Lake Winnipeg Stewardship Board

Reducing Nutrient Loading to Lake Winnipeg and its Watershed

Our Collective Responsibility and Commitment to Action

Report to the Minister of Water Stewardship – December 2006

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Lake Winnipeg Stewardship Board

Message from the Chair

It is nearing two years since the Lake Winnipeg Stewardship Board released its Interim Report containing draft recommendations on how to clean up Lake Winnipeg, and how each of us as a resident of the Lake Winnipeg watershed might accept our shared responsibility in this critical task. Since then, the Board has been gathering reaction and input from the public, governments, agencies, and scientists in a determined effort to refine those earlier recommendations. In this report, our December 2006 report to the Minister of Water Stewardship,, the fruits of our labour are presented.

There is an urgency surrounding the recommendations contained in this report. Algal blooms on Lake Winnipeg continue to increase in frequency, duration, and intensity, an ominous sign that the lake is not well. Unless we take action throughout the watershed now, the impacts of nutrient loading to the lake will increase. Although those who live and fish on the lake have been aware of the deteriorating water quality for some time, most people, communities, and governments in the watershed are not aware of the water quality problems facing Lake Winnipeg. Developing a watershed-wide understanding of what needs to be done to solve these problems is paramount. By far, not enough is happening in the watershed that might first initiate a slow-down, and secondly a reduction, of nutrient loading to the lake to restore the health of Lake Winnipeg.

The Lake Winnipeg Stewardship Board's January 2005 Interim Report detailed the challenge facing us and presented some 87 separate recommendations for government and public consideration. An intense period of public discussion followed. Much thoughtful and well-researched input was received from individuals, agricultural producer associations, municipal organizations, private corporations, environmental organizations, independent scientists, and students. Manitoba Water Stewardship invited comment from affected provincial and federal departments, many of whom responded.

This report, after very careful consideration by the Lake Winnipeg Stewardship Board, presents a blueprint for action. It builds on the foundation lain by the Interim Report and contains some notable features. Many of the Board's Interim Report recommendations have been revised, others are new, and some are unchanged from those presented in the Interim Report. A quick "What YOU Can Do Now" guide is printed on a handy cut-out page. This page provides advice to the public on actions that can be taken now.

We have enough information now to move upstream from the lake into the watershed and begin to take action at the sources of nutrient loading. We know that in some cases there will be large costs for acting as environmental stewards, and all governments and citizens in the watershed will have a financial role to play in cleaning up Lake Winnipeg. But the benefits are substantial. Now is the time to accept our collective responsibility, and to support a commitment to action for the benefit of Lake Winnipeg.

It will be critical to the success of the undertaking that those living near the lake, and throughout the entire Lake Winnipeg watershed within Manitoba and beyond, understand the magnitude of the issue, and how their actions may lead to a resolution.

The recommendations presented in this report are based on the collective knowledge, experience, and investigations of the Board. It is recognized that some of these recommendations are far-reaching and cross every sector of society. It will be important to gain feedback on these recommendations from all Manitobans, including First Nations communities and others who have important Traditional Knowledge.

It is in the best interests of all Manitobans to return Lake Winnipeg to the majestic condition it once was.

We cannot wait. The time for action is now!

Bill Barlow, Chair
Lake Winnipeg Stewardship Board

Memorandum

To: Honourable Christine Melnick, Minister of Water Stewardship

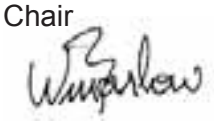
From: The Lake Winnipeg Stewardship Board

Date: December 31, 2006

Re: Reducing Nutrient Loading to Lake Winnipeg and Its Watershed

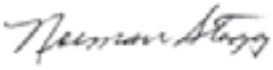
The Lake Winnipeg Stewardship Board is pleased to submit this report on recommended strategies to reduce nutrient loading to Lake Winnipeg and its watershed. Since the release of it's January 2005 Interim Report, the Board has sought input from the public, organizations, and the scientific community. As a result, many of the earlier recommendations have been revised, and others added. In this report, the Board presents recommendations developed around 38 separate issues. These recommendations are aimed at protecting the health of Lake Winnipeg and its watershed.

Mr. Bill Barlow
Chair



Mr. Robert T Kristjanson
Member

Mr. Norman Stagg
Member



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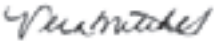
Ms. Vera Mitchell
Member



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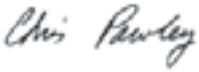

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Ms. Halina Zbigniewicz
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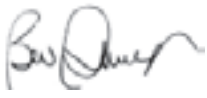

Executive Summary

In February 2003, Manitoba unveiled a provincial action plan to protect Lake Winnipeg. Among the six points in the Lake Winnipeg Action Plan was the establishment of the Lake Winnipeg Stewardship Board. In July 2003, the Board was formally established. The Lake Winnipeg Stewardship Board was directed to assist the Province of Manitoba in implementing the Lake Winnipeg Action Plan and to identify actions necessary to reduce nitrogen and phosphorus loading to Lake Winnipeg to pre-1970 levels.

The Lake Winnipeg Stewardship Board's January 2005 Interim Report presented recommendations in 32 areas directed at protecting Lake Winnipeg and improving its state of health. Action is already underway on many of the recommendation areas, but much more needs to be done. Since the release of its Interim Report, the Lake Winnipeg Stewardship Board and its committees have undertaken several important activities which have helped the Board formulate new recommendations and revise many of its existing recommendations. The Board has received feedback and advice from the public through public meetings, written correspondence, and through its web site. As well, the Board has received feedback during the many presentations made by the Chair to groups and agencies at conferences and meetings.

On May 31, 2006 the Lake Winnipeg Stewardship Board's Science Committee hosted a workshop of approximately 50 scientists from across Canada and the northern United States. The main purpose of this workshop was to review a comprehensive literature compilation[1] to ensure that it was complete, accurate, and suitable for use in the next steps of the process as long-term, ecologically-relevant objectives for nutrients are developed. Input was invited on draft principles to guide this process. Those in attendance were also asked to help in identifying approaches and the next steps necessary to formulate these objectives. Developing these ecologically-relevant objectives for Lake Winnipeg is an essential component of the overall nutrient management strategy to the lake and its watershed.

The Board has made several positive changes and additions to the background information and to the original recommendations presented in the Interim Report. This, the December 2006 Report of the Lake Winnipeg Stewardship Board, reflects those changes.

This report prescribes what can be done for the health of Lake Winnipeg and its watershed and asks all Manitobans and our neighbours to work together and take action in a spirit of collective responsibility. The Lake Winnipeg Stewardship Board is mindful that some of its recommendations may have more economic and social impact on some watershed sectors than on others. Developing a plan for watershed action that is economically and environmentally sensible will involve acquisition of data and in-depth analysis by government to carefully assess socio-economic and environmental factors.

Clearly there is a need for a more in-depth understanding of many of the issues identified in the report. This will require government commitment to additional finances, research, monitoring, and action.

Timely action is needed for all of the recommendations in this report. A broad-ranged, collective movement toward achieving our common goal is essential. The public must be made aware of the issues facing Lake Winnipeg and the watershed, and be provided with information so it may make informed choices concerning its actions. Gaps in scientific knowledge need to be filled, but this must not delay the implementation of the plan, since there is enough information and experience at hand to begin the task. Upstream jurisdictions in the watershed must be brought into the effort, and Manitoba must lead by example.

[1] North/South Consultants Inc. May 2006. Literature Review Related to Setting Nutrient Objectives for Lake Winnipeg. This report may be viewed on the Lake Winnipeg Stewardship Board website at www.lakewinnipeg.org

Recommendations

1.0 Public Education on Water Quality Protection

1.1 With the goal of reaching every Manitoban, the Province of Manitoba should develop an extensive and innovative public education program to inform Manitobans of the issues facing Lake Winnipeg, their roles in addressing these issues, and to engage them in taking action.

1.2 Recognizing there are public education activities related to water quality issues currently underway in the watershed, there is a need to coordinate and build on this work.

1.3 A public education program should promote a community-to-community awareness and clearly identify the contribution that all communities, such as urban dwellers, waterfront property owners, agricultural producers, industry, and First Nation communities, must make to reducing nutrient loading.

1.4 To raise awareness of Lake Winnipeg issues, the Province of Manitoba and others should sponsor special events related to Lake Winnipeg.

1.5 The Lake Winnipeg Research Consortium research vessel the Namao should continue to be used for research, on-board education, and public open house events to raise awareness about the challenges facing Lake Winnipeg, and to inform people of the scientific research that is underway.

1.6 A committee of First Nations representatives, commercial fishers, Metis elders, and others as appropriate, should be formed to compile and describe the history of the lake from Traditional Knowledge and identify concerns and solutions for Lake Winnipeg.

1.7 The Province of Manitoba should develop a public relations advertising program related to the issues facing Lake Winnipeg, targeting watershed jurisdictions outside Manitoba.

1.8 The Province of Manitoba should initiate a regular "State of the Lake and Watershed" forum with participation from provinces and states within the Lake Winnipeg watershed.

1.9 The material in the Lake Winnipeg Stewardship Board's December 2006 Report should be presented in public forums and schools throughout the province.

2.0 Curriculum Development and Implementation in Manitoba Schools

2.1 Manitoba Education, Citizenship and Youth should design teaching units, credit courses, and upgrade holistic environmental curricula specific to Lake Winnipeg and local watersheds for mandatory implementation in Manitoba schools.

2.2 Manitoba Education, Citizenship and Youth should consider sharing Lake Winnipeg watershed-related curricula with other provincial departments of education, particularly those provinces in the Lake Winnipeg watershed.

2.3 An awareness of Lake Winnipeg water quality and watershed influences must be created among those teachers and administrators in First Nations schools involved in curriculum development. Also, special events and awards for students conducting projects on the Lake Winnipeg issues should be considered.

2.4 Lake Winnipeg and watershed issues should be promoted through professional development opportunities for teachers.

2.5 Manitoba's conservation districts and other environmental agencies and organizations should be actively involved in promoting school projects related to protecting the health of Lake Winnipeg and its watershed.

3.0 A Scientific Basis for the Protection of Lake Winnipeg

3.1 On-going research and monitoring is required on Lake Winnipeg to address outstanding information gaps, to monitor progress towards achieving targets for nitrogen and phosphorus, and to refine these targets. To this end, there is a need for the provincial and federal governments to develop and implement a long-term, collaborative science plan for Lake Winnipeg.

3.2 The Province of Manitoba should substantially increase its investment in the development of expertise within the scientific community in the areas of hydrological and contaminant transport mechanisms at the land-water interface, and to build and support strong multi-disciplinary teams to address outstanding science needs.

3.3 Manitoba Water Stewardship must continue its long-term water quality monitoring of watersheds contributing to Lake Winnipeg, and should augment this routine monitoring to better estimate loadings of nutrients from short-term runoff of rain and snowmelt events. It is also important that this monitoring continue in order to track progress towards achieving targets set for Lake Winnipeg.

3.4 The Province of Manitoba together with other agencies needs to develop and implement a focused program of applied research aimed at better understanding the human-induced changes in water flows, circulation patterns, seasonal lake residence time, and lake levels on nutrient dynamics within Lake Winnipeg.

3.5 The Province of Manitoba together with other agencies needs to develop and implement a focused program of applied research aimed at better understanding the human-induced changes caused by dams, ditches, and diversions on water flows, in rivers and streams within the Lake Winnipeg watershed.

3.6 The Province of Manitoba and other agencies need to identify the factors responsible for increases in flow on the Red River and the associated increase in nutrients to Lake Winnipeg, and determine the sources of these nutrients.

3.7 The Province of Manitoba should investigate innovative technologies that might be appropriate to help mitigate nutrient levels within Lake Winnipeg.

3.8 The provincial and federal governments need to develop a strategy to collect Traditional Knowledge from commercial fishers, First Nations, Metis, agricultural producers, and others knowledgeable on Lake Winnipeg conditions, and ensure that this information is integrated with contemporary science as additional knowledge of Lake Winnipeg is gained.

4.0 Setting Long-Term Ecologically-Relevant Objectives for Nutrients in Lake Winnipeg

4.1 Manitoba Water Stewardship should continue the process of establishing long-term, ecologically-relevant objectives for nutrients in Lake Winnipeg, its contributing basins, and the downstream environment. This will involve estimating the historical nutrient regime in Lake Winnipeg through assembling the lake's paleolimnological record, developing a nutrient water quality and an ecosystem model for the lake, proposing draft nutrient objectives, and reviewing the draft objectives through a second workshop.

5.0 Transboundary and Inter-jurisdictional Issues

5.1 The Province of Manitoba, with the support of the Government of Canada, should continue to communicate with North Dakota and Minnesota regarding transboundary issues related to the Red River, and ultimately to Lake Winnipeg itself.

5.2 The Province of Manitoba must continue to work with neighbouring jurisdictions in Saskatchewan and Alberta through the Prairie Provinces Water Board to develop commitments to reduce phosphorus and nitrogen loadings entering Manitoba.

5.3 The governments of Manitoba and Canada are urged to initiate discussions with the Province of Ontario with the goal of developing targets for nutrient contribution in the Winnipeg River at the Manitoba/Ontario boundary.

5.4 The Province of Manitoba must work to strengthen its working relationship with the Government of Canada on First Nations issues related to impacts on water quality, and each should be prepared to accept their full fiduciary responsibilities as per their constitutional obligations.

5.5 The Province of Manitoba should consider forming a basin management board comprised of government and public representatives from throughout the watershed to deal with the health of Lake Winnipeg and its watershed.

6.0 Integrated Watershed Management Planning

6.1 Manitoba Water Stewardship should work with local communities to establish watershed management districts or watershed authorities within the Manitoba portion of the Lake Winnipeg watershed.

6.2 The Province of Manitoba should initiate watershed management planning with the watersheds that contribute the highest amount of nutrient export per unit of land area. However, it is important not to delay watershed planning in other regions of the province.

6.3 Those jurisdictions outside of Manitoba who share watersheds with Manitoba should be encouraged to participate in the development of watershed management plans.

6.4 Watershed management districts should be established based on natural watershed boundaries rather than municipal boundaries.

6.5 Watershed management districts should be responsible for managing all drainage issues within their jurisdictions, including in-field drainage activities and the drainage of natural wetlands. The Province of Manitoba should retain responsibility for issuing and enforcing permits for these projects.

6.6 Watershed management plans need to be consistent with provincial water quality objectives. While recognizing regional variability, the Province needs to develop water quality objectives to facilitate the watershed planning process.

6.7 Watershed planning and activities under the *Planning Act* need to be harmonized.

7.0 Cosmetic Use of Phosphorus-Based Fertilizers

7.1 The Province of Manitoba should explore the option of implementing province-wide restrictions on the use of phosphorus-based fertilizers for cosmetic purposes.

7.2 The Province of Manitoba and the Government of Canada should implement restrictions on the cosmetic use of phosphorus fertilizers for lawn care on provincial and federal properties.

7.3 The Government of Canada should institute a consistent policy for the use of fertilizers for cosmetic use on all federal lands, including national parks and First Nations communities.

8.0 Water Usage, Sewage Treatment, and Related Financing

8.1 The Province of Manitoba should ensure that all Manitobans are served by wastewater treatment practices that safeguard human health and water quality.

8.2 Manitobans should pay the true cost of the operation and maintenance of the systems required to provide the water they consume, and the true costs of the services required to adequately treat wastewater.

8.3 Utility reserves that cover the true costs of infrastructure upgrades or replacement must be established within each community such that monies are available when utility upgrades are required. Monies collected for these reserves need to be protected from competing financial needs within the community.

8.4 Over the short term, the Province of Manitoba should negotiate predictable funding agreements with municipal and federal governments for wastewater treatment infrastructure (for example, on a one-third municipal, one-third provincial, and one-third federal funding formula), for municipalities to undertake the necessary work to ensure adequate nutrient removal. Over the long-term, utilities need to implement full-cost recovery funding models that cover complete life cycle costs.

8.5 New subdivisions, including new provincial cottage lots, need to have the costs of infrastructure considered in the lot costs. Financial compensation to municipalities may be required to allow adequate servicing of cottages or homes built on Crown land.

8.6 The sources of extraneous groundwater inflow into wastewater collection systems need to be investigated and minimized where feasible.

9.0 Water Use Efficiency

9.1 The Manitoba Building Code and the National Building Code should be revised to require all new homes to be fitted with low-flush toilets and low-flow faucets.

9.2 Governments should demonstrate leadership by instituting a program to convert fixtures in government-owned buildings to water-saving fixtures. When government agencies are leasing space, a condition of tenancy should be the conversion of existing fixtures to low-flow alternatives.

9.3 All levels of government should consider incentives or rebates for homeowners to retrofit fixtures to low-flow alternatives. An environmental levee for the purchase of higher volume fixtures should be considered.

9.4 A public education program should be implemented to encourage the safe collection and use of rainwater for lawn and garden use.

9.5 Water consumers on community water systems that currently are not metered, should be metered, and be billed on a water use basis at the full cost of the water supply.

9.6 Consideration should be given to applying higher billing rates for water as usage increases. Discontinuing the practice of bulk discounts and reduced water rates for large commercial and industrial consumers should be considered.

10.0 Regionalization of Wastewater Treatment Services

10.1 The Province of Manitoba should do more to promote and facilitate regionalization of wastewater treatment systems.

10.2 Options for regionalization need to be fully explored by the proponent prior to receiving funding through the Manitoba Water Services Board.

10.3 Comprehensive sewage management plans should be developed for areas of the province where existing sewage treatment practices such as septic fields and holding tanks are releasing excessive nutrients.

11.0 Development of Nutrient Abatement Plans for Large Wastewater Treatment Facilities in Manitoba Communities

11.1 The Province of Manitoba should continue to require that nutrient reductions be implemented as quickly as possible at the large municipal and industrial wastewater treatment facilities in the cities of Winnipeg, Portage la Prairie, and Brandon.

11.2 Nutrient reduction strategies for large facilities, such as biological nutrient removal, chemical treatment, effluent irrigation, constructed wetlands, and other proven technologies, need to be evaluated for their effectiveness and practicality given Manitoba conditions and economic circumstances. Source control pollution prevention plans should also be implemented as measures to reduce nutrient input.

11.3 The Province of Manitoba must finalize its Nutrient Management Strategy along with developing a comprehensive prioritized plan for nutrient abatement for all wastewater treatment facilities in the Manitoba portion of the watershed.

11.4 The Province of Manitoba should set limits for nutrient reduction that meet or exceed those in neighbouring jurisdictions, and at levels that are adequate to protect Lake Winnipeg.

11.5 The Lake Winnipeg Stewardship Board recognizes that the priority for nutrient abatement at municipal wastewater treatment systems should be on phosphorus first with nitrogen as a second priority.

12.0 Environmental Planning for Urban, Rural and Cottage Development

12.1 The Province of Manitoba and municipalities should establish an integrated land and water resource planning process that is environmentally conscientious, and ensures planned and orderly growth with respect to land drainage and sewer and water services. "Smart Growth" concepts need to be considered for future land use planning.

12.2 The Province of Manitoba should ensure that all rural residential, commercial, industrial, and urban developments are comprehensively reviewed with respect to water and wastewater treatment requirements to protect the environment.

12.3 Developers should be required to include the full-cost recovery expense of installing the required water and wastewater treatment services for new developments and ensure that these are built into the costs of the development.

12.4 There is a need to consider regional wastewater treatment services for new rural residential developments.

12.5 Developers should be responsible for land drainage issues for new residential developments that consider the nutrient impacts of the development, and should build in strategies such as stormwater retention and treatment and erosion control to minimize these impacts.

12.6 Developers of all new urban and rural development projects should be required to incorporate low-impact, environmentally conscientious concepts into the design of the project, with the aim of reducing environmental service costs to minimize pollution loads.

12.7 The Province of Manitoba should consider establishing regulations, such as minimum set-back distances from shorelines for new developments, to prevent significant disturbances which would result in increased erosion along lakes and waterways.

13.0 Stormwater Retention Ponds

13.1 All new stormwater retention ponds should be designed to maximize nutrient retention without compromising stormwater management needs.

13.2 Monitoring should be conducted by the Province of Manitoba to compare managed ponds with unmanaged ponds in their nutrient removal capabilities. Data from other jurisdictions with a similar climate should be collected to help determine the best design and management strategy for nutrient capture under Manitoba conditions.

14.0 Nutrient Abatement Options for Small Wastewater Treatment Facilities

14.1 Small municipal and smaller industrial facilities should meet the same standard of 1 mg/L of phosphorus as those for large municipal and industrial facilities. Reducing nitrogen discharges from these facilities may also receive consideration should it be determined that further nitrogen removal is necessary for the health of Lake Winnipeg.

15.0 Effluent Irrigation/Land Application of Municipal Effluents

15.1 *Environment Act* licence proposals for municipal lagoons need to comprehensively consider effluent irrigation, or an equivalent treatment process, as a means of effluent disposal.

15.2 Alternatives to the use of sodium chloride in water softeners, such as potassium chloride, should be explored to ensure wastewater is more suitable for land application. Other alternatives to the use of salts for softening water, such as reverse osmosis and magnetic water softeners, should be considered as viable options.

15.3 Consideration should be given to minimizing industrial or commercial contaminants from reaching sewage treatment facilities to ensure effluents are suitable for land application.

16.0 Appropriate Lagoon Design, Operation, and Storage Capacity

16.1 A review of lagoon design and operation to optimize nutrient removal should be conducted. Nutrient data should be gathered from Manitoba and other jurisdictions with similar climates to determine what benefits may be realized from a longer storage capacity.

16.2 The Province of Manitoba should explore the option of ensuring that there is an appropriate storage capacity for new and expanded lagoons as a strategy to greatly reduce emergency discharges, and also to give increased resiliency to permit other effluent disposal approaches, for example, trickle discharge. Water conservation strategies will assist municipalities in realizing increased storage capacity (see Recommendation 9: Water Use Efficiency).

16.3 Those communities with repeated emergency discharges of effluent from their sewage storage lagoons should be required to immediately develop strategies, such as increased lagoon capacity, to eliminate these emergency discharges.

17.0 Constructed/Engineered Wetlands

17.1 The Province of Manitoba should undertake a focused review of the effectiveness and appropriateness of using engineered wetlands as a nutrient abatement option for small wastewater treatment facilities.

18.0 Chemical Treatment of Lagoons (e.g. Alum, Ferric Salts, Magnesium Salts etc.)

18.1 A review of the use of alum, ferric salts, and other salts in wastewater treatment should be conducted. This review would evaluate the resultant concentration of salts in the waste sludge and determine whether these levels pose any environmental or health risks. The suitability of applying this type of sludge to land should also be investigated. Those strategies which facilitate the recycling of phosphorus should be favoured over those strategies that immobilize the phosphorus.

19.0 Conversion of Lagoons to Wastewater Treatment Plants with Nutrient Removal Capabilities

19.1 The Province of Manitoba and rural municipalities should consider the conversion of lagoons to wastewater treatment plants with nutrient removal capabilities, perhaps through the development of regional wastewater treatment facilities. Larger communities may want to consider the option of converting their lagoons to wastewater treatment plants with nutrient removal capabilities on their own.

20.0 Other Innovative Approaches that will Achieve Nutrient Reduction

20.1 The Province of Manitoba and Government of Canada should explore, encourage, and support innovative emerging technologies that will result in reducing nutrients in effluent in an environmentally sensitive manner.

21.0 Environmental Licensing Fees and Environmental Review Process for Small Wastewater Treatment Facilities

21.1 The Province of Manitoba should seek opportunities to reduce the financial disincentives to those proponents voluntarily improving their waste management practices such that the risk of nutrients and other contaminants reaching surface water is reduced. The Province should consider establishing a fund, perhaps within an existing program, such as the Sustainable Development Innovation Fund or the Manitoba Water Services Board, that would be directed towards reimbursing proponents for the cost of the environmental licensing fee, where a demonstrated improvement to the environment is realized.

21.2 Proponents applying for an *Environment Act* licence for a new or upgraded municipal lagoon should be required to evaluate alternative wastewater treatment technologies which recycle nutrients as a method of effluent disposal, such as effluent irrigation, which involve zero discharge.

21.3 Where it has been demonstrated that innovative nutrient removal technologies for wastewater are deemed beneficial, opportunities to expedite the regulatory review process should be explored.

22.0 Leachate Handling

22.1 The Province of Manitoba should evaluate options to remove leachate from domestic wastewater treatment systems such as establishing a dedicated leachate treatment facility within the province. Priority should be given to dealing with leachate which is of poorest quality and highest quantity.

22.2 To minimize the amount of toxic substances collected in landfill leachate, the Province of Manitoba should expand opportunities for the public to safely and conveniently recycle and dispose of toxic substances.

23.0 Nutrient Management Issues on First Nations Communities

23.1 Sewage treatment on First Nations communities must be upgraded to meet both public health and environmental standards. As a minimum, federal standards for First Nations communities should match provincial standards. Nutrient control strategies should be considered for all new and upgraded wastewater treatment facilities.

23.2 Immediate action needs to be taken to remedy malfunctioning or non-existent waste management systems in First Nations communities, and to address the problem of sewage disposal. Alternative waste management systems such as composting systems, semi-compressed peat moss systems, and constructed wetlands need to be explored.

23.3 Nutrient management strategies which evaluate the sources of nutrient losses, and identify opportunities to reduce or eliminate these losses should be developed in collaboration with First Nations communities. These strategies should include a strong educational component.

23.4 The Province of Manitoba should work towards ensuring that sewage treatment and disposal standards are consistent across the province, including those regulating First Nations and northern communities.

23.5 Where there are First Nations and non-First Nations communities located adjacent to one another, regional cooperation for sewer and water services across jurisdictional boundaries needs to be developed between the governments of Manitoba and Canada.

23.6 Senior levels of government should provide adequate levels of funding within their respective jurisdictional responsibilities to support education, training, and resourcing to ensure that waste treatment facilities in First Nations communities are properly maintained and operated.

23.7 Federal and provincial governments should work with First Nations communities to review the environmental regulations that apply to First Nations land, the extent to which those regulations minimize nutrient loading, and the degree to which they are enforced. Federal environmental standards and guidelines for First Nations communities should meet provincial standards as a minimum.

24.0 Septic Field Maintenance and Alternatives to Septic Fields

24.1 A focused educational campaign should be undertaken to provide guidance to homeowners on how to properly maintain septic fields, and how to recognize when they are failing.

24.2 The Province of Manitoba should consider mandatory inspection of private sewage treatment systems at the time of sale. The seller would pay for the inspection, and the sale of the property would be conditional on a properly functioning system.

24.3 The Province of Manitoba should explore the option of instituting an annual levy to recover the costs of conducting an ongoing comprehensive septic field inspection program, and maintaining a septic field database.

24.4 There is a need to implement regional sewage treatment plants with nutrient removal capabilities, prioritizing areas such as those with high rural residential density, and those with close proximity to waterbodies and aquifers.

24.5 Where regionalization of sewage treatment is not feasible, or as an interim measure until regionalization is practicable, alternatives to septic fields should be explored.

25.0 Management of Domestic Septage and Greywater

25.1 The Province of Manitoba should develop a strategy for handling septage and greywater in an economic and environmentally sensitive manner, in consideration of potential health issues. This should include options for handling these wastes within existing wastewater treatment facilities, as well as the option of controlled and managed land application of this waste.

25.2 Efforts to prevent illegal disposal of septage in ditches or other inappropriate locations must be strengthened.

25.3 The Province of Manitoba should undertake a review of septage and greywater use being employed in other jurisdictions to assess its feasibility for Manitoba conditions.

26.0 Manitoba Water Services Board

26.1 The Province of Manitoba needs to ensure funding of sewage treatment works through the Manitoba Water Services Board supports the commitments in the Lake Winnipeg Action Plan, and complements the funding principles identified in Recommendation 8.4 of this report.

26.2 The Province of Manitoba is urged to review and revise existing funding criteria used by the Manitoba Water Services Board to include environmental protection, specifically to meet the goals of the Lake Winnipeg Action Plan nutrient reduction.

26.3 The Province of Manitoba, through the Manitoba Water Services Board should accelerate the development of regional wastewater treatment facilities.

27.0 Phosphoric Acid Use in Water Supplies

27.1 The Province of Manitoba should initiate a project to identify the number of communities in Manitoba, in addition to Winnipeg and Portage la Prairie, that are using phosphorus-based strategies for lead control in water mains and in collaboration with each community, determine the amount of phosphorus lost to receiving water. This evaluation should consider phosphorus removal plans being implemented for these wastewater treatment facilities, and examine alternatives to phosphoric acid.

28.0 Phosphorus Content in Cleaning Supplies

28.1 Manitoba Water Stewardship should raise the issue of the lack of regulation controlling phosphorus content in cleaning products, such as dishwashing detergents, with the Canadian Council of Ministers of the Environment with a view to having the Government of Canada restrict the phosphorus content in those cleaning products currently not regulated.

29.0 Nutrient Loss from Confined Livestock Areas and Over-Wintering Sites

29.1 Drainage from confined livestock areas should be directed to retention basins, grassed buffer strips, and constructed wetlands, or other generally recommended nutrient reduction practices should be employed.

29.2 Where possible, holding areas and wintering areas for livestock should be used on a rotational basis to prevent a build-up of nutrients in the soil. Otherwise, manure accumulated in confined holding areas should be regularly removed and applied to crop or pasture lands at agronomic rates.

29.3 Legislation should be reviewed and revised, where appropriate, to ensure that new or expanded confined livestock operations are constructed and operated in such a way as to minimize nutrient loss to the environment.

29.4 Governments should intensify their own agriculture extension programs (such as those offered by Manitoba Agriculture, Food and Rural Initiatives), as well as those delivered in partnership with other programs, to help producers assess the environmental risk of their operations, and to provide advice on how to prevent the contamination of groundwater and surface water.

30.0 Livestock Access to Riparian Areas and Waterways

30.1 The enforcement of the prohibition of winter feeding of livestock on frozen lakes, rivers, and other waterbodies should receive more attention.

30.2 Livestock producers should be encouraged through enhanced incentives, education, and when required, regulations to implement measures to protect riparian areas and waterways, such as managing livestock access in riparian areas and providing off-site watering structures.

31.0 Soil Fertility and Manure Testing

31.1 Additional strategies that promote and support annual soil testing must be developed to provide producers with the tools necessary to make sound agronomic, economic, and environmental decisions.

31.2 Incentives for producers conducting soil testing and manure testing should be considered.

31.3 The Province of Manitoba should ensure that soil test laboratories are accredited, and are using accredited analytical methods, and that fertilizer recommendations are accurate and appropriate for Manitoba soil, crop, and climatic conditions.

31.4 Soil testing laboratories should ensure that their soil and manure test recommendations and reports are user-friendly and informative to producers.

31.5 Additional research is needed to understand the difference in nutrient availability for different types of livestock manures (for example, liquid versus solid).

31.6 Enhanced education on the economic and environmental benefits of soil and manure testing is required.

32.0 Matching Nutrient Inputs with Crop Nutrient Requirements and Exports, and Establishing Soil Phosphorus Limits

32.1 For planning individual livestock operations, the Province of Manitoba should ensure that operators have sufficient land available for new and expanding livestock operations to balance phosphorus application rates with removal rates over the long-term.

32.2 The Province of Manitoba should develop a regional terrestrial nutrient budget for Agro-Manitoba which would assist producers, municipalities, and regulators in siting intensive livestock operations and managing manure in an environmentally sustainable manner.

32.3 Where excess nutrients are being generated, the Province of Manitoba should work with private industry to develop practical options for treating and exporting manure to nutrient-deficient areas.

32.4 The Province of Manitoba should adopt the soil test phosphorus thresholds for agricultural land as recommended by the Manitoba Phosphorus Expert Committee. The Province should also act on the Committee's recommendation to support research which will help to further refine soil phosphorus thresholds for varying Manitoba soil types and landscapes.

33.0 Evaluation of Beneficial Management Practices as Nutrient Reduction Strategies

33.1 The Province of Manitoba should lead a partnership effort to determine what beneficial management practices would be practical, economically feasible, and environmentally effective in reducing nutrient loading to the Lake Winnipeg watershed. As a first step, a literature review on the effectiveness of beneficial management practices should be undertaken on existing applicable knowledge. Secondly, these beneficial management practices must be evaluated under Manitoba field conditions.

33.2 For those beneficial management practices that have been proven effective through Manitoba-specific research, the federal and provincial governments should encourage and help fund these practices.

34.0 Nutrient Inputs from Agricultural Tile Drainage

34.1 The Province of Manitoba should evaluate the impact of tile drainage on water quality.

34.2 Where feasible, producers should direct tile drainage water into retention basins, held, and reused when supplemental water is required for agricultural land.

34.3 Producers considering tile drainage should investigate new tile drainage systems, such as "controlled drainage", which regulates the quantity of water removed at different times of the year, so that excess water and the associated nutrients are not removed unnecessarily.

34.4 The process of obtaining a permit for tile drainage should be reviewed with the aim of ensuring that water quality and water quantity issues are considered.

35.0 Drainage of Surface Water from Agricultural Lands

35.1 Agricultural producers need to consider the capability of the agricultural drainage system serving their fields to remove standing water when selecting crops to plant on that land.

