REGIONAL ASSESSMENT
DES PRAIRIES RIVER AND MILLE ÎLES RIVER

Regional Assessment
Des Prairies River and Mille Îles River

Priority Intervention Zone 25

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NOTICE TO READERS

Reports on Priority Intervention Zones (ZIPs) are published as part of the St. Lawrence Vision 2000 Action Plan by the St. Lawrence Centre of Environment Canada, in conjunction with Fisheries and Oceans Canada, Health Canada, the Ministère de la Santé et des Services Sociaux and its partners, and the Ministère de l'Environnement du Québec.

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Preface

In April 1994, the governments of Canada and Quebec agreed to carry on the work of the St. Lawrence Action Plan, approving a five-year program (SLV 2000) extended in 1998 until 2003.

The goal of St. Lawrence Vision 2000 (SLV 2000) is to conserve and protect the St. Lawrence River and the Saguenay River so that people living along their shores can reclaim use of these rivers in a manner compatible with sustainable development.

The Priority Intervention Zones program — better known by its French acronym ZIP (zones d'intervention prioritaire) *— is a major element of the Community Involvement component of the St. Lawrence Vision 2000 Action Plan.*

Through the ZIP Program, riverside communities are invited to play an active part in achieving the objectives aimed at restoring the St. Lawrence and Saguenay rivers.

The program enables various community partners, non-governmental organizations and citizens committees to work together to identify common priorities for the conservation and restoration of the St. Lawrence River.

We are pleased to present this assessment report on the uses, resources and main environmental problems specific to this area. It has been prepared using all the data available from the various federal departments and provincial ministries involved in SLV 2000.

We hope it will prompt a more enlightened debate based on information that is as objective as possible, and that the debate will help the different partners involved to draw up and implement an action plan for the restoration of the area in question.

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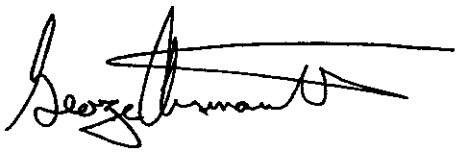

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Management Perspective

The Priority Intervention Zones (ZIP) Program is a federal-provincial initiative involving stakeholders and shoreline communities in implementing measures to restore the St. Lawrence River. The program has three phases: producing a regional assessment report on the state of a specific area of the St. Lawrence, consulting shoreline partners in setting priorities for action, and developing an ecological rehabilitation action plan (ERAP).

The regional assessment is a synthesis of four technical reports on the biological, physico-chemical, socio-economic and public health aspects of the study area, prepared by the federal and provincial partners of the St. Lawrence Vision 2000 Action Plan as part of its Community Involvement component.

The process of gathering and analysing data area by area has never before been undertaken for the entire St. Lawrence River. The technical reports go a step further, assessing our knowledge of the current state of a given area based on known quality criteria.

The challenge, then, is to offer a scientific opinion based on the available information. The pitfalls are numerous: the data were collected for other purposes, the geographic and temporal coverage is less than ideal, and the chemical analysis methods are not standardized, to name but a few.

The ZIP Team remains nonetheless convinced that an enlightened and thoughtful overview of each study area can be presented without further delay. This initial assessment is therefore intended as a discussion paper that will serve as a starting point for the shoreline partners in each study area.

Perspective de gestion

Le programme des Zones d'intervention prioritaire (ZIP) relève le défi de la concertation entre les gouvernements fédéral et provincial et de l'implication communautaire des partenaires riverains, en vue de mettre en œuvre des mesures de réhabilitation du Saint-Laurent. Ce programme comporte trois grandes étapes, soit l'élaboration d'un bilan environnemental sur l'état du Saint-Laurent à l'échelle locale, la consultation de partenaires riverains, avec l'identification de priorités d'intervention, et l'élaboration d'un plan d'action et de réhabilitation écologique (PARE).

Un bilan régional est établi à partir d'une synthèse des quatre rapports techniques portant sur les aspects biologiques, physico-chimiques, socio-économiques et sur la santé humaine du secteur étudié. Ces rapports sont préparés par les partenaires fédéraux et provinciaux du Plan d'action Saint-Laurent Vision 2000, dans le cadre du volet Implication communautaire.

La cueillette et l'analyse des données existantes à l'échelle locale constituent une première pour l'ensemble du Saint-Laurent. Les rapports techniques vont plus loin encore, en proposant un bilan des connaissances sur l'état actuel d'un secteur à partir de critères de qualité connus.

Le défi consiste donc à poser un jugement scientifique fondé sur l'information disponible. Les embûches sont nombreuses : les données ont été recueillies à d'autres fins, la couverture spatiale ou temporelle n'est pas idéale, les méthodes d'analyses chimiques ne sont pas uniformes, etc.

L'équipe de travail ZIP demeure convaincue qu'il est possible de poser, sans plus attendre, un regard éclairé et prudent sur chaque secteur. Cette première évaluation constitue un point de départ et un document de base rédigé à l'intention des partenaires riverains de chaque secteur d'étude.

Abstract

The Lake of Two Mountains–Des Prairies River and Mille Îles River study area has been divided into two Priority Intervention Zones, called ZIPs 24 and 25. The Des Prairies River and Mille Îles River (ZIP 25) sector of this overall study area, which is dealt with in this assessment, is not located on the St. Lawrence River proper, but borders the lower reaches of its main tributary, the Ottawa River.

These two outlets of the Lake of Two Mountains transport the brown waters of the Ottawa River toward the St. Lawrence River, flowing on either side of Île Jesus. They traverse some highly urbanized areas, industrial zones and sectors devoted to intensive agriculture. Until the early 1990s, water quality in both rivers was found to decline rapidly in a downstream direction, especially around municipal sewer discharge points, since wastewater treatment was not instituted until 1999. The connection of sewage collectors to treatment stations, which is almost complete now, has brought about a reduction in inputs of suspended solids and phosphorus to the rivers. While it is evident that cleanup and treatment efforts need to be carried further and consolidated, the already noticeable improvements should provide impetus for participation in the restoration of the watercourses. Since the inputs of contaminants are predominantly from local sources, it can be hoped that the water quality will one day be comparable to that found in Lake of Two Mountains.

Although both rivers were once heavily contaminated, the biodiversity of their aquatic and riparian habitats does not appear to have been irreversibly affected. Nonetheless, a number of local plant and wildlife populations are threatened by encroachments on their habitat. Most of the natural wetlands along the watercourses were destroyed or were substantially altered during the 20th century as a result of pressure from urban development. Dams and other flow control structures have impeded the movement of migratory fish and curbed recreational boating.

In spite of these problems, the two rivers still have exceptional natural qualities and resources. These include a number of rare vascular plants, a diversity of bird species and fish species that are seldom encountered elsewhere in Quebec, such as the American Shad, an

anadromous species that undertakes distant migrations, and the Copper Redhorse, which is endemic to Quebec and listed as a threatened species. In addition, a major spawning ground for the Lake Sturgeon of the St. Lawrence is situated downstream from the Rivière-des-Prairies generating station. The Des Prairies and Mille Îles rivers represent jewels of Quebec's natural heritage and as such deserve to be protected.

Surprisingly, these rich resources are not well known and the wetlands along the watercourses have not been studied to any great extent. These knowledge gaps should be addressed as soon as possible to ensure that unique and fragile components of the environment are afforded adequate protection.

Résumé

Le secteur d'étude Lac des Deux Montagnes – Rivières des Prairies et des Mille Îles a été divisé en deux zones d'intérêt prioritaire, soit les ZIP 24 et 25. La portion du secteur d'étude Rivières des Prairies et des Mille Îles (ZIP 25), à laquelle s'intéresse ce bilan, n'est pas située le long du fleuve Saint-Laurent même, mais dans le cours inférieur de son affluent le plus important, la rivière des Outaouais. Ces deux émissaires du lac des Deux Montagnes transportent vers le fleuve les eaux brunes de la rivière des Outaouais en passant de part et d'autre de l'île Jésus; ils traversent des territoires fortement urbanisés, des zones industrielles et des terres d'agriculture intensive. Jusqu'au début des années 1990, la qualité des eaux des deux rivières se dégradait rapidement le long de leurs cours, surtout aux points de rejets des égouts municipaux, dont les eaux ne sont toujours pas traitées en 1999. Le raccordement des réseaux collecteurs d'eaux usées à des stations d'épuration, aujourd'hui presque complété, a permis de réduire les apports de matières en suspension et de phosphore vers les rivières. Il sera, à l'évidence, nécessaire de poursuivre et d'accentuer les efforts d'assainissement déjà amorcés, mais les améliorations déjà perceptibles devraient stimuler la participation à la restauration de ces cours d'eau. Puisque les apports de contaminants sont essentiellement d'origine locale, on peut espérer retrouver un jour une eau de qualité comparable à celle du lac des Deux Montagnes.

