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Apr. 17/03 VS.

ALBERTA ENVIRONMENT WATER MANAGEMENT OPERATIONS LETHBRIDGE			
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April 3, 2003

Denis Magowan, Regional Manager
Operation Branch, Southern Region
Provincial Building
200-5th Avenue South
Lethbridge, Alberta T1J4L1

Dear Denis:

Enclosed is a copy of the Alternatives Scoping Document prepared by the Bureau of Reclamation, Montana Area Office in Billings for the north central Montana region. This documents identifies present and potential water supplies, existing water uses and management schemes, major water-related issues in these basins, and opportunities to resolve these issues. The study area includes the St. Mary, Milk and Marias rivers. If you have questions, regarding this document and the next steps the Bureau plans on taking, please direct them to Brent Esplin of the USBR in Billings.

Sincerely,

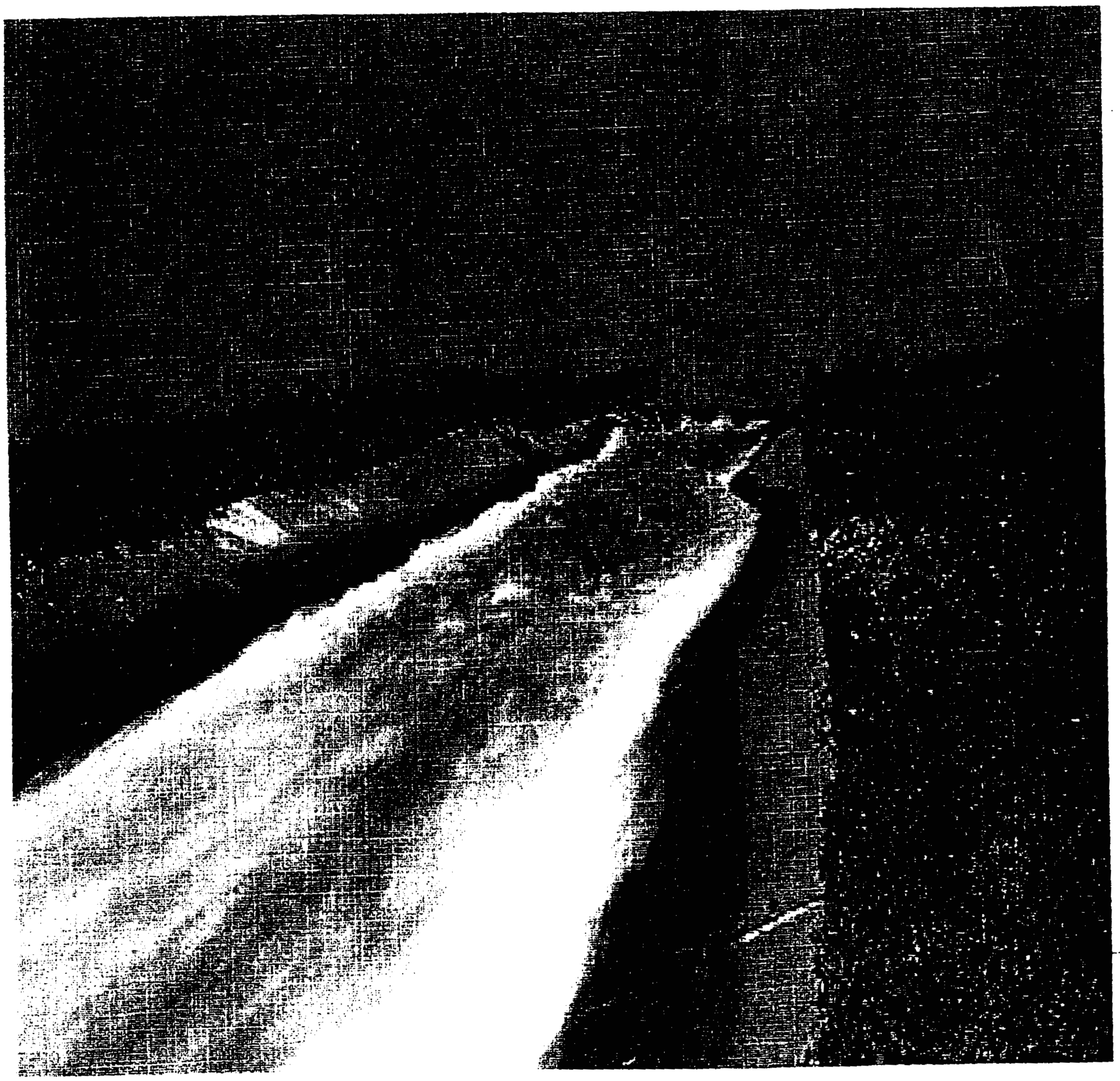
Rich Moy, Chief
Water Management Bureau
Dept. of Natural Resources and Conservation

Cc.
Brent Esplin

DRAFT

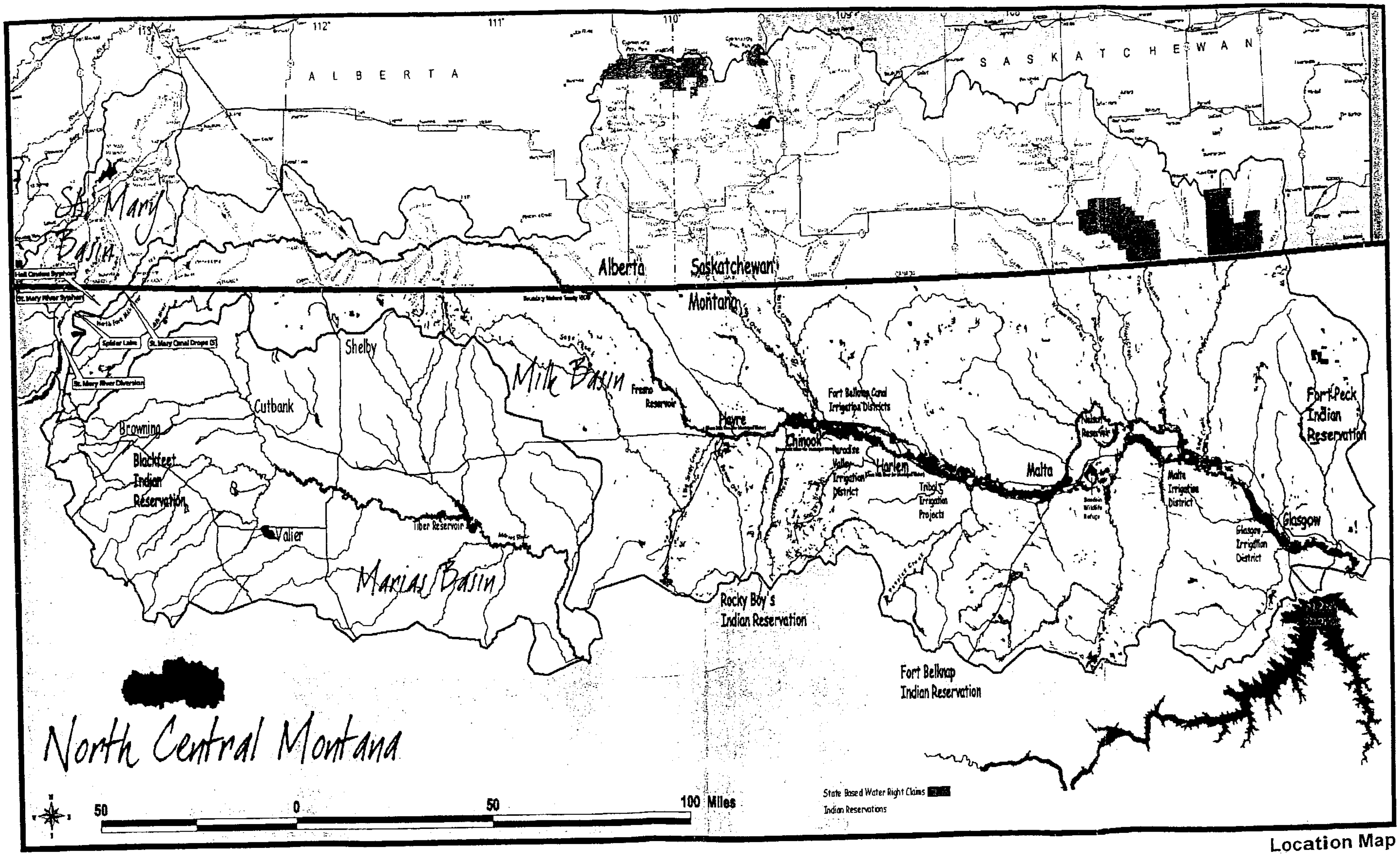
ORTH CENTRAL MONTANA

lternatives Scoping Document



MARCH 2003

U.S. Bureau of Reclamation
Montana Area Office
Billings, Montana



Location Map

EXECUTIVE SUMMARY

DRAFT

The *Chippewa Cree Tribe of the Rocky Boy's Reservation Indian Reserved water Rights Settlement and Water Supply Enhancement Act of 1999* directed Reclamation (the U.S. Bureau of Reclamation) to conduct a regional feasibility study of north central Montana. The purpose of the study was to identify present and potential water supplies, water uses and management, major water-related issues, and opportunities to resolve these issues. North central Montana includes the basins of the St. Mary River, Milk River, and the Marias River (see the Location Map). Two Reclamation projects–the Milk River Project and the Lower Marias Unit of the Pick-Sloan Missouri Basin Program–are located in the region.

This *Alternatives Scoping Document* is an interim step in the feasibility study process. Objectives of this report are to identify major and related issues as required by the act and to develop alternative plans to address them. Because of the wide range of issues and opportunities in the region, many alternative plans were developed at a preliminary level of detail. (More background on the study and the region are included in Chapters 1 and 2.)

Major water and related issues identified by the report include shortages of water for irrigation and for MR&I (municipal, rural, and industrial) supplies, threatened and endangered species, water quality, Federal reserved water rights, fish and wildlife, and recreation. All issues are discussed in detail in Chapter 3.

Of the three river basins in the region, the Milk River basin is the only one short of water to meet current needs. Shortages are caused by periodic severe droughts, over-development of irrigation in relation to the available water supply, and aging, under-designed canals unable to meet needs even when an adequate water supply is available. Shortages for irrigation water under Reclamation contract occur in seven out of ten years. After water rights are adjudicated and enforced, the 25,000 acres of private irrigation in the basin are likely to be left without water in all but the wettest years.

Settlement and implementation of Federal reserved water rights of the Fort Belknap and Blackfeet Reservations and of Bowdoin National Wildlife Refuge could stretch the present water supply even further, affecting the Milk River Project and perhaps the towns and the rural water district that rely on the Milk as their source of MR&I water.

The St. Mary Canal System—through which St. Mary River water is transferred to the Milk—is aging and in need of rehabilitation to ensure water for the Milk River basin. Diversions from the St. Mary supply about half the Milk River Project's water in an average year, more than 90% in drought years.

Alternatives in this report were formulated under the U.S. Water Resource Council's *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies,* commonly referred to as the P&Gs. The P&Gs require assumptions to be made of the most likely condition in the future if no Federal action were taken (called the *Future Without the Project Condition*), which is used as the baseline to which the alternatives are compared. Both the Future

Without the Project Condition and the future with the project (or, in other words, the alternatives) are thus based on assumptions of what would occur in the future.

General assumptions of the Future Without the Project are listed below. The Future Without and assumptions are defined in Chapter 4.

- The catastrophic failure of the St. Mary Canal, which exceeds the ability of the irrigators to pay for
- Adjudication and enforcement of water rights in the Milk River basin
- Reduction of the surplus water received from Canada under the Boundary Waters Treaty
- A continued reduction of the storage capacity of Fresno Reservoir due to sedimentation
- Implementation of the Fort Belknap Reserved Water Rights Compact
- Settlement of the reserved water rights of the Blackfeet Tribe
- A modest increase in both on-farm and canal system efficiencies in the Milk River Project.

Chapter 4 presents the alternatives developed to address issues and opportunities identified for the region. These alternatives are grouped into four classifications: *Water Operations and Management Alternatives*; *Water Storage Alternatives*; *Water Augmentation Alternatives*; and *Alternatives to Reduce Demands*. Costs, economic benefits, and b/c (benefit/cost) ratios are listed in Table S.1 below and in Table 4.1.

This Alternatives Scoping Document found no single alternative would meet the irrigation demands of the Milk River Project and MR&I needs of the region, mitigate for reserved water rights, and allow the opportunity to provide irrigation for junior water rights holders, threatened or endangered species, water quality, fish and wildlife, recreation, and hydro-power production. Some of the alternatives, however, could improve the water supply and benefit some issues (see Chapter 5). These include St. Mary System Rehabilitation, Enlarge Fresno Reservoir, Dodson South Canal Rehabilitation, Nelson Pumping Plant, Glasgow Irrigation District Re-Regulation Reservoir, and Duck Creek-Vandalia Canal.

These six alternatives will be evaluated in greater detail in the regional feasibility study. If any of the alternatives advance beyond this next step, they will include compliance with the National Environmental Policy Act, National Historic Preservation Act, and other environmental laws and regulations.

Table S.1 – Alternative Costs, Economic Benefits, Benefit/Cost Ratios

Alternative	Total Investment Costs ($)	Total O&M Costs ($/yr)	Total Annual Costs ($/yr)	Incremental Annual Economic Benefits	Benefit/Cost Ratio
5% On-Farm Efficiency Improvements	$10,600,000	$118,402	$702,402	$649,000	0.9
River Operations Improvements	$100,000	$245,000	$251,000		
Canal Efficiency Improvements	$12,920,000	$100,800	$814,800	$903,000	1.1
Nelson Reservoir Pumping Plant					
6-cfs pumps	$3,046,000	$24,400	$192,400	$173,000	0.9
25-cfs pumps	$3,907,000	$74,300	$290,000	$266,000	0.9
50-cfs pumps	$5,136,000	$104,900	$388,900	$637,000	1.6
75-cfs pumps	$6,089,000	$117,800	$453,000	$863,000	1.9
100-cfs pumps	$7,620,000	$136,400	$557,400	$1,075,000	1.9
150-cfs pumps	$9,449,000	$166,300	$688,000	$1,381,000	2.0
Dodson South Canal Rehabilitation					
600-cfs canal	$5,347,000	$7,000	$302,000	$412,000	1.4
700-cfs canal	$10,797,000	$7,300	$604,300	$624,000	1.0
800-cfs canal	$16,966,000	$7,700	$945,700	$744,000	0.8
Glasgow Irrigation District Re-Regulation Reservoir	$1,400,000	$11,300	$88,300	$159,000	1.8
Water Storage Alternatives					
Babb Dam (850-cfs St. Mary Canal)	$247,485,000	$212,000	$14,441,200	$20,553,000	1.4
Enlarge Fresno Reservoir					
95,400 AF	$5,361,000	$44,000	$340,000	$505,000	1.5
129,200 AF	$8,149,000	$45,000	$495,000	$836,000	1.7

Alternative	Total Investment Costs ($)	Total O&M Costs ($/yr)	Total Annual Costs ($/yr)	Incremental Annual Economic Benefits	Benefit/Cost Ratio
[illegible]					
217,400 AF	$42,889,000	$51,000	$2,421,000	$996,000	0.4
Enlarge Nelson Reservoir	$19,300,000	$30,000	$1,097,000	$66,000	0.1
Tributary Storage					
Peoples Creek Dam	$37,608,000	$35,400	$2,113,400	$597,000	0.3
30 Mile Creek Dam	$44,011,000	$36,000	$2,468,000	$1,460,000	0.6
Beaver Creek Dam	$17,814,000	$24,000	$1,008,000	$358,000	0.4
Water Augmentation Alternatives					
St. Mary System Rehabilitation					
500-cfs canal	$81,973,000	$136,000	$4,666,000	$14,4870,000	3.2
670-cfs canal	$92,554,000	$150,000	$5,265,000	$16,304,000	3.1
850-cfs canal	$101,932,000	$165,000	$5,798,000	$16,822,000	2.9
1,000-cfs canal	$140,768,000	$170,000	$7,949,000	$16,942,000	2.1
Virgelle-Milk River Canal					
175-cfs canal	$65,807,000	$700,200	$4,337,000	$6,386,000	1.5
200-cfs canal	$72,015,000	$873,000	$4,853,400	$7,236,000	1.5
230-cfs canal	$78,224,000	$938,000	$5,261,000	$8,165,000	1.6
Duck Creek-Vandalia Canal	$17,448,000	$226,000	$1,190,000	$1,739,000	1.5
Tiber-Fresno Reservoir Pipeline	$119,987,000	$1,252,000	$7,883,000	$2,828,000	0.4
Alternatives to Reduce Demand					
Buying Lands	$41,888,000				
Water Marketing					

Single alternatives could be joined into combined alternatives that could meet the needs of north central Montana. Table S.2 shows costs, economic benefits, and b/c ratios of four such combinations as examples of how the alternatives could complement one another.

Table S.2 – Costs, Economic Benefits, Benefit/Cost Ratios

Combination	Total Investment Costs ($)	Total O&M ($/yr)	Total Annual Costs	Incremental Annual Economic Benefits ($)	Benefit-Cost Ratio
A: St. Mary System Rehabilitation (850-cfs canal)/Enlarge Fresno (95,400 AF)	$107,293,000	$209,000	$6,138,000	$18,442,000	3.0
B: St. Mary System Rehabilitation (850-cfs canal)/Enlarge Fresno (95,400 AF)/Nelson Pumping Plant (75-cfs pumps)	$113,382,000	$326,800	$6,591,800	$19,504,000	2.82
C: St. Mary System Rehabilitation (850-cfs canal)/Enlarge Fresno (95,400 AF)/Glasgow Irrigation District Re-Regulation Reservoir	$114,782,000	$338,100	$6,680,100	$19,504,000	2.92
D: St. Mary System Rehabilitation (850-cfs canal)/Enlarge Fresno (95,400 AF)/Glasgow Irrigation District Re-Regulation Reservoir/Duck Creek-Vandalia Canal	$132,230,000	$564,000	$7,870,100	$20,646,000	2.62

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Recommended Alternatives/Combined Alternatives: Chapter 5

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INTRODUCTION
Chapter 1

PURPOSE

Water is crucially short in north central Montana. Irrigation, MR&I (municipal, rural, and industrial) water supplies, threatened and endangered fish and wildlife species, water quality, Federal reserved water rights, fish and wildlife species, recreation, and hydro-power needs in the region must be met by U.S. Bureau of Reclamation facilities built in many cases a century ago. (See "Needs" in this chapter.) The result is that competing demands are increasingly at odds over a finite supply of water.

Congress recognized this situation when it passed the *Chippewa Cree Tribe of the Rocky Boy's Reservation Indian Reserved Water Rights Settlement and Water Supply Enhancement Act of 1999* (Public Law 106-103). This act authorized Reclamation to conduct a regional feasibility study "to evaluate water and related resources in North-Central Montana. . .to determine. . .how those resources can best be managed and developed to serve the needs of the citizens of Montana" (Section 203 (a) (1)). While broad, the act specifically directed that the study:

(1) evaluate existing and potential water supplies, uses, and management;
(2) identify major water-related issues, including environmental, water supply, and economic issues;
(3) evaluate opportunities to resolve the issues. . .and;
(4) evaluate options for implementation of resolution to the issues. (Section 203 (a) (2))

Rural water issues, part of the authorizing legislation (Section 202), are being considered in a separate study. They aren't included in this report.

STUDY PROCESS

Because Congress has already authorized a feasibility study, Reclamation must depart from the usual planning report process in this case. The *Alternatives Scoping Document* is an interim step in producing the regional feasibility study. The objectives are to identify major water and related issues and opportunities, as stated in the legislation, and to develop alternative plans to address them. Due to the wide range of issues and opportunities in the region, many alternative plans were identified and developed to a preliminary level of detail.

Review of the present report by the public and other agencies will be used to confirm that all appropriate issues and opportunities have been identified and alternative plans developed as required by Section 203 (a) (2) (2) and Section 203 (a) (2) (3) of the act. Reclamation will then proceed without the usual request for Congressional authorization.

As the next step of the process, Reclamation will use comments received on the present report to guide the regional feasibility study. This study will develop in detail the alternatives recommended by the *Alternatives Scoping Document* and confirmed by public meetings. The regional feasibility study will identify the best plan— or combination of alternatives— for implementation. Compliance with NEPA (National Environmental Policy Act), NHPA (National Historic Preservation Act), and other environmental laws and regulations would be done if an alternative (or combination) advanced beyond the regional feasibility study.

In the chapters to follow, background is provided (Chapter 1), setting described (Chapter 2), water issues and opportunities discussed (Chapter 3), and alternatives presented (Chapter 4). Chapter 5 includes Reclamation's recommendations for alternatives for the regional feasibility study and possible combinations of alternatives. The report concludes with Chapter 6, future work needed.

MILK RIVER PROJECT OPERATION

Reclamation's Milk River Project serves much of north central Montana. Lake Sherburne on the St. Mary River and Fresno and Nelson Reservoirs on the Milk River store water, while the St. Mary Canal, Lohman, Paradise, Dodson, and Vandalia Diversion Dams and the Dodson and Harlem Pumping Plants divert water for the project. About 200 miles of canals and 219 miles of laterals convey diverted water to project lands.

Spanning two basins, project facilities are still operated as an integrated system. The St. Mary Canal diverts the U.S. share of the St. Mary River to the North Fork of the Milk River. When the U.S. share is less than the needed volume of the diversion, stored water is released from Lake Sherburne to make up the deficit. When the U.S. share is more than needed, water is stored in Lake Sherburne. The St. Mary Canal begins diversions in March or April, continuing until September or October. Lake Sherburne generally stores water from October-February or March, releasing water in April and May, again storing water in June and July, and finally releasing water in August and September.

Fresno Reservoir doesn't fill every year. It generally stores water from October-March or April, most runoff in the Milk River Basin occurring those months. Releases during late March to mid-May transfer water downstream to Nelson Reservoir, the volume determined by the basin supply. Fresno releases for irrigation usually begin by May 1 but can begin as early as mid-April, the volume determined by basin water users. Releases continue through the summer until about September 15. Water is again transferred to Nelson in the fall to balance storage between the two reservoirs.

HISTORY OF THE STUDY AREA

Humans have occupied north central Montana for at least 11,900 years, evidenced by finds of distinctive stone artifacts. Early people depended on hunting game during this period. Climatic and technological changes occurred in the years before 1,300 BP (before present): smaller projectile points associated with light darts or atlatls have been excavated in the region, used on species including big game. During the final stages of prehistory, arrow points became dominant. Contact with Euro-Americans led to use of the horse and trade goods, which transformed the native culture. Impacts from epidemics such as smallpox, reported as early as 1732, resulted in population shifts and cultural disruption.

First records were made by Lewis and Clark in 1804, although fur trappers traveled the region for some time before. The fur trapping period saw establishment of a string of trading posts and forts along the Missouri River.

The region was designated a common hunting grounds for Indian tribes in 1855. The Federal government established forts specifically for distribution of annuities and other goods to the tribes. Fort Belknap, for instance, was first built as one of these posts in 1871, abandoned in 1876, and then reestablished in 1878. In 1888, 17,500,000 acres of the common hunting grounds were ceded back to the Federal government, with three reservations—Blackfeet, Fort Belknap, and Fort Peck—all that remained. The Rocky Boy's Reservation was created in 1916 (see Chapter 2, "Social and Economic Characteristics" for details).

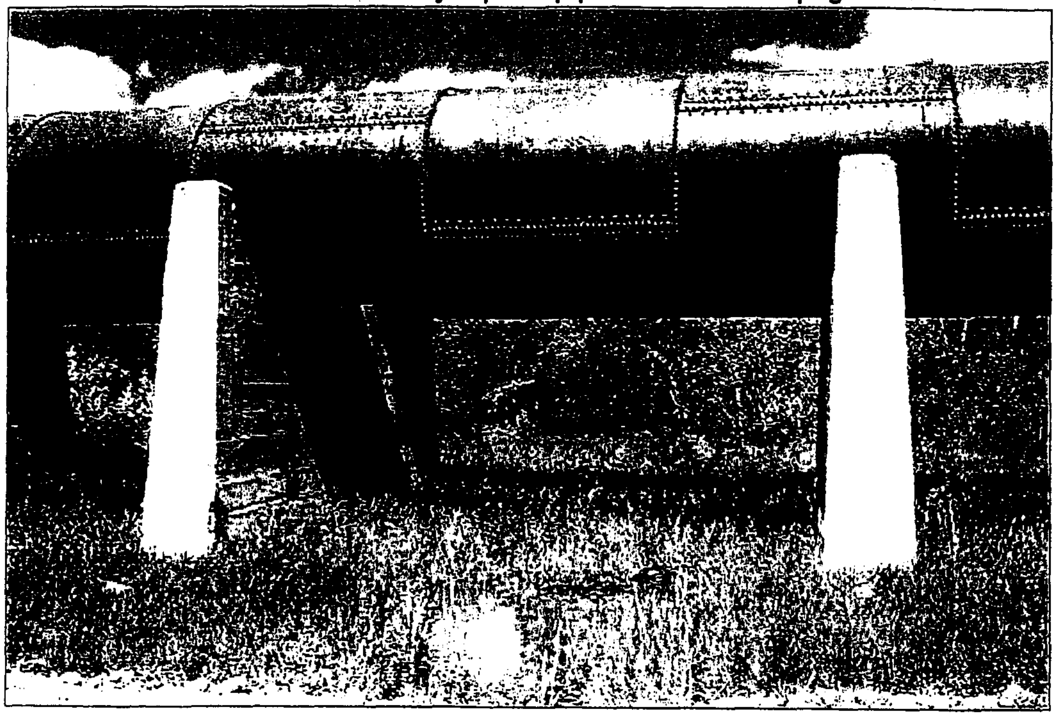
The discovery of gold in the 1860s drew people to Montana. Wagon traffic on the Fisk Trail and other trails and steamboat traffic to Fort Benton on the Missouri River became common. The Federal government began issuing grazing permits to the region in 1883. The Great Northern Railroad was authorized by Congress through the region in 1887 and parts were completed a year later. Homesteading of the area followed as lands were made available for settlement. A few private irrigation systems were developed along the Milk River, but uncertain water supplies led to Federal development of the Milk River Project, authorized in 1903.

A U.S. Supreme Court case concerning Fort Belknap around the turn of the century resulted in a finding that, when the reservation was created, enough water had implicitly been set aside for this purpose by the Federal government . This ruling, known as the *Winters Doctrine*, along with other cases, established the concept of Federal reserved water rights, as explained further on in this report (see Chapter 3, "Reserved Water Rights").

NEEDS

Water is needed in north central Montana for irrigation, MR&I water supplies, threatened and endangered species, water quality, reserved water rights, the Bowdoin National Wildlife Refuge, fish and wildlife, recreation, and hydro-power development as explained in more detail in Chapter 3.

Photo 1.1 – Twin St. Mary Siphon pipelines–note seepage below



Irrigation

Irrigated agriculture is an economic mainstay of the region. Two Reclamation projects are located in the region—the Milk River Project and the Lower Marias Unit of the Pick-Sloan Missouri Basin Program. Other acres are irrigated by the U.S. Bureau of Indian Affairs on the Blackfeet and Fort Belknap reservations, Tribal systems on the Rocky Boy's Reservation, and by individual irrigators.

MR&I Water Supplies

Many people in the region depend on Reclamation facilities for MR&I water supplies. Several towns along the river have contracts for water from the Milk River Project, as does the Hill County Water District for a rural water supply. The Lower Marias Unit supplies a town, rural water district, and a private water corporation.

