INTERNATIONAL RED RIVER TASK FORCE
PLAN OF STUDY
August 1998

The Plan of Study describes briefly studies to be undertaken by the International Red River Basin Task Force to support its final report on Red River flooding.

The Plan of Study remains a work in progress. It reflects the concerns raised by the public during consultations within the basin in February 1998 and the expertise of the Task Force and workgroups established by the Task Force. However, new data, emerging technology, early results of studies, coordination during the study, changing needs and priorities, resource and financing considerations and other issues dictate that the Plan of Study will need to be continually reviewed and revised.

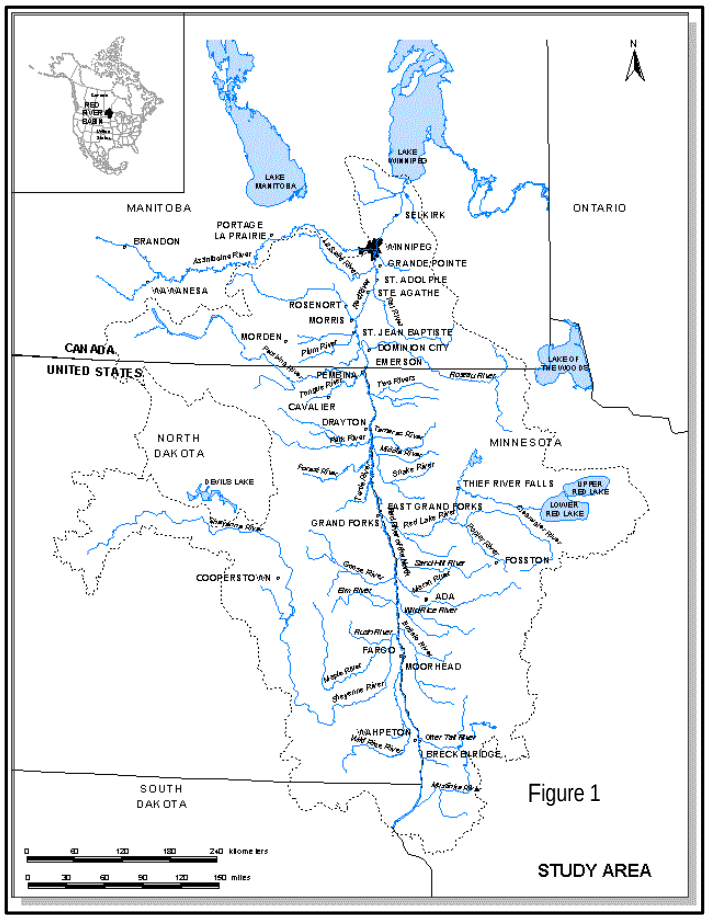
OBJECTIVES

The Task Force's studies aim to provide insights and advice for decision-makers on reducing or preventing devastation such as occurred during the 1997 flood. The Task Force's work will also provide useful data and tools for those who plan, design, and implement flood reduction policies, programs and projects. These data and tools will provide those with operational responsibilities a much greater ability to forecast flood events and to carry out efficiently emergency measures to save lives and property.

The study will also address the question as to what collaborative and integrated problem solving mechanisms are required in the Red River basin. The aim is to enhance coordination and cooperation throughout the entire basin long after the Task Force has finished its assignment.

In summary, the Task Force has defined specific objectives for its investigations as:

- Develop and recommend a range of alternatives to prevent or reduce future flood damages.
- Improve tools for planning and decision making.
- Facilitate integrated flood management in the basin.



STUDY AREA

The 45,000 square-mile Red River basin slopes northward from the U.S. Great Plains to Lake Winnipeg. The basin includes portions of South Dakota, North Dakota, Minnesota, and Manitoba. It is illustrated in Figure 1.

The primary focus for the plan of study will be the Red River and its major tributaries. Of particular importance are those areas of the basin flooded in 1997. Excluded from the study area are the Assiniboine and its tributary the Souris river, which joins the Red River in Winnipeg, and the Devils Lake basin, a closed sub-basin of the Red River basin.

STUDY ORGANIZATION

The International Red River Basin Task Force will manage the studies. It will define required studies, coordinate the funding and scheduling, exercise quality control, provide oversight of subgroups, synthesize the findings, and prepare the recommendations for the final report to the IJC. The Task Force has established three subgroups—Database, Tools, and Strategies—to conduct or direct much of the data collection, model development, program evaluation, and to prepare preliminary recommendations. The study management structure is shown in Figure 2.

Each subgroup has subject matter experts from the United States and Canada. The teams will develop procedures for accomplishing their assigned work within the budget and time constraints of the study. The work will be accomplished directly by subgroup members or through contracts and work agreements with consultants, institutions, and agencies. The Task Force will coordinate and synthesize the work of the three subgroups.

STUDY DESIGN

The concept for accomplishing the study is shown in Figure 3. A coordinated database is fundamental as it supports the development of models and flood damage reduction strategies. Each of these working groups are key elements in the decision support system.

The Task Force's final report will draw together the findings of the subgroups and make recommendations on policy, operations, and research issues. The IJC will use the final report as the basis for hearings in the basin prior to the submission of its report to governments.

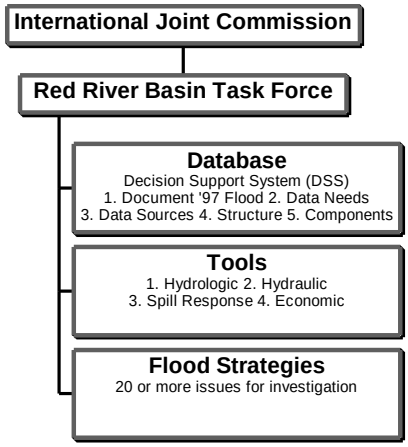


Figure 2

PUBLIC INVOLVEMENT

Public participation is an important part of the process. Following the distribution of the Interim Report, the IJC and the Task Force conducted a series of public meetings throughout the basin in February 1998. The results from these meetings have been incorporated into the study plan. Efforts will be made to keep people in the basin informed throughout the study using the Internet, news releases, and other means of contact. Public and technical input will be invited throughout the study period.

