International St. Mary - Milk Rivers Administrative Measures Task Force

Report to the
International Joint Commission

April 2006

ST. MARY-MILK RIVERS
ADMINISTRATIVE MEASURES TASK FORCE

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EXECUTIVE SUMMARY

In April 2003, the Governor of Montana requested the International Joint Commission (IJC) to undertake a review of the IJC Order of 1921 (1921 Order) pursuant to Article VI of the Boundary Waters Treaty regarding the sharing of water between Canada and the United States. The IJC subsequently held a series of public meetings within the basins and in December of 2004 established the St. Mary / Milk Rivers Administrative Measures Task Force (Task Force). The Task Force was directed to examine opportunities to improve the administrative procedures for the apportionment of the St. Mary and Milk rivers to ensure more beneficial use and optimal receipt by both Canada and the United States of its apportioned water.

The Task Force investigated a number of opportunities for improving the current administrative measures used in apportioning the flows including: natural flow calculations; balancing periods; allowing for surpluses and deficits; letters of intent; and, other potential options.

An accurate determination of natural flows is essential for determining the apportionment of the St. Mary and Milk rivers. This determination is relatively straight-forward on the St. Mary River, but is significantly more complex on the Milk River due in part to the co-mingling of water from the St. Mary River via the U. S. St. Mary Canal. The Task Force concluded that the natural flow determinations would be improved by: flow monitoring at several additional points in the basin; better accounting of consumptive uses; and, determining channel conveyance losses for the U. S. St. Mary Canal. The Task Force recognized that these computational improvements will not, by themselves, result in significant improvement in beneficial use and optimal receipt by each country of its apportioned waters, but they will ensure that the best methods are applied to the administrative measures.

To evaluate the potential impact of various balancing periods (ranging from weekly to annually), as well as to account for surpluses and deficits, the Task Force developed a series of spreadsheet models of the apportionment formulas. For the St. Mary River, the model results showed that the U. S. could divert a greater volume of its entitlement under longer balancing periods. For the Milk River, the model results showed that Canada could receive a greater portion of its entitlement under longer balancing periods. These potential gains would only be appreciable if credits for surplus flows were permitted and procedures for crediting were developed and implemented. Extending the balancing period without a mechanism for allowing credit for surplus deliveries is of little benefit in helping either country realize a greater portion of their respective entitlement.

A Letter of Intent is a voluntary administrative instrument employed since 1991 to help both jurisdictions realize more beneficial use of their respective entitlements under the existing Administrative Procedures. This negotiated document recognizes that it is most beneficial for the U. S. to use more than its share of the St. Mary River in the March-May period each year to supply water to U. S. Milk River irrigators, and for Canada to use more than its share of the Milk River in the June-September period to supply water to Canadian Milk River irrigators. In its current form, the Letter of Intent does not directly address the issue of credits for surplus deliveries.

The Task Force briefly discussed other potential options that fall beyond the scope of the directive including: water banking and tradable permits (water marketing); joint water management operations; and, infrastructure improvements and enhancements. Some or all of these options may warrant further investigation and consideration by the parties.

During its deliberations, the Task Force also identified and reported on a number of other matters which have an impact on the apportionment issue and may warrant attention in the future. These include: transboundary tributaries; instream flow requirements; unusable flows (spills); Southern Tributaries; and Eastern Tributaries.

INTRODUCTION

The Boundary Waters Treaty of 1909 (Treaty) between the United States (U. S.) and Great Britain was signed on January 11, 1909 to deal with boundary waters and questions arising along the boundary between the U. S. and Canada. The Treaty also established the International Joint Commission (IJC) as a formal mechanism to investigate and resolve boundary water issues.

Article VI of the Boundary Waters Treaty (Appendix A) provides the framework for measuring and apportioning the flows of the St. Mary River, the Milk River, and the Eastern Tributaries of the Milk River (Lodge Creek, Battle Creek, and the Frenchman River). Questions over the interpretation of Article VI led to a series of legal and public hearings between 1915 and 1921. Significant points presented during the hearings included: the locations at which flow apportionment balances should be determined; the interpretation of prior appropriation; and, native water rights.

Following completion of the U. S. St. Mary Canal in 1917, the IJC issued annual provisional orders specifying the water entitlements of each country for the irrigation seasons from 1918 to 1921. However, agreement could not be reached on how the waters were to be specifically apportioned. Low flows in 1919 and the first operational use of Lake Sherburne that same year prompted the IJC to direct the Accredited Officers for the U. S. and Canada (who are charged with administering the apportionment) to seek some compromise. When this effort failed in March 1921, the IJC issued new instructions (commonly referred to as the 1921 Order) which directed how the waters of the two rivers at the international boundary were to be measured and apportioned (Appendix B). As early as 1927, the U. S. sought to re-open the 1921 Order over concerns about the apportionment, but the vote was split between the U. S. and Canadian Commissioners.

For the past 84 years, the 1921 Order has been used as the basis for apportioning the flows of the two rivers. The Canadian and U. S. Accredited Officers have developed over time a number of administrative procedures to facilitate this function. These "Administrative Procedures", which are periodically reviewed and updated, include:

1. a set of equations, referred to as the "computational procedures", for determining the natural flow for each of these streams;

2. a reporting of daily natural flow on a twice per month basis (15^{th} day and end of month), which has become known as the "balancing period"; and

3. a set of rules for refunding deficits when one country is calculated to have diverted more than its apportioned share, to be restored in the next balancing period or at a time beneficial to both countries.

In 2003, the Governor of Montana requested the IJC to review the 1921 Order for the purpose of determining whether or not it is successfully meeting the intent of the Treaty. The

IJC subsequently conducted a series of public meetings within the St. Mary River and Milk River basins to obtain public comment on the request from Montana. In December 2004, following the conclusion of those public consultations, the IJC established the International St. Mary / Milk Rivers Administrative Measures Task Force (Task Force) to investigate administrative options for improving the performance of the apportionment. This report documents the findings of the Task Force.

TASK FORCE OBJECTIVES AND PROCESS

The objective of the Task Force is to examine and report to the IJC on opportunities to improve the existing administrative procedures for the apportionment of the St. Mary and Milk rivers to ensure more beneficial use and optimal receipt by each country of its apportioned waters. This includes examining all administrative procedures (such as computational procedures, surpluses and deficits, accounting periods, balancing periods, etc.), and any other administrative measures the Task Force may find pertinent (Appendix C).

The IJC appointed four representatives from each country to serve on the Task Force (Appendix D). The Canadian and U. S. Co-Chairs are responsible for organizing and executing the work of the Task Force, and for coordinating with, and reporting to, the IJC. Each member of the bi-national, multi-disciplinary group is expected to act in their personal and professional capacity rather than represent their respective country, agency, organization, or other affiliation. The IJC provides guidance to the Task Force and seeks resources from the two Governments to support its efforts (including resource contributions by Task Force member agencies).

In addressing its mission, and to access the full breadth of available information, the Task Force communicated with appropriate entities in both countries, and with work groups of the Accredited Officers' Field Representatives. The Task Force analyzed and evaluated available information, and kept the IJC informed of its progress.

TASK FORCE MEETINGS

The Task Force met formally on ten occasions; twice in Saskatchewan, three times in Alberta, and five times in Montana (Appendix E). Meeting dates and locations were established by the Task Force through a Plan of Work. Where practicable, meetings alternated between Canada and the United States. Formal meeting minutes were not taken, although meeting notes and action items arising from the meetings were recorded to help track progress of the Task Force.

All the Task Force meetings were open to the public, although no effort was made to formally advertise the meetings through the local media. Representatives of the Chippewa-Cree, Assiniboine-Gros Ventre, and Blood nations were specifically invited to attend meetings in an observer status, and frequently did so.

The Co-Chairs provided periodic updates to IJC staff via e-mail and conference calls. In addition, the Co-Chairs made formal presentations to the IJC at its semi-annual meetings in Washington, D.C. (April 2005), in Ottawa, Ontario (October 2005), and in Seattle, Washington (April 2006).

PUBLIC INVOLVEMENT

The Co-Chairs made themselves available to the media on behalf of the Task Force, as agreed to by the Task Force. Media contacts were limited to one television spot and the local newspaper which provided limited coverage of Task Force deliberations during two of the meetings in Lethbridge, Alberta (Appendix F).

As the Task Force got closer to concluding its efforts, it was determined that raising the level of awareness by the public (throughout the two basins) might be of value, particularly prior to release of a draft report to the IJC and initiation of formal public review. Accordingly, several public outreach sessions were scheduled throughout the basins.

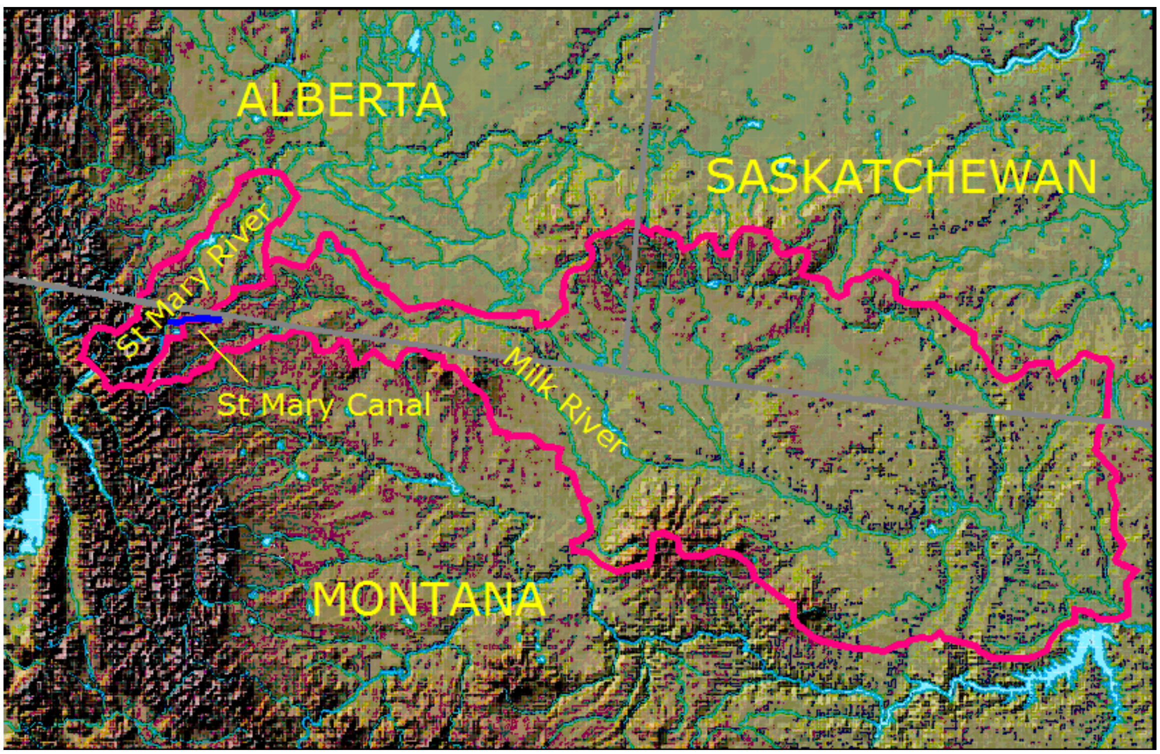
Outreach sessions were attended by the Co-Chairs, and in some instances, by some of the Task Force membership. Outreach sessions included: Blackfeet Tribal Council in Cut Bank, Montana on September 26, 2005; Milk River Joint Board of Control in Malta, Montana on November 15, 2005; St. Mary and Milk River Water Users in Milk River, Alberta on November 16, 2005; and, members of the Assiniboine-Gros Ventre Tribal Council in Billings, Montana on March 3, 2006. No sessions were held in Saskatchewan since the work of the Task Force focused more directly on the St. Mary River and Milk River, rather than the Eastern Tributaries. In all instances, interest by the attendees has been keen and the efforts of the Task Force have been well-received.

Under the current schedule, it is anticipated that formal public consultation on this report will be initiated jointly by the Task Force and the IJC sometime in Spring 2006. Specific details of that process will evolve pending further consideration by the IJC.

BASIN DESCRIPTION

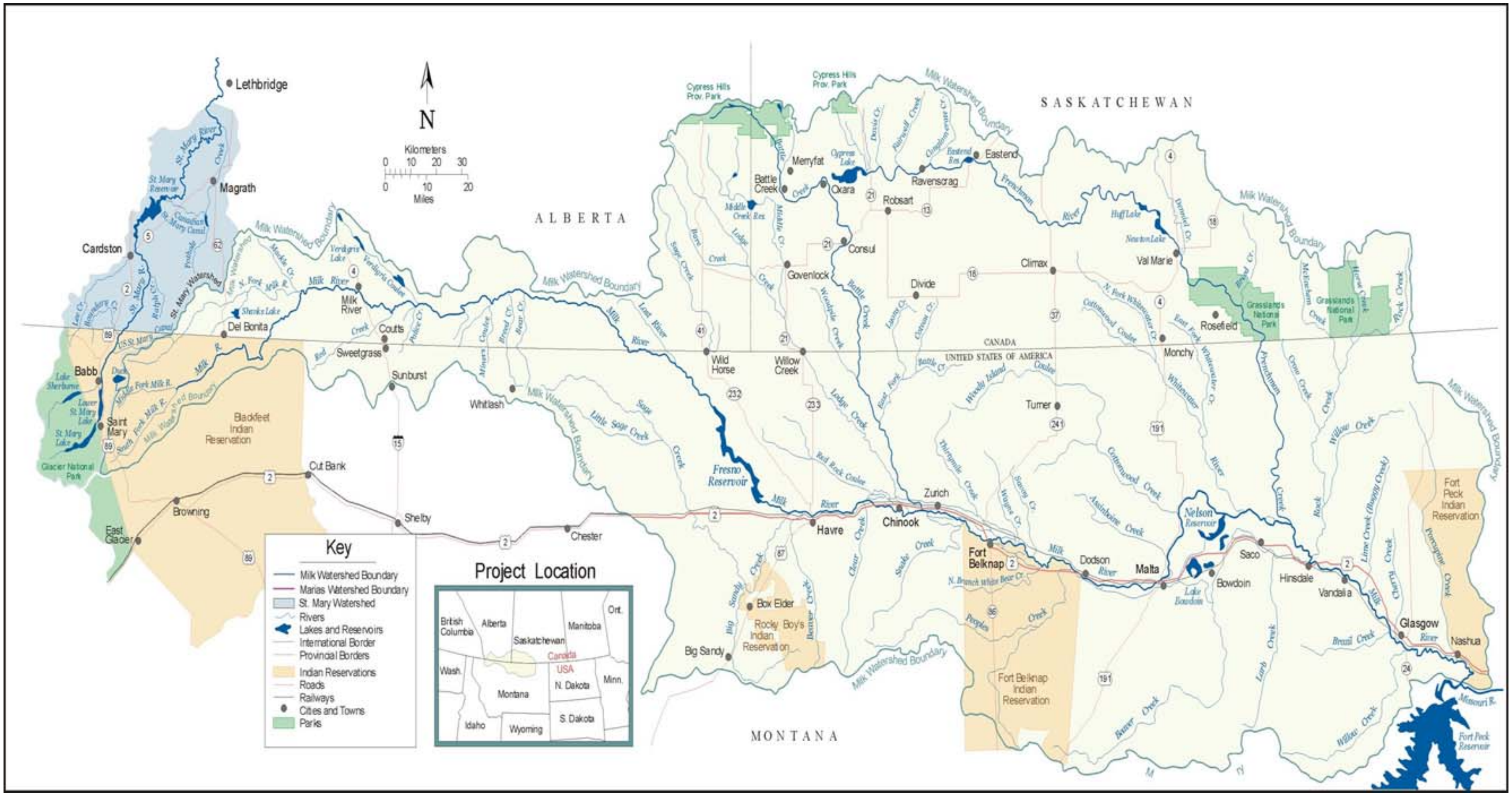
The St. Mary and Milk rivers originate in Montana along the eastern slopes of the Rocky Mountains and flow north and northeast, respectively, into Alberta (Figures 1 and 2). The St. Mary River joins the Oldman River, a tributary of the South Saskatchewan River, near Lethbridge, Alberta, and ultimately discharges into Hudson Bay. In contrast, the Milk River initially flows northeast into Alberta, where it turns east and runs parallel to the international boundary for approximately 100 miles (160 km) and re-enters the U. S. near the Saskatchewan border. The Milk River discharges into the Missouri River just downstream of Fort Peck Reservoir, and ultimately joins the Mississippi River, which discharges into the Gulf of Mexico.

Figure 1. St. Mary and Milk Rivers Drainage Basin



The St. Mary River (at its mouth) has a total drainage area of approximately 1390 miles^2 (3 600 km^2) of which approximately 465 miles^2 (1 200 km^2) is located in the U. S. The St. Mary River rises from glaciers and snowpack on the eastern slopes of the Rocky Mountains in Montana and is part of the Saskatchewan-Nelson system within the Hudson Bay drainage. South of the international boundary, the St. Mary River drainage basin has a mean annual precipitation of about 47 inches (1200 mm), most of which falls as snow. The St. Mary River basin north of the international boundary is drier.

Figure 2. St. Mary and Milk Rivers Drainage Basin



The Milk River (at its mouth) has a total drainage area of approximately 19,300 miles^2 (50 000 km^2), of which approximately 2,500 miles^2 (6 400 km^2) is located upstream of the western crossing of the international boundary. The Milk River rises from snowpack and rainfall in the foothills along the eastern slopes of the Rocky Mountains in Montana before crossing into Alberta and running parallel to the border before turning back into Montana about 112 river miles (180 km) later. Upstream of the Eastern Crossing of the International Boundary, the Milk River drainage basin has a mean annual precipitation of about 13.8 inches (350 mm) and a mean annual lake evaporation of 30.3 inches (770 mm). The moisture deficit places the basin in a semi-arid zone.

The drainage area of the Milk River basin is significantly larger than the drainage area of the St. Mary River basin. The Milk River basin includes portions of the Cypress Hills in Canada, the Sweetgrass Hills, Bears Paw Mountains, and Little Rocky Mountains in Montana, and extensive prairie areas in both the U. S. and Canada.

The tributaries of the Milk River which flow from the Cypress Hills in Alberta and Saskatchewan are collectively known as the Eastern Tributaries. These include the Frenchman River, Battle Creek, and Lodge Creek. The natural flows of these tributaries are highly variable and are often low after spring freshet (runoff).

The Southern Tributaries of the Milk River, which include Bear Creek, Breed Creek and Miners Coulee, are intermittent streams that flow north from the Sweetgrass Hills of northern Montana into Canada. Water from these international streams is used for agricultural purposes. Consumptive uses from the Southern Tributaries are indirectly included in the determination of the natural flow of the Milk River.

Both the St. Mary and Milk rivers pass through lowlands that are viable for agricultural production (particularly with irrigation). However, the alpine source of the St. Mary River provides a more reliable supply of water for irrigation purposes, both in quantity and timing.

In the 1880's, Canada conducted studies to assess the feasibility of using the St. Mary River for irrigation. In 1899, the Alberta Irrigation Company applied for, and received, the right to divert the entire low water flow and up to 2000 cfs of high water flow, from the flow of the St. Mary River to irrigate up to 500,000 acres. By 1900, Canada had completed a 115 mile (185 kilometer) diversion canal with a capacity of 500 cfs, which conveyed St. Mary River water from a point near the crossing of the international boundary to present day Magrath, Alberta. By 1921, the canal capacity had been increased to 800 cfs. This canal came to be known as the Canadian St. Mary Canal and it was generally operated from April through to the end of October. It was replaced by the St. Mary Reservoir and a larger canal in the early 1950's.

Proposals in the U. S. for diverting water from the St. Mary River into the Milk River for the purpose of irrigating lands within the Milk River basin downstream of the Eastern Crossing of the International Boundary began in the 1890s. In 1917, the U. S. Reclamation Service completed construction of the U. S. St. Mary Canal. The canal had a design capacity of 850 cfs, but over time this capacity has diminished to somewhere near 670 cfs. In addition to providing a reliable water supply to irrigate approximately 140,000 acres, the canal provides water to numerous communities for municipal purposes. The canal is typically operational during the months of April through October. The volume of water that it conveys constitutes a significant portion of the flow recorded during these same months for the Milk River at the Eastern Crossing of the International Boundary. This amount is often 10 to 20 times the natural flow of the Milk River.

BASIN HYDROLOGY

The magnitude and variability of flow of the St. Mary River, Milk River, and Eastern Tributaries (Frenchman River, Battle Creek, and Lodge Creek) at the international boundary for 1950-2004 are presented in Table 1. The range of flow as a percent of the median flow is included as a measure of the variability of flow measured at each border crossing. The variability and timing of the natural flow in the subject water courses present significant challenges to the Field Representatives and water managers in both the U. S. and Canada.

Table 1. Natural Flow at the International Boundary (1950-2004)

Drainage Sub-basins		Minimum	Median	Average	Maximum	Range as a Percent of the Median
St. Mary River Annual (Nov - Oct)	acre-ft	365,200	625,300	657,600	1,027,000	106%
	dam^3	450 000	771 300	811 200	1 266 000	
Milk River[1] Annual (Nov - Oct)	acre-ft	19,800	121,200	126,900	286,000	220%
	dam^3	24 400	149 400	156 600	353 000	
Frenchman River Seasonal (March - Oct)	acre-ft	9,000	58,100	65,100	361,000	605%
	dam^3	11 100	71 700	80 200	445 000	
Battle Creek Seasonal (March - Oct)	acre-ft	3,630	20,900	25,800	112,000	518%
	dam^3	4 480	25 800	31 800	138 000	
Lodge Creek Seasonal (March - Oct)	acre-ft	100	20,800	24,200	131,000	628%
	dam^3	139	25 600	29 900	161 000	

[1] at Eastern Crossing of the International Boundary

The St. Mary River has the greatest average annual flow of the five international boundary sites at 657,600 acre-feet or 811 200 cubic decametres (dam^3) and the least variability (the range of flow as a of median is 106 percent). In contrast, the average annual flow of the Milk River is significantly less at 126,900 acre-feet (156 600 dam^3) and the variability is much greater (the range of flow as a percent of median is 220 percent). Lodge Creek has the least annual flow of the five international boundary sites at 24,200 acre-feet (29 900 dam^3) and the greatest variability (the range of flow as a percent of median is 628 percent).

Estimated natural flow data at the mouths of the St. Mary and the Milk rivers are presented in Table 2. As indicated, the Milk River at its mouth has a larger maximum flow and a slightly higher average flow, but a lower minimum flow, than the St. Mary River at its mouth. Hence, the Milk River at its mouth has a higher variability than the St. Mary River at its mouth. This observation has implications for the management of flows, including the economic viability of constructing water management infrastructure. Caution should be exercised in comparing these data however, since the periods of record are not identical. Also, the irrigation depletion data for both the St. Mary River and Milk rivers was not as reliable prior to about 1950.

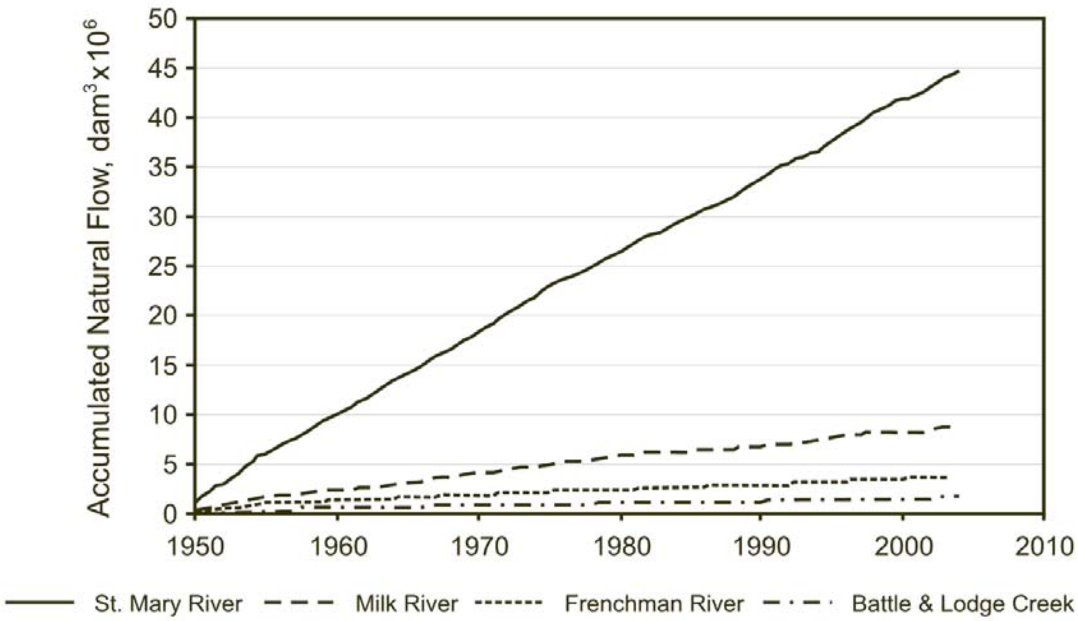
Table 2. Estimated Natural Flow at the Mouth of the St. Mary River and Milk River

Drainage Basins		**Minimum**	**Median**	**Average**	**Maximum**	**Range as a Percent of the Average**
St. Mary River at the Mouth[1]	acre-ft	344,548	688,284	715,037	1,317,388	136%
	dam^3	425 000	849 000	882 000	1 625 000	
Milk River at the Mouth[2]	acre-ft	117,600	611,800	790,220	2,808,800	440%
	dam^3	145 000	754 350	974 341	3 463 250	

[1] Source: South Saskatchewan River Basin Historical Weekly Natural Flows 1912-2002; Alberta Environmental Protection, 2005 Estimated Annual Flows, January to December at 05AE006 St. Mary River near Lethbridge.
[2] Source: Synthesis of Natural Flows at Selected Sites in and near the Milk River Basin, Montana, 1928-89; Water-Resources Investigations Report 95-4022, U. S. Geological Survey.

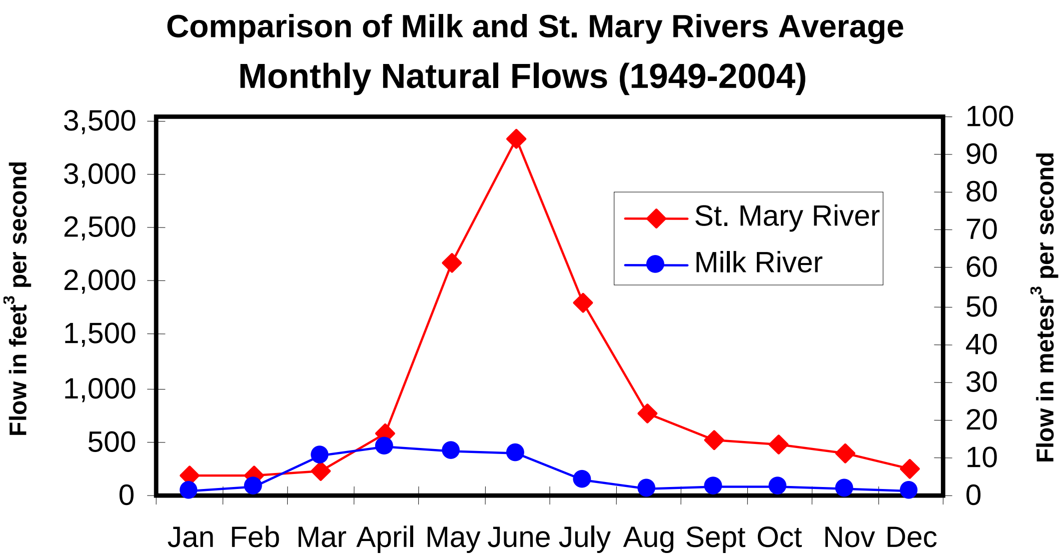
The accumulated natural annual volumes for the St. Mary River, Milk River, and Eastern Tributaries for 1950-2004 are presented in Figure 3. Although the streamflow values in Figure 3 are not directly comparable (the St. Mary River and Milk River flows are annual flows while the Frenchman River, Battle Creek, and Lodge Creek flows are seasonal flows) the relative difference in flow of the streams is readily apparent. The lines for all five international boundary sites suggest relative consistency in the annual yield for each basin over the period of record. However, the Task Force suggests that a more rigorous statistical analysis of the data is needed to support more definitive conclusions.

Figure 3. Accumulated Natural Flow of the St. Mary River, Milk River, and Eastern Tributaries at the International Boundary, 1950-2004.



The St. Mary and Milk rivers are the primary focus of the Task Force deliberations. The magnitude of their relative natural flows and the seasonal fluctuation in those flows at the international boundary are displayed in Figure 4.

Figure 4. Average Monthly Natural Flows for the St. Mary and Milk Rivers



IJC ORDER OF 1921

As discussed earlier in this report, the 1921 Order provides the basis for apportioning the flows of the St. Mary and Milk Rivers. Accordingly, the 1921 Order provides a means to identify each country's respective "entitlement" to the flow of each river. The 1921 Order also specifies sites where international gauging stations are to be maintained and directs the Reclamation and Irrigation Officers to ascertain and keep a daily record of the natural flow of: the St. Mary River at the International Boundary; the Milk River at the Eastern Crossing of the International Boundary; and, the Eastern Tributaries at the international boundary. Provisions of the 1921 Order are summarized directly below (see Appendix B for the complete text).

St. Mary River

Irrigation Season (April 1 to October 31)

During the irrigation season when the natural flow of the St. Mary River at the point where it crosses the international boundary is six hundred and sixty-six (666) cubic feet per second or less Canada shall be entitled to three-fourths and the United States to one-fourth of such flow.

During the irrigation season when the natural flow of the St. Mary River at the point where it crosses the international boundary is more than six hundred and sixty-six (666) cubic feet per second Canada shall be entitled to a prior appropriation of five hundred (500) cubic feet per second, and the excess over six hundred and sixty-six (666) cubic feet per second shall be divided equally between the two countries.

Non-irrigation Season (November 1 to March 31)

During the non-irrigation season the natural flow of the St. Mary River at the point where it crosses the international boundary shall be divided equally between the two countries.

Milk River

Irrigation Season (April 1 to October 31)

During the irrigation season when the natural flow of the Milk River at the point where it crosses the international boundary for the last time (commonly and hereafter called the Eastern Crossing) is six hundred and sixty-six (666) cubic feet per second or less, the United States shall be entitled to three-fourths and Canada to one-fourth of such natural flow.

During the irrigation season when the natural flow of the Milk River at the Eastern Crossing is more than six hundred and sixty-six (666) cubic feet per second the United States shall be entitled to a prior appropriation of five hundred (500) cubic feet per second and the excess over six hundred and sixty-six (666) cubic feet per second shall be divided equally between the two countries.

Non-irrigation Season (November 1 to March 31)

During the non-irrigation season the natural flow of the Milk River at the Eastern Crossing shall be divided equally between the two countries.

The 1921 Order also states that the channel of the Milk River in Canada may be used at the convenience of the United States for the conveyance, while passing through Canadian territory, of waters diverted from the St. Mary River.

Eastern Tributaries (Frenchman River, Battle Creek, and Lodge Creek)

Irrigation Season (April 1 to October 31) and Non-irrigation Season (November 1 to March 31)

The natural flow of the eastern (otherwise known as the Saskatchewan or northern) tributaries of the Milk River at the points where they cross the international boundary shall be divided equally between the two countries.

Waters Not Naturally Crossing the Boundary

Each country shall be apportioned such waters of the said rivers and of any tributaries thereof as rise in that country but do not naturally flow across the international boundary.

The 1921 Order defines the procedures for measuring and apportioning the flows of the St. Mary and Milk rivers between the U. S. and Canada. It also establishes the requirement for keeping daily records of natural flow; identifies specific "irrigation and non-irrigation seasons"; and, provides for prior appropriation and allocation of flows in both the St. Mary and Milk rivers.

Over the period from 1950 to 2004, based on application of the 1921 Order's provisions, the U. S. entitlement of the St. Mary River has averaged approximately 41 percent of the total annual flow (269,600 acre-feet or 332 600 dam^3). Canada's entitlement of the St. Mary River has averaged approximately 59 percent of the total annual flow (388,000 acre-feet or 478 600 dam^3).

The percentages tend to be opposite for the Milk River where the U. S. entitlement of the Milk River has averaged approximately 65 percent of the total annual flow (82,100 acre-feet or 101 200 dam^3), while Canada's entitlement of the Milk River has averaged approximately 35 percent of the total annual flow (44,900 acre-feet or 55 400 dam^3).

The apportionment for the Eastern Tributaries provides for an equal entitlement of the total annual flow (50 per cent) to each country. This amounts, on average, to approximately 57,600 acre-feet or 71 000 dam^3 to each country.

Based on the past 55 years of record, application of the 1921 Order does not provide for equal entitlements to both countries of the annual flows of the St. Mary and Milk rivers. The combined entitlement for the St. Mary River, Milk River and Eastern Tributaries results in approximately 45 percent going to the U. S. and 55 percent going to Canada.

FUNDAMENTAL DIFFERENCES BETWEEN THE PARTIES

Early in the Task Force deliberations, it became apparent that Alberta and Montana hold fundamentally different views regarding interpretation of the 1921 Order and subsequent applications of the administrative procedures. Alberta subscribes to the belief that the apportionment afforded under the 1921 Order is based on the instantaneous flow at any given point in time to ensure the viable operation of downstream canals and diversions. By contrast, Montana subscribes to the belief that the intent of the apportionment afforded under the 1921 Order is to ensure that the appropriate calculated volumes of water are received by the respective parties over time. This difference of interpretation as to the intent of the 1921 Order is fundamental to many of the conflicting views between the parties that arose during deliberations, as most, if not all, of the administrative options considered by the Task Force rely to some extent on a deviation from the notion of an instantaneous flow apportionment.

A strict adherence to the instantaneous flow interpretation leaves very little room for flexibility in administering the apportionment. Further, it all but eliminates the concept of allowing "credit" to an upstream jurisdiction for surplus deliveries to a downstream jurisdiction, absent a negotiated agreement based on mutual benefits (such as the existing Letter of Intent). Conversely, an extreme application of the volume-based interpretation could result in the upstream jurisdiction utilizing the majority of the flow at a time when the downstream jurisdiction might have a critical need for that flow, and then "passing" flows when they might be of minimal benefit to the downstream jurisdiction.

Despite these fundamental differences, it should be recognized that there does exist a strong desire by both countries to maintain (within their respective entitlements) some minimum instream flow at the international border for environmental and channel maintenance purposes.

Clearly, the Administrative Officer's Field Representatives are to be commended for their tireless efforts to foster cooperative solutions as they seek to administer the apportionment. The administrative record stands as a testimony to their diligence and perseverance.

DOCUMENTATION OF ADMINISTRATIVE PROCEDURES

Key to administering the apportionment provisions is an accurate determination of the natural flow. Natural flow is defined as the quantity of water which would naturally flow in any watercourse had the flow not been affected by man-made changes within the drainage basin. This determination is relatively straight-forward on the St. Mary River, but is significantly more complex on the Milk River due in part to the co-mingling with water diverted from the St. Mary River via the U. S. St. Mary Canal.

In general, for the St. Mary River the natural flow at the international boundary is calculated by adding the total flow used by the U. S. (including flow diverted into the U. S. St. Mary Canal) and the change in content of Lake Sherburne, to the flows recorded at the international boundary.

For the Milk River during the irrigation season, the natural flow at the Eastern Crossing is calculated from recorded flow at various monitoring stations: North Fork Milk River above U. S. St. Mary Canal; North Milk River near International Boundary; Milk River at Western Crossing; Verdigris Coulee near the Mouth; and Milk River at Eastern Crossing. Adjustments are made for increased evaporative losses attributed to diverted St. Mary River water, and water used for irrigation (consumptive uses) in both countries. During the non-irrigation season, the natural flow is approximated as the recorded flow of the Milk River at Milk River, Alberta.

