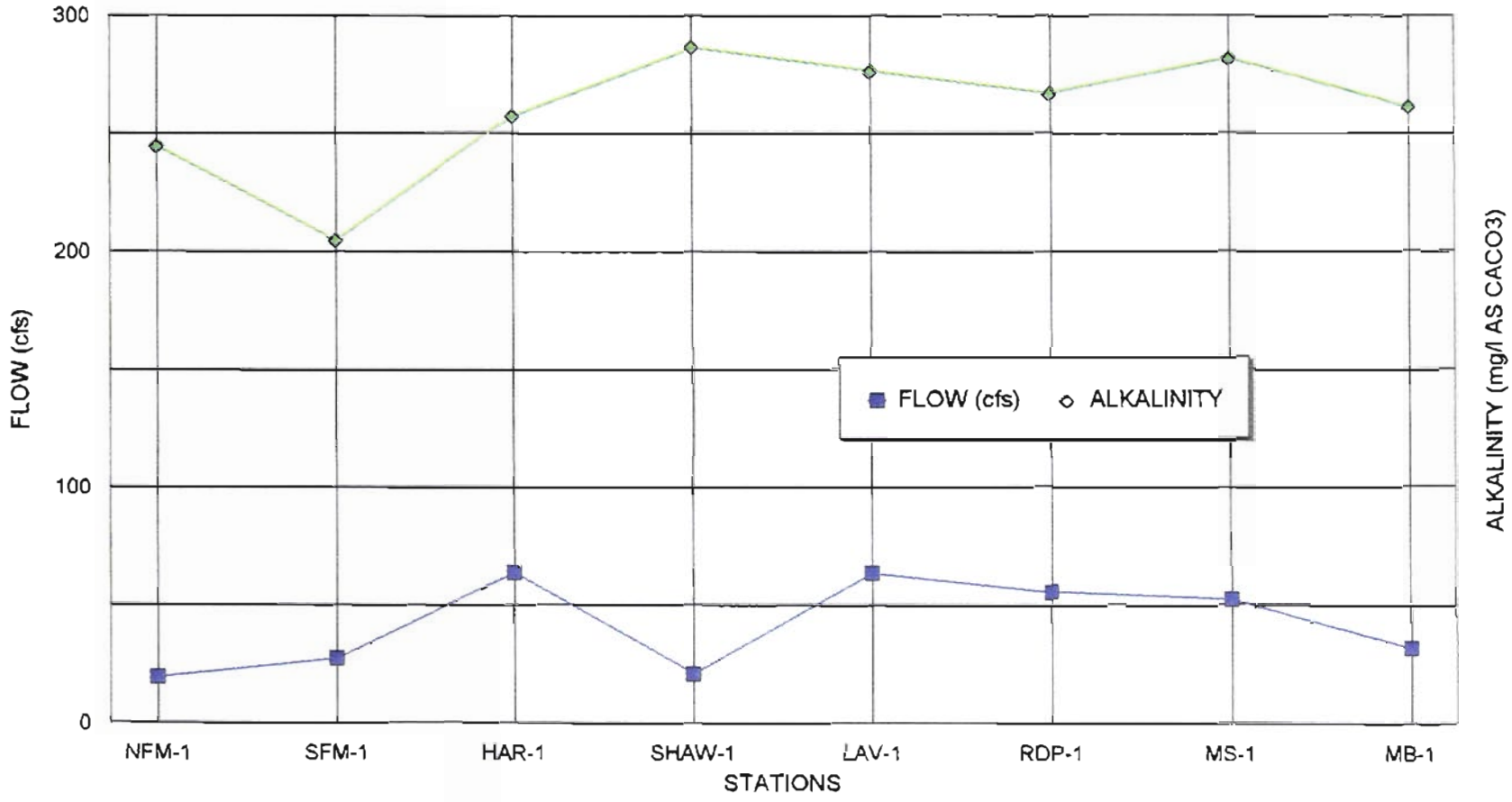


USE THE SAME SCALE FOR BOTH ALKALINITY, AND FLOW

Fig. WQ-41

ALKALINITY ALONG MUSSELSHELL RIVER

OCTOBER 12 ,1994



