



**Lake Manitoba Stewardship Board**

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**Science Workshops Report**

**Delta Marsh Field Station**

**May 12, 2008**

**St. Laurent**

**June 24, 2008**

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## *Introduction*

On 27 February 2007, the Honourable Christine Melnick announced the formation of the Lake Manitoba Stewardship Board. Formation of this Board was recommended by the Lake Manitoba Regulation Review Advisory Committee (LMRRAC), which functioned between 2001 and 2003.

It is within the Lake Manitoba Stewardship Board's (LMSB) terms of reference “to advocate long-term monitoring and research on the water levels and the health of Lake Manitoba, Lake Pineimuta and Lake St. Martin, including coastal marshlands along these water bodies.” To achieve this, the LMSB requires a solid foundation of knowledge on the Lake.

The LMSB held Science Workshops on May 12, 2008 and the June 24, 2008 to establish what is known about Lake Manitoba and also to identify knowledge gaps. To effectively manage the lake, the LMSB must understand how the lake may be affected by climate change and associated changes in water supply, lake level regulation, invasive species, present and future agricultural and residential land use in the watershed, and other potential threats to water quality and fisheries.

The Board invited technical experts (Appendix A) from a wide range of fields including remote sensing, water quality, water management, fisheries, agriculture and cottage development to the Science Workshop. Invited experts were from federal, provincial, academic and non-government organizations. The meeting was facilitated by the Chair of the Lake Manitoba Stewardship Board, Gordon Goldsborough.

The Science Workshop focused on a number of topics including remote sensing, water quality, water management, wetlands, agriculture and cottaging.

## *Remote Sensing & Satellite Imagery*

In a presentation to the Board, Greg McCullough (Center for Earth Observation Science, University of Manitoba) suggested that data on the magnitude, frequency, and extent of algal blooms, suspended sediment concentrations, carbon concentrations, and surface temperature could be obtained through remote sensing and satellite imagery. Satellite images and remote sensing allow good estimates of water quality.

Satellite imagery is currently being used to determine concentrations of algae and suspended sediments in Lake Winnipeg. McCullough indicated that these types of images could also be used to estimate concentrations of algae and suspended sediments in Lake Manitoba but that appropriate algorithms would need to be developed. Manitoba Water Stewardship discussed the possibility of assessing these images on a regular basis to provide more routine, spatial information on the concentration of algae and suspended sediments.

McCullough also explained that the rate of evaporation could be estimated with data collected from remote sensing. Evaporation rate is a vital piece of information required to prepare a detailed water budget for Lake Manitoba.

To use satellite imagery and remote sensing to help understand the health of Lake Manitoba discussions need to take place amongst interested parties.

## *Land Drainage*

Commencing in the late 1800's and continuing today drainage has impacted the three lakes. Between 2002 and 2006 the drains in Manitoba have been mapped and classified by fish utilization and habitat type (Fisheries & Oceans, unpublished data). In the same study, water quality parameters were measured. The results of this study have not yet been published. This information is vital to the understanding of changes in Lake Manitoba and its watershed over the past century. Drainage works, such as the Shoal Lake Drainage Proposal, have the potential to impact Lake Manitoba's water quality.

The landscape surrounding Lake Manitoba has changed substantially over the past 130 years due to changes in land use and drainage. This may have impacted the water quality of the lake. Due to the potential impact of drains, it may be important to determine the drainage density (number of drains per square kilometer) in the Lake Manitoba watershed. A 2005 report titled *Summary of Resources and Land Use Issues Related to Riparian Areas in the Lake Manitoba Watershed Study Area* by Agriculture and

Agri-Food Canada – Prairie Farm Rehabilitation Administration looked at land use change around the south basin of Lake Manitoba from 1992 to 2003. This report may assist in quantifying the increase in drainage surrounding the lake.

The Dominion Land Survey Maps for the Red River Valley, south of Winnipeg were shown to the Board and guests. A comparison of wetland coverage between the 1870s and the mid-1990s showed that the amount of wetland coverage has decreased immensely (Irene Hanuta, *Land Cover and Climate for Part of Southern Manitoba: A Reconstruction from Dominion Land Survey Maps and Historical Records of the 1870s*, PhD Dissertation, University of Manitoba, 2006). Further investigation is needed to determine if similar drainage development has occurred in the Lake Manitoba Watershed and its impacts.