The computation of natural flow in the St. Mary-Milk River basin is performed on an interim basis throughout the year to provide timely information for water management purposes. These provisional natural flow data, including approximations, are then re-computed at the end of each year when final data become available. The year-end computations represent a final accounting of the division of flows and are included in the Accredited Officers' annual report to the IJC. In practice, it was (and remains) difficult to do final accounting and balancing on a real-time basis.

History of Administrative Procedures

The procedures, assumptions, and approximations used in determining natural flow have evolved over time in response to factors such as: improved streamflow measurement technology; improved access to monitoring sites; and a better understanding of the hydrology of the basin. Changes to the procedures are always approved by the Field Representatives and Accredited Officers of both the U. S. and Canada. These procedures are documented in a Procedures Manual.

Several questions regarding the Administrative Procedures were raised during the deliberations of the Task Force including:

> 1. When was the decision to adopt the 15/16 day balancing period and the concept of surpluses and deficits first documented?
>
> 2. When were the Administrative Procedures formally documented in the Procedures Manual?
>
> 3. How have the Administrative Procedures changed over time?

The Task Force requested the Field Representatives of the Accredited Officers and IJC staff in Ottawa and Washington to research their archives to provide answers to these questions - no pertinent documentation dated prior to 1975 was located.

It was not until the January 1975 meeting of the Field Representatives that a decision was made to document the methods used to compute the natural flows. The Water Survey Office of Environment Canada in Regina, Saskatchewan undertook this task and in 1979 prepared the first formal "*Procedures Manual for the Division of the Waters of the St. Mary and Milk Rivers*". According to the former Water Survey engineer assigned to this task, the document was based on verbal discussions with experienced hydrometric supervisors, Field Representatives and Accredited Officers, and a review of pertinent memoranda and other documents on file. This same document provides the framework for the Procedures Manual that is in use today.

The Procedures Manual was first updated in 1991. That update focused mainly on the computational procedures based on data collected by the U. S. Geological Survey (USGS) and the Water Survey Division (WSD) of Environment Canada in the 1980s. The update also included the establishment of the 1991 Letter of Intent, which addressed modifications to the Administrative Procedures (the Letter of Intent was revised in 2001). The Procedures Manual was again updated in 2003 with minor changes to the computational and reporting procedures.

The IJC sets policies and reviews changes to the Administrative Procedures based on specific recommendations from the Accredited Officers and their Field Representatives. The Accredited Officers and their Field Representatives in turn, work with water management agencies from Alberta and Saskatchewan, the State of Montana, Bureau of Reclamation, and other stakeholders in formulating proposed changes. Technical working committees are created by the Field Officers periodically to help update, refine, and verify technical data.

Data on the number of acres irrigated in Alberta and Montana have not been updated since about 1980. This information is considered essential for accurately calculating the natural flow of the Milk River because diversions in Alberta and Montana are currently estimated based on the irrigated acreage. An initiative by Alberta to measure diversions directly is underway.

The Task Force was unsuccessful in locating historical information which might have provided a rationale for the balancing periods, as well as the criteria applied in determining surpluses and deficits used in the apportionment calculations.

<u>SUMMARY</u>: The Administrative Procedures have evolved over time in response to a variety of changing conditions. Although historical changes to the procedures may have been well-documented when they were considered and implemented, the Task Force experienced difficulty in locating such formal documentation. The Task Force suggests that it would be prudent practice for any future changes to the Administrative Procedures, as well

as the rationale for making the changes, to be thoroughly documented and archived by the Accredited Officers and the IJC for future reference.

HISTORICAL APPORTIONMENT

Before investigating opportunities to improve the administrative measures, the Task Force examined the 1950 to 2004 record provided by the Field Representatives (Appendix G) to determine whether or not the apportionment, as defined by the 1921 Order, was being met. Data for apportioned and received natural flows for the period of 1950-2004 are summarized and presented in Table 3 (acre-feet) and Table 4 (dam^3).

Application of the apportionment provisions results in a specific amount of water being identified as each country's apportioned amount or "entitlement". In practice, the amount of water actually diverted (or utilized) by either country has typically deviated from their respective entitlement. Under the existing Administrative Procedures and current level of infrastructure within the basin, the U. S. has not been able to fully divert (or utilize) its entitlement of St. Mary River flows. At the same time, Canada has not been able to fully divert (or utilize) its entitlement of Milk River flows.

Over the 1950-2004 period of record, the U. S. has, on average, diverted (or utilized) approximately 62 per cent of its entitlement of St. Mary River total annual volume (approximately 167,400 acre-feet or 206 500 dam^3). Canada has, on average, received approximately 126 per cent of its entitlement of St. Mary River total annual volume (approximately 490,200 acre-feet or 604 600 dam^3).

Over this same period of record, the U. S. has, on average, received approximately 141 per cent of its entitlement of Milk River total annual volume (approximately 115,500 acre-feet or 142 500 dam^3). Canada has, on average, diverted (or utilized) approximately 25 per cent of its entitlement of Milk River total annual volume (approximately 11,400 acre-feet or 14 000 dam^3).

On the Eastern Tributaries, the U. S. has, on average, received approximately 145 per cent of its entitlement of total annual volume (83,500 acre-feet or 103 000 dam^3). Canada has, on average, diverted (or utilized) approximately 55 per cent of its entitlement of total annual volume (31,600 acre-feet or 39 000 dam^3).

The U. S. entitlement of the combined flows of the St. Mary River and the Milk River (including its Eastern Tributaries) is 45%, but it has historically received (or diverted) 41%. The Canadian entitlement of the combined flows of the St. Mary River and the Milk River (including the Eastern Tributaries) is 55%, but it has historically received (or diverted) 59%.

The shortfall in water diverted by the U. S. from the St. Mary River is partially offset by Canada being unable to fully divert its entitlement of the Milk River and Eastern Tributaries total annual volume.

Under the existing Administrative Procedures there are several reasons why the entitlement afforded under the apportionment is not diverted (or utilized) by each country on an annual basis. First, the U. S. lacks sufficient infrastructure capacity to capture and divert its full entitlement of the St. Mary River flow, particularly during periods of higher flows. Likewise, Canada lacks storage and diversion capacity on the Milk River to divert its full entitlement of Milk River flow. Second, the U. S. cannot divert its share of St. Mary River flow through the U. S. St. Mary Canal during the winter months. Likewise, Canada cannot divert its share of Milk River flow during the winter months. Third, the apportionment procedures do not allow the U. S. to receive credit for surplus deliveries of water to Canada during those times when the U. S. cannot divert its apportioned flows of the St. Mary River; likewise, the apportionment procedures do not allow Canada to receive credit for surplus deliveries of water to the U. S. during those times when Canada cannot divert its apportioned flows of the Milk River.

<u>SUMMARY</u>: In simple terms, and based on the 1950-2004 period of record, the U. S. received more than its annual entitlement of the Milk River and Eastern Tributaries, while Canada received more than its annual entitlement of the St. Mary River. The net effect is a differential of roughly 42,700 acre-feet or 52 700 dam^3 annually. The annual differential tends to be larger during high-runoff years and smaller during drought or low water years.

Table 3. Summary of Apportioned and Received Natural Flows (acre-feet), 1950-2004[1]

Drainage Sub-basins		St. Mary River @ IB	Milk River @ IB	Sum of Eastern Tributaries @ IB	Combined Flow
Annual flow apportioned to U. S. (entitlement)	Maximum	443,000	187,800	301,600	
	Mean	269,600	82,100	57,600	409,300
	Median	253,000	79,300	46,300	
	Minimum	125,400	13,300	6,660	
	[2]Range	317,600	174,500	294,900	
	Range as a percentage of median	126 %	220 %	637 %	
Annual flow received or diverted by U. S. (receipt)	Maximum	264,900	267,600	574,800	
	Mean	167,400	115,500	83,500	366,400
	Median	170,100	110,000	65,200	
	Minimum	79,900	6,100	6,570	
	[2]Range	185,000	261,500	568,200	
	Range as a percentage of median	109 %	238 %	872 %	
Amount of mean annual flow received or diverted by U. S. above or below (-) mean annual flow apportioned to U. S.		(102,200)	33,400	25,900	(42,700)
Percent of mean annual flow apportioned to U. S. (entitlement)		41 %	65 %	50 %	45 %
Percent of mean annual flow received or diverted by U. S.		25 %	91 %	73 %	41 %
Annual flow apportioned to Canada (entitlement)	Maximum	583,600	101,900	301,600	
	Mean	388,000	44,900	57,600	490,500
	Median	372,300	41,800	46,300	
	Minimum	225,300	6,450	6,660	
	[2]Range	358,300	95,500	294,900	
	Range as a percentage of median	96 %	228 %	637 %	
Annual flow received or diverted by Canada (receipt)	Maximum	946,800	23,800	79,100	
	Mean	490,200	11,400	31,600	533,200
	Median	457,500	10,900	30,000	
	Minimum	235,500	(1,790)	5,920	
	[2]Range	711,300	25,600	73,200	
	Range as a percentage of median	155 %	235 %	244 %	
Amount of mean annual flow received or diverted by Canada above or below (-) mean annual flow apportioned to Canada		102,200	(33,500)	(26,000)	42,700
Percent of mean annual flow apportioned to Canada (entitlement)		59 %	35 %	50 %	55 %
Percent of mean annual flow received or diverted by Canada		75 %	9 %	27 %	59 %
Total Mean Annual Flow		657,600	126,900	115,100	899,600

[1] *Data compiled from summary tables in Appendix G. Minor deviations may be present due to rounding.*
[2] *Range is the difference between maximum and minimum.*

Table 4. Summary of Apportioned and Received Natural Flows (dam^3), 1950-2004[1]

Drainage Sub-basins		St. Mary River @ IB	Milk River @ IB	Sum of Eastern Tributaries @ IB	Combined Flow
Annual flow apportioned to U. S. (entitlement)	Maximum	546 500	231 700	372 000	
	Mean	332 600	101 200	71 000	504 800
	Median	312 100	97 800	57 100	
	Minimum	154 700	16 400	8 210	
	Range[2]	391 800	215 200	363 800	
	Range as a percentage of median	126 %	220 %	637 %	
Annual flow received or diverted by U. S. (receipt)	Maximum	326 800	330 100	709 000	
	Mean	206 500	142 500	103 000	452 000
	Median	209 800	135 700	80 400	
	Minimum	98 500	7 530	8 100	
	Range[2]	228 300	322 500	700 900	
	Range as a percentage of median	109 %	238 %	872 %	
Amount of mean annual flow received or diverted by U. S. above or below (-) mean annual flow apportioned to U. S.		(126 100)	41 300	32 000	(52 800)
Percent of mean annual flow apportioned to U. S. (entitlement)		41 %	65 %	50 %	45 %
Percent of mean annual flow received or diverted by U. S. (receipt)		25 %	91 %	73 %	41 %
Annual flow apportioned to Canada (entitlement)	Maximum	719 800	125 700	372 000	
	Mean	478 600	55 400	71 000	605 000
	Median	459 200	51 600	57 100	
	Minimum	277 900	7 960	8 210	
	Range[2]	442 000	117 800	363 800	
	Range as a percentage of median	96 %	228 %	637 %	
Annual flow received or diverted by Canada (receipt)	Maximum	1 167 800	29 300	97 600	
	Mean	604 600	14 100	39 000	657 700
	Median	564 400	13 400	37 000	
	Minimum	290 500	(2 200)	7 300	
	Range[2]	877 400	31 500	90 300	
	Range as a percentage of median	155 %	235 %	244 %	
Amount of mean annual flow received or diverted by Canada above or below (-) mean annual flow apportioned to Canada		126 000	(41 300)	(32 000)	52 700
Percent of mean annual flow apportioned to Canada (entitlement)		59 %	35 %	50 %	55 %
Percent of mean annual flow received or diverted by Canada (receipt)		75 %	9 %	27 %	59 %
Total Mean Annual Flow		811 200	156 600	142 000	1 109 800

[1] *Data compiled from summary tables in Appendix G. Minor deviations may be present due to rounding.*
[2] *Range is the difference between maximum and minimum.*

LETTERS OF INTENT

During the water-short 1980s, Canada often needed more than its share of the Milk River natural flow during the summer months, while the U. S. often had the capability to divert more than its share of the St. Mary River natural flow during the early spring months prior to commencement of the spring freshet (runoff). Accordingly, Canada requested the U. S. to divert and convey a portion of Canada's St. Mary River entitlement to the Milk River. In return, the U. S. was allowed to accumulate deficits on the St. Mary River and to carry them forward over multiple division periods.

A Letter of Intent was subsequently developed by the Accredited Officers and their Field Representatives, in cooperation with Montana and Alberta, to help achieve more beneficial use of the waters of the St. Mary and Milk rivers under the existing Administrative Procedures. The current Letter of Intent can be terminated by either party upon written request two months prior to the commencement of the irrigation season (April 1st as specified by the 1921 Order).

In 1991, the Accredited Officers signed a Letter of Intent which allowed Canada to accumulate a deficit on the Milk River until the end of September of any given year. In exchange, the U. S. was allowed to accumulate a deficit on the St. Mary River from March through May. This allowed Canada to take more than its entitlement of Milk River natural flow during the irrigation season, while the U. S. was allowed to divert more than its entitlement of St. Mary River natural flow prior to the irrigation season. Deficits were to be offset or "repaid" by each country by the end of the year.

The Accredited Officers signed a revised Letter of Intent in February 2001 (Appendix H). This Letter replaced the 1991 Letter of Intent and clarified the timing and quantity of allowable deficit deliveries. It allows the U. S. to create a deficit of up to 4,000 cfs-days (8,000 acre-feet or 9 800 dam^3) on the St. Mary River between March 1 and May 31. The U.S. is allowed to reduce the deficit to 2,000 cfs-days (4,000 acre-feet or 4 900 dam^3) through surplus releases of St. Mary River water into Canada between June 1 and July 15. In return, Canada is allowed to create a deficit of up to 2,000 cfs-days (4,000 acre-feet or 4 900 dam^3) on the Milk River between June 1 and September 15 to help meet Alberta's irrigation needs in the Milk River Basin. Deficits on the two streams can be offsetting, and deficits as of September 15 must be equalized by October 31.

Through the Letter of Intent, the U. S. is allowed to divert more that its entitlement of St. Mary River water early in the season before the spring freshet (runoff). Canada is allowed to divert more than its entitlement of Milk River water later in the irrigation season. While it does not provide a means to allow credits for surplus deliveries, the existing Letter of Intent does address some of the constraints posed by the bi-monthly balancing period and the limited diversion capacities of each country. However, during Task Force deliberations it became apparent that Alberta and Montana do not necessarily share a common interpretation of the current Letter of Intent. Since the Letter of Intent is a voluntary document, it remains the responsibility of the affected parties to resolve any outstanding differences relative to the terms of the document.

A draft Letter of Intent for the Eastern Tributaries has been prepared by the Eastern Tributaries Technical Working Group under the Field Representatives. Discussions on this document have been suspended pending the outcome of the Administrative Measures Task Force deliberations.

SUMMARY: A Letter of Intent is a voluntary administrative measure that can provide a practical approach to achieving more beneficial use of water in both Canada and the United States. Since 1991, a Letter of Intent has been used to address some of the constraints by the existing Administrative Procedures related to timing and capacity issues inherent in daily operations of water management structures within the St. Mary and Milk rivers. The Eastern Tributaries Technical Working Group has prepared a draft Letter of Intent for consideration by the parties on the Eastern Tributaries.

A Letter of Intent does not supercede the Treaty or the 1921 Order, but rather it provides a mechanism for both parties to acknowledge that modifications to a strict interpretation of the 1921 Order may be mutually beneficial. Although some issues related to interpretation of the current Letter of Intent for the St. Mary and Milk rivers apparently exist, it is the responsibility of the affected parties to resolve any outstanding differences therein.

OPTIONS FOR IMPROVING ADMINISTRATIVE MEASURES

The Task Force investigated a number of potential improvements to the current Administrative Measures used in apportioning the flows of the St. Mary River, Milk River, and the Eastern Tributaries. The Task Force also investigated changes that could provide more opportunity for each country to utilize a greater share of their respective entitlements. Opportunities considered by the Task Force included: natural flow calculations; balancing periods and accounting for surpluses and deficits; Letters of Intent; and other potential options which were considered to be beyond the scope of the Task Force directive. The Task Force limited its endeavors to the St. Mary and Milk rivers since this was the focus of the issues raised by Montana and to a lesser extent, due to the limited amount of time available. The Task Force recognizes, however, that any changes in interpretation of the procedures in the St. Mary and Milk rivers also might be applicable to the Eastern Tributaries.

NATURAL FLOW CALCULATIONS

The Task Force found it instructive to consider all aspects of natural flow determination such as: consumptive use values; flow depletion associated with diversion in the U. S. St. Mary Canal; the number of irrigated acres in Montana and Alberta; and real-time natural flow computations. In so doing, the Task Force identified potential inaccuracies in the current natural flow calculations for both the St. Mary and Milk rivers, and suggested ways to improve the calculations. The intent of this analysis was to improve the computation and dissemination of information used in the accounting procedures and in making basin water management decisions, rather than to change the accounting procedures themselves.

The foundation for this discussion is the two formulas currently used by the Accredited Officers and their Field Representatives to apportion the flows of the St. Mary and Milk Rivers.

St. Mary River

The current formula for computing the natural flow of the St. Mary River is:

$$\mathbf{Q_N = Q_R + \triangle_S + US_{DIV}}$$

Where:

$\mathbf{Q_N}$ is the natural flow of the St. Mary River at the International Boundary.

$\mathbf{Q_R}$ is the recorded flow of the St. Mary River near the International Boundary (real time station).

Concern: To compute a daily apportionment throughout the year, daily flows are needed at this gauging station.

Suggestion: The gauging station will need to continue to be maintained and operated throughout the year.

> $\triangle_S$ is the volume of water held in, or released from, storage in Sherburne Reservoir in Montana since the last period.

Concern: Water released from Sherburne Reservoir must first flow into lower St. Mary Lake where some of it temporarily goes into storage as it raises the level of St. Mary Lake before being discharging downstream. However, this may be partially compensated for as the negative number will soon be "zeroed out" and/or made up by the faster spilling of natural inflow from lower St. Mary Lake.

Suggestion: Check the calculations to ensure that there is no under accounting or "double accounting".

> $\mathbf{US_{DIV}}$ is the real-time diversion of the St. Mary River by canal near Babb, Montana.

Concern: The diversion is measured at the beginning of the siphons where the U. S. St. Mary Canal crosses the St. Mary River and not at the upstream point of diversion below St. Mary Lake. This location was chosen to negate the need for measuring canal losses that are assumed to return 100 percent into the St. Mary River.

Suggestion: If there is any consumptive loss of water from the canal upstream of the gauging station, the depletion will need to be identified in the calculations.

General Comments:

- The St. Mary flow computations should be more representative of real-time to assist operational decisions and be made available daily for public use and view.
- The computations spreadsheet should include more columns to identify the details of the elements of the calculations. Currently assumptions are lumped together in some values making it difficult to understand the impact of changing or recording the specific elements. For example, the formula should add a value (USuse) to account for U. S. consumptive use in the Babb and St. Mary Lake area. This use is currently considered zero, however, there are some uses in the St. Mary Lake recreational developments and some filed claims on the river.

Milk River

The current formula for computing the natural flow of the Milk River can be expressed as:

$$\mathbf{Q_N = Q_{EX} - US_{DIV} + C_{USE} + US_{USE} + I_{EVAP} - C_{DIV}}$$

Where:

Q_N is the calculated natural flow of the Milk River at the Eastern Crossing of the International Boundary.

Q_{EX} is the recorded Milk River flow at the gauging station located near the eastern boundary between the U. S. and Canada.

Concern: The Milk River channel at the Eastern Crossing is unstable making it difficult to use the continuous flow readings for establishing an accurate stage-discharge correlation at the gauging station. Frequent monthly discharge measurements define the shifts for the flow calculations at the gauging station, but this frequency of measurement is inadequate for making accurate computation of natural flows when they are needed for operational purposes.

Suggestions: Conduct more frequent discharge measurements at key times to define channel shifts (end of spring runoff) and to re-calibrate the stage-discharge correlation.

1. Timely publication of changing stage-discharge correlations.

2. Consider constructing a measuring structure to stabilize the river at the cross-section. However, we recognize the expense and logistic problems associated with this suggestion.

US_{DIV} is the flow diverted from the St. Mary River that is released into the North Fork of the Milk River.

Concern: The flow value is presently the calculated difference between the two gauging stations on the North Fork - one located directly upstream of where the St. Mary diversion water enters the North Fork and the other near the international boundary. This approach may be less accurate as it depends on the measurement of two gauging stations and estimation of U. S. depletions between the two sites.

Suggestions:

1. Montana and the U. S. will consider placing a gauging station on the U. S. St. Mary Canal immediately before the canal flows enter the North Fork of the Milk as a part of the rehabilitation of the U. S. St. Mary Canal.

2. Identify and add in any U. S. depletions between the two existing gauging stations and update every five years.

CU_{CAN} is the consumptive use in Alberta. These values have been established under the existing Administrative Procedures and vary by period, and with dry vs. wet years.

Concern: The values were last established 25 years ago and do not accurately reflect actual depletions in Alberta from the Milk River.

Suggestions:

1. Milk River mainstem water use in Alberta will be reported in a more timely fashion based on daily consumptive use reports from the local water users or from meters (includes municipal).

2. Milk River tributary water use in Alberta will be reported every 15 days based on daily consumptive use reports from local water users. Tributaries include the Sweetgrass Hills, Verdigris Coulee, South Fork of the Milk River and other tributaries.

3. The apportionment calculation sheet should show three columns for reporting use; by acres, by reported/metered and by a calculated daily "agri-met" value.

4. Municipal use will be included in reports (20 per cent of the municipal use by the Town of Coutts will be applied to U. S. consumptive use to account for the water they supply to the town of Sweetgrass in Montana)

5. One meteorological station will need to be installed at an appropriate location along the Milk River and used to calculate daily depletions based on daily agri-met values and the number of acres irrigated and types of irrigation as a means to check against the reported 15-day depletion reports.

6. The Accredited Officers will update the terms (acres irrigated, and types of irrigation systems) used to calculate depletions every five years beginning in 2005.

7. Establish and maintain a current GIS base map of all mainstem and tributary irrigation acres and points of diversion within the Milk River Basin of Alberta.

   CU_{US} is the consumptive use in Montana. These values have been established under the existing Administrative Procedures and vary by period, and with dry vs. wet years.

Concern: The values were last established 25 years ago and do not account for accurate depletions in Montana from the Milk River.

Suggestions:

1. Milk River tributary water use in Montana will be reported every 15 days based on daily consumptive use reports collected from the local water users or from meters. Tributaries include North Fork of the Milk River, South Fork of the Milk River, Sweetgrass Hills, and Red Creek.

2. Establish accurate "record of water usage" for each tributary of the Milk River in Montana.

3. The calculation sheet should show three columns for reporting use; by acres, by reported/metered and by a calculated daily "agri-met" value.

4. The Accredited Officers will update the terms (acres irrigated, and types of irrigation systems) used to calculate depletions every five years beginning in 2005.

5. Establish and maintain a current GIS base map of all tributary irrigation acres and points of diversion within the Milk River Basin of Montana.

NOTE: Further clarification is required on what water use will be reported (e.g. irrigation, municipal, industrial, other, etc.).

$\mathbf{I_{EVAP}}$ represents the incremental increase in evaporation losses from the Milk River due to the U. S. St. Mary diversion water within the Milk River channel (conveyance losses). Losses may include evaporation from increased surface area, seepage losses and plant use.

Concern: Currently the value is calculated using a formula based on the incremental increase in the Milk River channel caused by the St. Mary River water which increases the wetted channel surface area between the western and eastern crossing gauging stations, and with evaporation pan data measured at Onefour, Alberta (daily).

Suggestions: Evaporation pan data at Onefour, Alberta will need to be readily available to Montana for operational decisions.

1. Investigate using the calculated natural flow of the Milk River, rather than the combined gauged flow of the North Fork of the Milk River above the canal and the Milk River at the western crossing (South Fork of the Milk River).

NOTE: This is a complex issue that should be discussed further, however the change in allocation entitlements in a perfect formula are expected to be small.

$\mathbf{C_{DIV}}$ represents a 'credit' to Alberta for water entering the Milk River at Verdigris Coulee that originated outside the Milk River Basin. The project to divert St. Mary water to the Milk River at Verdigris has been discontinued; therefore, the flow that enters the Milk River from Verdigris Coulee now represents mostly natural runoff.

Suggestion: Alberta will not be given a credit for flows discharging from Verdigris Coulee into the Milk River unless the Province can document a volume of water released into Verdigris Coulee from another basin.

General Comments:

- The Milk River flow computations for apportionments should be automated, calculated daily and maintained current to assist operational decisions and for public use and view.

- The computations spreadsheet should include more columns to identify the details of the elements of the calculations. Currently, some terms are lumped together making it difficult to understand the impact of changing or recording the specific elements.

- Current Administrative Procedures set the computed negative natural flows to zero. Negative natural flows represent inaccuracies in the natural flow computation procedures and need to be addressed.

Comments Applicable to Both Rivers

- The values in the existing formulas should be updated with existing information for the 2005 season, and annually updated thereafter by the Accredited Officers.

- Credibility should be provided to the water use numbers through regular field inspections each year and in each jurisdiction.

- The volume and timing of diversions and/or depletions on tributaries must be clarified and added to the calculations for both Alberta and Montana.

- All parties should encourage the exchange of information by the system operators for enhancing more efficient management of the operations of the St. Mary and Milk River systems.

- An automated daily apportionment model or excel spreadsheet should be developed and used by the Accredited Officers, and accepted by all affected parties, to apportion flows and the data should be made available to all parties to improve management of diversions and uses.

- The responsible water agencies will need to encourage the expedited adjudication of water rights in the Sweetgrass Hills in Montana, followed by a cooperative hydrologic investigation (by Montana and Alberta) of water supplies and uses.

- Minimum instream flows for the St. Mary and Milk Rivers will likely be established at some point in the future to protect fish and other important aquatic habitats in both Montana and Alberta. Instream flows are discussed later in this report.

CONCLUSION: While Task Force members are in agreement with these suggested improvements to the calculation of natural flow, and notwithstanding that the respective jurisdictions have already begun to address some of the findings, the Task Force recognizes that the IJC may need to provide further direction to the Accredited Officers. Furthermore, the Task Force recognizes that implementing several of these suggestions will be a long-term undertaking.

The Task Force believes that these suggested computational improvements will enhance the perception of fairness in the calculations and will ensure that the best methods are applied to the administrative measures.

BALANCING PERIODS, SURPLUSES AND DEFICITS

Within the context of this report, the term "surplus" refers to that amount of the upstream jurisdiction's entitlement that is not diverted and continues on to the downstream jurisdiction. The term "deficit" refers to that amount of water in excess of the upstream jurisdiction's entitlement that is diverted for that jurisdiction's use. The term "balancing period" refers to the time period allowed for balancing any surplus or deficit.

As mentioned earlier in this report, the 1921 Order provides for a daily record of natural flow and does not address the issue of surplus or deficit deliveries. Without any surplus or deficit deliveries, there would be no need for a balancing period. Until recently, real-time accounting was simply not feasible and the Field Representatives recognized this from the beginning by establishing a 15- to 16-day balancing period to allow sufficient time to complete the appropriate calculations. Today, with the ability to receive and process near real-time data, the estimation of daily apportionment is more feasible.

The length of the balancing period can potentially impact the proportion of the natural flow that a downstream jurisdiction receives during the less desirable high flow and winter periods. However, it had also been surmised that the specific balancing period employed could affect the proportion of its entitlement that an upstream jurisdiction could realize. Accordingly, the Task Force investigated the effect of various balancing periods on each country's ability to divert or utilize more of its respective entitlement. Five progressively longer balancing periods were evaluated using Excel-based spreadsheet models of the St. Mary and Milk River apportionment formulas (Appendix I). The balancing period options included: 7-day; 15- to 16-day; monthly; seasonal (November 1 to March 31 and April 1 to October 31); and, annual (November 1 to October 31).

In modeling the five options, the Task Force attempted to meet each country's irrigation requirement. Longer balancing periods can lead to a situation in which the upstream jurisdiction can take all of the natural flow, particularly during periods of low flow. To address this concern, certain minimum flow conditions (for environmental purposes) were assumed for this initial evaluation (refer to Instream Flow section). Should a longer balancing period prove to be a viable modification to the administrative procedures, a more rigorous analysis will be necessary to establish more definitive minimum instream flow targets. In modeling the five options, the Task Force also attempted to optimize the proportion of its entitlement taken by each country. Refer to Appendix I for a complete description of the analysis of options.

Description of Model

The spreadsheet models utilize the latest 25 years of hydrologic data (1980 through 2004). These years were chosen because they reflect the present status of irrigation development in the basins, and because they offer the most comprehensive data record.

A water year beginning on November 1 of one calendar year and extending to October 31 of the following calendar year was initially identified for the annual balancing period simulation because October 31 is the end of the irrigation season as defined in the Treaty and the 1921 Order. This is similar to the standard water year of October 1 to September 30 that is frequently used in the U. S. for hydrologic analysis.

The St. Mary River model simulation allows for more precise manipulation of Sherburne Reservoir and the U. S. St. Mary Canal than actually would occur in practice because it was impractical to incorporate all operational constraints within the model. For example, the model uses several assumptions such as: flow in the U. S. St. Mary Canal can be shut off, or started, within one day if a deficit exists; flow in the U. S. St. Mary Canal is not reduced during high flow events; no scheduled maintenance; etc. Although these assumptions are unrealistic from an operational and hydraulic standpoint, the scenarios evaluated provide a reasonable comparison of the relative differences between options.

Historical St. Mary River Operations

The U. S. stores water from Swiftcurrent Creek (a tributary of the St. Mary River) in Sherburne Reservoir, and makes releases as necessary to meet irrigation demands and Treaty obligations. The U. S. has no storage facility on the mainstem St. Mary River and is limited in its ability to utilize its entitlement of St. Mary River water by the capacity of the St. Mary Diversion Dam and Canal. Accordingly, that portion of the U. S. entitlement which cannot be captured in Lake Sherburne and/or be diverted through the U. S. St. Mary Canal is passed downstream to Alberta, particularly during the winter months and during periods of high flow.

The U. S. diverts St. Mary River water into the U. S. St. Mary Canal during the late March through April period using a combination of its entitlement of the natural flow and releases of water from Sherburne Reservoir that was stored or carried over during the winter. During the spring freshet (runoff), when the U. S. entitlement of natural flow from the St. Mary River is equal to or greater than the capacity of the U. S. St. Mary Canal, the U. S. again stores Swiftcurrent Creek flows in Sherburne Reservoir. In summary, the U. S. strives to optimize the diversion of its St. Mary River entitlement during the March 1 to October 31 irrigation season, using either St. Mary River natural flows, or a combination of St. Mary River natural flows and storage releases from Sherburne Reservoir. The U. S. does not currently maintain a minimum instream flow in either Swiftcurrent Creek, or in the St. Mary River below the St. Mary Diversion Dam, for purposes other than meeting obligations under the Treaty and 1921 Order.

Taking into account projections of snow pack and diversion of the U. S. entitlement, Alberta operates its St. Mary Reservoir (the 1899 Kimball Canal was abandoned in 1953 as unreliable and was replaced with an on-stream reservoir and a new canal of 3500 cfs capacity) to optimize Alberta's beneficial use of their apportioned share of St. Mary River water. In addition to storing St. Mary River water, Alberta also diverts and stores a portion of the Belly River and Waterton River water in their St. Mary Reservoir. This stored water is available for release later in the year, either through the irrigation supply canal, or in the St. Mary River channel. The irrigation supply canal and one of two tunnels releasing downstream into the St. Mary River are equipped with hydroelectric turbines (having a capacity of 1,800 cfs and 195 cfs, respectively) that make opportunistic use of irrigation diversions, riparian releases, and some minor spills to generate electricity. Releases are not made specifically for this purpose, however.

The results of the model runs for each balancing period option are summarized in Table 5 (the results are shown in greater detail in Appendix I). In these runs, the U. S. assumed an instream flow release from Sherburne Reservoir of 25 cfs or the actual inflow into Sherburne (whichever is less) for environmental purposes, and an instream flow at the international boundary of the lesser of the Canadian entitlement, 50 percent of the average annual flow, or 50 percent of the average monthly flow. Note that this analysis is based on 25 years of record and the results are not directly comparable to recorded data for the 1950-2004 period of record referenced previously in this report. Nonetheless, the relative differences between the various balancing periods are valid for comparison purposes.

Table 5. Summary of Modeled U. S. Diversions (acre-feet per year) of St. Mary River Water under Various Balancing Period Scenarios[1]

Type of Year	Historical U. S. Entitlement	Historical U. S. Diversions	7-day balancing	Current 15/16-day balancing	Monthly balancing	Seasonal balancing	Annual balancing
Average	246,500	174,600	201,000	202,000	204,000	211,500	227,000
Median	228,000	177,200	199,000	202,000	203,000	206,000	223,000
Average of 5 wettest years	352,000	169,700	239,000	240,000	242,000	255,000	265,000
Average of 5 driest years	166,000	148,400	149,500	150,000	151,000	152,000	166,000

[1] The values for average and median entitlement and receipt do not exactly match the documented St. Mary River values (Table 3) since they are derived from 1980 to 2004 data whereas Table 3 uses data for the 1950 to 2004 period.

SUMMARY: The modeling results suggest that the U. S. could expect to divert an increasingly greater portion of its annual St. Mary River entitlement under increasingly longer balancing periods. However, the relative magnitude of these increases becomes significant only with the seasonal and annual balancing periods. A seasonal balancing period could allow the U. S. to build a surplus (or credit) during the spring freshet (runoff) period when it is not able to divert its full entitlement, and then divert these credited flows later in the season. An annual balancing period could allow the U. S. to build a larger surplus (or credit) by accommodating both spring and winter flows. Further, the U. S. has a greater capability of diverting more of its entitlement while providing instream flows both below Sherburne Reservoir and at the international boundary under the annual apportionment scenario. However, this would result in Canada receiving a greater portion of its St. Mary River entitlement in the winter and during periods of high flows, and a reduced instream flow during the early spring and late summer periods. These changes in flows could have impacts on fisheries, riparian vegetation, and reservoir operations in Alberta.

Historical Milk River Operations

As discussed earlier, the U. S. diverts its St. Mary River entitlement into the U. S. St. Mary Canal beginning in late March or early April, and continues through the end of the irrigation season (usually in early to-mid October). Canada generally begins diverting its entitlement from the Milk River during April or early May, and continues to do so until the end of the irrigation season (usually in early to mid-October).

Other than during the irrigation season, Canada diverts very little Milk River water and, because Canada has no storage on the Milk River, most of their entitlement flows past the Eastern Crossing of the International Boundary and into Montana. During the irrigation season, a significant portion of the flow in the Milk River is typically U. S. entitlement of St. Mary River water that has been diverted into the Milk River (via the U. S. St. Mary Canal) and which is being conveyed across southern Alberta in the Milk River channel.

The U. S. operates Fresno Reservoir on the Milk River, and Sherburne Reservoir on Swiftcurrent Creek, conjunctively to optimize their combined storage potential. Both reservoirs are used to supply water to meet contract obligations of Montana water users along the Milk River.

