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Progress Report on the
Lake Winnipeg Basin Initiative
2012–13 and 2013–14



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Cover photos:

Commercial fishing boats at Gull Harbour in Lake Winnipeg

Environment Canada scientists conducting freshwater ecological studies in the Lake Winnipeg basin

Algal blooms at a swimming area on the shoreline of Lake Winnipeg (Gull Harbour, Manitoba)

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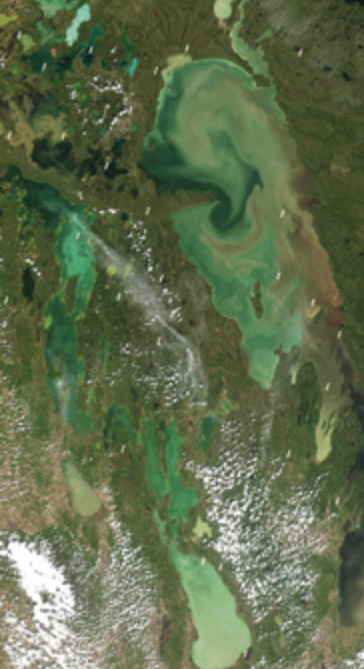
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Finally, we would also like to acknowledge the work of all the organizations that have participated in or provided funding and in-kind support for Lake Winnipeg Basin Stewardship Fund projects. A full list of projects can be found in the appendices of this report.



Satellite imagery shows green algal blooms in the north and south basins of Lake Winnipeg.

Threats to the Health of Lake Winnipeg

Lake Winnipeg is the tenth largest freshwater lake in the world and the sixth largest in Canada. Although Lake Winnipeg is located entirely within Manitoba, its vast (almost 1 million km²) basin is the second largest in Canada and encompasses parts of four provinces and four American states. The scale of the basin and the size of the lake make it a freshwater body of international significance.

The water quality in Lake Winnipeg has been deteriorating for several years. This has put the health of the lake at serious risk. The chief concern is an increasing amount of nutrients, such as phosphorus and nitrogen, which are a food source for algae in the lake. These nutrients originate mainly from agricultural runoff and municipal waste water and are carried into Lake Winnipeg by rivers and streams. Nutrient loading is made worse by the extended wet-cycle in the Red River basin, which has resulted in higher spring runoff and floods such as those experienced in 2009, 2011 and 2014. More than 50% of the nutrient loading to Lake Winnipeg originates from beyond Manitoba's borders, and the Red River is the largest source.



Lake Winnipeg basin: Almost 1 million square kilometres of land drains into Lake Winnipeg.



Approximately half of the phosphorus in Lake Winnipeg comes from the Red River, making it the largest source of phosphorus to the lake. On average, the Red River contributes approximately 7150 tonnes of phosphorus per year to Lake Winnipeg.

Lake Winnipeg's suffering health is evident in satellite images taken over the past decade, which indicate an increasing trend in the frequency and size of algal blooms. Some of the algal blooms cover thousands of square kilometres of the lake and have been three times bigger than the province of Prince Edward Island. Algal blooms clog fishing nets, foul beaches and, under certain conditions, produce harmful toxins.

More concerning, though, is that algal blooms are evidence that the lake is in an advanced state of eutrophication due to high concentrations of nutrients. Eutrophication means that healthy freshwater has become so over-enriched with nutrients that algal blooms and other decaying organisms may eventually deprive the lake of its oxygen. The situation is comparable in many respects to that of Lake Erie in the 1970s and again in recent years.



Healthy water quality in Lake Winnipeg is important to support a thriving commercial freshwater fishery (Hecla Village Harbour in Lake Winnipeg).

Lake Winnipeg is also facing threats from several invasive fish and other aquatic species. These non-native species are thriving in the nutrient-rich waters of Lake Winnipeg and pose a threat to the native species in the lake. In 2013, zebra mussels were found in several harbours in Lake Winnipeg. Efforts to eradicate them in the infested harbours were successful, but undetected seed populations survived outside the treated harbours and will continue the infestation of the lake. The presence of zebra mussels in Lake Winnipeg has potentially severe negative implications for its ecosystem health. They affect how energy and nutrients move through the food chain, they aggressively compete with native species for food, and their biological processes often result in more algal blooms.

The ongoing eutrophication of Lake Winnipeg and the threat from invasive species have potentially serious repercussions. The lake plays a vital role in Manitoba's economic prosperity and well-being by supporting an annual \$50-million freshwater commercial fishery and a \$110-million tourism industry. Without a reduction in nutrients, deterioration in the lake's water quality will continue towards severe eutrophication with potentially irreversible negative impacts on the aquatic ecosystem and on the livelihood of those who depend on a healthy lake.

The problems and solutions to the challenges faced by Lake Winnipeg are interprovincial and international in scope. Any solutions for improving the health of the lake will require the coordinated efforts of multiple stakeholders. The Government of Manitoba and its neighbouring jurisdictions are already taking action and developing strategies to reduce nutrient loading to local waterways that drain into Lake Winnipeg. Since 2007, the Government of Canada has collaborated with other governments and stakeholders, conducted science and monitoring, and supported local stewardship action through the Lake Winnipeg Basin Initiative. This increased coordination of efforts across Lake Winnipeg's vast basin will help governments to better synchronize action, share innovative solutions and pool research findings. Although progress has been made, continued collaboration is needed to improve the health of Lake Winnipeg and its basin.



Marsh grasses extract nutrients from the water, reducing the load going into Lake Winnipeg (Hecla Island in Lake Winnipeg).

Lake Winnipeg Basin Initiative Overview

The Lake Winnipeg Basin Initiative (LWBI) is the Government of Canada's response to address the water quality issues in Lake Winnipeg. The LWBI aims to engage citizens, scientists, and domestic and international partners in actions to restore the ecological health of Lake Winnipeg, reduce pollution and improve water quality. As part of the Action Plan for Clean Water, Budget 2007 committed \$18 million in funding to address excess nutrient problems in Lake Winnipeg. While the LWBI was successful in achieving its initial objectives, ongoing poor water quality from multiple transboundary sources continues to stress the health of the lake and puts substantial lake-based commercial and recreational industries at risk.

Phase II of the LWBI (\$18 million, 2012-2017) was announced under the Economic Action Plan in Budget 2012. Building on the work from Phase I, Phase II increases focus on stakeholder stewardship actions that measurably reduce nutrient loading and improve Lake Winnipeg's water quality. Science efforts during Phase II will focus on watershed and in-lake research and monitoring to help identify and measure which actions on the land will best improve water quality in the lake. An enhanced transboundary focus in Phase II will encourage other jurisdictions to consider water quality in Lake Winnipeg as they make water management decisions in their local watersheds.

Phase II also shifts emphasis from building a scientific understanding of the lake and its algal bloom challenges, to taking more direct action to manage the excess nutrients that create these blooms. The following program elements comprise Phase II of the LWBI.

Science

- To help ensure that decision makers have access to relevant scientific information and tools to guide and evaluate water management, the federal government is focusing on high priority research and monitoring needs within the Lake Winnipeg basin and tracking the effectiveness of land and water management decisions. These science activities are intended to complement actions under way by the Province of Manitoba as well as other federal, provincial and state jurisdictions within the watershed.
- Science objectives in Phase II have shifted from lake-based research to more land- and watershed-based research, monitoring and reporting. Some in-lake research activities will continue to further develop understanding of the ecology of the lake and to help set relevant nutrient objectives. Water-quality monitoring programs will focus on understanding how the lake and watershed are responding to nutrient management efforts within the basin.



On-site planned biological removal of nutrients in a former wastewater treatment lagoon in Niverville, Manitoba.



Harvesting cattails from nutrient-rich areas to reduce phosphorus loading in the Lake Winnipeg basin.

