International Souris River Study Board

DRAFT WORK PLAN FOR THE SOURIS RIVER BASIN

Photos of the 2011 floods and Boundary Reservoir in the Souris River Basin

Submitted by the International Souris River Study Board to the International Joint Commission

November 5, 2017

2/12/2018

Executive summary

Introduction and Organization

The sharing and management of water across the International Boundary between Canada and the United States, including the Souris River Basin, has its origin in the Boundary Waters Treaty of 1909 between the two countries. The Treaty also established an International Joint Commission (IJC) to have jurisdiction over the use, obstruction, or diversion of the waters. Over the decades various binational boards have been established by the IJC to address the management of transboundary waters of the Souris River Basin and its major tributaries.

In May 1959, the International Joint Commission (IJC) was directed by the U.S. and Canadian Governments that interim measures recommended by the IJC in a report dated 1940 were accepted by Governments. The IJC subsequently issued a directive creating the International Souris River Board of Control, which specified flow apportionment between the states and provinces and empowered the Board of Control to advise on flow apportionment in the case of severe droughts.

An agreement between the Government of Canada and the United States for Water Supply and Flood Control in the Souris River Basin was signed in October 1989. Pursuant to that agreement, and a subsequent request from Governments in April 1992 and December 2000, the 1959 interim measures were modified.

In 2000, the IJC directed the International Souris-Red Rivers Engineering Board to transfer its responsibilities related to the Souris River to the International Souris River Board of Control. The IJC also changed the International Souris River Board of Control's name to the International Souris River Board (ISRB). The ISRB operated under an April 11, 2002 Directive until 2006 when the IJC changed the mandate to move to a more encompassing watershed approach. The new Directive dated January 18, 2007 sets out the duties of the ISRB as it moves toward a watershed approach. The ISRB is responsible for ensuring compliance for flow apportionment and low-flow measures. Also, the ISRB ensures the terms of the 1989 International Agreement for Water Supply and Flood Control in the Souris River Basin are met, including the terms of Annexes A and B of the Agreement and subsequent Amendments to Annexes A and B in 2000.

Unprecedented flooding in the Souris River Basin in 2011 focused attention on review of the Operating Plan contained in Annex A to the 1989 International Agreement. Interests in the basin, particularly in North Dakota, asked that additional flood protection measures be evaluated, above and beyond what is currently provided under the International Agreement, and that the Operating Plan contained in Annex A of the Agreement be reviewed. In addition, the Agreement requires that the Operating Plan be reviewed periodically to maximize the provision of flood control and water supply benefits that can be provided consistent with the terms of the Agreement. In light of

these facts, the IJC's ISRB established the 2012 Souris River Basin Task Force at its February 22, 2012 meeting in Bismarck, North Dakota to conduct a review of the Operating Plan contained in Annex A for presentation to the Governments of Canada and the United States. The Task Force held its organizational conference call under its Terms of Reference (TOR) from the ISRB on April 20, 2012. The ISRB reported to the IJC and the IJC reported to the Governments on the status of Task Force activities at the IJC Semi-Annual Meeting in October of 2012.

The first requirement of the Task Force TOR was to development a Plan of Study in 2013 (2013 POS) to conduct the review. The 2013 POS document describes the detailed POS and studies that are needed to review the existing Annex A Operating Plan for the reservoirs comprising the Souris Basin Project described in the 1989 Agreement in Saskatchewan and North Dakota and to evaluate alternatives to maximize flood control and water supply benefits. The ISRB submitted the 2013 POS to the IJC in April 2013. The IJC submitted to governments a "Plan of Study: For the Review of the Operating Plan Contained in Annex A of the 1989 International Agreement Between the Government of Canada and the Government of the United States of America" on June 7, 2013.

On July 5, 2017, the governments of Canada and the United States issued a reference for the IJC to undertake the Plan of Study. In accordance with Article IX of the Boundary Waters Treaty of 1909, the governments of Canada and the United States request that the IJC examine and report on flooding and water supply in the Souris River Basin, and coordinate the completion of the full scope of the 2013 "Plan of Study: For Review of the Operating Plan Contained in Annex A of the 1989 International Agreement Between the Government of Canada and the Government of the United States of America."

On September 5, 2017, the IJC issued a directive to establish and direct the International Souris River Study Board (Study Board) to examine and report to the IJC on matters raised by the Governments of Canada and the United States in the reference dated July 5, 2017 directing the Study Board to aid the IJC in fulfilling the terms of the reference. Under item (1) of the Directive, the IJC directed the Study Board to develop a Work Plan by November 5, 2017. The Work Plan needed to include a detailed schedule and budget for the studies and tasks to be conducted. This document is the Work Plan.

The purpose of this Work Plan is to describe all studies needed to assist the IJC in fulfilling the terms of the July 5, 2017 reference. The Work Plan also documents the actions taken to guide and direct the activities of the Study Board.

The Study Board is responsible for providing oversight to study activities and ensuring that study activities will meet the goals of the references and directives of the IJC's International Souris River Board Study. The IJC has appointed an equal number of members from Canada and the United States to the Study Board and named a member from both Canada and the United States to be the Co-chairs of the Study Board. The Co-chairs are jointly taking a leadership role in

planning and implementing the Study Board's mandate. Two study managers, one from Canada and one from the United States, are responsible for assisting the Study Board on delivering its mandate. The Study Managers will work under the joint direction of the co-chairs of the Study Board and shall not be members of the Study Board. The Study Managers will keep fully abreast of the work of the different groups and function as liaisons between the Study Board and those groups. The Study Managers will be responsible for the effective management of the Study Board's Work Plan. Study Managers are responsible for communicating to the different groups the direction of the Study Board and assisting in general administrative and financial/contractual tasks.

Study Objectives

Each element of the Governments joint reference will be addressed by the plan described in this document, which contains a number of tasks that are grouped under four broad activities:

a. Operating Rules Review
b. Data Collection and Management
c. Hydrology and Hydraulics
d. Plan Formulation

The operating rules review (table1-OR1) will identify areas where the language and text in Annex A of the 1989 Agreement can be improved for ease of understanding and clarity of interpretation. This study activity directly addresses the Governments' Reference item 5: *A detailed review of the Operating Plan contained in Annex A of the 1989 Agreement.*

The data collection and management activities (table1-DW1-DW4) will collect and harmonize the data necessary to support hydraulic and hydrologic modelling and associated studies. This study objective directly addresses the governments' Reference item 1: *The collection and harmonization of data necessary to support hydraulic and hydrologic modelling and associated studies.* These efforts are considered necessary in order to carry out the analysis phase of the study formulated in the Hydrology/Hydraulic activities (HH1-HH9). It is important to note that many elements of the analysis phase can be carried out in parallel to the review and data collection phases of the Work Plan.

The hydrology and hydraulics activities (table 1-HH1-HH9) will setup the stochastic, hydrologic, hydraulic and reservoir modelling platforms to be used for testing and evaluating alternative operating scenarios. This study activity directly addresses the Governments' Reference items 2, 3, and 4. Reference item 2: *The development of hydrological watershed runoff and inflow sequences to allow for the simulation of various water supply conditions including historical conditions, extreme conditions, and conditions influenced by the effects of climate change.* Item 3: *The development of hydraulic, hydrologic and optimization modelling tools that will allow for the accurate simulation of flows within the Souris River so that operational scenarios may be evaluated.* Item 4: *Studies evaluating the physical processes occurring in the Souris Basin which are thought to have contributed to recent flooding events.*

The Plan Formulation (PF1-PF3) study activities will lead to formulating alternative plans and evaluating the plans regarding improvements in the Operating Plan outlined in Annex A of the 1989 agreement. Also, study activities will evaluate various flood protection and water supply measures beyond what is provided under the 1989 agreement. This study objective directly addresses the governments' Reference items 6 through 10. Reference item 6: *Identifying and, as appropriate, making recommendations regarding improvements to the Operating Plan contained in Annex A of the 1989 Agreement to reduce the flooding and water supply risks in the Souris River basin with consideration to low flow, apportionment, water quality and aquatic ecosystem health.* Item 7: *The evaluation, on a qualitative and quantitative basis, of the costs and benefits of a range of possible infrastructure and operational plans regarding flooding and water supply in the Souris River basin.* Item 8: *The evaluation of additional flood protection measures, beyond what is currently provided under the 1989 Agreement, which may include feasibility evaluations of increasing storage at existing dams, more efficient channel alignment and capacity, and the provision of flood control measures in and around communities within the basin.* Item 9: *Assessing possible adaptation strategies to address the potential future variability in water supplies associated with climate change.* Item 10: *Facilitating collaboration among various Federal, State, Provincial, local agencies, the public, as well as Native American Tribes, First Nations, and Métis located within the basin to share their views and provide input during the study process.*

Throughout the study, public opinions, Government agencies and stakeholder perspectives will be sought to foster communication and participation at all levels on both sides of the border. The IJC is committed to providing all interested parties with convenient opportunity to be heard, as required in the Boundary Waters Treaty. The IJC emphasizes the importance of public outreach, consultation and participation, and promotes policies and programs that enable community input in the decision-making process. Accordingly, the Study Board will carry out its public participation and outreach activities according to the Directive and the *Guidance to the Study Board on Communication and Public Participation - November 2016* document. A Public Advisor Group (PAG) will be established to help engage the public during the study on an ongoing basis. PAG members will represent multiple areas of interest and various geographic locations across the Souris River basin, and include an equal number of people from Canada and the US. PAG members will have the opportunity to provide advice on the Study Board's public participation activities laid out in its Directive.