Threatened and Endangered Species

Several water-associated species listed on the Federal threatened and endangered species list occur in north central Montana. Other threatened and endangered species reside in or migrate through the region. In addition, a number of Montana *Species of Special Concern* can be found in the region. Water is needed for these species.

Water Quality

Segments of the St. Mary, Milk, and Marias River basins are designated as impaired under the *Clean Water Act.* Water is needed to protect, improve, or maintain water quality.

Reserved Water Rights

Water is needed in the region to settle Federally reserved water rights for four Indian reservations, a national park, and a wildlife refuge. Three of the reservations have negotiated water compacts with the State.

Fish and Wildlife

North central Montana provides habitat for many fish and wildlife species, including a number of game species. Water is needed to protect, improve, or maintain fish and wildlife habitat.

Recreation

The region offers fine hunting and fishing opportunities, water-borne recreation like boating, water skiing, and swimming, as well as camping, picnicking, and wildlife observation. Water is needed to preserve recreational opportunities.

PUBLIC INVOLVEMENT PROCESS

Meetings with Tribes, agencies, and interest groups below were held to develop issues and alternative plans for this report. Findings of the report will be presented to these groups and to the public for comment.

- Blackfeet Tribe
- Chippewa and Cree Tribes
- Gros Ventre and Assiniboine Tribes
- Milk River Project Joint Board of Control
- Milk River Project Irrigation Districts
- Montana Department of Natural Resources and Conservation
- Montana Department of Fish, Wildlife, and Parks
- Montana Department of Environmental Quality
- Montana Bureau of Mines and Geology
- U.S. Bureau of Indian Affairs

- U.S. Geological Survey
- U.S. Fish and Wildlife Service
- U.S. Natural Resources Conservation Service
- Federal Water Rights Negotiating Team
- Milk River International Alliance
- Milk River Basin Water Management Committee (Alberta, Canada).

PREVIOUS INVESTIGATIONS

Many studies of the region (in particular the Milk River basin) have been done as shown below. Information, and—in some cases—alternative plans were updated from these studies for the present report.

- U.S. Bureau of Reclamation, 1977. *Milk River Feasibility Study.* Department of the Interior, Billings, Montana.

- Montana Department of Natural Resources and Conservation, 1977. *Supplemental Water for the Milk River.* Helena, Montana.

- Missouri River Basin Commission, 1981. *Upper Missouri River Basin Level B Study Report and Environmental Impact Statement.*

- U.S. Bureau of Reclamation, 1987. *Draft Report on Proposed Rehabilitation and Betterment Program, Malta Division, Milk River Project.* Department of the Interior, Billings, Montana.

- U.S. Bureau of Reclamation, 1987. *Draft Report on Proposed Rehabilitation and Betterment Program, Glasgow Division, Milk River Project.* Department of the Interior, Billings, Montana.

- U.S. Bureau of Reclamation, 1988. *Report on Canal Seepage.* Department of the Interior, Billings, Montana.

- U.S. Bureau of Reclamation, 1990. *Summarizing the Milk River Water Supply Study.* Department of the Interior, Billings, Montana.

- HKM Engineering, 2001. *Rocky Boy's Reservation MR&I Water System Planning/Environmental Report*. Billings, Montana. (This study was authorized by P.L. 106-163 also.)

- HKM Engineering, 2002. *Northcentral Montana System*. Billings, Montana.

Photo 1.2 – Milk River immediately downstream of Fresno

SETTING
Chapter 2

The St. Marys, Milk, Marias rivers region stretches nearly 350 miles from the Rocky Mountains in the west to the confluence of the Milk with the Missouri River in the east. The region extends about 60 miles south from the Canadian border to the confluence of the Marias with the Missouri River (see Location Map). Climate, water volume and quality, geology, soils, threatened or endangered species, fish and wildlife species, social and economic characteristics, recreation, and cultural resources in the region are described in this chapter.

CLIMATE

Climatological information was obtained from the 2001 *Montana Climate Summaries* (Western Regional Climate Center, 2001). The climate of the region is typical of the northern Great Plains, with summers cooler and wetter in the higher elevations of the western part near Glacier National Park. The Babb, Montana, station (6NE) is closest to the St. Mary River. For the station's 1948-2001 period of record, average maximum temperature in June-August was 73 °F. Average minimum temperature December-February was 9.8 ° F. Precipitation averaged 18.27 inches/year, most falling May-September. The average frost-free period was only 66 days, with snow reported every month of the year.

The Havre, Montana, station (Havre WSO AP) is located near the center of the region. Average maximum temperature for the station's 1961-2001 period of record for June-August was 81.6 °F, while the average minimum temperature December-February was 7.3° F. Precipitation averaged 11.35 inches/year, most falling April-September. The average frost-free period was 128 days.

The Glasgow, Montana, weather station (Glasgow WSO Airport) is on the eastern edge of the region. Average maximum temperature for June-August for the 1955-2001 period of record was 81.6°F. The average minimum temperature December-February was 5.3° F. Precipitation averaged 10.99 inches/year, most falling May-September. The average frost-free period was 138 days.

WATER VOLUME AND QUALITY

Figure 2.1 shows annual total and the U.S. annual share of stream flows of the St. Mary, Marias, and Milk rivers. Much of the water supply of the Milk River Project comes from the St. Mary River (see Chapter 3, "Water Supply Shortage"). Apportionment of water between the St. Mary and Milk Rivers is governed by the *Boundary Waters Treaty of 1909* (clarified by the 1921 Order of International Joint Commission). U.S. and Canadian representatives to the Commission compute natural flows of both rivers, apportioning flows from meteorological and hydrological data.

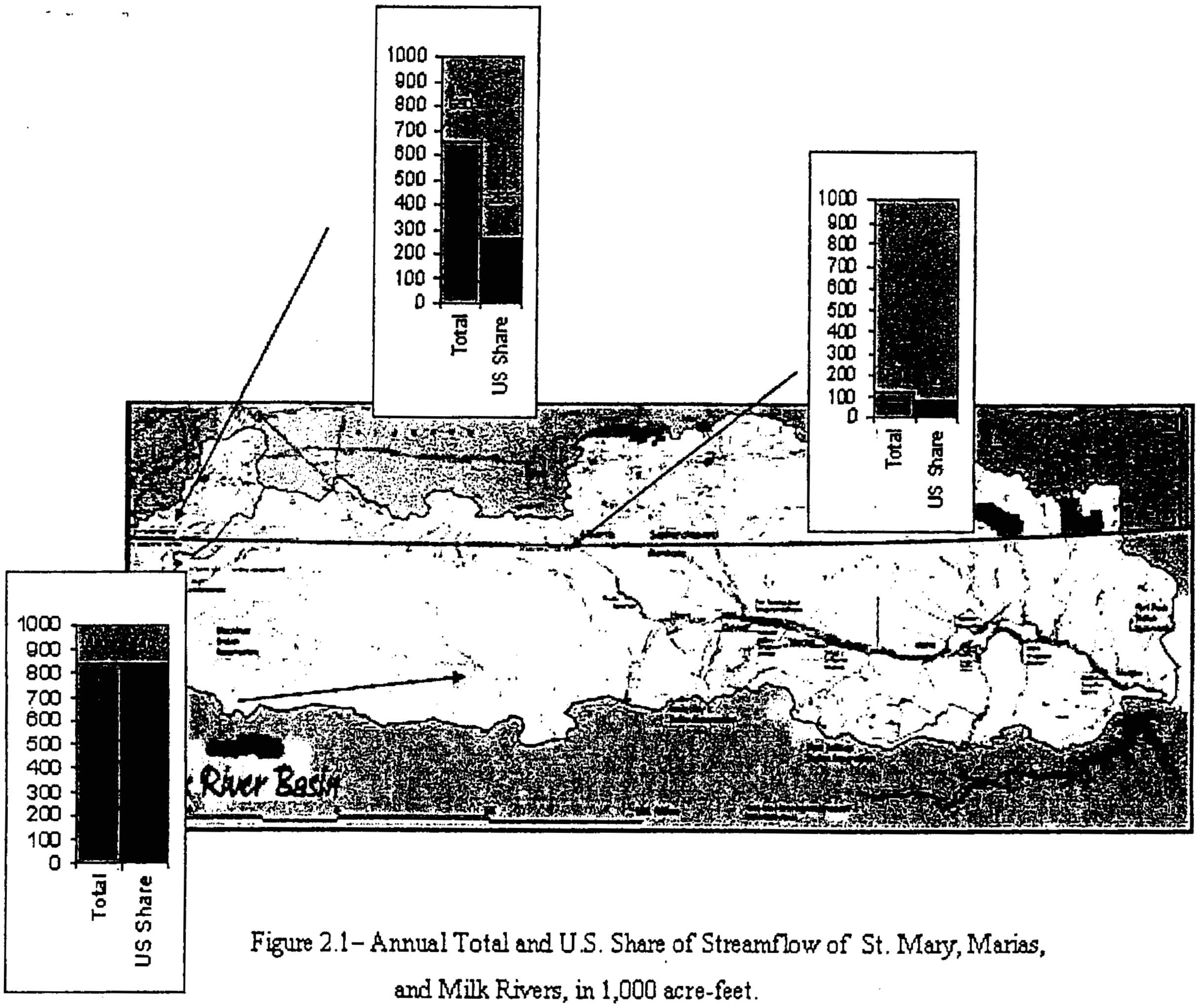


Figure 2.1– Annual Total and U.S. Share of Streamflow of St. Mary, Marias, and Milk Rivers, in 1,000 acre-feet.

Snowmelt from mountains provides most of the runoff in north central Montana. It's generally of good quality, but nutrients, salts, and water temperature gradually increase as the rivers flow from the mountains to the plains. Degradation is due to evaporation and transpiration that concentrates minerals; irrigation diversions and return flows; suspended sediment from erosion; and pollutants from farming and ranching.

Under the Clean Water Act, the Montana DEQ (Department of Environmental Quality) classifies quality by water use, with standards equal to or exceeding EPA water quality standards. Classes run from *A-closed* (the highest quality) through *A-1*, *B*, *C*, to *I* (the lowest quality). Water uses are by suitability for drinking; processing food; bathing; swimming; propagation and growth of fish and aquatic life, waterfowl and furbearers; and agricultural and industrial use.

In drought years, water quality problems are more pronounced. Dissolved chemical concentrations and water temperatures are highest during droughts. In contrast, suspended sediments are the reverse: highest concentrations are during high river flows, primarily during spring runoff. Irrigation can contribute to non-point pollution. Problems typically result when irrigation diversions result in low flows and when irrigation return flows contain higher concentrations of salts, nutrients, suspended solids, and pesticides than the water diverted.

St. Mary River

The St. Marys River heads on the east slope of the Rocky Mountains in Glacier National Park and flows northerly, joining the Oldman River near Lethbridge, Alberta, Canada (Location Map).

Volume

During the April 1-October 31 irrigation season, the U.S. share of the natural flows of the river at the International Boundary is a fourth of the flows when they are 666 cfs (cubic-feet/second) or less. Excess flows are divided equally between Canada and the U.S., and the rest of the year flows are divided equally between the two countries.

Stream flows in the St,.Mary River are fairly consistent from year-to-year. Information on flows is available from 1902 to the present (U.S. Geological Survey, 2001). During that period, maximum flow of the river at the International Boundary (Station 05020500) was estimated to be 40,000 cfs on June 5, 1905. The lowest annual seven-day minimum flow was 27 cfs ending November 26, 1936. The average annual natural flow of the river is 900 cfs or 650,000 AF, of which the U.S. share is 266,000 AF. 40.92%

Figure 2.2 shows the average natural flows (those that would exist without human interference) and measured flows of the St. Mary River. The difference in natural and measured stream flow is the volume used by the U.S.

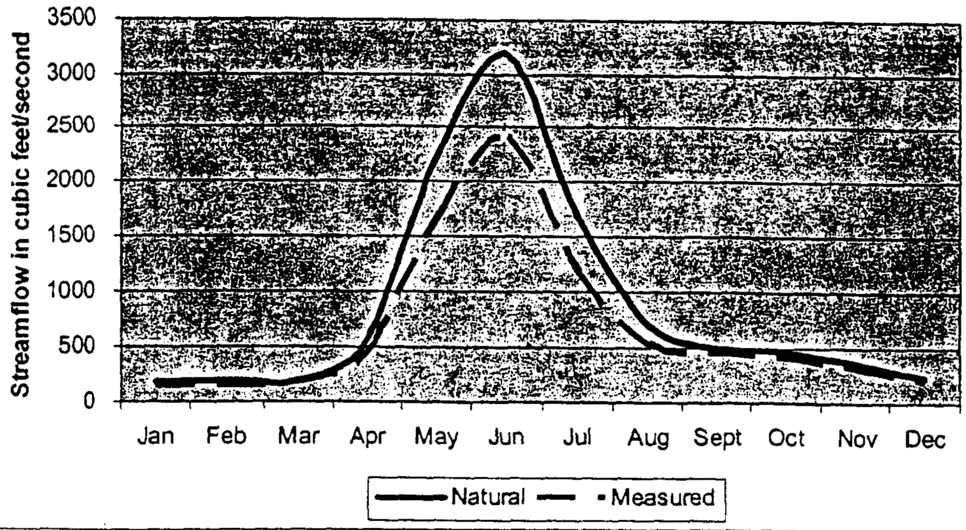
Quality

The St. Mary and its tributaries outside Glacier National Park are classified B-1, suitable for drinking and food processing after conventional treatment and all other uses.

Milk River

The Milk River, a tributary of the Missouri River, heads in Glacier National Park and the Blackfeet Reservation. The river flows northeasterly into Canada, then turns easterly for about 200 miles before it reenters the U.S. about 50 miles northwest of Havre, Montana (Location Map). The Milk flows southeasterly in Montana to near Glasgow, where it enters the Missouri River just downstream of Fort Peck Reservoir.

Figure 2.2 – Average Streamflow of St. Mary River at International Boundary, natural flow for 1928-89 and measured flow for 1917-2001



Milk River flows are stored in Fresno Reservoir near Havre, and Nelson Reservoir, an off-stream reservoir, near Malta, Montana. The reservoirs store water and provide recreation, flood control, and fish and wildlife benefits. Most consumption is for irrigation by the Milk River Project. Primary lands irrigated are located along a 165-mile reach of river in Blaine, Phillips, and Valley counties.

Volume

Apportionment of the Milk River is similar to that of the St. Mary River, except that most of the natural flows go to the U.S. The U.S. share during the irrigation season at the Eastern Crossing of the International Boundary is three-fourths of the natural flows when flows are 666 cfs or less. Flows beyond that volume are divided equally. The rest of the year flows are divided equally between the countries. Flows of Lodge Creek, Battle Creek, and Frenchman River—all tributaries of the Milk —are divided equally where they cross the International Boundary.

Stream flows in the Milk River are more erratic year-to-year than flows in the St. Mary River (U.S. Geological Survey, 2001). Information on flows near the mouth of the Milk River is available from 1939-present. During that period, maximum flows at the Nashua, Montana (Station 06174500) near where the river joins the Missouri River was 45,300 cfs, recorded on April 18, 1952. The lowest annual seven-day minimum flow was 0 cfs ending July 17, 1984. The average March-October flows at the Eastern Crossing (Station 06135000) upstream of Fresno Reservoir are 235 cfs, or 113,500 AF. The U.S. share is 75,600 AF. Average estimated natural flows during the non-irrigation season is 10,800 AF, 5,400 AF of which is the U.S. share. Figure 2.3 shows total computed natural flows, the U.S. share, and measured stream flow at the Eastern Crossing.

U.S share 66.61%
Can 33.39%

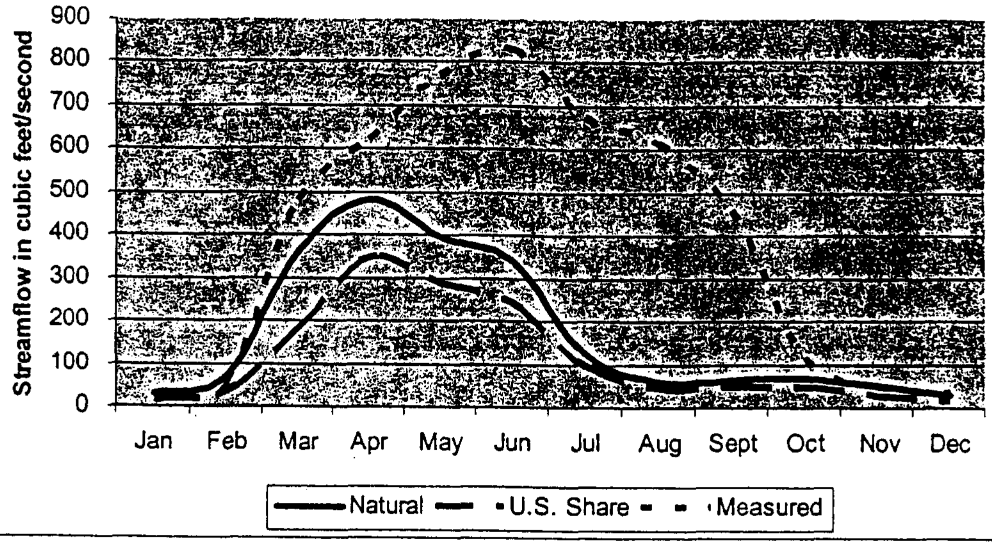
The difference between the U.S. share of computed natural flows and measured flows represents the unused part of Canada's share of natural flows plus the water from the St. Mary River diverted into the Milk. If water were not transferred into the basin by the St. Mary Canal, the Milk River would dry up in the vicinity of Havre about one out of every four years. Most likely, the river would dry up during July or August and could remain dry from a few days up to two months.

Total
650,000
+ 113,500
763,500

U.S.
266,000
+ 75,600
341,600
44.7%

Quality

Figure 2.3 – Average Streamflow of Milk River at Eastern Crossing, natural flows for 1928-89 and measured flow for 1965-85



The Milk River in Glacier National Park is classified as A-1, suitable for all uses. The river and tributaries from the Park to the Canadian Border are classified B-1. The river from where it reenters the U.S. to the joining with the Missouri is classified B-3, suitable for drinking and food processing after conventional treatment and for all uses except propagation of salmonid fish. All tributaries in this reach are classified B-3, except for the Big Sandy Creek drainage (to the town of Big Sandy's infiltration wells), Beaver Creek, Little Box Elder Creek, Clear Creek drainage (near Havre) and Peoples Creek drainage (to and including the South Fork of Peoples Creek). These exceptions are classified B-1.

Marias River

The Marias River is formed by the joining of Cut Bank Creek and Two Medicine River southeast of Cut Bank, Montana (Location Map). Cut Bank Creek heads on the east slope of the Blackfeet Reservation, flowing east to Cut Bank and then southeast to its confluence with Two Medicine River. Two Medicine River heads on the east slope of the Continental Divide, flowing easterly through the Blackfeet Indian Reservation.

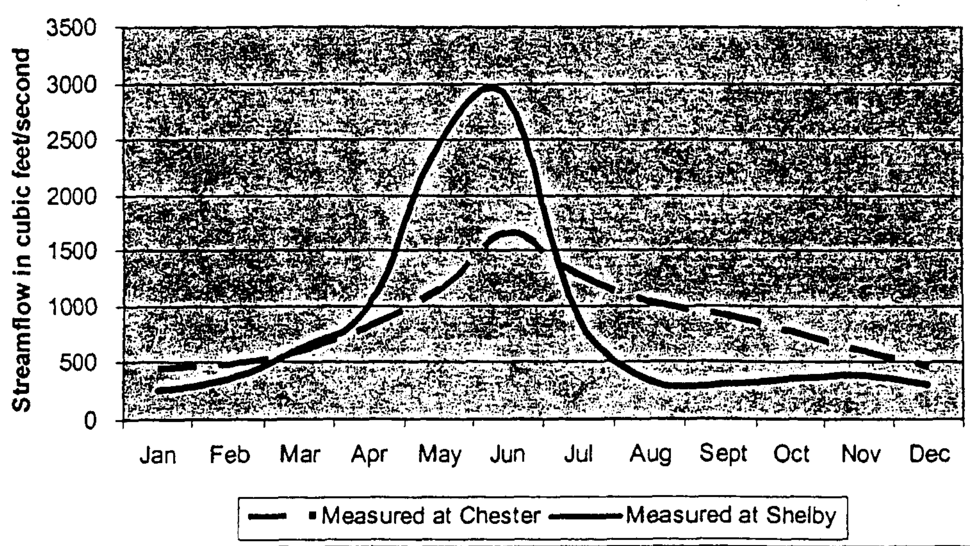
From this juncture, the Marias River flows easterly about 60 miles to Tiber Reservoir (Lake Elwell), formed behind Tiber Dam. The dam was completed in 1956. From the dam, the Marias flows southeast about 80 miles to join the Missouri River near Loma, Montana.

Water is diverted from the river for irrigation and M&I uses, and the river is home to several native fish species, sport fish, and fish of special concern. Recreational use includes boating, fishing, and hunting along the river.

Volume

Information for the Marias River is available for 1921-present (U.S. Geological Survey,2001). During that period, maximum flows of the river near Chester, Montana (Station 06101500), downstream of Tiber Dam, was 10,400 cfs on June 16, 1964. The lowest annual seven-day minimum flow was 0.2 cfs ending October 29, 1955. Average annual measured flows are 830 cfs, 604,000 AF; measured flows reflect upstream irrigation depletion and many storage reservoirs. Average estimated natural flows of the Marias River near Chester, Montana, are 11160 cfs, 840,000 AF. Figure 2.4 shows flows near Shelby, Montana (Station 06099500), upstream of Lake Elwell, and the Marias River near Chester. The difference in flows between the two stations reflects the flow regulation effect of Tiber Reservoir.

Figure 2.4 – Average Streamflow of the Marias River at Shelby and at Chester, 1960-2000



Quality

The Marias River and tributaries are classified B-1 and B-2, suitable for drinking and food processing after conventional treatment and all other uses, marginal for salmonid fish. Cut Bank Creek drainage is classified B-1, except for Willow Creek from the Highway 464 crossing about ½ mile north of Browning, Montana, to Cut Bank Creek and Cut Bank Creek mainstem from Old Maid Miller Coulee near Cut Bank to Birch Creek. These sections are classified B-2.

Two Medicine River is B-1, except for Midvale Creek drainage to the town of East Glacier's water supply intake, and Summit Creek drainage to the town of Summit's water supply intake. These are A-closed. The mainstem of the Two Medicine from Badger Creek to Birch Creek is classified B-2. The Dry Fork of the Marias River (mainstem) is B-3 from the Interstate 15 crossing near Conrad, Montana, to the Marias River. The Teton River drainage (to and including Deep Creek near Choteau) is B-1. The Marias mainstem from Tiber Reservoir to the county road crossing in Section 17, T29N, R6E is classified B-1, and the Teton River below Interstate 15 to the Marias River is classified B-3.

The only significant water quality data is for the reach just downstream of Tiber Dam near Chester, covering 1964-1986. The monitoring site is in the B-1 classified reach.

GEOLOGY

Geology of north central Montana consists of unconsolidated and consolidated deposits ranging in age from Cambrian to recent. Unconsolidated deposits mantling much of the area include Quaternary alluvium and glacially-deposited silt, sand, and gravel. Tertiary terrace and pediment gravels can be found in several locations, which—if thick enough—provide significant volumes of water. One such source is the Tertiary Flaxville gravels found in Blaine County and along the eastern boundary of the Milk River basin. Unconsolidated deposits form the most widely used aquifers in the area, as they can supply water for irrigation where sufficiently thick.

Part of the region is located in the Glaciated Central Region, which has been covered by several episodes of continental glaciation. Advancing glaciers rerouted some pre-glacial stream channels and buried the old channel deposits. The ancestral Missouri River channel used to be located where present-day Big Sandy Creek joins the Milk River below Havre. Retreating glaciers left behind unconsolidated till, glacial lake deposits, and outwash deposits. Coarser glacial deposits and buried stream channels can be significant sources of groundwater if thick enough. Less permeable glacial lake and till deposits of poorly sorted clay, silt, sand, and gravel are less likely to supply significant volumes of water.

Underlying unconsolidated deposits (also called bedrock formations) are Cretaceous sedimentary formations consisting of sandstones and shales. These deposits, generally without sufficient transmissivity to supply large volumes of water, are used for domestic supply or stock watering. Included among these formations are the Hell Creek, Foxhills, Bearpaw Shale, Judith River, Clagett, Eagle, and Colorado Group. Sandstones can supply significant water volumes in some localities, especially where exposed near the land surface. Generally, these Cretaceous deposits slope gently to the east towards the structural depression called the Williston Basin in far eastern Montana.

Pre-Cretaceous deposits exposed near the land surface are generally found near mountain uplifts where they were thrust upward and younger overlying formations were eroded away. Mountain uplifts comprised of igneous and metamorphic formations generally are not a source of significant volumes of water in the region. They have a low primary permeability and depend on fracture zones and other secondary permeability for storage and movement of water. Older and deeper formations also tend to have poor quality water since recharge and movement through them is relatively slow. One potential pre-Cretaceous formation with the potential for yielding moderate volumes of water (although it may contain high total dissolved solids) is the Mississippian Madison Group.

SOILS

Soils in the region are predominately derived from glacial till. Many of the irrigated lands—especially in the Milk River basin—are alluvial soils, but they also include soils derived from wind-blown deposits, old lake plains, glacial outwash, in addition to upland glacial till. Much of the till was derived from mixed rock sources, but a few soils have formed in till from specific rock sources.

Most of the irrigated land in the region is in the Milk River Valley east of Havre; some irrigation also occurs in the upper parts of the Marias River basin. Besides individual irrigators, there are also public and private developments on the Marias River tributaries, including Birch Creek and Two Medicine River. Soils irrigated by these projects include old alluvial soils on bottomlands and glacial-till derived soils on uplands. Individual irrigators are found throughout the region who irrigate soils ranging from glacial till to eolian (wind blown deposits) to alluvial in origin.

THREATENED AND ENDANGERED SPECIES

A number of species listed under the ESA (Endangered Species Act) can be found in the region, residents and migrants alike: the bull trout, grizzly bear, bald eagle, gray wolf, piping plover, and pallid sturgeon. The mountain plover is proposed for listing. Candidate species (those for which sufficient information is available to support a proposal to list) include the black-tailed prairie dog. Threatened, endangered, and candidate species are shown in Table 2.1.

In addition to threatened and endangered species, Montana DFWP (Department of Fish, Wildlife, and Parks) has identified the westslope cutthroat trout, sauger, pearl dace, paddlefish, and the blue sucker as *Species of Special Concern* that occur in the region.

St. Mary River Basin

The bull trout has been subject of continuing studies by Reclamation, USFWS (U.S. Fish and Wildlife Service), NPS (National Park Service), and the Blackfeet Tribe for several years (Mogen and Kaeding, 2002). The DPS (*Distinct Population Segment*) in the St. Mary basin is the only one found east of the continental divide. This DPS is also unique as most of its habitat —including all spawning habitat—is within Glacier National Park or the Blackfeet Reservation.

Studies identified three major effects Reclamation facilities may have on bull trout. First, the Lake Sherburne outlet works are closed after the irrigation season, de-watering a stretch of Swiftcurrent Creek, occasionally stranding bull trout which use it for wintering habitat. Second, the St. Mary Diversion Dam act as a partial barrier to fish, disrupting bull trout migration patterns from wintering habitat to upstream tributary spawning habitat. Finally, bull trout have been entrained by the St. Mary Canal and thereby lost from the population.