### *Water Quality*

Water quality is the physical, chemical and biological characteristics of water in relation to a set of standards. The water quality dataset for Lake Manitoba is fairly limited. In partnership with staff at the University of Manitoba Delta Marsh Field Station, Manitoba Water Stewardship has monitored water quality monthly since 1991 at a station located approximately 1 km offshore from the Delta Marsh Field Station. Since 2004 and 2006, the province has also monitored water quality quarterly at Lake Manitoba Narrows and at the outlet of Lake Manitoba at the Fairford River respectively. In addition, a recent Masters Thesis project by Elaine Shipley (University of Manitoba) has contributed to the current understanding of water quality in Lake Manitoba. It was agreed that a commitment to long-term monitoring of water quality is important.

Lake Manitoba is generally well mixed, so depth gradients are not expected; surface water quality monitoring should be sufficient. Further investigation and discussion will be required to determine the variables that should be assessed and whether flow data should also be collected. The value of using volunteers to collect water samples was recognized, given the large size of the lake. Volunteer citizens and fishers could help to collect samples if standard protocols and training were provided. The use of volunteers is often cost effective and improves the connection between local residents and their interests in the lake health.

More information is required on the impacts of the operation of the Portage Diversion on water quality in Lake Manitoba. For example, the south basin of Lake Manitoba seems to be becoming less saline and it has been speculated that this is due to the

operation of the Portage Diversion. The Portage Diversion has operated 27 times since its completion in 1970.

Paleolimnology could be used to hindcast historical phosphorus and nitrogen concentrations and the trophic status of Lake Manitoba. Since the sediment in Lake Manitoba is often resuspended, the cores would probably indicate changes over decades and not years. Since paleolimnology and the associated coring can be very expensive, it may be appropriate to start with a smaller scale study on one or two cores. Further studies could be undertaken, if required, based on the results from the initial cores.

### *Water Management*

Since the late 1800s, attempts have been made to control the water level of Lake Manitoba, in response to high lake levels in the early 1880s, low levels in the 1930s, and high levels in the mid-1950s. The lake is currently regulated by the Fairford River Water Control Structure (FRWSC) which was installed in 1961. In 1961, operating rules were put in place to regulate the elevation of Lake Manitoba between 810.87 – 812.87 feet with a target elevation of 812 feet. In 2003, the LMRRAC recommended that the provincial government allow the lake levels to fluctuate more to protect the marshlands surrounding the lake. Lake Manitoba is now permitted to fluctuate naturally between 810.5 and 812.5 feet above sea level. This is a result of Manitoba Water Stewardship accepting the recommendation made by the LMRRAC in 2003. Further information and a better understanding are needed about downstream flooding around Lake St. Martin and the Dauphin River and other effects of the FRWSC such as fish movement

A number of knowledge gaps on hydrological issues in Lake Manitoba were identified. A detailed water budget is required to understand water flows and water quantity in the lake. There is also a lack of information on water flow through the Lake Manitoba Narrows and the water exchange between the north and south basins of the lake. The largest inflows and outflows from the lake occur in the north basin, however, it is not known to what extent water from the south basin mixes with water from the north basin. Development of hydraulic and water quality models would help to address these issues. Such modelling requires an accurate digital bathymetric map of Lake Manitoba, but it is not known if one exists. Hydrographic maps were generated for Lake Manitoba in the mid 1980s. There is a need to determine if a digital bathymetry for Lake Manitoba exists through contacting federal and provincial geomatics branches.

## *Fisheries*

The Lake Manitoba fishery is the largest winter fishery in the province and the third most important fishery in the Province of Manitoba.

The group suggested that the natural spawning habitat surrounding the lake may not be sufficient to support the modern fishery. To support the fishery, hatcheries in St. Laurent, Swan Creek and Lonely Lake are used for restocking the lake with walleye. Anecdotal evidence from Lake Manitoba fishers indicate that when the lake water levels are higher, there is often a better yield. Higher water levels may improve accessibility of the lake to the hatchlings, such that they do not get caught inland after high spring run-off.

The Fairford Fishway may be influencing the passage of fish from Lake St. Martin and the Dauphin and Fairford Rivers into Lake Manitoba as well as in the opposite direction. In October of 2007, North/South Consultants completed a study of the Fairford fishway, which was criticized as too short and open-ended. It was suggested that a spring study on the fishway would be critical to better understand the effects that the fishway has on the movement of fish. The fishway is often clogged with debris that impedes fish passage and only a certified hoist operator can remove the debris. This debris can sit for a lengthy period of time before being removed since someone from Winnipeg or Dauphin must come out to operate the hoist. Training local residents as hoist operators would allow the fishway to be cleared in a timely manner, thus reducing the impact on the movement of fish.