Four general levels of study review will be used to assure technical quality of the activities: Sufficiency Review (by ISRSB) (SR) Agency Quality Control (AQC), Agency Technical Review (ATR), and Independent external review conducted by an Independent Review Group (IRG). The IRG will be contracted by the IJC; however, the IRG will operate independently outside the control of the IJC and the ISRSB.

The Study review process is based on a few simple but fundamental principles:

- Peer review is key to improving the quality of work in studies and so interim reviews as well as the final reviews are beneficial for checking methods and assumptions early when corrections are still feasible;
- Reviews will be scalable to the content of each component of the study, deliberately included as part of the study process throughout the life cycle of the study (scoping, interim products, and final products), and concurrent with recommendations to include previous work in the study and completion of new study phases/ products from each contributing agency/contractor and the study board;
- Since previously completed work products may have already undergone sufficient peer and independent reviews, products will be screened for level and need for review for the purposes of this study.
- An IRG level review will be completed on all recommendation and implementation documents and specific study products identified as fundamental to making those recommendations. For other products, the Study board will provide documentation of existing reviews and recommendations to the IRG for level(s) of review, and the IRG will provide their decisions on whether to perform additional review.

Cost

The total cost for each group of tasks planned by the ISRSB is shown in table 1. The Work Plan is considered a living document and will be revised as the Study progresses, scope of work is modified, funding levels change, results become available, and stakeholders and public inputs are provided.

Old No.	New No.	Name	Group	Canada Costs (USD)	USA Costs (USD)
1a, 1b, 2	OR1	1989 Agreement Language Review	Operating Rules Review	0	0
3	DW1	Summarize POS Projects and Report Progress since 2013			
4	DW2	Lidar and Bathymetry for Reservoirs	Data Collection and Management	196	60
5	DW3	Review of Hydrometerological Network Report			
6	DW4	Data Collection for PRM			
7	HH1	Regional Hydrology			
8	HH2	Stochastic Water Supplies			
9	HH3	Artificial Drainage Impacts Review			
10	HH4	Water Supply Forecasting Tools - Development			
11	HH5	ECCC Climate Change Supplies	Hydrology & Hydraulics	248	505
12	HH6	Reservoir Flow Release Planning (RES-SIM)			
13	HH7	Reservoir Flow Release Planning (HEC-RAS)			
new	HH8	Develop PRM Model			
new	HH9	Model System Integration			
14	PF1	Workshops			
15, 16, 17	PF2	Run and Evaluate Alternatives	Plan Forumlation	88	280
new	PF3	Dam Safety			
	A1	Reporting			
	A2	Outreach and Public Comment			
	A3	Information Management			
	A4	Study Manager (Canada)			
	A5	Study Manager (US)	Study Management and Governance	368	55
	A6	Public Advisory Group (PAG)			
	A7	Independent Review Group (IRG)			
	A8	Climate Advisory Group (CAG)			
	A9	Resource/Agency Advisory Group (RAG)			
	A10	First Nations/Metis/Tribes			
			Total	900	900

Table 1. Canadian and U.S. costs, activities required to meet the IJC September 5, 2017 Directive to the International Souris River Study Board

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1 Preamble

The International Souris River Study Board (ISRSB) Draft Work Plan, dated November 5, 2017, is respectfully submitted by the ISRSB to the International Joint Commission (IJC). The ISRSB will use the Work Plan to complete the scope of work outlined in the July 5, 2017 reference letter to the ISRSB. In the reference the IJC directed the ISRSB to undertake the "Plan of Study: For the Review of the Operating Plan Contained in Annex A of the 1989 International Agreement Between the Government of Canada and the Government of the United States of America" for the Souris River Basin that was submitted to the IJC in April 2013.

2 Acknowledgements

This Work Plan could not have been developed without the assistance of the current members of the ISRSB, the past Task Force, and Core Committee; both established by the International Souris River Board (ISRB). We would also like to thank the ISRB for their support and assistance in formulating this plan.

The previous Task Force was instrumental in developing the "Plan of Study: For the Review of the Operating Plan Contained in Annex A of the 1989 International Agreement Between the Government of Canada and the Government of the United States of America" for the Souris River Basin in 2013.

The Core Committee was charged with reviewing and updating the language and data in the International Agreement. The Core Committee reviewed the Agreement, identified sections of the Agreement which are no longer relevant, updated and re-plotted a number of tables and graphics pertaining to reservoir properties, and compiled these recommendations for presentation to the ISRB.

The members of the Study Board were appointed by the IJC to provide expertise needed to develop and guide the scientific activities and tasks required to complete the Work Plan. Although most Study Board members are employed by government agencies in both Canada and the United States, all members serve in their personal and professional capacities and not as representatives of their agencies, countries, or organizations. The proposals presented in this Work Plan were developed by ISRSB members and staff from government agencies they are employed by. The proposals adopted by the Study Board should not be considered as official opinions, positions, or commitments of any organizations, agencies, or departments named in this Work Plan.

3 Introduction to the International Souris River Study

The Souris River Basin is a 61,900 square kilometers (23,900 square mile) basin in the Provinces of Saskatchewan and Manitoba in Canada and the State of North Dakota in the United States (fig. 1). The Souris River originates in Saskatchewan, crosses the International Boundary into the United States and passes through the North Dakota, and then again crosses the International Boundary into Manitoba before joining the Assiniboine River. The Souris River is known locally in North Dakota as the Mouse River. The river valley is flat and shallow, and the basin's semi-arid prairie landscape has been extensively cultivated. Major reservoirs have been constructed in both Canada and the United States, including Boundary, Rafferty and Alameda Reservoirs in Saskatchewan, and Lake Darling in North Dakota (fig. 1). The basin also includes a number of wildlife refuges and small impoundments along the North Dakota portion of the river.

The sharing and management of water across the International Boundary between Canada and the United States, including the Souris River Basin, has its origin in the Boundary Waters Treaty of 1909 between the two countries. The Treaty also established an International Joint Commission (IJC) to have jurisdiction over the use, obstruction, or diversion of the waters. Over the decades various binational boards have been established by the IJC to address the management of transboundary waters of the Souris River Basin and its major tributaries.

In May 1959, the International Joint Commission (IJC) officially approved and signed a directive that created the International Souris River Board of Control. In 2000, the IJC directed the International Souris-Red Rivers Engineering Board (1948 Reference) to transfer its responsibilities related to the Souris River to the International Souris River Board of Control. The IJC also changed the International Souris River Board of Control's name to the International Souris River Board (ISRB). The ISRB operated under an April 11, 2002 Directive until 2006 when the IJC changed the mandate to move to a more encompassing watershed approach. The new directive, dated January 18, 2007, sets out the duties of the ISRB as it moves toward a watershed approach. The ISRB operates under the 2007 Directive from the IJC and reports to the IJC annually. The ISRB is responsible to:

1. Oversee the implementation of compliance with the 2000 Interim Measures as Modified;
2. Assist the Commission with the Joint Water Quality Monitoring Program;
3. Perform an oversight function for flood operation;
4. Maintain an awareness of existing and proposed developments;
5. Report on aquatic ecosystem health issues in the watershed; and
6. Carry out other studies or activities the Commission may request.

- The terms of the 1989 Agreement including Annexes A and B
- The amendments, dated 2000, to Annexes A and B

Unprecedented flooding in the Souris River basin in 2011 focused attention on review of the Operating Plan contained in Annex A to the 1989 International Agreement. Interests in the basin

asked that additional flood protection measures be evaluated, above and beyond what is currently provided under the International Agreement, and that the Operating Plan contained in Annex A of the Agreement is reviewed. In addition, Article V of the Agreement requires that the Operating Plan be reviewed periodically to maximize the provision of flood control and water supply benefits that can be provided consistent with the terms of the Agreement. In light of both of these realities, the IJC's ISRB established the 2012 Souris River Basin Task Force at its February 22, 2012 meeting in Bismarck, North Dakota to conduct a review of the Annex A Operating Plan for presentation to the Governments of Canada and the United States. Subsequently, members from Federal, State, Provincial, and local agencies were appointed by the ISRB. The Task Force held its organizational conference call under its Terms of Reference from the ISRB on April 20, 2012. The ISRB reported to the IJC and the IJC reported to the Governments on the status of Task Force activities at the IJC Semi-Annual Meeting in October of 2012.

The first requirement of the Task Force (TOR) was to develop a Plan of Study (2013 POS) to conduct the review. The 2013 Plan of Study describes the detailed POS and studies that are needed to review the existing Annex A Operating Plan for the reservoirs comprising the Souris Basin Project described in the 1989 Agreement in Saskatchewan and North Dakota and to evaluate alternatives to maximize flood control and water supply benefits. The ISRB submitted the 2013 POS to the IJC in April 2013. The IJC submitted to governments a "Plan of Study: For the Review of the Operating Plan Contained in Annex A of the 1989 International Agreement Between the Government of Canada and the Government of the United States of America" on June 7, 2013. On July 5, 2017, the governments of Canada and the United States issued a reference for the IJC to undertake the Plan of Study. In accordance with Article IX of the Boundary Waters Treaty of 1909, the governments of Canada and the United States request that the IJC examine and report on flooding and water supply in the Souris River Basin, and coordinate the completion of the full scope of the 2013 "Plan of Study: For Review of the Operating Plan Contained in Annex A of the 1989 International Agreement Between the Government of Canada and the Government of the United States of America."

On September 5, 2017, the IJC issued a directive to establish and direct the International Souris River Study Board (Study Board) to examine and report to the IJC on matters raised by the Governments of Canada and the United States in the reference dated July 5, 2017. Accordingly, the IJC established the Study Board to aid the IJC in fulfilling the terms of the reference. Under item (1) of the Directive, the IJC directed the Study Board to develop a Work Plan by November 5, 2017. The Work Plan needed to include a detailed schedule and budget for the studies and tasks to be conducted.