Other bull trout issues that should be evaluated include maintaining quality of spawning tributaries, further study and protection of the population above Sherburne Reservoir in Cracker Lake, use of

Table 2.1 -- Federally-Listed Species in the Region

Species	Status	Habitat and Special Requirements
bull trout	Threatened	Prefers cold water of headwater streams and rivers adjoining natal streams
pallid sturgeon	Endangered	Turbid, free-flowing riverine habitat preferred with rock or sandy substrate
piping plover	Threatened	Breeds on gravel shores os shallow saline lakes and prairie lakes
interior least tern	Endangered	Breeding highly dependent on dry exposed sandbars and forage fish
whooping crane	Endangered	Uses intermingled wetlands and agricultural fields during migration
bald eagle	Threatened	Winters in mature cottonwoods along Marias and Missouri rivers
mountain plover	Proposed	Prefers large flats or short grass prairie; associated with prairie dog colonies
black-footed ferret	Endangered	Associated with prairie dog colonies
grizzly bear	Threatened	Large home ranges requires undisturbed habitat and migratory corridors
gray wolf	Endangered	Found in forests, plains, and mountains; habitat loss a problem
swift fox	Candidate	Prefers mid-grass prairie; associated with prairie dog colonies
black-tailed prairie dog	Candidate	Native to short grass prairie; less than 1% of previous habitat remains

Lower St. Mary Lake as wintering habitat and migration corridor, the relationship between these fish and the upper St. Mary Lake bull trout, and instream flows in the St. Mary River to support growth, migration, and wintering.

The grizzly bear uses the St. Many Canal System as a travel corridor, using the narrow bands of riparian vegetation along the canals to move through open parts of their range. An environmental assessment (Reclamation, 1990b) concluded that selective removal of vegetation along the canal wouldn't affect the grizzly.

The area around Reclamation facilities in the St. Mary basin is also occupied by bald eagles and gray wolves. Effects to these species aren't as well understood as those to bull trout, but it's known that these species use riparian habitat as travel corridors like the grizzly.

Milk River Basin

Piping plover nesting habitat on the shore and islands in Nelson Reservoir, as well as Bowdoin National Wildlife Refuge, are the main concern for threatened and endangered species in the basin. Reclamation began formal consultation with USFWS on operation of the Milk River Project—specifically Nelson Reservoir—in 1990 following inadvertent inundation of a piping plover nest. The USFWS responded with a *No Jeopardy* biological opinion, with recommended conservation actions and mandatory RPMs (reasonable and prudent measures) to reduce the take ((U.S. Fish and Wildlife Service, 1990). These RPM's include annual monitoring of piping plovers at the reservoir and coordination with USFWS. A *Memorandum of Understanding* among Reclamation, USFWS, and the irrigation districts established a framework of communication regarding monitoring and operation of the reservoir to reduce effects. In addition, two islands in the reservoir have been graveled about two feet higher to provide further operational flexibility while avoiding the inundating of nests.

Nelson Reservoir was recently included as proposed critical habitat under ESA but was removed from final designation at Reclamation's request. The official designation of critical habitat cited the Memorandum of Understanding, implementation of the 1990 biological opinion, and the conservation measures enhancing habitat on the islands as the reasons USFWS concurred with Reclamation (U.S. Fish and Wildlife Service, 2002).

The Milk River provides suitable habitat for the pallid sturgeon, though none have been captured there. Preliminary studies (Stash, et al., 2001) indicated use of the lower Milk by Missouri River fish for spawning and rearing, including shovelnose sturgeon which have a similar life history and are often used as a surrogate species for pallid sturgeon. Fort Peck Reservoir alters water temperatures and flows downstream in the Missouri, affecting migration and spawning, however. Without spawning cues, pallid sturgeon aren't likely to move up to the mouth of the Milk. Altering Missouri flows would provide suitable habitat for pallid sturgeon, and spawning in the Milk could be expected as the species recovered and re-established its historic territory.

Bald eagles, peregrine falcons, mountain plovers, swift foxes, black-tailed prairie dogs, and black-footed ferrets could also be expected to be found within the Milk River basin. Black-tailed prairie dogs provide unique habitat for many wildlife species, including the black-footed ferret, burrowing owl, mountain plover, and ferruginous hawk, all except the first State Species of Special Concern.

Marias River Basin

The Marias River is not known to be used by any listed fish species but could be used by fish in the Missouri River, including pallid sturgeon. Flows below Tiber Reservoir could affect Missouri River fish as well, and any operational modifications should examine possible effects. Habitat in the Marias River basin could also be used by bald eagles, peregrine falcons, mountain plovers, swift foxes, black-tailed prairie dogs, and black-footed ferrets.

FISH AND WILDLIFE

The three river basins provide diverse aquatic and terrestrial habitat for other fish and wildlife species, forming a complex, dynamic ecosystem: riparian habitat mixed with wetlands can be found along the rivers; upland habitat—mixed grass prairie of short and moderate grasses and some shrubs—much of which has been converted to croplands and rangelands; and Montane zones primarily of aspen forest, shrub lands, and intermixed spruce, lodgepole, and douglas fir conifers.

Fish

Fish species native to the St. Mary drainage include bull trout, westslope cutthroat trout, mountain whitefish, lake trout, northern pike, burbot, white sucker, longnose sucker, lake chub, trout-perch, longnose dace, pearl dace, mottled sculpins, and spoonhead sculpins (Brown, 1971).

Larger natural lakes in the St. Mary drainage contain native populations of bull trout, lake trout, burbot, northern pike, and sucker species, as well as the smaller species listed above. This habitat is shared with non-native populations of Yellowstone cutthroat trout, rainbow trout, brook trout, kokanee, and lake whitefish. St. Mary lakes also contain the only known population of trout-perch in Montana. Lake Sherburne has native mountain whitefish, burbot, northern pike, and sucker species, in addition to introduced populations of rainbow trout, brook trout, and kokanee.

A study of the Milk River fishery completed as part of this report (Stash, et al. , 2001), was done to collect baseline information on populations and habitat use. Species found during the study are listed in

Table 2.2. The most numerous were flathead chub, river carpsucker, shovelnose sturgeon, and stonecat in spring, and emerald shiner, flathead chub, goldeye, and shorthead redhorse in fall. An additional fishery study is underway on the lower Milk River below Vandalia Dam. This study will focus more on the spawning times of certain species, including the endangered pallid sturgeon.

Table 2.2 – Fish in the Milk River

bigmouth buffalo	black bullhead	black crappie	blue sucker	brook stickleback
brown trout	burbot	brassy minnow	carp	channel catfish
creek chub	emerald shiner	fathead minnow	flathead chub	freshwater drum
Hybognathus spp	Iowa darter	lake chub	lake whitefish	largemouth bass
longnose sucker	longnose dace	northern pike	northern redbelly dace	paddlefish
pearl dace	rainbow trout	river carpsucker	sand shiner	sauger
shorthead redhorse	shovelnose sturgeon	smallmouth bass	smallmouth buffalo	spottail shiner
stonecat	walleye	white crappie	white sucker	yellow perch
goldeye				

The Marias River fishery was studied in 2000 as part of the Milk River study (Zollweg and Leathe, 2000). Many species found in the Milk were also found in the Marias. Diversions have affected the character of the Marias River fishery by limiting species distribution and abundance, influencing timing and success of spawning, changing thermal regimes, and changing the availability of suitable habitat. Also, Tiber Dam has affected the fishery by blocking migration, replacing stream with reservoir habitat, and creating coldwater habitat immediately downstream of the dam.

Species in the upper Marias River include mountain sucker, mountain whitefish, and sculpin, in addition to those listed in Table 2.2. Flathead chub and mountain whitefish were the most abundant in this reach of the river.

In 1955, the upper Marias basin was poisoned to remove unwanted species like carp and goldeye, then restocked with rainbow trout. Due to this poisoning— and to Tiber Dam—sauger are no longer found in the upper Marias, and shovelnose sturgeon and blue suckers no longer spawn there.

Thirty species were documented in the eighty-mile reach of the river below Tiber Dam. Three new species (western silvery minnow, plains minnow, and white crappie) were confirmed in the lower Marias during the study. Brook trout are rare and none were collected. Paddlefish, blue suckers, and bigmouth buffalo use the Marias only seasonally during spawning, which did not correspond to the sampling times.

Species found in the lower Marias include mountain sucker, plains minnow, sculpin, western silvery minnow, in addition to the species listed in Table 2.2. Emerald shiner, flathead chub, and longnose sucker were the most abundant.

Wildlife

Diversity of habitat allows for a great number of wildlife and bird species. The region contains three Montana WMA's (Wildlife Management Areas): Blackleaf (northwest of Great Falls), Milk River (northeast of Malta), and Freezeout Lake (west of Great Falls). The region also contains two national wildlife refuges: Benton Lake (northeast of Great Falls) and Bowdoin (east of Malta).

Big game in the region are elk; whitetailed and mule deer; and pronghorn antelope. Bison can be found on Indian reservations. Many predatory species exist in the region, including grizzly and black bear; mountain lion; lynx; coyote; red fox; and badger. Small mammals, like the beaver; muskrat; cottontail and jack rabbit; black-tailed prairie dog; mink; weasel; raccoon; porcupines; skunk; and several bat species can be found.

The region is a haven for songbirds, shorebirds, and waterfowl. Over 150 species of non-game birds can be found in the region during at least part of the year, including redheaded and downy woodpecker; belted kingfisher; grasshopper and Bairds sparrow; common loon; white pelican; and trumpeter swan. Shorebirds include the long-necked stilts,; American avocet; piping plover; willet; long-billed curlew; and marbled godwit. Game birds include the ring-necked pheasant; hungarian partridge; Merriams turkey; sharptailed, sage grouse; blue grouse; ruffled grouse; mourning dove; Canada goose and snow goose; and blue winged teal, green winged teal, canvasback, gadwall, pintail, lesser scaup, shoveler, American widgeon, and mallard ducks. Birds of prey in the region include bald and golden eagle; peregrine and prairie falcon; ferruginous hawk; and great horned owl and burrowing owl. A study of the riparian community and associated wetlands is currently underway.

A crucial part of the ecosystem, many reptile and amphibian species inhabit the region. Reptiles include the western painted turtle, soft shelled turtle, prairie rattlesnake, bull snake, short horned lizard, and garter snake. Amphibians in the abundant wetlands and riparian areas include the western chorus frog, leopard frog, and Woodhouse's toad.

SOCIAL AND ECONOMIC CHARACTERISTICS

The study area includes Blaine, Chouteau, Glacier, Hill, Liberty, Phillips, Pondera, Toole, and Valley counties (Location Map). While primarily rural and agricultural, the region has a number of towns scattered throughout.

Irrigation Projects

Two Reclamation projects—the Milk River Project and the Lower Marias Unit of the Pick-Sloan Missouri Basin Program—are located in the region. The Milk River Project contains three divisions with eight irrigation districts and two pumping units, as shown in Table 2.3.

Table 2.3 -- Districts in the Milk River Project

Chinook Division	Malta Division	Glasgow Division
Fort Belknap District	Malta District	Glasgow District
Alfalfa Valley District	Dodson District	
Zurich District	Dodson Pumping Unit	
Paradise Valley District		
Harlem District		
Harlem Pumping Unit		

About 150,000 irrigated acres can be found in the Marias River basin, most upstream of Tiber Reservoir. Two large projects, both upstream, make up 80% of this irrigated acreage. The Blackfeet Irrigation Project is located mainly in the east part of the Blackfeet Reservation. Principle streams supplying the project are the Two Medicine River, Badger Creek, Birch Creek, and their tributaries. Operated by the BIA (U.S. Bureau of Indian Affairs), the Blackfeet Irrigation Project supplies water to about 35,000 acres in three active units lying west and south of Cut Bank, Montana, and west and north of Valier, Montana. Three reservoirs store high flows in the spring: Lower Two Medicine Lake with a capacity of 13,500 AF, Four Horns Reservoir with 19,250 AF capacity, and Swift Reservoir with 30,000 AF capacity.

The second large project, the Pondera County Canal and Reservoir Company Irrigation Project, is about 50 miles south of the Canadian border and about 35 miles east of the Rockies. The project consists of two main storage reservoirs and 360 miles of canals and laterals. Water is diverted from Birch Creek and Dupuyer Creek to irrigate about 83,000 acres. The storage reservoirs are Lake Francis with a capacity of 112,000 AF and Swift Reservoir, 29,975 AF.

There is little irrigation on the Marias below Tiber Dam. Flows is this reach generally range from 380-500 cfs after spring runoff. About 100 cfs is needed to satisfy water rights of the water users downstream of the dam.

Reservations

The region also contains four Indian reservations: Blackfeet, Rocky Boy's, Fort Belknap, and Fort Peck

(Location Map). The Blackfeet Reservation occupies about 1,500,000 acres, bordered to the north by Canada, to the west by Glacier National Park. Topography is rolling plains rising to the west, with elevations ranging from 3,800 in the east to 9,066 feet at Chief Mountain. In 1855, a treaty was concluded with the Blackfeet, Flathead, and Nez Perce. By act of Congress on May 1, 1888, the Tribes ceded most of their joint reservation, and were confined to their present-day reservations. Browning, Montana, is the seat of Tribal government. Major economic endeavors on the reservation are ranching and farming.

Rocky Boy's was created for the Chippewa and Cree Tribes by executive order in the 20th century rather than by treaty in the 19th. In 1916, it was the last reservation to be created, out of lands once part of the Fort Assiniboine Military Reserve. It occupies 108,015 acres of rolling plains and foothills in Hill County southwest of Havre. Box Elder, Montana, is the seat of Tribal government. Ranching and dryland farming are the major economic activities.

Home to the Gros Ventre and Assiniboine Tribes, Fort Belknap was created in 1855 at the same time as the Blackfeet Reservation. It occupies 653,939 acres in Blaine and Phillips counties, bordered on the north by the Milk River, on the south by the Little Rocky Mountains. Most of the reservation is rolling prairie. Tribal seat is at Fort Belknap Agency, Montana. Ranching and farming are the major economic activities.

The Fort Peck Reservation occupies about 2,900,000 acres in extreme northeastern Montana. While just outside the region at the confluence of the Milk and the Missouri rivers, the reservation has been included because it affects social and economic characteristics of the region. Mainly rolling prairie, major economic activities are ranching and farming. It was created in 1886 for the Assiniboine and Sioux Tribes. Tribal seat is at Poplar, Montana.

Population

The study area is a sparsely populated rural region in north central Montana. With a total area of 29,117 square miles, it has a population density of 2.4 people/square mile. Of the nine counties, only two have populations that exceed 10,000. Between the 1990 and 2000 Census, total population of the region declined by 0.2%, compared to a decline of 3.9% between 1980 and 1990. Table 2.4. shows total regional population by county (U.S. Bureau of Census, 2003).

Table 2.4 -- Regional Population

County	1980	1990	2000	% Change 1980-2000
Blaine	6,999	6,728	7,009	.01
Chouteau	6,092	5,452	5,970	-2.0
Glacier	10,628	12,121	13,247	24.6

County	1980	1990	2000	% Change 1980-2000
Hill	17,985	17,654	16,673	-7.3
Liberty	2,329	2,295	2,158	-7.3
Phillips	5,367	5,163	4,601	-14.3
Pondera	6,731	6,433	6,424	-4.6
Toole	5,559	5,046	5,267	-5.3
Valley	10,250	8,239	7,675	-25.1
Totals	71,940	69,131	69,024	-4.1

Source: U.S. Census Bureau.

The Native American part of the total population has increased significantly in the last two decades, growing from 16% of the population in 1980 to 25% in 2000 (U.S. Bureau of Census, 2003). Table 2.5 gives Native American populations on the four reservations for the past three decades, as well as summarizing percentages of Native Americans compared to the total population in the region.

Table 2.5 – Regional Native American Population and Percentage of Total

Reservation	1980	1990	2000	% Change 1980-2000
Blackfeet	5,080	7,025	8,507	67.5
Rocky Boy's	1,549	1,882	2,578	66.4
Fort Belknap	1,870	2,338	2,790	49.2
Fort Peck	4,273	5,782	6,391	49.6
Totals	12,772	17,027	20,266	58.7
Total Regional Population	71,940	69,131	69,024	-4.1
Native American Percentage of Total	16.3	20.8	25.1	8.8

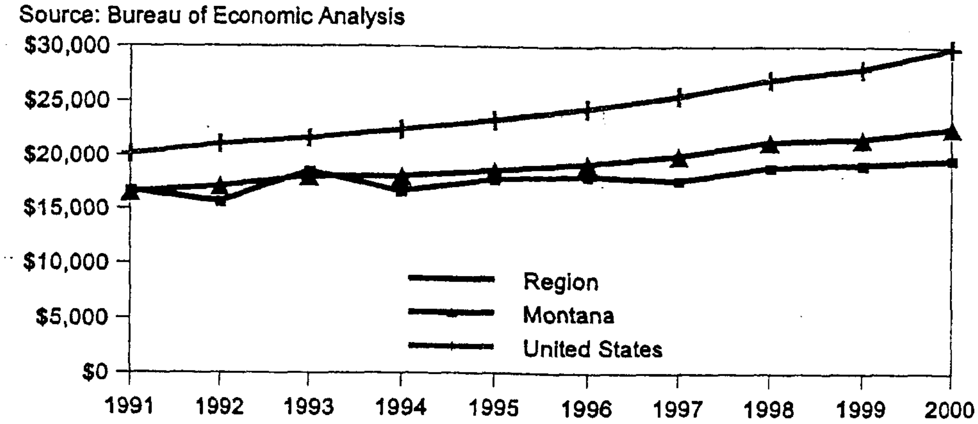
Source: U.S. Census Bureau.

Income

PCPI (*Per Capita Personal Income*) for the nine-county area increased from $16,673 in 1991 to $19,566 in 2000 (U.S. Bureau of Census, 2003). The regional PCPI has lagged behind that of the State, however, which in turn has lagged behind that of the nation. Montana has ranked 46th nationally in PCPI since 1998. Figure 2.4 compares PCPI for the region, Montana, and the U.S. from 1991-2000.

Major Industries

Figure 2.5 -- Per Capita Income



In terms of earning as listed by the U.S. Bureau of Economic Analysis, State and local government, Federal civilian government, and services are the major industries in the nine-county area (2003). Farming and transportation and utilities also constitute major industries in some counties. Table 2.6 shows the top three major industries in the region by county, percentage of earnings by this industry to the total, and the same information for the State as a whole.

Table 2.6 -- Major Industries by Earnings

	First	Second	Third
Blaine	State and Local Government–24.2%	Federal Civilian Government–20.6%	Services–15.3%
Chouteau	State and Local Government–25.0%	Farm–24.5%	Services–13.9%
Glacier	Services–26.1%	Federal Civilian Government–19.5%	State and Local Government–19.1%
Hill	Services–28.7%	Transportation and Utilities–18.2%	State and Local Government–16.9%
Liberty	Farm–20.6%	Services–19.0%	State and Local Government–15.7%
Phillips	State and Local Government–20.5%	Services–19.2%	Transportation and Utilities–10.2%

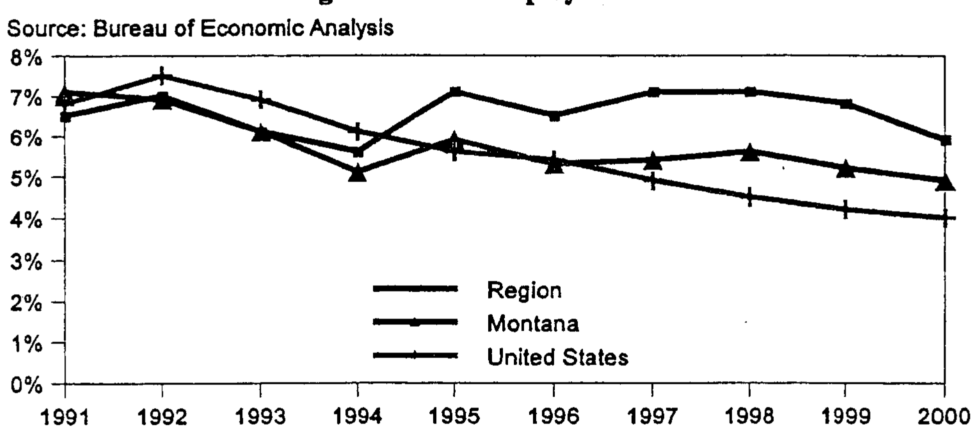
	First	Second	Third
Pondera	State and Local Government–17.4%	Services–17.2%	Construction–16.7%
Toole	Transportation and Utilities–20.4%	State and Local Government–19.3%	Services–18.8%
Valley	Services–19.9%	Farm–16.2%	State and Local Government–15.0%
State	Services–27.8%	State and Local Government–14.2%	Retail–11.5%

Source: U.S. Bureau of Economic Analysis.

Unemployment

As shown in Figure 2.5, unemployment in the nine-county area and the State has been higher than the national rate since about 1995. The national rate has declined steadily since 1992, while the region's and State's have fluctuated above it.

Figure 2.6 -- Unemployment Rate



Unemployment rates for Blaine and Phillips counties are particularly high, 6.8% and 13.0% of the workforce, respectively. One reason for the high unemployment rate is the relatively high Native American populations, which have an extremely high rate. Table 2.7 shows unemployment for the reservations in north central Montana (Montana Department of Labor and Industry, 2003).

Poverty

U.S. Census Bureau estimates indicate the poverty rate is generally higher in Montana than in the U.S. as a whole (U.S. Bureau of Census, 2003). Individual counties in the region have higher poverty rates than the State as a whole, particularly in Blaine and Glacier counties. Table 2.8 compares poverty rates in the nine counties to the State and the U.S. in 1989 and in 1999.

Table 2.7 -- Unemployment Rate by Reservation, 1996-2000

	1996	1997	1998	1999	2000
Blackfeet	20.2%	20.3%	21.8%	21.3%	19.6%
Rocky Boy's	26.1%	28.4%	31.8%	30.0%	27.1%
Fort Belknap	27.2%	27.0%	25.8%	23.7%	19.3%
Fort Peck	11.4%	10.3%	10.6%	11.4%	11.0%

Source: Montana Department of Labor and Industry

Table 2.8 -- Poverty Rates in the Region

	1989	1999
Blaine	27.7%	25.1%
Chouteau	13.7%	13.4%
Glacier	35.7%	28.8%
Hill	18.0%	18.2%
Liberty	18.0%	15.2%
Phillips	17.3%	18.3%
Pondera	17.5%	19.1%
Toole	14.9%	15.2%
Valley	16.6%	15.8%
Montana	**16.1%**	**14.3%**
U.S.	**13.1%**	**11.9%**

RECREATION

The region provides recreational opportunities for residents and visitors alike, much of it directly related to the river and reservoirs as described below (Location Map). Fishing; boating; other water-borne sports; picnicking and camping; and winter sports are popular at Reclamation facilities in the region. The wildlife refuges and WMAs offer hunting, hiking, photography, and wildlife observation. Hunting and fishing along the rivers also provides recreational opportunities. Water-borne recreation, picnicking, wildlife observing, and other recreational activities provide about $15,000,000 annually to the region, according to a November 2001 report (Majerus, 2001).

Reservoir Recreation

Recreational use of reservoirs in the region correlates with water levels, storage, and weather. Recreation at Fresno and Nelson Reservoirs in the Milk River Project and at Tiber Reservoir on the Marias River are shown in Table 2.9 (no information is available on visitors to Lake Sherburne).

Lake Sherburne

This 1,601 surface-acre lake on Swiftcurrent Creek, an impoundment of Sherburne Dam, is mostly within Glacier National Park, partly within the Blackfeet Reservation. The NPS manages recreation. Facilities are limited, with scenic views of the lake and park being the principal draw. Visitor usage is unavailable.

Fresno Reservoir

Fresno is on the Milk River near Havre. Only 5 of the 25,618 acres of land surrounding the 7,388 surface acres of water are developed. The lake surface and its 65 miles of shoreline are available for recreation, however. Reclamation manages recreation: facilities are a boat launching ramp, 40 mooring slips, and 3 picnic areas, with 4 shelters and 12 tables. These facilities complement two swimming beaches. There are also 24 leased cabin sites.

Table 2.9 – Visitors in 2002

Fresno	Nelson	Tiber
64,362	23,803	174,613

Nelson Reservoir

Nelson Reservoir is located 19 miles northeast of Malta on U.S. Highway 2. Of the site's 7,702 acres of land, 10 acres are developed for public use. The reservoir's 4,320 surface acres and 30 miles of shoreline are also available for public use. Nine campsites, three picnic areas with two shelters and sixteen tables, and one boat-launching ramp are available, managed by Reclamation. There are also 106 leased cabin sites.

Nelson experienced the same conditions as other reservoirs in the region, with similar effects. Visitors at the reservoir, as shown in Table 2.9, were down in comparison to 2001. (It should be noted that the traffic counter at Nelson wasn't installed until May, 2001, so some of the early usage for that year was estimated and private areas also provide access to the reservoir, which Reclamation estimated at 20% of other usage.)

Nelson boasts a substantial northern pike fishery, attracting visitors both in summer and winter. Many waterfowl or upland game bird or big game hunters in the Malta area use the reservoir for camping.

Tiber Reservoir

Tiber Reservoir (Lake Elwell), on the Marias River near Chester includes 17,176 surface acres of water and 21,244 acres of land, with about 68 acres developed. A marina and 5 boat ramps are available. About 179 of the reservoir's 180 miles of shoreline are available for camping and picnicking. Reclamation manages 7 campgrounds provide 32 campsites, 3 tent-only sites, and 5 recreational vehicle sites with hookups. An RV dump station is available. Seven picnic areas offer nine picnic shelters and 164 picnic tables. While the Marias River basin has started to recover from the drought, high runoff and maximum water levels in 2002 made some recreational areas unavailable. Also, Sanford Park below the dam was closed for months because of national security concerns. Weather hampered some activities. Still, visitor hours rebounded to nearly their 2000 level as shown in Table 2.9.

Two walleye fishing tournaments are held yearly at Tiber, attracting visitors from the region as well as from the nation. As at Nelson, many bird or big game hunters in the area use Tiber for camping.

Bowdoin National Wildlife Refuge

The refuge, about 7 miles east of Malta is within the Central Flyway of the great waterfowl migration route extending from Canada to Mexico. The 15,550-acre refuge provides food and habitat for up to 100,000 ducks, geese, and other waterfowl each fall and spring. Hunting, wildlife viewing, and photography are popular. Recreational use was 1,803 visitors in 1998, rising to 1,834 in 1997. Use dropped to 1,734 in 2000.

The WMAs also provide wildlife viewing and photography opportunities.

Recreation along the Rivers

People hunt and fish along the rivers but the number is unknown. Fishing along the Milk and Marias rivers (including Fresno and Nelson reservoirs) is estimated to provide about $9,000,000 in net economic value to the region annually (Majerus, 2001). Hunting in the State's *Block Management Areas* in the region (including Bowdoin) provides about $245,0000 annually in net economic value.

CULTURAL RESOURCES

North central Montana abounds in prehistoric and historic resources (see "History of the Study Area," Chapter 1). Cultural resources include prehistoric archeological sites, Indian sacred sites, and other traditional properties important to Native Americans. Many of the facilities of the Milk River Project are considered eligible for the National Register of Historic Places. Much of the area that would be affected by the alternatives haven't been examined for cultural resources.

Cultural resource surveys to comply with NHPA (National Historic Preservation Act) and other laws and regulations will be required when specific plans are developed.