Stewardship Action

- The Government of Canada continues to provide support for stakeholder-based projects that improve the health of the watershed through the Lake Winnipeg Basin Stewardship Fund. In Phase II of the LWBI, this funding program supports on-the-ground action to improve the health of the lake and places more emphasis on activities aiming to reduce nutrient inputs to the lake. Stewardship funding is targeted in geographic areas with the largest sources of nutrients, and on actions with the greatest impact on nutrient reduction.
- The LWBI also provides funding to support science activities and research related to Lake Winnipeg. Annual support is provided to the Lake Winnipeg Research Consortium to assist in the operation of the MV Namao, the only research and monitoring vessel operating in Lake Winnipeg. A multi-year funding arrangement is also in place to support the University of Manitoba's operation of the Lake Winnipeg Web-based data portal. This information-sharing portal for lake-related science was developed in Phase I of the LWBI, and its management was subsequently transferred to the university.

Transboundary Partnerships

- As Lake Winnipeg's watershed spans four provinces and four U.S. states, Phase II of the LWBI will place increased emphasis on building partnerships across provincial and state borders to address water quality issues within Lake Winnipeg and its basin. These efforts will build provincial and international collaboration to reduce nutrients and ultimately support development of a Canada-U.S. basin-wide nutrient management strategy.
- Phase II of the LWBI will also continue to support implementation of the Canada-Manitoba Memorandum of Understanding (MOU) Respecting Lake Winnipeg and the Lake Winnipeg Basin (2010). This MOU is an important step forward in ensuring a collaborative and coordinated approach between the two governments on issues related to Lake Winnipeg water quality. The MOU Steering Committee, which includes representatives from key federal and provincial departments, was established to provide oversight for shared management efforts to reduce nutrient loading to the lake and ensure its long-term sustainability. A collaborative science arrangement was also finalized under the MOU to assist in coordinating federal-provincial monitoring and research.

Some of the early outcomes expected in Phase II of the LWBI include:

- Increased nutrient management action;
- Continued engagement of domestic and international governments in improved nutrient management efforts; and
- Priority research tracking of ecosystem health.

Longer-term outcomes remain focused on:

- Restoring the ecological integrity of Lake Winnipeg;
- Reducing the magnitude and extent of harmful algal blooms and beach water quality advisories; and
- Improving water quality for both recreation and a sustainable fishing industry.



The International Joint Commission and the Prairie Provinces Water Board have a mandate to address international and domestic transboundary water quality and quantity issues.



Scientists use electrofishing to study how changes in water quality affect the health of fish (Plum Coulee Creek, Manitoba).

Science (Research and Monitoring)

Research undertaken by Environment Canada scientists, through the LWBI, provides the Canadian public and stakeholders across the watershed with sound scientific data and information to help make informed decisions about how we can work together to improve water quality in Lake Winnipeg. Under the LWBI, Environment Canada has developed a Science Plan that provides freshwater science and water quality research, monitoring and modelling expertise to contribute to the complex science needs within Lake Winnipeg and its vast basin.

Governments and other partners need the data and science provided by Environment Canada to make informed watershed and nutrient management decisions. The goal of the LWBI science plan is to bridge current knowledge gaps related to the lake's ecology and nutrient cycling, and to track the sources and transport of nutrients (such as phosphorus and nitrogen) throughout the lake and its basin. Research conducted by Environment Canada is providing the information that will help decision makers develop nutrient objectives for the lake and develop performance indicators to assess the health of the lake and its response to nutrient management actions within the

basin. Environment Canada science activities complement actions underway by the Province of Manitoba as well as other federal, provincial and state jurisdictions within the watershed.

The Science Plan in Phase II of the LWBI builds on activities and projects conducted in Phase I (2007-2012). Research from Phase I addressed knowledge gaps about the physical, chemical and biological nature of Lake Winnipeg and helped the scientific community gain a better understanding of the impacts of nutrients attributed to algal blooms in the lake. Several publications have already been produced by Environment Canada scientists to report on work from Phase I of the LWBI. A full listing of Lake Winnipeg-related publications by Environment Canada scientists up to 2014 is available in Appendix 1.

In Phase II of the LWBI, the main focus of LWBI scientific activities shifted from lake-based to land-based research, monitoring and reporting with the intention to:

- Fill priority data gaps;
- Target actions to improve the ecological health of the lake; and
- Measure performance of actions taken to improve water quality.

Phase II will further develop the knowledge base established in Phase I and inform management decisions about how to improve the health of Lake Winnipeg and ensure the ecological sustainability of the lake and its basin.

Environment Canada continues to work closely with other federal departments, provincial agencies, binational agencies, and regional and local partners to address data and knowledge gaps. This work will help decision makers develop a science-based nutrient and algal bloom management program with ecologically relevant information. Every effort is made to ensure that federal actions will build upon work and expertise already in place.

In Phase II of the LWBI, Environment Canada is enhancing its contribution to Lake Winnipeg research, monitoring and modelling with the following activities that support the science needs of the lake:

- Implementing a plan that provides the necessary science to inform policy and programs, and to support decision making related to the nutrient management issues of the lake;
- Supporting and promoting information sharing between partners through use of the single window information portal developed in Phase I;
- Utilizing research and monitoring data to inform the establishment of ecologically relevant nutrient objectives for Lake Winnipeg; and
- Developing performance indicators that can be used to assess the ecological health of the lake and its watershed.

The Science Plan includes a number of key deliverables that will help meet the science needs in Lake Winnipeg and its basin. These key deliverables are:

- Addressing knowledge gaps related to the impacts of human activity, particularly land use, on the fate, effect and delivery of nutrients in Lake Winnipeg tributaries;
- Developing predictive models in support of nutrient management in Lake Winnipeg and its basin;
- Undertaking water quality and biotic monitoring to track spatial and temporal flux of nutrients and algae transported from the watershed to Lake Winnipeg and to support development of modelling scenarios; and
- Addressing critical knowledge gaps in lake nutrient dynamics relative to changes in nutrient loads to Lake Winnipeg.

Science Deliverable 1: Addressing knowledge gaps related to the impacts of human activity, particularly land use, on the fate, effect and delivery of nutrients in Lake Winnipeg tributaries

Projects and Progress 2012-2013 to 2013-2014

- **Investigating Nutrient Sources and Transport in Runoff from Agricultural Fields**
 - In collaboration with researchers from Agriculture and Agri-Food Canada and the University of Manitoba, Environment Canada scientists continued their research in assessing nutrient sources and transport in runoff from agricultural fields. Discharge and nutrient data were obtained for snowmelt and rainfall runoff events at four edge-of-field sites, including two in-stream sites where hog manure was applied, and 14 stream sites in the Red River watershed. The research is showing that snowmelt is the critical period for delivery of water and nutrients (particularly dissolved nutrients) to watersheds in southern Manitoba. These findings will further our ability to develop appropriate management practices to minimize nutrient loss from agricultural lands in this region.
- **Quantifying the Fate and Effects of Nutrients from Agriculturally Dominant Watersheds through Tributaries of the Red and Assiniboine Rivers**
 - Land use activity is a major contributor of total phosphorus and total nitrogen to small watersheds in the Canadian prairies, and these inputs affect the ecological condition of prairie streams. This project has two components:
 1. To quantify seasonal patterns in nutrient concentrations in relation to human activity for streams in the Red River Valley; and
 2. To identify a suite of biological indicators suitable for monitoring the impacts of human activities on the ecological condition of stream ecosystems within the Red River Valley.



Data sonde equipment is used to measure water quality parameters in waterways that eventually drain into Lake Winnipeg (Tobacco Creek, Miami, Manitoba).



Periphyton samplers are used to collect micro-organisms such as bacteria, protozoa, fungi and algae in order to gauge the level of nutrients in the stream.



