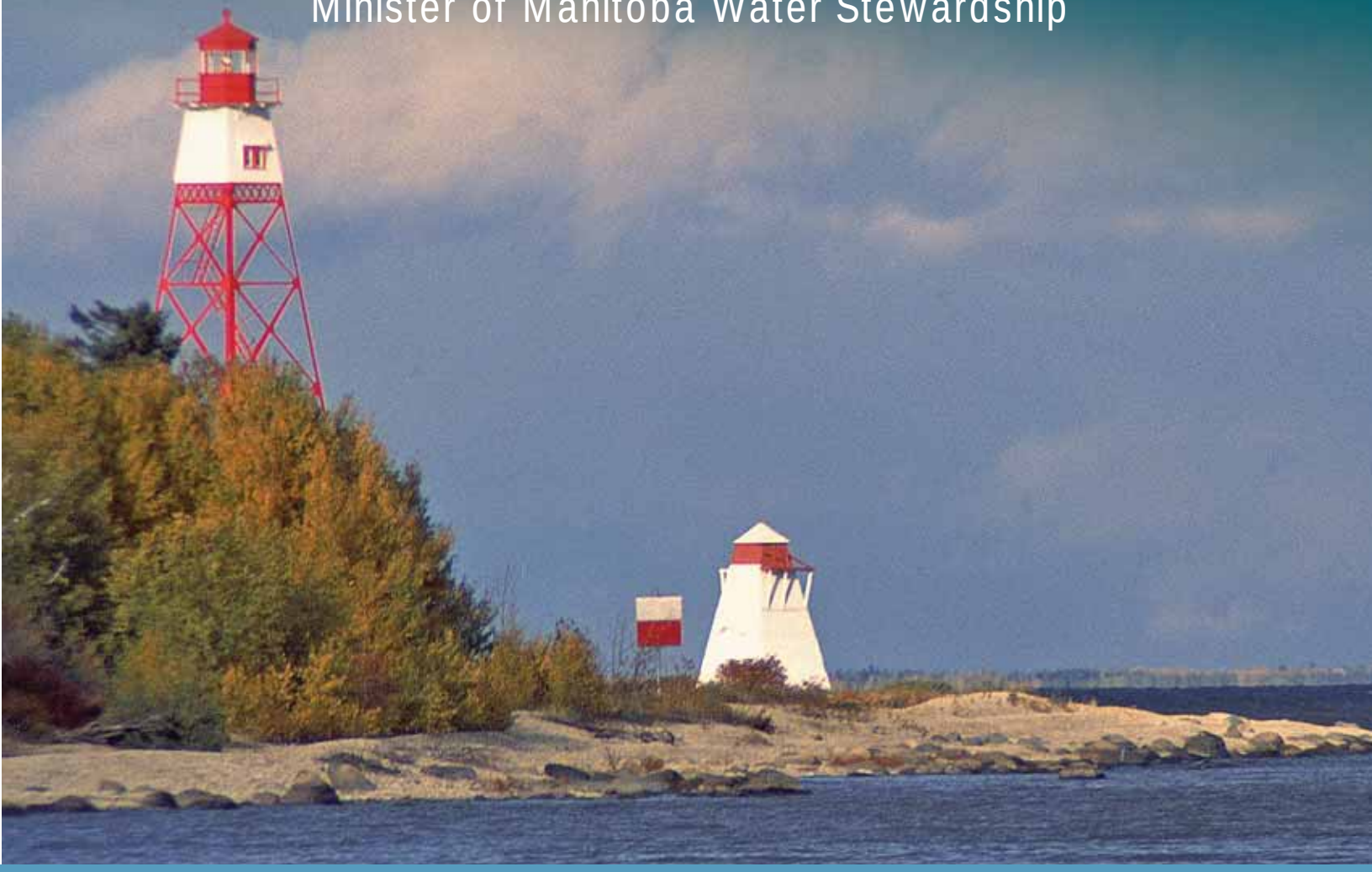
Our Collective Responsibility

Reducing Nutrient Loading to Lake Winnipeg

An Interim Report to the
Minister of Manitoba Water Stewardship



Lake Winnipeg Stewardship Board

Our Collective Responsibility

Reducing nutrient loading to Lake Winnipeg

An Interim Report
to the
Minister of Water Stewardship for Manitoba

Lake Winnipeg Stewardship Board

January, 2005

Message from the Chair

Lake Winnipeg, one of the world's great lakes, is sending us a message. Activities throughout its huge watershed are stressing the natural balances of its ecosystem. This message is being manifested in the appearance of more intense and frequent blooms of algae and water quality warnings along our most popular beaches.

Lake Winnipeg has a drainage area of nearly one million square kilometres, and is home to more than 5.5 million people. The lake is fed by many streams and rivers, but the most significant are the Winnipeg, Saskatchewan, and Red rivers. Down these rivers flow the nutrient-rich waters emanating from our communities, cottages, industries, and farmlands.

Lake Winnipeg is bound on the east by the Canadian Shield cloaked in thick boreal forest. Ringed by magnificent sandy beaches, the south portion of the lake borders the eastern edge of the Canadian Prairies. Its northwestern shores are graced by the layered face of limestone cliffs. Lake Winnipeg is magnificent in its diversity of moods. It can rise quickly into a frenzied storm only moments after laying quietly in the shimmering sunshine, or gently reflecting the spectacle of the Northern Lights.

For thousands of years of human history, Lake Winnipeg has provided a highway and sustained us with the bounty of its water and spirit of its beauty. The ancient sturgeon, our whitefish and pickerel, and Lake Winnipeg goldeye are well known to Manitobans and people in other parts of the world. Multitudes of gulls, squadrons of pelicans, and the occasional Bald Eagle ply the skies over the lake.

Unfortunately, not all is as it appears. Lately, those familiar with Lake Winnipeg have noted a change – an increase in the frequency and intensity of algal blooms. These present themselves as algae that clog fishing nets, and blue-green algae that from time to time blanket the shoreline in bright turquoise and release harmful toxins. Scientists point to the cause as an overloading of nutrients produced from a variety of human activities. They know from experiences in lake systems in other parts of the world that left unchecked, nutrient enrichment (eutrophication) can lead to toxin-producing algal blooms that will deplete the lake's oxygen supply as they decompose, seriously compromising the lake's ecosystem.

The message from the Lake is clear. Nutrient loads on the rivers feeding the lake must be decreased to a point where natural balances in the lake can be re-established. The key for the protection and rehabilitation of Lake Winnipeg is through the sustainable management of its watershed. That is the task facing the Lake Winnipeg Stewardship Board and all residents in the basin.

We are part of the ecosystem, and perhaps the most influential component. It is our collective responsibility to take action to help improve the health of Lake Winnipeg, and to leave it in better condition for future generations. The Lake Winnipeg Stewardship Board is confident that the recommended actions described in this interim report will set us on that path.

Bill Barlow, Chair
Lake Winnipeg Stewardship Board

Memorandum

To: **Honourable Steve Ashton, Minister of Water Stewardship**

From: **The Lake Winnipeg Stewardship Board**

Date: **January 25, 2005**

Re: *Our Collective Responsibility – Reducing Nutrient Loading to Lake Winnipeg (First Interim Report)*

The Lake Winnipeg Stewardship Board is pleased to submit its first interim report on recommended strategies to reduce nutrient loading to Lake Winnipeg. The Board has examined a large number of issues and has developed recommendations around 32 separate issues. These recommendations are aimed at protecting the health of Lake Winnipeg and its watershed.

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Member

Ms. Halina Zbigniewicz
Member

Executive Summary

In February, 2003, Manitoba Water Stewardship Minister Steve Ashton (formerly Minister of Manitoba Conservation), announced the Lake Winnipeg Action Plan. This Plan included the formation of a Lake Winnipeg Stewardship Board to help Manitobans identify actions necessary to reduce nitrogen and phosphorus loading to Lake Winnipeg to pre-1970 levels.

Research, as well as observations by those who work and live on Lake Winnipeg, has demonstrated that water quality on the lake has deteriorated. Increased nutrient loads to the lake has lead to an over-abundance of algae in both summer and winter. Large blooms of algae have been documented in both the north and south basins of the lake. Increased abundance of undesirable species of algae can impact:

(1) the aesthetic appeal of the lake,
(2) safety of water for recreational uses and consumption,
(3) aquatic habitat,
(4) biodiversity, and
(5) long-term ecosystem sustainability.

Lake Winnipeg's watershed is enormous and includes parts of four provinces in Canada and four states in the United States. The watershed supports a number of important economic interests and much or all of this human development has had some impact on the water quality in Lake Winnipeg. In addition, nutrients are also contributed to Lake Winnipeg naturally from the rich prairie soils in much of the watershed.

The Lake Winnipeg Stewardship Board is pleased to provide its first Interim Report to the Honourable Steve Ashton, Minister of Water Stewardship. This first Interim Report provides initial guidance to the Province of Manitoba on strategies to reduce nutrient loading to Lake Winnipeg based on the Board's collective knowledge, experience, and investigations.

The Lake Winnipeg Stewardship Board has made recommendations on 32 separate issues. Details are provided on each of these issues in this report.

The following is a summary of the Board's recommendations.

Recommendations

1.0 Transboundary and Inter-jurisdictional Issues

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

1.2 The Manitoba government needs to 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.

1.3 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.

1.4 The Province of Manitoba needs to strengthen its working relationship with Canada on First Nation issues related to impacts on water quality, and each should be prepared to accept their full fiduciary responsibilities as per their constitutional obligations.

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

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

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

2.3 Legislation should be reviewed and revised where appropriate to include small as well as large livestock operations, and to ensure that new or expanded confined operations are constructed to meet contemporary environmental standards.

2.4 Government should intensify its agriculture extension programs (such as those offered by Manitoba Agriculture, Food, and Rural Initiatives) and those delivered in partnership with existing or new 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.

3.0 Livestock Access to Riparian Areas and Waterways

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

4.0 Soil Fertility Testing on Agricultural Land

4.1 Develop strategies that promote and support annual soil testing. Provide the tools necessary to make sound agronomic decisions.

4.2 Consider incentives and subsidies for producers conducting soil testing, similar to private drinking water testing subsidies.

4.3 Ensure that soil test laboratories are accredited, and are using accredited analytical methods and fertilizer recommendations that are appropriate for Manitoba soil, crop, and climatic conditions. Soil test recommendations need to reflect the difference between commercial and organic fertilizer use.

4.4 Ensure that soil test recommendations and reports are user-friendly and informative to producers.

4.5 Enhance education on the economic and environmental benefits of soil testing.

5.0 Matching Nutrient Inputs with Crop Nutrient Requirements and Exports, and Establishing Soil Phosphorus limits

5.1 The Province should adopt an interim soil phosphorus regulatory limit for agricultural land in Manitoba by March 2005. This interim regulatory limit should consider soil phosphorus limits set by neighbouring jurisdictions such as Minnesota.

5.2 A terrestrial nutrient budget should be developed for Agro-Manitoba which would assist producers, municipalities, and regulators in siting intensive livestock operations, and managing manure.

5.3 Where excess nutrients are being generated, practical options for exporting manure to nutrient-deficient areas must be considered.

6.0 Evaluation of Beneficial Management Practices as Nutrient Reduction Strategies

6.1 Undertake focused research to determine what beneficial management practices appropriate for Manitoba conditions would be effective in reducing nutrient loading to the Lake Winnipeg watershed.

7.0 Nutrient Inputs from Agricultural Tile Drainage

7.1 Where feasible, tile drainage water should be directed into retention basins, held and, reused when supplemental water is required for agricultural land.

7.2 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.

7.3 The process of obtaining a permit to install tile drainage should be reviewed with the aim of ensuring that water quality issues are considered in addition to water quantity

8.0 Integrated Watershed Management Planning and Management

8.1 Manitoba Water Stewardship should establish Watershed Management Districts province-wide that would be responsible for preparing, implementing, and regulating watershed management plans as outlined in Part 3 of the proposed Water Protection Act.

8.2 Watershed Management Districts should be established based on natural watershed boundaries rather than municipal boundaries.

8.3 Watershed Management Districts should be responsible for managing all drainage issues, including in-field drainage activities and the drainage of natural wetlands. The Province should retain responsibility for issuing permits for these projects.

9.0 Drainage of Surface Water From Agricultural Lands

9.1 A review of agricultural land drainage networks on a watershed basis should be undertaken. 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 should be explored to determine their effectiveness in reducing nutrient loading along drains. This work would include a review of the feasibility of acquiring marginal land and wetland areas that could serve as natural filters for drain water.

9.2 Drain construction and maintenance practices should be reviewed to minimize nutrient loss to the watercourse. This would include exploring vegetation harvesting opportunities in areas where this is not already done.

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

10.0 Cosmetic Use of Phosphorus-Based Fertilizers

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

10.2 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.

10.3 Canada should institute a consistent policy for the use of fertilizers for cosmetic use on all Federal lands, including National Parks and First Nation communities.

11.0 Water Usage, Sewage Treatment, and Related Financing

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

11.2 Manitobans should pay the true cost of the water they consume, and the true costs of the services required to adequately treat wastewater.

11.3 Utility reserves must be established such that monies are available when utility upgrades are required. Monies collected for these reserves need to be protected from competing financial needs.

11.4 In order to promote efficient water use and effective waste treatment, metering of regional water supplies should be implemented and rates should be based on consumption, and the true cost of providing the service.

11.5 Extraneous groundwater inflow into wastewater collection systems needs to be investigated and minimized were feasible.

12.0 Regionalization of Wastewater Treatment Services

12.1 The Province of Manitoba should promote regionalization of wastewater treatment systems.

12.2 Provincial funding through the Manitoba Water Services Board should be explicitly tied to an evaluation of regionalization opportunities. Funding priority should be given to those systems that are employing nutrient removal technologies.

12.3 Comprehensive sewage management plans should be developed for areas of the Province where existing sewage treatment practices (septic fields, holding tanks, lagoons) are not meeting environmental standards.

12.4 There is a need for the Province and Canada/Indian and Northern Affairs Canada to work together more cooperatively on regional sewage management plans.

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

13.1 The Province of Manitoba needs to finalize its Nutrient Management Strategy along with developing a comprehensive prioritized plan for nutrient abatement for all wastewater treatment facilities in the watershed. The comprehensive plan needs to consider whether the application of best practicable technology is sufficient for reducing effluent phosphorus concentrations to 1 milligram per litre or whether best available technologies need to be employed to achieve greater reductions and the plan needs to consider where nitrogen removal is necessary and to what level.

13.2 Nutrient reduction strategies such as biological treatment, 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.

13.3 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.