The results of the five balancing periods for the Milk River are summarized in Tables 6. The Milk River frequently has very little, if any, natural flow by late June. Accordingly, Alberta would receive very little benefit from an extended balancing period (which would allow it to accumulate a surplus, but provide no opportunity to draw on this accumulation to meet its water use requirements). Similarly, Alberta would receive very little benefit from an extended balancing period that would provide Montana with the opportunity to access Canada's St. Mary River entitlement (which it would then convey across southern Alberta via the Milk River), while denying Milk River irrigators in Alberta access to these same Canadian entitlements. As such, while Alberta and Montana agreed to the concept of an extended balancing period for modeling purposes, they could not reach consensus on which waters could be accessed by Alberta to draw on its surplus accumulations.

Table 6. Summary of Modeled Canadian Diversions (acre-feet per year) of Milk River Water under Various Balancing Period Scenarios

			Access Solely to Milk River Natural Flows[2]					Access to All Flows in Milk River[2]
Type of Year	**Historical Canadian Entitlement[1]**	**Current Canadian Needs[3]**	**7-day balancing**	**15 / 16-day balancing**	**Monthly balancing**	**Seasonal balancing**	**Annual balancing**	**Annual balancing**
Average	36,500	10,600	4,400	4,700	5,100	7,300	7,600	10,300
Median	34,100	10,800	4,800	4,500	4,600	6,000	6,000	10,800
Average of 5 wettest years[4]	69,500	9,500	5,400	5,900	6,300	8,100	8,100	9,500
Average of 5 driest years[4]	13,500	13,500	2,500	2,700	3,100	5,000	5,800	12,000

1. Based on Montana computations of natural flow and diversions including updated acreage for Alberta and Montana

2. Subject to availability of accumulated surplus deliveries

3. Based on current irrigation (8,100 acres)

4. Based on Milk River natural flow.

Table 6 provides a relative comparison of the quantity of water Canada requires for its current 8,100 acres of irrigation in the Milk River Basin versus the quantity of water which it would be able to divert under various balancing periods (if it could draw on its surplus delivery accumulations). As indicated, while each progressive balancing period extension would provide Canada access to a greater share of its Milk River entitlement, Canada would not be able to achieve the current level of access (even under an annual balancing period) unless it had access to all flows within the Milk River. This is because:

- While Canada would accumulate sufficient surplus deliveries to meet its irrigation demands (because the Milk River natural flow is often non-existent by late June), frequently there would be no natural flow within the Milk River from which Canada could draw on its accumulated surpluses.

- Since the U. S. would have accumulated surplus winter deliveries from which to draw during the spring freshet (runoff), it might no longer require the existing Letter of Intent.

<u>SUMMARY</u>: The modeling results show that Canada could be expected to receive (or have available for use) an increasingly greater portion of its annual Milk River entitlement under increasingly longer balancing periods. However, the relative magnitude of these increases only becomes significant with the seasonal and annual balancing periods. A seasonal balancing period could allow Canada to build a surplus (or credit) during the spring freshet (runoff) period when it is not able to utilize its full Milk River entitlement, and then divert these credited flows later in the season. An annual balancing period could allow Canada to build a larger surplus (or credit) by accommodating both spring and winter flows. However, Canada would not have the ability to use all of its credited surpluses if it could only draw from an accounting of the natural flow of the Milk River, which is often low to zero during portions of the irrigation season.

The 7-day, 15/16 day, and monthly options all allow Canada to use similar amounts of water. The reason is that there is relatively low natural flow in the Milk River by later June or early July, the Milk River natural flow frequently is very low or non-existent. The model results indicate that there is no Milk River natural flow in Alberta for an average of 16 days per year, ranging from a maximum of 67 days per year during severe drought (such as in 2001) to 0 days during wet years (such as 1993 and 1995). During these periods, Canada would have little access to the water in the Milk River, even though there may be substantial flow in the river channel due to U. S. diversions through the U. S. St. Mary Canal.

Table 7 provides a summary of the modeled gain or loss that each country (Canada on the Milk River and the U. S. on the St. Mary River) might expect to receive under four different length balancing periods in comparison to what they are modeled to receive under the current (15/16 day) balancing period (these data are compiled from Tables 5 & 6).

Table 7. Modeled Gains or Losses (by the U. S. on the St. Mary River and by Canada on the Milk River) in Acre-feet and Percentage Under Various Balancing Periods Compared to the Modeled 15/16-day Balancing Period (current scenario)

Balancing Period	**Average Year**		**5 Wettest Years**		**5 Driest Years**	
	Milk River	**St. Mary River**	**Milk River**	**St. Mary River**	**Milk River**	**St. Mary River**
7-day balancing	-300 -6.4 %	-1,000 -0.5 %	-500 -8.5 %	-1,000 -0.4 %	-200 -7.4 %	-500 -0.3 %
Monthly balancing	400 8.5 %	2,000 1.0 %	400 6.8 %	2,000 0.8 %	400 14.8 %	1,000 0.7 %
Seasonal balancing	2,600 55.3 %	9,500 4.7 %	2,200 37.3 %	15,000 6.3 %	2,300 85.2 %	2,000 1.3 %
Annual balancing	2,900 61.7 %	25,000 12.4 %	2,200 37.3 %	25,000 10.4 %	3,100 114.8 %	16,000 10.7 %

For example, the average year Milk River gain or loss for Canada under a 7-day balancing period is calculated to be 4,400 - 4,700 = -300. In other words, the model results indicate that Canada might expect to receive 300 acre-feet less Milk River water under a 7-day balancing period than they receive under the current 15/16 day balancing period. On a percentage basis, this is a 6.4% reduction (-300 / 4,700 = -6.4%). Likewise, the average year St. Mary River gain or loss for the U. S. under a 7-day balancing period is calculated to be 201,000 - 202,000 = -1,000. On a percentage basis, this is a 0.5% reduction (-1,000 / 202,000 = -0.5%). Under an annual balancing period, Canada would receive an average increase of about 62% (from the Milk River) and the U. S. would receive an average increase of about 12% (from the St. Mary River). This would reach about 115% during dry years for Canada (from the Milk River) and about 11% for the U. S. (from the St. Mary River).

<u>CONCLUSION</u>: The modeling analysis indicates that changes in the surplus/deficit accounting procedures, and lengthening the balancing period, provides the U. S. with an opportunity to divert a larger portion of its St. Mary River entitlement. Likewise, the

analysis indicates that changes in the surplus/deficit accounting procedures, and lengthening the balancing period, provides Canada with an opportunity to divert a larger portion of its Milk River entitlement. The model results provide a reasonable indication of potential gains under various scenarios, but the distribution and timing of receipts under the modeled balancing periods has not been fully considered and evaluated. Additional work is recommended to verify the models so that additional scenarios can be evaluated before more definitive results can be considered.

Instream Flow Requirements

The Task Force recognizes that each country is entitled to a share of the water of the St. Mary River, Milk River and Eastern Tributaries as established by the Boundary Waters Treaty and the 1921 Order, and each country must meet its management requirements out of that share. This includes maintaining a "live" stream, whether for aquatic life, esthetic or other purposes. Minimum flow considerations, or "instream flow needs", may come into play when the parties consider allowing an upstream country to take more than its share (by drawing on accumulated surpluses) during certain periods of time.

There exist two major concerns relative to instream flow requirements. The first involves how minimum instream flow requirements for environmental considerations might impact the ability of a given jurisdiction to realize its entitlement. For instance, it is conceivable that the U. S. may establish a minimum instream flow requirement for Swiftcurrent Creek below Sherburne Dam to address fishery needs. To help assess the potential impacts associated with such a requirement, the Task Force included one option in its modeling efforts with a continuous, minimum instream flow release of 25 cfs from Sherburne Dam into Swiftcurrent Creek. This value (25 cfs) was chosen because it is believed to be representative of an upper limit of what might ultimately be required.

The second issue deals with a minimum instream flow requirement for the St. Mary River and the Milk River at the respective international boundary crossings. One interpretation of the 1921 Order concludes that such a minimum flow is the downstream country's entitlement at any given point in time. However, if a consideration of various surplus and/or deficit scenarios is to be made, then a reduction in the minimum flow prescribed by the 1921 Order must be evaluated. For modeling purposes, Montana offered that the minimum instream flow at the international boundary should be the lesser of:

1. the downstream entitlement;
2. 50% the average annual flow; or
3. 50% the average monthly flow.

The latter two values are based, in part, on the Wetted Perimeter Inflection Point method used by Montana (see Appendix J). This method recognizes that: 1) aquatic organisms make up the majority of food for gamefish; 2) the food supply for fish is the major factor in determining the number and weight of fish a stream can support; and 3) most aquatic organisms are produced in riffles. Riffles are also used by many fish for spawning and rearing of their young. The wetted perimeter method estimates the flow needed to cover these important riffle areas. The wetted perimeter method was used to establish instream flows in 1990 for the Missouri River and its tributaries upstream of Fort Peck Reservoir and in 1978 for the entire Yellowstone River and tributaries in Montana.

While this approach was used as the assumed instream flow for the St. Mary River at the international boundary for modeling purposes, there was no agreement as to whether this (or some other value) may ultimately form the basis of instream flow agreement. Alberta has a specific process for determining instream flows that requires significant fieldwork.

CONCLUSION: Since the amount of additional water that can be diverted under alternative surplus/deficit accounting procedures and balancing periods is dependent on instream flow requirements, additional work is needed on this subject if progress is to be made in helping both countries optimize the receipt of their respective entitlements.

Unusable Flows (Spills)

Water retention structures have historically been constructed for a variety of purposes including flood control, water supply, hydropower generation, fish & wildlife benefits, recreation, etc. Major retention structures are typically designed with some type of spillway to protect the structure during large runoff events when the incoming flows exceed the capacity of the structure to store and/or make releases through outlet works which are integral to the structure. In simple terms, major water retention structures have a design capacity to release a specific flow, either through controlled means, through uncontrolled means (spillway discharges), or some combination of the two.

For the purpose of these discussions, the term "unusable flows" applies to any flows (including spillway flows and releases from outlets works) which do not meet a recognized beneficial use. This concept becomes important during consideration of allowing upstream "credits" for surplus deliveries to a downstream jurisdiction. It is generally agreed that any potential allowance of such a credit should be limited to the portion of such surplus delivery that was able to be beneficially used by the downstream jurisdiction. Conversely, credit should not be allowed for any portion of such surplus delivery that was determined to be "unusable". In other words, the concept of allowing upstream credits for surplus flows is predicated upon the downstream jurisdiction being able to realize beneficial use of the surplus. Also, some consideration to valuing the beneficial use should be made. For example, a volume of water for irrigation may have a higher value in a dry year than the electricity that can be generated by that same volume, or by the instream flow benefits provided by passing the water downstream.

The following hypothetical scenarios are included to help illustrate the concept. If the U. S. were to surplus 50,000 acre-feet (61 700 dam^3) to Canada on the St. Mary River, but 40,000 acre-feet (49 300 dam^3) of that water was determined to be "unusable" by Canada, then it might be concluded that only 10,000 acre-feet (12 300 dam^3) should be credited to the U. S. In a similar manner, if Canada were to surplus 10,000 acre-feet (12 350 dam^3) to the U. S. on the Milk River, and the U. S. did not have to increase releases or spill at Fresno Dam as a result (i.e. none of the surplus was designated “unusable”), then it might be concluded that all of the 10,000 acre-feet (12 350 dam^3) should be credited to Canada.

The intent of these considerations is not to afford one jurisdiction unfair advantage over the other, but rather to better define a set of conditions which could allow both jurisdictions to mutually benefit. In essence, the ability of one downstream jurisdiction to utilize a surplus delivery in one location (Canada on the St. Mary River) is being balanced against the ability of the other downstream jurisdiction to utilize a surplus delivery in another location (the U. S. on the Milk River), and vice versa. Obviously, in a more perfect situation where both jurisdictions had sufficient infrastructure in-place to accommodate *any* hydrological condition, there would be no need for these discussions.

CONCLUSION: Unusable flow criteria need to be considered in any determination of allowing credit for surplus deliveries and should be flexible enough to recognize certain conditions when water that is spilling at a given facility is still available for beneficial use further downstream. As an example, water “spilled” at Fresno Dam in the U. S. may or may not be available to meet downstream irrigation demands, and may or may not be diverted to offstream storage at Nelson Reservoir for future irrigation use. These types of considerations need to be factored into any determination of the credit afforded by surplus flows.

LETTERS OF INTENT

Under the existing Administrative Procedures, a Letter of Intent is an option that has been used since 1991 within the St. Mary-Milk Basin. The terms of a Letter of Intent are negotiated between willing parties and the result is a voluntary, administrative measure that is intended to help both countries achieve more beneficial use of their respective entitlements. The existing (or a modified) Letter of Intent remains a viable option for present and future application within the St. Mary-Milk River Basin.

OTHER POTENTIAL OPTIONS

During its deliberations, some Task Force members identified several potential approaches related to optimizing the beneficial use by each country of its apportioned share of the waters within the St. Mary-Milk River Basin. Members concluded that, while these concepts are outside the specific Task Force Directive (they go beyond addressing measures for improving the existing administrative procedures), there may be merit in future discussions at the IJC level, and possibly elsewhere, about these conceptual opportunities. In addition, it should be recognized that Task Force members did not have the in-depth knowledge of these potential instruments to undertake more than a cursory review of the concepts which are presented in this section. Accordingly, the IJC may wish to pursue these ideas further to better assess their applicability to the St. Mary-Milk Basin.

Water Banking and Tradable Permits (Marketing)

In the U. S., the term 'water banking' has been applied to two quite different water management strategies: groundwater storage banks; and, voluntary water transfer banks. A related economic instrument is known as a "tradable permit".

For example, the Arizona Water Banking Authority was created in 1996 as a key element in securing the state's water resources for current and future generations living within the Lower Colorado Basin. The Arizona Legislature prohibited interstate water banking until it was satisfied that the state's interests were sufficiently safeguarded. In 1999, the U. S. announced a federal rule governing interstate water banking specifically between Arizona, Nevada, and California.

Under the concept of interstate water banking, a state can pay another state to store excess water when it becomes available. In the case of the Colorado River, water is carried from the Colorado River to central and southern Arizona by the Central Arizona Project canal system. It would then be recharged into aquifers and recovered at a time when water is needed to relieve drought conditions or to meet growing demands. In this example, Nevada would pay Arizona to store excess Colorado River water. Nevada water users would then redeem these credits from surface water supplies (such as Lake Mead) and Arizona would recover and utilize water that Nevada had put into storage in Arizona's aquifers. More details about this aspect of water banking can be found on various web sites such as:

http://www.waterbank.com/Newsletters/nws35.html

or

http://www.awba.state.az.us/annc/interstate_water.pdf.

Another application of water banking is voluntary water transfers through water marketing. This mechanism is utilized to facilitate short-term transfers of water from willing sellers to willing buyers. Often referred to as "water transfer banks", this concept involves the trading of water to temporary users. The primary role of the water bank is to manage a water supply from various available sources and water demand with respect to existing water rights entitlements and priorities. In order for a viable water market to exist, several conditions must prevail, such as: water rights holders who are willing to forego use of their entitlement for a limited period; users who are willing to rent water; adequate water storage capacity; and, a system for monitoring delivery.

Administration may be through a cooperative of local institutions and user groups. Water banks in Idaho, for example, are administered through a combination of state rules, statutory provisions, and local procedures. Water is leased through a statewide bank, local rental pools, and the Shoshone-Bannock Tribal Water Supply. Similarly, there have been discussions within the Blackfeet Nation that water marketing and/or leasing opportunities may exist relative to their water rights of both the St. Mary and Milk rivers.

As another example, water users and managers in the Yakima River Basin in Washington State have worked together over the years to develop effective ways to facilitate the voluntary transfer of water through water depositories such as the Yakima Basin Project and the Washington Trust Water Rights Program. In spite of this significant progress, there is no existing institution in the state which can provide many of the services which would facilitate banking and the exchange of water and water rights within the basin. A Yakima Water Exchange program has been proposed to address this concern.

In the case of agricultural producers, water banks might offer temporary one-year or two-year leases. Water rights holders would then modify their pattern of land use during this period (such as by substituting less water intensive crops or grazing livestock on previously irrigated fields).

While Montana currently lacks the statutory framework for developing and implementing water markets, the same does not hold true in Alberta. The existing water policy regime within the St. Mary-Milk River Basin in Alberta includes a number of flexible mechanisms such as transfers, assignments, and a variety of tools that promote water rights moving to higher value uses, as well as conservation and reassignment of conserved water. Under Alberta's 1999 Water Act, transfers can now be made on either a permanent or a temporary basis. Under a temporary transfer, the transferred allocation of water reverts back to the original licensee after a specified time period. Upon transfer of a license, the new Act also provides the ability for the Government to withhold up to 10 percent of the water that is being transferred. The water that is withheld will generally remain in the water body to meet the needs of the aquatic environment and is not available for reallocation for other uses. The holdback of water is applicable to both permanent and temporary transfers of allocations.

Joint Operations

Several Task Force members have recognized that, in some cases, the international boundary appears to act as an artificial barrier and impediment to efficient water administration. Some have theorized that water management might likely have evolved differently had the entire basin been within one jurisdiction and they go on to suggest that there exists an opportunity for the existing jurisdictions to develop an innovative, collaborative approach to management of the entire St. Mary-Milk River Basin.

In 1997, the IJC proposed the creation of ecosystem-based international watershed boards in transboundary river watersheds which would "monitor, study, and report to the IJC on a full range of transboundary environmental and water-related issues and... improve dialogue and information sharing to resolve issues".[2] This initiative proposes to develop the capabilities of existing IJC Boards in three transboundary watersheds: the St. Croix River, Red River, and Rainy River.

The Task Force recognizes that, unlike some other international watersheds, no formal IJC Board currently exists for the St. Mary-Milk Rivers. However, the IJC's International

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[2] A Discussion Paper on the International Watersheds Initiative, Second Report to the Governments of Canada and the United States, IJC, June 2005.

Watersheds Initiative may provide a future opportunity to promote the collective growth of watershed capabilities within the St. Mary-Milk Rivers watershed.

The above concept has strong linkages to another related approach to water management which is currently receiving considerable attention from both the federal and provincial/state levels of government. Integrated Water Resource Management (IWRM) is a technique that fosters environmental management through a collaborative, problem-focused, and adaptive framework.

Infrastructure Improvements / Enhancements

St. Mary Storage and Conveyance Facilities

The St. Mary storage, diversion, and conveyance facilities in the U. S. are reaching the end of their design life and are in need of rehabilitation. These facilities, located on the Blackfeet Reservation in Glacier County, Montana, consist of: Sherburne Dam, the St. Mary Diversion Dam and U. S. St. Mary Canal headworks; approximately 29 miles of canal; two sets of steel siphons; and, 5 concrete drop structures.

This system, which brings water from the St. Mary River Basin to the Milk River Basin, has been in operation for over 85 years. The capacity of the system has decreased over time from a design capacity of 850 cfs to approximately 670 cfs. Should rehabilitation become a reality, it would be prudent to construct the system to a capacity that would optimize the ability of the U. S. to divert its full entitlement of St. Mary River water.

In addition, it should be recognized that additional diversion and conveyance capacity in the system potentially increases operational flexibility and hence provides an opportunity to increase the ability of both countries to access and utilize their respective entitlements. Environmental impacts, as well as administrative and operational considerations associated with increased diversion and conveyance capacity, would necessarily have to be addressed.

Milk River Storage Project in Alberta

Alberta has been considering construction of a dam and storage reservoir on the Milk River for a number of years. Such a facility may potentially improve operational flexibility and provide an opportunity to increase the ability of both countries to access and utilize their respective entitlements. Additional storage would have to account for increases in system evaporation losses, allow for routing of U. S. entitlements, accommodate any instream flow requirements, and other administrative and operational considerations.

TRANSBOUNDARY TRIBUTARIES

Several small drainage basins cross the international boundary. The most significant drainages are listed in Table 8. While these streams currently are not apportioned under the 1921 Order, the Task Force concluded that the respective water monitoring agencies should estimate all flows and uses which impact natural flow determination. This approach should be consistent for all ungauged tributaries in the basin.

Table 8. Rivers, Creeks and Coulees Crossing the International Boundary (from west to east)

Flows from	Flows to	River, Creek or Coulee
Montana	Alberta	Lee Creek
		Boundary Creek
		St. Mary River
		Rolph Creek
		North Fork Milk River
		South Fork Milk River
		Red Creek
		Police Creek
		Deer Creek
		Macdonald Creek
		Miners Coulee
		Breed Creek
		Bear Creek
		Philp Coulee
Alberta	Montana	Milk River
		Lost River
		Sage Creek
		Cutbank Creek
Saskatchewan	Montana	Lodge Creek
		Woodpile Coulee
		Battle Creek
		Lyons Creek
		Coteau Creek
		Cottonwood Coulee
		N. Fork Whitewater Creek
		S. Fork Whitewater Creek
		Crow Creek
		Frenchman River
		Bluff Creek
		McEachern Creek
		Horse Creek
		Rock Creek

HKM Engineering Inc. completed an assessment of natural flow from the U. S. portion of the drainage basins of two tributaries of the St. Mary River (Lee Creek and Rolph Creek). The results, plus subsequent work by HKM based on review comments to its April 2005 Draft Report, are included as Appendix K.

SOUTHERN TRIBUTARIES

A consideration of flows from the Sweetgrass Hills in Montana northward through Alberta to the Milk River arose as the Task Force attempted to understand the basin-wide impact of water use in the Southern Tributaries. The issue of apportioning individual streams that cross the international boundary within the Milk River Basin is not clear. The Field Representatives explained that the entitlement of water in the Milk River Basin is determined at the eastern crossing, not at each border crossing of the Southern Tributaries. Consequently, Alberta water users between the international boundary and the Milk River at Eastern Crossing find at times they are entirely without flow in the streams (due in part to water use upstream in Montana). A similar situation has been reported on Red Creek and the south fork of the Milk River.

Montana maintains that their ability to describe the existing water rights in the area is impaired by the lack of a final adjudication of water rights in these basins. This information is necessary to calculate Montana's potential use of water upstream of the Eastern Crossing flow monitoring station. Previous reports identified this potential as 9,497 acres claimed for irrigation in Montana's adjudication process. These numbers are being evaluated as a part of that process and more than likely will be decreased based on determination of actual water use. According to a joint USGS and Environment Canada report published in 1980, Montana currently irrigates closer to 2,250 acres. However, because of the unreliability of existing water supplies on these tributaries, the number of acres actually irrigated is considerably less during drought years. The record of the maximum potential water use in Montana's portion of the basin will likely remain unclear until the water rights are adjudicated. This situation adds uncertainty to evaluating the impact of water use in Montana's portion of the Southern Tributaries on Alberta water users, and on calculating the Milk River natural flows at the Eastern Crossing.

History

In 1986, Canada raised concerns about the Southern Tributaries of the Milk River that flow into Alberta from the Sweetgrass Hills. These tributaries, which experience some level of diversion in the U. S., are not directly included in the determination or division of the natural flow of the Milk River at the present time.

The IJC established an *ad hoc* task force in 1987 to investigate stream flow utilization in the Southern Tributaries of the Milk River and to recommend solutions to existing problems. These international streams included Bear Creek, Breed Creek, and, Miners Coulee, all which originate in the Sweet Grass Hills of Montana. In its Terms of Reference, the IJC asked that a number of tasks be completed which are summarized below:

- Conduct field investigations to develop procedures for calculating the natural flow of the Southern Tributaries at the international boundary,

- Develop a basin management plan for each stream that recognizes the volume of water delivered to Canada in low, average, and high flow years,

- Investigate storage sites in Canada,

- Hold public consultation meetings in each country, and

- Report to the Accredited Officers.

The *ad hoc* Task Force met with water users in both the U. S. and Canada, representing the governments of the United Sates and Canada through their Accredited Officers and the Province of Alberta and the State of Montana, and conducted public meetings, toured water-use projects, compiled information on water availability and use, and investigated groundwater supplies.

In September 1991, the Montana Department of Natural Resources and Conservation (DNRC) closed the Southern Tributaries to the issuance of additional water permits. No direct diversion has since been allowed for new irrigation or any other consumptive use from January 1 through December 31 inclusive of each year without an integrated on-source storage facility. Domestic and stock watering uses of up to 3 acre-feet (3.7 dam^3) per year are exempted from the closure.

In 1993, the Southern Tributaries *ad hoc* task force issued its report entitled *Southern Tributaries of the Milk River: Evaluation of Water Management Opportunities,* in which the *ad hoc* task force: described available surface and ground water supplies; described existing uses and demands within the three basins; and, evaluated a number of management options. Based on the analyses and discussions with local water users on both sides of the border, the *ad hoc* task force reached the following conclusions:

- In the extensively developed U. S. portion of the basin, more efficient and complete use of water, coupled with drought, has reduced the amount of irrigation return flow available to Canadian ranchers for watering stock or for irrigation.

- Lacking reliable water sources and feasible storage sites, it is not economical for Canadian or U. S. ranchers to develop additional irrigation delivery systems.

- In response to the unreliable water supply, Canadian ranchers have developed groundwater resources and dugouts to meet stockwatering requirements; ground water resources are either insufficient or of too poor quality for irrigation purposes.

- U. S. ranchers, faced with a highly variable, limited water supply and investments in irrigated agriculture, feel threatened and are reluctant to discuss equitable apportionment. They perceive that any changes in water administration will weaken their claim to water in the Montana water right adjudication process.

- Formal apportionment is not a viable option due to the logistics and cost of measuring small, but highly variable runoff, and numerous diversions; measurements and administration would cost more than the value of the water.

The *ad hoc* task force report also included a number of recommendations which are cited below along with their current status:

1. Use the IJC's influence to expedite adjudication of water rights in the Montana portion and the Basin.

   Status: In 1985, The Montana Legislature directed the chief water judge to make issuing a temporary preliminary decree in the Milk River basin the state's highest priority in the adjudication process. The Montana Department of Natural Resources and Conservation has examined all of the water right claims in Basin 40f (which includes the Southern Tributaries of the Milk River). The Montana Water Court, however, has not moved to create a temporary preliminary decree in these sub-basins, primarily because much of the Milk River basin lies within the Blackfeet Reservation and the Court is waiting for a compact that settles the reserved water rights of the Blackfeet Tribes.

2. Obtain agreement by Montana to notify the Governments of Canada and Alberta when adjudication hearings are to commence and provide Canadians the opportunity to seek representation in the adjudication process under the jurisdiction of the Montana Water Court.

   Status: Since the Water Court has not yet initiated any adjudication hearings in Basin 40f, there have been no opportunities for Canada to participate in the Montana adjudication process. The mechanism for Alberta to participate in the Montana adjudication process is identified under Montana water law (Section 85-2-232 (1) (f) (iii &iv)). The law informs water users how they can receive a notice from the Montana Water Court when the Court begins the adjudication process in these sub basins. Alberta may have the right to object to a Montana water right claim. However, the Montana Water Court has yet to determine how and whether an out-of-state/country individual will have standing to object.

3. Encourage the State of Montana to recognize the requirements of Canadian water users in the Montana adjudication program.

   Status: As noted above, Alberta may have the right to participate in the Montana adjudication process. However, the Montana Water Court has not yet determined whether Alberta water users will have standing based on their downstream water licenses.

4. The Southern Tributaries *ad hoc* task force should be terminated.

   Status: The *ad hoc* task force was terminated in 1994.

In September 1994, the IJC asked the Accredited Officers to continue to monitor the situation in the basin. Many of the issues described in the *ad hoc* task force report remain unchanged, and concerns continue to be expressed by Alberta residents about the lack of flow across the international boundary during dry years. In contrast, in the 1970s the IJC closely examined the Sage Creek Basin (Sage Creek flows from Alberta to Montana) and determined that the flows should be apportioned equally. Montana has raised concern that flows in Sage Creek rarely cross the international boundary in most years.

EASTERN TRIBUTARIES

The tributaries of the Milk River which flow from the Cypress Hills in Alberta and Saskatchewan (including Lodge Creek, Battle Creek, and the Frenchman River) are collectively known as the Eastern Tributaries. The 1921 Order apportions these streams equally between Canada and the U. S. The natural flows of these tributaries are often minimal after the spring freshet (runoff). Irrigation in Canada has been sufficient since 1940 for the Frenchman River and Battle Creek to be formally apportioned and reported, while apportionment and reporting for Lodge Creek started in 1950.

The letter from the Governor of Montana to the IJC focused exclusively on issues related to the application of the 1921 Order to the sharing of water between Alberta and Montana on the St. Mary and Milk Rivers. The Eastern Tributaries have provisions separate and apart from those related to the sharing of the St. Mary and Milk rivers.

The apportionment calls for a 50-50 split of the natural flow of the Eastern Tributaries. Over the past approximately 55 years, Saskatchewan has diverted (or had available for use) on average about 27 percent of the total annual natural flow of the Eastern Tributaries. At the same time, the U. S. has received (or had available for use) about 73 percent of the total annual natural flow. This has generally occurred because during the balance periods of 10 to 15 days, any surplus deliveries by Saskatchewan when flows cannot be captured for storage or use, are not credited to Canada's obligation to deliver at least 50 percent of the natural flow (i.e. Canada does not receive credit for surplus flows it passes to Montana).

During the public consultations by the IJC, Saskatchewan indicated that it was generally satisfied with the current arrangements for the Eastern Tributaries. Montana also generally supported the current method of apportionment on the Eastern Tributaries, but expressed a desire for the methodology to be reviewed after the administrative procedures have been addressed for the St. Mary River and the Milk River. This support is based in part on recent work done by a Technical Working Group established by the Accredited Officers for Canada and the U. S. That working group identified a number of potential measures (within the framework of the administrative measures under the 1921 Order) by which more equitable sharing could be achieved on the Eastern Tributaries by each country. In addition, Montana has expressed interest in an assessment of: water supplies; irrigated acreage; and irrigation efficiencies in both countries; and, water quality at the international boundary, for each of the tributaries.

Accordingly, the Task Force agreed in the interest of the limited time lines, to focus its efforts on the St. Mary and Milk Rivers. The Task Force agreed that any general principles established in the conduct of its work related to the St. Mary and Milk Rivers should be provided to the Technical Working Group for the Eastern Tributaries for consideration before they finalize any recommendations to the Accredited Officers.

APPENDICES

APPENDIX A. 1909 BOUNDARY WATERS TREATY – Article VI

The High Contracting Parties agree that the St. Mary and Milk Rivers and their tributaries (in the State of Montana and the Provinces of Alberta and Saskatchewan) are to be treated as one stream for the purposes of irrigation and power, and the waters thereof shall be apportioned equally between the two countries, but in making such equal apportionment more than half may be taken from one river and less than half from the other by either country so as to afford a more beneficial use to each. It is further agreed that in the division of such waters during the irrigation season, between the 1st of April and 31st of October, inclusive, annually, the United States is entitled to a prior appropriation of 500 cubic feet per second of the waters of the Milk River, or so much of such amount as constitutes three-fourths of its natural flow, and that Canada is entitled to a prior appropriation of 500 cubic feet per second of the flow of St. Mary River, or so much of such amount as constitutes three-fourths of its natural flow.

The channel of the Milk River in Canada may be used at the convenience of the United States for the conveyance, while passing through Canadian territory, of waters diverted from the St. Mary River. The provisions of Article II of this treaty shall apply to any injury resulting to property in Canada from the conveyance of such waters through the Milk River.

The measurement and apportionment of the water to be used by each country shall from time to time be made jointly by the properly constituted reclamation officers of the United States and the properly constituted irrigation officers of His Majesty under the direction of the International Joint Commission.

APPENDIX B. 1921 ORDER OF THE IJC

INTERNATIONAL JOINT COMMISSION

IN THE MATTER OF THE MEASUREMENT AND

APPORTIONMENT OF THE WATERS OF THE

ST. MARY AND MILK RIVERS AND THEIR TRIBUTARIES IN THE UNITED STATES

AND CANADA

UNDER ARTICLE VI OF THE TREATY OF JANUARY 11, 1909

BETWEEN THE UNITED STATES AND

GREAT BRITAIN

ORDER

OTTAWA, OCTOBER 4, 1921

RECOMMENDATIONS

OTTAWA, OCTOBER 6, 1921

WASHINGTON

GOVERNMENT PRINTING OFFICE

1923

INTERNATIONAL JOINT COMMISSION.

CANADA.

Charles A. Magrath, Chairman.

Henry A. Powell, K.C.

Sir William H. Hearst, K.C.M.G.

Lawrence J. Burpee, Secretary.

UNITED STATES.

Obadiah Gardner, Chairman

Clarence D. Clark.

Marcus A. Smith.

William H. Smith, Secretary.

INTERNATIONAL JOINT COMMISSION.

ORDER.

IN THE MATTER OF THE MEASUREMENT AND APPORTIONMENT OF THE WATERS OF THE ST. MARY AND MILK RIVERS AND THEIR TRIBUTARIES IN THE STATE OF MONTANA AND THE PROVINCES OF ALBERTA AND SASKATCHEWAN.

Whereas by Article VI of the Treaty entered into between the United States of America and His Majesty, the King of the United Kingdom of Great Britain and Ireland and of the British Dominions beyond the Seas, Emperor of India, signed at Washington on the 11th of January, 1909, it is provided as follows:

The High Contracting Parties agree that the St. Mary and Milk Rivers and their tributaries (in the State of Montana and the Provinces of Alberta and Saskatchewan) are to be treated as one stream for the purposes of irrigation and power, and the waters thereof shall be apportioned equally between the two countries, but in making such equal apportionment more than half may be taken from one river and less than half from the other by either country so as to afford a more beneficial use to each. It is further agreed that in the division of such waters during the irrigation season, between the 1st of April and 31st of October, inclusive, annually, the United States is entitled to a prior appropriation of 500 cubic feet per second of the waters of the Milk River, or so much of such amount as constitutes three-fourths of its natural flow, and that Canada is entitled to a prior appropriation of 500 cubic feet per second of the flow of St. Mary River, or so much of such amount as constitutes three-fourths of its natural flow.

The channel of the Milk River in Canada may be used at the convenience of the United States for the conveyance, while passing through Canadian territory, of waters diverted from the St. Mary River. The provisions of Article 11 of this treaty shall apply to any injury resulting to property in Canada from the conveyance of such waters through the Milk River.

The measurement and apportionment of the water to be used by each country shall from time to time be made jointly by the properly constituted reclamation officers of the United States and the properly constituted irrigation officers of His Majesty under the direction of the International Joint Commission.

And whereas the said Reclamation and Irrigation Officers have been unable to agree as to the manner in which the waters mentioned in the said Article VI should be measured and apportioned;

And whereas, before giving directions as to the measurement and apportionment of the said waters, the International Joint Commission deemed it proper to hear such representations and suggestions thereon as the Governments of the United States and Canada, the Provinces of Alberta and Saskatchewan, and the State of Montana, and as corporations and persons interested might see fit to make, and for such purposes sittings of the Commission were held at the following times and places: At the city of St. Paul, in the State of Minnesota, on the 24th, 25th, 26th, 27th, and 28th days of May, 1915; at the city of Detroit, in the State of Michigan, on the 15th, 16th, and 17th days of May, 1917; at the city of Ottawa, in the Province of Ontario, on the 3d, 4th, and 5th days of May, 1920; at the village of Chinook, in the State of Montana, on the 15th day of September, 1921; and at the city of Lethbridge, in the Province of Alberta, on the 17th day of September, 1921, when counsel and representatives of the said Governments, corporations, and persons appeared and presented their views;

And whereas, pending final decision as to the proper method of measuring and apportioning said waters, interim orders with reference thereto have been made by the International Joint Commission from time to time, the last of such orders bearing the date of 6th day of April; 1921;

And whereas the members of the International Joint Commission have unanimously determined that the said Reclamation and Irrigation Officers should be guided in the measurement and apportionment of said waters by the directions and instructions hereinafter set forth:

IT IS THEREFORE ORDERED AND DIRECTED by the Commission in its pursuance of the powers conferred by the said Article VI of the said Treaty that the Reclamation and Irrigation Officers of the United States and Canada shall, until this order is varied, modified, or withdrawn by the Commission, make jointly the measurement and apportionment of the water to be used by the United States and Canada in accordance with the following rules:

St. Mary River.

