

Missisquoi Bay Inter-Agency Advisory Committee –
Montérégie

Phosphorus Reduction Action Plan 2003-2009

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Missisquoi Bay

October 2003
Updated September 9, 2004

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1. OVERVIEW

INTRODUCTION

The Missisquoi Bay Inter-Agency Advisory Committee – Montérégie is pleased to present the **Phosphorus Reduction Action Plan 2003-2009**, which confirms the priority the Government of Québec has given to the Missisquoi Bay as part of the *Agreement for Reducing Phosphorus Pollution to Missisquoi Bay* between the Government of Québec and the State of Vermont. This agreement's goal is to reduce Québec and Vermont point source phosphorus loads to the Missisquoi Bay by 70.1 metric tonnes per year.

For several years, the Missisquoi Bay Inter-Agency Advisory Committee, working closely with its partners from the region, has been actively working to improve the water quality of the Missisquoi Bay watershed. The regional Advisory Committee is made up of several agencies and organizations that are actively involved in the Missisquoi Bay Watershed, including the ministère des Affaires municipales, du Sport et du Loisir (MAMSL), the ministère de l'Agriculture, des Pêcheries et de l'Alimentation (MAPAQ), the ministère de l'Environnement (MENV), the ministère de la Santé et des Services sociaux (MSSS), the Ministère des ressources naturelles, de la Faune et des Parcs (MRNFP) and Tourisme Québec (TQ). Contact with the region is established through the *Corporation Bassin Versant Baie Missisquoi* (CBVBM), which is made up of municipal, agricultural, environmental and wildlife representatives, tourism and economic development representatives and citizens. Thus, the Advisory Committee ensures that the actions of the Government of Québec are conveyed and acts as coordinator between the Government and local interests.

The Action Plan is an expression of the commitment of the Government of Québec and its partners to assume Québec's responsibilities under the Québec-Vermont Agreement signed on August 26, 2002. It also sets forth the Government's intention as expressed on August 3, 2004, to step up its efforts to improve the water quality of the Missisquoi Bay as quickly as possible. It proposes doing this by advancing the 2016 deadline for implementing the measures in the first action plan to 2009. This approach is part of the Memorandum of understanding between Québec, New York and Vermont and the National Water Policy to improve water quality in Lake Champlain in order to protect its ecosystem and recover its uses.

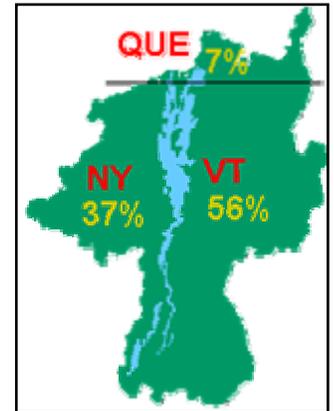
In such a context, the **Agreement for reducing phosphorus to Missisquoi Bay** between the Government of Québec and Vermont represents a turning point in the efforts to reduce phosphorus in Missisquoi Bay. In fact, the *Québec-Vermont Agreement* defines for the first time the division of responsibilities for a total phosphorus load target for the Missisquoi Bay watershed of 38.9 metric tonnes per year (40%) for Québec and 58.3 metric tonnes per year (60%) for Vermont.

The Action Plan 2003-2009 sets forth the Missisquoi Bay's environmental problem and the actions proposed in the programs and legislation that are currently in force. This framing plan is updated once a year to take into account new actions or changes that have been made to the program. An annual plan is also drawn up on the basis of this plan.

ENVIRONMENTAL ISSUES

State of Missisquoi Bay

- ✓ Most of Lake Champlain is located in the United States, with the states of New York and Vermont sharing its borders with the Province of Québec. It flows into the Richelieu River, and 7% (1,493 km²) of its watershed is located in Québec and mostly drains into Missisquoi Bay.
- ✓ 42% of the Missisquoi Bay watershed is located in Québec and drains 1,315 km². There are over 20 municipalities and 23,000 permanent citizens in the area.
- ✓ For several years, the water quality of the Missisquoi Bay has been steadily deteriorating. The water in the bay, which is considered to be a sensitive environment, has undergone serious episodic proliferations of cyanobacteria. During the summers of 2001, 2002, 2003 and 2004, the proliferations contained high levels of bacteria and concentrations of toxins. Some samples, with densities exceeding 1 million cells per millilitre, were several times higher than the benchmark of 100,000 cells per millilitre set by the World Health Organization (WHO). Among these cyanobacteria are species known to produce toxins. Concentrations of microcystine, a toxin that affects liver function, measured in the untreated waters of the bay, largely exceeded the criterion of 1 µg/l set for water used for drinking water. Values exceeding the hundreds of 1 µg/l were measured in the scum (type of scum formed by cyanobacteria along the shores). The intensity of the proliferations led the regional authorities of the ministère de l'Environnement and the ministère de la Santé et des Services sociaux to jointly call for the closure of the public beaches and to recommend prohibiting use of the bay for other activities involving direct



Cyanobacteria, Philipsburg
MENV 2001

- contact with the water over the course of the four summers. Moreover, it appears that proliferations are occurring increasingly earlier in the summer. Some years, the proliferations have remained visible until October. The proliferation of cyanobacteria significantly restricts use of the bay. In addition to being an important resort area, the bay is a source of potable water for two municipalities, Bedford and Philipsburg de Saint-Armand.
- ✓ Phosphorus is the principal cause of the proliferation of aquatic plants and algae. The phosphorus concentration observed from 1992 to 2003 in the waters of the Missisquoi Bay is an average of 0.043 mg/l according to the Lake Champlain Monitoring Program. The phosphorus concentration criteria targeted by the joint New-York-Vermont-Québec agreement is 0.025 mg/l.
 - ✓ The Québec-Vermont Task Force report released in June 2000 revealed that 79% of the nonpoint source phosphorus may be attributed to agriculture, which makes up 26% of the area of the Missisquoi Bay watershed located in Québec and Vermont.