14.0 Environmental Planning for New Urban and Rural Development

14.1 The Province and municipalities should establish an integrated land and water planning process that is environmentally conscientious and that ensures planned and orderly growth with respect to sewer and water services. This process would encourage planning, rather than discourage growth.

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

14.3 Developers should be required to consider the cost of the required water and wastewater treatment services and ensure that these are built into the costs of the development (full cost recovery). It is expected that different strategies for wastewater treatment would be required depending on the local conditions.

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

14.5 Developers should be responsible for land drainage issues for new residential developments which consider the nutrient impacts of the development and build in strategies to minimize these impacts such as storm water retention and treatment, and erosion control. Developers should be required to implement strategies to retain rainwater and reduce runoff.

14.6 All new urban and rural development projects should be required to incorporate low impact, environmentally-conscious concepts into the design with the aim of reducing environmental service costs to minimize pollution loads. These may include re-use of rainwater, reducing runoff by incorporating more permeable surfaces, and retention ponds.

15.0 Environmental Licensing Fees

15.1 The Province should look for opportunities to reduce the financial disincentives to those proponents voluntarily improving waste management practices such that the risk of nutrients and other contaminants reaching surface water is reduced. The Province could consider establishing a fund, perhaps within an existing funding program (e.g. Sustainable Development Innovation Fund, or 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.

16.0 Land Application of Municipal Effluents

16.1 Effluent irrigation should be promoted and encouraged where feasible, and in consideration of potential health risks.

16.2 Alternatives to the water softener sodium chloride should be explored to ensure wastewater is more suitable for land application (e.g. Potassium chloride).

17.0 Leachate Handling

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

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

18.0 Management of Domestic Septage and Greywater

18.1 The Province should develop a strategy for handling of 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. Strong deterrents for those who illegally dispose of septage in ditches or other inappropriate locations are required.

18.2 The Province of Manitoba should undertake a review of septage and greywater re-use being employed in other jurisdictions to assess its feasibility for Manitoba conditions. Health risk issues associated with these re-uses need to be fully explored.

19.0 Water Use Efficiency

19.1 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.

19.2 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 water flow alternatives.

19.3 All levels of governments 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.

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

19.5 Ensure that water users on regional water systems have water meters and are billed on a water use basis, at the full cost of the water supply.

19.6 Consideration should be given to applying higher rates as usage increases. Reduced water rates for large commercial and industrial consumers should be reconsidered.

20.0 Using Constructed Wetlands for Nutrient Removal

20.1 The Province of Manitoba should undertake a focused review of the effectiveness of constructed wetlands as a nutrient abatement strategy. The study should consider local climatic conditions, as well as management requirements such as vegetation harvesting.

21.0 Storage Requirements for Municipal Lagoons

21.1 The Province should explore the option of expanding the storage capacity of new and expanded lagoons to 400 days. Water conservation strategies will assist municipalities in realizing this capacity.

22.0 Stormwater Retention Ponds

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

22.2 Monitoring should be conducted 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.

23.0 Nutrient Management Issues on First Nations Communities

23.1 Sewage treatment on First Nation communities must be upgraded to meet both public health and environmental standards. As a minimum, Provincial standards should be communicated to Indian and Northern Affairs Canada and First Nation communities to be used as guidelines.

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 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 Nation communities. The strategies should include a strong educational component.

23.4 The Province 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 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.

24.0 Septic Field Alternatives

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

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

24.3 The Province 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 in the Province.

25.0 Manitoba Water Services Board

25.1 The Province of Manitoba needs to explore options for how nutrient removal upgrades may be best funded, and how Provincial funding through the Manitoba Water Services Board should support the commitments in the Lake Winnipeg Action Plan.

25.2 Manitoba is urged to establish criteria to assist the Manitoba Water Services Board in prioritizing funding requests that would favour implementing regional options for wastewater treatment facilities.

26.0 Phosphoric Acid Use in Water Supplies

26.1 The Province 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.

27.0 Use of Alum as a Nutrient Control Strategy

27.1 A review of the use of alum in wastewater treatment should be conducted. This review would evaluate the resultant concentration of aluminum 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.

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 solutions with the Canadian Council of Environment Ministers with a view to having the Federal Government restrict the phosphorus content in those cleaning products currently not regulated. The Province of Manitoba should raise this issue with the Federal Government.

29.0 Science Needs for the Long-Term Protection of Lake Winnipeg

29.1 On-going research and monitoring will be required on Lake Winnipeg to address outstanding information gaps and to monitor progress towards achieving the established targets for nitrogen and phosphorus. To this end, Manitoba Water Stewardship, Environment Canada, and Fisheries and Oceans Canada are urged to continue their existing process to develop and then implement a collaborative, long-term science plan for Lake Winnipeg.

29.2 The Province of Manitoba should consider jointly funding a Research Chair specializing in hydrological and contaminant transport mechanisms at the terrestrial-aquatic interface, at one of the academic institutions in Manitoba. Support could be provided by both senior levels of government. The establishment of such a position would require the establishment of strong partnerships among other academic institutions in Manitoba and with provincial and federal government departments with a mandate in this area. To assure success, it will be necessary to provide some initial operating funding and to provide annual direction to assist with setting and maintaining research priorities.

29.3 Manitoba Water Stewardship must continue its work towards completing the Nutrient Management Strategy announced in April 2000. In particular, draft water quality objectives for nutrients in Lake Winnipeg that are based upon ecologically-sensitive end-points must be developed as quickly as possible. Following the development of these objectives, broad consultations will need to be undertaken involving the local Lake Winnipeg communities, scientists, contributing sectors within Manitoba, upstream jurisdictions, and others. These long-term water quality objectives will then replace the interim targets identified in the Lake Winnipeg Action Plan.

29.4 Manitoba Water Stewardship must continue its long-term water quality monitoring of streams contributing to Lake Winnipeg and should be encouraged to 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 the targets set for Lake Winnipeg.

29.5 The Province of Manitoba should consider developing and implementing a focused program of applied research aimed at better understanding of the human-induced changes in water flows, seasonal lake residence time, and lake levels on nutrient dynamics relevant to Lake Winnipeg.

30.0 Education Program Development

30.1 The Manitoba Department of Education should design teaching units, credit courses, and upgrade holistic environmental curricula specific to Lake Winnipeg and its watershed for implementation in Manitoba schools.

30.2 An awareness of the issue of Lake Winnipeg water quality and watershed influences must be created among educational staff in First Nations schools, both teaching staff and administrative staff involved with curriculum development.

31.0 Public Education on Water Quality Protection

31.1 The Province of Manitoba should develop a public education campaign/program to help Manitobans understand the importance of making the appropriate personal choices on issues that will affect water quality in Lake Winnipeg and its watershed.

32.0 The Lake Winnipeg Stewardship Board's First Interim Report – Public Discussion

32.1 The Board recommends that a focused public discussion be undertaken on many of these recommendations, and with those who may be affected by these recommendations.

Contents

Appendices

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 cause of this problem.

The health of the lake 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 the 953,000 square-kilometre watershed feeding Lake Winnipeg 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 and plant material.

The Lake Winnipeg Stewardship Board presents a series of recommendations for action directed at protecting Lake Winnipeg and improving its state of health.

Commercial fishers have reported increased densities of diatom algae attached to their fishing nets in the winter. 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 February 2003, Manitoba Conservation Minister Steve Ashton unveiled a provincial action plan to protect Lake Winnipeg. The Lake Winnipeg Action Plan (Appendix A) contains six points, among them being the establishment of the Lake Winnipeg Stewardship Board. In July 2003, the Board was formally established. Appointees to the Board (Appendix B) represent a cross section of Manitobans having an interest in improving the health of Lake Winnipeg.

The Board was directed to assist the Provincial Government in implementing the Lake Winnipeg Action Plan, and to identify actions necessary to reduce nitrogen and phosphorous loading to Lake Winnipeg to pre-1970 levels. (Terms of Reference, Appendix C) This goal calls for a reduction of 13 per cent in the loading of nitrogen to Lake Winnipeg in the short term, and 10 per cent for phosphorus. Long-term targets for the lake will be subject to further findings of the Province's Nutrient Management Strategy.

In this, its first Interim Report, the Lake Winnipeg Stewardship Board presents a series of recommendations for action directed at protecting Lake Winnipeg and improving its state of health. Committees representing the various issues facing the Board (Appendix D) were instrumental in drafting the recommendations presented in this report.

There are a number of issues currently before the Board that have not yet been addressed. These issues are listed in Appendix F. They will receive consideration in future reports.

Appendix E provides a summary of many of the Board's activities.

Lake Winnipeg and its Watershed

Description

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 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.

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. The north basin is by far the larger of the two, at about 111 km 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
(Courtesy of the Lake Winnipeg Research Consortium)

Although large in surface area, Lake Winnipeg is generally a shallow lake and therefore has a small volume of water compared to other Canadian great 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 four U.S. States (Montana, North Dakota, South Dakota, and Minnesota). At about 953,000 square kilometres, the watershed is second only in size in Canada to the McKenzie 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 the great lakes in North America.[1] 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.

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

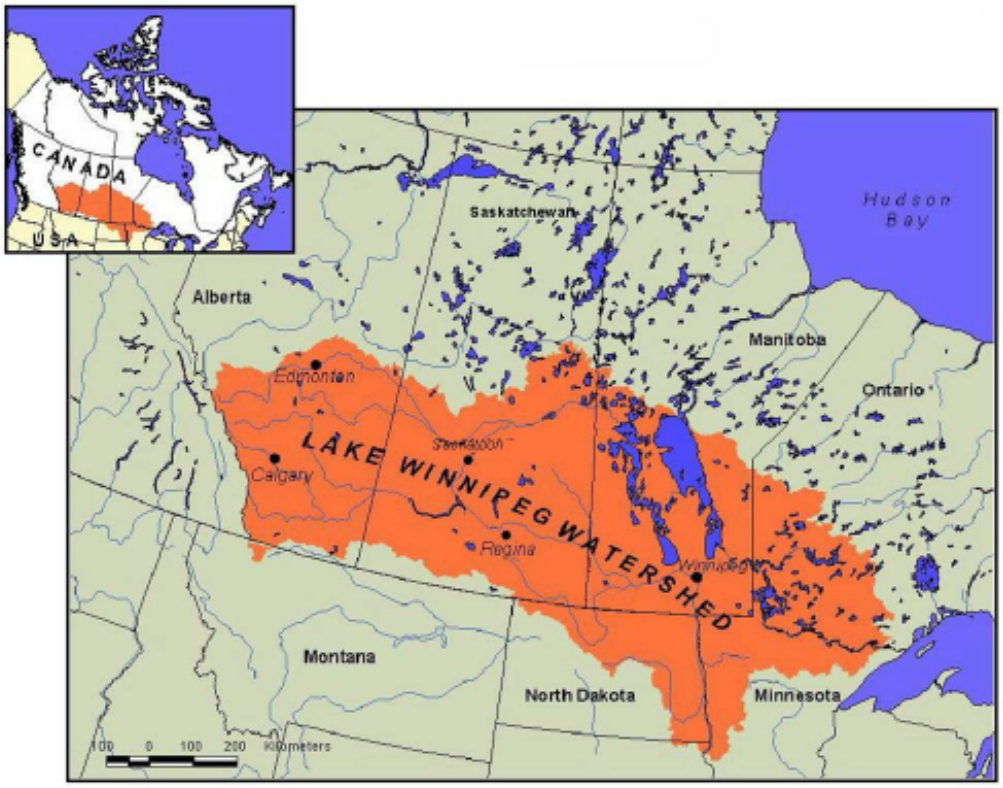

Figure 2: The Lake Winnipeg watershed.

The Lake Winnipeg Watershed is dominated by three river systems – 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.[2] 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.[3] 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.[4] 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.[5] It is joined a short distance downstream by the Red Deer River. These streams all arise 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.

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

The Red River begins at a point near 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. Along its way, it is joined by the Sheyenne River in North Dakota, the Pembina River near the International Boundary, 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 southwest Manitoba.

Significant marshes are located along the south and eastern shores of the south basin of Lake Winnipeg. Most notable are Netley Marsh, through which the Red River flows, and wetland areas in the Libau/Scanterbury area. While changes have occurred to these wetlands over time, the reasons for, and the full impact of, these changes are not yet fully understood.

Human History and Settlement of the Lake Winnipeg Area

Native peoples were present in the area surrounding present-day Lake Winnipeg as early as 8000 years ago.

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 3000 to 4000 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 8000 years ago. About 2000 years ago, a migration from the east brought the Cree to the Lake Winnipeg basin.[6] In the 1700s, the Ojibway arrived in the area, drawn from the east by the fur trade.[7]

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. Over the course of the following century, Lake Winnipeg was traversed and explored by many notable adventurers and explorers, among them Christophe Dufrost de La Jemerais and Jean-Baptiste de La Verendrye, Pierre de La Verendrye (the younger), Alexander Henry, Alexander McKenzie, Henry Youle Hind, and Captain John Palliser.[8]

Below: Beachfront at Gimli

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.[9]

[6] *"Mistehay Sakahegan: The Great Lake"* by Francis Russell, 2004. Page 37
[7] Ibid, page 41
[8] Ibid, page 57
[9] Ibid, pages 72 - 75

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.

About 80 per cent of the population in the watershed lives in major urban centres.

Today, more than 23,000 permanent residents live in 30 communities along the shores of Lake Winnipeg, including 11 First Nations communities.[10]

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.[11] 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. Careful management of these effluents will be important to help reach the interim targets set out for nitrogen and phosphorus in the Lake Winnipeg Action Plan.

Hydrology and Climate of Lake 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. Flows on the Saskatchewan River have been decreasing over the past few decades, but whether the reasons are climatic, increased water use upstream, or a combination, are unclear.[12] Conversely, flows to Lake Winnipeg from the Red River have 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.[13]

Lakes Winnipegosis and Manitoba, the province's second and third largest lakes respectively, also drain into Lake Winnipeg through the Fairford River into the Dauphin River. 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

[10] Estimated from Statistics Canada 2001 Community Profiles data.
[11] Estimated from Statistics Canada demographic statistics, October 2004, and U.S. Bureau of Census data.
[12] Personal communication, Alfred Warkentin, Manitoba Water Stewardship.
[13] Source - Water Survey of Canada.

The Winnipeg River dominates the contribution of inflow to Lake Winnipeg at about 45 per cent, with the Saskatchewan and Red rivers contributing about 26 and 11 per cent respectively.