The group stressed the importance of knowing whether the Lake Manitoba fishery is sustainable. It was indicated that fisheries management in Manitoba is based on maximum sustainable yield (MSY). Obtaining the history of index netting on Lake Manitoba in conjunction with a summary and interpretation of the data is essential.

The group indicated a lack of knowledge regarding fish habitat surrounding Lake Manitoba. The impacts on fish habitat as a result of the building of stream crossings and the straightening of streams due to agriculture, road construction, etc are not well known around Lake Manitoba. It is known that in some instances, these practices, as well as beaver dams, can result in loss of fish habitat. Improved enforcement of Best Management Practices (BMPs) for stream crossings is expected as a result of an increase in fisheries officers in Manitoba.

## *Wetlands*

Wetlands are among the least studied aquatic ecosystems in the province, with almost no ongoing long term monitoring. There is an estimated 236, 700 hectares (ha) of wetlands in the area surrounding Lake Manitoba, Pineimuta Lake and Lake St. Martin, with more than 121, 400 of those hectares having high to moderate capability of supporting waterfowl due to the degradation of wetlands. Since Lake Manitoba is surrounded by an abundance of wetlands it is vital to learn about the interrelatedness of the wetlands and the lake. Wetlands are water bodies that require variation in water level for wetland regeneration and to support and maintain aquatic life. Variation in water levels on Lake Manitoba is important for maintaining the health of wetlands surrounding the lake. Wetlands are an important source of native hay and provide grazing, for cattle and are therefore of economic importance as well.

Wetlands surrounding the lake provide vital habitat for a variety of species. Invasive species present a risk to native species in the lake and the wetlands that surround it. The invasive species of most concern to the group was carp. Carp have completely altered many of the wetlands surrounding Lake Manitoba, therefore affecting many other species including muskrats and waterfowl.

The effect of carp on wetlands is well demonstrated in the Lake Francis management area, where carp have uprooted many native plant species and destroyed habitat for water fowl, muskrats and various invertebrates. When water levels on Lake Manitoba were high an emergency discharge channel was built on Lake Francis, which allowed passage of carp into the Lake Francis management area. Hunters and trappers from the area have voiced their concerns regarding the channel, associating the channel with the disappearance of waterfowl and muskrats in the area. In 2005 Manitoba Conservation placed screens on the culvert that links the channel to Lake Francis in order to prevent the carp from entering Lake Francis. Shortly after installing the screens, the waterfowl and muskrat populations rebounded to what they were prior to the channel being constructed. The recent high water levels seem to have benefitted muskrat populations in the area of Lake St. Martin.

## *Agriculture*

Agriculture surrounding Lake Manitoba is greatly influenced by the soil capability and limitations imposed by natural conditions, such as the water table and soil type. Agriculture varies markedly from south to north along the lake. Approximately 40



percent of the total acreage of the farms adjacent to Lake Manitoba consists of lands from which native hay is harvested. The remaining acreages on these farms are predominately used for pasture.

Agricultural activities have been underway in the Lake Manitoba watershed for the last century and during this time the landscape has changed immensely. Cattle ranching dominates agriculture along Lake Manitoba. Due to economic conditions, cattle ranching is becoming less profitable, which may lead to a change in the type of farming around the lake. The land north of Lundar and Amaranth is not suitable for crops so cattle ranching will likely continue in that region and will continue to be sustainable in the long term. Manitoba Water Stewardship currently monitors pesticide concentrations at long-term monitoring stations across Manitoba including sites within the Lake Manitoba watershed. The group emphasized that the LMSB needs to stay informed of changing agricultural practices since this may lead to a change in the composition of runoff that enters the lake. This may include increases in pesticides, nutrients and suspended solids.

There are incentives, such as the Environmental Farm Plan, that are important in encouraging farmers to improve their practices to reduce potential impacts on water quality. An example of an improved practice is to fence off water ways and instead use solar powered water pumps to water livestock.

### *Cottaging*

In 2003 there were approximately 2,000 cottage properties along the shores of Lake Manitoba. Although cottaging is an important use of the Lake Manitoba shoreline, recreational activities can impact water quality and quantity. The group stressed the importance of advocating water conservation to the local cottage associations. Seasonal cottages are becoming full-time residences, leading to higher grey water production year round and potentially resulting in greater impacts on the lake's water quality. It is important to ensure that appropriate wastewater treatment technologies are employed by cottagers, and also to have sufficient enforcement to ensure that treatment is adequate. There is a need to verify that septic tanks are in tact. The group expressed an interest in surveying cottages surrounding the lake in order to compile information on their seasonal use, water source and wastewater treatment etc.