1. (a) During the irrigation season when the natural flow of the St. Mary River at the point where it crosses the international boundary is six hundred and sixty-six (666) cubic feet per second or less Canada shall be entitled to three-fourths and the United States to one-fourth of such flow.

(b) During the irrigation season when the natural flow of the St. Mary River at the point where it crosses the international boundary is more than six hundred and sixty-six (666) cubic feet per second Canada shall be entitled to a prior appropriation of five hundred (500) cubic feet per second, and the excess over six hundred and sixty-six (666) cubic feet per second shall be divided equally between the two countries.

(c) During the nonirrigation season the natural flow of the St. Mary River at the point where it crosses the international boundary shall be divided equally between the two countries.

Milk River.

II. (a) During the irrigation season when the natural flow of the Milk River at the point where it crosses the international boundary for the last time (commonly and hereafter called the Eastern Crossing) is six hundred and sixty-six (666) cubic feet per second or less, the United States shall be entitled to three-fourths and Canada to one-fourth of such natural flow.

(b) During the irrigation season when the natural flow of the Milk River at the Eastern Crossing is more than six hundred and sixty-six (666) cubic feet per second the United States shall be entitled to a prior appropriation of five hundred (500) cubic feet per second and the excess over six hundred and sixty-six (666) cubic feet per second shall be divided equally between the two countries.

(c) During the nonirrigation season the natural flow of the Milk River at the Eastern Crossing shall be divided equally between the two countries.

Eastern Tributaries of Milk River.

III. The natural flow of the eastern (otherwise known as the Saskatchewan or northern) tributaries of the Milk River at the points where they cross the international boundary shall be divided equally between the two countries.

Waters not naturally crossing the boundary.

IV. Each country shall be apportioned such waters of the said rivers and of any tributaries thereof as rise in that country but do not naturally flow across the international boundary.

V. For the purpose of carrying out the apportionment directed in Paragraphs I, II, and III hereof the said Reclamation and Irrigation Officers shall jointly take steps:

(a) To ascertain and keep a daily record of the natural flow of the St. Mary River at the international boundary, of the Milk River at the Eastern Crossing, and of the eastern tributaries of the Milk River at the international boundary by measurement in each case:

(1) At the gauging station at the international boundary;

(2) At all places where any of the waters which would naturally flow across the international boundary at that particular point are diverted in either country prior to such crossing;

(3) At all places where any of the waters which would naturally flow across the international boundary at that particular point are stored, or the natural flow thereof increased or decreased prior to such crossing;

(b) To fix the amount of water to which each country is entitled in each case by applying the directions contained in paragraphs 1, 2, and 3 hereof to the total amount of the natural flow so ascertained in each case.

(c) To communicate the amount so fixed to all parties interested, so that the apportionment of the said waters may be fully carried out by both countries in accordance with the said directions.

VI. Each country may receive its share of the said waters as so fixed at such point or points as it may desire. A gauging station shall be established and maintained by the Reclamation or Irrigation Officers of the country in which any diversion, storage, increase, or decrease of the natural flow shall be made at every point where such diversion, storage, increase, or decrease takes place.

VII. International gauging stations shall be maintained at the following points:

St. Mary River near international boundary; the north branch of Milk River near international boundary; the south branch of Milk River near international boundary; Milk River at Eastern Crossing;: Lodge Creek, Battle Creek, and Frenchman River, near international boundary; and gauging stations shall be established and maintained at such other points as the Commission may from time to time approve.

VIII. The said Reclamation and Irrigation Officers are hereby further authorized and directed:

(a) To make such additional measurements and to take such further and other steps as may be necessary or advisable in order to insure the apportionment of the said waters in accordance with the directions herein set forth.

(b) To operate the irrigation works of either country in such a manner as to facilitate the use by the other country of its share of the said waters and subject hereto to secure to the two countries the greatest beneficial use thereof.

(c) To report to the Commission the measurements made at all international and other gauging stations established pursuant to this order.

IX. In the event of any disagreement in respect to any matter or thing to be done under this order the said Reclamation and Irrigation Officers shall report to the Commission, setting forth fully the points of difference and the facts relating thereto.

X. The said order of the Commission, dated the 6th day of April 1921, is hereby withdrawn, except with respect to the report to be furnished to the Commission thereunder.

Dated at Ottawa, Canada, this 4th day of October, 1921.

O. GARDNER,

C. A. MAGRATH,

C. D. CLARK, HENRY

A. POWELL,

W. H. HEARST,

MARK A. SMITH.

INTERNATIONAL JOINT COMMISSION.

RECOMMENDATIONS.

IN THE MATTER OF THE MEASUREMENT AND APPORTIONMENT OF THE WATERS OF THE ST. MARY AND MILK RIVERS AND THEIR TRIBUTARIES IN THE STATE OF MONTANA AND THE PROVINCES OF ALBERTA AND SASKATCHEWAN, UNDER THE TERMS OF ARTICLE VI OF THE TREATY OF JANUARY 11, 1909.

The Commission finds, as the result of a very thorough investigation of the possibilities of irrigation development in those portions of the State of Montana and the Provinces of Alberta and Saskatchewan capable of irrigation by the waters of the St. Mary and Milk Rivers and their tributaries, that the quantities of land in this international region susceptible of development far exceed the capacity of the rivers in question even under the most exhaustive system of conservation. It is therefore of the utmost importance, not only because of the practical benefits to accrue to the people of this western country, but still more because the St. Mary and Milk Rivers problem is one that might easily become a source of serious irritation and misunderstanding to the people of the two countries, that every effort should be made to obtain the maximum efficiency in irrigation from these waters.

In the first Annual Report of the United States Reclamation Service, 1902, a project was outlined for the storage of 250,000 acre-feet of water by means of a dam across the outlet of the St. Mary Lakes.

And, further, the United States Reclamation Service has already constructed a reservoir at Sherbourne Lake, and the Commission is informed that said Service has in contemplation the construction of what is known as the Chain-of-Lakes Reservoir in the valley of the Milk River after that stream leaves Canada; and that the Reclamation Service of Canada has in contemplation the construction of what is called the Verdigris Coulee Reservoir on the northern side of the Milk River.

The Commission is strongly of the opinion that the construction of said St. Mary Lakes, Chain-of-Lakes, and Verdigris Coulee reservoirs, and the operation of all reservoirs under its direction will make it possible to conserve practically the entire winter flow and flood waters of the two streams and insure the greatest beneficial use of the same to both countries. Because of the international interests involved and as a means of furthering those relations of neighborliness and good fellowship which it is convinced the people of both countries have earnestly at heart, the Commission believes that the cost of construction of the works at the outlet of St. Mary Lakes should not be charged against any particular project, but should be borne jointly- by the Governments of the United States and Canada, the legal title of said reservoir to be vested in the United States.

It is therefore ordered that the following recommendations be respectfully submitted to the Governments of the United States and Canada:

That the Governments of the United States and Canada enter into an agreement for the construction of a reservoir at St. Mary Lakes in Montana.

That the Reclamation Service of the United States proceed with the construction of the proposed Chain-of-Lakes Reservoir in Montana, and the Canadian Reclamation Service with the proposed Verdigris Coulee Reservoir in Alberta.

That all reservoirs herein mentioned be constructed, controlled, and operated in the manner, for the purpose, and subject to the conditions above set forth.

Dated at Ottawa, Canada, this 6th day of October, 1921.

O. GARDNER,

C. A. MAGRATH,

C. D. CLARK,

HENRY A. POWELL,

W. HEARST,

MARK A. SMITH.

APPENDIX C. TASK FORCE DIRECTIVE

DIRECTIVE TO THE INTERNATIONAL ST. MARY-MILK RIVERS ADMINISTRATIVE MEASURES TASK FORCE

The purpose of this directive is to establish and direct the International St. Mary-Milk Rivers Administrative Measures Task Force. This Task Force is formed to examine and report to the International Joint Commission on measures for improvements to existing administrative procedures of the St. Mary and Milk Rivers apportionment to ensure more beneficial use and optimal receipt by each country of its apportioned waters. This will include examining these administrative procedures, such as accounting procedures, surpluses and deficits, accounting periods, and any other administrative measures the group may find pertinent to its task.

The Commission will appoint members of the Task Force and Co-Chairs to lead the Task Force's efforts. The Co-Chairs will be responsible for organizing and executing the work of the Task Force, and for coordinating with and reporting to the Commission. The Task Force will be binational and multi-disciplinary and comprise an equal number of members from each country. Members of the Task Force will act in their personal and professional capacities and not as representatives of their countries, agencies, organizations, or other affiliations. The Commission will provide guidance to the Task Force and will seek resources from the two Governments to support its efforts (including resource contributions by Task Force members' agencies). Members of the Task Force and work groups will be responsible for their own expenses unless otherwise arranged by the Commission.

In addressing its mission, and to access the full breadth of available information, the Task Force will consult with appropriate organizations in both countries, and with the work groups of the Accredited Officers' Field Representatives. It will analyze and evaluate available information, and will inform the Commission of any additional information necessary to address pertinent issues.

The Task Force will strive to reach decisions by consensus and will notify the Commission of any irreconcilable differences. Any lack of clarity in instructions or directives received from the Commission shall be referred promptly to the Commission.

The Commission stresses the importance of public outreach and consultation. It will be necessary to coordinate such activities with the Commission.

The Task Force will keep the Commission fully informed of its meetings and progress through regular communications with the Commission Secretaries or their designees.

The Commission authorizes the Task Force to begin its work in January 2005. The Task Force shall submit a work plan with an associated schedule of activities and budget for the Commission's approval by February 5, 2005. The work plan shall include provision for an appropriate public consultation process. The Task Force shall submit an interim report to the Commission by March 28, 2005, and its final report no later than June 30, 2005. Any recommended measures that could be implemented as early as the 2005 irrigation season shall be included in the interim report or earlier if practicable. The final report shall contain the Task Force's complete findings and recommendations.

While the Commission intends for this to be an open study, the Task Force may meet privately in executive session when needed. Communications between the Task Force and the Commission are privileged and become available for public information only after release by the Commission.

Signed: November 30, 2004

Elizabeth C. Bourget	Murray Clamen
Secretary	Secretary
United States Section	Canadian Section

APPENDIX D. TASK FORCE MEMBERSHIP

In December 2004, the IJC appointed and announced the Co-Chairs to the Task Force:

Mr. Daniel Jewell, P. E.
Manager, Montana Area Office
Bureau of Reclamation

Mr. Ross Herrington, P. Eng.
Senior Water Policy Advisor
Environment Canada

The IJC appointed the following as Members of the Task Force:

Mr. Robert E. Davis
Field Representative to the Accredited
Officer for St. Mary and Milk Rivers

Mr. Richard M. Moy
Chief of Water Management Bureau
Montana Dept. of Natural Resources

Mr. Russell G. Boals, P. Eng.
Field Representative to the Accredited
Officer for St. Mary and Milk Rivers

Mr. Wayne Dybvig, P. Eng.
Vice President for Operations
Saskatchewan Watershed Authority

Mr. Ronald Billstein, P. E.
Manager, Eastern Montana Region
HKM Engineering, Inc.

Mr. David McGee
District Approvals Manager
Alberta Environment

The IJC appointed the following Observers:

Ms. Annabel Crop Eared Wolf
Blood Tribe

Mr. Donald Meyers
Chippewa-Cree Tribe
Rocky Boy Reservation

Mr. Randy Perez
Assiniboine and Gros Ventre Tribes
Fort Belknap Water Resources
Department

APPENDIX E. SUMMARY OF TASK FORCE MEETINGS

The Task Force met nine times between February and November, 2005. Meeting dates and locations were established by the Task Force through a Plan of Work. The following provides a record of the main areas of discussion at each meeting.

i. Lethbridge, Alberta

The Task Force met for the first time on February 8, 2005 at Lethbridge, Alberta. The objectives of this inaugural meeting were to: provide an opportunity for members to meet and network; attain a common understanding of the Task Force Directive; initiate discussion of potential Administrative Options; and, assign responsibility for drafting a work plan and budget.

Task Force members particularly appreciated the opportunity to interact directly with Commissioner Olson and IJC technical staff. Both print and television media were present and showed considerable interest in the work of the Task Force. Commissioner Olson requested the Task Force to provide the IJC with options for their consideration.

ii. Cypress Hills, Saskatchewan

The next meeting was held on February 23 in conjunction with the annual International St. Mary-Milk Rivers Records Meeting at Cypress Hills, Saskatchewan. The objectives were to: discuss the draft work plan and budget; define a range of potential administrative options; assign responsibility of each option to specific members; and, discuss a conceptual process for public consultation.

iii. Great Falls, Montana

The third meeting of the Task Force took place at Great Falls on March 24. Much of the discussion at this meeting was focused on selecting an appropriate daily hydrologic natural flow accounting process which would be suitable for running a series of “what if” scenarios. The Task Force also identified the types of input parameters required for the accounting spreadsheet and began to consider a range of potential flow management scenarios.

Other items considered included: the historic development of apportionment procedures; the need for an assessment of daily natural flows for Lee and Rolph creeks; the public engagement process; and, the preparation of the draft report to the IJC.

iv. Lethbridge, Alberta

The May 4 meeting was preceded by a meeting of technical support staff to arrive at a consensus for a daily hydrologic natural flow accounting process. Montana presented the results of their analysis for progressively lengthening the accounting period. The accounting process was discussed in detail with Task Force members on May 4 and suggestions made to improve the document. The second draft report would be discussed and approved at the next meeting of the Task Force. A draft outline for the IJC Task Force report was approved in principle.

The Task Force discussed the proposed public involvement process. Locations and timing were suggested. The Task Force expressed concern about the original timing of the pubic involvement process (mid-August) given the irrigation season. This was conveyed to the IJC and it was agreed that it would be more fruitful to convene the public involvement process in mid- to late- September.

v. Havre, Montana

The meeting on June 7 focused on a detailed review of the draft report prepared by the Alberta and Montana Task Force members, and their technical staffs, outlining a natural flow accounting process. This report documented potential inaccuracies in the calculation of flow apportionment throughout the basin and identified areas where improvements in measuring and calculating flows might be possible. The report is attached as Appendix 5.

The Task Force also reviewed a report prepared by HKM Engineering which estimated stream flows for Lee and Rolph creeks in Montana. These streams rise in Montana and cross the International Boundary before joining the St. Mary River in Canada. Given that measured flows for Lee Creek, in particular, seem low compared to similar streams in the basin, the Task Force requested that appropriate technical staff undertake further review of the data, including the streamflow record.

Task Force members discussed the statutory requirement for minimum stream flows throughout the basin to support instream (riparian) flow needs.

vi. Helena, Montana

The sixth meeting of the Task Force on July 15 was preceded by a meeting of technical experts to review and discuss a draft report, prepared by technical staff at the direction of the Task Force. This report compared and evaluated various proposed scenarios including data inputs, methodology for testing and comparing scenarios, and the potential impacts of various scenarios on apportionment of natural flows. This discussion was then summarized at the Task Force meeting and members agreed on a set of assumptions for running the scenarios. The Task Force instructed technical staff to produce another iteration of the spreadsheet based on these assumptions and to provide a revised report for the next meeting.

The Task Force also reviewed the draft report and timetable for completion, and discussed the proposed timetable for the Public Engagement process.

vii. Lethbridge, Alberta

The Task Force met in Lethbridge on August 11. Consistent with previous meetings, this meeting was preceded by a technical discussion of potential alternative administrative measures for the St. Mary River and Milk River. The Task Force was subsequently briefed and provided comments. Task Force members were in agreement that the spreadsheet provides a reasonable reflection of historic flow conditions in the basin as well as reasonable results under various administrative measures scenarios. The Task Force instructed technical staff to complete the assessment report prior to the next meeting.

Task Force members discussed the level of detail required for the report to the IJC as well as the public involvement process. The draft report on Lee and Rolph Creeks was discussed and guidance provided for improving this report. Members also discussed the unmonitored tributaries from the Sweetgrass Hills.

viii. Regina, Saskatchewan

The agenda of the Task Force meeting in Regina, Saskatchewan, on October 12, included an in-depth discussion of apportionment options, an update by the Co-Chairs on the presentation to the IJC at its semi-annual meting in Ottawa on October 19, and discussion about previous and proposed public information sessions.

With regard to apportionment options, members specifically discussed whether and how credit for surplus flows should be given, especially when these flows are spilled from either St. Mary Reservoir in Alberta or Fresno Reservoir in Montana and are, in effect, of no direct benefit to either country. Members also discussed the need to document for the report how the Task Force is planning to address the Eastern and Southern Tributaries.

ix. Shelby, Montana

The ninth meeting of the Task Force was held November 16-17 in Shelby, Montana. The discussion focused on the content and structure of the latest draft report to the IJC. Several gaps were identified and tasks were assigned to members to complete these deficiencies by the end of November. The next iteration of the Task force report would then be distributed to members before being forwarded to the IJC.

x. Great Falls, Montana

The Task Force met on March 22-23 in Great Falls, Montana to reach consensus on the key issues and to finalize the report for the IJC.

APPENDIX F. MEDIA ARTICLES

Montana has concerns over water usage

PUBLICATION: The Lethbridge Herald

DATE: 2005.06.13 SECTION: Agriculture PAGE: b4 BYLINE: Bank, Natalie

Ron Renwick knows water.

He also has a pretty good handle on how important a consistent supply of water is to the hundreds of irrigation farmers served by the St. Mary River Irrigation District.

Renwick is general manager of that district, and he has learned how to strongly defend that valuable water supply.

The district has a direct stake in the International Joint Commission study into the 1921 IJC order that stipulates the sharing of water in the St. Mary and Milk Rivers between Canada and the United States.

Renwick says his ratepayers, and those of the Raymond, Magrath and Taber irrigation districts which are included in the region served by the Waterton, Belly and St. Mary Rivers, have built their systems based on that water sharing agreement.

Former Montana Gov. Judy Martz asked IJC to review the water order of 1921, claiming Alberta is taking about 100,000 acre feet of water beyond the agreement.

Renwick said the order is vital because the St. Mary River Project gets about 40 per cent of its water from the St. Mary River which originates in Glacier National Park near St. Mary, Mont. Mind you, that is within the existing IJC water agreement.

It also gets about 40 per cent from the Waterton River which originates in Waterton Lakes National Park, and 20 per cent from the Belly River.

Renwick says he has hope the six-person task force studying Martz's request, three each from Canada and the U.S., will come down with a satisfactory report Sept. 30. The deadline for that report was extended from June.

Lobby work, likely only at any public sessions with the task force, is the only chance to influence IJC, says Renwick. It is not a government body, and it answers to no government officials.

Renwick says much of the problem stems from the antiquated Montana irrigation system. It includes about 140,000 acres of land, most of it in the Havre, Mont. area which is roughly south of Maple Creek, Sask. The canals leading to the project are badly clogged and in poor repair, and the Fresno Reservoir near Havre is about half full of silt.

A major obstacle is the flume which carries the U.S. share of the St. Mary River across that river and into the north fork of the Milk River which becomes the main canal to take the water to the Fresno Reservoir. That flume too often is out of commission or unable to carry the full U.S. share of the water.

Renwick says when the sharing agreement was signed, each country was to make sure there was infrastructure like reservoirs to store the shared water until it could be used by irrigators.

"Canada did, the U.S. didn't," says Renwick.

Extra storage would be needed in the U.S. because it would be very difficult to carve out storage space in the St. Mary Lake. That lake is owned mostly by the Blackfeet Nation.

Another positive for Canada is its long-standing water licensing system. That system was in place even before there was irrigation. It resulted in orderly issuance of licenses in Canada.

Still, flow problems are causing problems.

Canada is not using 36,000 acre feet of water annually from the Milk River. And still, the proposed dam on the Milk River in Canada is alarming Americans.

He said the U.S. is not using 102,000 acre feet of water annually from the St. Mary River that it is entitled to.

Renwick said there is a partnership in capital spending on water management in Alberta − the province pays 75 per cent of capital projects with the water users paying 25 per cent, although that used to be a ratio of 86:14 − and Americans generally can't believe what Alberta has for irrigation infrastructure and on-farm irrigation systems.

"The SMRID has 372,000 acres of irrigated land, and only 12,000 is flood irrigation, and all is better than Montana's irrigated land," says Renwick. "We are far, far ahead of them. If they had our system, there wouldn't be a dispute over the Milk River and St. Mary River flow. And our ratepayers have 262,000 acres of the most modern low-pressure centre pivot sprinklers which is a very efficient way of applying water."

Improved efficiency is also where Canada is winning the water battle.

Southern Alberta farmers have cut average water applications in the SMRID two inches per acre in the past 20 years. They use more water in dry years. "Irrigation is really good for the economy."

Renwick is correct to ponder what, if any, changes are made.

For sure, Canada must keep its long-term rights, and if it turns out the Americans simply can't begin to use their share, Canada has a legitimate right to ask for a bigger share for its farmers mostly in southern Alberta and some in southern Saskatchewan.

IJC task force hopes to avoid rewriting water-sharing agreement

Original agreement between U.S. and Canada was written in 1921

By RIC SWIHART
Lethbridge Herald

A more equitable sharing of St. Mary River water between Montana and Alberta-Saskatchewan is the driving force of an industry task force which kicked off deliberations in Lethbridge Tuesday.

Established by the International Joint Commission, the task force aims to resolve a dispute on the distribution of water raised by then Montana Gov. Judy Martz, who claimed Alberta was taking too much water.

That water sharing agreement for the St. Mary River, and the much-smaller Milk River, was arrived at in 1921.

The task force co-chairmen — Ross Herrington of Regina and Dan Jewell of Billings — agree the goal of the task force is to avoid the political reality of rewriting that 1921 IJC order.

Jewell, area manager for the Montana area for the U.S. Bureau of Reclamation, said it is much easier to find solutions through administrative channels than writing a 2005 IJC apportionment order and he expects to reach such an agreement.

"Historically, the spirit of co-operation between the two countries has been admirable."

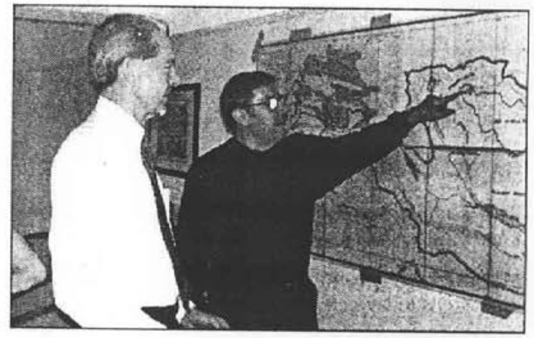
Herrington, senior water policy adviser for Environment Canada, said they need to find common ground in water sharing in the water basin that straddles the 49th parallel from St. Mary, Mont., east of Havre, into southern Alberta and Saskatchewan.

He said the task force, with three members and a co-chairman from each country, "will try to look at all ways of apportioning the water that is equitable."

Jewell said this first task force meeting is valuable because it allows the members to meet and to confirm the task force goals expected to be presented to the commission in June.

The task force is looking for solutions to some of the issues and problems raised at public meetings held in Havre, East End, Sask., and Lethbridge last summer.

Jewell admitted some of the problem stems from the water diversion structure that allows the U.S. to divert water from the St. Mary River, just south of the U.S.-Canadian border, into the Milk River so it can flow eastward to the Fresno Reservoir, where water flow is managed into the state's main irrigated area near Havre.



HERALD PHOTO BY RIC SWIHART

Dan Jewell, U.S. co-chairman for the International Joint Commission task force seeking equal water apportion between Canada and the U.S. for the St. Mary River, checks the water basin map with Canadian co-chairman Ross Herrington of Regina at the first task force meeting Tuesday in Lethbridge.

That diversion structure was built about 100 years ago by the U.S. Bureau of Reclamation and "it has reached the age of its designed service life."

Regardless of the capacity to divert water to the Milk River, any agreement must provide equal sharing of the water, said Jewell.

That is critical to Montana, he said.

"In water-short years, 80 per cent of the water flow in the Milk River comes from the St. Mary River," he said. "It (the St. Mary River water flow) is huge."

International Joint Commission
Canada and the United States

MEDIA RELEASE
For Release: December 1, 2004

IJC announces intent to establish Task Force on St. Mary and Milk Rivers

The International Joint Commission (IJC) announced today that it intends to establish a St. Mary and Milk Rivers Administrative Measures Task Force to examine whether the existing administrative procedures in its 1921 Order under which water is apportioned between Southern Saskatchewan, Southern Alberta and Northern Montana for irrigation purposes can be improved to ensure more beneficial use and optimal receipt by each country of its apportioned waters within the terms of the Order that was issued by the Commission in 1921.

The St. Mary River flows north from Montana into Alberta and the Milk River criss-crosses the Canada-U.S. border between Montana, Southern Alberta and Saskatchewan.

The IJC decided to establish a task force after meeting with the Field Representatives of the Canadian and U.S. Accredited Officers in October, and considering the views presented to the Commissioners at their public consultation meetings last summer and in writing. The IJC held these meetings and toured irrigation works and water structures the last week of July in Montana, Saskatchewan and Alberta to hear comments in response to a request by the Governor of Montana that the IJC review its 1921 Order. Over 100 written submissions were received by the IJC and they are all available on the Commission's website.

The IJC was established under the Boundary Waters Treaty (1909) to help prevent and resolve disputes over the use of waters shared by the United States and Canada. Under Article VI of the treaty, Accredited Officers appointed by the two countries measure and apportion the waters of the St. Mary and Milk rivers in accordance with the IJC's order. More information is available online at WWW.IJC.ORG.

Contact:

Nick Heisler	Ottawa	613-992-8367
Frank Bevacqua	Washington	202-736-9024

POST West

Friday, May 13, 2005

Opening doors in Stavely

Page 3

Water dispute answers tough to get

By RIC SWIHART
Prairie Post West

Hopefully, another spite ditch won't be necessary in the St. Mary and Milk River water dispute between Canada and the U.S.

In the late 1800s when the issue of water-sharing was a hot topic, the Canadian side of things dug a canal to cut the Americans off from the precious resource. This time, finding a truly equal way of sharing the water in the St. Mary River and Milk River between Canada and the United States may not be possible but an agreeable solution should be within reach..

Major engineering and technical work will help fine-tune the water sharing agreement established in 1921, both for water apportionment and water use, Ross Herrington of Regina and Dan Jewell of Billings, Mont. said during a break in the second task force meeting in Lethbridge 'e it was struck late last year.

tablished by the International Joint .mission which takes care of all cross-order issues the length of the 49th parallel, the task force aims to resolve a 2003 dispute on the distribution of water raised by then Montana Gov. Judy Martz, who claimed Alberta was taking too much water in violation of the 1921 agreement.

The chairmen said in February the goal of the task force is to avoid the political reality of rewriting that 1921 IJC order.

Jewell, area manager for the Montana area for the U.S. Bureau of Reclamation, said that historically, Canada gets about 60 per cent of the flow of the rivers, all of it used in southern Alberta and southern Saskatchewan before the Milk River flows bank into Montana.

He said the spring runoff, when most of the annual river flow rushes eastward in the larger St. Mary River, is much too large for Montana to capture its share. But at times, the Montana water sharing account is in areas, allowing the state irrigators near Havre to get more water. Every year, the accountants who monitor the water sharing have been satisfied that the water agreement goal has been met. The last accounting was held in the Cypress Hills this spring.

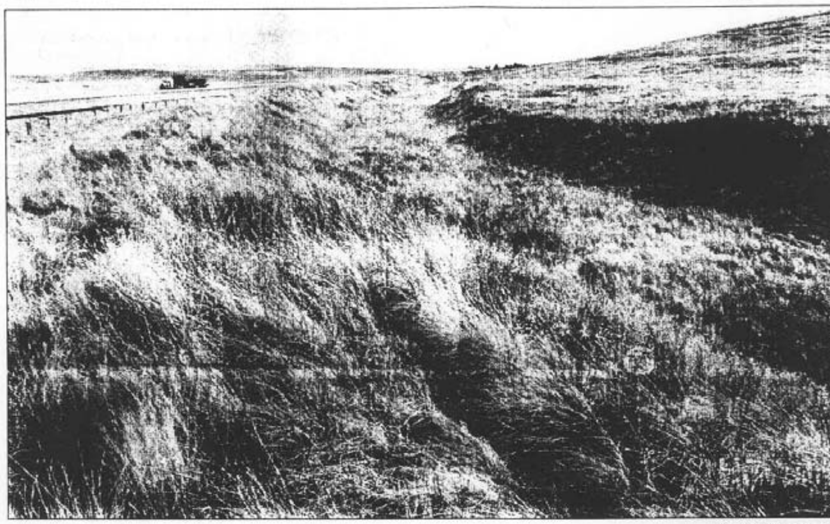


PHOTO BY IAN MARTENS

A photo of the Spite Ditch, dug at the turn of the previous century by Canadians angry at American threats to divert the St. Mary River.

Herrington, senior water policy adviser for Environment Canada, said the task force was able to update its study for the commissioners in Washington, D.C. about April 12. "They were happy with our progress."

But both men were relieved with the commission extended the deadline for a final report to the end of September.

"I think that is do-able," said Jewell.

Jewell said Montana's chances of attaining its 1921 water share is doubtful. "There is no way we have the capacity (to divert that much water)," he said. "We can't divert the U.S. apportionment."

There would also be concerns with the capacity of the much-smaller Milk River to handle that much water from the St. Mary. The St. Mary River water, which is diverted into the Milk River that acts as a canal to feed the Fresno Reservoir near Havre which is the storage structure for about 140,000 acres in the Havre area.

Jewell said the task force will continue to seek solutions to technical issues, and have recommendations ready for the commission to make a decision of the Montana request to open the water agreement so the U.S. gets more water.

"If nothing else comes of the task force, just the increased open dialogue between Montana and Alberta is really beneficial," said Jewell.

Herrington agreed, claiming, "Both sides understand the other side's position better already."

Another meeting will be held in June, site to be determined, so some of the task force members can receive more technical work, "to get us another step down the road."

They said another phase of their work will be taking the study "on the road to stakeholders and the general public to get feedback on the various issues. (Some) of the commission members will be at the public sessions."

The task force, with three members and a chairman from each country, is looking for solutions to some of the issues and problems raised at public meetings held in Havre, East End, Sask., and Lethbridge last summer.

AGRI-BUSINE

A Look at Farming and Business

Task force probes water sharing

Inability of U.S. to use water it is entitled to a sticking point for IJC

By RIC SWIHART
Lethbridge Herald

Finding the best way of sharing the water in the St. Mary and Milk rivers between Canada and the United States may not be possible, the co-chairmen of a joint task force said Wednes-day.

But major engineering and technical work will help fine-tune the water-sharing agreement established in 1921, both for water apportionment and water use, Ross Herrington of Regina and Dan Jewell of Billings, Mont., said during a break in the second task force meeting in Lethbridge since it was struck late last year.

Established by the International Joint Commission, the task force aims to resolve a 2003 complaint about the distribution of water raised by the then Montana governor, Judy Martz, who claimed Alberta was taking too much water in violation of the 1921 agreement.

The chairmen said in February the goal of the task force is to avoid the political reality of rewriting that 1921 IJC order.

Jewell, area manager for the Montana area for the U.S. Bureau of Reclamation, said that historically Canada gets about 60 per cent of the flow of the rivers, all of it used in southern Alberta and southern Saskatchewan before the Milk River flows back into Montana.

He said the spring runoff, when most of the annual river flow rushes eastward in the larger St. Mary River, is too large for Montana to capture its share. But at times, the Montana water-sharing account is in arrears, allowing the state irrigators near Havre to get more water. Every year, the accountants who monitor the water sharing have been satisfied the water agreement goal has been met. The last accounting was held in the Cypress Hills this spring.

Herrington, senior water policy adviser for Environment Canada, said the task force was able to update its study for the commissioners in Washington, D.C., three weeks ago.

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But both men were relieved with the commission extended the deadline for a final report to the end of September.

"I think that is doable," said Jewell.

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APPENDIX G. 1950-2004 DATA SUMMARY TABLES

HISTORICAL SUMMARY OF ST. MARY RIVER FLOW AT THE INTERNATIONAL BOUNDARY (November - October)

Small differences from original data might be present due to unit conversion and rounding.