Table 1: Mean Monthly Flows into Lake Winnipeg in cubic metres per second (percentages rounded). Period of Record 1964 to 2003.[1]

River	Mean monthly flow (cubic metres per second)	Percentage of total
Winnipeg River	983	45
Saskatchewan River	560	26
Red River	242	11
Other metered rivers[2]	176	8
Estimated un-metered flow (excluding precipitation and evaporation)	219	10
Totals	2180	100

Source: Manitoba Water Stewardship, Water Science and Management Branch
[1]Period of record for Bloodvein River - 1976 to 2003; Berens River - 1957 to 1991.
[2]Fairford, Fisher, Icelandic, Brokenhead, Whitemouth, Bloodvein, and Berens rivers.

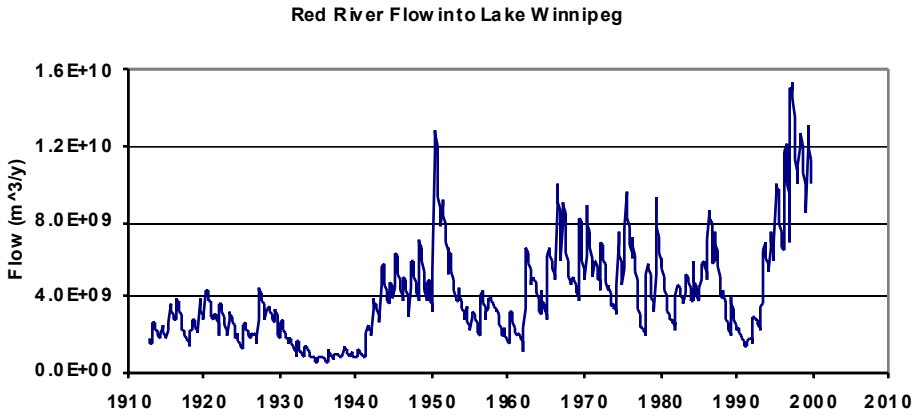

Figure 3: Changes in annual flow volume from the Red River into Lake Winnipeg between 1912 and 2003. Source: Water Survey of Canada.

cent of the annual runoff from the southern plains portion of the watershed.[14] In fact, one study 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.[15] 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[16] per year.

Unlike many other large, deeper lakes, the water residence time in Lake Winnipeg is relatively

[14] Personal communication, Alfred Warkentin, Manitoba Water Stewardship
[15] Nikolaichuk, W. 1967. Comparative watershed studies in southern Saskatchewan. Trans. Am. Soc. Agric. Eng. 10(4):502-504.
[16] Brunskill, GJ., 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. 1556: v + 23p.

short. Due to the large inflows and relatively low volume of the lake, water refreshes about every three to five years[17]. This results in a lake that responds relatively quickly to the 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 on the most north-eastern tip of the lake.[18] Mean annual temperatures range from about 1.9^0 C in the south to 0.5^0 C in the north. Precipitation amounts vary geographically from an annual mean of 589 mm (equivalent) at Bissett to 483 mm at Grand Rapids. About one-quarter to one-third of the precipitation falls as snow, depending on location.

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.[19] 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 between less frequent intense rain events.

The lake responds relatively quickly to the quality of water entering from its rivers.

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

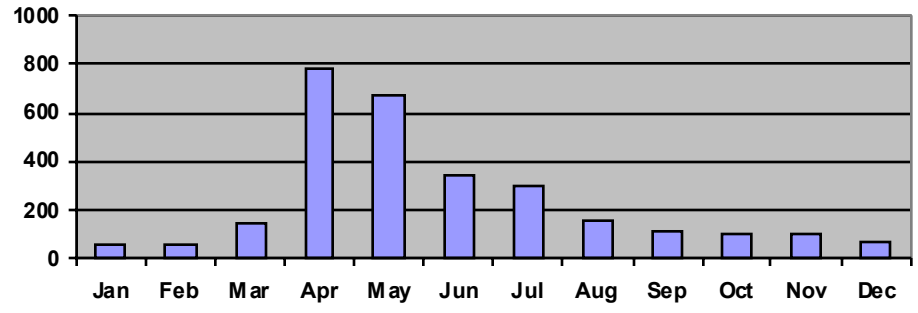

Figure 4: Mean monthly flows in cubic metres per second, Red River at Lockport (1964 – 2003).

[17] 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. 1556: v + 23p.

[18] "Terrestrial Ecozones, Ecoregions, and Ecodistricts of Manitoba", Land Resource Unit, Research Branch, Agriculture and AgriFood Canada. 1998

[19] Manitoba Energy, Science and Technology website: http://www.gov.mb.ca/est/climatechange/issues/affectus.html

Agriculture

In 2000, over 20 million hectares of cropland across the Prairies received commercial fertilizers, compared to just over one million that had manure applied.

Agriculture is an integral part of the culture on the Canadian Prairies and is a major contributor to the economy. In 2003, the total gross receipts for farms in Alberta, Saskatchewan, and Manitoba combined exceeded $16 billion.[20] In Manitoba alone, exports of agricultural products and food from Manitoba to points throughout the world exceeded $2.7 billion in 2001. 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.[21] Agriculture processing facilities, such as the three potato processing plants in Manitoba, 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.[22] In addition, an estimated 10 million hectares of land in the U.S. portion of the Red River Valley are also within the lake's watershed.[23]
In 2001, there were nearly 11 million cattle in the three Prairie Provinces, 5.6 million pigs, 24 million chickens and turkeys, and one-half million sheep. Other livestock combined – horses, goats, bison, elk, and others – totalled about 700,000.[24] There are an estimated 2.6 million livestock in the U.S. portion of the watershed.[25]

Proper management of the nutrient-rich manure produced by the rapidly growing livestock industry is essential. However, management of commercial fertilizer is also critical. In 2000, over 20 million hectares of cropland across the Prairie Provinces received commercial fertilizers. This compares to just over one million hectares that had manure applied as fertilizer in that same year.[26]

Agricultural drainage networks constructed and maintained by provincial governments, municipalities, and the 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 transmit runoff water and the nutrients they contain from fields and pastures directly into streams and rivers, and eventually into Lake Winnipeg.

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 the agriculture industry is a major player in responsible stewardship in the watershed.

[20] Statistics Canada, Canadian Statistics, Agriculture, Farm Finance, from Net Farm Income by Province.
[21] Statistics Canada, 2001 Census of Agriculture
[22] Statistics Canada, 2001 Census of Agriculture. Total area of farms, land tenure, and land in crops by provinces.
[23] "Red River Flooding: Short-Term Measures." International Red River Basin Task Force, International Joint Commission. 1997
[24] Statistics Canada, 2001 Census of Agriculture, Canadian Statistics, Agriculture, Livestock.
[25] United States Department of Agriculture data, 1997.
[26] Statistics Canada, 2001 Census of Agriculture, Canadian Statistics, Agriculture, Farms, Applications to the land.

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.[27] 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. Fish harvested from the lake include pickerel, whitefish, sauger, and goldeye. Most of the fish are marketed through the Freshwater Fish Marketing Corporation to consumers in western Canada, the United States, and Europe.

The Lake Winnipeg commercial freshwater fishery is the largest in Canada west of the Great Lakes.

During the 5-year period 1998/99 to 2002/2003, an average of 1,030 licensed fishers were employed in the Lake Winnipeg commercial fishery (Table 2). During that period, the total landed weight of fish harvested averaged nearly six million kilograms per year. The average annual landed value of the commercial fishing catch from Lake Winnipeg for that period averaged over $19 million, representing about 60 per cent of the total of all Manitoba commercial fisheries.

Table 2: Lake Winnipeg Commercial Fishery Statistics, 1998/99 to 2002/03.

Year	Weight (kg) Winter and Summer seasons combined	Value ($2003)	Approximate Number of Licensees
1998/99	4,825,600	15,700,717	938
1999/00	5,419,050	18,528,999	983
2000/01	6,217,850	21,691,502	1,059
2001/02	6,237,950	21,134,423	1,073
2002/03	6,204,150	20,894,400	1,095
5-yr Average	5,780,920	19,590,008	1,030
Source: Manitoba Water Stewardship, Fisheries Branch, 2004			

[27] From "Some Stories of the Fishing Industry on Lake Winnipeg" by Ted Kristjanson – Personal collection of Robert T. Kristjanson, 2004.

In addition to the licensed fishers themselves, the industry employs helpers on the lake, and 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 several Lake Winnipeg 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. Recreational fishing on the tributary rivers such as the Red and Winnipeg rivers is a highly valued industry, estimated at 17 million dollars of direct expenditures annually.[28] Sports fishing in the Dauphin, Mantagao, and Warpath rivers, and at Grand Rapids are dependent on Lake Winnipeg fish stocks.

It is important to ensure that the quality of water in Lake Winnipeg is such that it can continue to support its commercial, recreational, bait, and subsistence fisheries.

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.

It is important to ensure that the quality of water in Lake Winnipeg is such that it can continue to support these fisheries. It is also critical that the associated spawning and rearing habitat remain healthy. Although increased algal productivity can benefit fish communities 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 harmful toxic blue-green algal species, depleted oxygen supplies when these algal blooms die and decompose. Other algal species can significantly impact the commercial harvest by coating the mesh of fishing nets, making them visible to the fish and useless for fishing.

Lakeshore 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. They are 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.

The economic benefits are not confined to summer months. The establishment of first-class resorts attracts many visitors in winter as well for conventions, and sporting events, and other activities such long distance snowmobiling along the lake.

An expanding permanent population in communities surrounding the south basin of the lake in particular is strengthening the economies of the communities involved.

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.

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

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, and Arnes are examples of west shore cottage communities. In 2001, 10,200 cottages/residences were counted around the south basin of Lake Winnipeg.[29]

Many communities around the south basin of Lake Winnipeg are growing as a "baby boomer" phenomenon is taking place. Many retirees and their families are choosing to build permanent homes in lakeside communities. For example, the newly merged Municipality of Gimli has experienced close to a 10 per cent increase in population during the last Census period. With a permanent population base of approximately 5000, its $180 million in total taxable assessment gives it one of the highest per capita assessments in the Province. Most of this assessment relates to permanent and cottage subdivisions, resort development, and industry. Winnipeg Beach has a total taxable assessment of $27 million, almost all of which is lake-related.

Lake Winnipeg's quality beaches have established a reputation as popular destinations and excellent get-aways for local residents, other Manitobans, and visitors from around the world.

Recreation and tourism expenditures in the area along the Red River and surrounding the lake generate an estimated $110M per year.[30] 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 2002, more than 19,000 overnight campers registered at Hecla.[31] 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.

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.

Lake Winnipeg's quality beaches have established a reputation as popular destinations and excellent get-aways for local residents, other Manitobans, and visitors to the Province from around the world. For example, during the summer of 2002, more than 87,000 people visited Winnipeg Beach and nearly 400,000 visited the beach at Grand Beach Provincial Park.[32]

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 Canadian Coast Guard research 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.[33]

[29] 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.
[30] http://www.gov.mb.ca/waterstewardship/transboundary/positions/man-position/ib000403.html.
[31] Manitoba Conservation Annual Report for the year ending March 31, 2003.
[32] Ibid.
[33] Fisheries and Oceans Canada, Small Craft Harbours Program, Harbour Authorities - Manitoba.

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.

The water outflow pattern from Lake Winnipeg has been modified by storing water in the spring and early summer for use in the fall and winter (Figure 5). 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.

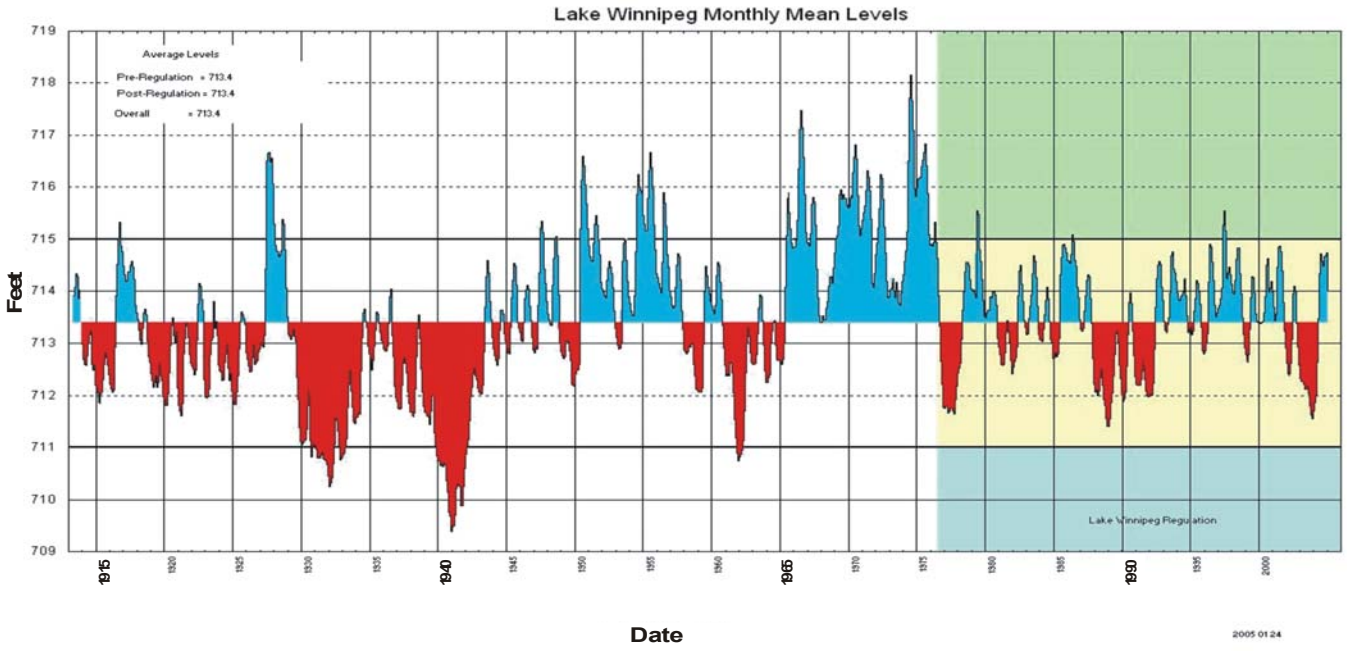

Figure 5: Lake Winnipeg monthly mean water levels (1912-2004). Source: Manitoba Hydro.

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 1997.

The importance of Manitoba Hydro to the provincial economy is apparent. Over the past 10 years, Manitoba Hydro has averaged about $365 million per year in export power sales. Total revenue from power sold in 2003/04 was in excess of $1.2 billion.[34]

[34] Manitoba Hydro-Electric Board 53rd annual report, for the year ending March 31, 2004.

Hydro-electric generation is considered by many to be a relatively clean source of energy. By using water power instead of fossils fuels, Manitoba avoids the production of an estimated 30 million tons of carbon dioxide per year.[35]

The impacts of altering the seasonal outflow from Lake Winnipeg are not fully understood.