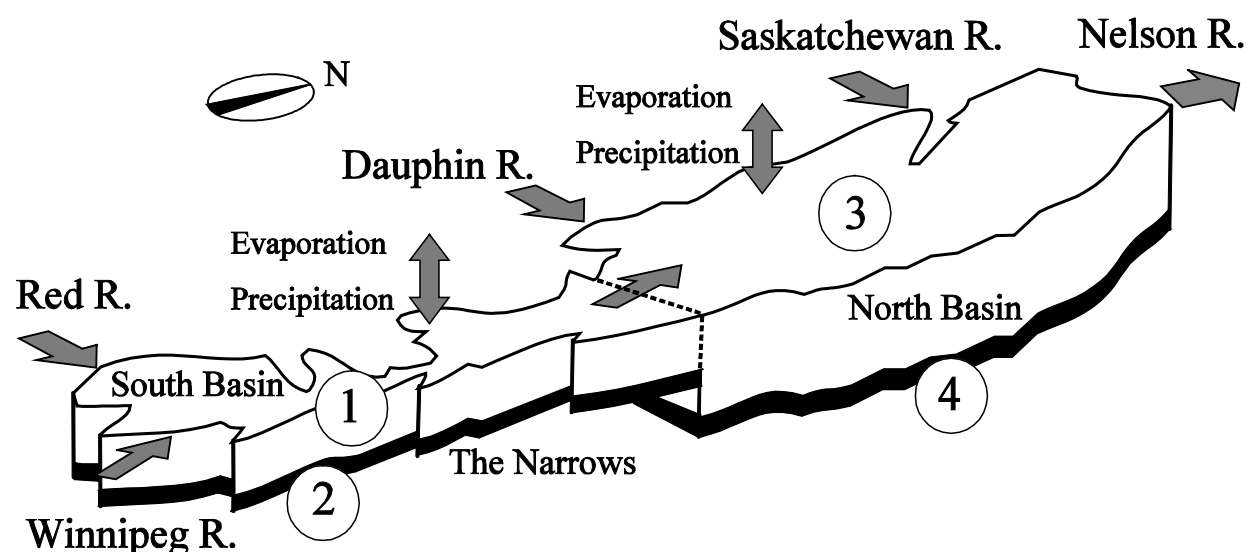
Kick net sampling is a method used to collect samples of insects and plant material from rivers and streams.

- Intensive fieldwork during 2010 and 2013, and continuing in 2014, showed that the highest concentrations of total phosphorus and total nitrogen in Red River Valley streams occur during snowmelt, with the only exception being streams that receive waste water discharged from sewage lagoons during summer. Export of total phosphorus and total nitrogen from streams is correlated with agricultural land area, specifically canola and small grains, and fertilizer application.
- In partnership with the Tobacco Creek Model Watershed Consortium, research is under way to develop biological and biochemical indicators to assess the ecological condition of watersheds in southern Manitoba and determine how these conditions change over time as a result of both natural process (e.g., climate) and land use practices (e.g., agriculture). Initial research indicates that the selected indicators are sensitive to the types of disturbance or stress occurring in southern Manitoba and are likely to respond in proportion to the degree of stress. Landscape-scale activities of agriculture (e.g., types of land cover) and waste water treatment are important drivers of the ecological condition of watersheds.
- **Assessing the Role of Human Activity on the Hydrology of Key Areas in the Lake Winnipeg Watershed**
 - This work builds on hydrologic studies in Phase I of the LWBI, and includes assessing the impact of land use changes, wetland drainage and climate variability on flooding and nutrient export to Lake Winnipeg. Streamflow generation in the Lake Winnipeg basin is highly influenced by the capacity of the landscape to store water in natural low areas and wetlands. In order to represent these processes in hydrological models, research was performed at the St. Denis National Wildlife Area in partnership with the University of Saskatchewan. The work includes water budget studies to better understand the importance of groundwater on maintaining streamflow, and hydrological process studies to improve understanding of the relationship between contributing area and streamflow. These studies are being used to improve hydrological models that will be used to assess the relative roles of climate and land management on streamflow and nutrient loads to Lake Winnipeg.

Science Deliverable 2: Developing predictive models in support of nutrient management in the Lake Winnipeg Basin

Projects and Progress 2012-2013 to 2013-2014

- **Modelling of Effects of Land Use Changes, Wetland Drainage and Climate Variability on Flooding and Nutrient Export to Lake Winnipeg**
 - In order to meet the expectations of reducing nutrient loads to Lake Winnipeg, an integrated modelling framework was developed to evaluate a range of nutrient management scenarios. This will assist governments in making informed decisions about which actions will provide the best results for the health of Lake Winnipeg and protect the livelihoods of people who depend on the lake for their income.
 - Environment Canada completed the design specifications and development of the LWBI Integrated Modelling and Scenario Decision Support System. Research continued on adjustments to lake/watershed models to achieve in-lake water quality objectives within the decision support system. Environment Canada is working collaboratively with Agriculture and Agri-Food Canada to improve, implement and evaluate the beneficial management practices that were selected as the best approaches for reducing nutrient load within the Lake Winnipeg watershed.
 - Environmental data was collected to fill knowledge gaps in the understanding of the physical, chemical and biological aspects of the lake. This information is used in Lake Winnipeg modelling research to improve our knowledge on the effect of water movements and temperature on the water quality in the lake.
 - A lake ecosystem model, developed under Phase I, was further verified with more recent data and additional simulations. This information was shared with the Government of Manitoba and other partners, and Manitoba Conservation and Water Stewardship selected this model for developing nutrient management options in Lake Winnipeg.



Scientists have developed models that help us to better understand how water quality in Lake Winnipeg changes when the nutrient loading to the lake is reduced.

- Under Phase I of the LWBI, Environment Canada developed the LWBI Information Portal, a data and information Web portal for biological and physical information about the Lake Winnipeg watershed. It was designed to provide open data access to stakeholders and the public. The portal has since been transferred to the University of Manitoba, where it was renamed the Lake Winnipeg Basin Information Network. Environment Canada provided guidance and funding to the university for maintaining the portal.

Science Deliverable 3: Undertake water quality and biotic monitoring to track spatial and temporal flux of nutrients and algae transported from the watershed to Lake Winnipeg and to support development of modelling scenarios

Projects and Progress 2012-2013 to 2013-2014

- **Monitoring to Track Changes in Nutrients Within the Lake Winnipeg Basin and Support Modelling Scenarios**
 - Measuring nutrient concentrations, including total phosphorus, is part of the ongoing monitoring activities implemented on the most important rivers crossing boundaries between Canada and the United States, such as the Red, Pembina and Souris rivers, and interprovincial rivers such as the Assiniboine, Qu'Appelle and Saskatchewan rivers (Sask.-Man.), Winnipeg River (Man.-Ont.), and the North and South Saskatchewan rivers (Alta.-Sask.). This broad-scale monitoring network, which has been enhanced in some areas such as the Red River and the Rainy River-Lake of the Woods basin, will eventually support nutrient-based objectives between jurisdictions and nutrient-control performance measurements. This work, as well as more local-scale research in sub-watersheds closer to Lake Winnipeg, complements the nutrient-monitoring activities that the Province of Manitoba is conducting inside its boundaries.



Field work with team of Environment Canada scientists testing the ECOMapper, which has the ability to create a “snapshot” of the entire physical and chemical makeup of a body of water

- As part of a nationwide, risk-based assessment of its long-term water-quality monitoring network, Environment Canada is analyzing the impact of changes in frequency of water-quality sampling within the Lake Winnipeg basin on the ability to detect long-term trends for things such as nutrients, major ions and metals.
- A research project on Netley-Libau marsh was initiated to better understand nutrient sequestration. Nutrient sequestration refers to the ability of a lake, pond or wetland to store nitrogen and phosphorus, thus preventing it from flowing into Lake Winnipeg. The capacity of the marsh to influence nutrient loadings to the lake from the Red-Assiniboine sub-watershed is also being studied.
- Research is also being conducted to assess frogs' sensitivity to environmental changes, including excess nutrients and habitat degradation. The objective is to establish whether frogs could be part of a bio-monitoring program in the future. This project also focuses on the Red-Assiniboine sub-watershed.
- A study of the macro-benthos in Lake of the Woods was also completed. Macro-benthos are the tiny organisms, about 1 mm in size, that live in the water and sediment of water bodies. The results of this study allow scientists to develop a reference model based on the national Canadian Aquatic Biomonitoring Network protocol. This reference model will help scientists to better understand what a healthy macro-benthos community should look like within the lake and its watershed.