ISSUES and OPPORTUNITIES

Chapter 3

Water is vital to north central Montana for a dependable irrigation and MR&I water supply, threatened and endangered species, water quality, reserved water rights, fish and wildlife, and recreation. There is also an opportunity for hydro-power development in the region. The water supply in the St. Mary and Marias River basins can be characterized as abundant in general, but the supply in the Milk River basin is generally short, insufficient to meet existing and future water needs. Present irrigation and MR&I demands together exceed the current supply. The environment is also affected by this water shortage.

The water shortage in the Milk River basin is complicated by several factors: the aging infrastructure of the Milk River Project makes a reliable water supply problematic; Canada is considering plans to use more of its allocation of the Milk River under the Boundary Waters Treaty; several water-associated threatened and endangered species can be found in the basin; parts of water bodies in the region are classified *Impaired* under the Clean Water Act; settlement of reserved water rights require water. All these factors affect water supply in the basin.

Water issues and resultant opportunities are the subject of this chapter, divided into statements of the *Issue*, then the *Opportunity* for solution. Background on each issue is also included.

WATER SUPPLY SHORTAGE

Of the three river basins in north central Montana, the Milk River basin is the only one short of water to meet current needs. Shortages are caused by a combination of periodic severe droughts, over-development of irrigation in relation to the available water supply, and aging, under-designed canals unable to carry enough water to meet needs even when an adequate supply is available.

About 140,000 acres on average are irrigated in the basin each year as shown in Table 3.1. The Milk River Project irrigates 110,306 acres, including district irrigation and irrigation under contracts with individual farmers. The Fort Belknap Indian Irrigation Project contains 10,425 acres, but only about 5,000-6,000 acres are presently irrigated with natural flows and supplemental water from Fresno Reservoir. Another 25,000 acres are irrigated in the basin under private water rights.

Table 3.1: Annual Milk River Basin Irrigation

	Average Acres
Project Irrigation Districts	98,777
Contracts with Project	11,529
Fort Belknap Indian Irrigation Project	5,000-6,000
Private	25,000
Total	**140,000**

Diversions from the St. Mary River supply about half the Milk River Project's water in an average year, more than 90% during drought years. The St. Mary River provided an average of about 160,000 AF/year to the project over the past 20 years. The current system of canals and storage reservoirs supply irrigators with only one-third to one-half of the water needed for full crop production in a normal year.

Irrigators often don't receive a full allocation of water, undermining their ability to maximize crop production. Being accustomed to frequent water shortages, the irrigators routinely don't apply the full crop irrigation requirement even when water is available. In this way, frequent water shortages affect the irrigators' willingness to invest in necessary equipment and infrastructure to diversify crops. The lack of crop diversity contributes to water shortages as project facilities were not designed to meet current peak irrigation demands.

Assessment of the basin's current water supply generally agrees with earlier studies (see "Previous Investigations" in Chapter 1). Shortages for Reclamation's contracted irrigation water users occur in 7 years of 10, even though most users request far less than a full crop irrigation requirement. In 6 of the 7 short years, the shortage is due to inadequate capacity of project canals and laterals.

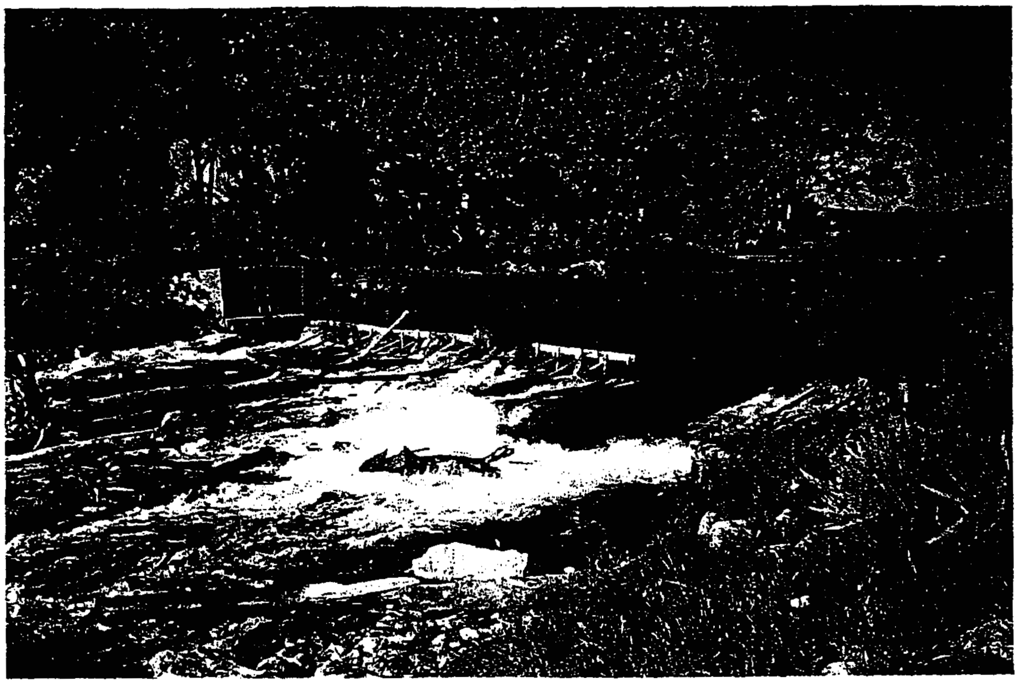
Water shortages occur for individual users relying on natural flows in 2 of 10 years. In this case, the shortage is due to lack of water supply, not the inability to deliver water. At present, individual water users with a right only to natural flows in the river actually are getting some project water to reduce their shortages. Shortages to this group would increase if water rights in the basin were adjudicated and enforced.

Shortages will probably increase with settlement of the reserved water rights of the Fort Belknap and Blackfeet Tribes. The Fort Belknap Tribes have a right to water from the Milk River, while the Blackfeet have rights to water from the St. Mary, Milk, and Marias rivers, all of which either originate or flow through the reservations. According to the Winters Doctrine (see Chapter 1, "History of the Region"), both the Fort Belknap and Blackfeet reservations have senior reserved water rights to natural flows of the rivers.

In addition, the Bowdoin National Wildlife Refuge also has a reserved water right to water in the Milk River basin. The rights claim of the USFWS from tributaries of the Milk River is junior in priority to the project's water rights. A settlement could enhance habitat within the refuge. Milk River water might be necessary to mitigate the effect of any settlement between the State and USFWS.

The Milk River is apportioned between Canada and the U.S. under terms of the Boundary Waters Treaty of 1909 (see Chapter 2, "Water Volume and Quality"). The U.S. receives on average about 40,000 AF of Canada's share of the Milk. Irrigators and towns in Alberta, Canada, are currently looking at plans to use their share of the river more fully. Locations for storage reservoirs are being reinvestigated as the southern part of the province experiences a drought. Construction of a reservoir and the possibility of more irrigated acres in Alberta could increase the water shortages of project irrigators, towns, and other water users in the Milk River basin.

Photo 3.1 – Lohman Diversion Dam



Issue

The deteriorating St. Mary Canal system and decreasing storage in Milk River reservoirs due to sedimentation are major causes of water shortages in the Milk River basin. Most project facilities were completed between 1907-1937.

The Milk River Project was authorized strictly as an irrigation project. Thus, irrigators are responsible for most O&M (operations and maintenance) costs of the facilities. They have generally kept up with routine O&M costs of the St. Mary Canal system, which they pay in addition to their individual conveyance systems, but they don't have the ability to pay for replacement of major infrastructure.

The key component of the project is the St Mary Canal. The 29-mile long canal has outlived its design life, having been completed in 1915. The St. Mary River Siphon in the canal and five large drop structures are in imminent danger of failure. Capacity has diminished from the design capacity of 850 cfs to about 650 cfs today. Canal headworks and diversion structures require modernization to avoid effects to the threatened bull trout. Rehabilitation of the St. Mary Canal will be necessary if lands in the project are to remain in production.

Fresno Reservoir, main storage reservoir of the project, was completed in 1939. Original storage capacity was 130,000 AF. A 1999 survey of the reservoir indicated capacity of 93,000 AF. Loss of storage has affected the ability of the project to store enough water to meet irrigation and MR&I demands, along with maintaining adequate water levels in the reservoir and flows in the river downstream for fish, wildlife, and recreation.

Nelson Reservoir supplies irrigation needs in the lower end of the basin. At present, Nelson can only be filled through the Dodson South Canal. Filling must be coordinated with irrigation demands and with USFWS to avoid affecting the piping plover during nesting season.

There are few demands for St. Mary River water on the U.S. side of the border, except for the Milk River Project. The St. Mary River is apportioned between Canada and the U.S. like the Milk River. Some of the U.S.'s share of the St. Mary flows unused into Canada most years, except when the water supply is at its lowest. Settlement of the Blackfeet's reserved water rights could affect water available to the project.

While local shortages occur in the headwaters of the Marias River basin, none exist in the lower basin because of Tiber Reservoir, which stores spring runoff for release during the rest of the year. There are no significant contracts for Tiber water. The Chippewa and Cree Tribes of Rocky Boy's Reservation, however, were allocated 10,000 AF out of the reservoir as part of their reserved water rights settlement, and the Fort Belknap Tribes are negotiating for water out of the reservoir as part of their settlement. At the same time, the Blackfeet Tribe contends that all water in Tiber Reservoir is part of their reserved water right.

Opportunity

While the issue is complicated, there is the possibility of providing north central Montana with a stable, dependable water supply. An improved water supply would benefit irrigators, towns, Tribes, environmental concerns, and recreation in the region.

MR&I WATER SUPPLY

Havre, Chinook, and Harlem, and the Hill County Water District receive an MR&I supply under contract from Fresno Reservoir. Current water use is about 50% of the contracted volume from Fresno. Releases during the non-irrigation season vary from 20-40 cfs, providing flows in the river downstream. The Fort Belknap Agency also draws its municipal supply from the Milk River.

The town of Chester, the Liberty County Water District, and Devon Water, Inc. receive an MR&I supply from Tiber Reservoir under contract. In addition, the North Central Rural Water Project was recently authorized by Congress; it would draw about 6,000 AF annually from Tiber.

Issue

During drought years, water for the Milk River Project, including MR&I supplies, comes almost entirely from the St. Mary River. Failure of the St. Mary Canal, or other essential facility could therefore result in loss of the MR&I water supply in the Milk River basin during droughts. Shortages aren't experienced at present as Fresno Reservoir is operated to provide a full supply every year.

Opportunity

Increasing the water supply in the Milk River and increasing reliability of the St. Mary Canal and storage systems could provide a more stable MR&I water supply for the Milk River Basin.

THREATENED AND ENDANGERED SPECIES

Two species listed associated with the project can be found in the region: the bull trout and the piping plover. In addition, the pallid sturgeon is in the Missouri River at the confluence with the Milk. Other threatened and endangered species also reside or migrate through the region (see Table 2.1 in Chapter 2). The State has several Species of Special Concern in the region.

Issue

Managing the river basins compatibly with needs of threatened and endangered species and species of concern could affect existing water users.

The bull trout is found in the St Mary River drainage. Studies among Reclamation, USFWS, and the Fish and Wildlife Department of the Blackfeet Tribe (2001) have shown that operation of the St Mary Canal headworks and diversion dam affect bull trout through entrainment into the canal and as a fish barrier, respectively. Studies are underway to determine how best to manage facilities to aid recovery of the species. Changes in operation of the Milk River Project might be necessary to maintain instream flows in Swiftcurrent Creek.

The piping plover is found in the Milk River basin at Bowdoin National Wildlife Refuge and Nelson Reservoir. The plover uses the reservoir's shore as nesting habitat. Reclamation consulted on operations of Nelson Reservoir in 1990, and the USFWS issued a *non-jeopardy opinion* under the Endangered Species Act in 1991. An agreement among Reclamation, USFWS, and the irrigation districts to reduce effects on nesting habitat allows the reservoir to avoid designation as critical habitat.

Pallid sturgeon are found in the Missouri River below Fort Peck Dam. Studies are underway to determine if they are using warmer waters of the lower Milk River as breeding habitat and what kind of flows attract them into the river.

Issues affecting bull trout in the St. Mary River basin also affect the westslope cutthroat trout, a State

Species of Special Concern. Sauger are a Species of Special Concern as well as a game fish. Stash (2001) found a strong sauger run in the section of the Milk from the Canadian border to Fresno Reservoir. . Another Species of Special Concern—pearl dace—was found in the Milk River from below Fresno to Vandalia Dam associated with the tailwater fishery below diversion dams. From Vandalia Dam to the confluence with the Missouri River, three Species of Special Concern can be found. Sauger, paddlefish and blue suckers have been shown to migrate up into the Milk in springtime with adequate flows (Stash, 2001; Dennis Scarnecchia, University of Idaho, personal communication).

Downstream of Tiber Reservoir on the Marias River is a warmwater fishery, sauger being the most numerous game fish (Montana Department of Fish, Wildlife, and Parks, 1998). Paddlefish were believed to have used the Marias River for spawning in the 1960's and 1970's, but recent surveys haven't found them above the confluence.

Opportunity

Bull trout could be benefitted by modification of the outlet works at Lake Sherburne Dam to provide winter flows. Rehabilitation of the St. Mary Diversion Dam and canal headworks could incorporate fish passage through the dam and fish screens to prevent or reduce entrainment in the canal. These changes could also benefit the westslope cutthroat trout.

More flexibility in water deliveries to Nelson Reservoir could further protect nesting piping plover without a loss of water supply.

Project facilities and operations could be modified to create favorable breeding habitat for the pallid sturgeon in the lower reaches of the Milk River if it were determined that this would benefit the species.

WATER QUALITY

The Montana DEQ (Department of Environmental Quality) has responsibility under the Clean Water Act and the Montana Water Quality Act to assess and monitor quality of surface water and to identify impaired or threatened stream segments and lakes.

Certain water bodies in the State are designated as *impaired* in accordance with Section 303(d) of the Clean Water Act (Figure 3.1.) Once a water body is designated as impaired (shown in purple on the figure), the TMDL (total maximum daily load) process is used to prescribe loads for pollutants specific to that particular water body. The TMDL process requires development of benchmarks as a way to control pollutants causing impairment or loss of beneficial uses of the water body. When TMDLs are implemented, the beneficial uses of the impaired water body are expected to be restored.

FIGURE 3.1
IMPARIED WATERS ACCORDING TO THE 2002
MONTANA 303 (d) LIST

000009HQ

A TMDL is the total amount of a pollutant that a water body can receive and still meet water quality standards on a daily basis. It consists of the sum of the individual waste load allocations from point sources, plus the load allocation from non-point and natural background sources of pollution. Thus, the TMDL is a tool for determination of the capacity of a water body to assimilate individual pollutants and for development of a control program to allocate pollutant loads from all sources.

Plans for river basins include a program to implement standards and practices to achieve water quality objectives set forth in the Montana *Water Quality Code*. These standards and practices are imposed through NPDES (National Pollutant Discharge Elimination System) permits, WDRs (waste discharge requirements), waivers, and/or BMP (*Best Management Practices*) programs. Standards and control programs developed by the TMDL process usually are incorporated into basin plans, although—when the impairment is geographically limited and caused by few sources—a TMDL may be implemented without a basin plan amendment.

Issue

Segments of the St. Mary, Milk, and Marias rivers and tributaries are on the State's 303(d) list. Probable impaired uses include cold water fishery, recreation, agriculture, aquatic life support, drinking water supply, and swimming. Degree of impairment is listed as either a threat or as only partially supporting the designated uses of the stream. Matters of concern are flow alteration, siltation, suspended solids, nutrients, thermal modifications, salinity, metals, and organic enrichment.

Non-point source pollution from agriculture is being addressed through a voluntary program. Groups such as watershed organizations and conservation districts are encouraged to develop and implement their own TMDL plans.

Ten separate watersheds (designated HUCs–*Hydrologic Unit Codes*) exist within north central Montana, containing 15 individual impaired stream segments (Figure 3.1). The 2002 list includes water bodies in the Milk and Marias rivers and tributaries and Fresno Reservoir. The date for completion of the TMDL process for all impaired segments is 2011, except for Big Sandy Creek and Lonesome Lake Coulee, which have a 2013 due date.

Several point source discharges are permitted by DEQ within the region. Havre, Chinook, and Harlem all have wastewater discharge permits. A minimum release of 25 cfs from Fresno Reservoir provides mixing flows for these communities discharging treated wastewater into the Milk.

Opportunity

Improving flows in the Milk River and reducing water demands along with State and local efforts to implement BMPs would provide an opportunity to improve water quality.

RESERVED WATER RIGHTS

The Blackfeet, Rocky Boy's, Fort Belknap, and Fort Peck Reservations, the USFWS, and the NPS (National Park Service) have Federally reserved water rights in the St. Mary, Milk, and Marias River basins. Since the USFWS claim for the Bowdoin National Wildlife Refuge is somewhat different, it's treated as a separate issue below.

In the Winters Doctrine, the U.S. Supreme Court in 1908 decided that the Fort Belknap Tribes had a reserved water right of 125 cfs for an existing irrigation project with an 1888 priority date. The Supreme Court reaffirmed that when Federal lands are reserved for a specific purpose, the reservation included water to fulfill the reservation's purpose. In the case of Indian reservations, this includes water for domestic use, stock watering, MR&I supplies, irrigated agriculture, and propagation of fish and wildlife.

Issue

Reserved water rights have various priority dates. Settlement of these water rights could affect other water users in the region since reserved water rights generally have the senior priority date.

The Blackfeet of the Blackfeet Reservation and the Gros Ventre and Assiniboine Tribes of the Fort Belknap Reservation assert a water rights priority date of 1855 based on the *Stevens Treaty*, which established a territory for these Tribes encompassing both present-day Blackfeet and Fort Belknap Reservations. The Fort Belknap Reservation was established by an Act of Congress of May 1, 1888, under which the Tribes ceded all lands except those on the reservation.

The Blackfeet Tribe has wavered between litigation and negotiation of their water rights, more recently in favor of negotiation. Their reservation has unquantified reserved water rights in each basin in the region. They are in the process of developing a settlement proposal. Their 1855 priority date would be senior to most—if not all—water rights in the river basins.

The reserved water rights compact for the Rocky Boy's Reservation has been signed by the Chippewa and Cree Tribes, Montana Legislature, and Congress. The Montana Water Court adjudicated their water rights in 2002. The settlement provided water to the Tribes from tributaries of the Milk River, but not from the mainstem as the reservation doesn't border the river. The Tribes were also allocated 10,000 AF annually from Tiber Reservoir. The Chippewa and Cree Tribes have the right to either use the water to meet their own needs or to market the water as they see fit.

The Montana Legislature in 2001 approved a reserved water rights compact with the Fort Belknap Tribes. The compact must be approved by Congress, the Tribes, and adjudicated by the Water Court to become final. The settlement recognizes the 125-cfs water right decreed in *Winters.*, and quantifies another 520 cfs from the U.S.'s share of natural flows of the mainstem of the Milk and water from the tributaries.

The Fort Peck Reservation settled their reserved water rights in 1985. The compact relinquishes claim to water from the Milk River in exchange for water in the Missouri River. Congress doesn't need to ratify the compact unless the Sioux and Assiniboine Tribes decide to market part of their water.

Finally, the NPS has reserved water rights for Glacier National Park, which contains the headwaters of all three rivers. The park's reserved water rights have been approved by Congress and adjudicated by the Water Court. These rights are largely non-consumptive—being for instream flows—which don't affect downstream water users.

Opportunity

Success of the settlement of the Fort Belknap Compact depends on the continued operation of the St. Mary Canal system. Rehabilitation or modification of the system could provide an opportunity to help resolve Blackfeet reserved water rights.

WATER FOR BOWDOIN

The USFWS has reserved water rights in the Milk River basin for wildlife refuges, the most significant of which is Bowdoin. The refuge was created by Executive Order on February 14, 1936, as a "refuge and breeding ground for migratory birds and other wildlife".

The refuge also receives water from tributaries of the Milk, which are being considered in the settlement discussions, as well as water from irrigation return flows. Water from these sources is infrequent, not meeting the needs of the refuge.

The USFWS has presented an initial settlement proposal being considered by the State.

Issue

The refuge should receive up to 3,500 AF/year from the Milk River Project under their contract, but this doesn't happen every year because of frequent shortages. The USFWS estimates the refuge needs about 16,000 AF/year to meet objectives.

Managing water quality in the refuge is also a need.

Opportunity

Increasing flexibility of water deliveries to either Bowdoin or to Nelson Reservoir could provide water to the refuge when it's most beneficial for refuge purposes.

FISH AND WILDLIFE

In addition to threatened and endangered species and Species of Special Concern, north central Montana is rich with a diversity of other fish and wildlife species.

Issue

Effects to the relatively pristine St. Mary River basin should be minimized. Burbot are found in the upper end and appear to be especially susceptible to entrainment into the St. Mary Canal as evidenced by a recently conducted study (J. Mogen, U.S. Fish and Wildlife Service, personal communication). The St. Mary is the only Montana drainage with native trout-perch and spoonhead sculpin populations (Brown, 1971, Montana Department of Fish, Wildlife, and Parks, 2002; Bramblett, 2001). Trout-perch have also been found in the upper Milk River basin (Bramblett, 2001), indicating a cross-basin transfer of biota. Operation of the St. Mary headworks and diversion dam affect fish by entrainment in the canal and by acting as a fish barrier.

The St. Mary basin is also rare in that several top predators—bull trout, lake trout, and northern pike—are indigenous (the latter two considered non-native almost everywhere else in Montana). Some species have been introduced in the basin, such as brook, brown, and rainbow trout, but these don't appear to have dominated fisheries as they have elsewhere in the State. Some commercial fishing for whitefish exists on the Blackfeet Reservation, particularly in the St. Mary lakes.

Mountain species of wildlife are abundant in the St. Mary area. There are several wetlands that benefit from canal seepage and need to be protected. This area is also heavily used by raptors. Wildlife is managed by the Blackfeet Tribe's Fish and Wildlife Department; coordination with them is critical for wildlife issues in the area.

Loss of fish due to habitat fragmentation is a concern throughout the Milk River basin because of lack of fish passages at diversion dams. Entrainment is also a concern. The section of the Milk River from the Canadian border to Fresno Reservoir is relatively unaffected by the project, except for the addition of St. Mary water. Stash (2001) found a high percentage of native species in this section, including a strong sauger run. Another native—flathead chub—were more abundant here than any other section in the study.

The Milk River from Fresno to Vandalia Dam is heavily influenced by operations of the reservoir and by project depletions. This section was found to be dominated by non-native species, some of which are game fish (Stash, 2001).

Several species that live in the Missouri River are also commonly found in the Milk from Vandalia Dam to the confluence with the Missouri. This section may provide spawning and rearing habitat for sauger, paddlefish, and blue sucker, Species of Special Concern, as well as the native shovelnose sturgeon.

Concern has been expressed about fishkills below Vandalia Dam when the irrigation season ends and accumulated sediment is flushed down the river.

In addition to river fisheries, project reservoirs are managed for walleye, perch, and northern pike fisheries. Fluctuating water levels can damage these fisheries. Any alternatives involving water level changes or additional reservoirs should consider fishing opportunities.

Wildlife issues in the Milk River basin include effects from agriculture on wetland and upland game species that inhabit irrigated croplands and associated riparian areas. The possibility for conflict between ranchers and environmental interests over protection of prairie dog colonies could also become an issue.

Photo 3.2 – Dodson Diversion Dam

The Marias River should receive special consideration because planned irrigation at Tiber Reservoir was never developed, so the public expect operations to be tailored to recreation, fish, and wildlife needs. The fishery in the reservoir—walleye, northern pike, and yellow perch, plus forage and sucker species—is considered good, maintaining itself through natural reproduction. The river fishery is influenced by effects of water regulation: water released from the reservoir through a river outlet low in the water column is colder than what would be expected normally. The first 20 miles below Tiber is thus a coldwater fishery with rainbow trout, brown trout, and mountain whitefish.

The Montana Department of Fish, Wildlife, and Parks established guidelines in 1998 for reservoir and river operations for fish, wildlife, and recreation. If any alternatives affected Reclamation's ability to meet these guidelines, there could be negative effects to these resources. Further downstream the fishery converts to warmwater species, with sauger being the most numerous resident game fish (Montana Department of Fish, Wildlife, and Parks, 1998).

Many species of wildlife are associated with the riparian areas of the Marias River, those most influenced by the project being beaver and Canada geese. Beaver lodges may be threatened by unnatural flows. Canada geese nest on the islands in the river; when spring flows are high, predators are discouraged from crossing side channels, so goose nest success is good.

Opportunity

Increasing the water supply in the river basins, increasing reliability of the project, and increasing flexibility of water deliveries could provide fish and wildlife benefits both in and around the reservoirs and riparian corridors. Reservoir water levels could be maintained at more desirable levels for fish, including minimum pool levels. Minimum flows in the Milk River in winter could be maintained.

RECREATION

Fish and wildlife species in the region provide both local and non-resident hunting and fishing opportunities. In addition, the scenery and undeveloped nature of the area encourages a wide variety of outdoor recreation like canoeing, hiking, recreational floating, camping, and picnicking. Much of the water-based recreation is affected by operations of the Milk River Project.

The St. Mary basin is on Blackfeet Reservation and Glacier National Park, with spectacular scenery and wildlife viewing opportunities. Also, hunting is important to Tribal members, and they are accustomed to enjoying healthy herds of elk.

Fishing on the reservation is managed by the Blackfeet Tribe, with focus on stocked lakes on the reservation not directly linked to the basin. Reclamation has been asked to contribute to an on-reservation Tribal fish hatchery and to stocking Lower St. Mary Lake with westslope cutthroat trout. Lake Sherburne does not have any developed boat access and angling pressure is usually low.

Much of the recreational opportunity in the region is focused on the reservoirs in the Milk River basin. Fresno Reservoir has good walleye, northern pike, and yellow perch fishing, and water-based recreation is popular. The Milk itself also provides recreational fisheries and is considered good for sauger, channel catfish, and pike. While issues with entrainment and passage cause concern for many native species, they also create habitat for non-native sport fish that flourish in fragmented habitat and canals.

The Marias River and Tiber Reservoir provide most of the water-based recreation in that area. Tiber sees significant fishing pressure for walleye, pike, perch, and trout. People are accustomed to water levels in the reservoir that allow for recreation, so changes may cause significant public outcry. The coldwater trout fishery below Tiber is considered especially valuable by the Montana Department of Fish, Wildlife, and Parks (1998), since stream trout fishing is scarce in this area.

Issue

Fluctuations in the water levels of the reservoirs limit fishing opportunities in the Milk River basin. Low water levels during drought years sometimes restricts fishing and other water borne recreation. Low flows in the river also affect fishing.

Opportunity

Maintaining the reservoirs at more desirable water levels for fishing and water borne activities could improve recreational opportunities in the region. Maintaining flows in the river could improve fisheries.

HYDRO-POWER

Since legislation for neither project authorized hydro-power as a benefit, Reclamation has no authority to pursue development for the Milk River Project or the Lower Marias Unit. The agency which has the authority, FERC (Federal Energy Regulatory Commission), however, has received proposals for development through its hydro-power permitting process.

For the Milk River Project, hydro-power development has been investigated at the St. Mary Canal terminal drop structures and at Fresno Dam. A private enterprise evaluated a small development at the St. Mary Canal drops, while several others showed interest in a small hydro-power plant at Fresno in the 1980s. Economic factors precluded hydro-power development at either point.

