Photos Courtesy of Saskatchewan Watershed Authority

FIFTY-THIRD ANNUAL REPORT

TO THE International Joint Commission

COVERING Calendar Year 2011

International Souris River Board

FIFTY-THIRD ANNUAL REPORT

TO THE

International Joint Commission

COVERING

Calendar Year 2011

International Souris River Board

INTERNATIONAL SOURIS
RIVER BOARD

CONSEIL INTERNATIONALE
DE LA RIVIERE SOURIS

October 2013

The International Joint Commission
Ottawa, Ontario and Washington, D.C.

Commissioners:

In accordance with the Directive of January 22, 2007 (replaces Directives of April 11, 2002 and May 31, 1959), we have enclosed the Fifty-Third Annual Report covering calendar year 2011.

Respectively submitted,

Russell Boals
Canadian Co-chair
Environment Canada
2365 Albert St., Rm 300
Regina, SK S4P 4K1
Ph. 306-780-5338

Todd Sando
United States Co-chair
North Dakota State Water Commission
900 East Boulevard
Bismarck, ND 58505
Ph. 701-328-4940

Girma Sahlu
Canadian Co-secretary
Environment Canada
2365 Albert St., Rm 300
Regina, SK S4P 4K1

girma.sahlu@ec.gc.ca
Ph. 306-780-6425

Robert White
United States Co-secretary
North Dakota State Water Commission
900 East Boulevard
Bismarck, ND 58505

bwhite@nd.gov
Ph. 701-328-2756

Mike Sauer
United States Co-secretary
North Dakota Dept of Health
918 East Divide Ave.
Bismarck, ND 58501-1947

msauer@nd.gov
Ph. 701-328-5237

TABLE OF CONTENTS

LIST OF TABLES

PAGE

LIST OF FIGURES

APPENDICES

HIGHLIGHTS 2011

For the 2011 calendar year, the natural flow of the Souris River at the Sherwood Crossing was 1 572 094 cubic decametres (1,274,497 acre-feet), which represents about 1,000 percent of the 1959-2011 long-term mean. North Dakota received 130 percent of the natural flow.

Net depletions in Canada were minus 473 396 cubic decametres (minus 383,782 acre-feet). Recorded runoff for the Souris River near Sherwood, North Dakota, was 2 043 157 cubic decametres (1,656,387 acre-feet), or about 1,500 percent of the 1931-2011 long-term mean. The natural flow at Sherwood exceeded 50 000 cubic decametres (40,535 acre-feet), resulting in a 60/40 sharing of the natural flow at the Sherwood Crossing. The apportionment between Canada and the United States was discussed at the September 14, 2011 International Souris River Board meeting. The August 31, 2011 determination of Natural Flow showed a surplus of 1 391 040 cubic decametres (1,127,716 acre-feet) to the United States. Fall releases were made from Rafferty and Alameda dams to drawdown the reservoirs for the 2012 spring runoff. Calculations made after the end of the year indicated that Saskatchewan was in surplus to the United States by 1 416 650 cubic decametres (1,148,478 acre-feet).

The flow of the Souris River as it enters North Dakota at Sherwood was more than 0.113 cubic metres per second (4 cubic feet per second) during the entire year from January 1 through December 31. Saskatchewan complied with the 0.113 cubic metres per second (4 cubic feet per second) provision specified in Recommendation No. 1 of the Interim Measures.

Recorded runoff for Long Creek at the Western Crossing as it enters North Dakota was 339 435 cubic decametres (275,180 acre-feet), or 1,000 percent of the long-term mean since 1959. Recommendation No. 2 of the Interim Measures was met with a net gain in the North Dakota portion of the Long Creek basin of 142 736 cubic decametres (115,716 acre-feet).

Recorded runoff leaving the United States at Westhope during the period of June 1 through October 31, 2011, was 2 760 820 cubic decametres (2,238,287 acre-feet). The flow was in compliance with the 0.566 cubic metres per second (20 cubic feet per second) minimum flow requirement as specified in Recommendation No. 3(a) of the Interim Measures for the period of June 1 through October 31, 2011.

The water quality of the Souris River in calendar year 2011 was similar to prior years with no major changes to pollution sources. Nonpoint pollution from agriculture is the primary source of pollution. As in past years the principle water quality concerns in the Souris River basin relate to elevated concentrations of total dissolved solids (TDS), depleted dissolved oxygen, and high levels of nutrients especially phosphorus. Exceedances of specific water quality objectives at the Saskatchewan/North Dakota boundary include sodium, iron, dissolved oxygen, and phosphorus which exceeded its Water Quality Objective for all samples collected. Exceedances of specific water quality objectives at the Manitoba/North Dakota boundary include sodium, Fecal coliform, TDS, TSS, dissolved oxygen, pH, Picloram and phosphorus which exceeded its Water Quality Objective for all samples collected.

The September 13, 2011 International Souris River Board public meeting was well attended by the public. Most of the discussion centered on the 2011 flood.

1.0 INTERNATIONAL SOURIS RIVER BOARD

1.1 SOURIS RIVER REFERENCE (1940)

The following excerpt describes the history of the water-apportionment program that the International Souris River Board currently maintains.

In a letter on behalf of the Government of Canada dated 20 March 1959 and a letter on behalf of the Government of the United States of America dated 3 April 1959, the International Joint Commission was informed that the Interim Measures recommended in its report of 19 March 1958, in substitution for those recommended in the report dated 2 October 1940 in response to the Souris River Reference (1940), had been accepted by both Governments.

The Governments of the United States and Canada entered into an Agreement for Water Supply and Flood Control in the Souris River Basin on October 26, 1989. Pursuant to this Agreement, the Interim Measures related to the sharing of the annual flow of the Souris River from Saskatchewan into North Dakota contained in paragraph 22(1) of the Commission's 1958 Report to the Governments were modified. In light of the modifications in 1989 and pursuant to a February 28, 1992, request from the Governments of the United States and Canada, the Commission, on April 23, 1992, directed the International Souris River Board of Control to begin applying the "Interim Measures as Modified in 1992." The measures were further modified by the Governments in December 2000. The "Interim Measures as Modified in 2000" are shown in Appendix C of this report.

1.2 INTERIM MEASURES AS MODIFIED IN 2000

In December 2000, the International Joint Commission directed the Board to implement the "Interim Measures as Modified in 2000" for the 2001 calendar year and each year thereafter. The 2000 Interim Measures, shown in Appendix C, were developed to provide greater clarification of the conditions that must prevail for the determination of the share of natural flow between Saskatchewan and North Dakota at the Sherwood Crossing.

In general, the Interim Measures provide that Saskatchewan shall have the right to divert, store, and use waters that originate in the Saskatchewan portion of the Souris River basin, provided that the annual runoff of the river into North Dakota is not thereby reduced to less than half of the runoff that would have occurred in a state of nature; that North Dakota shall have the right to divert, store, and use the waters that originate in the North Dakota portion of the basin together with the waters that cross the boundary from Saskatchewan; and that Manitoba shall have the right to use the waters that originate in the Manitoba portion of the basin and, in addition, that North Dakota must provide to Manitoba, except during periods of severe drought, a regulated flow of 0.566 cubic metres per second (20 cubic feet per second) during the months of June through October.

For the benefit of riparian users of water between the Sherwood Crossing and the upstream end of Lake Darling, the Province of Saskatchewan shall as far as practicable regulate its diversions, storage, and uses in such a manner that the flow in the Souris River channel at the Sherwood Crossing shall not be less than 0.113 cubic metres per second (4 cubic feet per second) when that level of flow would have occurred under the conditions of water-use development prevailing in the Saskatchewan portion of the drainage basin prior to the construction of Boundary Dam, Rafferty Dam, and Alameda Dam.

Under certain conditions, a portion of the North Dakota share will be in the form of evaporation from Rafferty and Alameda Reservoirs. During years when those conditions occur, the minimum flow actually passed to North Dakota will be 40 percent of the natural flow at the Sherwood Crossing. This lesser amount is in recognition of Saskatchewan's operation of Rafferty Dam and Alameda Dam for flood control.

Except in flood years, flow releases to the United States should occur in the pattern that would have occurred in a state of nature. To the extent possible and in consideration of potential channel losses and operating efficiencies, releases from the Canadian dams will be scheduled to coincide with periods of beneficial use in North Dakota. The flow release to the United States may be delayed when the State of North Dakota determines and notifies Saskatchewan through the International Souris River Board that the release would not be of benefit to the State at that time.

The State of North Dakota shall have the right to divert, store, and use the waters that originate in the North Dakota portion of the Souris River basin together with the waters delivered to the State of North Dakota at the Sherwood Crossing, provided that any diversion, use, or storage of Long Creek water shall not diminish the annual runoff at the Eastern Crossing of Long Creek into Saskatchewan below the annual runoff of Long Creek at the Western Crossing into North Dakota.

In periods of severe drought, when it becomes impracticable for North Dakota to deliver the regulated flow of 0.566 cubic metres per second (20 cubic feet per second), North Dakota's responsibility to Manitoba will be limited to providing such flows as the Board determines to be practicable and in accordance with the objective of making water available for human and livestock consumption as well as for household use.

1.3 BOARD OF CONTROL

At its meeting in May 1959, the International Joint Commission officially approved and signed a directive that created the International Souris River Board of Control. At that time, the Board was charged with the responsibility of ensuring compliance with the Interim Measures set out and of submitting to the Commission such reports as the Commission may require or as the Board at its discretion may desire to file.

1.4 AMALGAMATION OF THE INTERNATIONAL SOURIS-RED RIVERS ENGINEERING BOARD AND INTERNATIONAL SOURIS RIVER BOARD OF CONTROL

In 2000, the International Joint Commission directed the International Souris-Red Rivers Engineering Board to transfer its responsibilities that related to the Souris River to the International Souris River Board of Control. The Commission also changed the International Souris River Board of Control's name to the International Souris River Board.

1.5 AMALGAMATION OF THE INTERNATIONAL SOURIS RIVER BOARD AND SOURIS RIVER BI-LATERAL WATER QUALITY MONITORING GROUP

In 2006 the International Joint Commission changed the Board’s mandate. Because of the change in the mandate and the desire of the Commission to move to a more encompassing watershed approach, the Board was requested to develop a Directive based on existing Commission responsibilities in the Souris River basin that would move toward an enhanced mandate for the Board. By letter dated

January 22, 2007, the International Souris River Board was officially notified by the Commission that the new directive dated January 18, 2007, replaced the previous directive dated April 11, 2002. The new Directive sets out the duties of the Board as it moves toward a watershed approach in the Souris River basin and combined the duties of the International Souris River Board and Souris River Bi-Lateral Water Quality Monitoring Group. It also increased the membership of the Board to twelve members.

The Board's duties were revised to include the following:

- Maintain an awareness of existing and proposed developments, activities, conditions, and issues in the Souris River basin that may have an impact on transboundary water levels, flows, water quality, and aquatic ecosystem health and inform the Commission about existing or potential transboundary issues.
- Oversee the implementation of compliance with the Interim Measures as Modified for Apportionment of the Souris River as described in Appendix A of the Directive.
- Assist the Commission in the review of a Joint Water Quality Monitoring Program.
- Perform an oversight function for flood operations in cooperation with the designated entities identified in the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin.
- Report on aquatic ecosystem health issues in the watershed and regularly inform the Commission on the state and implications of aquatic ecosystem health.
- Carry out such other studies or activities as the Commission may, from time to time, request.
- Prepare an annual work plan including both routine board activities and new initiatives planned to be conducted in the subsequent year.
- The Board shall submit an annual report covering all of its activities at least three weeks in advance of the Commission’s fall semi-annual meeting, and the Board shall submit other reports as the Commission may request or the Board may feel appropriate in keeping with this Directive.
- The Board shall provide opportunities for the public to be involved in its work, including at least one public meeting in the basin each year. The Board has agreed to hold the public meeting in the spring/summer and to advertise it.

In 2007 three committees were established to assist with administering the conditions of the Board’s mandate. The Natural Flow Methods Committee was renamed as the Hydrology Committee, which is charged with investigating procedures and questions on the approach and methods used to determine the natural flow of the Souris River basin. The Flow Forecasting Liaison Committee has the responsibility to ensure there is information sharing and coordination between the forecasting agencies in the basin. The Ecosystem Health Committee has responsibility to identify water quality and aquatic health concerns in the basin and report on the adequacy of the aquatic quality monitoring programs. Membership on these committees includes all affected agencies in the basin.

1.6 BOARD MEMBERS

At the end of 2011, the members of the International Souris River Board were as follow:

Todd Sando North Dakota State Engineer Bismarck, North Dakota	Member for the United States (Co-Chair)
Col. Michael Price U.S. Army Corps of Engineers St. Paul, Minnesota	Member for the United States
Gregg Wiche U.S. Geological Survey Bismarck, North Dakota	Member for the United States
Megan Estep U.S. Fish and Wildlife Service Denver, Colorado	Member for the United States
Dennis Fewless North Dakota Department of Health Bismarck, North Dakota	Member for the United States
Scott Gangl North Dakota Game and Fish Department Bismarck, North Dakota	Member for the United States
Russell Boals Retired Regina, Saskatchewan	Member for Canada (Co-Chair)
Robert Harrison Manitoba Water Stewardship Winnipeg, Manitoba	Member for Canada
Doug Johnson Saskatchewan Watershed Authority Moose Jaw, Saskatchewan	Member for Canada
Richard Zitta Saskatchewan Environment Regina, Saskatchewan	Member for Canada
Dwight Williamson Manitoba Water Stewardship Winnipeg, Manitoba	Member for Canada
David Donald Environment Canada Regina, Saskatchewan	Member for Canada

2.0 2011 ACTIVITIES OF THE BOARD

Since the presentation of the Fifty – Second Annual Report to the International Joint Commission, the International Souris River Board has held two meetings and has had five teleconference calls. The discussions and decisions made are summarized in the following sections.

2.1 FEBRUARY 23, 2011, MEETING IN REGINA, SASKATCHEWANN

Members in attendance were:

Russell Boals
Member for Canada

Doug Johnson
Member for Canada

David Donald
Member for Canada

Dwight Williamson
Member for Canada

Richard Zitta
Member for Canada

Todd Sando
Member for the United States

Megan Estep
Member for the United States

Gregg Wiche
Member for the United States

Dennis Fewless
Member for the United States

The determination of Natural Flow of the Souris River at Sherwood for the period of January 1 through December 31, 2010, was presented at the February 23, 2011, meeting. The recorded flow for Long Creek at Western Crossing was 24 100 cubic decametres (19,538 acre-feet), and the recorded flow at Eastern Crossing was 33 196 cubic decametres (26,912 acre-feet) which resulted in a surplus delivery by North Dakota to Saskatchewan of 9 096 cubic decametres (7,374 acre-feet).

The 2010 total natural flow at Sherwood was 132 005 cubic decametres (107,017 acre-feet). Therefore, the United States share (40% of the total natural flow at Sherwood) was 52 800 cubic decametres (42,805 acre-feet). Flow received by the United States was 101 646 cubic decametres (82,404 acre-feet). The final apportionment balance for the 2010 calendar year showed that Saskatchewan was in surplus to North Dakota by 48 846 cubic decametres (39,600 acre-feet).

The United States Geological Survey reported the peak flow at Sherwood was 12.7 cubic metres per second (450 cubic feet per second) on June 25, 2010. This ranked 59th in 81 years of record. The peak flow at Westhope was 46.4 cubic metres per second (1,640 cubic feet per second) on June 26, 2010. This ranked 30th in 81 years of record. Westhope for the period June 1 to October 31 was 294 097 cubic decametres (238,424 acre-feet). This was 286 611 cubic decametres (232,355 acre-feet) more than the 7 486 cubic decametres (6, 069 acre feet) North Dakota is required to deliver to Manitoba.

The Saskatchewan Watershed Authority reported 2010 summer precipitation in southern Saskatchewan averaged 5 inches. Fall precipitation ranged from 85 percent in the northern portion of the basin to 150 percent of normal in the south. Snow water equivalent was about 3-4 inches. The Saskatchewan Watershed Authority forecasted that above normal runoff was expected in the Saskatchewan portion of the basin in 2011.

Manitoba Water Stewardship forecasted above normal spring runoff in the Souris basin in 2011. Soil moisture and snow cover were forecasted above normal along the North Dakota/Manitoba border. The United States National Weather Service said flooding in Manitoba could be similar to flooding that occurred in 1974. The 1974 flood was the third largest on record.

The United States Fish and Wildlife Service noted that refuge pools were above their target levels. Releases from the refuge pools were started in September 2010 and continued through the winter months. The release from Lake Darling as of February 23, 2011, was 25.5 cubic metres per second (900 cubic feet per second) and would go up to 34 cubic metres per second (1,200 cubic feet per second) by the end of February. Lake Darling was at 486.3 metres (1595.4 feet).