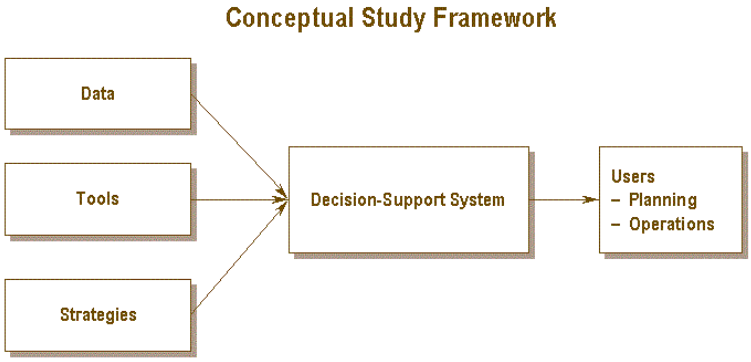


Figure 3

WHOLE BASIN APPROACH

The fact that this study involves two countries implies two different systems of doing business, two political systems, two or more ways of collecting, analyzing, and storing data, and many other political dichotomies. These dichotomies create a unique challenge for this study, but the reality that floodwaters do not recognize an international border makes a basin-wide approach to flood management imperative. Although this study will not develop a comprehensive basin-wide water management plan, the work of the data, tools, and strategies groups will contribute to more effective and efficient floodplain management, facilitate integrated flood emergency management in the basin, and foster improved international cooperation and communication.

INTERACTION/COORDINATION AMONG SUBGROUPS

The work to be done requires interaction and communication among the three subgroups and the Task Force. The major focus of the Database Subgroup, for example, is to develop a system that will allow data required by the Tools and Strategies Subgroups to be easily accessed for modeling and study purposes. This requires close coordination to ensure that the efforts of this subgroup generate products of value and use in the near and long term. This coordination is being promoted in several ways:

- Two members of the Database Subgroup are also members of the Tools Subgroup
- U.S. Co-leaders for all three subgroups are employees of or contracted with the Corps of Engineers in St. Paul, Minnesota

- Canadian Task Force members are Co-leaders on the three subgroups and all are participating in work of the subgroups.

Members of the Subgroups

Database Subgroup	
Slobodan Smonovic* (Co-leader)	University of Manitoba
Terry Birkenstock (Co-leader)	Army Corps of Engineers
Rick Bowering	Manitoba Natural Resources
Alf Warkentin	Manitoba Natural Resources
Glenn Radde	Minnesota Natural Resource
Randy Gjestvang	ND State Water Commission
Russ Harkness	US Geological Survey
Ron Wencl	US Geological Survey
Mike Anderson	US National Weather Service
Tools Subgroup	
Bob Halliday* (Co-leader)	R. Halliday & Associates
Scott Jutila (Co-leader)	Army Corps of Engineers
Rick Bowering	Manitoba Natural Resources
Alf Warkentin	Manitoba Natural Resources
Jim Solstad	Minnesota Natural Resource
Tim Faye	ND State Water Commission
Strategies Subgroup	
Bruce Rawson* (Co-leader)	Rawson Group Initiatives
Lou Kowalski (Co-leader)	Contractor w/Corps of Engineers
Larry Whitney*	Manitoba Natural Resources
Dwight Williamson*	Manitoba Environment
Me Sinn	Minnesota Natural Resources
Dale Frink	ND State Water Commission

* Task Force members

IMPLEMENTATION AND FUNDING (revised March 1999)

In **December** 1997, the Task Force completed its interim report, **Red River Flooding: Short Term Measures**, together with a draft Plan of Study. Both were subjects of public meetings held in the Red River Basin in February 1998. However, lack of U.S. funding delayed implementation of new studies. In November 1998 funds become available for U.S. Fiscal Year 1999 and the Task Force adopted a new work schedule. The Task Force will submit two reports to present study findings and recommendations – in November 1999 and September 2000. Each report will be followed by a series of public consultations and release of an IJC report to Governments.

The November 1999 report will include discussion on flood storage, floodplain management regulations and policies, transboundary flooding issues in the Pembina sub-basin, flood risk in Winnipeg and other communities, water quality impacts in Lake Winnipeg from the flood, and inter-basin hydraulic connection issues at Lake Traverse. Work on the data collection, decision support system, hydrologic and hydraulic modeling, and evaluation of institutional arrangements is ongoing. Portions of these efforts will be included, as part of the November 1999 report, but these final products will not be available until the September 2000 report.

A summary of key tasks for each report is presented at the end of this Plan of Study as an appendix. The current estimated cost for work to be undertaken with this study is $5.1 million (U.S.), with each country providing approximately equal funding.

The following three sections provide the work plans for the data, tools and strategies subgroups of the Task Force.

DATABASE SUBGROUP

SCOPE

Data about the Red River basin exist in many forms and are not always widely available. The Database Subgroup will assemble information about data existing in paper records, electronic databases, and will establish new data collection efforts. The subgroup will develop the procedures to integrate in a virtual sense the distributed databases that currently exist. The subgroup will do this by taking advantage of existing communication and computing infrastructure. The ultimate goal is to ensure that data required for floodplain management and flood disaster activities is available to those users needing it.