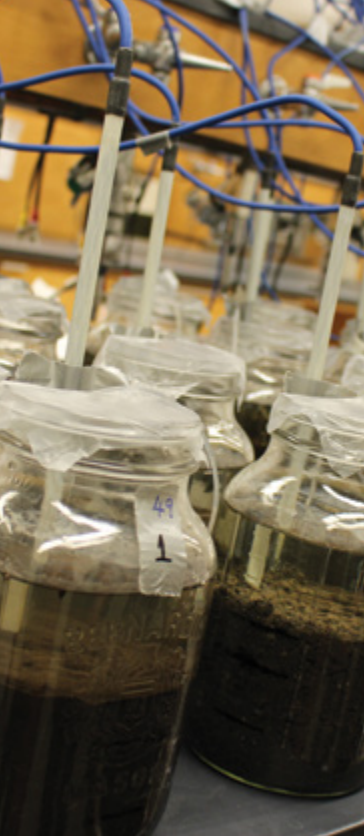
Water quality sampling is conducted throughout the year at key points on major tributaries to Lake Winnipeg.

- Satellite remote sensing is being used as a cost-effective tool for lakewide algal bloom monitoring on Lake Winnipeg. To validate the satellite data, environmental monitoring data from the lake were gathered at the same time. The information from the satellite images and the lake sampling is being compared, and used to develop algal bloom index prediction algorithms.
- Nutrients have a distinct “fingerprint” that helps identify where they originated. The technology and science exist to identify the “fingerprints” of the nutrients in Lake Winnipeg and then identify the path they travelled to reach the lake. The research on stable isotope fingerprinting, to determine the origins and distribution of nutrient loading to Lake Winnipeg, continued with intensive sampling in the Red and Assiniboine river basins. Preliminary findings suggest isotopic differences based on different land use in the Red-Assiniboine sub-watershed. The Assiniboine River appears to be dominated by animal manure and sewage treatment plant sources of nutrients, while the Red River is a mixture of chemical fertilizer, animal manure and sewage treatment plant sources.
- In order to assist in the development and improvement of environmental indicators used for reporting on the health of the lake and its watershed, a scientific workshop was held in October 2013. This workshop involved approximately 30 research and monitoring experts from universities, research institutes, the Lake Winnipeg Research Consortium, and provincial and municipal governments. The workshop focused on developing physical-chemical and biological indicators, and fact sheets that will explain these key nutrient indicators to the general public are currently in development.

Science Deliverable 4: Addressing critical knowledge gaps in lake nutrient dynamics relative to changes in nutrient loads to Lake Winnipeg

Projects and Progress 2012-2013 to 2013-2014

- **Filling Critical Knowledge Gaps with Respect to Nutrient Dynamics and Loads to Lake Winnipeg**
 - As part of our research on Lake Winnipeg and its major tributaries, Environment Canada is evaluating the composition and amount of nutrients flowing into the lake. Using stable isotopes, genetics and other biological tracers, Environment Canada scientists are investigating the major sources of these nutrients, how they vary over the season and among years, their bio-availability to algal cells, and how they influence the risk of harmful algal blooms. Part of this research is conducted aboard the research vessel M.V. Namoo, allowing scientists to measure algal growth and toxicity, nutrient uptake, cell storage and nitrogen fixation.
 - A lot of the nutrients that flow into Lake Winnipeg each year are stored in the muddy sediment on the bottom of the lake and then mixed back into the lake during strong wind events. This is a process called nutrient recycling. Environment Canada scientists are investigating the importance of nutrient recycling in the lake. The large amount of nutrients stored in the sediment in the lake bottom could mean that, even with a reduction in nutrients entering the lake, it may take a while to see improvements in water quality. To better understand this situation, scientists are measuring the amount and the way nutrients are released from the lake bottom over the year. These and other measures will be used to improve nutrient management models. They will also help to develop a way to predict the risk of harmful algal blooms as conditions in the lake and its watershed change.



Scientists are studying which types of soil release the most phosphorus during periods of prolonged flooding.

The Lake Winnipeg Basin Stewardship Fund

In an ongoing effort to promote stewardship, protect water resources and achieve nutrient reductions through support of stakeholder-driven projects, Environment Canada was allocated \$5.4 million in Grants and Contributions funds under Phase II of the LWBI to continue support of the Lake Winnipeg Basin Stewardship Fund (LWBSF). This fund provides financial support to implement high-impact, solution-oriented projects aimed at reducing nutrient loads and improving the ecological sustainability of the lake and watershed. Environment Canada administers this funding with support from multi-agency technical reviewers and a Public Advisory Committee (PAC).

Phase II of the LWBSF focuses on projects in geographic areas known to have the most influence on water quality in Lake Winnipeg, such as the Red-Assiniboine river basin or Winnipeg River basin. Priority is given to physical stewardship projects with on-the-ground action that results in demonstrable nutrient reductions in the lake and watershed. Projects involving “tried and proven” activities as well as those demonstrating innovative techniques, technologies and measures to reduce nutrient inputs into Lake Winnipeg are good candidates for funding. The funding also supports activities that contribute to a better understanding of current conditions and track improvements in environmental quality within Lake Winnipeg and its watershed.

The program’s four strategic priorities are projects that:

- Reduce nutrient inputs from rural and urban sources;
- Control point and non-point sources of nutrients;
- Rehabilitate priority aquatic ecosystems that support nutrient reduction and sequestration; and
- Enhance research and monitoring capacity to assist in decision making.

Two special projects are being funded by the LWBSF in Phase II of the LWBI. Funding of \$904,500 will be provided to the Lake Winnipeg Research Consortium to facilitate and coordinate monitoring and scientific research activities on Lake Winnipeg. This support will ensure the continued operation of the research vessel M.V. Namao, which is critical for scientific research and monitoring, as well as education related to Lake Winnipeg.

In addition, a funding agreement of \$150,000 was signed with the University of Manitoba to operate and expand awareness and use of the Lake Winnipeg Basin Information Network. The intent of this Lake Winnipeg Web-based information portal is to provide access to relevant scientific data, models, information and tools, and support long-term information sharing, collaboration and support for water management and decision making in the basin.

Progress in 2012-2013 and 2013-2014

- In 2013, a new PAC was established. The PAC represents the interests of people who live and work around the lake and provides project funding recommendations to the Minister of the Environment. In Phase II, six PAC members were appointed by the Minister of the Environment. To ensure continuity, two members of the new PAC were also former members of the committee in Phase I.
- Following the first round of project proposals in Phase II (Round 6), the LWBSF moved to a single annual fall funding round to streamline the application and approval process. This change brings the LWBSF in line with other application-based Environment Canada funding programs.
- In 2012-2013, Environment Canada approved contribution funding of \$2.73 million to 18 recipient groups to implement stewardship projects in the Lake Winnipeg basin. Most of the projects are multi-year projects, ending by March 2017. See Appendix 1 for a list of projects funded under Round 6 of the LWBSF.
- The \$2.73 million in funding from Environment Canada leveraged approximately \$6.4 million in cash and in-kind contributions from 97 project partners. For every dollar that Environment Canada contributed to stewardship projects in 2012-2013, project partners contributed \$2.35 to help restore the health of Lake Winnipeg and its basin.



Fencing keeps cattle out of waterways, reducing stream bank erosion and improving water quality.