More recently, several companies indicated renewed interest in hydro-power development of the Milk River Project. FERC issued preliminary permits to study development at Fresno Dam in June 2000 to the Universal Electric Power Corporation of Akron, Ohio, and to study development at Sherburne Dam in May 2002 to Symbiotics, LLC, of Rigby, Idaho. With three-year time limits, these permits haven't expired at the time of this writing. FERC also issued a permit in October 2001 to study development at the Leishman Drop in the St. Mary Canal to BAE Energy of Browning, Montana, but this permit was surrendered in July 2002.

On the Lower Marias Unit, Tiber Dam has been the focus of interest. CHC (Continental Hydro Corporation) of Boston, Massachusetts, applied for a preliminary permit for study of development at Tiber Dam in 1993. After completion of economic and environmental studies, FERC issued an Environmental Assessment/Finding of No Significant Impacts for the proposal in September 1996. CHC received a license to construct and operate a 7.5 megawatt hydro-electric powerplant at the dam in June 1997. This license has a term of 50 years.

In 2001, this license was transferred from CHC to Tiber Montana, LLC, of Idaho Falls, Idaho. Plans and specifications for the powerplant were begun in 2002, and construction could begin in the summer of 2003.

Issue

Continued interest of private enterprises in development could indicate undeveloped hydro-power potential in the region.

Opportunity

Development of small hydro-power plants at various facilities of the Milk River Project could provide economic benefits to the region.

ALTERNATIVES

Chapter 4

This chapter presents alternatives to address water and related issues identified in Chapter 3. The *Future Without the Project Condition*—the most likely condition in the future if no Federal action were taken—serves as a basis of comparison for the alternatives.

Non structural alternatives would reduce demands on water resources in the region; structural alternatives (those that would require construction) would meet one of the following functions:

- To improve water operations and management
- To improve water storage
- To augment the supply of water.

After a section on how alternatives were developed, the Future Without the Project is discussed, followed by the alternatives arrayed in the categories above. Alternatives are described; contribution to the water supply estimated; ability of the alternative to satisfy various water issues discussed; and economic benefits and costs estimated. Table 4.1 at the end of the chapter profiles costs and benefits of the alternatives. Chapter 4 concludes with a section on alternatives considered but dropped during the study.

DEVELOPMENT OF ALTERNATIVES

Some alternatives were updated from previous reports, while others were suggested during meetings with interest groups, tribes, and other agencies. Information for the alternatives was developed from a number of sources, as explained below. Assumptions, benefits, costs, and other information could change after further study.

Water Supply Contribution

A hydrology model was used to characterize present operations in the St. Mary River and Milk River basins. The model described how water enters, is used, and how it leaves the basins. Information fed into the model included: monthly streamflows from several locations along the rivers; reservoir capacities; irrigation demands in the form of a CIR (*crop irrigation requirement*) and acres irrigated; canal and on-farm efficiencies; canal diversion capacities; return flow factors; and minimum stream flow requirements. Other information was also included. Results of the initial computer run were compared to past information on stream flows in the basin to calibrate the model. The model allows for changes in water entering, being used, and exiting the basins as well.

In this way, the model could be used to estimate how an alternative would (or would not) meet water needs of the basins. It was used in this report to determine the volume of water delivered to the canal head gates in the Milk River basin. The volume delivered in an alternative was then compared to the volume estimated for the Future Without the Project Condition. Any increase in the volume delivered became the *Water Supply Contribution* of the alternative (see Table 4.1).

Issues

The water supplied by an alternative was also used to estimate effects on MR&I (municipal, rural, and industrial water) benefits; threatened and endangered species (and species of special concern); water quality; reserved water rights; the Bowdoin National Wildlife Refuge; other fish and wildlife species; and recreation.

Economic Benefits

Economic benefits in this report include only the direct benefit of increased crop production, not indirect benefits resulting from increased production (other economic benefits will be figured in future studies). Economic benefits of the alternatives were estimated from AF (acre-feet) of water delivered to canal headgates (acre-inches to the farm headgates). AF/acre of water from the hydrology model were used to estimate increases in production of alfalfa. The increased crop production was then converted to dollars for the economic benefits.

Economic benefits of the alternatives are compared in Table 4.1.

Cost Estimates

Cost estimates were developed at a preliminary level of detail, depending on existing information. Estimates generally were prepared from preliminary layouts of facilities on existing maps, such as U.S. Geological Survey 7.5 minute quad sheets or Reclamation drawings. Quantities and units necessary were computed. To these costs was added a percentage of the costs for mobilization, unlisted items, contingencies, and non-contract costs, including compliance with environmental and cultural resource laws and regulations.

Particular cost estimates developed were *total investment cost* (costs of construction plus interest during construction), annual *O&MR costs* (costs of operation, maintenance, and replacement), and *annual energy costs* figured on 50 mills/kilowatt-hour. *Total annual costs* are the sum of OM&R and energy costs. Table 4.1 compares costs of the alternatives.

FUTURE WITHOUT THE PROJECT CONDITION

Reclamation plans water projects under direction of the U.S. Water Resource Council's *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (1983), commonly known as the *P&Gs*. The P&Gs require assumptions to be made of the most likely condition in the future if no Federal action were taken. Thus, both the *Future Without the Project Condition* and the future with a project (or, in other words, the alternatives) are based on assumptions of what would occur in the future. The Future Without a Project Condition is the baseline to which the alternatives are compared.

Each alternative was compared to the most likely conditions in the region 2050 if no Federal action were taken. The Milk River Project was assumed to exist at this date, although in a much different form than today.

General Assumptions

Based on current trends, catastrophic failure of the St Mary Canal is likely to occur between now and 2050. This failure—whether the result of a single event or continued deterioration over time—would probably exceed the ability of project irrigators to pay for.

The State water rights adjudication process would be completed with issuance of final decrees, and water rights would be enforced in the Milk River. Irrigated acres junior in right to the Blackfeet and Fort Belknap Reservations and the Milk River Project would be left without a water supply in all but extremely wet years when some natural flows would be available.

Faced with the prospect of no reliable water supply, it was assumed that holders of junior water rights would agree to contribute to the construction and operation and maintenance costs of any water supply project that provided them with water. Based on this assumption, the hydrology model provides an equal share of water to all current irrigated acres in the basin along with the additional acres proposed for development under the Fort Belknap Compact. Irrigated acres would thus total about 150,000 acres.

The U.S. receives on average about 40,000 AF/year from the Milk that rightly belongs to Canada under the Boundary Waters Treaty. In the Future Without the Project, it was assumed that Canada would significantly reduce this surplus by 2050 as they developed storage facilities north of the border and added irrigated acreage in southern Alberta.

An assumption was made about future capacity of Fresno Reservoir, also. Based on data for the past twenty years, the average loss to sedimentation is about 500 AF/year; extending this average loss to 2050 would mean Fresno's capacity would be reduced to about 68,000 AF by that time.

The Fort Belknap Compact was assumed to be fully implemented by 2050, by which acres would be added to the present irrigation on the reservation. New irrigation on the reservation would have the senior water right to natural flows of the Milk. The Blackfeet Tribe's reserved water rights have yet to be settled, although a settlement would be expected by 2050. The effects are unknowable at this stage.

Current trends suggest that irrigators in the project would increase both on-farm and canal efficiencies in the future to stay in business and maximize crop production with available water. An increase in on-farm efficiency of 7% was assumed in the Future Without the Project, from the basin-wide average of 43% at present to 50% in 2050. A canal efficiency increase of 10% was assumed, from the present 50% to the future 60%. While specific programs might change, Federal and State funds would probably be available (along with local funds), to help fund increases in efficiencies.

Effects of the Future Without the Project Condition

Based on the assumptions above, the future would affect irrigation, MR&I supplies, threatened and endangered species, water quality, settlement of reserved water rights, fish & wildlife, and recreation as described below.

Irrigation

With loss of St. Mary River water, loss of storage capacity in Fresno Reservoir, and with Canada using it's full share of the river, the Milk River basin could not support irrigation at the present level. The water supply would be significantly reduced from present levels to an average of 11.82 in/ac (inches per acre) annually. This would be much less the 29 in/ac needed annually according to the U.S. Natural Resources Conservation Service (nd). The water supply would vary greatly from year to year with loss of St. Mary River water and Fresno's reduced storage capacity.

MR&I

Several towns and a rural water district draw MR&I water directly from the Milk River. Loss of St. Mary River water would render this source unreliable. They would either have to find another source (possibly Tiber Reservoir) or ask for reallocation of storage in Fresno Reservoir. Reallocation would affect the supply available to irrigation, perhaps leading to a further loss of irrigated acreage in the basin.

Threatened and Endangered Species

The bull trout in the St Mary River basin would probably benefit from the loss of the St Mary System. The river would revert to a more natural hydrologic pattern and the barrier to fish migration would be removed. Loss of St. Mary water on the piping plover around Nelson Reservoir couldn't be accurately determined. Operation of Nelson would probably change as some acres were no longer irrigated. Effects (if any) on the pallid sturgeon are unknown.

Water Quality

Loss of the diluting effect of good quality water from the St. Mary River would result in a decrease of water quality in the Milk River. As on-farm and canal efficiencies improved, the volume of return flows from irrigated fields back to the river would decrease, but concentrations of pollutants would increase. Segments of the river would probably be "dewatered" more often; when flowing, water temperatures would increase.

A number of stream segments in the region and Fresno Reservoir are impaired, with TMDL (total maximum daily load) development scheduled for 2011-2013 (see Chapter 3, "Water Quality"). Probable causes of impairment include nutrients, metals, habitat alternation, flow alternation, bank erosion, riparian degradation, thermal modification, among others.

Reserved Water Rights

Loss of water from the St Mary would require the Tribes, State, and Federal Negotiating Team in the Fort Belknap Compact to re-enter "negotiations on alternative remedies to supply water to portions of the Reservation served from the Milk River and to water rights arising under state law within the Milk River Project" (MCA 85-20-1001, Article VII.A.1).

A settlement with the Blackfeet Tribe hasn't progressed to the point where effects could be estimated. The Tribe is interested in using the St Mary Canal to transport water to the North Fork of the Milk River for benefit of the Tribe. Failure of the St. Mary Canal would remove this possibility.

Fish and Wildlife

In the Future Without a Project, fisheries in the St. Mary River basin would generally benefit by removal of the St. Mary Diversion Dam, elimination of the canal entrainment threat, and more natural flows. In the Milk River, however, fisheries could suffer as irrigation demands were met without St Mary River water, resulting in very little water left in the river. Reservoirs would probably fluctuate more that at present, resulting in adverse effects on reservoir fisheries.

Wildlife in the St Mary River basin would generally remain the same, but habitat in the Milk River basin could be affected. Water probably couldn't be provided as consistently to the Bowdoin National Wildlife Refuge, reducing habitat which could lead to overcrowding and disease outbreaks among waterfowl. On the other hand, if loss of water resulted in some croplands reverting back to grasslands, upland species such as sage grouse could benefit from increased habitat.

Recreation

Loss of St. Mary River water would have an adverse effect on water-borne recreation and other forms of recreation in Fresno and Nelson reservoirs since water levels probably would drop. Fishing below the reservoirs would also decrease because releases from the reservoirs would decline.

WATER OPERATIONS AND MANAGEMENT ALTERNATIVES

Alternatives in this category would improve water operations and management in the Milk River Project by improving on-farm efficiency; river operations; efficiency of the canal system; water management at Nelson Reservoir; or, by construction of a re-regulation reservoir in the Glasgow Irrigation District.

On-Farm Efficiency Improvements

The *Milk River On-farm Irrigation Study* (Dalton, 2001) provided the information for this alternative. This study estimated average on-farm efficiency could be improved by implementing irrigation system and management improvements.

Description

The Dalton study proposed field leveling, conversion from flood irrigation to sprinkler, and shorter irrigation canal runs for providing water more efficiently to the crop root zone when water is needed by the plant. On-farm efficiency would be improved to about 55%, an increase of 5% in comparison to the Future Without.

Water Supply Contribution

Improvement in the efficiency in use of water on-farm would reduce the supply available to the canal headgates by 12,881 AF annually, which equates to 0.63 inch less water delivered to the farm headgates than in the Future Without the Project (11.19 inches/acre compared to 11.82 inches/acre–see Table 4.1). Because of improvement in efficiency, however, about ¼- inch more water would be consumed by crops, increasing production. Twenty-nine inches/acre would be required for full crop production.

Issues

Improving efficiency on-farm would improve crop production by increasing the volume of water consumed by crops, reducing the supply available for other uses. Less water would return to the river from irrigated lands (*return flows*), and fertilizers would be used more efficiently, thereby improving water quality in the Milk River. Less water would be available for implementation of the Fort Belknap Compact. Water available for the Bowdoin National Wildlife Refuge would be reduced. Lack of an adequate supply in Fresno in the future would probably result in the river being dewatered more frequently, affecting the river fishery, wildlife along the river, and riparian and wetland habitat. Game species like deer and pheasants might benefit from increased crop production. Recreational opportunities would decrease as water levels in Fresno and Nelson reservoirs were drawn lower.

Economic Benefits

Incremental crop yields are estimated to increase 0.05 tons/acre of alfalfa annually, a basin-wide increase of 7,549 tons/year. This would equate to an annual economic benefit of $649,000 (Table 4.1).

Costs

Total investments costs would be $10,600,000 (Dalton, 2001) and annual OM&R costs $61,162, and energy costs $57,240. Total annual costs would be $704,402. The benefit-to-cost ratio would be 0.9 (Table 4.1).

River Operations Improvements

Water deliveries in the Milk River Project are measured using non-standard devices, the accuracy of which is less than optimum. USGS (U.S. Geologic Survey) gauges, of which there are five in this reach of the Milk, are used by Reclamation to monitor flows and adjust releases from Fresno Reservoir. Reclamation also remotely monitors water diversions from project canals and for the Fort Belknap Irrigation Project. Deliveries are commonly measured by ditch riders using hand-held propeller flow meters in headgate/pipe structures. Meters are calibrated for a typical pipe size, being adjusted by tables or formulas when other sizes are encountered. While reasonably accurate, field checks in 2001 indicated these measurements varied depending on the condition of the meters or headgate/pipe structures. Practices among the districts and individual ditch riders also varied considerably, ranging from several measurements per delivery per day to no measurements at all.

Description

This alternative would improve water deliveries measurement by adding more gauging stations and more frequent measurement of discharge. Reclamation would improve the accuracy and reliability of canal diversion measurements, including permanent measurement structures at the heads of the Paradise, Harlem, Fort Belknap, and Dodson North and Dodson South Canals, which might include remote monitoring at some locations.

A river basin management program would be developed and managed by a full time river manager. The manager would be responsible for scheduling water releases and deliveries of water from Fresno, while monitoring river flows and diversions by canals and pumpers along the river. The manager would maintain water measurement equipment at sites throughout the project to assure accuracy and transmittal of information on a timely basis, and work with irrigation districts, Milk River Joint Board of Control, Fort Belknap Irrigation Project, and river pumpers to develop delivery plans and water allotments based on water supply and forecasts.

Water Supply Contribution

This alternative would allow for more efficient, timely, and equitable delivery of water throughout the basin. Continuous monitoring and daily management of river operations would probably contribute to the water supply, but the increase wasn't estimated since it couldn't be adequately modeled.

Issues

Improving river operations would probably improve the water supply in the Milk River basin and allow some more water to remain stored in the reservoirs, perhaps making MR&I deliveries more reliable. Slightly more water could be available for implementation of the Fort Belknap Compact. Project facilities would be operated more efficiently, slightly improving conditions for the piping plover around Nelson Reservoir. More water could be routed to Bowdoin occasionally. Intensive management to maximize water deliveries could result in more frequent dewatering of the river, affecting the river fishery, wildlife along the river, and riparian and wetland habitat. Water levels in the reservoirs would probably be a little higher, slightly improving recreational opportunities, but recreational fishing along the river might decline.

Economic Benefits

Economic benefits couldn't be determined for this alternative separately.

Costs

Total investment costs are estimated to be $100,000 and annual OM&R costs $245,000 (Table 4.1). There would be no added energy costs. Total annual costs would be $251,000. No benefit/cost ratio was estimated.

Canal Efficiency Improvements

Canals in the Milk River Project could be modified to deliver water more efficiently to farm headgates. Releases from Fresno irrigate project lands over 300 river miles away, a trip that may take water up to two weeks before reaching the last canal headgate at Vandalia Dam (see Location Map). Nearly half the water diverted from the Milk River returns from canal and lateral wasteways. Project main canals and laterals are earth-lined. These canals and laterals are often too small to supply peak irrigation demand. At other times, they supply more water than irrigators can efficiently use.

Description

Methods to improve efficiency would include lining canals and laterals, putting laterals into pipe, and reusing spills and return flows, in addition to improving water measuring devices. Canal efficiency would improve by 10%, from 60% in the Future Without to 70% in this alternative.

Water Supply Contribution

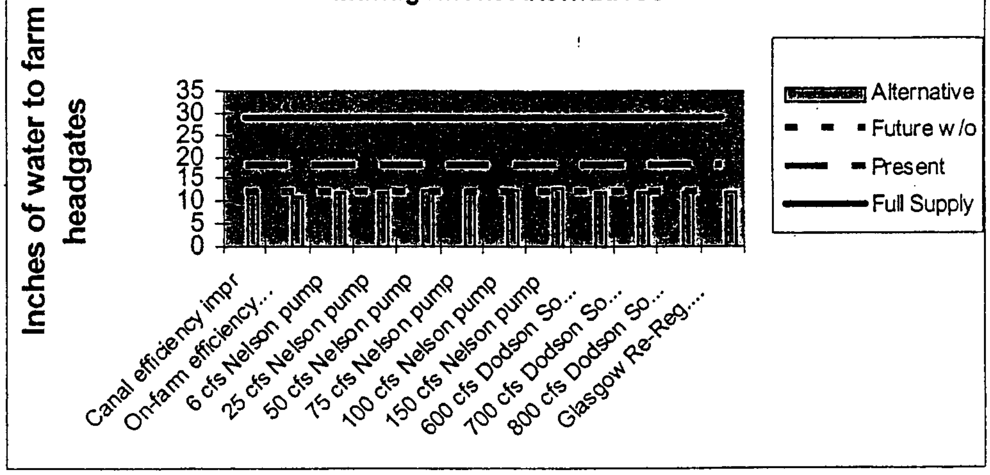
Improvement in canal efficiency would reduce water delivered to the canal headgates by 8,369 AF annually, 0.68 inches/acre more would be delivered to farm headgates than in the Future Without the Project (12.50 inches/acre compared to 11.82 inches/acre–Table 4.1). About 29 inches/acre would be required for full crop production. Water supply for Water Operations and Management Alternatives are compared in Figure 4.1.

Issues

Similar to on-farm efficiency improvements, water saved by canal efficiency improvements would be delivered to irrigators for improved crop production, reducing the supply available to other uses. Less water would be available to contribute to implementation of the Fort Belknap Compact. Water available for Bowdoin would be reduced. Less water would return to the river from canal spills, resulting in more frequent dewatering with consequent adverse effects on the river fishery, wildlife along the river, and riparian and wetland habitat. Recreational opportunities would probably remain the same at Fresno but would decrease at Nelson.

Economic Benefits
Incremental crop yields would increase 0.07 tons/acre of alfalfa annually, a basin-wide increase of 10,498 tons/year. This would equate to an annual economic benefit of $903,000 (Table 4.1).

Figure 4.1 – Water Supply for Water Operations and Management Alternatives



Costs
Total investment costs are estimated to be $12,920,000, annual OM&R costs $34,800, and energy costs $66,000 (Table 4.1). Total annual costs would be $814,800. The benefit/cost ratio would be 1.1.

Nelson Reservoir Pumping Plant

Nelson Reservoir, with a total storage capacity of about 79,000 AF, is formed by a series of five homogenous earth-filled riprapped dikes. The reservoir supplies water to about 20,000 acres in the lower part of the Malta Irrigation District through the Nelson South Canal. Water is also sometimes released through the Nelson North Canal into the Milk River as part of the supply to the 18,000 acres in the Glasgow District.

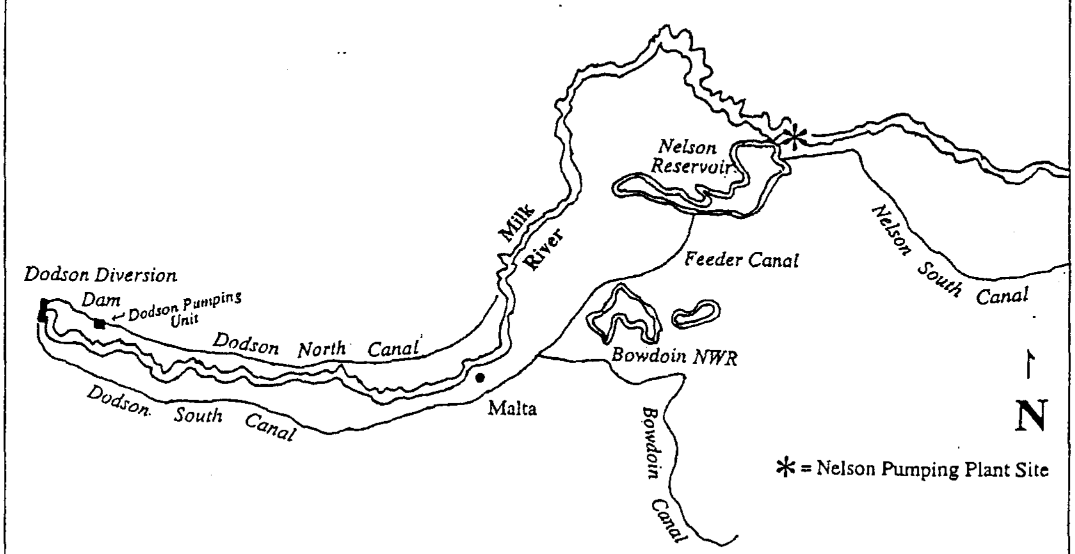
Water for Nelson —a combination of natural flows and water from Fresno Reservoir—is diverted from the river at Dodson Diversion Dam and delivered to Nelson via the 45-mile long Dodson South Canal (Figure 4.2). Water usually is delivered to Nelson in March-early May and September-October. The canal also delivers water for irrigation: during the irrigation season (May-mid-September), there is only capacity in Dodson South Canal to satisfy irrigation, with little or no capacity to transport water to Nelson Reservoir. In drought years, the only water available for Nelson is stored Fresno water.

Typically water is stored in the reservoir in the spring after the ice breaks up and before full irrigation begins. Water is also stored in the fall after the irrigation season, but before the river freezes. During the irrigation season, Dodson South Canal is typically flowing at maximum capacity to serve lands above the reservoir. Storage in Nelson is thus limited by availability of flows in the Milk and by the short time the Dodson South Canal can be used to fill the reservoir.

Description

Nelson's water supply could be augmented by pumping water up 70 feet from the Milk River at Cree Crossing to the reservoir (Figure 4.2). Facilities would include a lowhead diversion dam, a multi-bay pump house with varying size pumps, and a 3,300-foot long pipeline to the reservoir terminating in a concrete outlet structure. Pumps ranging from 6-150 cfs capacity were examined for this report. At 6 cfs they would pump year-round, while at 150 cfs they would pump just during runoff. Capacity would be defined in the regional feasibility report should this alternative be recommended.

Figure 4.2 – Milk River from Dodson Diversion Dam to Nelson Reservoir



Water Supply Contribution

Total water delivered to farm headgates would vary from 11.95 inches/acre annually for the 6-cfs pumps to 12.86 inches/acre annually for the 150-cfs pumps. This would be 0.13-.1.04 inches/acre more for the 6-cfs and 150-cfs pumps, respectively, than in the Future Without. It would be less than the 29 inches/acre required for full crop production.

Issues

All sizes of pumps in a pumping plant at Nelson would reduce water supply shortages to some extent and allow for more flexibility in operations. Irrigators could receive water both earlier and later in the irrigation season when flows are often used for filling Nelson. More water could be left in Fresno, improving reliability of MR&I supplies. The pumping plant would allow water levels in Nelson to be kept higher in the spring, causing piping plovers to build nests higher on the shoreline, thereby reducing possible effects to nesting sites. River flows below the pumping plant would be reduced, while more sediment might be delivered to Nelson Reservoir from the river. By improving management in the basin, the pumping plant could contribute to implementation of the Fort Belknap Compact. Water could be provided more consistently to Bowdoin since water normally routed to Nelson could go to the refuge.

Nelson water levels could be better controlled and coordinated with Montana DFWP to improve fish production, but pumping high flows from the spring river rise could adversely affect migratory spawning fish like paddlefish, sauger, and blue suckers that rely on high peak flows for spawning cues. All sizes of pumps in a pumping plant would allow water levels to be kept higher in Fresno and Nelson later in the season, providing more recreational opportunities.

Economic Benefits

Incremental crop yields would range from an increase of less than .01 tons/acre of alfalfa annually with the 6-cfs pumps to 0.11 tons/acre annually for the 150-cfs pumps, a basin-wide increase ranging from 2,007-16,056 tons/year, respectively (Table 4.1). This would equate to an annual economic benefit ranging from $173,000-$1,381,000, respectively.

Costs

Pumping plant sizes in relation to costs, crop yields (in tons of alfalfa), annual economic benefits, and benefit-cost ratios are:

Pumping Plant Capacity	Total Investment	Annual OM&R	Annual Costs	Crop Yields	Annual Economic Benefits	B/C Ratio
6 cfs	$3,046,000	$24,400	$192,400	2,007	$173,000	0.9
25 cfs	$3,907,000	$74,300	$290,300	3,088	$266,000	0.9
50 cfs	$5,136,000	$104,900	$388,900	7,410	$637,000	1.6
75 cfs	$6,089,000	$117,800	$453,800	10,035	$863,000	1.9
100 cfs	$7,620,000	$136,400	$557,400	12,505	$1,075,000	1.9
150 cfs	$9,449,000	$166,300	$688,300	16,056	$1,381,000	2.0

Table 4.1 compares all the alternatives in these respects.

Dodson South Canal Rehabilitation

Increasing the 500-cfs capacity of this canal to 600 cfs, 700 cfs, and 800 cfs was examined for this alternative. It would provide a means of transferring to Nelson Reservoir early spring flows and excess water available during the irrigation season.

Description

Capacity of Dodson South would be increased to 600-800 cfs, depending on which capacity offered the greatest economic benefits. Capacity of the canal would be defined in the regional feasibility report.

Water Supply Contribution

Total water delivered to farm headgates would range from 12.13 inches/acre annually for the 600 cfs canal to 12.38 inches/acre for the 800 cfs canal, respectively, 0.31-0.56 inches/acre more than the 11.82 inches/acre annually in the Future Without (Table 4.1). This would be less than the 29 inches/acre required for full crop production.

Issues

A larger capacity canal would allow Nelson to receive more early spring flows and other flows from the river during the irrigation season, reducing water supply shortages and slightly improving reliability of MR&I supplies. More flexibility in Nelson operation would slightly benefit the piping plover. This alternative would slightly decrease water quality as more water would be diverted from the river into the reservoir. More water in Nelson would contribute to implementation of the Fort Belknap Compact, albeit slightly. A rehabilitated larger canal could provide water more consistently to Bowdoin. Fish and wildlife habitat in and around Nelson Reservoir could improve, but diversion of high flows from the spring rise of the Milk could adversely affect spawning paddlefish, sauger, and blue sucker that rely on high peak flows for spawning cues. This alternative would allow water levels to be kept higher in Fresno and Nelson later in the season, providing more recreational opportunities.

Economic Benefits

Incremental crop yields increases would range from 4,786-8,646 tons/year basin wide for the 600-cfs and 800-cfs canals, respectively (Table 4.1). This would equate to annual economic benefits of from $412,000-$744,000, respectively.