USE THE SAME SCALE FOR BOTH ALKALINITY, AND FLOW

Fig. WQ-42

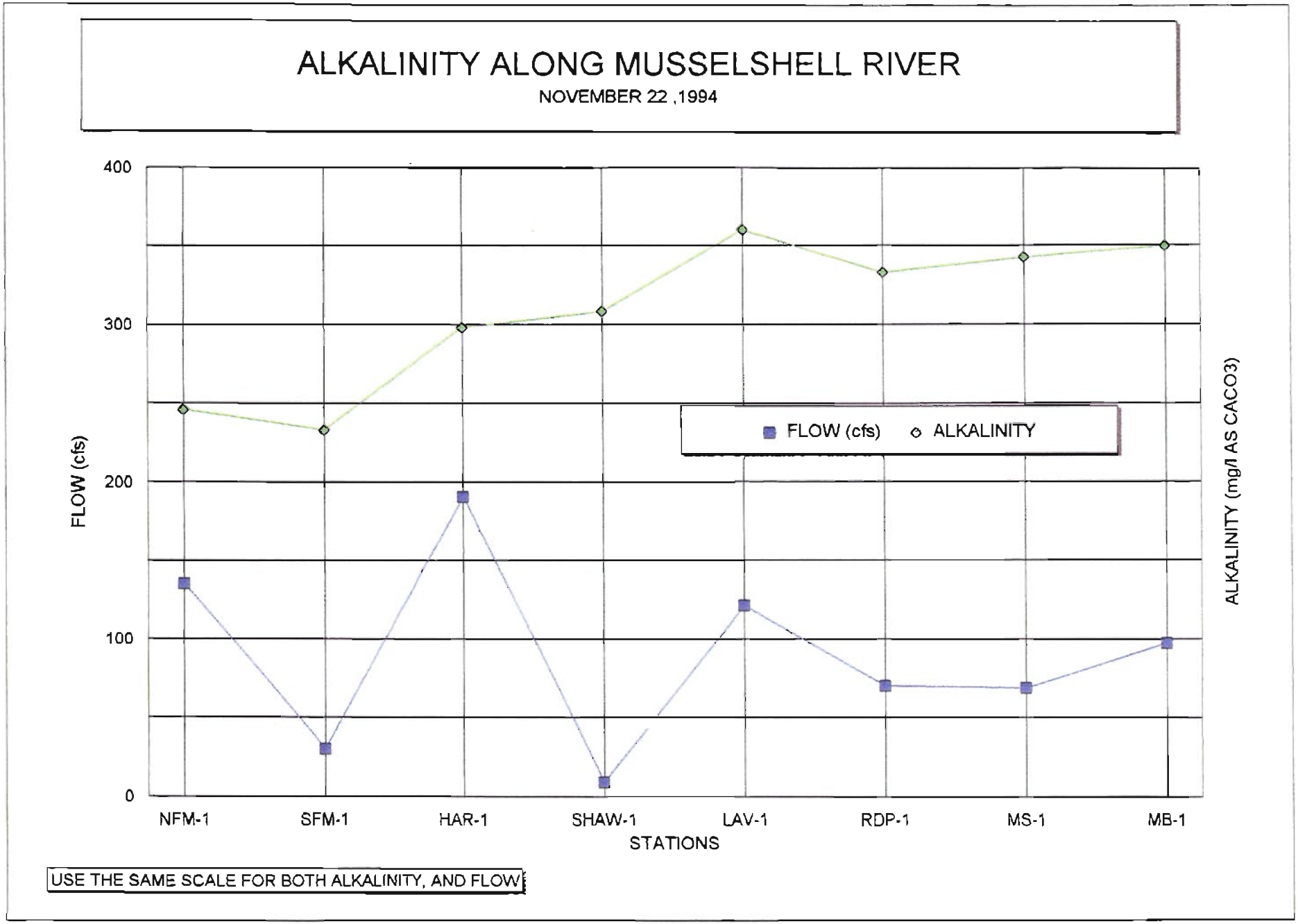
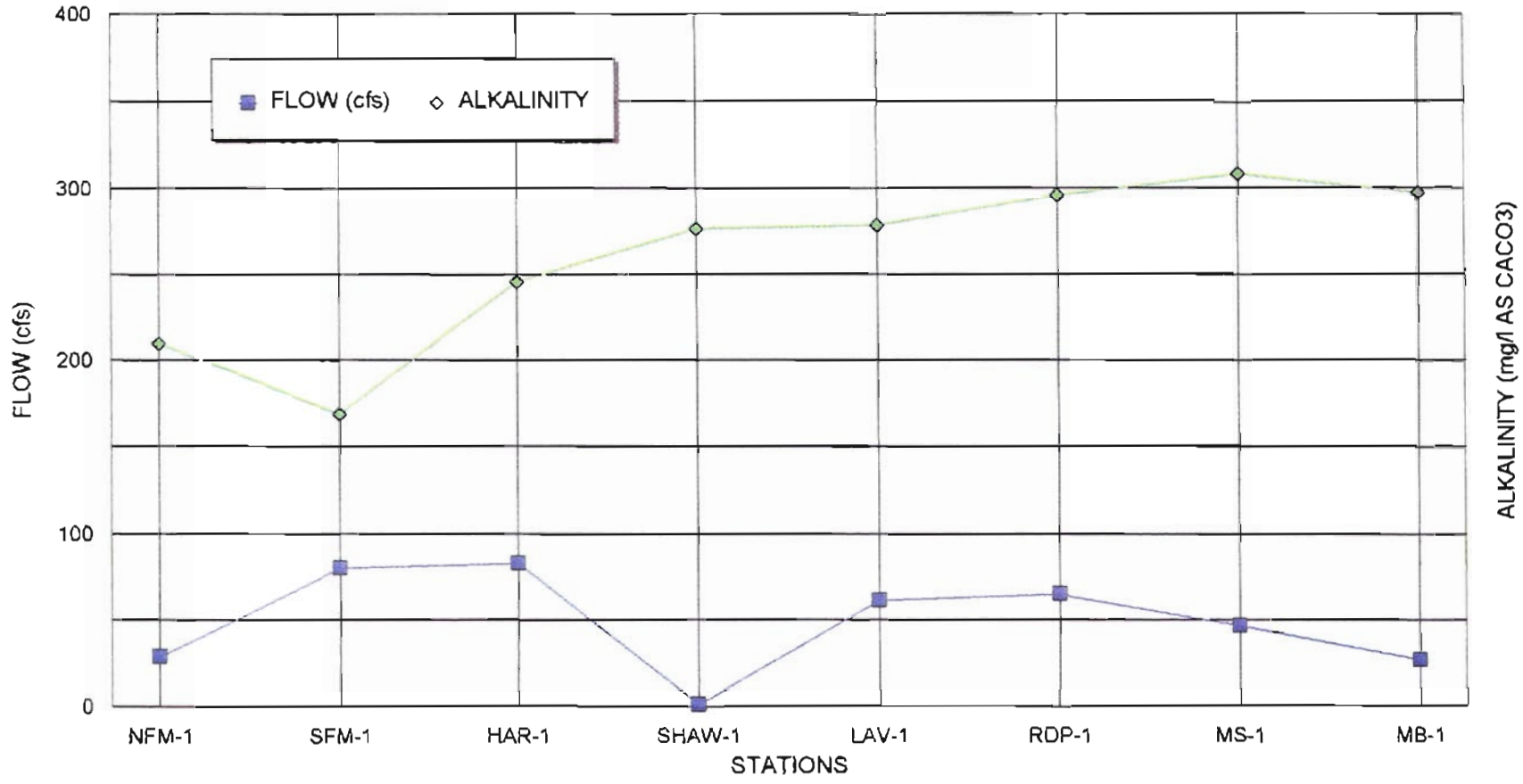