Pressures on the waters of Missisquoi Bay

Agricultural pressures: The following table illustrates the increase in certain indicators of

agricultural pressures on the bay's watershed. The area used for large row crops, of which more of 90% is corn, have continued to increase over the last 15 years, to the detriment of forage crops and pasture. Large row crops (corn, soybean, potatoes and most vegetables) require vast quantities of fertilizers and pesticides, and are prone to erosion. The loss of fine particules caused by rainfall is compounded by the absence of vegetative cover between the rows of plants. In addition, it is suspected that herbicides used on these crops have an impact on the phytoplankton communities living in the water. The cyanobacteria could be particularly resistant to these pesticides, which could give them an advantage over other types of microscopic aquatic vegetation.

Table 1 Percentage of crop and breeding activity percentages in the Québec portion of the Missisquoi Bay watershed for the period from 1991 to 2001

Year	Percentage in hectares				Cattle (as % of a.u.*)	Swine (as % of a. u.*)	Poultry and others (as % of a.u.*)	Animal density (a.u.* per hectare under cultivation)
	Large row crops	Forage crops and pasture	Narrow row crops	Other crops				
1991	42	49	8	1	66	28	6	0.88
1996	47	44	6	3	46	43	11	1.38
2001	56	36	6	2	39	49	12	1.34

(Source: Statistics Canada, 1991, 1996 and 2001 censuses), * Generally, one animal unit (a.u.) equals 500 kg.

The increase in large row crops in the Missisquoi Bay watershed has occurred in parallel to the decrease in forage crops and pasture. In 2001, over 56% of the area was used for large row crops. At the same time, there was a significant decrease in the proportion of beef cattle, which grazed the pasture and fed upon forage crops. This decrease is largely due to a sharp increase in the number of animal units of swine, and to a lesser extent, of poultry. A notable increase in animal density was observed between 1991 and 1996. Herds went from 28,030 animal units to 44,270. In 2001, despite an increase of 600 animal units, there was a decrease in animal density due to an increase of 2,200 hectares in cultivated land between 1996 and 2001 following logging activities in the area, among other things. The area under cultivation was 33,577 hectares.

It is important to note the efforts that have been made to date by the farmers in the region. Several farms have already started to make changes, such as installing inlet drain (avaloir) and making changes to farming practices, such as direct sowing and minimal working of the soil. There is also a very active farmers club (the Dura-Club) in the area whose actions have served to significantly decrease impacts on the watercourses.

Table 2 Status of agricultural cleanup in the Missisquoi Bay Watershed, 1988-2002

Number of farms ¹	551
Number of farms with storage facility (<i>Prime-Vert</i> program)	180
Total cost of work	\$4.3 M
Total funding under <i>Prime Vert</i> program	\$3 M
Number of farms targeted by the AOR to 2010	N/D
Cost estimate	\$1.5 M

¹ According to Statistics Canada, 2001

To date, approximately 180 storage installations have been built for a total approximate cost of \$4.3 million. The subsidized portion of the work is \$3 million, that is, 70% of the cost of the work carried out as part of the *Prime-Vert* program. Farmers have made up the difference. Regarding agricultural cleanup, the majority of the farms targeted by the legal obligation to store manure in a watertight facility in the Missisquoi Bay Watershed now have storage installations. Note that the remaining farms required to comply by the deadline set forth under the *Agricultural Operations Regulation* (AOR) are small operations.

Municipal pressures: Municipal pressures are stable in the Missisquoi Bay watershed. There are approximately 23,000 inhabitants in the Bay’s Watershed. Pressure from human activity is not very intense in the region since the municipalities number no more than 3,000 in population.

Industrial pressures: A large vegetable conservation plant is located in Bedford. Its process waters, however, are treated by the municipal wastewater treatment facility.

Tableau 3 Status of municipal wastewater cleanup in the Missisquoi Bay watershed, 1992-2002

Facility	Completion Date	Cost (\$)
Bedford	1992	7,915,000
Stanbridge Station	1996	883,000
Eastman	1993	1,825,000
Venise-en-Québec	1994	4,929,000
Potton	1995	2,687,000
Saint-Georges-de-Clarendville	1998	1,860,000
Sutton	2000	1,057,000
Saint-Armand (secteur Philipsburg)	2002	2,500,000
Total cost		23,656,000
<u>Project currently being evaluated</u>		
Abercorn		1,250,000
Notre-Dame-de-Stanbridge		1,650,000
Stukely		(N/D)
Pointe Jameson		(N/D)
Estimation of cost		2,900,000

The municipal water cleanup programs have enabled 8 municipalities to equip themselves with wastewater treatment facilities at a cost of \$24 million, which means that 83% (about 6,341 people) of the Missisquoi Bay Watershed's population connected to a sewer network is now served by a wastewater treatment facility. In other respects, 41% of the watershed's total population is connected to a sewer network whereas the other 59% uses individual septic tanks to process its wastewater.