In the Work Plan, reference is made to links that contain supplemental information providing comprehensive information on membership of various Groups assisting the Study Board. Some of the links are not complete and are not available for the first draft of the Work Plan.

Considerable POS Project work was done by various agencies since 2013. The cost and time estimates provided in the Work Plan are based on assumptions that the work from the 2013 POS scope that has been completed in the interim, will be sufficient to meet the needs of the study and approved for use by the Study Board. In advance preparation for the reference, the International

Souris River Board with IJC Liaisons recommended that the schedule for completing the entire study be increased from the two years proposed in the 2013 POS to three years in the 2017 reference. The additional year included time necessary for the IJC to form the Study Board on the front end, and preparation time for submittal to the Governments at the back end and allowing some additional time for Task work in the Work Plan.

From October 11 to 13, 2017, the Study Board met at the United States Army Corps of Engineers Office in St. Paul, Minnesota, to discuss each item of the 2013 POS, the progress on each item outlined in the 2013 POS, and how the Work Plan should be formed in light of the work done to date. The current Work Plan was developed from the discussions at the St. Paul meeting as well as through subsequent discussions. These discussions are still ongoing and are expected to provide further insights that will likely result in the Work Plan continuing to evolve.

The purpose of this Work Plan is to describe all studies needed to assist the IJC in fulfilling the terms of the July 5, 2017 reference. The Work Plan also documents the actions taken to guide and direct the activities of the Study Board.

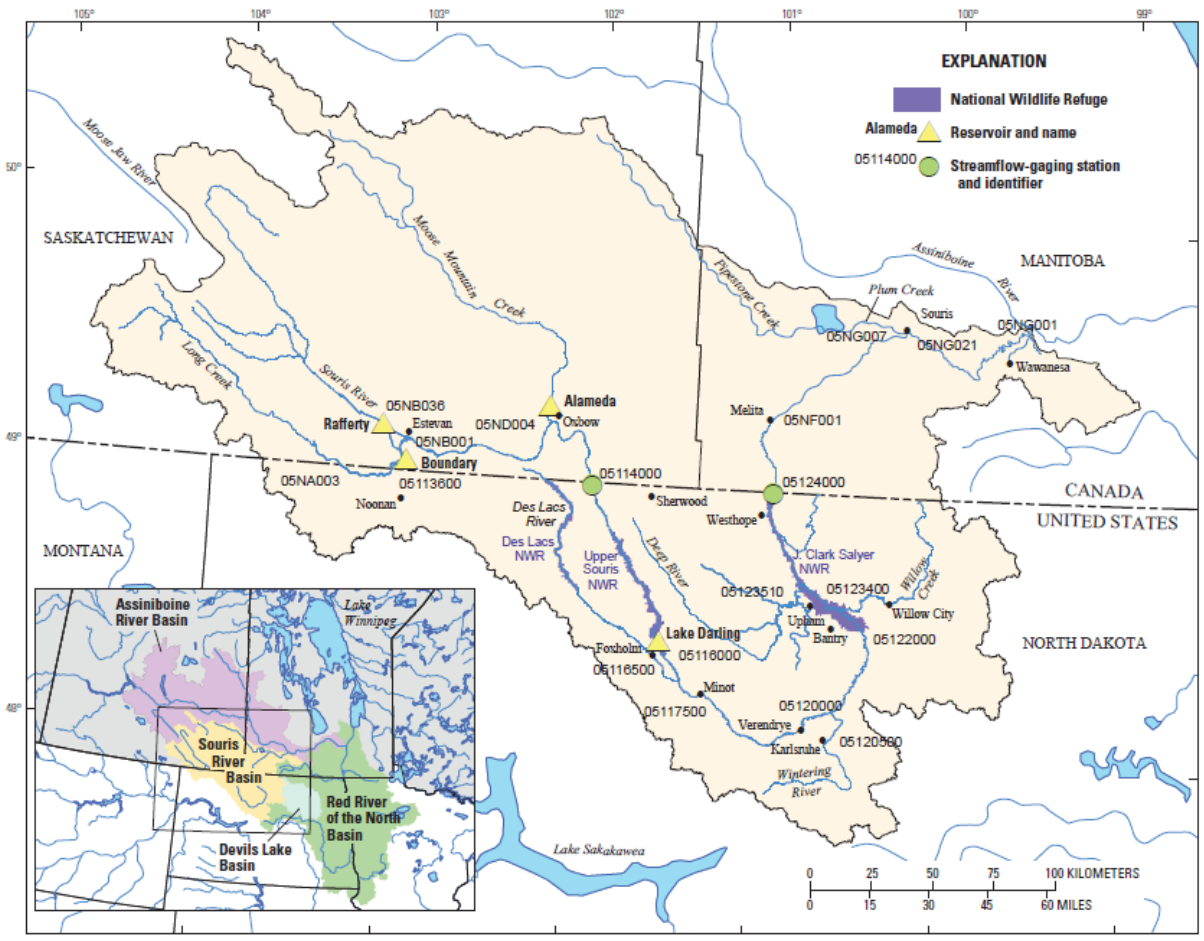

Figure 1. Souris River Basin showing locations of major reservoirs and National Wildlife Refuges and general direction of flow (From Kolars and others, 2015).

4 Organization of the study and governance structure

The detailed description of the study's governance structure is summarized below. Please refer to the cited organizations and program acronyms as needed.

- **Study Board**: The International Souris River Study Board is responsible for providing oversight to study activities and ensuring that study activities will meet the goals of the references and directives of the IJC's International Souris River Board Study. The Study Board and its advisory bodies will conduct their work by consensus. The IJC has appointed an equal number of members from Canada and the United States to the Study Board and named a member from both Canada and the United States to be the Co-chairs of the Study Board. The Co-chairs are jointly taking a leadership role in planning and implementing the Study Board's mandate. On behalf of the Board, the Co-chairs have authority and responsibility for the study.
- **Study Managers**: Two study managers, one from Canada and one from the United States, are responsible for assisting the Study Board on delivering its mandate. The Study Managers will work under the joint direction of the co-chairs of the Study Board and shall not be members of the Study Board but will participate in every Study Board meeting. The Study Managers will keep fully abreast of the work of the different groups and function as liaisons between the Study Board and those groups. The Study Managers will be responsible for the effective management of the Study Board's Work Plan. Study Managers are responsible for communicating to the different groups the direction of the Study Board and assisting in general administrative and financial/contractual tasks, including providing briefings to the Study Board on tasks identified by the Co-chairs.
- **Public Advisory Group (PAG):** The IJC, with advice from the Study Board, will establish a binational PAG by December 5, 2017. Members of the PAG will be appointed by the United States and Canadian IJC secretaries in consultation the IJC Liaisons and the Study Board. The PAG will include an equal number of members from each country representing key interests and geographic regions within the Souris River Basin. The PAG will help involve the public by bringing information from the Study Board to their various networks throughout the community, as well as bringing back views from the community for consideration by the Study Board. The PAG will assist the Study Board in the development of a Stakeholder Engagement Plan to be delivered by the Study Board to the IJC by December 5, 2017.
  Co-Chairs, one from Canada and one from the United States, will direct the PAG as well as serve on the Study Board. The PAG is an advisory group and an important means of engaging the public in the study on an ongoing basis.
- **Climate Advisory Group (CAG):** No working group has been created yet. Topic will be discussed by Study Board and IJC.
- **Resource Advisory Group (RAG):** No working group has been created yet. Topic will be discussed by Study Board and IJC.
- **First Nations, Metis and Tribes:** Topic will be discussed by the Study Board and the IJC.
- **Independent Review Group (IRG)**: The IRG has been established by the IJC to ensure that independent technical reviews are carried out as required during the Study process.

The resulting Souris River Study Board governance structure is shown on figure 2.

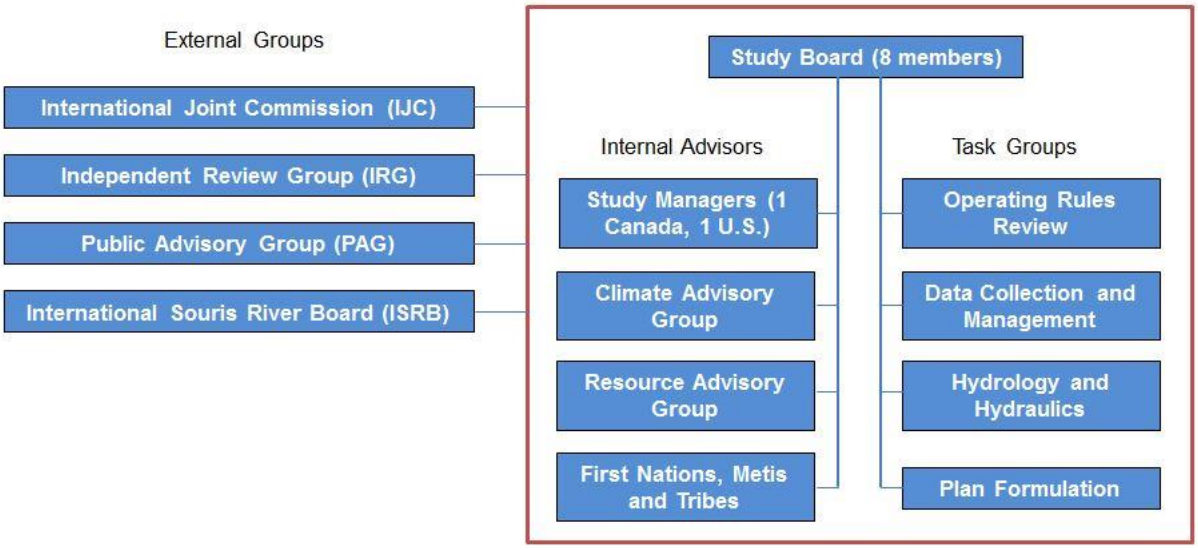

Figure 2 ISRSB Governance Structure. The ISRB, Study Board, PAG and IRG are creatures of the IJC. The red boundary illustrates the makeup and task groups of the ISRSB.