ALKALINITY ALONG MUSSELSHELL RIVER
NOVEMBER 22 ,1994
400
300
200
100
0
FLOW (cfs)
ALKALINITY (mg/l AS CACO3)
FLOW (cfs)
ALKALINITY
NFM-1
SFM-1
HAR-1
SHAW-1
LAV-1
RDP-1
MS-1
MB-1
STATIONS
USE THE SAME SCALE FOR BOTH ALKALINITY, AND FLOW

Fig. WQ-43

ALKALINITY ALONG MUSSELSHELL RIVER

MAY 12 ,1995



USE THE SAME SCALE FOR BOTH ALKALINITY, AND FLOW
DEADMANS BASIN IS DIVERING ALMOST ALL FLOW BETWEEN HAR-1 AND SHAW-1

Table WQ-2: Raw Water Quality Data

MUSSELSHELL RIVER WATER MANAGEMENT STUDY

Report of Water Quality Analysis
Painted Robe Creek

Site ID: PRC-1

Date Collected	FLOW cfs	Lab EC umHos	Field EC umHos	Lab PH	Field PH	Lab Temp C	Field Temp C	Calcium mg/l	Magnesium mg/l	Potassium mg/l	Sodium mg/l	Alkalinity CACO3 mg/l	Chloride mg/l	Sulfate mg/l	TDS mg/l	SAR	Hardness mg CaCO3/l	Cation/Anion Balance %
10/26/93	2.3	5670	3000	7.83		25	3	279	373	11.4	775	360.5	71.7	3438	5164.5	7.14	2231.9	-1.4
11/18/93	1.62		2980		7.6		0	294	383	10.8	831	394.1	74.4	3491.2	5319.7	7.52	2309	-0.1
4/13/94	0.738		3425		8.52		11	233	329	8.7	6.3	333.8	68	2668.1	4119.2	6.06	1934.8	1.1
6/1/94	0.123		4800		8.5		17	198	358	8.3	925	277.2	86.8	3326.6	5068.9	9.07	1968.7	1.6
8/2/94	NO FLOW																	
9/1/94	NO FLOW																	
10/12/94	NO FLOW																	
11/23/94	NO FLOW		>8000		8.2		32	EC, PH, AND TEMPERATURE MEASUREMENTS TAKEN IN SCOUR HOLE FILLED WITH STANDING WATER										
5/12/95	6		n/a		n/a		n/a	251	367	10.3	807	366.9	68.5	2962	4685.7	7.6	2136.8	4.8

Date Collected	Arsenic ug/l	Cadmium ug/l	Chromium ug/l	Copper ug/l	Iron ug/l	Lead ug/l	Manganese ug/l	Mercury ug/l	Selenium ug/l	Zinc ug/l
6/1/94	1.3	0.04	<1.0	2.1	44	<1.0	26	<0.2	<1.0	10

Report of Water Quality Analysis
Roundup

Site ID: RDP-1

Date Collected	Flow cfs	Lab EC umHos	Field EC umHos	Lab PH	Field PH	Lab Temp C	Field Temp C	Calcium mg/l	Magnesium mg/l	Potassium mg/l	Sodium mg/l	Alkalinity CACO3 mg/l	Chloride mg/l	Sulfate mg/l	TDS mg/l	SAR	Hardness mg CaCO3/l	Cation/Anion Balance %
9/29/93	309	1000		8.31		25	13	78	46	3.2	96	229.3	9.9	310.4	680.9	2.13	383.5	2.6
10/26/93	306	1090	750	8.07	8.95	25	5.75	84	51	3.1	109	243	13.3	375.9	781.6	2.31	420.2	0.5
11/16/93	220		630		7.75		0.5	90	50	3	104	249.7	13	379.8	788.3	2.18	430	-0.2
4/14/94	78		1300		8.7		9	101	90	3.9	226	281.7	25.9	758.1	1374.1	3.95	622.2	0.5
6/2/94	270		810		10.5		17	78	44	3.3	86	229.4	10.2	306.4	664.8	1.93	374.3	0.2
8/3/94	175		1425		9.34		N/A	79	57	3.4	122	215	12.7	425.7	828.9	2.57	431.1	1.8
9/2/94	180		N/A		N/A		N/A	65	50	2.4	113	215.7	12.1	448.1	820	2.57	366.6	-6.4
10/12/94	55		1775		8.46		45	93	77	3.6	182	266.4	17.8	622.3	1155.1	3.38	547.7	0.4
11/22/94	70		2130		8.97		32	117	91	3.8	210	332.8	21.3	770.5	1413	3.54	666.5	-1.6
5/12/95	65		n/a		n/a			120	117	5.6	291	295.4	35.2	1026.4	1772.1	4.53	780.2	0.2