OBJECTIVES

The Database Subgroup's objectives are to:

- Develop a virtual distributed spatial database to support user needs in Red River Basin flood planning, flood fighting, and flood recovery efforts.
- Coordinate and initiate development of a detailed Digital Elevation Model (DEM) for the basin.
- Develop a Decision Support System (DSS) that integrates databases and models for improved decision making capability and enhanced communication

AREAS OF SUPPORT

The Database Subgroup will address data needs of the Tools Subgroup to support model development and analysis, data needs described by the Strategies Subgroup as necessary to support their studies, as well as data integration and development in a number of areas to meet the objectives stated above.

The main areas of work for the Database Subgroup are expected to fall into the categories listed below. Some of the recommendations of the IJC Red River Flooding Interim Report that are supported in each area are listed in parentheses following each item.

- Documentation of the 1997 flood (Ongoing Archive) (26, 33)
- Evaluation of Data Needs, Data Sources, and Communication Links (5, 25, 27, 28, 29)
- Basin-wide Flood Management Database & Database Components (9, 11, 19, 17, 18, 25, 27, 30, 31, 32, 36, 38)
- Decision Support System (8, 19, 29, 33, 34)

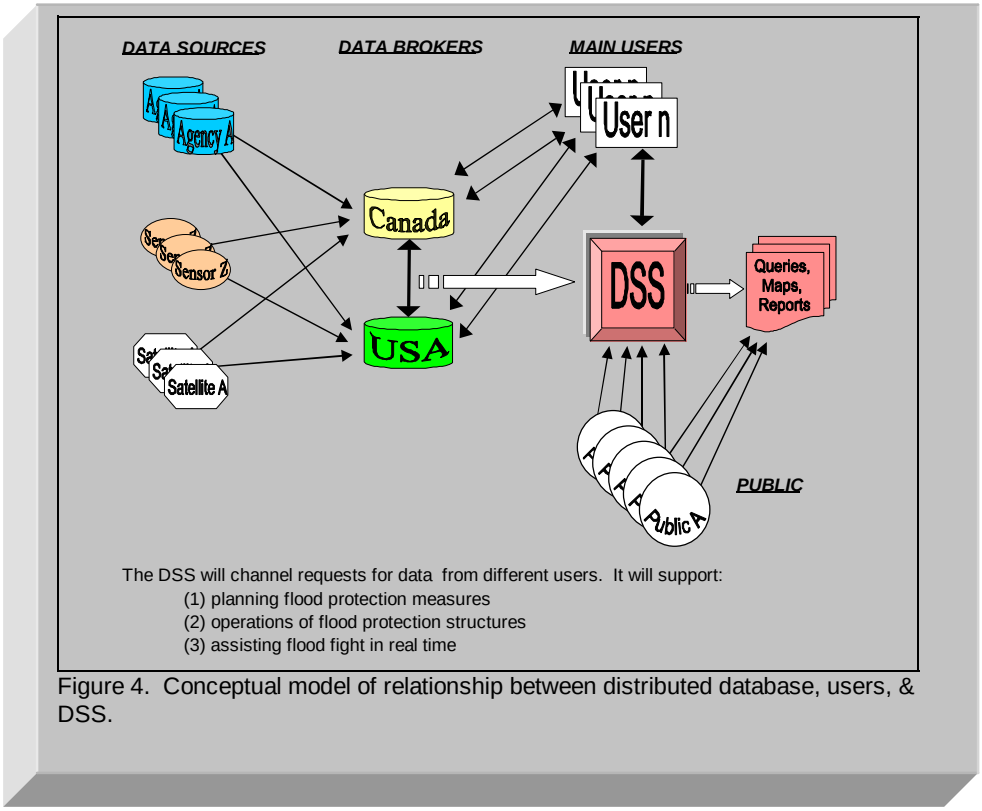


Figure 4. Conceptual model of relationship between distributed database, users, & DSS.

STUDY COMPONENTS

1. Red River Basin Data Users - Needs Assessment

The critical components (user needs) of the virtual database of information available or required in the Red River Basin must be defined by the groups that generate, distribute, and use the data. User needs, however, include more than just the data requirements. They also include the definition of critical links between providers and users, and processes for transferring data between these various groups. For example, the flood forecasters provide the predictions for flood crests and this information must be passed on to a number of users who can then take action to protect property and life. During a flood, the typical "infrastructure" that is used to pass along information may become disabled or fragmented. Thus alternative means to assure a viable communication link is critical.

Potential users of the virtual database possess a range of sophistication in terms of needs and capabilities to process this data. The varying degrees of sophistication need to be considered in the context of at least three different functional uses of the database: planning, operations, and recovery. Defining the needs of these users for the range of sophistication and function will essentially define the framework that is essential for ultimately building a Decision Support System (DSS) for the basin. Thus user needs will dictate/define the DSS requirements.
User needs assessment should produce the list of data users, type of data required by each user, data format, data need frequency and potential data communication mode.

Implementation Strategy:

1) Conduct workshops in July.
   - Workshops (two in US, one in Canada) in the basin with public and private users of the system to gain an understanding of the data, models, products and communication links that are in use as well as desired/required for better planning, flood fighting, and flood recovery.
2) Final Report to be developed with Global Disaster Information Network (GDIN) contractor and available mid-September.
3) Consider supplementing workshops with a "virtual internet meeting" to expand input.

2. Database Components - Digital Elevation Model

Digital elevation data of the Red River Basin is of primary importance for the decision support requirements of floodplain management. Development of a detailed DEM has been determined to be the single most critical dataset that can improve analysis of future flood control measures, operation of existing flood control structures, and evaluation of different hydrologic scenarios for the basin. These critical types of analysis depend on the adequate topographical representation of the basin.