Bien que les rivières des Prairies et des Mille Îles aient été fortement contaminées dans le passé, la biodiversité de leurs habitats aquatiques et riverains ne semble pas en avoir été affectée de façon irrémédiable. Par contre, plusieurs populations de la faune et de la flore locales sont menacées par des empiétements sur leurs habitats. La majeure partie des milieux naturels aux abords des deux rivières a disparu ou ils ont été profondément modifiés au cours du 20^{e} siècle sous la pression du développement urbain. Des barrages ou autres structures de contrôle de l'écoulement bloquent les déplacements de poissons migrateurs et limitent la navigation de plaisance.

Malgré ces problèmes, les deux rivières possèdent encore des atouts exceptionnels. On y trouve plusieurs espèces de plantes vasculaires rares, une avifaune diversifiée et des poissons rarement rencontrés ailleurs au Québec, comme l'Alose savoureuse, un grand migrateur anadrome, et le Chevalier cuivré, un poisson endémique au Québec et menacé de disparition; une importante frayère de la population d'Esturgeon jaune du Saint-Laurent est située en aval de la centrale Rivière-des-Prairies. Les rivières des Prairies et des Mille Îles constituent des joyaux du patrimoine naturel québécois qu'il est important de sauvegarder.

Chose surprenante, ces richesses sont peu connues et les milieux naturels des deux rivières n'ont pas été beaucoup étudiés. Les lacunes, à cet égard, auraient avantage à être comblées le plus tôt possible, afin que les éléments uniques ou fragiles de l'environnement puissent être adéquatement protégés.

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CHAPTER 1 The St. Lawrence, Then and Now

For the great majority of Quebecers, the mere mention of the St. Lawrence River evokes a deep-rooted feeling of belonging to the land traversed by these waters on their way from the Great Lakes to the sea. The pictures that spring to mind are those of a mighty river, fertile plains on either side, shady banks, and rich wildlife.

The country was born on the banks of the river, as can still be seen today by the division of land — a vestige of the seigneurial system. In those days, people had to learn to live with the whims of the St. Lawrence, including spring flooding. In return, it provided the European settlers, still struggling with unreliable harvests, with a sure supply of fish and a crucial means of communication linking the first towns and villages that grew up along its banks.

With time, forests gave way to farmland, and then towns and cities sprang up. Until that point, the low population density and the very size of the St. Lawrence meant that human uses of the river had had virtually no impact on its resources. But things would soon change. The first major impact seems to have been caused by logging and the beginnings of industrialization, in the 19th century; this included the floating of timber down the Ottawa River and the St. Lawrence to Quebec City, the building of dams and sawmills along tributaries, and the construction and commissioning of the first hydro-electric power plants.

The pace of change accelerated in the 20th century, with the construction of major dams on the St. Lawrence, controlling its flow, shipping channels and then the St. Lawrence Seaway. More and more industries were established near towns, often right on the river. The proximity of the waterway offered several advantages: it reduced the cost of transporting raw materials, solved water supply problems and provided an easy way of getting rid of waste.

The St. Lawrence gradually succumbed to these numerous onslaughts. A few informed observers noted that some animal populations were declining and suggested that the reason was habitat degradation. Their warnings aroused little public interest, however.

Public awareness was sharply raised in the early 1970s with the realization that mercury contamination of fish was not just an abstract research topic, but a real risk to which some Native people and many sport fishers were exposed. As the list of toxic substances reported in the aquatic environment continued to grow, the general public changed its perception and put environmental quality at the top of its list of priorities. There is virtually unanimous agreement now that the comforts afforded by an industrial society have a drawback: unbridled exploitation of resources and increasing levels of contaminants will eventually threaten all forms of life, including human beings.

Most industrialized countries have now agreed to base their economies on sustainable development. The profit motive alone can no longer govern human activity. Given the fragile nature of our environment and the limitations of our planet, sustainable economic development must ensure that scarce resources are used for a variety of purposes; it must also take into account the quality of life of human beings and promote the maintenance of biological diversity.

CHAPTER 2 The ZIP Program

Starting in the 1960s, growing public awareness of the degradation of the Great Lakes and the St. Lawrence and Saguenay rivers, along with the urgency of the situation, prompted governments to take substantive joint action. This paved the way for the 1972 *Great Lakes Water Quality Agreement.* A 1987 amendment added a local use restoration program (Remedial Action Plan, RAP). In 1988, the eight American states concerned and the provinces of Ontario and Quebec signed the *Great Lakes Charter* and an agreement to control toxic discharges into the Great Lakes Basin. In response to the poor quality of the waters of the St. Lawrence and its tributaries, the Quebec government launched its wastewater treatment program (PAEQ) in 1978.

In 1989, the federal and Quebec governments decided to combine their efforts under the St. Lawrence Action Plan, which was renewed in 1994 as St. Lawrence Vision 2000 (SLV 2000). In 1998, the plan was extended until 2003 and renamed the *St. Lawrence Vision 2000 Action Plan, Phase III.* One of the objectives of this action plan is to prepare a comprehensive state of the environment report on the Quebec portion of the St. Lawrence River. Under the Priority Intervention Zones Program, the St. Lawrence and two of its main tributaries — the Ottawa and Saguenay rivers — were subdivided into 25 sectors, or ZIPs, combined into 13 study areas (Figure 1). The aim is to encourage community stakeholders to work together locally to restore and protect aquatic and riparian habitats and to harmonize use of the river.

As part of the groundwork for public consultation meetings, a state-of-the-environment review is conducted by the partners for each study area, and the findings are compiled in four technical reports.[1] This report summarizes these findings to provide an overall assessment of the resources, and present and potential uses, of the Des Prairies River and Des Mille Îles River sector.

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[1] The technical reports deal with the physico-chemical aspects of the water and sediments (Fortin, 1999), the biological communities (Armellin and Mousseau, 1999), socio-economic aspects (Jourdain et al., 1999), and human health issues (Chartrand et al., 1999).

The document is intended above all for stakeholders of this segment of the St. Lawrence, and summarizes the main points of the available scientific and technical literature, with the aim of allowing them to participate actively in the discussions and the process of defining priorities for action.

The information presented here should provide the foundation for a common vision of the situation in the study area, thereby paving the way for concerted action by the partners.