2. ACTION PLAN

THE CHALLENGES

Faced with the seriousness of the Missisquoi Bay environmental problem described earlier, and despite the various measures that have been implemented the last several years, it is essential to take steps that are complementary to the traditional approach to reduce the environmental impacts of pollution from all sectors of activity in the Missisquoi Bay Watershed.

The main challenge of Québec's Action Plan is to improve the quality of the water and the aquatic ecosystem in the Québec portion of the Missisquoi Bay Watershed of Lake Champlain to in turn recover its uses and protect its environment. Water quality in the bay will be improved mainly by reducing phosphorus and nitrogen inputs to the Missisquoi Bay Watershed at source.

In such a context, the proposed actions aim to achieve environmental gains by, notably, acting on the nonpoint source pollution of agricultural origin through the implementation of sustainable agricultural practices, since 79% of the nonpoint source phosphorus may be attributed to agriculture. Nonpoint source agricultural pollution is associated with erosion and runoff. The generalized adoption of agro-environmental practices would decrease inputs, of phosphorus and nitrogen in particular, to the aquatic environment.

Cleanup measures must take into account the important economic role that agriculture plays in the Missisquoi Bay Watershed as well as develop and maintain the vitality of the rural environment and its social acceptability. This means that the Action Plan must serve as a concrete step in the transition towards sustainable agriculture, which has already been initiated by the watershed's farmers with existing programs and new initiatives.

It is important to remember that with the renewal of the Memorandum of Understanding in 1996 the Government of Québec already committed itself to the implementation over a 20-year period of *Opportunities for Action* (OFA), Lake Champlain's management plan. The plan's first priority is to reduce phosphorus.

PARTNERSHIP

Within the framework of the *Memorandum of Understanding*, the ministère de l'Environnement co-chairs the Lake Champlain Basin Program (LCBP) Steering Committee on behalf of the Government of Québec. Faune Québec and the ministère de l'Agriculture, des Pêcheries et de l'Alimentation recently joined the committee as representatives of Québec.

In parallel, the Direction régionale de l'Estrie et de la Montérégie of the ministère de l'Environnement in recent years set up the Missisquoi Bay Inter-Agency Advisory Committee on a regional level made up of all the agencies and organizations interested in the problem. The committee also supported the creation of the Corporation Bassin Versant Baie Missisquoi (CBVBM), which represents the municipal and agricultural sectors as well as environment, wildlife and tourism and economic development.

The Action Plan presents the actions proposed by all the partners who are combining their efforts, notably to reduce phosphorus and nitrogen loads to the Missisquoi Bay Watershed. It specifically takes into account the government's intention to step up its efforts in this regard.

PRIORITIES FOR ACTION

The Action Plan's main objective is to reduce phosphorus and nitrogen loads to the Missisquoi Bay Watershed, and principally to the Pike River Watershed, by promoting and implementing best management practices to, among other things, reduce Québec source phosphorus loads to the Bay by 27.3 tm/year.



Rivière aux Brochets

FAPAQ

The Committee's main activities therefore target the Pike River Watershed, of which 85% is located in Québec.

Specifically, the Action Plan proposes to begin by addressing the problems associated with the rational management of livestock waste and other fertilizers, erosion and runoff. Table 4 presents a summary of the objectives broken down according to the selected priorities and the participants. Table 5 presents the participants' main responsibilities. Appendix 1.A goes into greater detail on how the Action Plan will be implemented over a 6-year period.

In addition, the Government of Québec wishes to remind those in the affected area of its intention to complete the cleanup work before the 2016 deadline to provide the population with full use of the Missisquoi Bay as soon as possible. To achieve this objective, the Government together with its partners will implement other measures to bring forward the deadline for reaching the objectives that were previously set. In this respect, Appendix 1.B is presented as a working document to be shared with all the partners and the community as support for the initiative.

