

Restoring the Health of Lake Winnipeg



CANADA'S SIXTH GREAT LAKE
A Report by the Lake Winnipeg Implementation Committee

Canada 

Manitoba 
Building for the Future

Table of Contents

Letter of Transmittal	3
Executive Summary	5
1. Introduction	9
2. Lake Winnipeg - Canada's Sixth Great Lake	11
Lake Winnipeg – A Post-Glacial Lake in Central Canada	11
The Lake Winnipeg Watershed	12
Thriving Tourism And Fisheries Industries	13
Downstream Uses of Lake Winnipeg Water	14
3. Lake Winnipeg - A Lake Under Stress	15
Extreme Eutrophication – A Sign of Poor Health	15
Blue Green Algae Known to Producers of Toxins	16
Human Activity is the Cause Eutrophication	16
Phosphorus Causes Eutrophication	17
Excess Nitrogen -a Toxic Substance that Needs to be Controlled	18
Non-Point Sources of Nitrogen and Phosphorus	19
Point Sources of Nutrients to Lake Winnipeg	19
Lake Level Regulation Promotes Accumulation of Nutrients in the Sediments	20
Quantifying Sources and Loadings of Phosphorus to Lake Winnipeg	20
Other Threats to the Health of Lake Winnipeg	21
Persistent Organic Pollutants	21
Pharmaceuticals and Personal Care Products	21
Exotic Species - Biological Contamination	21
Endangered or Threatened Species	22
Water from Devils Lake, North Dakota, Poses Uncertain Risk	22
World-class Wetlands on Lake Winnipeg	23
Global Climate Change	23
4. Our Scientific Understanding of the Lake Today	25
The Lake Winnipeg Science Workshop	26
The Great Lakes Experience as a Model for Lake Winnipeg	27

5.	What Others are Thinking	29
6.	Conclusions	33
7.	Recommendations	37
	Acknowledgements	41
	Glossary	42
	List of Appendices	43
	Appendix 1 - Draft Federal – Provincial Agreement	43
	Appendix 2 - A Funding Formula	49
	Appendix 3 - Draft Healthy Lake Winnipeg Charter	51

November 2005

The Honourable Reg Alcock
President of the Treasury Board
Government of Canada
House of Commons
Ottawa

The Honourable Steve Ashton
Minister of Water Stewardship
Province of Manitoba
Legislative Building
Winnipeg

Dear Ministers:

We are pleased to present you with the report of the Lake Winnipeg Implementation Committee prepared at your request.

We began with the premise that much good work had already been done both inside and outside government to highlight the issues concerning Lake Winnipeg and to recommend specific work that needs to be done. Rather than repeating the efforts of others, we have focused on how to do it, particularly with respect to the future co-operative efforts of the governments of Canada and Manitoba.

We have both good and bad news for you. The bad news, you have already heard from others: Lake Winnipeg is in trouble. The good news is that your governments are committed to doing something about it. The Manitoba public is fully behind you and sees Lake Winnipeg as a public treasure that needs to be restored and preserved. In addition, the prognosis for recovery seems to be considerably better than for the eastern Great Lakes because deterioration is less advanced and chemical pollution is less significant in the Lake Winnipeg basin. This is, of course, no cause for complacency.

You have a rare opportunity to set in place the means to restore Lake Winnipeg to full health and keep it healthy for our children and their children. We hope that our report and its recommendations will provide you with some useful ideas about how to begin the process.

We think that our report and its technical annex will be a useful reference work, bringing under one cover a substantial body of material otherwise spread across a number of different sources. We trust that our work will be valuable as your governments proceed together to address the challenges and opportunities we have identified.

Sincerely,



Terry Duguid
Co-Chair

Norm Brandson
Co-Chair

Executive Summary

Lake Winnipeg is at a critical point in its history. It has been compared to the highly-stressed Lake Erie in the 1960s before concerted action was taken to improve it. Slightly larger than Lake Erie, Lake Winnipeg covers 24,500 square kilometers and is the 10th largest freshwater lake in the world. It is comprised of a larger North Basin and smaller South Basin. The lake is located in North America's second largest drainage basin, the Nelson River Basin, that drains into Hudson Bay.

Water flowing into and through Lake Winnipeg serves over an estimated six million people, passes through 55 million hectares of agricultural land and supports 17 million livestock. Over 23,000 Manitobans live along the shores of Lake Winnipeg and take advantage of its recreational opportunities. This includes, about 10,000 cottages, parks and beaches, and commercial and sport fisheries. Recreation and tourism expenditures along the Red River and around the lake generate an estimated \$100 million per year. Lake Winnipeg supports the largest freshwater commercial fishery in Western Canada estimated to return more than \$20 million per year. Eighty per cent of the fishers are First Nations or Metis. The lake also provides important subsistence harvest to Aboriginal communities. Manitoba Hydro generates between \$350 and \$580 million per year in total hydroelectric export sales from generating plants on the Nelson River.

Visible in satellite photos, the over-fertilization or eutrophication of Lake Winnipeg is capturing widespread media and public attention recently. In late August 2005, thick mats of blue-green algae, covered an estimated 50 per cent of the surface area of the lake, or about 13,000 square kilometers. This occurs primarily in the North Basin, a situation that appears to be worsening. The algae clog the nets of fishers on the lake and discourage water-based recreational activities. Even more importantly, the algae are known to produce toxins of several types, including rapid-acting neurotoxins and liver-seeking hepatotoxins that can accumulate over the long-term in human and aquatic species. The presence of various forms of these toxins in the lake are poorly documented and the risks to residents on Lake Winnipeg and the Nelson River are unknown.

Compared with other great lakes in the world, particularly the eastern Great Lakes, Lake Winnipeg has received surprisingly little scientific attention until the past decade. This partly explains why the signs of eutrophication were not detected earlier. Scientists attribute the dramatic response of Lake Winnipeg to a co-occurrence of several factors.

- excess loading of plant nutrients from the watershed
- the uncommonly shallow depth of Lake Winnipeg for its size making it especially prone to eutrophication
- the damming of the Saskatchewan River from the west causing the North Basin of the lake to receive less suspended sediments, resulting in more light penetration into surface waters



- the holding back of water rich with nutrients and algal populations during the summer growing season by lake level regulation for hydroelectric generation downstream.
- the amounts of nitrogen and phosphorus reaching Lake Winnipeg are not in the ratios required by the usual algal community.
- insufficient nitrogen for the amount of phosphorus present, a condition that favours the toxin-producing, filamentous blue-green algae that are able to obtain the nitrogen they need from the atmosphere

Although reversing eutrophication by reducing the amount of phosphorus reaching Lake Winnipeg is the immediate priority, several other human impacts are poorly understood and also require attention. A group of chemicals, including pharmaceuticals and personal care products, such as fragrances and disinfectants, collectively known as PPCPs, contain substances that are endocrine disruptors. These substances are released primarily in wastewater effluents. Overall, little is known about the impacts of PPCPs on aquatic ecosystems and communities that use waterways in the Lake Winnipeg sub-basin for drinking and domestic water.

Lake Winnipeg is known to contain at least eight species of non-indigenous fish, including the rainbow smelt established since 1991. Rainbow smelt was introduced to several lakes in the upper portion of the Winnipeg River watershed in northwestern Ontario. After making its way into Lake Winnipeg it has become a dominant fish in the lake. Little is known about the actual or potential impact of rainbow smelt on the important commercial fishery of Lake Winnipeg. The possibility of biotic transfer from the cyclically flooded Devils Lake in North Dakota into the Red River system is also a subject requiring more study.

Some impacts on the lake are less serious than in previous decades. For example, persistent organic pollutants are detectable in fish from Lake Winnipeg, although the concentrations are not considered to be harmful to the fish or human consumers. No species extinctions have been reported although one species

of snail indigenous to Lake Winnipeg is designated as endangered.

Across the world, climate change is an overarching concern for freshwater ecosystems and the water they supply. Lake Winnipeg is no exception. Climate change is decreasing the inflow of water to Lake Winnipeg from the water-poor western prairie provinces while resulting in more frequent extreme weather events in the Red River watershed. These include floods that bring increased loads of nutrients and hazardous substances into Lake Winnipeg.

Although Lake Winnipeg is heavily eutrophied, and at risk from a range of human impacts, many believe it can be returned to a healthy state and are committed to making it happen. A large number of official and non-governmental organizations have expressed concern for the lake and offered perspectives and advice. Manitoba Water Stewardship announced the Lake Winnipeg Action Plan in 2003 to reduce nutrient loadings to Lake Winnipeg, and simultaneously established the Lake Winnipeg Stewardship Board to identify actions to reduce nitrogen and phosphorus by 13 per cent or more to pre-1970 levels in the lake. The Lake Winnipeg Science Workshop held in 2004 identified a number of scientific questions requiring study and developed co-ordinated research proposals. The scientific and academic community, working with industry and community stakeholders, created the innovative Lake Winnipeg Research Consortium in 1998. With the acquisition of the research vessel, the MV Namao, the consortium is currently working hard to fill the large gaps in basic knowledge of the Lake Winnipeg ecosystem.

Building on this momentum, on our understanding of the natural, social and economic value of Lake Winnipeg to everyone in the basin, and on the input from the Lake Winnipeg Implementation Committee's Advisory Committee and others, we have reached several conclusions:

Lake Winnipeg is in trouble and there is insufficient scientific knowledge about the lake and its drainage basin to fully deal with the problem. The citizens of Manitoba want action. The federal and provincial gov-

ernments and a number of other groups have initiated some action but their efforts are poorly co-ordinated and resourced. A similar degree of attention to that now focused on the five eastern Great Lakes needs to be applied to the sixth Great Lake – Lake Winnipeg. First Nations and Metis people need to be brought more fully into the dialogue and action on the lake.

There is no shortage of good ideas about what needs to be done, both to fill in the science gaps and to initiate actions to begin restoring the lake to a healthy state. Nonetheless, the local science capacity in terms of human, financial and physical resources needs to be bolstered; priorities need to be set involving a broad range of interests, not just by governments; and several key issues need to be addressed on an urgent basis. New and re-profiled government funding, as well as private sector resources, will be needed to meet the challenges ahead. Whatever actions are taken, all institutions involved must be fully accountable to the public through tracking and reporting on their progress.

And finally, public education and engagement will be needed to bring a basin-wide commitment to the lake, and to prepare citizens for tough personal and institutional choices that will have to be made for the recovery of Lake Winnipeg.

Our conclusions have led to 22 recommendations for action by the governments of Manitoba and Canada:

MANITOBA/CANADA CO-OPERATION

1. The two governments embody their future co-operation on Lake Winnipeg in a formal 5-year Federal/Provincial agreement signed by the Prime Minister and the premier.
2. The agreement provides for total funding of \$40 million over five years sourced 2/3 by Canada and 1/3 by Manitoba.
3. The agreement contains the means of integrating input from the full range of interests, particularly those embodied in the Healthy Lake Winnipeg Charter Council.

SCIENCE

4. The two governments act expeditiously to reach a scientific consensus on the historic loading of phosphorus and nitrogen to Lake Winnipeg and a science-based target and time table for the reduction of nutrient inflows to the lake.
5. The two governments acknowledge, notwithstanding that phosphorus is the controlling nutrient in the lake, the importance of controlling human-induced nitrogen sources to achieve important water quality objectives in the basin that may not directly impact Lake Winnipeg.
6. The two governments act expeditiously to address the question of possible human health implications of algal toxins in Lake Winnipeg.
7. Chemical pollution and climate change receive attention as emerging issues for Lake Winnipeg.
8. The two governments actively seek the input of all interests, particularly utilizing the Healthy Lake Winnipeg Charter Council, in setting priorities for their programming.
9. An annual “balance point” be determined between lake- and land-based monitoring and research to ensure that adequate attention is paid to causal actions on the landscape. This balance point should be expressed in dollars and initially should start at approximately 60 per cent for the lake and 40 per cent for the land, given the more mature state of the water-based science planning.





If the Millenium Assessment tells us one thing, it's that it is not enough to talk about change, or to bicker incessantly about the tools needed. In many cases, we've already created the tools. Now we must use them.

David Suzuki, 8 April 2005 about the Millenium Ecosystem Assessment

10. The Lake Winnipeg Research Consortium be provided with an endowment from Fisheries and Oceans Canada to ensure the on-going maintenance and operation of the MV Namao as a major research platform on Lake Winnipeg. It is suggested that this endowment be capable of generating approximately \$0.6 million annually.
11. Address the backlog of historic scientific samples from Lake Winnipeg, and prepare a detailed "State of the Science" report as urgent priorities under the federal/provincial agreement.
12. The Federal Department of Fisheries and Oceans should identify Lake Winnipeg as a "flagship" issue for the Freshwater Institute, and adopt the goal of substantially increasing the human and financial resources of the Freshwater Institute to provide the freshwater science capacity required to meet the challenge.
13. A formal link be established between the Healthy Lake Winnipeg Charter Council and the Great Lakes Science Council to ensure that maximum use is made of the extensive knowledge accumulated under the Great Lakes Water Quality Agreement.
14. The two governments recognize and promote the value of watershed planning on both a macro- and micro-scale, and institute mechanisms to build capacity within watersheds to effect planning in both scales.
15. Recognizing the use of Lake Winnipeg as a reservoir to facilitate power generation, Manitoba Hydro should be a positive contributor to the initiative, providing \$1 million per year for research related to the restoration of the health of the lake.
16. The two governments establish an institution under the auspices of the Healthy Lake Winnipeg Charter Council, and fund its start up, with a mandate to attract private funding to engage in public education and information dissemination, research and capacity building related to the lake and its basin.
17. An Annual State of the Basin Summit sponsored by the Healthy Lake Winnipeg Charter Council should be supported as a major public accountability event, integral to engaging the general public in the basin in the issues.
18. The governments aggressively promote watershed planning both to the general public and to individuals, organizations and institutions in the basin involved in land and water management as the foundation of all efforts to restore Lake Winnipeg; and empower participation through capacity building.
19. The governments commit to a Healthy Lake Winnipeg Charter to provide to the charter signatories, advice, recommendations and leadership in the co-ordination of research, educational programs and basin management activities, towards the restoration and continuing health of Lake Winnipeg.
20. The signatories to the Charter form the Healthy Lake Winnipeg Charter Council and agree to fulfill the charter responsibilities, including, among other things, commitment to over-all goals, development of, and commitment to, broad annual priorities, public accountability and reporting at an annual State of the Basin Summit.
21. The two governments request the involvement of the International Joint Commission in an independent audit capacity in the future accountability process established under the charter.
22. The governments initiate discussion at the Prairie Provinces Water Board with the International Joint Commission and the Province of Ontario concerning the early formal inclusion of all jurisdictions in the effort to restore and maintain a healthy Lake Winnipeg.

EDUCATION AND ENGAGEMENT

16. The two governments establish an institution under the auspices of the Healthy Lake Winnipeg Charter Council, and fund its start up, with a mandate to attract private funding to engage in

INTEGRATION

19. The governments commit to a Healthy Lake Winnipeg Charter to provide to the charter signatories, advice, recommendations and leadership in the co-ordination of research, educational programs and basin management activities, towards the restoration and continuing health of Lake Winnipeg.
20. The signatories to the Charter form the Healthy Lake Winnipeg Charter Council and agree to fulfill the charter responsibilities, including, among other things, commitment to over-all goals, development of, and commitment to, broad annual priorities, public accountability and reporting at an annual State of the Basin Summit.
21. The two governments request the involvement of the International Joint Commission in an independent audit capacity in the future accountability process established under the charter.
22. The governments initiate discussion at the Prairie Provinces Water Board with the International Joint Commission and the Province of Ontario concerning the early formal inclusion of all jurisdictions in the effort to restore and maintain a healthy Lake Winnipeg.

Introduction

1.