35.2 A review of agricultural land drainage networks on a watershed basis should be undertaken. There is a need to balance damage from flooding with water quality impacts from drainage. This review should explore the feasibility of reducing the velocity of flow in agricultural drains to allow particulate nutrients an opportunity to settle out. The use of nutrient traps or settling basins along drains should be explored to determine their effectiveness in reducing nutrient loading. This work would include a review of the feasibility of acquiring marginal land and developing wetland areas that could serve as natural filters for drain water.

35.3 All drain construction, design, and maintenance practices should be reviewed and guidelines should be developed to minimize nutrient loss to the watercourse. This would include exploring vegetation harvesting opportunities in areas where this is not already done. There is the potential that harvested material could be utilized as animal feed or refined into bio-fuel. Consideration should also be given to using retention basins along surface drains, particularly where irrigation is being employed in the region.

35.4 All drainage projects where water leaves private property, including the drainage of natural wetlands, require a permit. Compliance with this requirement should be enforced.

36.0 Natural Wetlands as Nutrient Abatement Options

36.1 The Province of Manitoba should explore innovative options to preserve and protect wetlands from drainage. The Province should consider options to sharing the cost of preserving these wetlands more broadly throughout society as a whole.

36.2 The Province of Manitoba should undertake an in-depth review of the effectiveness of natural wetlands to reduce nutrient loading to Lake Winnipeg.

36.3 The Province of Manitoba should obtain a more complete understanding of the historic role of the Netley-Libau Marsh in reducing nutrient load from the Red River basin. Opportunities to re-create any natural historic nutrient reduction mechanisms within the Netley-Libau Marsh should be explored.

37.0 Retention Basins as Nutrient Abatement Options

37.1 The Province of Manitoba should undertake a focused review of the effectiveness and appropriateness of using retention basins as a nutrient abatement option.

38.0 Implementation of Lake Winnipeg Stewardship Board's Recommendations

38.1 The Minister of Water Stewardship should consider bringing together executives of appropriate provincial government departments to discuss how to best prioritize and implement these recommendations.

38.2 The Province of Manitoba should engage the federal government in discussions to implement the recommendations contained within the Lake Winnipeg Stewardship Board Report, December 2006.

Contents

Message from the Chair ii
Memorandum iii
Executive Summary iv
Contents xiv
Introduction 1
Background 3
Description of Lake Winnipeg and Its Watershed 4
Human History and Settlement of the Lake Winnipeg Area 6
Natural Habitats and Lakeshore Wetlands 7
Lake Winnipeg Fisheries 9
Lakeshore Communites, Lifestyles, and the Economy 11
Agriculture 13
A Hydro-Electric Reservoir 16
Drinking Water and Water Process Use 17
Municipal and Industrial Wastewater 18
Hydrology and Climate of Lake Winnipeg 20
Lake Winnipeg Water Quality 22

Issues and Recommendations 31
1.0 Public Education on Water Quality Protection 31
2.0 Curriculum Development and Implementation in Manitoba Schools 33
3.0 A Scientific Basis for the Protection of Lake Winnipeg 34
4.0 Setting Long-Term Ecologically-Relevant Objectives for Nutrients in Lake Winnipeg 36
5.0 Transboundary and Inter-jurisdictional Issues 38
6.0 Integrated Watershed Management Planning and Management 39
7.0 Cosmetic Use of Phosphorus-Based Fertilizers 40
8.0 Water Usage, Sewage Treatment, and Related Financing 41
9.0 Water Use Efficiency 43
10.0 Regionalization of Wastewater Treatment Services 44
11.0 Development of Nutrient Abatement Plans for Large Wastewater Treatment Facilities in Manitoba Communities 45
12.0 Environmental Planning for Urban, Rural and Cottage Development 47
13.0 Stormwater Retention Ponds 48
14.0 Nutrient Abatement Options for Small Wastewater Treatment Facilities 49
15.0 Effluent Irrigation/Land Application of Municipal Effluents 49
16.0 Appropriate Lagoon Design, Operation, and Storage Capacity 51
17.0 Constructed/Engineered Wetlands 52
18.0 Chemical Treatment of Lagoons (e.g. Alum, Ferric Salts, Magnesium Salts etc.) 52
19.0 Conversion of Lagoons to Wastewater Treatment Plants with Nutrient Removal Capabilities 53
20.0 Other Innovative Approaches that will Achieve Nutrient Reduction 53
21.0 Environmental Licensing Fees and Environmental Review Process for Small Wastewater Treatment Facilities 54
22.0 Leachate Handling 54

23.0 Nutrient Management Issues on First Nations Communities 55
24.0 Septic Field Maintenance and Alternatives to Septic Fields 56
25.0 Management of Domestic Septage and Greywater 57
26.0 Manitoba Water Services Board 58
27.0 Phosphoric Acid Use in Water Supplies 59
28.0 Phosphorus Content in Cleaning Supplies 59
29.0 Nutrient Loss from Confined Livestock Areas and Over-Wintering Sites 60
30.0 Livestock Access to Riparian Areas and Waterways 61
31.0 Soil Fertility and Manure Testing 62
32.0 Matching Nutrient Inputs with Crop Nutrient Requirements and Exports, and Establishing Soil Phosphorus Limits 64
33.0 Evaluation of Beneficial Management Practices as Nutrient Reduction Strategies 66
34.0 Nutrient Inputs from Agricultural Tile Drainage 68
35.0 Drainage of Surface Water from Agricultural Lands 68
36.0 Natural Wetlands as Nutrient Abatement Options 70
37.0 Retention Basins as Nutrient Abatement Options 71
38.0 Implementation of Lake Winnipeg Stewardship Board's Recommendations 71

Non-Nutrient Issues 72
Conclusion 73
Appendices 74
Appendix A: Lake Winnipeg Stewardship Board Member Biographies 74
Appendix B: Lake Winnipeg Action Plan 75
Appendix C: Lake Winnipeg Stewardship Board Terms of Reference 75
Appendix D: Lake Winnipeg Stewardship Board Committee Structure 76
Appendix E: Locations of Lake Winnipeg Stewardship Board Public Registries 76

What YOU Can Do Now 77

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Introduction

It is generally accepted that water quality in Lake Winnipeg has deteriorated over time, and in particular, over the past three decades. Evidence points to excessive nutrient enrichment from nitrogen and phosphorus as the leading cause of this problem.

In February 2003, the Province of Manitoba unveiled a provincial action plan to protect Lake Winnipeg. Among the six points in the Lake Winnipeg Action Plan was the establishment of the Lake Winnipeg Stewardship Board. In July 2003, the Board was formally established. Appointees to the Board represent a cross section of Manitobans having an interest in improving the health of Lake Winnipeg (Appendix A: Board Member Biographies).

The Lake Winnipeg Action Plan (Appendix B) identified an interim goal to reduce nitrogen loading to Lake Winnipeg by 13 per cent and to reduce phosphorus loading by 10 per cent - the increases in nutrient loading estimated to have occurred since the early 1970s. The Lake Winnipeg Stewardship Board was directed to assist the Provincial Government in implementing the Lake Winnipeg Action Plan, and to identify actions necessary to reduce nitrogen and phosphorus loading to Lake Winnipeg to pre-1970 levels (See Appendix C: Lake Winnipeg Stewardship Board Terms of Reference).

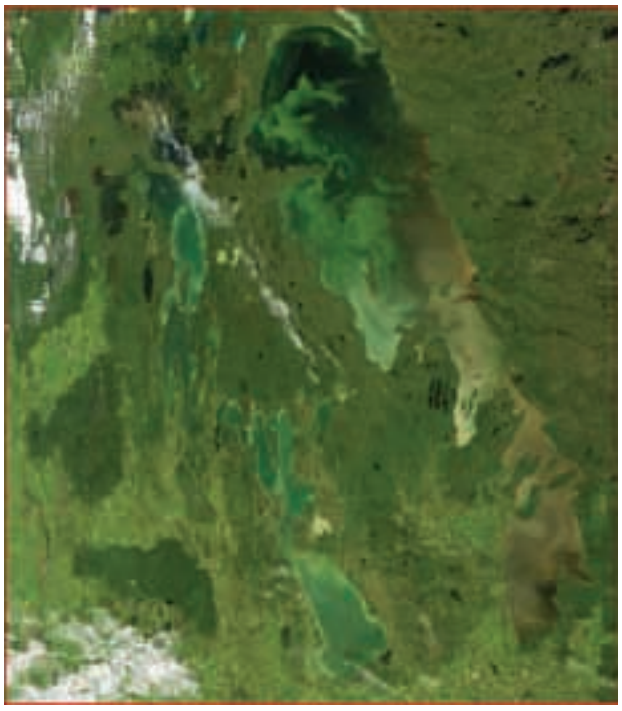
Since the release of its Interim Report, the Lake Winnipeg Stewardship Board has undertaken several important activities to formulate new recommendations and revise many of its existing recommendations.

In February of 2005, the Minister of Manitoba Water Stewardship released the Lake Winnipeg Stewardship Board's Interim Report that presented recommendations in 32 areas directed at protecting Lake Winnipeg and improving its state of health. Action has been taken on many of the recommendations, however more needs to be done at the municipal, provincial, and federal level. Some of the recommendations presented in the Lake Winnipeg Stewardship Board's Interim Report were referred to other government departments and agencies better positioned to implement these recommendations. It will be important for the Province to work cooperatively with these other departments and agencies to implement action to protect the health of Lake Winnipeg.

Since the release of its Interim Report, the Lake Winnipeg Stewardship Board and its committees (see Appendix D) have undertaken several important activities that have helped the Board formulate new recommendations and revise many of its existing recommendations. In April and May 2005, the Board organized a series of public meetings throughout the province to receive feedback on its Interim Report. The Board has also received feedback and advice from the public through written correspondence and through its web site.[2] As well, the Board has received feedback during the many presentations made by the Chair to groups and agencies at conferences and meetings.

Following the public discussion on the Interim Report, the Board shifted into the process of revising and developing new recommendations based on both the input received and an analysis of issues not fully developed in the Interim Report. As a part of that process, the Board undertook several other significant initiatives.

Satellite image of Lake Winnipeg.



[2] The Lake Winnipeg Stewardship Board website is: www.lakewinnipeg.org

The Beneficial Management Practices Task Force was established to begin the process of better understanding the processes responsible for non-point loading of nutrients into Manitoba's watersheds that flow into Lake Winnipeg. The Task Force would bring researchers and producers together to develop, evaluate, and promote nutrient and water management beneficial management practices that would reduce non-point nutrient loading in an environmentally and economically effective manner. A proposal, *"Lightening the Load - A Proposal for a Watershed Beneficial Management Practices Research and Demonstration Program"*, was forwarded by the Task Force in March, 2006 to the Minister of Water Stewardship. The work proposed by the Task Force will need long-term provincial and federal support as well as the cooperation of many agencies and producers.

A workshop was held on May 31, 2006 to begin the process of developing long-term, ecologically-relevant water quality objectives for Lake Winnipeg.

A workshop was held on May 31, 2006 to begin the process of developing long-term, ecologically-relevant water quality objectives for Lake Winnipeg. The main purpose of this workshop was to review a comprehensive literature compilation to ensure that it was complete, accurate, and suitable for use in the next steps of the process as long-term, ecologically-relevant objectives for nutrients are developed. The workshop, organized by the Board's Science Committee, was attended by approximately 50 scientists from across Canada and the northern United States. Input from participants was also invited on draft principles to guide the development of long-term, ecologically-relevant objectives for nutrients. Recommendation 4.0 of this report lists those draft principles as presented at the workshop. Those in attendance were also asked to help identify approaches and the next steps necessary to formulate long-term, ecologically-relevant nutrient objectives for Lake Winnipeg.[3]

After the release of the Interim Report, the Lake Winnipeg Stewardship Board continued to examine what changes and additions needed to be made to its Interim Report. The Board's committees were instrumental in drafting the recommendations presented in this report. Also, through the benefit of public input and further deliberation, study, and research, the Board has been able to make several positive changes and additions to the background information and to the original recommendations presented in the Interim Report. This, the December 2006 Report of the Lake Winnipeg Stewardship Board, reflects those changes.

This report provides background facts on the current state of knowledge on government policies, programs, and environmental licensing issues. These background facts are provided only as context for the Board's recommendations and do not constitute advice to government on the overall Nutrient Management Strategy and its implementation.

The May 31, 2006 Nutrient Objective Workshop was attended by approximately 50 scientists.

A new section titled "What YOU Can Do Now" can be found as a handy cut-out page at the end of this report. While much of the focus for reducing nutrient loading to Lake Winnipeg is placed on governments, communities, business, and industry, there are many actions individuals can take to minimize the stress on Lake Winnipeg and the waters flowing into the lake. This section provides advice on what steps all watershed residents can take to reduce their contributuions to the nutrient loading of Lake Winnipeg.

[3] The report "Lake Winnipeg Nutrient Management Workshop" may be viewed on the Lake Winnipeg Stewardship Board's website at www.lakewinnipeg.org.

Background

The health of Lake Winnipeg is a reflection of human presence on the landscape, and the algae in the lake can be thought of as a barometer of change. Human activities throughout Lake Winnipeg's watershed have resulted in an increased amount of nitrogen and phosphorus reaching the lake. These nutrients originate from a variety of sources. These include municipal sewage, septic fields, crop fertilizers, industrial discharges, livestock manure, and urban runoff carrying nutrient-rich contaminants such as lawn fertilizers and pet waste. Nutrients also enter the lake from a number of natural sources, including soil, the atmosphere, and decaying plant material.

Commercial fishers have reported increased densities of algae attached to their fishing nets in the winter and summer. During the summer of 2003, warning signs were posted at one Lake Winnipeg beach because of algal toxins, and at a second beach because of the presence of a dense bloom of algae capable of producing toxins. Satellite imagery has shown that large algal blooms are frequently observed in the north basin of Lake Winnipeg. In the summer of 2006, very large blooms of algae were again visible in the north basin of Lake Winnipeg, and more localized blooms developed in the south basin.[4]

Action must be taken now to protect the health of Lake Winnipeg.

Action must be taken now to protect the health of Lake Winnipeg. The recommendations presented by the Lake Winnipeg Stewardship Board later in this report set the theme and lay the groundwork for meeting this objective.

[4] Satellite images of the algal blooms on Lake Winnipeg can be viewed at: http://home.cc.umanitoba.ca/~gmccullo/LWsat.htm

Description of Lake Winnipeg and its Watershed

As the last Ice Age drew to a close about 13,000 years ago, glaciers covering most of Canada began to melt. In the middle of the continent, Lake Agassiz was created when meltwater collected along the southern margin of the retreating ice sheet. Lake Agassiz covered most of southern Manitoba in different stages over a period of about 5000 years. Eventually this glacial lake drained into Hudson Bay, leaving behind remnants of Lake Agassiz. Lake Winnipeg is an amalgamation of three of these remnants.

In terms of surface area, Lake Winnipeg is the 10th largest body of freshwater in the world.

In terms of surface area, Lake Winnipeg is the 10th largest body of freshwater in the world. It covers approximately 24,500 square kilometres. From the Red River Delta on the south to Limestone Bay on the north, the lake is 436 kilometres long.

Lake Winnipeg has two distinct basins (Figure 1). The north basin is by far the larger of the two, at about 111 kilometres across at its widest point. The south basin is about 40 kilometres wide. The two are connected by a 2.5 kilometre-wide channel called The Narrows about one-third of the way up the lake. Because of the many bays, harbours, and peninsulas along its shore, the total length of the Lake Winnipeg shoreline is about 1,760 kilometres. Isostatic rebound – the "springing back" of the earth's surface after the removal of the immense weight of the glacier – continues to occur in the region. As a result, the uneven uplifting of the lake is continually effecting shoreline change on Lake Winnipeg, particularly throughout the south basin.

Figure 1: Lake Winnipeg

Although large in surface area, Lake Winnipeg is generally a shallow lake and therefore, has a small volume of water compared to other great Canadian lakes. The lake averages about 12 metres deep. Depths generally do not exceed 19 metres in the north basin, or 13 metres in the south, with one exception. The deepest spot on the lake, at about 60 metres, occurs in a 500 metre-wide channel between the eastern point of Black Island and the mainland in the south basin.

The Lake Winnipeg watershed extends from the Canadian Rockies to within about 20 kilometres of Lake Superior (Figure 2). It encompasses portions of four Canadian provinces (Alberta, Saskatchewan, Manitoba, and Ontario) and parts of four states (Montana, North Dakota, South Dakota, and Minnesota). At about 953,000 square kilometres, the watershed is second in size in Canada to the MacKenzie River Basin. The watershed is very large relative to lake's surface area. In fact, Lake Winnipeg has the largest land drainage to surface area ratio of any of the great lakes in the world.[5] For every one square kilometre of lake surface, there are about 40 square kilometres of watershed. This high ratio raises the potential for loading Lake Winnipeg with levels of nutrients, contaminants, and sediments derived from human activities at levels that exceed the lake's natural capacity to process these materials.

[5] Lake Winnipeg Research Consortium website, www.lakewinnipegresearch.org

Figure 2: Lake Winnipeg watershed.

The Lake Winnipeg watershed is dominated by the Winnipeg, Saskatchewan, and Red rivers, and their tributaries.

The Lake Winnipeg watershed is dominated by three river systems – the Winnipeg, Saskatchewan, and Red rivers, and their tributaries. The Winnipeg River lies for the most part in the Pre-Cambrian Shield. The Shield is characterized by an abundance of lakes and forest cover over shallow or exposed bedrock.[6] The Winnipeg River receives about half of its flow from the Lake of the Woods watershed in Ontario and Minnesota, and about 28 per cent from the Lac Seul watershed in Ontario.[7] The Winnipeg River empties into Lake Winnipeg along its eastern shore downstream from Pine Falls.

Through the Saskatchewan and Red river systems, the majority of the agricultural land on the Canadian Prairies drains into Lake Winnipeg. The Saskatchewan River is comprised of two major branches – the North Saskatchewan and South Saskatchewan rivers. The North Saskatchewan River begins in the Columbia Icefield in western Alberta. From its origin, it flows along the northern fringe of the prairie past Edmonton, the Battlefords, and Prince Albert before merging with the South Saskatchewan east of Prince Albert.[8] Its most significant tributary is the Battle River, which joins the North Saskatchewan near North Battleford, Saskatchewan.

The South Saskatchewan begins between Lethbridge and Medicine Hat, Alberta at the confluence of the Bow and Oldman rivers.[9] It is joined a short distance downstream by the Red Deer River. These streams all rise in the Rockies and associated foothills. The South Saskatchewan flows through the prairies of southern Alberta and southwestern Saskatchewan to Lake Diefenbaker. From there it turns northeasterly through Saskatoon and on to merge with the North Saskatchewan. The Saskatchewan River enters Lake Winnipeg at Grand Rapids.

[6] Government of Canada. Canada's Digital Collections. Website address: http://collections.ic.gc.ca/soilandwater/pr3.htm
[7] Lake of the Woods Control Board, Winnipeg River Drainage Basin Schematic. Website: www.lwcb.ca/schematic.html
[8] "The Basin Story", Partners for the Saskatchewan River Basin. (no date) Website: www.saskriverbasin.ca
[9] Ibid

The Red River begins at a point near the meeting of the North Dakota/South Dakota/Minnesota borders. It flows due north to enter Lake Winnipeg on its southern-most shore. The Red flows through the intensely cultivated Red River Valley, comprised of nutrient-rich soils. Along its way, it is joined among many others by the Sheyenne River in North Dakota, the Red Lake River in Minnesota, the Pembina River near the International Boundary, the Roseau River near Letellier, Manitoba, and the Assiniboine River at Winnipeg. The Assiniboine River rises in east-central Saskatchewan, flows east and southeast through west-central Manitoba and then through Brandon and Portage la Prairie. It is joined upstream of Brandon by the Qu'Appelle River from Saskatchewan, and east of Brandon by the Souris River which drains southeastern Saskatchewan, portions of North Dakota, and southwestern Manitoba.

Human History and Settlement of the Lake Winnipeg Area

When Native North Americans first arrived in southwestern Manitoba about 12,000 years ago, Lake Winnipeg was still under the continental ice sheet.

When Native North Americans from the south first arrived in what is now southwestern Manitoba about 12,000 years ago, Lake Winnipeg was still under the continental ice sheet. Over the next 3,000 to 4,000 years, the ice margin retreated to the north, followed by Lake Agassiz. When the glacial lake finally drained and the landscape emerged from the waters, indigenous peoples, over generations, populated the area. Archaeological evidence indicates that native peoples were present in the area surrounding present-day Lake Winnipeg as early as 8,000 years ago. About 2,000 years ago, a migration from the east brought the Cree to the Lake Winnipeg Basin.[10] In the 1700s, the Ojibway arrived in the area, drawn from the east by the fur trade.[11]

While it remains uncertain, many believe Henry Kelsey was the first European to see Lake Winnipeg. In 1690, he travelled from York Factory on Hudson Bay to The Pas, possibly passing across the top of Lake Winnipeg on his way.

The first permanent European settlers arrived on the shores of Lake Winnipeg in October 1875 when a group of 285 Icelanders lead by Sigtryggur Jonasson established a community at Gimli. The following year, another 1,200 Icelanders arrived. Over time, the community expanded to populate the Lake Winnipeg shoreline from Willow Point to Hecla Island.[12]

During the late 1890s and early 1900s, other ethnic groups joined the Icelanders in populating the western shore of Lake Winnipeg and the Interlake area inland. The arrival of Ukrainian, German, Hungarian, Polish, and other European immigrants to the area, combined with the Aboriginal population, has given the Interlake the rich multi-cultural mix it enjoys today.

The eastern shores of Lake Winnipeg are home to several widely-scattered First Nations communities and associated Metis and European settlements. The shoreline between the mouth of the Brokenhead River and Traverse Bay, because of its superb beaches, has been developed primarily as a recreational and cottage region.

An historic view of Gimli.

[10] *"Mistehay Sakahegan: The Great Lake"* by Francis Russell, 2004. Page 37
[11] Ibid, page 41
[12] Ibid, pages 72-75

Today, more than 23,000 permanent residents live in 30 communities along the shores of Lake Winnipeg, including 11 First Nations communities.[13]

The Canadian portion of the Lake Winnipeg watershed is home to 5.5 million people, and in the United States sector, there are over 1.1 million people.[14] About 80 per cent of the population lives in major urban centres including Edmonton, Calgary, Saskatoon, Regina, Brandon, and Winnipeg in Canada, and Grand Forks and Fargo, North Dakota. Each of these communities and many smaller centres contribute nutrients to the rivers and streams feeding Lake Winnipeg.

Within Manitoba alone, Lake Winnipeg receives effluent from about 200 small wastewater treatment facilities and approximately 10 larger municipal and industrial facilities.

Natural Habitats and Lakeshore Wetlands

Lake Winnipeg has immense intrinsic value, not only to the peoples who live on its shores, depend on it for a livelihood, and view it as a precious recreation resource, but also to the aquatic and terrestrial life within the lake and on its margins.

Wetlands and other natural habitats once comprised a much larger portion of the landscape throughout the Lake Winnipeg watershed than is the case today. Waterfowl and other wildlife depend on wetland and riparian areas for habitat and for food sources. Wetlands slow the speed at which water moves off the land, and remove nutrients from runoff water. However, changes in the landscape following European settlement have resulted in the loss of large areas of wetlands and riparian zones.

Wetlands and other natural habitats once comprised a much larger portion of the landscape throughout the Lake Winnipeg watershed than is the case today.

Much of the marshland throughout the watershed has been drained to gain agricultural land. In addition, as farms have grown in size, the equipment needed to work the land has become larger as well. To improve operational efficiency, more wetlands and wooded regions have been removed to accommodate the use of larger equipment. Urban and infrastructure development has also altered natural habitats across the Prairies.

The loss of these ecologically-valuable wetlands and wooded regions, for example, allows water to move off the land much more rapidly, carrying with it soil and associated nutrients. The loss of riparian zones along streams has allowed the erosive power of the water to damage shorelines resulting in sediments being transporting downstream more readily. These sediments and nutrients eventually find their way into Lake Winnipeg.

Lake Winnipeg and its shores provide valuable habitat for rare species such as the Lake Winnipeg Physa snail and the piping plover. Lakeshore marshes are home to a myriad of waterfowl and shore birds.

A number of marshes are located along the shores of Lake Winnipeg, and in particular, adjacent to the south and eastern shores of the south basin. These marshes have traditionally provided important areas of wildlife habitat and essential fish spawning and rearing areas.

A number of important marshes are located along the shores of Lake Winnipeg.

[13] Estimated from Statistics Canada 2001 Community Profiles data.
[14] Estimated from Statistics Canada demographic statistics, October 2004, and U.S. Bureau of Census data.

These marshlands have been the traditional wild fur trapping grounds for First Nations people for centuries. In addition, they may provide a nutrient buffer between the lake and the landscape surrounding it.

The Netley-Libau Marsh along the southern shore, through which the Red River flows, and wetland areas in the Libau/Scanterbury area adjacent to the southeastern shore of the lake are particularly notable. The Netley-Libau Marsh complex has received a national designation as an important bird area, and is a candidate to be designated as a heritage marsh under Manitoba's Heritage Marsh Program. Libau Bog is one of four ecological reserves designated by the Province on Lake Winnipeg. Ecological reserves are intended to preserve unique and representative plants, animals, geological features, natural landscapes, and ecological processes. Libau Bog earned its designation as an example of a black spruce/tamarack bog, and floating sedge bog, and as a habitat for wild orchids. The other ecological reserves on the lake are Long Point, Reindeer Island, and Little George Island located in the north basin of the lake about 40 km west of Poplar River First Nation.

The Netley-Libau Marsh has undergone significant change over time.

The Red River through Netley-Libau Marsh, 1923 (above) and 2003 (below). Note the increased size of the inlet to Netley Lake, and the decreased vegetation density in the more recent photo.

The Netley-Libau Marsh has undergone significant change over time. A recent study revealed several significant changes in the marsh between 1979 and 2001.[15] The study reports that loss of emergent vegetation and the erosion of separating uplands between adjoining water bodies has been extensive, resulting in the amalgamation and expansion of many marsh bays and ponds. Half of the entire marsh (13,125 ha, 51 per cent) is now open water, compared to 35 per cent (8,884 ha) in 1979. This study concluded that the Red River has likely contributed to some of the observed changes in the marsh. High flow events on the river result in the erosion and collapse of weak points in the levees that border the river and other channels.

Due to the shallow nature of the Red River, the river is not well suited to the navigation of large boats. Dredging of the Red River began as early as 1884, and continued periodically until 1999.[16] This dredging extended into the Netley-Libau Marsh. The Netley Cut, which was originally dredged through the marsh in 1913, has been gradually eroded to a point where it now carries a substantial portion of the Red River flow into Netley Lake - a large body of open water within the marsh. The authors of the study concluded that Netley-Libau Marsh now resembles a shallow turbid lake more than a healthy coastal wetland. Any benefits to Lake Winnipeg which the marsh could provide as wildlife and fisheries habitat, and in removing and storing nutrients that would otherwise enrich the lake, have probably been degraded or lost.

[15] Grosshans, R. E., Wrubleski, D. A. and Goldsborough, L. G. 2004. Changes in the emergent plant community of Netley-Libau Marsh between 1979 and 2001. Delta Marsh Field Station (University of Manitoba), Occasional Publication No. 4, 52 pp. www.umanitoba.ca/delta_marsh/pubs

[16] Gordon Goldsborough, pers com, 2006 (University of Manitoba, Winnipeg, Manitoba).

Lake Winnipeg Fisheries

Commercial fishing has been a major industry on Lake Winnipeg for nearly 125 years. Upon their arrival in 1875, the Icelanders immediately were drawn to fishing the lake. Learning the skills of ice fishing from First Nations who had been fishing the lake year-round for centuries, the new settlers soon realized the bounty available to them.

Commercial fishing officially began when Don Reid and James Clark arrived from Ontario where they had fished Georgian Bay on Lake Huron.[17] In 1880, they set up a plant in Selkirk, and fishing began in 1881. The first shipment of whitefish was frozen at the new Selkirk plant and shipped to various locations in the United States.

Today, the Lake Winnipeg commercial freshwater fishery is the largest in Canada west of the Great Lakes. Table 1 displays the total annual harvest and value of the harvest from Lake Winnipeg for the period 2000/01 to 2004/05. Fish harvested from the lake include walleye, whitefish, sauger, and goldeye.

Table 1: Lake Winnipeg Commercial Fishery Statistics, 2000/01 to 2004/05.

Year	Weight (kg) Winter and Summer seasons combined	Value ($2006)	Number of Licensees
2000/01	6,217,850	23,057,414	883
2001/02	6,237,950	22,459,146	895
2002/03	6,204,150	22,670,424	913
2003/04	6,543,300	18,154,247	921
2004/05	6,380,100	17,477,521	910
5-yr Average	6,316,670	20,763,750	904

Source: A Profile of Manitoba's Commercial Fishery, Manitoba Water Stewardship, Fisheries Branch, June 2006.

Most of the fish are marketed through the Freshwater Fish Marketing Corporation to consumers in western Canada, the United States, and Europe.

Most of the fish are marketed through the Freshwater Fish Marketing Corporation to consumers in western Canada, the United States, and Europe. Walleye dominate the harvest (3.8 million kilograms in 2004/05) with whitefish the second highest volumes landed (1.6 million kilograms in 2004/05).[18]

The commercial harvest of walleye from Lake Winnipeg has been steadily increasing in recent years and continues to be at an all time record high. It is currently the largest commercial walleye fishery in North America. By comparison, when in 2004/05, 3.8 million kilograms of walleye were taken from Lake Winnipeg, the harvest from Lake Erie was 1.3 million kilograms.[19]

[17] From "Some Stories of the Fishing Industry on Lake Winnipeg" by Ted Kristjanson – Personal collection of Robert T. Kristjanson, 2004.
[18] A Profile of Manitoba's Commercial Fishery. Manitoba Water Stewardship, Fisheries Branch. June 2006.
[19] Ontario Ministry of Natural Resources. March 2005. Lake Erie Fisheries Management - Walleye and Yellow Perch Fishing. http://www.mnr.gov.on.ca/MNR/Csb/news/2005/mar31fs_05.html

On the other hand, whitefish populations appear to be declining on Lake Winnipeg, which may be in part due to environmental conditions. Data indicate the Lake Winnipeg whitefish fishery peaked in the 1927 – 1930 period at 3.75 million kg and declined to 0.8 million kg in 1999. By 2003, catches had recovered to 1.9 million kg but this is still one half of historic peak yield.[20]

During the 5-year period 2000/01 to 2004/05, an average of 904 licensees plus a similar number of helpers,[21] were employed in the Lake Winnipeg commercial fishery (Table 1). During that period, the total landed weight of fish harvested averaged more than six million kilograms per year. The average annual landed value of the commercial fishing catch from Lake Winnipeg for that period averaged over $20 million, representing about 61 per cent of the total of all Manitoba commercial fisheries. About 85 per cent of the Lake Winnipeg commercial fishing production occurs during the open water seasons.

The McBeth Point Fish Packing Plant owned and operated by the Fisher River Fishermen Association.

In addition to the licenced fishers and their helpers on the lake, the industry also employs people for packing, shipping, and processing the product. Commercial fishing is the sole source of income for many individuals and a major source of income for many communities around Lake Winnipeg, including First Nations communities. Loss of the Lake Winnipeg commercial fishery would be a significant loss to the provincial economy and cause economic and social disruption within fisheries-based communities around the lake.

In addition to commercial fishing, recreational fishing and bait fishing are also extremely valued activities. The direct value of recreational fishing on the tributary rivers such as the Red and Winnipeg rivers is estimated at 17 million dollars annually.[22] Sports fishing in the Dauphin, Mantagao, and Warpath rivers, and at Grand Rapids are dependent on Lake Winnipeg fish stocks.

Subsistence fishing is very important as a source of food for most families living in fisheries-based communities. The activity also plays a central role in the traditional cultural life of the First Nations peoples.

While the commercial fishery continues to grow on Lake Winnipeg, and in particular the walleye fishery, this growth may not be sustainable. As water quality in the lake deteriorates, the fishery will ultimately be adversely affected. While increased algal productivity can benefit fish populations by providing an abundant source of energy at the base of the food chain, excess nutrient loading to the lake can lead to the development of blue-green algal species. These species accumulate because they are not eaten by zooplankton grazers, and when these algal blooms die and decompose, oxygen supplies become depleted. Other algal species can significantly impact the commercial harvest by coating the mesh of fishing nets, making them visible to the fish and impairing the harvest.

[20] Nalepa, T. F., Mohr, L..C., Henderson, B. A., Madenjian, C. P., and Schneeberger, P. J. 2005. Lake Whitefish and Diporeia spp. in the Great Lakes: an overview. pp. 3-20. In Proceedings of a Workshop on the Dynamics of Lake Whitefish (Coregonus clupeaformis) and the amphipod Diporeia spp. in the Great Lakes. Edited by L. C. Mohr, and T.F. Nalepa. Great Lakes Fishery Commission, Technical Report 66, Ann Arbor, MI. http://www.glerl.noaa.gov/pubs/fulltext/2005/20050005.pdf.

[21] Personal communication – three Lake Winnipeg commercial fishers.

[22] Pers. Comm. Gary Swanson, Manitoba Water Stewardship, Fisheries Branch, 2004.