Costs

Canal capacities in relation to costs, crop yields, annual economic benefits, and benefit-cost ratios are shown below. Table 4.1 compares all alternatives in these respects.

Canal Capacity	Total Investment	Annual OM&R	Annual Costs	Crop Yields	Annual Economic Benefits	B/C Ratio
600 cfs	$5,347,000	$7,000	$302,000	4,786	$412,000	1.4
700 cfs	$10,797,000	$7,300	$604,300	7,256	$624,000	1.0
800 cfs	$16,966,000	$7,700	$945,700	8,646	$744,000	0.8

Glasgow Irrigation District
Re-Regulation Reservoir

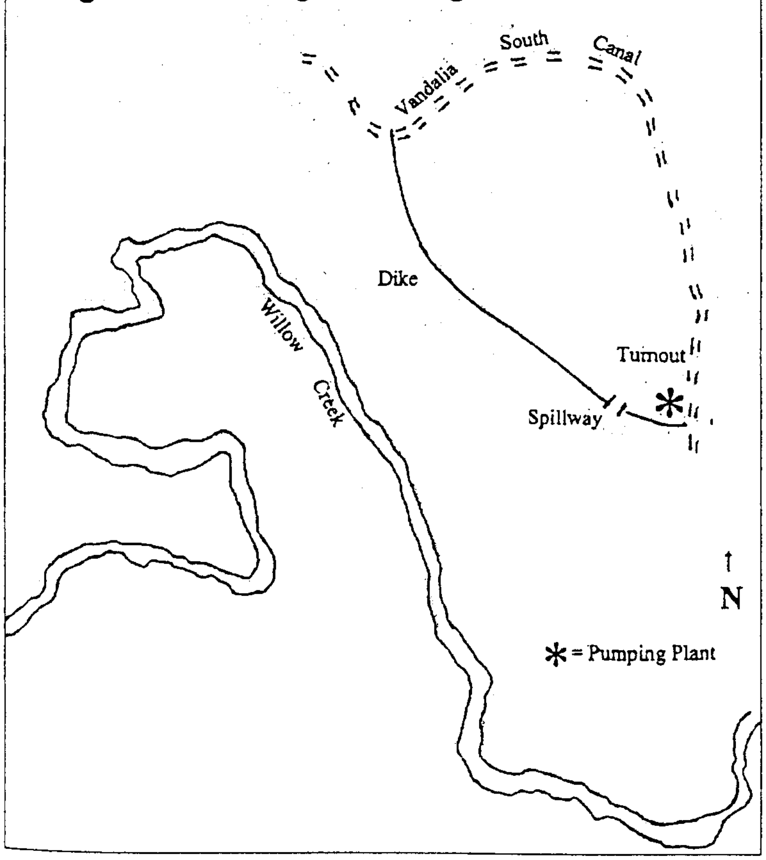
Water supplied to the Vandalia Canal is sometimes insufficient. The 130-AF Glasgow Irrigation District Re-Regulation Reservoir would capture surplus flows from the canal, to be released later when needed.

Description

The reservoir would be located on state and private lands near the Vandalia South Canal Siphon about 3¼ miles south of Glasgow, Montana (Figure 4.3). It would be constructed by building an embankment about 1,450 feet long and modifying the present canal bank.

The embankment would be about 10 feet high, with a 14-foot top width. A PVC liner would be installed on the face of the embankment to reduce seepage and erosion. The canal bank would be raised about 1 ½ feet to provide adequate freeboard and widened to provide for a 16 foot road. Filter fabric and 12-inch riprap would be installed on the reservoir side of the bank to reduce erosion. Total storage of the reservoir would be 130 AF, with a maximum water surface elevation of 2089.61 feet. Total surface area would be 18 acres.

Figure 4.3 – Glasgow Re-Regulation Reservoir



The reservoir would be filled by gravity from a new turnout off the canal, consisting of a reinforced, concrete inlet structure, 48-inch reinforced concrete pipe, and a flared end section. The turnout would have a maximum capacity of 36 cfs.

An overflow structure would control the water level in the reservoir and would provide a means of draining the reservoir in an emergency. It would consist of a reinforced, concrete inlet structure, 48-inch reinforced concrete pipe, and a flared end section. The reservoir could be drained using a 24-inch diameter slide gate in the overflow structure.

Water would be raised a maximum of 13 feet from the reservoir back into the canal. The pumping plant would consist of a vertical turbine pump mounted on a reinforced, concrete intake structure. A 20-inch steel pipe would be installed from the pump into the existing siphon inlet. Power is available within 400 feet of the pump plant.

Water Supply Contribution

Total water delivered to farm headgates would be 11.94 inches/acre annually, more than the 11.82 inches/acre annually in the Future Without, an incremental benefit of 0.12 inch/acre annually (Table 4.1). The alternative would deliver less than the 29 inches/acre required for full crop production.

Issues

This alternative would have little—if any—effect on water supply shortages in the basin but would improve crop production in the Glasgow Irrigation District by improving efficiency of canals and other delivery facilities. Improvement in operation of the district might reduce their needs for water from Nelson Reservoir. Added operational flexibility would benefit the piping plover at Nelson. The new reservoir would contribute little towards implementation of the Fort Belknap Compact. No additional water would be available for Bowdoin. The fishery at Nelson could improve slightly. While operational improvement would reduce canal spills back to the river, less water would have to be diverted at Vandalia Dam, leaving more water in the river for the fishery. Recreational opportunities at Nelson could improve slightly.

Economic Benefits

Incremental crop yields would increase 0.01 tons/acre annually or 1,853 tons/year basin wide. This would equate to annual economic benefits of $159,000 (Table 4.1).

Costs

Total investment costs in this alternative are estimated to be$1,400,000, annual OM&R costs $9,200, and energy costs $2,100 (Table 4.1). Total annual costs would be $88,300. The benefit/cost ratio would be 1.8.

WATER STORAGE ALTERNATIVES

This category includes alternatives for the St. Marys River basin—the Babb Dam—and three in the Milk River basin: enlarging Fresno Reservoir, enlarging Nelson Reservoir, and constructing storage reservoirs on Milk River tributaries.

Babb Dam

A dam on the St. Marys River near Babb, Montana, could store water, either to be transferred to the Milk River Project or used by the Blackfeet Tribe. An 850-cfs capacity St. Mary Canal would be included in the alternative.

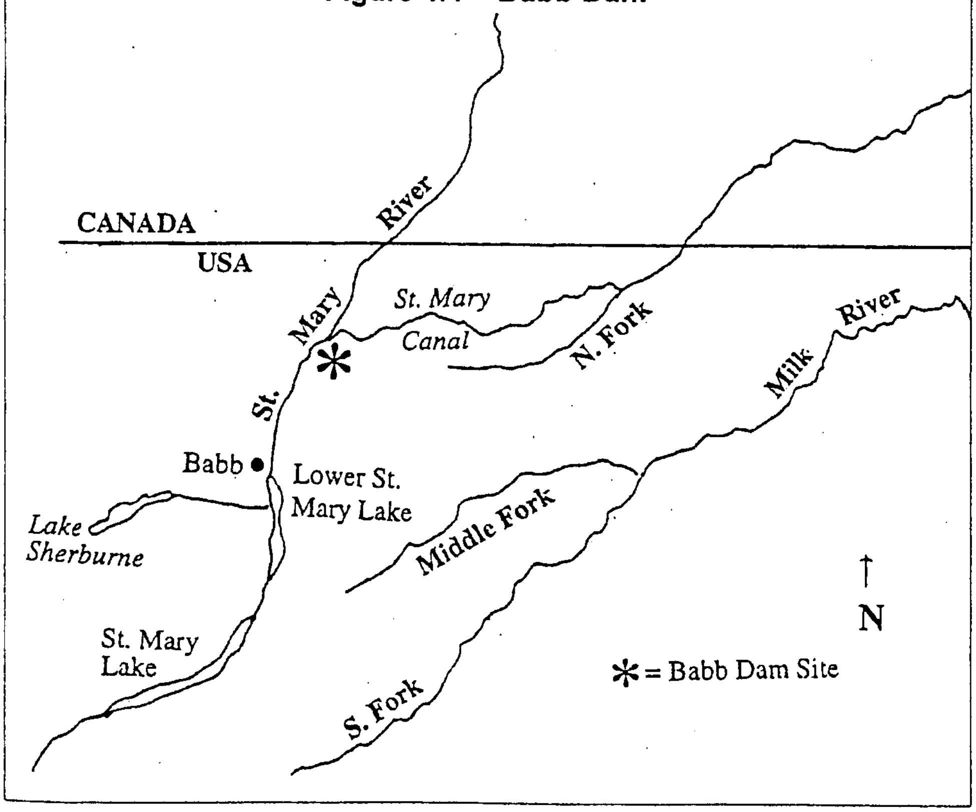
The dam would be operated in accordance with the Boundary Waters Treaty. Operation of the dam and the St. Mary Canal would allow for fuller utilization of the St. Mary River, resulting in less surplus water entering Canada.

The dam and reservoir would be located entirely on the Blackfeet Reservation. Without the Tribe's support, this alternative wouldn't be considered.

Description

The dam—about 220 feet high and 3,600 feet long—would be located about 2,000 feet downstream from the St. Mary River Siphon (Figure 4.4). It would include an emergency spillway in the left abutment which would release flood flows into the river about ½ mile downstream of the dam. The 297,000 AF reservoir formed behind the dam (at maximum) would include Spider Lake, which would be diked on the east side. Passage for bull trout around the dam would be provided. The St. Mary Canal would be rehabilitated for its last 20 miles to 850-cfs capacity; the first 9 miles would be abandoned.

Figure 4.4 – Babb Dam



Water Supply Contribution

Total water delivered to farm headgates would be 27.30 inches/acre annually in this alternative, more than the 11.82 inches/acre annually in the Future Without, an incremental benefit of 15.48 inches/acre annually (Table 4.1). It would deliver less than the 29 inches/acre needed for full crop production. This alternative would add slightly to the water supply in the St. Mary River, significantly to the water supply in the Milk River.

Issues

This alternative could provide the largest contribution to the water supply in the basin of the alternatives in this report, benefitting MR&I supplies as well. It would have a significant effect on bull trout without a fish passage, as the area of the new reservoir would be in the heart of bull trout winter habitat. On the other hand, it would improve conditions for the piping plover in Nelson. Water quality in the Milk would be slightly improved because more water would be left in the river. This alternative would allow for full implementation of the Fort Belknap Compact, and would also present an opportunity to provide a significant volume of water towards settlement of the Blackfeet Tribe's reserved water rights. Water could be provided more consistently to Bowdoin. River habitat in the St. Mary River basin would be lost, while lake habitat were gained. The new reservoir might create favorable habitat for non-native species which could move into the river system and out-compete native species. More water in the river would improve fish and wildlife habitat, riparian areas, and wetlands in the Milk River basin. Recreational opportunities would be improved as water levels in Fresno and Nelson reservoirs could be kept higher later in the season. The opportunity for hydro-power would be significant.

Economic Benefits

Incremental crop yields would increase 1.58 tons/acre annually or 238,988 tons/year basin wide(Table 4.1). This would equate to annual economic benefits of $20,553,000.

Costs

Total investment costs would be $228,734,000 and annual OM&R costs $212,200. Energy costs were not estimated (Table 4.1). Total annual costs would be $14,441,200. The benefit/cost ratio would be 1.4.

Enlarge Fresno Reservoir

Fresno's active conservation storage level could be enlarged by modifying or replacing the concrete-crest overflow spillway to accommodate gates. Modification of the spillway would allow more water to be stored in the reservoir. Design storage capacity of the reservoir was 130,000 AF; a recent survey, however, showed present capacity to be 93,000 AF, a loss of 37,000 AF of storage between 1937-1999, or about 500 AF/year.

Description

Raising the crest 5 feet to elevation 2580 feet would increase storage to 95,400 AF, raising it 10 feet would increase storage to 129,200 AF, and raising the crest 20 feet would increase storage to 217,400 AF. All three possibilities were examined for this report, with storage capacity to be defined in the regional feasibility report. In addition, Reclamation is conducting a flood routing study to determine if raising the spillway crest would require other spillway modifications to handle floods safely.

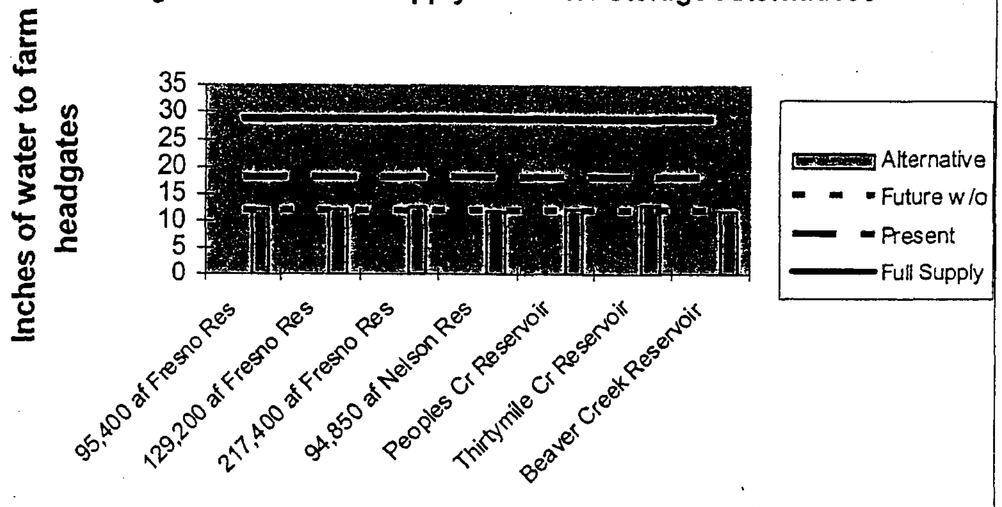
Little or no modification of the dam—besides the spillway and perhaps installation of seepage and piping protective measures on the downstream face— would be required.

Water Supply Contribution
Total water delivered to farm headgates would vary from 12.20 inches/acre annually for the 95,400 AF capacity reservoir to 12.57 inches/acre annually for 217,400 AF capacity reservoir. In comparison to 11.82 inches/acre annually in the Future Without, this would mean an incremental benefit of from 0.38-0.75 inches/acre, respectively. This alternative would deliver less than the 29 inches/acre required for full crop production. Table 4.1 displays all three capacities, while Figure 4.5 shows the water supply for all alternatives in this category.

Issues
All three reservoir capacities would have similar—and modest—effect in the Future Without the Project since St. Mary River water would be unavailable. By improving water supply in the Milk, this alternative would slightly improve the possibility that water would be available for MR&I supplies. Water quality in the Milk would be slightly improved by the slim increase in stream flows and less frequent dewatering. This alternative could contribute to implementation of the Fort Belknap Compact. Water could be provided somewhat more consistently to Bowdoin. Fisheries in Fresno would improve from more water if the reservoir were operated to realize this benefit. The alternative would slightly improve fish and wildlife habitat downstream by providing more flows more often, but peak spring flows might be reduced, adversely affecting fish species depending on these flows to cue spawning . The larger reservoir would improve recreational and hydro-power opportunities.

Economic Benefits
Incremental crop yields would range from an increase of 0.04 tons/acre annually for the 95,400 AF capacity reservoir to 0.08 tons/acre annually for the 217,400 AF capacity reservoir, respectively. The 95,400 AF capacity would increase yields 5,867 tons/year basin wide, the 217,400 AF capacity 11,579 tons/year basin wide. This would equate to annual economic benefits of $505,000 for the smaller capacity, $996,000 for the largest capacity (Table 4.1).

Figure 4.5 – Water Supply for Water Storage Alternatives



Costs
Storage capacities in relation to costs, crop yields, annual economic benefits, and benefit-cost ratios are shown below. Table 4.1 compares the alternatives in these respects.

Storage Capacity	Total Investment	Annual OM&R	Annual Costs	Crop Yields	Annual Economic Benefits	B/C Ratio
95,400 AF	$5,361,000	$44,000	$340,000	5,867	$505,000	1.5
129,200 AF	$8,149,000	$45,000	$495,000	9,726	$836,000	1.7
217,400 AF	$42,899,000	$51,000	$2,421,000	11,579	$996,000	0.4

Enlarge Nelson Reservoir

Since more water is needed for users downstream of Nelson Reservoir, a means of storing additional water would be beneficial.

Description

This alternative would provide about 16,000 AF of additional storage in Nelson Reservoir, adding capacity by a dike at the upper end of the reservoir and adding riprap to the dike both on the upstream and downstream faces The earthen dike would be located about 2,000 feet downstream of Dodson South Canal's discharge point into the reservoir at elevation 2245 feet. It would span from the south ridge below the canal to the opposite ridge, thus creating an impoundment within the south drainage wash. A 20-foot wide roadway on the crest of the dike and a 48-inch diameter outlet would be included in the facilities. Normal downstream water elevation would be elevation 2222 feet, upstream maximum elevation 2240 feet.

Water Supply Contribution

Total water delivered to farm headgates in this alternative would be 11.87 inches/acre annually, more than the 11.82 inches/acre annually in the Future Without, an incremental benefit of 0.05 inches/acre annually (Figure 4.5 and Table 4.1). This would be less than the 29 inches/acre required for full crop production.

Issues

Because St. Mary River water would be unavailable, this alternative would provide only a small benefit to water supplies and little improvement to reliability of MR&I supplies in the basin. It would provide operational flexibility at Nelson Reservoir, with good opportunity to improve habitat for the piping plover although water for Bowdoin would be provided somewhat less consistently. This alternative would contribute slightly to implementation of the Fort Belknap Compact. The Nelson fishery could benefit from more water if the reservoir were better managed for that purpose. Peak spring flows in the river might be reduced, adversely affecting fish species depending on this to cue spawning. The larger reservoir might improve recreational opportunities in and around Nelson.

Economic Benefits

Incremental crop yields would increase 0.01 tons/acre annually, 772 tons/year basin wide. This would equate to annual economic benefits of $66,000 (Table 4.1).

Costs

Total investment costs were estimated to be $18,000,000, annual OM&R costs $30,000, with energy costs not estimated. Total annual costs would be $1,097,000. The benefit/cost ratio would be 0.1 (Table 4.1).

Storage Reservoir on Peoples Creek

Three sites on tributaries of the Milk River—Peoples Creek, Thirty Mile Creek, and Beaver Creek—were examined as possible sites for storage reservoirs (Figure 4.6). Stored water would be released during the irrigation season.

Description

Peoples Creek dam site is on the Fort Belknap Reservation southwest of Dodson. An earth fill dam 1,010-feet long, it would have a concrete-lined chute service spillway and a grass-lined auxiliary spillway. Crest height would be at elevation 2445 feet, the outlet at elevation 2330 feet. The reservoir behind the dam would cover 974 acres. This alternative would provide 34,900 AF of storage in the new reservoir.

Water Supply Contribution

Total water delivered to farm headgates would be 12.27 inches/acre annually in this alternative, more than the 11.82 inches/acre annually in the Future Without. The incremental benefit would be 0.45 inches/acre annually (Figure 4.5 and Table 4.1). This would be less than the 29 inches/acre needed for full production.

Issues

Any of the storage reservoir alternatives would contribute only modestly to water supplies in the basin, allowing for some more flexibility in project operations—with possible higher storage levels in Fresno and Nelson reservoirs—and improved reliability of MR&I supplies. Operational flexibility would allow improvement of Nelson operations to benefit the piping plover. By adding to water supplies, this alternative could contribute to implementation of the Fort Belknap Compact. Water could be provided more consistently to Bowdoin. The new reservoir could be managed for the fishery (and recreation) but perhaps at the expense of the native fishery in the river. This alternative would store spring runoff, thereby reducing peak spring flows, adversely affecting fish species depending on this to cue spawning.
Water levels could be maintained higher in Fresno and Nelson later in the season, slightly improving recreational opportunities.

Economic Benefits

Incremental crop yields would increase 0.05 tons/acre annually, 6,947tons/year basin wide. This would equate to annual economic benefits of $597,000 (Table 4.1).

Costs

Total investment costs would be $35,890,000, annual OM&R costs $35,400. Energy costs were not estimated. Total annual costs would be $2,113,400. The benefit/cost ratio would be 0.3 (Table 4.1).

Storage Reservoir on 30 Mile Creek

Description

The dam on 30 Mile Creek would be situated about 9 miles upstream of Harlem, Montana, in Blaine County (Figure 4.6). An earth fill dam at this point would be 2,550 feet or 3,250 feet long, depending on whether the dam crest height was at elevation 2650 feet (the maximum height to avoid flooding a country road and bridge at the upper end of the reservoir) or 2665 feet (the maximum height obtainable at this site). Both crest heights were examined for this report (crest height would be defined in the regional feasibility report). The spillway would be similar to that for Peoples Creek. A 36-inch diameter hand-operated concrete pipe would serve as the outlet. The reservoir behind the dam would cover 1,548 acres or 1,964 acres at maximum, depending on the crest height. Storage volume of the new reservoir would be 47,850 AF or 80,490 AF at maximum.

Water Supply Contribution

Total water delivered to farm headgates in this alternative would be 12.92 inches/acre annually. It would be more than the 11.82 inches/acre annually in the Future Without, an incremental benefit of 1.10 inches/acre annually (Figure 4.5 and Table 4.1). This alternative would deliver less than the 29 inches/acre needed for full crop production.

Issues

Issues would be similar to those described for a storage reservoir on Peoples Creek.

Economic Benefits

Incremental crop yields would increase 0.11 tons/acre annually, 16,982 tons/year basin wide. This would equate to annual economic benefits of $1,460,000 (Table 4.1). This alternative would have flood control benefits also, but this is outside the scope of the present report.

Costs

Total investment costs would be $42,000,000, annual OM&R costs $36,000, with energy costs not estimated. Total annual costs would be $2,468,000. The benefit/cost ratio would be 0.6 (Table 4.1).

Storage Reservoir on Beaver Creek

Description

The dam on Beaver Creek would be about 13 miles south of U.S. Highway 2 in Phillips County (Figure 4.6). Crest height of the earth fill dam would be at elevation 2255 feet, length 3,400 feet. The spillway would be similar to that for Peoples Creek, while a 24-inch diameter concrete pipe with hand-operated gate would serve at the outlet. The reservoir impounded by the dam would cover 1,290 acres at maximum. Storage volume in the new reservoir would be a maximum of 9,800 AF.

Water Supply Contribution

Total water delivered to farm headgates would be 12.09 inches/acre annually in this alternative, more than the 11.82 inches/acre annually in the Future Without, an incremental benefit of 0.27 inches/acre annually (Figure 4.5 and Table 4.1). It would be less than the 29 inches/acre needed for full crop production.

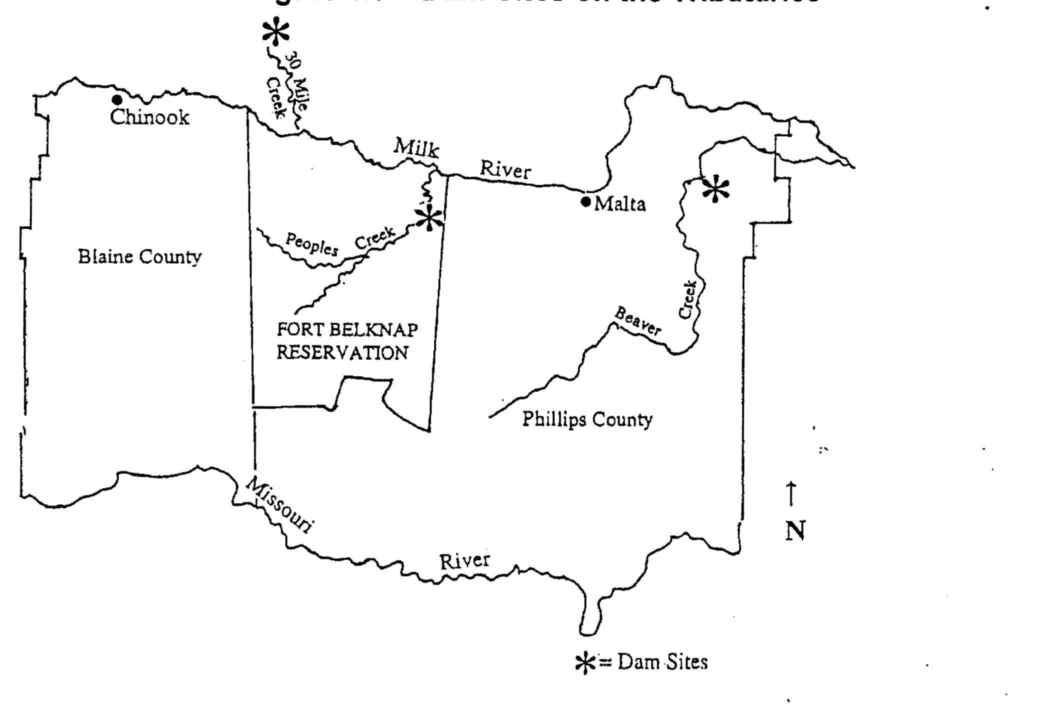
Issues

Issues would be similar to those described for a storage reservoir on Peoples Creek.

Economic Benefits

Incremental crop yields would increase 0.03 tons/acre annually, 4,168 tons/year basin wide. This would equate to annual economic benefits of $358,000 (Table 4.1).

Figure 4.6 – Dam Sites on the Tributaries



Costs

Total investment costs would be $17,000,000, annual OM&R costs $24,000. Energy costs were not estimated for this report. Total annual costs would be $1,008,000. The benefit/cost ratio would be 0.4 as shown in Table 4.1.

WATER AUGMENTATION ALTERNATIVES

This category includes an alternative to rehabilitate the St. Mary System, alternatives to construct a canal from the Missouri River to the Milk River via two different routes, and an alternative to construct a pipeline from Tiber Reservoir to Fresno Reservoir.

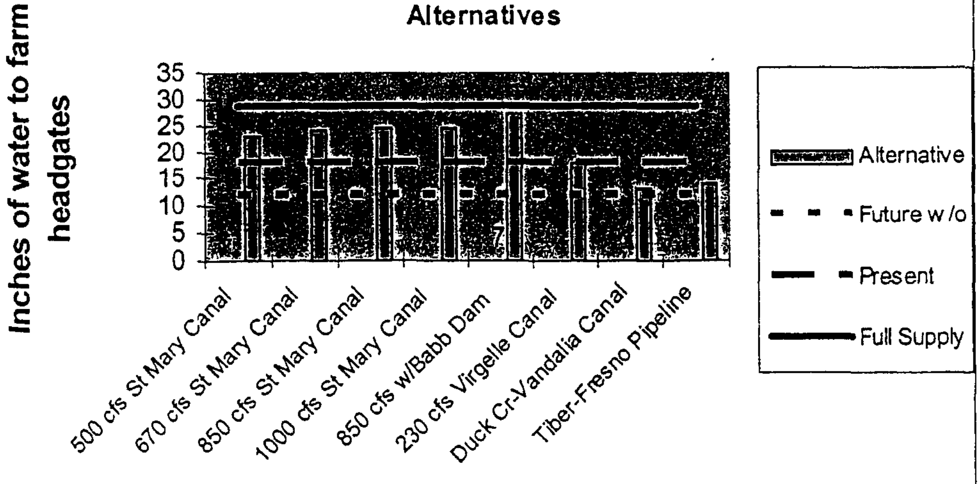
St. Mary System Rehabilitation

The 85-year old St. Mary Canal is badly in need of rehabilitation; most of the structures have exceeded their design life and thus are in need of major repairs or replacement. Canal capacity has dropped from the original 850 cfs in 1925 to about 650 cfs today. Landslides along the canal route and the dilapidated structures make the canal unreliable as a water source.