The Flow Forecasting Liason Committee reported that they were holding frequent meetings to coordinate releases.

The U.S. Army Corps of Engineers reported they were working on the 2009 Spring Flood report and it would be ready before the June 2011 International Souris River Board meeting. They noted that the estimates for the 2009 spring runoff were to high. Airborne Gamma ray snow surveys used in the National Weather Service forecast indicated a much higher runoff. However, the snow surveys were not verified with ground surveys.

The Aquatic Ecosystem Health Committee reported that Environment Canada is monitoring water quality monthly at the Westhope site. The Saskatchewan Watershed Authority is monitoring winter releases from Rafferty and Alameda dams on a weekly basis. The North Dakota Department of Health is monitoring water quality at sites upstream of Lake Darling. The Aquatic Ecosystem Health Committee is drafting a water quality proposal under the International Watershed Initiative to have the United States Geological Survey review the available water quality data.

The International Souris River Board declared the 2011 Spring Flood to be a 1:10 year event

2.2 MAY 19, 2011, TELECONFERENCE CALL

Members in attendance were:

Russell Boals
Member for Canada

Doug Johnson
Member for Canada

Robert Harrison
Member for Canada

David Donald
Member for Canada

Todd Sando
Member for the United States

Col. Michael Price
Member for the United States

Gregg Wiche
Member for the United States

Scott Gangl
Member for the United States

Megan Estep
Member for the United States

Dennis Fewless
Member for the United States

The purpose of the teleconference call was to review spring operations and to consider the forecast. The National Weather Service provided the updated precipitation data for the Souris basin. The basin experienced heavy precipitation from May 9 to 11, resulting in higher flows in Long Creek and the Souris River above Sherwood. The flow at Sherwood had increased to 212 cubic metres per second (7,500 cubic feet per second) but was expected to decrease to the Sherwood target flow of 113 cubic metres per second (4,000 cubic feet per second) by month's end. Additional precipitation was expected from May 27 to 29.

Lake Darling was at 486.7 metres (1596.8 feet) and releasing 142 cubic metres per second (5,000 cubic feet per second). Releases from Lake Darling would remain at 5,000 cfs until the expected precipitation passes. The United States Army Corps of Engineers expected to maintain the flows at Minot in the 156 to 161 cubic metres per second (5,500 to 5,700 cubic feet per second) range for about a week after the precipitation event. The National Weather Service reported that there was limited local inflow between the Sherwood and Lake Darling. They estimated local inflow to be only 2.8 cubic metres per second (100 cubic feet per second). The inflow hydrograph showed 204 to 210 cubic metres per second (7,200 to 7,400 cubic feet per second) entering Lake Darling with limited attenuation taking place between Sherwood and Lake Darling.

The Saskatchewan Watershed Authority reported that Rafferty dam was at elevation 553.5 metres (1815.9 feet) and releasing 100 cubic metres per second (3,531 cubic feet per second). They noted that there was only about 0.5 metres (1.5 feet) of maximum allowable storage. Alameda was at elevation 566.0 metres (1856.9 feet), about 1 metre (3.28 feet) below the maximum allowable flood elevation and releasing 45 cubic metres per second (1589 cubic feet per second). No releases were being made from Boundary.

The National Weather Service estimated that inflows to Rafferty were about 65 cubic metres per second (2,300 cubic feet per second), Alameda about 45 cubic metres per second (1600 cubic feet per second) and Boundary 14 cubic metres per second (500 cubic feet per second). The inflow to Rafferty was estimated to be less than outflow, while at Alameda inflow was matching outflow.

The Board authorized the reservoirs to be operated above their target release levels to provide additional storage capacity. The authorization was to be reviewed at the next confernce call to be held May 27, 2011.

2.3 MAY 26, 2011, TELECONFERENCE CALL

Members in attendance were:

Russell Boals
Member for Canada

Doug Johnson
Member for Canada

Robert Harrison
Member for Canada

David Donald
Member for Canada

Col. Michael Price
Member for the United States

Megan Estep
Member for the United States

The purpose of the teleconference call was to provide an update on spring runoff operations. The North Dakota State Water Commission reported that Lake Darling was releasing 156 cubic metres per second (5,500 cubic feet per second) on May 25, 2011, and that they may increase the release to 156 cubic metres per second (6,500 cubic feet per second) by the coming weekend.

The United States Army Corps of Engineers was working on a 1 372 metres (4,500 feet) long dike to provide flood protection to 255 cubic metres per second (9,000 cubic feet per second) plus 0.3 metre (1 foot) of freeboard for the City of Minot. The river stage at Sherwood was falling due to lower releases from Rafferty and Alameda reservoirs. Forecasts were calling for 0.5- to 0.75 inches of rain on Monday and Tuesday and 0.5 to 1.25 inches of rain the following week. The gage at Minot was holding steady. A worst case scenario suggested flows up to 227 cubic metres per second (8,000 cubic feet per second) on May 29 and possibly 229 cubic metres per second (8,100 cubic feet per second) on May 30.

The United States Fish and Wildlife Service and the United States Army Corps of Engineers had discussed flood operations prior to the meeting. A proposed plan to operate Lake Darling was emailed to Board members seeking their concurrence. Board members indicated their agreement with the proposed operating plan.

The Board approved the flood operations plan to surcharge Lake Darling to an elevation of 1601.5 ft to reduce flooding downstream at Minot.

The next conference call was to be held June 3, 2011, at 8:30 a.m. CST / 9:30 CDT.

2.4 JUNE 3, 2011, TELECONFERENCE CALL

Members of International Souris River Board in attendance were:

David Donald
Member for Canada

Doug Johnson
Member for Canada

Gregg Wiche
Member for the United States

Dennis Fewless
Member for the United States

Scott Gangl
Member for the United States

There was no quorum for the conference call to make decisions. Members in attendance agreed to use the opportunity to exchange information about flow conditions in the basin and to discuss what agencies are currently doing to minimize the impacts of flooding. The Saskatchewan Watershed Authority expressed concerns regarding water levels in both Rafferty and Alameda reservoirs and the limited amount of storage available to store floodwaters. They noted that, according to the Agreement, flows above 90 cubic metres per second (3,200 cubic feet per second) at Sherwood would be acceptable after June 1. Current flows at Sherwood are well above this value and Minot is to sustaining high flows for. The Saskatchewan Watershed Authority reported that these releases were required to create storage in the reservoirs for the significant rains forecasted for the coming week and future summer rains. Some areas in the basin are expected to receive 38 millimetres (1.5 inches) to 114 millimetres (3 inches) or even 152 millimetres (4 inches) of rain in the coming week. The members on the conference call agreed to the proposed plan by the Saskatchewan Watershed Authority. The

Saskatchewan Watershed Authority commented that they will continue to release water from the reservoirs and recommended that the Flood Forecasting and Liaison Committee apprise members and the International Souris River Board about events and operations.

Those at the conference call were canvassed if the could attend the Public and Board meetings on June 20 and 21, 2011. Given the ongoing flood situation it was agreed to delay the meetings.

2.5 JULY 26, 2011, TELECONFERENCE CALL

Members of International Souris River Board in attendance were:

Russell Boals
Member for Canada

Doug Johnson
Member for Canada

David Donald
Member for Canada

Robert Harrison
Member for Canada

Todd Sando
Member for the United States

Gregg Wiche
Member for the United States

Scott Gangl
Member for the United States

Megan Estep
Member for the United States

The Saskatchewan Watershed Authority noted there was a dam safety issue with Alameda Dam. In late May an engineering consultant had determined a Factor of Safety for Alameda Dam. At max flood level the Factor of Safety was 1.0 (unity) and at Full Supply Level the Factor of Safety was 1.1. Unity means the driving forces equal the resisting force. The Saskatchewan Watershed Authority plans to bring Alameda reservoir to Full Supply Level by the end of July then draw it down another 0.5 metre to 1 metre. They expect to draw down Alameda reservoir further than normal this winter. The dam is currently releasing 32 cubic metres per second (1,130 cubic feet per second) with inflow of 6.6 cubic metres per second (233 cubic feet per second). Alameda reseervoir is above Full Supply Level by 0.66 metres (2.2 feet).

The Saskatchewan Watershed Authority plans to conduct additional soil sampling and stability modeling to assess options. The weakest section of the dam traverses the dam in an oblique section across the river channel.

When the reservoir rose in early May there was a spike in the movement of the dam, of about 0.5mm per day to 0.4mm per day. The increase in reservoir levels caused the movement. The reservoir had never been that high before. The piezometric levels have held steady.

The North Dakota Department of Health is sampling the Souris River upstream and downstream of Minot. E-coli exceed 1,000 colonies per 100ml. They said that North Dakota is doing okay with respect to water quality. Dissolved oxygen levels are suitable for aquatic life.

The Saskatchewan Watershed Authority reported that Boundary Dam is not releasing water. Rafferty Dam is releasing 35 cubic metres per second (1,236 cubic feet per second and is at 550.8 metres (1,806 feet) with a target of 550.0 metres (1,804 feet) by August 4, and then will pass only inflows. Yellowgrass is contributing about 11 cubic metres per second (388 cubic feet per second) to Rafferty reservoir.

The United States Army Corps of Engineers is releasing 99 cubic metres per second (3500 cubic feet per second) from Lake Darling and plans to at 14 cubic metres per second (500 cubic feet per second) by end of August.

It was noted that until the reservoirs are at or below Full Supply Level and the flow through Minot is at or below 14 cubic metres per second (500 cubic feet per second) the International Souris River Board is in flood operations. It was noted that Long Creek had 4 or 5 peaks in 2011. From 1960 - 2010, the total volume was 1.72 million cubic decametres (1.4 million acre-feet) at Noonan. By July 20, 2011, Noonan had recorded 26% of that volume in 2011 alone.

2.6 SEPTEMBER 1, 2011 TELECONFERENCE CALL

Members in attendance were:

Russell Boals
Member for Canada

Robert Harrison
Member for Canada

Doug Johnson
Member for Canada

David Donald
Member for Canada

Todd Sando
Member for the United States

Gregg Wiche
Member for the United States

Col. Michael Price
Member for the United States

Dennis Fewless
Member for the United States

Megan Estep
Member for the United States

Scott Gangl
Member for the United States

The Saskatchewan Watershed Authority reported that both Rafferty and Alameda Dams were below their Full Supply Level. Rafferty Dam was releasing 15 cubic metres per second (530 cubic feet per second). Alameda Dam was passing inflow. The flow at Sherwood was 31.1 cubic metres per second (1,100 cubic feet per second).

The United States Geological Survey reported the United States Army Corps of Engineers will reduce the release from Lake Darling to check levees and increase the release once the inspection is complete. Manitoba noted the flow at Wawanesa was 142 cubic feet per second (5,000 cubic feet per second).

There was much discussion on the upcoming public and International Souris River Board meetings. The public meeting was advertised in the United States and in local Saskatchewan and Manitoba newspapers.

The North Dakota State Water Commission reported that Minot would like better precipitation data and runoff forecasts.

2.7 SEPTEMBER 13, 2011, INTERNATIONAL SOURIS RIVER BOARD PUBLIC MEETING, SOURIS, MANITOBA

The public meeting was attended by about 50 people including the media. The International Souris River Board was pleased with the turnout of people. Comments at the public meeting were on flood operations and request to review the operating plan under the Agreement. In addition, comments were received regarding water quality, winter releases and drainage issues.

The Souris River Joint Board (Renville, Ward, McHenry, Bottineau Counties) asked that the following items be reviewed and considered.

1. Increased monitoring of upstream conditions such as soil saturation, snow levels, moisture content and rainfall events.
2. Any methods to reduce extreme flows by increasing storage capabilities.
3. Any methods to reduce flows earlier, especially in moderate flood events to improve the utilization of the extensive agricultural land in the Mouse River (Souris River) basin. Methods such as May 10 flows at 42 to 57 cubic metres per second (1500 - 2000 cubic feet per second) for cereal crop production, June 1 flows at 14 cubic metres per second (500 cubic feet per second) for grassland production.

All members agreed that the presentations at the public meeting were very good and well done. They said the presentations were made in a manner the public could understand.

2.8 SEPTEMBER 14, 2011, MEETING IN BRANDON MANITOBA

Members in attendance were:

Russell Boals
Member for Canada

Robert Harrison
Member for Canada

Doug Johnson
Member for Canada

Dwight Williamson
Member for Canada

Todd Sando
Member for the United States

Gregg Wiche
Member for the United States

Col. Michael Price
Member for the United States

Dennis Fewless
Member for the United States

Megan Estep
Member for the United States

Both the International Souris River Board meeting and the Public meeting were originally scheduled to be held in June, however, severe flooding in the Souris River basin caused the meetings to be rescheduled to September.

Under the 1989 Agreement the United States Corps of Engineers takes the lead during major flood events and prepares a flood document. The International Souris River Board agreed that the flood report should be prepared in a timely manner given the significance of the 2011 flood event.

The International Joint Commission said they would be supportive of a proposal to review the operating plan. It was noted that approval from the Governments of Canada and the United States is required to change the operating plan.

The United States Army Corps of Engineers noted that the flood report is done in cooperation with the United States Fish and Wildlife Service and Saskatchewan Watershed Authority. The 1989 Agreement puts the onus on the United States Army Corps of Engineers to complete the flood report.

The United States Army Corps of Engineers commented that the flood report will document the hydrology, chronology of events, how decisions were made, issues encountered, and how they were resolved. The United States Fish and Wildlife Service and Saskatchewan Watershed Authority will provide data to the United States Army Corps of Engineers for the flood report.

The United States Army Corps of Engineers commented on the need to review the current operating plan. It was noted a review of the operating plan could be done in two phases – short term, before next year's flood and long term for future floods. The International Souris River Board's task now becomes to look at three major issues:

- Post-flood report,
- Short term Operating Plan (before next year's flood), and
- Long term Operating Plan (for future floods).

The United States Fish and Wildlife Service mentioned the public wanted the reservoirs to be lower prior to the spring freshet but, if the reservoirs did not refill, there will also be public concern.

The Saskatchewan Watershed Authority noted that winter releases are within the terms of the Agreement. They cautioned that with lower drawdown levels there needs to be confidence that the reservoirs can refill during the spring freshet.

The United States Army Corps of Engineers will prepare a draft flood report ready by the end of December 2011. The flood report will document the event without limited analysis, present issues encountered; and make suggestions on what can be done in the future.

The Eaton Irrigation Project members present suggested that there is a need to allow for higher target flows to move more water through the system.

The public requested a review of the Operating Plan in light of the 2011 floods. An approach is to draft a proposal under the International Watershed Initiative program. The International Joint Commission noted they would be supportive of a proposal.

Water Survey of Canada reviewed the determination of Natural Flow of the Souris River at Sherwood for the period January 1 to August 31, 2011. The total diversion to August 31, 2011 in the Souris River basin was 164 268 cubic decametres (133,172 acre-feet). Total recorded flow at Sherwood was 1 965 274 cubic decametres (1,593,248 acre-feet). Flow from non-contributing areas was 360 000 cubic decametres (291,852 acre-feet). The total natural flow at Sherwood was 1 441 006 cubic decametres (1,168,224 acre-feet). Therefore, the United States share (40 percent of the total natural flow at Sherwood) was 576 400 cubic decametres (467,287 acre-feet). Flow received by the United States was 1 967 440 cubic decametres (1,595,004 acre-feet); which resulted in a surplus delivery of 1 391 040 cubic decametres (1,127,716 (acre-feet). With respect to Long Creek, the recorded flow at Western

Crossing was 345 000 cubic decametres (279,692 acre-feet), and the recorded flow at Eastern Crossing was 472 011 cubic decametres (382,659 acre-feet) which also resulted in a surplus delivery of 127 011 cubic decametres (102,968 acre-feet).

The Saskatchewan Watershed Authority provided a summary of the 2011 spring runoff forecast for Saskatchewan. They noted that most sloughs are full this year that weren't last year. There are 50 square miles covered with 3 to 4 feet of water. There are 15 square miles that were farmed in 2010 that will not be farmed in 2011. Some 40 of the 60 homes in Roche Percee were destroyed and will not be rebuilt. These families will be relocated and the local people are in agreement. Another 25 to 30 homes downstream of Estevan were destroyed.

The flow at Sherwood is about 34 cubic metres per second (1200 cubic feet per second) which is above normal for this time of year. The Saskatchewan Watershed Authority wants to have its reservoirs drawn down to target levels and maybe even lower. They plan to hold releases steady over the fall and winter, and will make winter releases in conjunction with Lake Darling operations.