Lakeshore Communities, Lifestyles, and the Economy

Seasonal cottaging, all-season recreation, tourism, and eco-tourism activities are lifestyle choices being made largely as a result of the attraction of Lake Winnipeg. These are all major contributors to the local economies.

In addition, hosting world-class events such as the Pan Am Games in 1967 and 1999, and the World Boardsailing Championships in 1994, brings hundreds of thousands of dollars to the area. Weekend festivals such as the Icelandic Festival in Gimli and the Winnipeg Beach Boardwalk Days bring large number of visitors to Lake Winnipeg each year. Thousands of tourists and campers visit the white sand beaches of Grand Beach each summer.

The economic benefits are not confined to summer months. The establishment of first-class resorts also attracts many visitors in winter for conventions, sporting events, and other activities such as long distance snowmobiling along the lake. The future water quality of Lake Winnipeg could have an impact on the appeal of the lake for the continued growth in these areas, the value of real estate, and the related economies of the region. However, continued recreational development itself around the lake could also impact the quality of water in Lake Winnipeg if not properly managed.

Cottage living, with its 100-year history on Lake Winnipeg's shores, is concentrated along the shores of the south basin. Lakeshore Heights, Grand Beach, Hillside Beach, Victoria Beach, and Albert Beach are the major developments along the east shore. Dunnottar, Winnipeg Beach, Sandy Hook, Gimli, Arnes, and Grindstone-Helca Provincial Park are examples of west shore cottage communities. In 2001, 10,200 cottages/ residences were counted around the south basin of Lake Winnipeg.[23]

Thousands of tourists visit the white sand beaches of Grand Beach each summer.

The demand for summer cottage lots has led the Province of Manitoba to offer for sale or lease 1000 new cottage lots on Crown land and in provincial parks. This objective was met in the summer of 2006. While some of these lots are in the northern portion of the province outside of the Lake Winnipeg watershed, the vast majority are within the watershed, and as many as 300 along, or near, the shores of Lake Winnipeg itself.

While the Lake Winnipeg Stewardship Board recognizes there may be economic benefit to communities and municipalities as these new lots are developed, it stresses the importance that development occurs in an environmentally sustainable manner – with low impact, environmentally-conscious concepts adopted to minimize pollution loads. Practices such as minimum setbacks from shorelines and waterways, restrictions on removal of native vegetation, and environmentally-sensitive waste management systems should be implemented.

Many communities around the south basin of Lake Winnipeg are growing as the "baby boomer" generation is seeking recreational and retirement properties. This expanding permanent population in communities surrounding the south basin of the lake in particular is strengthening the economies of the communities involved. For example, the newly merged Rural Municipality of Gimli experienced close to a 10 per cent increase in population during the most recent

[23] Dr. Eva Pip, University of Winnipeg, Canada. pers. com., in reference to a property count conducted as part of the COSEWIC (Committee on the Status of Endangered Wildlife in Canada) status report on the endangered Lake. Winnipeg Physa snail.

Census period for which data is available (1996-2001). With a permanent population base of approximately 5000, its $229 million in 2006 total taxable assessment gives it one of the highest per capita assessments in the province. Most of this assessment relates to permanent residential and cottage subdivisions, resort development, and industry. Winnipeg Beach has a total taxable assessment of $41 million, almost all of which is lake-related.

Recreation and tourism expenditures in the area along the Red River and surrounding the lake generate an estimated $110 million per year.[24] Eight provincial parks and provincial recreation parks are located along the south basin of Lake Winnipeg. The largest are Hecla/Grindstone, Winnipeg Beach, and Grand Beach. Camping is a popular activity at these locations. In 2005, there were an estimated 8,052 unit-nights registered at Hecla.[25] A unit-night is one camping unit (tent, trailer, recreational vehicle) occupying a camp spot for one night. There are also many camps along the lake operated by ethnic, religious, and social services groups that provide young people, and others, opportunities for experiencing the outdoors and the grandeur of Lake Winnipeg.

There are 11 First Nations communities along the shores of Lake Winnipeg supporting a registered population of more than 14,000 people.

The establishment of a Canadian national park which would border the western and northwestern shores of Lake Winnipeg is being considered. This proposed Manitoba Lowlands National Park would include the Limestone Bay area and Long Point as well as Black and Deer islands, and attract additional tourists to the area.

There are 11 First Nations communities along the shores of Lake Winnipeg supporting a registered population of more than 14,000 people. These communities rely heavily on Lake Winnipeg and its surrounding natural lands for their livelihood, sustenance, and traditional activities. Along the east side of the lake, 16 First Nations communities have partnered with governments through the Wabanong Kanaygum Okimawin (formerly the East Side Planning Initiative) in developing a Broad Area Plan for the 82,000-square kilometre area. Among its activities is the protection of traditional territory such as old trap lines. The group has also established a park reserve extending inland from Poplar River First Nation, called the Poplar/Nanowin Rivers Park Reserve.

Harbours are full to capacity each summer with the boats.

Lake Winnipeg's quality beaches have established a reputation as popular destinations for local residents, other Manitobans, and visitors to the province from around the world. For example, during the summer of 2005, nearly 400,000 visited the beach at Grand Beach Provincial Park.[26]

Harbours at Arnes, Gimli, Victoria Beach, and Winnipeg Beach are full to capacity each summer with the boats of recreational sailors and powerboaters. Gimli Harbour, in addition to being home port to one of the largest fishing fleets on the lake and the Lake Winnipeg Research Consortium vessel Namao, has berths for over 220 recreational boaters. Winnipeg Beach's Boundary Creek Marina has 148 berths for recreational boaters. There are more than 15 harbours on Lake Winnipeg registered with Fisheries and Oceans Canada.[27]

[24] http://www.gov.mb.ca/waterstewardship/transboundary/positions/man-position/ib000403.html.
[25] Personal communication, Linda Novak, Manitoba Conservation.
[26] Ibid
[27] Fisheries and Oceans Canada, Small Craft Harbours Program, Harbour Authorities - Manitoba.

Agriculture

Agriculture is an integral part of the culture on the Canadian Prairies and is a major contributor to the economy. A large portion of the Lake Winnipeg watershed is agricultural land. In 2005, the total gross cash receipts for farms in Alberta, Saskatchewan, and Manitoba combined was nearly $18 billion.[28] When agricultural output from the United States portion of the watershed is considered, gross income to farms in the entire watershed is estimated to be more than $22 billion. In Manitoba alone, exports of agricultural products and food from Manitoba to points throughout the world exceeded $3.4 billion in 2004.

Exports of agricultural products and food from Manitoba to points throughout the world exceeded $3.4 billion in 2004.

In 2001, according to Statistics Canada, 49,000 jobs in Manitoba, or about 11 per cent of the workforce, were directly dependent on primary agricultural production and the industries that support, market, and process that production.[29] Agriculture processing facilities, such as the potato processing plants in Carberry and Portage la Prairie, and livestock processing facilities in Brandon, Neepawa, and Winnipeg, play a large role in the industry. In addition to jobs created directly, many rural businesses rely on agriculture and its producers for their success.

Within the Lake Winnipeg drainage basin, there are nearly 55 million hectares of farmland in the three Prairie provinces, of which more than half is under crop production and the vast majority is part of the Lake Winnipeg watershed.[30] In addition, there is an estimated 10 million hectares of farmland within the U.S. portion of the lake's watershed.[31]

As of July 1, 2006, there were about 11.5 million cattle on farms in the three Prairie provinces[32] and 452,000 sheep.[33] Pig production in Manitoba, Saskatchewan, and Alberta in 2005 totaled 14.3 million, with 7.9 million being produced in Manitoba.[34] In the U.S. portion of the Lake Winnipeg watershed, there are about 800,000 cattle and fewer than 50,000 sheep.[35] The number of pigs marketed from the same region averages less than 500,000 per year.[36]

There are about 11.5 million cattle on farms in the three Prairie provinces.

Proper management of the nutrient-rich manure produced by the rapidly growing livestock industry is essential. According to Statistics Canada, Census of Agriculture for 2001, approximately one million hectares of agricultural land in the three Prairie provinces received manure in 2000, of which 80 per cent was solid, surface-applied manure.[37] Management of synthetic fertilizer is also critical. Census data also reported over 20 million hectares, or about two-thirds, of cropland across the Prairie provinces received synthetic fertilizers in 2000.[38]

[28] Statistics Canada, Canadian Statistics, Agriculture, Farm Finance, from Net Farm Income by Province.
[29] Statistics Canada, 2001 Census of Agriculture. Note: The Statistics Canada, 2006 Census of Agriculture is not yet available.
[30] Statistics Canada, 2001 Census of Agriculture. Total area of farms, land tenure, and land in crops by provinces.
[31] USDA, National Agriculture Statistics Service, 2002 Census of Agriculture – County Data.
[32] Statistics Canada, Agriculture Division, Cattle Statistics 2006, Vol. 5, no. 2.
[33] Statistics Canada, Agriculture Division, Sheep Statistics 2006, Vol. 5, no. 2.
[34] Canadian Pork Council Statistics. Hogs marketed in Canada by province, 1984-2005.
[35] Estimated from USDA, National Agriculture Statistics Service, 2002 Census of Agriculture – County Data for North Dakota and 2006 Minnesota Agriculture Statistics by County.
[36] Ibid
[37] Statistics Canada, 2001 Census of Agriculture, Canadian Statistics, Agriculture, Farms, Applications to the land.
[38] Ibid

Agricultural drainage networks constructed and maintained by provincial governments, municipalities, and producers themselves, are designed to accelerate the movement of snowmelt and rainfall runoff water from fields. This allows producers to begin seeding earlier in the spring and remove standing water from growing crops after a heavy summer rain before significant damage to the crop can occur. However, agricultural land drainage systems quickly transport runoff water and the nutrients they contain from fields and pastures directly into streams and rivers, and eventually into Lake Winnipeg.

Agricultural drainage networks are designed to move snowmelt and rainfall runoff water from fields.

The demands facing agriculture are constantly changing as a result of shifting markets and external pressures. While individual farms tend to be more specialized, the agricultural industry as a whole is now much more diverse than it was historically. Shifts in economies, land uses, and management decisions have the potential to alter water quality in the watershed, either positively or negatively. Therefore agriculture needs to be an integral partner in responsible stewardship in the watershed.

In recent decades, the United States and Canada have promoted a variety of agri-environmental programs, but these were met with limited success. Past experiences must be used as a learning ground to help in the development of more effective agri-environmental programs for the Lake Winnipeg watershed. These programs must allow Manitoba to remain competitive in the agricultural marketplace while at the same time providing long-term stable environmental approaches to addressing the issues.

Although nutrient loading from agriculture practices remains a significant source, recent incentive programs, regulations, and extension programs aimed at reducing these impacts have been made available through a variety of federal and provincial initiatives.

Through the Environment Chapter of the Agricultural Policy Framework (APF), a strong, new emphasis is being placed on agri-environmental issues. Under this national federal-provincial initiative, producers can identify environmental assets and risks on their farms and develop action plans to address those risks as part of the Environmental Farm Plan Program.

Through the Environment Chapter of the Agricultural Policy Framework, a strong, new emphasis is being placed on agri-environmental issues.

The Farm Stewardship Association of Manitoba is a producer-directed organization whose mandate is the delivery and review of environmental farm plans in Manitoba. Through workshops conducted by the Farm Stewardship Association of Manitoba, producers prepare their individual environmental farm plans. Each plan is reviewed by the Farm Stewardship Association of Manitoba with the individual producer and a Statement of Completion is issued. Once this has been accomplished, the producer is eligible to apply for cost-shared funding through Canada-Manitoba Farm Stewardship Program to support the implementation of beneficial management practices to reduce on-farm environmental risks. The entire process is completely confidential.

The Canada-Manitoba Farm Stewardship Program is the Manitoba component of the National Farm Stewardship Program, launched under the Agricultural Policy Framework. The overall objective of the National Farm Stewardship Program is to accelerate the adoption of beneficial management practices on farms and agricultural landscapes.

As of September 30, 2006 there have been more than 2700 environmental farm plans completed in Manitoba. An estimated 4.5 million acres of farmland have been assessed by producers participating in the program. Payments of nearly two million dollars have been issued to producers implementing beneficial management practices on their land. The most popular categories of beneficial management practices being implemented are improved cropping systems, product and waste management, wintering site management, improved pest management, and nutrient management planning.

To encourage Manitoba producers to target water quality protection on their farms, Manitoba Water Stewardship provides top-up funding to specific beneficial management practices incentives provided under the Canada-Manitoba Farm Stewardship Program. Top-up funding may be as high as 25 per cent of the total project cost, up to a maximum of $5,000 per project. The three beneficial management practices categories specified for top-up in 2006 are improved manure storage and handling, manure treatment, and nutrient management planning.

Manitoba Water Stewardship provides top-up funding to specific beneficial management practices incentives provided under the Canada-Manitoba Farm Stewardship Program.

Another environmental planning option for agricultural producers is the Equivalent Agri-Environmental Planning Program. The program approaches agri-environmental planning on a group basis through an association, commodity group, or conservation district, as examples. A pilot equivalent agri-environmental planning project was conducted in the Coleman Creek Watershed near Miami, Manitoba to gain experience in the process before full launch of the program. Twenty-six producers have received a Statement of Completion for completing the Coleman Creek Watershed Equivalent Agri-Environmental Plan.

The Ecological Goods and Services Program (previously called Alternative Land Use Services) is a voluntary, incentive-based environmental program that recognizes and rewards the positive contributions that farmers make to clean air and water and biodiversity through their land management practices. This program was initially developed by Delta Waterfowl and Keystone Agricultural Producers. This concept has received widespread support from farmers, farm organizations, conservation groups, government officials, and other decision makers.

The first pilot project was launched in Manitoba in November 2005, in the Rural Municipality of Blanshard, located northwest of Brandon, Manitoba. It will test the program concept, to see if farmers will participate, to evaluate the efficiency of program delivery, and help to determine if the program could be implemented as a national program. The pilot project is taking place with the partnership of Delta Waterfowl Foundation, Agriculture & Agri-Food Canada, Manitoba Agriculture, Food & Rural Initiatives, the RM of Blanshard, Manitoba Rural Adaptation Council, Manitoba Agricultural Services Corporation, and the Little Saskatchewan River Conservation District.

It is estimated that present day agriculture contributes five per cent of the nitrogen load and 15 per cent of the phosphorus load to Lake Winnipeg (figures 4 and 5).

Erosion control is one example of a beneficial management practice.

A Hydro-Electric Reservoir

Lake Winnipeg is Manitoba Hydro's largest and most important reservoir. It provides the Manitoba Hydro system with 50 per cent of its storage for 75 per cent of its generating capacity. Manitoba Hydro's system is primarily hydroelectric and needs a reliable supply of water that matches the seasonal demand for power. In 1976, Manitoba Hydro began regulating Lake Winnipeg for the purpose of producing hydroelectric power along the Nelson River system downstream. With this development, Lake Winnipeg became the third largest hydroelectric reservoir in the world, after Lake Superior and Lake Victoria in East Africa. The Lake Winnipeg regulation project is comprised of a control structure and generating station at Jenpeg, three excavated channels (2-mile, 8-mile and Ominawin Bypass), and a number of channel improvements.

Lake Winnipeg is Manitoba Hydro's largest and most important reservoir.

The water outflow pattern from Lake Winnipeg has been modified by typically storing more water in the spring and early summer for use in the fall and winter, moderating the variability in water levels (Figure 3). However, during high inflow years, 1997, 2001, and 2005, for example, more water is released in the spring and summer than would have been prior to regulation. The Lake Winnipeg regulation project increased Lake Winnipeg outflow capability by 40 to 50 per cent, enabling Manitoba Hydro to increase outflow during the winter months when Manitoba peak electrical demand occurs.

Another design feature of Lake Winnipeg regulation is flood reduction on Lake Winnipeg. Manitoba Hydro is obligated to use the increased outflow capacity to reduce the magnitude and duration of flood events on Lake Winnipeg, as was experienced most recently in 2005.

Total revenue from (Manitoba Hydro) power sold in 2005/06 was nearly $1.9 billion, of which $881 million was in export sales.

The importance of Manitoba Hydro to the provincial economy is apparent. Total revenue from power sold in 2005/06 was nearly $1.9 billion, of which $881 million was in export sales. Net revenues for the year totaled $415 million, setting a new record.[39]

Hydro-electric generation is considered by many to be a relatively clean source of energy. By using water power instead of fossil fuels, Manitoba avoids the production of an estimated 30 million tons of carbon dioxide per year.[40]

The impacts of altering the seasonal outflow from Lake Winnipeg on nutrient cycling, retention, and algal production are not fully understood.

The impacts of altering the seasonal outflow from Lake Winnipeg on nutrient cycling, retention, and algal production are not fully understood. Lake regulation may have some impact on water quality in the lake in terms of the potential for nutrient accumulation, and nutrient dynamics within the lake and downstream, and the subsequent production of algae. Further study is also needed on how water circulation patterns within the lake, which may have been modified by lake regulation, may be impacting the fishery. Many people with Traditional Knowledge of the lake believe that the lake has changed in terms of currents and flow patterns since the lake has been regulated. Further scientific research and collection of this Traditional Knowledge on this issue is needed. However, it should be noted that the regulation of Lake Winnipeg appears to have reduced the frequency and magnitude of flooding by moderating high water levels from historical trends.

[39] Manitoba Hydro-Electric Board 55rd annual report, for the year ending March 31, 2006.
[40] Edward Schreyer, Winnipeg, Canada. Personal communication, 2004.

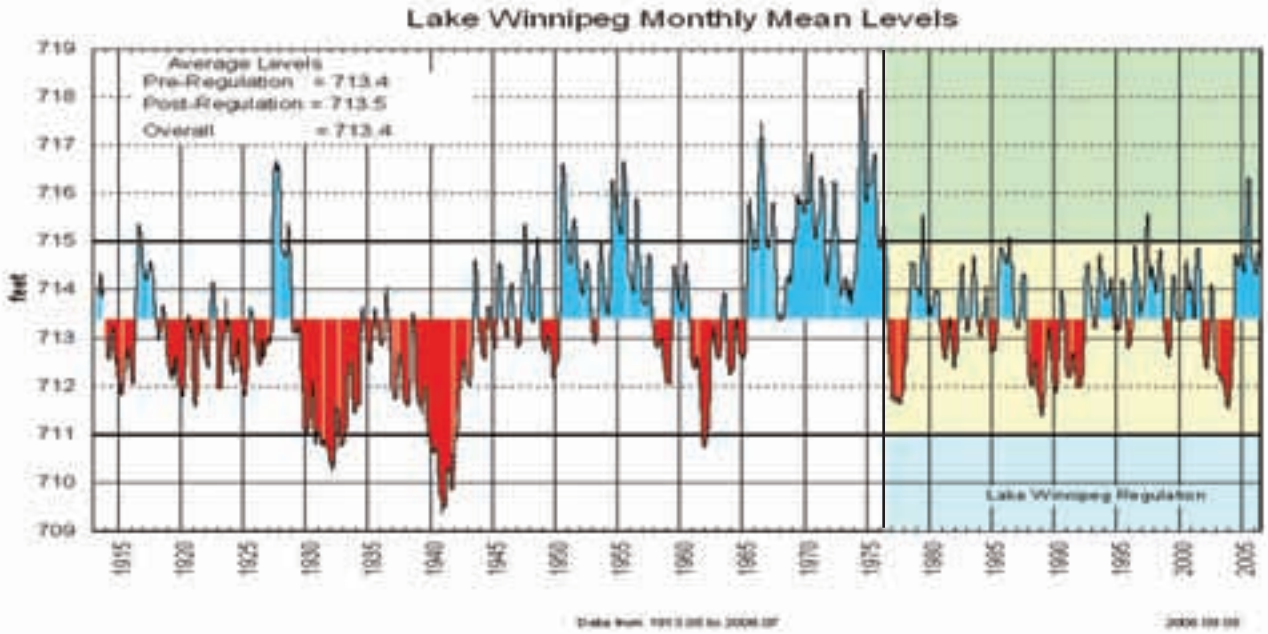


Figure 3: Lake Winnipeg monthly mean water levels (1912-2005). Source: Manitoba Hydro.

Drinking Water and Process Water Use

A number of small communities along Lake Winnipeg, primarily on the east shore, draw water from the lake and provide treatment for community use.[41] These include Victoria Beach and Seymourville. Pine Dock has a community system supplied with well water which serves most of the community, but a few individual homes may be drawing water directly from the lake. Most homes on Matheson Island have wells, but some use lake water. In some communities such as Loon Straits and Princess Harbour, a community system is not available and individual households use water directly from the lake. It is likely that other individuals living along the lakeshore may use lake water for drinking water, irrigation, or for livestock use.

Many of the communities mentioned above are adjacent to First Nations communities which do not draw water from Lake Winnipeg, but instead access tributary streams entering Lake Winnipeg, or draw water from local aquifers. Many other communities also draw their water from aquifers surrounding the lake.

Large algal blooms in the lake pose water treatment challenges for communities. The potential for algal toxins to make their way into a community water distribution system is a concern, and even more of a concern for individuals using lake water directly. The water quality guideline for the presence of the algal toxin Microcystin-LR in drinking water is 1.5 micrograms per litre.

Some of the fish packing plants on the lake use lake water for making ice and cleaning. The water is chlorinated before use.[42]

[41] Manitoba Department of Aboriginal and Northern Affairs, Community Profiles, 2004.
[42] Pers. Comm. Stephen Kendall, Freshwater Fish Marketing Corporation, Winnipeg, Canada 2004.

Municipal and Industrial Wastewater

Many wastewater treatment facilities across Canada, the United States, and Europe remove nutrients from their effluent. For example, Ontario requires phosphorus removal to 1 mg/L at municipal and industrial facilities discharging to many of its major lakes and drainage systems. Nutrient removal technologies are in place in other large prairie cities that discharge to the Lake Winnipeg watershed such as Edmonton, Calgary, Saskatoon, and Regina. These cities are currently required to meet phosphorus limits of 1 mg/L and 5 – 15 mg/L nitrogen, in part based on the nature of the receiving stream.

The City of Brandon is developing a plan for wastewater treatment that envisages providing wastewater treatment services including nutrient controls to 1 mg/L phosphorus and 15 mg/L nitrogen for both its municipal and industrial components. Portage la Prairie has limits on the amount of ammonia that may be discharged but there is currently no limit on phosphorus. Fargo and Grand Forks in North Dakota do not have limits set for phosphorus in their effluent discharge, although limits are in place for ammonia.

In the Manitoba portion of the Lake Winnipeg watershed, there are over 200 small wastewater treatment facilities and fewer than 10 larger wastewater treatment systems.

In Minnesota, phosphorus removal to 1 mg/L is required for all facilities that discharge to the Lake Superior basin and the interstate waters of Lake St. Croix. To further protect lakes and rivers from the negative effects of excess nutrients, the Minnesota Pollution Control Agency is proposing that new or expanding dischargers must meet a 1 mg/L total phosphorus effluent limit after January 1, 2007 if they discharge more than 817 kg of phosphorus per year.[43] In the European Union, urban wastewater treatment plants discharging to sensitive areas that are subject to eutrophication must meet total phosphorus limits of 1 to 2 mg/L and in some cases, a limit for total nitrogen of 10 to 15 mg/L.

In the Manitoba portion of the Lake Winnipeg watershed, there are over 200 small wastewater treatment facilities and fewer than 10 larger wastewater treatment systems. The City of Winnipeg has three wastewater treatment facilities that currently contribute about five per cent of the phosphorus load to Lake Winnipeg, and four per cent of the nitrogen load.

Prior to the recent issuing of the *Environment Act* licences for its sewage treatment facilities, the City of Winnipeg did not have effluent limits for nitrogen and phosphorus for its wastewater treatment plants. The City of Winnipeg's sewage treatment plants have an average effluent quality of 3.3 mg/L total phosphorus, and average total nitrogen of 30 mg/L.[44] Table 2 illustrates the anticipated reductions in annual total phosphorus and total nitrogen loads from current values of 450 and 3618 tonnes per year, respectively, and target dates for Winnipeg to achieve the reductions.

Table 2. City of Winnipeg current phosphorus and nitrogen loads and anticipated reductions at the wastewater treatment plants based on *Environment Act* licence requirements.[44]

Timeline	Total Nitrogen tonnes/year	% Reduced	Total Phosphorus tonnes/year	% Reduced
Currently	3618	-	450	-
December 31, 2006[45]	3168	12	402	11
December 31, 2012	2945	19	345	23
December 31, 2014	1910	47	158	65

[43] Minnesota Polution Control Agency web site: http://www.pca.state.mn.us/water/standards/rulechange.html#draftrules#draftrules

[44] Environmental Assessment of Canadian Strategic Infrastructure Funded Upgrades to the City of Winnipeg Water Pollution Control Centres. August 2006. City of Winnipeg, Waste and Water. Website: http://www.winnipeg.ca/waterandwaste/dept/publicRegistry/default.stm

[45] In late November 2006, The City of Winnipeg advised that construction was behind schedule and that an extension would be required.

The City of Winnipeg is required, through its *Environment Act* licence, to reduce its nutrient load to Lake Winnipeg by 12 per cent for nitrogen and 11 per cent phosphorus by the end of December, 2006. This will be accomplished through nutrient removal at the west end plant, and centrate treatment at the north end plant. Centrate is the liquid by-product of dewatering sewage sludge by centrifugal force. Nutrient removal at the south and north end plants will follow by December 31, 2012 and 2014, respectively. It is expected that by December 31, 2014, phosphorus loads from the City of Winnipeg wastewater treatment plants will have decreased by 65 per cent and nitrogen by 47 percent. The City of Winnipeg's licences will require phosphorus levels to be reduced to 1 mg/L and 15 mg/L for total nitrogen. This will reduce the total nutrient load to Lake Winnipeg by approximately 2.5 per cent.

The City of Winnipeg's west end wastewater treatment plant.

A few large industrial facilities are also located within the Manitoba portion of the Lake Winnipeg watershed. Some discharge directly into waterways, while others have pre-treatment on-site and the wastes are discharged into community wastewater treatment facilities. For any new or expanding industrial facility discharging wastewater to surface water, the Province is requiring effluent limits of 1 mg/L phosphorus and 15 mg/L of nitrogen.

Although nutrient limits have recently been required for large municipal and industrial facilities, clearly more advanced treatment of Manitoba's wastewater is needed for the approximately 200 smaller wastewater facilities located within the Lake Winnipeg watershed. Typical secondary lagoons have effluent quality of about 5 mg/L for total phosphorus. Very few of these facilities have nutrient limits imposed in their licences. The Falcon Lake lagoon currently has phosphorus effluent limits of 1 mg/L, but no limits for nitrogen. The new wastewater treatment plants being built by the Rural Municipality of Gimli and at Hecla will also meet a 1 mg/L phosphorus limit. Regionalization of wastewater services in Manitoba has lagged behind the regionalization of potable water services. However, as more stringent wastewater effluent standards emerge, regionalization of wastewater services will gain greater merit and acceptance. As effluent standards become more stringent, so does the cost of meeting those requirements.

Regionalization of wastewater treatment provides opportunities for communities to implement more advanced technologies at lower costs relative to meeting these needs on an individual basis. An example of regionalization in Manitoba includes the new lagoon servicing the communities of Oakbank, Anola, and Dugald.

Regionalization of wastewater treatment provides opportunities for communities to implement more advanced technologies.

The cities of Brandon, Winnipeg, and Selkirk are exploring opportunities to provide regional services outside their current service range. In some areas of the province, sewage treatment practices such as septic fields, holding tanks, and lagoons are not meeting environmental standards. Sewage management plans need to be developed for some areas of cottage country, many First Nations communities, and the Selkirk-Winnipeg corridor which releases a substantial amount of nutrients to the Red River.[46] These plans are particularly important where septic fields are the main waste management system for communities comprised of high density, small lots. In addition, several wastewater lagoons in the province are undersized and due to capacity problems, request approval from Manitoba Conservation for a licence variance to allow emergency discharge of the effluent. In many cases, the effluent quality would be of poorer quality than would be the case had the effluent had a longer storage time.

[46] Bourne, A., N. Armstrong and G. Jones. 2003 A preliminary estimate of total nitrogen and total phosphorus loading to streams in Manitoba, Canada. Manitoba Conservation Report No. 2002-04. Winnipeg, MB, Canada. 49 pp.

Hydrology and Climate of Lake Winnipeg

The Red River in Winnipeg.

The Winnipeg, Saskatchewan, and Red rivers combined account for an estimated 82 per cent of the mean monthly flow into Lake Winnipeg. The Winnipeg River dominates that contribution at about 45 per cent, with the Saskatchewan and Red rivers contributing about 26 and 11 per cent respectively (Table 3). Flows from the nutrient-poor Saskatchewan River have been generally decreasing over the past few decades, but whether the reasons are climatic, increased water use upstream, or a combination, are unclear.[47] Conversely, flows to Lake Winnipeg from the nutrient-rich Red River have generally increased since the early 1990s. The last decade has been the period of highest annual flows on the Red since record keeping was initiated in 1920.[48] This is one of the reasons for a higher concentration of nutrients in Lake Winnipeg in recent years. The changing contribution of flows into Lake Winnipeg will influence the nutrient concentration in Lake Winnipeg and the resultant response of the algal community in the lake.

Table 3: Mean Monthly Flows into Lake Winnipeg in cubic metres per second (percentages rounded). Period of Record 1964 to 2005.

River	Mean monthly flow (cubic metres per second)	Percentage of total
Winnipeg River	999	45
Saskatchewan River	567	26
Red River	252	11
Other flow into Lake Winnipeg*	400	18
Totals	2218	100

Source: Manitoba Water Stewardship, Water Science and Management Branch.
* Other flows include that from the many smaller rivers that flow into the lake but does not include precipitation and evaporation.

Approximately 45 per cent of the flow from the watershed into the lake occurs during the April to July period.

Lakes Winnipegosis and Manitoba, the province's second and third largest lakes respectively, also drain into Lake Winnipeg through the Fairford River into Lake St. Martin and then into the Dauphin River which empties into Lake Winnipeg at Dauphin River First Nation. Approximately 60 smaller rivers flow directly into the lake, including Poplar, Berens, Bloodvein, Pigeon, Manigotogan, Brokenhead, Fisher, and Icelandic rivers. The Nelson River is the only outlet for Lake Winnipeg, flowing north into Hudson Bay.

Approximately 45 per cent of the flow from the watershed into the lake occurs during the April to July period, primarily as a result of runoff from snowmelt and spring rains. While snowfall is a relatively small portion of the total annual precipitation in the watershed, ranging between one-quarter and one-third throughout most of the Prairies, it can produce as much as 75 per cent of the annual runoff from the southern plains portion of the watershed.[49] In fact, one study

[47] Personal communication, Alfred Warkentin, Manitoba Water Stewardship.
[48] Source – Water Survey of Canada.
[49] Personal communication, Alfred Warkentin, Manitoba Water Stewardship,2006.

conducted in southern Saskatchewan indicated that more than 85 per cent of total annual runoff from agricultural watersheds in western Canada is from snowmelt runoff.[50] This seasonal variation is illustrated by the mean monthly flows on the Red River (Figure 4). The average annual inflow into Lake Winnipeg for the period 1969 to 1974 is about 98.7 billion cubic metres[51] per year.

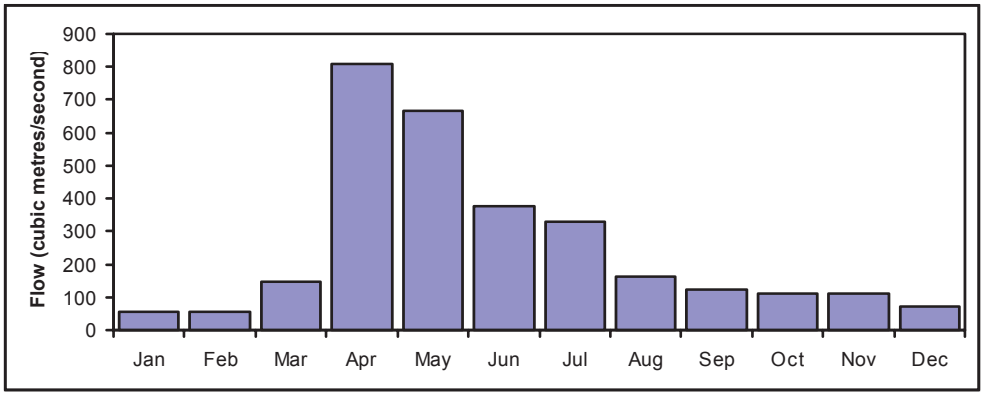
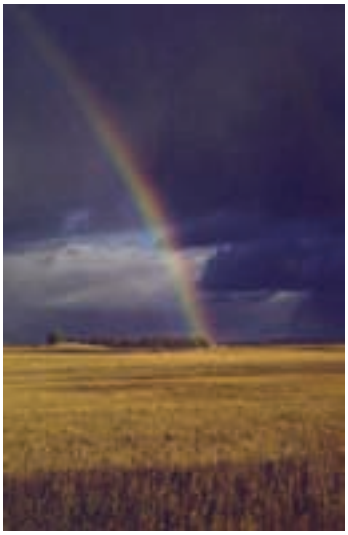


Figure 4: Mean monthly flows in cubic metres per second, Red River at Lockport (1964 – 2005). Source: Water Survey of Canada data.