The impacts of altering the seasonal outflow from Lake Winnipeg 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.

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.[36] These include Victoria Beach, Seymourville, and Berens River. Pine Dock has a community system supplied with well water which serves most of the community, but a few individual homes may being 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.

In some communities, individual households use water directly from the lake.

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

Large algal blooms in the lake pose challenges to communities for water treatment. 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.

Some of the fish packing plants on the lake use lake water for making ice and cleaning. The water is chlorinated before use.[37]

Natural Habitats

Lake Winnipeg has an immense intrinsic value, not only to the people 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 down the speed at which water moves off the land, and they may also 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.

[35] Edward Schreyer, Winnipeg, Canada. Personal communication, 2004.
[36] Manitoba Department of Aboriginal and Northern Affairs, Community Profiles, 2004.
[37] Pers. Comm. Stephen Kendall, Freshwater Fish Marketing Corporation, Winnipeg, Canada 2004.

Much of the marshland throughout the watershed has been drained to gain valuable, fertile 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.

Lake Winnipeg and its shores provide valuable habitat for rare species such as the Lake Winnipeg Physa snail and the piping plover.

The loss of 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. These marshlands have also been the traditional wild fur trapping grounds for Aboriginal peoples for centuries. In addition, they may provide a nutrient buffer between the lake and the landscape surrounding it.

Libau Bog is one of three 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. The 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 two Ecological Reserves on the lake are Long Point and Reindeer Island.

The Netley-Libau Marsh complex has received a national designated as an Important Bird Area, and is a candidate to be designated as a heritage marsh under Manitoba's Heritage Marsh Program.

The preservation of the value of the lake and its marshes as natural areas will hinge on responsible management throughout the watershed.

Lake Winnipeg Water Quality

Eutrophication of surface waters is a serious water quality problem for many lakes worldwide, and Lake Winnipeg is no exception. Eutrophication is the excessive growth of aquatic plants brought on by enrichment of surface waters with nutrients. The degree of eutrophication in a lake is assessed from changes in its transparency and chlorophyll-*a* content resulting from algae growth and its phosphorus concentration.[38] Studies conducted by the Province of Manitoba[39] 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. 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 control algal growth in Lake Winnipeg requires further evaluation.

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 and the algal community has shifted towards more troublesome blue-green species. Researchers at the University of Manitoba, analyzing satellite imagery, have shown that large algal blooms occur more frequently in the North Basin of Lake Winnipeg.[40] Members 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:

(1) the aesthetic appeal of the lake,
(2) safety of water for recreational uses and consumption,
(3) aquatic habitat,
(4) biodiversity, and
(5) long-term ecosystem sustainability.

The excessive growth of algae, particularly blue-green forms can have a detrimental effect on the Lake Winnipeg ecosystem. When algal blooms die, they are 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.

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.

The increased incidence of blue-green algae is troublesome because the toxins they can produce are potentially harmful to aquatic life, wildlife, pets, livestock, and people.

[38] North American Lake Management Society http://www.nalms.org/glossary/lkword_e.htm
[39] 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 No. 2002-04. Winnipeg, MB, Canada. 49 pp.
[40] Lake Winnipeg Satellite images, http://home.cc.umanitoba.ca/~gmccullo/LWsat.htm.

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

Limnological studies of Lake Winnipeg conducted in the late 1920s[41,42] and 1969[43] provide a baseline against which more recent ecosystem conditions can be assessed. Since first observations were made, water transparency has increased in the north, but has dropped in the south, and 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.[44,45, 46,47,48,49.] 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. Mixing by wind periodically reintroduces nutrients back into the water column.

Water quality changes in Lake Winnipeg reflect the increasing quantities of nutrients that are reaching the lake from natural landscapes and human activities in the watershed. Soils in the western prairie regions of the watershed are naturally rich in phosphorus and, when eroded, introduce this nutrient into surface waters. 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 naturally in the atmosphere (derived in part from agricultural sources) 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 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.

[41] Bajkov, A. 1930. Biological conditions of Manitoba lakes. Contrib. Can. Biol. Fish.5(12): 382-422.

[42] Bajkov, A. 1934. The plankton of Lake Winnipeg drainage system. Int.Rev. Gesamten Hydrobiol.Hydrogr. 31:239-272.

[43] 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.

[44] 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.

[45] 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.

[46] 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.

[47] 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.

[48] Lake Winnipeg Research Consortium 2002 and 2003 Science Workshop presentations

[49] 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.

Table 3 shows the amounts and proportions of total phosphorus and total nitrogen reaching Lake Winnipeg each year, on average, between 1994 and 2001 (modified from Bourne *et al.* 2002).[50] The table details estimates of point source and non-point source contributions. 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). The total phosphorus amount from various sources is comprised of dissolved and particulate forms of phosphorus, not all of which are equally usable or biologically available to algae.

The data presented in the table demonstrate that nutrient loading to Lake Winnipeg originates from a diversity of watersheds from both within and outside of the province. It is clear from these data that both municipal and industrial sources, as well as agricultural sources, are important contributors to nutrient loading to the lake. The contribution of loading from the atmosphere is significant, and is estimated to exceed that contributed by the City of Winnipeg.

Table 3: Summary of estimated nutrient loading to Lake Winnipeg (1994 - 2001) (rounded to the nearest 100 tonnes.) Source: Manitoba Water Stewardship, Water Quality Section.

Category	Average Total Nitrogen (t/yr) and per cent of Loading			Average Total Phosphorus (t/yr) and per cent of Loading		
Overall annual nutrient loading to Lake Winnipeg	**70,600 (100%)**			**6,600 (100%)**		
Upstream Jurisdictions	**45,100 (64%)**			**3,900 (59%)**		
United States (Red River)		19,000 (27%)			2,500 (38%)	
United States (Souris River)		1,000 (1%)			200 (3%)	
Saskatchewan and Alberta (Assiniboine and Saskatchewan)		8,300 (12%)			400 (6%)	
Ontario (Winnipeg River)		16,800 (24%)			800 (12%)	
Manitoba sources	**25,500 (36%)**			**2,700 (41%)**		
Manitoba point sources		5,000 (7%)			700 (11%)	
City of Winnipeg			3,600 (5%)			400 (6%)
All others			1,400 (2%)			300 (5%)
Manitoba watershed processes		11,000 (16%)			1,500 (23%)	
Estimated natural background*			7,600 (11%)			600 (9%)
Estimated current agriculture			3,400 (5%)			900 (14%)
Atmospheric deposition directly on Lake Winnipeg		9,500 (13%)			500 (7%)	

* Estimated natural background loading has not been estimated for other jurisdictions.

[50] 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.

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 1, page 6). Both the naturally fertile soils of this region and the intense residential and agricultural development contribute to this nutrient loading.

The relatively high contribution of nutrients originating from upstream jurisdictions accentuates the need to not only work in cooperation with neighbouring provinces and states to reduce loading to Lake Winnipeg, but also to lead by example.

Of the 64 per cent of the phosphorus load contributed by the Red River to Lake Winnipeg, just over one-half orginates in the United States (Figure 6).

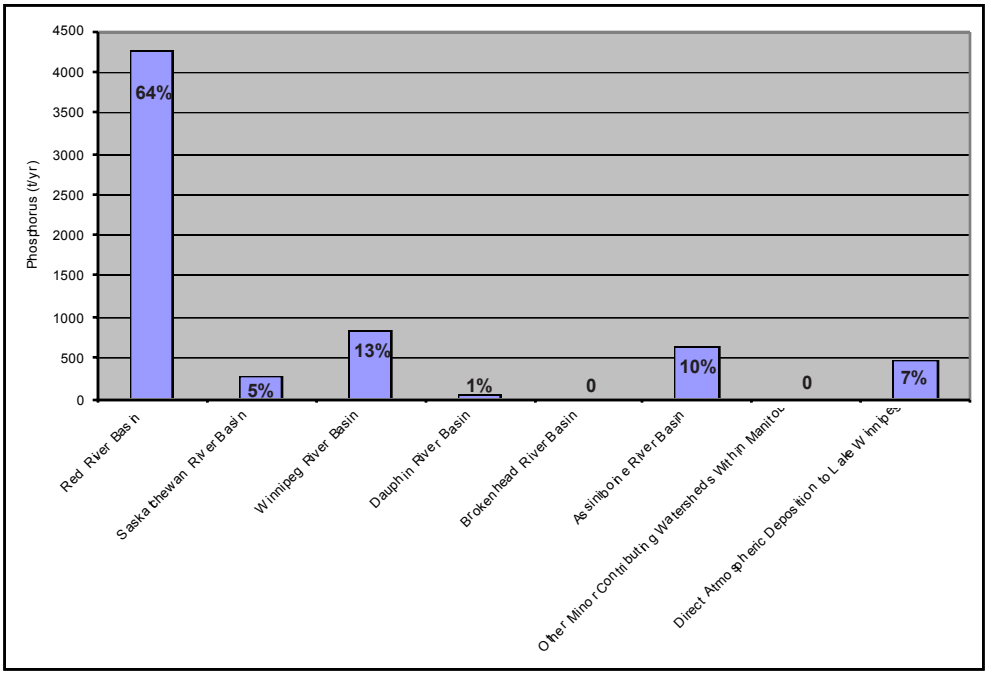

Figure 6: Phosphorus loading to Lake Winnipeg from contributing sources. This illustrates that the Red River contributes by far the largest phosphorus loading to Lake Winnipeg. Period of record 1994 to 2001. Source: Manitoba Water Stewardship, Water Quality Section.

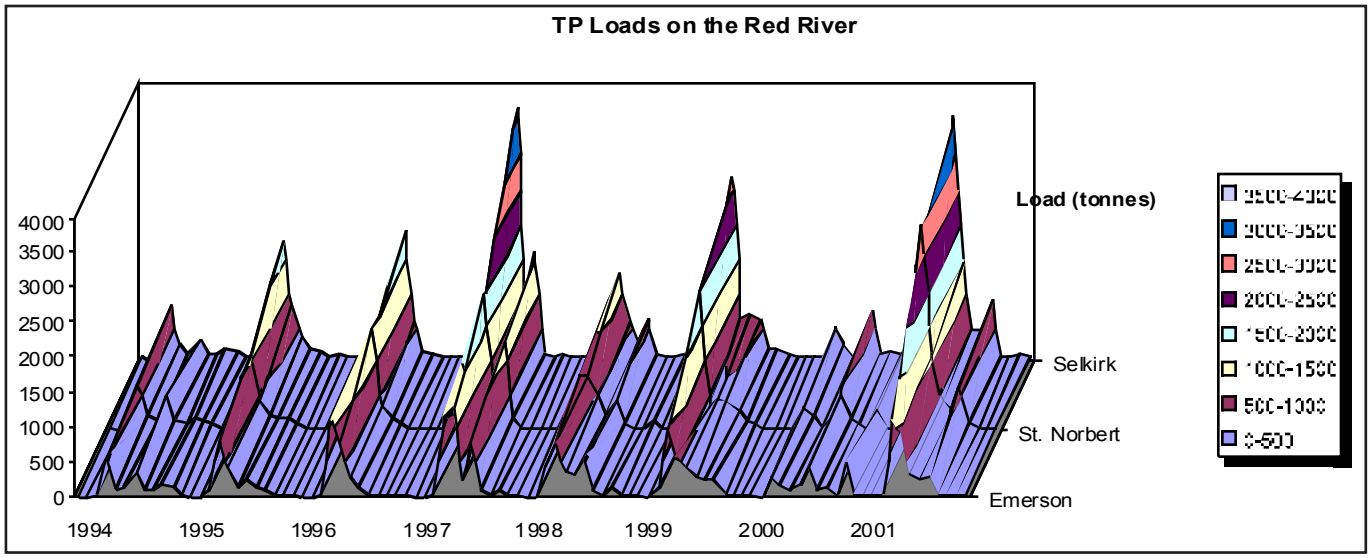

Figure 7: Monthly total phosphorus loads on the Red River at Emerson, St. Norbert and Selkirk for 1994 to 2001. Data adapted from Manitoba Water Stewardship and Water Survey of Canada.[51]

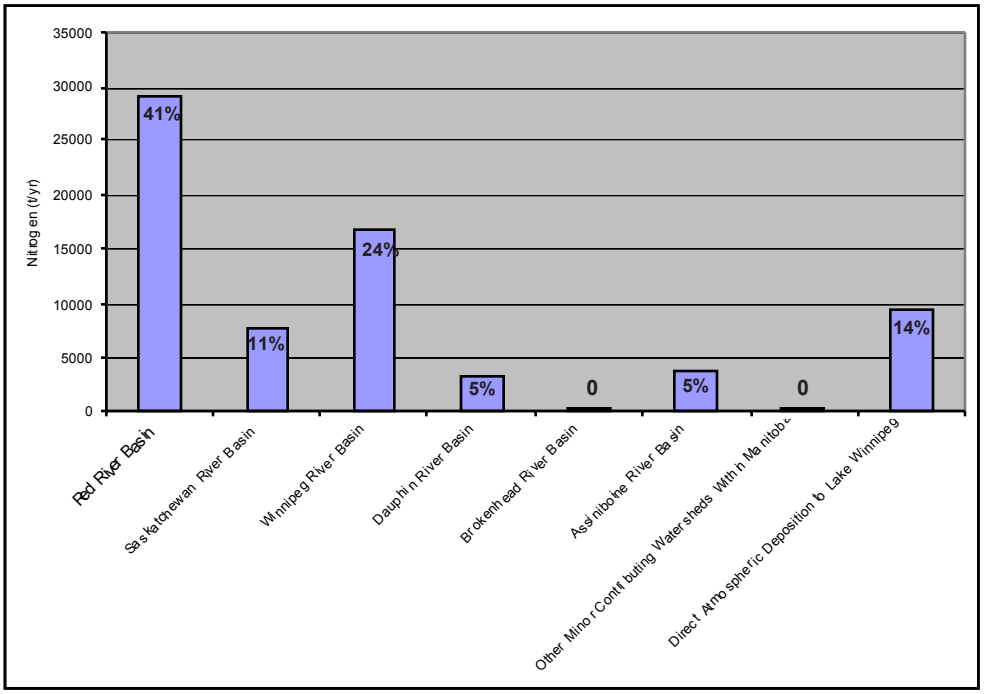

Figure 8: Nitrogen loading to Lake Winnipeg from contributing sources. Period of record 1994 to 2001. Source: Manitoba Water Stewardship, Water Quality Section.

Of the 41 per cent of the nitrogen load contributed by the Red River, two-thirds orginates in the United States (Figure 8).

Consistent with the trends observed for phosphorus, Figure 8 illustrates that the Red River contributes the greatest load on nitrogen to the lake, followed by contributions by the Winnipeg River, and then atmospheric deposition.