The United States Army Corps of Engineers reported there was good communication and the project handled the snowmelt runoff very well. The rainfall event made flooding worse.
The United States Geological Survey reported that record flows occurred throughout the Souris River basin for the spring and summer of 2011. The total volume of flow past the Long Creek at Noonan gage, for the first 8 months of 2011, exceeded the sum for each year recorded since the gage was installed in October 1959. A peak record of 297 cubic metres per second (10, 500 cubic feet per second) was recorded on June 21, 2011.

The flows recorded at the Souris at Sherwood gage were also record setting. Record snowfall along with above normal precipitation through May and June led to increasing flows until June 23 when the record flow of 841 cubic metres per second (29, 700 cubic feet per second) was recorded. Recorded flows at the Sherwood gage exceeded the 80 year average flows for the entire January 1 to August 31 period. Flows recorded at the Souris River near Westhope gaging station exceeded the long term mean for the entire January 1 to August 31 period, as well. The peak gage height of 6.9 metres (22.75 feet) exceeded the previous peak of record by 1.1 metres (3.6 feet). The gaging station structure and associated infrastructure was extensively damaged by the record high flows.

Manitoba Water Stewardship provided a summary of the spring 2011 hydrologic conditions and outlook. They reported that the 2011 spring and summer flows and stages on the Souris River in Manitoba were of historic proportions. Major flooding occurred along the Manitoba portion of the Souris River from April to August 2011. Flooding was still occurring in the Souris River Valley upstream of Hartney. The current flow on the Souris River at Wawanesa is 136 cubic metres per second (4,800 cubiuc feet per second), which is well above the historic maximum recorded flow of 28 cubic metres per second (1,000 cubic feet per second) in 1999.

The United States Fish and Wildlife Service reported that Lake Darling performed as designed. Dam 87 is closed and the gates can not be opened as water is still flowing through the spillway. Dam 357 has no appreciable damage. Gate 96 was washed out.

There were regular daily conference calls with the National Weather Service, Saskatchewan Watershed Authority, and ND State Water Commission. Conference calls started early March and continued until mid July. There were no communication problems between Canada and the United States.

The principal water quality concerns in the Souris River basin relate to elevated concentrations of total dissolved solids (TDS), depleted dissolved oxygen, and high levels of nutrients especially phosphorus. A total of 5 samples were collected by the USGS in 2010. Exceedances of specific water quality objectives at the Saskatchewan/North Dakota Border include phosphorus, sodium, iron, TDS and dissolved oxygen (DO). These results are relatively consistent with prior year's data except for sulfate and pH for which no exceedances were observed.

Total phosphorus exceeded the objective of 0.10 milligrams per liter in 80 percent of the samples. The maximum phosphorus concentration was 0.31 milligrams per liter, which 3 is times the objective. TDS also exceeded the objective of 1,000 milligrams per liter in 20 percent of the samples. Sodium and sulfate represent major constituents in the mineral composition of the Souris River and exceeded the objectives 40 percent and 0.0 percent, respectively.

Dissolved oxygen ranged from 0.6 milligram per liter to 13 milligram per liter. A concentration of less that 5 milligram per liter is considered an exceedance and this occurred in 17 percent of the samples.

A total of 10 samples were collected by Environment Canada in 2010. Nine were collected at Westhope (Manitoba/North Dakota Border), and one was collected at Sherwood (Saskatchewan/North Dakota Border) as part of the yearly joint USGS/EC QA/QC program.

The number of exceedances has decreased compared to 2009; although a number of other parameters have exceeded their objectives at least once. The decrease maybe partially due to higher flows in the basin.

It was noted that Picloram has exceeded its water quality objective of 0.05μg/L for the first time in 10 years with a concentration of 0.0607 μg/L on May 5, 2010. Similarly, over the past 10 years iron has always exceeded its water quality objective of 300 μg/L; however, this year iron did not exceed its objective. The highest value recorded was 260 μg/L.

The water quality monitoring plan for 2011/2012 remains unchanged.

3.0 MONITORING

3.1 INSPECTIONS OF THE BASIN

During the year, the staff of the Water Survey Division of Environment Canada, Saskatchewan Watershed Authority, the North Dakota State Water Commission, Manitoba Water Stewardship, and the United States Geological Survey carried out frequent field inspections of the Souris River basin.

3.2 GAUGING STATIONS

A list of the gauging stations being operated in the Souris River basin is given in Table 1. In addition, the United States Geological Survey operated three miscellaneous stream flow-measurement sites in the vicinity of the Eaton Irrigation Project near Towner, North Dakota.

The station numbers and the locations of the hydrometric stations measuring streamflow are shown in Part I of Table 1. The gauging station numbers and the locations of the hydrometric stations located on lakes and reservoirs in the basin are shown in Part II of Table 1.

Table 1.
STREAMFLOW, WATER-LEVEL, AND WATER QUALITY STATIONS
IN THE SOURIS RIVER BASIN
Part I--Streamflow

Index Number	Stream	Location	State or Province	Operated By
05NA003	Long Creek[1]	at Western Crossing	Saskatchewan	Environment Canada
(05113360)				
05NA004	Long Creek	near Maxim	Saskatchewan	Saskatchewan Watershed Authority
05NA005	Gibson Creek	near Radville	Saskatchewan	Environment Canada
05NB001	Long Creek	near Estevan	Saskatchewan	Environment Canada
05NB011	Yellowgrass Ditch	near Yellowgrass	Saskatchewan	Environment Canada
05NB014	Jewel Creek	near Goodwater	Saskatchewan	Environment Canada
05NB017	Souris River	near Halbrite	Saskatchewan	Environment Canada
05NB018	Tatagwa Lake Drain	near Weyburn	Saskatchewan	Environment Canada
05NB021	Short Creek[1]	near Roche Percee	Saskatchewan	Saskatchewan Watershed Authority
(05113800)				
05NB031	Souris River	near Bechard[2]	Saskatchewan	Saskatchewan Watershed Authority
05NB033	Moseley Creek	near Halbrite	Saskatchewan	Environment Canada
05NB034	Roughbark Creek	near Goodwater	Saskatchewan	Environment Canada
05NB035	Cooke Creek	near Goodwater	Saskatchewan	Environment Canada
05NB036	Souris River	below Rafferty Reservoir	Saskatchewan	Environment Canada
05NB038	Boundary Reservoir Diversion Canal	near Estevan	Saskatchewan	Environment Canada
05NB039	Tributary	near Outram	Saskatchewan	Environment Canada
05NB040	Souris River	near Ralph	Saskatchewan	Environment Canada
05NB041	Roughbark Creek	above Rafferty Reservoir	Saskatchewan	Environment Canada
05NC001	Moose Mountain Creek	below Moose Mountain Lake	Saskatchewan	Saskatchewan Watershed Authority
05ND004	Moose Mountain Creek	near Oxbow	Saskatchewan	Environment Canada
05ND010	Moose Mountain Creek	above Alameda Reservoir	Saskatchewan	Environment Canada
05ND011	Shepherd Creek	near Alameda	Saskatchewan	Environment Canada
05NE003	Pipestone Creek	above Moosomin Reservoir	Saskatchewan	Environment Canada
05NF001	Souris River	at Melita	Manitoba	Environment Canada
05NF002	Antler River	near Melita	Manitoba	Environment Canada
05NF006	Lightning Creek	near Carnduff	Saskatchewan	Environment Canada

05NF007	Gainsborough Creek	near Lyleton	Manitoba	Environment Canada
05NF008	Graham Creek	near Melita	Manitoba	Environment Canada
05NF010	Antler River	near Wauchope	Saskatchewan	Environment Canada
05NG001	Souris River	at Wawanesa	Manitoba	Environment Canada
05NG003	Pipestone Creek	near Pipestone	Manitoba	Environment Canada
05NG007	Plum Creek	near Souris	Manitoba	Environment Canada
05NG012	Elgin Creek	near Souris	Manitoba	Environment Canada
05NG020	Medora Creek	near Napinka	Manitoba	Environment Canada
05NG021	Souris River	at Souris	Manitoba	Environment Canada
05NG024	Pipestone Creek	near Sask. Boundary	Manitoba	Environment Canada
05113520	Long Creek Tributary	near Crosby	North Dakota	U.S. Geological Survey
05113600	Long Creek[1 3]	near Noonan	North Dakota	U.S. Geological Survey
(05NB027)				
05114000	Souris River[1 3]	near Sherwood	North Dakota	U.S. Geological Survey
(05ND007)				
05116000	Souris River[3]	near Foxholm	North Dakota	U.S. Geological Survey
05116135	Tasker Coulee Tributary	near Kenaston	North Dakota	U.S. Geological Survey
05116500	Des Lacs River[3]	at Foxholm	North Dakota	U.S. Geological Survey
05117500	Souris River[3]	above Minot	North Dakota	U.S. Geological Survey
05119410	Bonnes Coulee	near Velva	North Dakota	U.S. Geological Survey
05120000	Souris River[3]	near Verendrye	North Dakota	U.S. Geological Survey
05120180	Wintering River Tributary	near Kongsberg	North Dakota	U.S. Geological Survey
05120500	Wintering River[3]	near Karlsruhe	North Dakota	U.S. Geological Survey
05122000	Souris River[3]	near Bantry	North Dakota	U.S. Geological Survey
05123300	Oak Creek Tributary	near Bottineau	North Dakota	U.S. Geological Survey
05123400	Willow Creek[3]	near Willow City	North Dakota	U.S. Geological Survey
05123510	Deep River[3]	near Upham	North Dakota	U.S. Geological Survey
05124000	Souris River[1 3]	near Westhope	North Dakota	U.S. Geological Survey
(05NF012)				

Table 1.
STREAMFLOW, WATER-LEVEL, AND WATER QUALITY STATIONS
IN THE SOURIS RIVER BASIN
Part II--Water Level

Index Number	Stream	Location	State or Province	Operated By
05113750	East Branch Short Creek Reservoir	near Columbus	North Dakota	U.S. Geological Survey
05115500	Lake Darling	near Foxholm	North Dakota	U.S. Geological Survey
LGNN8	Souris River	at Logan	North Dakota	U.S. Corps of Engineers
				U.S. N. Weather Service
SWRN8	Souris River	at Sawyer	North Dakota	U.S. Corps of Engineers
				U.S. N. Weather Service
TOWN8	Souris River	at Towner	North Dakota	U.S. Corps of Engineers
				U.S. N. Weather Service
VLVN8	Souris River	at Velva	North Dakota	U.S. Corps of Engineers
				U.S. N. Weather Service
	Upper Souris Refuge	Dams 87 and 96	North Dakota	U.S. Fish and Wildlife
	Des Lacs Refuge	Units 1 - 8 inclusive	North Dakota	U.S. Fish and Wildlife
	J. Clark Salyer Refuge	Dams 320, 326, 332, 341, and 357	North Dakota	U.S. Fish and Wildlife
05NA006	Larsen Reservoir	near Radville	Saskatchewan	Environment Canada
05NB012	Boundary Reservoir	near Estevan	Saskatchewan	Saskatchewan Watershed Authority
05NB016	Roughbark Reservoir	near Weyburn	Saskatchewan	Environment Canada
05NB020	Nickle Lake	near Weyburn	Saskatchewan	Environment Canada
05NB032	Rafferty Reservoir	near Estevan	Saskatchewan	Environment Canada
05NC002	Moose Mountain Lake	near Corning	Saskatchewan	Environment Canada
05ND008	White Bear (Carlyle) Lake	near Carlyle	Saskatchewan	Saskatchewan Watershed Authority
05ND009	Kenosee Lake	near Carlyle	Saskatchewan	Saskatchewan Watershed Authority.
05ND012	Alameda Reservoir	near Alameda	Saskatchewan	Environment Canada
05NE002	Moosomin Lake	near Moosomin	Saskatchewan	Environment Canada
05NF804	Metigoshe Lake	near Metigoshe	Manitoba	Manitoba Water Stewardship
05NF805	Sharpe Lake	near Deloraine	Manitoba	Manitoba Water Stewardship
05NG023	Whitewater Lake	near Boissevain	Manitoba	Environment Canada
05NG801	Plum Lake	above Deleau Dam	Manitoba	Manitoba Water Stewardship
05NG803	Elgin Reservoir	near Elgin	Manitoba	Manitoba Water Stewardship
05NG806	Souris River	above Hartney Dam	Manitoba	Manitoba Water Stewardship

05NG807	Souris River	above Napinka Dam	Manitoba	Manitoba Water Stewardship
05NG809	Plum Lake	near Findlay	Manitoba	Manitoba Water Stewardship
05NG813	Oak Lake	at Oak Lake Resort	Manitoba	Manitoba Water Stewardship
05NG814	Deloraine Reservoir	near Deloraine	Manitoba	Manitoba Water Stewardship

Table 1.
STREAMFLOW, WATER-LEVEL, AND WATER QUALITY STATIONS
IN THE SOURIS RIVER BASIN
Part III--Water Quality

Index Number	**Stream**	**Location**	**State or Province**	**Operated By**
05114000	Souris River[1 3]	near Sherwood	North Dakota	U.S. Geological Survey
(05ND007)				
05115500	Lake Darling	near Foxholm	North Dakota	U.S. Geological Survey
05116000	Souris River[3]	near Foxholm	North Dakota	U.S. Geological Survey
05116500	Des Lacs River3	at Foxholm	North Dakota	U.S. Geological Survey/
(380021)				N.D. Dept. of Health
05117500	Souris River[3]	above Minot	North Dakota	U.S. Geological Survey/
(380161)				N.D. Dept. of Health
05120000	Souris River[3]	near Verendrye	North Dakota	U.S. Geological Survey/
(380095)				N.D. Dept. of Health
05122000	Souris River[3]	near Bantry	North Dakota	U.S. Geological Survey
05123400	Willow Creek[3]	near Willow City	North Dakota	U.S. Geological Survey
05123510	Deep River[3]	near Upham	North Dakota	U.S. Geological Survey
	J. Clark Salyer Refuge	Pool 357	North Dakota	U.S. Fish and Wildlife
051240000	Souris River[1 3]	near Westhope (QA)	North Dakota	U.S. Geological Survey
(05NF012)				

[1] International gauging station

[2] Formerly published as Souris River below Lewvan

[3] Operated jointly for hydrometric and water-quality monitoring

4.0 TRANSBOUNDARY WATER QUALITY OBJECTIVES AND MONITORING

4.1 OVERVIEW OF WATER QUALITY

The water quality of the Souris River at the International Boundary has been monitored by the International Souris River Board (formerly the Souris River Bilateral Water Quality Monitoring Group) since 1990.

Water quality objectives are established at the two border crossings. When water quality objectives are not achieved such conditions are referred to as "exceedances." A summary of water quality exceedances for 2011 is reported in Appendix E. Historical data is also included.

The principle water quality concerns in the Souris River basin relate to elevated concentrations of total dissolved solids (TDS), depleted dissolved oxygen and high levels of nutrients especially phosphorus.

A total of 7 samples were collected by the USGS in 2011. Exceedances of specific water quality objectives at the Saskatchewan/North Dakota boundary include phosphorus, sodium, iron and dissolved oxygen. These results are relatively consistent with prior year's data except for sulfate, TDS and pH for which no exceedances were observed.

Total phosphorus exceeded the objective of 0.10 milligrams per liter in 100 percent of the samples. The maximum phosphorus concentration was 0.45 milligrams per liter, which is over 4 times the objective. Sodium and sulfate represent major constituents in the mineral composition of the Souris River and exceeded objectives 14 percent and 0.0 percent respectively.

Dissolved oxygen ranged from 4.1 milligrams per liter to 14.7 milligrams per liter. A concentration of less than 5.0 milligrams per liter is considered an exceedance and this occurred in 14 percent of the samples.

Water quality samples were collected 10 times at Westhope, North Dakota and Coulter, Manitoba in 2011. A triplicate QA/QC was collected in December bringing a total number of samples collected to 12. Because of flooding and access problems at the Westhope site, the April, May and June samples were collected at Coulter, Manitoba. The July sample was not collected due high water at Westhope, a washed out bridge at Coulter and unsafe conditions at Melita, Manitoba, otherwise all samples were collected at Westhope according to the sampling schedule. Joint USGS/EC samples were collected at Westhope and Sherwood in August 2011.

Total Phosphorus exceeded the Objective of 0.10 mg/L in 100% of the samples collected. Other parameters that exceeded their Objectives were Sulphate (4 out of 11 samples), Iron (3 samples), pH (one sample), Dissolved Oxygen (4 samples, ranging from 0.5 to 4.6 mg/L).