Unlike many other large, deeper lakes, the water residence time in Lake Winnipeg is relatively short. Due to the large inflows and relatively small volume of the lake, water refreshes on average every three to five years.[52] This results in a lake that responds relatively quickly to the quantity and quality of water entering from its rivers.

Because of its vastness and its south-north orientation, the climate over Lake Winnipeg varies significantly. Climate zones range from low boreal eco-climate region in the south, to mid-boreal, and finally to high boreal eco-climate at the north-eastern tip of the lake.[53] Mean annual temperatures range from about 1.9 Celcius in the south to 0.5 Celcius in the north. Precipitation amounts vary geographically from an annual mean of 589 millimetres (equivalent) at Bissett to 483 millimetres at Grand Rapids.

Throughout Lake Winnipeg's existence, climate change has resulted in fluctuations in the size and extent of the lake. Similar changes can be expected in the future. Global climate models are predicting significant changes in the climate throughout the world. Scientists predict that Manitoba can probably expect warmer and wetter winters and springs, and longer, warmer and drier summers.[54] The consequences of these changes may include more frequent winter thawing cycles, an increase in the number of intense thunderstorms, and dry periods of longer duration.



Climate change could result in an increase in the number of intense thunderstorms.

These changes would be expected to influence how the lake will respond. Intense rainfall could increase erosion in the watershed, and therefore increase nutrient loading. An increase in lake temperature would be expected to accelerate the growth rate of plants and animals in Lake Winnipeg and may influence the species composition of its biological community.

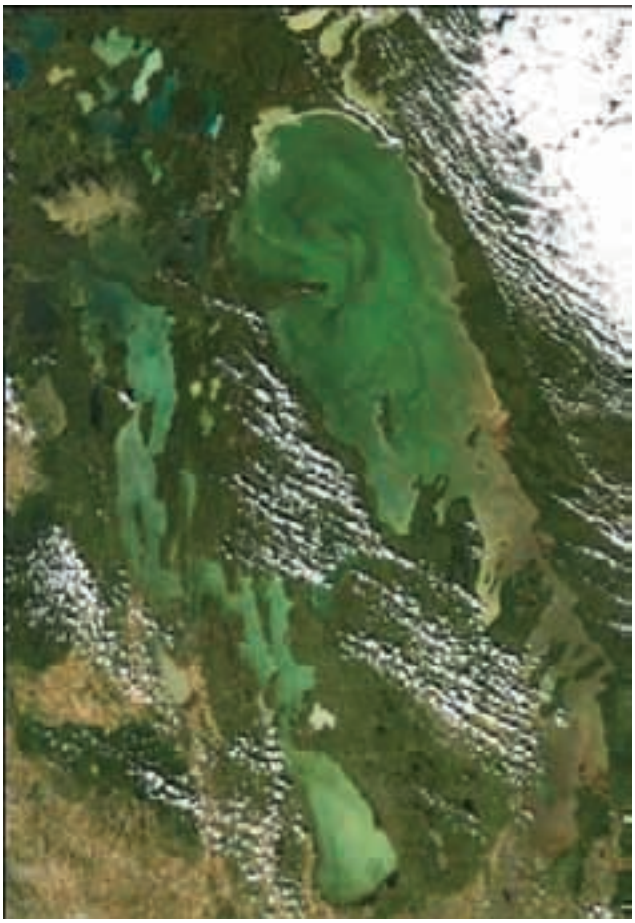
[50] Nikolaichuk, W. 1967. Comparative watershed studies in southern Saskatchewan. Trans. Am. Soc. Agric. Eng. 10(4):502-504.
[51] Brunskill, G.J., S. E. M. Elliot, and P. Campbell. 1980. Morphometry, hydrology, and watershed data pertinent to the limnology of Lake Winnipeg, Can. Manuscr. Rep. Fish. Aquat. Sci. no. 1556.
[52] Ibid
[53] "Terrestrial Ecozones, Ecoregions, and Ecodistricts of Manitoba", Land Resource Unit, Research Branch, Agriculture and AgriFood Canada. 1998.
[54] Manitoba Energy, Science and Technology website: http://www.gov.mb.ca/est/climatechange/issues/affectus.html

Lake Winnipeg Water Quality

Eutrophication of surface waters is a serious water quality problem for many lakes worldwide, and Lake Winnipeg is no exception. In fact, among the world's ten largest lakes, Lake Winnipeg appears to be the most eutrophic as measured by levels of chlorophyll, an indicator of the amount of algae present during summer.[55]

Eutrophication is the excessive growth of aquatic plants caused by enrichment of surface waters with nutrients, principally phosphorus and nitrogen. The degree of eutrophication in a lake is most often assessed from changes in its phosphorus concentration, transparency, and the chlorophyll-a content resulting from algal growth. Studies conducted by the Province of Manitoba have determined that over the past three decades, phosphorus loading to Lake Winnipeg has increased by about 10 per cent, and nitrogen loading by about 13 per cent.[56] Nitrogen and phosphorus are the two major nutrients that appear to be contributing to eutrophication of Lake Winnipeg. The degree to which phosphorus and nitrogen, versus phosphorus alone, controls growth and the types of algae present in Lake Winnipeg, requires further evaluation.

Large algal blooms are occurring more frequently in the north basin of Lake Winnipeg than in the past.



As a result of nutrient enrichment, not only have the algae in Lake Winnipeg increased in abundance, but blue-green species now dominate the summer and fall communities.[57] Such species are promoted by high concentrations of phosphorus, as frequently found in Lake Winnipeg.[58] Excess phosphorus and warm water temperatures encourage rapid algal growth which can lead to depletion of nitrogen in lake waters. Many species of blue-green algae are able to overcome this temporary shortage of nitrogen by fixing it from the atmosphere. Blue-greens gain further advantage because zooplankton preferentially feed on other forms such as green algae and not on less edible blue-greens. A literature review conducted by North-South Consultants for a Lake Winnipeg Stewardship Board Science Workshop in May 2006 has documented a range of situations where either nitrogen or phosphorus, or both nitrogen and phosphorus, have been the key nutrients controlling algal growth in lakes and rivers. Workshop participants acknowledged that Lake Winnipeg is a complex lake that will require a unique nutrient management strategy to attain water quality improvement.

Eutrophication can lead to changes in species composition and reduction in species diversity in a water body. There is a growing body of evidence to suggest that as a result of nutrient enrichment, the frequency and intensity of algal blooms have increased in Lake Winnipeg and the algal community has shifted towards more troublesome blue-green species. Researchers at the University

[55] Lake Winnipeg Research Consortium, 2006. Lake Winnipeg Research Consortium website: http://www.lakewinnipegresearch.org; International Lake Environment Committee World Lake Database, http://www.ilec.or.jp/database/database.html)

[56] Jones, G, and N. Armstrong. 2001. Long term trends in total nitrogen and total phosphorus concentrations in Manitoba streams. Manitoba Conservation Report No. 2001-07. Winnipeg, MB, Canada. 154 pp., and Bourne, A., N. Armstrong and G. Jones. 2003. A preliminary estimate of total nitrogen and total phosphorus loading to streams in Manitoba, Canada. Manitoba Conservation Report 2002-04. Winnipeg, MB, Canada. 49 pp.

[57] Lake Winnipeg Research Consortium, 2006. Lake Winnipeg Research Consortium 2004 Report to Manitoba Hydro.

[58] Ibid

of Manitoba, analyzing satellite imagery, have shown that large algal blooms are occurring more frequently in the north basin of Lake Winnipeg than in the past.[59] Member agencies of the Lake Winnipeg Research Consortium have documented large blooms of algae on the lake as well as other chemical and biological changes in the lake. These water quality changes can impact the aesthetic appeal of the lake, safety of water for recreational uses and consumption, aquatic habitat, biodiversity, and long-term ecosystem sustainability.

The excessive growth of algae, particularly blue-green forms can have a detrimental effect on the Lake Winnipeg ecosystem. Blue-green algae are a less desirable food source for other organisms in Lake Winnipeg, such as zooplankton, and consequently accumulate in the lake. When this algal biomass dies and settles to the lake bottom, it is broken down by bacteria and oxygen is consumed from the surrounding water. Oxygen depletion can kill fish and other aquatic organisms that are part of the food web. The increased incidence of blue-green algae is also troublesome because of the toxins they can produce that are potentially harmful to aquatic life, wildlife, pets, livestock, and people.

Elevated levels of algal toxins have been recorded periodically at points around the lake. During the summer of 2003, warning signs were posted at one Lake Winnipeg beach because of algal toxins, and at a second beach because of the presence of a dense bloom of algae capable of producing toxins. The Federal-Provincial-Territorial Committee on Health and Environment is revising the Canadian Recreational Water Quality Guidelines and is proposing a guideline for the algal toxin Microcystin-LR of 20 g/L in waters being used for recreational activities. The concentrations of this toxin at Lake Winnipeg beaches during 2006 were found to be below this proposed guideline level.

Blue-green algae on Grand Beach, August 2006.

Algal blooms generally develop in the south basin of Lake Winnipeg during periods of calm, warm, and sunny weather. During the summer of 2005, heavy rainfall in Manitoba lead to high flows in the Red and Saskatchewan rivers bringing larger than average loads of nitrogen and phosphorus into Lake Winnipeg. Nitrogen and phosphorus was therefore available in the lake to support algae growth during the summer of 2006. During July and August of 2006 large blooms of blue-green algae developed along the shores of several beaches including Grand Beach, Victoria Beach, and Grindstone Beach. The blooms persisted along many beaches through the fall of 2006.

Commercial fishers have reported increased densities of diatom algae growing attached to their fishing nets in the winter and spring fishery. These forms of algae can either clog nets or, because of the increased visibility of the nets to the fish, cause reduced catches. Some fish processing plants at remote locations on the lake have reported difficulty extracting sufficient lake water for cleaning fish when heavy blue-green algal blooms clog the intake filters.

[59] Lake Winnipeg Satellite images, http://home.cc.umanitoba.ca/~gmccullo/LWsat.htm.

Commercial fishing nets become clogged with algae, both summer and winter.

Limnological studies of Lake Winnipeg conducted in the late 1920s[60,61] and 1969[62] provide a baseline against which more recent ecosystem conditions can be assessed. Since first observations were made, water transparency had increased in the north basin until 1994 but then began to fall because of increased blue-green algal growth. In the south basin, water transparency has steadily declined. Water column and sediment phosphorus, nitrogen, and carbon concentrations have increased, zooplankton abundance has increased by a factor of five, the north basin algal community composition has shifted towards more troublesome blue-green species, and the species composition of the bottom-dwelling community has changed.[63, 64, 65, 66, 67, 68] The lake, because of its shallow, wind-swept nature, has generally maintained adequate dissolved oxygen levels, although there may be short periods of time when oxygen levels are depressed in portions of the lake due to decaying blooms of algae. Oxygen depletion can lead to the release of phosphorus from bottom sediments. Mixing by wind periodically reintroduces nutrients back into the water column which promotes further algal growth.

Water quality changes in Lake Winnipeg reflect the increasing quantities of nutrients that are reaching the lake from human activities in the watershed.

Water quality changes in Lake Winnipeg reflect the increasing quantities of nutrients that are reaching the lake from human activities in the watershed. Soils in the prairie regions of the watershed are naturally rich in phosphorus and, when eroded, introduce this nutrient into surface waters. In the Red River watershed these nutrient-rich soils contribute a significant amount of nutrient loading to Lake Winnipeg. Decaying vegetation also produces dissolved nutrients. Nitrogen and phosphorus in animal waste from waterfowl, shorebirds, gulls, deer, and other wildlife may be deposited directly into surface waters or are transported off the land and into streams and lakes during rainfall and snowmelt runoff. Significant quantities of nutrients are also found in the atmosphere (derived in part from wind erosion) and are deposited through either dry deposition, or in solution with rainfall and snowfall.

Human activities in the watershed, as well as significant runoff events such as the 1997 flood in the Red River basin and increased flows of the Red in the last decade, have increased the amount of nitrogen and phosphorus reaching Lake Winnipeg. Human sources of nutrients have a variety of origins. In the Lake Winnipeg watershed, these include municipal sewage discharges, leaking septic fields, crop fertilizers, industrial discharges, livestock manure, and

[60] Bajkov, A. 1930. Biological conditions of Manitoba lakes. Contrib. Can. Biol. Fish. 5(12): 382-422.
[61] Bajkov, A. 1934. The plankton of Lake Winnipeg drainage system. Int. Rev. Gesamten Hydrobiol.Hydrogr. 31:239-272.
[62] Patalas, K., and A. Salki. 1992. Crustacean plankton in Lake Winnipeg: variation in space and time as a function of lake morphology, geology, and climate. Can. J. Fish. Aquat. Sci. 49:1035-1059.
[63] Patalas, K., and A. Salki. 1992. Crustacean plankton in Lake Winnipeg: variation in space and time as a function of lake morphology, geology, and climate. Can. J. Fish. Aquat. Sci. 49:1035-1059.
[64] Stewart, A.R., Stern, G.A., Salki, A. Stainton, M.P., Lockhart, W.L., Billeck, B.N., Danell, R., Delaronde, J., Grift, N.P., Halldorson, T., Koczanski, K., MacHyutcheon, A., Rosenberg, G.B., Savoie, D.A., Tenkula, D., Tomy,G., and Yarchewski, A. 2000. Influence of the 1997 Red River flood on contaminant transport and fate in southern Lake Winnipeg. Report to the International Red River Basin Task Force. http://www.ijc.org/pdf/winnipegwaterquality.pdf.
[65] Stewart, R.A., G.A. Stern, W.L. Lockhart, K.A. Kidd, A.G. Salki, M.P. Stainton, K. Koczanski, G.B. Rosenberg, D.A. Savoie, B.N. Billeck, P. Wilkinson, and D.C.G. Muir. 2003. Assessing trends in organochlorine concentrations in Lake Winnipeg fish following the 1997 Red River flood. J. Great Lakes Res. 29(2):332-354.
[66] Crowe, J.M.E. 1972. The south basin of Lake Winnipeg – an assessment of pollution. Manitoba Mines, Resources and Environmental Management Department, Report 72-14.
[67] Lake Winnipeg Research Consortium 2002 and 2003 Science Workshop presentations.
[68] Salki, A. 1996. The crustacean plankton community of Lake Winnipeg in 1929, 1969 and 1994. In Lake Winnipeg Project: cruise report and scientific results, pp.319-344. Geological Survey of Canada.

urban runoff carrying nutrient-rich contaminants such as lawn fertilizers and pet waste. Household wastewater contains nutrients not only from sewage, but also from household cleaning products containing phosphorus and nitrogen.

Table 4 shows the estimated amounts and proportions of total phosphorus reaching Lake Winnipeg each year, on average, between 1994 and 2001 (updated from data presented in Bourne *et al.* 2002,[69] as presented in the Issues and Options Paper describing the proposed regulation defining Water Quality Management Zones for nutrients[70]). The proportion of contribution from point and non-point sources will vary in wet and dry years, with the relative

Table 4: Summary of estimated annual phosphorus loading to Lake Winnipeg 1994-2001 (tonnes per year, rounded to the nearest 100 tonnes). Source: Manitoba Water Stewardship*.

Category	Average Total Phosphorus (t/yr)			% of Total Phosphorus to Lake Winnipeg (% of Manitoba sources)		
Upstream jurisdictions	4,200			53%		
United States (Red River)		2,500			32	
United States (Souris River)		200			3	
Saskatchewan and Alberta (Assiniboine and Saskatchewan)		400			5	
Ontario (Winnipeg River)		800			10	
Ontario (Other rivers)		300			3	
Manitoba Sources	3,700			47%		
Manitoba Point Sources		700			9 (19)	
City of Winnipeg (Wastewater sources)			400			5 (11)
All others (Wastewater sources)			300			4 (8)
Manitoba Watershed Processes		2,500			32 (67)	
Natural background & undefined sources**			1,300			17 (35)
Present day agriculture			1,200			15 (32)
Atmospheric Deposition		500			6 (14)	
Internal Lake Processes	Currently there are no estimates available for internal phosphorus cycling that may occur in the lake.					
Overall annual total phosphorus load to Lake Winnipeg	**7,900**			**100%**		

* An update of these loading figures is currently being prepared by Manitoba Stewardship.
**Estimated natural background and undefined sources would also include contributions from sources such as forests, wildlife and septic fields.

[69] Bourne, A., N. Armstrong and G. Jones. 2003 A preliminary estimate of total nitrogen and total phosphorus loading to streams in Manitoba, Canada. Manitoba Conservation Report No. 2002-04. Winnipeg, MB, Canada. 49 pp.
[70] Issues and Options Arising from the Initial Consultation on Water Quality Management Zones for Nutrients, Manitoba Water Stewardship, February 3, 2006.

proportion from point sources higher in dry years and lower in wet years. However, both non-point and point source contributions are significant contributors of nutrients to the lake and require action be taken across the entire watershed.

Table 5 shows the estimated amounts and proportions of total nitrogen reaching Lake Winnipeg each year, on average, between 1994 and 2001. Tables 4 and 5 have been updated by Manitoba Water Stewardship since the release of the Interim Report (January 2005). These updates include the addition of the nitrogen fixation data provided by the federal Department of Fisheries and Oceans, as well as additional contributions that have been estimated by Manitoba Water Stewardship from the watershed on the east and west side of Lake Winnipeg.

Table 5: Summary of estimated annual nitrogen loading to Lake Winnipeg 1994-2001 (tonnes per year, rounded to the nearest 100 tonnes). Source: Manitoba Water Stewardship*.

Category	Average Total Nitrogen (t/yr)			% of Total Nitrogen to Lake Winnipeg (% of Manitoba sources)		
Upstream jurisdictions	48,900			51%		
United States (Red River)		19,000			20	
United States (Souris River)		1,100			1	
Saskatchewan and Alberta (Assiniboine and Saskatchewan)		8,300			9	
Ontario (Winnipeg River)		16,800			17	
Ontario (Other rivers)		3,700			4	
Manitoba Sources	47,100			49%		
Manitoba Point Sources		5,100			5 (11)	
City of Winnipeg (Wastewater sources)			3,700			4 (8)
All others (Wastewater sources)			1,400			1 (3)
Manitoba Watershed Processes		23,200			24 (49)	
Natural background & undefined sources**			18,100			19 (38)
Present day agriculture			5,100			5 (11)
Atmospheric Deposition		9,500			10 (20)	
Internal Lake Processes - Nitrogen Fixation***		9,300			10 (20)	
Overall annual nitrogen load to Lake Winnipeg	**96,000**			**100%**		

* An update of these loading figures is currently being prepared by Manitoba Stewardship.
**Estimated natural background and undefined sources would also include contributions from sources such as forests, wildlife and septic fields.
*** Nitrogen fixation: it has been estimated that species of blue-green algae are adding about 9300 tonnes of total nitrogen per year to Lake Winnipeg, by fixing the nitrogen gas found in the atmosphere.(Source: Len Hendzel, DFO, Winnipeg, 2006).

Tables 4 and 5 estimate point source and non-point source contributions to Lake Winnipeg. Point sources are those contributions of nitrogen and phosphorus originating from direct discharges (municipal sewage discharges, and industrial discharges), whereas non-point sources are those that are contributed diffusely through the watershed (runoff from agricultural land, recreational properties, and natural landscapes). In Table 4, the total phosphorus load from various sources is comprised of dissolved and particulate forms of phosphorus, not all of which are readily available to algae. In addition, in Table 5 there is an estimate of the amount of nitrogen added to Lake Winnipeg through the process of nitrogen fixation by blue-green algae.

The data presented in tables 4 and 5 demonstrate that nutrient loading to Lake Winnipeg originates from watersheds within and outside of the province. It is clear from these data that watershed processes and the atmosphere are the largest contributors of nutrients to the lake. Within Manitoba, watershed processes including natural background sources and agricultural activities contribute 67 per cent and 49 per cent of the total phosphorus and total nitrogen loadings, respectively, to Lake Winnipeg.

Contributions of nutrients from the Red River watershed are high in comparison to the other major rivers in Lake Winnipeg's watershed.

It is also clear that the contributions from the Red River watershed are high in comparison to the other major rivers in Lake Winnipeg's watershed, even though the Red River contributes considerably less flow (Table 3). Both the naturally fertile soils of this region and the intense residential and agricultural development contribute to this nutrient loading.

Although point sources contribute a relatively small proportion of the total loading to Lake Winnipeg, these sources are the easiest to identify and manage. Even though the complete elimination of point sources would not achieve the overall reductions of nutrients necessary to restore the health of Lake Winnipeg, these sources must not be ignored.

The dominant form and process of phosphorus loading from the watershed appears to be as dissolved phosphorus during the spring runoff. The application of appropriate beneficial management practices on the landscape to reduce loading during the spring will be an important measure to improve water quality of streams feeding Lake Winnipeg.

Researchers at the Department of Fisheries and Oceans in Winnipeg have estimated the amount of nitrogen added to Lake Winnipeg through blue-green algae fixing the nitrogen gas found in the atmosphere. This amount is estimated at 9300 tonnes of total nitrogen per year, which is almost equivalent to the amount of particulate nitrogen deposited to Lake Winnipeg by the atmosphere (through rainfall and dry deposition). Twenty per cent of the total loading of nitrogen to Lake Winnipeg arises from atmospheric deposition and nitrogen fixation.

The dominant form and process of phosphorus loading from the watershed appears to be as dissolved phosphorus during the spring runoff.

The relatively high contribution of nutrients originating from upstream jurisdictions (51 per cent of the nitrogen and 53 per cent of the phosphorus) accentuates the need to work in cooperation with neighbouring provinces and states to reduce loading to Lake Winnipeg, and also to lead by example. In 2004, the International Red River Board indicated that jurisdictions within the Red River basin agreed to work toward reducing nutrient loads in the Red River by 10 per cent over a five-year period in an effort to reduce nutrient loading to Lake Winnipeg. The commitment of North Dakota and Minnesota to reduce the nutrient load by 10 per cent at the International Border will be an important step in achieving the interim targets.

There is a large annual and seasonal variability in the amount of water and nutrients being supplied to Lake Winnipeg from the Red River watershed.

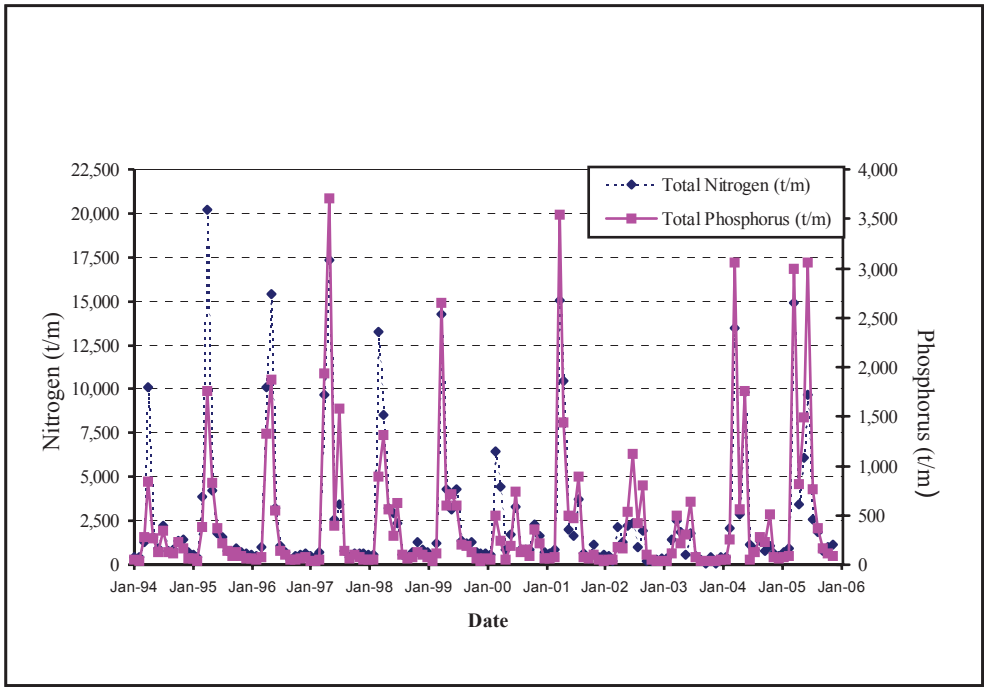


Figure 5: Monthly total phosphorus and total nitrogen loading rates for data collected from the Red River at Selkirk (1994-2005), in tonnes per month (t/m).

Figure 5 above illustrates that total phosphorus and total nitrogen loading to the Red River at Selkirk. This data demonstrates that large annual and seasonal variability in the amount of water and nutrients being supplied to Lake Winnipeg from the Red River watershed.

Loading rates for nitrogen and phosphorus are highest in April and May.

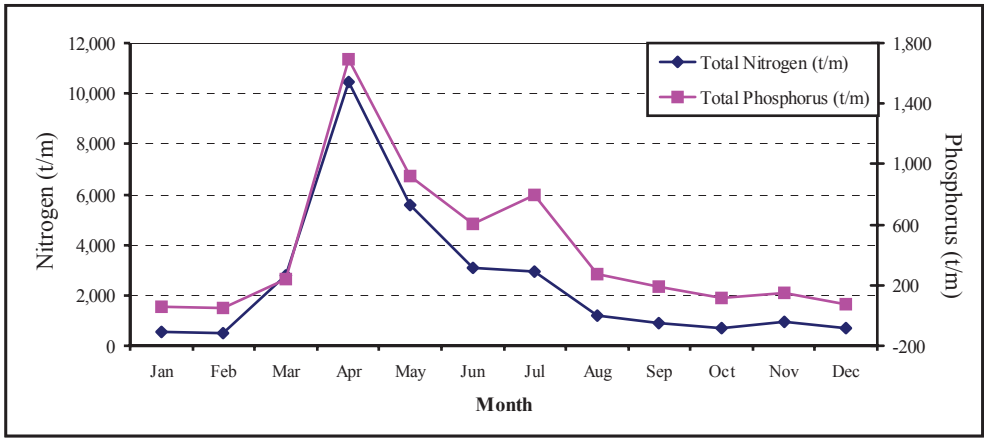


Figure 6: Mean monthly total phosphorus and total nitrogen loading to the Red River at Selkirk (averaged from 1994-2005), in tonnes per month (t/m).

Figure 6 above illustrates the strong influence of spring runoff to the nutrient loading to Lake Winnipeg. Loading rates for nitrogen and phosphorus are highest in April and May, with little loading occurring during the late fall and winter months.

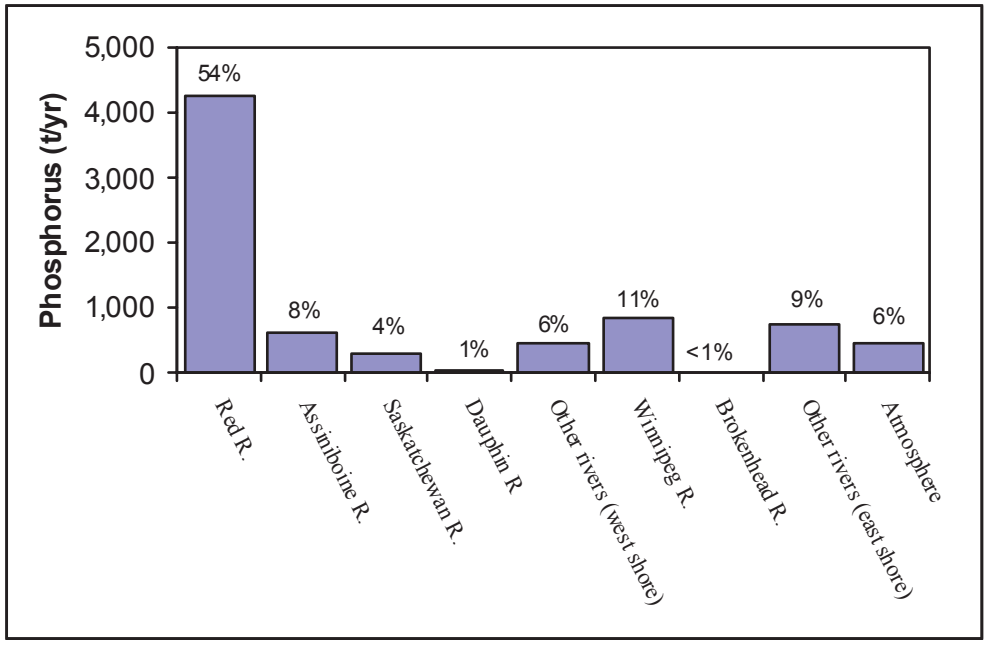


Figure 7: Total phosphorus loading to Lake Winnipeg from contributing sources, 1994-2001, in tonnes per year (t/yr). Source: Manitoba Water Stewardship, 2006.

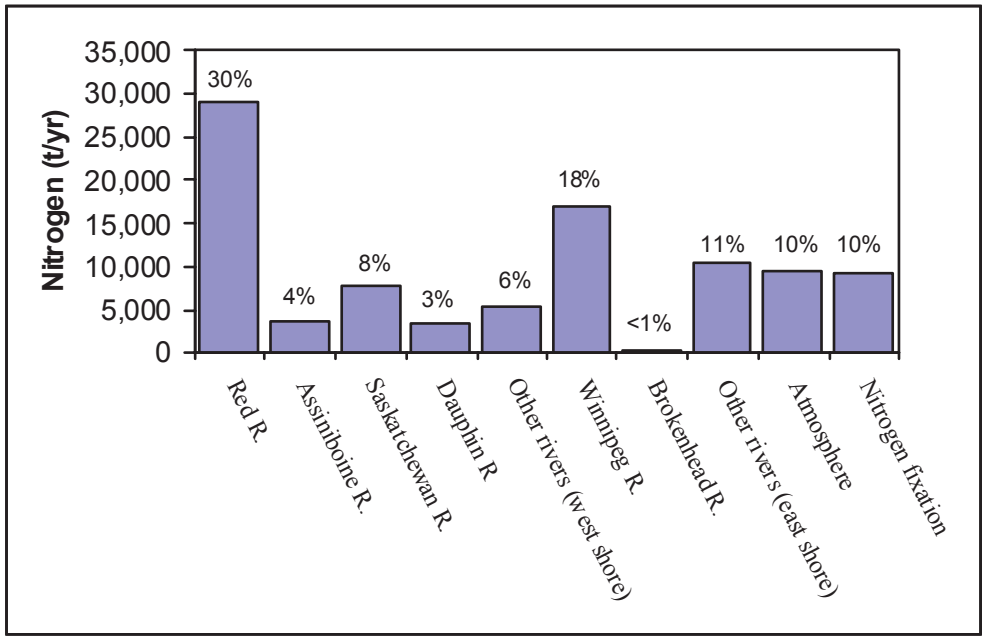


Figure 8: Total nitrogen loading to Lake Winnipeg from contributing sources, 1994-2001, in tonnes per year (t/yr). Source: Manitoba Water Stewardship, 2006.

The Red River supplies 54 percent of the phosphorus load, and 30 percent of the nitrogen load to Lake Winnipeg, despite the fact that it delivers only 11 per cent of the flow to the lake.

Figures 7 and 8 illustrate the dominant role the Red River plays in supplying nutrients to Lake Winnipeg. Based on 1994-2001 data, the Red River supplies 54 percent of the phosphorus load, and 30 percent of the nitrogen load to the lake, despite the fact that it delivers only 11 per cent (1964-2005) of the flow to Lake Winnipeg (Table 3). However in the past several years, the flows on the Red River have increased substantially and therefore the loading of nutrients

from the Red River has increased accordingly. Conversely, the Winnipeg River contributes 45 percent of the flow to the lake, but contributes 11 percent of the phosphorus load and 18 percent of the nitrogen load. The recent trends of higher nutrient-rich Red River flows, and lower flows on the nutrient-poorer Saskatchewan River may be contributing to the algal problems in Lake Winnipeg. Clearly, it will be important to manage drainage and runoff in the Red River valley to reduce the loading to the lake from that watershed.

Clearly, it will be important to manage drainage and runoff in the Red River valley to reduce the loading to the lake from that watershed.

A large percentage of the nutrients entering Lake Winnipeg are retained within the lake. Some of the nutrients become buried in the bottom sediments and are unavailable to support growth, but some of the nutrients retained in the lake may become available for biological uptake by algae. Table 6 illustrates that based on research from 1994 to 2001, about 56,300 tonnes (58 per cent) of the nitrogen and 5,900 tonnes (74 per cent) of the phosphorus entering the lake each year, is retained in Lake Winnipeg.

Table 6: Estimate of the amount of nutrients (tonnes per year) retained in Lake Winnipeg. Based on the amount of nutrients entering Lake Winnipeg via all sources, and the amount of nutrients leaving the lake via the Nelson River, Period of Record 1994-2001. Source: Manitoba Water Stewardship.

	Total Nitrogen (t/year)	Total Phosphorus (t/year)
Nutrient Load to Lake Winnipeg (all sources)	96,000	7,900
Nutrient load leaving Lake Winnipeg via the Nelson River (East and West Channels)	39,700	2,000
Nutrient Load Retained in Lake Winnipeg	**56,300 (58%)**	**5,900 (74%)**

Table 7: Estimate of the amount of nutrients (tonnes per year) retained in Lake Winnipeg based on data collected from Brunskill (1973).