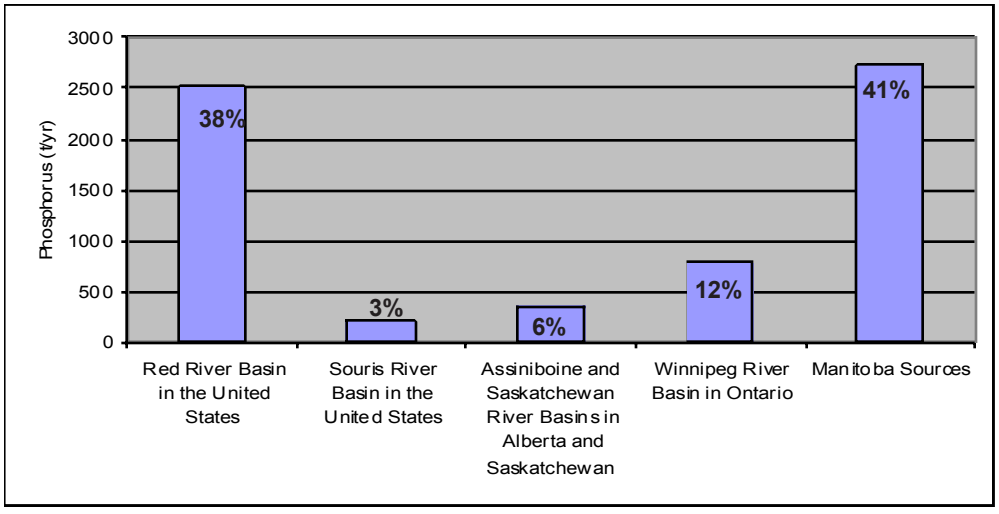

Figure 9: Relative contribution of phosphorus loading to Lake Winnipeg from upstream jurisdictions as compared to Manitoba sources. Period of record 1994 to 2001. Source: Manitoba Water Stewardship, Water Quality Section.

Figures 9 and 10 illustrate that phosphorus and nitrogen loading to Lake Winnipeg originates from both Manitoba sources and sources in upstream jurisdictions. The United States portion of the Red River watershed contributes a significant load of nutrients to Lake Winnipeg.

[51] Flaten, D., Snelgrove, K., Halket, I., Penn, G., Akinremi, W., Wiebe, B., and Tyrchniewicz, E. 2003. 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. http://www.manure.mb.ca/projects/completed/pdf/02-hers-01.pdf (verified 2004/01/11)

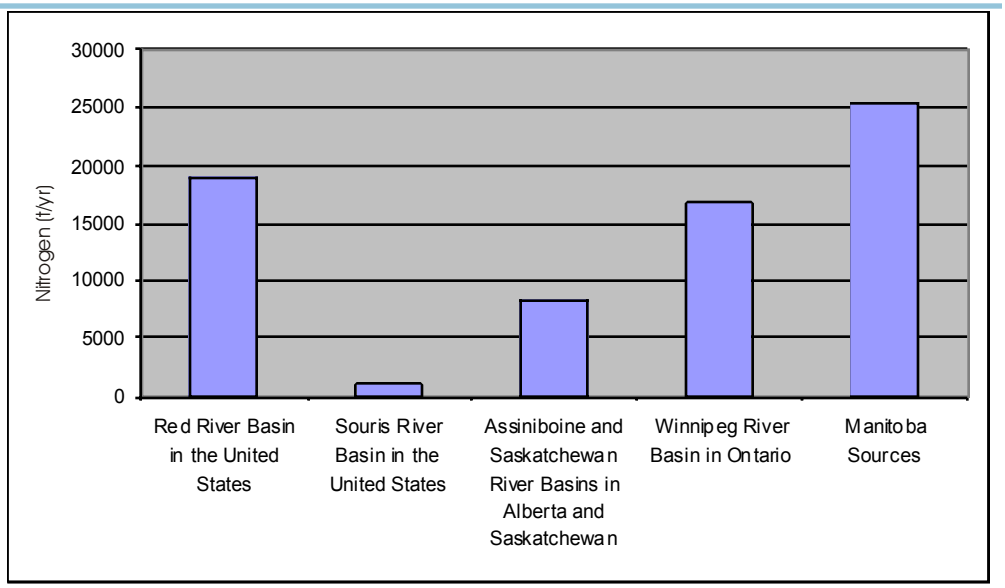

Figure 10: Relative contribution of nitrogen loading to Lake Winnipeg from upstream jurisdictions as compared to Manitoba sources. Period of record 1994 to 2001. Source: Manitoba Water Stewardship, Water Quality Section.

Figures 11 and 12 illustrate the contributions of nutrients to the lake from Manitoba sources (1994-2001). During that period, agriculture appears to have been the largest contributor of phosphorus, and the atmosphere the largest contributor of nitrogen.

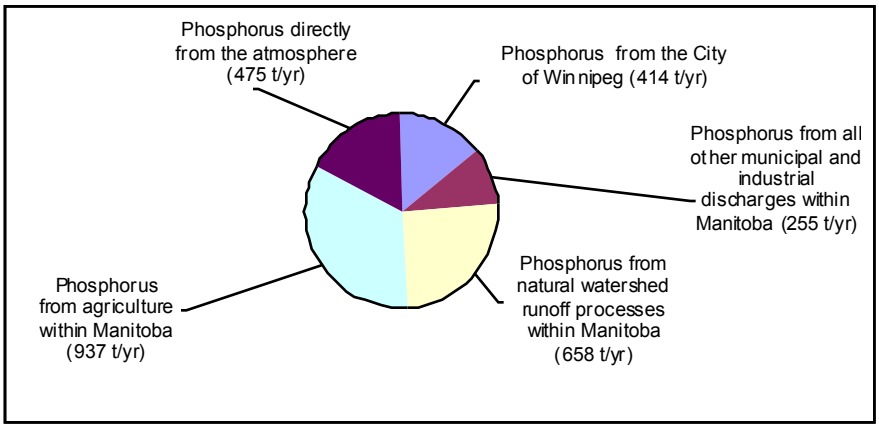

Figure 11: Relative contribution of phosphorus loading to Lake Winnipeg from Manitoba sources. Period of record 1994 to 2001. Source: Manitoba Water Stewardship, Water Quality Section.

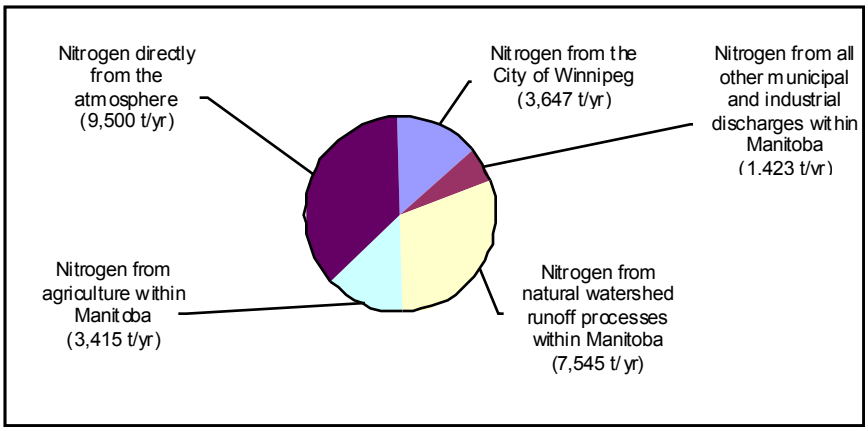

Figure 12: Relative contribution of nitrogen loading to Lake Winnipeg from Manitoba sources. Period of record 1994 to 2001. Source: Manitoba Water Stewardship, Water Quality Section.

Issues and Recommendations

Introduction

The Lake Winnipeg Stewardship Board recognizes that it may take some time for many of the strategies described on the following pages of this report to effect a decrease in nutrient loading and an improvement in water quality in the watershed and Lake Winnipeg. It is also recognizes that Lake Winnipeg will take some time to recover once nutrient loads are reduced. This reality strengthens the need to continue to implement actions now.

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

This section describes the specific issues related to agriculture, municipal, education, and scientific requirements considered by the Lake Winnipeg Stewardship Board and presents recommendations for addressing them. For each recommendation, a time frame for initiating implementation has been suggested. These are:

- High Priority (Short-term: 6 - 12 months)
- Medium Priority (Medium-term: 1 - 4 years)
- Long-term: 4 - 10 years

The recommendations presented in this report focus primarily on actions that may be taken within the Manitoba Government's jurisdiction.

But, as described earlier in this report, the Lake Winnipeg watershed extends well beyond the boundaries of Manitoba. With that in mind, the Manitoba Government is encouraged to implement actions, and to strengthen initiatives already underway, to approach transboundary and inter-jurisdictional issues affecting water quality in Lake Winnipeg in concert with the appropriate agencies.

1.0 Transboundary and Inter-jurisdictional Issues

Background

In Canada, the federal government has constitutional jurisdiction over transboundary waters. Manitoba has asked Canada 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 Red River basin from Minnesota and North Dakota. Cooperation has been initiated with Minnesota and North Dakota through the International Joint Commission's International Red River Board.

The Red River, while supplying a relatively small proportion of the total inflow of water to Lake Winnipeg, contributes the largest total volume of phosphorus compared to other rivers contributing to Lake Winnipeg. In addition, an assessment of long-term trends has indicated that phosphorus concentrations have increased at the International Boundary by about 20 per cent over the last three decades.

In mid-2004, the International Joint Commission's International Red River Board agreed as follows:

"Participating Red River Basin jurisdictions and water management agencies will strive towards reducing Red River nutrient loading to meet the interim goal of reducing nutrient loading into Lake Winnipeg by 10 % over the next five years."

A significant portion of the Lake Winnipeg watershed lies within the provinces of Alberta and Saskatchewan. Good communication with the governments of those two provinces is imperative since they will have a role to play in assisting to achieve long-term water quality objectives for nutrients in Lake Winnipeg.

The Winnipeg River is the single largest contributor of water to Lake Winnipeg. Increased phosphorus levels have been detected in the Winnipeg River near the Ontario/Manitoba border over the past three decades. Communication between the governments of Manitoba and Ontario will be key to addressing this issue and how it relates to water quality in Lake Winnipeg.

Water and sewer treatment facilities in many First Nations communities in the Lake Winnipeg watershed are 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 communities within the watershed.

Recommendations

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

1.2 The Manitoba government needs to 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.

1.3 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.

1.4 The Province of Manitoba needs to strengthen its working relationship with Canada on First Nation issues related to impacts on water quality, and each should be prepared to accept their full fiduciary responsibilities as per their constitutional obligations.

Timeframe: Short-term
Who should implement: Province of Manitoba

2.0 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 accumulate 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.

Recommendations

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

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

2.3 Legislation should be reviewed and revised where appropriate to include small as well as large livestock operations, and to ensure that new or expanded confined operations are constructed to meet contemporary environmental standards.

2.4 Government should intensify its agriculture extension programs (such as those offered by Manitoba Agriculture, Food, and Rural Initiatives) and those delivered in partnership with existing or new 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.

Timeframe: Medium-term
Who should implement: Province of Manitoba

3.0 Livestock Access to Riparian Areas and Waterways

Background

Some livestock are allowed direct access to streams and other water bodies. This results in the direct deposition of manure and related nutrients into watercourses. Moreover, when shoreline vegetation is trampled, slumping of banks is increased, and erosion of nutrients into the watercourse occurs. Controlled access to riparian zones allows the natural vegetation to stabilize the shoreline and reduce erosion and can allow the natural vegetation to be harvested, 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.[52]

Recommendation

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

Timeframe: Short-term
Who should implement: Province of Manitoba

4.0 Soil Fertility Testing on Agricultural Land

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 commercial fertilizers in excess of agricultural requirements, wind erosion, transport of sediment-bound nutrients, and dissolved nutrients during rainfall events and spring runoff.

Producers with inadequate soil test results may be applying commercial fertilizer and animal manure at rates either above or below agronomic requirements. When fertilizers are applied at rates greater than agronomic requirements, the potential for nutrient loss increases.

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.[53] However, even producers who soil test regularly 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.

Proper soil testing can ensure fertilizer application rates, whether commercial fertilizer or animal manure, are appropriate for crop needs and based on the amount of nutrients already in the soil. In the case of manure, testing of the manure is also necessary in order to determine its nutrient concentration. Proper application rates help to prevent excess nutrients from moving into the water system, either by direct runoff or into groundwater. The producer may also realize economic benefits by avoiding expenditures on un-needed fertilizers.

It is important to ensure that soil test results are determined by appropriate tests conducted by accredited laboratories. Currently, test methods vary in laboratories across Manitoba and often differ from those in other jurisdictions providing service to Manitoba producers. It is important that the best available agronomic advice be provided to Manitoba producers.

[52] 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)

[53] "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

4.1 Develop strategies that promote and support annual soil testing. Provide the tools necessary to make sound agronomic decisions.

4.2 Consider incentives and subsidies for producers conducting soil testing, similar to private drinking water testing subsidies.

4.3 Ensure that soil test laboratories are accredited, and are using accredited analytical methods and fertilizer recommendations that are appropriate for Manitoba soil, crop, and climatic conditions. Soil test recommendations need to reflect the difference between commercial and organic fertilizer use.

4.4 Ensure that soil test recommendations and reports are user-friendly and informative to producers.

4.5 Enhance education on the economic and environmental benefits of soil testing.

Timeframe: Short-term
Who should implement: Province of Manitoba.

5.0 Matching Nutrient Inputs with Crop Nutrient Requirements and Exports, and Establishing Soil Phosphorus limits

Background

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

With the expansion of the livestock industry in Manitoba, there has been a corresponding increase in the amount of organic fertilizer (manure) produced. While 7.3 million Manitoba hogs were placed on the market in 2003[54], cattle are still the most significant contributor of livestock manures. Estimates of manure production in Manitoba indicate that cattle and hogs supply most of the 25 million kilograms of manure phosphorus produced annually, of which almost 70 per cent is produced by cattle.[55]

In some regions of intensive livestock production, the import of large quantities of animal feed results in a substantial accumulation of nitrogen and phosphorus in the region.[56] As a result, in some areas of Manitoba, organic fertilizer production exceeds the rate of crop removal of phosphorus from the land base in some years.[57] Conversely, other areas of the province have nutrient-poor soils and could benefit from more use of organic fertilizers.

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, phosphorus is often applied at rates that exceed agronomic requirements. A build-up phosphorus in the soil can lead to soil phosphorus saturation and the subsequent release of phosphorus when water travels through the soil matrix.

[54] Manitoba Agriculture, Food and Rural Initiatives statistics.