Although this study does not have the funding to develop a complete and highly detailed DEM, considerable effort will be made in leveraging available funds with other agencies interested and involved in DEM development in the basin.

Implementation Strategy: This research oriented effort will include:

- Detailed DEM for specific locations (urban areas) with vertical accuracy of 15 cm. Detailed elevation of infrastructure within the floodplain with vertical accuracy of 5 cm including: (a) roads; (b) railway; (c) main drains; and (d) Red River tributaries.
- More coarse (1 meter) DEM for preferably the whole 1826 flood high water area, or alternatively the 1997 flood high water area.
- Detailed DEM of ten areas, approximately 25 square miles each, to provide data to verify DEM extrapolation for the rest of the basin.

DEM development will use course data and combine them with the detailed infrastructure layer. Based on these two layers different interpolation methods will be tested for the development of adequate DEM representation within the floodplain.

3. Virtual Database for the Red River Basin

A considerable amount of data required for the various phases of flood and floodplain management already exists on Internet Web sites of various agencies, and many of these agencies know how to access this information. This is probably more true during non-emergency situations. In emergencies, when critical data is needed in near real-time, users have fewer opportunities to make demands of providers to exact the data they need. Also, during a flood emergency the user needs and providers of data are easily identifiable. For planning and recovery

the uses of the various datasets can be more varied, harder to define, and be of interest to a considerably wider audience (researchers, agencies documenting or reconstructing flood events, the media, etc.).

During the flood of 1997 numerous Internet "Flood Information" Web pages appeared that provided useful information to data consumers in the basin. However, these sites were not integrated in a way that allowed someone searching for data to ensure that they had access to all potential sites or sources of information. Thus, there is a need to integrate in a virtual sense existing distributed databases and those that will be developed in the future.

Implementation Strategy: This task will involve development of a "Data Catalog" searchable by data type or data holder/owner. The database will remain distributed. Agencies responsible for the development and/or management of a data set will maintain control and upkeep of that data, but will make the data available to end-users over the Internet. There will be no single data repository. This eliminates the requirement to provide regular updates to a data clearinghouse. A single link , such as a Web Page, will be established to access the overall Flood Database. Examples of this data catalog or clearinghouse exist on the Internet such as the USGS "GLIS" tool, the State of MN GIS catalog, and CEONET of the Canadian Geospatial Data Infrastructure

Metadata (a text file describing various characteristics of each data set, such as accuracy, format, etc) will be obtained or developed for each available data set. Metadata is critical for users of a distributed database to evaluate accurately the usefulness of a specific data set for a certain type of analysis. Metadata also provides a method to ensure “long-term memory” about data when government “institutional memory” is lost.

Stage 1 - This phase will incorporate the initial database components listed in Table 1 below and assemble a seamless dataset for "base map" data for the basin. The product will be a draft web site with metadata (FGDC compliant) describing the data and links.

Stage 2 - This phase will take the draft from stage 1 and integrate the findings from the User Needs Assessment to enhance the virtual database and make it queryable. This effort recognizes the need to ultimately integrate into the DSS framework.

TABLE 1 Initial database components for support of Study and DSS

FLOOD of 1997 DOCUMENT

1 High-water Marks - Flood Extent
2 Head loss - Structures/roads/levee breaches
3 Head loss - Changes since flood
4 Elevation-Discharge Curves extension
5 Discharge-Frequency curves update
6 Bathymetry to confirm x-sec changes

OPERATIONAL DATA NEEDS

7 Gauges
8 Hydrometric and meteorologic sites/network
9 Stage and discharge data
10 Precipitation, snow, temperature, dew point, wind, solar radiation
11 Ice data
12 Wells - Active and abandoned
13 Use of National Technical Means (classified imagery)
14 Critical Facilities

PLANNING DATA NEEDS (ALSO OPERATIONAL FOR MOST ITEMS)

15 Digital Terrain Mapping
16 Stage measurements during high water for model calibration
17 Roads - elevation and alignment
18 Levees - elevation and alignment
19 Drains - dimensions and alignment
20 Bridge and Culvert openings (>5ft)
21 Raised Pads - locations and elevations
22 Impoundments - size, sill elev., location, date of construction
23 Land Use - current and historic
24 Soils
25 Floodway Alignment
26 Wetlands - Drained Basins
27 Potential Spill Sources (Hazardous Material)
28 Stage damage data
29 Base Map features for output products (various scales)
30 Agricultural and other Chemical Use in the Basin
31 Water Quality data
32 Critical Aquatic & Wildlife Habitat
33 Threatened and Endangered Species (T&E)
34 Archeological Sites

FLOOD RECOVERY DATA NEEDS

35 Satellite images catalog/Acquisition
36 Aerial Photographs catalog
37 Emergency plans and emergency organizational charts

4. Decision Support System - Prototype

The virtual DSS is a tool that provides a computerized interface allowing the integration of various database and model outputs to answer basic questions or complex "what-if" scenarios about floods or flood damage reduction activities. The DSS is dependent on the type, format, accuracy, and availability of the databases and the models it attempts to integrate. To develop the most effective and robust DSS, the objectives and requirements of the DSS must be spelled out prior to the design and construction of the supporting databases and models. This is being done under Task 1 - User Needs Assessment. Because of the wide range of users, providers, decision makers with a stake in the DSS, and the number of flood management processes that can be addressed in the DSS, a two phase process is proposed -- an initial DSS prototype leading to a second phase expanded DSS.