Water Year	Data Year	Natural Flow[1] (acre-feet)	Natural Flow[1] (dam^3)	U. S. Entitlement[2] (acre-feet)	U. S. Entitlement[2] (dam^3)	Canada's Entitlement[2] (acre-feet)	Canada's Entitlement[2] (dam^3)	U. S. Receipt[3] (acre-feet)	U. S. Receipt[3] (dam^3)	% of U. S. Entitlement Received	Canada's Receipt[4] (acre-feet)	Canada's Receipt[4] (dam^3)	% of Canada's Entitlement Received
1949-1950	1950	862,889	1,064,375	368,821	454,941	494,068	609,434	152,060	187,566	41%	710,829	876,809	177%
1950-1951	1951	1,026,599	1,266,312	443,034	546,483	583,565	719,829	79,851	98,496	18%	946,748	1,167,816	200%
1951-1952	1952	599,925	740,009	241,495	297,885	358,430	442,124	107,410	132,491	44%	492,515	607,518	169%
1952-1953	1953	849,505	1,047,866	367,520	453,337	481,985	594,529	118,125	145,708	32%	731,380	902,159	187%
1953-1954	1954	858,492	1,058,952	363,943	448,924	494,549	610,027	106,870	131,825	29%	751,622	927,127	187%
1954-1955	1955	668,998	825,210	277,276	342,020	391,724	483,192	113,527	140,035	41%	555,471	685,175	175%
1955-1956	1956	741,415	914,537	309,365	381,602	432,048	532,932	200,108	246,834	65%	541,307	667,703	155%
1956-1957	1957	604,627	745,809	250,930	309,523	353,697	436,286	175,473	216,446	70%	429,154	529,362	150%
1957-1958	1958	589,157	726,726	235,321	290,269	353,837	436,459	181,143	223,440	77%	408,014	503,286	142%
1958-1959	1959	808,206	996,924	334,710	412,865	473,495	584,057	210,052	259,099	63%	598,154	737,824	156%
1959-1960	1960	578,292	713,324	231,971	286,137	346,321	427,188	180,481	222,624	78%	397,811	490,700	142%
1960-1961	1961	625,256	771,254	252,999	312,075	372,258	459,181	206,595	254,835	82%	418,661	516,420	139%
1961-1962	1962	556,013	685,843	216,770	267,386	339,241	418,454	199,294	245,830	92%	356,719	440,013	130%
1962-1963	1963	610,165	752,640	250,849	309,423	359,314	443,215	216,807	267,432	86%	393,358	485,208	135%
1963-1964	1964	808,300	997,040	343,622	423,858	464,677	573,180	175,796	216,844	51%	632,504	780,195	168%
1964-1965	1965	739,209	911,816	304,678	375,821	434,530	535,994	132,710	163,698	44%	606,499	748,117	172%
1965-1966	1966	648,349	799,740	262,188	323,409	386,161	476,330	187,649	231,466	72%	460,700	568,274	147%
1966-1967	1967	747,440	921,969	320,001	394,722	427,438	527,246	133,644	164,850	42%	613,796	757,119	177%
1967-1968	1968	678,987	837,532	275,254	339,526	403,732	498,004	221,497	273,217	80%	457,490	564,315	140%
1968-1969	1969	621,827	767,025	251,876	310,690	369,952	456,336	164,283	202,644	65%	457,544	564,381	153%
1969-1970	1970	652,673	805,073	274,682	338,821	377,991	466,253	169,812	209,463	62%	482,861	595,610	158%
1970-1971	1971	757,208	934,018	318,544	392,925	438,664	541,093	164,915	203,423	52%	592,293	730,594	167%
1971-1972	1972	839,305	1,035,284	353,341	435,847	485,966	599,440	201,350	248,366	57%	637,955	786,919	162%
1972-1973	1973	461,423	569,166	180,537	222,693	280,886	346,473	161,659	199,406	90%	299,764	369,760	132%
1973-1974	1974	794,804	980,392	339,653	418,963	455,152	561,431	206,472	254,684	61%	588,332	725,709	159%
1974-1975	1975	870,495	1,073,757	374,612	462,085	495,883	611,673	97,531	120,305	26%	772,964	953,453	192%
1975-1976	1976	701,338	865,102	289,308	356,862	412,031	508,241	208,024	256,598	72%	493,314	608,504	148%
1976-1977	1977	367,565	453,392	125,437	154,727	242,130	298,668	111,305	137,295	89%	256,260	316,098	131%
1977-1978	1978	680,498	839,396	275,521	339,856	404,977	499,540	92,718	114,367	34%	587,780	725,028	179%
1978-1979	1979	556,873	686,904	225,218	277,807	331,657	409,100	130,524	161,001	58%	426,349	525,903	159%
1979-1980	1980	587,851	725,115	233,047	287,464	354,795	437,640	203,828	251,422	87%	384,023	473,694	134%
1980-1981	1981	655,755	808,875	273,804	337,738	381,855	471,019	227,312	280,390	83%	428,347	528,367	138%
1981-1982	1982	602,410	743,074	245,526	302,857	356,884	440,217	118,136	145,722	48%	484,274	597,352	167%
1982-1983	1983	468,532	577,935	181,420	223,782	287,104	354,144	169,089	208,572	93%	299,443	369,364	129%
1983-1984	1984	500,422	617,271	192,406	237,333	308,016	379,938	178,381	220,033	93%	322,041	397,238	129%
1984-1985	1985	584,571	721,069	226,922	279,909	357,649	441,161	206,631	254,880	91%	377,940	466,190	130%
1985-1986	1986	611,583	754,389	241,930	298,422	369,653	455,968	145,282	179,206	60%	466,301	575,183	156%
1986-1987	1987	557,169	687,269	220,058	271,443	337,112	415,828	181,419	223,780	82%	375,750	463,489	137%
1987-1988	1988	433,993	535,331	163,666	201,882	270,327	333,449	162,075	199,920	99%	271,918	335,411	124%
1988-1989	1989	694,002	856,053	282,730	348,749	411,271	507,304	264,898	326,752	94%	429,104	529,301	129%
1989-1990	1990	758,101	935,119	314,750	388,245	443,351	546,875	221,453	273,163	70%	536,648	661,956	149%
1990-1991	1991	845,496	1,042,921	364,790	449,970	480,705	592,951	218,133	269,067	60%	627,363	773,854	161%
1991-1992	1992	435,714	537,454	157,251	193,969	278,464	343,486	138,637	171,009	88%	297,077	366,445	132%
1992-1993	1993	571,386	704,806	221,065	272,684	350,321	432,122	192,202	237,082	87%	379,184	467,724	134%
1993-1994	1994	497,977	614,256	196,335	242,179	301,642	372,077	140,800	173,677	72%	357,177	440,578	146%
1994-1995	1995	786,540	970,199	333,514	411,391	453,026	558,808	112,114	138,293	34%	674,426	831,905	184%
1995-1996	1996	823,873	1,016,249	349,826	431,511	474,051	584,743	132,663	163,640	38%	691,210	852,609	180%
1996-1997	1997	819,804	1,011,230	344,612	425,080	475,193	586,151	180,383	222,503	52%	639,421	788,727	166%
1997-1998	1998	562,853	694,280	229,848	283,517	333,005	410,763	192,379	237,300	84%	370,474	456,981	137%
1998-1999	1999	615,088	758,712	247,090	304,786	367,998	453,927	211,376	260,733	86%	403,712	497,979	135%
1999-2000	2000	572,503	706,184	229,173	282,685	343,330	423,499	150,204	185,277	66%	422,299	520,907	152%
2000-2001	2001	365,157	450,422	139,852	172,508	225,304	277,913	129,678	159,958	93%	235,479	290,464	129%
2001-2002	2002	851,339	1,050,128	368,120	454,077	483,219	596,052	152,302	187,865	41%	699,037	862,263	178%
2002-2003	2003	489,411	603,689	191,570	236,301	297,841	367,388	170,105	209,825	89%	319,306	393,865	132%
2003-2004	2004	568,617	701,390	219,281	270,483	349,336	430,907	198,563	244,928	91%	370,054	456,462	131%
Median		625,256	771,254	252,999	312,075	372,258	459,181	170,105	209,825	67%	457,544	564,381	123%
Mean		657,563	811,106	269,601	332,554	387,960	478,550	167,377	206,460	62%	490,185	604,644	126%

[1] Calculated as the recorded flow of the St. Mary River at the International Boundary adjusted for changes in storage of Lake Sherburne and flows diverted to the St. Mary Canal for November 1 - October 31, from annual reports to the IJC.

[2] Calculated as one-half of the recorded flow of the St. Mary River at the International Boundary adjusted for changes in storage in Lake Sherburne for November 1 - February 28/29, plus the computed entitlements for March 1 - October 31, from annual reports to the IJC.

[3] Calculated as natural flow minus Canada's receipt.

[4] Calculated as the recorded flow of the St. Mary River at the International Boundary for November 1 - October 31.

HISTORICAL SUMMARY OF MILK RIVER FLOW AT EASTERN CROSSING OF THE INTERNATIONAL BOUNDARY (November - October)

Small differences from original data might be present due to unit conversion and rounding.

Water Year	Data Year	Natural Flow[1] (acre-feet)	Natural Flow[1] (dam^3)	U. S. Entitlement[2] (acre-feet)	U. S. Entitlement[2] (dam^3)	Canada's Entitlement[2] (acre-feet)	Canada's Entitlement[2] (dam^3)	U. S. Receipt[3] (acre-feet)	U. S. Receipt[3] (dam^3)	% of U. S. Entitlement Received	Canada's Receipt[4] (acre-feet)	Canada's Receipt[4] (dam^3)	% of Canada's Entitlement Received
1949-1950	1950	125,854	155,241	88,526	109,197	37,328	46,044	113,770	140,335	129%	12,084	14,906	32%
1950-1951	1951	286,197	353,025	187,801	231,653	98,396	121,372	267,580	330,061	142%	18,617	22,964	19%
1951-1952	1952	237,205	292,593	142,744	176,075	94,461	116,518	217,203	267,921	152%	20,002	24,672	21%
1952-1953	1953	271,661	335,094	169,720	209,350	101,941	125,744	256,183	316,002	151%	15,478	19,092	15%
1953-1954	1954	167,701	206,860	113,285	139,737	54,416	67,122	152,787	188,463	135%	14,914	18,396	27%
1954-1955	1955	169,782	209,426	113,316	139,776	56,466	69,651	148,838	183,592	131%	20,944	25,835	37%
1955-1956	1956	121,158	149,449	83,141	102,555	38,017	46,894	111,842	137,957	135%	9,316	11,492	25%
1956-1957	1957	114,782	141,584	76,709	94,621	38,073	46,963	102,795	126,798	134%	11,987	14,786	31%
1957-1958	1958	126,068	155,505	79,304	97,822	46,764	57,683	112,532	138,808	142%	13,536	16,697	29%
1958-1959	1959	140,455	173,252	90,725	111,909	49,730	61,342	128,267	158,218	141%	12,188	15,034	25%
1959-1960	1960	111,639	137,707	68,499	84,494	43,140	53,213	95,414	117,694	139%	16,225	20,013	38%
1960-1961	1961	46,747	57,663	30,973	38,205	15,774	19,457	34,233	42,226	111%	12,514	15,436	79%
1961-1962	1962	68,356	84,317	44,237	54,566	24,119	29,751	53,582	66,093	121%	14,774	18,224	61%
1962-1963	1963	41,747	51,495	26,142	32,246	15,605	19,249	25,506	31,461	98%	16,241	20,034	104%
1963-1964	1964	127,829	157,677	86,034	106,123	41,795	51,554	119,213	147,049	139%	8,616	10,628	21%
1964-1965	1965	242,346	298,934	153,080	188,824	89,266	110,110	232,308	286,552	152%	10,038	12,382	11%
1965-1966	1966	129,806	160,116	85,363	105,295	44,443	54,821	115,598	142,590	135%	14,208	17,526	32%
1966-1967	1967	264,021	325,670	163,404	201,559	100,617	124,111	249,766	308,087	153%	14,255	17,583	14%
1967-1968	1968	128,263	158,213	85,957	106,028	42,306	52,185	115,763	142,794	135%	12,500	15,419	30%
1968-1969	1969	206,923	255,240	127,011	156,668	79,912	98,572	183,156	225,924	144%	23,767	29,316	30%
1969-1970	1970	108,149	133,402	73,666	90,867	34,483	42,535	97,258	119,968	132%	10,891	13,434	32%
1970-1971	1971	128,357	158,329	86,322	106,478	42,035	51,850	110,043	135,738	127%	18,314	22,590	44%
1971-1972	1972	189,670	233,958	122,488	151,089	67,182	82,869	171,964	212,118	140%	17,706	21,840	26%
1972-1973	1973	44,158	54,469	28,042	34,590	16,116	19,879	30,610	37,757	109%	13,548	16,712	84%
1973-1974	1974	102,340	126,237	70,486	86,945	31,854	39,292	90,470	111,595	128%	11,870	14,641	37%
1974-1975	1975	266,697	328,971	169,030	208,499	97,667	120,472	257,452	317,567	152%	9,245	11,404	9%
1975-1976	1976	119,102	146,913	76,964	94,935	42,138	51,977	103,348	127,480	134%	15,754	19,432	37%
1976-1977	1977	40,072	49,429	25,879	31,922	14,193	17,507	30,948	38,174	120%	9,124	11,255	64%
1977-1978	1978	225,581	278,255	142,180	175,379	83,401	102,875	215,674	266,034	152%	9,907	12,221	12%
1978-1979	1979	209,285	258,153	127,774	157,609	81,511	100,544	194,834	240,328	152%	14,451	17,825	18%
1979-1980	1980	86,266	106,409	59,157	72,970	27,109	33,439	76,529	94,399	129%	9,737	12,010	36%
1980-1981	1981	103,910	128,173	70,193	86,583	33,717	41,590	93,461	115,284	133%	10,449	12,889	31%
1981-1982	1982	138,028	170,258	90,972	112,214	47,056	58,044	126,248	155,727	139%	11,780	14,531	25%
1982-1983	1983	43,121	53,190	29,157	35,965	13,964	17,225	33,742	41,620	116%	9,379	11,570	67%
1983-1984	1984	25,071	30,925	15,950	19,674	9,121	11,251	8,665	10,688	54%	16,406	20,237	180%
1984-1985	1985	49,431	60,973	34,674	42,770	14,757	18,203	37,384	46,113	108%	12,047	14,860	82%
1985-1986	1986	111,894	138,021	67,955	83,823	43,939	54,199	106,210	131,010	156%	5,684	7,011	13%
1986-1987	1987	53,988	66,594	36,512	45,038	17,476	21,557	47,601	58,716	130%	6,387	7,878	37%
1987-1988	1988	33,288	41,061	22,358	27,579	10,930	13,482	24,928	30,749	111%	8,360	10,312	76%
1988-1989	1989	96,221	118,689	64,406	79,445	31,815	39,244	86,592	106,811	134%	9,629	11,878	30%
1989-1990	1990	115,348	142,282	75,315	92,901	40,033	49,381	107,997	133,215	143%	7,351	9,067	18%
1990-1991	1991	129,623	159,890	90,095	111,132	39,528	48,758	126,083	155,523	140%	3,540	4,367	9%
1991-1992	1992	41,853	51,626	26,974	33,272	14,879	18,353	33,131	40,868	123%	8,722	10,758	59%
1992-1993	1993	133,850	165,104	90,741	111,929	43,109	53,175	127,361	157,100	140%	6,489	8,004	15%
1993-1994	1994	170,074	209,787	102,380	126,286	67,694	83,501	163,581	201,778	160%	6,493	8,009	10%
1994-1995	1995	196,867	242,836	131,276	161,929	65,591	80,907	190,220	234,637	145%	6,647	8,199	10%
1995-1996	1996	197,116	243,143	118,559	146,243	78,557	96,900	186,506	230,055	157%	10,610	13,088	14%
1996-1997	1997	155,953	192,368	99,568	122,817	56,385	69,551	157,739	194,571	158%	(1,786)	(2,203)	-3%
1997-1998	1998	70,328	86,750	48,468	59,785	21,860	26,964	63,231	77,996	130%	7,097	8,754	32%
1998-1999	1999	70,130	86,505	48,366	59,660	21,764	26,846	64,351	79,377	133%	5,779	7,128	27%
1999-2000	2000	36,067	44,489	23,403	28,868	12,664	15,621	25,793	31,816	110%	10,274	12,673	81%
2000-2001	2001	19,759	24,373	13,311	16,419	6,448	7,954	6,105	7,531	46%	13,654	16,842	212%
2001-2002	2002	192,029	236,868	118,604	146,298	73,425	90,570	184,286	227,318	155%	7,743	9,550	11%
2002-2003	2003	94,619	116,713	59,500	73,393	35,119	43,319	88,135	108,715	148%	6,484	7,998	18%
2003-2004	2004	55,299	68,211	36,863	45,471	18,436	22,741	49,747	61,363	135%	5,552	6,848	30%
Median		121,158	149,449	79,304	97,822	41,795	51,554	110,043	135,738	139%	10,891	13,434	26%
Mean		126,947	156,589	82,065	101,227	44,882	55,362	115,537	142,516	141%	11,409	14,074	25%

[1] Calculated as the recorded flow of the Milk River at Milk River, Alberta for November 1 - February 28/29 plus computed natural flow of the Milk River at the Eastern Crossing of the International Boundary.

[2] Calculated as one-half of the recorded flow of the Milk River at Milk River, Alberta for November 1 - February 28/29 plus the computed entitlements for March 1 - October 31 from annual reports to the IJC.

[3] Approximate value calculated as the recorded flow of the Milk River at Milk River, Alberta for November 1 - February 28/29, plus the recorded flow of the Milk River at the Eastern Crossing of International Boundary minus the difference between the recorded flow of the North Milk River at the International Boundary and the North Fork Milk River above the St. Mary Canal near Browning, Montana for March 1 - October 31, from annual reports to the IJC. For 1985-2004, the U. S. Receipts calculations include the addition of estimates of incremental evapotranspiration and U. S. water use upstream from Milk River at the Eastern Crossing of the International Boundary and subtraction of St. Mary River return flows in Verdigris Coulee, from annual reports to IJC.

[4] Approximate value calculated as the natural flow minus the approximate U. S. receipt.

HISTORICAL SUMMARY OF COMBINED FLOW OF EASTERN TRIBUTARIES AT THE INTERNATIONAL BOUNDARY (March - October)

Small differences from original data may be present due to unit conversion and rounding.

Water Year	Data Year	Natural Flow[1] (acre-feet)	Natural Flow[1] (dam^3)	U. S. Entitlement[2] (acre-feet)	U. S. Entitlement[2] (dam^3)	Canada's Entitlement[2] (acre-feet)	Canada's Entitlement[2] (dam^3)	U. S. Receipt[3] (acre-feet)	U. S. Receipt[3] (dam^3)	% of U. S. Entitlement Received	Canada's Receipt[4] (acre-feet)	Canada's Receipt[4] (dam^3)	% of Canada's Entitlement Received
1949-1950	1950	109,445	135,000	54,722	67,500	54,722	67,500	83,421	102,900	152%	26,023	32,100	48%
1950-1951	1951	191,244	235,900	95,622	117,950	95,622	117,950	147,223	181,600	154%	44,021	54,300	46%
1951-1952	1952	603,161	744,000	301,580	372,000	301,580	372,000	574,786	709,000	191%	28,375	35,000	9%
1952-1953	1953	143,656	177,200	71,828	88,600	71,828	88,600	108,634	134,000	151%	35,022	43,200	49%
1953-1954	1954	132,874	163,900	66,437	81,950	66,437	81,950	106,704	131,620	161%	26,169	32,280	39%
1954-1955	1955	355,168	438,100	177,584	219,050	177,584	219,050	327,036	403,400	184%	28,131	34,700	16%
1955-1956	1956	91,204	112,500	45,602	56,250	45,602	56,250	66,964	82,600	147%	24,240	29,900	53%
1956-1957	1957	92,987	114,700	46,494	57,350	46,494	57,350	65,018	80,200	140%	27,969	34,500	60%
1957-1958	1958	131,252	161,900	65,626	80,950	65,626	80,950	106,526	131,400	162%	24,726	30,500	38%
1958-1959	1959	87,231	107,600	43,616	53,800	43,616	53,800	56,911	70,200	130%	30,320	37,400	70%
1959-1960	1960	135,468	167,100	67,734	83,550	67,734	83,550	100,770	124,300	149%	34,698	42,800	51%
1960-1961	1961	26,169	32,280	13,085	16,140	13,085	16,140	14,609	18,020	112%	11,561	14,260	88%
1961-1962	1962	91,439	112,790	45,719	56,395	45,719	56,395	59,270	73,110	130%	32,169	39,680	70%
1962-1963	1963	66,413	81,920	33,206	40,960	33,206	40,960	44,670	55,100	135%	21,743	26,820	65%
1963-1964	1964	38,905	47,990	19,453	23,995	19,453	23,995	20,349	25,100	105%	18,557	22,890	95%
1964-1965	1965	238,994	294,800	119,497	147,400	119,497	147,400	159,870	197,200	134%	79,124	97,600	66%
1965-1966	1966	146,980	181,300	73,490	90,650	73,490	90,650	98,581	121,600	134%	48,399	59,700	66%
1966-1967	1967	244,750	301,900	122,375	150,950	122,375	150,950	201,864	249,000	165%	42,886	52,900	35%
1967-1968	1968	60,567	74,710	30,284	37,355	30,284	37,355	34,495	42,550	114%	26,072	32,160	86%
1968-1969	1969	138,062	170,300	69,031	85,150	69,031	85,150	92,420	114,000	134%	45,642	56,300	66%
1969-1970	1970	162,464	200,400	81,232	100,200	81,232	100,200	114,065	140,700	140%	48,399	59,700	60%
1970-1971	1971	86,907	107,200	43,454	53,600	43,454	53,600	55,047	67,900	127%	31,861	39,300	73%
1971-1972	1972	81,719	100,800	40,859	50,400	40,859	50,400	45,237	55,800	111%	36,482	45,000	89%
1972-1973	1973	33,547	41,380	16,773	20,690	16,773	20,690	17,787	21,940	106%	15,760	19,440	94%
1973-1974	1974	125,415	154,700	62,708	77,350	62,708	77,350	85,367	105,300	136%	40,049	49,400	64%
1974-1975	1975	157,681	194,500	78,841	97,250	78,841	97,250	103,445	127,600	131%	54,236	66,900	69%
1975-1976	1976	125,415	154,700	62,708	77,350	62,708	77,350	95,257	117,500	152%	30,158	37,200	48%
1976-1977	1977	16,036	19,780	8,018	9,890	8,018	9,890	10,116	12,478	126%	5,920	7,302	74%
1977-1978	1978	108,310	133,600	54,155	66,800	54,155	66,800	65,180	80,400	120%	43,129	53,200	80%
1978-1979	1979	164,167	202,500	82,083	101,250	82,083	101,250	109,769	135,400	134%	54,398	67,100	66%
1979-1980	1980	36,887	45,500	18,443	22,750	18,443	22,750	19,758	24,372	107%	17,128	21,128	93%
1980-1981	1981	22,910	28,260	11,455	14,130	11,455	14,130	11,607	14,317	101%	11,304	13,943	99%
1981-1982	1982	153,952	189,900	76,976	94,950	76,976	94,950	102,797	126,800	134%	51,155	63,100	66%
1982-1983	1983	53,960	66,560	26,980	33,280	26,980	33,280	28,488	35,140	106%	25,472	31,420	94%
1983-1984	1984	14,858	18,327	7,429	9,164	7,429	9,164	7,345	9,060	99%	7,513	9,267	101%
1984-1985	1985	68,585	84,600	34,293	42,300	34,293	42,300	34,584	42,660	101%	34,001	41,940	99%
1985-1986	1986	223,834	276,100	111,917	138,050	111,917	138,050	161,086	198,700	144%	62,748	77,400	56%
1986-1987	1987	119,416	147,300	59,708	73,650	59,708	73,650	80,016	98,700	134%	39,400	48,600	66%
1987-1988	1988	21,427	26,430	10,713	13,215	10,713	13,215	9,785	12,070	91%	11,642	14,360	109%
1988-1989	1989	28,820	35,550	14,410	17,775	14,410	17,775	15,411	19,010	107%	13,409	16,540	93%
1989-1990	1990	67,775	83,600	33,887	41,800	33,887	41,800	37,779	46,600	111%	29,996	37,000	89%
1990-1991	1991	108,391	133,700	54,195	66,850	54,195	66,850	72,720	89,700	134%	35,671	44,000	66%
1991-1992	1992	15,394	18,988	7,697	9,494	7,697	9,494	8,756	10,800	114%	6,638	8,188	86%
1992-1993	1993	128,091	158,000	64,045	79,000	64,045	79,000	75,963	93,700	119%	52,128	64,300	81%
1993-1994	1994	130,117	160,500	65,059	80,250	65,059	80,250	91,528	112,900	141%	38,589	47,600	59%
1994-1995	1995	37,746	46,560	18,873	23,280	18,873	23,280	19,432	23,970	103%	18,314	22,590	97%
1995-1996	1996	256,830	316,800	128,415	158,400	128,415	158,400	182,813	225,500	142%	74,017	91,300	58%
1996-1997	1997	243,940	300,900	121,970	150,450	121,970	150,450	197,892	244,100	162%	46,048	56,800	38%
1997-1998	1998	28,366	34,990	14,183	17,495	14,183	17,495	14,122	17,420	100%	14,244	17,570	100%
1998-1999	1999	82,618	101,910	41,309	50,955	41,309	50,955	56,676	69,910	137%	25,942	32,000	63%
1999-2000	2000	28,524	35,184	14,262	17,592	14,262	17,592	14,503	17,890	102%	14,020	17,294	98%
2000-2001	2001	13,311	16,419	6,656	8,210	6,656	8,210	6,567	8,100	99%	6,744	8,319	101%
2001-2002	2002	77,813	95,983	38,907	47,992	38,907	47,992	45,925	56,649	118%	31,888	39,334	82%
2002-2003	2003	92,539	114,147	46,270	57,074	46,270	57,074	68,508	84,505	148%	24,031	29,642	52%
2003-2004	2004	86,816	107,088	43,408	53,544	43,408	53,544	57,389	70,789	132%	29,428	36,299	68%
Median		92,539	114,147	46,270	57,074	46,270	57,074	65,180	80,400	141%	29,996	37,000	65%
Mean		115,101	141,977	57,550	70,989	57,550	70,989	83,506	103,005	145%	31,595	38,972	55%

[1] Calculated as the combined natural flow of: Lodge Creek below McRae Creek at the International Boundary; Battle Creek at the International Boundary; and, the Frenchman River at the International Boundary for March 1 - October 31 (from annual reports to the IJC).

[2] Approximate value calculated as one-half of the natural flow (from annual reports to the IJC).

[3] Calculated as the sum of recorded flows at the International Boundary crossings of Lodge Creek, Battle Creek, and the Frenchman River for March 1 - October 31 (from annual reports to the IJC).

[4] Approximate value calculated as the natural flow minus the approximate U. S. receipt.

APPENDIX H. LETTER OF INTENT

LETTER OF INTENT
TO BETTER UTILIZE THE WATERS OF THE ST. MARY AND MILK RIVERS

Whereas Article VI of the Boundary Waters Treaty of 1909 states that the St. Mary and Milk Rivers and their tributaries are to be treated as one for the purposes of irrigation and power;

And whereas, the Boundary Waters Treaty of 1909 and the International Joint Commission Order of 1921 authorizes the Reclamation and Irrigation Officers of the United States and Canada (currently designated as the Accredited Officers of the United States and Canada) to make the greatest beneficial use of the waters of the St. Mary and Milk Rivers;

And whereas, Canada finds it beneficial to use more than its share of the Milk River in the June-September period each year to supply water to Canadian Milk River irrigators;

And whereas, the United States finds it beneficial to use more than its share of the St. Mary River in the March-May period each year to supply water to United States Milk River irrigators;

It is therefore ordered and directed by said Accredited Officers or their designates that the United States be allowed to accumulate a deficit on the St. Mary River of up to 4,000 cfs-days (9 800 dam^3) between March 1 and May 31 of each year which, at the discretion of the United States, may be reduced to no less than 2,000 cfs-days (4 900 dam^3) between June 1 and July 15 of each year with surplus deliveries of St. Mary River water, and that Canada be allowed to accumulate a deficit on the Milk River of up to 2,000 cfs-days (4 900 dam^3) between June 1 and September 15 of each year. The incurred deficits on the St. Mary and Milk Rivers can be offsetting and the outstanding deficits as of September 15 will be equalized by October 31 of each year under administration by Field Representatives of the Accredited Officers. Detailed accounting procedures for the computation of deficit and surplus deliveries under this Letter Of Intent are outlined in Appendix A, " Procedures for the Computation of Deficit and Surplus Deliveries to Better Utilize Waters of the St. Mary and Milk Rivers".

In signing this letter, the parties recognize this agreement is within the 1921 Order of the International Joint Commission. Additionally, the parties recognize that this Letter of Intent and Appendix A will form part of the St. Mary - Milk River Procedural Manual.

Termination of this Letter Of Intent will be allowed upon request by either the United States or Canada notifying the other party in writing two months prior to the commencement of the irrigation season (April 1st as specified by the 1921 Order).

____
Tim Goos
Accredited Officer of Her Majesty
Dated this 8th day of February, 2001

____
William J. Carswell, Jr. for the
Accredited Officer of the United States
Dated this 8th day of February, 2001

<u>Appendix A</u> - PROCEDURES FOR THE COMPUTATION OF DEFICIT AND SURPLUS DELIVERIES TO BETTER UTILIZE WATERS OF THE ST. MARY AND MILK RIVERS

ST. MARY RIVER

As of January 2001, the accounting procedures for the computation of deficit and surplus deliveries during March 1 through September 15 of each year on the St. Mary River are:

1. During March 1 through May 31 of each year, deficit deliveries from the U. S. to Canada at the end of each division period will carry over from one division period to another for the year, are cumulative for the year, and are allowed up to a cumulative total of 4,000 cfs-days (9 800 dam^3). Deficit deliveries greater than the allowed cumulative total of 4,000 cfs-days (9 800 dam^3) are to be refunded in the subsequent division period. Surplus deliveries at the end of a division period are not cumulative, cannot be used to reduce the accumulated deficit from previous division periods to below the allowed total deficit of 4,000 cfs-days (9 800 dam^3), and cannot be used as a credit to make up future deficits. Exceptions to these procedures for this period are allowed only if agreed upon in writing by the Field Representative for Canada.

2. During June 1 through July 15 of each year, the U. S., at its discretion, may reduce the deficit accumulated in the March 1 through May 31 period to 2,000 cfs-days (4 900 dam^3) by making surplus deliveries of St. Mary River water. The remaining deficit is not refundable until after September 15 of that year unless agreed upon in writing by the Field Representative for Canada.

3. During June 1 through September 15 of each year, deficit deliveries from the U. S. to Canada at the end of each division are not to be incurred. However, if deficits are incurred, they are to be refunded by surplus deliveries in the subsequent division period or at a time agreed upon by both parties. Surplus deliveries do not carry over from one division period to another, are not cumulative, and cannot be used as a credit to make up future deficits.

4. On September 15 of each year, outstanding deficits are to be determined using the best available data, even though those data may be provisional. Any outstanding deficits as of September 15 are to be equalized by October 31 of each year. Deficit deliveries accumulated by Canada on the Milk River can be used to offset deficit deliveries accumulated by the U. S. on the St. Mary River.

5. The U. S. Bureau of Reclamation shall contact Canada (Environment Canada), the United States (U. S. Geological Survey), Montana (Montana Department of Natural Resources and Conservation), and Alberta (Alberta Environment) when they plan to begin deficit deliveries during the March 1 through May 31 period and when they plan to make surplus deliveries to reduce the accumulated deficits to 2,000 cfs-days (4 900 dam^3) during June 1 through July 15. On or about July 1, and again by September 15 of each year, the parties shall participate in a conference call or meeting to discuss refund of remaining deficit deliveries.

MILK RIVER

As of January 2001, the accounting procedures for the computation of deficit and surplus deliveries during March 1 through September 15 of each year on the Milk River are:

1. During March 1 through May 31 of each year, deficit deliveries from Canada to the U. S. at the end of each division period are not to be incurred. However, if deficits are incurred, they are to be refunded by surplus deliveries in the subsequent division period or at a time agreed upon by both parties. Surplus deliveries do not carry over from one division period to another, are not cumulative, and cannot be used as a credit to make up future deficits.

2. During June 1 through September 15 of each year, deficit deliveries from Canada to the U. S. at the end of each division period will carry over from one division period to another for the year, are cumulative for the year, and are allowed up to a cumulative total of 2,000 cfs-days (4 900 dam^3). Deficit deliveries greater than the allowed total of 2,000 cfs-days (4 900 dam^3) are to be refunded in the subsequent division period. Surplus deliveries at the end of a division period cannot be used to reduce the deficit accumulated during the June 1 through September 15 period to below the lesser of the allowed total deficit of 2,000 cfs-days (4 900 dam^3) or the outstanding United States' deficit accumulated on the St. Mary River in the March 1 through May 31 period, and cannot be used as credits to make up future deficits. The remaining deficit is not refundable until after September 15 of that year unless agreed upon in writing by the Field Representative for the United States.

3. On September 15 of each year, outstanding deficits are to be determined using the best available data, even though those data may be provisional. Any outstanding deficits as of September 15 are to be equalized by October 31 of each year. Deficit deliveries accumulated by Canada on the Milk River can be used to offset deficit deliveries accumulated by the United States on the St. Mary River.

4. Canada (Environment Canada), the United States (U. S. Bureau of Reclamation and U. S. Geological Survey), Alberta (Alberta Environment) and Montana (Montana Department of Natural Resources and Conservation) shall participate in a conference call or meeting on or about July 1, and again by September 15 of each year to decide on the approach to be used to reconcile outstanding deficit deliveries.

APPENDIX I. HYDROLOGIC MODELING

The purpose of this report is to document the development of a set of natural flows and hydrologic models (water balance spreadsheets) that were used by the Task Force to evaluate potential alternative administrative measures, with respect to optimal receipt by each country of its apportioned waters. More specifically, the report examines the effect of different surplus/deficit accounting procedure and different balancing periods with respect to:

> The potential additional utilization by the U. S. of its share of the waters of the St. Mary River, and the potential additional utilization by Canada of its share of the waters of the Milk River.

This report does not examine the relative advantages, disadvantages, and/or desirability of these alternatives.

The historical assumptions included:

- The number of acres irrigated in Montana on the North and South Forks of the Milk River and other tributaries were 3,200 acres with a depletion of 8 inches per year and 1,750 acres with a depletion of 13.3 inches per year.
- The number of acres irrigated in Alberta in the Milk River Basin was 1,500 acres with a depletion of 8 inches per year and 2,900 acres with a depletion of 13.3 inches per year.
- Alberta was given a credit for deliveries of St. Mary River water into Verdigree Coulee.
- Any time the calculated natural flow of the Milk River was negative, the number was arbitrarily changed to zero.
- No minimum instream flow in the St. Mary River at the international border or downstream of Sherburne Reservoir in Swiftcurrent Creek was maintained.
- No accounting of the use of the United States share of St. Mary River water by Canada in the Milk River channel.
- Letter of Intent was implemented in 1990 and modified in 2001.

Corresponding assumptions used for modeling the five options included:

- The existing St. Mary canal capacity of 650 cfs was used in the analyses.
- Both rivers are apportioned daily, but five different accounting or balancing periods were analyzed and compared: 7-day, 15/16-day, monthly, seasonal and annual.

- The U. S. would maintain a release of up to 25 cfs from Sherburne Reservoir or the natural inflow into the reservoir whichever is less.

- For the St. Mary River at the international border, the U. S. would maintain an instream flow. For modeling purposes, the instream flow was assumed to be the lesser of: ½ of the average monthly flow rate; ½ of the average annual flow rate; or, the Canadian monthly entitlement.

- For the Milk River at the Eastern Crossing, Canada would not be required to maintain an instream flow in the river. The U. S. maintains instream flows in the Milk River with St. Mary water from March 1 to October 31st and since Alberta has no infrastructure to store Milk River water, the natural flow would cross the border uninhibited outside of the irrigation season.

- Based on recent discussion with local water users, reviewing aerial maps and conducting field investigations, the number of acres irrigated on the tributaries of the North and South Forks of the Milk River in Montana is assumed to be 300 with a depletion of 13.3 inches per year full service acres. The historical numbers of 3,200 acres is retained with a lower application per acre.

- Based on Alberta data, the Province is irrigating 1,500 acres with a depletion of 8 inches per year and 8,100 acres with depletion of 13.3 inches per year from the mainstem of the Milk River.

- Any time the calculated natural flow of the Milk River was negative, the number was arbitrarily changed to zero.

St. Mary River Natural Flows and Model Development

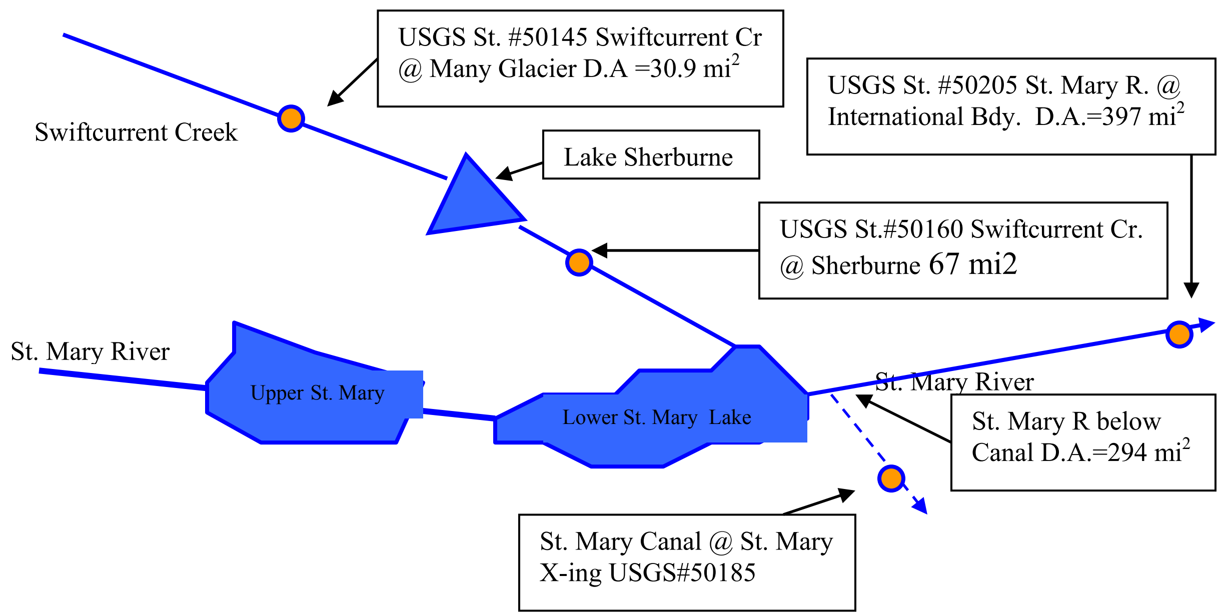
Swiftcurrent Creek is one of the major tributaries of the St. Mary River. Originating in the high elevation areas of Mount Grinnel, Swiftcurrent Creek flows in a northeasterly direction into Lake Sherburne, a man-made storage reservoir. From Lake Sherburne, Swiftcurrent Creek flows in an easterly direction for a distance of about five miles before emptying into Lower St. Mary Lake.