- Anticipated results from the 18 approved LWBSF projects in 2012-2013 include:
 - A one-time reduction of 21 345 kg of phosphorus through one project, and an ongoing 17 954 kg/year reduction or diversion from use of phosphorus;
 - 11 250 metres of stream/lake bank will be protected or stabilized;
 - 16 000 native plants, trees and shrubs will be planted;
 - 3400 hectares of wetlands/aquatic habitat will be protected or conserved;
 - 574 erosion control structures will be installed;
 - A risk indicator tool will be created to identify soils with a high risk of releasing phosphorus; and
 - Four waste water treatment pilot technology/processes will be implemented or improved.
- In fall 2013, a total of 32 project applications were received and reviewed by technical experts. A PAC meeting was held in January 2014 to review the applications, and 16 projects were recommended for funding in the amount of \$916,900. These projects have the potential to result in an additional reduction of 4051 kg of phosphorus per year across the watershed.
- The following project success indicators have already been exceeded or are on track to meet the short-term expected outcomes of the LWBSF:
 - 10 800 kg/year of phosphorus reduced and/or sequestered within the Lake Winnipeg Basin. This LWBSF Phase II program goal was met through projects funded in 2012-2013;
 - Accelerated restoration/creation of wetlands, the adoption of sustainable farming practices and the development of innovative waste treatment technologies/practices within the watershed. LWBSF projects are already making a difference. Projects are expected to restore/create 4800 hectares of wetlands. Another 10 projects will also support and provide education on sustainable farming practice, and a further six projects will develop/improve waste water treatments; and
 - Leverage \$10 million in external stakeholder/partner cash and in-kind contributions towards stewardship efforts. So far, \$9.4 million has been leveraged in Phase II.



Birdtail Creek near
Miniota, Manitoba.

Transboundary Partnerships

The Lake Winnipeg Basin covers approximately one million square kilometres encompassing parts of two countries, four provinces and four states. This has resulted in complex governance with respect to transboundary water management in the basin due to the numerous stakeholders, jurisdictions and organizations involved. No one jurisdiction has sole authority to address the issue on its own.

International and provincial water management boards play a key role in establishing transboundary nutrient objectives that are critical for telling us how much phosphorus we can expect the lake to naturally process from each waterway. Governments can then make decisions that will guide actions to meet these nutrient objectives. Environment Canada participates on a number of water science and water management boards (e.g., Prairie Provinces Water Board, International Joint Commission [IJC] boards) to facilitate coordinated and integrated nutrient management efforts across the basin and to help address nutrient loading originating from within and outside of Manitoba's borders.

The Transboundary Partnerships pillar of the LWBI (formerly known as the Governance pillar in LWBI Phase I) places an increased emphasis on the use of existing transboundary water management boards to encourage government action to reduce nutrients. There is also an increased focus on working more closely with other governments (provincial, state, federal), jurisdictions and organizations within the basin to manage nutrients affecting water quality.

In Phase II of the LWBI, Environment Canada transboundary partnership activities in the basin seek to:

- Engage upstream jurisdictions to effectively manage nutrients;
- Coordinate and complement nutrient management efforts; and
- Ensure that policy, science and program development is informed with information relevant to Lake Winnipeg ecosystem health.

As well, Environment Canada continues to ensure priority progress on nutrient issues through domestic and international water boards is made while working with partners toward the development of a broad binational nutrient management strategy across the basin.

Progress in 2012-2013 and 2013-2014

- Environment Canada and Manitoba Conservation and Water Stewardship continue to implement the Canada-Manitoba MOU Respecting Lake Winnipeg and the Lake Winnipeg Basin (2010) by co-chairing and providing secretariat support to the Canada-Manitoba MOU Implementation Steering Committee. The MOU formalizes the commitment of both governments to a long-term, collaborative and coordinated approach to support the sustainability and health of the lake and its basin. The MOU

Steering Committee met three times in the 2012-2013 to 2013-2014 period and shared information amongst federal and provincial departments on programs and issues affecting the health of Lake Winnipeg. The MOU Secretariat initiated a management review of the Canada-Manitoba MOU to inform decisions related to the extension of the MOU after its expiration in September 2015.

- Environment Canada is an active member of the IJC's Water Quality Committee of the International Red River Board. The Water Quality Committee is tasked with implementing the Basin-wide Nutrient Management Strategy for the International Red River Watershed. This IJC committee is currently focusing on developing nutrient load allocations and/or water quality targets for nutrients for the Red River. A literature review on methods for setting nutrient objectives in the Red River portion of the Lake Winnipeg basin was completed and accepted by the International Red River Board. The committee is moving forward with the recommendations from the review to develop a model of the relationships between nutrient concentrations in the river and criteria to protect or restore water resource uses (aquatic life, recreational use, etc.).
- In December 2012, the Canadian Consulate in Minneapolis invited Environment Canada to participate in a panel discussion at a forum it was hosting on water quality in Lake Winnipeg and the Red River Basin. This provided an opportunity to inform a broader international audience of Environment Canada actions to address Lake Winnipeg's water quality problems.
- Environment Canada provided support to Manitoba Conservation and Water Stewardship and the South Basin Mayors and Reeves on the formation and implementation of the provincially led Lake Friendly Accord and Stewards Alliance. The Lake Friendly Accord document is a declaration of support by signatories to take action to reduce nutrient loading and improve water quality in the Lake Winnipeg basin. The federal Minister of the Environment signed the accord on behalf of the Government of Canada on March 21, 2014, and was one of the first signatories of the accord. Environment Canada staff participated in the Lake Friendly Stewards Alliance Steering Committee, assisting in developing an overall vision, overseeing the implementation of the accord, and participating in working groups related to Governance, and Science and Research.
- Environment Canada increased its engagement with United States jurisdictions to address nutrient issues within the U.S. portion of the Lake Winnipeg basin. Staff attended North Dakota's Nutrient Reduction Strategy Stakeholder meeting and participated in follow-up working groups. Environment Canada staff also attended the 2013 Minnesota Water Resource Conference, where the Pollution Control Agency presented Minnesota's Nutrient Reduction Strategy and announced the launch of its consultative process on the strategy.

APPENDIX 1

Lake Winnipeg Basin Initiative Science Publications

1. Bawden, A.J., D.H. Burn and T.D. Prowse. 2013. An Analysis of Spatial and Temporal Trends and Patterns in Western Canadian Runoff: A CROCWR Component. Proceedings of the 19th International Northern Research Basins Symposium and Workshop.
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3. Binding, C.E., T.A. Greenberg and R.P. Bukata. 2011. Time series analysis of algal blooms in Lake of the Woods using the MERIS maximum chlorophyll index. *Journal of Plankton Research* 33(12):1847-1852.
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7. Chittibabu, P. and Y.R. Rao. 2011. Numerical Simulation of Storm Surges in Lake Winnipeg. *Natural Hazards* 60:181-197.
8. Corriveau, J., P.A. Chambers, A.G. Yates and J.M. Culp. 2010. Snowmelt and its role in the hydrologic and nutrient budgets of prairie streams. In *Issues and Solutions to Diffuse Pollution*. (Edited by E. van Bochove, P.A. Vanrolleghem, P.A. Chambers, G. Thériault, B. Novotná and M.R. Burkart.) International Water Association. pp. 179-188.
9. Corriveau, J., P.A. Chambers, A.G. Yates and J.M. Culp. 2011. Snowmelt and its role in the hydrologic and nutrient budgets of prairie streams. *Water Science and Technology* 64:1590-1596.
10. Corriveau, J., P.A. Chambers and J.M. Culp. 2013. Seasonal variation in nutrient export along streams in the northern Great Plains. *Water, Air, & Soil Pollution* 224:1594-1609.
11. Dibike, Y., T. Prowse, R. Shrestha and R. Ahmed. 2012. Observed trends and future projections of precipitation and temperature in the Lake Winnipeg Watershed. *Journal of Great Lakes Research* 38:72-82.