Description

This alternative would include rehabilitation of existing facilities, as well as new facilities to keep bull trout out of the canal and add winter flows to Swiftcurrent Creek for benefit of the species. A small dam would be built at Spider Coulee to flood part of the canal prone to failure.

Figure 4.7 – Water Supply for Water Augmentation Alternatives



Four possible canal capacities were examined: 500 cfs; 670 cfs (the present capacity), 850 cfs, and 1,000 cfs (Figure 4.7). Final capacity of the canal would be defined in the regional feasibility report.

In addition to enlarging or maintaining canal capacity, this alternative would include other work as well:

- Building a low flow outlet at Sherburne Dam
- Stabilizing of Swiftcurrent Creek's banks
- Building a fish passage around the diversion dam
- Building a fish screen at the canal intake
- Building new headworks
- Replacing the Spider Lake check structure
- Repairing the Kennedy Creek check structure, wasteway, and grade control
- Replacing the barrels of the St. Mary River and Hall Coulee siphons
- Replacing the Hall Coulee wasteway
- Building or improving O&M roads
- Improving cross drainage
- Repairing slide areas
- Armoring some canal banks
- Installing a full or half PVC lining on section of the canal
- Replacing drop structures, and
- Removing trees and rocks.

Building a dam at Willow Creek is a possibility, depending on the interest of the Blackfeet Tribe. It would flood a section of the St. Mary Canal prone to failure because of steep slopes on the south side, avoiding the necessity of rehabilitating this section. The new reservoir would be about 3 miles long (back to the upper end of Spider Lake) ¼-mile wide at its widest point. Storage at maximum water elevation of 4436 feet would be 5,080 AF, with a surface area of 235 acres.

Water Supply Contribution

Total water delivered to farm headgates in the Milk River basin would vary from 23.02 inches/acre annually for the 500-cfs capacity canal to 24.58 inches/acre annually for the 1,000-cfs capacity (Table 4.1). In comparison to 11.82 inches/acre annually in the Future Without, this alternative would deliver an incremental benefit of from 11.20-12.76 inches/acre annually for the 500-cfs and1,000-cfs capacities, respectively. This would be less than the 29 inches/acre needed for full crop production.

The flows in the St. Mary River would slightly decrease with the 850-cfs and 1,000-cfs capacity canals as more water would be diverted to the Milk.

Figure 4.7 shows the water supply for all of the alternatives in this category.

Issues

All canal capacities would provide a significant contribution to water supplies in the Milk River basin. Reliability of MR&I supplies would significantly improve. Water would be available to allow for better management of the piping plover. Water quality in the Milk would be improved because more water would be left in the river. This alternative would allow for full implementation of the Fort Belknap Compact and would also provide an opportunity to provide water towards settlement of the reserved water rights of the Blackfeet Tribe. Water could be provided more consistently to Bowdoin, and more water could be left in the Milk River and in the reservoirs to improve fish and wildlife habitat. Recreational opportunities would be improved as water levels in Fresno and Nelson reservoirs could be kept higher later in the season. The opportunity for hydro-power development at the St. Mary Canal drops and at Fresno Dam could be significant.

St. Mary River facilities are located entirely on the Blackfeet Reservation, so this alternative would require support of the Tribe. Flows in the St. Mary River could be reduced, with adverse effects on the bull trout and other fish. Screening of the canal intake and a fish passage at the dam would be necessary to reduce these effects. Wildlife which use the canal and surrounding area as a travel corridor would be affected. Canal seepage would contribute to nearby wetlands, benefitting wildlife.

Economic Benefits

Incremental crop yields would range from an increase of 1.14 tons/acre annually for the 500-cfs capacity canal to1.30 tons/acre annually for the 1,000-cfs capacity canal (Table 4.1) The 500-cfs capacity would increase yields 172,911 tons/year basin wide, the 1,000-cfs capacity 196,955 tons/year basin wide. This would equate to annual economic benefits of $14,870,000 for the smaller capacity, $16,942,000 for the largest capacity.

Costs

Canal size in relation to costs, basin-wide increases in crop yields (in tons of alfalfa), annual economic benefits, and benefit-cost ratios can be summarized as follows:

Canal Capacity	Total Investment	Annual OM&R	Annual Costs	Crop Yields	Annual Economic Benefits	B/C Ratio
500 cfs	$82,000,000	$136,000	$4,666,000	172,900	$14,870,000	3.2
670 cfs	$92,600,000	$150,000	$5,265,000	189,600	$16,304,000	3.1
850 cfs	$102,000,000	$165,000	$5,800,000	195,600	$16,822,000	2.9
1,000 cfs	$140,800,000	$170,00	$7,950,000	197,000	$16,942,000	2.1

Virgelle-Milk River Canal

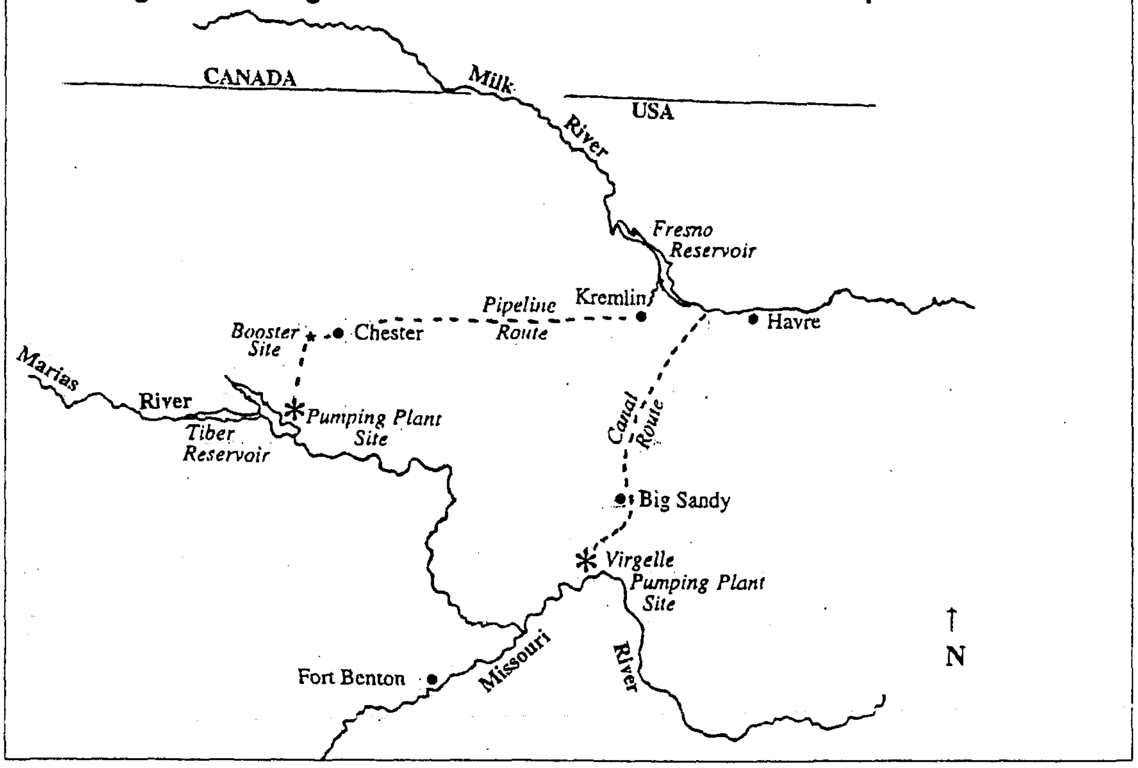
Two earlier plans to convey Missouri River water to the Milk River were updated for the present report.

Description

The Virgelle-Milk River Alternative would convey water from Virgelle on the Missouri River to the Milk

River near Havre. The alternative would include a pumping plant at Virgelle (of a 175-cfs, 200-cfs, or 230-cfs capacity) about ½ mile upstream of Boggs Island (Figure 4.8). Final capacity would be defined in the regional feasibility report. The pumping plant would draw water from the river via an infiltration gallery in the river bottom and convey it by a 66-inch diameter pipeline to a surge tank on the bluff, a static lift of 200 feet. From this point the water would flow into a 46-mile long canal following the old Northern Pacific Railroad's right-of-way. The canal would be about 12-feet wide at the bottom, 42-feet wide at the top, and 7½-feet deep. The drop into the Milk near Havre would be by a 60-inch diameter pipe abut 850 feet long after the water emptied into an energy-dissipating stilling basin.

Figure 4.8 – Virgelle-Milk Canal Route and Tiber-Fresno Pipeline Route



Water Supply Contribution

Total water delivered to farm headgates would vary from 16.63 inches/acre annually for the 175-cfs capacity canal to 17.97 inches/acre annually for the 230-cfs capacity (Table 4.1 displays all three canal capacities). In comparison to 11.82 inches/acre annually in the Future Without, this alternative would deliver an incremental benefit of from 4.81-6.15 inches/acre annually for the 175-cfs and 230-cfs capacities, respectively (Table 4.1). This would be less than the 29 inches/acre needed for full crop production.

Issues

Effects would be similar for all three canal capacities. This alternative would significantly improve water supplies in the basin, benefitting irrigation and MR&I uses. Water levels could be kept higher in Fresno and Nelson Reservoirs, allowing for opportunities to benefit the piping plover. Due to high arsenic concentrations in Missouri River water, this alternative would probably violate State water quality standards. This alternative could contribute significantly to implementation of the Fort Belknap Compact and would also provide an opportunity to provide water towards settlement of reserved water rights of the Blackfeet Tribe. Water could be provided more consistently to Bowdoin. Higher water levels would improve fish and wildlife habitat in and around the reservoirs, and increased flows would improve fish and wildlife habitat in and along the Milk River. Wildlife would benefit from increased crop production. Recreational opportunities would be improved with higher water levels in the reservoirs and greater stream flows in the river.

Economic Benefits

Incremental crop yields would range from an increase of 0.49 tons/acre annually for the 175-cfs capacity canal to 0.63 tons/acre annually for the 230-cfs capacity pumps (Table 4.1). The 175-cfs capacity would increase yields 74,259 tons/year basin wide, the 230-cfs capacity 94,947 tons/year basin wide. This would equate to annual economic benefits of $6,386,000 for the smaller capacity pumps, $8,165,000 for the largest capacity.

Costs

Canal capacities in relation to costs, crop yields, annual economic benefits, and benefit-cost ratios are show below. Table 4.1 compares the alternatives in all respects.

Canal Capacity	Total Investment	Annual OM&R	Annual Costs	Crop Yields	Annual Economic Benefits	B/C Ratio
175 cfs	$65,807,000	$700,200	$4,337,200	74,259	$6,386,000	1.5
200 cfs	$72,015,000	$873,400	$4,853,400	84,140	$7,236,000	1.5
230 cfs	$78,224,000	$938,800	$5,261,800	94,947	$8,165,000	1.6

Duck Creek-Vandalia Canal

The other Missouri-River-Milk River route would convey water from Duck Creek in Fort Peck Reservoir to Vandalia near the end of the Milk River system.

Description

The Duck Creek-Vandalia Canal would divert Missouri River water from the South Fork Duck Creek Arm of Fort Peck Reservoir through the Vanadalia area to the Milk River (Figure 4.9). A channel about 100-feet long in the South Fork Duck Creek Arm would be needed. The 100-cfs canal would be 31 miles long. A pumping plant would be included in the facilities in case the water level at Fort Peck fell below the canal elevation at 2200 feet.

The possibility of placing part—or all—of the route into pipe is also being investigated. This decision would be made in the regional feasibility report.

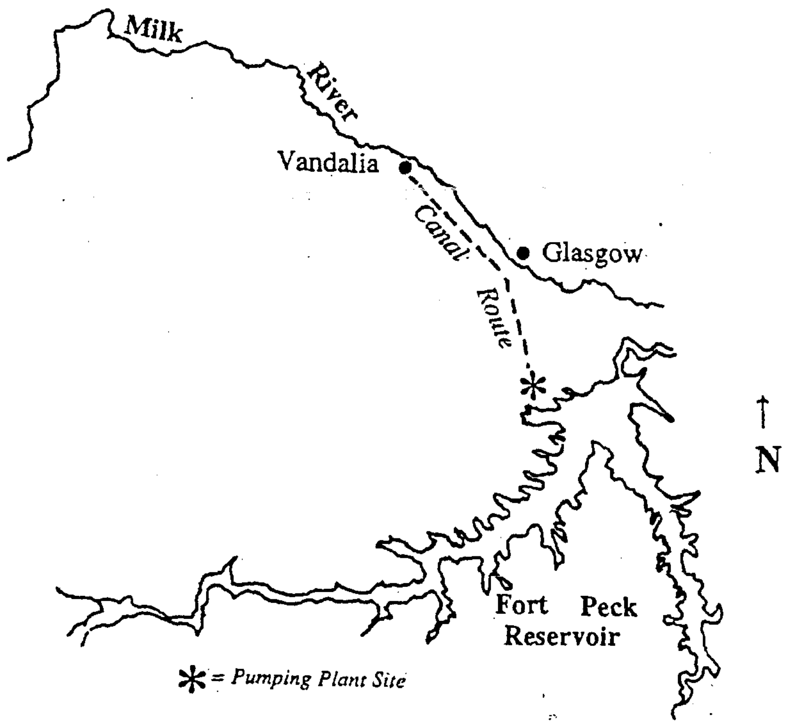
Water Supply Contribution

Total water delivered to farm headgates would be 13.13 inches/acre annually (Table 4.1). In comparison to 11.82 inches/acre annually in the Future Without, this alternative would deliver an incremental benefit of 1.31 inches/acre annually. This would be less than the 29 inches/acre needed for full crop production.

Issues

Issues in this alternative would be similar to those of the Virgelle-Milk River Canal but lesser in degree. Due to high arsenic concentrations in Missouri River water, this alternative might violate State water quality standards as well, but concentrations in Fort Peck Reservoir are close enough to those of the Milk River to apply to the State for a non-degradation exemption under the Clean Water Act.

Figure 4.9 – Duck Creek-Vandalia Canal Route



Economic Benefits

Incremental crop yields would increase 0.50 tons/acre annually, an increase in yield of 20,224 tons/year basin wide (Table 4.1) This would equate to annual economic benefits of $1,739,000.

Costs

Total investment costs would be $17,448,000, OM&R costs $33,000, and energy costs $193,000 (Table 4.1). Total annual costs would be $1,190,000. The benefit/cost ratio would be 1.5.

Tiber-Fresno Reservoirs Pipeline

Water would be piped from Tiber Reservoir on the Marias River to Fresno Reservoir on the Milk in this alternative (Figure 4.8)

Description

A pumping plant near Tiber Dam housing 4 500-hp pumps would lift water 60 feet from the reservoir's active conservation storage (elevation 2993-2966 feet). Total dynamic head would be 272 feet. From this point, water would be conveyed to just east of Chester, Montana. Here a booster pumping plant housing 4

450-hp pumps, would pump the water up a 200-foot high ridge. Total dynamic head of the water at this plant would be 221 feet.

From the booster plant, the 54-inch diameter pipeline would parallel U.S. Highway 2 for most of its 59.1 mile length. At Fresno Reservoir, it would empty into Grand Coulee. Capacity of the pipeline would be 50 cfs.

Water Supply Contribution

Total water delivered to farm headgates in the Milk River basin would be 13.95 inches/acre annually (Table 4.1). In comparison to 11.82 inches/acre annually in the Future Without, this alternative would deliver an incremental benefit of 2.13 inches/acre annually. This alternative would have a slight negative effect on the water supply of the Marias. It would deliver less than the 29 inches/acre needed for full crop production.

Issues

This alternative would improve water supplies in the basin, benefitting irrigation and MR&I uses. A greater water supply would allow water levels to be kept higher in the reservoirs later in the season, providing opportunities to better manage Nelson for the piping plover. Water quality in the Milk would be slightly improved by good quality water from Tiber allowing for higher streamflows in the Milk during the irrigation season, making dewatering less frequent. This alternative would contribute to implementation of the Fort Belknap Compact but would mean less water would be available from Tiber for settlement of reserved water rights of the Blackfeet Tribe. Water could be provided somewhat more consistently to Bowdoin. Higher water levels in the reservoirs later in the season would improve fish and wildlife habitat and greater flows would improve river fish and wildlife habitat. Recreational opportunities would be improved for the same reasons.

Economic Benefits

Incremental crop yields would increase 0.22 tons/acre annually, an increase in yield of 32,884 tons/year basin wide (Table 4.1). This would equate to annual economic benefits of $2,828,000.

Costs

Total investment costs would be $119,987,000, OM&R costs $220,000, and energy costs $1,032,000 (Table 4.1). Total annual costs would be $7,883,000. The benefit/cost ratio would be 0.4.

ALTERNATIVES TO REDUCE DEMANDS

Non-structural alternatives seek to meet needs in the region by reducing demands. Two were developed for this report: buying irrigated lands to take them out of production and water marketing.

Buying Lands

This alternative would entail buying lands presently irrigated and removing them from irrigated production. Data was gathered from the 1992 *Census of Agriculture*; Farm Credit Publications; interviews with county assessors, extension agents and agricultural credit institutions in Blaine, Phillips, and Valley counties for this analysis.

The *Census of Agriculture* recorded values for land and buildings of $170, $145 and $190/acre for Blaine, Phillips, and Valley County, respectively. Telephone conversations with Farm Credit appraisers in Glasgow and Lewistown, responsible for appraisals in the three counties, developed a more localize range of values for the Milk River area of from $480-$1,000/acre. Again, this was influenced by location and quality of both land and buildings. Also, lands closer to Glasgow showed some influence from the recreational values at Fort Peck Reservoir. Out in the Milk River valley where agricultural production is the primary influence, values ran from $480-$580/acre.

Description

This alternative would buy 80,000 acres of irrigated land. Irrigated acreage in the basin at present and the acreage in the Fort Belknap Compact total about 150,000 acres. The water supply in the Future Without could to this full acreage, but these lands would be receiving much less water than they are receiving at present. It would be inefficient as well as extremely difficult to deliver a small volume of water to these 150,000 acres. Irrigated acreage in the basin would need to be reduced to 70,000 acres in order for these acres to receive a water supply comparable to the present. Thus, 80,000 acres would need to be bought out of irrigation.

Blaine, Phillips, and Valley counties had 48,690, 42,443 and 38,699 acres of irrigated land, respectively, in the 1992 census on total farm sizes of 774,144, 730,203 and 654,082, acres, respectively. In total for the three counties, irrigation of 128,132 acres takes place on 6% of the 2,158,429 acres of farmland in irrigated farms in the counties.

Water Supply Contribution

This alternative would contribute to the water supply by reducing irrigation demand.

Issues

While not adding to the water supplies in the basin, this alternative might improve reliability of MR&I supplies if enough irrigated lands were taken out of production and water allocated specifically for this use. Effects on threatened and endangered species and water quality couldn't be estimated without knowing which lands would be bought. This alternative could contribute to implementation of the Fort Belknap Compact if enough lands were taken out of production and water allocated specifically for the purpose. Nelson could be out of operation in this alternative, so effects on water for Bowdoin couldn't be estimated. Water levels in Fresno would remain higher later in the season, benefitting reservoir fish and wildlife habitat. Recreational opportunities could be improved at Fresno.

Economic Benefits
This alternative could significantly affect the regional economy by reducing irrigated acres.

Costs
To remove 80,000 acres of irrigation from production would require purchasing a total of 1,360,000 acres at $182/acre, or $247,520,000. Reselling lands at the composite rate of $168/acre would yield $228,480,000. The net cost, exclusive of transactions costs which could be 6-10% of sales, would thus be $19,040,000. Adding transaction costs of $22,848,000 would bring the total to $41,888,000, or about $31/acre.

These costs presume lands could be bought at the average price, unlikely because transactions of this magnitude would drive up prices once the program were underway. This would be particularly true in the three county area which has limited sales activity. As the land were resold, the value of dryland farmland would fall, so the net spread could be considerably larger.

One outstanding fact ran across all of the comments of those contacted: land tenure in the valley was relatively stable with very little turnover of land. In areas where agriculture is the prime influence, sales were usually estates sold to neighboring farmers. This suggests that, while buying irrigated lands could be pursued, it might be difficult to find willing sellers.

Water Marketing

An alternative not given much consideration to this point is to let the marketplace equate water supply to demand. This approach has been used successfully in other regions to solve water shortage and allocation problems (Anderson and Snyder, 1997). Water marketing facilitates the selling/leasing of water rights between willing buyers and willing sellers. Properly structured, a water market allocates the resource.

The Milk River basin would be a good location for water marketing because:

- Water rights in Montana are guided by *Prior Appropriation*, which gives the owner exclusive rights to use a given volume of water at a certain place and time, including the right to transfer this water right to others. They are defined property rights that can be sold with the land or separately from it, leased, or changed in use. The State has recently allowed conversion to non-consumptive uses such as instream flow

- The Milk River basin has many right holders, with some already being traded but only under provision of Montana law, not in a directed market. Water selling within an irrigation district might take place, but it would require further examination under what rules—district, Federal or State—it would apply

- The Milk River itself serves as a conveyance system, in addition to the facilities of the project

- Water is currently over-appropriated in the basin. Settling reserved water rights and adjudicating other rights would leave some— if not most—junior water right holders with no quantified rights

- Alternatives to import water into the basin remain significantly more expensive than purchasing water from willing sellers. Other possible sources of supply might create water quality concerns (the Missouri River) or might be limited in their ability to meet future needs (Tiber-Fresno Pipeline)

- Most water is used to grow irrigated hay and barley as feed for cattle

- Differences in crops, growing conditions and efficiency lead to different values attached to irrigation water in agricultural production. These differentials could lead to an incentive to lease water. For example, a farmer irrigating a small acreage of marginal land could find it advantageous to sell/lease his water right to a farmer with higher productivity land. Also there is demand for instream flows and recreational uses of water. Thus, agricultural water could be sold/leased for these purposes.

One necessity for the alternative to succeed would be to restructure or eliminate institutional barriers and establish institutions that facilitate water leasing or permanent transfer.

Description

Water user organizations and resource advocacy groups exist in the basin: the irrigation districts, which have also formed a Joint Board of Control; the Milk River International Alliance; various tribes; and possibly other groups. Probably none of these groups should run the water marketing program, but representatives could make up a committee (or committees) to direct input from the organizations to a controlling authority, or be part of a smaller committee for more localized exchange of information, etc.

Water Marketing in Idaho is run by the Idaho Water Resources Board, similar to DNRC (Idaho Department of Water Resources, 2002). There are two distinct categories of water in the Idaho Water Supply Bank: first, are natural flow rights which are controlled directly by the Board. The second category is stored water, which is in "rental pools" operated by local committees.

Within the framework of current Montana Law, water rights could be sold/leased, changed in their point of diversion, etc., as discussed above. Thus, for natural flow rights at least, part of the existing laws are similar to Idaho's. There is no formal water bank structure at DNRC, necessary for the formation of a directed market in both natural flow and storage rights. While no injury rules and other rules for marketing water rights would be applicable within the water bank at present, formation of the bank would allow water rights to be sold/leased and held in the bank for future sale or lease. Currently there is no mechanism for the State to collectively hold water rights for future sale/lease.

The only storage for the Milk River Project is Federal reservoirs: conceivably, one or more local rental pools could be developed around this storage.

Enabling legislation could help mesh the operation of a water market with existing rules for water rights. It would need to contain all necessary provision for deposit of water into the bank, payment for the water, charges for the water, including administrative costs, and so on. It should also make clear that operation of the banks or rental pools in no way restricted the marketing of rights between people outside of the bank, other than such transactions would still be subject to the State's approval.

The water bank or local rental pools would only be successful if the property rights to water sold/leased could be protected by precise measurement. In that respect, structural plans should take into consideration how system improvements might impact or aid operation of a water marketing system.

Water Supply Contribution

This alternative wouldn't contribute to the water supply.

Issues

This alternative would allow the market to determine water use in the Milk River basin. Thus, more water could be available for any use, depending on the readiness of the government, Tribes, or private interests to pay for it. Effects of this alternative on any issues couldn't be estimated.

Economic Benefits

Water marketing would probably provide economic benefits, but these couldn't be estimated at this point.

Costs

Costs for this alternative were not estimated but might be investigated should this alternative be recommended for further study.

MATRIX TABLE

Table 4.1 displays the alternatives in this chapter in a matrix, with alternatives listed down the left hand of the page. The first five columns show costs: *Total Construction Cost*, *Total Investment Costs*, *Annual OM&R Costs*, and *Annual Energy Costs*. The fifth column is the *Total Annual Cost* of the alternative, the sum of the other three costs annualized over the 50-year period of analysis. The next three columns present water delivered to *canal headgates* in an alternative, the same for the Future Without, and the incremental benefit of an alternative at the canal headgates, all in AF.