5 Plan to achieve the objectives of the study

Each element of the governments' joint reference will be addressed by the plan described in this document, which contains a number of tasks that are grouped under four broad activities:

a. Operating Rules Review
b. Data Collection and Management
c. Hydrology and Hydraulics
d. Plan Formulation

The operating rules review will identify areas where the language and text in Annex A of the 1989 Agreement can be improved for ease of understanding and clarity of interpretation. The data collection and management activities will include tasks to collect and harmonize the data necessary to support several hydraulic and hydrologic modelling tasks. Both of these efforts (Operating Rules Review and Data Collection and Management) are considered necessary in order to carry out the analysis tasks of the study formulated in the Hydrology and Hydraulics and Plan Formulation tasks. It is important to note that many of the analysis tasks in the Hydrology and Hydraulics and Plan Formulation activities can be carried out in parallel with the Operating Rules Review and Data Collection and Management activities of the Work Plan. The hydrology and hydraulics activities will setup the stochastic, hydrologic, hydraulic and reservoir modelling platforms to be used for testing and evaluating alternative operating scenarios. Throughout the study, public opinions, Government agencies and stakeholder perspectives will be sought to foster communication and participation at all levels on both sides of the border. The Study Board will monitor flood control and water-supply activities and studies being conducted by Federal, State, and Provincial agencies to avoid any duplication of effort. An overall schematic representation of the modeling process is outlined in Figure 3.

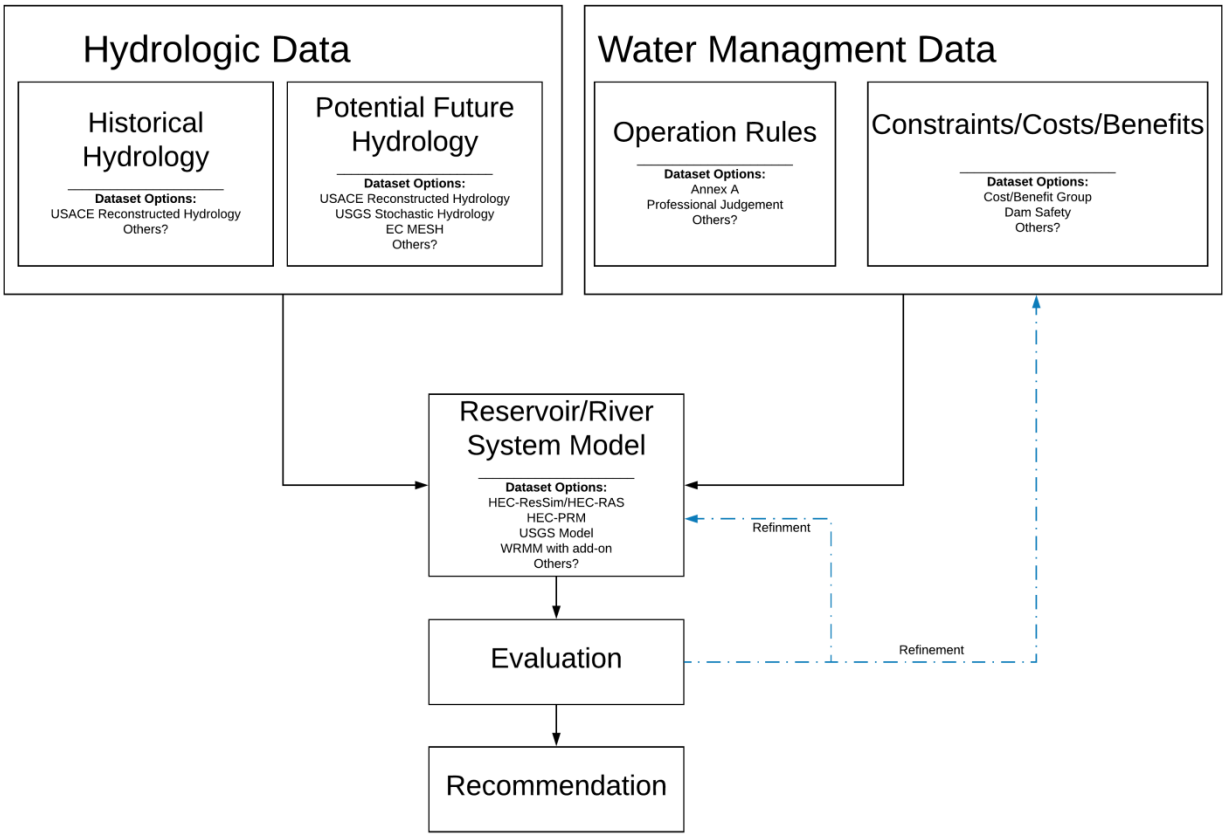

Figure 3. Connections between the various modelling components in the Work Plan.

The public is and will remain involved at strategic milestones of this study, notably through the efforts of the PAG, to obtain input and to register concerns regarding flooding and potential management and mitigation measures.

The study Work Plan has been submitted to the IJC, and the Study Board has modified the Work Plan based on comments from the IJC. The Work Plan will be submitted to an IRG for third party review. The IRG will also be called upon to assess the quality of key developments and publications throughout the study and to ensure scientific soundness. At about the same time the Work Plan is submitted to the IRG, the Work Plan will be submitted to the PAG for their input. Major comments from the IRG and PAG and responses will be provided at IJC website in the near future.

The following sections provide information on each of the study objectives. Each objective will state which Reference item it addresses, provide a description of the study objective, identify the lead and responsible individuals, and describe the scope of work under the objective. The scope of work entails a description of work tasks, which individuals will be performing that task, an estimated budget and timeline for completion. Each task is numbered and can be cross referenced in the summary table for that objective.

It is important to note that while some work has occurred during the intervening years of proposing the initial POS in 2013, and that those efforts may help reduce the amount of funds needed to address the remaining Tasks, that until those work elements are integrated with the other tasks to be developed it will not be known if they are sufficient as they stand or if additional work will be needed. This has potential implications for both cost and schedule for the study which are already reduced from the 2013 estimate. The cost and schedule presented in this Work Plan currently assumes that the work done since 2013 will be sufficient to meet the requirements of the succeeding tasks.

5.1 Operating Rules Review

This study objective directly addresses the Governments' Reference item 5: *A detailed review of the Operating Plan contained in Annex A of the 1989 Agreement.*

This objective consists of identifying areas where the language and text in Annex A of the 1989 Agreement can be improved for ease of understanding and interpretation. An ISRB Core Committee has been working on this initiative and it is expected to be complete by February 21, 2018. Although there is zero cost to the ISRSB for this task, it is included in the Work Plan because it directly relates to the mandate of the ISRSB.

Scope of Work:

Task OR1: 1989 Agreement Language Review

Point of Contact: Michael Bart, United States Army Corps of Engineers (USACE), John Fahlman, Saskatchewan Water Security Agency (SWSA)

This task involves completing a draft document for the ISRSB and ISRB to review. Specific work tasks include:

- Complete draft document by December 31, 2017.
- The ISRSB to review the draft document by January 31, 2018.
- Present the document to the ISRB on February 21, 2018.

Est. Cost: No cost to the Study Board budget. However, work on this task has been completed and funded by Agencies who have members on the ISRB Core Committee.

Resources: ISRB Core Committee

Predecessor: n/a

Successor: n/a

Review: ISRSB and ISRB to review.

5.2 Data Collection and Management

This study objective directly addresses the governments' Reference item 1: *The collection and harmonization of data necessary to support hydraulic and hydrologic modelling and associated studies.*

Within the topic of data collection and management, four broad classes of data are to be harmonized and made available to water-resource scientists and engineers working on various Work Plan tasks. In addition, the data will be available for use by anyone interested in the

hydrological information. These are the physical data of the Souris River basin, reservoir elevation-storage-volume-outflow information, hydro-climatic and hydrometric network information, and bathymetric information of the river system. The study board has determined that much of this data has already been collected and, with the exception of a few gaps, mainly needs to be summarized for publication. As a result, the Data Collection and Management tasks are as follows. DW1 is to Summarize POS projects and report progress since 2013, DW2 is the collation and collection of bathymetry and LiDAR data for Rafferty and Alameda Reservoirs, DW3 is a review of a Hydrometeorological Data Network Improvement Report, and DW4 is data collection for the Prescriptive Modelling System.

Scope of Work:

Task DW1: Summarize POS Projects and Report Progress since 2013

Points of Contact: Bruce Davison, Environment and Climate Change Canada (ECCC) and Gregg Wiche, retired United States Geological Survey (USGS)

This task involves summarizing the available studies, datasets, and modelling setups that pertain to the POS as it stands today, and in relation to the 2013 POS optimal scope option. It will also strive to make any of these studies, datasets and modelling setups available to the ISRSB along with information to the public about what is available. Specific work tasks include:

- Complete draft document by December 31, 2017.
- The ISRSB to review the draft document by January 31, 2018.
- Document completion by February 21, 2018.
- All information to be made available to the ISRSB by March 31, 2018.
- POS website to be updated with information about what is available by March 31, 2018.

Est. Cost: $0. The expectation is that the study managers will complete this task with the support of the ISRB and the ISRSB.

Resources: POS Board

Predecessor: n/a

Successor: n/a

Review: Internal review by ISRSB.