12. Ehsanzadeh, E., C. Spence, G. van der Kamp and B.G. McConkey. 2012. On the behaviour of dynamic contributing areas and flood frequency curves in North American Prairie watersheds. *Journal of Hydrology* 414: 364-373.
13. Ehsanzadeh, E., G. van der Kamp and C. Spence, 2012. The impact of climatic variability-change on the hydro-climatology of Lake Winnipeg watershed. *Hydrological Processes* 26(18): 2802-2813.
14. Elliott, J. 2013. Evaluating the potential contribution of vegetation as a nutrient source in snowmelt runoff. *Canadian Journal of Soil Science*. 93(4):435-443.
15. Environment Canada and Manitoba Water Stewardship. 2011. State of Lake Winnipeg: 1999 to 2007, Winnipeg.
16. Hobson, K.A., A. Ofukany, D.X. Soto and L.I. Wassenaar. 2012. An isotopic baseline ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$) for fishes of Lake Winnipeg: Implications for investigating impacts of eutrophication and invasive species, *Journal of Great Lakes Research* 38:58-65.
17. Khakbazan, M., C. Hamilton, J.A. Elliott and J.B. Yarotski. 2013. Economic analysis of agricultural nutrient management practices in the South Tobacco Creek Watershed in Manitoba, Canada. *Journal of Soil and Water Conservation* 68(4): 257-269.
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20. Li, S., J.A. Elliott, K.H. Tiessen, J. Yarotski, D.A. Lobb and D.N. Flaten. 2011. The effects of multiple beneficial management practices on hydrology and nutrient losses in a small watershed in the Canadian Prairies. *Journal of Environmental Quality* 40(5):1627-1642.
21. Liu, K., J.A. Elliott, D.A. Lobb, D.N. Flaten and J.B. Yarotski. 2013. Critical factors affecting field-scale losses of N and P in spring snowmelt runoff in the Canadian Prairies. *Journal of Environmental Quality* 42(2):484-496.
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42. Zhang, W. and Y.R. Rao. 2012. Application of a eutrophication model for assessing water quality in Lake Winnipeg. *Journal of Great Lakes Research*. 38:158-173.
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APPENDIX 2

2012-2013 and 2013-2014 Lake Winnipeg Basin Initiative

Scientific Research, Modelling and Monitoring Projects

Research Projects

Project Title: Investigation of Nutrient Sources and Transport in Runoff from Agricultural Fields

Environment Canada Scientist: J. Elliott

Project Title: Quantification of the Fate and Effect of Nutrients from Agriculturally Dominated Watersheds Through Tributaries of the Red and Assiniboine Rivers

Environment Canada Scientists: P. Chambers, J. Culp

Project Title: Hydrology of Key Areas in the Lake Winnipeg Watershed: Assessment of the Role of Human Activity

Environment Canada Scientists: P. Marsh, C. Spence, J. Elliott, A. Vander Kamp

Project Title: Evaluation of Microbial Loop: Food Web Deficiency, Energy and Nutrient Flow, Recycling and Assessment of the Role of Nutrient Ratios and Cell Sequestration in the Development of Toxigenic Blooms

Environment Canada Scientists: S. Watson, J. Guo

Modelling Projects

Project Title: Flooding and Nutrient Export to Lake Winnipeg: Modelling the Effects of Land Use Changes, Wetland Drainage and Climate Variability

Environment Canada Scientists: P. Marsh, G. Benoy

Project Title: Hydrodynamic and Hydro Climatic Water Quality Models for Lake Winnipeg and Its Watershed and Assessment and Validation of Lake Winnipeg Web Portal Model Outputs: Optimization of Lake/Watershed Models to Achieve In-lake Water Quality Objectives

Environment Canada Scientists: R. Yerubandi, W. Booty

Monitoring Projects

Project Title: Effectiveness of Nutrient Objectives: Ecosystem Health at Critical Transboundary Monitoring Stations

Environment Canada Scientists: K. Farmer, P. Klawunn (with B. Holliday, D. Legault, B. Aiken, D. Fred)

Project Title: Biotic Monitoring: Entry Point of the Red River to Lake Winnipeg and Nutrients Sequestration (Marshes)

Environment Canada Scientists: T. Pascoe, T. McDaniel (with C. Hudon, D. Baird)

Project Title: Water Quality and Biotic Monitoring: Rainy River, Lake of the Woods, Winnipeg River Watersheds

Environment Canada Scientists: P. Klawunn, T. Pascoe, T. McDaniel

Project Title: Inter-agency Comparisons of Data to Ensure Compatibility, Inter-operability and Accessibility

Environment Canada Scientists: K. Farmer, B. Holliday, D. Fred

Project Title: Delineation of Red and Assiniboine River Basin Dissolved Nutrient N Sources and Transformations

Environment Canada Scientist: G. Koehler

Project Title: Spatio-temporal Nutrient Trends Recorded in the Biota of Lake Winnipeg and Red/Assiniboine River Watersheds

Environment Canada Scientist: K. Hobson

Project Title: Remote Sensing Methodologies: The Use of Image Processing Capabilities to Identify and Track the Evolution of Algal Blooms on Lake Winnipeg

Environment Canada Scientist: C. Binding

Project Title: Testing and Refinement of Priority Performance Indicators for Lake Winnipeg in Collaboration with Manitoba Water Stewardship

Environment Canada Scientists: J.F. Bibeault, T. McDaniel, K. Farmer, D. Seburn

APPENDIX 3

Lake Winnipeg Basin Stewardship Fund Projects in Round 6 (2013-2014)

Project Name: Manitoba Wetland Restoration Project

Project Recipient: Manitoba Habitat Heritage Corporation

Environment Canada Contribution: \$720,000

Status: Project to be completed in March 2017

Description: The project will restore a total of 648 hectares (1600 acres) of drained wetlands throughout Manitoba over a 4-year period. Restorations will occur by infilling agricultural and other drainage ditches with earthen dams or other small structures. Over a 10-year period, these wetland restorations will prevent at least 64.8 tonnes of phosphorus and as much as 324 tonnes of nitrogen from potentially entering Lake Winnipeg. Mid-term securement and protection of the restored wetlands will occur through the completion of 10-year landowner contracts and the acquisition of “Licenses to Construct Small Works” through Manitoba Conservation and Water Stewardship. Landowners would also be offered the option of providing permanent protection under registered conservation easements. Conservation easements will provide perpetual protection of the restoration works, regardless of the landowner.

Project Name: Pelly’s Lake Watershed Management Area

Project Recipient: La Salle-Redboine Conservation District

Environment Canada Contribution: \$132,600

Status: Project to be completed in March 2015

Description: Pelly’s Lake, located near Holland, Manitoba, is a historical wetland area, consisting of two wetland basins covering 630 acres. The project will construct and operate two water retention structures, with a total storage of 1200 acre-feet, protect over 700 acres of wetland and riparian habitat under Conservation Agreements with six landowners, including the first Conservation Agreement with a Hutterite colony in Manitoba. A partnership between the conservation district, the colony and the International Institute for Sustainable Development will lead to a cattail harvesting operation that will see the colony harvest cattails from the reservoir basins and convert the biomass into biofuel for heating the colony buildings. An interpretive park will be established on a site that overlooks the wetland basins and will contain educational information about the project and recognition of all project partners and donors.

Project Name: Cattail and Novel Biomass: Nutrient Capture and Reclamation Turning a Waste/Pollution Stream into an Input for a Sustainable Manitoba Bio-economy

Project Recipient: International Institute for Sustainable Development

Environment Canada Contribution: \$180,000

Status: Project to be completed in March 2016

Description: The project will demonstrate and assess the effectiveness of harvesting wetland (i.e., cattail) biomass from nutrient-rich areas upstream in the Lake Winnipeg watershed to directly reduce nutrient loading to Lake Winnipeg. Sites will include areas around Winnipeg and within Manitoba's Interlake region. Areas that store flood water and capture nutrients from point and non-point sources will be selected: storm water ditches, upstream surface water retention areas and marginal agricultural land. This project will demonstrate and quantify: 1) phosphorus capture, removal and re-use by harvesting cattail biomass; 2) flood damage reduction from surface water retention basins; 3) greenhouse gas emissions comparing harvested versus unharvested sites; 4) heat energy produced, coal displaced and carbon dioxide offsets created from use of harvested cattail in solid fuel burners; 5) production of cattail biochar for soil amendment, bioenergy and fertilizer; and 6) the commercial large-scale environmental and economic opportunity of harvesting nutrient-rich biomass for bioenergy and bioproducts.