Pesticide samples were collected in April, May, June and August. 2,4-D, Atrazine, Bromoxynil, Dicamba, MPCA, and Picloram had positive results, but were below their respective Water Quality Objectives.

Since 2008 there has been a reduction of the number of exceedances of the Water Quality Objectives. Some parameters worth noting are Boron, Sulphate and Chloride, which had zero exceedance in 2011. Even though Total Phosphorus exceeded its Water Quality Objective 100% in 2011, the values have also shown a decreasing trend since 2008. Part of this may be attributed to increased flow in the Souris Basin.

4.2 CHANGES TO POLLUTION SOURCES IN 2011

There were no major changes to pollution sources in 2011. The most prevalent source of pollution is nonpoint pollution from agriculture. Agriculture dominates the land use of the Souris River basin, therefore, it can be surmised that contributions of phosphorus and nitrogen are substantial from these sources. Point sources of pollution from the cities of Estevan and Minot have been reduced by advanced wastewater treatment. Smaller cities continue to discharge effluent intermittently.

Future threats to water quality and aquatic ecosystem health include energy development, water appropriations that reduce flows, and reservoir operations.

4.3 TREND ANALYSIS REPORT

The latest Trend Analysis report was finalized in 2000 by the Souris River Bilateral Water Quality seasonal variability in daily discharge. The methodology used was compatible with changes in monitoring frequency and timing.

The group also discussed possible reasons for the increasing and decreasing trends and agreed that further trend analysis would be conducted on the sulfate data and other major ions data. USGS made slight changes to the model in 2003.

4.4 MONITORING PLAN CHANGES

No monitoring changes were implemented for 2011. The 2011 monitoring plan can be found in Appendix F.

4.5 SEDIMENT TOXICITY TESTING

Pollutants entrained in or attached to sediment represent an unassessed component of water quality at the two boundary sites.

The Board will continue to evaluate the various sediment toxicity testing protocols and, eventually, select an appropriate method and conduct tests at some point in the future when resources become available.

4.6 REVISION OF PHOSPHORUS OBJECTIVES

Phosphorus concentrations tend to be high in prairie soils. Under pre-settlement conditions, phosphorus could enter surface water by erosion, transported plant material, and animal activities. Human activities and hydrologic modifications exacerbate phosphorus loadings, which increases primary productivity. This process, called eutrophication has likely been accelerated in the Souris River. Common sources of phosphorus enrichment are municipal effluent, non-point contributions from agriculture, livestock, and hydrologic modifications. Substantial progress has been made in reducing phosphorus loading from Minot and Estevan by incorporating advanced wastewater treatment. Implementation of Best Management Practices on agricultural land, and installing animal waste systems has reduced loadings from these activities.

Dams frequently have a substantial additive affect on phosphorus loading. Large reservoirs that are recently constructed, and have hypolimnic releases, generally contribute high phosphorus loads. Low head dams can contribute to extremely high phosphorus loadings. These reservoirs often inundate nutrient rich prairie soils. The reservoirs often become anoxic during winter, releasing additional phosphorus from bottom sediments. As well, the reservoirs attract waterfowl that contribute large nutrient loadings to the system. The fall waterfowl population frequently moves out of the lower Souris River just prior to ice up. The organic load from waterfowl does not have sufficient time to become assimilated and, therefore, causes an oxygen demand that is not satisfied until the following open water period. Also, decaying vegetation in the off channel area contributes to anoxic conditions. Phosphorus release from the waterfowl contributions, decaying vegetation, and internal loading from the sediments results in significantly higher phosphorus concentrations than if the system was aerobic. Downstream loading at the border is very high, because spring runoff occurs prior to ice out, thereby purging these shallow ponds.

The phosphorus objective was reviewed as it was noted that phosphorus frequently exceeds the objective criterion at both border sites. Phosphorus tends to be quite high in concentration in prairie streams and differentiating between agricultural practices and baseline phosphorus concentrations remain largely unknown. It was decided that, since many initiatives, both in the United States and Canada, are moving forward on nutrient management, that it would be doubtful whether new information could be shed on this issue until the science was further developed. The review noted that the loading issue of phosphorus to Lake Darling would be important information; however, until a nutrient budget on Lake Darling is completed, the most appropriate course of action is to maintain the present nutrient objective.

The Board will not change the numeric objective of 0.10 milligrams per liter for total phosphorus at the present time and plans to refer the matter to the Aquatic Ecosystem Health Committee, once formed.

4.7 WINTER ANOXIA

Winter anoxia as the result of low dissolved oxygen and fish kills in the Souris basin has been documented on many occasions. Factors contributing to low oxygen levels have not been determined, but some possibilities could be increased sediment oxygen demand, macrophyte decomposition, organic enrichment, ground water influence, photosynthesis suppression, low flow, or dams. A dissolved oxygen concentration of 0.6 milligrams per liter was measured during 2010 at the North Dakota/Saskatchewan boundary and 0.47 milligrams per liter was measured during 2008 at the North Dakota/Manitoba boundary. These measurements were recorded during routine monitoring conducted by the United States Geological Survey and Environment Canada. The areal extent of the anoxia was not determined. The Board agreed to keep a watch on dissolved oxygen conditions and the North Dakota Department of Health and Environment Canada will attempt to collect dissolved oxygen and ammonia samples if low flow conditions prevail during future winters.

The upper portion of the Souris River was listed as impaired in 2004. This designation means this reach of the river needs a total maximum daily load (TMDL) study. The impairment for aquatic life is dissolved oxygen, and the impairment for recreation is fecal coliform bacteria. The study reach is 43.4 miles downstream from the border to Lake Darling. The lower portion of the Souris River in Saskatchewan from Glen Ewen to the border is also included. A final report was available for the Fecal Coliform bacteria TMDL in August 2010, and the final report for the Dissolved Oxygen TMDL was available in September, 2010.

The Fecal Coliform bacteria TMDL suggests the primary contributors are animal feeding areas located in close proximity to the Souris River with the majority of those occurring in Canada.

The dissolved oxygen TMDL identifies sediment oxygen demand as the primary source of oxygen depletion in the Souris River.

5.0 WATER-DEVELOPMENT ACTIVITIES IN 2011

5.1 NORTHWEST AREA WATER SUPPLY PROJECT

The Garrison Diversion Municipal, Rural, and Industrial (MRI) water-supply program, passed by the United States Congress on May 12, 1986, as part of the Garrison Diversion Reformation Act of 1986, authorized the appropriation of federal funds for the planning and construction of water-supply facilities throughout North Dakota. An agreement between the North Dakota State Water Commission and the Garrison Conservancy District in 1986 provided a method through which the agencies can request funding for MRI water-system projects from the Secretary of the Interior. On the basis of this agreement, the Northwest Area Water Supply (NAWS) study was initiated in November 1987.

The NAWS project has been designed to supply a reliable source of treated water to cities, communities, and rural water systems in 10 counties in northwestern North Dakota. The project has an estimated cost of $217 million.

The water supply for the project is Lake Sakakawea, located in the Missouri River system. The annual use authorized under the State of North Dakota water permit is 18 502 cubic decametres (15,000 acre-feet).

Canada is concerned that the NAWS project could permit the interbasin transfer of non-native biota. NAWS would be the first project to divert water across the continental divide to the Hudson Bay drainage basin.

The Province of Manitoba filed suit in U.S. District Court. The court required the project undergo further NEPA review, and placed an injunction on the project.
On April 15, 2005, the Court modified the injunction to allow the construction on the line between Lake Sakakawea and Minot to continue.

On March 24, 2006, the Court modified the injunction to allow additional construction of the Minot High Service Pump Station, the pipeline from the High Service Pump Station to the northern part of the City of Minot, and the pipeline to Berthold to proceed. It was determined that this construction would not affect treatment decisions. Design work on these projects was completed in 2006 and contract awards were made in 2007 and 2008. All 45 miles of this pipeline were completed by the summer of 2008. Berthold started receiving water in August 2008. The High Service Pump Station started operating in December 2009.

On March 18, 2008, the Court again modified the injunction to allow additional design and construction activities for the entire Northern Tier for features not affecting treatment decisions. The Kenmare-Upper Souris project started serving water in December 2009. The NAWS-All Seasons-Upham pipeline started serving water in September 2009. Berthold, the Kenmare-Upper Souris project, and the NAWS-All Seasons-Upham pipeline are currently receiving limited water supply from the Minot and Sundre aquifers.

Construction activity on NAWS in 2011 was severely hampered by the catastrophic flooding in the Souris River basin. Major operational issues were experienced due to the flooding, however, despite having a boil order for an extended amount of time, NAWS never had to cut service to any water users. Contract 2-2D was substantially completed which enabled NAWS to serve the communities of Sherwood and Mohall as well as All Seasons Rural Water system III by Antler. Construction was begun on two pipeline segments extending north of Minot that will serve Minot's North Hill, the Minot Air Force Base, and Upper Souris Water Users District in the Glenburn area. The first major upgrade to the Minot Water Treatment Facility was designed and bid. The project includes upgrading the filtration system and also includes the telemetry system for the North Tier of the project as well as the programming for the system as a whole.

5.2 WATER APPROPRIATIONS

5.2.1 Background

In 1995, the International Souris River Board adopted a new method for reporting minor project diversions for the purpose of determining apportionment. The new method uses a common set of criteria and ensures that the same criteria will be used in both Saskatchewan and North Dakota. It also involves taking the project lists generated by the Natural Flow Methods Committee and adding newly constructed projects or subtracting cancelled projects each year. The projects that met the criteria in 1993 are the benchmark for all future reporting.

5.2.2 Saskatchewan

In 1993, there were 137 minor projects in the Saskatchewan portion of the Souris River basin that met the new criteria. These projects had an annual diversion of 5 099 cubic decametres (4,134 acre-feet). On December 31, 2008, there were 139 minor projects in the Saskatchewan portion of the basin with an annual diversion of 4 824 cubic decametres (3,912 acre-feet). There were no new projects in 2011.

5.2.3 North Dakota

In 1993, there were 12 minor projects in the North Dakota portion of the Souris River basin upstream of Sherwood that met the new criteria. The projects had an annual diversion of 1 257 cubic decametres (1,019 acre-feet. On December 31, 2011, there were 12 minor projects in the North Dakota portion of the Long and Short Creek basins. The annual diversions totaled 1 423 cubic decametres (1,154 acre-feet).

The diversion from East Branch Short Creek near Columbus, North Dakota, was estimated by correcting for precipitation, evaporation and seepage, and the storage change. The diversion in 2011 was 910 cubic decametres (738 acre-feet). The diversion from the reservoir was added to the minor project diversions for the Long and Short Creek basins to obtain the total diversion of 2 334 cubic decametres (1,892 acre-feet) by the United States.

6.0 HYDROLOGIC CONDITIONS IN 2011

The Northern Plains experienced a very wet fall in 2009 and 2010. Saskatchewan had record and near-record rainfalls in 2010 and surplus topsoil moisture in the upper Souris River and Moose Mountain Creek basins. In the fall of 2010, conditions in the Souris River watershed within Saskatchewan were

far wetter than normal. The 90-day precipitation for August through October 2010 was 150-200 percent of average with an area centered on Weyburn just upstream of Rafferty reservoir being above 200 percent. Some areas in North Dakota have been in a very wet cycle for over 10 years. North Dakota experienced the 9th wettest fall since 1895. Minot, North Dakota set a new rainfall record on Sep 6th, 2010, recording 1.64 in (41.7 mm) of rain (previous record was 0.66 in (16.8 mm) in 2000). North Dakota soils were saturated going into the 2010/11 winter. The lower Souris River basin in Manitoba had well above normal (150-200 percent of normal) soil moisture at the time of freeze-up.

The development of La Nina during the summer of 2010 set the stage for a potentially active winter storm season, colder and wetter. La Nina conditions persisted through the winter into spring, resulting in a storm track that brought near to record snowfall across parts of the Northern Plains and Rockies. Precipitation continued throughout the winter, but there were discrepancies within and between data sources.

As winter progressed in Saskatchewan it became increasingly more apparent that a significant spring snowmelt event was developing. By April 1st runoff for the Souris was estimated to be varying from between “well above normal” to “very high.

North Dakota’s winter was colder and wetter than historical norms. It was the 11th wettest winter since 1895. Even though February was dry, overall winter precipitation was above normal. A major storm in December broke records at Dickinson, Bismarck, Minot and Williston. As of March 31st Minot recorded its 4th snowiest winter since 1905.

The winter of 2010-2011 brought a higher-than-normal snowfall accumulation of up to 4.7 in (120 mm) of snow water equivalent over the Souris River Watershed in Manitoba.

Precipitation during the winter (November-April) generally ranged from about 100 to 150 percent of the long-term seasonal average in North Dakota, 50 to 150 percent of the long-term seasonal average in Saskatchewan and between 130 to 150 percent of the long-term seasonal average in Manitoba.

The NWS National Operational Hydrologic Remote Sensing Center (NOHRSC) site shows daily maps of modeled SWE. The below list shows the average SWE at the beginning of each month from January through April.

- Saskatchewan portions of the Souris basin:
  - January 1st: 4 in (105 mm)
  - February 1st: 5 in (130 mm)
  - March 1st: 4 in (105 mm)
  - April 1st: 5 in (130 mm)
- North Dakota portions of the Souris basin:
  - January 1st: 3 in (75 mm)
  - February 1st: 4-4.5 in (105-115 mm)
  - March 1st: 3.5 in (90 mm)
  - April 1st: 4 in (105 mm)

- Manitoba portions of the Souris basin:
  - January 1st: 2.5 in (65 mm)
  - February 1st: 3 in (75 mm)
  - March 1st: 3.5 in (90 mm)
  - April 1st: 4 in (105 mm)

In addition to the heavy snowpack, the basin received substantial rainfall in the spring and summer. Storms frequented the region approximately every four to seven days, with each delivering around 2-4 in (50-100 mm) of rain over a large area.

In 2011 there were three distinct runoff periods: the spring snowmelt in April and early May, a series of moderate rainfall events in May and early June and the large rainfall event of June 17th and 19th in Saskatchewan.

In Saskatchewan, the snowmelt event was very large resulting in the watershed storage components being full and the soils near or at saturation by mid April when rainfall events started to occur. Several large precipitation events covering nearly the entire basin occurred from mid April to mid June. Rainfall in the Souris Basin from mid April to mid June was at a minimum of 150 percent above average and a large portion of the basin above 200 percent. Precipitation at Weyburn as compared to the long-term mean was more than double during the months of April through June 2011.

A series of intense storms focused on Long Creek and the Souris River, upstream of Rafferty occurred from June 17th to 21st. It was fortunate that the storms did not reach the Moose Mountain watershed and Alameda reservoir with the same intensity. There were essentially three different rainstorm events during the weekend of June 17th in the upper Souris River basin.

Summary of the amount of rain that fell over Long Creek watershed:

- 1st storm (Friday, June 17th) was centered over Gibson Creek near Radville, SK
- 2nd storm (Sunday, June 19th) between Maxim, SK and the Western Crossing
- 3rd storm (Tuesday, June 21st) downstream of the Western Crossing at Crosby, ND

Summary of the amount of rain that fell over Souris River upstream of Rafferty reservoir:

- 1st storm (Friday, June 17th) was centered over most of the watershed above Rafferty reservoir with the most intense rainfall over the Weyburn and Yellow Grass area
- 2nd storm (Sunday, June 19th) was distributed fairly well over the watershed above Rafferty reservoir
- 3rd storm (Monday night/Tuesday morning, June 20/21st) was centered on the lower end and directly over Rafferty reservoir

Real-time precipitation gauge data in Canadian portions of the Souris Basin were insufficient to define the large rainfall event of June 17th and very few precipitation reports filtered-in during the initial stages of this rainfall event. This initial lack of precipitation made accurate early NWS forecast model projections difficult to produce. Improved 72 hour to 120 hour event forecasting for rainfall and runoff by Canadian forecasters and regulators would be very helpful.

Long Creek near Noonan (inflow to Boundary reservoir) peaked eight different times between April 1st and June 3th. It broke the previous peak of record of 179 cubic metres per second (6,310 cubic

feet per second) in 1976 on April 12th with a peak instantaneous flow of 192 cubic metres per second (6,790 cubic feet per second) during the spring snowmelt runoff. It peaked six more times during the May through mid-June time period due to moderate rain events. Then on June 21st it reached a higher record peak of 306 cubic metres per second (10,800 cubic feet per second).

In North Dakota, Rainfall in May generally ranged from 150 to 300 percent of the long-term monthly average, with some sites receiving more than 400 percent above normal. Spring was colder and wetter than historically. It was the 12th wettest spring since 1895. June rainfall generally ranged from 100 to 200 percent of the long-term monthly average. Summer was warmer and wetter than historically. It was the 9th wettest summer since 1895. Minot recorded its third wettest July since 1948 with 5.58 in (141.7 mm). Minot's wettest July was in 1993 with 7.39 in (187.7 mm).