Development around Lake Manitoba is occurring at a rapid rate. The LMSB should keep informed about proposed development projects around the lake, since this will affect many of the issues discussed at the Lake Manitoba Science Workshop.

## *Conclusions*

The LMSB was appointed by the province to examine the health of Lake Manitoba, Lake Pineimuta and Lake St. Martin, including coastal wetlands along these water bodies. Through discussions at the May 12, 2008 and June 24, 2008 Science Workshops, the Board has become aware of a number of facts or findings related to Lake Manitoba and areas downstream that require additional research. The Board established some of what is known about Lake Manitoba and has also identified knowledge gaps as listed.

### *Established Knowledge*

- Lake Manitoba is quite shallow and well mixed, so surface water sampling is adequate.
- The major inflow and outflow of Lake Manitoba are both located in the North basin.
- Lake levels have been regulated by the Fairford River Water Control Structure since 1961.
- Lake levels must be allowed to vary to maintain healthy wetlands that surround the lake.
- Carp are detrimental to wetlands and species that inhabit them.
- Lake Manitoba has the largest winter fishery in the province.
- The construction of stream crossings and straightening of streams reduces and obstructs fish habitat and movement.
- Approximately 40 percent of the agricultural acreage adjacent to Lake Manitoba consists of lands from which native hay is harvested. The remaining acreages are predominately utilized for pasture.
- Environmental Farm Plan offers farmers incentives to farm sustainably around the lake.
- The number of cottages surrounding the lake is increasing and more of them are becoming full-time homes.

### *Knowledge Gaps Identified*

- Determine whether a digital bathymetric map exists for Lake Manitoba?
- Understand the impact of the Portage Diversion on the south basin of Lake Manitoba.
- Apply satellite imagery to help the understanding of Lake Manitoba's water quality, etc.
- The effectiveness of the Fairford Fishway in allowing the passage of fish.
- Is the Lake Manitoba fishery sustainable at current harvest levels?
- What types of wastewater treatment are appropriate for different areas surrounding the lake for preventing chemicals and nutrients from entering the lake?
- How will future changes in land use and land drainage will affect Lake Manitoba, Lake St. Martin and Pineimuta Lake water quality and quantity?
- Determine the interchange of water flows through the Narrows and to what extent is water exchanged between the North and South basins?
- Can drain classification data help us to better understand the impacts of land drainage and habitat loss?

- Could paleolimnological investigations provide useful information in understanding the history of phosphorus and nitrogen concentrations and the trophic status of Lake Manitoba?
- How do lake levels affect spring fish recruitment?
- Does wetland water have an impact on lake water quality?
- Do pesticides used in the Lake Manitoba watershed enter the lake?
- Will the function of the natural spawning habitat be sufficient to support the modern fishery.
- Review and update the water balance of Lake Manitoba.
- How has drainage surrounding the three lakes changes as a result of development?

*Appendix A:*  
*Attendees*

**Lake Manitoba Stewardship Board**

Gordon Goldsborough (Chair)  
Bill Finney  
Allan Gaudry  
Donald Smith  
David Milani  
Rae Trimble-Olson  
Linda Schroedter  
Tracy Fillion  
Dan Coyle  
Gary Morlock  
Bob Harrison  
Laura Manson (Technical Secretariat)

**Technical Experts**

Dwight Williamson (Manitoba Water Stewardship)  
Elaine Shipley (Manitoba Water Stewardship)  
Nicole Armstrong (Manitoba Water Stewardship)  
Greg McCullough (University of Manitoba)  
Don Sexton (Ducks Unlimited)  
Pascal Badiou (Ducks Unlimited)  
Greg Bruce (Ducks Unlimited)  
Chelsey Lumb (Manitoba Water Stewardship)  
Glen Sugget (Manitoba Conservation)  
Rod Drummond (Fisheries & Oceans Canada)

*Appendix B*  
*Glossary*

**Bathymetric Map** – A map displaying measurements of the depths of oceans or lakes.

**Hydrographic Map** – A map displaying measurements and description of any waters. It can pertain to physical characteristics of water and marginal land.

**Remote Sensing/Satellite Imagery** – The science of gathering data on an object or area from a considerable distance, to observe the earth or a heavenly body.

**Saline** – Containing salt.

**Paleolimnology** – The study of ancient lakes from their sediments and fossils.

**Trophic** – Describing the relationships between the feeding habits of organisms in a food chain.

**Wetland** – Includes the following three characteristics: 1) presence of water less than 2 meters deep for at least some part of the growing season; 2) low-oxygen conditions in the soil that arises from the persistent water, resulting in specific chemical conditions; and 3) plant species adapted to the preceding two conditions.