Project Name: Establishment of Pilot Sites for Innovative Surface Water and Nutrient Management Initiatives on Farms

Project Recipient: Manitoba Conservation Districts Association

Environment Canada Contribution: \$401,074

Status: Project to be completed in March 2017

Description: The project will take place at a number of locations across the Lake Winnipeg basin within Manitoba. Traditional water management schemes in Manitoba involve flooding land temporarily, and then releasing it later when the drainage network can handle the volume. However, on some soil types, this results in an increase in the loss of phosphorus from flooded soils. The project team will investigate the potential options for using the stored water for agriculture so that neither water nor nutrients are released downstream. A range of options will be tested through pilots on farms representing a range of ecozones, hydrology, habitat and agricultural uses across the Lake Winnipeg basin. The project will cover a number of priority areas in the Lake Winnipeg basin including the management of peak flows, reducing nutrient loads from agriculture and developing drought resilience on farms. The measures that will be examined include structures and management systems in the existing drainage network to store water, the use of constructed wetlands and retention ponds to store water, and the options for using the water for agriculture, such as for forage harvesting, bale grazing or irrigation of crops.

Project Name: Wetland Restoration (Two-year Program) in the Assiniboine River Watershed

Project Recipient: Assiniboine Watershed Stewardship Association Inc.

Environment Canada Contribution: \$230,000

Status: Project to be completed in March 2015

Description: The project proponent, in partnership with the Water Security Agency and Ducks Unlimited Canada, will restore up to 150 wetlands within southeast Saskatchewan. Using a reverse auction, interested landowners will be offered up to two times Fair Market Value per acre of restored wetland in return for a 10-year “no-breaching” agreement. Restoring 150 wetlands (average approximately one acre in area and 1000 m³ in volume) has the potential to improve water quality by storing between 607 and 1215 kg of phosphorus per year, reducing agricultural nutrient loading into Lake Winnipeg. This storage volume also has the potential to reduce the effects of flooding for downstream residents.

Project Name: Pipestone Phosphorus Reduction Program: Implementation and Measuring Efficacy of Beneficial Management Practices

Project Recipient: Lower Souris Watershed Committee Inc.

Environment Canada Contribution: \$120,720

Status: Project to be completed in March 2016

Description: The project is located within the uplands of the Pipestone Creek, which flows into the Souris River once in Manitoba. The project will reduce nutrient loading at the source by restoring 25 wetlands (45 hectares) that have previously been lost to agricultural drainage and converting 700 acres of cropland to perennial forage. Following implementation, a workshop and field day will be hosted to promote the benefits to agricultural producers of the two beneficial management practices (BMPs): wetland restoration and forage conversion. Additionally, site tours where these BMPs have been implemented will be held to demonstrate the benefits. Water quality (nutrients, particulates and volume) and quantity will be monitored in runoff from spring snowmelt and summer storm events.

Project Name: Niverville Lagoon System: The Investigation of Alternative Approaches for Bio-remediation

Project Recipient: Town of Niverville

Environment Canada Contribution: \$149,056

Status: Project to be completed in March 2016

Description: The Town of Niverville will investigate the feasibility of remediating biosolids (sludge) in decommissioned waste water lagoons through in situ treatment using phyto- and bio-remediation methods, under both aerobic (native grasslands) and anaerobic (wetland

plants) processes. In 2008, Niverville opened a new sewage lagoon north of the town; the old lagoon (32 acres), located within the town boundaries, must be decommissioned as a requirement of the town's environmental licence for its new lagoon. Only two options presently exist for decommissioning lagoons in Manitoba: removing the sludge and spreading it on agricultural land or disposing of it in a local landfill. Following removal, the old lagoon must also be filled in to grade. Landfilling is no longer an option, and in the case of Niverville it would require approximately 5 120 acres of agricultural land to accommodate the spreading of their sludge material. A positive outcome from this project will have broad application for other municipal governments across Manitoba and Canada. The Town of Niverville estimates the project will realize a nutrient loading reduction of 21 345 kg of phosphorus per year.

Project Name: Successful Initiation of Wetland Restoration Landowner Incentive Program

Project Recipient: Upper Souris Watershed Association Inc.

Environment Canada Contribution: \$80,000

Status: Project completed

Description: From April 2013-March 2014, the project will demonstrate wetland restoration as a beneficial management practice (BMP) and will highlight the benefits of having wetland restoration as a BMP eligible for stewardship incentives. Key project elements include establishing 10 wetland restoration demonstration sites (installing ditch plugs to restore at least two basins per site, secured for 10 years); re-vegetating 30-metre-wide buffer zones around each restored wetland to perennial cover; polling agriculture producers who have been exposed to the wetland demonstration sites to learn their motivations for draining wetlands, issues they may have with wetland restoration and what impediments or obstacles exist that prevent them from restoring wetlands on their farms; and undertaking communication activities including signage on site, highway billboards, field tours for both youth and adults, newsletter articles, media releases, and 15 radio ads about interesting wetland and watershed facts. Sites will be on arable land and will be highly visible to the public.

Project Name: Earthen Dam for Water Storage and Erosion Control

Project Recipient: Swan Lake Watershed Conservation District

Environment Canada Contribution: \$66,356

Status: Project to be completed in March 2015

Description: The Conservation District will work closely with landowners to construct new earthen dams in two locations within the watershed, situated between the Saskatchewan border and Lake Manitoba. Downstream of site locations has experienced municipal infrastructure damage, sheet erosion and temporary inundation of continuously cropped agricultural lands. Outlet discharge capacity and timing of release will consider downstream infrastructure and conditions. It is estimated that the surface water from 800 hectares of

continuously cropped agricultural land will be retained and allowed to release nutrients slowly as a result of the project. The Conservation District will complete surface water testing both upstream at high flow rates and at discharge to provide comparison of initial nutrient versus nutrient released with variable storage time to optimize nutrient reduction without compromising agricultural timelines. Upstream storage area will be surveyed for capacity and also for monitoring sediment deposition annually. The storage area will become a temporary riverine wetland, and the lowland and transitional vegetation will store sediment, organic matter, organic nitrogen and phosphorus while inundated.

Project Name: Assiniboine Basin Municipal Point Source Assessment and Reduction Initiative

Project Recipient: Upper Assiniboine River Conservation District

Environment Canada Contribution: \$34,798

Status: Project to be completed in March 2015

Description: The Conservation District will assess 32 waste water sites within southwest Manitoba to measure and quantify the nutrient contributions via chemical analysis and facility capacity, assess the feasibility of alternate uses (e.g., land availability, soils, irrigation demand/cost), and understand the local capacity and willingness to engage in this initiative. Secondly, the Conservation District will demonstrate, via two pilot projects within the rural municipalities of Miniota and Hamiota, the ability to achieve alternative uses that provide reduced nutrient loading to the basin, with the co-benefit of creating positive economic growth within the region. This will be achieved by creating two waste water irrigation sites where trees and shrubs will be grown for harvest and uses including heat energy, landscaping and increased wildlife habitat. Solar technology and irrigation equipment will be used to supply two nursery sites with waste water. The proponent estimates a phosphorus loading reduction of 2880 kg per year.