Table 4 Phosphorus Reduction Objectives – Missisquoi Bay

Objectives	Specific Objectives	Participants
<p>1 Application of AOR and nutrient management</p>	<p>1.1 Accelerate farm by farm visits in the Missisquoi Bay area. 1.2 As a priority, carry out agro-environmental fertilization plan for farms targeted by the AOR in the Pike River Watershed. 1.3 Comply with manure spreading dates, particularly after October 1, and buffers set by the AOR and RCES. 1.4 Bring forward compliance with the progressive timetable for manure spreading. 1.5 Produce phosphorus summary for raising and manure spreading sites targeted by a AEF. 1.6 Support implementation of an agro-environmental plan for each farm. 1.7 Encourage farmers to join an agro-environmental club. 1.8 Support farms with their adequate management and storing of manure.</p>	<p>MENV, MAPAQ (<i>Prime-Vert</i> program), agro-environmental clubs, consultants, agricultural producers, CBVBM</p> <p>MAPAQ, agricultural producers Dura-Club</p>
<p>2 Management of Protected Natural Areas and Soil Erosion Control</p>	<p>2.1 Develop private network of protected areas in cooperation with organizations from the area. 2.2 Identify and control preferential soil erosion zones by field and basin.</p>	<p>MENV, CBVBM, MAPAQ, farmers, CBVBM, IRDA</p>
<p>3 Soil Conservation and Protection of Watercourses</p>	<p>3.1 Implement best soil conservation practices as a priority in the Pike River Watershed. 3.2 Restore and protect the riparian strips along watercourses as a priority in the watersheds of the Castor, Ewing, aux Morpions and Wallbridge streams. 3.3 Ensure compliance with prohibited access of animals to watercourses and bodies of water and their riparian strips as required by AOR. 3.4 Ensure compliance with the <i>Politique de protection des rives, du littoral et des plaines inondables</i>.</p>	<p>MAPAQ, Dura Club, agro-environmental clubs, farmers, CBVBM</p> <p>MENV</p> <p>MENV, MAMSL, municipalities and CBVBM</p>
<p>4 Cleanup of Municipal Wastewater</p>	<p>4.1 Finalize urban cleanup and ensure follow -up. 4.2 Ensure compliance with residential septic installations. 4.3 Ensure compliance with commercial and institutional septic installations.</p>	<p>MAMSL, municipalities, MENV Municipalities and CBVBM MENV</p>
<p>5 Monitoring and Research and Development Projects</p>	<p>5.1 Evaluate control measures for cyanobacteria to reduce impact on water uses during the summer season in Missisquoi Bay. 5.2 Monitor water quality and flow of effluent in Missisquoi Bay. 5.3 Identify presence of cyanobacteria and toxins in Missisquoi Bay. 5.4 Develop spatial reference agro-environmental management tools. 5.5 Evaluate environmental efficiency of filtering swamps (FAQDD, Wallbridge stream). 5.6 Evaluate environmental efficiency of riparian zone (FAQDD for agricultural watersheds). 5.7 Develop an agro-environmental decision-making aid system to reduce water pollution from agricultural nonpoint sources. 5.8 Characterise mobility of P in surface runoff and underground drainage network.</p>	<p>MENV, CEHQ, MAPAQ, CBVBM, MSSS,</p> <p>IRDA, Dura-Club, MAPAQ, CEHQ, farmers</p> <p>McGill University</p> <p>Universities of Sherbrooke, McGill and Vermont, IRDA, MAPAQ, MENV, CBVBM</p> <p>McGill University</p>
<p>6 Community Involvement</p>	<p>6.1 Conduct information and educational activities regarding agricultural and municipal legislation and the <i>National Water Policy</i>. 6.2 Participate in advisory committees (CBVBM, LCBP, Québec-Vermont Task Force, TAC).</p>	<p>MBAIC - MR, partners and CBVBM</p>

Table 5 Main responsibilities of participants

Participants	Main Responsibilities
<p>Ministère des Affaires municipales, du Sport et du Loisir</p>	<p>With municipalities, finalize cleanup work to treat wastewater under the cleanup or infrastructure programs.</p> <p>In cooperation with the municipalities, ensure compliance with the <i>Politique de protection des rives, du littoral et des plaines inondables</i>.</p> <p>Ensure that performance of wastewater treatment plants is monitored.</p>
<p>Ministère de l’Agriculture, des Pêcheries et de l’Alimentation du Québec</p>	<p>Support farmers with cleanup work to manage livestock waste and help them implement soil and water conservation practices under the <i>Prime Vert</i> Program and agro-environmental plan.</p> <p>Promote sustainable agriculture practices and participate in research and monitoring of the state of the environment with players in the agricultural community.</p>
<p>Ministère de l’Environnement</p>	<p>Ensure the implementation of the <i>Québec–Vermont Agreement</i> with the other participants, determine and as required re-evaluate the water quality objectives and ensure follow-up of the Agreement, notably by drafting progress reports as part of the <i>National Water Policy</i> (NWP).</p> <p>Apply standards established by the <i>Agricultural Operations Regulation</i> (AOR).</p> <p>Ensure technical support for municipalities for the application of the <i>Règlement sur l’évacuation et le traitement des eaux usées des résidences isolées</i> and the <i>Politique de protection des rives, du littoral et des plaines inondables</i>.</p> <p>Closely monitor water quality of effluents and water from the Missisquoi Bay in response to cleanup pressures and interventions; develop joint monitoring program with Vermont.</p> <p>Ensure representation from the Government of Québec under the <i>Québec–Vermont Agreement</i> on phosphorus reduction.</p> <p>Develop government strategy stemming from commitments made under the intergovernmental agreements with the states of Vermont and New York and interested parties in Québec.</p> <p>Encourage and inform farmers about the adoption of sustainable agriculture practices.</p>
<p>Ministère de la Santé et des Services sociaux</p>	<p>Inform citizens about the health effects of pollution and principally the water quality of the Missisquoi Bay.</p> <p>Issue public health notices as required.</p>
<p>CBVBM and representatives from agricultural, environmental, municipal, tourism/economic and citizen</p>	<p>Develop master water plan under the NWP.</p> <p>Implement water management for the Missisquoi Bay watershed and allow for the combined objectives of the various water users to preserve and recover uses and invest in the collective resource.</p> <p>Coordinate actions with all sectors and participants as part of their cleanup efforts.</p> <p>Ensure that the citizens of Québec are represented on the LCBP Steering Committee.</p> <p>Inform and make the public aware of the environmental challenges, reflect their concerns and support user participation in decision-making.</p>

CONCLUSION

The Action Plan for Reducing Phosphorus demonstrates the Government of Québec's determination to step up its actions to improve the water quality of the Missisquoi Bay. This plan also presents the actions proposed by the Inter-departmental Committee to honour the commitments made by the government under the *Agreement for Reducing Phosphorus Pollution to Missisquoi Bay between the Government of Québec and the State of Vermont*.