[55] Flaten, D., Snelgrove, K., Halket, I., 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.

[56] 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.

[57] Flaten, D., Snelgrove, K., Halket, I., 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.

Commercial fertilizer must also be applied in a sustainable manner so that loss of nutrients from agricultural land is avoided. About 85 per cent of phosphorus applied to agricultural land comes from commercial fertilizer. In 2000, over 20 million hectares of cropland across the Prairie Provinces received commercial fertilizers. This compares to just over one million hectares that had manure applied as fertilizer in that same year.[58] For the Prairies as a whole, the amounts of nitrogen and phosphorus applied to agricultural land in 2002 were approximately four times Manitoba's totals.[59] Fertilizer use in Western Canada has increased an estimated six per cent per year since 1990[60] generally matching the increase in crop productivity and nutrient removal over the same period.[61]

In Manitoba, commercial fertilizer use has risen substantially over the past three decades. Nitrogen and phosphate application increased from about 25,000 tonnes each in 1965 to 309,000 tonnes of nitrogen and 106,000 tonnes of phosphates (46,000 tonnes of phosphorus) by 2002. This increase in fertilizer application has generally been matched by an increase in crop removal of nitrogen and phosphorus (Figure 13); therefore, fertilizer application and crop removal of these nutrients is generally balanced.[62,63]

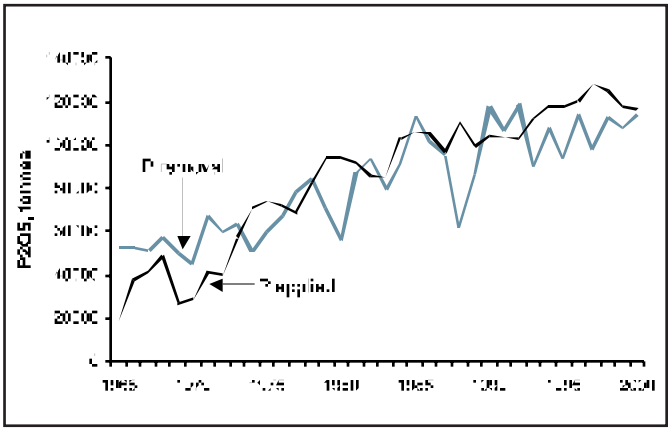

Figure 13: Crop removal and replacement of fertilizer phosphate (P_2O_5) in Manitoba from 1965 to 2000. This data assumes that P_2O_5 is removed in harvested grain and hay, and straw is returned to the soil.[64]

Some Manitoba soils are probably able to accept commercial fertilizer or manure applications of phosphorus at rates which exceed crop requirements for several years. However, soils do not have an infinite capacity to store phosphorus without creating environmental hazards.[65] 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 fertilizer or manure phosphorus application until soil phosphorus levels return to acceptable levels.

Until site-specific limits can be developed for Manitoba, an interim regulatory limit should be established. Manitoba Conservation's Phosphorus Expert Committee should be directed to recommend an interim regulatory limit by March 2005. This timeframe will then allow sufficient time for a public review period prior to the release of the revised Manitoba Manure and Mortalities Management Regulation (No. 42/98), scheduled for amendment by March 2006.

A terrestrial nutrient budget should be developed for Manitoba that would consider all agricultural nutrient sources (manure, feed, inorganic fertilizer, etc.) and all agricultural nutrient exports (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. A terrestrial nutrient budget would help livestock producers determine how much land is required to properly utilize the organic fertilizer generated. A terrestrial nutrient budget would assist local governments in siting intensive livestock operations and in identifying areas where valuable organic fertilizer can be best utilized with minimal environmental risk.

The Province of Manitoba has asked neighbouring jurisdictions reduce to their nitrogen and phosphorus loads in rivers entering Manitoba. Manitoba should display leadership in setting regulatory soil phosphorus limits that minimize the risk of phosphorus and nitrogen losses from agricultural lands and thereby, reduce loading to Lake Winnipeg.

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

[59] Canadian Fertilizer Consumption, Shipments and Trade, 2001/2002, April 2002. Korol, Maurice, Farm Input Markets Unit, Farm Income and Adaptation Policy Directorate, Agriculture and AgriFood Canada.

[60] Saskatchewan Interactive. Saskatchewan Centre for Soils Research, College of Agriculture, University of Saskatchewan. December, 2002.

[61] 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.

[62] 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.

[63] 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.

[64] Ibid.

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

Recommendations

5.1 The Province should adopt an interim soil phosphorus regulatory limit for agricultural land in Manitoba by March 2005. This interim regulatory limit should consider soil phosphorus limits set by neighbouring jurisdictions such as Minnesota.

5.2 A terrestrial nutrient budget should be developed for Agro-Manitoba which would assist producers, municipalities, and regulators in siting intensive livestock operations, and managing manure.

5.3 Where excess nutrients are being generated, practical options for exporting manure to nutrient-deficient areas must be considered.

Timeframe: 5.1 – Short-term
5.2 and 5.3 – Medium-term
Who should Implement: The Province of Manitoba in cooperation with Universities, Manitoba Conservation's Phosphorus Expert Committee, and others

6.0 Evaluation of Beneficial Management Practices as Nutrient Reduction Strategies

Background

Beneficial management practices (BMPs) are actions taken by 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 also need to help ensure the sustainability of resources for agricultural production. The effective use of beneficial management practices will benefit both the producer and society-at-large.

The implementation of 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.[66] 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.[67] The effectiveness of beneficial management practices in trapping particulate nutrients needs to be evaluated, as well as the undesirable potential of these practices to retain or release dissolved nutrients to watercourses through the growth and decomposition of plant material, respectively. Evaluations should be conducted for practices such as riparian zones, grassed waterways, constructed wetlands, and shelterbelts. The societal benefits of these practices should be considered when evaluating how to fund such projects.

In areas where there is a demonstrated loss of particulate forms of nutrients from agriculture cropland, beneficial management practices should be developed to reduce this source of nitrogen and phosphorus loading to the Lake Winnipeg watershed. Not all beneficial management practices will be equally effective in different regions of the province. Beneficial management practices need to be critically reviewed 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 work of the BMP Task Force of the Manitoba Phosphorus Expert Committee will be helpful in this area. However, more needs to be done to understand and to reduce non-point contamination from agricultural land.

[66] 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.

[67] 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.

Recommendation

6.1 Undertake focused research to determine what beneficial management practices appropriate for Manitoba conditions would be effective in reducing nutrient loading to the Lake Winnipeg watershed.

Time frame: Medium-term
Who Should Implement: Province of Manitoba, Agriculture and Agri Food Canada, Universities, and water research institutes

7.0 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.

Studies in Manitoba and elsewhere have demonstrated that tile drainage water contains leached nutrients, including environmentally significant concentrations of phosphorus in some cases.[68] It is important to explore measures that reduce the export of these plant nutrients off-site.

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

7.1 Where feasible, tile drainage water should be directed into retention basins, held and, reused when supplemental water is required for agricultural land.

7.2 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.

7.3 The process of obtaining a permit to install tile drainage should be reviewed with the aim of ensuring that water quality issues are considered in addition to water quantity.

Timeframe: Short-term
Who Should Implement: Province of Manitoba

[68] 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.

8.0 Integrated Watershed Management Planning and Management

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. However, policy direction from the Province must be clearly defined.

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 consistent watershed management plans throughout the Manitoba portion of the watershed.

Recommendations

8.1 Manitoba Water Stewardship should establish Watershed Management Districts province-wide that would be responsible for preparing, implementing, and regulating watershed management plans as outlined in Part 3 of the proposed Water Protection Act.

8.2 Watershed Management Districts should be established based on natural watershed boundaries rather than municipal boundaries.

8.3 Watershed Management Districts should be responsible for managing all drainage issues, including in-field drainage activities and the drainage of natural wetlands. The Province should retain responsibility for issuing permits for these projects.

Time line: Short-term
Who should implement: Province of Manitoba

9.0 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. 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.

Addressing drainage issues will be an important part of the Integrated Watershed Management Planning process (see Recommendation 8.3 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 a rate which imposes an environmental risk 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.

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.

Recommendations

9.1 A review of agricultural land drainage networks on a watershed basis should be undertaken. 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 should be explored to determine their effectiveness in reducing nutrient loading along drains. This work would include a review of the feasibility of acquiring marginal land and wetland areas that could serve as natural filters for drain water.

9.2 Drain construction and maintenance practices should be reviewed to minimize nutrient loss to the watercourse. This would include exploring vegetation harvesting opportunities in areas where this is not already done.

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

Timeframe: Short-term
Who Should Implement: Province of Manitoba (Conservation Districts and Watershed Management Authorities)

10.0 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 imperious surfaces such as sidewalks and driveways. There is a significant risk that this “over-spread” will be washed into storm drains which lead to rivers and lakes.

As of January 1, 2004, a law came into effect in the St. Paul and Minneapolis metropolitan area in Minnesota that restricts 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 illegal to spread fertilizer on hard surfaces such as sideways and driveways. 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.

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.

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.

Recommendations

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

10.2 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.

10.3 Canada should institute a consistent policy for the use of fertilizers for cosmetic use on all Federal lands, including National Parks and First Nation communities.

Timeframe: Short-term
Who Should Implement: Province of Manitoba, Canada

11.0 Water Usage, Sewage Treatment, and Related Financing

Background

It is important for the Province to work towards ensuring that all Manitobans have adequate sewage treatment systems. One method of improving sewage treatment is to reduce the load on the system. The volume of wastewater generated, and therefore the amount entering the sewage treatment system, is proportional to the amount of water used.

Water conservation could 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. As the cost to the consumer increases, it may be expected that water consumption would decrease, as would the amount of wastewater generated. Therefore, the cost of wastewater treatment would decrease, as facilities could be designed smaller. Providers of these services would have an adequate revenue source with which to operate. Metering is seen as a valuable tool to help individuals determine their water use and wastewater generation.

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

Recommendations

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

11.2 Manitobans should pay the true cost of the water they consume, and the true costs of the services required to adequately treat wastewater.

11.3 Utility reserves must be established such that monies are available when utility upgrades are required. Monies collected for these reserves need to be protected from competing financial needs.

11.4 In order to promote efficient water use and effective waste treatment, metering of regional water supplies should be implemented and rates should be based on consumption, and the true cost of providing the service.

11.5 Extraneous groundwater inflow into wastewater collection systems needs to be investigated and minimized were feasible.

Timeframe: Medium-term
Who should Implement: Province of Manitoba

12.0 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. 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 the new 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.

The Province, through the Manitoba Water Services Board, should promote the establishment of regional wastewater treatment facilities. Provincial funding should be provided to specific regional projects, rather than to individual municipalities to encourage collaboration among municipalities. For example, the cost of piping could be cost-shared, or the purchase of irrigation equipment for effluent irrigation could be cost-shared by more than one municipality.

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 should be developed for these areas. 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.

As treatment facilities become more advanced, the expertise and number of operators needs to increase. Regional systems are better able to accommodate this expanded technical expertise need.

Recommendations

12.1 The Province of Manitoba should promote regionalization of wastewater treatment systems.

12.2 Provincial funding through the Manitoba Water Services Board should be explicitly tied to an evaluation of regionalization opportunities. Funding priority should be given to those systems that are employing nutrient removal technologies.

12.3 Comprehensive sewage management plans should be developed for areas of the Province where existing sewage treatment practices (septic fields, holding tanks, lagoons) are not meeting environmental standards.

12.4 There is a need for the Province and Canada/Indian and Northern Affairs Canada to work together more cooperatively on regional sewage management plans.

Timeframe: Medium-term
Who should Implement: Province of Manitoba, Indian and Northern Affairs Canada and First Nation Communities

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

Background

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 majority of the population lives within the three large centres of Winnipeg, Portage la Prairie, and Brandon. Plans are either in place or are being developed to ensure that nutrient reductions are achieved at the large wastewater treatment facilities serving these population centres.

For example, a licence was issued in early September 2004 for the City of Winnipeg's west end wastewater treatment facility requiring that nutrient reductions occur by the end of 2006. It is the Board's understanding that other licences will follow for Winnipeg's south end and north end facilities that will require implementation of nutrient controls with full implementation targeted over the next eight to ten years.

The Board understands that the City of Winnipeg, by putting nutrient controls in the west end plant and centrate control at the north end plant, will reduce its contribution to Lake Winnipeg by 2006 consistent with the interim targets set out in the Lake Winnipeg Action Plan.

The City of Brandon is developing a regional wastewater treatment plan that envisages providing wastewater treatment services including nutrient controls for both its municipal and industrial components. Should the Maple Leaf Meats facility in Brandon expand to a second shift of operation, it will be required to implement full nutrient reduction.

The City of Portage la Prairie is concluding a study of the downstream portion of the Assiniboine River to Headingley. The Environment Act Licence recently issued to the City of Portage and which includes wastewater treatment from the food processing sector in the city is required to be re-opened in 2006 in order to be informed by the outcome of the Assiniboine River study. Nutrient controls will then be reflected in the City of Portage la Prairie's new licence and will need to be protective of both the Assiniboine River and Lake Winnipeg.

Nutrient control strategies have not yet been developed for the large number of the smaller communities in Manitoba.

The Board recognizes that the priority for nutrient abatement at municipal wastewater treatment systems should be on phosphorus followed by nitrogen. The benefits of phosphorus reduction to the freshwater environment are clear and unequivocal, particularly for limiting the growth of blue-green algae. However, the benefits of nitrogen removal remain controversial.

With regard to phosphorus, the Board understands that existing discharge limits for the City of Winnipeg's west end sewage treatment facility and those contemplated for the Maple Leaf Meats facility in Brandon are based upon the application of best practicable technology to achieve a concentration of phosphorus in the effluent of not more than 1 mg/L. However, it may be necessary to achieve greater reductions of phosphorus through the application of best available technologies.

The Manitoba Nutrient Management Strategy commits to developing water quality objectives for both nitrogen and phosphorus. Once completed, it is expected that the relative importance of both these major nutrients in Manitoba's various receiving environments will be reconciled, that ecologically-based targets will be set at least for the two major nutrients, and that these targets will form the basis for nutrient abatement programs.

Recommendations

13.1 The Province of Manitoba needs to finalize its Nutrient Management Strategy along with developing a comprehensive prioritized plan for nutrient abatement for all wastewater treatment facilities in the watershed. The comprehensive plan needs to consider whether the application of best practicable technology is sufficient for reducing effluent phosphorus concentrations to 1 milligram per litre or whether best available technologies need to be employed to achieve greater reductions and the plan needs to consider where nitrogen removal is necessary and to what level.

13.2 Nutrient reduction strategies such as biological treatment, 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.

13.3 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.