A healthy ecosystem is one that is stable and sustains itself through time while meeting social and economic needs of the people who are an integral part of the system.

The importance of Lake Winnipeg has been evident for centuries to the peoples who lived around it and relied on its resources. The lake has been a unique natural phenomenon that has shaped the lives of Manitobans, Aboriginals and immigrants alike.

The recent spate of books about Lake Winnipeg has reflected the strong attachment and lure that has been evident for generations. In her book *Mistehay Sakahegan: The Great Lake*, the writer Frances Russell described it as the hub of North America's heartland and a lake of beauty and treachery. Other authors have echoed the view of Lake Winnipeg in terms of the ecological treasure it represents. More than a body of water, Lake Winnipeg has come to have a remarkable significance in defining the cultural and economic life of an entire region of the continent.

Not surprisingly, it was always assumed that Lake Winnipeg would continue to be a testament to permanence in the midst of a world of change. The reality, however, is that the lake has been undergoing a significant transformation, mainly in the form of deterioration of its environmental condition with increasing risk to its economic and health status.

Public awareness of the situation has been heightened by high level of news media attention to Lake Winnipeg during the past year, and the newspaper and television coverage of the problems that appear in various ways to be escalating.

Concern for the state of the lake and its future has prompted community groups,

governments and other organizations to search for greater understanding of the causes of Lake Winnipeg's problems and to propose solutions. Several challenges have emerged, related to a range of topics including water quality, public health, land use practices and nutrient loading, with potential impacts on fisheries, tourism and economic development.

In recent years, the Government of Canada and Province of Manitoba, as well as local governments and agencies, have sought solutions to the problems identified in scientific research, advisory reports, consultant studies and public hearings. There has been no shortage of advice, some of it conflicting or inconsistent, from organizations and individuals who have proposed a wide variety of measures to restore and protect Lake Winnipeg.



What has been missing is a way to establish a coherent plan that draws together the governments and their agencies, along with all interested stakeholders, to determine the priorities for action, assemble the resources and proceed together. Also missing have been the financial resources to make this happen.

In May 2005, the Government of Canada and Province of Manitoba formed the Lake Winnipeg Federal/Provincial Implementation Committee with a mandate to:

...co-ordinate a Canada/Manitoba framework agreement on scientific research and basin-wide action plan to improve Lake Winnipeg water quality. This agreement will identify joint priorities and funding sources; it will also clarify respective roles and responsibilities for implementation of the plan.

This initiative was meant to build on the valuable work already done by organizations such as the Lake Winnipeg Stewardship Board and the Lake Winnipeg Research Consortium, rather than duplicate it in any way.

In announcing the formation of the Committee on behalf of their governments, the Honourable Reg Alcock and Honourable Steve Ashton emphasized the importance of collaboration to deal effectively with the health and sustainability of Lake Winnipeg.

The ministers jointly appointed Terry Duguid and Norm Brandson as co-chairs of the Lake Winnipeg Federal/Provincial Implementation Committee. Mr Duguid is president & CEO of the International Centre for Infectious Diseases and a former Chair of the Manitoba Clean Environment Commission. Mr. Brandson is a former deputy minister of the Manitoba Departments of Environment, Conservation and Water

Stewardship. They were given a short timeframe of four months to produce their report. Both served on a volunteer basis.

The Red River Basin Commission acted as proponent and administrator for the project. Funding for the committee's work was provided jointly by Western Economic Diversification, Indian and Northern Affairs and Province of Manitoba. This enabled the considerable research work, information collection and analysis of the extensive list of options and alternative solutions. The co-chairs met with several key stakeholders throughout the course of their work and were guided by the input provided by government experts and an advisory committee of knowledgeable and committed individuals.

This report presents a summary of the discussion that is particularly relevant to the primary issues identified by the co-chairs. A more extensive description of the issues addressed in this report, along with detailed data and sources of the information, is contained in a separate Technical Annex. That background document is available upon request and on-line at >>>>>>

The recommendations contained in this report are meant to be practical measures that constitute a framework for action and co-operation for Lake Winnipeg and can be implemented immediately.

Appendix 1 of this report is a proposed agreement that suggests specifically how the Government of Canada and Province of Manitoba could work together on an on-going basis. Appendix 3 is a draft of the Healthy Lake Winnipeg Basin Council Charter that is proposed to serve as a basis for the stakeholders to work together and co-ordinate their activities.



2.

Lake Winnipeg - Canada's Sixth Great Lake

A healthy ecosystem is one that is stable and sustains itself through time while meeting social and economic needs of the people who are an integral part of the system.

Lake Winnipeg is one of the world's great freshwater lakes located in the heart of the North American continent at the geographic centre of Canada. In surface area, it is the tenth largest freshwater lake in the world, covering 23,750 square kilometers, more than Lake Erie.

The lake drains a huge sub-basin, that is nearly 40 times the size of the lake and includes portions of four Canadian provinces and four US states. The sub-basin reaches west to the edge of the Rocky Mountains in Alberta, east almost as far as Lake Superior in northern Ontario, and south to the headwaters of the Red River in South Dakota.



LAKE WINNIPEG – A POST-GLACIAL LAKE IN CENTRAL CANADA

A comprehensive analysis of Lake Winnipeg requires an understanding of the many sources of its water supply, the dynamics of the lake's complex ecosystems, and the nature of the downstream uses of the outflows from the lake.

Lake Winnipeg has often been perceived as a northern lake, presumed to be remote and environmentally undisturbed. In fact, the lake is located just north of Winnipeg, a metropolitan area with a population of more than 650,000, and its watershed includes the heavily populated southern portions of the prairie provinces.

The lake receives most of its water from three major river systems, smaller rivers, streams and from precipitation:

Winnipeg River (Northwestern Ontario)	39.6%
Saskatchewan River (southern Alberta and Saskatchewan)	22.1%
Red River (Manitoba, North Dakota and northern Minnesota)	8.2%
Rain and snowfall	12.1%
Smaller rivers, Fisher, Manigotogan, Poplar, Dauphin, Berens and Pigeon	9.6%
Streams	8.4%

Lake Winnipeg was formed as a result of repeated glaciation and the scraping away of relatively soft Paleozoic sediments along the margin of the Canadian Shield. The lake is flanked by granitic Precambrian rocks on its eastern and northern shores, and softer Paleozoic carbonate rocks to the west and south. The water chemistry of the lake reflects the major differences in the geology, soils, vegetation and human activities found within each of the three watershed areas drained by the Winnipeg, Saskatchewan and Red Rivers.

Riparian stewardship – Many Small Projects, One Large Result

Riparian areas are the lands adjacent to waterways. That makes them important in the health of rivers, streams and lakes. Because the quality of the water is determined, to a large degree, by what we do on the land, riparian areas can act as either buffer areas to protect water quality and fish habitat, or pathways for contamination. They can be well vegetated for stability, or bare and prone to slumping. It is important to use riparian areas wisely. The Manitoba Habitat Heritage Corporation has for many years cost-shared riparian restoration and protection with Conservation Districts and individual farmers. New organizations such as the Manitoba Riparian Health Council are springing up to encourage and co-ordinate good stewardship of riparian areas, largely, though not exclusively on-farm. The Manitoba Conservation Districts Program also actively sponsors and promotes riparian health in the member districts. The quality of our rivers and streams, and ultimately that of Lake Winnipeg can only be improved by the activities of these organizations, illustrating the kind of grass roots effort that must be mobilized on a wide scale if we are to be successful in restoring lake Winnipeg.

Oriented along a north-south axis, Lake Winnipeg is over 400 kilometers long and has a shoreline of more than 1,700 kilometers. The lake is divided into two large basins by The Narrows, a very narrow channel only half a kilometer wide. The larger north basin is 100 kilometers wide, while the smaller south basin is 40 kilometers wide at its widest part. Lake Winnipeg is a relatively shallow lake, with average depth of about 12 meters. Strong winds on the lake can drive water from one basin into the other, and cause water levels to rise an average of one-to-two meters.

Water flows out of the north end of Lake Winnipeg into the powerful Nelson River system, finding its way eventually to Hudson Bay and the Arctic Ocean. Since 1976, Manitoba Hydro has regulated the water levels and outflows of Lake Winnipeg, using the lake as a hydroelectric power generation reservoir to optimize the output of all the power stations built downstream on the Nelson River. In terms of surface area, Lake Winnipeg is the third largest hydroelectric reservoir in the world.

THE LAKE WINNIPEG WATERSHED

Lake Winnipeg's watershed contains six million people, 80 per cent residing in major urban centers, the source of substantial volumes of domestic and industrial effluents. Approximately 50 per cent of the Canadian portion of the Lake Winnipeg watershed is agricultural land, 40 per cent is mixed forest, both coniferous and deciduous, and 10 per cent is wetlands.

The watershed area includes 55 million hectares of farmland in the three prairie provinces and another 10 million hectares in the American portion of the Red River valley. More than half of this farmland is under crop production. In fact, the Lake Winnipeg watershed contains most of the agricultural land on the Canadian prairies and a very large component of all agricultural land in Canada. A total of 17 million livestock live in the Lake Winnipeg sub-basin.

Wetlands cover approximately 40 per cent of Manitoba. The peatlands concentrated in Manitoba's boreal forest regions compose approximately 90 per cent of all wetlands in the province and support habitats for many species of waterfowl and other wildlife.

Manitoba is home to two of the largest river delta marshes in North America, Delta Marsh at the south end of Lake Manitoba and the Netley-Libau Marsh, located along the south and eastern shores of the South Basin of Lake Winnipeg. Marshes slow the speed at which water moves off the land, and they may also remove nutrients from runoff water, helping to maintain the health of downstream habitats.

Climate varies significantly over the length of Lake Winnipeg. Climatic zones range from the low boreal eco-climate region in the south, to mid-boreal, and finally to the high boreal eco-climate on the most north-eastern tip of the lake. Depending on location, about one-quarter to one-third of the total precipitation in the Lake Winnipeg watershed falls as snow.

Because Lake Winnipeg's ecosystem has a large climate gradient and three major river systems draining into

it, each contributing its own species, the lake exhibits significant biodiversity in algae, zooplankton, fish, bottom-dwelling invertebrates and waterfowl.

THRIVING TOURISM AND FISHERIES INDUSTRIES

Recreation and tourism expenditures in the area along the Red River and surrounding the lake generate an estimated \$100 million per year. The lake's beaches and associated parks, with camping and other facilities, have long been popular recreational destinations for Winnipeggers and visitors from elsewhere in Canada and other countries. Eight provincial parks are located along the South Basin, with camping being a popular activity at these locations. In 2002, almost half a million people visited the beaches in two of the largest provincial parks, Grand Beach and Winnipeg Beach on the south shores. In that same year, almost twenty thousand overnight campers were registered at the largest campground.

Boating is a popular activity on the lake. Fifteen harbours provide berthing facilities for recreational and commercial boats. The largest harbour, Gimli, has berths for over 220 recreational boaters. Gimli is also home port for one of the largest fishing fleets on the lake, as well as for the Lake Winnipeg Research Consortium's MV Namao. Recreational fishing on the Red and Winnipeg rivers is a highly valued industry, estimated at \$17 million of direct expenditures annually.

More than 23,000 permanent residents live in 30 communities along the shores of Lake Winnipeg. These include 11 First Nations communities. The desirability of lakeshore living has resulted in rapid growth of the more "urban" communities such as Gimli and Winnipeg Beach. Currently it is estimated that there are over ten thousand cottages/residences along the southern edge of the lake, and increasingly these residences are being used year-round.

The Municipality of Gimli has a permanent population base of about 5,000. Its taxable assessment base of \$180 million makes it one of the highest per capita assessment areas in Manitoba, mostly relating to permanent and cottage subdivisions, resort development and industry. Winnipeg Beach has a total taxable assessment of \$27 million, almost all of which is lake-related.

Lake Winnipeg supports the largest freshwater commercial fishery in western Canada

The fishery on Lake Winnipeg is the largest freshwater commercial fishery in Canada west of the Great Lakes, with average annual returns of \$20 million from 1998 to 2003. Moreover, the lake has the largest commercial walleye fishery in the world. The lake supports the livelihoods of one thousand commercial fishers, 80 per cent of whom are First Nations or Metis. From 1998 to 2003, almost thirty million kilograms of fish were harvested, representing about 60 per cent of the total production from all Manitoba freshwater commercial fisheries for that period.

In addition to the licensed fishers themselves, the fishery provides a major source of income for those who work as packers, shippers, and processors, and who generally reside in the shoreline communities. Subsistence fishing also plays a central role in the traditional cultural life of the First Nations communities along the shores of the lake, serving as a main source of income and food for many families.



DOWNSTREAM USES OF LAKE WINNIPEG WATER

Manitoba Hydro generates between \$350 million and \$580 million per year in total export sales, assisted in part by Hydro's ability to regulate water levels and outflows from Lake Winnipeg to achieve optimum power generation in the hydroelectric generation stations on the Nelson River further downstream. Regulation decreases outflow in spring and early summer to make more water available in fall and winter. Regulation affects the range and timing of fluctuations in water levels of the lake itself, as well as the amount of sedimentation that takes place.

Both the quality and quantity of water flowing out of Lake Winnipeg affect the downstream communities located on the Nelson River that use the water for drinking and indigenous fisheries.



Managing the Watershed – A Basin of Basins

The principle that water must be managed on a watershed basis is universally embraced. In the case of the Lake Winnipeg drainage basin or watershed, because of its enormous size (almost 1,000,000 square km) this represents a huge challenge. The task may appear to be, and actually prove to be, doable by thinking of the entire basin as an aggregate of several smaller yet still significant basins. Each of these basins is already at some stage of organized planning and activity to manage water within its boundaries. The Red River Basin has a number of institutions involved in water management the foremost being the International Joint Commission (IJC). The commission has recognized the need for a more integrated approach than has been the case in the past and efforts are well underway to bring a broader array of interests to the table in dealing with trans-boundary water issues including water quality in Lake Winnipeg. The portion of the Lake Winnipeg basin located in the provinces of Manitoba, Saskatchewan and Alberta is subject to the Prairie Provinces Water Board Agreement controlling apportionment of flow and administering water quality objectives at provincial boundaries. The Lake of the Woods/Rainy River portion of the basin (that in turn flows into the Winnipeg River and Lake Winnipeg) falls under another IJC mandate. The province of Manitoba has established a planning board for the Assiniboine River basin and although its mandate has lapsed, a planning process was initiated. The South Saskatchewan River basin is in the early stages of institutionalizing a basin-wide planning and management process. Managing each of the component parts according to common principles and standards can add up to a successful outcome for Lake Winnipeg.

A Lake Under Stress

3.

Lake Winnipeg has received remarkably little scientific study largely because of the perception that it is remote and generally unaffected by development.

There has been a lack of long-term continuous monitoring and scientific programs on the lake that would have flagged the water quality problems earlier.

EXTREME EUTROPHICATION – A SIGN OF POOR HEALTH

The recent appearance of highly visible mats of blue-green algae, particularly in the remote and relatively unpopulated North Basin of Lake Winnipeg, has been most responsible for bringing national attention to the deteriorating health of the lake. These mats or blooms of blue-green algae are highly visible signs of eutrophication of the lake, caused by excess amounts of nutrients entering the aquatic ecosystem.