The Action Plan aims to reduce phosphorus and nitrogen inputs at source in order to reach the 0.025 mg/l phosphorus concentration criterion set forth in the *Québec-Vermont Agreement* as quickly as possible.

The actions taken by the Government of Québec are part of a watershed water management initiative in cooperation with the State of Vermont, and the citizens and organizations of the Missisquoi Bay watershed represented by the *Corporation bassin versant baie Missisquoi* and as part of the *Entente intergouvernementale sur la coopération en matière d'environnement relativement à la gestion du lac Champlain* and the *National Water Policy*.

We wish to thank all those who took part in putting together this document.

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Appendix 1A – Implementation of the Action Plan for Reducing Phosphorus – Missisquoi Bay

2003-2009 Operational Objectives

1. Application of the AOR and nutrient management

Specific Objectives	Actions	Responsible Authority	Deadline	Environmental and Organizational Impacts	Cost Estimate (MENV or partners)
1.1 Accelerate farm by farm visits in the Missisquoi Bay area.	Inspect all farms (approx. 550) following an accelerated schedule (12 months instead of 36 months) By November 30, 2003, conduct farm by farm visits of the 30 pork operations in the watershed to ensure full compliance with REA.	MENV Idem	September 30, 2004 Completed	Update agricultural data for application of the AOR and identify cases requiring corrective measures	
1.2 As a priority, carry out agro-environmental fertilization plan for farms targeted by the AOR in the Pike River Watershed.	Establish number of existing AEFP of all targeted farms. Require all targeted farms to have an AEFP and submit a summary to the ministère as provided for under REA. Ensure agronomist produce AEFP followup reports at the end of each cropping season. Ensure PAEF requirements are being followed in the field.	MENV Idem Idem Idem	September 30, 2004 September 30, 2004 Underway Underway	Reduction of phosphorus soil enrichment and improved management of fertilizers.	
1.3 Comply with manure spreading dates, particularly after October 1, and buffers set by the AOR and GCR.	Over flight (spring and fall) to monitor compliance with manure spreading dates, protection of riparian strips and well buffers.	MENV	Starting in spring 2004, 2 times a year	As required, exercise necessary legal recourse.	
1.4 Bring forward compliance with progressive timetable for manure spreading.	Encourage farmers to bring forward deadlines (2005, 2008 and 2010) to enable them to obtain the required manure spreading surfaces earlier.	MENV, MAPAQ	September 30, 2004	Improved spreading of livestock waste over greater surface area to comply with AOR. Based on farm by farm summary, targeted farmers will be inspected.	

Specific Objectives	Actions	Responsible Authority	Deadline	Environmental and Organizational Impacts	Cost Estimate (MENV or partners)
1.5 Produce phosphorus summary for raising and manure spreading sites targeted by a AEFP.	Priority evaluation of phosphorus summaries for the entire watershed. Require deposit of all phosphorus summaries to ministry, as provided for by AOR. Develop and implement strategies, if applicable, to reduce agricultural pressure in the watershed.	MENV Idem Idem	August 31, 2004 August 31, 2004 Ongoing	Obtain necessary data to, notably, analyse the carrying capacity of the watershed.	
1.6 Support implementation of an agro-environmental plan for each farm.	Do agro-environmental plans. Propose appropriate solutions and, if applicable, provide financial fund. Evaluate implementation of each plan in order to measure results.	MAPAQ Idem Idem	March 31, 2009 Ongoing Ongoing	Support each farmer with reaching agro-environmental objectives.	
1.7 Encourage farmers to join an agro-environmental club.	Increase number of members who adopt soil and water conservation practices.	MAPAQ	March 31, 2009	Support each farmer with reaching agro-environmental objectives.	
1.8 Support farms with their adequate management and storing of manure.	Build storage facilities or increase their capacity for rational manure management.	MAPAQ	March 31, 2010	Support each farmer with reaching agro-environmental objectives.	

3. Management of Protected Natural Areas and Soil Erosion Control

Specific Objectives	Actions	Responsible Authority	Deadline	Environmental and Organizational Impacts	Cost Estimate (MENV or partners)
2.1 Develop private network of protected areas in cooperation with organizations from the area.	Create sites as part of the Program for the Development of a Private Network of Protected Areas.	MENV, Conservation de la Nature, Ducks Unlimited, CBVBM	March 31, 2009	Conservation of wetlands in the Missisquoi Bay watershed and protection of biodiversity.	50% of acquisition costs by MENV
2.2 Identify and control preferential soil erosion zones by lot and basin.	Develop intervention strategies related to hydro-agricultural work and as a priority carry out the work in the Pike River Watershed.	IRDA, MAPAQ, MENV	March 31, 2009	Reduced soil loss, notably phosphorus loads. Establish compensation mechanism complementary to <i>Prime Vert Program</i> .	