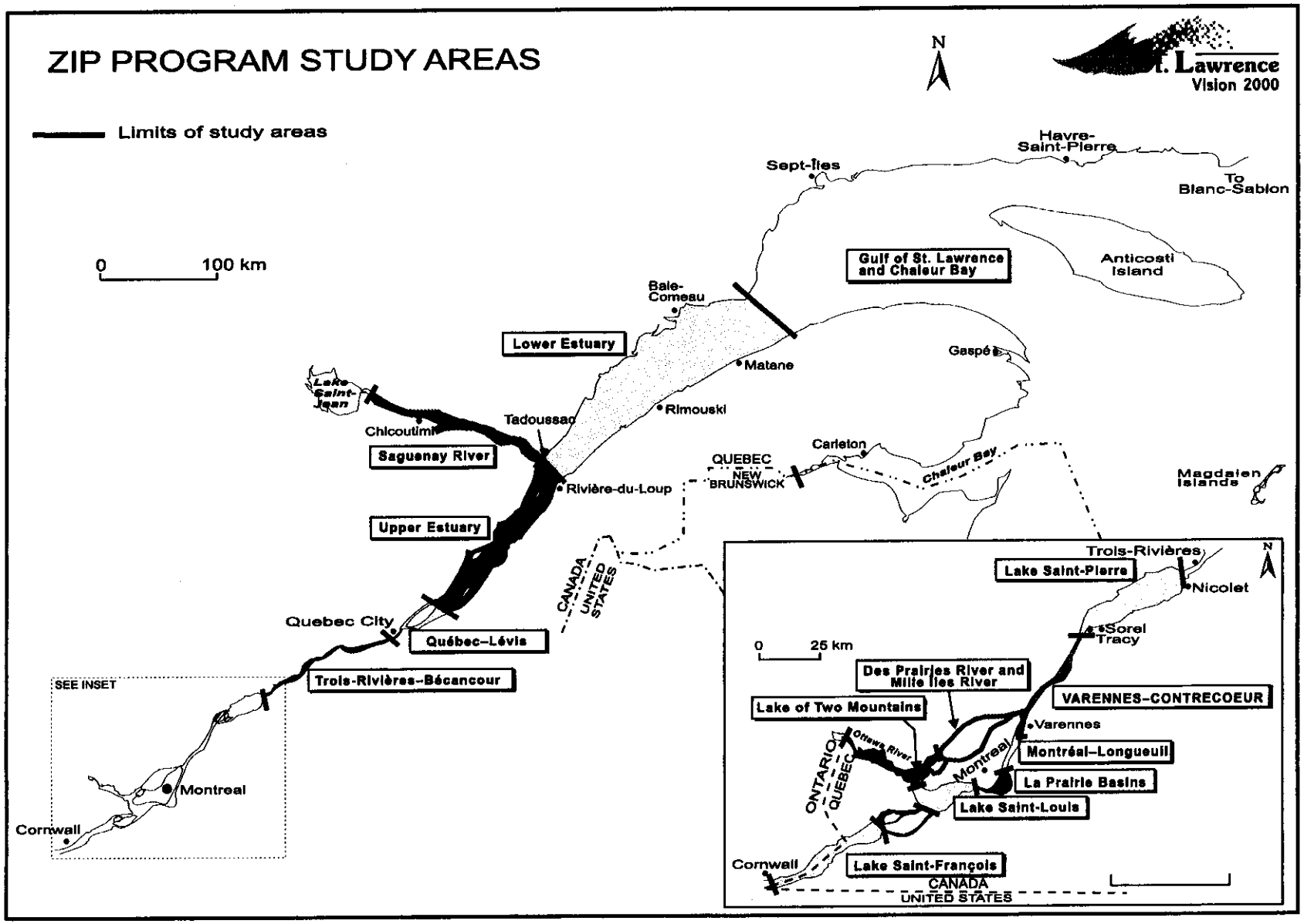

Figure 1 **ZIP Program study areas**

CHAPTER 3 Characterization of the Sector

At the end of the last ice age, several thousand years ago, southern Quebec and Ontario were covered by a major inland arm of the sea. As the ice receded, the Earth's crust gradually rebounded, exposing some land areas and isolating salt water in the huge basins that now form the Great Lakes.

Over thousands of years, the river carved out its bed in the unconsolidated deposits and clay that settled at the bottom of the former inland sea. This fertile plain, known as the St. Lawrence Lowlands, is bounded by the Canadian Shield to the north and by the Appalachian Mountains to the south.

The sector of interest here, comprising the Des Prairies River and the Mille Îles River, is not located along the St. Lawrence River proper. Instead, it corresponds to two branches of the Ottawa River, which is the largest tributary of the St. Lawrence. The waters in Lake of Two Mountains, a widening of the Ottawa River, flow through five different outlets before joining the St. Lawrence River (Figure 2). Part of the flow re-enters the St. Lawrence near Lake Saint-Louis, via the Vaudreuil and Sainte-Anne rapids; the rest empties into the Mille Îles River and Des Prairies River, which flow on either side of Ile Jésus and then join up again at the eastern tip of the Island of Montreal. The Des Prairies River flows between Île Jésus and the Island of Montreal, traversing a heavily urbanized region with a diversity of industries. By contrast, the Mille Îles River is located in a predominantly urban and agricultural region, which has only a few major industrial sites.

The defining characteristic of this sector is unquestionably its water mass, which is completely distinct from the water mass of the upper St. Lawrence which originates in the Great Lakes (see Section 3.1). The chemical properties of this water have multiple repercussions on the characteristics and composition of the aquatic and riparian communities (see Section 3.2).

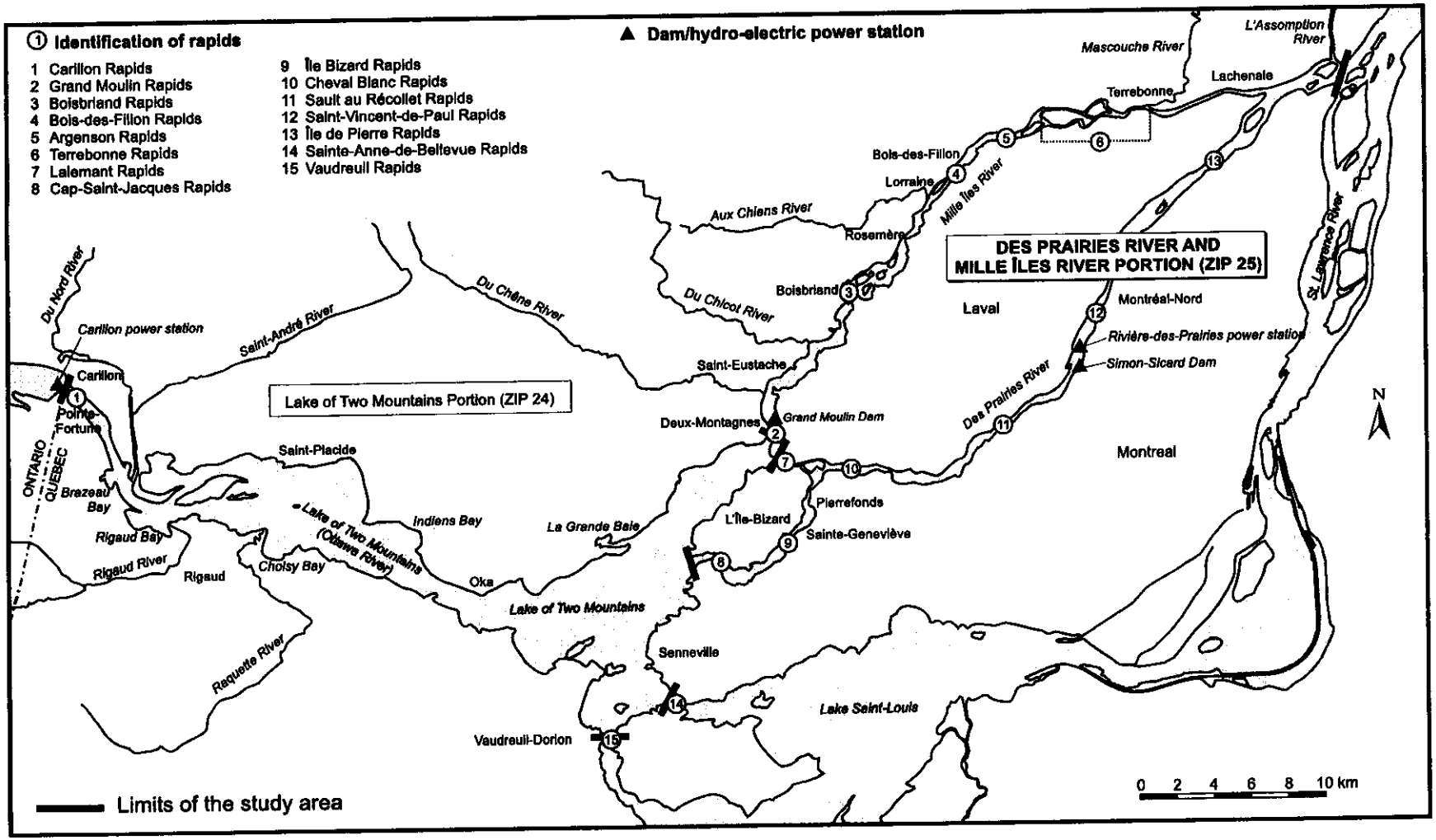

Figure 2 **Des Prairies River and Mille Îles River sector (ZIP 25)**

3.1 Physical Environment

The Ottawa River is the main tributary of the St. Lawrence in the area between the Great Lakes and Quebec City. This tributary's mean annual discharge, 1940 m^3/s at Carillon, is equal to about 16% of the discharge of the St. Lawrence near Quebec City[2].

3.1.1 Ottawa River and Lake of Two Mountains watershed

The magnitude of the discharge from the Ottawa River is related to the surface area of its drainage basin; the waters that flow into Lake of Two Mountains drain an area of 146 344 km^2, most of which (63%) is located in Quebec[3]. This hinterland is sparsely populated; forests occupy 86% of the drainage basin and major water bodies (lakes or reservoirs) roughly 12%.

Although the Des Prairies River and Mille Îles River sector is situated near the St. Lawrence River and likewise traverses the lowlands of the St. Lawrence Valley, it stands apart on account of the natural properties of the waters from the Ottawa River, which are directly linked to the drainage basin's geology. Most of the basin in the north lies on the Canadian Shield, which is basically exposed bedrock from the Precambrian Era; the southeastern part is underlain by sedimentary rocks dating from the Paleozoic. These rocky formations have been covered in some areas by unconsolidated deposits transported by the glaciers of the Quaternary period. The mineral particles released through the erosion of ancient rocks and glacial deposits contribute a major portion of the suspended load transported by the Ottawa River. Runoff causes leaching of organic acids (humic and fulvic acids) from the acidic soils (podzols) of the boreal forest and the extensive wetland habitats (peatland, marshes and swamps), and these acids give the watercourses

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[2] In comparison, the Great Lakes contribute 61% of the mean discharge at Quebec City.