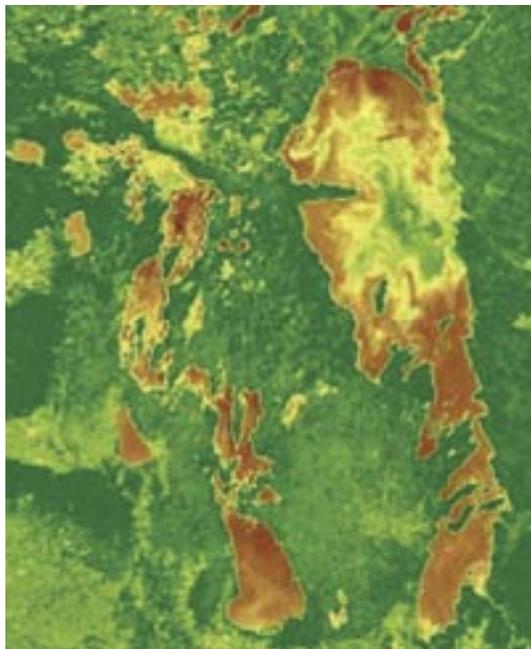
Satellite photos over the past decade show a marked trend towards increasing blooms of blue-green algae. In 2003, it was estimated that algal blooms covered close to 8,000 square kilometers of the surface of Lake Winnipeg. Recently, on 29 August 2005, the bloom covered about 13,000 square kilometers.

Eutrophication is defined as the complex sequence of changes initiated by the enrichment of natural waters with plant nutrients from external sources.

Ecological impacts of eutrophication can be serious, including:

- changes to the quality of the lake water
- changes in the numbers and types of organisms in the lake, including blooms of algae
- reduction in dissolved oxygen as the large populations of algae decompose and consume the available oxygen, leading to fish kills and declines in other species

- under some circumstances, the release of toxins, some of which are known to be harmful to human health and to aquatic organisms



Satellite photo of Lake Winnipeg, taken on September 26 2001, shows large green areas of chlorophyll in the North Basin.

Studies in 2003, during a period of mid-summer oxygen depletion in the bottom waters of Lake Winnipeg, revealed a moderate to severe reduction in the numbers of worms, fingernail clams, snails, clam shrimps and amphipods. Some, but not all, of the populations recovered in better conditions in 2004. The regions of the lake with low oxygen also had higher than normal levels of carbon dioxide and ammonia. In 2005, populations of the important commercial species, whitefish, had moved from their normal lake bottom

habitat to presumably better oxygenated conditions mid-water locations, becoming more difficult to catch in the process.

Some of the Blue Green Algae in Lake Winnipeg are Known to Produce Toxins

Some of the blue green algae in Lake Winnipeg are known to produce toxins that may have serious implications for the health of people using the lake and for lake ecosystems.

One of the toxins of concern is Microcystin-LR, that can cause headaches, stomach and muscle cramps, vomiting, diarrhea and skin irritations. Such toxins have also been identified as promoters of liver cancer. Conventional water treatment processes do not completely remove these toxins from raw water. Microcystin-LR is the only algal toxin routinely measured in Manitoba's waters, but it is only one of a number that may be present.

Anatoxins are the other main group of toxins produced by blue green algae. They are responsible for rapid on-set symptoms and, on occasion, death. Studies are underway to determine if these are present in Lake Winnipeg. Recent initial studies on Lake Winnipeg fish,

zooplankton and water indicate the presence of low levels of both microcystins and anatoxins.

Algal toxins could also be of significant concern to those using Lake Winnipeg water for drinking and domestic purposes, whether in the lakeside communities or downstream on the Nelson River.

In addition, algal blooms can clog fish nets and interfere with fishing efforts and foul beaches for tourists and lakeside residents.

Human Activity is the Cause of Eutrophication

Eutrophication is usually attributed to the increase in the human population of the watershed, a lack of tertiary sewage treatment, intensive cropping and increased use of fertilizers and increased cattle and hog production. All of these activities increase the loads of nutrient-rich wastes discharged in the watershed. Floods are another factor. The 1997 Red River flood resulted in the largest known transport of nutrients to the South Basin in a single event. Concentrations of nutrients in the South Basin in 1998 were the highest on record.

Scientists attribute the dramatic evidence of eutrophication of the North Basin of Lake Winnipeg to the interaction of three factors, all caused by human activities:

- excessive quantities of phosphorus entering Lake Winnipeg from its watershed
- regulation of the lake as a hydroelectric power generation reservoir leading to the hold-back of water during the productive spring and summer season
- damming of the Saskatchewan River upstream of the North Basin, causing its sediment load to be deposited before reaching Lake Winnipeg, resulting in more transparent water and increased light for algal growth.



Phosphorus Causes Eutrophication

Nutrients are essential elements required for all plant and animal life. They include oxygen, carbon, nitrogen, phosphorus, sulfur, magnesium and calcium, among others. Scientific experiments were carried out on a small lake in northwestern Ontario to determine the roles carbon, nitrogen and phosphorus in eutrophication. Divided into two by a curtain, the lower basin received additions of carbon, nitrogen and phosphorus while the upper basin received carbon and nitrogen only. The bright green water shown below is algae surface scum as a result of the phosphorus additions.



Phosphorus is the nutrient that determines the amount of algal growth because its supply in nature is limited. Prior to the mining of fertilizers, the primary source of phosphorus for aquatic and land plants was the weathering of phosphorite rocks and the phosphorus that cycled through biological processes. Nutrients are supplied by nature in approximately the proportions needed for plant growth, i.e., about 15 parts of N to 1 part of phosphorus. If the ratio of nitrogen and phosphorus supplied to water bodies is equal to, or greater than, 15:1, populations of algae known as greens and other groups of algae will develop. These

algae characteristic of healthy lakes form the base of the plankton-to-fish food chain on which fisheries and other aquatic animals depend.

On the other hand, if the ratio of nitrogen to phosphorus available in the aquatic ecosystem is less than 15:1, blue-green algae, also called cyanophytes, will grow instead of the green algae. The blue-greens can obtain the extra nitrogen they need from the atmosphere by nitrogen fixation. These are the nuisance algae. They are filamentous and accumulate in masses because they are generally not edible and not part of the plankton-to-fish food chain. As mentioned earlier, some of them produce toxins. When these algae die and decompose, oxygen is depleted in the water, particularly near the bottom of a lake.

Efforts to control the eutrophication should focus first on reducing phosphorus loading. When efforts are directed to reducing both nitrogen and phosphorus, the ratio of nitrogen to phosphorus entering the system should be maintained above 15:1.

The shallowness of Lake Winnipeg is also a factor that worsens the effect of excessive nutrient loading. Shallow lakes are more sensitive to nutrient overloading than deeper lakes with the same surface area.

As far back as 1970, loading of phosphorus to the South Basin was sufficient to classify it as a very eutrophic lake. Nevertheless, the normally high sediment load and relatively high water flow through the lake probably prevented the build-up of large algal blooms.

It was estimated that in 1968-1970 Lake Winnipeg received 61,920 tonnes of nitrogen/year and 5,215 tonnes of phosphorus/year. In recent years, river and stream monitoring indicates that the loadings are 63,207 tonnes of nitrogen/year and 5,838 tonnes of phosphorus/year. Manitoba Water Stewardship has set goals to reduce the nitrogen and phosphorus loading to Lake Winnipeg by 13 and 10 per cent, respectively to return the lake to a pre-1970 state. Responses of zooplankton in the lake and accumulation in the sediments can provide independent measures of the

changes in phosphorus loading over time. The observed increases in zooplankton abundance amounts to 300 per cent over the past 30 years, suggesting an increase greater than 10 per cent in phosphorus loading. Because phosphorus loading, lake level regulations and higher light penetration in the North Basin are complex, interacting factors, it may be useful to review the scientific evidence on the history of phosphorus loading to Lake Winnipeg from river and stream monitoring. This data should be combined with evidence of accumulation of phosphorus in the sediment and biological responses in the lake over time to confirm the appropriate goal for phosphorus reduction.

Limitation of the natural supply of phosphorus to water bodies explains its role in controlling eutrophication. Phosphorus is limited in another way. Rock phosphorite (P₂O₅) is a non-renewable fertilizer ore that is in diminishing global supply, particularly in North America, and for which there is no substitute. Adequate supply of phosphorus is an absolute requirement for food security in Canada, since Canada possesses virtually no phosphorite rock reserves. Large reserves on continental shelves in tropical areas are generally outside the extended legal continental shelf of countries and will be difficult to mine. Therefore, careful agricultural management of phosphorus to reduce the risk of eutrophication, will also result in efficient use of this limited resource and reduce its loss to lake sediments and the sea. At present, phosphorus is accumulating in the sediments of Lake Winnipeg at the rate of 230 tonnes per year.

Careful stewardship of phosphorus on land could reduce eutrophication and the rate of loss of irreplaceable phosphorus fertilizer resources to lake and marine sediments.

Excess Nitrogen - a Toxic Substance that Needs to be Controlled

The oversupply of the plant nutrient nitrogen to aquatic ecosystems is not the cause of eutrophication. Nevertheless, excess nitrogen acts in other ways that are detrimental indirectly or directly to aquatic systems, aquatic life, livestock and human health.

Excess nitrogen:

- causes fish kills due to ammonia toxicity
- contaminates groundwater at levels that exceed safe drinking water guidelines for nitrate
- leads to acidic deposition – acid rain
- contributes to a decline in amphibian populations due to elevated nitrate levels
- increases emissions of the potent greenhouse gas, nitrous oxide
- increases concentrations of nitrogen oxides contributing to the formation of photochemical smog in some cities
- leads to nitrogen saturation in some forested watersheds



The two most important problems of excess nitrogen in the Lake Winnipeg watershed are ammonia toxicity and nitrate contamination of groundwater. Groundwater is an essential source of drinking and domestic water for many communities. For these reasons, it is vital to monitor and control nitrogen inputs to the land.

Non-Point Sources of Nitrogen and Phosphorus

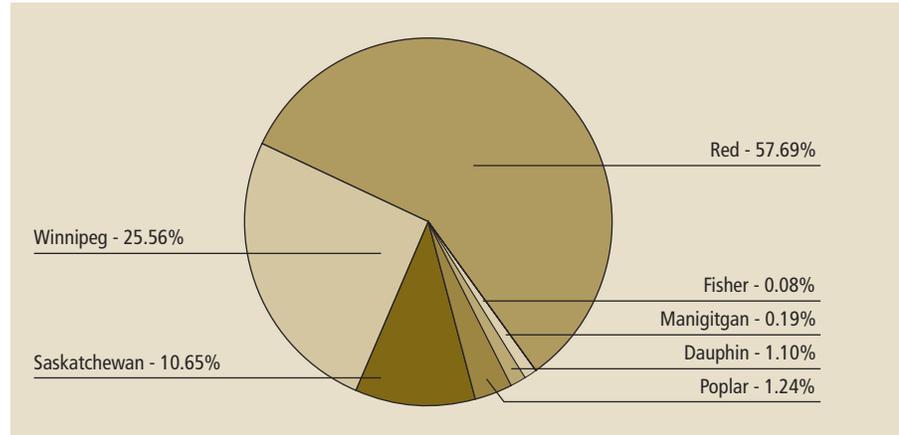
The Red River watershed is the largest source of nitrogen and phosphorus for Lake Winnipeg. More nutrients come from the U.S. via the Red River than come from Canada.

Of the three main rivers draining into Lake Winnipeg, the Red River contributes considerably less water than the Winnipeg and Saskatchewan Rivers, but it is by far the largest contributor of nitrogen and phosphorus to Lake Winnipeg.

The U.S. portion of the land area in the Red River watershed is four times greater than that in Manitoba. Nevertheless, the contribution of phosphorus and nitrogen per square kilometer is greater in Manitoba. Sources of nutrients in the Red River are agriculture, natural processes such as erosion and deposition from the atmosphere and direct wastewater effluent discharges.

Point Sources of Nutrients to Lake Winnipeg

While most of the excess nutrients originate from non-point sources, that is, numerous small sources, some of the largest point sources of phosphorus in the Red River basin are municipal wastewater treatment facilities. The City of Winnipeg's contribution to Lake Winnipeg is significant. It is estimated that it contributes on the average 7 per cent of the total Red River loading of phosphorus. Depending on the variability in the flows of the Red River, the City of Winnipeg effluent may vary from 5 to 35 per cent of the total Red River phosphorus loading. The effluent contributes an average of 23 per cent of the Manitoba portion of the Red River loading. Compared with phosphorus in runoff from natural landscapes where 25 to 40 per cent is relatively insoluble mineral, in treated sewage up 100 per cent of the total phosphorus available to plants.



In 2003, the Clean Environmental Commission recommended that the City of Winnipeg develop a plan to remove nitrogen and phosphorus from its municipal wastewaters with priority placed on phosphorus. Nitrogen removal is required to reduce the toxicity of ammonia to aquatic animals in the Red River. The city's move to tertiary treatment of sewage effluents to remove phosphorus is important in reducing the loading of bioavailable phosphorus to Lake Winnipeg.

Lake Winnipeg P Sources

Proportions of loading of phosphorus to Lake Winnipeg.

Scientific evidence indicates that removing nitrogen without reducing phosphorus from effluents entering the rivers flowing into Lake Winnipeg will not reduce eutrophication. Instead it will encourage the troublesome blue-green algae that are capable of obtaining nitrogen from the atmosphere.

The City of Winnipeg is being required to reduce ammonia toxicity in wastewater effluent being released to the Red River. If this involves the removal of nitrogen from the effluent, this would further reduce the already low nitrogen to phosphorus ratio in the Manitoba portion of the Red River. On the other hand, ammonia in the wastewater effluent can be removed by its conversion to non-toxic nitrate by the process of nitrification, preserving the nitrogen: to phosphorus balance. Contribution by the City of Winnipeg to reducing eutrophication in Lake Winnipeg will be made by moving to tertiary treatment of the wastewater that removes phosphorus.

International Co-operation – Nation to Nation and Person to Person

A complicating factor in the management of the Red River is that it is an international river. Manitoba is dependant on the US for sustained flow and quality as the river crosses the border. The International Joint Commission (IJC) superintends trans-boundary water quantity and quality issues in the basin under the Canada/US Boundary Waters Treaty of 1909. The IJC has provided objective oversight to the benefit of both countries for many years. Notwithstanding the formal mandate of the IJC, there are a multitude of projects, actions and activities that are outside that mandate and yet can have an impact downstream of their origin, often contributing to the cumulative impact on Lake Winnipeg. The Red River Basin Commission (RRBC) formed in 2002 is a voluntary grass roots organization formed to bring together a broad range of practitioners, officials and interests to address land and water issues in a basin-wide context. Through the 41-member RRBC Board of Directors representing Manitoba, Minnesota, North Dakota and South Dakota cities, counties, rural municipalities, watershed boards, water resource districts, joint powers boards, First Nations and other local interests, the RRBC provides a forum for sharing experience and best practices in water management and endeavors to build consensus and commitment to a comprehensive, integrated basin-wide vision.

Lake Level Regulation Promotes Accumulation of Nutrients in Sediments

Since the onset of lake level regulation in 1976, much of the water from higher spring and summer water inflows has been retained in Lake Winnipeg. This results in enhanced algal productivity and accumulation of algal biomass. The major significance of this is that nitrogen and phosphorus are accumulating in the sediments of the lake. A corresponding decline in nutrient concentrations in the outflow to the Nelson River has been documented.

As controls are placed on phosphorus loading into Lake Winnipeg and eutrophication is reduced, the sediments could then become a source of phosphorus to the algae. This is expected to slow the rate of recovery of Lake Winnipeg from eutrophication.

Quantifying Sources and Loadings of Phosphorus to Lake Winnipeg

The task of accurately attributing total phosphorus loading to a water body such as Lake Winnipeg, to particular locations or to various types of land use in the watershed, is a highly complex one. Some particular challenges related to this include:

- major nutrient loading events are not well measured because water flows are monitored on a pre-set schedule, and not necessarily at peak weather events
- understanding of phosphorus transport from land to water during snowmelt is limited
- the processes that temporarily retain phosphorus in rivers, streams and lakes are not well understood

Since almost two thirds of the phosphorus load in the Red River originates outside Manitoba, efforts to control phosphorus will involve international and inter-provincial as well as intra-provincial actions.

Every decade of delay in controlling phosphorus inputs to the Lake adds another 2,000 tonnes of phosphorus to that retained in the North Basin of the Lake, and will make recovery an even longer process.