Project Name: Whitemud Watershed Surface Water Storage Program

Project Recipient: Whitemud Watershed Conservation District

Environment Canada Contribution: \$39,899

Status: Project to be completed in March 2015

Description: The Conservation District will construct three temporary water storage projects in the headwaters of the Whitemud River. Each project will consist of a backflood area (reservoir), earth dam with rock and/or geotextile for erosion control, and control structures consisting of an open-top culvert as well as a release culvert with screw-gate valve. The projects are designed to fill up during runoff events to Full Supply Level (FSL), and any excess water continues to run through the spillway until the reservoir returns to FSL. During late season (prior to freeze-up), the release valve is opened, allowing the reservoir to drain. The valve is then closed, and the project is ready to fill again the next year. Each project will

be protected through caveats placed on the land titles for both the structures and backflood areas. The Conservation District will be responsible for operation of the projects, as well as annual inspections and maintenance. When completed, the projects are estimated to hold approximately 120 acre-feet of water. The wetland area that will be enhanced and/or created by these projects is estimated at approximately 100 acres. Each project will receive signage noting the project partners, in both official languages.

Project Name: Lake Friendly Practices and Actions - Do What Matters

Project Recipient: South Basin Mayors and Reeves Inc.

Environment Canada Contribution: \$210,000

Status: Project to be completed in March 2016

Description: The project will build public awareness and create long-term changes in behaviour by showcasing practices and actions that reduce nutrients from entering Lake Winnipeg. Through the engagement of all Winnipeg capital region and south basin municipalities, the project will reach 70% of Manitoba's population. Building on the first phase of the Lake Friendly initiative, the project will expand on the initial practices outlined and create resources to monitor and track nutrient reductions occurring as a result of implementation of Lake Friendly Practices and Actions in two partnering municipalities and two partnering schools. Beneficial management practices will be introduced and monitored in the partnering sites. Using the results from the partnering sites, a "Lake Friendly Marking System" will be developed to allow various sectors and supply chain components to be recognized as Lake Friendly.

Project Name: Lake of the Woods Discovery Centre Model Shoreline

Project Recipient: Lake of the Woods Development Commission

Environment Canada Contribution: \$29,636

Status: Project completed

Description: The model shoreline will be built along a 256 m shoreline at the Lake of the Woods Discovery Centre in Kenora, Ontario. The project is an interactive and interpretive environmental education project driven by community partners and grassroots support. The project will include three shoreline demonstration sites: natural shoreline with native plantings, minimal landscaping and fish/aquatic habitat protection; soft shoreline protection to reduce erosion with considerable native plantings and environmentally friendly dock installation; and hardened shoreline with extensive landscaping to demonstrate significant impact on the environment. The remainder of the shoreline will be left natural, with appropriate information explaining the benefits of doing so. Interpretive information panels will be installed at each demonstration site and will identify native plant species appropriate to plant in this ecozone, impacts of phosphorus on water quality and typical sources, the

relationship between buffer zones and nutrient uptake, recommended septic system and building setbacks and reasons for these distances, benefits of shoreline naturalization and options for low-impact dock installation. The centre anticipates reaching 20 000 visitors during the summer season.

Project Name: Development of a Risk Indicator to Identify Soils Prone to Phosphorus Release Under Prolonged Flooding

Project Recipient: University of Winnipeg (Dr. Kumaragamage)

Environment Canada Contribution: \$109,200

Status: Project to be completed in March 2015

Description: The research study will develop and validate a suitable risk indicator to identify the soils that are prone to releasing large quantities of phosphorus under waterlogged, anoxic conditions to surface runoff water, using soils in the Interlake area and Red River basin in Manitoba that contribute substantially to phosphorus loading to Lake Winnipeg. The risk indicator will be tested using surface soil and subsoil to provide additional information on the influence of top soil removal on phosphorus release to surface water under flooded conditions. The information generated would help in: (a) selecting and preparing sites (including top soil removal) for wetland restoration; (b) identifying soils where holding water could reduce phosphorus loadings downstream; and (c) identifying soils where holding water could substantially increase phosphorus loadings downstream. This tool to identify soils with a high risk of releasing phosphorus under anoxic conditions could be used in making recommendations on drainage management of flooded soils.

Project Name: Development of a Simulation Tool to Identify Priority Areas for Wetland Conservation and Restoration

Project Recipient: University of Manitoba (Dr. Ali)

Environment Canada Contribution: \$53,475

Status: Project to be completed in March 2017

Description: The project will develop a water quantity and quality simulation tool to explore scenarios of wetland conservation and restoration. Due to landscape heterogeneity and variable hydro-meteorological conditions, not all wetlands function the same way; wetlands termed “critical” are those whose drainage would result in the most significant adverse impacts on watershed connectivity, flooding and water quality. The proposed tool will allow an examination, in a virtual environment, of which wetlands can be characterized as critical and should be conserved or restored in priority at the watershed scale. The scenarios explored will be ranked both as a function of the number of hectares of wetland conserved or restored and as a function of the decrease in the magnitude of peak flows and the decrease in the annual exports of phosphorus. Different wetland conservation and restoration scenarios will

be explored, targeting a minimum 25% decrease in phosphorus export in the next 15 years. The project will take place in two watersheds in pothole-dominated landscapes of the Lake Winnipeg basin where past research has established a clear link between historical wetland drainage, increased flooding and decreasing water quality.

Project Name: Management of Sediments in Surface Waterways to Reduce Phosphorus Loading in Lake Winnipeg

Project Recipient: University of Manitoba (Dr. Lobb)

Environment Canada Contribution: \$40,234

Status: Project to be completed in March 2015

Description: The project will: (i) identify and characterize locations within the Red River and the Winnipeg River basins where sediments accumulate; (ii) quantify the amounts of sediment and associated phosphorus; (iii) characterize management practices that affect these sediments and associated phosphorus; and (vi) evaluate existing and alternative management practices for their potential to reduce phosphorus levels within these waterways and loading to Lake Winnipeg. The project will focus on the Tobacco Creek and LaSalle River watersheds in the Red River basin and in the Catfish Creek and Whitemouth River watersheds in the Winnipeg River basin. In addition to a survey of sedimentation and sediment management practices within these watersheds, detailed evaluation of existing and alternative sediment removal and disposal practices will take place at several locations.

Project Name: Designing and Managing Riparian Areas to Filter Phosphorus and Sediment

Project Recipient: University of Northern British Columbia

Environment Canada Contribution: \$114,222

Status: Project to be completed in March 2017

Description: The project will enhance understanding of how sediment and phosphorus move from agricultural fields into watercourses and determine whether riparian buffers are net sinks or sources of phosphorus; determine how buffer features can be manipulated to increase their filtering capacity; develop buffer design criteria and outreach materials for use by farm advisors and land managers; and produce improved protocols for the implementation of riparian buffers by assessing the bio-physical parameters and socio-economic criteria that control their uptake. Previous LWBSF-funded research by Dr. Lobb (2012) identified that it should be possible to manipulate the topography of buffer “steps” to enhance their effectiveness. However, this has yet to be evaluated through detailed field-based studies. This project will do so at a number of locations within the Lake Winnipeg watershed. Numerous study sites will be evaluated in the Winnipeg River, Red River Valley and Assiniboine River catchments, and 5-10 will be selected for detailed monitoring, manipulation and management studies.

Project Name: Quantification of the Internal Phosphorus Load in Lake Winnipeg to Improve Phosphorus Budgets

Project Recipient: Freshwater Research

Environment Canada Contribution: \$28,000

Status: Project completed

Description: The project will determine whether internal phosphorus loading in Lake Winnipeg can be quantified using three approaches. Approach 1 uses water column increases of phosphorus concentrations throughout the summer. Approach 2 is based on mass balance calculations, involving water and phosphorus loading data from previous studies on Lake Winnipeg. Approach 3 relies on predicting an aerial phosphorus release rate from total and releasable phosphorus fractions previously determined in Lake Winnipeg sediments. Internal phosphorus loading estimates would help decision makers in several ways. First, internal phosphorus loading estimates would improve the predictive ability of any phosphorus mass-balance model currently under development. Second, internal loading estimates can tell us whether and in what time frame lake water quality will respond to external load control. Worst-case scenarios of increased anoxia and internal phosphorus release as a result of increased temperatures or drought could be investigated. Therefore, knowledge about the amount of internal load is needed in setting nutrient objectives for Lake Winnipeg.

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Additional information can be obtained at:

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