3. Soil Conservation and Protection of Watercourses

Specific Objectives	Actions	Responsible Authority	Deadline	Environmental and Organizational Impacts	Cost Estimate (MENV or partners)
3.1 Implement best soil conservation practices as a priority in the Pike River Watershed.	Raise farmer awareness and encourage them to adopt conservation practices (reduced work and direct sowing, crop rotation, green fertilizers and staggered crops). Develop monitoring indicators for the implementation of best practices following update of agro-environmental profile.	MAPAQ, advisory clubs and farmers Idem	March 31, 2009 March 31, 2009	General adoption of agro-environmental practices to reduce phosphorus loads in Missisquoi Bay, notably as part of the MAPAQ accompaniment plan.	
3.2 Restore and protect the riparian strips along watercourses as a priority in the watersheds of the Castor, Ewing, aux Morpions and Wallbridge streams.	Complete installation of riparian zone in targeted watersheds. Install inlet drain. Build various hydro-agricultural outfitting.	MAPAQ, advisory clubs and farmers Idem Idem	March 31, 2009 March 31, 2009 March 31, 2009	Reduction in phosphorus loads and protection of watercourses, particularly as part of the MAPAQ accompaniment plan.	
3.3 Ensure compliance with prohibited access of animals to watercourses and bodies of water and corresponding riparian zone as required by AOR.	During farm by farm visits, encourage farmers who still allow their animals access to watercourses to bring forward the deadline to 2005. Propose appropriate solutions and, if applicable, provide financial fund.	MENV MAPAQ	March 30, 2009 March 31, 2009	Reduction in phosphorus loads and protection of watercourses.	
3.4 Ensure compliance with the <i>Politique de protection des rives, du littoral et des plaines inondables</i> .	Organize information meeting with municipal mayors and inspectors of targeted municipalities. Ensure technical support for municipalities and MRC. Conduct activities with partners to raise awareness of riparian landowners. Produce annual summary of the application of the <i>Politique de protection des rives, du littoral et des plaines inondables</i> and make public.	MENV, MRC, municipalities MENV MENV, CBVBM MENV	October 10, 2003 Ongoing Ongoing Annually	Reduction in bank erosion, including phosphorus loads, while increasing biodiversity.	

4. Cleanup of Municipal Wastewater

Specific Objectives	Actions	Responsible Authority	Deadline	Environmental and Organizational Impacts	Cost Estimate (MENV or partners)
4.1 Finalize urban cleanup and ensure follow-up.	Prioritize registration of wastewater cleanup work with MAMSL, for Abercorn, Notre-Dame-de-Stanbridge, Stukely and Pointe Jameson and carry out the work.	MENV, MAMSL, municipalities	March 31, 2009	Reduction in phosphorus and nitrogen loads.	
4.2 Ensure compliance with residential septic installations.	Require 3 riparian municipalities of the bay to check compliance of residential septic installations and require corrective measures of owners who do not comply. Oblige municipalities to ensure that septic tanks are emptied. Produce annual report on work carried out by municipalities and make them public.	Municipalities with support from MENV and MAMSL MENV Idem	Completed Ongoing Ongoing	Reduction in phosphorus and nitrogen loads.	
4.3 Ensure compliance with commercial and institutional septic installations.	Update list of compliant and non-compliant installations. Inspect installations, including campgrounds, to ensure compliance. Produce annual report of actions and results.	MENV Idem Idem	Completed September 30, 2004 Annually		

5. Monitoring and Research and Development Projects

Specific Objectives	Actions	Responsible Authority	Deadline	Environmental and Organizational Impacts	Cost Estimate (MENV or partners)
5.1 Evaluate control measures for cyanobacteria to reduce impact on water uses during the summer season in Missisquoi Bay.	Coordinate work group mandated to find innovative solutions for controlling cyanobacteria. Conduct pilot project in summer 2005 in cooperation with researchers.	MENV, CBVBM Idem	March 31, 2005 March 31, 2005		
5.2 Monitor water quality and flow of effluent in Missisquoi Bay.	Continue running hydrometric and water quality stations. Analyse results of last years in view of measuring impacts of sources of pressure and identify trends. Based on analysis obtained, orient cleanup work toward priority targets.	MENV, MAPAQ, CEHQ, VT Idem Idem	Ongoing March 31, 2005 March 31, 2005	Evaluate water quality based on sources and completed actions.	

Specific Objectives	Actions	Responsible Authority	Deadline	Environmental and Organizational Impacts	Cost Estimate (MENV or partners)
	Harmonize follow-up programs with the State of Vermont.	Idem	Ongoing		
5.3 Identify presence of cyanobacteria and toxins in Missisquoi Bay.	Conduct sampling to evaluate possibility of presence of cyanobacteria and microcystine – L-R in fresh water and treated water. Issue public health notices as required. Distribute annual follow-up program for cyanobacteria.	MENV, DSÉE MSSS DSÉE	Annually As needed Annually	Monitoring cyanobacteria to protect water uses.	
5.4 Develop spatial reference agro-environmental management tools.	Develop spatial reference soil and water management tools for company managers and farm consultants as well as land managers.	IRDA, MAPAQ, MENV, CBVBM, Laval University	March 31, 2006	Reduction in nonpoint source outputs of nitrogen, phosphorus and pathogenic agents.	
5.5 Evaluate environmental efficiency of filtering wetland (FAQDD, Wallbridge stream).	Evaluate environmental efficiency of filtering wetland (FAQDD, Wallbridge stream).	CVBVM, McGill University, Ducks Unlimited, MAPAQ, IRDA	Underway	Reduction in nonpoint source phosphorus and nitrogen inputs.	
5.6 Evaluate environmental efficiency of riparian zone (FAQDD for agricultural watersheds).	Support hydro-agricultural work of agricultural watersheds and evaluate environmental practices.	IRDA, Dura-club, MAPAQ, CEHQ, farm producers	March 31, 2005	Reduction in nonpoint source phosphorus and nitrogen inputs.	
5.7 Develop an agro-environmental decision-making fund system to reduce water pollution from agricultural sources	Develop an agro-environmental decision-making system for the Pike River Watershed.	Universities of McGill, Sherbrooke and Vermont, IRDA, MAPAQ, CEHQ, DPE, DRAEEM, CBVBM	March 31, 2007	Reduction in nonpoint source phosphorus and nitrogen inputs.	
5.8 Characterise mobility of P in surface runoff and underground drainage network.	Follow and model the mobility of P in surface runoff and drains of underground drains in two fields.	McGill University	March 31, 2006	Reduction in nonpoint source phosphorus and nitrogen inputs.	