OTHER THREATS TO THE HEALTH OF LAKE WINNIPEG

While eutrophication of Lake Winnipeg is the most obvious and pressing problem, other factors have the potential to threaten the health of the lake. They include contaminants; the establishment of non-indigenous species (NIS), also called exotic species; and the uncertain risks associated with the inflow of water from the Devils Lake basin in North Dakota. There are also concerns about the alteration of wetlands habitat by lake regulation, and changes in incoming water flows because of global climate change.

Persistent Organic Pollutants

Persistent Organic Pollutants (POPs), such as the pesticide DDT, PCBs, and dioxin, came to wide attention during the 1960's when it was discovered that these widely used compounds persist in biological organisms including humans for very long periods. POPs are of particular concern to human and animal health because some, such as PCB's, are known to act as endocrine disruptors. They mimic or block hormones and disrupt normal physiological functioning. Some sources of endocrine disruptors to the environment are industrial, agricultural and municipal wastes from incineration, landfills, agricultural runoff, atmospheric transport, harbours, industrial and municipal effluents and pulp mill effluents.

Until 1995, little attention was given to the determination of levels of persistent organic pollutants in Lake Winnipeg from such sources as agricultural and industrial activities in the watershed, hydroelectric developments on the Winnipeg and Saskatchewan Rivers and atmospheric transport of such compounds. In 1995, levels of PCB's in South Basin sediments exceeded those in remote lakes but were similar to those in other large lakes and reservoirs subject to industrial, agricultural and urban activities. The Red River flood of 1997 resulted in significant inputs of POPs into Lake Winnipeg. Nevertheless, while fish in Lake Winnipeg contain POPs, the concentrations are relatively low, do not pose a hazard for human consumption and are not believed to be of significant harm to the fish populations.

Pharmaceuticals and Personal Care Products

On the other hand, a group of chemicals of increasing concern are pharmaceuticals and personal care products, collectively known as PPCPs. Municipal sewage, direct dumping of excess or outdated medications, and agricultural and aquaculture wastes are all sources of PPCPs. These chemicals include antibiotics and other pharmaceuticals, fragrances and disinfectants.

Like POPs, some of these compounds can act as endocrine disruptors. When exposed at low levels, non-target species in the environment and possibly humans may be affected. Two particular concerns are the disruption of development and reproduction and the enhancement of antibiotic resistant bacteria.

Unlike POPs, PCPPs do not bioaccumulate in the environment. Nonetheless, they are still entering the environment in increasing amounts.



There is little knowledge of the effects of these chemicals, if any, on Lake Winnipeg fish and other organisms. The Manitoba Clean Environment Commission has recommended that the City of Winnipeg monitor the levels of heavy metals, organochlorines, endocrine-disrupting substances and pharmaceuticals in its influent and effluent streams.

Exotic Species - "Biological" Contamination

The worldwide spread of exotic or non-indigenous species (NIS) is now considered one of the most serious conservation issues facing us today. Once established, NIS can cause habitat change, compete for food, prey on existing species, introduce new diseases, mate with existing species to create new hybrid organisms and finally cause local extinction of native species. Through one or more and combinations of the above, biological invasions are responsible for more extinctions than any other factor, excluding human land use changes.



While habitat destruction is reducing species at a greater rate than NIS, it is much easier to restore degraded habitats than to control biological pollutants such as NIS that can reproduce, grow, and disperse once introduced successfully. Economic damage can be extremely high. In the U.S. there are an estimated 50,000 non-indigenous species (both aquatic and terrestrial) that account for economic and environmental damages totaling an estimated \$137 billion per year.

At least eight species of fish and one microscopic crustacean zooplankton have been introduced by human activities to Lake Winnipeg.

Recent additions to Lake Winnipeg's fish fauna include introduced exotic species and new range expansions for species formerly absent from the immediate drainage of Lake Winnipeg. Exotic fish enter Manitoba largely through human introduction, such as authorized and unauthorized stocking of game species, accidental and intentional introduction of live bait or other non-game species, illegal release of tropical and temperate aquarium specimens and accidental escape from culture ponds.

Rainbow smelt was introduced to several lakes in the upper portion of the Winnipeg River watershed in northwestern Ontario. After making its way into Lake Winnipeg by 1991 it has become a dominant fish in the lake. This introduction has resulted in declines in populations of several native fish species such as emerald shiners and spottail shiners. It is reported that walleye that feed on smelt have poorer flesh quality. Rainbow smelt feed on the young of larger fish like walleye, northern pike, whitefish and ciscoes. It is too early to tell the magnitude of this introduction on the \$20 million commercial fishery of Lake Winnipeg.

Endangered or Threatened Species

Lake Winnipeg has one species of snail and five species of fish designated as endangered, threatened or of special concern.

The snail, *Physa winnipegensis*, is found only in Lake Winnipeg. It is designated as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and is under consideration for addition to the *Species at Risk Act* (SARA). It is reported disappearing from two areas in the lake due to its sensitivity to pollution.

Water from Devils Lake, North Dakota, Poses Potential Risk

Devils Lake in North Dakota is in the Red River watershed. It is unusual in being a lake that normally has no outlet. The lake is subject to dramatic cyclical water level changes over long periods of time driven by climate. At the present time, water levels have risen 25 feet since 1993.

As a solution to the present critical state of flooding, North Dakota constructed a 22-km long pipeline, at an estimated cost of \$28 million, to release water from Devils Lake to the Sheyenne River, that drains east into the Red River and eventually to Lake Winnipeg. In August, 2005, water flowed through the outlet for 10 days, until it was ordered stopped because of excessive sulfate levels in the Sheyenne River.



During the past 10,000 years, water from Devils Lake has occasionally overflowed into the Red River, and, therefore the infrequent transfer of water and biota to the Red River is a natural phenomenon. Nevertheless, the modern occurrence of species introductions could mean the potential for NIS to enter Lake Winnipeg from this source. Further study is required to better assess the risks. One potential concern is that the blue-green algae community in Devils Lake contains species not presently found in Lake Winnipeg.

World-class Wetlands on Lake Winnipeg

The artificial stabilization of water levels on Lake Winnipeg is causing the physical structure of Netley-Libau marsh to be altered, leading to the loss of wetland habitat. In 1960, before stabilization of water levels on Lake Winnipeg, there were 50 individual waterbodies within the marsh, whereas in 1980, after stabilization, the number had decreased to 17.

The capability of the marsh to support wildlife has been reduced. Stabilized water levels are recognized as the principle factor affecting the marsh and its flora and fauna.

Climate Change

Climate change is an overarching reality that currently affects all ecosystems and human activities. Evidence of this is the very high levels of carbon dioxide in the global atmosphere, higher than at any other time during the past 20 million years, and the measurable increase in global average temperature.

Ecological impacts due to climate change are most evident at the highest latitudes in both hemispheres, as reported by the Arctic Climate Impact Assessment. Canada's freshwater is one of the resources particularly at risk.

Summer flows in the major rivers of Canada's western prairie provinces have declined by 30 to 85 per cent during the twentieth century. All of the major rivers crossing the western prairie provinces originate in the Rocky Mountains, where deep snowpacks and melting glaciers maintain river and groundwater supplies. Glaciers have melted rapidly in the twentieth century and some are now at a point where the glacial melt is declining.

In 2001, Manitoba Climate Change Task Force recognized that the water supply to Lake Winnipeg, particularly from the Saskatchewan River, would be decreased by climate change. The task force recommended that Manitoba Hydro immediately sponsor research to address climate change impacts on reservoirs and water levels.

The effect of climate change on Lake Winnipeg is subtle so far. The mean water temperature of the lake appears to have risen between 1 and 2 ° C between 1909 and 2004. Although changes in the time of ice break-up are not yet clearly measurable, break-up is predicted to be a week or more earlier by the middle of the century. A species of crustacean zooplankton preferring warm water has significantly expanded its range in the lake.

While climate change is causing decreased inflow of water to Lake Winnipeg from the western prairie provinces, it is associated with more extreme weather events in the Red River watershed, including floods that bring increased loads of nutrients and hazardous materials into Lake Winnipeg.

Climate change will impact all Canadians. Freshwater ecosystems are among the resources at particular risk.



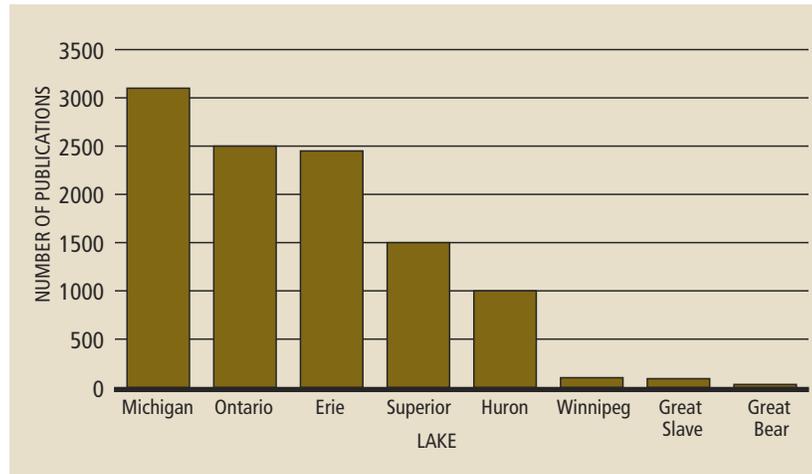
Our Scientific Understanding of the Lake Today

4.

Compared with the eastern great lakes, and like the northern Great Bear and Great Slave Lakes, Lake Winnipeg has received little scientific attention.

As compared with other large lakes, the physical, chemical and ecological parameters of Lake Winnipeg are poorly understood.

Moreover, comprehensive scientific study of Lake Winnipeg has been intermittent. The lake was studied quite intensively in 1929 but did not received scientific attention again until 1969. At that time, scientists from the Freshwater Institute, that would later become the regional headquarters for the Department of Fisheries and Oceans' (DFO) Central and Arctic Region, undertook studies because of the lake's geographical importance rather than because of an institutional mandate. The next major study took place in 1994 and 1996, when the Geological Survey of Canada began to learn more about the geological history of post-glacial Lake Winnipeg, a remnant of Lake Agassiz.



Comparison of the number of scientific publications on fisheries and aquatic sciences from Canada's great lakes from 1981 to 2003

Following the Red River flood in 1997, the "flood of the century", the International Red River Basin Task Force of the International Joint Commission funded a one-time study from 1997 to 1998 on the degree of contamination in the South Basin from the flood waters. With the formation of the Lake Winnipeg Research Consortium in 1998 by a group of researchers at the Freshwater Institute along with other stakeholders an on-going whole ecosystem study of the lake was finally begun. In 2001, the Lake Winnipeg Research Consortium Inc. started annual reporting of the results of its whole ecosystem research studies.

Some excellent scientific work has been carried out on Lake Winnipeg, providing a great deal of information on geology, paleolimnology (geological history of life in the lake), hydrology, and ecology of a number of trophic levels in the food chain. Nevertheless, because of the general lack of research funding dedicated to Lake Winnipeg since the 1997 flood study, a large number of scientific samples await analysis at the Freshwater



Institute. Large bodies of data have not yet been analyzed and published.

The small total scientific research over the decades, plus its lack of continuity, leaves large gaps in the understanding of the lake's natural variability in physical, chemical and biological processes across the lake and through time. This makes it much more difficult to know whether changes in fauna or flora populations are due to natural variability or to human influence.



Boots and Boats

Lake Winnipeg is the funnel through which a land-base forty times the area of the lake is drained. The land is largely agricultural and it drains at incalculable points along the rivers and streams that make their way to Lake Winnipeg, bringing with them the nutrients they received from the lands they crossed. The land houses a population base of approximately six million people, with the associated waste water that also impacts the rivers and streams that receive the waste and carry it along to the great lake. To understand this “basin of basins” requires not only an understanding of the dynamics of the lake itself, but also of the lands that ultimately drain into it. Research is required to study the scientific and socio-economic factors that influence the relationships between the land-based activities, the waterways and the lake. The economic activities in the region and their impacts on the lands, the characteristics of the lands and their impacts on the rivers, the transmission of the waters from smaller to larger tributaries and ultimately to the great lake and the changes in the lake resulting from these factors all need to be researched. The interactions in this complex system must be studied on land and on water. Restoration of Lake Winnipeg will necessitate research in boots and boats so that a comprehensive understanding of the basin and its dynamics can lead to appropriate action and a healthy Lake Winnipeg.

THE LAKE WINNIPEG SCIENCE WORKSHOP

The Lake Winnipeg Science Workshop (LWSW) held in Winnipeg in November 2004, focused on knowledge gaps and proposals for further scientific research on Lake Winnipeg. This important step in the implementation of the provincial Lake Winnipeg Action Plan was organized through collaboration among Manitoba Water Stewardship, Fisheries and Oceans Canada and Environment Canada. The primary goal of the workshop was: To identify science priorities and research needs for water quality and nutrients, fish communities and fish habitat in Lake Winnipeg in support of current and emerging management issues as identified by the agencies directly responsible for the lake's aquatic resources.

Workshop participants identified a prioritized list of research proposals to address the major aquatic issues facing Lake Winnipeg:

- Climate change
- Biological contaminants, e.g. fecal coliforms
- Chemical contaminants
- Endangered species
- Eutrophication
- Exotic species
- Floods
- Inter-basin transfers
- Overfishing
- Sediment levels
- Shoreline disturbance
- Water control

“In the future, a whole-watershed approach will be necessary to develop the scientific knowledge and understanding to support aquatic ecosystem-based management for Lake Winnipeg”.

G.B. Ayles and D.M. Rosenberg

THE GREAT LAKES EXPERIENCE AS A MODEL FOR LAKE WINNIPEG

The eastern Great Lakes have received much more attention than Lake Winnipeg. Management of the Great Lakes offers lessons for dealing with Lake Winnipeg issues such as eutrophication, exotics and fish productivity.

Since 1972, much of the management of the Great Lakes has been guided by the Great Lakes Water Quality Agreement between Canada and the United States. The agreement expresses the commitment of each country to restore and maintain the chemical, physical and biological integrity of the Great Lakes Basin Ecosystem and includes a number of objectives and guidelines to achieve these goals. It is a watershed-based agreement. The first agreement was signed in 1972, and it was renewed in 1978, and amended by a protocol in 1987 to strengthen programs and increase accountability for their implementation. The agreement provides for two binational boards, the Great Lakes Water Quality Board and the Great Lakes Science Advisory Board, to advise the commission. It is interesting to note that the major issue at the time of the 1972 agreement was phosphorus over-enrichment. Three decades later, a milestone agreement is being presented for Lake Winnipeg for the same issue. As for the eastern Great Lakes, the solution will involve cooperative, concerted action by both Canada and the U.S.

Eutrophication began in the Great Lakes with increased inputs of phosphorus during the 1950s and 1960s. Loading of phosphorus to Lake Erie in 1968 was 28,000 tonnes/year. Unlike Lake Winnipeg, Lake Erie received most of its phosphorus load from municipal sewage. In particular, 25 per cent of its phosphorus load was from detergents. The largest sewage treatment plants were directed to reduce phosphorus in effluent to 1 mg phosphorus L⁻¹ and attempts were made to control non-point sources. The result was that phosphorus loads were reduced by 50 per cent in Lake Erie and

Lake Ontario and the phosphorus concentrations in shallow western Lake Erie and Lake Ontario decreased by 50 per cent. Loading of phosphorus to Lake Erie is being maintained at below 11,000 tonnes/year. The improvement was achieved by tertiary treatment of sewage and not by control of non-point sources.