Implementation Strategy: This task will expand on the needs identified in the User Needs Assessment to develop a prototype DSS. The prototype will be expandable and dynamic to allow incorporation of new models as they are developed and to address new issues that will arise in the future. A three stage approach is proposed:

Data

(a) Integration of findings from Tasks 1 & 3 to develop an overall framework for an expandable/dynamic DSS (this includes consideration of providers/users, databases, models, delivery systems, and potential communication links).
(b) Definition of small target audience in flood management planning process mode, subset of suitable models, minimum databases required, and delivery system that can reasonably be made to function as needed to demonstrate capabilities of an overall basin DSS.
(c) Development of the user interface for support of communication between the prototype DSS and identified target audience.
(d) Document lessons learned.

5. Red River Decision Support System - Phase II

General objectives and requirements of this particular flood management DSS are:
1) provision of support for planning different flood damage reduction alternatives;
2) evaluation of operational alternative choices during the flood fighting; and
3) support during the flood recovery period.

During the planning stage, different alternative measures (structural and non-structural) to minimize flood damages are analyzed and compared. The analysis involves project formulation for each measure, understanding advantages and disadvantages of alternative project arrangements, evaluation of the positive and negative project impacts, and finally the relative comparison of alternative measures.

Flood emergency management includes regular appraisal of the current flood situation and daily operation of flood control works. An important aspect of the appraisal process is identification of potential critical events (such as dike breaches, wind setup, heavy rainfall, etc.). At this stage, decisions are made on urgent major capital works and flood upgrading measures for existing structures. From the appraisal action is initiated regarding evacuation and re-population of different areas.

Post flood recovery involves numerous hard decisions regarding return to 'normal life'. Issues of concern include damage evaluation, property rehabilitation, and provision of flood assistance. At this stage also, all environmental impacts are evaluated and mitigation strategies selected.

Implementation Strategy:

1. Expand DSS prototype based on User Needs Assessment and lessons learned.
2. Develop DSS framework to support flood management planning, flood emergency management and flood recovery process. Development of the framework will include identification of users and providers and their particular needs, sources of data in the virtual data-base and appropriate means of communication between the data-base and the user; appropriate models, and optimal delivery systems including GIS data processing.
3. Expand the user interface to support communications between the DSS and all identified users.

6. Database Components – Time-series inundation maps - 1997 Flood

Time-series inundation maps referenced to stage and/or discharge hydrographs of mainstem and tributary streamflow gages are a valuable historical record of the flood. They can be used for a variety of flood analysis. Documentation of breakout flows is also important because of the impact they have in affecting forecasts and in improving model output. The flood extent and breakout data is also useful for model calibration. If done for the 1997 flood, the data could also be used for calibration of automated inundation mapping programs. Because of the complex nature of the 1997 flood, which included several peaks, a time series of images needs to be observed to get a true reconstruction of the flood.

Implementation Strategy: Catalog all RADARSAT images and aerial photographs collected during the 1997 flood event and document any post-processing of flood delineation that has occurred. Process additional scenes/photos to create a complete record of inundation and breakout events..

7. Real-Time Flow Gauging Needs

Accurate flow data is the foundation for all forecasting and modelling activities. Gauges to provide real-time discharge data, especially where looping effects make use of standard ratings impossible, such as at Grand Forks, are critical to improve flood forecasting/monitoring.

Implementation Strategy; Installation of two AFFRA-type units could be considered somewhat experimental and therefore a useful demonstration.

1) Grand Forks
2) Manitoba location

8. Stage-Damage Curves

Stage-damage curves allow estimates of damages for various classes of structures and levels of inundation to be made. Hence, the benefits of mitigation measures can be calculated and alternatives compared. At present the curves in use in the Red River valley are the 1983 ECOS curves based on the 1979 flood in Manitoba and the 1992 FEMA curves based on flooding throughout the USA. The 1997 flood damaged a significant number of structures in the valley. There is therefore an opportunity to create new basin specific curves, at least for residential properties.

Implementation Strategy:

1) Determine level of interest in emergency management agencies
2) Assemble damage particulars for 1997 to determine if a basin wide approach is feasible
3) Seek cost-sharing partners

TOOLS SUBGROUP

Improved management of the floodplain requires more coordinated and integrated decision-making, using models and other decision support tools. Agency and public interaction with the IJC and the International Red River Basin Task Force has clearly identified the need to improve flood forecasting in the Red River basin. This can be accomplished by improving the present hydrologic and hydraulic models for the basin. Other potential requirements for new models also exist; these would only be pursued if the Task Force determines that they are needed.

A word about nomenclature. In the context of this study plan, tools can be thought of as a suite of models, as in a decision support system; a means of presenting modeling results, as in a geographic information system; or a derived table of values or correlation. While models can be considered as numerical or physical, the Tools Subgroup has not considered developing physical models.

The work of the Tools Subgroup will depend on interaction with the Strategies Subgroup, particularly in identifying modeling needs as some of the models and other tools could be used in a planning tool by the Strategies Subgroup. The work of the Tools Subgroup will also require careful interaction with the Database Subgroup. Data assembled by that Subgroup will be required as input to new models. Also new data for modeling would be contributed to the database.

ANTICIPATED RESULTS

The projects defined in this section have different degrees of certainty and completeness. Depending on the final work plan, the Tools Subgroup may have to add additional members and increase cross-membership with other subgroups to ensure that all needs are met.

The principal activities of the Tools subgroup were identified during a November workshop aimed at examining hydrologic and hydraulic modeling needs and the related data requirements. Since that time other possible modeling or tools requirements have been identified.

In a very simplistic sense, priorities for the US portion of the basin are improvements to hydrologic models and for the Canadian portion are improvements to the hydraulic models. These priorities are tempered by the availability of funding in each country.

The purpose of this document is to summarize the Tools Plan of Study and to identify the means by which the plan would be implemented. An underlying strategy is to have the entire Tools Subgroup manage in Phase I some immediate tasks that would be funded largely with Canadian funds with the idea that complementary Phase II US projects could be added on later.