6. Community Involvement

Specific Objectives	Actions	Responsible Authority	Deadline	Environmental and Organizational Impacts	Cost Estimate (MENV or partners)
6.1 Conduct information and educational activities pertaining to agricultural and municipal	Inform citizens of the regulations and policies in force as well as environmental questions.	MENV, MAPAQ, CBVBM	Completed	Training given to municipalities related to the <i>Politique de protection des rives, du littoral et des plaines inondables</i> .	

Specific Objectives	Actions	Responsible Authority	Deadline	Environmental and Organizational Impacts	Cost Estimate (MENV or partners)
legislation and the <i>National Water Policy</i> .	Present annual summary of activities conducted in cooperation with all players in the area.	MENV, MAPAQ, CBVBM	Completed		
	Collaborate with various organizations in the area to combine efforts to improve the quality of the water in the Missisquoi Bay.	MENV, MAPAQ, CBVBM	Completed		
	Develop a master water plan and have contracts signed by all those who pledge to implement actions (farmers, municipalities, citizens, industries).	CBVBM	July 31, 2006		
6.2 Participate in advisory committees (CBVBM, LCBP, Québec-Vermont Task Force, TAC).	Implement Opportunities for Action, the <i>2003-2009 Action Plan</i> and the <i>National Water Policy</i> in cooperation with the various ministries and organizations.	MENV, MAPAQ, MRNFP, MAMSL, MDERR, TQ, CBVBM	Ongoing	Community involvement to improve water quality.	
	Coordinate management actions for all Lake Champlain resources.	Idem	Ongoing		
	Coordinate with the State of Vermont to reach objectives.	Idem	Ongoing		

Appendix 1.B – The actions proposed to bring forward the 2016 deadline to 2009 – Missisquoi Bay

Specific Objectives	Actions	Responsible Authority	Deadline	Environmental and Organizational Impacts	Cost Estimate (MENV or partners)
1. Reduce erosion.	After updating the agro-environmental profile and development of monitoring indicators for the implementation of best agricultural practices, increase adoption rate of best agricultural practices to over 80%.	MAPAQ, MENV and agro-environmental clubs	March 31, 2009		A compensation formula must be established with the local farmers in a spirit of community throughout the watershed. The cost of the compensation could reach \$1 million.
	<p>Make moves that will quickly reduce phosphorus intake due to erosion:</p> <ul style="list-style-type: none"> a. Subtract 100 to 200 hectares from areas under cultivation in the most problematic zones (significant soil erosion), through the purchase and leasing of land, or with compensation to the farmers. b. Substitute other crops in place of corn (e.g. forage crops) on another 200 to 500 hectares. c. Establish 200 to 500 hectares of riparian zone 1 to 3 metres wide in strategic places and 10 metre strips in other areas to maintain or create ecological corridors. 	MAPAQ, MENV	Spring 2004 or 2005 (depending on how quickly the suggested measures are implemented)	We know that certain areas are responsible for significant losses due to erosion. The presence of these riparian zone at well targeted areas will reduce erosion. Moreover, the 10-metre riparian strips along other watercourses will serve as ecological corridors. This will also contribute to Quebec's green belt commitments.	
2. Reduce wind erosion in cultivated fields.	Putting up windbreakers in strategic places.	MAPAQ, MENV and agro-environmental clubs	March 31, 2009	There are wind erosion problems, particularly where there market gardens. Soils are uncovered for increasingly longer periods in winter. Fine, phosphorus rich materials will continue to end up in the bay.	\$100 k (MAPAQ, agricultural groups, MENV)
3. Decrease quantities of herbicides used in the Missisquoi Bay watershed.	Determine quantities of herbicides used in the region and set a reduction objective of 50% depending on the level that has been observed.	Universities, MAPAQ, MENV and agro-environmental clubs	March 31, 2009	Essential step given the suspected effect these substances have on phytoplankton communities.	Suggested amount for the studies: \$50 k (MENV or MAPAQ)