[3] In Quebec, the main tributaries of the Ottawa River in terms of sub-basin area are the Gatineau (23 724 km^2), Du Lièvre (9583 km^2), Kipawa (6609 km^2), Rouge (5543 km^2) and Coulonge (5232 km^2) rivers. The principal tributaries in Ontario are the Madawaska (8210 km^2), Montreal (6605 km^2) and Blanche (5115 km^2) rivers.

of the Canadian Shield region a typical brownish tinge. Near the Island of Montreal, the brown waters of the Ottawa River meet the greenish waters from the Great Lakes[4].

The flow of the Ottawa River is partially regulated by means of control works located within its basin[5]; electricity generation during the winter provides inputs of water to the river from several reservoirs (Baskatong, Cabonga, Dozois, Decelles and a few others). During spring flood, which takes place in April, the discharge of the Ottawa River may be twice the mean annual mean rate, even quadrupling in exceptional cases[6]. Low water (the lowest water level) generally occurs at the end of the summer.

The Lake of Two Mountains covers an area of about 160 km^2, including Vaudreuil Bay (Figure 2). Waters from the lake flow into the St. Lawrence through five outlets. The Vaudreuil and Sainte-Anne canals channel part of the flow into Lake Saint-Louis (mean annual discharge of 335 and 550 m^3/s, respectively).

The Cap Saint-Jacques and Lalemant rapids, situated on either side of Île Bizard, drain into the Des Prairies River (1100 m^3/s). The Mille Îles River (200 m^3/s) begins at Grand Moulin rapids and joins up with the Des Prairies River about 40 km farther downstream.

The water's ability to transport, or entrain, particles depends essentially on current speed. Spring flood—the period of maximum runoff and erosion—has a decoupling effect on the suspended solids (SS) load in the waters of the Ottawa River, near Carillon. Whereas suspended solids reach a level of nearly 100 mg/L at Carillon in spring (April), the values recorded during the rest of the year are generally below 10 mg/L. Regardless of season, as the Des Prairies and Mille Îles rivers move through the urban environment, their load of suspended particles always increases.

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[4] The water from the Great Lakes contains more minerals and is more conductive and less turbid (cloudy) than that in the Ottawa River.

[5] Management of control works is co-ordinated by a special committee (*Comité de Régularisation de la rivière des Outaouais*) in order to regulate flood and low water periods.

[6] The extreme discharge values recorded at Carillon between 1962 and 1989 were 8190 m^3/s for the flood period (April 4, 1976) and 306 m^3/s for the low water period (September 7, 1971).

Some riverbank areas in the sector appear to be subject to erosion, particularly along the north shore of the Des Prairies River[7]. The Mille Îles River, however, does not appear to undergo erosion.

3.1.2 Des Prairies River

The Des Prairies River, which is the main outlet of Lake of Two Mountains, does not have any major tributaries. However, it does feature several sets of rapids, with the largest ones being the Cheval Blanc, Sault au Récollet and Moulin rapids. The Gros Sault rapids disappeared as a result of construction of the Rivière-des-Prairies hydro-electric power station, in 1928–29.

3.1.3 Mille Îles River

The Mille Îles River stretches over a course of about 40 km, interrupted only by the Île du Moulin dam and a former milldam, called Barrage des Juifs, which has collapsed. As it flows along, the river receives inflows of water on its left bank from four rivers: the Chêne (3 m^3/s) and Chicot (3 m^3/s) rivers, Riviere aux Chiens (0.2 m^3/s) and the Mascouche (10 m^3/s).

Over its annual cycle, the discharge of the Mille Îles River exhibits extreme fluctuations[8], which are associated with spring flooding of riparian lands and severe low-water episodes in summer. To limit bank overflows, a control work was constructed at the head of the river. The Mille Îles River has several zones of fast-flowing water; it also features numerous islands[9], several of which remain in a virtually natural state.

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[7] The segment most affected by this phenomenon is located on the north shore between the Rivière-des-Prairies power plant and Île Gagné.

[8] Extreme discharge values of 20 m^3/s (low water) and 1400 m^3/s (flood) have been measured, in contrast with the mean annual discharge of 200 m^3/s.

[9] The Mille Îles River has 94 islands, which cover a total area of 504 ha; the Des Prairies River has 39 islands all of which are small (total area of 185 ha).

3.2 Biological Environment

The sector offers a mosaic of agricultural and urban landscapes which include some tracts of land which have been preserved in a quasi-natural state.

Since most human activity in the study area began in the 20th century, historical records can be used to re-create the characteristics of the original riparian habitats.

3.2.1 Vegetation and habitats

In southern Quebec, in the absence of significant human activity, the plant associations that tend to dominate the rich clay soils of the St. Lawrence Valley are maple–hickory or maple–linden stands. However, since human activity has played a major role in shaping much of the study area, the plant communities have not evolved toward those associations. The lands bordering the Des Prairies and Mille Îles rivers, which had been cleared long before to make way for crops, were impacted by Montreal's northward and then westward expansion, particularly during the second half of the 20th century. Although the extensive virgin forests have long since disappeared, some islands, being less accessible than other areas, have retained remnants of their original vegetation communities.

The shoreline vegetation, too, has been altered by humans and in some cases replaced completely by artificial structures (wharves, retaining walls, rockfill). However, a few remnants of the original plant communities subsist, providing an indication of how the riparian habitats looked in their natural state.

The term *wetlands* designates a variety of habitat types associated with the presence of water, each with its own particular vegetation structure. Aquatic plant communities are domiated by completely submerged or floating plants; marsh is characterized by plants that emerge aboe the water surface. Riparian vegetation may be inundated occasionally, especially in the spring. It includes wet meadow, dominated by the herbaceous layer, and swamp, which is characterized mainly by shrubs or trees (shrubby or treed swamp). Wetlands are critical habitats

for wildlife and plants (Figure 3). Their importance in maintaining biological diversity is unanimously recognized today.

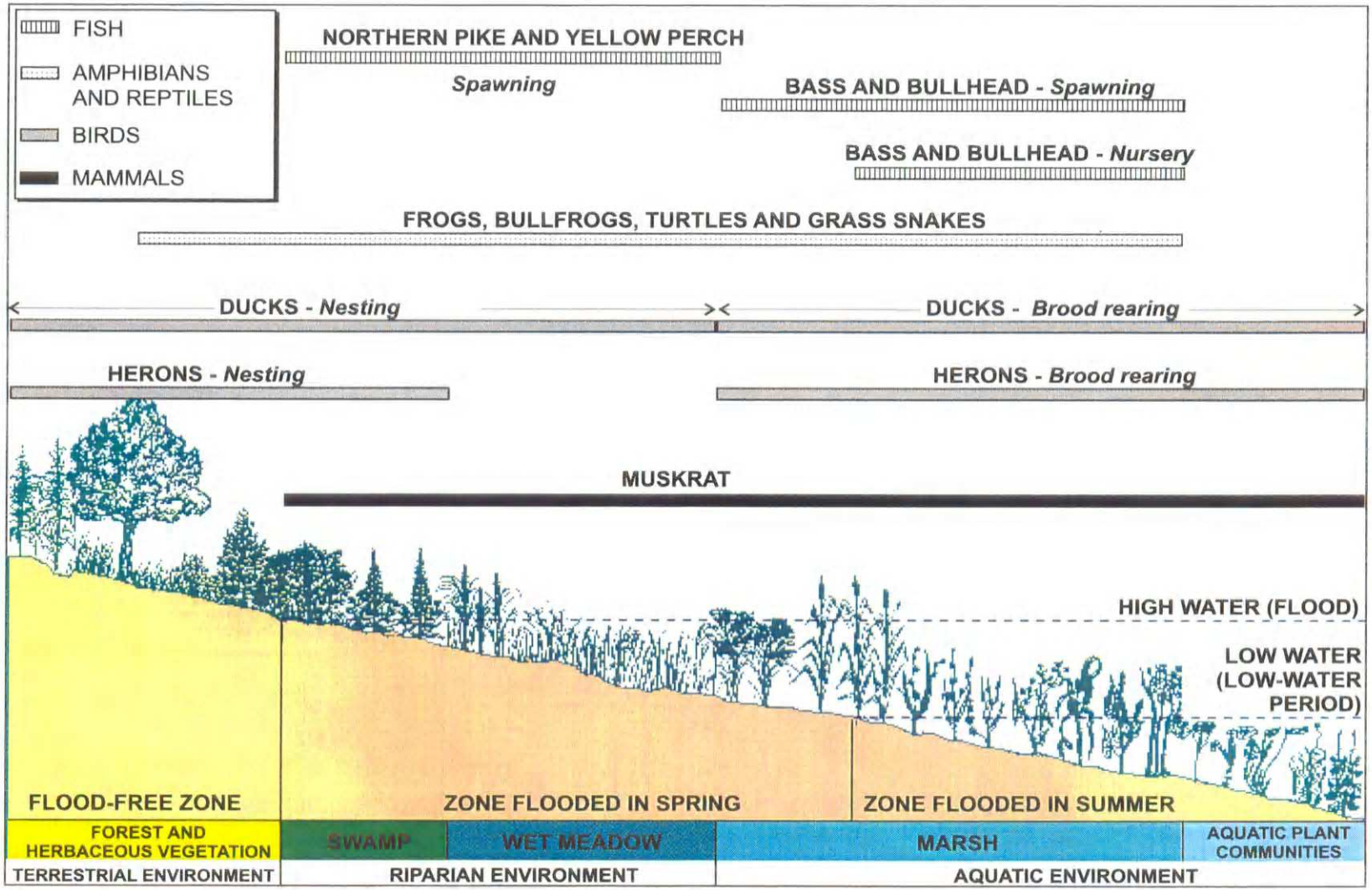
In the sector, the wetland habitats (Figure 4; Table 1) are concentrated mainly along the Mille Îles River. Aquatic and riparian vegetation is not well developed along the Des Prairies River owing to its straight banks, the extent to which they have been altered from their natural state and the zones with strong currents. Wet meadows are an exception, however: they are concentrated along the Des Prairies River.