Models developed as part of this study can form an important legacy if they meet the needs of operational agencies. For that reason, every effort will be made to identify key user agencies, build in agency requirements, and to ensure models can be run in a pc-based environment.

STUDY COMPONENTS

1. Hydrologic Models

Although the current flood forecast models did a reasonably good job of forecasting flood volumes, it should be noted that the 1997 flood was relatively simple from a hydrologic perspective. A number of improvements are needed in the short term and over a longer time period. In addition there is a need to improve our understanding of hydrological processes in the basin through sub-basin scale studies. These studies would allow a better understanding of effects of land use change, drainage, cultivation practices, and the role of wetlands. Needs include:

Real Time Flood Forecasting

- Updated present forecast models to include 1996 and 1997 data and to enhance soil moisture components
- Improved infiltration-runoff relations
- Regionalized models to better handle distributed precipitation patterns
- Hydrometric and climate data for forecasting and model verification
- New models based on lumped and, perhaps, distributed inputs
- Improved algorithms and remotely sensed products to support forecasts

Sub-basin Studies

- Identify 'data-rich' sub-basins that are representative of the Red River valley
- Run distributed hydrologic models with a time series of alternate landscapes to determine effects of land use on water yield
- Identify methodologies for scaling studies up

Implementation Strategy: Complete preliminary work so that projects can be implemented as funding becomes available.

1. Continue agency modifications to existing models.
2. Identify locations for sub-basin scale modeling studies.
3. Initiate additional work as funding becomes available.

2. Hydraulic Models

The need for hydraulic models that could be used to route forecasted flood volumes in the Red River valley and, in particular, handle overland flow was identified early in the study. The purposes of such models fall into two categories: real-time flood forecasting, and planning and design. Identified needs are:

Real Time Flood Forecasting

- Determine flood levels and timing of peaks
- Determine hydrograph shape and inundation

- Account for overland flows
- Conduct backwater calculations at critical locations
- Incorporate infrastructure changes such as breaches and blow outs
- Carry out what if analyses

Planning and Design

- Post flood analyses for infrastructure evaluation and design
- Determine effects of flood operations
- Analyze structural and non-structural peak shaving proposals
- Conduct what if and sensitivity analyses
- Define data and monitoring requirements
- Evaluate the aerial extent and volume of the 1826 flood

As part of the modeling, a GIS post-processor would be developed so that results can be incorporated into future decision support systems.

The development of 'quick pass' one dimensional unsteady flow models from Emerson to the Floodway inlet by consultants for the Manitoba Water Commission and by Environment Canada for the Task Force has shown that many requirements can be met by such modeling. It is assumed that a fully developed model could be used to identify needs for two dimensional models. Wind effects, in particular, are a concern.

Currently the elevations of Manitoba highways, railways and a few municipal roads are known to a high degree of accuracy. Bridge openings and head losses in 1997 are also documented. The sizes of drains and culverts, while available, have not been entered into the models. The models have shown that there are problems with the existing digital elevation data in parts of the basin – this must be improved if detailed analyses of certain key locations are to be carried out. There is also a need to verify the bathymetry of the River at key locations. Obtaining the available Radarsat imagery for the flood would be very useful for model verification.

Implementation Strategy:

- Proceed with developing a detailed one dimensional model for the portion of the basin from Grand Forks to the Red River delta. The model would include a GIS post processor.
- Use consultant contract with clearly defined milestones

STRATEGIES SUBGROUP

Flood strategies will cover components of the emergency planning cycle such as preparedness, response, recovery, and flood damage reduction. The strategies will also address specific technical, environmental and social topics.

STUDY COMPONENTS

A number of issues have been identified by Commissioners, the Task Force and by the public. These are listed and described below. The listing remains to be further defined. A number of the issues relate to recommendations in the Interim Report and may need no further Task Force effort, other than to monitor the success of the governments in implementing them. In the further refinement of the plan of study, the list may be modified to ensure that the Task Force covers the issues of most concern to the public and of most importance to future flood preparedness.

1. Water Management

Water management issues were of much concern in the public consultations that have been held. The Plan of Study proposes looking at the issue through three types of studies: land use including wetland issues, water retention, and water management strategies. Work will be undertaken to seek answers to the following questions in order to define primarily in a physical sense what actions are realistic and possible.

1. How much water needs to be stored to reduce the flood crests at various locations in the valley to below design standards (100-year flood, 1997 flood, 1826 flood)?
2. Is there enough retention capacity within the critical parts of basin to achieve that objective, using storage dams, on-land waffle or micro storage and wetland expansion?
3. If there were enough capacity, what would be the cost?
4. Can potential and existing water retention sites be regulated to reduce the peak flows?
5. Can agricultural drainage practices reduce quick runoffs and high peak flows?
6. If there is not enough capacity to affect the floods of 1997 or larger, is there a case for using these water retention alternatives to reduce the peak of smaller floods?
7. What are the costs be for different volumes of retention? What would be the disbenefits and benefits, including compensating environmental and other benefits?
8. What are the effects of water retention on downstream interests during low flow or normal flow years?

The subgroup would review existing studies in the Red River basin and relevant literature, use existing models, and conduct their own investigations as required. The work would be done in consultation with the Data and Tools Subgroups. Studies would be conducted that document:

1. Current land use practices, especially agricultural drainage, and their effect on peak

flows, and the potential for slower drainage or temporary on-farm water storage to reduce peak flows. If there were sufficient potential, the study would determine the economic costs of altering the existing land-use practices.
2. Wetland expansion to evaluate the potential for flood peak reduction
3. Potential reservoir storage and the management of such storage along with on-farm micro and waffle storage to reduce flood peaks.
4. Previous, current and proposed projects, including location and size of impoundments.
5. The potential benefits and costs, including downstream consequences, of water retention strategies.