The three columns thereafter list the water delivered to the *farm headgates* in an alternative, the Future Without, and the incremental benefit of an alternative, all in acre/inches. Water delivered to the farm headgates was determined by comparing total water delivered to the farm headgate with an alternative to the Future Without, assuming a canal efficiency of 50% for all the alternatives except the Canal Efficiency

Preliminary Appraisal Matrix of Alternatives for North Central Montana Study

Alternative	Total Construction Cost ($)	Total Investment Cost ($)	Annual Construction Costs ($/yr)	Annual Operation, Maintenance and Replacement Costs ($/yr)	Annual Energy Costs ($/yr) 60 mil	Total O&M ($/yr)	Total Annual Costs ($/yr)	Total delivered to Canal Headgate (ac-ft)	Future without a Project Water Delivery (ac-ft)	Incremental Benefits: Water Delivered @ Canal Headgate (ac-ft)	Total delivered to Farm Headgate (in/ac)	Future without a Project Water Delivery (in/ac)	Incremental Benefits: Water Delivered @ Farm Headgate (in/ac)	On-farm Efficiency	Incremental Crop Yield (ton/ac/yr)	Incremental Basin-Wide Crop Yield (tons/year)	Incremental Annual Economic Benefits	Benefit/Cost Ratio
Present Base-Line								XXXXX			18.12			0.43				
Future without a Project									216,172			11.82		0.50				
Improve Water Operations and Management																		
5% On-Farm Eff. Impro.	$ 10,600,000	$ 10,600,000	$ 586,000	$ 61,162	$ 57,240	$ 118,402	$ 704,402	203,291	216,172	-12,881	11.19	11.82	-0.63	0.55	0.05	7,549	649,000	0.9
River Operation Impro.	$ 100,000	$ 100,000	$ 6,000	$ 245,000		$ 245,000	$ 251,000											
Canal System Eff. Impro.	$ 12,920,000	$ 12,920,000	$ 714,000	$ 34,800.00	$66,000	$ 100,800	$ 814,800	207,803	216,172	-8,369	12.50	11.82	0.68	0.50	0.07	10,498	903,000	1.1
Nelson Reservoir Management																		
6-CFCS Pumping Plant	$ 2,907,000	$ 3,046,000	$ 168,000	$ 3,400	$ 21,000	$ 24,400	$ 192,400	219,190	216,172	3,018	11.95	11.82	0.13	0.50	0.01	2,007	$ 173,000	0.9
25-CFS Pumping Plant	$ 3,800,000	$ 3,907,000	$ 216,000	$ 18,700	$ 55,600	$ 74,300	$ 290,300	220,827	216,172	4,655	12.02	11.82	0.20	0.50	0.02	3,088	$ 266,000	0.9
50-CFS Pumping Plant	$ 4,995,000	$ 5,136,000	$ 284,000	$ 24,300	$ 80,600	$ 104,900	$ 388,900	225,352	216,172	9,180	12.30	11.82	0.48	0.50	0.05	7,410	$ 637,000	1.6
75-CFS Pumping Plant	$ 5,922,000	$ 6,089,000	$ 336,000	$ 27,300	$ 90,500	$ 117,800	$ 453,800	228,786	216,172	12,614	12.47	11.82	0.65	0.50	0.07	10,035	$ 863,000	1.9
100-CFS Pumping Plant	$ 7,411,000	$ 7,620,000	$ 421,000	$ 30,400	$ 106,000	$ 136,400	$ 557,400	231,796	216,172	15,624	12.63	11.82	0.81	0.50	0.08	12,505	$ 1,075,000	1.9
150-CFS PumpingPlant	$ 9,189,000	$ 9,449,000	$ 522,000	$ 35,300	$ 131,000	$ 166,300	$ 688,300	236,391	216,172	20,219	12.86	11.82	1.04	0.50	0.11	16,056	$ 1,381,000	2.0
Dodson South Canal Rehab																		
600-CFS Canal	$ 5,200,000	$ 5,347,000	$ 295,000	$ 7,000		$ 7,000	$ 302,000	223,090	216,172	6,918	12.13	11.82	0.31	0.50	0.03	4,786	412,000	1.4
700-CFS Canal	$ 10,500,000	$ 10,797,000	$ 597,000	$ 7,300		$ 7,300	$ 604,300	226,071	216,172	9,899	12.29	11.82	0.47	0.50	0.05	7,256	624,000	1.0
800-CFS Canal	$ 16,500,000	$ 16,966,000	$ 938,000	$ 7,700		$ 7,700	$ 945,700	227,942	216,172	11,770	12.38	11.82	0.56	0.50	0.06	8,646	744,000	0.8
																	0	
Vandalia Re-Regulation Reservoir	$ 1,400,000	$ 1,400,000	$ 77,000	$ 9,200	$ 2,100	$ 11,300	$ 88,300	215,367	216,172	-805	11.94	11.82	0.12	0.50	0.01	1,853	159,000	1.8
Non-Structural																		
Purchase Water Rights		$ -	$ -				$ -										0	
Water Market		$ -	$ -				$ -										0	
Improve Water Storage																		
Enlarge Fresno Reservoir																		
95,400 Acre Feet	$ 5,000,000	$ 5,361,000	$ 296,000	$ 44,000		$ 44,000	$ 340,000	223,780	216,172	7,608	12.20	11.82	0.38	0.50	0.04	5,867	505,000	1.5
129,200 Acre Feet	$ 7,600,000	$ 8,149,000	$ 450,000	$ 45,000		$ 45,000	$ 495,000	228,789	216,172	12,617	12.45	11.82	0.63	0.50	0.06	9,726	836,000	1.7
217,400 Acre Feet	$ 40,000,000	$ 42,889,000	$ 2,370,000	$ 51,000		$ 51,000	$ 2,421,000	231,339	216,172	15,167	12.57	11.82	0.75	0.50	0.08	11,579	996,000	0.4
Nelson Enlargement	$ 18,000,000	$ 19,300,000	$ 1,067,000	$ 30,000		$ 30,000	$ 1,097,000	216,293	216,172	121	11.87	11.82	0.05	0.50	0.01	772	66,000	0.1
Tributary Storage																		
Peoples Creek Dam	$ 35,890,000	$ 37,608,000	$ 2,078,000	$ 35,400		$ 35,400	$ 2,113,400	225,091	216,172	8,919	12.27	11.82	0.45	0.50	0.05	6,947	597,000	0.3
30 Mile Creek Dam	$ 42,000,000	$ 44,011,000	$ 2,432,000	$ 36,000		$ 36,000	$ 2,468,000	238,282	216,172	22,110	12.92	11.82	1.10	0.50	0.11	16,982	1,460,000	0.6
Bever Creek Dam	$ 17,000,000	$ 17,814,000	$ 984,000	$ 24,000		$ 24,000	$ 1,008,000	221,616	216,172	5,444	12.09	11.82	0.27	0.50	0.03	4,168	358,000	0.4
Augment Water Supply																		
St. Mary's Rehab**																		
500 CFS	$ 75,150,000	$ 81,973,000	$ 4,530,000	$ 136,000		$ 136,000	$ 4,666,000	444,049	216,172	227,877	23.02	11.82	11.20	0.50	1.14	172,911	14,870,000	3.2
670 CFS	$ 84,850,000	$ 92,554,000	$ 5,115,000	$ 150,000		$ 150,000	$ 5,265,000	465,779	216,172	249,607	24.10	11.82	12.28	0.50	1.25	189,584	16,304,000	3.1
850 CFS	$ 90,550,000	$ 101,932,000	$ 5,633,000	$ 165,000		$ 165,000	$ 5,798,000	473,413	216,172	257,241	24.49	11.82	12.67	0.50	1.29	195,605	16,822,000	2.9
1000 CFS	$ 125,050,000	$ 140,768,000	$ 7,779,000	$ 170,000		$ 170,000	$ 7,949,000	475,071	216,172	258,899	24.58	11.82	12.76	0.50	1.30	196,995	16,942,000	2.1
Babb Dam with a 850 cfs Canal	$ 228,734,000	$ 257,485,000	$ 14,229,000	$ 212,200		$ 212,200	$ 14,441,200	531,812	216,172	315,640	27.30	11.82	15.48	0.50	1.58	238,988	20,553,000	1.4
Virgelle Canal																		
175 cfs	$ 58,459,000	$ 65,807,000	$ 3,637,000	$ 181,000	$ 519,200	$ 700,200	$ 4,337,200	314,247	216,172	98,075	16.63	11.82	4.81	0.50	0.49	74,259	6,386,000	1.5
200 cfs	$ 63,974,000	$ 72,015,000	$ 3,980,000	$ 191,000	$ 682,400	$ 873,400	$ 4,853,400	327,339	216,172	111,167	17.27	11.82	5.45	0.50	0.56	84,140	7,236,000	1.5
230 cfs	$ 69,489,000	$ 78,224,000	$ 4,323,000	$ 197,000	$ 741,800	$ 938,800	$ 5,261,800	341,773	216,172	125,601	17.97	11.82	6.15	0.50	0.63	94,947	8,165,000	1.6
Duck Ck. -Vandalia	$ 15,500,000	$ 17,448,000	$ 964,000	$ 33,000	$ 193,000	$ 226,000	$ 1,190,000	242,210	216,172	26,038	13.13	11.82	1.31	0.50	0.13	20,224	1,739,000	1.5
Tiber-Fresno Pipeline	$ 110,000,000	$ 119,987,000	$ 6,631,000	$ 220,000	$ 1,032,000	$ 1,252,000	$ 7,883,000	258,945	216,172	42,773	13.95	11.82	2.13	0.50	0.22	32,884	2,828,000	0.4

Improvements Alternative, where 60% of water diverted at the canal headgates would be delivered to the farm headgates. The on-farm efficiency is listed in the next column.

The next three columns show incremental crop yield (in tons of alfalfa/acre/year), incremental basin-wide crop yield (tons/year), and incremental annual economic benefits ($). The incremental crop yield was determined by comparing the additional water made available to the crop root zone by an alternative to the same for the Future Without. This column assumes 50% on-farm efficiency except for the On-Farm Efficiency Improvement Alternative, where the efficiency is 55%. Additional water made available was converted to tonnage of alfalfa by multiplying the additional water supplied to the crop by 4.90 tons/inch (Bauder, 2002). This is the average volume of water in inches/acre required by the root zone to produce a ton of alfalfa in the Milk River basin.

Incremental basin-wide crop yield was computed by multiplying the increase in crop yield/acre for an alternative by the total number of acres in the basin for each alternative, assuming a total of 151,300 irrigated acres in the basin including full development of the Fort Belknap Compact. The last column is a comparison of the benefits estimated for an alternative in relation to the costs of the alternative, the benefit/cost ratio.

ALTERNATIVES CONSIDERED BUT DROPPED

Bowdoin National Wildlife Refuge

Bowdoin National Wildlife Refuge has a storage capacity of about 26,000 AF in various ponds and impoundments. Part of that storage could be used to store project water, both to the benefit of Bowdoin and project irrigators. Reclamation developed preliminary costs for rehabilitation of existing facilities and construction of additional facilities to help manage water in the refuge. Cost were estimated to be $4,500,000. This alternative was dropped due to the water quality issues. At present, Bowdoin is prohibited by DEQ from discharging water from the refuge because of the high concentrations of salts in the impoundments.

The USFWS has stated that they aren't interested in having the refuge operated as an off-stream reservoir.

Storage Reservoir at Willow Creek

Construction of a storage reservoir in the Willow Creek drainage in Valley County was suggested by residents. This alternative was dropped from consideration due to the highly erodible soils in the watershed. Previous studies conducted by the USGS have measured sediment yields in the basin ranging from 0.09-2.00 AF/square mile/year. The value of a reservoir would rapidly decrease as available storage space were filled with sediment. Treatment of uplands and the river channel would be required in order to make the reservoir feasible.

RECOMMENDED ALTERNATIVES & COMBINED ALTERNATIVES

Chapter 5

This study found no single alternative in this report would meet irrigation demands of the Milk River Project and MR&I (municipal, rural, and industrial) needs of north central Montana, mitigate for reserved water rights, and allow the opportunity to provide irrigation for junior water right holders, threatened and endangered species, water quality, fish and wildlife, and recreation. Some of the alternatives, however, could improve the water supply and benefit related issues. These alternatives, presented in "Recommended Alternatives" below, will be evaluated in more detail in the upcoming regional feasibility study.

On the other hand, some alternatives neither contribute to the water supply or benefit issues in relation to their costs. These alternatives, which won't be analyzed further, can be found in "Alternatives Dropped from Consideration" section.

Following the "Recommended Alternatives" section, these same alternatives are also shown in combination as examples of how they could be used to complement one another. Table 5.1 shows costs and benefits of the combined alternatives.

RECOMMENDED ALTERNATIVES

Examined from the aspect of economic benefits, b/c (benefit/cost) ratio, and the effects on issues in the Milk River basin, five of the alternatives in this report show the most potential for meeting water supply needs while contributing to solution of water related issues as explained in this section.

St. Mary System Rehabilitation

This alternative—regardless of the canal capacity ultimately chosen—would provide the most significant improvement to the Milk River basin water supply, along with the greatest increase in economic benefits to the region. Another 230,000-260,000 AF (acre-feet) of water annually would be available for diversion at canal headgates, producing a b/c ratio ranging from 3.2 to 2.1 for the 500-cfs (cubic-feet/second) and the 1,000-cfs canals, respectively. Benefits would be even greater when this alternative is considered in combination with an enlarged Fresno Reservoir. St. Mary System Rehabilitation would have the most potential to contribute to settlement of both Blackfeet and Fort Belknap reserved water rights, as well as providing more water to Bowdoin National Wildlife Refuge.

Compared to the Future Without the Project Condition, which included failure of the St. Mary Canal, this alternative could adversely affect the bull trout. Rehabilitation of the St. Mary System, however, would include a low flow outlet at Sherburne Dam, a fish screen at the canal intake, and fish passage at the diversion dam to address critical bull trout concerns identified by the U.S. Fish and Wildlife Service (see "St. Mary Rehabilitation" in Chapter 4). The piping plover at Nelson Reservoir and Bowdoin would probably benefit from this alternative, also.

Reliability of MR&I water supplies, water quality, fish and wildlife, and recreational opportunities could all benefit from the greater water supply in the basin. Rehabilitation of the St. Mary System would also allow the opportunity to develop hydro-power in the canal terminal drop structures.

Enlarge Fresno Reservoir

This alternative by itself would provide only a modest improvement in the basin's water supply, another 8,000-15,000 AF annually at the canal headgates. Benefits would increase significantly when combined with St. Mary System Rehabilitation, however. The b/c ratio would be 1.5 for raising the spillway crest 5 feet, and 1.7 for raising it 10 feet.

More storage in Fresno would improve reliability of MR&I supplies and would improve water quality in the river by allowing greater releases. It could contribute to implementation of the Fort Belknap Compact by minimizing much of the effect of the compact on current water users. It would also present an opportunity to provide water for settlement of the Blackfeet Tribe's reserved water rights. More storage would improve fish and wildlife in and around the reservoir and reservoir recreational opportunities. Enlarging Fresno would improve the opportunity to develop hydro-power at the dam.

Dodson South Canal Rehabilitation

Enlarging the Dodson South Canal from 500 cfs to 600 cfs would provide modest improvement to water supplies in the basin, an average of about 7,000 AF annually at the canal headgates. The b/c ratio for the 600-cfs canal would be favorable at 1.4, but it drops off for the larger capacities. This alternative could contribute to implementation of the Fort Belknap Compact by providing partial water replacement to current users. MR&I supplies, fish and wildlife, and recreational opportunities would also improve, fisheries and recreational opportunities at Nelson in particular. Water for Bowdoin would probably increase.

Nelson Pumping Plant

Like the alternative above, this alternative by itself would provide only a modest improvement in the water supply, another 7,000-18,000 AF annually at the canal headgates for pump sizes from 50-150 cfs. B/C ratios would be favorable for pump sizes from 50-150 cfs, with the B/c ratio for the 50 cfs pumps 1.4, and of the 150 cfs pumps 1.9.

This alternative would improve reliability of MR&I supplies, and it could contribute to implementation of the Fort Belknap Compact by minimizing some of the effect of the compact. A pumping plant at Nelson would improve fish and wildlife in and around the reservoir and reservoir recreational opportunities. The alternative would probably degrade water quality in the river below the pumping plant during much of the year because of reduced flows and higher water temperatures. Water quality could be improved in the river for hundreds of miles by releases from Fresno later being pumped into Nelson.

Glasgow Irrigation District Re-Regulation Reservoir

Although this alternative would contribute little to water supplies in the basin, it would improve delivery efficiency and crop production in the Glasgow Irrigation District. It has a b/c ratio of 1.8.

The alternative would contribute to overall better management of water in the basin and would reduce demands for water from Nelson. It would have little effect on other basin issues.

Duck Creek-Vandalia Canal

This alternative too would provide a modest improvement in the water supply, providing an average of 26,000 AF annually to the Glasgow Irrigation District at a b/c ratio of 1.5. Since the water supplied by this alternative would enter the Milk River Project at the end of the system, benefits for other issues would be small. It would transport water from the Missouri River at Fort Peck Reservoir to the Milk River basin, and perhaps thereby violate Montana water quality levels for arsenic. Still, arsenic concentrations in Fort Peck might be close enough to concentrations in the Milk for the State to grant an exemption to the standard.

Alternatives Dropped from Further Consideration

The other canal route alternative, the Virgelle-Canal, could significantly contribute to the water supply, but it's not likely that it would be built. It would provide another 100,000-125,000 AF annually to canal headgates (5-6 inches to the farm headgates), with an incremental annual economic benefit of from $6,000,000-$8,000,000. The b/c ratio would be 1.5. It would transport Missouri River water high in arsenic to the Milk River basin where arsenic concentrations are negligible. The difference is so great that it's unlikely the State would grant an exemption. Thus, this alternative won't be evaluated further.

The Babb Dam, Enlarge Nelson Reservoir, and Tiber-Fresno Reservoirs, and Buying Lands alternatives are being dropped because they wouldn't contribute significantly to water supplies in the basin, wouldn't significantly benefit the issues, and the costs would exceed the estimated benefits. The Storage

Reservoir on Peoples Creek, Storage Reservoir on 30 Mile Creek, and Storage Reservoir on Beaver Creek alternatives were dropped because costs would exceed benefits.

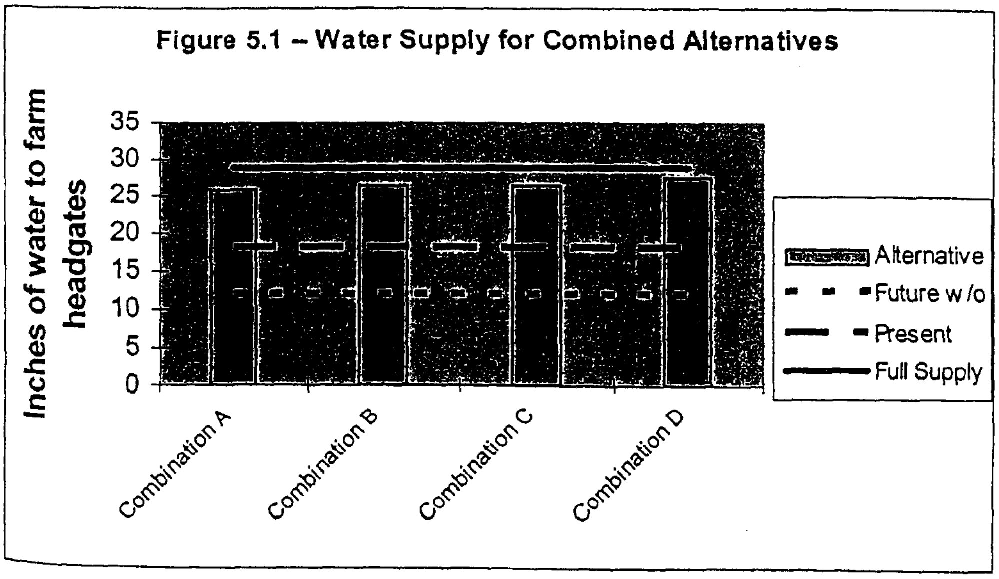
The On-farm Efficiency Improvements, River Operations, and Canal Efficiency Improvements alternatives might have significant value from the prospective of the irrigation district or individual farmer, but they don't contribute to improving the overall water shortage in the basin. The districts or farmers involved would be expected to use any water conserved by these alternatives to increase crop production since they invested their money and time in the improvements. This would contribute to the regional economy but not to the basin's water supply. While these alternatives should be encouraged at the local level, they are being dropped from further consideration in this study.

The Water Marketing Alternative is being dropped for a similar reason; it might contribute significantly to the economy of the Milk River basin, and should be encouraged, but it wouldn't improve the water supply or benefit issues.

COMBINED ALTERNATIVES

Combination A: St. Mary System Rehabilitation/ Enlarge Fresno Reservoir

A rehabilitated St. Marys System with an 850 cfs canal would increase the water supply by an average of 257,241 AF annually at the canal headgates, providing another 12.76 inches/acre at the farms headgates. A 5-foot rise in crest of Fresno Dam would increase the water supply by an average of 7,608 AF annually, an increase of 0.38 inches/acre at the farm headgates. Combining these alternatives would thus provide an average water supply of 272,842 AF annually in the basin, or an increase of 13.89 inches/acre to farm headgates (Table 5.1 and graphically in Figure 5.1). Combined, these two alternatives would provide about 8,000 AF more water supply to canal headgates that they would individually.



Incremental crop yields would increase 1.42 tons/acre annually or 214,440 tons/year basin wide. This would increase economic benefits annually by $18,442,000.

Total investment costs would be $107,293,000, annual OM&R $209,000, and energy costs undetermined (Table 5.1).

Annual costs would be $6,138,000 and the b/c ratio 3.0.

Combination B: St. Mary System Rehabilitation/ Enlarge Fresno Reservoir /Nelson Pumping Plant

Combination of a rehabilitated St. Marys System with 850 cfs canal, a 5-ft raise of the crest of Fresno Dam, and a 75-cfs pumping plant at Nelson Reservoir would increase the water supply in the basin to an average of 283,971 AF, or an increase of 14.47 inches/acre to farm headgates (Table 5.1). Adding the pumping plant to the other alternatives would add another 11,000 AF to the canal headgates. Figure 5.1 compares water supply of the combined alternatives.

Incremental crop yields would increase 1.48 tons/acre annually, 223,395 tons/year basin wide (Table 5.1). This would increase economic benefits annually by $19,212,000.

Total investment costs would be $113,382,000, annual OM&R $236,300, and energy costs $90,500 (Table 5.1). Annual costs would be $6,265,000, the b/c ratio 2.9.

Combination C: St. Mary System Rehabilitation/Enlarge Fresno Reservoir / Nelson Pumping Plant/Glasgow Irrigation District Re-Regulation Reservoir

The combination of a rehabilitated St. Marys System with 850 cfs canal, a 5-ft raise of the crest of Fresno Dam, a 75-cfs pumping plant at Nelson Reservoir, and a re-regulation reservoir in the Glasgow Irrigation District would increase the water supply to an average of 282,372 AF in the basin (Table 5.1). This would equate to an increase of 14.69 inches/acre at farm headgates. Including the re-regulation reservoir would provide another 0.22 inches/acre at the farm headgates by improving efficiency of the Vandalia Canal. Figure 5.1 shows the water supply of the alternative

Incremental crop yields would increase 1.50 tons/acre annually, 226,791 tons/year basin wide (Table 5.1). This would increase economic benefits annually by $19,504,000.

Total investment costs would be $114,782,000, annual OM&R $245,500, and energy costs $92,600 (Table 5.1). Annual costs would be $6,680,100, the b/c ratio 2.9.

Combination D: St. Mary System Rehabilitation/Enlarge Fresno Reservoir / Nelson Pumping Plant/Glasgow Irrigation District Re-Regulation Reservoir/ Duck Creek-Vandalia Canal

Combining a rehabilitated St. Marys System with 850 cfs canal, a 5-ft raise of the crest of Fresno Dam, a 75-cfs pumping plant at Nelson Reservoir, a re-regulation reservoir in the Glasgow Irrigation District, and the Duck Creek-Vandalia Canal would increase the water supply in the basin to an average of 298,183, equivalent to an increase of 15.55 inches/acre at farm headgates (Table 5.1). Adding the Duck

Creek-Vandalia Canal to the combination would provide another 16,000 AF to canal headgates, 0.86 inches/acre at farm headgates. Figure 5.1 compares water supplies of the combined alternatives.

Incremental crop yields would increase 1.59 tons/acre annually, 240,068 tons/year basin wide (Table 5.1). This would increase economic benefits annually by $20,646,000.

Total investment costs would be $132,230,000, annual OM&R $278,500, and energy costs $285,600 (Table 5.1). Annual costs would be $6,680,100, the b/c ratio 2.9.

Table 5.1
Combined Alternatives

Alternative	Total Construction Cost ($)	Total Investment Cost ($)	Annual Construction Costs ($/yr)	Annual Operation, Maintenance and Replacement Costs ($/yr)	Annual Energy Costs ($/yr) 50 mil	Total O&M ($/yr)	Total Annual Costs ($/yr)	Total delivered to Canal Headgate (ac-ft)	Future without a Project Water Delivery (ac-ft)	Incremental Benefits: Water Delivered @ Canal Headgate (ac-ft)	Total delivered to Farm Headgate (in/ac)	Future without a Project Water Delivery (in/ac)	Incremental Benefits: Water Delivered @ Farm Headgate (in/ac)	On-farm Efficiency	Incremental Crop Yield (ton/ac/yr)	Incremental Basin-Wide Crop Yield (tons/year)	Incremental Annual Economic Benefits	Benefit/Cost Ratio
															4.90	151,297	$ 86	
Combination of Alternatives																		
Combination A–St Marys System Rehabilitation (850 cfs)/Enlarged Fresno Reservoir (95,400 ac-ft)	$ 95,550,000	$ 107,293,000	$ 5,929,000	$ 209,000	$ -	$209,000	$ 6,138,000	489,014	216,172	272,842	25.71	11.82	13.89	0.50	1.42	214,440	18,442,000	3.0
Combination B–St Marys System Rehabilitation (850 cfs)/Enlarged Fresno Reservoir (95,400 ac-ft)/Nelson Pump (75 cfs)	$ 101,472,000	$ 113,382,000	$ 6,265,000	$ 236,300	$ 90,500	$326,800	$ 6,591,800	500,143	216,172	283,971	26.29	11.82	14.47	0.50	1.48	223,395	19,212,000	2.9
Combination C–St Marys System Rehabilitation (850 cfs)/Enlarged Fresno Reservoir (95,400 ac-ft)/Nelson Pump (75 cfs)/Vandalia Re-regulation Reservoir	$ 102,872,000	$ 114,782,000	$ 6,342,000	$ 245,500	$ 92,600	$338,100	$ 6,680,100	498,544	216,172	282,372	26.51	11.82	14.69	0.50	1.50	226,791	19,504,000	2.9
Combination D–St Marys System Rehabilitation (850 cfs)/Enlarged Fresno Reservoir (95,400 ac-ft)/Nelson Pump (75 cfs)/Vandalia Re-regulation Reservoir/Duck Creek Vandalia Canal (100 cfs)	$ 118,372,000	$ 132,230,000	$ 7,306,000	$ 278,500	$ 285,600	$564,100	$ 7,870,100	514,355	216,172	298,183	27.37	11.82	15.55	0.50	1.59	240,068	20,646,000	2.6

FUTURE WORK

Chapter 6

This chapter discusses criteria of the next step of the study, future work that needs to be done for the regional feasibility report and the NEPA (National Environmental Policy Act) document.

FEASIBILITY STUDY CRITERIA

The U.S. Water Resource Council's 1983 *Principles and Guidelines* (*Economic and Environmental Principles and Guidelines for Water and Related Resources Implementation Studies*) sets criteria for Federal water development studies. The Federal objective according to the P&Gs is to contribute to the NED (National Economic Development) while protecting the environment.

The P&Gs don't just limit plan formulation to the alternative that maximizes net NED benefits. They recommend that other alternatives be formulated as well—which may, as a consequence—reduce net NED benefits in order to satisfy other Federal, international, state, tribal, local concerns not fully met by the NED plan. Such alternatives might require changes in existing laws, regulations, or established common law (which are to be identified). Furthermore, already existing water and related land resource plans—such as state water resource plans—are to be considered as alternatives if within the scope of the project.

Each alternative plan is to formulated by the four criteria in Section 1.6.2 of the P&Gs defined below. Mitigation of adverse effects is to be an integral part of each alternative.

- *Completeness* is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. This may require relating the plan to other types of public or private plans if the other plans are crucial to realization of the contributions to the objective

- *Effectiveness* is the extent to which an alternative plan alleviates the specific problems and achieves the specified opportunities

- *Efficiency* is the extent to which an alternative plan is the most cost effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment

- *Acceptability* is the workability and viability of the alternative plan with respect to acceptance by state, local entities and the public and compatibility with existing laws, regulations, and public policies.

Alternatives will be narrowed down by the findings of the present report, which will be presented to the public, other agencies, and interest groups for comment. The alternatives recommended for the regional feasibility report will be studied in greater detail to refine cost estimates, benefits, and environmental effects.

The alternative selected as the *Best Plan* in future studies would produce the greatest net benefits consistent with addressing other considerations recommended in the P&Gs. The *Preferred Plan* might differ from the NED Plan if alternation were necessary to meet other criteria.

FUTURE WORK

This report was developed at an appraisal level of detail to provide a broad view of issues, opportunities, and alternatives. A number of alternatives have been described in this report, developed with appraisal-level criteria. Reclamation will review comments received on the report to recommend alternatives for further study.

The next step of this process will be to examine these few alternatives in much greater detail. Specific work to be done in future studies includes refinement of:

- Hydrologic modeling
- Cost estimates for the alternatives
- Economic feasibility of the alternatives
- Financial feasibility of the alternatives.

If any of the alternatives advance beyond this study, they will require compliance with NEPA, NHRA (National Historic Preservation Act), and other environmental laws and regulations.

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Mission of the U.S. Bureau of Reclamation

The mission of the U.S. Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.