The main lesson learned in Lake Erie was that the concentration and bioavailability of phosphorus caused eutrophication, and that phosphorus is the nutrient that must be controlled. An accepted estimate of the cost of reducing the phosphorus load to Lake Erie was \$15 billion U.S. This was mostly spent on infrastructure construction and improvement projects. The high population density around Lake Erie makes sewage the most important and controllable input of phosphorus. For Lake Winnipeg, non-point sources are considered to be proportionately more important and will need to be targeted for control of phosphorus, along with wastewater treatment facilities. The Lake Winnipeg sub-basin is 40 times the area of the lake, compared with three times for Lake Erie.

As phytoplankton biomass declined in western Lake Erie and shifted in species composition, the lack of lake-wide monitoring made it impossible to determine whether the cause was phosphorus abatement or grazing by zebra mussels, an exotic species recently introduced to the lake.

Adequate and consistent monitoring over time and space are required for scientists to identify the relative importance of such factors as eutrophication, contamination, loss of wetlands, presence of exotics and now climate change on ecosystems and their functions.

The science of environmental monitoring is well developed in the Great Lakes and serves as a model for Lake Winnipeg. The State of the Lake Ecosystem Conferences (SOLEC) database contains over 800 indicators of ecosystem health, and about 80 are applied routinely. Indicators are categories of evidence that tell us about the condition of something of interest. Categories of ecosystem health indicators include:

- state of the environment: these address state of the environment, quality and quantity of natural resources, and the state of human and ecological health; reflect the ultimate objective of environmental policy and implementation; are biological, chemical, physical variable, or ecological functions
- pressure: these describe natural processes and human activities that impact, stress or pose a threat to environmental quality
- human activities/response: These describe individual and collective actions to halt, mitigate, adapt to, or prevent damage to the environment; include actions for the preservation and conservation of the environment and natural resources; examples are education, regulation, market incentives, technology changes

Not only must there be indicators but there must also be general agreement on which indicators to use and how to use them. Indicators are measures of the effectiveness of specific mitigative and restorative efforts by society and can be applied to decide among competing priorities. Indicators are necessary when large expenditures of time and taxpayers' and industry's dollars are being made.

The Great Lakes experience puts into perspective the significance of the impoverished scientific record on Lake Winnipeg. There are no background and trends through time for many processes, species and ecosystem functions in the lake. Despite the challenges of measuring the effectiveness of action, it is absolutely essential to the people and the economies that depend on a healthy Lake Winnipeg that a serious start is made to reverse eutrophication and be proactive on other issues. In the meantime, we will need to invest more resources to develop a more complete understanding of natural processes in, and human impacts on, Lake Winnipeg.

Although the amount of funding allocated to Great Lakes ecosystems research and restoration is not necessarily optimal, several funding programs are very significant for improving the health of the Great Lakes. The Great Lakes Action Plan managed by Environment Canada provides \$40 million over a five-year period for restoring beneficial uses in identified Areas of Concern. Of this, \$500,000 per year was allocated to DFO from 2000 to 2005. Other sources of funds for research, monitoring, and restoration flow through the Canada-Ontario Agreement, the Species at Risk Act and invasive species programs.

The Fraser Basin Council – One Road to Success

Today's world is extremely complex. The integration of the formerly segregated concepts of economic, environmental and social health into a holistic notion of sustainability has created a need for a new type of decision-making; one that involves the collaborative participation of many sectors in the resolution of highly complex issues. An innovative organization in British Columbia has effectively tackled this new approach. The Fraser Basin Council, founded in 1997, brings together government, private sector and non-government partners to find enduring, workable solutions for many complex sustainability challenges in this large and diverse basin. Governed by a board of 36 directors representative of the basin's regions and sectors, the council guides and influences decision-makers in a myriad of issues ranging from preparing for the next great Fraser River flood to building constructive Aboriginal and non-Aboriginal relationships. The Fraser Basin Council provides a tangible model of institutional capability for influence through integrated, collaborative decision-making.

What Others are Thinking

Many voices have been raised expressing concern that action must be taken now to restore the vitality of this very important provincial and national resource, Lake Winnipeg.



The lack of sound knowledge about the basic ecology of the lake, the seriousness of the current and emerging threats to the lake's ecosystem, and the potential social, economic, and cultural losses we all face have been articulated by representatives of governments, international bodies, First Nations groups, the private sector, academia, non-governmental groups on both sides of the international border and the media. In the past year or two, Lake Winnipeg has received a great deal of media attention, including 144 stories in 2004 in the Winnipeg Free Press.

Concerned stakeholders have voiced clear messages about what needs to be done to restore Lake Winnipeg to full health and sustainability.

The need for enhanced science and research on Lake Winnipeg

- Environment Canada's pending Federal Lake Winnipeg Action Plan, with principles consistent with the Competitiveness and Environmental Sustainability Framework, has a goal of understanding the ecology of the lake and watershed, including its physical, chemical, biological dimensions and the drivers controlling the state of the lake such as climate variability and changing land use patterns.
- The Lake Winnipeg Science Workshop held in November 2004 through collaboration among Manitoba Water Stewardship, Fisheries and Oceans Canada, and Environment Canada recommended "The departments should develop an integrated science program proposal for funding within each

Northern River Basin Study - Research led by the community for the community

The Northern River Basin Study (NRBS) is a study with a difference. It was initiated in response to concerns by northern residents following the approval of the Alberta Pacific Pulp Mill in Athabasca Alberta in 1991. The four-and-one-half year, \$12-million project examined the relationships among industrial, agricultural, municipal and other development in the Peace, Athabasca and Slave River basins. It was managed by a 25-member study board made up of aboriginal leaders, government officials, municipal representatives, and members of the environmental, health, agricultural, industrial and public sectors. This process led to the defining of 16 environmental questions that reflected societal concerns as well as scientific needs. It represented a shift in emphasis from data collection to research directed to finding answers. Contributing to the study were some of Canada's most accomplished scientists who accessed some of the most advanced technology available. A third strength of the NRBS was the meaningful inclusion of traditional environmental knowledge in the science program. Knowledge held by First Nations, combined with that of other traditional and local residents, extended the reach of the scientific information-gathering process by providing insights into the influence of human activities. On-going co-operation and positive interaction among members of the study board, representing diverse stakeholder and interest groups, helped ensure a balanced and comprehensive study program and final report. As the study closed, new developments were being discussed in northern Alberta – a sign that successful process can lead to sustainable development.

department, based on the research proposals described in this workshop." The value of traditional ecological knowledge and local knowledge was recognized.

- The Lake Winnipeg Stewardship Board recommended that for the long-term protection of Lake Winnipeg, a collaborative, long-term science plan must be implemented.

Reducing phosphorus loadings to Lake Winnipeg

- Manitoba Water Stewardship released the Lake Winnipeg Action Plan that recognizes that the release of nutrients to water bodies will need to be reduced across all sectors.
- The role of the Lake Winnipeg Stewardship Board (LWSB) is to assist the government of Manitoba to achieve the main commitments in the Lake Winnipeg Action Plan of reducing phosphorus and nitrogen in the lake to pre-1970 levels. Specific actions include:
 - working towards reducing the loadings of nitrogen and phosphorus from the U.S., Saskatchewan and Alberta
 - pursuing a variety of activities to reduce impact of livestock production on water and riparian areas
 - encouraging matching of nutrient inputs with crop requirements
- Citizens for the Responsible Application of Phosphorus, recognizing that the supply of phosphorus to surface waters in Manitoba, including Lake Winnipeg, is the source of eutrophication, urges peer-reviewed, scientific research to determine a safe upper limit for phosphorus in soil and that immediate adjustments to manure application practices to this limit be made.

The need for an integrated watershed approach that includes knowledge of how nutrients move from land to water

- The Lake Winnipeg Science Workshop recommended that "The departments should develop a comprehensive program of integrated monitoring of the biological, chemical and physical components of the Lake Winnipeg ecosystem and its watershed based on management objectives and science-based ecosystem indicators."
- The University of Manitoba proposes the establishment of a research chair in watershed management.

The need for greater co-operation, new partnerships and increased engagement of agriculture and livestock producer communities

- A group of interested citizens recommend the formation of the Lake Winnipeg Watershed Action Council with a mandate to examine the watershed as a whole, and to seek a way to ensure the future health of the lake, through consultation with interested parties, organizations, federal, provincial and state governments.
- The Manitoba Environmental Network Water Caucus recommends improving citizenship consultation processes, including those with Aboriginal Peoples, for developing laws, regulations, policies and programs.
- Agriculture and Agri-Food Canada is proposing the development of a National Strategy for Agriculture Science and Innovation, concerned in part with the relationship between agriculture and the environment.

The need for international and inter-jurisdictional co-operation

- The Lake Winnipeg Stewardship Board recognized that reducing the loadings of nitrogen and phosphorus from the U.S., Saskatchewan and Alberta requires cooperation. Relationships with Aboriginal Peoples on water quality issues need to be strengthened.

The need for enhancing the capacity of government and non-governmental organizations in areas such as monitoring, enforcement, research, education and public outreach

- The Manitoba Eco-Network Water Caucus requested that both the federal and provincial governments substantially increase investment for the protection of our water resources, such as for watershed planning, improving our baseline data, implementing the Lake Winnipeg remediation plan and hiring staff for monitoring, enforcement, research, education and public outreach.

Managing the Watershed – Co-operation Works

Watersheds define geographic areas which are natural candidates for effective land and water planning. Planning on a watershed basis provides for focused attention on the substance of, and linkages between, the physical, economic and social considerations necessary for effective decision-making. In Saskatchewan, the Meewasin Valley Authority brings together the Province of Saskatchewan, the City of Saskatoon and the University of Saskatchewan to protect and develop the South Saskatchewan River Valley, a watershed area. It undertakes programs and projects in river valley education, development and conservation. In south central Manitoba, three municipalities and a charitable research foundation, the Deerwood Soil and Water Management Association Inc., intend to use watershed-based scientific research to support farm families, communities and economy of the Tobacco Creek watershed, while addressing emerging and historic land and water management issues. In both cases, the projects bring together various groups to deal with some key issues relating to water, infrastructure, agriculture and the environment and to address them on a watershed basis. Protecting the water quality in these, and other basin watersheds, will ultimately have positive impacts on Lake Winnipeg water quality.



- A particular emphasis of the Centre for Indigenous Environmental Resources is education and training. Most Aboriginal communities require training in technical and scientific skills to identify, record, interpret, monitor, problem-solve and engage in an ongoing process of environmental protection of their lands.
- Manitoba Wildlands urged the recognition of the value of the independent Lake Winnipeg Research Consortium, that its activities be appropriately funded and that it provide timely public release of research results.

The need for public education and timely flow of information

- The Lake Winnipeg Stewardship Board recommended enhanced public and formal education on water quality protection and watershed citizenship.
- The International Water Institute provides a forum for research, public education, training, and information distribution relating to flood damage reduction water resource protection and enhancement in the Red River Basin. The International Water Institute (IWI) oversees the Red River Basin River Watch Monitoring Program in North Dakota and Manitoba. It provides hands-on, real world science opportunities for students, teachers and citizens in baseline water quality in the Red River Basin.

It is essential that concerted action be taken before damage becomes irreversible or extremely costly to reverse.

Education and Engagement - Two River Watches

Without public engagement, there will be insufficient sustained stewardship of the lands and waters that make up the Lake Winnipeg basin to restore the lake to its previous healthy state. Effective public engagement relies heavily on public education and capacity-building. Good public education includes school and non-school centered learning. In Alberta, the province has created a ready resource to give students hands-on learning about water quality. Students spend time on the river, taking water quality measurements above and below a point source of pollution such as a wastewater treatment plant. The River Watch Science Program brings students from many different schools onto the water to collect physics, chemistry and biology data during fifty days of field research each year. The data collection has been done over many years and along the length of various rivers. The end result is a picture of overall river health and human impact in Alberta – as well as an interested and knowledgeable population. This is an excellent way to develop a culture of care in the coming generation of decision-makers. The River Watch name also attaches to another innovative education program. In a weekly television broadcast called River Watch, North Dakota Public Broadcasting station KFME presents information about current conditions in the Red River Valley (particularly geared to increasing public awareness about spring flooding risks and their mitigation), specific water issues of interest in the Red River Valley and items of historic and cultural interest in the watershed. The program developed as an initiative under the International Flood Mitigation Initiative following the 1997 Flood of the Century on the Red River. The program is underwritten in part by a local philanthropic foundation and demonstrates that government need not be the only source of useful public education on water issues.

Conclusions

6.

Several significant conclusions can be drawn from the foregoing review of information about the past and present condition of Lake Winnipeg, about the state of our knowledge of the natural processes at work in the lake, and about what knowledgeable and concerned people think ought to be done to address the issues.

WE HAVE CONCLUDED THAT:

Lake in Trouble – Science lacking

- **Lake Winnipeg is in trouble.** It is pointless to quibble about the extent of the problem. There is general scientific consensus on this point. We do not, in fact, know enough about the processes at work in the lake to evaluate the extent of the problem. What is needed is action.
- **Our scientific knowledge about Lake Winnipeg is inadequate.** Much more needs to be done to understand the present state of the lake and to formulate a prognosis for the future.
- Previous efforts to study and analyze the lake have been sporadic. **Funding** for these efforts **has been inadequate.**

Public Support for Action

- **The citizens of Manitoba have seized this issue and consider the health of Lake Winnipeg to be a high priority. *This interest appears to extend beyond those who live on the lake or utilize its resources.***

Co-operative action needed

- **Both provincial and federal governments have, in the past, paid inadequate attention to the health of Lake Winnipeg.** This situation has changed in recent years and provides an excellent foundation to build.



- The **governments need to pool their efforts to avoid duplication and overlap as they become more actively involved in Lake Winnipeg issues.** This is particularly important given that the two governments share parallel jurisdiction in several areas and roles and responsibilities are not always clear.
- There is **good reason to devote the same caliber of effort, proportionally, to the study and management of Lake Winnipeg as is devoted to the five Eastern Great Lakes.**
- The scale of effort required in the future will be considerably greater than in the past. This will mean utilizing existing government resources more efficiently, re-targeting some existing resources and mobilizing the private sector. But it will also mean additional new government spending. **It would be a grave mistake to assume that the task ahead can be purchased cheaply.**
- There are numerous agencies of government and non-government groups who have an active interest in Lake Winnipeg and its drainage basin. All of these institutions appear to occupy a distinctive niche and serve a useful purpose. There is however, **inadequate c-operation and co-ordination of these various players,** who nevertheless appear to be working towards common goals.
- In spite of the numerous groups already active, there remain **several interests that are not sufficiently engaged in Lake Winnipeg dialogue and action.** These include Aboriginal interests both governmental and individual, the agricultural community and academia.
- Although there is a significant Aboriginal Communities interest in the Lake Winnipeg fishery, and several First Nations communities are located on or close to the lake, **there has not been corresponding meaningful involvement of Aboriginal Peoples in the Lake Winnipeg dialogue to date.**
- There is also significant involvement of Metis people and communities in the Lake Winnipeg fishery. **Metis people have not been sufficiently involved in Lake Winnipeg issues in the past.**
- **There is a high degree of consensus** among the various stakeholders concerning the issues and broad direction that needs to be taken to deal with them. **This consensus needs to be articulated** as a key first step in the integration of the many players who are now engaged, or want to be engaged, in restoring Lake Winnipeg to full health.
- **What is needed is a voluntary coalition whose participants assume certain responsibilities for which they are publicly accountable.** All of the principal interests need to be included.