Date Collected	Arsenic ug/l	Cadmium ug/l	Chromium ug/l	Copper ug/l	Iron ug/l	Lead ug/l	Manganese ug/l	Mercury ug/l	Selenium ug/l	Zinc ug/l
9/29/93	1.6	<0.2	<1	<1	365	<1	30	<0.2	<1	n/a
6/2/94	1.1	0.3	3.45	3.3	1189	<1.0	66	1.07	1	12
10/13/95	<1.0	<0.2	<1.0	1.5	183	<1.0	14	<0.2	<1.0	4

Table WQ-2: Raw Water Quality Data

MUSSELSHELL RIVER WATER MANAGEMENT STUDY

Report of Water Quality Analysis
Harlowton

Site ID: HAR-1

Date Collected	Flow cfs	Lab EC umHos	Field EC umHos	Lab PH	Field PH	Lab Temp C	Field Temp C	Calcium mg/l	Magnesium mg/l	Potassium mg/l	Sodium mg/l	Alkalinity CACO3 mg/l	Chloride mg/l	Sulfate mg/l	TDS mg/l	SAR	Hardness mg CaCO3/l	Cation/Anion Balance %
9/29/93	173	630	550	8.37		25	14	71	27	2.4	37	207.7	4.1	148.9	415.1	0.95	287.9	0.4
10/26/93	163	620	425	7.98			7	72	28	1.8	38	212.9	4.9	171.4	444.1	0.96	296.3	-2.2
11/16/93	205		343		8.5		0.9	80	31	1.8	41	223.4	5.2	172.4	464.5	0.98	325.3	0.7
4/13/94	194		525		9.75		6.3	77	32	2.6	51	219.5	7	205.8	507.1	1.23	324.2	-0.6
6/1/94	172		650		9.19		18	75	26	2.3	43	210.4	5.2	162.2	439.8	1.09	293.6	0.5
8/2/94	120		925		9.6		n/a	77	34	3	53	216.2	6.1	208.5	511.8	1.27	332.4	1.2
9/1/94	22.4		n/a		n/a		n/a	86	43	2.9	92	262.9	9.9	360.4	751.6	2.03	389.8	-4.7
10/12/94	63.29		1085		8.65		46	97	43	2.7	75	257.3	9.1	304.9	686	1.59	418.9	-0.2
11/23/94	190		1100		9.1		32	100	43	2.6	68	297.8	8.4	279	679.6	1.44	425.6	-1.9
5/13/95	83		n/a		n/a		n/a	92	40	2.5	56	245.5	7.2	286.9	631.7	1.23	393.6	-3.3

Date Collected	Arsenic ug/l	Cadmium ug/l	Chromium ug/l	Copper ug/l	Iron ug/l	Lead ug/l	Manganese ug/l	Mercury ug/l	Selenium ug/l	Zinc ug/l
9/29/93	1	<0.2	<1	<1	87	<1	22	<0.2	<1	n/a
6/1/94	<1.0	0.3	<1.0	1.6	163	<1.0	24	<0.2	<1.0	0
10/12/95	<1.0	0.21	<1.0	<1.0	82	<1.0	17	<0.2	<1.0	0

Report of Water Quality Analysis
Lavina

Site ID: LAV-1

Date Collected	Flow cfs	Lab EC umHos	Field EC umHos	Lab PH	Field PH	Lab Temp C	Field Temp C	Calcium mg/l	Magnesium mg/l	Potassium mg/l	Sodium mg/l	Alkalinity CACO3 mg/l	Chloride mg/l	Sulfate mg/l	TDS mg/l	SAR	Hardness mg CaCO3/l	Cation/Anion Balance %
9/29/93	316	930		8.32		25	13	77	41	2.9	85	222.7	8.5	286.9	635.4	1.95	361.9	1.6
10/26/93	373	1070		7.83		25	5	84	48	4.6	103	243.9	11.1	340.9	737.4	2.22	406.6	1.7
11/16/93	317		*475		7.64		0.75	65	46	2.8	91	245.8	9.5	262.7	624.2	2.1	351.9	1.8
4/13/94	79		1150		9.01		11	89	74	3.6	192	276.2	21.3	619.3	1166.4	3.65	526.4	-0.2
6/1/94	261		650		9.51		16.5	61	38	2.6	84	227.4	8.4	268.8	619.5	1.94	358.1	2.4
8/2/94	174		1200		9.43		N/A	74	52	3.1	106	202.4	10.5	375.3	742.7	2.3	400.2	2.1
9/1/94	193.1		N/A		N/A		N/A	67	48	2.4	100	203.5	10.5	402.8	752	2.27	363.3	-4.5
10/12/94	63.2		1750		8.62		44	99	78	3.6	179	275.7	17.1	627	1169	3.27	568	0.5
11/23/94	121		1750		8.4		32	115	82	3.6	178	360	18.6	675.6	1288.8	3.1	624.8	-3.5
5/12/95	81.6		N/A		N/A		N/A	97	92	3.7	232	278.4	21.6	768	1381.3	4.05	620.7	0.9

* Appears an error occured during field measurement.