Implementation Strategy

1. Conduct studies wetlands for water retention possibilities.
2. Questions 1,2,4,5 to be answered through models developed by the Tools group. Based on the answers to these questions, the other questions will be addressed.
3. Update all existing data and costs on storage.

2. Floodplain Management

Floodplain management policies throughout the basin and how well they work need to be better understood. A study should be undertaken that explains the floodplain regulatory and management policies of agencies, such as Manitoba Natural Resources and FEMA, the incentives and disincentives for appropriate behaviour the policies promote, and how the floodplain management regime might be improved.

Tools Subgroup models could determine whether current regulatory standards are adequate – in Manitoba the 1997 flood plus 2 feet, in the US the 100-year floodplain. Issues include:

1. In Manitoba, is the approach to meeting the new 1997 plus two foot standard through the use of community and home dikes and pads creating potential flood problems?
2. In Manitoba, are there financial obstacles hindering or prohibiting residents from meeting the new standards?
3. Is there a case for removing more homes from high-risk areas?
4. In Minnesota and North Dakota, what are the factors that have reduced the acquisition of national flood insurance and what steps need to be taken to increase acquisition?
5. Does floodplain mapping need updating as the basis for enforcement or development of floodplain policies? (Mapping issue likely to be addressed by Data Subgroup.)
6. Can we develop stage-damage curves based on 1997 for use in project planning?

The outcome from the investigations would be:

1. Understanding the strengths and weaknesses of the basin's floodplain management.
2. Recommendations on how to strengthen the floodplain planning regime.

Implementation Strategy:

1. Describe the floodplain management structure within the various jurisdictions and areas of responsibility
2. Provide a critical review of the policies and programs.

Data Subgroup to deal with question 6 on stage-damage curves.

3. Pembina River Flooding

The negative transboundary impacts of certain dikes and drainage practices have been the subject of controversy in the lower Pembina basin. However, in the past there have been studies showing benefits from flood control to both sides. The economic considerations used in coming to a negative conclusion about the proposed projects are now dated. Before examining the specifics of dikes and drainage, the earlier proposals need to be revisited and examined in light of water demands from new crops, such as potatoes, and for domestic and industrial water supply. Other proposals for a boundary floodway may also need to be re-examined.

To help resolve the long standing border issue studies would be conducted to address issues, such as:

1. To what extent has diking and drainage on both sides of the border contributed to flooding in the lower Pembina River?
2. Is there a basis for revisiting previous proposals for resolving the issue?
3. Are there other alternatives that might be explored?
4. What are the positive and negative environmental and other impacts of the alternatives?

At a minimum the work could result in:

1. Agreement on the facts about the causes and responsibilities for local flooding.
2. Agreement on a process for resolution of the issue.
3. Recommendations on how the issue could be resolved.

Implementation Strategy:

1. Review old studies (Pemblier Dam, two dam proposal) and revise economic feasibility of the projects to account for changing demands for water for agriculture (irrigation of new crops such as potatoes), for industrial use and municipal water supply.
2. If feasible, review possible negative consequences, particularly environmental impacts.
3. Consult with the local organizations and groups.

Tools group to model diking and drainage in the lower basin.

4. Emergency Measures–Transboundary Cooperation

Transboundary emergency preparedness is important for cooperation and sense of unity in the basin. The press and public have no patience for failures in this area. Recommendation 13 of the Interim Report called for a regionally specific agreement for the Red River for transboundary emergency measures cooperation. Secretary of State Albright and Foreign Affairs Minister Axworthy requested the IJC to develop a framework for a flood emergency agreement for the Red River basin.

Emergency Preparedness Canada (EPC) and Federal Emergency Management Agency

(FEMA) have the authority to deal with transboundary emergency cooperation and will be the engines driving new arrangements.

The Strategies Subgroup will, with the cooperation of the relevant federal and state/provincial agencies, determine how transboundary flood emergency cooperation can be improved among the two federal governments, two states and the province and what new agreements or institutional arrangements are required in an international agreement? This work should lead to a Canada-US agreement on transboundary emergency cooperation for Red River flooding.

Implementation Strategy: Monitor discussions among federal state and provincial agencies. If required, based on discussions with local, state, provincial and federal emergency measures agencies, prepare a discussion paper on basin requirements for a transboundary emergency measures agreements.

5. Red River Forecasting Liaison Committee

Recommendation 15 of the Interim Report calls for a basin-wide flood forecasting committee patterned on the Souris River Flood Forecasting Liaison Committee. Secretary of State Albright and Foreign Minister Axworthy requested the IJC to define the way in which the proposed Red River flood forecasting committee would operate.

The Souris River Flood Forecasting Liaison Committee can serve as the model for the Red River. Information on how it works and any difficulties will be considered in recommending a structure for the Red River Forecasting Liaison Committee.

Implementation Strategy: Work with relevant agencies to provide recommendations on how such a committee should operate

6. Flood Design Standard

Political leaders must decide on the level of risk to be tolerated in the design standards for urban and rural areas. The Task Force can help provide the information to help inform the decisions, e.g. the likely repeat of the floods on scale of or larger than 1997 and the consequences of such floods.

A major issue on the Canadian side is the vulnerability of Winnipeg. There are a number of issues concerning the risks faced by the city, such as floodway capacity and operation, adequacy of primary and secondary dikes.

Should a greater degree of safety be built into standards adopted for areas where the risk of failure can have catastrophic consequences, particularly when there are records of even greater floods (1826) than experienced in 1997? Through risk analysis and exploration of long-term flood forecasting (note Geological Survey of Canada paleo-hydrology project

for the Red River to determine high flows), the subgroup will review the case for revising current flood design standards.