Timeframe: Short-term: 13.1 and 13.3,
Medium-term: 13.2
Who should Implement: Province of Manitoba

14.0 Environmental Planning for New Urban and Rural 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, 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. In rural areas it will be important to ensure that there is good communication and coordination between Conservation Districts, Planning Districts, and the new Watershed Planning Authorities.

Further investigation and evaluation is required on new emerging technologies in alternative waste treatment systems.

Recommendations

14.1 The Province and municipalities should establish an integrated land and water planning process that is environmentally conscientious and that ensures planned and orderly growth with respect to sewer and water services. This process would encourage planning, rather than discourage growth.

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

14.3 Developers should be required to consider the cost of the required water and wastewater treatment services and ensure that these are built into the costs of the development (full cost recovery). It is expected that different strategies for wastewater treatment would be required depending on the local conditions.

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

14.5 Developers should be responsible for land drainage issues for new residential developments which consider the nutrient impacts of the development and build in strategies to minimize these impacts such as storm water retention and treatment, and erosion control. Developers should be required to implement strategies to retain rainwater and reduce runoff.

14.6 All new urban and rural development projects should be required to incorporate low impact, environmentally-conscious concepts into the design with the aim of reducing environmental service costs to minimize pollution loads. These may include re-use of rainwater, reducing runoff by incorporating more permeable surfaces, and retention ponds.

Timeframe: Medium-term
Who should implement: Province of Manitoba, Municipalities, and Planning Districts

15.0 Environmental Licensing Fees

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 license which permits 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 license may be required. The cost of the license fee and a consultant to prepare the proposal may be significant.

Recommendation

15.1 The Province should look for opportunities to reduce the financial disincentives to those proponents voluntarily improving waste management practices such that the risk of nutrients and other contaminants reaching surface water is reduced. The Province could consider establishing a fund, perhaps within an existing funding program (e.g. Sustainable Development Innovation Fund, or 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.

Timeframe: Short-term
Who should Implement: Province of Manitoba

16.0 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 is one option that should be explored for municipal and industrial lagoons. Rather than discharging nutrient-rich effluents directly into waterways, it is preferable to retain those nutrients on land where they can be used for terrestrial 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 Environmental License are achieved, effluent irrigation 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 such as the town of MacGregor. The potato processing facility at Carberry is currently undertaking a two-year feasibility study of disposing of its nutrient-rich process water through effluent irrigation.
A confounding problem with effluent irrigation occurs when the wastewater contains high levels of sodium. 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.

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.

Recommendations

16.1 Effluent irrigation should be promoted and encouraged where feasible, and in consideration of potential health risks.

16.2 Alternatives to the water softener sodium chloride should be explored to ensure wastewater is more suitable for land application (e.g. Potassium chloride).

Timeframe: 16.1: Short-term
16.2 and 16.3: Medium-term
Who should Implement: Province of Manitoba

17.0 Leachate Handling

Background

Leachate collected from municipal solid waste disposal facilities is usually of strong organic content and may contain a wide range of potentially hazardous substances such as 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 it be managed carefully to prevent upsets in the biological processes in sewage treatment facilities. 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. Work needs to be done to substantially reduce the amount of toxic substances from being disposed of in landfills.

Recommendations

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

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

Timeframe: Medium-term
Who should implement: Province of Manitoba

18.0 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 have the same impact. Septage illegally disposed of into ditches or streams can be washed into the drainage network leading into major watercourses. As the material is broken down in water, it exerts a large biological oxygen demand, that is, it consumes a large amount of oxygen from the water around it. There needs to be a focused educational program for septage generators and haulers regarding the impact of improper disposal of septage, and 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. The phosphorus content of greywater will vary depending upon the amount of phosphorus-based cleaning products being used. Food scraps and other waste will also contain some phosphorus. Re-use of greywater is an option that needs further investigation. There may be some opportunities to re-use greywater for activities such as lawn watering.

Options for safe recycling of the nutrients in septage and greywater need to be considered where sufficient land is available.

Recommendations

18.1 The Province should develop a strategy for handling of 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. Strong deterrents for those who illegally dispose of septage in ditches or other inappropriate locations are required.

18.2 The Province of Manitoba should undertake a review of septage and greywater re-use being employed in other jurisdictions to assess its feasibility for Manitoba conditions. Health risk issues associated with these re-uses need to be fully explored.

Timeframe: Short-term
Who should implement: Province of Manitoba

19.0 Water Use Efficiency

Background

Excess water in biological and chemical sewage treatment facilities interferes with treatment efficiency and does not improve the final effluent quality. In lagoon facilities, excess water shortens the retention time and may be one of the factors leading to the need for emergency discharges or the need for unnecessary storage expansion.

In septic field systems, excess water may result in field failure and effluent may be transported to the surface soil. In order to reduce the pressure on treatment facilities, more needs to be done to ensure water conservation is practiced in Manitoba.

Recommendations

19.1 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.

19.2 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 water flow alternatives.

19.3 All levels of governments 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.

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

19.5 Ensure that water users on regional water systems have water meters and are billed on a water use basis, at the full cost of the water supply.

19.6 Consideration should be given to applying higher rates as usage increases. Reduced water rates for large commercial and industrial consumers should be reconsidered.

Timeframe: Medium-term
Who should implement: Province of Manitoba, and Municipal Governments, and First Nations Communities/INAC

20.0 Using Constructed Wetlands for Nutrient Removal

Background

A constructed wetland is a man-made marsh designed to receive and purify wastewater from sources such as livestock facilities or municipal sewage. The use of constructed wetlands as a nutrient abatement strategy for wastewater shows promise. Constructed wetlands can serve as nutrient sinks, that is, they absorb nutrients. These nutrients are taken up and stored by the plant material growing in the wetland.

But, constructed wetlands can also serve as sources of nutrients to downstream watercourses when nutrients from decaying vegetation are released and lost from the system. Constructed wetlands for wastewater treatment need to be managed in such a way to ensure they continue to function as nutrient sinks and not sources of nutrients.

It is uncertain 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 further investigated.

Examples of constructed wetlands such as the facilities at Roblin, Oak Hammock Marsh, Fort Whyte Centre, and livestock operations in the Interlake need to be further investigated to evaluate their effectiveness.

Recommendation

20.1 The Province of Manitoba should undertake a focused review of the effectiveness of constructed wetlands as a nutrient abatement strategy. The study should consider local climatic conditions, as well as management requirements such as vegetation harvesting.

Timeframe: Short-term
Who should implement: Province of Manitoba, academic institutions, PFRA, and others

21.0 Storage Requirements for Municipal Lagoons

Background

In Manitoba, municipal sewage lagoons are generally required to be constructed with sufficient capacity to store wastewater for 220 days. This is currently the case with older facilities in the province. A longer storage capacity for municipal sewage lagoons would expand the window of opportunity for effluent irrigation and would allow for an enhanced level of treatment. Moreover, it would allow more resiliency during wet periods, reducing the risk of all-too-frequent emergency discharges.

Toward this aim, nutrient data should be gathered from Manitoba and other jurisdictions with similar climates to determine what benefits may be realized from a 400-day storage period as compared to 220 days.

Recommendation

21.1 The Province should explore the option of expanding the storage capacity of new and expanded lagoons to 400 days. Water conservation strategies will assist municipalities in realizing this capacity.

Timeframe: Medium-term
Who should implement: Province of Manitoba

22.0 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.

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

Recommendations

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

22.2 Monitoring should be conducted 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.

Timeframe: Short-term
Who should implement: Municipal Governments, Province of Manitoba

23.0 Nutrient Management Issues on First Nations Communities

Background

Many First Nation 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. Other sources of nutrient losses from these communities include stormwater runoff.

Recommendations

23.1 Sewage treatment on First Nation communities must be upgraded to meet both public health and environmental standards. As a minimum, Provincial standards should be communicated to Indian and Northern Affairs Canada and First Nation communities to be used as guidelines.

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 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 Nation communities. The strategies should include a strong educational component.

23.4 The Province 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 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.

Timeframe: Short-term
Who should implement: Province of Manitoba in liaison with First Nations Communities, Indian and Northern Affairs Canada

24.0 Septic Field Alternatives

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.

Many septic fields are old and are in need of replacement. In addition, many fields are undersized as homes and cottages may have been expanded in size and water consumption increased since the fields were installed.

Resources for inspecting existing septic fields are limited and the inspections are often complaint-driven.

In areas of concentrated rural residential development where lot sizes are relatively small, septic systems may not be the most appropriate waste treatment strategy.

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 peat moss treatment systems, and constructed mini wetlands. The option of separating greywater from blackwater, and the reuse of greywater should be explored. An annual levy could be collected from septic field owners which would help pay for comprehensive inspections and maintenance of the database. A focused educational campaign should be undertaken to provide guidance on how to properly maintain septic fields, and how to recognize when they are failing.

Recommendations

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

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

24.3 The Province 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 in the Province.

Timeframe: Short-term
Who should implement: Province of Manitoba

25.0 Manitoba Water Services Board

Background

The Manitoba Water Services Board helps rural residents 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 provides technical and financial assistance to municipalities and water co-operatives. The 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 to procure, on behalf of the municipalities, all services including the hiring of private engineering consultants for design, and the tendering and awarding of contracts for installation of infrastructure works. The Board takes into account engineering feasibility, legal requirements, capital and operating costs, and development plans for the area and the unique requirements of the community.

Currently, there is insufficient funding available to assist all the communities that require sewage treatment upgrades. It is recognized that nutrient removal upgrades will require considerable expenditures of funds.

Recommendations

25.1 The Province of Manitoba needs to explore options for how nutrient removal upgrades may be best funded, and how Provincial funding through the Manitoba Water Services Board should support the commitments in the Lake Winnipeg Action Plan.

25.2 Manitoba is urged to establish criteria to assist the Manitoba Water Services Board in prioritizing funding requests that would favour implementing regional options for wastewater treatment facilities.

Timeframe: Medium-term
Who should implement: Province of Manitoba

26.0 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 adds 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

26.1 The Province 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.

Timeframe: Medium-term
Who should implement: Province of Manitoba working with cities and municipalities, and in collaboration with a professional water and wastewater association

27.0 Use of Alum as a Nutrient Control Strategy

Background

Alum has been used successfully to reduce phosphorus in wastewater treatment facilities, both in mechanical plants and lagoon systems. 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 aluminum.

Recommendation

27.1 A review of the use of alum in wastewater treatment should be conducted. This review would evaluate the resultant concentration of aluminum 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.

Timeframe: Medium-term
Who should implement: Province of Manitoba

28.0 Phosphorus Content in Cleaning Supplies

Background

In October 1989, the Canadian Government passed legislation restricting the concentration of phosphorus in laundry detergents. These regulations require that laundry detergents shall not contain phosphorus greater than 2.2 per cent by weight.[69] Currently, there are no regulations restricting phosphorus content in other household, commercial, or industrial cleaning products. A clear understanding of the amount of phosphorus in many commercial and industrial cleaning products is currently lacking. This issue should be addressed.

Dishwasher detergents have phosphate content ranging from about 1.5 per cent to 8.7 per cent.[70] 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.

Recommendation

28.1 Manitoba Water Stewardship should raise the issue of the lack of regulation controlling phosphorus content in cleaning solutions with the Canadian Council of Environment Ministers with a view to having the Federal Government restrict the phosphorus content in those cleaning products currently not regulated. The Province of Manitoba should raise this issue with the Federal Government.

Timeframe: Short-term
Who should implement: Province of Manitoba

[69] http://laws.justice.gc.ca/en/C-15.31/SOR-89-501/70546.html
[70] www.assabetriver.org/nutrient/detrergents.html

29.0 Science Needs for the Long-Term Protection of Lake Winnipeg

Background

The development of policy, regulations, and management approaches on matters related to the environment need to be informed by sound science. To this end, a number of existing and future science needs have been identified by the Lake Winnipeg Stewardship Board. Both existing and future science needs fall into four general categories, with each category requiring in some cases, different skills and expertise, different approaches, and different implementation mechanisms.

First, there continues to be a need to gain further scientific understanding of the lake itself so that ecosystem health and productivity can be sustained and that water quality deterioration can be reversed. This is particularly evident as the Province moves forward to develop long-term water quality objectives for nitrogen and phosphorus in Lake Winnipeg based upon ecologically-sensitive end-points that will supersede the interim targets identified in the Lake Winnipeg Action Plan. To develop these ecologically-sensitive end-points, additional information may be needed on the relationship between in-lake concentrations of nitrogen and phosphorus and the stimulation of blooms of cyanobacteria (i.e., blue-green algae) as well as other forms of nuisance algae.

The Board acknowledges that inclusion of an interim target for nitrogen reductions in the Lake Winnipeg Action Plan is more controversial than the interim target for phosphorus but further recognizes that this issue will be remedied through the development of ecologically-sensitive water quality objectives for Lake Winnipeg. In the meantime, priority should be placed on achieving reductions of phosphorus since the benefits to Lake Winnipeg are more clear and unequivocal.

The Board also recognizes that there is a need to better combine traditional knowledge with contemporary science as additional knowledge of Lake Winnipeg is gained. Additional information will almost certainly be needed to continue the development of a sound water quality model for the lake. Continued monitoring of the lake will be necessary in order to track progress towards achieving not only the interim targets set by the Lake Winnipeg Action Plan, but also the science-based water quality objectives.

Second, Lake Winnipeg reflects the nutrient contributions it receives from the watershed which are highly variable and strongly correlated to flow. Nutrient loading to Lake Winnipeg is strongly tied to the amount of runoff in the watershed. It is important that both water quantity and water quality are managed in the Lake Winnipeg watershed. Enhancing water retention and reducing unnecessary drainage, particularly in the Red River basin, would assist in reducing nutrient-rich Red River valley water from reaching the lake.

A number of science gaps have been identified in the interface between the terrestrial (land and soil) and the aquatic (water) components of the watershed, that is, the junction where the land and water meet – the terrestrial-aquatic interface. For example, it is important that more research be done to understand mechanisms by which non-point source agricultural nutrient runoff is occurring. Much of the research in this sector has been done in regions of different landscapes, soils, and climatic conditions. It is recognized that snowmelt is an important mechanism by which nutrients are transported from land to water within the Canadian prairies. 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.

To fill these information gaps, it is necessary that strong partnerships to 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. Over the short-term, information gaps need to be filled by all available means. However, the Board is 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 establishment of a Research Chair specializing in hydrological and contaminant transport mechanisms at the terrestrial-aquatic interface would require the establishment of strong partnerships among other academic institutions in Manitoba and with provincial and federal government departments with a mandate in this area. To assure success, it will be necessary to provide some initial operating funding and to provide annual direction to assist with setting and maintaining research priorities. For example, the need to develop beneficial management practices appropriate for Manitoba could be addressed through this work (see Recommendation 6).