Date Collected		Arsenic ug/l	Cadmium ug/l	Chromium ug/l	Copper ug/l	Iron ug/l	Lead ug/l	Manganese ug/l	Mercury ug/l	Selenium ug/l
9/29/93		1.7	<0.2	<1	1.6	312	<1	26	<0.2	<1
9/29/93	CONTROL								<0.2	
5/1/94		1	0.04	2.62	3.2	1186	<1.0	68	<0.2	<1.0
10/13/94		<1.0	<0.2	<1.0	<1.0	164	<1.0	22	<0.2	<1.0

Table WQ-2: Raw Water Quality Data

C:\-MUSSEL\MODEL\WQNARR\COMBWAT.WK4

MUSSELSHELL RIVER WATER MANAGEMENT STUDY

Report of Water Quality Analysis
Careless Creek

Site ID: CC-1

Date Collected		Flow cfs	Lab EC umHos	Field EC umHos	Lab PH	Field PH	Lab Temp C	Field Temp C	Calcium mg/l	Magnesium mg/l	Potassium mg/l	Sodium mg/l	Alkalinity CACO3 mg/l	Chloride mg/l	Sulfate mg/l	TDS mg/l	SAR	Hardness mg CaCO3/l	Cation/Anion Balance %
9/29/93		40	1290	1000	8.34		25	11	80	58	4.3	146	233.7	13.5	462.9	904.8	3.0	438.8	1.8
9/29/93	CONTROL	40	1310	1000	8.33		25	11	79	58	4.0	147	236.7	13.8	455.6	898.7	3.1	435.7	2.0
10/26/93		46	1320	875	8.04			4.5	83	64	3.8	144	245.1	16.4	525.7	984.4	2.9	472.0	-1.6
11/17/93		36.7		625		9		0.25	79	60	3.4	137	245.4	15.9	451.1	893.3	2.8	443.8	0.5
4/13/94		4.8		1675		8.78		11	97	101	4.7	320	352.0	46.1	928.0	1708.0	5.4	656.9	-1.0
6/1/94		40.35		850		9.34		16.5	82	51	4.1	123	221.6	12.6	431.8	837.5	2.6	414.3	-0.1
8/2/94		12.01		1510		9.33		n/a	72	61	3.6	149	185.7	12.6	515.8	925.6	3.1	430.3	1.3
9/1/94		36.06		n/a		n/a		n/a	64	46	3.1	112	182.0	10.4	455.3	799.4	2.6	348.8	-6.0
10/12/94		1		3050		8.29		11.1	127	124	4.5	423	291.1	25.7	1310.0	2189.2	6.4	829.4	1.8
11/23/94		1.75		4250		8.7		0	182	183	5.4	628	414.5	37.7	2197.8	3482.6	7.9	1208.0	-3.3
5/12/95		7.61		n/a		n/a		n/a	125	138	5.1	412	339.6	35.2	1337.5	2256.7	6.0	880.8	0.0

Date Collected	Arsenic ug/l	Cadmium ug/l	Chromium ug/l	Copper ug/l	Iron ug/l	Lead ug/l	Manganese ug/l	Mercury ug/l	Selenium ug/l	Zinc ug/l
9/29/93	1.5	<0.2	1.7	1.6	427	<1	26	<0.2	<1.0	0
6/1/94	1.9	0.03	2.75	3.8	1484	<1.0	45	<0.2	<1.0	9
10/12/94	<1.0	<0.2	<1.0	<1.0	120	<1.0	28	<0.2	<1.0	9

Report of Water Quality Analysis
Careless Creek Canal

Site ID: CC-2

Date Collected	Flow cfs	Lab EC umHos	Field EC umHos	Lab PH	Field PH	Lab Temp C	Field Temp C	Calcium mg/l	Magnesium mg/l	Potassium mg/l	Sodium mg/l	Alkalinity CACO3 mg/l	Chloride mg/l	Sulfate mg/l	TDS mg/l	SAR	Hardness mg CaCO3/l	Cation/Anion Balance %
11/17/93	28.3		550		9.1		0.5	69	44	2.8	81	192.6	8.1	280.1	599.6	1.87	352.2	3.4
4/13/94	NO FLOW																	
6/1/94	31.98		710		9.61		15	76	36	3.6	70	184	8.2	269.1	572.4	1.65	337	1.7
8/2/94	11.5		1025		9.4		n/a											
9/1/91	36.79		n/a		n/a		n/a	58	39	2.4	76	173.7	8.8	337.7	626.1	1.91	303.8	-6.4
10/12/94	NO FLOW																	
11/23/94	NO FLOW																	
5/12/95	NO FLOW																	

Date Collected	Arsenic ug/l	Cadmium ug/l	Chromium ug/l	Copper ug/l	Iron ug/l	Lead ug/l	Manganese ug/l	Mercury ug/l	Selenium ug/l	Zinc ug/l
9/29/93	NO SAMPLING AT THIS TIME									
6/1/94	1	0.03	1.73	2	607	<1.0	14	0.61	<1.0	3
10/12/95	NO FLOW									