	Total Nitrogen (t/year)	Total Phosphorus (t/year)
Nutrient Load to Lake Winnipeg (all sources)	61,920	5,215
Nutrient load leaving Lake Winnipeg via the Nelson River (East and West Channels)	27,410	3,900
Nutrient Load Retained in Lake Winnipeg	**34,510 (56%)**	**1,315 (25%)**

However, research by Brunskill [71] indicated that about 25 per cent of phosphorus was being retained in Lake Winnipeg during the late 1960s and early 1970s. For nitrogen, Brunskill estimated a retention rate of 56 per cent, which is similar to the present retention rate of 58 per cent. Clearly there are substantial differences between the total phosphorus estimates by Brunskill and those more recently calculated. More research is needed to better understand this issue. The numbers in this table are representative and indicative of the trends in Lake Winnipeg, although they may vary over different time periods

Studies indicate that nutrient loading to Lake Winnipeg has increased, and this is being reflected in increased frequency, intensity, and duration of algal blooms on Lake Winnipeg.

In summary, studies indicate that nutrient loading to Lake Winnipeg has increased, and this is being reflected in increased frequency, intensity, and duration of algal blooms on Lake Winnipeg. Of all the rivers entering Lake Winnipeg, the Red River contributes a relatively large proportion of the nutrient load, despite the fact that it contributes a relatively small volume of the total flow to the lake. Reductions in nutrient loading from all sources will be needed to reverse the trend of deteriorating water quality in Lake Winnipeg.

[71] Brunskill, G.J. 1973. Rates of supply of nitrogen and phosphorus to Lake Winnipeg, Manitoba, Canada. Verhandlungen Internationale Vereinigung fur Theoretische und Angewandte Limnologie. 18(3): 1755-1759.

Issues and Recommendations

Introduction

The following section lists the Board's advice in 38 recommendation areas. These recommendations target nutrient reduction opportunities for municipalities, cities, and the agricultural sector. These recommendations also discuss science and education needs. Based on the public feedback and further research and consultation, the Board has reviewed its recommendations put forward in its January 2005 Interim Report. Some of the recommendations in this report are new, others revised, and some are unchanged from the interim report.

The recommendations presented in this report focus primarily on actions that may be taken within the Manitoba Government's jurisdiction, but many also are directed at federal and municipal governments, including First Nations communities. The report also identifies actions that can be taken by individuals living in the watershed.

While considering each of these recommendations, the Province of Manitoba should determine the best policy instruments required to provide strong environmental protection to water sources. Options to be considered should include incentives, disincentives, subsidies, education, and regulations.

Since the Lake Winnipeg watershed extends well beyond the boundaries of Manitoba, the Province of Manitoba is encouraged to implement actions, work cooperatively with other agencies, and strengthen initiatives already underway, to address local and transboundary sources of nutrients to Lake Winnipeg.

The Lake Winnipeg Stewardship Board recognizes that it will require time for many of the strategies described on the following pages to take effect in decreasing nutrient loading and improving water quality in the watershed and Lake Winnipeg. It will also take time for Lake Winnipeg to recover once nutrient loads are reduced. For those reasons, it is critical that implementation of these actions begins immediately.

1.0 Public Education on Water Quality Protection

Background

Manitobans must play a leading role in rehabilitating and protecting Lake Winnipeg. It is critically important that all Manitobans gain the knowledge and understanding of how their choices and activities can influence the water quality of Lake Winnipeg and the rivers and streams of its watershed.

Many respondents to the Lake Winnipeg Stewardship Board's Interim Report expressed strong support for an effective education campaign to equip Manitobans with the necessary information on Lake Winnipeg's health and watershed issues, to help make informed choices and influence government policy. The knowledge, expertise, and talents of Manitobans should be key components in a public education program.

Some communities elsewhere in Canada have taken innovative approaches to educating the public about its role in protecting the environment. For example, the City of Toronto has undertaken a public education program aimed at protecting Lake Ontario and its contributing watershed. A series of advertisements has been developed to inform the public about how their activities can have an impact on the environment in general and on water quality in Lake Ontario in particular.[72] The Province of Manitoba needs to take a similar lead role in educating its citizens about ways to protect the health of Lake Winnipeg. There are many grassroots initiatives currently underway throughout the Lake Winnipeg watershed to educate the public on the issue of water quality. There is a need to coordinate these efforts and to build on them.

Manitobans need to recognize the present and potential environmental damage of excessive nutrient loading in the rivers and streams of the Lake Winnipeg watershed and downstream to Hudson Bay. They also need to understand the costs and benefits of the roles they must play individually to reduce that nutrient overload. Manitobans can support and encourage their governments - federal, provincial, First Nations, Metis, and municipal - to implement the actions necessary to ensure this great lake is in good health and its future is protected.

Manitobans need to better understand the unique challenges, and associated costs, faced by various sectors in the watershed in implementing changes necessary to reduce nutrient loading. For example, for many urban dwellers, there will be costs associated with upgrading municipal sewage treatment facilities, which they will be able to absorb collectively. On the other hand, agricultural producers will be challenged to implement nutrient mitigation strategies on the land, which they are expected to finance on an individual basis.

[72] The ads may be viewed at: http://www.toronto.ca/wesads/index.htm#storm

More Manitobans need to become familiar with the Traditional Knowledge that is available concerning the history of Lake Winnipeg and its watershed. This knowledge and experience has been passed down through generations and provides a valuable reference for gauging the impacts of our past activities and measuring the success of our future actions.

More than half of the drainage area contributing water to Lake Winnipeg lies outside of Manitoba. As the effort to improve the health of the lake grows, it will be increasingly important that cooperation from upstream jurisdictions, and the citizens of those jurisdictions, is realized. An awareness of the issues facing Lake Winnipeg must be created among those who live upstream if total success is to be achieved. Activities designed to implant that awareness should be undertaken.

The scientific research vessel Namao has also been used to raise public awareness of Lake Winnipeg issues.

Recommendations

1.1 With the goal of reaching every Manitoban, the Province of Manitoba should develop an extensive and innovative public education program to inform Manitobans of the issues facing Lake Winnipeg, their roles in addressing these issues, and to engage them in taking action.

1.2 Recognizing there are public education activities related to water quality issues currently underway in the watershed, there is a need to coordinate and build on this work.

1.3 A public education program should promote a community-to-community awareness and clearly identify the contribution that all communities, such as urban dwellers, waterfront property owners, agricultural producers, industry, and First Nation communities, must make to reducing nutrient loading.

1.4 To raise awareness of Lake Winnipeg issues, the Province of Manitoba and others should sponsor special events related to Lake Winnipeg.

1.5 The Lake Winnipeg Research Consortium research vessel the Namao should continue to be used for research, on-board education, and public open house events to raise awareness about the challenges facing Lake Winnipeg and to inform people of the scientific research that is underway.

1.6 A committee of First Nations representatives, commercial fishers, Metis elders, and others as appropriate, should be formed to compile and describe the history of the lake from Traditional Knowledge and identify concerns and solutions for Lake Winnipeg.

1.7 The Province of Manitoba should develop a public relations advertising program related to the issues facing Lake Winnipeg, targeting watershed jurisdictions outside Manitoba.

1.8 The Province of Manitoba should initiate a regular “State of the Lake and Watershed” forum with participation from provinces and states within the Lake Winnipeg watershed.

1.9 The material in the Lake Winnipeg Stewardship Board’s December 2006 Report should be presented in public forums and schools throughout the province.

2.0 Curriculum Development and Implementation in Manitoba Schools

Background

It is very important that young people take an active role in understanding Lake Winnipeg, its watershed, and the processes which impact water quality in the lake. They must be given the knowledge and the tools to understand how they may act to protect and manage the water resources in the Lake Winnipeg watershed.

Young people, through their knowledge and commitment, help influence sound environmental practices in their own homes and communities. Awareness generated through school curricula and related student activities will have a positive impact on the health of Lake Winnipeg in the long term.

Opportunities exist within Manitoba's high school science curriculum for the development of teaching modules on issues related directly to the Lake Winnipeg watershed. As an example, a learning module is being developed for the Red River basin in cooperation with stakeholders on both sides of the border.

Currently, curriculum developers are also working with Manitoba Water Stewardship's Fisheries Branch and teachers to develop a program called *SimFishery*, which deals with the Lake Winnipeg fishing industry and ecology. References to the Lake Winnipeg ecosystem and water quality throughout the watershed are also being included in other school science programs. The continuation and/or expansion of these initiatives appear to be dependent on the acquisition of grant funding.

Curricula related to Lake Winnipeg and water quality in the Lake Winnipeg basin developed for Manitoba students should be made available to students in jurisdictions outside of Manitoba, and in particular those provinces and states within the Lake Winnipeg watershed. This awareness should also be extended to those responsible for curriculum development in First Nations schools in Manitoba and beyond. Providing these students the opportunity to learn about Lake Winnipeg and related water quality issues would be beneficial to their own communities, and by extension, to the health of Lake Winnipeg. Educators should also be presented with the option of learning about Lake Winnipeg through workshops, conferences, and other professional development opportunities. The Lake Winnipeg Research Consortium which currently offers classroom and field training to high school and university students, could also provide educator training.

Many conservation organizations and agencies in Manitoba are involved in public and youth education. An excellent example is Manitoba's conservation districts. These locally-directed organizations cover a majority of the agriculture portion of the province. The mission of the Manitoba Conservation Districts Association states it will *"...communicate long term environmental stewardship through advocacy, education and promotion."* The opportunity exists to involve these organizations, and others involved with environmental education "on the ground", in school projects related to water quality and Lake Winnipeg.

Recommendations

2.1 Manitoba Education, Citizenship and Youth should design teaching units, credit courses, and upgrade holistic environmental curricula specific to Lake Winnipeg and local watersheds for mandatory implementation in Manitoba schools.

2.2 Manitoba Education, Citizenship and Youth should consider sharing Lake Winnipeg watershed-related curricula with other provincial departments of education, particularly those provinces in the Lake Winnipeg watershed.

2.3 An awareness of Lake Winnipeg water quality and watershed influences must be created among those teachers and administrators in First Nations schools involved in curriculum development. Also, special events and awards for students conducting projects on the Lake Winnipeg issues should be considered.

2.4 Lake Winnipeg and watershed issues should be promoted through professional development opportunities for teachers.

2.5 Manitoba's conservation districts and other environmental agencies and organizations should be actively involved in promoting school projects related to protecting the health of Lake Winnipeg and its watershed.

3.0 A Scientific Basis for the Protection of Lake Winnipeg

Background

The development of policy, regulations, and management approaches on matters related to the environment must be based on sound science. On-going research by federal and provincial governments, and university students, is helping to define changes occurring in Lake Winnipeg, and to identify the causes of these changes. A number of important knowledge gaps related to Lake Winnipeg and its contributing watershed still remain to be filled.

There continues to be a need to gain further scientific understanding of the lake itself so ecosystem health and productivity can be sustained and water quality deterioration, particularly the proliferation of blue-green algal blooms, can be reversed. Also, an optimum balance must be achieved between nutrient enrichment and productivity of the commercial and subsistence fishery – and subsequent economic return to communities – while protecting the lake's ecosystem health and recreational uses.

While the present focus is on reducing nutrient contributions to the lake to halt, and then reverse the trend of cultural eutrophication, other environmental and resource management issues in Lake Winnipeg should not be overlooked. There is a need to report regularly on the health of the lake. This will require an on-going, focussed monitoring of key ecosystem health indicators, preparation of "State of the Lake" reports, and following up on other issues that may be identified. It is important that research information collected on Lake Winnipeg by federal, provincial, and university scientists is used for developing policy, developing management strategies, and for public education.

Water quailty sampling on Lake Winnipeg

A number of gaps in our scientific knowledge of the interface between the terrestrial and the aquatic components of Lake Winnipeg's watershed need to be filled. For example, it is important that more research be conducted to understand the mechanisms by which non-point source agricultural nutrient runoff is occurring. There is need for field-scale hydrologic research at the terrestrial-aquatic interface to better understand how to reduce non-point contamination from agricultural land.

At the regional scale, loading of nitrogen and phosphorus from the Red River basin is the most important factor determining the concentration of nutrients in the lake. However, at the field scale (the scale at which the land, nutrients, and water are managed) the processes responsible for loading within the lake's watershed remain poorly understood. A large portion of the lake's watershed is relatively dry, cold, and flat, where most of the nutrient loss from soils to water is in the form of dissolved nutrients in runoff water that originates from snowmelt. Unfortunately, most of the world's knowledge of nutrient loss and effective beneficial management practices has been generated in wet, warm, sloping areas, where rainfall-induced erosion of soil particles is the main process of nutrient loading to surface water. With an increased understanding of the processes responsible for nutrient loading in Lake Winnipeg's watershed, we can develop scientifically sound, efficient methods of enhancing water and nutrient retention, particularly in the Red River basin.

Over the short-term, these information gaps need to be filled by all available means. To accomplish this, strong partnerships must be established between aquatic scientists and soil scientists. At the present time, there is a lack of knowledgeable professionals in Manitoba with expertise in the terrestrial-aquatic interface to meet current research needs. In addition, the Board continues to be of the opinion that such expertise will also be required over the long-term, not only to deal with the current issues surrounding nutrients, but to manage other issues or threats that will likely emerge in the future. Consequently, academic institutions in Manitoba need to be engaged to ensure that expertise in this area is generated.

The management of Lake Winnipeg as a reservoir by Manitoba Hydro has influenced the seasonal pattern of outflows from the lake. Although the average residence time of water in the lake has not changed and remains on average, between three and five years, more water is now being stored in the lake during the

summer and is being released during the fall and winter to meet demands for electricity. However, during high inflow years, 1997, 2001 and 2005 for example, more water was released from the lake in the spring and summer than would have been prior to regulation. The impact of regulation on lake water quality, altered circulation patterns, residence time, and the influence on nutrient retention and algal productivity is not understood and remains an important information gap that needs to be resolved.

The work being facilitated by the Lake Winnipeg Research Consortium is a positive beginning for filling the scientific information gaps existing for Lake Winnipeg. Strong multidisciplinary teams brought together by the Consortium to provide objective scientific assessments of Lake Winnipeg must be supported by the provincial and federal governments. There is a need to directly involve academic institutions in Manitoba and elsewhere. Involvement of these institutions and building expertise in Manitoba is critical. The Lake Winnipeg Stewardship Board advocates this multidisciplinary/academic approach as the best way to remedy these critical information gaps and to assure development of the appropriate expertise in Manitoba over the long-term.

On-going monitoring and research is required to gain a better understanding of the biological, chemical, and physical processes within the contributing streams draining to Lake Winnipeg. Existing routine monitoring may need to be augmented to gain a better understanding of short-term, episodic contributions of nutrients to streams following intensive run-off events from rainfall and snowmelt. As well, monitoring will be required into the future to track progress towards achieving the interim targets identified in the Lake Winnipeg Action Plan and the long-term, ecologically-relevant nutrient objectives once these are established.

The effects arising from the management of water flows and levels in streams and rivers in the watershed and in Lake Winnipeg through the use of structures such as dams, ditches, and diversions are not well understood. These alterations to the natural condition are thought to be important factors that influence nutrient losses from the landscape, nutrient cycling within Lake Winnipeg, and production of algae in Lake Winnipeg. For example, in recent years the volume of nutrient-rich water from the Red River basin has increased while the proportion of water from the Saskatchewan River basin, which contains fewer nutrients, has diminished. This has lead ultimately to a substantial increase of loading of nutrients to the lake. Such changes almost certainly arise from a combination of natural climatic variability, climate change, and human-influenced changes to water use and drainage patterns in the watershed. More research is required to identify the factors responsible for the recent increase in flows on the Red River, and the associated increase of nutrients to Lake Winnipeg from the Red River basin. The sources of these nutrients need to be determined.

The Province of Manitoba and other agencies need to develop and implement a focused program of applied research aimed at developing a better understanding of human-induced changes such as dams, ditches, and diversions in water flows in rivers and streams within the Lake Winnipeg watershed.

There is a need to continue to explore innovative technologies that may help to mitigate nutrient levels in Lake Winnipeg. Nutrient reduction or algal biomass reductions through chemical, biological, and physical means should be explored to determine whether these options are feasible. An examination of practices employed elsewhere which may be transferable to Manitoba conditions should be conducted.

The Board continues to recognize that there is a need to better combine the Traditional Knowledge of commercial fishers, First Nations, Metis, agricultural producers, and others knowledgeable on Lake Winnipeg conditions, with contemporary science as additional knowledge of Lake Winnipeg is gained. An entity similar to the current Lake Winnipeg Stewardship Board could facilitate gathering this knowledge and connecting this information with the scientific data being collected.

Recommendations

3.1 On-going research and monitoring is required on Lake Winnipeg to address outstanding information gaps, to monitor progress towards achieving targets for nitrogen and phosphorus, and to refine these targets. To this end, there is a need for the provincial and federal governments to develop and implement a long-term, collaborative science plan for Lake Winnipeg.

3.2 The Province of Manitoba should substantially increase its investment in the development of expertise within the scientific community in the areas of hydrological and contaminant transport mechanisms at the land-water interface, and to build and support strong multi-disciplinary teams to address outstanding science needs.

More...

3.3 Manitoba Water Stewardship must continue its long-term water quality monitoring of watersheds contributing to Lake Winnipeg, and should augment this routine monitoring to better estimate loadings of nutrients from short-term runoff of rain and snowmelt events. It is also important that this monitoring continue in order to track progress towards achieving targets set for Lake Winnipeg.

3.4 The Province of Manitoba together with other agencies needs to develop and implement a focused program of applied research aimed at better understanding the human-induced changes in water flows, circulation patterns, seasonal lake residence time, and lake levels on nutrient dynamics within Lake Winnipeg.

3.5 The Province of Manitoba together with other agencies needs to develop and implement a focused program of applied research aimed at better understanding the human-induced changes caused by dams, ditches, and diversions on water flows, in rivers and streams within the Lake Winnipeg watershed.

3.6 The Province of Manitoba and other agencies need to identify the factors responsible for increases in flow on the Red River and the associated increase of nutrients to Lake Winnipeg, and determine the sources of these nutrients.

3.7 The Province of Manitoba should investigate innovative technologies that might be appropriate to help mitigate nutrient levels within Lake Winnipeg.

3.8 The provincial and federal governments need to develop a strategy to collect Traditional Knowledge from commercial fishers, First Nations, Metis, agricultural producers, and others knowledgeable on Lake Winnipeg conditions, and ensure that this information is integrated with contemporary science as additional knowledge of Lake Winnipeg is gained.

4.0 Setting Long-Term Ecologically-Relevant Objectives for Nutrients in Lake Winnipeg

Background

Progress has been made towards setting long-term, ecologically-relevant water quality objectives for nutrients that will replace the interim targets identified in the Lake Winnipeg Action Plan. These interim targets are to reduce nitrogen loading to the lake by 13 per cent and to reduce phosphorus loading by 10 per cent - the increases in nutrient loading estimated to have occurred since the early 1970s.

Through the initiative of the Lake Winnipeg Stewardship Board Science Committee, a set of draft principles was prepared to guide the development of ecologically-relevant, long-term nutrient objectives for Lake Winnipeg. These draft principles emphasize that to improve Lake Winnipeg ecosystem health it will be important to:

(1) preserve or restore the important ratio between nitrogen and phosphorus, and be reflective of both in-lake concentrations and watershed loadings;
(2) reflect but not necessarily restore the historical regime of nitrogen and phosphorus concentrations in Lake Winnipeg;
(3) ensure the healthy functioning of the Lake Winnipeg ecosystem;
(4) minimize the duration, frequency, and intensity of blue-green algal blooms including the need to minimize the production of algal toxins harmful to aquatic life, recreation and drinking water;
(5) minimize the duration, frequency, and intensity of blooms of other forms of algae including those leading to fouling of commercial and subsistence fishing nets or that otherwise interfere with the successful harvest of fish;
(6) ensure that an optimum balance is achieved between nutrient enrichment, productivity of the commercial and subsistence fishery and subsequent economic return to communities, while protecting the lake's ecosystem health and recreational uses;
(7) be protective of the downstream environment in the Nelson River and Hudson Bay;

Setting long term objectives is critical to the health of Lake Winnipeg

(8) recognize water quality objectives established for the contributing watersheds, and that water quality objectives for nutrients established in the contributing watersheds need to recognize Lake Winnipeg; and
(9) consider the social and economic implications of implementation and compliance.

The Board recognizes that more work and consultation will be required to refine these principles.

The Lake Winnipeg Stewardship Board also commissioned a compilation and synthesis of nutrient-related science essential to developing the objectives.[73] On May 31 2006, the Science Committee of the Lake Winnipeg Stewardship Board hosted a workshop to gather comment on the draft principles, to critically review the assembled literature, and to identify next steps in the process of developing the objectives. Fifty participants representing government, academic institutions, and other organizations were in attendance. A report from this workshop is available for viewing on the Lake Winnipeg Stewardship Board website (wwww.lakewinnipeg.org).

The Board acknowledges that there is some controversy surrounding the roles of nitrogen and phosphorus in stimulating algal productivity and influencing algal community structure in Lake Winnipeg, its contributing basin, and the downstream environment. However, the Board is of the opinion that this issue will be remedied through the development of ecologically-sensitive, long-term water quality objectives for Lake Winnipeg. In the meantime, the Board feels priority should be placed on achieving reductions of phosphorus since the benefits to Lake Winnipeg are more clear and unequivocal.

The consultants and workshop participants identified several potential methods for setting long-term, ecologically-relevant objectives for nutrients. They also identified information gaps that will need to be filled as quickly as possible in order to establish these objectives. It is thought that the establishment of long-term water quality objectives for nutrients will likely include a combination of methods but all will need to rely on additional information including the following.

- Information on the nature of historical algal communities in Lake Winnipeg that can be derived from the paleolimnological record laid down in the bottom sediments over time. This may enable a re-construction of the nutrient regime that supported these historical algal communities.
- Water quality models will need to be constructed and calibrated based on existing conditions and then used to estimate historical conditions. A water quality model will be essential to further understand how Lake Winnipeg will respond to nutrient management scenarios.
- Focused scientific and ecological studies are needed to better identify the site-specific relationships in Lake Winnipeg between nutrients and algal growth.

The general process will involve filling these essential information gaps as quickly as possible, proposing draft water quality objectives for nutrients, then reviewing the proposed objectives through a second Lake Winnipeg Nutrient Objectives Workshop. It is recognized that while this process needs to be strongly based in science, all those potentially affected by the established objectives will need to be involved since significant social and economic issues need to be considered.

Recommendation

4.1 Manitoba Water Stewardship should continue the process of establishing long-term, ecologically-relevant objectives for nutrients in Lake Winnipeg, its contributing basins, and the downstream environment. This will involve estimating the historical nutrient regime in Lake Winnipeg through assembling the lake's paleolimnological record, developing a nutrient water quality, and an ecosystem model for the lake, proposing draft nutrient objectives, and reviewing the draft objectives through a second workshop.

[73] See http://www.lakewinnipeg.org/web/content.shtml?pfl=public/downloads.param&page=000101&op9.rf1=000101

5.0 Transboundary and Inter-jurisdictional Issues

Background

In Canada, the federal government has constitutional jurisdiction over transboundary waters. The Province of Manitoba has asked the Canadian Government to lend its support to Manitoba's efforts to reduce transboundary loading of nutrients to Lake Winnipeg. Early focus has been on waters flowing into Manitoba from the Minnesota and North Dakota portion of the Red River basin. Cooperation has been initiated with Minnesota and North Dakota through the International Joint Commission's International Red River Board.

Long-term records indicate that the Red River supplies only about 11 per cent of the total inflow of water to Lake Winnipeg (Table 3). However, it contributes approximately 54 per cent of the total amount of phosphorus entering Lake Winnipeg from all rivers flowing into the lake combined (Figure 7). In addition, an assessment of long-term trends has indicated that phosphorus concentrations increased in the Red River at the International Boundary by about 23 per cent between 1978 and 1999.[74] Moreover, flows on the Red River have increased in recent years, and phosphorus loadings to Lake Winnipeg have increased accordingly.

In 2004, the International Red River Board of the International Joint Commission indicated that jurisdictions within the Red River basin would work toward reducing nutrient loads in the Red River by 10 per cent over a five-year period in an effort to reduce nutrient loading to Lake Winnipeg. The International Joint Commission has subsequently informed the governments of Canada and the United States that this commitment had been adopted.

Many Manitobans have expressed concern to the Lake Winnipeg Stewardship Board over the Devils Lake issue. The Province of Manitoba continues to work to mitigate potential impacts from Devils Lake to waters within the Hudson Bay drainage basin. The Province has been particularly concerned with the potential introduction of non-native species to the basin. In addition to this concern, the discharge of water from Devils Lake will increase the total nutrient loading to Lake Winnipeg. Although the additional contribution of nutrients is expected to be relatively small (up to 16 tonnes per year of total phosphorus and up to 90 tonnes per year of total nitrogen if pumping occurs continuously at the maximum rate of 2.83 cubic metres per second), it nevertheless moves the ability to meet nutrient reduction targets in the opposite direction.

Since a significant portion of the Lake Winnipeg watershed lies within Alberta and Saskatchewan, good communication with these provincial governments is imperative. They will have an important role to play in helping Manitoba achieve long-term water quality objectives for nutrients in Lake Winnipeg. Collaboration among these governments could take place through existing bodies such as the Prairie Provinces Water Board.

The Winnipeg River is the single largest contributor of water to Lake Winnipeg at about 45 per cent of the total inflow. Currently, the Winnipeg River basin contributes about 11 per cent of the phosphorus entering the lake, but increased phosphorus levels have been detected in the Winnipeg River near the Ontario/Manitoba border over the past three decades.[75] It will be key for the governments of Manitoba and Ontario to establish communication to address this issue and how it relates to water quality in Lake Winnipeg.

There is evidence to suggest that water quality in the Lake of the Woods may be deteriorating[76], and the Lake of the Woods basin may be experiencing similar eutrophication pressures as Lake Winnipeg. Efforts to raise awareness over nutrient loading and algal densities in the Lake of the Woods watershed are underway.

Many First Nations communities in the Lake Winnipeg watershed have water and sewer treatment facilities that are considered substandard and are believed to be contributing nutrients to the lake. Management of these facilities is the combined responsibility of each community and Indian and Northern Affairs Canada. It is important that the Province of Manitoba work cooperatively with the federal government and First Nations communities to reduce nutrient loading from these communities within the watershed.

[74] Jones, G, and N. Armstrong. 2001. Long term trends in total nitrogen and total phosphorus concentrations in Manitoba streams. Manitoba Conservation Report No. 2001-07. Winnipeg, MB, Canada. 154 pp., and Bourne, A., N. Armstrong and G. Jones. 2003. A preliminary estimate of total nitrogen and total phosphorus loading to streams in Manitoba, Canada. Manitoba Conservation Report 2002-04. Winnipeg, MB, Canada. 49 pp.

[75] Ibid

[76] Lake of the Woods International Water Quality Forum, February 20-21, 2004, Summary Report, Recommendations & Future Directions – June 2004. (www.lowdpoa.com)

There is an obvious need for strong inter-provincial and international cooperation to address issues related to the health of Lake Winnipeg and its watershed. The Province of Manitoba should consider establishing a basin management board comprised of governments and stakeholders in the watershed. This body could work to develop management strategies to protect the health of Lake Winnipeg. Successful basin management entities should be considered as models for organizing such a board.

Recommendations

5.1 The Province of Manitoba, with the support of the Government of Canada, should continue to communicate with North Dakota and Minnesota regarding transboundary issues related to the Red River, and ultimately to Lake Winnipeg itself.

5.2 The Province of Manitoba must continue to work with neighbouring jurisdictions in Saskatchewan and Alberta through the Prairie Provinces Water Board to develop commitments to reduce phosphorus and nitrogen loadings entering Manitoba.

5.3 The governments of Manitoba and Canada are urged to initiate discussions with the Province of Ontario with the goal of developing targets for nutrient contribution in the Winnipeg River at the Manitoba/Ontario boundary.

5.4 The Province of Manitoba must work to strengthen its working relationship with the Government of Canada on First Nations issues related to impacts on water quality, and each should be prepared to accept their full fiduciary responsibilities as per their constitutional obligations.

5.5 The Province of Manitoba should consider forming a basin management board comprised of government and public representatives from throughout the watershed to deal with the health of Lake Winnipeg and its watershed.

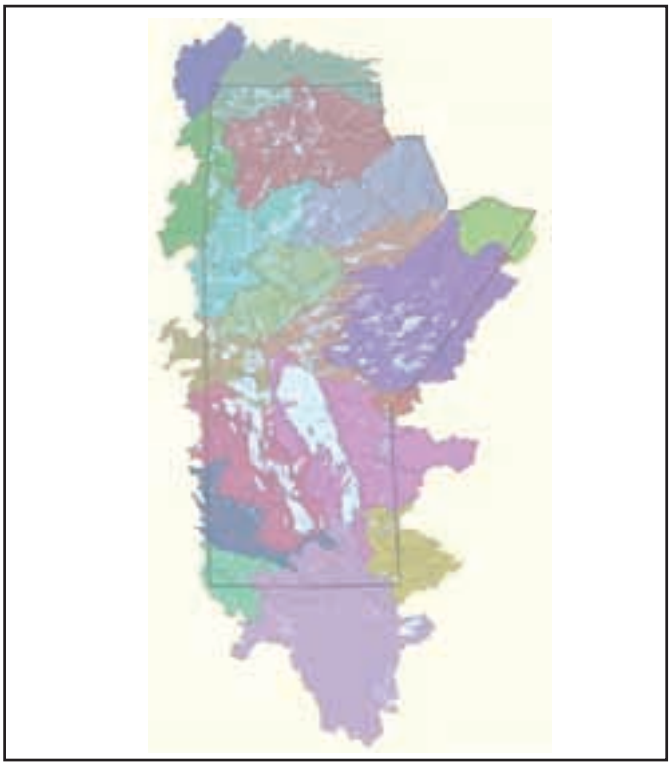
6.0 Integrated Watershed Management Planning

Background

Integrated watershed management planning is critical to the protection of water quality and quantity, and the sustainable management of the many activities that occur on the landscape. Watershed management planning must be conducted in a timely manner to encompass the many changes expected to occur over the next few years with respect to development and land use in Manitoba.

There is also a need for consistency across watersheds with respect to how and when watershed management plans are prepared, and with respect to what information is included within each plan. It will be necessary for these plans to reflect regional differences throughout Manitoba. However, policy direction from the Province must be clearly defined.

Manitoba's new *Water Protection Act* is intended to enable comprehensive watershed planning and ensure integration of the planning and regulatory framework within Manitoba. The *Act* states that the Province of Manitoba is committed to watershed planning as an effective means of addressing risks to water resources and aquatic ecosystems, and believes that watershed residents should be consulted when watershed plans are being developed.



Many of Manitoba's watersheds share drainage area with other jurisdictions.

To assist the goals of the Lake Winnipeg Action Plan, watershed management plans should be developed in concert with local people for all sub-watersheds within the Manitoba portion of the Lake Winnipeg watershed, and should address all water management issues within these watersheds. The establishment of watershed management districts would ensure timely development of these plans.

Since water knows no boundaries, many sub-watersheds in Manitoba have portions of their areas situated outside of the province. Jurisdictions sharing sub-watersheds with Manitoba should be encouraged to participate in joint integrated watershed planning in those areas. Cooperation with Saskatchewan, Ontario, and the U.S. states bordering Manitoba could provide a positive approach to addressing transboundary issues that may currently be at a stalemate, or not receiving attention.

Progress is being made in watershed planning in Manitoba, as some conservation districts are beginning the process of developing integrated watershed management plans for their districts. The Lake Winnipeg Stewardship Board supports a strong emphasis on the development of these plans. It will be important for the Province to provide clear guidance with respect to water quality objectives for the sub-watersheds within the Lake Winnipeg watershed to reach nutrient reduction targets.

It will be important that planning under both the *Planning Act* and integrated watershed planning under the *Water Protection Act* be harmonized across the province.

Recommendations

6.1 Manitoba Water Stewardship should work with local communities to establish watershed management districts or watershed authorities within the Manitoba portion of the Lake Winnipeg watershed.

6.2 The Province of Manitoba should initiate watershed management planning with the watersheds that contribute the highest amount of nutrient export per unit of land area. However, it is important not to delay watershed planning in other regions of the province.

6.3 Those jurisdictions outside of Manitoba who share watersheds with Manitoba should be encouraged to participate in the development of watershed management plans.

6.4 Watershed management districts should be established based on natural watershed boundaries rather than municipal boundaries.

6.5 Watershed management districts should be responsible for managing all drainage issues within their jurisdictions, including in-field drainage activities and the drainage of natural wetlands. The Province of Manitoba should retain responsibility for issuing and enforcing permits for these projects.

6.6 Watershed management plans need to be consistent with provincial water quality objectives. While recognizing regional variability, the Province needs to develop water quality objectives to facilitate the watershed planning process.

6.7 Watershed planning and activities under the *Planning Act* need to be harmonized.

7.0 Cosmetic Use of Phosphorus-Based Fertilizers

Background

Although the use of phosphorus-based fertilizers for cosmetic purposes is likely a relatively small contributor to the overall nutrient loading to Lake Winnipeg, it deserves attention. Fertilizer use on lawns is widespread in urban centres in Manitoba. Many lakeside cottage owners also use fertilizers on lawns and gardens as do some cottage owners within provincial and federal parks. In addition, fertilizers are often applied to properties surrounding provincial and federal government buildings.