- There are several excellent examples of successful multi-stakeholder watershed management that have evolved to meet local needs. All of these have valuable lessons for the Lake Winnipeg basin. **We must build our own model to meet our own needs and it must be designed so that it can evolve over time.**

Science Urgently Needed

- **There is no shortage of ideas about what needs to be done** to fill in our gaps in knowledge. In fact, there is a degree of consensus on the main elements of a program to move forward.
- Nonetheless, **there are a few major issues about which there appears to be, if not a lack of consensus, at least a lack of attention.** These issues are so important that they should be dealt with immediately. These issues include: the human health implications of toxic algae; future impacts of climate change and chemical pollution on the lake; and resolving conflicting estimates of the historic phosphorus and nitrogen loadings into the lake.
- The symptoms manifest themselves in the lake but are caused in the entire drainage basin. The activities that occur on the landscape, in four provinces and three states will determine the future of the lake. **Any effort to restore the health of the lake must include the entire basin.** Although the logical starting point is in Manitoba, an urgent priority is to formalize the involvement of all the other jurisdictions in the healthy Lake Winnipeg effort.
- **Management on a watershed-basis is fundamental to a healthy Lake Winnipeg.** This concept is not fully operational in any of the jurisdictions, although all are engaged in the effort.
- The capacity of the local scientific community will be challenged to meet the demands imposed by increasing our efforts on Lake Winnipeg. **There are serious concerns about local capacity** given long-term systematic reduction of government environmental research.

- Understanding what is happening in Lake Winnipeg will have to go hand-in-hand with understanding the processes at work on the landscape in the drainage basin. **There needs to be a balance between the monitoring, study and research that occurs on the lake and that which occurs in the basin.**
- The physical sciences have so far dominated research on Lake Winnipeg. **Socio-economic knowledge is also a critical element to the understanding of the what, and how, of restoring a healthy Lake Winnipeg.**
- **The MV Namao is a critical resource to the research on the lake. Its future sustainability needs to be ensured.**



- **Setting science priorities is a process that ought to involve all of the stakeholders.** This is particularly important because there are so many active and informed stakeholders in the basin, many of whom are capable of carrying out research themselves.
- Many of the most significant gaps in science relate to the lack of dependable, long-term data. Study and monitoring of the lake and the basin cannot be a stop-and-go effort. **Continuity and longevity are required.** The two orders of government have a mixed record of staying the course in working together on shared issues.

- There are already a number of commitments that have been made by the governments regarding Lake Winnipeg and there are likely to be many more in the future. **It is important that progress towards meeting these commitments be tracked and reported on objectively.**
- We talk about a **healthy Lake Winnipeg** but this **needs to be defined by a set of measurable indicators** so that progress and eventual success can be documented and communicated. Reporting must be credible and objective.
- Whether it's the prioritization and execution of the science agenda, the management of activities on the landscape in the basin, delivering public education or any of a number of actions that will contribute to a healthy lake, simply continuing to carry these out with traditional methods and approaches will not be enough. For a number of reasons, including the limits of government funding and the many established patterns of development integral to our economy already in place in the basin, **innovation will need to supplement traditional means.**

Further Public Education and Engagement Required

- Although there are many interested stakeholders already mobilized in the basin, and there is general public support for action on Lake Winnipeg, the commitment of those without a direct interest in the lake remains vague. When it comes to hard decisions that require public funds to be committed, and that may have impacts on actions in the basin distant from the lake, this softer commitment will not be enough. **A major education effort will be required to engage a wider audience with the sense of a crusade.** There are many examples of innovative ways to inform and educate the public on water issues available to us.

These conclusions lead logically, and we believe inexorably, to the following recommendations.

Recommendations

7.

MANITOBA/CANADA CO-OPERATION

The governments of Manitoba and Canada have recognized the importance of Lake Winnipeg as a provincial and national resource. Both have jurisdiction related to activities vitally affecting the health of the lake and its ecology. Both governments have pledged to work together to restore the vitality of the lake and have budgeted resources to begin the task. There are many good reasons to now formalize their resolve in the form of a federal/provincial agreement.

Such an agreement will identify the resource commitments the governments are willing to make over several years; it will bring a degree of predictability to the work of government scientists and technicians permitting a planned and measured approach to understanding the processes at work on the lake; it will provide a public and accountable statement of the governments' resolve, ensuring that if there is any future stalling on commitments this will occur with full public scrutiny; it will help clarify the roles and responsibilities of the various agencies, avoiding jurisdictional duplication and overlap; it can cast the widest possible net over government agencies with responsibilities related to Lake Winnipeg so that maximum resources can be directed to restoration and protection; and

finally it can formalize the inclusion of the broadest coalition of organizations and citizens in developing and implementing an action plan for the lake and its vast drainage basin.

It is recommended that:

1 The two governments embody their future co-operation on Lake Winnipeg in a formal five-year federal/provincial agreement (See Appendix 1). The agreement will:

- be signed by the prime minister of Canada and the premier of Manitoba and initially involve Manitoba Water Stewardship and Environment Canada
- be for a term of five years and contain a renewal clause worded strongly in favor of renewal except in the most unusual circumstances
- be in form and substance similar to the draft agreement appended to this report
- include funding support for university research, innovation and the integrative mechanism recommended below, as well as government programming
- include an addendum that would be signed by other partners in the federal and provincial families such as Manitoba Agriculture and Food, Fisheries and Oceans Canada and Indian and Northern Affairs Canada and Agriculture and Agri-food Canada. These associates would be expected to bring resources and programming to the table. Given the complexity of involving multiple departments of government, Canada and Manitoba should proceed immediately with the agreement between the initial departments noted above and work on the addendum over the longer-term



2 the agreement provides for total funding of \$40 million over five years sourced two-thirds by Canada and one-third by Manitoba, commencing with \$6.5 million in year one. It will increase by 10 per cent annually for the next four years to accommodate an accelerated pace of work as co-operative mechanisms are perfected. The rationale for this funding is presented in Appendix 2

3 the agreement contains the means of integrating input from the full range of interests, particularly those embodied in the Healthy Lake Winnipeg Charter Council. (See Appendix 3)

SCIENCE

Understanding the processes, natural and human-induced, that are at work in Lake Winnipeg and in its contributing watershed, and that are ultimately responsible for the state of the lake, is the fundamental basis for any action aimed at the restoration of the lake. Enough is known to move forward with a number of actions consistent with the precautionary principle. However, there are many significant gaps in our knowledge that require urgent attention to enable a sustainable long-term game plan.

The answer to this dilemma has many components. Certainly it means more financial resources – money – some but not all of it from governments and some but not all of it new money. It means addressing science capacity – human resources. It also means mobilizing those inside and outside of governments with an interest in the lake who can bring human and financial resources to the table. This means federal and provincial government agencies that can, and should, redirect some resources to activities in the watershed and on the lake that will contribute to its restoration; it means academia and its research capacity; it includes the private sector and philanthropic foundations and institutions.

Scientific knowledge necessary to address the problem is not confined to aquatic systems, the lake and its tributaries. It also must include a better understanding of the terrestrial processes in the basin and the socio-economic factors at work in the population of the basin.

It is further recommended that:

4 the two governments act expeditiously to reach a scientific consensus on the historic loading of phosphorus and nitrogen to Lake Winnipeg and a science-based target and time table for the reduction of nutrient inflows to the lake

5 the two governments acknowledge, notwithstanding that phosphorus is the controlling nutrient in the lake, the importance of controlling human-induced nitrogen sources to achieve important water quality objectives in the basin that may not directly impact Lake Winnipeg

6 the two governments act expeditiously to address the question of possible human health implications of algal toxins in Lake Winnipeg.

7 chemical pollution and climate change receive attention as emerging issues for Lake Winnipeg

8 the two governments actively seek the input of all interests, particularly utilizing the Healthy Lake Winnipeg Charter Council, in setting priorities for their programming

9 an annual balance point be determined between lake- and land-based monitoring and research to ensure that adequate attention is paid to causal actions on the landscape. This balance point should be expressed in dollars and initially should start at approximately 60 per cent for the lake and 40 per cent for the land, given the more mature state of the water-based science planning

10 the Lake Winnipeg Research Consortium be provided with an endowment from Fisheries and Oceans Canada to ensure the on-going maintenance and operation of the MV Namao as a major research platform on Lake Winnipeg, -it is suggested that this endowment be capable of generating approximately \$0.6 million annually

11 address the backlog of historic scientific samples from Lake Winnipeg, and prepare a detailed State of the Science report as urgent priorities under the federal/provincial agreement

12 the Federal Department of Fisheries and Oceans should identify Lake Winnipeg as a flagship issue for the Freshwater Institute, and adopt the goal of substantially increasing the human and financial resources of the Freshwater Institute to provide the freshwater science capacity required to meet the challenge

13 a formal link be established between the Healthy Lake Winnipeg Charter Council and the Great Lakes Science Council to ensure that maximum use is made of the extensive knowledge accumulated under the Great Lakes Water Quality Agreement

14 the two governments recognize and promote the value of watershed planning on both a macro- and micro-scale, and institute mechanisms to build capacity within watersheds to effect planning in both scales

15 recognizing the use of Lake Winnipeg as a reservoir to facilitate power generation, Manitoba Hydro should be a positive contributor to the initiative, providing \$1 million per year for research related to the restoration of the health of the lake

EDUCATION AND ENGAGEMENT

Lake Winnipeg is a great lake of the prairies. Its future depends on the combined interest and action of all citizens in its basin, not just the mandated decision makers and scientists. Lifestyle choices impact the quality of water in tributary watersheds and ultimately impact the lake. The public needs to understand the significance of their choices and the options available and that “we” and not some indefinite “them” are responsible for the quality of Lake Winnipeg. In addition their support may be required for some tough future choices, the consequences of which ultimately fall to the taxpayer.

Citizens must be convinced of the value of this unique resource, not just those who vacation on its shores or earn a living from its fishery, but all Canadians as part of our natural heritage and as a national bank deposit

that increases in value each year as healthy freshwater bodies continue to deteriorate around the world. Public information and education programs will result in changed perspectives and responsible stewardship in individual choices.

It is recommended that:

16 the two governments establish an institution under the auspices of the Healthy Lake Winnipeg Charter Council, and fund its start up, with a mandate to attract private funding to engage in public education and information distribution, research and capacity building related to the lake and its basin

17 an annual State of the Basin Summit, sponsored by the Healthy Lake Winnipeg Charter Council, should be supported as a major public accountability event, integral to engaging the general public in the basin in the issues

18 the governments aggressively promote watershed planning both to the general public and to individuals, organizations and institutions in the basin involved in land and water management as the foundation of all efforts to restore Lake Winnipeg; and empower participation through capacity building

INTEGRATION

In Canada’s diverse democratic society governments have recognized the importance, in fact the absolute necessity, of involving citizens both as individuals and interest groups in all aspects of the governance process. This inclusiveness must be an integral feature of government actions on Lake Winnipeg.

A number of groups representing a broad range of interests in the Lake Winnipeg basin are already active. There are also a number of municipal and aboriginal governments and groups with a significant stake in the basin. There is a degree of communication and cooperation among these groups and the governments, most of it informal. All of these players have a useful role to play but better integration of their efforts is greatly needed.

There are many ways to foster integration of existing and future players with an interest in contributing to the recovery of Lake Winnipeg. We believe the best way is to build on the foundation that already exists, bringing together the active players under a charter that spells out common principles, goals and obligations (about which we believe there is already a high degree of public accountability and citizen involvement and is open to include new players throughout the basin as they decide to participate.

It is recommended that:

19 the governments commit to a Healthy Lake Winnipeg Charter to provide to the Charter signatories, advice, recommendations and leadership in the co-ordination of research, educational programs and basin management activities, towards the restoration and continuing health of Lake Winnipeg. The charter should:

- be signed initially by the departments signatory to the agreement
- initiate the process outlined in Addendum 1 of the draft charter to refine and finalize the Charter
- specifically address the inclusion of Aboriginal Peoples in the charter and its processes, and acknowledge Aboriginal rights and the respecting of those rights
- invite the groups listed in Addendum 2 to the charter to also participate by signing the charter
- remain an open document to which more partners will be added over time
- be modeled after the example appended to this report 20the signatories to the charter form the Healthy Lake Winnipeg Charter Council and agree to fulfill the charter responsibilities, including, among other things, commitment to over-all goals, development of and commitment to broad annual priorities, public accountability and reporting at an annual State of the Basin Summit

21 the two governments request the involvement of the International Joint Commission in an independent audit capacity in the future accountability process established under the charter

Recognizing that the institutional integration will evolve over time, and that the actions noted above are to be implemented at an early date, the inclusion of Manitoba interests will come first. Formally integrating interests in the other three provinces and four states in the basin will occur over a longer period, building on existing institutions and relationships.

Therefore it is further recommended that:

22 the governments initiate discussion at the Prairie Provinces Water Board with the International Joint Commission and the Province of Ontario concerning the early formal inclusion of all jurisdictions in the effort to restore and maintain a healthy Lake Winnipeg



Acknowledgements

This report would not have been possible without the generous assistance from a large number of people who provided published and unpublished information, data and interpretation. Organizations include the Department of Fisheries and Ocean's Freshwater Institute; the Lake Winnipeg Implementation Committee Advisory Committee; the Fraser River Basin Commission, the Manitoba Eco-Network Water Caucus; the Lake Winnipeg Research Consortium; Manitoba Water Stewardship; the International Institute for Sustainable Development; the University of Manitoba; the Centre for Indigenous Environmental Resources; the City of Winnipeg; Manitoba Agriculture, Food and Rural Initiatives and the Aquatic Ecosystem Health and Management Society.

Special thanks are due to the provincial advisor to LWIC, Dwight Williamson and the federal Advisor, Kevin Cash. Our gratitude is also expressed to Jim Vallmerhausen, Bill Gummer and Susan Eros of Environment Canada, Murray Clamen of the International Joint Commission, David Marshall of Fraser Basin Commission, Alex Salki of the Department of Fisheries and Oceans and Glen Koroluk with the Manitoba Eco-Network.

Staff of DFO libraries at the Freshwater Institute and the Pacific Biological Station are thanked for their cooperation. Also invaluable in completing this project on schedule is the availability of a wealth of information on the websites of the above and other organizations.

The membership of the LWIC Advisory Committee that met three times over the course of the project was:

Bill Barlow - Lake Winnipeg Stewardship Board
 Bruce Benson – Lake Winnipeg Watershed Action Council
 John Jonasson - Manitoba Conservation
 Bud Oliver - Red River Basin Commission
 Merrell Ann Phare - Centre for Indigenous Environmental Resources
 Jonathan Scarth - Delta Waterfowl
 Muriel Smith – Red River Basin Commission
 Hank Venema – International Institute for Sustainable Development

The Red River Basin Commission, the proponent and administrator of this project, and its executive director, Lance Yohe, are particularly thanked for advice and financial management.

The Lake Winnipeg Implementation Committee acknowledges the work of its Secretariat, Richard Stephens, RAS Consulting, Winnipeg MB, for co-ordination of the project; Diane F. Malley, PDK Projects, Inc., Winnipeg Manitoba and Nanaimo British Columbia for research and drafting of the report and Technical Annex, Sagiotta Ramserran, SDS Strategic Directions and Solutions, Winnipeg Manitoba for report preparation; Ken Beeson, Public Policy Management, Vancouver British Columbia. for policy advice.

Glossary

Anatoxin also known as Very Fast Death Factor - a potent alkaloid toxin derived from a species of cyanobacteria called *Anabaena flos-aquae*; a severe neurotoxin, affecting the functioning of the nervous system, and often causing death due to paralysis of the respiratory muscles.

Boreal - referring to a far northern region; boreal forests are dominated by cone-bearing trees and typically found between the temperate deciduous forests to the south and the treeless tundra to the north.

Cyanophytes or Cyanophyceae, also referred to as blue-green algae – actually are a large and varied group of bacteria, the cyanobacteria, without a true nucleus, but because they contain chlorophyll and undergo photosynthesis they are often referred to as algae.

Drainage basin – the area of land drained into a river than ends in the sea, e.g., Nelson River Drainage Basin that ends in Hudson Bay.

Endocrine disruptors - substances that interfere with the endocrine system by mimicking, blocking or otherwise disrupting the function of hormones,, thereby affecting development, growth, or reproduction in people and animals.