Table 1
Area occupied by different types of wetlands in the sector

Type of wetland	*Des Prairies River*	*Mille Îles River*	*Total, sector*	*Montreal archipelago*	*Sector as a % of the archipelago*
			(in hectares)		
Aquatic beds	334	1 304	*1 638*	12 395	*13%*
Marsh	135	139	*274*	1 518	*18%*
Wet meadow	235	131	*366*	914	*40%*
Swamp	225	552	*777*	2 612	*30%*
Total, wetlands	**929**	**2 126**	**3 055**	**17 439**	**18%**

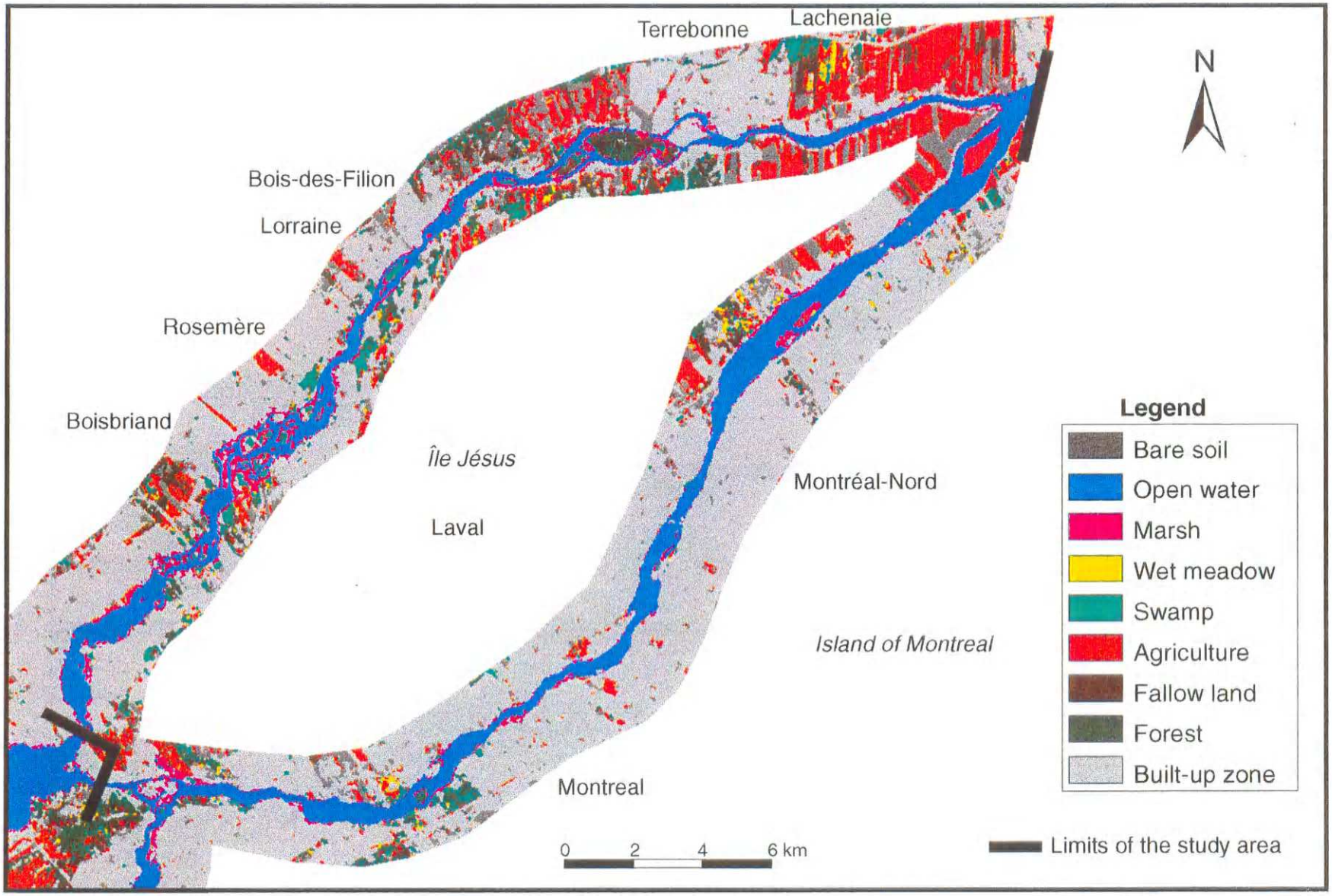
Source: Adapted from Armellin and Mousseau, 1999, after A. Marsan et Ass. Inc., 1986.

Dense stands of aquatic plants usually harbour a diverse and abundant community of small invertebrates, which find food and shelter there. This concentration of prey in turn attracts aquatic birds and fish. Aquatic plant communities also provide important spawning grounds for a number of stillwater fish species, including Yellow Perch, Northern Pike and Brown Bullhead. These habitats are also suitable for amphibians, certain reptiles, ducks and Muskrats.



Source: Armellin and Mousseau, 1999, after Auger et al., 1984.

Figure 3 Typical profile of the structure of wetland vegetation and main use by wildlife



Source: Létourneau, 1998.

Figure 4 **Wetlands of the Des Prairies River and Mille Iles River sector**

The aquatic plant communities in the sector, consisting primarily of submergent rather than floating vegetation, are not as numerous or as well developed as those in other water bodies located in the Montreal Archipelago. The turbidity of the water in the Ottawa River limits the penetration of light, which is essential for the development of submergent vegetation.

3.2.1.1 *Wetlands of the Des Prairies River*

The submerged beds in Des Prairies River cover a total area of roughly 273 ha; they are small, but nonetheless diversified. The main plant assemblages, dominated by tapeweed, are found chiefly to the south of Île Bizard, around various islands and along the riverbanks, in the downstream part of the river. The other communities, all of them small, have as their predominant species Canada waterweed, Nuttall's waterweed, common coontail or, in fast-flowing sectors, threadfoot (*Podostemum ceratophyllum*), a rare species.

The most common assemblages of floating vegetation contain tuberous water-lily and floating bur-reed. The Des Prairies River also has extensive areas covered with duckweed and great duckweed, species that typically occur along straight segments of shoreline where the current is slow.

In the sheltered zones, namely bays or upstream from islands, there are a few small marshes (135 ha in all), dominated variously by annual wildrice, broad-fruited bur-reed, broad-leaved arrowleaf or branching bur-reed.

The wet meadows are located mainly south of Île Bizard and on islands. Some low-lying islands in the downstream part of the river are almost completely covered with this type of vegetation, dominated by assemblages of reed canary-grass.

3.2.1.2 *Wetlands of the Mille Îles River*

The most extensive zones of wetlands that subsist in the sector are located along the Mille Îles River (2000 ha).

In the areas dotted with islands, submerged aquatic plant communities (1000 ha) practically cover the entire shoreline, often extending from one bank to the other. Tapeweed is the most common plant community, followed by waterweed species.

Floating beds of vegetation typically consist of tuberous water-lily communities. Filamentous algae are very common in the sector, where they occupy some 180 ha.

Marsh (140 ha) grows in narrow strips along the riverbanks, but may also form fringes around islands that are protected from the currents and around sheltered bays. Two plant associations are especially well represented in marshland: broad-leaved arrowleaf and broad-fruited bur-reed. In addition, some portions of marsh are dominated by American water-willow, a rare species.