Major flooding occurred along the North Dakota portion of the Souris River from April through September. The flooding occurred in three distinct periods (spring snowmelt, numerous moderate rainfalls and the large rainfall in June). Many sites in North Dakota had numerous peaks each larger than the previous. Discharges from Lake Darling Dam are supposed to keep Minot 4NW below 14 cubic metres per second (500 cubic feet per second) after June 1, but due to the large volume of flood water coming through the system this was not possible. On October 2 Minot 4NW finally fell below 14 cubic metres per second (500 cubic feet per second), 230 days after rising above 14 cubic metres per second (500 cubic feet per second).

In Manitoba, the river thalweg drops only about 6 in (15 cm) per mile between the eastern International Border and Hartney. The limited channel capacity and flat gradient of the Souris River from the in this reach of the Souris River makes it particularly susceptible to rural and agricultural flooding.

Major flooding occurred along the Manitoba portion of the Souris River from April to August. Runoff began at the end of the first week of April. The spring peak flow was not affected by ice. Most of the early spring runoff came from the United States portion of the watershed and consequently Melita was the most affected with a spring snowmelt peak level only 0.1 feet (3 centimetres) lower than the 1976 flood of record peak whereas the water level in Wawanesa was about 5.2 feet (160 centimetres) lower than the 1976 peak.

Following the spring runoff, heavy rainfalls across the basin caused the Souris River in Manitoba and its tributaries to rise several times, with ever-increasing peak estimates between mid-April and July 6th. Precipitation in May over the Manitoba portion of the basin was 200 to 300 percent of normal. The precipitation sustained the high flows along the main stem of the Souris River. In mid-June, rainstorms over the Manitoba portion of the watershed (up to 1.4 inches (35 millimetres)) caused peak stages higher than those recorded earlier in the spring at both Souris and Wawanesa. Pipestone Creek flows were already very high during May, had filled Oak Lake and Plum Lakes to record levels, and produced unprecedented flows in Plum Creek downstream towards the Town of Souris.

The impacts of the storms of June 17th and 19th over the upper portion of the watershed in Saskatchewan reached Manitoba in early July. The crest reached the Towns of Melita, Souris and Wawanesa on July 4th, 5th and 6th respectively. The 1976 peak water level at Melita was broken by 1.64 feet (50 centimetres) and the 1976 peak water level at Souris was broken by 0.38 feet (11.5 centimetres). Flooding in the three communities was prevented due to the emergency raising of the community dikes. The Coulter Bridge, just seven miles from the US border, was destroyed due to continuous high flows.

The table below, lists estimated frequencies and corresponding recurrence intervals for volumes of runoff of specified durations at Sherwood. The durations are for the months of April, May, June, April through July, maximum consecutive 31-day, and the annual volume for water year 2011. The frequencies can only be considered as estimates as the values for the period-of-record (POR) were not adjusted for the current reservoir configuration. These estimates are based on recorded flows at the Sherwood gauge for the POR. They are presented here as estimates to provide perspective on the relative magnitude of the 2011 event compared to what has occurred in the past. The table indicates that the April and May volumes are typical, but that June and July as well as the total annual volumes were unprecedented.

Estimated Frequencies for Specified Durations of Runoff near Sherwood, North Dakota.

Event or Duration	Estimated Exceedence Frequency, %	Estimated Recurrence Interval, years
April	6.3	16
May	2	50
June	<< 0.2	>> 500
July	<< 0.2	>> 500
April-July	0.28	360
31-Day	1	100
Annual	<< 0.2	>> 500

* Frequencies based on unadjusted peak flows for homogeneity (Canadian dams)

7.0 SUMMARY OF FLOWS AND DIVERSIONS

7.1 SOURIS RIVER NEAR SHERWOOD

The natural runoff near Sherwood for 2011 was 1 572 094 cubic decametres (1,274,495 acre-feet). Depletions in Canada totaled 91 501 cubic decametres (74,180 acre-feet). The additional water received from the Yellow Grass Ditch and Tatagwa Lake Drain basins was 381 895 cubic decametres (309,602 acre-feet). Total depletions in Canada were minus 473 396 cubic decametres (minus 383,782 acre-feet) more than the additional water received from the Yellow Grass Ditch and Tatagwa Lake Drain basins. The total volume of water released from Boundary, Rafferty, and Alameda Reservoirs in Canada in 2011 was 1 862 656 cubic decametres (1,510,054 acre-feet), representing 91 percent of the recorded flow at Sherwood, or 118 percent of the computed natural runoff at Sherwood. A schematic representation of the 2011 flow volumes in the Souris River basin above Sherwood is shown in Figure 2 and the summary of the natural flow computations is provided in Appendix A. It should be noted that Saskatchewan was in surplus on December 31, 2011 by 1 416 650 cubic decametres (1,148,477 acre-feet).

The flow of the Souris River at Sherwood was more than 0.113 cubic metres per second (4 cubic feet per second) except during the winter periods of January 1 through March 11. During those periods when the flow was less than 0.113 cubic metres per second (4 cubic feet per second), the Province of Saskatchewan did not divert, store, or use any water above what would have occurred under conditions of water-use development prevailing in the Saskatchewan portion of the basin prior to the construction of Boundary Dam, Rafferty Dam, and Alameda Dam. Accordingly, Saskatchewan complied with the 0.113 cubic metres per second (4 cubic feet per second) provision specified in Recommendation No. 1 of the Interim Measures.

7.2 LONG CREEK AND SHORT CREEK

Recorded runoff for Long Creek at the Western Crossing as it enters North Dakota was 339 435 cubic decametres (275,180 acre-feet), or 1,000 percent of the long-term mean since 1959. Recommendation No. 2 of the Interim Measures was met with a net gain in the North Dakota portion of the Long Creek basin of 142 736 cubic decametres (115,716 acre-feet).

Short Creek, which rises in North Dakota, contributed 101 674 cubic decametres (82,427 acre-feet) to runoff in the Souris River above Sherwood.

7.3 SOURIS RIVER NEAR WESTHOPE

Recorded flow near Westhope during the period of June 1 through October 31, 2011, was 2 760 820 cubic decametres (2,238,287 acre-feet). Figure 5 illustrates the recorded flows at Westhope and at Wawanesa near the mouth of the Souris River in Manitoba.

The peak daily discharge of 841 cubic metres per second (29,700 cubic feet per second) occurred on June 23, and was double the previous peak of record, 419 cubic metres per second (14,800 cubic feet per second) on April 10, 1976.

The flow was in compliance with the 0.566 cubic metres per second (20 cubic feet per second) minimum flow requirement as specified in Recommendation No. 3(a) of the Interim Measures.

8.0 WORKPLAN SUMMARY FOR 2011

The International Souris River Board was created by the International Joint Commission in April 2000 when it combined responsibilities for the Souris River previously assigned in two separate References. The two were the International Souris River Board of Control Reference (1959) and the Souris-Red Rivers Engineering Board Reference (1948).

On June 9, 2005, the International Souris River Board's mandate was changed further through an exchange of diplomatic notes, assigning water quality functions and the oversight for flood forecasting and operations to the International Souris River Board. The consolidation of water quantity, water quality, and the oversight for flood forecasting and operations is a step in the evolution of the International Souris River Board as it moves towards an integrated approach to transboundary water issues in the Souris River basin.

The International Souris River Board determined that a workplan would be beneficial in helping the International Souris River Board identify resource requirements and deliver on results. The International Souris River Board agreed that the workplan should include costs related to normal International Souris River Board activities such as meetings, the annual report, and special projects.

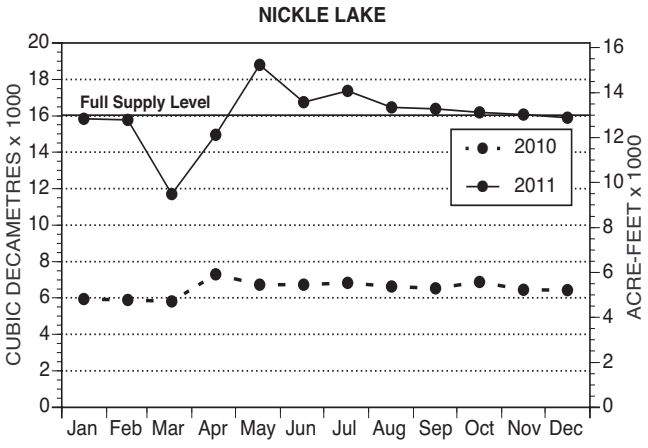
A multi-year workplan was developed for 2008-2009 and was updated for 2009-2010. The workplan follows the four strategic initiatives of the International Watershed Initiative.

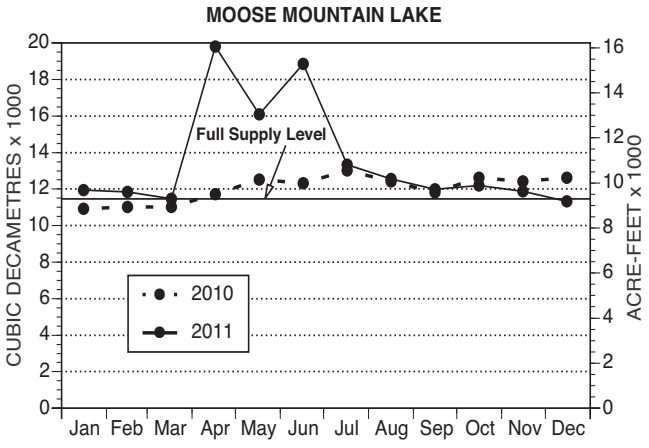
- Build shared understanding of the watershed and related transboundary issues.
- Communicate watershed issues at the local, regional and national levels to increase awareness, highlight potential issues, and identify opportunities for cooperation and resolution.
- Contribute to the resolution of watershed issues.
- Administer the existing orders and references.

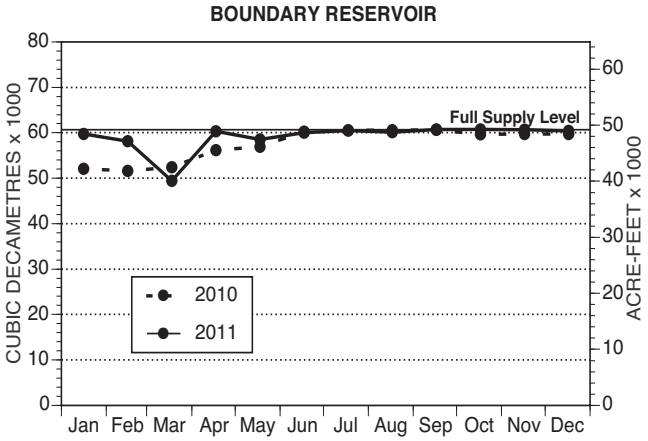
The International Souris River Board's workplan for the coming years will be shaped by the Plan of Study for the 2011 Flood event.

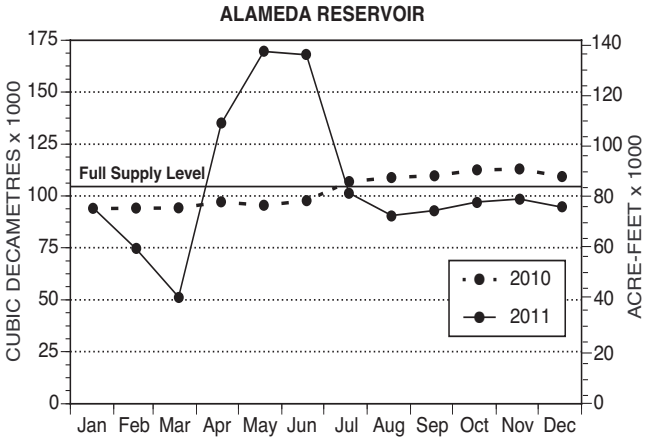
Figure 1

MONTH END CONTENTS OF RESERVOIRS IN CANADA FOR THE YEARS 2010 AND 2011









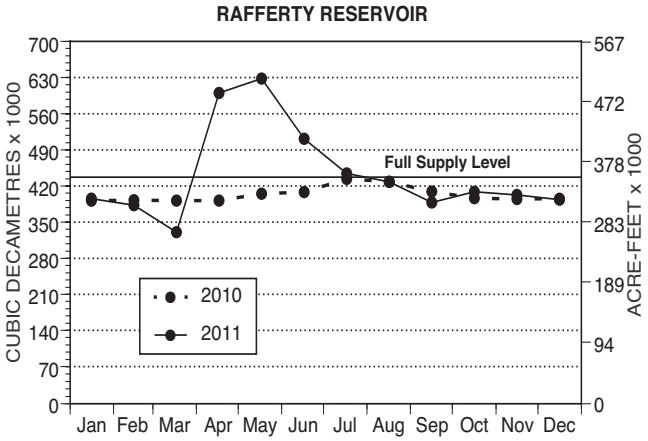


Figure 2

SCHEMATIC REPRESENTATION OF 2011 FLOWS IN THE SOURIS RIVER BASIN ABOVE SHERWOOD, NORTH DAKOTA, U.S.A.