Eutrophication - over-enrichment of a water body with phosphorus or the response of the biological community to phosphorus over-enrichment, resulting in excessive growth of organisms, such as algal blooms, and depletion of oxygen concentration.

Exotic species - also referred to an non-indigenous species - a species that did not originally occur in the areas in which it is now found, but that arrived as a direct or indirect result of human activity.

Glaciation - the condition of being covered with glaciers or masses of ice; a period during which the polar ice-caps extend towards the equator, covering large areas of the Earth and altering the land surface.

Glacial rebound - vertical raising of a portion of the earth's crust following the removal of an ice mass also referred to as deglaciation.

Indicators - are pieces of evidence that tell us about the condition of something of interest, such as the state of the environment, the impacts from human activity, or the actions that are being taken for environmental protection and improvement.

Indigenous species - also referred to an endemic species - A species that is native or naturally occurring in a specific area; plants and animals that live in a place without human influence.

Microcystins – a class of peptides (components of protein) produced by some cyanobacteria; can be very toxic to plants and animals including humans; they may be accumulated by organisms and cause damage to, or cancer of, the liver.

Nutrient – substances that provide nourishment and promote growth of micro-organisms and vegetation including nitrogen, phosphorus, carbon, hydrogen, oxygen, potassium, sulfur, magnesium and calcium, as well as minor elements such as iron, zinc, copper, manganese, boron, molybdenum and chloride.

Nutrient loading – the quantities of the principal nutrients, nitrogen and phosphorus entering a river, stream, lake or other body of water per unit time; occurs naturally with seasonal variation at levels characteristic of the ecozone; can be modified considerably by human activity.

Paleozoic – one of four geological eras, extending from about 570 to 225 million years ago, from the end of the Precambrian to the beginning of the Mesozoic.

Precambrian – the first of four geological eras extending from the formation of the earth to the beginning of the Paleozoic about 600 million years ago; equivalent to 90 per cent of geologic time.

Sub-basin – major portion of a drainage basin, upstream of the river that flows into the sea; e.g., Lake Winnipeg Sub-basin that ends at the outflow of the lake into the Nelson River.

Zooplankton - the animal component of plankton that passively drift or weakly swim within the water column; all major animal phyla are represented in zooplankton as adults, larvae or eggs.

Tributary - a river or stream that feeds into a larger stream, river, or lake; does not reach the sea.

Watershed - the specific land area that drains water into a river system or other body of water, e.g., Red River watershed, used here to mean a portion of the sub-basin.

Draft Federal – Provincial Agreement

THIS AGREEMENT made this day of , 2005

BETWEEN:

THE GOVERNMENT OF CANADA, represented herein by the Prime Minister of Canada and the Minister of the Environment (hereinafter referred to as “Canada”),

AND

THE GOVERNMENT OF THE PROVINCE OF MANITOBA, represented herein by the Premier of Manitoba and Minister of Water Stewardship (hereinafter referred to as “Manitoba”),

WHEREAS the *Canada Water Act* encourages federal-provincial co-operation in the examination and resolution of water resource issues; and

WHEREAS the *Manitoba Water Stewardship Act* encourages the province to enter into agreements with the Government of Canada relating to any matter pertaining to the environment; and

WHEREAS Lake Winnipeg is a Great Lake of the Prairies contributing to the history, character and economy of the province and the prairie region;

WHEREAS Lake Winnipeg has had direct and significant relevance and impact on the history, culture, livelihood and economy of the Aboriginal Communities of the region;

WHEREAS Lake Winnipeg has world significance as the 10th largest lake and the 3rd largest reservoir in the world and the 3rd largest lake situated wholly within Canada;

WHEREAS Lake Winnipeg encompasses an enormous drainage area involving four provinces, four states and two federal governments and is directly impacted by water related decisions and actions taken in those jurisdictions;

WHEREAS Lake Winnipeg is under significant stress and deteriorating from anthropogenic activities that

have resulted in not yet totally understood effects;

WHEREAS Lake Winnipeg and the basin and will be impacted in undetermined ways from the forecasted climatic uncertainties underlying the need for increasing knowledge of the area and of methods for adapting to the climate variations;

WHEREAS Lake Winnipeg has historically been considered to be a northern lake, receiving proportionately significantly less research and management attention than the eastern Great Lakes;

WHEREAS Lake Winnipeg supports significant economic activity in the region, particularly through the fishing and recreation industries;

WHEREAS Lake Winnipeg serves as a major local and destination tourism opportunity;

WHEREAS the Governor in Council, by Order in Council dated , 2005 has authorized the Prime Minister, and the Ministers of the Environment and Fisheries and Oceans to enter into this agreement on behalf of Canada; and,

WHEREAS the Lieutenant Governor in Council, by Order in Council /2005 dated , 2005, has authorized the Premier and Minister of the Water Stewardship to enter into this agreement on behalf of Manitoba; and

IT IS THEREFORE AGREED BETWEEN THE PARTIES HERETO AS FOLLOWS:

Section 1 - Definitions

1. In this agreement, unless the context otherwise requires:

- (a) "fiscal year" means the period commencing on April 1 of any year and terminating March 31 of the immediately following year;
- (b) "Management Committee" means a committee of public servants appointed by the ministers to manage the implementation of the agreement;
- (c) "Ministers" means the Minister of the Environment for Canada and the Minister of Water Stewardship for Manitoba;
- (d) "Science Advisory Group" means a group of objective and professional experts appointed by the council to advise on the design, co-ordination and implementation of the research to be conducted consistent with the purposes of this agreement and the charter.

Section 2 - Purposes

2. This agreement has the following purposes:

- (a) Restore and sustain Lake Winnipeg as an economically and environmentally healthy lake;
- (b) Implement federal-provincial co-operative initiatives that will lead to short and long term action towards Lake Winnipeg improvements;
- (c) Establish a sustainable institutional mechanism for multi-party and public co-operation; and
- (d) Through public education and promotional materials, encourage water stewardship in the Lake Winnipeg basin and promote Lake Winnipeg as a Great Lake worthy of a management regime reflecting care and caution; and
- (e) Establish management and research priorities and facilitate immediate action for immediate gain.

Section 3 - Objectives

3. The agreement has the following objectives:

- (a) to establish a long term, multi-stakeholder mechanism to oversee the development and implementation of a research and management regime that will provide for the health and sustainability of Lake Winnipeg;
- (b) to understand and characterize the state of the water and aquatic environment of Lake Winnipeg by co-ordinating with existing programs and undertaking appropriate new technical studies in the lake and in the basin;
- (c) to provide a scientifically sound information base for planning and management of the water and aquatic environment of the Lake Winnipeg basin so as to enable lake improvement, long- term protection and wise use;
- (d) to collect and interpret data and develop appropriate models related to hydrology/hydraulics, water quality, fish and fish habitat, riparian vegetation/wildlife and use of aquatic resources for use in predicting and assessing effects and cumulative effects of future development;
- (e) to ensure that technical studies undertaken in the basin are conducted in a co-ordinated and co-operative manner and that their purpose, progress and results are reported regularly to the public; and
- (f) to develop indicators of the health of the lake and the basin impacting the lake

Section 4 - Principles

4. The purpose of this agreement is consistent with the following principles:

- (a) Lake Winnipeg should be treated under the same set of principles as the other Great Lakes;
- (b) Lake Winnipeg should be managed such that its full potential as a productive, healthy lake is realized;
- (c) The key to the health of Lake Winnipeg lies largely in the basin, therefore a basin-wide approach is required;

(d) Lake Winnipeg is the product of the hydrology and geology of multiple government jurisdictions, and its sustained health should be a legacy of their collaborative stewardship towards the lake they hold in common; and

(e) The restoration and sustained health of Lake Winnipeg will require a long term commitment of financial, scientific and institutional resources.

Section 5 - Management and Coordination

Management Committee

5.1 Canada and Manitoba agree to establish a management committee to implement the terms of this Agreement.

5.1.1 The management committee will be comprised of an equal number of federal and provincial representatives appointed by the respective ministers.

5.1.2 The management committee shall implement the agreement to ensure that the objectives and intent of the agreement are carried out and to ensure continuing liaison with the federal and provincial governments.

Healthy Lake Winnipeg Charter Council (The council)

5.1.3 The management committee shall establish a multistakeholder "Healthy Lake Winnipeg Charter Council" (the council) to provide to the members, advice, recommendations and leadership in the coordination of research, educational programs and basin management activities, towards the restoration and continuing health of Lake Winnipeg.

5.1.4 The founding members of the council will include the federal and provincial departments signatory to this agreement and up to X stakeholder groups recognized as having legitimate interest and influence in the health of Lake Winnipeg, including Aboriginal, municipal, academic and research interests.

5.2 The duties of the Council

Healthy Lake Winnipeg Charter

5.2.1 The council shall:

- undertake to **finalize a Healthy Lake Winnipeg Charter**, consistent with the draft set out in Appendix 1 and the process outlined therein, such that the charter represents a consensus of the members for the long-term care and management of Lake Winnipeg, including: a vision statement for a healthy Lake Winnipeg basin, principles of sustainability for the basin and goals and means to achieve the goals
- **prepare an interim program of work and an annual budget** for proposed programs and projects to be done under this agreement for the subsequent fiscal years
- **appoint a science advisory group** to advise on priority research needs, including analysis of a backlog of data and assessment of the results and to foster co-operation and co-ordination among research providers
- **facilitate the preparation of a detailed state of the science report** incorporating all of the geological, physical, chemical, and biological data available from 1969 – 2004.
- **prepare and implement a program of public information** and engagement including, but not limited to, reports on the purpose, progress and results of the charter deliberations, an annual state of the lake and basin report and the development of indicators for determining the health of Lake Winnipeg for use in planning and public reporting
- **design and host an annual State of the Basin Summit** for stakeholders and interested public for the purposes of presenting their State of the Basin report, report on the activities of the respective members and recommend research and follow-up activities for the coming year
- **encourage watershed planning** and provide capacity-building advice and information to local and regional governments and agencies as they pursue that activity

- **undertake discussions with representatives of the other jurisdictions** that contribute to the flow of water to Lake Winnipeg to encourage their involvement on the council and/or in the activities being undertaken in pursuit of the goal of restoring and sustaining the health of Lake Winnipeg
- provide opportunity for **expanding the membership on the council** to include federal and provincial government departments, Aboriginal interests and First Nation governments and stakeholder groups recognized as having a functional interest in the health of Lake Winnipeg and a capacity to contribute substantively to the discussions of the council and the activities associated with the goals of the council
- carry out such **other related duties** as the ministers may direct

Financial Management

5.2.2 In conjunction with the management committee, the council shall discharge the financial and accounting provisions of the agreement and, in particular:

- ensure that the manner in which funds are spent complies with the intent of the agreement
- ensure that funds are controlled and expended in accordance with the provisions of the legislative requirements of the funding parties
- reallocate funds, as appropriate, between approved projects
- determine eligible costs pursuant to this Agreement
- prepare annual budgets and work programs and reports

Public Records

5.2.3 In order to ensure transparency, the council shall meet regularly, keep minutes of its meetings and decisions, with the records to be available for public review.

Miscellaneous

5.2.4 The council may engage the services of an executive director to manage the activities of the council, and provide the executive director with offices and a secretariat as required to adequately perform the tasks assigned by the Council;

5.2.5 The management committee or the council may enter into contracts with individuals, government departments or agencies, universities, consultants, or private firms to carry out various aspects of the work.

5.2.6 Until such time as the council is operational, the functions set out in this section shall be undertaken by the management committee.

5.2.7 The ultimate responsibility for all decisions with regard to the operation of the agreement will rest with the ministers.

Section 6 - Financial Provisions

6.1 Consistent with the principle of longevity for this agreement, funding of this agreement will be in the form of a five-year renewal commitment, with a 10 per cent annual increment each year for the first five years, cost shared on a two-third federal and one-third provincial ratio, for total five- year federal and provincial contribution of \$26.7 million and \$13.3 million respectively for a total contribution of \$40 million.

Envelopes

6.2 Funds provided by the federal and provincial governments under this agreement will be allocated towards a number of envelopes. Suggested disbursement between the major envelopes is as follows:

(a) Provision of an integrative mechanism, initially a secretariat and operating costs for the committee, and subsequently, the Healthy Lake Winnipeg Charter Council: 2.5 per cent, or \$1million

(b) Establishment of an innovation fund to encourage the development of scientific and institutional capacity to effectively understand and manage the basin in a sustainable manner: 15 per cent , or \$6 million

(c) Underwriting research priorities by government: 37.5 per cent, or \$15 million

(d) Funding university research related to the health of Lake Winnipeg: 12.5 per cent, or \$5 million

(e) Preparing and implementing effective watershed planning in the Lake Winnipeg Basin: 25 per cent, or \$10 million

(f) Undertaking capacity-building, developing educational materials and other activities to promote proper stewardship of the basin: 7.5 per cent, or \$3 million

6.4 Where Canada and Manitoba are supplying goods and services as part of their share of eligible costs, such goods or services shall be supplied at no more than cost.

6.5 The provisions of funds by Canada and Manitoba for the implementation of this agreement are subject to the Parliament of Canada and the Legislative Assembly of Manitoba having approved and appropriated such funds for the fiscal year in which they are required.

Section 7 – Effective Date, Renewal and Amendment

Effective Date

7.1 This agreement shall take effect on _____, 2005. It shall be reviewed in the fifth year and at the end of every subsequent five-year period and be renewed after each review, except in extraordinary circumstances.

Review

7.2 A minister may cause a review of this agreement with three months notice, and the review will be undertaken by equal representation from the two senior governments with input from the charter members. The recommendations of the review team will be made to the initiating governments and may result in, subject to section 7.2, amendments to the agreement, continuation of the agreement or recommendations to terminate the agreement.

Amendment

7.3 This agreement may be amended by agreement of the ministers with the exception of Section 6.1 which can only be amended with the approval of the Governor in Council for Canada and the Lieutenant Governor in Council for Manitoba

Section 8 – General

Information Exchange

Canada and Manitoba shall, upon request, make available to each other, and to the participants, all available documents, including past and current reports, studies and analyses concerning land, water and the aquatic environment of the Lake Winnipeg basin for their use.

Indemnification

Where Canada or Manitoba undertakes or is responsible for any portion of the research or work associated with this agreement, it shall indemnify and save harmless each of the others, their officers, servants and agents, against all claims and demands of third parties in any way arising out of any work undertaken pursuant to this agreement, except as such claims or demands relate to the act or negligence of any officer, employee or agent of the others.

Conflict of Interest

No member of the Parliament of Canada or member of the Legislative Assemblies of Alberta or the Northwest Territories shall hold, enjoy or be admitted to any share or part of any contract, agreement, commission or benefit arising out of this agreement.

Participation in this agreement, entered into by those who have signed below, will be expanded at the earliest convenience by other departments and agencies of the two governments, as set out in the attached Addendum. Signature to the addendum will include a capacity and willingness to participate in the activities and funding associated with the implementation of this agreement.

IN WITNESS WHEREOF, the Prime Minister of Canada, Minister of Environment for Canada and the Minister of Fisheries and Oceans for Canada have hereto set their hands on behalf of Canada; Premier of Manitoba and the Minister of Water Stewardship for Manitoba have hereto set their hands on behalf of Manitoba.

The Right Honourable Paul Martin
Prime Minister of Canada
Dated, this day of , 2005

The Honourable Gary Doer
Premier of the Province of Manitoba
Dated, this day of , 2005

The Honourable Stéphane Dion
Minister of Environment for Canada
Dated, this day of , 2005

The Honourable Steve Ashton
Minister of Water Stewardship for Manitoba
Dated, this day of , 2005

A Funding Formula

This report is recommending a formal agreement between the governments of Manitoba and Canada. The agreement identifies various actions to monitor and study Lake Winnipeg to support management actions that will restore the lake to good health. These actions will either be carried out directly by the governments or supported by them, and will require funding.