Specific Objectives	Actions	Responsible Authority	Deadline	Environmental and Organizational Impacts	Cost Estimate (MENV or partners)
	Maintain and accentuate the reduction of herbicide use.	Agro-environmental clubs	March 31, 2009	Joint research with the university community must be done in this area.	
	Integrate this objective into watershed agreement contracts.	CBVBM	March 31, 2009	Plan for funds to subsidize the studies.	
4. Improve our knowledge of water quality and flows and obtain phosphorus data from soil analyses.	Prioritize study of the data available on water quality, flows and phosphorus, nitrogen and suspended sediment loads to the bay.	MENV, MAPAQ, IRDA, universities	Fall 2004 and ongoing	This information will allow for elements of information to be obtained which will serve to better target interventions.	2 times \$25 k = \$50 k (MENV) and 2 times \$3 k = \$60 k
	Do the same for phosphorus data obtained from soil analyses.	Idem	Fall 2004 and ongoing	Certain data on soils are already available for the region. However, soil analyses from the AEFPP should serve to evaluate soil changes over time. Soil analyses carried out every three years are suggested for the bay's watershed.	
5. Prohibit forest clearing for purposes other than tree planting.	Intervene with municipalities and MRC so that they acquire the tools needed to limit clearing.	Municipal level and landowners	March 31, 2009	Wooded areas generate considerably less phosphorus per hectare and serve as a habitat for many living species.	

Appendix 2 – Agreement between Quebec and Vermont for the Reduction of Phosphorus in Missisquoi Bay

As part of the Québec – New-York – Vermont memorandum of understanding, Vermont and Quebec created the *Missisquoi Bay Phosphorus Reduction Task Force* in December 1997.

In June 2000, the Québec – Vermont Task Force presented its report entitled *A Division of Responsibilities between Québec and Vermont for the Reduction of Phosphorus Loads to the Missisquoi Bay*. The report presented an agreement proposal between the Government of Québec and the State of Vermont on reducing phosphorus in Missisquoi Bay, which was signed on August 26, 2002. The agreement highlights are as follows:

The objective for the reduction of total phosphorus to Missisquoi Bay is maintained at 0.025 mg/l as agreed by the QC–NY–VT task force in 1993.

The phosphorus total target load from the Missisquoi Bay watershed is set at 97.2 mt/year over a 20-year period starting in 1996 to reach the concentration objective target.

The division of responsibilities is set at 40% for Québec and 60% for Vermont, based on the relative phosphorus contributions from Québec and Vermont to the Missisquoi Bay measured in 1991. As a result, Québec's target load will be 38.9 mt/year and Vermont's target load is 58.3 mt/year. Actions required to reach the phosphorus concentration and load objectives are defined within the context of the LCBP and the *Memorandum of Understanding between Québec, the State of New York and the State of Vermont*.

Table 5 Québec and Vermont joint effort to reduce phosphorus in the Missisquoi Bay

Loads measured in 1991 (mt/an)	Vermont	Québec	Total
Point source	6.9 ^a	8.5 ^a	15.4 ^a
Nonpoint source	94.2 ^b	57.7 ^b	151.9 ^a
Total	101.1	66.2	167.3 ^a
Total percentage	60%	40%	100%
Target load	58.3	38.9	97.2 ^a
Required reduction	42.8	27.3	70.1 ^a

^a Values taken from the *Lake Champlain Diagnostic-Feasibility Study* (Vermont DEC and New York State DEC 1997).

^b Distribution between Vermont (62%) and Québec (38%) of total load from nonpoint sources according to data from Hegman *et al.* (1999).

Attainment of the objectives will be evaluated by a joint Vermont-Québec program on water quality monitoring in the tributaries of the Missisquoi Bay and a progress report of activities carried out in the Bay's Watershed.

Appendix 4 – Acronyms

AEFP	Agro-environmental fertilization plan
IRDA	Agro-environmental Research Institute
AOR	Agricultural Operations Regulation
CBVBM	Corporation Bassin Versant Baie Missisquoi
CCQ	Comité consultatif des citoyens du Québec
CEHQ	Centre d'expertise hydrique du Québec
CEDAQ	Conseil de développement de l'Agriculture du Québec
CICBM-RM	Comité interministériel régional sur la baie Missisquoi – Région Montérégie
CSBVRB	Coopérative de solidarité du bassin versant de la rivière aux Brochets
CRF	Canadian Research Fund
GCR	Groundwater Catchment Regulation
LCBP	Lake Champlain Basin Program
MAMSL	Ministère des Affaires municipales, du Sport et du Loisir
• PADEM	Programme d'assainissement des eaux municipales
• PEVQ	Programme Les Eaux Vives du Québec
MAPAQ	Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec
• DEDD	Direction de l'environnement et du développement durable
MCC	Ministère de la Culture et des Communications
MENV	Ministère de l'Environnement
• DAIEE	Direction des Affaires intergouvernementales et des études économiques
• DPMT	Direction des politiques en milieu terrestre
• DPE	Direction des politiques de l'eau
• DPEDD	Direction du patrimoine écologique et du développement durable
• DRAEEM	Direction régionale de l'analyse et de l'expertise de l'Estrie et de la Montérégie
• DSEE	Direction du suivi de l'état de l'environnement
MDERR	Ministère du Développement économique et régional et de la Recherche
MRNFQ	Ministère des Ressources naturelles, de la Faune et des Parcs
MSSS	Ministère de la Santé et des Services sociaux
• DSPM	Direction de la santé publique de la Montérégie
NY	New York
QC	Québec
TAC	LCBP Technical Advisory Committee
TICQ 1997	Travaux d'infrastructures Canada-Québec 1997
TQ	Tourisme Québec
VT	Vermont
VTDEC	Vermont Department of Environmental Conservation