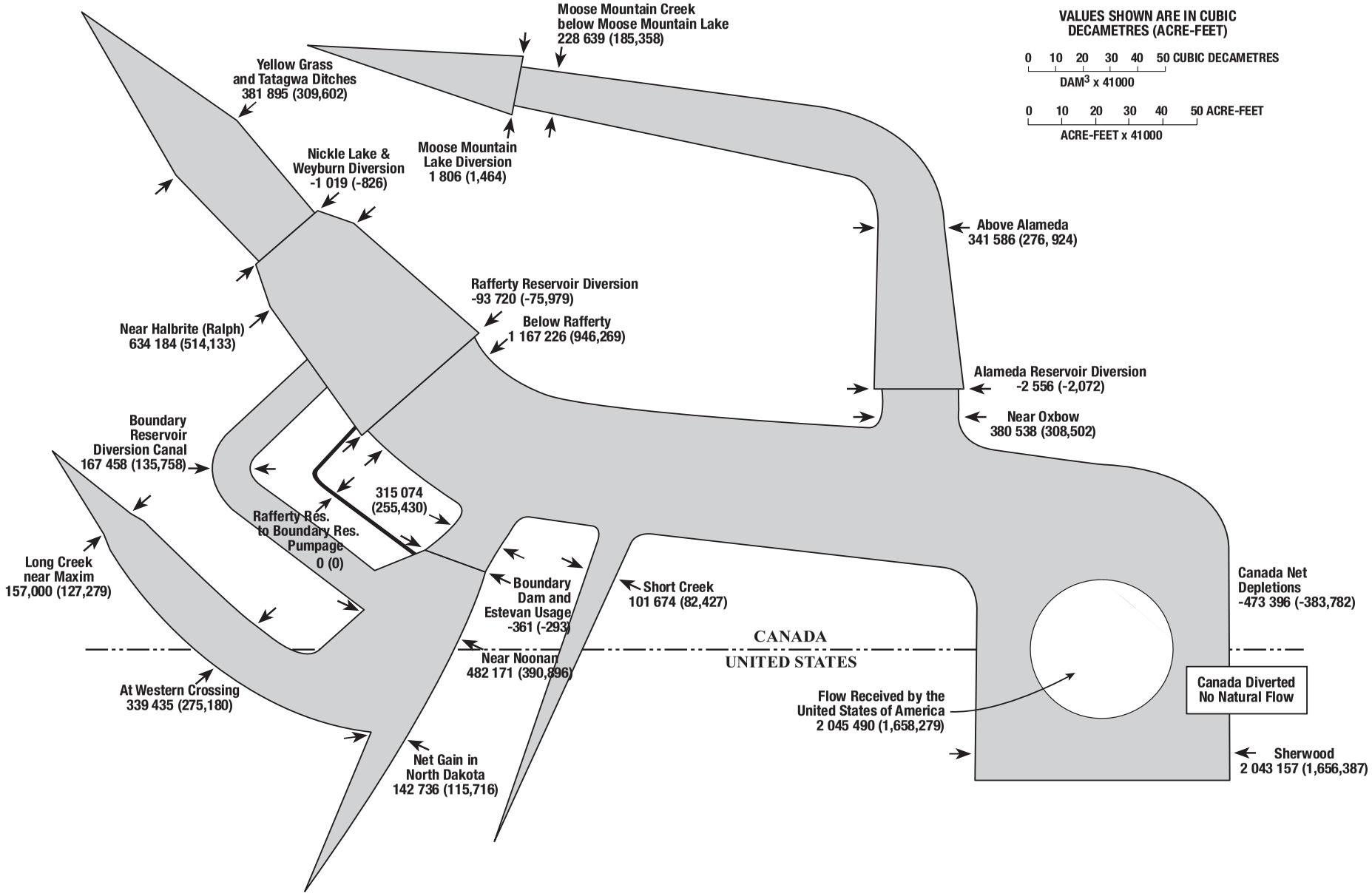


Figure 3

MONTH END CONTENTS OF RESERVOIRS IN USA FOR THE YEARS 2010 AND 2011

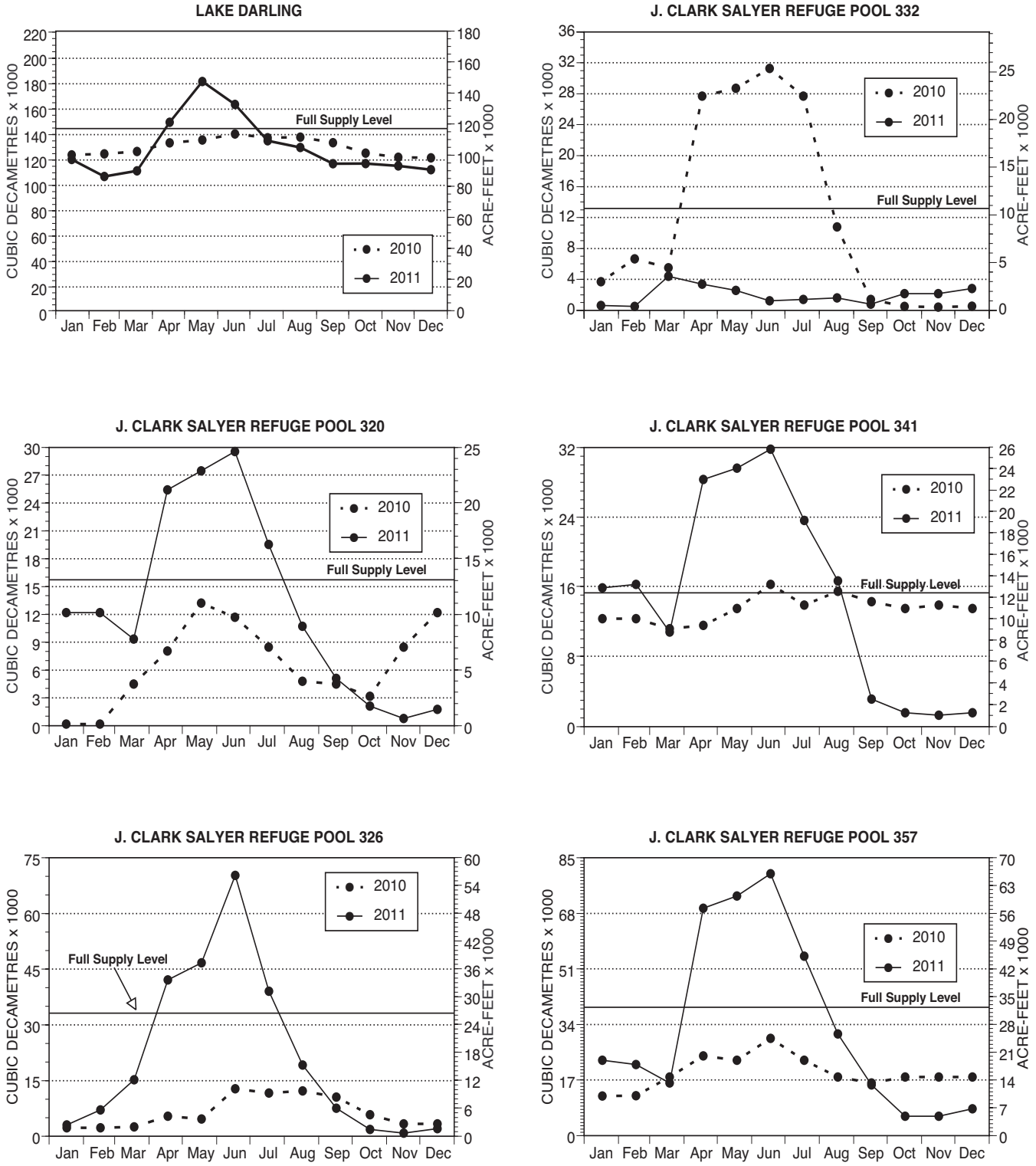


Figure 4

MONTHLY RESERVOIR RELEASES FOR THE YEAR 2011

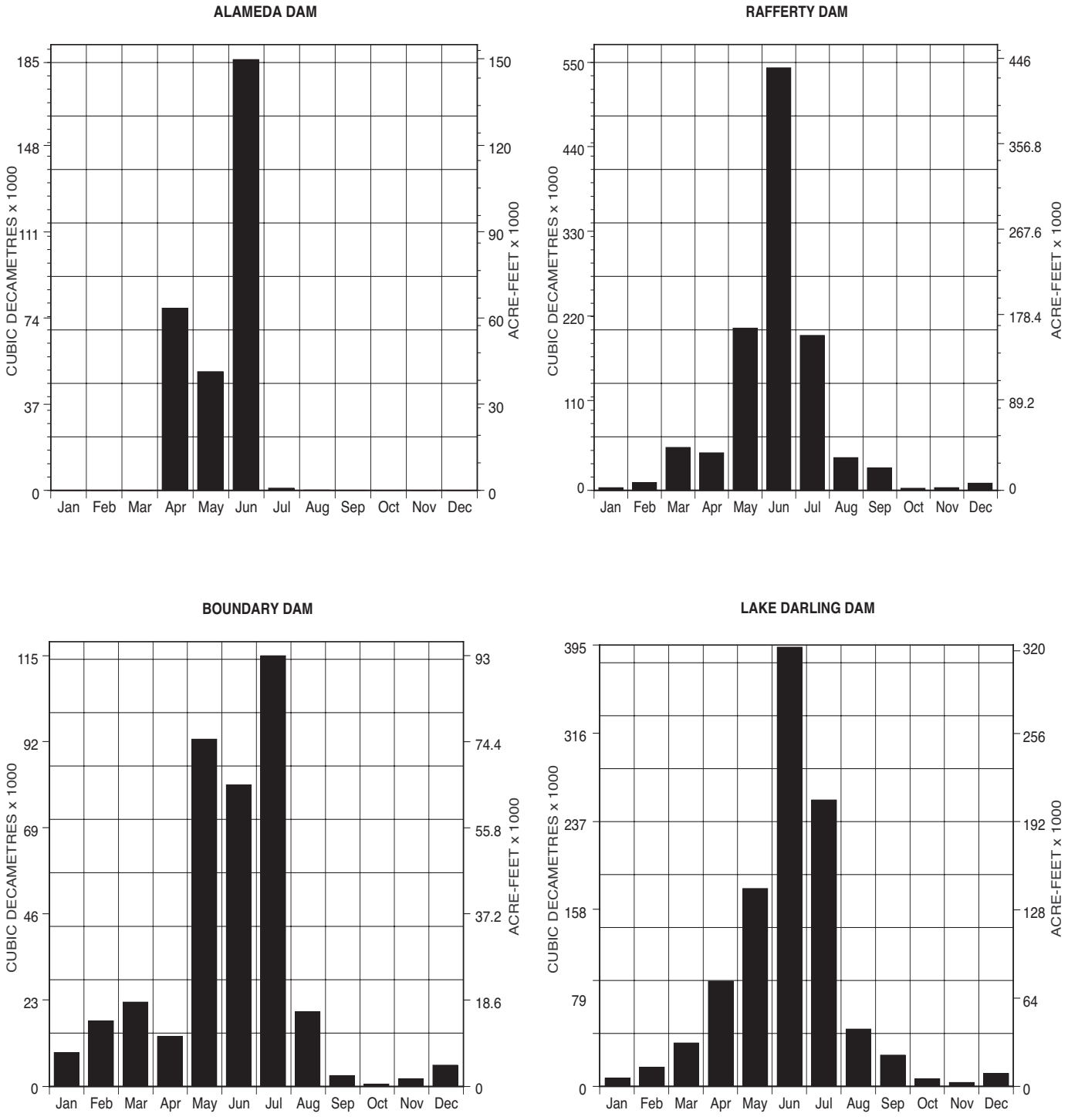
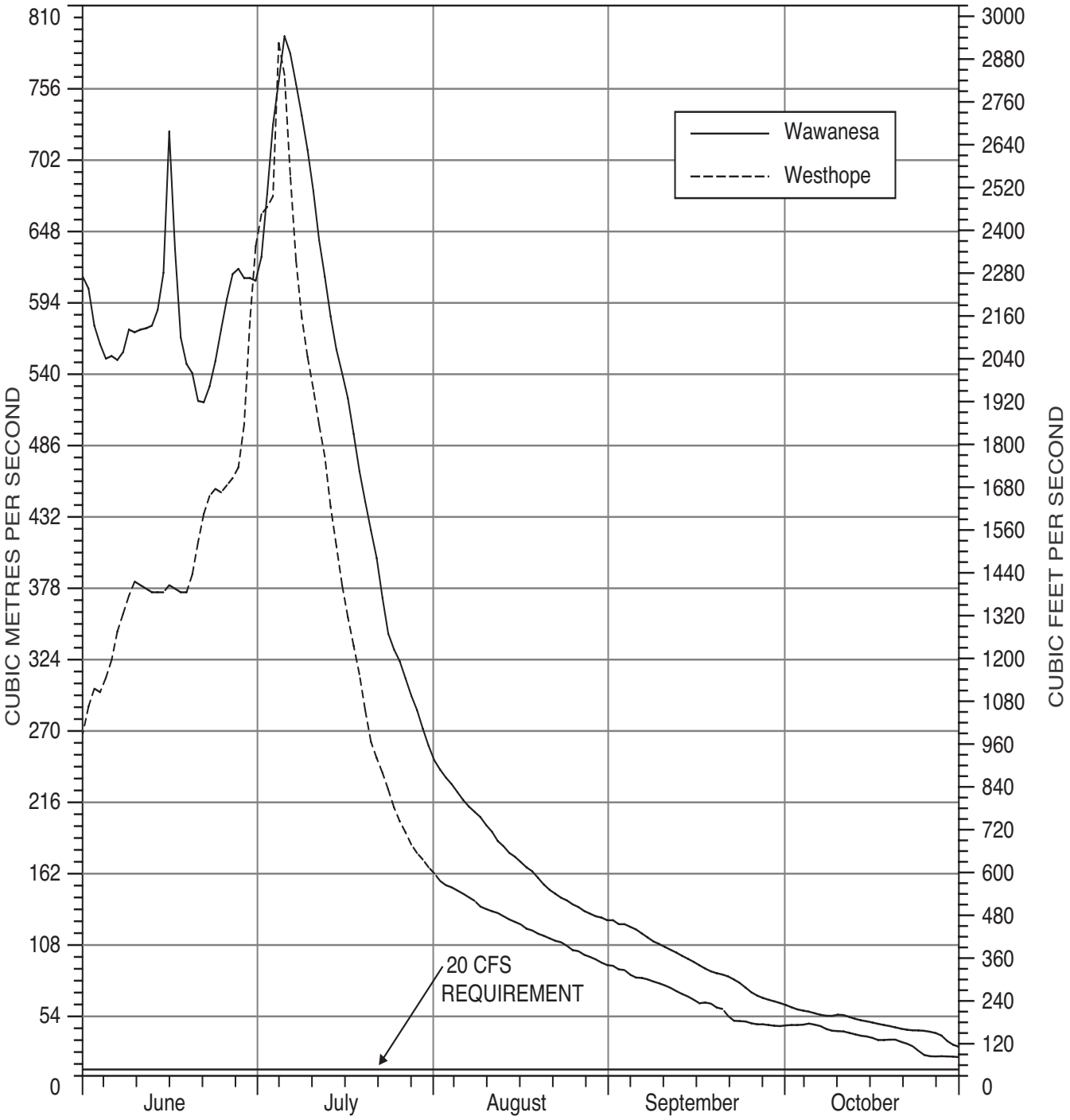


Figure 5

SOURIS RIVER NEAR WESTHOPE
AND
SOURIS RIVER NEAR WAWANESA

June 1, 2011 to October 31, 2011



Map of the Souris River Drainage Basin

INTERNATIONAL JOINT COMMISSION • COMMISSION MIXTE INTERNATIONALE 1909

0 5 10 15 20
Miles
0 10 20 30 40
Kilometres
North

Legend

- Souris River Basin
- Indian / Native Reserve
- Provincial Park
- US Fish and Wildlife
- Gauging Stations
- City
- Town, Village
- Highway
- River
- Lake or Reservoir

Datum: NAD 1983
Projection: Lambert Conformal Conic
Latitude of Origin: 49'
Central Meridian: -104'
Standard Parallel 1: 49'
Standard Parallel 2: 77'

Date: October 2007

Contact: M.R. Gilchrist, 306-780-6411
Environment Canada

Manitoba
Saskatchewan
Canada
U.S.A.
Montana
North Dakota

APPENDIX A

Determination of Natural Flow of Souris River at International Boundary (Sherwood)

DETERMINATION OF NATURAL FLOW OF SOURIS RIVER AT INTERNATIONAL BOUNDARY (SHERWOOD)

All Quantities Reported In Cubic Decametres

FOR THE PERIOD: JANUARY 1 TO DEC 31, 2011

LONG CREEK BASIN

LARSEN RESERVOIR				BOUNDARY RESERVOIR								
				INFLOW	OUTFLOW							
1	2	3	4	5 *	6	7	8	9	10	11	12 *	13
STORAGE CHANGE	EVAPORATION	DIVERSION	TOWN OF RADVILLE PUMPAGE	LONG CREEK AT EASTERN CROSSING	LONG CREEK NEAR ESTEVAN	ESTEVAN PIPELINE	DIVERSION CANAL	TOTAL (OUTFLOW)	DIVERSION	MINOR PROJECT DIVERSION	U.S.A. DIVERSION BETWEEN WESTERN & EASTERN CROSSING	**TOTAL DIVERSION LONG CREEK**
				482171								
-83	118	35 (1+2)	30	0 PIPELINE	314781	2084	167458	484323 (6+7+8)	-2152 (5-9)	840	403	-844 **(3+4+10+11+12)**

UPPER SOURIS RIVER BASIN - ABOVE ESTEVAN

NICKLE LAKE RESERVOIR					ROUGHBARK RESERVOIR			RAFFERTY RESERVOIR				
14	15	16	17	18	19	20	21	22	23	24	25	26
STORAGE CHANGE	EVAPORATION	CITY OF WEYBURN PUMPAGE	DIVERSION	CITY OF WEYBURN RETURN FLOW	STORAGE CHANGE	EVAPORATION	DIVERSION	INFLOW	OUTFLOW	DIVERSION	MINOR PROJECT DIVERSION	**TOTAL DIVERSION UPPER SOURIS RIVER**
									1167226			
-15	1590	1143	2718 (14+15+16)	3737	-1361	182	-1153 (19+20)	1073506	0 PIPELINE	-93720 (22-23)	1542	-94350 **(17-18+21+24+25)**

LOWER SOURIS RIVER--ESTEVAN TO SHERWOOD

27	28 *	29	30
CITY OF ESTEVAN NET PUMPAGE	SHORT CREEK DIVERSIONS IN U.S.A.	MINOR PROJECT DIVERSION	**TOTAL DIVERSION LOWER SOURIS RIVER**
1791	1930	1603	5324 **(27+28+29)**

MOOSE MOUNTAIN CREEK BASIN

MOOSE MOUNTAIN LAKE			ALAMEDA RESERVOIR				
31	32	33	34	35	36	37	38
STORAGE CHANGE	EVAPORATION	DIVERSION	STORAGE CHANGE	EVAPORATION	DIVERSION	MINOR PROJECT DIVERSIONS	**TOTAL DIVERSIONS MOOSE MOUNTAIN CREEK BASIN**
-363	2169	1806 (31+32)	-7901	5345	-2556 (34+35)	1452	702 **(33+36+37)**

NON-CONTRIBUTORY BASINS

39	40	41
YELLOW GRASS DITCH	TATAGWA LAKE DRAIN	**TOTAL ADDITIONS**
322319	59576	381895 (39+40)

SUMMARY OF NATURAL FLOW

42	43 *	44	45	46	47
TOTAL DIVERSION SOURIS RIVER BASIN	RECORDED FLOW AT SHERWOOD	NATURAL FLOW AT SHERWOOD	U..S.A. SHARE	FLOW RECEIVED BY U.S.A.	**SURPLUS (+) OR DEFICIT (-) TO U.S.A.**
			40% OF 44 628840		(46-45) 40% SHARE **1416650**
-89168 (13+26+30+38)	2043157	1572094 (42+43-41)	50% OF 44	2045490 (12+28+43)	(46-45) 50% SHARE

RECOMMENDATION - SECTION 2 ANNUAL FLOW OF LONG CREEK

48	49 *	50
RECORDED FLOW AT WESTERN CROSSING	RECORDED FLOW AT EASTERN CROSSING	**SURPLUS (+) OR DEFICIT (-) FROM U.S.A.**
339435	482171	**142736** (49-48)

*** DATA CONTRIBUTED BY U.S.G.S.**

APPENDIX B

Equivalents of Measurements

EQUIVALENTS OF MEASUREMENTS

The following is a list of equivalents of measurement that have been agreed to for use in reports of the International Souris River Board.