In determining the level of funding required to underwrite the federal/provincial Healthy Lake Winnipeg Agreement there is no purely objective answer to the question "how much is enough". Governments must serve multiple priorities with scarce resources. They are already devoting some resources to Lake Winnipeg activities. They have the ability, should they choose to do so, to re-direct funds from other sources.

Is the present level of funding for Lake Winnipeg science adequate? The three best indicators to answer this question are: what is the value of the resource for present and future generations; what has been done to date on the lake and in the basin; and what has been identified as needed to be done to give us an adequate understanding of the natural systems and processes of the lake. In addition, a comparison to what is being done for the Great Lakes can be instructive – it can permit informed consideration of some proportional commitment for Lake Winnipeg, perhaps on the basis of population.

What is an appropriate level of funding? There are some indicators that might provide guidance. These include again, the value of the resource, comparisons to funding in other large drainage basins for similar activities to those envisaged under the Healthy Lake Winnipeg Agreement and a rough approximation of costs for research and monitoring priorities identified by the governments' own scientists.

How should funding be apportioned between the two governments? The answer to this question can be guided by considering the jurisdictional roles and responsibilities of each government, as well as their respective contributions to Lake Winnipeg science to date.

A further consideration relates to the multi-year commitment of funding. Should each year's funding be equal? The answer to this question can be guided by considering whether or not the agreement activities can all be implemented immediately; there may be a startup period required before the agreement is fully implemented. It may be necessary to accelerate actions over time because knowledge gaps are so large.

1. The annual monetary value of the resources of Lake Winnipeg is at least x\$.
2. The value to future generations may be incalculable.
3. The two governments have x\$ budgeted for agreement activities for 2005-2006.
4. Activities identified in the 2004 Science Workshop could cost x\$ per year.
5. Federal spending on Great Lakes science was x\$ last year.
6. Population in the Canadian portion of the Lake Winnipeg Basin is about 1/3 that of the Canadian portion of the Great Lakes basin.
7. The government of Canada has a clear research and science mandate under the sponsorship of several departments and acts of Parliament.
8. The government of Canada has been relatively inactive on Lake Winnipeg compared to its expenditures in other major Canadian watersheds. Provincial responsibilities relate mainly to the management functions that require sound science as a foundation.

- 9. Research and remediation work has been underway on the Great Lakes for over three decades while similar work is just now getting underway on Lake Winnipeg.
- 10. There are several examples of federal/provincial agreements for which the funding has eroded over time. Given the huge gaps in our knowledge of the lake, it is more likely that as some of the fundamental questions are answered, more complex issues will arise. Building in a funding accelerator will guard against future claw-backs.

FUNDING ALLOCATIONS AT A GLANCE

Total \$40 million over five years

Healthy Lake Winnipeg Charter Council:	2.5%, or \$1 million
Innovation Fund:	15%, or \$6 million
Research by government:	37.5%, or \$15 million
Research by universities:	12.5%, or \$5 million
Watershed planning:	25%, or \$10 million
Capacity building, education and other stewardship activities:	7.5%, or \$3 million

Suggested funding amounts from Fisheries and Oceans Canada and Manitoba Hydro are not included in the above.

Draft - Healthy Lake Winnipeg Charter

INTRODUCTION

Lake Winnipeg is a great lake. Although not in the cluster of the better known eastern Great Lakes, it is a great lake nonetheless. The 10th largest freshwater lake in the world and the 3rd largest in Canada, Lake Winnipeg serves a catchment area that includes four Canadian provinces and four US states. It is a basin made up of many other basins. It hosts the one of the largest single lake commercial fresh water fisheries in Canada and the largest commercial walleye fishery in the world. It is the 3rd largest hydro electric reservoir in the world.

The value of the lake to the province and region is inestimable. Aside from its tangible value arising from a commercial fishery that contributes in excess of \$20 million annually, and making a considerable contribution to provincial and Interlake tourism and recreation, Lake Winnipeg contributes significantly to the culture of Winnipeg and surrounding region. It has an intangible appeal caused by its very existence as a nearby great lake. The lake carries the stuff of legends – stories of intense storms and wave activity beating solid boats apart; long and arduous treks by early settlers in York boats plowing the vast waters from York Factory near Hudson Bay, down Lake Winnipeg to Selkirk; and nights of raucous entertainment at the amusement park at Winnipeg Beach – home of the great wooden roller coaster on the sand. The lake continues to be a draw to folks contemplating a move to Manitoba, as it provides ready access to wonderful and affordable cottage country only one hour away from Winnipeg..

Lake Winnipeg has been in a state of decline for a number of years. Satellite photos reveal increasingly large blankets of blue-green algae, especially in the

northern basin. These algal blankets contain toxins that can accumulate and enter food chains and drinking water, causing health concerns. The algal blooms are fed by nutrients from point source sewage treatment and from landscape activities such as agriculture.

This lake is influenced and managed by a multiplicity of interested governments, including federal, provincial, state, local and First Nations, and a legion of legitimate interested stakeholders and users of the water and related resources. Keeping Lake Winnipeg viable ecologically and economically has become a challenge for everyone involved in its future. Its continued viability requires co-operation and co-ordination between all relevant governments, interested organizations and citizens resident in the basin.

BACKGROUND

Lake Winnipeg, long treated as a northern lake, has had little research attention until very recently, in comparison with the other Great Lakes which have benefited from orders of magnitude, more attention and investment. In response to this situation, the Manitoba Government appointed a Lake Winnipeg Water Stewardship Board to make recommendations related to action required for the lake. Subsequently, in 2005 the federal and provincial Governments appointed a Lake Winnipeg Implementation Committee, co-chaired by Terry Duguid and Norm Brandson, to identify and advise on mechanisms of federal and provincial co-operation on Lake Winnipeg. The adoption of the proposed Charter and the formation of the Healthy Lake Winnipeg Charter Council are logical next steps proposed by the Lake Winnipeg Implementation Committee to provide leadership.

There is much more to learn about Lake Winnipeg and the impacts of the water and land based decisions that impact it. There is much to be done to engage the residents and governments of the basin in the critical decisions and action that are required to restore it. This charter is meant to be the beginning of a long and effective initiative to ensure a healthy Great Lake in the heart of Canada and in the hearts of Canadians; Lake Winnipeg - Canada's sixth great lake.

NATURE AND PURPOSE OF THE CHARTER

In order to co-ordinate and influence the management of a lake and watershed of such complexity, new ways must be found to ensure a collaborative approach to decision-making. The many interests must be prepared to engage in building consensus and making collaborative decisions aimed at restoring the health and ensuring sustainability of the lake.

The Healthy Lake Winnipeg Charter is an agreement between the governments of Canada and Manitoba and other interested parties with a recognized stake in the sustainability of Lake Winnipeg and the management of the sub-basins that input into Lake Winnipeg. This charter recognizes Lake Winnipeg as a basin with sub-basins, each with its own character, issues and management mechanism. The charter recognizes that it is largely the decisions made in these sub-basins that determine the quality of the water in Lake Winnipeg. This charter brings together representatives of the interested parties to collaborate in information sharing, planning, decision-making and monitoring.

This charter is a statement of common purpose and forms the basis for moving ahead in an inclusive good-faith agreement. A charter of this nature represents the combined thinking of the relevant interests, including government, commercial, environmental and health. This charter will facilitate progress by setting out the vision, principles, goals and activities of people and organizations working in common pursuit of a sustainable lake system and its basin

THE LAKE WINNIPEG BASIN VISION

The following vision will guide the participating organizations in the implementation of this charter:

- A great lake that is healthy and vibrant and supports the livelihood and recreational and commercial needs of the basin on a sustained basis.
- A great lake that is well understood through a sustained and well-resourced research effort involving academia, government and the private sector in co-ordinated interdisciplinary studies.
- A great lake that benefits from sound, sustainable decisions in the sub-basins that contribute its water.
- A great lake that is a popular destination for recreation and tourism.
- A great lake basin that benefits from healthy waterways with healthy riparian areas.
- A great lake basin that benefits from decision making that is shared and the residents and governments work together to develop common goals that reflect the interests of a diverse population and reach creative decisions to achieve those goals.
- A great lake basin where Aboriginal interests and knowledge are reflected in decisions and where their rights and title now being defined and recognized are reconciled in a just and fair manner.

OPERATING PRINCIPLES

The following principles will form the foundation of deliberations, decisions and actions respecting the implementation of the Charter:

- Inclusiveness – This is large basin made up of smaller basins with different and, at times, competing interests. All interests must be represented in the decision-making processes.
- Transparency – Decisions must be made in an environment of understanding. Information must be readily available. Processes must be highly public.

- Solvency – For effective collaboration and good research, adequate resources, both human and financial, need to be available.
- Cohesiveness - Basic science must be the foundation for planning, education and management.
- Longevity – A long-term commitment from all the parties is required to ensure sustained benefits to the basin and lake
- Diversity - Just as inclusiveness should ensure human diversity, actions have to respect and reflect natural diversity.
- Accountability – Each of us must be accountable for the environmental, social and economic implications of our decisions and actions.
- Integration – Consideration of social, economic and environmental costs and benefits must be an integral part of decision-making.
- Adaptive approaches – Plans and activities must be adaptable and able to respond to changing needs and social values.
- Recognition – There must be recognition of existing rights agreements and obligations in all decision-making.
- Aboriginal rights and title – Aboriginal nations within the Lake Winnipeg basin assert aboriginal rights and title. These rights and title now being defined must be acknowledged and reconciled in a fair and just manner.
- Time for transition – Sustainability is a journey that requires constant feedback, learning and adjustment. In the short term, the elements of sustainability may not always be in balance.

CHARTER GOALS

Understanding the lake

Develop and maintain excellence in research to understand the workings of the lake including the impacts of human activity on the water quality of the lake.

- Nutrients – phosphorus and nitrogen
- Regulation – impacts of lake regulation – minimal flushing action
- Pollution – for example, endocrine disruptors

Understanding the basin and its impacts on the lake

Develop and maintain excellence in research to understand the interaction between land-based practices and the quality of water draining into the lake.

- Application of land based fertilizers and transfer of nutrients through soils
- Effectiveness of buffer strips along riparian zones
- Efficacy of phosphorus and/or nitrogen removal in sewage treatment

Influencing decisions that lead to sustainability in the lake and the basin

Develop mechanisms for bringing together in consensus processes groups and individuals whose decisions have a significant impact on the lake.

Resolving conflicts that can impact sustainability and hinder careful decision-making

Provide a service to assist in problem-solving in an area, or about an issue, that has ramifications in the basin.

Promoting partnerships for co-ordinated action or research for issues related to sustainability in the basin

Establish a science advisory council or similar mechanism that can translate policy and other issues into specific research needs and priorities, and provide liaison with academia and foundations to promote needed research.

The Lake Winnipeg Consortium and MV Namao, Freshwater Institute, Universities and governments have the opportunity to work collaboratively to establish and pursue research goals.

Promoting sound agricultural practices to balance economic opportunities with the protection of ecological systems

Encourage farm management programs and sound practices through partnering with educational organizations and federal and provincial governments.

Promoting Lake Winnipeg as a destination for recreation and tourism

Assist in planning for economic opportunities to attract tourists and sports enthusiasts from outside the basin and promote the lake as a local holiday haven.

Partnering in the immediate priorities associated with nutrient management to address the issue of blue-green algae

Collaborate through the Science Advisory Group to design and implement priority research programs to address the issue in a concerted manner, with each member organization contributing in its area of expertise.

Promoting and providing assistance in watershed planning throughout the larger basin

Regional watershed organizations, such as Manitoba's Conservation Districts are at different levels of competence and commitment to watershed planning. Provide information and expertise to encourage and

build capacity in the regions for effective planning in watersheds within the Lake Winnipeg basin.

Providing assistance and coaching for sustainability decision-making

Undertake capacity-building activities such as educational seminars, planning and consultation assistance and coaching, to assist local and regional decision-makers in sustainability decision making

The implementing mechanism - a council for the basin

To accomplish the above goals, there shall be a Healthy Lake Winnipeg Council (The council) that will provide oversight to the implementation of the charter. It provides opportunity for all groups recognized as having an interest in the sustainability of Lake Winnipeg to sign the charter and thereby participate in the deliberations and activities associated with the council. By signing the charter, groups undertake to take an active role in the charter's implementation. The council will, in conjunction with performing its broad mandate in the basin:

- initiate a multistakeholder process to refine and finalize this draft charter
- recommend immediate action or research on critical issues needing urgent attention
- assist in capacity-building for communities and regions to undertake effective watershed planning
- undertake educational programs to influence healthy stewardship of the land and waterways in the basin
- appoint a science advisory group to advise on matters of science and recommend co-ordinated research priorities to the respective research providers
- facilitate the development of indicators to assist in the quantification and qualification of the health of Lake Winnipeg and the key river inputs to the lake

- prepare an annual State of the Basin Report for public information
- plan and host an annual State of the Basin Summit where members report on the progress of their organization, the council reports on the activities, overall progress and plans of the council and presents the annual State of the Basin Report; and the science advisory group makes recommendations for the coming year's research priorities
- partner with capable research providers such as universities, Lake Winnipeg Research Consortium (MV Namao) and the Freshwater Institute to acquire private and government funding for further activity

Membership in the council will begin with the federal Department of Environment and the provincial Department of Water Stewardship and expand to incorporate other government departments, local and First Nations governments and stakeholders as they meet the membership criteria.

Membership criteria include:

- a general recognition that the applicant organization represents a legitimate interest base in the outcome of decisions or actions impacting the lake and the basin
- the capacity to actively engage in discussions and activities associated with achieving the goals of the council
- commitment adhere to the obligations associated with membership

Obligations associated with charter membership

Agreement to participate requires a commitment to active involvement towards achieving the overall goals set out in the Charter, including:

- a commitment, in its annual action plan, to undertake activities that are consistent with the broad directional goals of the Council for the coming year;
- a commitment to accountability to the Council through the provision of an annual public report to the Council; and
- participation in the Annual State of the Basin Summit.

It implies taking responsibility for action towards the goal of Lake Winnipeg's sustainability. The annual State of the Basin Summit sponsored by the council should be supported by all members as a major public event, integral to engaging the general public in issues under discussion in the basin and demonstrating the accountability of members to live up to their charter obligations.

In terms of membership and other aspects of involvement, the issues of Aboriginal rights and title will be acknowledged and reconciled in a fair and just manner.

We, the undersigned, agree to support and adhere to the provisions of this charter in the pursuit of restoring the health of Lake Winnipeg:

Name

Organization

Date

ADDENDUM 1

The process for the finalization of the Healthy Lake Winnipeg Charter will be as follows:

The council will review the draft charter and identify issue areas - agreed need for amendment, areas of possible contention and areas for elaboration.

The council will identify and invite participation from stakeholders with a legitimate interest in formulating the charter. This may include direct networking or public advertising, or both.

The council will establish and run a consultative process most likely to achieve consensus and prepare a revised draft that reflects the consensus reached. Where no consensus is reached, the council will propose its own solution.

The council will submit the draft charter to the management committee for approval of the federal and provincial governments through the ministers.

Upon receipt of approval, the council shall adopt the charter

Upon adoption of the charter by the council, it shall be opened to participants and other recognized and qualified (commitment and capacity) stakeholders to sign the charter and become members of this group committed to restoring the health of Lake Winnipeg.

ADDENDUM 2

Additional federal and provincial participants

Canada

Fisheries and Oceans Canada
Indian and Northern Affairs Canada
Natural Resources Canada
Agriculture and Food Canada

Manitoba

Manitoba Agriculture , Food and Rural Initiatives
Manitoba Intergovernmental Affairs and Trade
Manitoba Conservation
Manitoba Hydro