In the vast majority of situations, these fertilizers are applied in the absence of a soil test which would determine whether the soil is actually deficient in nitrogen or phosphorus. While phosphorus is an essential plant nutrient for lawns, many of Manitoba soils have an abundant supply of natural phosphorus and additional phosphorus will not be of benefit. Over-application of fertilizers in these instances is likely widespread. Also, when fertilizers are broadcast over lawns, some will unintentionally

be applied to impervious surfaces such as sidewalks and driveways. There is a risk that this "over-spread" will be washed into storm drains which lead to rivers and lakes.

On January 1, 2004, a law came into effect in the St. Paul and Minneapolis metropolitan area in Minnesota restricting the use of lawn fertilizers. In this region, fertilizers may not contain phosphorus, and in Greater Minneapolis, the phosphorus content is restricted to no more than three per cent. It is also illegal to spread fertilizer on hard surfaces such as sidewalks and driveways. In Minneapolis, these restrictions do not apply to fertilizers used on agricultural crops, flower and vegetable gardens, or on golf courses.

Restricting the use of phosphorus-based fertilizers for cosmetic uses in Manitoba should be considered. These fertilizers could continue to be available to customers that have a soil test report demonstrating phosphorus deficiency in the soil. Commercial lawn applicators would be required to follow these same rules. Retailers should be required to display only those fertilizers that meet the phosphorus limits set out for each region. Before considering the application of restrictions in Manitoba similar to those in Minneapolis, there is a need to determine whether phosphorus restrictions should vary in different regions of the province.

Grass clippings contain beneficial plant nutrients. The practice of leaving grass clippings on the lawn so that these nutrients can be recycled should be encouraged.

Recommendations

7.1 The Province of Manitoba should explore the option of implementing province-wide restrictions on the use of phosphorus-based fertilizers for cosmetic purposes.

7.2 The Province of Manitoba and the Government of Canada should implement restrictions on the cosmetic use of phosphorus fertilizers for lawn care on provincial and federal properties.

7.3 The Government of Canada should institute a consistent policy for the use of fertilizers for cosmetic use on all federal lands, including national parks and First Nations communities.

8.0 Water Usage, Sewage Treatment, and Related Financing

Background

It is important for the Province of Manitoba to work towards ensuring that all Manitobans are served by adequate sewage treatment systems. For some systems, reducing the hydraulic load may improve sewage treatment. The volume of wastewater generated, and therefore the amount entering the sewage treatment system, is proportional to the amount of water used by the community.

Water conservation should be encouraged by employing the principles of user-pay and true-cost accounting. In this manner, the actual cost of providing water and wastewater treatment services may be recovered. Providers of these services would then have an adequate revenue source with which to operate. As the cost to the consumer increases, it may be expected that water consumption would decrease, as would the amount of wastewater generated. In some cases, the cost of constructing wastewater treatment facilities may decrease, as some parts of facilities might be designed smaller. Metering is seen as a valuable tool to help individuals determine their water use and wastewater generation.

The financial burden for municipalities to provide acceptable water and waste treatment is significant. Consequently, water and sewer infrastructure is often substandard and may pose risk to human health and the environment. Currently, there is little or no incentive for municipalities to properly maintain their infrastructure, as funding from the federal and provincial governments is often provided on a priority or emergency basis to those communities with failed systems. Competing capital demands for other projects within the community such as recreation centres often result in the diversion of municipal funds away from sewer and water reserve accounts.

Sewer and water infrastructure should be a public service priority funded through a systematic and sustainable partnership between municipal, provincial, and federal levels of government. But the existing approach to funding sewer and water projects through provincial or federal programs is unpredictable and does not allow municipalities to accurately predict how much financial support may be forthcoming. Requests for funding support by municipalities far exceed monies available. A more reliable method of cost-sharing sewer and water infrastructure projects is needed. The Federation of Canadian Municipalities has adopted a series of policies surrounding innovative funding models for the long-term sustainability of Canada's municipal infrastructure.[77] These policies should receive consideration when funding programs are developed for sewer and water infrastructure works in the Lake Winnipeg watershed.

Regarding wastewater treatment facilities specifically, the Lake Winnipeg Stewardship Board believes that in the long term, the costs of constructing and operating sewer infrastructure that include enhanced nutrient removal need to be funded through full-cost recovery models based on the entire life cycle of the facility. In the meantime, until such an approach can be fully implemented, the Province of Manitoba should work with the federal and municipal governments to formulate funding agreements that are fair and predictable so that municipalities clearly understand their share of the cost. One example of an interim funding policy may be a one-third municipal, one-third provincial, and one-third federal funding formula.

The costs of new infrastructure to service new subdivisions, including new cottage lots on provincial land, may not have been adequately considered in the past. For future cottage lot development and all other development, the costs of providing adequate water and wastewater services must be considered. Often municipalities are required to provide services to new cottage developments, therefore the Province should ensure that infrastructure for cottage lot should be included in the cost of the lots. The Province should also ensure that cottage lot infrastructure on Crown land is included in the cost of the lots.

Groundwater seepage and infiltration into wastewater collection systems can place an unnecessary strain on treatment systems. This is a widespread problem that should be addressed.

Recommendations

8.1 The Province of Manitoba should ensure that all Manitobans are served by wastewater treatment practices that safeguard human health and water quality.

8.2 Manitobans should pay the true cost of the operation and maintenance of the systems required to provide the water they consume, and the true costs of the services required to adequately treat wastewater.

8.3 Utility reserves that cover the true costs of infrastructure upgrades or replacement must be established within each community such that monies are available when utility upgrades are required. Monies collected for these reserves need to be protected from competing financial needs within the community.

8.4 Over the short term, the Province of Manitoba should negotiate predictable funding agreements with municipal and federal governments for wastewater treatment infrastructure (for example, on a one-third municipal, one-third provincial, and one-third federal funding formula), for municipalities to undertake the necessary work to ensure adequate nutrient removal. Over the long-term, utilities need to implement full-cost recovery funding models that cover complete life cycle costs.

8.5 New subdivisions, including new provincial cottage lots, need to have the costs of infrastructure considered in the lot costs. Financial compensation to municipalities may be required to allow adequate servicing of cottages or homes built on Crown land.

8.6 The sources of extraneous groundwater inflow into wastewater collection systems need to be investigated and minimized were feasible.

[77] Federation of Canadian Municipalities, Green Municipal Fund, (http://www.fcm.ca/english/main.html).

9.0 Water Use Efficiency

Background

Excess stormwater in sewage treatment facilities interferes with treatment efficiency and can degrade the quality of the final effluent. In lagoons, excess water such as greywater and groundwater infiltration into pipes leading to the lagoon shortens the retention time in the lagoon. This may be one of the factors leading to the need for emergency discharges or the need for unnecessary storage expansion.

In a septic field system, excess water fed into the system may overload the field, resulting in field failure and the effluent seeping to the surface of the soil and running overland into the natural drainage system.

More needs to be done to ensure water conservation is practiced in Manitoba. This is particularly important for treatment facilities that are at their hydraulic capacity. Many methods and technologies are available to allow for more efficient use of water in individual homes, business establishments, and offices. These include low-flow taps, showers, and toilets. Lawn and garden watering may be enhanced through the use of rainwater, thereby reducing the need for water from the municipal system, for example. Governments – municipal, provincial, and federal – can play a leading role in the community-at-large by implementing water conservation initiatives in their facilities and encouraging their constituents to do likewise.

Devices such as low-flow toilets can reduce water use.

Metering water use, for those consumers who are not presently being charged for the water they use, can have the effect of increasing water use efficiency. For larger users of water, bulk discounts or reduced rates as consumption increases may, in fact, discourage efforts to practice water conservation. These issues need attention.

Recommendations

9.1 The Manitoba Building Code and the National Building Code should be revised to require all new homes to be fitted with low-flush toilets and low-flow faucets.

9.2 Governments should demonstrate leadership by instituting a program to convert fixtures in government-owned buildings to water-saving fixtures. When government agencies are leasing space, a condition of tenancy should be the conversion of existing fixtures to low-flow alternatives.

9.3 All levels of government should consider incentives or rebates for homeowners to retrofit fixtures to low-flow alternatives. An environmental levee for the purchase of higher volume fixtures should be considered.

9.4 A public education program should be implemented to encourage the safe collection and use of rainwater for lawn and garden use.

9.5 Water consumers on community water systems that currently are not metered, should be metered, and be billed on a water use basis at the full cost of the water supply.

9.6 Consideration should be given to applying higher billing rates for water as usage increases. Discontinuing the practice of bulk discounts and reduced water rates for large commercial and industrial consumers should be considered.

10.0 Regionalization of Wastewater Treatment Services

Background

Regionalization of water services in several locations in Manitoba has resulted in better access to safe, reliable water services for many Manitobans. Due to the rising cost of treating water to meet drinking water standards, communities are recognizing the economic benefits of regionalizing potable water services. However, significant opportunities still exist for implementing additional regionalized water systems, as well as wastewater systems throughout the province.

Regionalization of wastewater services in Manitoba has lagged behind the regionalization of potable water services. However, with more stringent wastewater effluent standards emerging, regionalization of wastewater services is gaining greater merit and acceptance. But, as effluent standards become more stringent, so does the cost of meeting those requirements.

Regionalization of wastewater treatment provides opportunities for communities to implement more advanced technologies at lower costs relative to meeting these needs on an individual basis. Examples of regionalization in Manitoba include a shared lagoon servicing the communities of Oakbank, Anola, and Dugald. The cities of Brandon, Winnipeg, and Selkirk are currently exploring opportunities to provide regional services outside their current service range.

Through the Manitoba Water Services Board, funding should be provided to specific regional projects, rather than to individual municipalities to encourage collaboration among municipalities. For example, the cost of piping, or the purchase of irrigation equipment for effluent irrigation could be cost-shared among municipalities.

In some areas of the province, sewage treatment practices such as septic fields, holding tanks, and lagoons are not meeting environmental standards. Sewage management planning in these areas needs attention. Some examples include the Selkirk-Winnipeg corridor, some areas of cottage country, and many First Nations communities. These plans are particularly important where septic fields are the main waste management system for communities comprised of high density, small lots.

Sewage management planning in areas such as cottage country needs attention.

Regionalized sewage services for adjacent First Nations and non-First Nations communities need to be developed for the benefit of both communities. Regionalization may provide opportunities to pool resources to make sewage treatment more efficient and economical. There is a need for the Province and Indian and Northern Affairs Canada to work together more cooperatively on regional sewage management plans.

As sewage treatment technology becomes more advanced, more operators with better technological expertise are required. Regional systems are better able to accommodate this expanded need.

Recommendations

10.1 The Province of Manitoba should do more to promote and facilitate regionalization of wastewater treatment systems.

10.2 Options for regionalization need to be fully explored by the proponent prior to receiving funding through the Manitoba Water Services Board.

10.3 Comprehensive sewage management plans should be developed for areas of the province where existing sewage treatment practices such as septic fields and holding tanks are releasing excessive nutrients.

11.0 Development of Nutrient Abatement Plans for Large Wastewater Treatment Facilities in Manitoba Communities

Background

In the Manitoba portion of the Lake Winnipeg watershed, the majority of the population is served by large wastewater treatment systems in the cities of Winnipeg, Portage la Prairie, and Brandon. A number of large industrial facilities are also located within Manitoba, including potato processing facilities, meat packaging plants, and pulp and paper operations. Some of these facilities discharge directly into waterways, while others have pre-treatment on site and the wastes are then discharged into community wastewater treatment facilities.

The City of Winnipeg will reduce its phosphorus and nitrogen content in wastewater by 11 per cent phosphorus and 12 per cent nitrogen respectively, by December 31, 2006.[78] This will be accomplished based on nutrient removal at the west end plant and the centrate treatment at the north end plant.[79] The centrate produced at the north end plant is treated further to reduce its nutrient content. Nutrient removal at the south end and north end plants will follow by December 31, 2012 and 2014, respectively. The City's *Environment Act* licence limits require effluent quality of 1 milligram per litre (mg/L) total phosphorus and 15 mg/L total nitrogen.

The City of Winnipeg's sewage treatment plants have an average effluent quality of 3.3 mg/L total phosphorus, and an average total nitrogen of 30 mg/L. The City expects that by December 31, 2014, it will have reduced its phosphorus load to Lake Winnipeg by approximately 65 per cent, and its nitrogen load by 47 per cent.

The City of Brandon is developing a wastewater treatment plan that envisages providing wastewater treatment services including nutrient controls to 1 mg/L phosphorus and 15 mg/L nitrogen for both its municipal and industrial components.

While the *Environment Act* licence issued to City of Portage la Prairie, which includes wastewater treatment from the food processing sector in the city, places limits on the amount of ammonia that may be discharged, there is currently no limit on phosphorus. However, the licence could be re-opened in the future should unacceptable impacts be identified.

In the U.S. portion of the watershed, Fargo and Grand Forks do not have limits set for phosphorus in their effluent discharge, although limits are in place for ammonia.

With respect to large industrial facilities in Manitoba, the Province is requiring effluent limits of 1 mg/L phosphorus and 15 mg/L of nitrogen for any new or expanding industrial facility discharging wastewater to surface water. This would apply to facilities such as an expansion of the Maple Leaf Meats in Brandon. Some of the other large industrial dischargers which currently have some nutrients limits imposed in their licences include Simplot Canada (Brandon), and McCain Foods (Portage la Prairie).

The Lake Winnipeg Stewardship Board recognizes that the priority for nutrient abatement at municipal wastewater treatment systems should be on phosphorus first with nitrogen as a second priority. Many wastewater treatment facilities within the Lake Winnipeg watershed already remove phosphorus and other nutrients from their effluent, including Edmonton, Calgary, Saskatoon, and Regina. The phosphorus limits for these facilities are currently 1 mg/L. Ontario requires phosphorus removal to 1

City of Winipeg north end wastewater treatment plant.

[78] In late November 2006, The City of Winnipeg advised that construction was behind schedule and that an extension would be required.
[79] Centrate is the liquid by-product of dewatering sewage sludge by centrifugal force.

mg/L at municipal and institutional facilities discharging to Lake Erie and tributaries and all recreational waterways. The same limit applies to facilities that discharge more than 4,546 cubic metres per day if they are discharging to Lake Superior and tributaries, Lake Huron and tributaries, Lake Ontario and tributaries, the St. Lawrence basin, and the Ottawa River basin.

Many jurisdictions in the United States, including Minnesota[80], Wisconsin and Illinois, also use phosphorus removal to 1 mg/L as a benchmark for effluent discharge. The European Union requires urban wastewater treatment plants discharging to sensitive areas to meet total phosphorus limits of 1 to 2 mg/L, and in some cases, a limit for total nitrogen of 10 to 15 mg/L, depending on the particular situation.

In setting wastewater effluent nutrient limits for Manitoba, the Province of Manitoba should meet or exceed those established in neighbouring jurisdictions. The Manitoba Nutrient Management Strategy commits to developing water quality objectives for both nitrogen and phosphorus (see Recommendation 4.0 Setting Long-Term Ecologically-Relevant Objectives for Nutrients in Lake Winnipeg). Once completed, it is expected that the relative importance of both these major nutrients in Manitoba's various receiving environments will be reconciled, that long-term, ecologically-relevant water quality objectives for Lake Winnipeg will be set at least for the two major nutrients, and that these objectives will form the basis for nutrient abatement programs. The science is being collected to develop long-term, ecologically-relevant nutrient objectives for Lake Winnipeg. It will be important to determine these objectives to ensure the standards being employed are appropriate to protect Lake Winnipeg.

Land drainage outfall - Red River.

The Manitoba Nutrient Management Strategy needs to consider whether the application of best practicable technology is sufficient for reducing effluent phosphorus concentrations to 1 mg/L. Also, it may be necessary to achieve greater reductions of phosphorus. The plan also needs to consider where nitrogen removal is necessary and if so, to what level.

Recommendations

11.1 The Province of Manitoba should continue to require that nutrient reductions be implemented as quickly as possible at the large municipal and industrial wastewater treatment facilities in the cities of Winnipeg, Portage la Prairie, and Brandon.

11.2 Nutrient reduction strategies for large facilities, such as biological nutrient removal, chemical treatment, effluent irrigation, constructed wetlands, and other proven technologies, need to be evaluated for their effectiveness and practicality given Manitoba conditions and economic circumstances. Source control pollution prevention plans should also be implemented as measures to reduce nutrient input.

11.3 The Province of Manitoba must finalize its Nutrient Management Strategy along with developing a comprehensive prioritized plan for nutrient abatement for all wastewater treatment facilities in the Manitoba portion of the watershed.

11.4 The Province of Manitoba should set limits for nutrient reduction that meet or exceed those in neighbouring jurisdictions, and at levels that are adequate to protect Lake Winnipeg.

11.5 The Lake Winnipeg Stewardship Board recognizes that the priority for nutrient abatement at municipal wastewater treatment systems should be on phosphorus first with nitrogen as a second priority.

[80] Minnesota Pollution Control Agency: http://www.pca.state.mn.us/water/standards/rulechange.html#draftrules#draftrules

12.0 Environmental Planning for Urban, Rural and Cottage Development

Background

There is a need for strong environmental planning for new urban and rural developments. Examples exist where rural and urban expansion has taken place without adequate evaluation of future surface drainage and water and wastewater treatment needs. This has lead to situations where private wastewater treatment systems are failing, and replacement of these systems is problematic due to the small size of the building lots.

An integrated land and water resource planning process should be established within Manitoba that is environmentally conscientious and that ensures planned and orderly growth with respect to land drainage and sewer and water services in new developments. This process would encourage planning, rather than discourage growth. The process should allow for the review of all new developments to ensure water and wastewater treatment services are adequate to protect the environment. The cost of providing these services should be built into the overall costs of the development. It is expected that different strategies for wastewater treatment would be required depending on the local conditions. Further investigation and evaluation is required on new emerging technologies in alternative waste treatment systems. The installation of regional services should be a serious consideration for new rural residential developments.

In rural areas, it will be important to ensure that there is good communication and coordination among conservation districts, planning districts, and the new watershed planning authorities in the development and implementation of such a planning process.

Conventional development generates significantly more stormwater runoff than pre-development conditions due to impermeable driveways, roads, parking lots, and roofs. This prevents infiltration of water into the soil, and causes the runoff of non-point source pollutants. The Lake Winnipeg Stewardship Board is of the opinion that land developers have an important role to play in reducing this form of non-point pollution by employing strategies to reduce runoff from new developments. Directing runoff water into storm water retention ponds is one example. Minimizing soil erosion from new developments should also be considered as a way of preventing the associated nutrients from entering the natural drainage system.

Homeowners, too, can have a positive impact on reducing runoff from developed areas. They should be encouraged implement strategies such as the Wisconsin Rain Garden concept[81] which provides an example of an innovative option for reducing non-point source runoff from urban properties. Roof water is diverted into constructed rain gardens. These garden areas are designed as shallow swales, planted with native species that can tolerate wetter conditions. The gardens are designed so that the water infiltrates into the ground rather than running into storm sewers. Other strategies such as the use of rain barrels, and incorporating more permeable surfaces to facilitate infiltration need to be encouraged.

The Province of Manitoba should encourage and support the "Smart Growth" concept for land-use planning. Smart Growth is an innovative way of thinking about the growth of neighbourhoods, cities, and regions by replacing standard development practices with low impact alternates. The partnership between The Design Centre for Sustainability at the University of British Columbia, the Real Estate Institute of BC, and Smart Growth BC subscribes to the concept of Smart Growth and the benefits of that approach to the community. This partnership describes Smart Growth as a method of preserving and enhancing the quality of life of residents both within and between communities, while minimizing local impacts on the natural environment. The approach is dependent on partnerships between governments, researchers, businesses, and community members.[82]

Shoreline erosion is a concern to Lake Winnipeg cottage owners as well as to other waterfront property owners in Manitoba, primarily as it relates to shoreline loss and the associated impacts on the property. However, the erosion also results in nutrients from the soil being deposited into the water body.

Regulations requiring minimum set-back distances for new developments along shorelines and waterways would help prevent shoreline damage and would assist in retaining vegetative buffer zones along waterways. The Province should consider the application of Water Quality Management Zones as a mechanism to implement such regulations. The Water Quality Management Zones regulations would need to be modified, or other regulations implemented to allow this to take place.

[81] University of Wisconsin - Wisconsin Rain Gardens http://clean-water.uwex.edu/pubs/home.htm#rain
[82] Smart Growth on the Ground - http://www.sgog.bc.ca/content.asp?contentID=10

Recommendations

12.1 The Province of Manitoba and municipalities should establish an integrated land and water resource planning process that is environmentally conscientious, and ensures planned and orderly growth with respect to land drainage and sewer and water services. "Smart Growth" concepts need to be considered for future land use planning.

12.2 The Province of Manitoba should ensure that all rural residential, commercial, industrial, and urban developments are comprehensively reviewed with respect to water and wastewater treatment requirements to protect the environment.

12.3 Developers should be required to include the full-cost recovery expense of installing the required water and wastewater treatment services for new developments and ensure that these are built into the costs of the development.

12.4 There is a need to consider regional wastewater treatment services for new rural residential developments.

12.5 Developers should be responsible for land drainage issues for new residential developments that consider the nutrient impacts of the development, and should build in strategies such as stormwater retention and treatment and erosion control to minimize these impacts.

12.6 Developers of all new urban and rural development projects should be required to incorporate low-impact, environmentally conscientious concepts into the design of the project, with the aim of reducing environmental service costs to minimize pollution loads.

12.7 The Province of Manitoba should consider establishing regulations, such as minimum set-back distances from shorelines for new developments, to prevent significant disturbances which would result in increased erosion along lakes and waterways.

13.0 Stormwater Retention Ponds

Background

Stormwater retention ponds are commonly used in new developments to collect stormwater runoff. The runoff often contains nutrients from lawn fertilizers, pet feces, leaves and grass clippings, and other sources. The cities of Winnipeg and Selkirk, and other communities, use retention ponds to reduce the loading to sewer systems during high rainfall events and periods of spring runoff. Unfortunately, these facilities were not specifically designed to maximize nutrient removal. Many of these ponds are intensively managed to remove aquatic plant growth, including the use of chemicals to reduce algal growth. Some ponds are less intensively managed and the vegetation is left to flourish. Different structural designs may be more effective at removing nutrients than others.

Data needs to be collected to evaluate the effectiveness of existing stormwater ponds, and their varying management practices, in removing nutrients.

Recommendations

13.1 All new stormwater retention ponds should be designed to maximize nutrient retention without compromising stormwater management needs.

13.2 Monitoring should be conducted by the Province of Manitoba to compare managed ponds with unmanaged ponds in their nutrient removal capabilities. Data from other jurisdictions with a similar climate should be collected to help determine the best design and management strategy for nutrient capture under Manitoba conditions.

14.0 Nutrient Abatement Options for Small Wastewater Treatment Facilities

Background

The existing practice of discharging nutrient-rich wastewater effluents directly into surface waters accounts for a relatively large portion of the total load to Lake Winnipeg. This load comes from both small and large industrial and municipal discharges. The smaller wastewater treatment facilities in Manitoba contribute approximately one per cent of the nitrogen and four per cent of the phosphorus load to Lake Winnipeg (tables 4 and 5).

The nutrients from wastewater effluents are readily available (bio-available) for uptake by algae when they reach Lake Winnipeg. Consequently it is desirable to minimize the amount of nutrients being discharged to waterways from municipal and industrial effluents. It is more desirable to have these nutrients recycled onto the land where they can be used for crop production or other vegetative uptake. With nutrient reductions achieved from both large and small facilities, Lake Winnipeg will receive lower amounts of bio-available phosphorus.

Larger cities and large industrial operations are now required to remove nutrients from their effluent as a part of their *Environment Act* licences. However, Manitoba's Nutrient Management Strategy has not yet developed policy on nutrient abatement for small municipal facilities and as a consequence, few small municipal wastewater treatment facilities remove nutrients from their discharge. An exception includes the Falcon Lake lagoon. Some newer facilities, such as the new wastewater treatment plant being built by the Rural Municipality of Gimli and the plant being built at Hecla, will remove phosphorus from the effluent. The Lake Winnipeg Stewardship Board feels that, in general, the status quo is not acceptable, as it is the collective responsibility of all Manitobans and all communities to reduce their impact on the quality of Lake Winnipeg and other waterways in the province.

The Board feels that small municipal and smaller industrial facilities should meet the same standard as those for large municipal and industrial facilities of 1 mg/L of phosphorus. Reducing nitrogen discharges from these facilities may also receive consideration should it be determined that further nitrogen removal is necessary for the health of Lake Winnipeg. To meet these standards, some financial assistance may be required for small facilities that may not have the tax base to support the required infrastructure or operational changes (i.e. consider tax effort). The possible options should be evaluated on a site-specific basis to determine the most cost-effective, practical, appropriate, and sustainable choice for the individual facility.

Recommendation

14.1 Small municipal and smaller industrial facilities should meet the same standard of 1 mg/L of phosphorus as those for large municipal and industrial facilities. Reducing nitrogen discharges from these facilities may also receive consideration should it be determined that further nitrogen removal is necessary for the health of Lake Winnipeg.

The following six recommendations (Recommendations 15 to 20) are related to Recommendation 14 and provide a discussion of various nutrient reduction options that should be considered singly or in combination for each small wastewater treatment facility.

15.0 Option 1: Effluent Irrigation / Land Application of Municipal Effluents

Background

Small, non-regionalized wastewater treatment facilities may find the cost of instituting chemical or biological nutrient removal prohibitive. The choice of what nutrient abatement strategy to employ will be based on many site-specific considerations.

Land application of effluent through irrigation is one option that should be explored for municipal and industrial lagoons. Rather than discharging nutrient-rich effluents from lagoons directly into waterways, it is preferable to retain those nutrients on land where they can be used for plant growth. In addition to the nutrient benefits, many crops would respond favourably to an enhanced water supply. As long as the requirements in the *Environment Act* licence are achieved, effluent irrigation from lagoons should be a safe alternative to the standard practice of releasing nutrients into waterways.

Effluent irrigation is currently being practiced in Manitoba by many Hutterite colonies and other communities. McCain Foods potato processing plant at Carberry has completed a two-year feasibility study that utilizes its effluent to agronomically enhance crop production through irrigation. The nutrient-rich effluent was applied to several crops including potatoes, wheat, and forages. The project has reduced, and in some cases eliminated, the need for inorganic fertilizer inputs for crops under the program.

Effluent irrigation retains nutrients on the land where they can be used for plant growth.

A confounding problem with effluent irrigation occurs when the wastewater contains high levels of sodium. In these instances, careful agronomic management of effluent is required to ensure the salts are not harmful to the crop, or accumulate in the soil. Domestic water is routinely softened with sodium chloride. By replacing the use of sodium chloride with the water softener potassium chloride, sodium problems in irrigation water could be alleviated. In addition, it would be prudent to ensure that chloride levels are also properly managed. California's Water Plan (2005) discusses strategies to recycle municipal wastewater, reduce the use of salt for water softening, and encourages other non-salt softening alternatives such as reverse osmosis.[83]

The cost of purchasing effluent irrigation equipment may be prohibitive for some communities. However, purchasing this equipment for regional use may be more practical. Regionalized use of the equipment would require coordination among the users to ensure that all facilities in the region can dispose of the effluent in a coordinated and timely fashion.

The issue of contaminants from industrial discharges being applied to agricultural land along with human sewage needs to be considered. If industrial or commercial effluents are rendering unsuitable for land application, then consideration should be given to treating those wastes separately to recover contaminants before they are discharged to the environment. For example, the City of Winnipeg has worked with the dental industry to recover mercury instead of it being discharged to the City sewer system and eventually to Lake Winnipeg.

Recommendations

15.1 *Environment Act* licence proposals for municipal lagoons need to comprehensively consider effluent irrigation, or an equivalent treatment process, as a means of effluent disposal.

15.2 Alternatives to the use of sodium chloride is water softeners, such as potassium chloride, should be explored to ensure wastewater is more suitable for land application. Other alternatives to the use of salts for softening water, such as reverse osmosis and magnetic water softeners, should be considered as viable options.

15.3 Consideration should be given to minimizing industrial or commercial contaminants from reaching sewage treatment facilities to ensure effluents are suitable for land application.

[83] California Department of Water Resources. California Water Plan Update 2005. http://www.waterplan.water.ca.gov/cwpu2005/content.html#highlights

16.0 Option 2: Appropriate Lagoon Design, Operation, and Storage Capacity

Background

Lagoon design and operation in Manitoba need to be reviewed to determine what opportunities are available to optimize nutrient removal. Options such as various water depths, and vegetation use need to be explored. In Manitoba, municipal sewage lagoons are generally required to be constructed with sufficient capacity to store wastewater for approximately 220 days. This is currently the case with most older facilities in the province. Some jurisdictions, such as Alberta, require approximately a one-year storage period for municipal sewage lagoons.

An increased storage capacity for municipal sewage lagoons would allow more flexibility with respect to the timing of effluent irrigation from these facilities and would allow for a longer period of natural treatment in the lagoon itself. Increased storage capacity would also provide more resiliency during wet periods, reducing the risk of all-too-frequent emergency discharges. From May 2003 to May 2006, there were more than 70 emergency discharges from lagoons in Manitoba.[84] Some communities required emergency discharges two or three times over that time period.

With increased lagoon capacity, it may also be feasible to allow for a slower discharge (trickle discharge) from these facilities, rather than two high-discharge periods each year, in the spring and fall. By permitting a slow trickle discharge under appropriate conditions and with careful management, there is increased opportunity for the nutrients to enter the soil and be absorbed by growing plants along the discharge route, before the effluent can reach a major waterway. Since vegetative uptake of the nutrients is important, discharges in the manner should be limited to the growing season.

Water conservation practices can significantly reduce the hydraulic load on wastewater treatment systems. Wasting water results in increased consumer costs due to increased wastewater treatment demands, and the need to expand facilities to address hydraulic capacity shortages. By instituting water conservation strategies, many communities may be able to extend the storage capacity time in their existing lagoons.

As an example, the Town of Gimli, prior to its merger with the Rural Municipality of Gimli, was able to reduce its water consumption rate in the town by 30 per cent by instituting a variety of water conservation strategies. These measures included installing meters at private residences as well as water conservation devices on toilets, taps, and showerheads. In addition to reducing water use, the amount of wastewater entering the sewage system from private homes was also reduced. Businesses in the community had been metered prior to this initiative while homes had not been. Flow into the lagoon was further reduced by the municipality by redirecting a portion of its storm drainage from the waste water system to a separate storm drainage system. Also, several old, unused wells were located and sealed to prevent unnecessary flow into the system.

Recommendations

16.1 A review of lagoon design and operation to optimize nutrient removal should be conducted. Nutrient data should be gathered from Manitoba and other jurisdictions with similar climates to determine what benefits may be realized from a longer storage capacity.

16.2 The Province of Manitoba should explore the option of ensuring that there is an appropriate storage capacity for new and expanded lagoons as a strategy to greatly reduce emergency discharges, and also to give increased resiliency to permit other effluent disposal approaches, fpr example, trickle discharge. Water conservation strategies will assist municipalities in realizing this increased storage capacity (see Recommendation 9: Water Use Efficiency).

16.3 Those communities with repeated emergency discharges of effluent from their sewage storage lagoons should be required to immediately develop strategies, such as increased lagoon capacity, to eliminate these emergency discharges.

[84] Data provided by Manitoba Conservation, 2006.

17.0 Option 3: Constructed/Engineered Wetlands

Background

A constructed, or engineered, wetland is a man-made marsh designed to receive and purify wastewater from sources such as livestock facilities, industrial operations, or municipal wastewater treatment facilities. The use of constructed wetlands as a nutrient abatement option for wastewater shows promise. Constructed wetlands have been used successfully in Manitoba and elsewhere to reduce nutrient levels in municipal and industrial effluents, as well as in runoff from confined livestock areas. Examples of constructed wetlands in Manitoba include facilities at Roblin, Oak Hammock Marsh, Fort Whyte Centre, and livestock operations in the Interlake. Many jurisdictions in Ontario use engineered wetlands to meet stringent nutrient limits for municipal wastewater treatment facilities.

A constructed wetland in Manitoba's Interlake.

Constructed wetlands can serve as nutrient sinks, that is, they absorb nutrients. These nutrients are taken up and stored by plant material growing in the wetland. There is a need to further investigate and evaluate the effectiveness of constructed wetlands under Manitoba conditions. There is some uncertainty whether these systems, like natural wetlands, may produce a pulse release of dissolved nutrients in the spring from dead and decaying plant material.

The issue of harvesting the wetland plants with their nutrient stores, and disposal of the harvested material also needs to be investigated. Some research suggests harvesting the vegetation in the wetland may not be necessary, and the decayed vegetation may actually enhance nutrient retention in the wetland.

Recommendation

17.1 The Province of Manitoba should undertake a focused review of the effectiveness and appropriateness of using engineered wetlands as a nutrient abatement option for small wastewater treatment facilities.