1 centimetre equals 0.39370 inch
1 metre equals 3.2808 feet
1 kilometre equals 0.62137 mile

1 hectare equals 10 000 square metres
1 hectare equals 2.4710 acres
1 square kilometre equals 0.38610 square mile

1 cubic metre per second equals 35.315 cubic feet per second

The metric (SI) unit that replaces the British acre-foot unit is the cubic decametre (dam^3), which is the volume contained in a cube 10 m x 10 m x 10 m or 1 000 cubic metres.

1 cubic decametre equals 0.81070 acre-feet
1 cubic metre per second flowing for 1 day equals 86.4 cubic decametres
1 cubic foot per second flowing for 1 day equals 1.9835 acre-feet

APPENDIX C

Interim Measures as Modified in 2000

INTERIM MEASURES AS MODIFIED IN 2000

APPENDIX A TO THE DIRECTIVE TO THE INTERNATIONAL SOURIS RIVER BOARD

1. The Province of Saskatchewan shall have the right to divert, store, and use waters which originate in the Saskatchewan portion of the Souris River basin, provided that such diversion, storage, and use shall not diminish the annual flow of the river at the Sherwood Crossing more than 50 percent of that which would have occurred in a state of nature, as calculated by the International Souris River Board. For the purpose of these calculations, any reference to "annual" and "year" is intended to mean the period January 1 through December 31.

   For the benefit of riparian users of water between the Sherwood Crossing and the upstream end of Lake Darling, the Province of Saskatchewan shall, so far as is practicable, regulate its diversions, storage, and uses in such a manner that the flow in the Souris River channel at the Sherwood Crossing shall not be less than 0.113 cubic metre per second (4 cubic feet per second) when that much flow would have occurred under the conditions of water use development prevailing in the Saskatchewan portion of the Souris River basin prior to construction of the Boundary Dam, Rafferty Dam, and Alameda Dam.

   Under certain conditions, a portion of the North Dakota share will be in the form of evaporation from Rafferty and Alameda Reservoirs. During years when these conditions occur, the minimum amount of flow actually passed to North Dakota will be 40 percent of the annual natural flow volume at the Sherwood Crossing. This lesser amount is in recognition of Saskatchewan's operation of Rafferty Dam and Alameda Dam for flood control in North Dakota and of evaporation as a result of the project.

   a. Saskatchewan will deliver a minimum of 50 percent of the annual natural flow volume at the Sherwood Crossing in every year except in those years when the conditions given in (i) or (ii) below apply. In those years, Saskatchewan will deliver a minimum of 40 percent of the annual natural flow volume at the Sherwood Crossing.

      i. The annual natural flow volume at Sherwood Crossing is greater than 50 000 cubic decametres (40,500 acre-feet) and the current year June 1 elevation of Lake Darling is greater than 486.095 metres (1594.8 feet); or

      ii. The annual natural flow volume at Sherwood Crossing is greater than 50 000 cubic decametres (40,500 acre-feet) and the current year June 1 elevation of Lake Darling is greater than 485.79 metres (1593.8 feet), and since the last occurrence of a Lake Darling June 1 elevation of greater than 486.095 metres (1594.8 feet) the elevation of Lake Darling has not been less than 485.79 metres (1593.8 feet) on June 1.

   b. Notwithstanding the annual division of flows that is described in (a), in each year Saskatchewan will, so far as is practicable as determined by the Board, deliver to North Dakota prior to June 1, 50 percent of the first 50 000 cubic decametres (40,500 acre-feet) of natural flow which occurs during the period January 1 to May 31. The intent of this division of flow is to ensure that North Dakota receives 50 percent of the rate and volume of flow that would have occurred in a state of

nature to try to meet existing senior water rights.

c. Lake Darling Reservoir and the Canadian reservoirs will be operated (insofar as is compatible with the Projects' purposes and consistent with past practices) to ensure that the pool elevations, which determine conditions for sharing evaporation losses, are not artificially altered. The triggering elevation of 485.79 metres (1593.8 feet) for Lake Darling Reservoir is based on existing water uses in North Dakota, including refuges operated by the U.S. Fish and Wildlife Service. Each year, operating plans for the refuges on the Souris River will be presented to the Board. Barring unforeseen circumstances, operations will follow said plans during each given year. Lake Darling Reservoir will not be drawn down for the sole purpose of reaching the elevation of 485.79 metres (1593.8 feet) on June 1.

   Releases will not be made by Saskatchewan Watershed Authority from the Canadian reservoirs for the sole purpose of raising the elevation of Lake Darling Reservoir above 486.095 metres (1594.8 feet) on June 1.

d. Flow releases to the United States should occur (except in flood years) in the pattern which would have occurred in a state of nature. To the extent possible and in consideration of potential channel losses and operating efficiencies, releases from the Canadian dams will be scheduled to coincide with periods of beneficial use in North Dakota. Normally, the period of beneficial use in North Dakota coincides with the timing of the natural hydrograph, and that timing should be a guide to releases of the United States portion of the natural flow.

e. A determination of the annual apportionment balance shall be made by the Board on or about October 1 of each year. Any shortfall that exists as of that date shall be delivered by Saskatchewan prior to December 31.

f. The flow release to the United States may be delayed when the State of North Dakota determines and notifies Saskatchewan through the Board that the release would not be of benefit to the State at that time. The delayed release may be retained for use in Saskatchewan, notwithstanding the 0.113 cubic metre per second (4 cubic feet per second) minimum flow limit, unless it is called for by the State of North Dakota through the Board before October 1 of each year. The delayed release shall be measured at the point of release and the delivery at Sherwood Crossing shall not be less than the delayed release minus the conveyance losses that would have occurred under natural conditions between the point of release and the Sherwood Crossing. Prior to these releases being made, consultations shall occur between the Saskatchewan Watershed Authority, the U.S. Fish and Wildlife Service, and the State of North Dakota. All releases will be within the specified target flows at the control points.

2. Except as otherwise provided herein with respect to delivery of water to the Province of Manitoba, the State of North Dakota shall have the right to divert, store, and use the waters which originate in the North Dakota portion of the Souris River basin together with the waters delivered to the State of North Dakota at the Sherwood Crossing under Recommendation (1) above; provided, that any diversion, use, or storage of Long Creek water shall not diminish the annual flow at the eastern crossing of Long Creek into Saskatchewan below the annual flow of said Creek at the western crossing into North Dakota.

3. (a) In addition to the waters of the Souris River basin which originate in the Province of Manitoba, that Province shall have the right, except during periods of severe drought, to receive for its own use and the State of North Dakota shall deliver from any available source during the months of June, July, August, September, and October of each year, six thousand and sixty-nine (6,069) acre-feet of water at the Westhope Crossing regulated so far as practicable at the rate of twenty (20) cubic feet per second except as set forth hereinafter: provided, that in delivering such water to Manitoba no account shall be taken of water crossing the boundary at a rate in excess of the said 20 cubic feet per second.

   (b) In periods of severe drought when it becomes impracticable for the State of North Dakota to provide the foregoing regulated flows, the responsibility of the State of North Dakota in this connection shall be limited to the provision of such flows as may be practicable, in the opinion of the said Board of Control, in accordance with the objective of making water available for human and livestock consumption and for household use. It is understood that in the circumstances contemplated in this paragraph the State of North Dakota will give the earliest possible advice to the International Souris River Board of Control with respect to the onset of severe drought conditions.

4. In event of disagreement between the two sections of the International Souris River Board of Control, the matters in controversy shall be referred to the Commission for decision.

5. The interim measures for which provision is herein made shall remain in effect until the adoption of permanent measures in accordance with the requirements of questions (1) and (2) of the Reference of January 15, 1940, unless before that time these interim measures are qualified or modified by the Commission.

APPENDIX D

Board Directive from January 18, 2007

DIRECTIVE TO THE INTERNATIONAL SOURIS RIVER BOARD

The International Souris River Board was created by the International Joint Commission in April 2000 when it amalgamated the Souris River basin responsibilities previously assigned to the Commission in two separate references by the governments of Canada and the United States. The two references were the International Souris River Board of Control Reference (1959) and the Souris-Red Rivers Engineering Board Reference (1948). The International Souris River Board's mandate changed further through an exchange of diplomatic notes on June 9, 2005 assigning water quality functions and the oversight for flood forecasting and operations as described in Section 4 below. The consolidation of water quantity, water quality, and the oversight for flood forecasting and operations is a step in the evolution of the International Souris River Board as it moves towards an integrated approach to transboundary water issues in the Souris River basin.

This directive replaces the April 11, 2002 Directive to the International Souris River Board and sets out the mandate under which the Board will operate.

1. Pursuant to the Boundary Waters Treaty of 1909 and related agreements, responsibilities have been conferred on the Commission to ensure compliance with apportionment measures for the waters of the Souris River, to investigate and report on water requirements and uses as they impact the transboundary waters of the Souris River basin, and to assist in the implementation and review of the Joint Water Quality Monitoring Program pursuant to the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin.

2. The apportionment measures derive from the approvals given by the governments of Canada and the United States, by letters of March 20, 1959 and April 3, 1959 respectively, to the recommendations made by the Commission in paragraph 22 of its report to the governments of March 19, 1958. Subsequently, with the signing of the Canada-United States Agreement for Water Supply and Flood Control in the Souris River basin on October 26, 1989 (hereafter referred to as the 1989 Agreement), the Interim Measures for apportionment of the Souris River at the Saskatchewan-North Dakota boundary were revised as described in Annex B of the 1989 Agreement. By letters of February 28, 1992, the Commission was requested to monitor compliance with the measures as modified in the 1989 Agreement. By letters of December 20 and 22, 2000, the governments amended Annex B of the 1989 Agreement. The attached Appendix A is a consolidation of the apportionment measures against which the Commission is to monitor compliance.

3. By letters of January 12, 1948, the governments requested the Commission to undertake investigations of water requirements and uses arising out of existing dams and other works or projects in the mid-continent portion of the Canada-United States boundary, including the Souris River basin, and to make advisory recommendations.

4. By exchange of diplomatic notes between the governments of Canada and the United States dated January 14 and June 9, 2005, the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin was formally revised to include a reference pursuant to Article IX of the Boundary Waters Treaty which assigned water quality responsibilities contained in the 1989 Agreement to the Commission. The Commission was requested to assist with the implementation and review of the Joint Water Quality Monitoring Program. On October 21, 2005 at the October 2005 Commission's meeting with governments, the U.S. State Department read a statement into the Commission's formal record that the U.S. State Department is of the opinion the Commission has the authority and has obtained the notification it needs from the U.S. State Department to proceed with carrying out the flood related responsibilities for the Souris River. On April 6, 2006 at the April 2006 Commission's meeting with governments, the Department of Foreign Affairs and International Trade indicated that the Board should be assigned these responsibilities. It is recognized that Article X of the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River basin designates the entities responsible for operation and maintenance of the improvements mentioned in the 1989 Agreement and that the operations will be in accordance with the Operating Plan shown in Annex A of the 1989 Agreement. The Department of Army is the entity designated responsible for flood operations within the United States. The Government of Saskatchewan is the Canadian entity designated responsible for flood operations within the Canadian Province of Saskatchewan.

5. The Board's mandate is to support the Commission's initiative to explore and encourage the development of local and regional capacity with the objective of preventing and resolving transboundary disputes regarding the waters and aquatic ecosystem of the Souris River and its tributaries and aquifers. This would be accomplished through the application of best available science and knowledge of the aquatic ecosystem of the basin and an awareness of the needs, expectations and capabilities of residents of the Souris River basin. The Board's mandate will be accomplished by performing the tasks identified in Clause 6 below.

6. The Board's duties shall be to:

   (i) Maintain an awareness of existing and proposed developments, activities, conditions, and issues in the Souris River basin that may have an impact on transboundary water levels, flows, water quality, and aquatic ecosystem health and inform the Commission about existing or potential transboundary issues.

   (ii) Oversee the implementation of compliance with the Interim Measures As Modified For Apportionment of the Souris River as described in Appendix A of this document by:
   - identifying an adequate hydro-climatic monitoring network to support the determination of natural flow and apportionment balance,
   - encouraging the appropriate authorities to establish and maintain hydro-climatic monitoring and information collection networks and reporting

systems to ensure suitable information is available as required for the determination of natural flow and apportionment balance,

- informing the Commission, in a timely manner, of critical water supply or flow conditions in the basin,
- encouraging appropriate authorities to take steps to ensure that apportionment measures are met, and
- preparing an annual report and submitting it to the Commission.

(iii) Assist the Commission in the review of a Joint Water Quality Monitoring Program (referred to hereafter as "the Program") by:

- developing recommendations on the Program and the setting of water quality objectives,
- exchanging data provided by the Program on a regular basis,
- collating, interpreting, and analyzing the data provided by the Program,
- reviewing the Program and the water quality objectives at least every five years and developing recommendations, as appropriate, to the Commission to improve the Program and the objectives, and
- preparing an annual report containing:
  - a summary of the principal activities of the Board during the year with respect to the Program,
  - a summary of the principal activities affecting water quality in the Souris River Basin during the year,
  - a summary of the collated, interpreted, and analyzed data provided by the Program,
  - a summary of the water quality of the Souris River at the two locations at which it crosses the International Boundary,
  - a section summarizing any definitive changes in the monitored parameters and the possible causes of such changes,
  - a section discussing the water quality objectives for the Souris River at the Saskatchewan/North Dakota boundary and at the North Dakota/Manitoba boundary as established and revised pursuant to the 1989 Agreement,
  - a section summarizing other significant water quality changes and the possible causes of such changes, and
  - recommendations on new water quality objectives or on how existing water quality objectives can be met, including suggestions on water quality as it relates to water quantity during periods of low flow, in the event that the annual report indicates that the water quality objectives have not been attained as a result of activities pursued under the 1989 Agreement.

(iv) Perform an oversight function for flood operations in cooperation with the designated entities identified in the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin by:

- ensuring mechanisms are in place for coordination of data exchange, flood forecasts and communications related to flood conditions and operations;
- determining whether the operations under the 1989 Agreement should proceed based on the Flood Operation or Non-Flood Operation of the Operating Plan, which is Annex A to the 1989 Agreement, using its criteria and informing designated agencies of this determination;
- reporting to the Commission on any issues related to flood operations and management; and
- providing the Commission and the designated entities under the 1989 Agreement recommendations on how flood operations and coordination activities could be improved.

(v) Report on aquatic ecosystem health issues in the watershed, regularly informing the Commission on the state and implications of aquatic ecosystem health, and encourage the appropriative authorities to establish and maintain water quality and other monitoring and information collection networks and reporting systems to ensure suitable information is available as required for the determination of the health of the aquatic ecosystem.

(vi) Carry out such other studies or activities as the Commission may, from time to time, request.

(vii) Prepare an annual work plan including both routine board activities and new initiatives planned to be conducted in the subsequent year. The work plan shall be submitted annually to IJC for review.

7. The Board shall provide opportunities for the public to be involved in its work, including at least one public meeting in the basin each year.

8. The Board shall coordinate and collaborate with other agencies and institutions both within and outside the Souris River basin as may be needed or desirable, and facilitate the timely dissemination of pertinent information within the basin. The Board shall keep the Commission informed of these activities.

9. The Board shall have an equal number of members from each country. The Commission shall normally appoint each member for a three-year term. Appointments may be renewed for additional terms. Members shall act in their personal and professional capacity, and not as representatives of their countries, agencies or institutions. The Commission shall appoint Canadian and United States co-chairs of the Board and will strive to appoint chairs with complementary expertise that encompasses a broad spectrum of basin issues.

10. The co-chairs of the Board shall be responsible for maintaining proper liaison between the Board and the Commission, and among the Board members.

11. The co-chairs shall ensure that members of the Board are informed of all instructions, inquiries, and authorizations received from the Commission and also of activities undertaken by or on behalf of the Board, progress made, and any developments affecting such progress.