Task DW2: Collation and collection of bathymetry and LiDAR data for Rafferty and Alameda Reservoirs

Point of Contact: Jeff Woodward, ECCC

This task involves reviewing what bathymetry and LiDAR is available for Rafferty and Alameda reservoirs and collecting the data that is needed to complete the dataset as required for the plan formulation group. The plan formulation group will use existing bathymetry data sets to begin its model testing and will adjust as data is made available. Specific work tasks are described in more detail in the following timeline.

Timeline:

2a. Data Gap Analysis:

Verify what data already exists – now

(Include data needed for both RESSIM and RAS model in Saskatchewan)

Collate existing data – Dec 31, 2017

Buy-in from POS Board that existing data is sufficient.

2b. Initiate Contracting

Start the contracting process for remaining data needs – now

2c. Executing the Contract

Collecting Lidar field data in the spring of 2018 before leaf-up.

Process Lidar and Bathymetry Data to produce capacity curves (part of contract) – Spring, 2018

Final products received from contractor (end of June, 2018)

2d. Receipt and Review of the Data

Depends on when the modellers need the data. Expected by end of July, 2018.

Est. Cost: Estimates are being developed.

Resources: POS Board

Predecessor: n/a

Successor: HH6

Review: USGS and/or the USACE to review contractor's work.

Task DW3: Review and Update of Hydrometeorological Data Network Improvement Report

Point of Contact: Jeff Woodward, ECCC

This task involves reviewing work that was completed since 2013 to evaluate the atmospheric and streamflow monitoring networks for water supply and flood forecasting. Potential sub-tasks include:

- Review the existing report
- Summarize existing datasets (WIN, CaPA, streamflow) that are not included in the report.
- If the report doesn't do so already, identify gaps in the observational network that would help with water supply forecasting and flood forecasting.

Sub-tasks: Review of hydrometeorological network report

Timeline: Jan – Mar, 2018

Est. Cost: Estimates are being developed.

Resources: ECCC

Predecessor: n/a

Successor: n/a

Review: Internal review by ISRSB.

Notes: This could fit-in with real-time WIN precipitation data and the Canadian Precipitation Analysis (CaPA) in Canada, and their equivalents in the U.S.

Task DW4: Data Collection for the Prescriptive Modelling System

Point of Contact: Rebecca Seal-Soileau, USACE

This task involves collecting input data for the PRM model. The main data gap at the moment is to determine "penalty functions" to evaluate different operating schemes. HEC-ResPRM uses a modified form of network-flow programming to perform reservoir operations optimization. HEC-ResPRM "prescribes" optimal values of flow and storage over time by minimizing user-defined penalty functions at selected locations in the water resource network. Penalty functions associate a penalty or reward with designated levels of flow or storage. HEC-ResPRM then optimizes the system using the penalty functions and the hydrology inputs.

Determining model simulation penalty functions will be a complex and iterative task. This effort will involve coordination between all agencies and using input from the PAG, RAG and other interested stakeholders. The goal is for Saskatchewan, North Dakota and Manitoba to independently come up with lists and then meet as a group to determine a unified path forward.

Sub-tasks: Data Gap Analysis, collect missing data

Timeline:

4a. Data Gap Analysis – now to December 31, 2017

Verify what data already exists – now

Include ECCC model and USACE model data needs.

Buy-in from ISRSB that existing data is sufficient.

4b. Collect Missing Data Can – January 1 to July 31, 2018

Includes water use on the SK side of the Souris.

Talking with PAG.

Holding workshops. (PF1)

Talking through the penalties in the June 2018 F2F.

Follow-up discussions.

Est. Cost: Estimates are being developed

Resources: ISRSB, PAG

Predecessor: PF1

Successor: PF1, PF2

Review: IRG

Notes:

5.3 Hydrology and Hydraulics

This study objective directly addresses the governments' Reference items 2, 3, and 4. Reference item 2: *The development of hydrological watershed runoff and inflow sequences to allow for the simulation of various water supply conditions including historical conditions, extreme conditions, and conditions influenced by the effects of climate change.* Item 3: *The development of hydraulic, hydrologic and optimization modelling tools that will allow for the accurate simulation of flows within the Souris River so that operational scenarios may be evaluated.* Item 4: *Studies evaluating the physical processes occurring in the Souris Basin which are thought to have contributed to recent flooding events.*

This section describes the work needed to setup the stochastic, hydrologic, hydraulic, and reservoir modelling platforms to use for the plan formulation piece. Task HH1 involves reconstructing the hydrology of the

basin in order to have a frame of reference when considering supply sequences for operational review. Task HH2 involves providing a stochastic analysis and simulated data required for plan formulation. Task HH3 involves summarizing known information about artificial drainage in the Souris River Basin. Task HH4 involves developing additional tools and evaluating existing tools for flow forecasting. Task HH5 involves developing climate change scenarios using atmospheric General Circulation Model (GCM) and/or Regional Climate Model (RCM) climate change predictions as inputs to hydrologic models under various climate-change-induced land-change scenarios. Task HH6 involves updating the RES-SIM model with the Canadian reservoir data, along with calibrating the model for floods and droughts. Task HH7 involves updating the RAS model (including SK and ND) with any data SK finds and re-calibrating the model. Task HH8 involves developing a HEC-ResPRM model to be used in optimizing flow schemes in the basin. Task HH9 involves coupling the various models together to form integrated modelling systems.

Figure 4illustrates how some of the models will fit together into an integrated modelling system. The hydrologic models will be used throughout the basin to predict how water moves from the land-surface to the rivers, and in the waterways not modelled by reservoir or hydraulic models. A hydraulic model will be used to more accurately predict the water flowing in the main stem of the Souris River, and the reservoir models will be used to predict the water fluxes in the four reservoirs indicated on the map (Rafferty, Boundary, Alameda and Lake Darling). These integrated models will be driven by inputs from the stochastic and climate models.

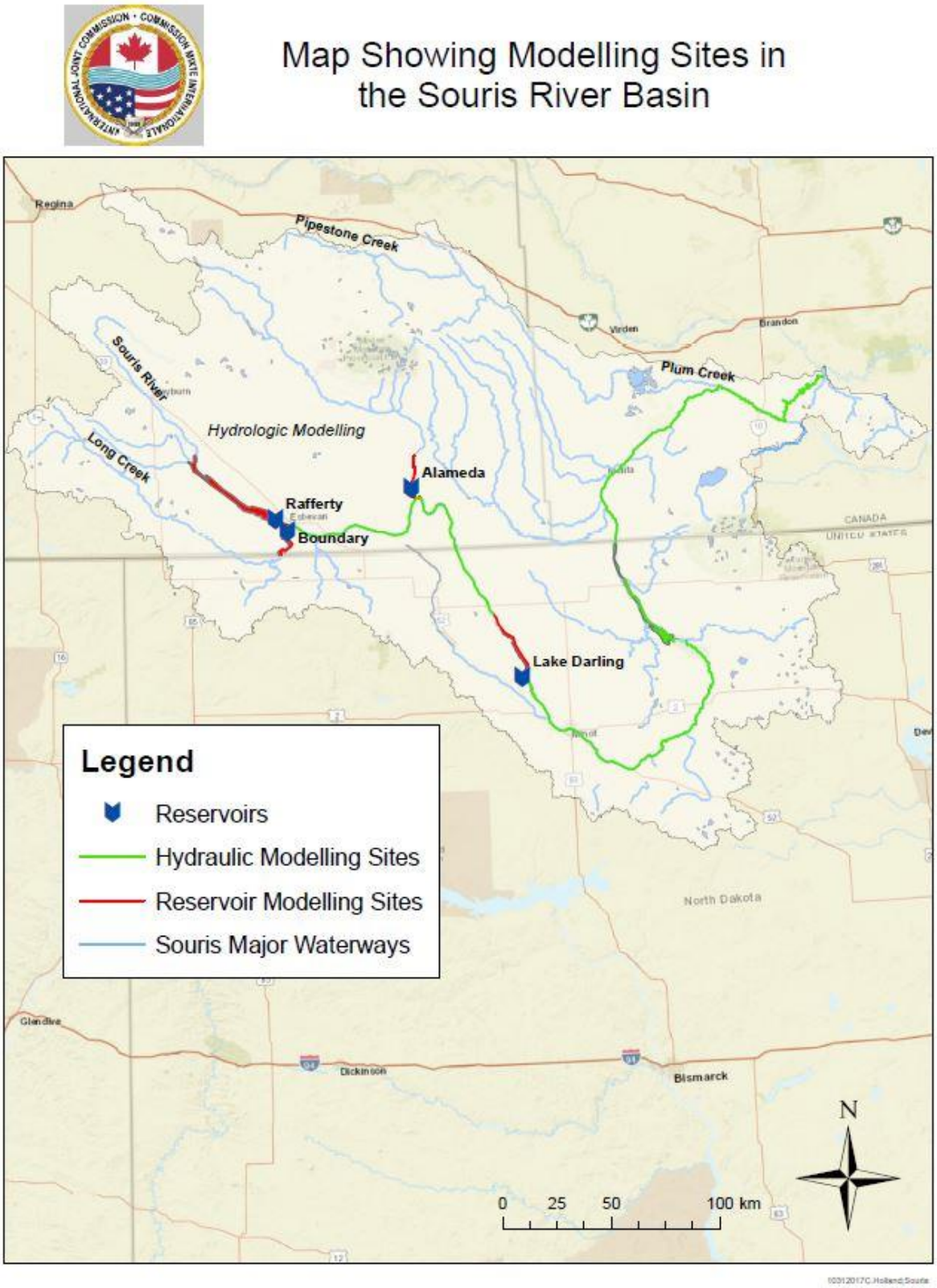

Figure 4 A map showing how the hydrologic, hydraulic and reservoir models fit together in their representation of the hydrology on the landscape**.**

Task HH1: Regional and Reconstructed Hydrology

Point of Contact: Michael Bart, USACE

This task involves reconstructing the hydrology of the basin in order to have a frame of reference when considering supply sequences for operational review. The current historical record for the Souris Basin contains years where there were no reservoirs and years where there were some reservoirs and years where all reservoirs were present. Reconstructing the hydrology recreates all historical years with both all reservoirs and no reservoirs.