18.0 Option 4: Chemical Treatment of Lagoons (e.g. Alum, Ferric Salts, Magnesium Salts etc.).

Background

Alum and other related products have been used successfully to reduce phosphorus in wastewater treatment facilities, both in wastewater treatment plants and lagoon systems. But it should be noted that it is not practical to consider chemical treatment for a lake as large as Lake Winnipeg. In addition to the practicality issue, there would be concern over the impact of such a treatment to the ecological integrity of the lake.

When phosphorus management strategies are being investigated, it is important to consider whether or not the treatment technique may inadvertently render the resulting sludge unsuitable for application to agricultural land. In addition to containing high concentrations of nitrogen and phosphorus, wastewater sludge generated with the use of alum will also contain high concentrations of aluminium.

It should be noted that some of these treatment options, such as the use of alum, may render the phosphorus unavailable for plant uptake and therefore prevent these harvested nutrients from being reused on land. Options should be considered where the phosphorus can be reused/recycled onto land.

Recommendation

18.1 A review of the use of alum, ferric salts, and other salts in wastewater treatment should be conducted. This review would evaluate the resultant concentration of salts in the waste sludge and determine whether these levels pose any environmental or health risks. The suitability of applying this type of sludge to land should also be investigated. Those strategies which facilitate the recycling of phosphorus should be favoured over those strategies that immobilize the phosphorus.

19.0 Option 5: Conversion of Lagoons to Wastewater Treatment Plants with Nutrient Removal Capabilities.

Background

Larger communities should consider converting existing lagoon systems to wastewater treatment plants with nutrient removal capability. This is presently the case in the communities of Gimli and Hecla on the west shore of Lake Winnipeg. For example, the Rural Municipality of Gimli, which has recently merged with the former Town of Gimli, is decommissioning its existing lagoon and a mechanical plant in favour of one new regional wastewater treatment plant that will remove phosphorus from its effluent down to 1 mg/L. Wastewater will be treated by a sequencing batch reactor (SBR) treatment plant designed for biological phosphorus removal and ultraviolet disinfection. The treated and disinfected wastewater will be discharged via a forcemain into Lake Winnipeg approximately 400 metres from the shoreline. The resulting biosolids from treatment process will be thickened, and then injected into agricultural land in accordance with an *Environment Act* licence.

The construction of wastewater treatment plants may also be a viable option for communities developing larger regional wastewater treatment plans. Constraints to implementation may be the cost of developing these plants and the need to have qualified staff to operate them. Phosphorus removed by these plants should be recycled/reused.

Recommendation

19.1 The Province of Manitoba and rural municipalities should consider the conversion of lagoons to wastewater treatment plants with nutrient removal capabilities, perhaps through the development of regional wastewater treatment facilities. Larger communities may want to consider the option of converting their lagoons to wastewater treatment plants with nutrient removal capabilities on their own.

20.0 Option 6: Other Innovative Approaches that will Achieve Nutrient Reduction.

Background

Alternative and new emerging technologies for nutrient reduction that may be environmentally and economically viable for Manitoba communities should receive support from governments.[85] For example, composting toilets may be an attractive alternative for homes, businesses, and community facilities whose existing septic fields are overloaded or not functioning adequately. Another example is a compressed peat moss septic system being used in some communities in Canada. The system appears to be effective in treating septage and is suitable for isolated communities such as cottage developments and First Nations communities. The system is similar to a conventional septic field system, but the field is filled with sphagnum peat moss to act as a filter. The effluent may then percolate into the subsoil or be directed into a constructed wetland for further treatment.

The matter of exploring new emerging technologies for Manitoba should be referred to an agency that can recommend appropriate new technologies for small wastewater treatment systems. The availability of these technologies should be communicated to communities and incentives should be provided to those developing, distributing, and purchasing these technologies.

Recommendation

20.1 The Province of Manitoba and Government of Canada should explore, encourage, and support innovative emerging technologies that will result in reducing nutrients in effluent in an environmentally sensitive manner.

[85] Joy, Douglas, Claude Weil, Anna Crolla, and Shelly Bonte-Gelok. February 2001.Published on the National Research Council Research Press website.

21.0 Environmental Licensing Fees and Environmental Review Process for Small Wastewater Treatment Facilities.

Background

The Board is aware of circumstances where existing environmental licensing fees may have served as an impediment to improving wastewater treatment systems. For example, many municipalities have an *Environment Act* licence permitting them to dispose of sewage sludge in a landfill. However, if a municipality wishes to apply the sludge in an agronomic and more environmentally practical way to agricultural land, a new *Environment Act* proposal and licence may be required. The combined cost of the licence and a consultant to prepare the proposal may be significant. When innovative nutrient removal technologies for wastewater are deemed beneficial, opportunities to expedite the regulatory review process should be explored.

Recommendations

21.1 The Province of Manitoba should seek opportunities to reduce the financial disincentives to those proponents voluntarily improving their waste management practices such that the risk of nutrients and other contaminants reaching surface water is reduced. The Province should consider establishing a fund, perhaps within an existing program such as the Sustainable Development Innovation Fund or the Manitoba Water Services Board, that would be directed towards reimbursing proponents for the cost of the environmental licensing fee, where a demonstrated improvement to the environment is realized.

21.2 Proponents applying for an *Environment Act* licence for a new or upgraded municipal lagoon should be required to evaluate alternative wastewater treatment technologies which recycle nutrients as a method of effluent disposal, such as effluent irrigation, which involve zero discharge.

21.3 Where it has been demonstrated that innovative nutrient removal technologies for wastewater are deemed beneficial, opportunities to expedite the regulatory review process should be explored.

22.0 Leachate Handling

Background

Leachate collected from municipal solid waste disposal facilities usually has strong organic content and may also contain a wide range of potentially hazardous substances such as heavy metals, pesticides, solvents, and pharmaceuticals. Currently, leachate collected from solid waste facilities is transported to sewage treatment facilities for treatment. The high strength of this waste requires that its introduction to the sewage treatment system be managed carefully to prevent upsets in the biological processes in the system, therefore degrade the effluent quality. The toxic nature of some leachate constituents may make sewage sludge less desirable for land application, thereby precluding its use as a valuable source of nutrients for growing crops.

It is essential that this material be handled and disposed of in an environmentally sound manner. The amount of toxic substances from being disposed of in landfills needs to be substantially reduced.

Recommendations

22.1 The Province of Manitoba should evaluate options to remove leachate from domestic wastewater treatment systems such as establishing a dedicated leachate treatment facility within the province. Priority should be given to dealing with leachate which is of poorest quality and highest quantity.

22.2 To minimize the amount of toxic substances collected in landfill leachate, the Province of Manitoba should expand opportunities for the public to safely and conveniently recycle and dispose of toxic substances.

23.0 Nutrient Management Issues on First Nations Communities

Background

Many First Nations communities in Manitoba do not have adequate levels of water and sewage treatment. Not only does this pose a public health concern, it also results in nitrogen and phosphorus losses to the environment from these communities. There are circumstances where First Nations and non-First Nations communities located adjacent to each other each has its own treatment facility where one system could function to serve both communities. Other sources of nutrient losses from these communities include stormwater runoff.

Since First Nations lands fall under the responsibility of the federal government, provincial agricultural management regulations and watershed management planning activities do not involve or regulate activities on First Nations lands. There is a need to review what federal regulations apply to First Nations land, and the degree to which those regulations are adequate and enforced. This could involve a task force consisting of First Nations, federal, and provincial representation. The task force would consider all activities that have a potential water quality impact. To protect water quality, federal environmental standards and guidelines for First Nations communities should meet provincial standards as a minimum.

Water sampling at Black River First Nation.

Recommendations

23.1 Sewage treatment on First Nations communities must be upgraded to meet both public health and environmental standards. As a minimum, federal standards for First Nations communities should match provincial standards. Nutrient control strategies should be considered for all new and upgraded wastewater treatment facilities.

23.2 Immediate action needs to be taken to remedy malfunctioning or non-existent waste management systems in First Nations communities, and to address the problem of sewage disposal. Alternative waste management systems such as composting systems, semi-compressed peat moss systems, and constructed wetlands need to be explored.

23.3 Nutrient management strategies which evaluate the sources of nutrient losses, and identify opportunities to reduce or eliminate these losses should be developed in collaboration with First Nations communities. These strategies should include a strong educational component.

23.4 The Province of Manitoba should work towards ensuring that sewage treatment and disposal standards are consistent across the province, including those regulating First Nations and northern communities.

23.5 Where there are First Nations and non-First Nations communities located adjacent to one another, regional cooperation for sewer and water services across jurisdictional boundaries needs to be developed between the governments of Manitoba and Canada.

23.6 Senior levels of government should provide adequate levels of funding within their respective jurisdictional responsibilities to support education, training, and resourcing to ensure that waste treatment facilities in First Nations communities are properly maintained and operated.

23.7 Federal and provincial governments should work with First Nations communities to review the environmental regulations that apply to First Nations land, the extent to which those regulations minimize nutrient loading, and the degree to which they are enforced. Federal environmental standards and guidelines for First Nations communities should meet provincial standards as a minimum.

24.0 Septic Field Maintenance and Alternatives to Septic Fields

Background

There is concern that septic fields in many regions of the Lake Winnipeg watershed are not functioning adequately. Even in cases where they continue to function as designed, septic fields are simply not an appropriate technology for containing and treating wastes in high-density communities. Septic systems located in heavy clay soils may eventually become saturated, leading to overland flow of waste into drainage ditches. Where there is little soil above bedrock, such as in some areas of the Whiteshell, preferential flow along bedrock may carry nutrient and pathogens directly into watercourses. In areas of concentrated rural residential development where lot sizes are relatively small, septic systems may not be the most appropriate waste treatment strategy.

While proper maintenance can extend the life of a septic field, septic fields will not function indefinitely and will ultimately require replacement. Many septic fields in this province have reached that point. In addition, many fields are undersized as homes and cottages may have been expanded in size and water consumption increased since the fields were originally installed.

Measures need to be taken to prevent ecological disasters from occurring as a result of septic systems located over sensitive aquifers. The accumulative impact of septic fields in rural residential developments also needs to be considered. Development along the Winnipeg-Selkirk corridor serves as an example. Currently, "boil water" orders are a regular occurrence in this area, largely due to septic fields contaminating wells, which in turn are contaminating groundwater supplies. These areas need special attention, and the installation of regional wastewater treatment facilities must receive priority in these situations. During the period from July 2000 to August 2006, 52 "boil water" advisories were issued in Manitoba, including the communities of Ile de Chene, Victoria Beach, and St. Lazare, as examples.[86]

Consideration should be given to a wide range of septic management strategies including incentives for implementing alternative waste treatment systems that reduce nutrient loading such as composting systems and biofilters including semi-compressed peat moss treatment systems and constructed mini-wetlands. The option of separating greywater from blackwater, and the reuse of greywater should be explored.

The Province of Manitoba should consider instituting mandatory inspections of sewage treatment systems for all private properties before the property can be sold. It would be a good investment for the buyer and a good investment for the environment. This could be considered similar to safety check and the sale of the house, vacation property, or small business, for example, would be conditional on a properly functioning system.

Resources for inspecting existing septic fields are limited and the inspections are often complaint-driven. An annual levy could be collected from septic field owners which would help pay for comprehensive inspections and maintenance of the database.

Recommendations

24.1 A focused educational campaign should be undertaken to provide guidance to homeowners on how to properly maintain septic fields, and how to recognize when they are failing.

24.2 The Province of Manitoba should consider mandatory inspection of private sewage treatment systems at the time of sale. The seller would pay for the inspection, and the sale of the property would be conditional on a properly functioning system.

24.3 The Province of Manitoba should explore the option of instituting an annual levy to recover the costs of conducting an ongoing comprehensive septic field inspection program, and maintaining a septic field database.

24.4 There is a need to implement regional sewage treatment plants with nutrient removal capabilities, prioritizing areas such as those with high rural residential density, and those with close proximity to waterbodies and aquifers.

24.5 Where regionalization of sewage treatment is not feasible, or as an interim measure until regionalization is practicable, alternatives to septic fields should be explored.

[86] Source: Manitoba Water Stewardship data.

25.0 Management of Domestic Septage and Greywater

Background

The content of facilities such as septic tanks and pit privies is called septage. Septage contains large quantities of nitrogen and phosphorus. When septage is added to a wastewater treatment facility incorrectly, it can overload the system and cause the release of unusually high concentrations of nitrogen and phosphorus from the system into the receiving watercourse. Septage needs to be added to sewage plants slowly to ensure proper treatment of the waste.

Illegal dumping of septage, directly into the sewer network leading to the waste treatment facility for example, can also overload the treatment process. In addition, septage illegally disposed of into ditches or streams can be washed into the drainage network leading into major watercourses. There needs to be a focused educational program aimed at those who generate septage and septage haulers regarding the impact of improper disposal of septage. It is important that there is adequate enforcement to ensure illegal dumping is eliminated.

Greywater is household wastewater not associated with human sewage. Sources of greywater include kitchen, laundry, and bathroom sinks, and showers. Some of these sources may not be appropriate if the greywater is to be used. The phosphorus content of greywater will vary depending upon the amount of phosphorus-based cleaning products being used. Large amounts greywater often cause overloading of failing septic fields.

Winnipeg Beach sewage lagoon.

Using greywater is an option that needs further investigation. Reusing greywater would reduce the risk of break–out from overloaded leaking septic systems and the resulting loss of nutrient-rich wastewater to downstream waterbodies. Potential health risk issues associated with the re-use of greywater need to be fully explored. There may be some opportunities to use greywater for activities such as lawn watering.

Options for safe recycling of the nutrients in septage and greywater need to be considered by the Province of Manitoba.

Recommendations

25.1 The Province of Manitoba should develop a strategy for handling septage and greywater in an economic and environmentally sensitive manner, in consideration of potential health issues. This should include options for handling these wastes within existing wastewater treatment facilities, as well as the option of controlled and managed land application of this waste.

25.2 Efforts to prevent illegal disposal of septage in ditches or other inappropriate locations must be strengthened.

25.3 The Province of Manitoba should undertake a review of septage and greywater use being employed in other jurisdictions to assess its feasibility for Manitoba conditions.

26.0 Manitoba Water Services Board

Background

The Manitoba Water Services Board is a provincial Crown corporation that provides technical and financial assistance to municipalities and water cooperatives to develop safe and sustainable water and sewage treatment facilities. The Board's primary objectives are to ensure that public health and environmental concerns are alleviated and to ensure the sustainability of rural communities. The Board also provides technical and financial assistance to rural residents to obtain safe drinking water through the development of regional water systems and rural pipelines. The Lake Winnipeg Stewardship Board recognizes the leading role of the Manitoba Water Services Board in funding sewer and water infrastructure.

The Manitoba Water Services Board prioritizes project requests for assistance, and subject to the availability of funds and approvals, enters into agreements with municipalities or water cooperatives. The Board acts as project manager on behalf of the municipalities, to procure all services for the installation of infrastructure works including the hiring of private engineering consultants for design, and the tendering and awarding of contracts. The Board takes into account engineering feasibility, legal requirements, capital and operating costs, development plans for the area and the unique requirements of the community.

It is recognized that nutrient removal upgrades for municipal facilities will require considerable expenditures of funds. Current funding is insufficient to assist all the communities that require sewage treatment upgrades. There is a need for increased funding for wastewater treatment and nutrient removal with emphasize on phosphorus removal first. Municipalities need to work together more cooperatively to develop regional wastewater treatment facilities with nutrient removal capabilities.

Recommendations

26.1 The Province of Manitoba needs to ensure funding of sewage treatment works through the Manitoba Water Services Board supports the commitments in the Lake Winnipeg Action Plan, and complements the funding principles identified in Recommendation 8.4 of this report.

26.2 The Province of Manitoba is urged to review and revise existing funding criteria used by the Manitoba Water Services Board to include environmental protection, specifically to meet the goals of the Lake Winnipeg Action Plan nutrient reduction.

26.3 The Province of Manitoba, through the Manitoba Water Services Board should accelerate the development of regional wastewater treatment facilities.

27.0 Phosphoric Acid Use in Water Supplies

Background

Many cities and communities in the Lake Winnipeg watershed, including the cities of Winnipeg and Portage la Prairie, use phosphoric acid to coat the inner lining of drinking water distribution lines to prevent lead from leaching into the water. For example, each year the City of Winnipeg uses approximately 57 tonnes of phosphorus (as phosphoric acid). Although a large proportion of the phosphorus is retained either in the water distribution lines or removed at the wastewater treatment systems, some is ultimately discharged to Lake Winnipeg. Alternatives to phosphoric acid such as sodium silicate, potassium silicate, or carbon dioxide are being used by other cities who are also concerned about lead levels in water supplies.

It is currently unknown how many communities in Manitoba are using phosphorus-based lead control strategies.

Recommendation

27.1 The Province of Manitoba should initiate a project to identify the number of communities in Manitoba, in addition to Winnipeg and Portage la Prairie, that are using phosphorus-based strategies for lead control in water mains and in collaboration with each community, determine the amount of phosphorus lost to receiving water. This evaluation should consider phosphorus removal plans being implemented for these wastewater treatment facilities, and examine alternatives to phosphoric acid.

28.0 Phosphorus Content in Cleaning Supplies

Background

In 1972, the *Canada Water Act* placed a limit on the proportion of phosphates in laundry detergents, allowing no more than five per cent phosphates by weight. In 1989 the Government of Canada passed legislation further restricting the concentration of phosphorus in laundry detergents. These new regulations limited the concentration of phosphorus in laundry detergents to five percent by weight expressed as phosphorus pentoxide or 2.2 per cent by weight expressed as elemental phosphorus.[87] Currently, there are no regulations restricting phosphorus content in other household, commercial, or industrial cleaning products in Canada. A clear understanding of the amount of phosphorus in many commercial and industrial cleaning products is currently lacking.

Phosphorus loading encourages algal growth in the lake.

Dishwasher detergents have phosphate content ranging from zero to 8.7 per cent.[88] Phosphorus load from dishwashers is a significant source of phosphorus to treatment plants and to septic fields. Many lake-front cottages now have dishwashers, and this may be a significant source of phosphorus loading from these septic systems. In March 2006, Washington became the first state in the United States to adopt restrictions on the amount of phosphorus in dishwashing detergents. The law will be effective state-wide in July 2010. The law prohibits sale or distribution of dishwashing detergent that contains more than 0.5 percent phosphorus by weight. It is important to ensure that any phosphorus substitutions do not pose other environmental risks.

Recommendation

28.1 Manitoba Water Stewardship should raise the issue of the lack of regulation controlling phosphorus content in cleaning products, such as dishwashing detergents, with the Canadian Council of Ministers of the Environment with a view to having the Government of Canada restrict the phosphorus content in those cleaning products currently not regulated.

[82] Environment Canada. http://lois.justice.gc.ca/en/C-15.31/SOR-89-501/68966.html
[83] Organization for the Assabet River: www.assabetriver.org/nutrient/detergents.html

29.0 Nutrient Loss from Confined Livestock Areas and Over-Wintering Sites

Background

Livestock manure is a significant source of phosphorus in the environment. Throughout agricultural Manitoba, nutrients from livestock manure are lost from confined areas such as feedlots and wintering sites. During spring runoff and summer precipitation events, water running through these areas can pick up and transport substantial quantities of nitrogen and phosphorus. The risk of nutrient transport to surface waters is higher where land is sloped and the soils provide poor infiltration. In addition, the runoff from these sites may also contain other contaminants such as pathogens (*e.g., Escherichia coli* O157) and livestock pharmaceuticals.

Runoff through confined livestock areas can pick up nutrients and pathogens.

Producers operating livestock wintering sites are encouraged to implement beneficial management practices designed to mitigate the potential impacts of their operations on the environment. Financial incentives for implementing many beneficial management practices are available through the Canada-Manitoba Farm Stewardship Program.

Projects that are currently considered eligible include:

- Shelterbelts, portable shelters and windbreaks
- Mobile watering systems
- Field access improvements
- Fence modifications
- Improved manure storage and handling
- Manure treatment (dewatering, composting, or other nutrient recovery strategies)
- Upstream diversion around farmyards and downstream protection (e.g. catch basins, retention ponds, constructed wetlands)
- Relocation of livestock facilities
- Improved on-farm storage, handling and disposal of agricultural waste
- Nutrient recovery strategies from wastewater

These measures should help reduce nutrient loss to waterways, and eventually Lake Winnipeg. However, future evaluation of beneficial management practices will help further define the most effective mitigation strategies (see Recommendation 33.0).

Recommendations

29.1 Drainage from confined livestock areas should be directed to retention basins, grassed buffer strips, or constructed wetlands, or other generally recommended nutrient reduction practices should be employed.

29.2 Where possible, holding areas and wintering areas for livestock should be used on a rotational basis to prevent a build-up of nutrients in the soil. Otherwise, manure accumulated in confined holding areas should be regularly removed and applied to crop or pasture lands at agronomic rates.

29.3 Legislation should be reviewed and revised where appropriate to ensure that new or expanded confined livestock operations are constructed and operated in such a way as to minimize nutrient loss to the environment.

29.4 Governments should intensify their own agriculture extension programs (such as those offered by Manitoba Agriculture, Food and Rural Initiatives), as well as those delivered in partnership with other programs, to help producers assess the environmental risk of their operations, and to provide advice on how to prevent the contamination of groundwater and surface water.

30.0 Livestock Access to Riparian Areas and Waterways

Background

Allowing livestock direct access to streams and other water bodies results in the direct deposition of manure and related nutrients into the water. Moreover, when shoreline vegetation is trampled, slumping of banks is increased, and erosion of nutrients from the shoreline into the watercourse occurs.

Controlled livestock access to riparian zones allows the natural vegetation to stabilize the shoreline and reduce erosion. It may be possible to harvest the natural vegetation, while still maintaining enough vegetation to prevent erosion and serve as a riparian buffer zone. Furthermore, research has demonstrated that animal health and weight gain is improved for those provided with clean off-site water compared to animals that have direct access to natural waterways or dugouts. One study reports that clean water produced 23 per cent greater weight gains for yearlings compared with direct access to dugouts or ponds.[89]

It is clear that the practice of the feeding of livestock on frozen waterways poses an unnecessary environmental risk. Manure accumulated on the ice or adjacent shoreline over the winter is washed away with the spring runoff, contributing nutrients and pathogens to the water. Legislation currently prohibits livestock wintering areas within 100 metres of any surface water source, but the practice still occurs.

Many financial and educational programs are available to producers to provide alternatives for livestock using streams, rivers, lakes, and potholes as watering sources. Though many of these incentives have been available for a number of years and much work has already been accomplished in these areas, it is imperative these programs continue to be available to both new and established livestock producers in the future. These include the Riparian Health Council, Riparian Tax Credits, the Riparian Stewardship Program, Environmental Goods & Services pilot project, work through conservation districts and the Stuartburn-Piney Agricultural Development Association, and the Canada Manitoba Farm Stewardship Program.

Solar-powered pumping systems allow producers to water cattle away from the stream.

Examples of some of the beneficial management practices producers are adopting with funding or tax credits include:

- Remote watering systems
- Buffer establishment
- Fencing to manage grazing and improve riparian condition/function
- Native rangeland restoration or establishment
- Grazing management in surrounding uplands
- Improved stream crossings
- Riparian health assessment consultative services
- Grazing management planning consultative services
- Relocation of livestock facilities away from riparian areas

Although there is a variety of funding programs available, the Lake Winnipeg Stewardship Board recognizes that compared to the cost of implementation of these measures, the financial incentives to do so are often small.

Recommendations

30.1 The enforcement of the prohibition of winter feeding of livestock on frozen lakes, rivers, and other waterbodies should receive more attention.

30.2 Livestock producers should be encouraged through enhanced incentives, education, and when required, regulations to implement measures to protect riparian areas and waterways, such as managing livestock access in riparian areas and providing off-site watering structures.

[89] Fitch, L., Admas, B., and O'Shaughnessy, K. 2003. Caring for the green zone: Riparian areas and grazing management - Third Edition. Lethbridge, AB. Cows and Fish Program. http://www.cowsandfish.org/pdfs/greenzone3rd/greenzone3rd.pdf (verified 2004/01/06)

31.0 Soil Fertility and Manure Testing

Background

Loss of nitrogen and phosphorus from agricultural land is a significant source of nutrient loading to Lake Winnipeg. The movement of these plant nutrients from agricultural land into waterways may arise from a variety of sources and mechanisms. These include the field application of manure and synthetic fertilizers in excess of agricultural requirements, wind erosion, and the transport of sediment-bound nutrients and dissolved nutrients during high rainfall events and spring runoff.

Annual soil testing allows producers to make sound agronomic, economic, and environmental decisions. Soil testing can ensure that nutrient application rates, whether synthetic fertilizer or animal manure, are appropriate for crop needs and based on the amount of nutrients already in the soil. Economically, soil test results may provide a producer with enough information to save money by avoiding expenditures on fertilizer that is not required. Environmentally, when fertilizers are applied at rates greater than agronomic requirements – that is, more than the crop is able to use – the potential for nutrient loss to the environment increases.

Some producers soil test all their fields every year. This allows these producers to monitor soil nutrient levels on a continuous basis and adjust application rates accordingly. Manitoba Agriculture, Food and Rural Initiatives reports that 26 per cent of producers soil test every year, 27 per cent every two to three years, 22 per cent every four years, and 25 per cent never test.[90] However, even those producers who soil test annually may not be testing the entire farm, but only a few fields of particular interest. Consequently, the number of individual fields that are tested every year is likely considerably lower than 26 per cent.

It is important to ensure that nutrient application recommendations based on soil test results are determined by appropriate analytical methods conducted by accredited laboratories. Currently, test methods vary in laboratories providing service to Manitoba producers. In addition, test results and associated recommendations produced by laboratories should be user-friendly and easy to interpret to allow the producer to use the information properly. It is important that the best available agronomic and environmental advice be provided to Manitoba producers to allow them to make the proper choices.

Both livestock manure and synthetic fertilizers contain nutrients essential to crop growth. Although the amount of each nutrient contained in synthetic fertilizers is a known quantity, the content of phosphorus and nitrogen in manure will vary depending upon the type of animal and factors such as feed intake, housing, environmental conditions, and manure management system. Therefore, testing the manure is necessary to determine its nutrient concentration. Moreover, different forms of manure (solid vs. liquid manure, for example) have different rates of nutrient release. More research is needed on the differences in nutrient availability for different types of livestock manures.

Under Manitoba's *Livestock Manure and Mortalities Management Regulation*, all producers with 300 or more animal units (based on individual species) must sample both manure and proposed spread fields for nitrogen levels. Only then are they allowed to apply the manure at a rate which will allow the nitrogen to be removed by future crops. Regulations are expected in the future to require producers to manage not only soil nitrogen levels but also soil phosphorus levels.

Producers should be encouraged to test both their soils and livestock manure on a regular basis. The agronomic, economic, and environmental benefits of proper testing should be promoted.

Annual soil testing allows producers to make sound agronomic, economic, and environmental decisions.

[90] "Test Your Soil – So the nutrients you apply match the nutrients your crop needs", a brochure produced by Manitoba Agriculture, Food and Rural Initiatives, 2003.

Recommendations

31.1 Additional strategies that promote and support annual soil testing must be developed to provide producers with the tools necessary to make sound agronomic, economic, and environmental decisions.

31.2 Incentives for producers conducting soil testing and manure testing should be considered.

31.3 The Province of Manitoba should ensure that soil test laboratories are accredited, and are using accredited analytical methods, and that fertilizer recommendations are accurate and appropriate for Manitoba soil, crop, and climatic conditions.

31.4 Soil testing laboratories should ensure that their soil and manure test recommendations and reports are user-friendly and informative to producers.

31.5 Additional research is needed to understand the difference in nutrient availability for different types of livestock manures (for example, liquid versus solid).

31.6 Enhanced education on the economic and environmental benefits of soil and manure testing is required.

When fertilizers are applied at rates greater than the crop is able to use, the potential for nutrient loss to the environment increases.

The content of phosphorus and nitrogen in manure will vary depending upon the type of animal and other factors.

32.0 Matching Nutrient Inputs with Crop Nutrient Requirements and Exports, and Establishing Soil Phosphorus Limits

Background

Matching nutrient inputs, whether livestock manure or synthetic fertilizer, with crop requirements will help to reduce the amount of nitrogen and phosphorus lost to the environment.

Livestock manure is recognized as an important crop nutrient source but it must be applied at appropriate rates. Currently, manure application rates in Manitoba are regulated based on crop nitrogen requirements alone. However, the ratio of phosphorus to nitrogen removed by crops is lower than the phosphorus to nitrogen ratio in manure. Therefore, when only the nitrogen content of the manure is considered when determining application rates, phosphorus is often applied at rates that exceed agronomic requirements. A build-up of phosphorus in the soil can lead to soil phosphorus saturation and the subsequent release of phosphorus when water travels through, or over, the soil.

Estimates of manure production in Manitoba indicate that cattle and pigs supply most of the 25,000 tonnes of manure phosphorus produced annually, of which nearly 70 per cent is produced by cattle.[91] The average total phosphorus output by a pig ranges from 0.005 kilograms per day to 0.039 kg/day, depending primarily on the size of the animal.[92] Beef cattle phosphorus outputs range from 0.052 kg/day to 0.124 kg/day, again related to the size of the animal.[93]

With the expansion of the livestock industry in Manitoba, there has been a corresponding increase in the amount of organic fertilizer (manure) produced. In Manitoba, 7.9 million pigs were placed on the market in 2005.[94] As of July 1, 2006, there were an estimated 1.7 million cattle in Manitoba.[95]

Intensive livestock production in Manitoba tends to be concentrated in certain locales. In these regions, the import of large quantities of animal feed (which contains nutrients) results in a substantial accumulation of nitrogen and phosphorus in the region.[96] As a result, production and application of manure phosphorus exceeds the rate of crop removal of phosphorus from the land base in some situations.[97] Conversely, other areas of the province have nutrient-poor soils and could benefit from increased use of organic fertilizers.

However, manures contain relatively small amounts of nutrients per volume when compared to synthetic fertilizers. Consequently, transporting manure to these nutrient-poor areas is generally not an economical option. More practical options for manure management in these situations need to be developed.

The amount of land required for spreading livestock manure from a particular operation varies widely depending upon several factors. First, the type of animals – whether pigs, dairy cows, or beef cattle, for example – and the manure management system use by the producer are factors. Different crops have different rates of nutrient uptake, and may favour one nutrient over another. Soil types and topography affect how much manure may be applied to the land. The nutrient characteristics of the manure and the residual nutrient levels in the soil are important parts of the formula. In effect, each situation has its own unique conditions when considering application rates of livestock manure.

In September 2002, the Manitoba Minister of Conservation established the Manitoba Phosphorus Expert Committee to examine the issues surrounding phosphorus and livestock manure. In its January 2006 report[98], the Committee concluded that the focus for regulating phosphorus in Manitoba should be to minimize the risk of phosphorus loss to surface water by reducing excessive phosphorus loading onto land and minimizing the mobilization and delivery of phosphorus to water.

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[91] Flaten, D., Snelgrove, K., Halket, I., Buckley, K., Penn, G., Akinremi, W., Wiebe, B., and Tyrchniewicz, E. Acceptable phosphorus concentrations in soils and impact on the risk of phosphorus transfer from manure amended soils to surface water. Phase 1 report to the Manitoba Livestock Manure Management Initiative, May 1, 2003.

[92] Manitoba Agriculture, Food and Rural Initiatives. Farm Practices Guidelines for Hog Producers in Manitoba.

[93] Manitoba Agriculture, Food and Rural Initiatives. Farm Practices Guidelines for Beef Producers in Manitoba.

[94] Canadian Pork Council Statistics. Hogs marketed by province, 1984 – 2005.

[95] Statistics Canada, Agriculture Division, Cattle Statistics 2006.

[96] Nicolas, L., Small, D., Racz, G., Abbott, D., Hodgkinson, D., Liu, C., and Warkentine, G. 2002. Study of Regional Nutrient Balances in Four Municipalities in Manitoba. A report to the Manitoba Livestock Manure Management Initiative Inc.

[97] Salvano, Esther, Tyrchniewicz, E, and Flaten, D. March 2004. Acceptable phosphorus concentrations in soils and impact on the risk of phosphorus transfer from manure amended soils to surface waters. Phase 2 report to the Manitoba Livestock Manure Management Initiative.

[98] Recommendations for Regulating Phosphorus from Livestock Operations in Manitoba, Final report by the Manitoba Phosphorus Expert Committee to the Manitoba Minister of Conservation, January 2006.

The Committee also indicated, that for planning purposes over the long-term, phosphorus applications need to be balanced with phosphorus removal rates.

The Committee recommended that the most promising approach to regulating the land application of phosphorus is to use soil test phosphorus threshold ranges to trigger a change in management. Four ranges of soil test phosphorus thresholds were proposed and imply an increasing degree of restriction for land application of livestock manure based upon the soil's phosphorus content.[99] In addition, the Committee recommended that research must be supported toward the further refinement of soil phosphorus thresholds for Manitoba. The Committee also recommended the introduction of Special Management Areas, including the Red River Valley and other designated flood plains and land adjacent to lakes, rivers and other water bodies, where the location of intensive livestock operations and the application of livestock manure would be carefully managed to restrict the movement of nutrients to water.