Although there are few natural wet meadows, some sectors of riverbank are occupied by cultivated land and herbaceous communities are found in floodplains. In the lower reaches of the river, canary reed-grass covers a few large expanses of wet meadow.

Swamps, typically treed rather than shrubby, are generally dominated by silver maple. Shrub swamp occurs mainly on fallow land.

3.2.2 Benthos

The term benthos comprises all organisms, both plants and animals, which live on, within or attached to the bottom. The study of benthic animals yields highly useful information for describing aquatic habitats. On the one hand, these organisms are at the base of the food chain and their abundance is a significant condition for the establishment of populations of higher organisms such as fish or birds. As well, the distribution of benthic animals in the environment is highly dependent on local conditions (presence of aquatic beds, nature of bottom, depth, and current speed) and individual species' requirements in this respect.

The benthos surveys conducted in the brown waters of the Ottawa River focused mainly on Lake of Two Mountains. Most of the samples were collected in the early 1980s in the context of studies under the "Archipelago Project." At the time, 30 habitat types were described in the waters of the Montreal archipelago, nine of them represented in Lake of Two Mountains

(7 open water habitats, 2 aquatic plant communities). By definition, a habitat type has a similar benthos community composition regardless of its geographic location. The environmental variables that have the greatest influence on benthos composition are type of water (brown, green or mixed), type of bottom, current speed, presence of vegetation and depth.

In the Des Prairies and Mille Îles rivers, only three habitat types were identified, primarily because of a lack of information about certain environmental variables. Only the benthic stands of aquatic plant communities were described in detail. Both rivers contain zones where the currents have entrained all the sediments, except for hardened clay and coarse substrate materials like boulders and cobble. The Des Prairies River also has some deep areas (over 3 m deep), where the benthic fauna was not studied.

3.2.3 Fish

In all, 73 fish species occur in the brown waters of the lower reaches of the Ottawa River. This species diversity is somewhat smaller than that in lakes Saint-Louis (87 species) and Saint-Pierre (80 species), but greater than the diversity observed in the fluvial stretches of the St. Lawrence. Certain characteristics of the water bodies fed by the Ottawa River most likely influence the composition of the fish communities. For example, the varied aquatic habitats and the presence of fast-flowing waters promote diversity, whereas the small floodplain area probably has an adverse effect on diversity, by limiting the spawning activity of Northern Pike, Yellow Perch, minnows and other fish.

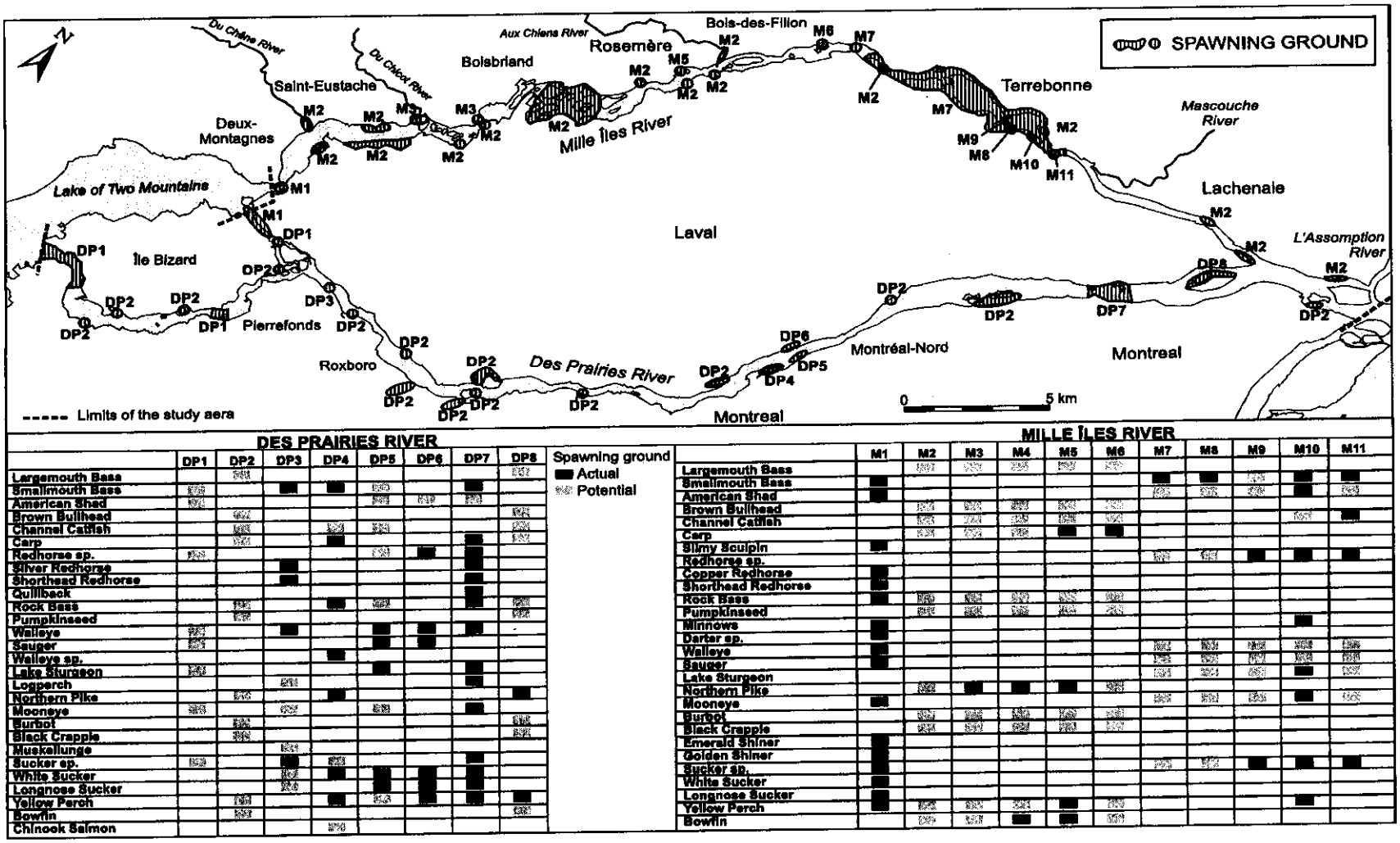
The Lake of Two Mountains, Des Prairies River and Mille Îles River form a whole and share a number of ichthyofaunal components. However, certain species have a distribution that is limited to just one of these waterbodies. Muskellunge, Blackchin Shiner, Spotfin Shiner, Ninespine Stickleback, Bluegill, Freshwater Drum and Rainbow Smelt appear to be present only in Lake of Two Mountains. In contrast, the Brook Silverside was observed only in the two rivers. The Copper Redhorse and the Tessellated Darter were caught only in the Mille Îles River. The species with the broadest geographic range, encompassing the lake and both rivers, are

Pumpkinseed and Yellow Perch, followed by Brown Bullhead, Rock Bass, White Sucker and Walleye.

The principal spawning grounds in the sector are located in zones of rapids (Figure 5). They are concentrated in the upstream part of the Des Prairies River (in the Île de Pierre, Saint-Vincent-de-Paul and Cheval Blanc rapids), and the downstream part of the Mille Îles River in the Terrebonne and Grand Moulin rapids.

Conditions in the the lower reaches of the Ottawa River are especially favourable for spawning by American Shad, an anadromous species which undertakes large migrations and which sustained an important commercial fishery in the St. Lawrence River until the middle of the 20th century. The only known spawning ground that is still used by shad is situated downstream from the Carillon power station, in Lake of Two Mountains. To reach this spot, American Shad used to swim upriver from the ocean via one of three possible routes: the Sainte-Anne–Vaudreuil canals, the Mille Îles River and, above all, the Des Prairies River, where large numbers of shad could be caught at Gros Sault. Construction of various works on the two rivers has reduced access to the route that runs through Lake Saint-Louis.

The Mille Îles and Des Prairies rivers appear to contain important spawning grounds for the Lake Sturgeon population that frequents the entire fluvial corridor, between Montreal and Quebec City. This is one of the most heavily fished populations in North America. Conservation of spawning habitats is essential to allow this stock to produce new individuals and thus compensate for the losses that fishing, poaching and water pollution add to natural mortality. Various works have been constructed at the base of the power station to assist spawners.



Source: Armellin and Mousseau, 1999, after Mongeau and Massé, 1976; MEF, 1998b.