The Lake Sherburne Reservoir has a storage capacity of about 67,850 acre-feet (83,660 dam^3), about 4000 acre-feet of which is dead storage. The reservoir is the only storage facility in the headwaters of the St. Mary River available to the U. S. to capture and more favorably distribute part of the U. S. entitlement of the St. Mary River.

The U. S. relies on the U. S. St. Mary Canal, which has a capacity of about 650 cfs, to convey its entitlement of the St. Mary River into the Milk River. Once in the Milk River channel, the U. S. diversions are conveyed across Southern Alberta and into north central Montana, where the water is either stored in Fresno Reservoir or put to immediate beneficial use. Due to current conditions which include: a limited canal capacity; limited storage; and apportionment administrative procedures, the U. S is unable to take its full entitlements of the flow of the St. Mary River, particularly during periods of high flow.

Figure 1 provides a schematic representation of the St. Mary River and of the location of Swiftcurrent Creek and Sherburne Reservoir relative to Lower St. Mary Lake and the location of streamflow gauging stations within the basin.

Figure 1. Schematic of Swiftcurrent Creek and Related Gauging Stations



<u>Computation of Natural Inflow to Lake Sherburne</u>

Daily natural inflows to Lake Sherburne were computed by taking the sum of the change in storage at Lake Sherburne, as computed by Reclamation, and the recorded flow for Swiftcurrent Creek at Lake Sherburne (USGS Station #5016000). While the USGS station #5016000 had a number of data gaps, it was determined that the majority of the data gaps were for a period when there were no releases from Sherburne Reservoir and as such were set to zero.

The summation of these two data sets frequently resulted in highly variable inflow estimates with a number of occurrences, generally in winter months, in which a negative inflow was computed. While the variability and negative natural flow computations were generally attributed to such items as inaccuracies in the computed Lake Sherburne water level (change in storage) due to ice, infrequent winter measurements, wind setup, etc., no effort was made to “smoothen” the data as it was felt that it would not have any appreciable impact on the assessment of potential diversions.

In instances where the above noted procedure resulted in a negative natural flow, generally in winter, the negative flow was often proceeded or followed by a significant flow spike thus implying that the negative flow was likely due to short term fluctuations resulting from such items as wind setup or ice conditions. To eliminate the negative flows (while maintaining the accuracy of the water balance) the computed flows for a variable period before and after the occurrence of a negative value were averaged so as to produce a positive flow. The length of the period to be averaged was arbitrarily selected using the upstream USGS station #5014500, Swiftcurrent Creek at Many Glacier to select a reasonably stable period for which the averaging would provide a reasonable estimate. The only exception to the foregoing procedure was for the period of November 6 to December 11, 1995 during which there are no recorded flows for the station Swiftcurrent Creek at Sherburne, and for which it is known that there were significant inflows into Sherburne Reservoir. For this short period, the flow was estimated as 140 per cent of the recorded flow for the upstream station Swiftcurrent Creek at Many Glaciers (USGS #5014500).

The resulting flows are available in a spreadsheet maintained by Alberta Environment and Montana Department of Natural Resources and Conservation.

Computation of Natural Flows for the St. Mary River at the International Boundary

The Field Representatives compute the daily natural flows for the St. Mary River at the International Boundary for the period during which the U. S. St. Mary Canal is operational, generally March 1 to October 31. Since an electronic copy of the official computed daily natural flows for the St. Mary River at the International Boundary were not available, they were recomputed using the IJC procedures as follows:

$$QNix(t)= QRix(t)+QRusc(t)+\Delta Sls(t-1)$$

Where QNix(t) = the naturalized mean daily flow for the St. Mary River at the International Boundary on day “t”.

QRix(t) = the recorded mean daily flow for the St. Mary River at the International Boundary (USGS St. # 5020500) on day “t”.

QRusc(t)= the recorded mean daily flow for the U. S. St. Mary Canal at the International Boundary (USGS St. # 5018500) on day “t” and

ΔSls(t-1)= the daily change in storage for Lake Sherburne Reservoir on day (USGS St. # 5015500) on day “t-1”.

Computation of the daily natural flow using the above procedure on occasion resulted in the computation of several days of negative natural flows for the St. Mary River at the International Boundary, typically for the period shortly before or after the start of the U. S. St. Mary Canal diversions. This occurrence, which has been noted previously by the Field Representatives, is attributed to instances in which Lower St. Mary Lake is at a relatively low level, thus requiring the use of releases from Lake Sherburne to replenish storage and hydraulic head before releases are realized as a flow in the St. Mary River.

While the Field Representatives have traditionally set these negative flow values to zero, a practice which results in a minor overestimation of available water, within this report the negative flow values were eliminated by averaging the computed natural flow values using USGS station #5014500, Swiftcurrent Creek at Many Glacier to select a reasonably stable period over which the averaging would provide a reasonable estimate. The resulting computed values were subsequently compared to the computed natural inflows to Lake Sherburne and a number of instances, in which the flow for the St. Mary River at the International Boundary was lower than the inflows to Lake Sherburne were identified. These occurrences are believed to be in error as they suggest a negative flow from the St. Mary River upstream from the confluence of Swiftcurrent Creek.

Therefore these occurrences were eliminated by averaging the previously computed flow for St. Mary River at the International Boundary until such time as it was higher than the inflow to Lake Sherburne. The only exception to the foregoing procedure was for the period of March 1 to March 23, 1980 that would have required averaging over an extended period to eliminate the large negative flow values computed for this period. In this instance, the flows for the St. Mary River at the International Boundary were set equal to the computed inflow to Lake Sherburne for the period. While this procedure introduced an additional 2870 cfs-days to the computed flow of the St. Mary River sub-basin, it is believed that it would have no significant impact on the subsequent modeling of the St. Mary system.

The 1979-80 to 2003-2004 annual natural flows computed by the above noted procedures were compared to the annual natural flows calculated and reported by the Field Representatives in their annual apportionment report to the IJC. In general, the annual natural flow values computed within this report were found to be within +/- 5000 acre-feet (average 103 ac-ft or 0.010 per cent of annual) of the values reported by the Field Representatives (table 7). The natural flows developed here were therefore deemed suitable for use in the daily model.

The resulting flows are available in a spreadsheet maintained by Alberta Environment and Montana Department of Natural Resources and Conservation.

<u>Assumed Conditions in the Computation of Potential U. S. St. Mary Canal Diversions</u>

The computation of potential diversions from the St. Mary River via the U. S. St. Mary Canal was carried out using a hydrologic accounting model that determines the daily diversions given a set of general assumptions, including assumptions as to administrative procedures, operating rule curves for Lake Sherburne, and operating rules for the U. S. St. Mary Canal. The model assumptions are as follows:

A. The drainage area of the St. Mary River upstream of the St. Mary Diversion Dam is only $286mi^2$ or 61.5 per cent of the $465mi^2$ drainage area of the St. Mary River at the International Boundary. However, it is believed that this portion of the drainage area likely generates more than 80 per cent of the total flow within the St. Mary River upstream of the International Boundary. As the volume generated from areas downstream of the St. Mary Diversion Dam is likely always substantially less than Canadian entitlements, it was agreed that the developed model could be simplified, without any impact on the overall results, by assuming that all flow at the International Boundary is generated upstream of the St. Mary Diversion Dam.

B. Canadian apportionment (entitlement) at the International Boundary is computed on a daily basis as per the 1921 Order and may be summarized as follows:

   April 1 to October 31 Irrigation Season

   For QNix< 666 cfs, QCanada=0.75QNix

   For QNix> 666 cfs, QCanada=500+0.5*(QNix-666)

   Where, QCanada =daily Canadian St. Mary River entitlements, and other parameters are as previously defined

   November 1 to March 31 Non-irrigation Season

   QCanada=0.50QNix

   Daily deliveries above Canadian entitlements are referred to as surplus deliveries, daily shortfalls in the delivery of Canadian entitlements are referred to as deficit deliveries.

C. The current administrative procedures are based on a bi-monthly (15th and end of month) balancing period in which daily surplus and deficit deliveries are permitted but must be balanced at the end of the balancing period. Any residual deficits at the end of the period are carried forward and due in the next period, any residual surplus' are forfeited. Included in the current Administrative Procedures is a Letter of Intent signed in 2001 which permits the U. S. to accumulate a delivery deficit of 4,000 cfs-days or 8,000 acre-feet in the March to May period and unconditionally repay up to ½ of this total in the June-July with surplus flows. Repayment of the balance requires discussion with Canada to ensure the most beneficial use to both countries, and is usually accommodated through offsets of Canadian Milk River deficits and surplus St. Mary River deliveries later in the season (frequently through storage releases from Sherburne Reservoir).

   In the modeled scenarios the following administrative conditions were assumed:

   (i) Daily surplus deliveries during a balancing period are permitted and are cumulative during the balancing period, residual surplus deliveries at the end of the balancing period are forfeited,
   (ii) Daily deficit deliveries are permitted provided:
      i. There is no accumulated deficit during the period (i.e. deficits are drawn against previously accumulated surplus deliveries during the period)
      ii. Minimum in stream flow requirements are maintained. As per Montana's recommendation (not agreed to by Canada), daily instream flow requirements, and minimum deliveries to Canada, must at all times remain above the lesser of :
         a. ½ the mean annual flow at the St. Mary River at the International Boundary
         b. ½ the mean Monthly flow of the St. Mary River at the International Boundary
         c. the daily Canadian apportionment entitlements.

The computed mean monthly and mean annual flows used to determine the minimum flow values are as follows:

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Monthly Flow (cfs)	190	186	228	572	2106	3297	1688	726	514	446	386	236

Mean Annual Flow (cfs)	884

Lake Sherburne Operating Rule Curves and Modeling Assumptions

1. Maximum Storage = 67,850 acre-feet.
2. Minimum (dead) Storage = 4,000 acre-feet.
3. Any runoff generated above Lake Sherburne is captured and retained in Lake Sherburne unless releases are required to meet Canadian entitlements, or to maintain desired (assumed maximum) diversions rates within the U. S. St. Mary Canal.

U. S. St. Mary Canal Operating Rule Curves

1. The canal has an average historic flow capacity of 650 cfs.
2. Diversions commence on March 15 of each year.
3. Canal diversions are discontinued on October 31 of each year.
4. Rate of change in diversions during start up and shut down is 100cfs per day.
5. After September 1, discontinue diversions if available water is less than 100 cfs.
6. U. S. St. Mary Canal requirements are to be met through the following order of priorities:
    a. Diversion of U. S. entitlements of natural flow of the St. Mary River then
    b. Permissible deficit deliveries to Canada, and
    c. Storage releases from Lake Sherburne

Computation of Potential U. S. St. Mary Canal Diversion Under Alternate Balancing Period, Surplus/Deficit Accounting Procedures, and Minimum Flow Conditions

The computation of potential U. S. diversions from the St. Mary River via the U. S. St. Mary Canal under alternate surplus/deficit accounting procedures were carried out for the 1979-80 through to 2003-04 water year using the previously described hydrologic model for the following balancing periods and minimum flow release conditions from Lake Sherburne:

Scenario 1a: 7-day balance period and 25 cfs continuous release from Lake Sherburne.
Scenario 1b: 7-day balance period and 0 cfs continuous release from Lake Sherburne.

Scenario 2a: bi-monthly (15^{th} and end of month) balance period and 25 cfs release from Lake Sherburne.
Scenario 2b: bi-monthly (15^{th} and end of month) balance period and 0 cfs min. flow release from Lake Sherburne

Scenario 3a: monthly balance period and 25 cfs min. flow release from Lake Sherburne.
Scenario 3b: monthly balance period and 0 cfs min. flow release from Lake Sherburne.

Scenario 4a: seasonal balance period and 25 cfs continuous release from Lake Sherburne.
Scenario 4b: seasonal balance period and 0 cfs continuous release from Lake Sherburne

Scenario 5a: annual balance period and 25 cfs continuous release from Lake Sherburne.
Scenario 5b: annual balance period and 0 cfs continuous release from Lake Sherburne

Discussion of Simulated Conditions and Model Results

The results reported in this section provide a summary of the potential diversions for the stated conditions and balancing periods without factoring potential limiting conditions (such as floods, canal maintenance, etc.) which at times may dictate more cautious or reduced diversions. Rather, the simulations are based on the assumption of exact knowledge as to status of flow and apportionment conditions, on the maximization of diversions without any consideration to limiting weather or streamflow (flood) conditions and without any consideration to storage conditions of downstream reservoirs and their ability to capture and store diverted waters.

As such, the model results are likely an overestimation of the quantity of water that would be diverted under actual operational conditions. The model results however, are believed to provide a reliable relative comparison as to what diversion is possible under the various conditions being analyzed.

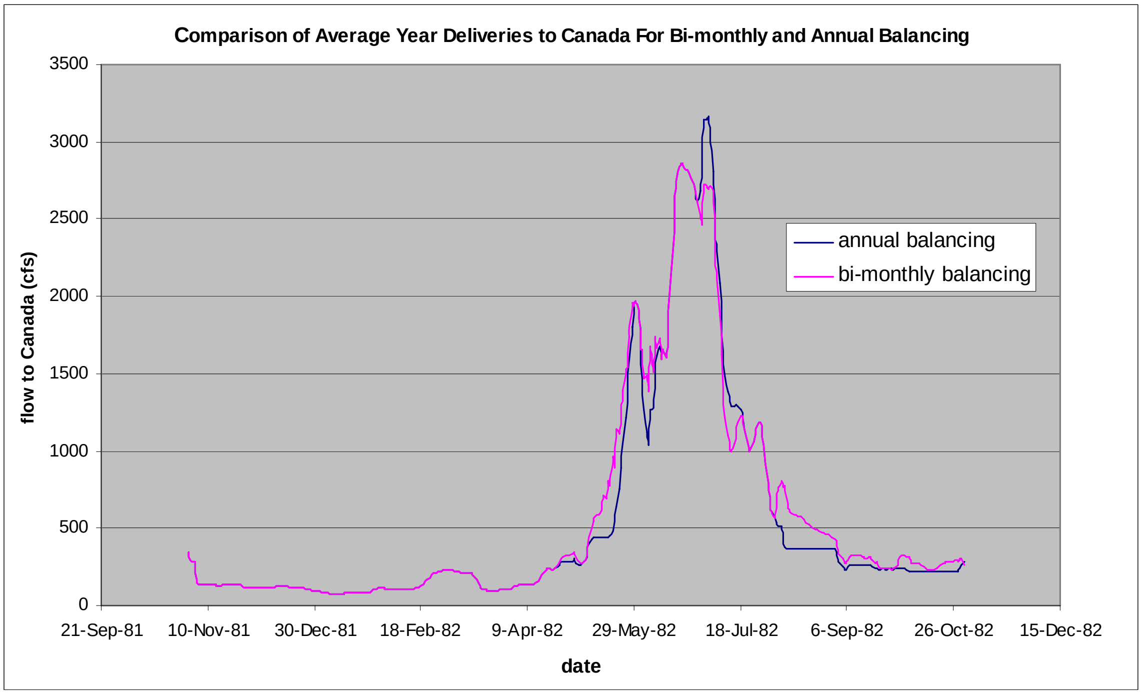
In a similar fashion, the model simply assesses the quantity of water that can be diverted under various surplus/deficit accounting conditions, minimum flow conditions and balancing periods, without any consideration to the viability or desirability of implementing these conditions. However, it is noted that the implementation of a longer balancing period and the accumulation of surplus deliveries that can be drawn upon by future deficit deliveries will result in:

- Less residual flow in the St. Mary River during the shoulder period (spring and late summer)

- The downstream country (Canada on the St. Mary River) receiving a greater portion of its entitlement in the winter, during high flow, and flood periods, while

- The upstream country (the U. S. on the St. Mary River) receives a greater share of its entitlement during the spring and summer low flow periods. These effects are shown in Figure 2, which shows the daily deliveries to Canada during an average (1981-82) year for a bi-monthly and annual balancing period.

Figure 2. Comparison of Daily Flows to Canada during an Average Year For Bi-monthly and Annual Balancing



The model results of potential diversions for the above noted simulations are summarized in Table 1, Table 2 and Figure 3. As indicated in Table 1, during the November 1, 1979 to October 31, 2004 period, the U. S. has on average diverted approximately 175,400 acre-feet of its 246,400 acre-feet entitlement from the St. Mary River. As also indicated in Table 1, under the "near current" operational conditions, on average the U. S. should have been able to divert approximately 216,800 acre-feet of its entitlements. While the exact reason for this large difference between actual and simulated diversions is uncertain, it is believed that it is likely due to one or more of the following factors:

1. Degradation in canal capacity for some historical periods,

2. Shut downs or reduced diversion for canal maintenance,

3. Operational decisions to reduce or eliminate diversions during floods so as to safeguard against canal failure, and

4. Operational decisions to reduce or eliminate diversions during period when there is an adequate water supply within the Milk River system to meet Milk River irrigation requirements in the U. S.

A comparison between Scenarios 2b, 3b, 4b, and 5b in Table 1 indicates that a change in the surplus/deficit accounting process and a lengthening of the balancing period, on average, will not provide measurable benefit over existing conditions unless it is lengthened to either a seasonal or annual balancing period. A comparison of the same scenarios in Table 2 indicates that even with these changes in the surplus/deficit accounting, and the lengthened balancing period, there would likely be very modest increases in the potential diversions during the drier years with more benefit during the average and wetter years.

A comparison between “a” scenarios, which include a 25 cfs minimum flow release from Lake Sherburne and “b” scenarios, which have no minimum release requirement, indicates that the minimum release of 25 cfs from Sherburne Reservoir will result in a reduction of about 6,800 acre-feet in potential diversions. This reduction in diversion potential is nearly eliminated in the annual balancing period, likely due to the winter releases being accumulated as surplus deliveries to Canada, which can then be drawn on in the spring through deficit deliveries to Canada.

In summary, the analysis indicates that the change in the surplus/deficit accounting procedures and the lengthening of the balancing period provides the U. S. with additional opportunity to divert a larger share of its entitlement only if the balancing period is extended to a seasonal or annual balancing. Further, the simulations indicate that most of the potential increase in the U. S. diversions would occur during the average-to-wet years, with relatively modest increase during the drier years, when water availability (rather than infrastructure) is the limiting condition.

Figure 3. Comparison of Average Annual Potential U. S. St. Mary Canal Diversions for Various Balancing Scenarios

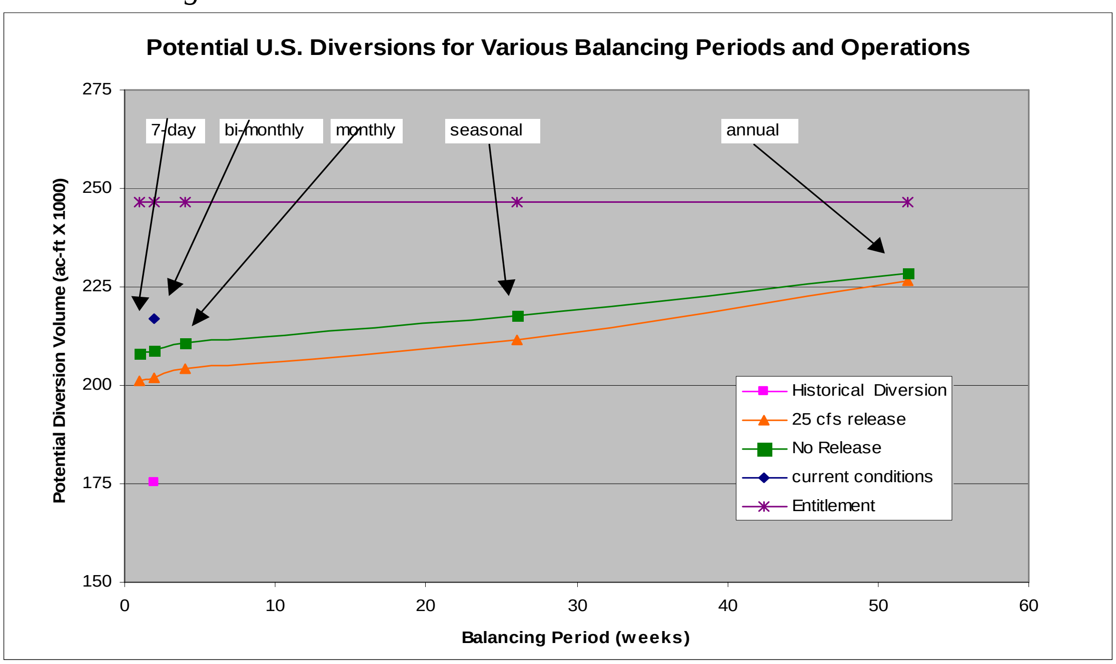


Table 1 - Summary Of U.S. St. Mary River Diversions Possible For Various Operational And Administrative Alternatives

Water Year	Modelled Nat Flow St. Mary R. @ Int. Boundary	Actual Nat Flow St. Mary R. @ Int. Boundary	Modelled U.S. St. Mary R. entitlement	Actual U.S. St. Mary R. entitlement	Historical U.S. St. Mary Diversions	Potential U.S. Diversion For Indicated Scenario of Canal Capacity, Balance Period and Min Release from L. Sherburme 1a 650 cfs Canal 7-day bal. 25 cfs min Q	1b 650 cfs Canal 7-day bal. 0 min release	2a 650 cfs Canal 15/16day bal. 25 cfs	2b 650 cfs Canal 15/16day bal. 0 cfs min Q	near current Scenario 2a + 8,000 ac-ft as per LOI	3a 650 cfs Canal monthly bal. 25 cfs min Q	3b 650 cfs Canal monthly bal. 0 cfs min Q	4a 650 cfs Canal seasonal bal. 25 cfs min Q	4b 650 cfs Canal seasonal bal. 0 cfs min Q	5a 650 cfs Canal annual bal. 25 cfs min Q	5b 650 cfs Canal annual bal. 0 cfs min Q
	(ac-ft)	(ac-ft)	(Ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
1979-1980	592,298	587,851	231,771	233,047	199,494	206,483	214,067	211,751	219,175	227,175	211,751	219,381	223,114	229,030	234,796	234,796
1980-1981	657,465	655,755	272,404	273,799	231,831	225,050	232,257	225,137	232,428	240,428	231,029	237,576	246,980	252,883	257,110	263,013
1981-1982	601,754	602,450	245,627	245,526	99,414	206,511	213,403	206,164	212,872	220,872	206,809	213,518	222,057	228,766	226,557	233,266
1982-1983	468,396	468,532	181,681	181,420	178,516	165,191	171,800	165,649	171,979	179,979	165,769	172,100	165,830	172,662	181,904	182,053
1983-1984	500,104	500,422	192,606	192,406	164,066	172,753	179,123	172,828	179,148	187,148	172,828	179,148	172,828	179,280	192,271	192,287
1984-1985	584,774	584,711	227,065	226,922	215,670	199,010	207,644	198,790	207,474	215,474	203,018	210,958	206,742	213,385	223,314	223,314
1985-1986	611,561	611,677	241,789	241,930	135,673	198,343	205,896	198,229	205,881	213,881	210,660	217,927	212,028	218,886	244,316	244,465
1986-1987	557,133	557,258	219,910	220,058	177,513	196,456	203,574	197,161	204,039	212,039	197,947	204,342	199,221	205,404	220,261	220,291
1987-1988	432,966	433,993	162,984	163,666	177,166	149,940	155,776	149,940	155,776	163,776	150,493	156,053	151,143	156,978	162,337	162,386
1988-1989	693,424	694,002	282,568	282,730	277,426	242,272	250,028	243,861	250,910	258,910	246,230	254,180	256,129	262,694	262,992	268,268
1989-1990	757,948	758,101	314,344	314,750	206,885	254,540	263,370	260,058	267,875	275,875	263,704	270,310	272,006	278,153	287,436	287,436
1990-1991	845,249	845,496	364,529	364,790	218,439	238,074	244,652	238,387	244,966	252,966	238,402	244,981	252,110	258,689	279,977	279,976
1991-1992	435,297	435,714	156,950	157,251	137,629	138,445	144,840	138,445	144,840	152,840	138,825	146,394	140,114	146,509	156,342	156,441
1992-1993	571,475	571,386	220,966	221,065	188,071	197,620	204,684	197,620	205,136	213,136	199,414	206,930	200,367	207,090	221,049	221,178
1993-1994	502,599	497,977	198,713	196,335	162,728	173,634	180,284	174,503	180,998	188,998	176,824	183,696	176,824	183,696	198,504	198,652
1994-1995	786,804	786,540	333,545	333,514	85,538	241,869	248,551	241,815	248,547	256,547	243,866	250,647	249,821	256,602	250,253	257,034
1995-1996	822,288	823,873	349,293	349,826	149,074	260,691	264,925	261,472	265,971	273,971	268,577	268,577	287,375	287,375	287,375	287,375
1996-1997	819,620	819,804	344,287	344,612	172,517	244,700	251,459	245,883	252,625	260,625	248,409	254,457	260,061	267,002	269,080	276,020
1997-1998	562,486	562,853	229,589	229,848	214,234	204,777	210,363	205,140	210,726	218,726	205,771	213,050	239,409	246,123	249,798	256,540
1998-1999	614,907	615,088	246,747	247,090	179,588	221,899	227,539	222,165	228,356	236,356	222,531	228,722	230,962	237,599	245,612	245,981
1999-2000	572,120	572,503	228,846	229,173	178,709	188,486	195,221	190,164	196,868	204,868	190,164	197,539	190,852	197,475	229,683	229,457
2000-2001	364,776	365,157	139,714	139,852	131,123	127,674	133,008	127,892	134,155	142,155	127,892	134,155	127,892	134,155	139,727	139,826
2001-2002	851,669	851,339	367,946	368,120	152,539	210,514	217,003	210,514	217,003	225,003	210,514	217,003	225,245	231,734	237,670	240,853
2002-2003	484,804	489,663	189,521	191,696	160,556	166,276	173,396	166,370	174,096	182,096	172,061	178,497	175,835	182,578	189,423	189,522
2003-2004	565,965	568,301	217,758	219,124	188,615	202,454	209,067	201,840	208,453	216,453	202,534	209,147	202,534	209,147	217,360	217,360
average	610,315	610,418	246,446	246,742	175,321	201,346	208,077	202,071	208,812	216,812	204,241	210,772	211,499	217,756	226,606	228,312

Table 2 - Comparison Of Potential U.S. St. Mary River Diversions For Dry, Anerage, and Wet year Under Various Operational And Administrative Alternatives

Water Year	Modelled Nat Flow St. Mary R. @ Int. Boundary	Actual Nat Flow St. Mary R. @ Int. Boundary	Modelled U.S. St. Mary R. entitlement	Actual U.S. St. Mary R. entitlement	Historical U.S. St. Mary Diversions	Potential U.S. Diversion For Indicated Scenario of Canal Capacity, Balance Period and Min Release from L. Sherburme 1a 650 cfs Canal 7-day bal. 25 cfs min Q	1b 650 cfs Canal 7-day bal. 0 min release	2a 650 cfs Canal 15/16day bal. 25 cfs	2b 650 cfs Canal 15/16day bal. 0 cfs min Q	near current Scenario 2a + 8,000 ac-ft as per LOI	3a 650 cfs Canal monthly bal. 25 cfs min Q	3b 650 cfs Canal monthly bal. 0 cfs min Q	4a 650 cfs Canal seasonal bal. 25 cfs min Q	4b 650 cfs Canal seasonal bal. 0 cfs min Q	5a 650 cfs Canal annual bal. 25 cfs min Q	5b 650 cfs Canal annual bal. 0 cfs min Q
	(ac-ft)	(ac-ft)	(Ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
5 DRIEST YEARS																
2000-2001	364,776	365,157	139,714	139,852	131,123	127,674	133,008	127,892	134,155	142,155	127,892	134,155	127,892	134,155	139,727	139,826
1987-1988	432,966	433,993	162,984	163,666	177,166	149,940	155,776	149,940	155,776	163,776	150,493	156,053	151,143	156,978	162,337	162,386
1991-1992	435,297	435,714	156,950	157,251	137,629	138,445	144,840	138,445	144,840	152,840	138,825	146,394	140,114	146,509	156,342	156,441
1982-1983	468,396	468,532	181,681	181,420	178,516	165,191	171,800	165,649	171,979	179,979	165,769	172,100	165,830	172,662	181,904	182,053
2002-2003	484,804	489,663	189,521	191,696	160,556	166,276	173,396	166,370	174,096	182,096	172,061	178,497	175,835	182,578	189,423	189,522
1993-1994	502,599	497,977	198,713	196,335	162,728	173,634	180,284	174,503	180,998	188,998	176,824	183,696	176,824	183,696	198,504	198,652
average	448,140	448,506	171,594	171,703	157,953	153,527	159,851	153,800	160,307	168,307	155,311	161,816	156,273	162,763	171,373	171,480
1992-1993	571,475	571,386	220,966	221,065	188,071	197,620	204,684	197,620	205,136	213,136	199,414	206,930	200,367	207,090	221,049	221,178
1999-2000	572,120	572,503	228,846	229,173	178,709	188,486	195,221	190,164	196,868	204,868	190,164	197,539	190,852	197,475	229,683	229,457
1984-1985	584,774	584,711	227,065	226,922	215,670	199,010	207,644	198,790	207,474	215,474	203,018	210,958	206,742	213,385	223,314	223,314
1979-1980	592,298	587,851	231,771	233,047	199,494	206,483	214,067	211,751	219,175	227,175	211,751	219,381	223,114	229,030	234,796	234,796
1981-1982	601,754	602,450	245,627	245,526	99,414	206,511	213,403	206,164	212,872	220,872	206,809	213,518	222,057	228,766	226,557	233,266
1985-1986	611,561	611,677	241,789	241,930	135,673	198,343	205,896	198,229	205,881	213,881	210,660	217,927	212,028	218,886	244,316	244,465
average	588,997	588,430	232,677	232,944	169,505	199,409	206,819	200,453	207,901	215,901	203,636	211,042	209,193	215,772	229,953	231,079
1994-1995	786,804	786,540	333,545	333,514	85,538	241,869	248,551	241,815	248,547	256,547	243,866	250,647	249,821	256,602	250,253	257,034
1996-1997	819,620	819,804	344,287	344,612	172,517	244,700	251,459	245,883	252,625	260,625	248,409	254,457	260,061	267,002	269,080	276,020
1995-1996	822,288	823,873	349,293	349,826	149,074	260,691	264,925	261,472	265,971	273,971	268,577	268,577	287,375	287,375	287,375	287,375
1990-1991	845,249	845,496	364,529	364,790	218,439	238,074	244,652	238,387	244,966	252,966	238,402	244,981	252,110	258,689	279,977	279,976
2001-2002	851,669	851,339	367,946	368,120	152,539	210,514	217,003	210,514	217,003	225,003	210,514	217,003	225,245	231,734	237,670	240,853
average	825,126	825,410	351,920	352,172	155,621	239,169	245,318	239,614	245,823	253,823	241,954	247,133	254,922	260,280	264,871	268,252
overall average	610,315	610,418	246,446	246,742	175,321	201,346	208,077	202,071	208,812	216,812	204,241	210,772	211,499	217,756	226,606	228,312

Milk River Natural Flows and Model Development

<u>NOTE</u>: Differences of opinion exist between Alberta and Montana with respect to various modeling constraints and operating criteria for the Milk River modeling effort. Accordingly, neither version has been endorsed or accepted in its entirety by the Task Force. However, both versions are included here for purposes of comparison.

Alberta Simulation

<u>Computation of Natural Flows</u>

The first step in modeling the Milk River was to compute natural flows. Daily U. S. Geological Survey (USGS) flow records from November 1, 1979 through October 31, 2004 were used as the basis to calculate the natural flow of the Milk River at the Eastern Crossing of the International Boundary. In simple terms, natural flow of the Milk River is calculated as:

$$Qnex = Qrex + CUus + CUcan - (USdiv\text{-}EEdiv) - Ecdiv$$

Where:

Qnex = the computed natural flow for the Milk River at the Eastern Crossing

Qrex = the recorded flow for the Milk River at the Eastern Crossing (USGS gage 0613500),

CU = Consumptive use by Canada (can) and the US (us)

USdiv = U. S. St. Mary canal diversions reaching the Milk River, which are computed as the recorded flow for the North Fork Milk River at the Western Crossing (USGS gage 0613400 – USGS gage 06133500) lagged by a four/five day time lag these include both U.S diversions of St. Mary River entitlements as well as requested diversions of Canadian St. Mary entitlements (mostly in the 1980's),

EEdiv = the incremental increases in evaporation and evapotranspiration from the Milk River channel caused by Saint Mary canal diversions, and

ECdiv = Canadian Verdigris diversion (effective only during the 1980-1998 period)

The current IJC Milk River accounting procedures were last modified in the early 1980's. The Task Force has met and tentatively agreed that some of these procedures are dated and should be modified to compute the natural flow more accurately. Irrigation practices in the basin have changed in the last 25 years, and review of recent LandSat imagery and water license records indicates that there are now approximately 8,100 acres of full service licensed irrigation out of the Milk River in Alberta, verse the 2,900 acres of full service irrigation and 1500 acres of partial service flood irrigation accounted for in the old procedures. Montana irrigation development has changed less, but the amount of depletion by Montana irrigators needs to be better quantified. Also, the current procedures have a set irrigation demands for wet years and for dry years, but do not make adjustments to account for the variability in irrigation demand that is unique to each season.

In order to estimate consumptive uses more accurately, full service irrigated acres in Alberta were linearly adjusted, incrementally each year, starting in 1980 and ending in 2004, from the 2,900 acres used previously to the present level of 8,100 acres. For Montana, full service irrigated acres were adjusted in a similar manner from 1,750 in 1980 to 300 acres in 2004. The "**NET Crop Water Req'mnt Deficit (in)**", needed to estimate consumptive uses were provided by Alberta in spreadsheet "T002R15W4 Summary_Jul05.xls". This spreadsheet calculates net crop irrigation requirement by estimating the crop irrigation need and subtracting any recorded rainfall.

Because the rainfall is subtracted, this procedure will generate negative crop requirements during wet periods. Negative crop irrigation values were counterbalanced by recognizing that some of the excess rain is stored in the soil and will be used by the crop later. By averaging the irrigation water requirement over a 14-day period, most negative values were eliminated. Negative values in a 14-day average would imply excess rainfall is returning to the river from soil storage, which ultimately should be captured by the streamflow gages. The estimated daily crop requirement was then divided by a typical irrigation efficiency for a sprinkler system of 0.75 to compute a daily per acre depletion. These full service irrigation depletions then were multiplied by the number of full service acres to calculate total irrigation flow depletions. This same procedure was used to compute both Alberta and Montana full-service irrigation depletions.

The rest of the irrigation in the Milk River basin is partial service flood irrigation. For the modeling, 1,500 acres of this type of irrigation was used for Alberta and 3,200 acres for Montana. The current administrative procedures per-acre depletion rates were used for these partial service flood irrigated acres. The methods set forth in the current administrative procedures were followed for all other aspects of the natural flow computations, including the zeroing of computed negative natural flows.