Table WQ-2: Raw Water Quality Data

MUSSELSHELL RIVER WATER MANAGEMENT STUDY

Report of Water Quality Analysis
Careless Creek - Upstream Careless Canal Confluence

Site ID: CC-3

Date Collected	Flow cfs	Lab EC umHos	Field EC umHos	Lab PH	Field PH	Lab Temp C	Field Temp C	Calcium mg/l	Magnesium mg/l	Potassium mg/l	Sodium mg/l	Alkalinity CACO3 mg/l	Chloride mg/l	Sulfate mg/l	TDS mg/l	SAR	Hardness mg CaCO3/l	Cation/Anion Balance %
11/17/93								95	72	4.3	177	388.7	30.6	435	1046.9	3.34	533.4	2.2
4/13/94	7.32		900		8.89		9	94	88	4.2	256	374.7	46.9	695.9	1408.4	4.6	589.5	-0.6
6/1/94	8.41		1210		8.91		17	84	62	3.6	165	334.2	21.4	452.1	988.4	3.34	464.2	-0.4
8/2/94	0.4		3000		8.85		n/a	127	110	4.2	315	339	22.8	1000.4	1782.5	4.95	768	1.5
9/1/94	0.4		n/a		n/a		n/a	130	115	3.3	352	352.3	21.7	1289.3	2122.3	5.43	796.9	-4.8
10/12/94	0.1		3050		8.36		50	178	151	5.8	393	348.5	31.3	1371.9	2340.2	5.24	1066.7	2.9
11/23/94	2		3750		8.73		32	173	158	5.2	451	463	44	1574.2	2683.5	5.96	1084.3	-2.2
5/12/95	6.36		n/a		n/a		n/a	126	111	6.2	274	391.1	37.8	878.9	1669	4.29	773.4	0.6

Date Collected	Arsenic ug/l	Cadmium ug/l	Chromium ug/l	Copper ug/l	Iron ug/l	Lead ug/l	Manganese ug/l	Mercury ug/l	Selenium ug/l	Zinc ug/l
6/1/94	<1.0	0.02	<1.0	1.4	249	<1.0	46	<0.2	<1.0	2
10/12/94	<1.0	3.59	<1.0	1.7	254	1.4	37	<0.2	<1.0	17
10/13/95	<1.0	<0.2	<1.0	<1.0	164	<1.0	22	<0.2	<1.0	4

Report of Water Quality Analysis
Flat Willow Creek

Site ID: FW-1

Date Collected	Flow cfs	Lab EC umHos	Field EC umHos	Lab PH	Field PH	Lab Temp C	Field Temp C	Calcium mg/l	Magnesium mg/l	Potassium mg/l	Sodium mg/l	Alkalinity CACO3 mg/l	Chloride mg/l	Sulfate mg/l	TDS mg/l	SAR	Hardness mg CaCO3/l	Cation/Anion Balance %
9/29/93		1760		8.16		25		147	92	5.8	181	248	9.3	773.4	1336.9	2.56	744.7	1.6
10/26/93	83.5	1910	1250	7.97	8.6	25	7	152	99	5.5	181	261.7	11.3	889	1494.7	2.81	787.7	-0.7
11/17/93	78.5		1160		8.99		3	164	103	5	199	274.9	10.7	920.7	1567.8	3	835.6	1
4/14/94	117.69		1300		8.64		9	141	90	6.6	175	241.5	11	797.8	1366.1	2.81	721.3	1
6/2/94	81.1		1900		8.95		18	181	99	6.4	208	217.3	11.9	1037.6	1674.4	3.09	859.6	0.2
8/3/94	2		4750		n/a		n/a	216	194	10.9	422	244.6	22.1	1826.5	2838.5	5.02	1339	2.1
9/2/94	8.5		n/a		n/a		n/a	212	203	9.2	532	258.5	28.3	2433.2	3572.8	6.27	1365.3	-5.6
10/13/94	0.4		4250		8.38		46	235	196	9.9	495	269.7	29	2060.8	3187.7	5.77	1394.7	0.5
11/22/97	13.75		5250		9.88		32	271	225	9.7	686	391.5	33.5	2737.3	4197.4	7.46	1603.2	-2.9
5/12/95	0.75		n/a		n/a		n/a	235	172	8.7	446	270.2	23.1	1787.3	2834.5	5.39	1296.3	2.5

Date Collected	Arsenic ug/l	Cadmium ug/l	Chromium ug/l	Copper ug/l	Iron ug/l	Lead ug/l	Manganese ug/l	Mercury ug/l	Selenium ug/l	Zinc ug/l
9/29/93	1.6	<0.2	1.9	2.5	352	<1	46	0.9	<1	
8/2/94	1.5	0.04	2.68	4	1133	1.1	88	0.64	<1	12
10/13/95	<1.0	0.41	1.1	2	341	<1.0	104	<0.2	<1.0	23