Figure 5 Main spawning grounds in the Des Prairies River and Mille Îles River sector

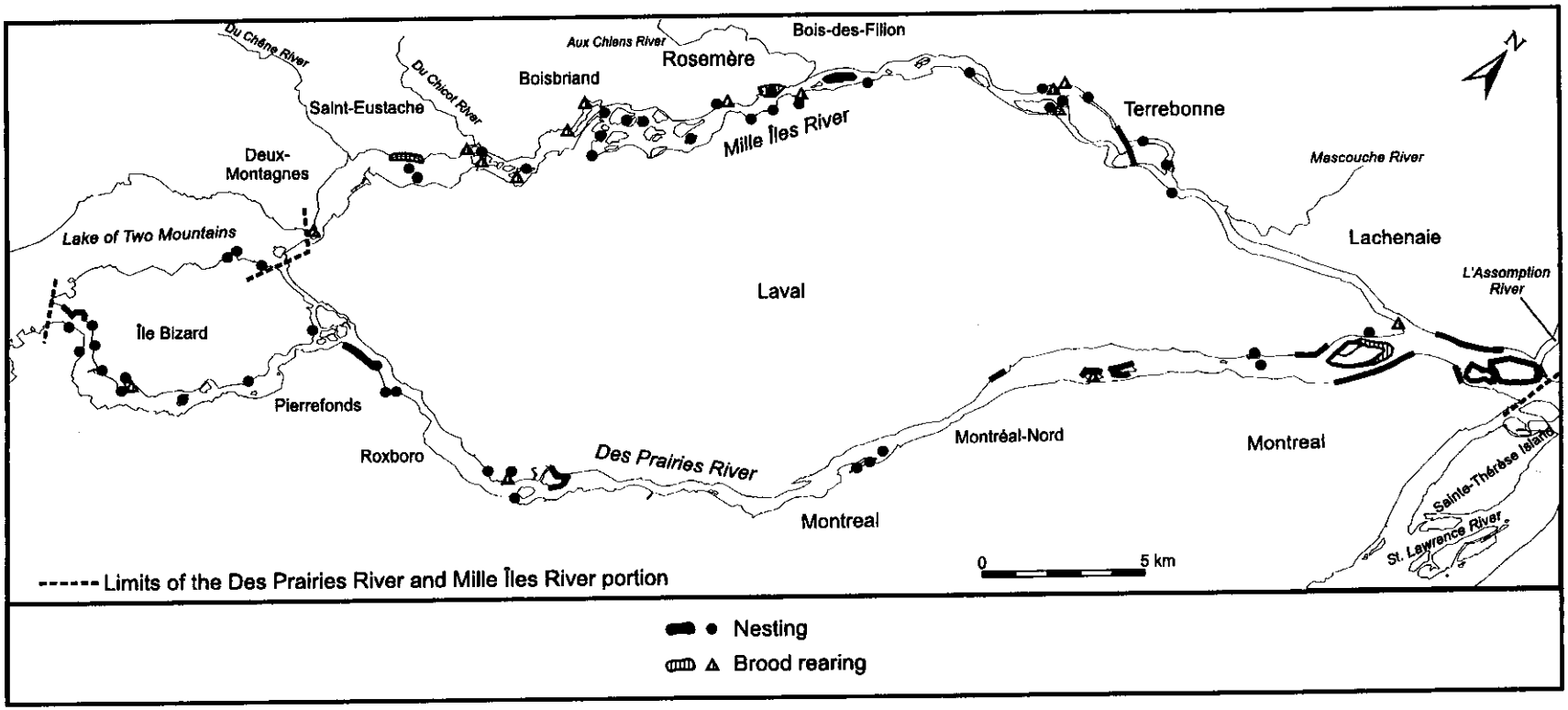
The Mille Îles River is frequented by an unusual fish species: the Copper Redhorse, which is the only vertebrate endemic to Quebec. An endemic species has a geographic range that is limited to a given area; the species is not found elsewhere. The Copper Redhorse feeds exclusively on molluscs by using its large pharyngeal teeth to crush their shells. Although the Copper Redhorse has always been quite rare, catch records show that its geographic range, which originally covered much of the St. Lawrence and a few rivers in the Montérégie, has declined considerably over the past 50 years. Today, the species is found solely in the Richelieu River and in the Mille Îles River. The survival of the Copper Redhorse, which will soon receive legal protection as a threatened species, is a key biodiversity conservation challenge in Quebec.

3.2.4 Birds

It is estimated that 145 bird species nest in the sector or nearby. The bird life is characterized by considerable diversity, the presence of rare nesting species and a number of infrequent visitors. However, bird colonies are essentially absent from the region, and shorebirds do not stop over there during their migrations.

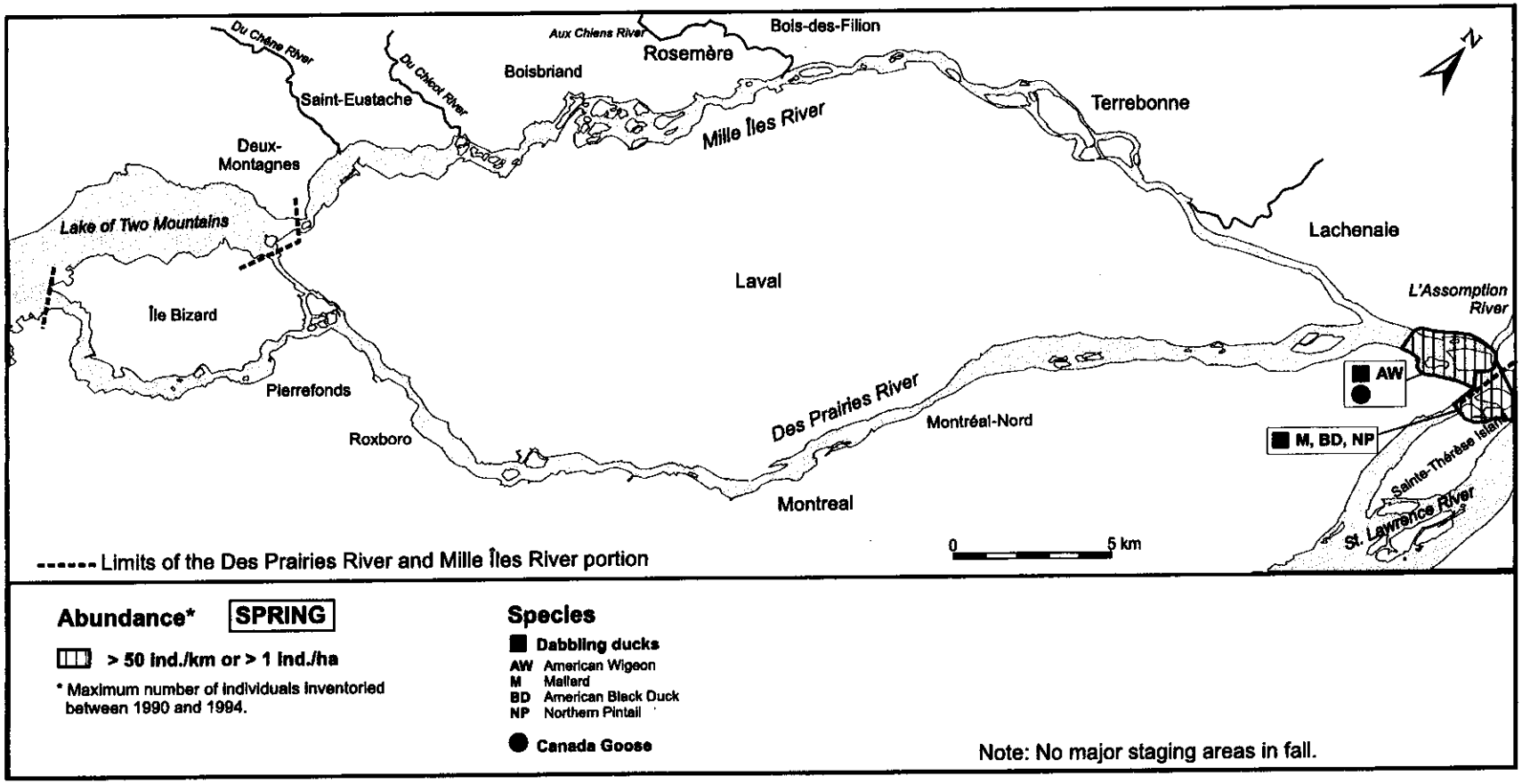
Islets fringed with marshes and beds of aquatic plant communities constitute excellent sites for waterfowl nesting and brood rearing (Figure 6). In comparison with Lake of Two Mountains, the Des Prairies and Mille Îles rivers have only small areas of such habitats. Furthermore, disturbances appear to limit brooding success. Twelve anatid species are believed to nest in the area. The main nesting species are, for the dabbling ducks, American Wigeon, Gadwall, Mallard, Northern Pintail, Northern Shoveler, Black Duck and Green-winged Teal. Diving ducks comprise the Common Merganser and Ring-necked Duck. Recently, the Canada Goose has been nesting in adjacent areas.