The Milk River natural flow estimates, along with the computed United States and Canadian shares, are summarized in Table 1. Because the Milk River natural flow computations discussed above incorporate these refinements, these computed natural flows differ somewhat from the Milk River natural flows as reported in the IJC annual reports.

Table 1 provides a summary of the annual natural flows for the Milk River at the Eastern Crossing as computed by the above noted procedures. As indicated in Table 1 the natural flow for the Milk River at the Eastern Crossing of the International Boundary varies from a low of 23,050 acre-feet in 2000-01 to a high of 206, 278 acre-feet in 1995-96 and have an average value of about 103,878 acre-feet.

<u>Computation of Canadian Entitlements</u>

Canadian Apportionment entitlements at the Eastern Crossing of the International Boundary are computed on a daily basis as per the 1921 Order of the IJC and may be summarized as follows:

April 1 to October 31 Irrigation Season

For Qnex< 666 cfs, QCanada=0.25Qnex

For Qnex> 666 cfs, QCanada=166+0.5*(Qnex-666)

where, QCanada =daily Canadian Milk River entitlements, and other parameters are as previously defined

November 1 to March 31 Non-irrigation Season

QCanada=0.50Qnex

Table 1 provides a summary of the annual Canadian entitlements from the natural flows of the Milk River at the Eastern Crossing. As indicated in Table 1 the natural flow for the Milk River at the Eastern Crossing of the International Boundary varies from a low of 7,297 acre-feet in 2000-01 to a high of 81,607 acre-feet in 1995-96 and have an average value of about 36,468 acre-feet. In comparison, U. S. Milk River entitlements vary from a low of 15,752 acre-feet in 2000-01 to a high of 130,118 acre-feet in 1994-95 and have an average value of about 67,410 acre-feet.

Table 1. Summary of Computed natural flows of the Milk River, Canadian and U. S. shares of that natural flow, and Canadian Irrigation needs (based on 1980-2004 data).

Year	Rank by natural flow volume	Natural flow at Eastern Crossing (acre-feet)	Canadian share of natural flow (acre-feet)	US share of natural flow (acre-feet)	Canadian annual need (8,100 acres of irrigation)
1979-80	12	96,126	30,355	65,771	10,531
1980-81	17	127,126	43,864	83,262	10,632
1981-82	20	142,445	47,814	94,631	9,595
1982-83	8	59,780	20,544	39,236	11,048
1983-84	3	39,957	15,224	24,733	13,392
1984-85	5	55,222	16,393	38,829	13,129
1985-86	15	117,967	45,667	72,300	11,776
1986-87	10	71,906	25,263	46,643	10,899
1987-88	4	42,353	15,107	27,245	12,961
1988-89	13	100,523	34,056	66,466	7,610
1989-90	16	116,539	40,372	76,167	10,775
1990-91	18	131,627	39,846	91,781	8,674
1991-92	7	58,469	22,879	35,590	7,859
1992-93	19	134,111	43,166	90,946	2,951
1993-94	22	176,039	69,533	106,506	11,322
1994-95	24	194,914	64,796	130,118	5,870
1995-96	25	206,278	81,607	124,671	11,634
1996-97	21	169,515	63,151	106,364	10,807
1997-98	11	70,839	22,435	48,404	10,111
1998-99	9	69,752	21,655	48,097	10,493
1999-2000	2	38,165	13,410	24,755	13,954
2000-01	1	23,050	7,297	15,752	14,276
2001-02	23	186,674	68,567	118,107	8,091
2002-03	14	111,737	41,396	70,340	14,455
2003-04	6	55,828	17,298	38,530	12,180
Year of occurrence	**Average**	103,878	36,468	67,410	10,601
1989	**Median**	100,523	34,056	66,466	7,610
1996	**Max**	206,278	81,607	124,671	11,634
2001	**Min**	23,050	7,297	15,752	14,276
Average of 5 wettest years		186,684	69,531	117,153	9,500
Average of 5 driest years		39,749	13,486	26,263	13,500

Modeling of Apportionment Period Options for the Milk River

E. The current administrative procedures are based on a bi-monthly (15^{th} and end of month) balancing period in which daily surplus and deficit deliveries are permitted but must be balanced at the end of the balancing period. Any residual deficits at the end of the period are carried forward, and due in the next period, any residual surpluses are forfeited. Included in the current Administrative Procedures is a "Letter of Intent" (LOI) signed in 2001 which permits the Canada to accumulate a delivery deficit of 2,000 cfs-days (4,000 acre-feet) in the July 1 to September 30 period in exchange for the U. S. being allowed to accumulate a delivery deficit of 4,000 cfs-days on the St. Mary River during the March to May period.

In the modeling of apportionment options the following administrative conditions were assumed:

(i) Daily surplus deliveries during a balancing period are permitted and are cumulative during the balancing period, residual surplus deliveries at the end of the balancing period are forfeited,

(ii) Daily deficit deliveries are permitted provided there is no accumulated deficit during the period. In this respect two alternatives in which deficit are drawn against previously accumulated surplus deliveries were considered

Alternative 1 – solely from the natural flow of the Milk River, and
Alternative 2 – from any flow in the Milk River

A spreadsheet model of the Milk River system to the Eastern Crossing reflecting the above conditions was developed and used to evaluate Alberta's potential utilization of Canadian entitlements for the following apportionment scenarios

Scenario 1a - 7-day balancing period, and drawing on surplus deliveries from the natural flow of the Milk River

Scenario 1b - 7-day balancing period, and drawing on surplus deliveries from all flows in the Milk River

Scenario 2a – bi-monthly balancing period, and drawing on surplus deliveries from the natural flow of the Milk River

Scenario 2b – bi-monthly balancing period, and drawing on surplus deliveries from all flows in the Milk River

Scenario 3a - monthly balancing period, and drawing on surplus deliveries from the natural flow of the Milk River

Scenario 3b - monthly balancing period, and drawing on surplus deliveries from all flows in the Milk River

Scenario 4a - seasonal balancing period, and drawing on surplus deliveries from the natural flow of the Milk River

Scenario 4b - seasonal balancing period, and drawing on surplus deliveries from all flows in the Milk River

Scenario 5a - annual balancing period, and drawing on surplus deliveries from the natural flow of the Milk River

Scenario 5b - annual balancing period, and drawing on surplus deliveries from all flows in the Milk River

The new natural flow estimates for the Milk River that are summarized in Table 1 were used in the spreadsheet as baseline data. In the modeling the options, it is assumed that streamflows during the future will be similar to those that occurred during the past 25 years, and that irrigation demands in Alberta and Montana will be similar to present levels.

The spreadsheet calculates daily Canadian excess or deficits deliveries for the Milk River by subtracting Canadian uses from the Canadian share of the natural flow as follows:

Milk R Daily excess/deficit = Canadian share of natural flow – Canadian use.

Canadian use is calculated based on Alberta's irrigation need up to the natural flow of the Milk River, as long as there is an accounting surplus. When an accounting period deficit occurs, Canada is limited to using its share of the natural flow of the Milk River, even though the irrigation demand may be higher.

Daily deliveries to the U. S. at the Eastern Crossing that are above Canadian entitlements are referred to as surplus deliveries, daily shortfalls in the delivery of U. S. entitlements are referred to as deficit deliveries.

Model Results

Table 2 summarizes how much Milk River water Canada would be able to use under the various balancing period options and under current conditions, for the current level of irrigation development. As indicated in Table 2, for the shorter balancing periods Canada's ability to use its share of Milk River flow is restricted by its inability to capture and utilize its share of the higher spring flows. With the modified surplus/deficit accounting procedures and longer balancing periods, Canada accumulate credits for some of these excess early season deliveries for use later during the irrigation season but still would be unable to take even as much water as under the current procedures. In other words, the enhanced access due to a modified surplus deficit accounting and lengthened balancing period, on average, is less than 2,000 acre-feet benefit Canada receives under the current "Letter of Intent".

Model results further indicate that Canada even with an annual balancing period Canada would not be able to meet all of its current irrigation demands, even in the wettest year, if it is limited to drawing on its surplus deliveries only from the natural flow of the Milk River. This is because the natural flow of the Milk River often is at or close to zero flow during the summer months. This would lead to a situation in which Canada has an accumulated surplus delivery in the Milk River. There is ample flow in the Milk River from U. S. St. Mary River diversions, enhanced by Canadian entitlement being drawn from U. S. surplus accumulations on the St. Mary River, but Canadian irrigators would have no access to these flows as they would be considered as U. S. diversions.

Table 2. Modeled Alberta access to its share of the natural flow of Milk River for various accounting periods compared to the water demands for 8,100 acres of full service irrigation.

Model run year	7-day balancing Period (acre-feet)	15-day balancing (acre-feet)	Near current 15-day balancing Plus 4,000 ac-ft as per LOI	30-day balancing (acre-feet)	Seasonal balancing period (acre-feet)	Annual balancing period (acre-feet)	Canadian need for 8,100 acres of irrigation
1	5,120	5,591	9,591	5,611	8,895	8,895	10,531
2	5,537	5,906	9,906	5,906	9,222	9,222	10,632
3	5,883	6,271	10,271	6,468	8,657	8,657	9,595
4	5,002	5,375	9,375	5,475	8,652	9,205	11,048
5	2,187	2,460	6,460	2,791	3,902	5,867	13,392
6	2,859	2,966	6,966	3,918	6,014	6,014	13,129
7	3,846	3,977	7,977	3,977	7,360	7,360	11,776
8	3,822	4,344	8,344	4,456	7,736	7,736	10,899
9	2,497	2,636	6,636	2,829	5,064	5,064	12,961
10	3,950	4,466	8,466	4,636	5,994	5,994	7,610
11	3,631	4,290	8,290	4,290	6,782	6,782	10,775
12	5,256	5,622	9,622	7,201	8,216	8,216	8,674
13	1,905	2,084	6,084	2,811	4,470	4,945	7,859
14	2,408	2,936	6,936	2,936	2,936	2,936	2,951
15	4,814	5,124	9,124	5,533	7,879	7,879	11,322
16	5,492	5,870	9,870	5,870	5,870	5,870	5,870
17	5,107	5,714	9,714	6,080	9,398	9,398	11,634
18	5,540	6,229	10,229	6,362	9,521	9,521	10,807
19	4,428	4,911	8,911	6,491	7,996	7,996	10,111
20	5,586	6,009	10,009	6,139	9,220	9,220	10,493
21	2,843	3,028	7,028	3,110	5,479	7,085	13,954
22	2,068	2,220	6,220	2,699	4,628	4,785	14,276
23	6,233	6,630	10,630	7,622	7,915	7,915	8,091
24	5,777	6,236	10,236	6,251	11,464	11,464	14,455
25	7,026	7,137	11,137	7,166	9,189	11,132	12,180
Average	4,353	4,721	8,721	5,065	7,298	7,566	10,601
Max	5,107	5,714		6,080	9,398	9,398	11,634
Min	2,068	2,220		2,699	4,628	4,785	14,276
Median	3,950	4,466		4,636	5,994	5,994	7,610
Average of Five Wettest Years	5,400	5,900		6,300	8,100	8,100	9,500
Average of Five Driest Years	2,500	2,700		3,100	5,000	5,800	13,500

Montana Simulation

Computation of Natural Flows

The first step in modeling the Milk River was to compute natural flows. Daily U. S. Geological Survey (USGS) flow records from November 1, 1979 through October 31, 2004 were used as the basis to calculate the natural flow of the Milk River at the Eastern Crossing of the International Boundary. In simple terms, natural flow of the Milk River is calculated as:

$$Qnex = Qrex + CUus + CUcan - (USdiv\text{-}EEdiv) - Ecdiv$$

Where:

Qnex = the computed natural flow for the Milk River at the Eastern Crossing

Qrex = the recorded flow for the Milk River at the Eastern Crossing (USGS gage 0613500)

CU = Consumptive use by Canada (can) and the US (us)

USdiv = U. S. St. Mary canal diversions reaching the Milk River, which are computed as the recorded flow for the North Fork Milk River at the Western Crossing (USGS gage 0613400 – USGS gage 06133500) lagged by a four/five day time lag,

EEdiv = the incremental increases in evaporation and evapotranspiration from the Milk River channel caused by Saint Mary canal diversions.

The current IJC Milk River accounting procedures were last modified in the early 1980’s. The Task Force has met and tentatively agreed that some of these procedures are dated and should be modified to compute the natural flow more accurately. Irrigation practices in the basin have changed in the last 25 years, and review of recent LandSat imagery and water license records indicates that there are now approximately 8,100 acres of full service licensed irrigation out of the Milk River in Alberta, verse the 2,900 acres of full service irrigation and 1500 acres of partial service flood irrigation accounted for in the old procedures. Montana irrigation development has changed less, but the amount of depletion by Montana irrigators needs to be better quantified. Also, the current procedures have a set irrigation demands for wet years and for dry years, but do not make adjustments to account for the variability in irrigation demand that is unique to each season.

In order to estimate consumptive uses more accurately, full service irrigated acres in Alberta were linearly adjusted, incrementally each year, starting in 1980 and ending in 2004, from the 2,900 acres used previously to the present level of 8,100 acres. For Montana, full service irrigated acres were adjusted in a similar manner from 1,750 in 1980 to 300 acres in 2004. The “**NET Crop Water Req'mnt Deficit (in)**”, needed to estimate consumptive uses were provided by Alberta. This spreadsheet calculates net crop irrigation requirement by estimating the crop irrigation need and subtracting any recorded rainfall. Because the rainfall is subtracted, this procedure will generate negative crop requirements during wet periods. Negative crop irrigation values were counterbalanced by recognizing that some of the excess rain is stored in the soil and will be used by the crop later. By averaging the irrigation water requirement over a 14-day period, most negative values were eliminated. Negative values in a 14-day average would imply excess rainfall is returning to the river from soil storage, which ultimately should be captured by the streamflow gages. The estimated daily crop requirement was then divided by a typical irrigation efficiency for a sprinkler system of 0.75 to compute a daily per acre depletion. These full service irrigation depletions then were multiplied by the number of full service acres to calculate total irrigation flow depletions. This same procedure was used to compute both Alberta and Montana full-service irrigation depletions.

The rest of the irrigation in the Milk River basin is partial service flood irrigation. For the modeling, 1,500 acres of this type of irrigation was used for Alberta and 3,200 acres for Montana. The current administrative procedures per-acre depletion rates were used for these partial service flood irrigated acres. The methods set forth in the current administrative procedures were followed for all other aspects of the natural flow computations, including the zeroing of computed negative natural flows.

The Milk River natural flow estimates, along with the computed United States and Canadian shares, are summarized in Table 1. Because the Milk River natural flow computations discussed above incorporate these refinements, these computed natural flows differ somewhat from the Milk River natural flows as reported in the IJC annual reports.

Table 1 provides a summary of the annual natural flows for the Milk River at the Eastern Crossing as computed by the above noted procedures. As indicated in Table 1 the natural flow for the Milk River at the Eastern Crossing of the International Boundary varies from a low of 23,050 acre-feet in 2000-01 to a high of 206,278 acre-feet in 1995-96 and have an average value of about 103,878 acre-feet.

Computation of Canadian Entitlements

Canadian Apportionment entitlements at the Eastern Crossing of the International Boundary are computed on a daily basis as per the current administrative procedures and may be summarized as follows:

April 1 to October 31 Irrigation Season

For Qnex< 666 cfs, QCanada=0.25Qnex

For Qnex> 666 cfs, QCanada=166+0.5*(Qnex-666)

where, QCanada =daily Canadian Milk River entitlements, and other parameters are as previously defined

November 1 to March 31 Non-irrigation Season

QCanada=0.50Qnex

Table 1 provides a summary of the annual Canadian entitlements from the natural flows of the Milk River at the Eastern Crossing. As indicated in Table 1 Canadian Entitlement to the natural flow for the Milk River at the Eastern Crossing of the International Boundary varies from a low of 7,297 acre-feet in 2000-01 to a high of 81,607 acre-feet in 1995-96 and have an average value of about 36,468 acre-feet. In comparison, U. S. Milk River entitlements vary from a low of 15,752 acre-feet in 2000-01 to a high of 130,118 acre-feet in 1994-95 and have an average value of about 67,410 acre-feet.

Table 1. Summary of Computed natural flows of the Milk River, Canadian and U. S. shares of that natural flow (based on 1980-2004 data).

Year	Rank by natural flow volume	Natural flow at Eastern Crossing (acre-feet)	Canadian share of natural flow (acre-feet)	US share of natural flow (acre-feet)
1979-80	12	96,126	30,355	65,771
1980-81	17	127,126	43,864	83,262
1981-82	20	142,445	47,814	94,631
1982-83	8	59,780	20,544	39,236
1983-84	3	39,957	15,224	24,733
1984-85	5	55,222	16,393	38,829
1985-86	15	117,967	45,667	72,300
1986-87	10	71,906	25,263	46,643
1987-88	4	42,353	15,107	27,245
1988-89	13	100,523	34,056	66,466
1989-90	16	116,539	40,372	76,167
1990-91	18	131,627	39,846	91,781
1991-92	7	58,469	22,879	35,590
1992-93	19	134,111	43,166	90,946
1993-94	22	176,039	69,533	106,506
1994-95	24	194,914	64,796	130,118
1995-96	25	206,278	81,607	124,671
1996-97	21	169,515	63,151	106,364
1997-98	11	70,839	22,435	48,404
1998-99	9	69,752	21,655	48,097
1999-2000	2	38,165	13,410	24,755
2000-01	1	23,050	7,297	15,752
2001-02	23	186,674	68,567	118,107
2002-03	14	111,737	41,396	70,340
2003-04	6	55,828	17,298	38,530
Year of occurrence	**Average**	103,878	36,468	67,410
1989	**Median**	100,523	34,056	66,466
1996	**Max**	206,278	81,607	124,671
2001	**Min**	23,050	7,297	15,752
Average of 5 wettest years		186,684	69,531	117,153
Average of 5 driest years		39,749	13,486	26,263

Modeling of Apportionment Period Options for the Milk River

In the modeling of apportionment options the following administrative conditions were assumed:

(iii) Daily surplus deliveries during a balancing period are permitted and are cumulative during the balancing period, residual surplus deliveries at the end of the balancing period are forfeited,

(iv) Daily deficit deliveries are permitted provided there is no accumulated deficit during the period.

A spreadsheet model of the Milk River system to the Eastern Crossing was developed and used to evaluate Alberta's potential utilization of Canadian entitlements for the following apportionment balancing periods: 7-day, bimonthly, monthly, seasonal, and annual. The new natural flow estimates for the Milk River that are summarized in Table 1 were used in the spreadsheet as baseline data. In the modeling the options, it is assumed that streamflows during the future will be similar to those that occurred during the past 25 years, and that irrigation demands in Alberta and Montana will be similar to present levels.

The spreadsheet calculates daily Canadian excess or deficits deliveries for the Milk River by subtracting Canadian uses from the Canadian share of the natural flow as follows:

Milk R Daily excess/deficit = Canadian share of natural flow – Canadian use.

Canadian use is calculated based on Alberta's irrigation need up to the natural flow of the Milk River, as long as there is an accounting surplus. When an accounting period deficit occurs, Canada is limited to using its share of the natural flow of the Milk River, even though the irrigation demand may be higher.

Daily deliveries to the U. S. at the Eastern Crossing that are above Canadian entitlements are referred to as surplus deliveries, daily shortfalls in the delivery of U. S. entitlements are referred to as deficit deliveries.

Model Results

Table 2 summarizes how much Milk River water Canada would be able to use under the various balancing period options at the current level of irrigation development. As indicated in Table 2, for the shorter balancing periods Canada's ability to use its share of Milk River flow is restricted by its inability to capture and utilize its share of the higher spring flows. With the modified surplus/deficit accounting procedures and longer balancing periods, Canada can accumulate credits for some of these excess early season deliveries for use later during the irrigation season. Consequently, Canada's has greatest access to Milk River irrigation water under the "seasonal" and "annual" balancing period scenarios.

Model results further indicate that Canada even with an annual balancing period Canada would not be able to meet all of its current irrigation demands, even in the wettest year, and under the more favorable scenarios. This is because the natural flow of the Milk River often is less than the Canadian irrigation demand, and at times the computed natural flow is zero. There would probably still be water in the Milk River during these times of shortage, but these flows would be U. S. diversions from the St. Mary River that Canada does not have access to.

Table 2. Modeled Alberta access to its share of the natural flow of Milk River for various accounting periods compared to the water demands for 8,100 acres of full service irrigation.

Model run year	7-day balancing Period (acre-feet)	15-day balancing (acre-feet)	30-day balancing (acre-feet)	Seasonal balancing period (acre-feet)	Annual balancing period (acre-feet)	Canadian need for 8,100 acres of irrigation
1	5,120	5,591	5,611	8,895	8,895	10,531
2	5,537	5,906	5,906	9,222	9,222	10,632
3	5,883	6,271	6,468	8,657	8,657	9,595
4	5,002	5,375	5,475	8,652	9,205	11,048
5	2,187	2,460	2,791	3,902	5,867	13,392
6	2,859	2,966	3,918	6,014	6,014	13,129
7	3,846	3,977	3,977	7,360	7,360	11,776
8	3,822	4,344	4,456	7,736	7,736	10,899
9	2,497	2,636	2,829	5,064	5,064	12,961
10	3,950	4,466	4,636	5,994	5,994	7,610
11	3,631	4,290	4,290	6,782	6,782	10,775
12	5,256	5,622	7,201	8,216	8,216	8,674
13	1,905	2,084	2,811	4,470	4,945	7,859
14	2,408	2,936	2,936	2,936	2,936	2,951
15	4,814	5,124	5,533	7,879	7,879	11,322
16	5,492	5,870	5,870	5,870	5,870	5,870
17	5,107	5,714	6,080	9,398	9,398	11,634
18	5,540	6,229	6,362	9,521	9,521	10,807
19	4,428	4,911	6,491	7,996	7,996	10,111
20	5,586	6,009	6,139	9,220	9,220	10,493
21	2,843	3,028	3,110	5,479	7,085	13,954
22	2,068	2,220	2,699	4,628	4,785	14,276
23	6,233	6,630	7,622	7,915	7,915	8,091
24	5,777	6,236	6,251	11,464	11,464	14,455
25	7,026	7,137	7,166	9,189	11,132	12,180
Average	4,353	4,721	5,065	7,298	7,566	10,601
Max	5,107	5,714	6,080	9,398	9,398	11,634
Min	2,068	2,220	2,699	4,628	4,785	14,276
Median	3,950	4,466	4,636	5,994	5,994	7,610
Average of Five Wettest Years	5,400	5,900	6,300	8,100	8,100	9,500
Average of Five Driest Years	2,500	2,700	3,100	5,000	5,800	13,500

APPENDIX J. MONTANA INSTREAM FLOW RATIONALE

For modeling purposes, Montana offered that the minimum instream flow at the international boundary should be the lesser of:

1. the downstream entitlement;
2. 50% the average annual flow; or
3. 50% the average monthly flow.

The latter two values are based, in part, on the Wetted Perimeter Inflection Point method used by the State of Montana. This method recognizes that: (1) aquatic organisms make up the majority of food for gamefish, (2) that the food supply for fish is the major factor in determining the number and weight of fish a stream can support, and (3) that most aquatic organisms are produced in riffles. Riffles are also used by many fish for spawning and rearing of their young. The wetted perimeter method estimates the flow needed to cover these important riffle areas. The wetted perimeter method was used to establish instream flows in 1990 for the Missouri River and its tributaries upstream of Fort Peck Reservoir and in 1978 for the entire Yellowstone River and tributaries in Montana.

The suggested instream flows for the St. Mary River are comparable to those derived for other streams using the wetted perimeter method. For example, the Marias River above Tiber Reservoir has a similar runoff volume to the St. Mary River and also has its headwater in Glacier National Park. A minimum instream flow water reservation of 200 cfs was established for the Marias River using the Wetted Perimeter method. Inflows to the Marias River above Tiber Reservoir averaged 539,000 acre-feet/year during the 1980-2004 period and the instream flow requirement of 200 cfs over the course of a year would accumulates to 144,793 acre-feet/year, or approximately 27 percent of the average annual flow of the stream. The natural flow of the St. Mary River at the international border averages 611,000 acre-feet/year and the average instream flow requirement, as suggested by Montana is 169,300 acre-feet /year, or approximately 28 percent of the average annual natural flow.

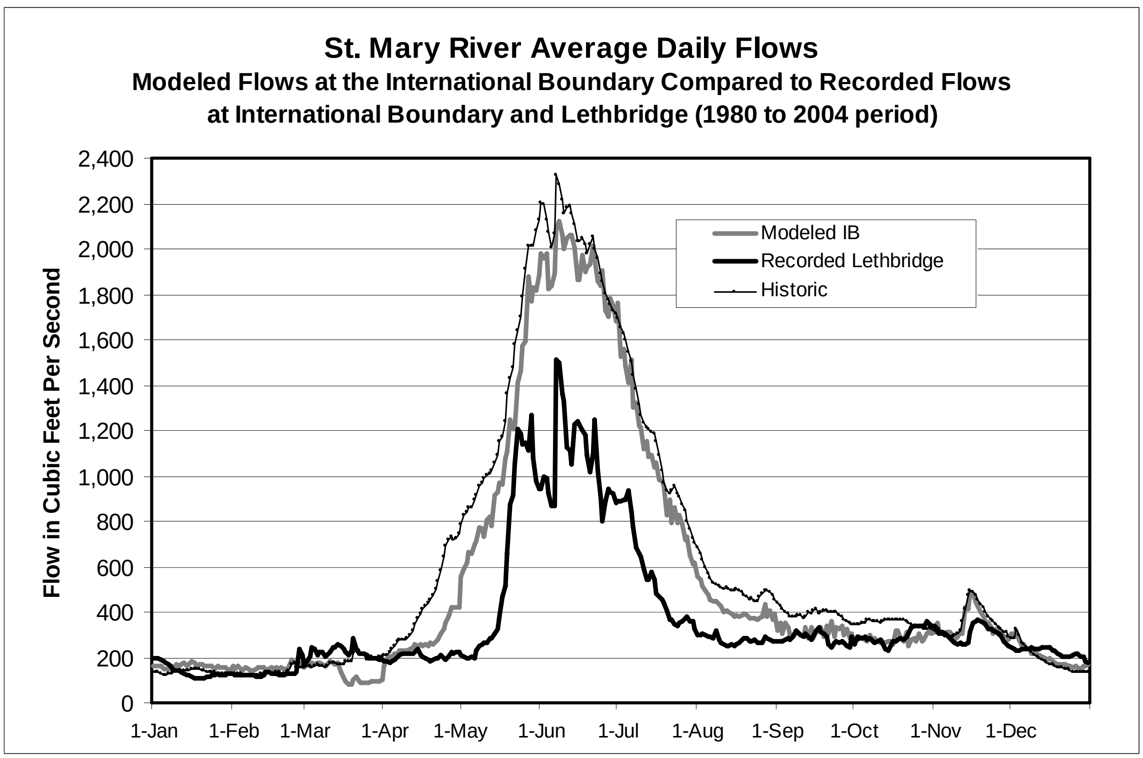
Table 1 compares the instream flows requirements of the St. Mary River at the international border with the instream flow requirements for the Marias River above Tiber Reservoir by month. Based on a percentage of the average annual and monthly flows, the minimum instream flow for the St. Mary River at the international border is similar to the State of Montana reserved instream flow for the Marias River. Unlike the Milk River, the St. Mary River will never go dry under these criteria.

Table 1. Instream flow requirements for the Marias River above Tiber Reservoir as a percentage of the average monthly flow compared to those suggested by Montana for the St. Mary River as a percentage of the average monthly flow.

Percent of Average	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Marias R.	79%	58%	38%	21%	9%	9%	27%	68%	73%	59%	48%	64%
St. Mary R.	41%	40%	36%	39%	21%	15%	27%	49%	49%	45%	32%	37%

Figure 1 compares the modeled instream flows of the St. Mary River under the annual balancing period described in Options Section to the historical flows for the same period of record at the international border and to the historical instream flow of the St. Mary River at Lethbridge, all for the 1980 to 2004 period. The Figure depicts the daily average instream flows and the results show that the flows provided by the United States under the above instream flow criteria are only slightly less than the historical flows at the international boundary, but higher than those that have occurred historically at the St. Mary River near Lethbridge, except during March, even though the drainage area at Lethbridge is considerably larger. On average, the instream flow at the international boundary under an annual balancing period would be 570 cfs as compared to 359 cfs at Lethbridge.

Figure 1. Modeled daily average minimum instream flows requirements under an annual balancing period at the international boundary as compared to historic minimum flows for St. Mary River at the international boundary and at Lethbridge.



It should be noted that Alberta has not agreed to this instream flow requirement in the St. Mary River at the international border. Clearly, additional work is needed on this subject if progress is to be made in helping both countries optimize the receipt of their respective entitlements.

APPENDIX K. REPORT ON LEE AND ROLPH CREEKS

DETERMINATION OF ESTIMATES OF NATURAL FLOW FROM LEE & ROLPH CREEK DRAINAGE BASINS WITHIN THE UNITED STATES BY HKM ENGINEERING, INC. NOVEMBER 2005

INTRODUCTION

As part of the IJC negotiations on the split use by Canada and the United States of the waters of the St. Mary River and the Milk River, HKM Engineering Inc. was given the task to determine estimates of natural flow from the United States portion of the drainage basins of two tributaries of the St. Mary River (Lee Creek and Rolph Creek) which were not included in the 1921 Order. This report summarizes the methodologies and results of that work effort by HKM plus subsequent work by HKM based on review comments to its April 2005 Draft Report. See Appendix A of this report for a summary of these review comments and corresponding HKM responses.

LEE CREEK

General Setting and Hydrologic Information

Lee Creek is a west side tributary of the St. Mary River. The creek has its headwaters in the mountains of Glacier National Park and the Blackfeet Indian Reservation in Montana, and flows north to its confluence with the St. Mary River just north of Cardston, Alberta. The portion of the Lee Creek drainage basin within the United States (Montana) was determined to be 27.6 square miles (71.5 square km), based on electronic planimeter measurements on 50 per cent reduced US Geological Survey 1:24000-scale topographic maps. See Figure 1 in Appendix B at the back of this report. The drainage area in Montana consists of several forks and tributaries which flow into Alberta and meet to form the main stem of Lee Creek.

There are no active or inactive continuous or peak streamflow gages in the Montana portion of the Lee Creek basin. There are, however, some active and inactive streamflow gages in Alberta. The following table lists the streamflow gages in downstream order found on the Water Survey of Canada web site for the main stem or major forks of Lee Creek in Alberta.

Gage #	Gage name	Drainage Area Sq mi (sq km)	Period of Record, Cal. Year
05AE040	Lee Cr. (E. Branch) nr. Beazer	14.6 (37.8)	1978-85 --seasonal
05AE904	Lee Cr. bel. Confluence of E. Fork	36.2 (93.8)	1981-92 --seasonal
05AE023	Lee Cr. Nr. Beazer	42.1 (109)	1941-45
05AE037	Lee Cr. At Beazer	67.6 (175)	1978-85 --seasonal
05AE008	Lee Cr. at Layton's Ranch	88.8 (230)	1913-20
05AE002	Lee Cr. At Cardston	119 (307)	1909-14 (seas), 1920-2004

Based on location information on the website, topographic maps of the region, and water use information received by email from Dave McGee of the Alberta Environment, gages 05AE040, 05AE904, and 05AE023 lie in the mountains and foothills in T1, R27 upstream of the first licensed water use, and hence their measured flow data can be considered natural (not impacted by man). Further downstream, there are diversions for municipal and irrigation uses, as well as some return flow from district irrigation which is served from other sources of water. Based on an April 16, 2005 email from Dave McGee, the diversion rates of uses above Cardston and the return flow rates of district irrigation are estimated to be approximately the same, hence McGee felt that the recorded data at the Cardston gage should be close to natural flow. The Water Survey of Canada website indicates the flow at the Cardston gage is subject to regulation, but the source, degree, and history could not be identified by Tim Davis of the Water Survey. Review comments from Water Survey of Canada indicate that it is likely return flows balance diversions for the Cardston gage.

Methods of Estimating Natural Flow

Two general methods were used to estimate natural flows from the Montana portion of the drainage basin. These methods are described below.

Initial Method

The initial method involved using monthly regression equations based on drainage area and basin average annual precipitation developed and published in the U. S. Geological Survey (USGS) publication Water Resources Investigation Report 89-4082 to determine the mean monthly flows for the base period water years 1937-86. For the Lee Creek basin area in Montana of 27.6 square miles and the basin average annual precipitation of 54.2 inches (derived from precipitation maps of Montana), 1937-86 mean monthly flows were determined. These monthly mean flows were then distributed on year by year basis using long term natural flow data by proportioning the mean monthly data by the ratio of monthly natural flow to 1937-86 water year mean monthly natural flow. Two distributions were made, one using monthly natural flow data for St. Mary River at the International Boundary covering the period 1928-89 published by the U. S. Geological Survey in Water Resources Investigations Report 95-4022, and the other using recorded data converted to acre-feet for gage 05AE002 Lee Creek at Cardston for the period 1921-2003. (The USGS St. Mary natural flow data was derived from data synthesized by the USGS and the Water Survey of Canada, and therefore should not significantly differ from current IJC data.) In both distributions, the average annual flow for the basin within Montana for the respective periods of distribution was over 47,000 AF. These estimates from this method were deemed to be too high, considering that the average annual 1921-2003 average annual flow for Lee Creek at Cardston is only about 43,700 AF and because the monthly flows were mostly higher than corresponding measured natural flows at the downstream gage 05AE904. In addition, this initial method was also found to give results which were too high at two other nearby sites of St. Mary River at International Boundary and Cut Bank Creek at Browning, MT (see HKM response B.1.e in Appendix A.) Therefore these estimates were discarded.

Second Method
The second method involved using a correlation analysis to develop regression equations to fill in and extend the recorded data at the two most upstream gages 05AE040 and 05AE904, then transferring or applying this data to the Montana portion of the drainage area. Historic mean monthly flow in cubic meters per second was obtained for the gages from the Water Survey of Canada web site and converted to monthly acre feet using the relation AF= m^3/s x 35.315 x days in month x 1.9835. (A sensitivity analysis showed the difference in acre-feet determination from a mean monthly value versus from a monthly sum of daily mean values was not significant.) The gage acre-feet data were then separately correlated to two sets of long-term natural flow data. One set was the 1928-89 natural flow data of St. Mary River described above in the Initial Method, and the second set was the 1921-2003 monthly historic acre-feet flows at the gage Lee Creek at Cardston (# 05AE002). As suggested in review comments, the two upper Lee Creek gages were also correlated with measured natural flow data at Swiftcurrent Creek at Many Glacier, MT (gage 05014500). Two types of regression equations were used in each analysis, one based on the acre-feet data (linear equation) and one based on the log of the acre-feet data (power equation) commonly used by the U.S. Geological Survey and Corps of Engineers. The regression was performed using the Microsoft Excel spreadsheet regression analysis and the graphical trendline analysis. Results using all the gage data (versus using individual monthly data in separate monthly analyses) showed that the correlation coefficient R was much better with correlations to Lee Creek at Cardston than to the natural flow at St. Mary River or Swiftcurrent Creek, as summarized in the following table of correlation coefficients R:

Natural flow set	Type of Equation	Gage 05AE040	Gage 05AE904
St. Mary R. Nat. Flow	Linear	0.77	0.73
	Power	0.83	0.80
Swiftcurrent Creek	Linear	0.74	0.68
	Power	0.81	0.76
Lee Cr. at Cardston	Linear	0.88	0.93
	Power	0.96	0.97

Individual separate monthly correlation was also performed for the analysis with St. Mary River and Lee Creek at Cardston, but the 6-11 data points per month of gage 05AE040 and gage 05AE904 were deemed too few to yield reliable results to extend data for a long period of record. Therefore, with the highest coefficient correlation, the following power regression equations from correlation to Lee Creek at Cardston (05AE002) were used to fill and extend the historic data of the upstream gages for the period 1921-2003:

$$\text{05AE040 flow} = 0.09866\ (\text{05AE002 flow})^{1.0841}$$

$$\text{05AE904 flow} = 1.8464\ (\text{05AE002 flow})^{0.8720}$$

Because the entire portion of the Lee Creek drainage basin in Montana is contained in the drainage area of gage 05AE904, a preliminary estimate of the flow from the Montana portion of the drainage basin was made by transferring the historic/filled-in data from gage 05AE904 as follows:

$$\text{Montana Flow= 05AE904 flow x (drain. area Montana/drain. area 05AE904)}^{0.7}$$

The 0.7 ratio power factor is commonly used to transfer flows upstream along a stream so that flows decrease but flows per unit area increase in an upstream direction to higher basin elevations. This resulted in Montana basin monthly flows which averaged 21,360 AF/yr for the 1921-2003 period. Two checks were then made concerning this methodology. The first check involved checking the ratio power factor. Monthly drainage area ratio power factors were determined between upstream gage 05AE040 on the East Fork and downstream gage 05AE904 below the forks by comparing their mean monthly acre-feet recorded historical flows for their common period of record 1981-85. These factors averaged 1.48, which indicates the opposite of what was expected, i.e., that the upstream East Fork gage has a smaller flow per unit area than does the downstream gage below the forks. The drainage area power factors in the USGS equations described in the Initial Method were also looked at, and found to vary from 0.85 to 0.99. The second check involved comparing the filled-in data at gage 09AE904 with historical recorded flow at downstream gage 05AE023. This comparison showed several filled-in values at gage 05AE904 were larger than the corresponding flows at downstream gage 05AE023, and indicates that the filled-in data at gage 05AE904 (and hence the flows in Montana) may be too high. Because of this and the uncertainty of what to use for the drainage area power factor, there is a question as to the reliability of these results. This gage, however, includes the higher yielding western tributaries of the upstream watershed.