Sub-tasks: USACE updating existing models (extending from 1946-2011 to 1946-2016), ISRB natural flow calculations, compare and summarize the two approaches

Timeline:

USACE update existing models – Jan 1 – Feb 28, 2018

ECCC to compare ISRB and USACE Natural Flow calculations – Feb 1 – Mar 31, 2018

Est. Cost: Estimates are being developed

Resources: USACE

Predecessor: N/A

Successor: PF2

Review: USACE, ISRSB

Notes: USACE work will be reviewed using internal processes and compared to ECCC natural flow calculations. If appropriate, the ISRSB will sign-off on the work as being suitable for the POS.

Task HH2: Stochastic Hydrology Dataset

Point of Contact: Gregg Wiche, retired USGS

This task involves:

1) Generating stochastic traces of future realizations (or "traces") of precipitation, temperature, potential/actual evapotranspiration, and unregulated runoff for 15 disjoint sub-basins upstream from the International crossing near Westhope.
2) For each trace in (1), a flow-routing/ reservoir simulation model will be used to simulate 10-day streamflow volumes for the outlet of 15-subbasins.
3) Developing climate change scenarios by developing prescribed trends in seasonal temperature and or precipitation
4) A peer reviewed report evaluating the frequency/magnitude of severe floods and droughts during the next 50 years will be completed using the results from tasks 1-3.
5) The stochastic inputs in task 1 will be disaggregated from a 10-day to a daily time step.

Sub-tasks: Review of Approach, Contracting, Final Product Review

Timeline:

Review of approach: November-December 2017

Contracting (see Skip Vecchia proposal emailed to ISRSB on October 20, 2018)

- Generate stochastic traces of future climatic inputs and (unregulated) runoff.
- Generate stochastic traces of future regulated runoff.
- Develop climate change scenarios
- Statistical analysis and reporting of flood/drought risk in relation to reservoir operation and climate change scenarios
- Provide stochastic inputs for deterministic/numerical models.

Final review of stochastic traces: September 30, 2018

Reviewed Report: September 30, 2019

Review of Approach – The stochastic methodology that will be used to complete tasks 1 and 2 are outlined in a USGS report by Kolars and others (2015). Tree-ring-based estimates of long-term seasonal precipitation completed by Ryberg (2016) will be used to explain the multi-decadal variability in seasonal precipitation that is used to drive the stochastic model. The reports by Kolars and others (2015) and Ryberg (2016) have been submitted to the ISRB for approval by the IRG. Dave Sauchyn has agreed to review the work.

Contracting – Summary proposal (summary and reference of work to date, budget on the temporal disaggregation of data, initial estimate of climate change scenarios, provide climate extremes from existing work to climate change sub-committee) has been submitted to ISRSB

Deliverables – Skip to provide temporal disaggregation of 10-day water supply scenarios to daily water supply scenarios, climate change scenarios (with and without reservoirs) and final report.

Final Product Review – Final report will receive at a minimum two technical reviews from subject matter experts in the USGS. The USGS is open to other subject matter expert reviews from scientists outside the USGS. IRG, in consultation with the ISRSB, will determine what if any additional reviews should be completed.

Est. Cost: Estimates are being developed.

Resources: None.

Predecessor: Climate Change sub-committee formation and meeting for the climate change piece.

Successor: Some of the modelling work (work to be done in conjunction with some of the modelling work.)

Review: USACE, ECCC, SWSA,

Notes: Details around this item are still being discussed by the ISRSB.

Task HH3: Artificial Drainage Impacts Review

Points of Contact: Mark Lee, MB; John Fahlman, SWSA

This task involves summarizing known information about artificial drainage in the Souris River Basin. It is expected that this will be an important issue on the minds of the public. Most of the public's questions around drainage relate to the flow of water between Saskatchewan and Manitoba, but there are some potential questions that may arise for the ISRSB. A review of the existing literature will help to illuminate these questions and provide information to the public.

Sub-tasks: Literature Review, Create Fact Sheet(s) and other public material

Timeline: May '18 – Aug '18

Est. Cost: Estimates are being developed.

Resources: IJC Communications

Predecessor: n/a

Successor: n/a

Review: POS Board, PAG

Notes: The ISRSB should probably begin this before May '18. Plus it may take more time to complete.

Task HH4: Flow Simulation Tools Development and Forecasting Assessment

Point of Contact: Al Pietroniro, ECCC

This task involves developing additional tools and evaluating existing tools for flow forecasting, which includes flood forecasting in addition to water supply forecasting. In addition, the current forecasting procedures will be documented for the ISRSB and a forecast performance review will be undertaken to evaluate existing flow forecasting capabilities for various models making real-time predictions in the basin (NOAA model and US National Weather Model.)

Sub-tasks: MESH model development and integration with water supplies (Canada), Forecast procedure review (US and Canada), combined forecast performance review between Canada and the U.S., Possible publication in a journal of the review.

Timeline:

MESH model development and integration with water supplies (Nov '17 – Apr '19)

Forecast procedures review (Nov '17 – Jan '18)

Combined forecast performance review (Apr '18 – May '18)

Est. Cost: Estimates are being developed.

Resources: ECCC, NWS

Predecessor: HH9 for MESH coupled with HEC models.

Successor: HH5

Review: ECCC, ISRSB, IRG

Notes:

Task HH5: ECCC Climate Change Supplies

Point of Contact: Al Pietroniro, ECCC

This task involves developing climate change scenarios using atmospheric General Circulation Model (GCM) and/or Regional Climate Model (RCM) climate change predictions as inputs to hydrologic models under various climate-change-induced land-change scenarios.

Sub-tasks: Develop scenarios, determine appropriate GCM/RCM model output to use, run and analyze scenarios with climate model outputs.

Timeline:

Est. Cost: Estimates are being developed.

Resources: Climate Change Advisory Group

Predecessor: HH4, HH9

Successor: PF2

Review: Climate Advisory Group, ISRSB, IRG?

Notes:

Task HH6: Reservoir Flow Release Planning (HEC-RESSIM)

Point of Contact: Michael Bart, USACE

This task involves updating the RES-SIM model with the Canadian reservoir data, along with calibrating the model for floods and droughts. Making sure the RES-SIM model is ready to run alternatives.

Sub-tasks: Add Canadian Reservoir data. Calibrate for floods, droughts, average flows making sure the RES-SIM model is ready to run alternatives.

Timeline: March 2018 through August 2018.

Est. Cost: Estimates are being developed.

Resources: USACE

Predecessor: DW2

Successor: HH9, PF2

Review: USACE, ISRSB

Notes: The model is already setup for floods from the USACE Souris feasibility study.

Task HH7: Reservoir Flow Release Planning (HEC-RAS)

Point of Contact: Michael Bart, USACE

This task involves updating the RAS model (includes SK and ND) with any data SK finds and re-calibrating the model. Making sure the RAS model is ready to run alternatives. This will also include coordination with Manitoba on determining how to hand off the data from our RAS model to their RAS model.

Sub-tasks: Add SK data to RAS model. Calibrate model for floods, average and low flows making sure RAS is ready to run alternatives. Coordinate with Manitoba on hand off.

Timeline: March 2018 through August 2018

Est. Cost: Estimates are being developed.

Resources: USACE

Predecessor: DW2

Successor: HH9, PF2

Review: USACE, ISRSB

Notes: The model is already setup, but there is some data in SK that isn't incorporated into the model yet.

Task HH8: Develop PRM Model

Point of Contact: Michael Bart, USACE

This task involves developing a HEC-ResPRM model to be used in optimizing flow schemes in the basin.

Sub-tasks: Build the PRM model. Calibrate the model and make sure it is ready to run alternatives.

Timeline: April 2018 through September 2018

Est. Cost: Estimates are being developed.

Resources: USACE

Predecessor: DW4, HH2

Successor: HH9, PF2

Review: USACE, ISRSB

Notes: This is the new model that hasn't been setup yet.

Task HH9: Model System Integration

Points of Contact: Michael Bart, USACE; Al Pietroniro, ECCC

This task involves coupling RES-SIM and RAS models in a CWMS or WAT model on the US side and coupling MESH with RAS on the Canadian side.

Sub-tasks: RAS and RESSIM Model Integration, MESH with RAS models with FEWS

Timeline: RAS and RESSIM Model Integration (Sept '18 – Dec '18)

MESH with RAS models with FEWS

Est. Cost: Estimates are being developed.