Third, on-going monitoring and research is required to gain a better understanding of 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 need to continue into the future to track progress towards achieving the targets identified in the Lake Winnipeg Action Plan.

Fourth, the effects arising from the management of water flows and levels in both the watershed and in Lake Winnipeg are not well understood. But they 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 an increased 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.

Further, the management of Lake Winnipeg as a reservoir by Manitoba Hydro has influenced the seasonal pattern of outflows. 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 period and is being released during the fall and winter periods to meet demands for electricity. The impact of regulation on lake water quality is not understood.

The Board recognizes the significance of these information gaps, and that there is an urgent need to address these short-falls in scientific knowledge. On-going research and monitoring will be required on Lake Winnipeg to address these issues and to monitor progress towards achieving the established targets for nitrogen and phosphorus.

Recommendations

29.1 On-going research and monitoring will be required on Lake Winnipeg to address outstanding information gaps and to monitor progress towards achieving the established targets for nitrogen and phosphorus. To this end, Manitoba Water Stewardship, Environment Canada, and Fisheries and Oceans Canada are urged to continue their existing process to develop and then implement a collaborative, long-term science plan for Lake Winnipeg.

29.2 The Province of Manitoba should consider jointly funding a Research Chair specializing in hydrological and contaminant transport mechanisms at the terrestrial-aquatic interface, at one of the academic institutions in Manitoba. Support could be provided by both senior levels of government. The establishment of such a position would require the establishment of strong partnerships among other academic institutions in Manitoba and with provincial and federal government departments with a mandate in this area. To assure success, it will be necessary to provide some initial operating funding and to provide annual direction to assist with setting and maintaining research priorities.

29.3 Manitoba Water Stewardship must continue its work towards completing the Nutrient Management Strategy announced in April 2000. In particular, draft water quality objectives for nutrients in Lake Winnipeg that are based upon ecologically-sensitive end-points must be developed as quickly as possible. Following the development of these objectives, broad consultations will need to be undertaken involving the local Lake Winnipeg communities, scientists, contributing sectors within Manitoba, upstream jurisdictions, and others. These long-term water quality objectives will then replace the interim targets identified in the Lake Winnipeg Action Plan.

29.4 Manitoba Water Stewardship must continue its long-term water quality monitoring of streams contributing to Lake Winnipeg and should be encouraged to 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 the targets set for Lake Winnipeg.

29.5 The Province of Manitoba should consider developing and implementing a focused program of applied research aimed at better understanding of the human-induced changes in water flows, seasonal lake residence time, and lake levels on nutrient dynamics relevant to Lake Winnipeg.

Timeframe: Short-term
Who should implement: Province of Manitoba in collaboration with appropriate partners

30.0 Education Program Development

Background

The future of Lake Winnipeg will depend on initiatives and efforts of many people – not only those living near its shores, but all who live in the watershed contributing to the lake. It will also be 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.

It is often the youth, through their knowledge and commitment, who help influence sound environmental practices in their own homes and communities. Awareness generated among these young people will have a positive impact on the health of Lake Winnipeg in the long-term.

Recommendations

30.1 The Manitoba Department of Education should design teaching units, credit courses, and upgrade holistic environmental curricula specific to Lake Winnipeg and its watershed for implementation in Manitoba schools.

30.2 An awareness of the issue of Lake Winnipeg water quality and watershed influences must be created among educational staff in First Nations schools, both teaching staff and administrative staff involved with curriculum development.

Time Frame: Short-term
Who Should Implement: Manitoba Department of Education

31.0 Public Education on Water Quality Protection

Background

In addition for the need to provide educational opportunities for the province's students, it is equally important that all Manitobans gain the knowledge and understanding of how their choices and activities can influence the water quality of Lake Winnipeg. Other jurisdictions have undertaken focused educational campaigns to achieve similar goals. For example, the City of Toronto has launched an effective series of television, radio and, print media advertisements to educate its citizens on how to protect the quality of Lake Ontario.[71] A similar educational campaign in Manitoba may need to be directed specifically to different sectors in society.

Recommendation

31.1 The Province of Manitoba should develop a public education campaign/program to help Manitobans understand the importance of making the appropriate personal choices on issues that will affect water quality in Lake Winnipeg and its watershed.

Time Frame: Short-term
Who Should Implement: Province of Manitoba

[71] http://www.toronto.ca/wesads/index.htm#storm

32.0 The Lake Winnipeg Stewardship Board's First Interim Report – Public Discussion

Background

The Lake Winnipeg Stewardship Board's first interim report to the Manitoba Minister of Water Stewardship is an important document which outlines the issues facing Manitobans, and presents recommendations for actions to be taken to protect the health 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, understand the magnitude of the issue, and how their actions may lead to a resolution of the problem.

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. Manitobans need to be provided the opportunity to critically review many of these recommendations and provide their feedback. It will be important to gain the perspective of all Manitobans. First Nation Communities and others who have important traditional knowledge will be able to provide essential feedback on these recommendations.

Recommendation

32.1 The Board recommends that a focused public discussion be undertaken on many of these recommendations, and with those who may be affected by these recommendations.

Timeframe: Short-term
Who should implement: The Province of Manitoba

Appendices

Appendix A: 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 B: Lake Winnipeg Stewardship Board Member Biographies

Chair **BILL BARLOW** is a former Mayor of Gimli and Chair of the Eastern Interlake planning District, and is retired from teaching at Gimli High School. He is presently a member of the Manitoba Municipal Board.

GARRY BROWN farms near Dugald. He was a long-time councillor for the RM 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, Ph.D. is a soil scientist with the Faculty of Agricultural and Food Sciences, University of Manitoba.

LES FELSCH is a farmer and member of Keystone Agricultural Producers executive as the District 4 representative.

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 Nations. She is an advocate for First Nations People's rights, and for sustainable environmental principles.

SAM MURDOCK, a commercial fisher, is former Chief of the Fisher River First Nation. He is a Director on the Board for the Lake Winnipeg Advisory Committee and President of the Fisher River McBeth Fisheries.

CHRIS PAWLEY is serving his third term as a member of Selkirk's City Council and a member of the Association of Rural Municipalities. 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 member of the Department of Fisheries and Oceans Experimental Lakes Area Research Team.

ED SCHREYER, former Premier of Manitoba and Governor General of Canada, 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 currently serving her second term as councilor 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 Nations. He is currently serving as an Economic Development Officer for the Dauphin River First Nations.

DON SULLIVAN is Executive Director for the Boreal Forest Network, an organization concerned with the protection and sustainable use of the boreal forest worldwide.

NICK SZOKE is Senior Engineer and Branch Head of Wastewater Planning for the Water and Waste Department, City of Winnipeg. As a licensed professional engineer, he is registered with the Association of Professional Engineers and Geoscientists of the Province of Manitoba (APEGM). He is also a member of the Board of Directors for the Canadian Public Works Association, and a long-standing member of the Western Canada Water and Wastewater Association, and Water Environment Federation.

GARY WASYLOWSKI is a beef cattle producer, Reeve of the RM of Armstrong and Rural Vice-President of the Association of Manitoba Municipalities.

DWIGHT WILLIAMSON is Director of Water Science and Management Branch, Manitoba Water Stewardship.

HALINA ZBIGNIEWICZ is Manager, Operations Planning – Manitoba Hydro.

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

Lake Winnipeg Stewardship Board - Committee membership	
Committee	**Membership**
Executive	Bill Barlow - 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)
Agriculture and other rural land uses	Les Felsch - Chair Garry Brown Helgi Einarsson Don Sullivan/Bryan Hart* Dwight Williamson Garry Wasylowski Don Flaten (Bill Barlow)
Communication	Sam Murdock - Chair Robert T Kristjanson Chris Pawley Vera Mitchell Bill Barlow Dwight Williamson Bev Smith
* Bryan Hart of the Boreal Forest Network attended meetings as an alternate to Don Sullivan.	

Appendix E: A Summary of Board Activities and Acknowledgements

Board Activities

The Board printed 15,000 copies of a public information brochure titled "Lake Winnipeg Needs Your Help", explaining the issues related to nutrient loading in the lake, and the actions being planned to address the problem. Copies have been distributed to communities, municipal offices, government establishments, and others throughout the Manitoba portion of the watershed. The Board also took out newspaper ads in a number of major newspapers in Manitoba. These ads were also designed to initiate public input early in the process.

A web site developed by the Board (www.lakewinnipeg.org) invites public feedback on strategies to reduce nitrogen and phosphorus loadings to Lake Winnipeg. The web site contains information on the Board's mandate and activities.

The Board Chair has made several presentations to groups and organizations over the past year and a half. The presentations focused on the mandate and activities of the Board, and invited feedback.

In response to the Board's request for public input, more than 30 inquiries were received from the general public and a number of formal submissions have been sent to the Board. For those individuals/agencies who have given the Board permission, copies of the public submission will be placed in the public registry and on the Board's web site. The importance and value of the public input in assisting the board in identifying issues and sources of nutrients cannot be overstated. All information gathered from the public by the Board was considered by the Board during its deliberations.

The Board has met approximately 20 times since September of 2003. In addition to the full Board meetings, the Municipal Committee, Agricultural Committee, Executive Committee, and Science Committee also held several meetings during that time. The committees have been responsible for drafting the recommendations presented in this report for review and approval by the Board.

Acknowledgements

The Board would like to acknowledge the support and contribution of the Technical Secretariat – Sharon Gurney (Manitoba Water Stewardship Department). The Board would also like to acknowledge the contribution of Brian Wilkes (Brian Wilkes and Associates) who served as the Technical Secretariat for the first several months of the Board's mandate. The writing and editing support supplied by Buzz Crooks (Beaverbrook Communications) is also gratefully acknowledged. Wilma Weekes of the Water Stewardship Department has also assisted the Board with administrative support.

The contribution that **FRANCIS RUSSELL** made to the Board during her term as a Board member is also acknowledged.

Appendix F: Other issues requiring further deliberations and recommendations by the Board in the next phase and future reports

Items for further consideration by the Board are not necessarily limited to those listed below.

1. Technical Workshop
The benefits of phosphorus reduction to the freshwater environment are clear and unequivocal, particularly for limiting the growth of blue-green algae. In prairie stream environments, nitrogen may play an important role in the production of aquatic plant growth of species other than blue-green algae.[72,73,74] Thus, different nutrient abatement strategies may ultimately need to be adopted for different rivers and the downstream waterbodies to which they flow.

1.1 The LWSB should organize a technical water quality workshop to determine the relative importance of reducing phosphorus relative to nitrogen as a means of improving water quality in Lake Winnipeg and its upstream and downstream waters. This is recognized by the Board to be a very high priority. This work needs to be completed before the Board prepares its final report. The outcome of this work should be used in future nutrient management decisions.

2. Review intensive livestock regulations in further detail.
3. Regulations concerning the location of manure storage facilities.
4. Elimination of wooded/ wetland areas for manure spreading purposes.
5. Need for municipal bylaws for intensive livestock operations.
6. Alternative livestock waste management options (e.g. composting, energy generation, etc.).
7. Need for permits to remove natural vegetation (e.g. wooded areas/ wetland/ native grasses etc.).
8. Consider nutrient management issues in relation to activities of the Municipal Planning Boards.
9. Water quality objectives for Watershed Planning Districts, and monitoring progress.
10. Riparian Tax Credit program expansion.
11. Ag Policy Framework, Environmental Farm Planning workbooks.
12. Implementation of existing watershed plans.
13. Develop a set of guiding principles for Lake Winnipeg.
14. Water level regulation on Lake Winnipeg, circulation patterns as it relates to the nutrient issue. Hydrologic modeling needs.
15. Nutrient/sediment runoff from construction sites.
16. Minimizing organic waste from reaching storm sewers and rivers.
17. Review options/emerging technologies for nutrient removal at small facilities.
18. Water Quality Management Zones.
19. Waterfront properties – environmentally sensitive lot care.
20. Prioritizing watershed management planning areas.
21. Review drain classification system as it relates to nutrient issues.
22. Sewage disposal on pleasure craft and commercial vessels. Legislative designations.
23. Role of natural and constructed wetlands in nutrient reduction.
24. Alternate Land Use Services initiative.
25. Livestock feed composition and nutrient output in manure.
26. Netley Marsh – Dredging, preferential flow, nutrient removal opportunities, harvesting, biogas generation proposal.
27. Shelter belts.
28. Lake Winnipeg Research Symposium.
29. Nutrient modeling for Lake Winnipeg.
30. Impact of river dredging on Lake Winnipeg.
31. Surface application of manure.
32. Tillage practices/zero till/ minimal till/ stubble to reduce wind erosion – sediment transport, etc.

[72] Dodds, W.K., V.H. Smith, and K. Lohman. 2002. Nitrogen and phosphorus relationships to benthic algal biomass in temperate streams. Can. J. Fish. Aquat. Sci. 59:865-874.

[73] Murphy, T.P., K. Irvine, J. Guo, J. Davies, H. Murken, M. Charlton, and S.B. Watson. 2003. New Microcystin concerns in the Lower Great Lakes. Water Qual. Res. J. Canada 38 (1):127-140.

[74] Chambers, P.A., and M. Guy. 2004. Setting nutrient guidelines for the northern rivers of Alberta. In: Environment Canada, Northern Rivers Ecosystem Initiative: Collective Findings (CD-ROM). Complied by F.M. Conly, Saskatoon SK, 2004 (With Alberta Environment).

33. Potential of dams/retention basins to reduce particulate nutrient loadings (e.g. South Tobacco Creek area, Holland dam).
34. Regulatory impediments to developing nutrient retention basins.
35. Review effluent standards for other wastewater facilities in similar geographic and climatic conditions.
36. Review options for zero discharge strategies for residential developments.
37. Modifications required in the National building code and the Manitoba building code in relation to water conservation, and issues affecting nutrient losses to waterways.
38. Pollution prevention strategies for toxic substances, product substitution options.
39. Consider scholarships for graduate students conducting research on Lake Winnipeg.
40. Consider the impact of water quality leaving Lake Winnipeg in terms of the impact on downstream waterways.
41. The total phosphorus and total nitrogen amount from various sources are comprised of dissolved and particulate forms of phosphorus and nitrogen from terrestrial and aquatic sources, not all of which are equally usable or biologically available to algae.
42. Declining muskrat populations in the lake's wetlands, as they may relate to water quality and changes in marshlands.
43. Further education opportunities/strategies for students, and watershed residents.
44. The Board may provide further recommendations on the issues addressed in this interim report.
45. Other issues including those recently raised through correspondence with the Board, and through discussion amongst Board members.

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