The next step was to estimate the Montana basin flow from gage 05AE040 on the East Fork. The extended/filled-in data of gage 05AE040 was transferred to the Montana portion of the drainage basin based on a direct proportion of the respective drainage areas (drainage area power factor =1.0). This method yielded monthly values for the Montana basin which had an average annual flow of 17,423 AF. A check was then made of the resulting Montana basin flows to recorded historical flows at downstream gages 05AE904 and 05AE023. Three Montana values were found that exceeded corresponding values at the two downstream gages (March 1943, May 1981, and September 1986. These three Montana basin values were adjusted to equal the downstream values to avoid these conflicts. This resulted in a slightly lower average annual flow of 17,391 AF. See Table 1 at the end of this report. This estimate is considered to be conservatively low because the power factor analysis described in the above paragraph indicates that the flow per unit area of the East Fork is less than the rest of the upper basin. Review comments from Water Survey Canada (see Appendix A) confirm that the unit runoff of the East Fork Lee Creek is lower than the rest of the upper basin.

Comments from some of the reviewing agencies indicate the 17,391 AF to 21,360 AF estimates are too low, and some even indicate the initial method estimate of over 47,000 AF is more realistic. While these agencies used a variety of methods to arrive at their conclusion, their results should be compared to historic measured data in the upper Lee Creek basin to check for consistency. HKM found higher flow estimates on Lee Creek appear to be larger than downstream measured gage natural flow data. There is no indication that the upper Lee Creek is a losing stream, and hence upstream flows within the USA should be smaller, not larger, than corresponding downstream measured flows in Canada.

To resolve this issue, it is recommended (as Alberta Environment suggested in its review comments) that the IJC monitor the Lee Creek flows. Because Lee Creek has several major forks as it leaves Montana and enters Canada, it is recommended the flows be monitored at each major fork on/near the international boundary, and that flows also be monitored at discontinued Canadian gages 05AE040 and 05AE904 to establish a relationship between flows at these gages versus flows upstream at the international boundary.

ROLPH CREEK

General Setting & Hydrological Data

Rolph Creek (shown as Willow Creek on USGS maps) is an east side tributary of St. Mary River. The creek begins in Montana near the U. S. St. Mary Canal, and then flows northeast into the foothills and plains of Alberta where it gradually curves to the northwest toward its confluence with the St. Mary River southeast of Cardston. The portion of the drainage area within Montana was measured by electronic planimeter on 50 per cent reduced 1:24000 scale topographic maps to be 37.5 square miles (97.1 square km). See Figure 2 in Appendix B. Although this drainage area is larger than Lee Creek within Montana, the headwaters of Rolph Creek are in lower elevation foothills and flats with a much lower basin average annual precipitation (18.7 inches), and hence the flows from the Rolph (Willow) Creek basin within Montana should be markedly less than those of the Lee Creek basin in Montana.

There are no active or inactive continuous or peak streamflow gages in the basin within Montana, but the Water Survey of Canada web site lists three mainstem gages in Alberta, summarized in the following table.

	Gage Name	Gross Drainage Area Sq mi (sq km)	Period of Record, Cal. Year
05AE017	Rolph Cr. at Vaughn Ranch	33.4 (86.5)	1920-30 - seasonal
05AE020	Rolph Cr. nr. Taylorville	44.4 (115)	1917-20 - seasonal
05AE005	Rolph Cr. nr Kimbell	85.3 (221)	1911-16, 1936-2004 -all seasons

It appears none of these gages are natural flow gages. The most upstream gage 05AE017 lies just north of the Montana /Alberta border, but its flows were impacted by several man-caused items within Montana including some seepage from U. S. St. Mary Canal, some sub-irrigation along U. S. St. Mary Canal, and some tributary flow cutoff by the U. S. St. Mary Canal, based on information provided by the U. S. Bureau of Reclamation, the Montana Water Resources Survey for Glacier County, and information emailed by Dave McGee of Alberta Environment. In Alberta, the other gages are impacted by several licenses for irrigation. Also, there appears to be some active and idle irrigation within the Montana basin. This irrigation appeared all idle in the 1969 Montana Water Resources Survey but part of it was determined to be active in a HKM study of aerial photography in the 1990's. The situation is further complicated because parts of the drainage area both in Montana and Alberta are considered non-effective (not contributing flow during average runoff years).

Estimating Natural Flow

HKM was not able to determine what was felt to be a reliable estimate of natural flow for the portion of the Rolph Creek drainage basin within Montana. A preliminary estimate of about 8500 AF/yr was obtained by using the USGS regression equations described in the Initial Method for Lee Creek, but this was based on using the entire gross drainage area within Montana assuming that flow lost by cutoff of tributaries and sub-irrigation by U. S. St. Mary Canal was approximately equivalent to seepage from the canal into Rolph Creek. It is uncertain how accurate this estimate is because the same method of using USGS regression equations yielded too high of a flow estimate for Lee Creek and is not meant to be used with basins that have portions considered to be ineffective in fully contributing to flow. In addition, there are apparently no studies comparing the loss of flow to Rolph Creek from cutoff tributaries and sub-irrigation to gains in Rolph Creek flow from canal seepage. There has been a comparison of gaged flows of the U. S. St. Mary Canal just above its crossing of the St. Mary River versus at Hudson Bay Divide that show both gains and losses in the canal, but it is unclear how much of the losses are captured by Rolph Creek.

The State of Montana is attempting to estimate runoff in Willow (Rolph) Creek above U. S. St. Mary Canal in their current rehabilitation study of the canal system. Preliminary results are not yet available. Once published, these results will be added to the appendices of this report

Because of uncertainties described above, it is recommended (as Alberta Environment suggested in its review comments) that the IJC conduct the necessary studies and monitoring program to determine natural flow of the Rolph Creek basin within the USA.

RESULTS

The natural flow estimate for the Lee Creek basin in Montana is shown on Table 1. As explained above, no reliable estimate was determined for the Rolph (Willow) Creek basin in Montana.

As previously noted, it is recommended the IJC conduct a monitoring program on Lee Creek to determine the reliability of the above natural flow estimate, and to conduct the necessary studies and monitoring program to arrive at a reliable estimate of natural flow on Rolph Creek.

TABLE 1

SITE: Lee Creek Basin within the United States (Montana)

DATA: Synthetic natural streamflow in AF=(filled in 05AE040/14.6 sq mi)*27.6sq mi, rounded, adjusted to avoid d/s lower flow conflicts

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1921	91	187	444	2596	5420	3316	768	178	212	212	147	198	13769
1922	149	32	55	152	5968	3964	157	267	155	180	172	153	1419

				2			7						4
1923	108	138	278	1000	3333	5760	1613	639	214	378	210	267	13938
1924	204	535	231	991	3061	6626	1665	1261	302	352	251	191	15670
1925	329	302	1348	3000	5225	3134	692	261	425	781	289	420	16206
1926	208	204	389	975	665	860	301	138	694	1355	442	112	6343
1927	134	189	1044	4752	19777	16914	3558	2151	4021	3463	1590	1026	58619
1928	2350	618	3756	2792	4405	5486	6174	1312	684	985	803	439	29804
1929	268	208	3006	2023	6095	4131	1070	166	208	278	299	170	17922
1930	110	921	1807	3826	5546	2756	647	127	208	233	242	151	16574
1931	164	272	310	497	900	543	155	93	178	208	197	100	3617
1932	38	136	573	2040	3446	2049	444	134	72	132	289	93	9446
1933	87	76	442	1590	4906	2588	457	134	144	314	104	267	11109
1934	586	699	968	3008	2304	5117	951	119	187	671	1140	465	16215
1935	1408	828	565	2163	3909	2023	442	53	85	129	106	95	11806
1936	100	17	1113	1427	1113	794	34	8	32	106	113	66	4923
1937	17	30	333	1149	1656	6569	815	181	108	335	170	142	11505
1938	125	138	378	2006	5635	3072	1488	195	121	130	100	78	13466
1939	91	43	762	875	577	1125	255	62	132	255	163	127	4467
1940	49	91	1295	828	3238	592	321	74	340	316	221	185	7550
1941	132	66	231	1140	1087	1437	798	202	321	342	208	178	6142
1942	157	98	180	1641	3794	7879	2015	824	584	465	408	422	18467
1943	291	272	875	3836	5478	6463	1728	316	200	181	172	96	19908
1944	93	60	178	677	630	1149	546	163	113	138	98	89	3934
1945	121	98	229	425	3061	7059	1217	172	289	287	306	210	13474
1946	151	189	469	1250	1934	1539	492	100	180	558	397	492	7751
1947	338	1223	2433	4977	6331	3261	726	285	578	762	786	611	22311
1948	365	263	616	4949	13823	19919	3323	917	291	234	102	78	44880
1949	123	78	474	1832	3501	1926	440	70	176	242	278	144	9284
1950	98	251	664	2596	6836	7040	2478	561	212	331	259	333	21659
1951	210	399	1401	4131	13927	14456	8116	3482	5240	4098	2686	1026	59172
1952	752	1036	2042	5325	3174	1684	951	747	452	374	340	299	17176

1953	293	267	1435	3809	11325	22539	2032	495	276	240	270	234	43215
1954	140	526	556	2703	9257	4473	1435	399	422	658	427	291	21287
1955	263	115	1391	2909	11739	7049	2414	367	206	306	180	149	27088
1956	104	91	805	1728	5119	2437	1853	552	270	185	198	142	13484
1957	146	363	584	1359	6677	2909	514	178	219	584	628	253	14414
1958	267	284	514	2605	3909	5514	2259	584	280	293	302	291	17102
1959	329	274	2087	2391	6342	3735	951	299	323	450	395	412	17988
1960	244	185	1960	2066	5460	2401	595	325	225	244	204	174	14083
1961	87	242	384	444	3127	1926	518	208	405	488	338	197	8364
1962	459	456	917	3017	3051	2499	735	234	231	234	132	93	12058
1963	74	467	204	588	1567	3008	1225	278	187	178	149	149	8074
1964	87	113	159	924	9582	18982	1675	408	537	459	251	159	33336
1965	293	408	546	4613	5567	7851	2580	781	1225	900	630	463	25857
1966	289	240	2068	2739	3548	8358	1817	662	355	582	425	289	21372
1967	272	423	1121	1546	13823	12634	2078	473	244	223	208	161	33206
1968	350	378	658	951	3098	2900	1157	741	2180	2414	1125	546	16498
1969	512	206	1630	4847	2783	6915	3380	384	251	399	197	66	21570
1970	79	104	276	1015	5333	6072	1053	302	319	355	206	96	15210
1971	125	336	301	1953	5420	3681	1225	272	316	376	348	112	14465
1972	129	117	3492	3390	9216	5996	2442	1096	686	467	446	299	27776
1973	397	233	510	1274	3183	1616	442	187	208	197	183	115	8545
1974	212	95	643	2006	4781	3864	907	427	312	261	282	142	13932
1975	149	53	125	1883	11119	17222	2894	907	429	565	348	798	36492
1976	389	336	1009	2278	4579	2463	1002	737	251	197	236	208	13685
1977	164	229	221	754	529	251	134	244	198	176	87	93	3080
1978	83	132	883	1259	3352	3253	1930	981	775	573	295	284	13800
1979	219	112	2388	3153	6887	3289	1023	301	119	200	89	87	17867
1980	57	246	289	1822	5187	5641	1170	456	537	701	484	733	17323
1981	781	595	1078	1875	11965	4371	1405	393	134	270	161	79	23107
1982	4	4	372	1849	1800	3337	1244	193	144	185	115	123	9370
1983	178	134	163	633	1745	1522	743	200	104	189	108	40	5759

1984	244	68	147	533	873	945	354	91	79	123	138	51	3646
1985	68	74	586	1437	1560	1648	361	344	1076	2544	917	467	11082
1986	560	1650	1889	1962	3089	1805	548	100	960	1478	550	463	15054
1987	369	219	671	2873	2068	1074	2369	1505	658	425	376	174	12781
1988	70	113	384	1291	1718	754	164	79	112	127	140	79	5031
1989	59	74	643	1342	2204	4717	1234	856	819	614	1962	357	14881
1990	363	478	1087	4085	5919	3516	1164	456	149	318	204	68	17807
1991	119	280	248	1883	5635	6473	2087	544	355	276	255	219	18374
1992	134	95	208	355	355	1291	3352	805	543	1104	794	437	9473
1993	371	285	1191	2739	2635	3562	8155	4607	5306	2278	1108	951	33188
1994	741	253	1996	3079	5499	1650	664	233	193	1070	369	157	15904
1995	83	486	873	909	17312	22330	5401	1191	917	985	1091	537	52115
1996	278	915	2278	3352	5157	3836	1234	369	422	267	147	181	18436
1997	253	414	1285	2304	8116	7252	1879	749	346	276	210	142	23226
1998	87	161	331	1132	2195	3883	1800	422	276	234	164	174	10859
1999	93	130	546	609	1817	2730	707	321	246	261	346	278	8084
2000	144	168	391	1410	992	975	374	130	216	140	79	78	5097
2001	78	55	346	1325	2543	2526	665	174	66	112	108	55	8053
2002	19	55	57	786	6688	28710	3794	917	673	577	467	268	43011
2003	219	106	1531	1125	1620	1225	251	72	108	106	161	142	6666
Avg.	253	284	896	2057	4938	5191	1538	523	519	550	387	256	17391

Appendix A - HKM RESPONSE TO REVIEW COMMENTS ON APRIL 2005 DRAFT REPORT

A. Review comments from Dan Jewell, U. S. Bureau of Reclamation (USBR)

1. Lee Creek:
    a. While the NRCS indicates that for most mountain streams 85-90 per cent of the precipitation becomes runoff, the HKM synthesized flows equal only about 22 per cent of the precipitation.
    b. Good correlation would be expected between Lee Creek and Swiftcurrent Creek, however there is poor correlation between HKM synthesized flows on Lee Creek to measured flows at Swiftcurrent Creek at Many Glacier, MT (gage 05014500).
    c. None of the methods used by HKM follow what is specified in the NRCS (SCS) National Engineering Handbook. It would be better to correlate Lee Creek flow data using the Handbook methods to an adjacent basin flow data records such as Swiftcurrent Creek at Many Glacier, MT, which is roughly the same size as Lee Creek basin within the USA.
    d. The HKM synthesized data does not correlate well to surrounding snow precipitation data, while streamflow at Swiftcurrent Creek does correlate well to snow data.
    e. It appears HKM's "Initial Method" gives more realistic results.
2. Rolph Creek:
    a. Natural streamflow could be estimated by adding depletion estimates made using crop irrigation requirements and acreages to historic streamflow data, then correlating it other streamflow data.
    b. A groundwater model most likely would have to be used to determine seepage from U. S. St. Mary Canal

B. HKM Response to USBR Comments

1. Lee Creek
    a. The percentage of precipitation that becomes runoff can be highly variable from basin to basin. According to a study of sites in Montana by the former SCS titled "Hydrology of Mountain Watersheds" revised May 1978, the age of precipitation that becomes runoff is dependent on the amount of precipitation. This study found that the higher the average annual basin precipitation, the greater the percentage of precipitation that becomes runoff. From equations listed on Figure 1 of this SCS study, for average annual precipitation of 54.2 inches for the Lee Creek basin within the USA, the runoff depth is calculated as .81 x prec. –15.0 = 28.9 inches, which is about 53 per cent of the average annual precipitation and much lower than the 85-90 per cent cited by the USBR. However, even the 53 per cent seems too high based on comparing this estimated runoff to downstream measured flow. The 28.9 inches runoff converts to an average flow volume of about 42,500 AF for the SCS study period, which is equivalent to about 36,300AF for the 1921-2003 period used by HKM. If this average annual flow is distributed

proportionately on a monthly basis using the measured gage flows of Lee Creek at Cardston (05AE002), the results show that most of the monthly flows of the upstream Lee Creek basin in the USA are larger than the corresponding historic measured monthly flows at the downstream gage 05AE904 Lee Creek below Confluence of East Fork. Unless Lee Creek is a losing stream (there is no evidence of this), the flows upstream should be less, not more, than the corresponding measured downstream flows. It can therefore be concluded that the runoff estimate of 28.9 inches (53 per cent of precipitation) is too high.

b. HKM found there was only fair to poor correlation between the historic measured flows on upper Lee Creek to historic measured flows on Swiftcurrent Creek. HKM performed a correlation analysis between the historic monthly measured data at Swiftcurrent Creek at Many Glacier, MT (gage 05014500) and Lee Creek below Confluence of East Fork (gage 05AE904) as well as with Lee Creek (East Branch) near Beazer (gage 05AE040), using both regular acre-feet data and transformed log data. Measured flow data for all three of these stations appear to have no man-made impacts and is considered natural flow. These analyses yielded correlation coefficients R ranging from 0.68 to 0.81. HKM also performed similar correlations of monthly measured data at these two Lee Creek gages with natural monthly flow data at St. Mary River at International Boundary published by the USGS in its publication WRIR 95-4022, with resulting correlation coefficient R values ranging from 0.73 to 0.83. These R values are much lower than the 0.96 and 0.97 obtained by correlating these upper Lee Creek gages to Lee Creek at Cardston. One of the reasons for the poorer correlation between upper Lee Creek and adjacent streams of Swiftcurrent Creek and St. Mary River may be differences in the monthly runoff pattern. On both Swiftcurrent Creek and St. Mary River (natural flows), the highest runoff months are May and June with monthly flows during these months averaging between three to six times as much as in April. This high runoff pattern during May-June is typically related to snow melt. On Lee Creek, the measured historic data shows that while May and June are the peak flow months, the monthly peaks are not as relatively high, with May and June averaging less than 50 per cent higher than April flows for Lee Creek below East Fork (05AE904) and slightly more than two times the April flows for Lee Creek at Cardston (05AE002). This may indicate a slower or delayed snowmelt on Lee Creek because the basin lies on the north (shaded) side of the mountains.

c. The “initial method” initially used by HKM utilizes results of a regionalized analysis performed by the USGS, who are considered experts in streamflow analysis. The final method used by HKM of correlation and regression of streamflow gage data is a method commonly used by the USGS and Corps of Engineers to extend and fill in streamflow data.

d. As noted above, historic measured data of the upper Lee Creek gages does not correlate well to Swiftcurrent Creek at Many Glacier (gage 05014500) and hence may not be related as strongly to snow melt as Swiftcurrent Creek. It should also be noted that the USGS indicates the average basin precipitation at gage 05014500 is 95 inches compared to about 54 inches for Lee Creek within the USA. This probably makes Swiftcurrent Creek much more dependent on snow melt than Lee Creek.

e. As indicated in the Draft Report, flows for Lee Creek derived by the HKM initial method are felt to be too high because they conflict with downstream historic measured flow. The average 1937-86 and 1921-03 average annual flow for Lee Creek basin in the USA using the initial method was over 47,000 AF. This exceeds the measured 1921-03 average annual flow at Lee Creek at Cardston of about 43,700 AF, which Canadian officials still indicate may be close to approximate natural flow. In addition, HKM generated two sets of monthly flows, with one set based on distributing the average monthly values from the initial method proportionally based on monthly flows for Lee Creek at Cardston, and another set similarly proportioned using USGS natural flows for St. Mary River at International Boundary. Most of the monthly data in both sets were larger than corresponding measured flows at downstream natural flow gage Lee Creek below East Fork (05AE904). Again, there is no evidence that upper Lee Creek is a losing stream, and upstream flows should be smaller, not larger, than corresponding downstream measured natural flows. In addition, HKM has checked this initial method at other nearby sites (St. Mary River at International Boundary and Cut Bank Creek near Browning, MT). For St. Mary River, the initial method resulted in a water year 1937-86 average annual flow of about 717,500 AF compared to a corresponding water year 1937-86 average of 643,600 AF using USGS natural flows. For Cut Bank Creek, the resulting distributed monthly and annual flows exceeded the sum of historic flow plus maximum possible irrigation depletions.

2. Rolph Creek
   a. Irrigation depletion estimates using crop irrigation requirements would have to be adjusted based on when and what portion of the irrigation was idle. This information is not yet available.

   b. While a groundwater model might estimate the amount of seepage lost by U. S. St. Mary Canal, it would be difficult to determine how much of that seepage entered into Willow (Rolph) Creek without some type of monitoring program

C. Review comments from Robert Davis, U. S. Geological Survey (USGS)

1. The mean annual flow for Lee Creek derived by HKM seems low because the runoff per square mile of drainage area is lower than at nearby non-regulated gages.

2. However, because HKM used gage data at other Canadian sites on Lee Creek to derive this synthetic data, either Lee Creek is an anomalous stream with low unit runoff, or the Canadian gage data is more impacted by withdrawals than the records indicate.

D. HKM response to USGS comments

1. A reason for higher unit runoff values at nearby un-regulated gages than that predicted by HKM at Lee Creek may be that these nearby gages have higher average annual basin precipitation values, which is one of the main characteristics that significantly impacts runoff. (Average annual precipitation is used by both the SCS in their runoff prediction in their publication "Hydrology of Mountain Watersheds", revised May 1978, and by the UGGS in their prediction of streamflow in the upper Missouri Basin published in WRIR 89-4082.) The table below compares the unit runoff to average annual basin precipitation for the three gage sites cited by the USGS as having higher unit runoffs.

Station	Stream	Mean runoff per USGS comment	Drainage area per USGS comment	Unit runoff per square mile of D.A.	Average annual basin precip. per USGS basin char. file
05011000	Belly R.	314 cfs	121 sq.mi.	2.6 cfs/sq.mi	65 inches
05013700	St. Mary R.	540 cfs	173 sq.mi.	3.1 cfs/sq.mi.	Unavailable
05014500	Swiftcurrent	141 cfs	30.9 sq.mi.	4.6 cfs/sq.mi	95 inches

The above figures compare to HKM's Lee Creek in USA estimate of about 24 cfs for a 27.6 square mile drainage area or 0.9 cfs/sq.mi, with a average basin precipitation of 54 inches.

2. HKM agrees with the second comment by the USGS.

E. Review comments from Dave McGee, Alberta Environment

1. Lee Creek
    a. Lee Creek lies in an area of rapidly changing runoff. Based on an assessment of historical streamflow in the area, it appears that the average annual flow for Lee Creek in the USA is about 24,000 to 26,000 dam3, which is about 10-15 per cent higher than the HKM estimate of about 17,391 AF (21,451 dam3).
    b. It may be worthwhile to request IJC to monitor the flow of Lee Creek at the international boundary
2. Rolph Creek
    a. The 8500 AF estimate by HKM using the initial method (which HKM felt was too high) was also felt to be high based on unit runoff at downstream gages and unit runoff at North Fork Milk River.
    b. It is difficult to quantify in the U. S. St. Mary Canal the amount of water lost to seepage versus evaporation and the amount of water of canal seepage which finds its way to Rolph Creek. It may be worthwhile requesting the IJC to conduct the

necessary monitoring to assess the natural flow of Rolph Creek in the USA.

F. HKM response to Alberta Environment comments

1. Lee Creek
    a. No details are given on how the estimate of 24,000 to 26,000 dam3 for Lee Creek in the USA was determined, therefore HKM cannot fully respond to this comment.
    b. HKM agrees that the IJC should monitor the flow of Lee Creek
2. Rolph Creek
    a. HKM agrees that the IJC should conduct the necessary studies and monitoring program to arrive at a reliable natural flow estimate for Rolph Creek.

G. Review comments from Russ Boals, Water Survey Canada

1. Lee Creek:
    a. HKM estimates of natural flow on Lee Creek in Montana may be underestimated as they rely on the eastern station 05AE040 which has a lower unit runoff that at the slightly more downstream station 05AE904. Based on a quick analysis using unit runoff, it is estimated the Montana portion of Lee Creek has at least 12,500 dam3 (10,100 AF) runoff when using runoff from the eastern gage, and 25,000 dam3 (20,200 AF) when using runoff from the more downstream gage.
    b. Based on a method using 1989 runoff isohyets, another higher estimate of 35,700 AF is obtained.
    c. The true magnitude and duration of irrigation diversions and return flows have not been accurately accounted for in the determination of natural flows at Lee Creek at Cardston. It is likely the return flows balance the diversions.
    d. Although there are frequent shifts in the rating curve for Lee Creek at Cardston and measurements are impacted by scour, weeds, and beaver dams, frequent open water measurements in the last 53 years have ensured the flow record is reliable
2. Rolph Creek
    a. U. S. St. Mary Canal in the USA considerably affects the naturals flows of Rolph Creek since the canal intercepts its natural drainage and has been known to divert water into the creek at times.
    b. Estimates of annual yield of natural flow for Rolph Creek in the USA range from 2930 AF based on a unit runoff analysis to 18,300 AF using runoff isohyets.

H. HKM response to Water Survey Canada comments

1. Lee Creek
    a. HKM concurs that unit runoff of the eastern fork of Lee Creek is less than on the main stem. However, HKM used flows derived from the eastern fork gage 05AE040 rather than from the further downstream gage 05AE904 because there were several more conflicts with upstream filled in data exceeding measured downstream measured data with the filled in station 05AE904 data than there was with the data derived from filled in station 05AE040. No evidence has been put

forward that Lee Creek is a losing stream in its upper region, and hence monthly upstream flow here should be smaller, not larger, than corresponding measured downstream flows.

b. Flow estimates need to be compared to actual measured data along Lee Creek to check for consistency and reasonableness. The estimate for Lee Creek in the USA of 35,700 AF based on runoff isohyets is close to the 36,300 AF HKM obtained using the SCS publication "Hydrology of Mountain Watersheds" which yielded monthly values larger than corresponding measured data at downstream station 05AE904 (see HKM response to USBR comments B.1.a). This is also much higher than the filled in data HKM obtained at gage 05AE904 which resulted in an average annual runoff of 25,826 AF at this station

2. Rolph Creek
   a. The estimates for Rolph Creek of 2930 AF to 18,300 AF show a very wide range, and indicate that further study with a possible monitoring program is necessary.

<u>Appendix B</u> - FIGURES OF LEE CREEK AND ROLPH CREEK BASINS WITHIN MONTANA

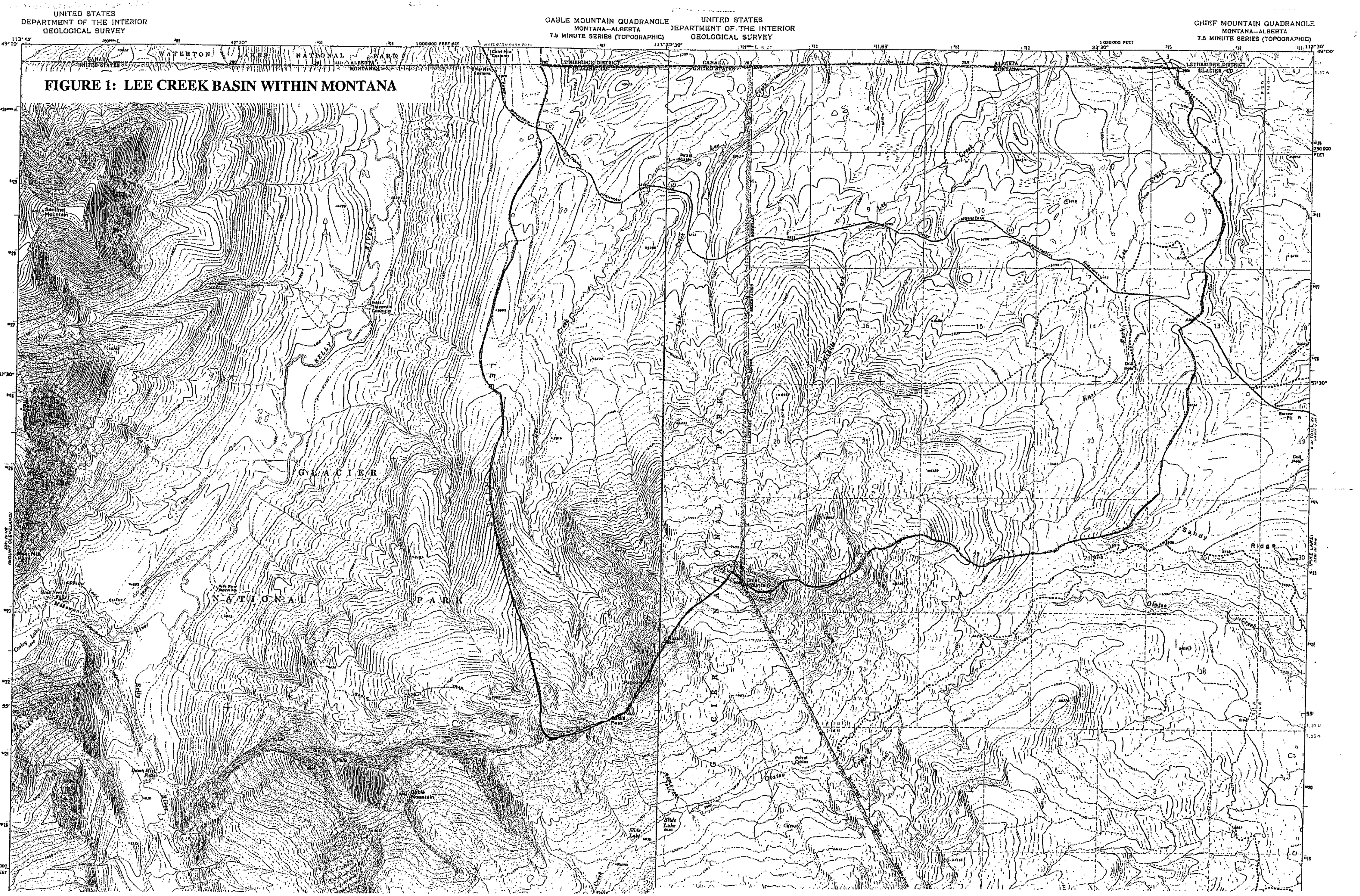


FIGURE 1: LEE CREEK BASIN WITHIN MONTANA

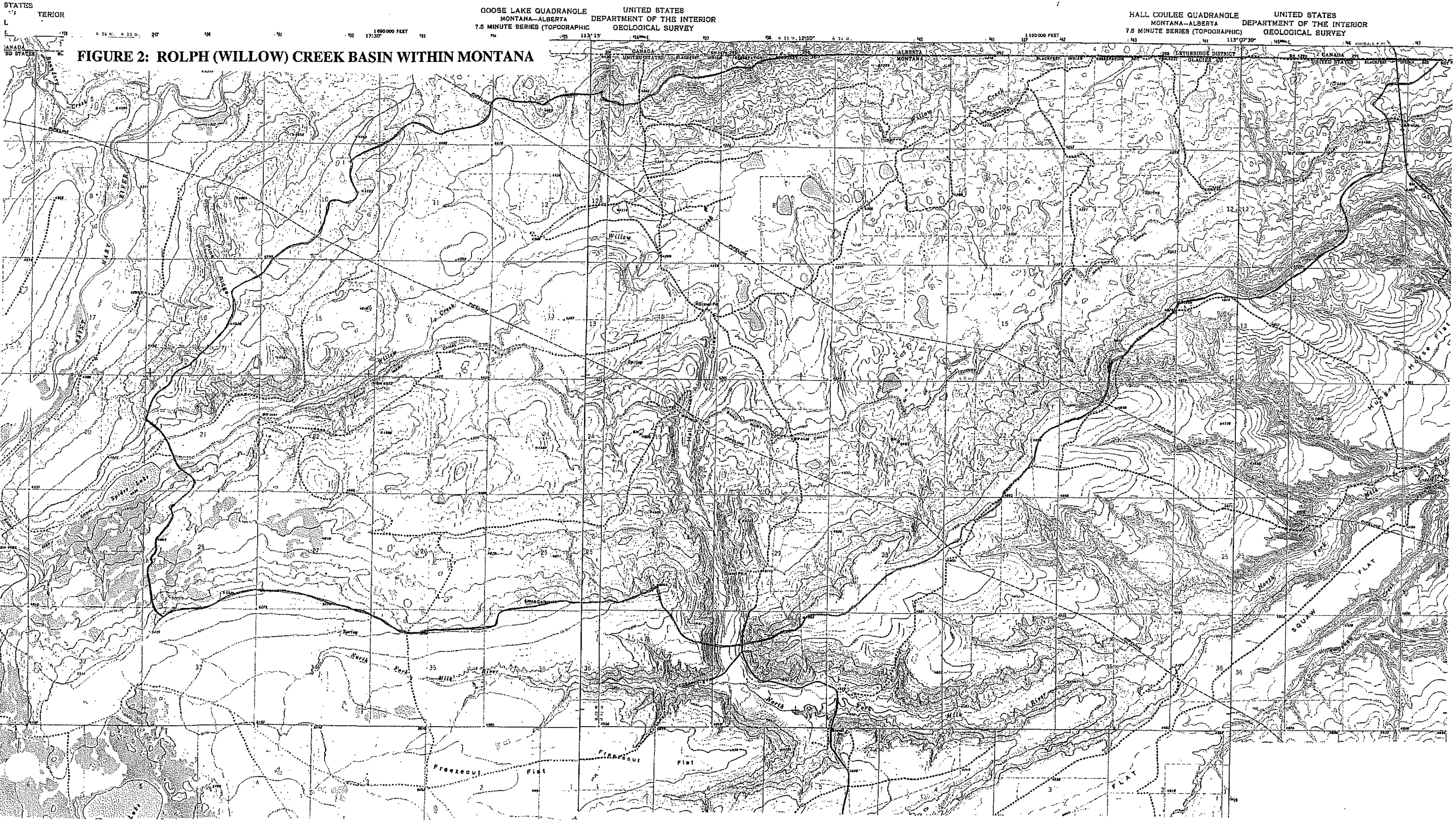


FIGURE 2: ROLPH (WILLOW) CREEK BASIN WITHIN MONTANA