Resources: ECCC, USACE

Predecessor: HH2, HH6, HH7 (US) and

Successor: PF2

Review: ECCC, USACE, ISRSB

Notes:

5.4 Plan Formulation

This study objective directly addresses the governments' Reference items 6 through 10. Reference item 6: *Identifying and, as appropriate, making recommendations regarding improvements to the Operating Plan contained in Annex A of the 1989 Agreement to reduce the flooding and water supply risks in the Souris River basin with consideration to low flow, apportionment, water quality and aquatic ecosystem health.* Item 7: *The evaluation, on a qualitative and quantitative basis, of the costs and benefits of a range of possible infrastructure and operational plans regarding flooding and water supply in the Souris River basin.* Item 8: *The evaluation of additional flood protection measures, beyond what is currently provided under the 1989 Agreement, which may include feasibility evaluations of increasing storage at existing dams, more efficient channel alignment and capacity, and the provision of flood control measures in and around communities within the basin.* Item 9: *Assessing possible adaptation strategies to address the potential future variability in water supplies associated with climate change.* Item 10: *Facilitating collaboration among various Federal, State, Provincial, local agencies, the public, as well as Native American Tribes, First Nations, and Métis located within the basin to share their views and provide input during the study process.*

The core of the work and the central focus of the Operating Plan review are captured in this section. The current operations are based on the 1989 Agreement and the essential elements are captured in Annex 'A'. The purpose of this section is to explore what tools are available to carry out a structured approach in meeting the intents of the Task Force, ISRB and 1989 Agreement, while satisfying the needs of the original stakeholders identified in the Agreement and the emerging stressors on the system. Task PF1 involves hosting one or more workshops for key stakeholder representatives to determine their goals and objectives throughout the basin. Task PF2 involves developing and evaluating trial operational plans using the modelling systems and model inputs developed in earlier tasks. Task PF3 involves evaluating the safety of dam operations given new concerns resulting from the 2011 flooding. A key point in this study objective is that the goal is **not to build a tool** to manage reservoir operations, but rather **to build a plan** to manage reservoir operations.

Task PF1: Workshops

Point of Contact: Bruce Davison, ECCC; and Gregg Wiche, retired USGS

This task involves hosting a workshop (or series of workshops) of key stakeholder representatives to determine the goals and objectives of the stakeholders throughout the Souris

River Basin. The key features that are needed for each of the identified reservoirs, river reaches and key locations throughout the basin are:

a) Each stakeholder group should provide their goals and objectives clearly;
b) The ISRSB will convert stakeholder goals into specific reservoir operation parameters (a function of storage, release, or flow) or other flow/stage variable for the river; and
c) The analyst must create a mathematical statement or evaluation metric of each objective at the target locations. These key mathematical statements allow the models to evaluate and compare alternative reservoir operating rules according to their performance.

In short, this task is to find out what range of storage or flows are important to maintain in various parts of the basin, based on stakeholder feedback.

Sub-tasks: Identify key parts of the basin (reservoirs, reaches, locations), identify key stakeholders, contract facilitator, host workshop(s), and write workshop report.

Timeline: Main workshop should be this spring or early summer. But PAG and workshops should be held throughout study.

Est. Cost: Estimates are being developed.

Resources: ECCC, USACE, ISRSB, IJC, PAG

Predecessor: DW4

Successor: DW4, PF2

Review: ISRSB, reference document for the IRG

Task PF2: Run and Evaluate Alternatives

Point of Contact: Michael Bart, USACE; and John Fahlman, SWSA

This task involves using the stochastic modeling in the HEC-RESPRM model to optimize different schemes in the basin. Then the stochastic model events along with historical events will be run through the more detailed MESH/RES-SIM and RAS models to determine the best operating plan. This will be an iterative process. Some form of screening or reduction of alternatives will likely be needed to stay within the budget.

Sub-tasks: Run and evaluate using HEC-RESPRM, Run and evaluate using RES-SIM/RAS and MESH/RAS.

Timeline: Run and evaluate using HEC-RESPRM. Oct 2018-Dec 2018.

Run and evaluate using RES-SIM/RAS and MESH/RAS. Jan 2019-Apr 2019.

Est. Cost: Estimates are being developed.

Resources:

Predecessor: HH8, HH9

Successor:

Review: USACE, ECCC, ISRSB, IRG

Notes:

Task PF3: Dam Safety

Point of Contact: Michael Bart, USACE; and John Fahlman, SWSA

This task involves evaluating the safety of dam operations given new concerns resulting from the 2011 flooding.

Sub-tasks: Review of Canadian PMF report, Using Res-SIM to determine impacts to Lake Darling.

Timeline: Review of Canadian PMF report now-Dec 2018.

Using Res-SIM to determine impacts to Lake Darling: September 2018-Dec 2018.

Est. Cost: Estimates are being developed.

Resources: USACE, USFWS, WSA

Predecessor: n/a

Successor: n/a

Review: USACE, USFWS, WSA, ISRSB, IRG?

Notes:

6 Public engagement

6.1 Introduction

The IJC is committed to providing all interested parties with convenient opportunity to be heard, as required in the Boundary Waters Treaty. The IJC emphasizes the importance of public outreach, consultation and participation, and promotes policies and programs that enable community input in the decision-making process. Accordingly, the Study Board will carry out its public participation and outreach activities according to the Directive and the *Guidance to the Study Board on Communication and Public Participation - November 2016* document.

The IJC and ISRSB will strive to collaborate with existing regional organizations in developing and carrying out its communication and public outreach activities.

6.2 Objectives

Public participation in the study will be objectives-driven. The principal objectives are to:

- Ensure that the study process is open, inclusive and fair;
- Make the public aware of the study, its purpose, and process, including how decisions will be made;
- Provide opportunities to the public and stakeholders to participate;
- Enhance public understanding of the causes and effects of flooding and potential solutions;
- Identify and build on local expertise and information;
- Invite and consider public and stakeholder views of the principle issues;
- Identify and consider the public's priorities and preferences;
- Broadly disseminate study findings as they become available; and
- Encourage the public and stakeholders to share study findings.

The public refers to any person, association, organization or group that is affected, likely to be affected by, or has an interest in the study and any decisions that may ultimately be taken by the IJC in response to the findings or recommendations of the study. The public includes, but is not limited to, the following individuals and organizations representing the following interests: environment, recreational boating, local industry, agriculture, water supply and stormwater/sewage treatment; as well as riparian interests and municipalities. Stakeholder refers mainly to decision-makers, public opinion influencers and elected officials.

6.3 Communication Plan

A Communication Plan is an important tool for any complex study. The Communication Plan for the Souris River Study Board – in development – will identify:

- Public environment, annotating public and stakeholder interests, including historical IJC activities in the basin;
- Communication objectives over the course of the study;
- Target audiences, including partner organizations (municipalities, elected officials, First Nations/Tribes, local media, and interest groups.);
- Strategic considerations, including communication needs, opportunities, challenges;
- Key communication deliverables from the Study Board, along with timelines and identification of leads and collaborators – this will include products to educate or inform, public engagement events, i.e., open houses/webinars/public meetings; and activities to promote the work of the study, i.e. social media, articles; and
- Budget.

The Communication Plan is an evergreen document, and will evolve as the communication needs of the study become more clearly defined. As such, the effectiveness of the communications approach will be continually evaluated.

The Study Board will use three important means for public participation and outreach: public meetings, the Public Advisory Group (PAG), and the ISRSB web page.

6.4 Public meetings

The Study Board will conduct public participation meetings, as appropriate, holding at least one in each country per year. During these meetings, the Study Board Co-Chairs will invite comments from the public on specific or general issues associated with the study as well as provide opportunities for the public to express its views.

In order to inform and provide context for the technical investigations associated with the study, the public will be consulted at the beginning of the Study to identify the public's views on the principle issues, questions and study objectives, acquire any available knowledge in the form of historical data, anecdotal information indigenous knowledge as well as existing or future plans, activities and initiatives. Public meetings will be held in both Canadian and US locations.

Other public participation activities or meetings will be conducted at strategic junctures throughout the study.

6.5 Public Advisory Group (PAG)

The IJC is committed to engaging with the public during the study on an ongoing basis through the Public Advisory Group (PAG). PAG members will represent multiple areas of interest and various geographic locations across the Souris River basin, and include an equal number of people from Canada and the US. PAG members will have the opportunity to provide advice on the Study Board's public participation activities laid out in its Directive. More specifically, the PAG will be asked to:

- Advise the Study Board on public consultation, involvement and information exchange;
- Serve as a conduit for public input to the study process, and for public dissemination of study outcomes;
- Review and provide feedback on Study Board approaches, reports, products, findings and conclusions as requested; and
- Advise the Study Board on the responsiveness of the study process to public concerns.

As such, PAG members will be asked to draw upon their knowledge, contacts and experience to provide informed input to the study.

- Develop effective techniques to engage the public and stakeholders on a wide range of issues;
- Facilitate outreach to First Nations and Tribes to encourage participation in the study;
- Use geospatial technologies (including geodatabases for archiving and analysis; GPS for geotagged imagery) to create a participatory mapping framework that captures stories, observations and other geospatial data across the basin.

6.6 ISRSB web page

The web is an important communication tool, serving as a primary means of providing information to a diverse public. As such, the IJC will keep the ISRSB web page up-to-date with information on the progress and achievements of the Study under the IJC's Rules of Procedure, and other information relevant to the study. Promotional resources, such as brochures, articles,

and social media posts will contain a consistent call to action directing target audiences to the web page.

The Study Board will also encourage public discussion by inviting comments from the public on specific or general issues associated with the study, and providing opportunities for the public to express its views by, among other means: publicizing a mailing address in each country for correspondence and submissions; establishing and promoting the use of a dedicated e-mail address; and hosting webinars, when warranted. In addition, the IJC will promote opportunities for public consultation on its public engagement platform: participateIJC.org.

The Study Board will develop the necessary communication tools and materials, ranging from posters to videos to interactive maps, to educate the public on flooding and a flood mitigation aspect considered in the study, for use during and after the study is complete.

7 Study Review

7.1 Introduction

The Study Review section outlines the scope and level of peer review that will be needed for the Souris River Study defining four general levels of review: Sufficiency Review (by ISRSB) (SR) Agency Quality Control (AQC), Agency Technical Review (ATR), and Independent external review via an IJC managed Independent Review Group (IRG).