12. The co-chairs may appoint secretaries of the Board who, under the general supervision of the co-chairs, shall carry out such duties as are assigned by the co-chairs or the Board as a whole.

13. The Board may establish such committees and working groups as may be required to fulfill its responsibilities in a knowledgeable and effective manner. The Commission shall be kept informed of the duties and composition of any committee or working group.

14. Unless other arrangements are made with the Commission, members of the Board, committees, or working groups shall make their own arrangements for reimbursement of necessary expenditures for travel or other related expenses.

15. The Board shall inform the Commission in advance of plans for any meetings, or other means of involving the public in Board deliberations, and shall report to the Commission, in a timely manner, on these and any other presentations or representations made to the Board.

16. The Board shall conduct its public outreach activities in accordance with the Commission's public information policies and shall maintain files in accordance with the Commission policy on segregation of documents.

17. Prior to their release, the Board shall provide the text of media releases and other public information materials to the Secretaries of the Commission for review by the Commission's Public Information Officers.

18. The Board shall submit an annual report covering all of its activities, including the annual report regarding the Program and the work plan, as described in Section 6 above, to the Commission, at least three weeks in advance of the Commission's fall semi-annual meeting, and the Board shall submit other reports as the Commission may request or the Board may feel appropriate in keeping with this Directive. Reports shall be submitted in a format suitable for public release and electronic copies shall be provided to each of the Commission's section offices.

19. Reports, including annual reports, minutes and correspondence of the Board shall, normally, remain privileged and be available only to the Commission and to members of the Board and its committees until their release has been authorized by the Commission. The Board shall provide minutes of Board meetings to the Commission within 45 days of the close of the meeting in keeping with the Commission's April 2002 Policy Concerning Public Access to Minutes of Meetings. The minutes will subsequently be put on the Commission's web site.

20. If, in the opinion of the Board or of any member, any instruction, directive, or authorization received from the Commission lacks clarity or precision, the matter shall be referred promptly to the Commission for appropriate action.

21. The Board shall operate by consensus. In the event of any disagreement among the members of the Board which they are unable to resolve, the Board shall refer the matter forthwith to the Commission for decision.

22. The Commission may amend existing instructions or issue new instructions to the Board at any time.

Signed this 18th day of January, 2007

Elizabeth Bourget
Secretary
United States Section

Murray Clamen
Secretary
Canadian Section

APPENDIX E

Water Quality Data for Sherwood and Westhope

ANNUAL WATER QUALITY OBJECTIVES SUMMARY
SOURIS RIVER – NORTH DAKOTA/SASKATCHEWAN BOUNDARY 2011 (Jan 1- Dec 31)
STATION 05114000 SHERWOOD USGS

WATER QUALITY PARAMETER	WATER QUALITY OBJECTIVE	UNITS	HISTORIC DATA* Median (max-min)#samples	ANNUAL DATA Median (max-min)#samples	PERCENT EXCEEDANCE
Biological Parameters					
Fecal Coliform	200/100 ml	#/100 ml	30 (8,300-<1) 196	NDA	0
Inorganic Parameters					
Ammonia (un-ionized as N)	****	mg/L	0.001 (0.025-<0.001) 214	NDA	0
Chloride	100	mg/L	47 (220-4) 324	11.8 (71.3-9.4) 7	0
Fluoride	1.5	mg/L	0.2 (1.8-<0.1) 324	0.10 (0.23-0.09) 7	0
NO_2 + NO_3(as N)dissolved	1.0	mg/L	0.1 (1.4-<0.01) 286	0.28 (0.75-0.04) 7	0
Phosphorus(total P)	0.10	mg/L	0.18(1.9-0.02) 363	0.38 (0.45-0.13) 7	100
Sodium	100	mg/L	120 (532-14) 322	44 (158-35) 7	14
Sulfate	450	mg/L	230 (1,000-45) 324	124 (323-87) 7	0
Arsenic (total)	50	µg/L	<5.0 (28.3-<5) 159	6.5 (7.9-3.6) 7	0
Barium(total)	1,000	µg/L	100 (300-15) 158	87 (114-81) 7	0
Boron(total)	500	µg/L	210 (3,500-40) 158	91 (259-66) 7	0
Beryllium(total)	100	µg/L	<10 (43-<10) 158	0.05 (0.08-<0.02) 7	0
Cadmium(total)	***27	µg/L	<1 (2-<1) 157	0.06 (0.09-<0.05) 7	0
Chromium(total)	50	µg/L	<1(30-<1) 157	1.3 (2.2-0.3) 7	0

***based on hardness of 300 mg/L
****unionized ammonia is calculated using temperature and pH
NDA: No Data Available

ANNUAL WATER QUALITY OBJECTIVES SUMMARY

SOURIS RIVER – NORTH DAKOTA/SASKATCHEWAN BOUNDARY 2011 (Jan 1- Dec 31)
STATION 05114000 SHERWOOD USGS

WATER QUALITY PARAMETER	WATER QUALITY OBJECTIVE	UNITS	HISTORIC DATA Median (max-min)#samples	ANNUAL DATA Median (max-min)#samples	PERCENT EXCEEDANCE
Cobalt(total)	500	µg/L	1 (3-<1) 157	0.9 (1.5-0.4) 7	0
Copper(total)	***30	µg/L	2.4 (20-<1) 151	3.4 (4.1-1.5) 7	0
Iron(total)	300	µg/L	510 (10,000- 16) 166	1,440 (2,710-571) 7	100
Lead(total)	***13	µg/L	<2 (3-<2) 151	1.1 (1.9-0.3) 7	0
Mercury	0.5 ug/g in fish flesh	µg/g	NDA	NDA	NDA
Molybdenum(total)	10	µg/L	2.5 (45-<1) 158	2.2 (5.2 -1.9) 7	0
Nickel(total)	***220	µg/L	4 (17-1) 172	5.3 (6.1-3.1) 7	0
Selenium(total)	5	µg/L	<1(14 -<1) 158	0.4 (0.7-0.3) 7	0
Zinc(total)	30	µg/L	2.5 (620-<2) 210	6.4 (9.7-<3) 7	0
Miscellaneous					
Total Dissolved Solids	1,000	mg/L	745 (2,540-170) 391	417 (973-324) 7	0
Total Suspended Solids	the lesser of 10 mg/L or 10% over ambient	mg/L	15 (98-<1) 200	68 (98-30) 7	NDA
pH (range)	8.5-6.5	standard units	8.1 (9.2-6.9) 441	7.9 (8.2-7.7) 7	0
Dissolved Oxygen (conc.)	>5.0	mg/L	8.0 (19.4-0.0) 428	8.0 (14.7-4.1) 7	14
Aesthetics		visual	NDA	NDA	NDA
Oil and Grease		visual	NDA	NDA	NDA

*** based on a hardness of 300 mg/L
NDA: No Data Available

ANNUAL WATER QUALITY OBJECTIVES SUMMARY

SOURIS RIVER – NORTH DAKOTA/SASKATCHEWAN BOUNDARY 2011 (Jan 1- Dec 31)
STATION 05114000 SHERWOOD USGS

WATER QUALITY PARAMETER	WATER QUALITY OBJECTIVE	UNITS	HISTORIC DATA Median (max-min)#samples	ANNUAL DATA Median (max-min)#samples	PERCENT EXCEEDANCE
Organic Parameters					
Atrazine	2	µg/L	<0.05(0.03-<0.001)12	NDA	NDA
Bromoxynil	5	µg/L	NDA	NDA	NDA
Carbaryl	90	µg/L	<0.003(<0.003)10	NDA	NDA
Chlordane	0.0043	µg/L	<0.10(0.10-<0.10)40	NDA	NDA
DDT	0.001	µg/L	<0.01(0.02-<0.01)40	NDA	NDA
Dieldrin	0.0019	µg/L	<0.01(0.03-<0.01)40	NDA	NDA
Dicamba	IN DEVELOPMENT	µg/L	<0.01(<0.01)3	NDA	NDA
Diclofop-methyl	IN DEVELOPMENT	µg/L	NDA	NDA	NDA
Heptachlor	0.0038	µg/L	<0.01(0.15-<0.01)40	NDA	NDA
MCPA	0.20	µg/L	NDA	NDA	NDA
Parathion	0.04	µg/L	<0.01(<0.01)40	NDA	NDA
Picloram	0.05	µg/L	<0.01(<0.01)3	NDA	NDA
Phenols(total)	1.0	µg/L	<16(26-<16)202	NDA	NDA
Polychlorinated biphenyl (total)	0.001	µg/L	<0.1(0.3-<0.1)39	NDA	NDA
Triallate	0.57	µg/L	<0.001(0.035-<0.001)10	NDA	NDA
Trifluralin	0.10	µg/L	<0.002(0.084-<0.002)10	NDA	NDA
2,4-D	4.0	µg/L	0.02(0.24-<0.01)26	NDA	NDA

NDA: No Data Available

ANNUAL WATER QUALITY OBJECTIVES SUMMARY

SOURIS RIVER – NORTH DAKOTA/MANITOBA BOUNDARY 2011 (Jan 1- Dec 31)

00US05NF0001 WESTHOPE

WATER QUALITY PARAMETER	WATER QUALITY OBJECTIVE	UNITS	HISTORIC DATA* Median(max-min)#samples	ANNUAL DATA -2003 Median(max-min)#samples	PERCENT EXCEEDANCE
Biological Parameters					
Fecal Coliform	200/100 ml	#/100 ml	<10(2300-<2)406	<2(5-<2)7	0
Inorganic Parameters					
Ammonia (un-ionized as NH3)	****	mg/L		NDA	
Chloride	100	mg/L	28(297-1.2)555	36.45(46.3-12.7)12	0
Fluoride	1.5	mg/L	0.2(0.98-<0.01)602	0.2(0.25-0.1)12	0
NO_2 + NO_3(as N)dissolved from 1990	1.0	mg/L	<0.01 (1.11-<0.01)189	<0.01(0.194-<0.01)11	0
Phosphorus(total P) from 1990	0.10	mg/L	0.3075(4.52-0.091)186	0.253(0.648-0.101)11	100
Sodium	100	mg/L	114(1040-6.4)800	145(186-55.7)12	58
Sulfate	450	mg/L	186(3490-4.8)800	353(425-144)12	0
Arsenic (total)	50	ug/L	4.1(33.4-0.5)367	3.61(6.8-2.14)12	0
Barium(total)	1000	ug/L	99(631-32.3)273	112(147-59.3)12	0
Boron(total)	500	ug/L	230(2080-<2)368	173(312-<88.5)12	0
Beryllium(total)	100	ug/L	0.05(<0.5-0.004)157	0.0105(0.018-0.007)12	0
Cadmium(total)	***27	µg/L	0.2(1-0.006)308	0.015(0.022-0.011)12	0
Chromium(total)	50	µg/L	<1(2.36-<0.01)155	0.11(0.23-0.07)12	0
Cobalt(total)	50	ug/L	<1(9-0.172)275	0.36(0.506-0.173)12	0

***based on hardness of 300 mg/L

****unionized ammonia is calculated using temperature and pH

NDA: No Data Available

ANNUAL WATER QUALITY OBJECTIVES SUMMARY

SOURIS RIVER – NORTH DAKOTA/MANITOBA BOUNDARY 2011 (Jan 1-Dec 31)

00US05NF0001 WESTHOPE

WATER QUALITY PARAMETER	WATER QUALITY OBJECTIVE	UNITS	HISTORIC DATA Median(max-min)#samples	ANNUAL DATA Median(max-min)#samples	PERCENT EXCEEDANCE
Copper(total)	***30	µg/L	2(38-0.41)307	1.185(1.93-0.58)12	0
Iron(total)	300	ug/L	120(14500-<7)335	258(591-108)12	42
Lead(total)	***13	µg/L	1.3(6.7-0.07)305	0.119(0.3-0.091)12	0
Mercury	0.5 ug/g in fish flesh	µg/g		NDA	
Molybdenum(total)	10	ug/L	2.71(35.2-0.591)154	3.285(5.8-1.29)12	0
Nickel(total)	***220	µg/L	3.18(24.7-1.6)309	3.34(3.92-1.78)12	0
Selenium(total)	5	ug/L	0.37(2-<0.05)366	0.38(0.6-0.32)12	0
Zinc(total)	30	µg/L	2.4(32-0.36)302	0.85(5.3-0.6)12	0
Miscellaneous					
Total Dissolved Solids	1000	mg/L	749(3821.074-129)273	758.9445(1132.482-442.504)10	40
Total Suspended Solids	the lesser of 10 mg/L or 10% over ambient	mg/L	15.8(300-<1)585	6(12.4-.2)11	36
pH (range)	8.5-6.5	standard units	8.3(9.85-6.8)472	8.175(8.48-7.38)12	0
Dissolved Oxygen (conc.)	>5.0	mg/L	8.4(21.6-0.05)468	5.1(13.4-0.5)12	44
Aesthetics		visual	NDA	NDA	NDA
Oil and Grease		visual	NDA	NDA	NDA

*** based on a hardness of 300 mg/L
NDA: No Data Available

ANNUAL WATER QUALITY OBJECTIVES SUMMARY

SOURIS RIVER – NORTH DAKOTA/MANITOBA BOUNDARY 2011 (Jan 1-Dec 31)

00US05NF0001 WESTHOPE

WATER QUALITY PARAMETER	WATER QUALITY OBJECTIVE	UNITS	HISTORIC DATA Median(max-min)#samples	ANNUAL DATA Median(max-min)#samples	PERCENT EXCEEDANCE
Organic Parameters					
Atrazine	2	µg/L	<0.05(2.4-<0.00186)136	0.00541(0.016-0.00186)5	0
Bromoxynil	5	µg/L	<0.0213(0.202-<0.00099)109	<0.00133(0.0117-<0.00133)4	0
Carbaryl	90	µg/L			
a-Chlordane	0.0043	µg/L	<0.003(0.003-<0.00014)225	<0.0006(<0.0006-<0.0006)4	0
g-Chlordane	0.0043	ug/L	<0.002(<0.002-<0.00004)226	<0.00031(<0.00031-<0.00031)4	0
o,p-DDT	0.001	µg/L	<1(<4.0-<.00004)227	<0.00056(0.00056-<0.00056)4	0
Dieldrin	0.0019	µg/L	<0.002(<0.002-<0.00018)264	<0.00107(<0.00107-<0.00107)4	0
Dicamba	IN DEVELOPMENT	µg/L	<0.03(0.0451-<0.00073)145	0.0134(0.0355-0.00763)4	0
Diclofop-methyl	IN DEVELOPMENT	µg/L	<0.0452(<0.05-<0.0034)121	(<0.00735-0.00735)5	0
Heptachlor	0.0038	µg/L	<0.001(0.004-<0.00014)262	<0.00056(<0.00056-<0.00056)4	0
MCPA	0.20	µg/L	0.0781(0.7-<0.00058)271	0.0104(0.0723-0.0067)5	0
Parathion	0.04	µg/L	<0.0155(<0.088-<0.0155)25	NDA	0
Picloram	0.05	µg/L	<0.05(<0.2-<0.00033)210	<0.00217(0.0275-<0.00217)4	0
Phenols(total)	1.0	µg/L			
Polychlorinated biphenyl (total)	0.001	µg/L	<0.00034(<0.0102-<0.00021)36	<0.00034(<0.00034-<0.00034)4	0
Triallate	0.57	µg/L	<0.00864(0.072-0.0013)128	<0.00222(<0.00222-<0.00222)5	0
Trifluralin	0.10	µg/L	<0.005(0.01-<0.00266)132	<0.00266(<0.00266-<0.00266)5	0
2,4-D	4.0	µg/L	<0.03(0.587-<0.00047)275	0.0981(0.0544-0.194)5	0

NDA: No Data Available

APPENDIX F

Water Quality Monitoring Plan for Sherwood and Westhope

1. Sherwood Monitoring Plan

Season	No. of Site Visits	No. of Samples Per Year			
		Dissolved Oxygen	Major Ions	Nutrients	Trace Elements
1 (Mar-Jun)	1	1	1	1	1
2 (Jul-Oct)	5	5	5	5	5
3 (Nov-Feb)	1	1	1	1	1
TOTAL	7	7	7	7	7

2. Westhope Monitoring Plan

Season	No. of Site Visits	No. of Samples Per Year				
		Dissolved Oxygen	Major Ions	Nutrients	Trace Elements	Pesticides
1 (Mar-Jun)	3	3	3	2	3	3
2 (Jul-Oct)	3	3	2	3	2	1
3 (Nov-Feb)	2	2	2	2	2	
TOTAL	8	8	7	7	7	4