In addition to revisions to the *Livestock Manure and Mortalities Management Regulation*, the *Water Protection Act* creates a framework for managing and protecting water in Manitoba. The first regulation being proposed for development under *The Water Protection Act* is the Nutrient Management Regulation for Water Quality Management Zones which would regulate all phosphorus and nitrogen loadings onto the land, regardless of the source.

About 85 per cent of phosphorus applied to agricultural land comes from synthetic fertilizer. In 2000, over 20 million hectares of cropland across the Prairie provinces received synthetic fertilizers. This compares to just over one million hectares that had manure applied as fertilizer in that same year.[100]

In Manitoba, synthetic fertilizer use has risen substantially over the past three decades. Nitrogen and phosphate application increased from about 25,000 tonnes each in 1965 to 265,000 tonnes of nitrogen and 106,000 tonnes of phosphates (46,000 tonnes of phosphorus) by 2005. Since 2002, phosphorus application rates and removal rates have tracked similar trends, although during this recent period, application rates have been higher than removal rates. (Figure 13).[101,102]

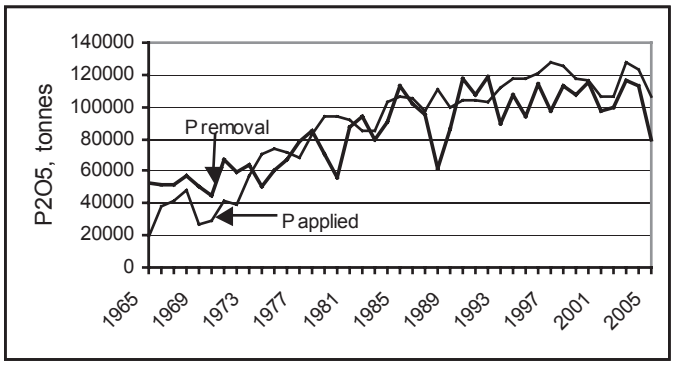

Figure 13: Crop removal and replacement of fertilizer phosphate (P_2O_5) in Manitoba from 1965 to 2005. This data assumes that P_2O_5 is removed in harvested grain and hay, and straw is returned to the soil.[103] Source: Adrian M. Johnston, Ph.D., P.Ag., CCA, President, PPIC - Asia Program Coordinator Northern Great Plains Director, Suite 704 - CN Tower, Saskatoon, SK.

Some Manitoba soils are probably able to accept phosphorus application rates which exceed crop requirements for several years before accumulations become an environmental concern. However, soils do not have an infinite capacity to accept phosphorus without creating environmental hazards.[104] Therefore, it is necessary for Manitoba to develop soil phosphorus limits. Limits would be used by producers and regulators to determine if soil phosphorus levels are below, approaching, or above recommended limits. If the limit for phosphorus is exceeded, the agricultural land should be withdrawn from synthetic fertilizer or manure phosphorus application until soil phosphorus levels return to acceptable levels.

A terrestrial nutrient budget should be developed for Manitoba that would consider all agricultural nutrient sources such as manure, feed, and inorganic fertilizer, as well as all agricultural nutrient exports such as harvested grain, crop residue removal, sales of animals, milk and eggs. It is essential that the terrestrial nutrient balance be considered when intensive operations are being sited and when manure is being applied to agricultural land.

[99] www.gov.mb.ca/conservation/regoperations/livestock/pdf/recommendations_for_regulating_phosphorus_from_livestock_operations_in_manitoba.pdf).

[100] Statistics Canada, 2001 Census of Agriculture, Canadian Statistics, Agriculture, Farms, Applications to the land.

[101] Doyle, P.J. and L.E. Cowell. 1993 Phosphorus. Pp 110-170. In, Impact of macronutrients on crop responses and environmental sustainability on the Canadian prairies. Canadian Society of Soil Science, Ottawa, ON.

[102] Johnston, A. M., and Roberts, T. L., 2001. High soil phosphorus — Is it a problem in Manitoba? Second annual Manitoba Agronomists Conference, 2001, pp.74-82.

[103] Ibid.

[104] Sharpley, A.N., Foy, B., and Withers, P. 2000. Practical and innovative measures for the control of agricultural phosphorus losses to water: an overview. J. Environ. Qual. 29:1-9.

The Province of Manitoba has requested neighbouring jurisdictions to reduce the nitrogen and phosphorus loads in rivers crossing into Manitoba. It is important that Manitoba display leadership to these other jurisdictions by setting regulatory soil phosphorus limits within Manitoba that minimize the risk of phosphorus and nitrogen losses from agricultural lands and thereby, reduce loading to Lake Winnipeg.

Recommendations

32.1 For planning individual livestock operations, the Province of Manitoba should ensure that operators have sufficient land available for new and expanding livestock operations to balance phosphorus application rates with removal rates over the long-term.

32.2 The Province of Manitoba should develop a regional terrestrial nutrient budget for Agro-Manitoba which would assist producers, municipalities, and regulators in siting intensive livestock operations and managing manure in an environmentally sustainable manner.

32.3 Where excess nutrients are being generated, the Province of Manitoba should work with private industry to develop practical options for treating and exporting manure to nutrient-deficient areas.

32.4 The Province of Manitoba should adopt the soil test phosphorus thresholds for agricultural land as recommended by the Manitoba Phosphorus Expert Committee. The Province should also act on the Committee's recommendation to support research which will help to further refine soil phosphorus thresholds for varying Manitoba soil types and landscapes.

33.0 Evaluation of Beneficial Management Practices as Nutrient Reduction Strategies

Background

Beneficial management practices (BMPs) are actions taken by agricultural producers and land managers to minimize negative impacts to the environment while maintaining or improving the quality of water, soil, air, and biodiversity. Beneficial management practices must be practical in application and should not negatively impact the long-term viability of those in the agricultural industry. They must also help ensure the sustainability of resources for agricultural production. Ideally, the effective use of beneficial management practices would benefit both the producer and society-at-large.

The implementation of proven beneficial management practices is an important mechanism for reducing the loss of nutrients from cropland and from lands sustaining livestock. Research has demonstrated that many beneficial management practices are effective at reducing loss of particulate phosphorus (phosphorus attached to soil particles) from land during high rainfall events.[105] However, there is less research demonstrating methods which may reduce dissolved phosphorus (phosphorus in solution) losses during spring runoff. This appears to be the dominant form and process of phosphorus loss in the Canadian Prairies.[106]

The effectiveness of beneficial management practices in trapping particulate nutrients needs to be evaluated, as does the undesirable potential of these practices to retain or release dissolved nutrients to watercourses through the growth and decomposition of plant material, respectively.[107] Evaluations should be conducted for practices such as establishment of riparian vegetation, grassed waterways, conservation tillage, variable rate fertilization, constructed wetlands, shelterbelts, and alternate animal feeding strategies. The practice of crop residue burning should also be evaluated in terms of its implication to nutrient movement off the land.

[105] Sharpley, A.N., Foy, B., and Withers, P. 2000. Practical and innovative measures for the control of agricultural phosphorus losses to water: an overview. J. Environ. Qual. 29:1-9., AND Chambers, B., Garwood, T.W.G., and Unwin, R.J. 2000, Controlling soil water erosion and phosphorus losses from arable land in England and Wales. J. Environ. Qual. 29:145-150.

[106] Wright, C.R., Martin, T.C., Vanderwel, D.S., Amrani, M., Jedrych, A.T., and Anderson, A.M. 2002. Developing phosphorus limits for agricultural lands in Alberta. Alberta Agriculture, Food and Rural Development.

[107] Freeze–Thaw effects on phosphorus loss in runoff from manured and catch-cropped soils; Marianne E. Bechmann,* Peter J. A. Kleinman, Andrew N. Sharpley, and Lou S. Saporito, Journal of Environmental Quality; Vol. 34; Nov-Dec 2005.

More work is needed to evaluate the effectiveness of surface versus subsurface application of manure and other fertilizers at various times of the year, especially in zero till and perennial forage situations. Work is also required to quantify the rates of nutrient transport in water removed by tile drainage and surface drainage. There is a need to balance crop production benefits with strategies to minimize nutrient loss to surface waters. The societal benefits of these practices should be considered when evaluating how to fund such projects.

Not all beneficial management practices will be equally effective in different regions of the province. There is a need to critically review beneficial management practices for their suitability to various soil types and weather conditions. For example, different strategies may be required for the heavy clay soils of the Red River valley as compared to lighter textured soils in portions of the Assiniboine River basin. The proposed work of the Beneficial Management Practices Task Force will be helpful in this area. While some research has been conducted on non-point contamination from agricultural land[108], more needs to be done to understand this issue and to reduce its impact.

The Lake Winnipeg Stewardship Board is proposing that funding be invested into a program that will identify the processes responsible for non-point loading of nutrients into Manitoba's watersheds and to develop, evaluate, and promote nutrient and water management practices that will reduce non-point nutrient loading in an environmentally and economically effective manner.

The proposed program would be a collaborative effort among all three levels of government and interested research, industry, and community organizations, working in partnership with local landowners, as follows:

- The Province of Manitoba needs to substantially increase its investment in the development of expertise within the scientific community in the areas of hydrological and contaminant transport mechanisms at the land - water interface, and to build and support strong, multi-disciplinary teams to address these science needs. (See Recommendation 3.0)
- Federal funding and scientific expertise will also be required from groups such as Agriculture and Agri-Food Canada (Research Branch and the Prairie Farm Rehabilitation Administration), Environment Canada (National Water Research Institute), and Fisheries and Oceans Canada (Freshwater Institute).
- Local conservation districts and soil and water management groups should also play an important role in the development and promotion of beneficial management practices, so that the beneficial management practices are practical for producers and adopted as quickly as possible. Such a cooperative effort has already been established for the Watershed Evaluation of Beneficial Management Practices project in the South Tobacco Creek watershed near Miami, Manitoba, where all of these organizations are already collaborating. However, this type of effort requires intensification, along with expansion into other representative Manitoba landscapes and climates.

Watershed Evaluation of Beneficial Management Practices project in the South Tobacco Creek watershed.

Recommendations

33.1 The Province of Manitoba should lead a partnership effort to determine what beneficial management practices would be practical, economically feasible, and environmentally effective in reducing nutrient loading to the Lake Winnipeg watershed. As a first step, a literature review on the effectiveness of beneficial management practices should be undertaken on existing applicable knowledge. Secondly, these beneficial management practices must be evaluated under Manitoba field conditions.

33.2 For those beneficial management practices that have been proven effective through Manitoba-specific research, the federal and provincial governments should encourage and help fund these practices.

[108] Sheppard, S.C., Sheppard, M.I., Long, J., Sanipelli, B. and Tait J. 2006. Runoff phosphorus retention in vegetated field margins on flat landscapes. Canadian Journal of Soil Science. (in press).

34.0 Nutrient Inputs from Agricultural Tile Drainage

Background

In many regions of Manitoba, agricultural production is limited due to excess soil moisture. Some producers are turning to tile drainage as a strategy to manage excess soil moisture and to enhance agricultural productivity on imperfectly drained or poorly drained soils. The use of tile drainage is also growing in potato-producing regions of the province.

In removing water from the land, tile drainage reduces ponding and surface runoff. However, studies in Manitoba and elsewhere have demonstrated that tile drainage water contains leached nutrients, including environmentally significant concentrations of phosphorus in some cases.[109] It is important to explore measures that reduce the export of these plant nutrients off-site. For example, tile drainage infrastructure should be designed to minimize the export of plant nutrients. Runoff from tile drainage could be directed into retention ponds and reused on the cropland. Also, controlled drainage systems could be employed to manage the amount of nutrient-rich drainage water being removed from the land at critical times of the year.

Currently, tile drainage proponents are required to obtain a permit under the *Water Rights Act*. However, the review of these projects under this *Act* focuses on water quantity issues and does not currently address issues of water quality. It may be necessary to include a water quality monitoring component to these permits to better assess the nutrient load being generated.

Recommendations

34.1 The Province of Manitoba should evaluate the impact of tile drainage on water quality.

34.2 Where feasible, producers should direct tile drainage water into retention basins, held, and reused when supplemental water is required for agricultural land.

34.3 Producers considering tile drainage should investigate new tile drainage systems, such as “controlled drainage”, which regulates the quantity of water removed at different times of the year, so that excess water and the associated nutrients are not removed unnecessarily.

34.4 The process of obtaining a permit for tile drainage should be reviewed with the aim of ensuring that water quality and water quantity issues are considered.

35.0 Drainage of Surface Water from Agricultural Lands

Background

Due to the relatively flat nature of much of the agricultural landscape in Manitoba, extensive drainage networks have been developed over the decades to enhance agricultural productivity by removing excess amounts of water from spring snowmelt and heavy rains. However, the level of service provided by agricultural drainage varies throughout the province. Therefore, producers should select their crops according to the ability of the drainage system to remove standing water from their lands after events such as heavy summer rains. Some fields may be subject to inundation in these circumstances and cannot support certain crops that are susceptible to flooding.

In some instances, water moves out of agricultural regions at rates that pose environmental risk to downstream waterways. As the velocity of water increases, so does its capacity to erode stream banks and streambeds. This water can carry substantial quantities of dissolved nutrients, as well as suspended nutrients bound to soil particles.

[109] Harland, M., Yarotski, J., Braul, L., Shewfelt, B., Miller, T., and Oosterveen, J. 2000. Tile drainage in Manitoba. Pages 207 – 215 In Proc. Manitoba Soil Science Annual Meeting, Jan. 25 – 26, 2000, Winnipeg, MB, and,
Simard, R.R., Beauchemin, S., and Haygarth, P.M. 2000. Potential for preferential pathways of phosphorus transport. J. Environ. Qual. 29:97-105, and
Sims, J.T., Simard, R.R., and Joern, B.C. 1998. Phosphorus losses in agricultural drainage: historical perspective and current research. J. Environ. Qual. 27:277-293.

Addressing drainage issues will be an important part of the Integrated Watershed Management Planning process (see Recommendation 6.0 Integrated Watershed Management Planning). This process would allow for re-evaluation of the drainage network in a particular watershed while planning for both water quantity and water quality management.

Strategies must be developed to ensure that water drained from agricultural land does not flow at rates which impose environmental risks to downstream waterways, while allowing the system to continue serving agricultural needs. Research has demonstrated that by allowing water to slow down, through the use of retention basins for example, substantial amounts of particulate nutrients can settle out before reaching rivers and lakes. Reducing the velocity of the flow will also reduce streambed scouring and streambank erosion.

Strategies must be developed to ensure that water drained from agricultural land does not flow at rates which impose environmental risks, while still allowing the system to serve agricultural needs.

Vegetation growing in and along drainage channels absorbs nutrients from the water and soil. If dead vegetation is allowed to accumulate in the channel, the effectiveness of the drain is reduced and nutrients from the decaying vegetation are released into the water. Nutrient loading from the vegetation in and along drainage channels to the drainage water may be reduced by cutting and removing this vegetation on a regular basis. Although burning vegetation reduces flow restrictions in drainage ditches, burning is not desirable as it results in the phosphorus within the ash to be easily transported downstream.

With the advent of global positioning systems and laser technologies, producers have the capability to design drainage systems with minimal gradients resulting in reduced water velocities and sediment transport.

Recommendations

35.1 Agricultural producers need to consider the capability of the agricultural drainage system serving their fields to remove standing water when selecting crops to plant on that land.

35.2 A review of agricultural land drainage networks on a watershed basis should be undertaken. There is a need to balance damage from flooding with water quality impacts from drainage. This review should explore the feasibility of reducing the velocity of flow in agricultural drains to allow particulate nutrients an opportunity to settle out. The use of nutrient traps or settling basins along drains should be explored to determine their effectiveness in reducing nutrient loading. This work would include a review of the feasibility of acquiring marginal land and developing wetland areas that could serve as natural filters for drain water.

35.3 All drain construction, design, and maintenance practices should be reviewed and guidelines should be developed to minimize nutrient loss to the watercourse. This would include exploring vegetation harvesting opportunities in areas where this is not already done. There is the potential that harvested material could be utilized as animal feed or refined into bio-fuel. Consideration should also be given to using retention basins along surface drains, particularly where irrigation is being employed in the region.

35.4 All drainage projects where water leaves private property, including the drainage of natural wetlands require a permit. Compliance with this requirement should be enforced.

36.0 Natural Wetlands as Nutrient Abatement Options

Background

Natural wetlands may provide significant benefit in reducing nutrients from the landscape. In southern Manitoba, large areas of natural wetlands have been lost to agriculture and urban development. Some estimates place this loss at as much as 40 to 70 per cent of the total since European settlement in the province. The loss of these wetlands has resulted in a corresponding loss of the nutrient-filtering capability and water-holding capacity of the natural landscape.

Wetlands on agricultural land have been drained largely because there are financial disincentives for landowners to maintain these lands in their natural state. Wetlands are taxed as part of the overall land holding and many producers see the need to gain revenue from wetlands by draining and cropping them. The current regulatory instruments and other non-regulatory programs do not appear to be adequately protecting wetland areas. The cost of preserving these wetlands needs to shared more broadly throughout society as a whole. Wetlands serve important ecological functions, and more needs to be done to provide incentives to landowners and municipalities to preserve and protect wetlands from drainage.

The hydrology of the landscape has also been modified such that runoff waters don't travel through wetlands in the same manner as they once did. For example, the Netley-Libau Marsh located at the mouth of the Red River on Lake Winnipeg is likely no longer functioning at its full potential as a nutrient sink. Historically, dredging of the Red River through Netley Marsh to Lake Winnipeg was undertaken to improve navigation between the lake and the river. This activity has created preferential flow channels through the marsh. Therefore, nutrient-rich Red River water does not have the opportunity to slow down and settle out many of the nutrients prior to the river water reaching Lake Winnipeg. Work being done by the University of Manitoba and the International Institute of Sustainable Development on the Netley-Libau Marsh may help provide some answers to the potential for more effective use of this marsh and other natural wetlands as nutrient abatement strategies.

Netley-Libau Marsh.

It will be important to better understand the potential role of natural wetlands in reducing nutrients loads to Lake Winnipeg. It must be recognized that natural wetlands have critical ecological functions and that if they are to be used as a nutrient abatement option the capacity of these wetlands to perform this function without losing environmental integrity, must be fully evaluated.

Recommendations

36.1 The Province of Manitoba should explore innovative options to preserve and protect wetlands from drainage. The Province should consider options to sharing the cost of preserving these wetlands more broadly throughout society as a whole.

36.2 The Province of Manitoba should undertake an in-depth review of the effectiveness of natural wetlands to reduce nutrient loading to Lake Winnipeg.

36.3 The Province of Manitoba should obtain a more complete understanding of the historic role of the Netley-Libau Marsh in reducing nutrient load from the Red River basin. Opportunities to recreate any natural historic nutrient reduction mechanisms within the Netley-Libau Marsh should be explored.

37.0 Retention Basins as Nutrient Abatement Options

Background

Retention basins have been used successfully to reduce nutrient loss from confined livestock areas, and from urban and rural drainage basins. By directing surface runoff through a retention basin, a portion of the particulate nutrients will settle out in the basin before it reaches downstream waterways. Retention basins may also show promise in areas where there are erosion concerns such as escarpment areas. By including retention basins within drainage networks, nutrient rich particulate material will be able to settle out rather than being carried downstream.

The Steppler Dam in the South Tobacco Creek Watershed is being used to monitor nutrient retention behind small dams.

The South Tobacco Creek Watershed Evaluation of beneficial management practices (WEBs) project near Miami Manitoba is currently monitoring the benefits of this type of non-point source beneficial management practice. In the watershed, a number of retention basins have been constructed within the existing drainage network to minimize flooding damage during high rainfall and runoff events. These retention basins have reduced peak flows and as a consequence, have reduced erosion and damage to roads and other infrastructure in the area. Water quality monitoring studies have been conducted by the Department of Fisheries and Oceans on these retention basins to determine whether they are also serving as nutrient sinks. The preliminary data would suggest that water quality benefits can be realized by these structures. More study is needed to see if these basins would function equally well in other regions of the province, and to determine whether they might eventually become sources of nutrients after significant quantities suspended material accumulates behind these structures over time.

Recommendation

37.1 The Province of Manitoba should undertake a focused review of the effectiveness and appropriateness of using retention basins as a nutrient abatement option.

38.0 Implementation of Lake Winnipeg Stewardship Board's Recommendations

Background

The implementation of the Lake Winnipeg Stewardship Board's recommendations will require cooperation and coordination within and between governments. It will be important for the Minister of Water Stewardship to communicate with Provincial Ministers and other political leaders, especially the Federal government, to ensure action is taken in these areas.

Recommendations

38.1 The Minister of Water Stewardship should consider bringing together executives of appropriate provincial government departments to discuss how to best prioritize and implement these recommendations.

38.2 The Province of Manitoba should engage the federal government in discussions to implement the recommendations contained within the Lake Winnipeg Stewardship Board Report, December 2006.

Non-Nutrient Issues

The Lake Winnipeg Stewardship Board recognizes that Lake Winnipeg faces many stresses, including eutrophication. During it's deliberations, a number of important non-nutrient issues were brought to the Board's attention (see the accompanying list). Although these issues were outside of the mandate of the present Board, it was acknowledged that they also have the potential to affect the health of Lake Winnipeg.

Governments need to consider these and other stressors and develop an action plan to study and address those that can impact the health of Lake Winnipeg.

Some of the other issues raised by the public and by Board members during their deliberations include:

- Pesticides
- Pharmaceuticals
- Hospital waste disposal
- Endocrine disrupters
- Invasive species
- Climate change and associated hydrological influences
- Heavy metals
- Resource harvesting
- Industrial discharges, including the pulp and paper industry
- Copper sulphate use

Conclusion

What we have seen on Lake Winnipeg in recent years demands our immediate attention. We all share responsibility for the future of the lake and as such, must make a commitment to restore its health. There is a sense of urgency in what we must do.

Lightening the nutrient load to Lake Winnipeg will require a significant financial investment by all residents in the watershed. Therefore, for practical reasons, implementation of these recommendations by governments will have to be prioritized. However, given the large number of diffuse sources of nutrients in the watershed, a broad-ranged, collective effort to reduce nutrient loading to Lake Winnipeg is essential. The recommendations presented in this report describe an integrated approach to improving the health of Lake Winnipeg. Each recommendation is interdependent on the others, and cannot be addressed in isolation. As a collection, they call on all who live in the watershed to participate. Central to the effort will be an educated public, equipped to make positive changes on the landscape, and to encourage governments to do the same.

A proactive and coordinated approach must be taken by governments to include upstream jurisdictions in the process, since so much of the solution lies with them. Action is required throughout the basin on the issues such as municipal wastewater management, and the loading of nutrients to the lake through watershed processes and non-point sources. Since we will expect our neighbours to do their part, Manitoba must lead by example, demonstrating its resolve to others in the watershed.

Success will be achieved through the application of sound science. While there are gaps in the scientific information that must be filled, we have enough information and knowledge to begin the task immediately.

We cannot afford to wait.

Appendix A: Lake Winnipeg Stewardship Board Member Biographies

Chair **BILL BARLOW** currently serves as a Councillor with the Municipality of Gimli and a member of the Manitoba Municipal Board. Bill has also served as a Councillor (1980-1989) and Mayor (1989-2002) of Gimli, Chair of the Eastern Interlake Planning District (1991-2002). He taught English and Drama at Gimli High School from 1969 until retirement in 2004.

Vice-Chair **SAM MURDOCK** is Chief of Staff for the Southern Chiefs Organization Inc., a commercial fisher, and former Chief of the Fisher River First Nation. He also serves as a Director on the Board for the Lake Winnipeg Advisory Committee, and President of the Fisher River McBeth Fisheries.

GARRY BROWN farms near Dugald. He was a long-time councillor for the Rural Municipality of Springfield, and a former Chair of the Cooks Creek Conservation District.

HELGI EINARSSON is a commercial fisher on north basin of Lake Winnipeg, and an agent of the Freshwater Fish Marketing Board. He also owns and operates a lodge on Dauphin River, and is Mayor of Dauphin River Community Council.

DON FLATEN is a soil scientist specializing in nutrient management at the Faculty of Agricultural and Food Sciences, University of Manitoba.

LES FELSCH is a grains, oil seeds, and bison producer from the Red River Valley and member of Keystone Agricultural Producers executive.

ROBERT T. KRISTJANSON has been a commercial fisher on Lake Winnipeg for over 50 years.

VERA MITCHELL is an educator/administrator for Poplar River First Nation. She is an advocate for First Nations People's rights, and for sustainable environmental principles.

CHRIS PAWLEY served three terms as a member of Selkirk's City Council. He is also a member of the Red River Basin Commission - North Chapter.

ALEX SALKI holds the position of Senior Research Biologist with the Federal Department of Fisheries and Oceans - Lake Winnipeg Project. He is the Science Program Coordinator for the Lake Winnipeg Research Consortium, a steering committee member for Climate Change Connection, and a member of the Department of Fisheries and Oceans Experimental Lakes Area Research Team.

The Right Honourable **EDWARD SCHREYER** – former Premier of Manitoba (1967-77) and Governor General of Canada (1979-1984), has also held the position of High Commissioner to Australia, Papua New Guinea, Solomon Islands, Vanuatu. He has also been Visiting Professor of Resource Economics in Global Context at Universities in Canada and Germany.

BEV SMITH is a former councillor for Brokenhead Ojibway Nation. Her commitment to the protection and sustainability of Lake Winnipeg is based on her historical and spiritual connection to the land and the lake, through her family and her community.

NORMAN STAGG is a commercial fisher on Lake Winnipeg, and a former Chief of the Dauphin River First Nation. He is currently serving as an Economic Development Officer for Dauphin River First Nation.

NICK SZOKE is Senior Engineer and Branch Head of Wastewater Planning for the Water and Waste Department, City of Winnipeg. As a licenced professional engineer, he is registered with the Association of Professional Engineers and Geoscientists of the Province of Manitoba (APEGM). He is a long-standing member of the Canadian Public Works Association, Western Canada Water and Wastewater Association, and Water Environment Association.

GARY WASYLOWSKI is a beef cattle producer, former Reeve of the Rural Municipality of Armstrong (1992-2006), former Rural Vice-President of the Association of Manitoba Municipalities (2001-2006) and Vice-Chair of the east Interlake Conservation District.

DWIGHT WILLIAMSON is Director of Water Science and Management Branch, Manitoba Water Stewardship.

HALINA ZBIGNIEWICZ is Manager, Water Resource Development and Engineering Department– Manitoba Hydro.

Appendix B: Lake Winnipeg Action Plan

In February 2003, Manitoba Water Stewardship (formerly Manitoba Conservation) Minister Steve Ashton unveiled a plan to protect Lake Winnipeg.

The points in the Lake Winnipeg Action Plan include:

- establishment of a Lake Winnipeg Stewardship Board to help Manitobans identify further actions necessary to reduce nitrogen and phosphorus to pre-1970 levels in the lake by 13 per cent reduction in nitrogen and 10 per cent reduction in phosphorus, subject to further findings of the Nutrient Management Strategy;
- introduction of new measures to help protect natural growth along the Red and Assiniboine rivers to prevent erosion and reduce nutrient run-off into the rivers to complement the Riparian Areas Tax Credit introduced in 2001;
- provision of a program to expand soil testing to ensure appropriate fertilizer application in both rural and urban settings;
- introduction of a new sewage and septic field regulation that will outline clear standards for the placement of systems;
- development of a shoreline protection project in partnership with Manitoba Hydro to help address erosion concerns; and
- commencement of cross-border nutrient management discussions.

Appendix C: Lake Winnipeg Stewardship Board Terms of Reference

The Terms of Reference for the Lake Winnipeg Stewardship Board are:

1. To assist in implementing the initial list of actions contained in the Lake Winnipeg Action Plan. These are:
   - Introduction of new measures to help protect natural growth along the Red and Assiniboine rivers to prevent erosion and reduce nutrient run-off into the rivers to complement the Riparian Areas Tax Credit introduced in 2001;
   - Provision of a program to expand soil testing to ensure appropriate fertilizer application in both rural and urban settings;
   - Introduction of a new sewage and septic field regulation that will outline clear standards for the placement of systems; development of a shoreline protection project in partnership with Manitoba Hydro to help address erosion concerns;
   - Commencement of cross-border nutrient management discussions.

2. To identify, prioritize and assist the implementation of further actions necessary to reduce nitrogen and phosphorus to pre-1970s levels in the lake;

3. To provide options on how implementation of actions could be funded;

4. To provide advice related to on-going science necessary to establish long-term water quality objectives for nutrients in Lake Winnipeg and in the contributing basins. Advice should also be provided on the principles around which these judgments will be made (*e.g.,* weight of scientific evidence, sustainability, balance economic burden with environmental goals, etc.)

5 To gather information for its own purposes where necessary, but not to fund scientific or other research;

6 To identify and prioritize additional actions required to achieve long-term water quality objectives;

7 To liaise and communicate progress, findings, etc., with local communities, stakeholders, etc.

8 To consult broadly and provide advice to government on the overall Nutrient Management Strategy and its implementation; and

9 To provide advice to government on other environment and resource management issues related to the sustainability of Lake Winnipeg's ecosystem and its communities.

Appendix D: Lake Winnipeg Stewardship Board Committee Structure

Executive
- Bill Barlow – Chair
- Sam Murdock – Vice Chair
- Chris Pawley
- Gary Brown
- Robert T. Kristjanson
- Ed Schreyer

Science
- Alex Salki, Dwight Williamson – Co-chairs
- Halina Zbigniewicz
- Ed Schreyer
- Don Flaten
- Nick Szoke
- (Bill Barlow)

Municipal
- Garry Wasylowski – Chair
- Norman Stagg
- Chris Pawley
- Alex Salki
- Ed Schreyer
- Dwight Williamson
- Nick Szoke
- Garry Brown
- (Bill Barlow)

Agricultural
- Les Felsch – Chair
- Garry Brown
- Helgi Einarsson
- Dwight Williamson
- Garry Wasylowski
- Don Flaten
- (Bill Barlow)

Communications
- Sam Murdock – Chair
- Robert T Kristjanson
- Chris Pawley
- Vera Mitchell
- Bill Barlow
- Dwight Williamson
- Bev Smith

Watershed Processes and Beneficial Management Practices Task Force
- Don Flaten – Chair
- Nick Szoke
- Alex Salki
- Dwight Williamson
- Les Felsch
- Garry Wasylowski
- Robert T Kristjanson
- Bill Barlow

Appendix E: Locations of Lake Winnipeg Stewardship Board Public Registries

Conservation & Environment Library (123 Main St, Winnipeg)
Legislative Library (Legislative Library, Room 100 – 200 Vaughan Street.)
Manitoba Eco-Network (3-303 Portage Ave., Winnipeg)
Winnipeg Public Library (4th Floor, 251 Donald).
Western Manitoba Regional Library (Brandon)
Lakeland Regional Library (Killarney)
Border Regional Library (Virden)
Selkirk & St. Andrews Regional Library (Selkirk)
Brokenhead River Regional Library (Beausejour)
Bibliotheque Allard (St. Georges)
Portage la Prairie City Library (Portage la Prairie)
Jake Epp Public Library (Steinbach)
South Central Regional Library (Morden)
Thompson Public Library (Thompson)
Manitoba Keewatinowi Okimakanak Inc. (Thompson)
Flin Flon Public Library (Flin Flon)
The Pas Public Library (The Pas)
Churchill Public Library (Churchill)

Cut Here and Post

Cut Here and Post

What YOU Can Do Now

While much of the focus for reducing nutrient loading to Lake Winnipeg is placed on governments, communities, business, and industry, there are many actions individuals can take to minimize the stress on Lake Winnipeg and the waters flowing into the lake. These include:

- **Choose** low phosphorus or phosphorus-free products.
- **Reduce or eliminate** the use of phosphorus-based fertilizers on lawns, gardens, cottage, properties, golf courses, and on workplace properties.
- **Keep lawn clippings** on the grass and out of waterways and sewers.
- **Minimize runoff** and encourage infiltration of rainwater and snowmelt water on private properties through the use of things such as rain gardens and rain barrels.
- **Maintain or stabilize** and restore your shoreline to a natural state, and provide a buffer between disturbed or built-up areas and the water.
- **Prevent** soil from eroding off your property and reaching storm drains or municipal ditches.
- **If you use** a septic field or holding tank, ensure that it is maintained and regularly pumped out. Consider alternative waste management systems such as composting toilets.
- **Minimize water use** to reduce loads to septic fields and municipal treatment systems.
- **Pick up pet feces.** In addition to carrying pathogens, this feces has a high nitrogen and phosphorus content. Rainwater and meltwater can flush pet waste directly into waterways through storm sewers.
- **Keep livestock out** of waterways to reduce soil erosion and vegetation disturbance. This will also prevent animal feces rich in nutrients from being deposited into waterways.
- **Reduce the impacts** caused by your recreational activities. This includes reducing your powerboat's speed when close to shore so as not to create a large wake which can erode sensitive shorelines. Wakeboats should avoid operating in areas where there are soft erodable shorelines. Do not drive your ATV in shallow water. Do not discharge the grey water or sewage in tanks on boats into waterways.
- **For business owners and operators** – take steps to identify sources of pollution from the business, and develop pollution prevention plans to mitigate these impacts. For example, install water efficient fixtures and use phosphate-free cleaning products and lawn care products.

Lake Winnipeg Stewardship Board
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