Regulatory standard issues are dealt with under issue #2, Floodplain Management.

Implementation Strategy:
1) Document design standard approaches in different jurisdictions within the basin and determine whether generic principles for looking at risk within the basin can be proposed.
2) Tools Subgroup to model floods of greater peak than 1997.
3) For Winnipeg conduct risk analysis for Winnipeg.

7. Lake Traverse Biota Transfer

Is there a hydraulic connection and that might permit the transfer of biota between the Red and Mississippi basins through Lake Traverse? The subgroup will undertake engineering studies to review the operation at Lake Traverse and Big Stone Lakes along with the role played by associated works. Following this review, recommendations will be made on what can be reasonably implemented to minimize or eliminate exchanges of water between the two basins during future flood events. The work envisioned would be on the possibility of a hydraulic connection. It would not address biota transfers, only whether conditions could exist in which biota transfer is possible.

Implementation Strategy: Consider the conditions under which there might be a hydraulic connection and the impacts (positive and negative) of acting to avoid such a connection.

8. Institutional Arrangements

One of the main objectives of the Task Force is to facilitate integrated flood management in the basin. This will require ongoing institutional arrangements.

The Strategies Subgroup will review the role of current and proposed organizations and evaluate the roles they might have in future integrated flood planning. The review will result in recommendations as to what institutional arrangements should be established to carry on basin-wide transboundary integrated flood planning and other water management issues.

Implementation Strategy: Prepare a discussion paper on institutional arrangements that would focus on concepts and parameters rather than on current or proposed institutional arrangements.

9. Water Quality – Lake Winnipeg

Flooding may result in downstream water quality problems. Work will be initiated to see whether Red River flooding causes such problems and whether they are serious. Investigations will determine what substances are the greatest risk and whether the source of the substances can be traced within the basin. Possible nutrient loading problems from floods will be explored. The outcome will be a determination of the concentration and distribution of hazardous substances as the result of Red River flooding and recommendations on how to deal hazardous substances that affect water quality.

Manitoba has a significant interest in the deposition of hazardous material in Lake Winnipeg because of the 1997 flood. Fishermen are concerned but they do not have sufficient information to know whether the fish stocks are threatened.

Implementation Strategy:

1. Department of Fisheries and Oceans to collect and analyze Lake Winnipeg samples.
2. The Red River Pollution Board to review the results.
3. Using the findings of the study, review the need to do work on spill response.
4. Based on the study, determine whether storage and use of hazardous material policy needs to be changed within the basin.

10. Groundwater

To what extent does flooding present a threat to water quality in aquifers? What measures can be taken to prevent contamination of aquifers? Are these measures adequate and sufficient? Studies may be undertaken to determine whether further recommendations are needed on measures to prevent groundwater contamination (as in recommendation 38 of the Interim Report on surveying and sealing wells). One product of the studies could be a best practices guide for abandonment and construction of wells.

The states and the province have policies and programs in place to deal with wells and contamination of groundwater.

Implementation Strategy: Monitor progress of states and the province in dealing with contaminated groundwater from flooding and determine whether additional studies needed in Phase II.

11. Environmental Design and Mitigation Phase II

How can water management projects be designed to increase habitat, support wildlife and provide other environmental benefits? Studies will be undertaken to determine the need and content for environmental design recommendations for floodplain and water retention projects.

Implementation Strategy: Prepare a compendium of best practices using Canada, American and international sources.

12. Recovery Assistance

Canada and the United States have different approaches to both individual and business disaster recovery. Are there lessons that can be learned from each other? More generally, should assistance be tied to other floodplain management objectives, such as floodproofing, insurance, or removal from areas at high risk? Residents in some areas of the floodplain feel they were flooded because of the operations of flood control works. If operations of certain works do lead to flooding for some, should there be different levels of assistance for those affected by flood operations?

The appropriate mechanics of recovery assistance and economic recovery assistance is a major undertaking that the Task Force may not be able to take on at this time. However, some assistance policy issues may be worthwhile to examine. What is the responsibility of the individual vs. the government in the disaster recovery process? Individuals and charities once provided all the assistance. Governments have come to provide a greater share, but the increasing number of disasters and cost are making governments reconsider their support. In recommending an equitable (to residents and citizens outside the basin) and effective floodplain management regime, disaster assistance is an important component. It can work to promote beneficial land use changes or help perpetuate an undesirable situation.

Implementation Strategy: Prepare a “think piece” on recovery assistance for flood prone areas of the Red River basin.

Anticipated Project Schedule

	Components	Phase I	Phase II
Data	1. Red River Basin Data Users — Needs Assessment	◆	
	2. Database Components — DEM	◆	◆
	3. Virtual Database for the Red River Basin	◆	
	4. Decision Support System — Prototype	◆	
	5. Red River Decision Support System — Phase II		◆
	6. Database Components — Inundation Maps		◆
	7. Real-time Flow Gauging Needs		◆
	8. Stage-Damage Curves	◆	
Tools	1. Hydrologic Models	◆	◆
	2. Hydraulic Models	◆	◆
Strategies	1. Water Management	◆	
	2. Floodplain Management	◆	
	3. Pembina River Flooding	◆	
	4. Emergency Measures — Transboundary Cooperation	◆	
	5. Red River Forecasting Liaison Committee	◆	
	6. Flood Design Standard	◆	
	7. Lake Traverse Biota Transfer	◆	
	8. Institutional Arrangements	◆	
	9. Water Quality — Lake Winnipeg	◆	
	10. Groundwater Contamination	◆	◆
	11. Environmental Design and Mitigation		◆
	12. Recovery Assistance	◆	