Table WQ-2: Raw Water Quality Data

MUSSELSHELL RIVER WATER MANAGEMENT STUDY

Report of Water Quality Analysis
South Fork of the Musselshell

Site ID: SFM-1

Date Collected	Flow cfs	Lab EC umHos	Field EC umHos	Lab PH	Field PH	Lab Temp C	Field Temp C	Calcium mg/l	Magnesium mg/l	Potassium mg/l	Sodium mg/l	Alkalinity CACO3 mg/l	Chloride mg/l	Sulfate mg/l	TDS mg/l	SAR	Hardness mg CaCO3/l	Cation/Anion Balance %
9/29/93	103	390	350	8.49			13	48	13	1.8	19	156.1	2.2	49.5	226.9	0.63	173	1.3
10/26/93	64	470	260	8.2		25	6	51	15	1.4	21	168.3	2.8	60.4	251.7	0.66	187	-0.2
11/16/93	53		258		8.83		2.5	55	16	1.8	23	175	3	53.2	256.3	0.69	202.4	4
4/13/94	56		240		10.66		4	46	14	7.9	21	138.3	3.9	88.2	258.5	0.69	172.3	-9.1
6/1/94	91		400		9		16	54	14	2	27	167.7	3.5	70.5	272.6	0.85	194.5	2.1
8/2/94	23		560		10.7		N/A	66	22	2.3	31	208.5	5.1	87.9	339.2	0.84	255.2	2.9
9/1/94	20		N/A		N/A		N/A	63	22	1.9	28	216.3	3.3	116.7	364.1	0.77	246.7	-5.1
10/12/94	27		610		9.01		40	67	20	1.8	30	204.6	3.7	103	348	0.83	248.4	-0.2
11/23/94	30		620		8.96		32	69	21	1.7	34	232.6	4.5	100.8	369.5	0.91	256.9	-1.8
5/13/95	80		n/a		n/a		n/a	55	16	1.7	22	188.3	3.4	84.7	283.4	0.67	201.6	-1.9

Date Collected	Arsenic ug/l	Cadmium ug/l	Chromium ug/l	Copper ug/l	Iron ug/l	Lead ug/l	Manganese ug/l	Mercury ug/l	Selenium ug/l	Zinc ug/l
9/29/93	1.3	<0.2	<1	<1	73	<1	20	<0.2	<1	n/a
6/1/94	<1.0	0.04	<1.0	1.5	253	<1.0	36	<.2	<1.0	1
10/12/94	<1.0	0.54	<1.0	<1.0	61	<1.0	23	<0.2	<1.0	0

Report of Water Quality Analysis
Mosby

Site ID: MB-1

Date Collected		Flow cfs	Lab EC umHos	Field EC umHos	Lab PH	Field PH	Lab Temp C	Field Temp C	Calcium mg/l	Magnesium mg/l	Potassium mg/l	Sodium mg/l	Alkalinity CACO3 mg/l	Chloride mg/l	Sulfate mg/l	TDS mg/l	SAR	Hardness mg CaCO3/l	Cation/Anion Balance %
9/29/93		431	1270		8.3		25		93	59	4	134	234.5	12.2	464.1	907.9	2.68	475.5	2.5
10/26/93		313	1470	1000	7.97	8.5	25	7	102	68	4	157	252.8	16.4	599.4	1098.5	2.97	533.1	-1.1
11/17/93		389		900		8.87		2.9	109	70	3.8	158	270	15	552.4	1069.3	2.9	559.4	2.3
4/14/94		216		1400		8.4		10.5	121	100	5.8	253	259.3	21.4	878.1	1534.1	4.12	712	2.6
6/2/94		270		1300		9.5		19	117	67	4.6	169	220.6	14.5	640.2	1144.2	3.08	566.7	1.7
8/3/94		58		N/A		N/A		N/A	113	105	6.4	288	223.1	24.8	957.5	1628.5	4.7	713.1	3.6
9/2/94		51		N/A		N/A		N/A	96	93	5.2	276	228.9	26	1003	1636.9	4.82	621	-3.3
10/12/94		31		2375		8.51		46	106	100	4.5	290	260.4	29.1	915.7	1601.8	4.85	677.7	2.3
10/12/94	**CONTROL**								**104**	**98**	**5.5**	**279**	**238.8**	**28.9**	**924.7**	**1583.1**	**4.72**	**662**	**1.3**
11/22/94		97		2550		9.33		32	135	110	4.8	314	349.3	27.6	1082.5	1883.4	4.86	790.1	-1.2
5/12/95		27		n/a		n/a		n/a	139	135	6.7	440	296.9	39.7	1302.9	2241.6	6.37	903.4	4.4

Date Collected		Arsenic ug/l	Cadmium ug/l	Chromium ug/l	Copper ug/l	Iron ug/l	Lead ug/l	Manganese ug/l	Mercury ug/l	Selenium ug/l	Zinc ug/l
9/29/93		1.5	<0.2	2.3	1.8	649	<1.0	44	0.3	<1.0	n/a
6/2/94		<1.0	0.02	2.87	3.5	1287	1.1	86	<0.2	<1.0	10
10/12/94		<1.0	<0.2	<1.0	1.9	184	1.3	34	<0.2	<1.0	9
10/12/94		**<1.0**	**<0.2**	**<1.0**	**<1.0**	**186**	**<1.0**	**26**	**<0.2**	**<1.0**	**5**