The Study review process is based on a few simple but fundamental principles:

- Peer review is key to improving the quality of work in studies and so interim reviews as well as the final reviews are beneficial for checking methods and assumptions early when corrections are still feasible;
- Reviews will be scalable to the content of each component of the study, deliberately included as part of the study process throughout the life cycle of the study (scoping, interim products, and final products), and concurrent with recommendations to include previous work in the study and completion of new study phases/ products from each contributing agency/contractor and the study board;
- Since previously completed work products may have already undergone sufficient peer and independent reviews, products will be screened for level and need for review for the purposes of this study.
- An IRG level review will be completed on all recommendation and implementation documents and specific study products identified as fundamental to making those recommendations. For other products, the Study board will provide documentation of existing reviews and recommendations to the IRG for level(s) of review, and the IRG will provide their decisions on whether to perform additional review.

** It is important to acknowledge that the reviews may result in additional work for the study to address concerns that are not currently accounted for in timelines and budgets.

7.2 Sufficiency Review (SR)

A preliminary review of existing/ completed products and their documented peer and independent reviews. This review can be done by the ISRSB or Technical work groups of the Board. These reviews ensure consistency and coordination across all study components.

Lists of products recommended for use without further independent review will be provided to the IRG with background documentation. The IRG can request to review or other additional reviews of these products at their discretion.

7.3 Agency/Contractor Quality Control Review (AQC)

AQC is the internal quality control process performed by the Study Task supervisors, senior staff, peers and the TWG. AQC consists of the following:

Quality Checks and reviews. These are routine checks and reviews carried out during the development of products by peers not responsible for the original work. These are performed by staff such as supervisors, technical leads or other senior designated to perform internal peer reviews.

PDT reviews. These are reviews by the production team responsible for the original work to ensure consistency and coordination across all project disciplines.

Expert reviews. These reviews will be conducted by regional experts that have not been involved in the development of the products. These experts may include water management and modeling experts from U.S. and Canada and expertise from Partner Agencies.

7.4 Agency/Contractor Independent Technical Review (ATR)

The objective of ATR is to ensure consistency with established criteria, guidance, procedures, and policy. ATR's assess whether the analyses presented are technically correct and comply with published guidance, and that the document explains the analyses and results in a reasonably clear manner for the public and decision makers.

Peer review typically evaluates or critiques the clarity of hypotheses, accuracy of assumptions, the validity of the study design, the quality of data collection procedures, the appropriateness of the methods, the extent to which the conclusions follow from the analysis, and the strengths and limitations of the overall product. Reviewers check that methods used to collect data and produce results are defensible and adequately documented; facts and interpretations are presented straightforwardly, without apparent bias; conclusions are based on the best available data interpreted with sound scientific reasoning that avoids speculation; forecasts and predictions of natural hazards are scientifically sound; and the manuscript is clear in presentation.

ATR will be conducted by qualified reviewers that are not involved with the day-to-day production of the program/product. ATR teams will be comprised of senior personnel and may be supplemented by outside experts as appropriate.

Organizations producing products for the study may have an existing Agency Quality Control (AQC) and Peer Review/ATR equivalent processes that they are required to follow. Information on those process and product specific reviews will be provided to the Study Board as part of the product documentation supplied to the IRG.

Documentation on some agency peer review processes will be expanded to include additional processes as organizations provide products.

7.5 Independent Review Group (IRG)

The Independent Review Group (IRG), appointed by the IJC, will provide independent technical review and documentation of appropriate Study components and documents produced jointly during the Study process. Anticipated involvement of the IRG will occur at strategic milestones such as review of selected products, draft work plan, and the final review of the study. IRG members can provide advice on the Study as a whole, as well as in regard to their respective subject-matter expertise. The IRG provides its reports through IJC staff for consideration by the Study Board and the IJC.

7.6 Peer Review Plan

A Peer Review Plan (PRP) will be developed by the ISRSB in collaboration with the IJC liaisons to the study and the IRG Co-chairs. The PRP will provide guidance on how reviews of products will be managed including processes for review comment resolution, documentation, and certification of completion. The PRP will be a living document with Tables of products to be reviewed, reviewers, review schedules, and budgets that are updated as products and information become available.

8 Information and Data Management.

The Study Board recognizes that the research under the "Plan of Study: For the Review of the Operating Plan Contained in Annex A of the 1989 Agreement Between the Government of Canada and the Government of the United States of America (2013)" as referenced in July 2017 and directive of September 2017 will generate a number of reports and large quantities of purchased, acquired and leveraged data and information, models and associated documentation.

This collection represents a significant investment and legacy of the study. As a result, the Study Board will pursue the following principle with regard to information management - "The International Souris River Study Board encourages unrestricted access to data. Data collected by the Souris River Study will be made available online once it has been approved for distribution by the Study Board and IJC. Most of the data collected by the study will be available to the general public by the completion of the review, scheduled for mid-2020. However, there may be licensed or proprietary information that may not be made available publicly."

The Study Board, with the technical assistance of the IJC, will address the information management needs of the study. Options and recommendations for the archiving and dissemination of the study's data assets will be developed. The Study Board will also develop an Information Management and Dissemination process to provide external parties with access to the study's data and information to help meet water level analysis and management objectives.

The Study Board will explore using web-based tools such as Office 365 and dynamic decision-mapping system to ensure the transparency of the Study Board's decisions similar to the one developed for the International Upper Great Lakes Study (http://www.iugls.org/Decision_tree_tool)."

9 Secretariat

The study managers will provide secretariat support to the study.

10 Study Management

Effective study management is necessary so that the study is conducted efficiently, within fiscal limits, is coordinated, and that proper oversight and study decisions are being made. This study management is provided by the Study Board, study co-chairs, and study managers.

11 Study Products, Timeline and Budget

This section summarizes the major products to be produced from this study, timelines of study activities and a summary of study costs by major task. As previously mentioned, this Work Plan is considered a living document and will be revised on a regular basis, as the Study progresses, work scope is modified, funding levels change, results become available and stakeholders and public inputs are provided.

Table 2 outlines the key reports that are currently envisioned to answer the joint References' objectives. A critical path for these objectives will be developed by first quarter of 2018. Reports will be jointly written by key individuals, reviewed as deemed necessary by the ISRSB, reviewed by the IRG, approved by the Study Board and presented to public.

All tasks have been placed into five groups of activities and the estimated cost for each group is listed in table 1. The cost for each task will be finalized in March 2018, and table 1 will be updated with the cost estimates.

Table 2 Key products and reports from the ISRSB

Study's main reports	Lead Organization(s)	Completion date (year-month)
1989 Agreement Language Review Report (Task OR1)	SWSA/USACE	2018-02
Summary of POS Projects and Report Progress since 2013 (Task DW1)	ECCC	2018-02
Initial repository of datasets and models for ISRSB (Task DW1)	ISRSB/IJC	2018-03

Report and data for all existing and additional data collected for the POS. (Tasks DW2, DW3, DW4)	ECCC/USGS/USACE	2018-08
Artificial Drainage Impacts Documentation and Public Materials (Task HH3)	SWSA/MB/IJC	2018-08
Hydrology and Hydraulics Report (Tasks HH1, HH2, HH4, HH5, HH6, HH7, HH8, HH9)	SWSA/MB/ECCC/USACE/USGS	Mid-study (when all models are setup and ready to go for plan formulation)
Plan Formulation Report (Tasks PF1, PF2)	SWSA/MB/ECCC/USACE/USGS	End of Study
Final repository of datasets and models for IJC (All tasks)	ISRSB/IJC	2018-03
Dam Safety Report (Task PF3)	SWSA/USACE	End of Study

Table 11.2 summaries proposed costs for the Study's main objectives over the course of the entire study. A critical path for these deliverables will be developed.

Old No.	New No.	Name	Group	Canada Costs (USD)	USA Costs (USD)
1a, 1b, 2	OR1	1989 Agreement Language Review	Operating Rules Review	0	0
3	DW1	Summarize POS Projects and Report Progress since 2013			
4	DW2	Lidar and Bathymetry for Reservoirs	Data Collection and Management	196	60
5	DW3	Review of Hydrometerological Network Report			
6	DW4	Data Collection for PRM			
7	HH1	Regional Hydrology			
8	HH2	Stochastic Water Supplies			
9	HH3	Artificial Drainage Impacts Review			
10	HH4	Water Supply Forecasting Tools - Development			
11	HH5	ECCC Climate Change Supplies	Hydrology & Hydraulics	248	505
12	HH6	Reservoir Flow Release Planning (RES-SIM)			
13	HH7	Reservoir Flow Release Planning (HEC-RAS)			
new	HH8	Develop PRM Model			
new	HH9	Model System Integration			
14	PF1	Workshops			
15, 16, 17	PF2	Run and Evaluate Alternatives	Plan Forumlation	88	280
new	PF3	Dam Safety			
	A1	Reporting			
	A2	Outreach and Public Comment			
	A3	Information Management			
	A4	Study Manager (Canada)			
	A5	Study Manager (US)	Study Management and Governance	368	55
	A6	Public Advisory Group (PAG)			
	A7	Independent Review Group (IRG)			
	A8	Climate Advisory Group (CAG)			
	A9	Resource/Agency Advisory Group (RAG)			
	A10	First Nations/Metis/Tribes			
			Total	900	900

Table 11.2 Summary of Study Costs

Cited References

Kolars, K.A., Vecchia, A.V., and Ryberg, K.R., 2016, Stochastic model for simulating Souris River Basin precipitation, evapotranspiration, and natural streamflow: U.S. Geological Survey Scientific Investigations Report 32015-5185, 55 p., https://doi.org/10.3133/sir20155185