* FLOW DATA FROM USGS ANNUAL PUBLICATION. ALL OTHER DATA IS THE RESULT OF DIRECT STAGE MEASUREMENTS AND DISCHARGE TABLES

Table WQ-2: Raw Water Quality Data

Report of Water Quality Analysis
Musselshell River

MUSSELSHELL RIVER WATER MANAGEMENT STUDY

Site ID: MS-1

Date Collected	Flow cfs	Lab EC umHos	Field EC umHos	Lab PH	Field PH	Lab Temp C	Field Temp C	Calcium mg/l	Magnesium mg/l	Potassium mg/l	Sodium mg/l	Alkalinity CACO3 mg/l	Chloride mg/l	Sulfate mg/l	TDS mg/l	SAR	Hardness mg CaCO3/l	Cation/Anion Balance %
9/29/93	312	980		8.54		25		76	45	3.2	93	219.4	10.6	308.7	667.4	2.1	372.3	2
10/26/93	277	1150	790	7.93	9	25	6	83	52	3.2	112	244.7	14.7	388	800.2	2.37	422.6	0.1
11/17/93	242		700		9.15		1	89	53	2.9	115	269.6	14.1	379.5	814.7	2.38	439.8	0.6
4/14/94	96		1400		8.7		9	106	95	4.1	246	287.4	28.6	822.8	1474.9	4.18	656.8	0.6
6/2/94	202		N/A		N/A		N/A	83	45	3.8	108	236.4	12.5	346.6	740.4	2.38	390.8	1.3
8/3/94	109		1640		9.12		N/A	79	64	3.6	145	227.3	16	483	926.3	2.9	458.3	1.7
9/2/94	136		N/A		N/A		N/A	67	54	2.5	131	221.1	14.1	492.7	893.9	2.9	388.4	-5.4
10/12/94	51.9		1925		8.62		45	93	83	4.4	213	281.6	21.4	748.1	1332.2	3.87	575.3	-2.2
11/22/94	68.7		2150		9.1		32	110	88	3.8	209	342.4	25.5	718.6	1360.1	3.61	636.2	-1.4
5/12/95	47		n/a		n/a		n/a	120	116	5.4	296	307.7	36.6	1025	1783.7	4.62	779	0.1

Date Collected	Arsenic ug/l	Cadmium ug/l	Chromium ug/l	Copper ug/l	Iron ug/l	Lead ug/l	Manganese ug/l	Mercury ug/l	Selenium ug/l	Zinc ug/l
9/29/93	1.4	<0.2	2.5	1.4	514	1.2	36	<0.2	<1	n/a
6/2/94	1.6	0.06	2.7	5.4	971	<1.0	64	<0.2	<1.0	9
10/13/94	<1.0	<0.2	<1.0	1.1	185	<1.0	19	<0.2	<1.0	5

Report of Water Quality Analysis
North Fork of the Musselshell

Site ID: NFM-1

Date Collected	Flow cfs	Lab EC umHos	Field EC umHos	Lab PH	Field PH	Lab Temp C	Field Temp C	Calcium mg/l	Magnesium mg/l	Potassium mg/l	Sodium mg/l	Alkalinity CACO3 mg/l	Chloride mg/l	Sulfate mg/l	TDS mg/l	SAR	Hardness mg CaCO3/l	Cation/Anion Balance %
9/29/93	50	540.0	325.0	8.5		25.0	14.0	70.0	27.0	2.3	13.0	200.9	2.2	92.4	327.4	0.3	284.5	2.6
10/26/93	48	490.0	300.0	8.0		25.0	5.3	61.0	24.0	1.8	11.0	192.6	1.9	81.2	296.2	0.3	251.6	-0.5
11/16/93	39		271.0		8.9		1.0	67.0	25.0	1.8	12.0	208.9	2.0	69.2	302.0	0.3	269.6	2.4
4/14/94	73		270.0		11.4		4.5	56.0	21.0	2.4	14.0	172.3	2.0	85.7	287.6	0.4	225.6	-0.9
6/1/94	78		350.0		9.6		14.8	61.0	21.0	2.6	10.0	189.0	1.8	75.1	285.6	0.3	239.2	-1.0
8/2/94	53		510.0		10.1		N/A	67.0	23.0	2.0	9.0	206.7	2.1	58.7	286.6	0.3	263.2	2.8
9/1/94	13		N/A		N/A		N/A	72.0	27.0	2.0	14.0	212.3	2.5	111.3	356.4	0.4	292.6	-1.0
10/12/94	19		710.0		9.8		39.0	98.0	35.0	3.2	17.0	244.4	2.7	155.0	456.9	0.4	387.2	2.2
11/23/94	135		625.0		9.3		32.0	77.0	30.0	2.1	13.0	245.7	2.7	101.3	373.2	0.3	314.1	-1.3
5/13/95	29		n/a		n/a		n/a	79.0	30.0	1.9	15.0	209.5	2.6	142.2	396.6	0.4	322.0	-0.6

Date Collected	Arsenic ug/l	Cadmium ug/l	Chromium ug/l	Copper ug/l	Iron ug/l	Lead ug/l	Manganese ug/l	Mercury ug/l	Selenium ug/l	Zinc ug/l
9/29/93	2.3	<0.2	<1	<1	148	<1	37	<0.2	<1	n/a
6/1/94	<1.0	1.3	1.75	2.5	578	<1.0	62	0.89	<1.0	18
10/12/94	1.2	0.65	1.1	3.9	314	1.3	59	<0.2	<1.0	19