During the spring migration, flocks of ducks can be seen at the mouth of the Des Prairies River; the Mille Îles River appears not to be used very much for staging. In the fall, few ducks stop over in the area (Figure 7).



Source: Armellin and Mousseau, 1999, after MLCP, 1984.

Figure 6 Potential waterfowl nesting and brood-rearing sites



Source: Armellin and Mousseau, 1999, after MEF, 1998a.

Figure 7 Main staging areas of migrating waterfowl

There are no true bird colonies in the region. The Bank Swallow is the only species that nests on cliffs in a few locations and on talus slopes composed of sand, clay or gravel, near the water.

3.2.5 Other animals

According to the list of amphibian and reptile species whose geographic distribution encompasses the region, almost all of the species of southwestern Quebec (18 out of 21) may be present in the sector.

The biology and ecology of Quebec amphibians and reptiles are not well known for the most part. There is no information about the abundance of most of these populations, and even less data that could be used to link their potential decline to a specific factor. However, herpetologists all agree that these animals are strongly dependent on their preferred habitats, generally wetlands. If certain habitats were to disappear, the amphibians and reptiles associated with them would suffer the same fate.

The Muskrat is the most common indigenous mammal in the aquatic and riparian habitats of the study area. This rodent species was trapped intensively until the late 1980s, when declining pelt prices caused a loss of interest in this activity.

3.3 The Human Imprint

It was the presence of the Lachine Rapids, which impeded the passage of boats, that led to the creation of Ville-Marie in 1642. Transferred to the Sulpicians under the seigneurial system in 1663, the Island of Montreal first began to be settled in a few strategic sites near the water, with settlement gradually extending northward.

Île Jésus, granted to the Jesuits in 1642, underwent development later than Montreal. The first parish, Saint-François-de-Sales, was founded there in 1702, with other parishes springing up as settlement of this predominantly agricultural territory continued toward the west. Until 1850, the village of Sainte-Rose was the only urban centre on the island.

In the early 20th century, Île Jésus gradually became a vacation spot for Montrealers. Urbanization of the island began with the establishment of Laval-des-Rapides (1912) and Abord-à-Plouffe (1915). Urban development took off in the 1960s, leading to an expansion of the metropolitan region and the development of major highways. To resolve the problems associated with rapid growth, the settlements on the island were encouraged to group together. In 1965, the 14 municipalities on Île Jésus joined together to form the City of Laval.

The Des Prairies River and Mille Îles River part of the sector now comprises 16 municipalities with a total area of 608 km^2 and about 870 000 residents in 1996 (Table 2).

For the purposes of this assessment, the study area includes the town of Île Bizard, which straddles the western limit of the sector, and the northern districts of Montreal that are adjacent to the Des Prairies River, namely the districts of Ahunstic-Cartierville and Rivière-des-Prairies (Rivières-des-Prairies–Pointe-aux-Trembles district).

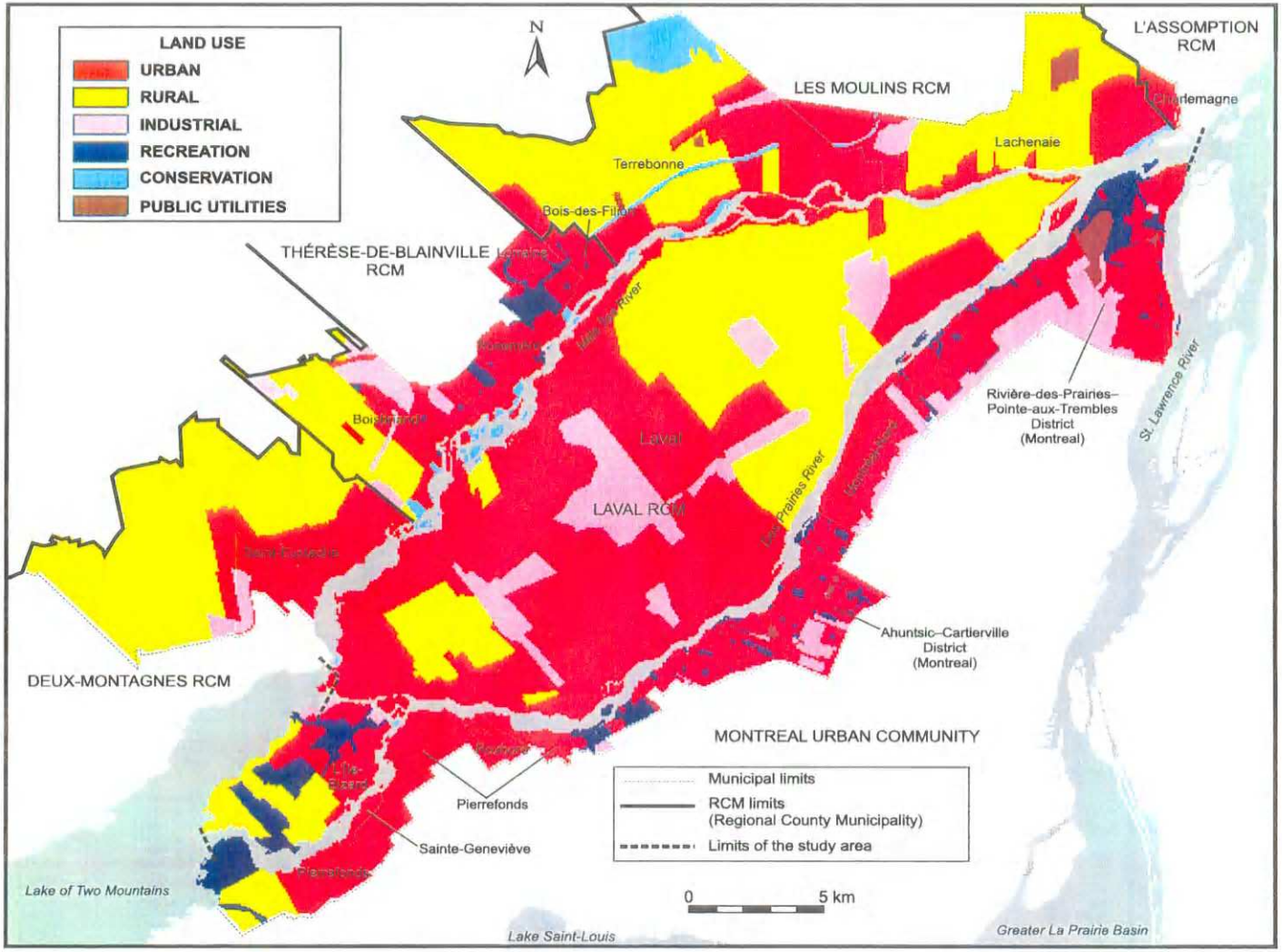
While the main type of land use is urban (48% of the territory), a large portion of the available area is still set aside for agriculture (37%). Tracts of land dedicated to industry occupy 9% of the region (Figure 8).

Table 2
Area and population of the municipalities in the Des Prairies River and Mille Îles River sector in 1996

Municipality	*Population (in 1996)*	*Area* (km^2)*	*Density* ($inhab./km^2$)*
L'Île-Bizard	13 038	22.7	575
Pierrefonds	52 986	24.5	2 165
Sainte-Geneviève	3 339	1.2	2 693
Roxboro	5 950	2.1	2 874
Ahuntsic-Cartierville District (Montreal)	123 365	24.0	5 140
Rivière-des-Prairies–Pointe aux-Trembles District (Montreal)	99 625	41.5	2 402
Montreal-North	81 581	11.0	7 396
Saint-Eustache	39 848	70.5	565
Boisbriand	25 227	26.4	954
Rosemère	12 025	10.4	1 162
Lorraine	8 876	6.0	1 484
Bois-des-Filion	7 124	4.3	1 649
Terrebonne	42 214	73.2	577
Lachenaie	18 489	42.7	434
Charlemagne	5 739	1.9	3 037
Laval	330 393	245.4	1 346
Total	**869 819**	**607.6**	**1 432**

Source: Jourdain et al., 1999, after MAM, 1997; Statistics Canada, 1997.

* Numbers are rounded off.



Source: RCM of Deux-Montagnes, 1987; RCM of Thérèse-de-Blainville, 1989; RCM of Les Moulins, 1997; RCM of L'Assomption, 1988; RCM of Laval, 1989; MUC, 1989.

Figure 8 Land use patterns in the shoreline municipalities of ZIP 25

CHAPTER 4

Human Activities and their Main Effects on the Environment

Human activity, which was particularly intense in the study area, has caused numerous alterations in the Des Prairies River and Mille Îles River sector. The major changes are summarized below.

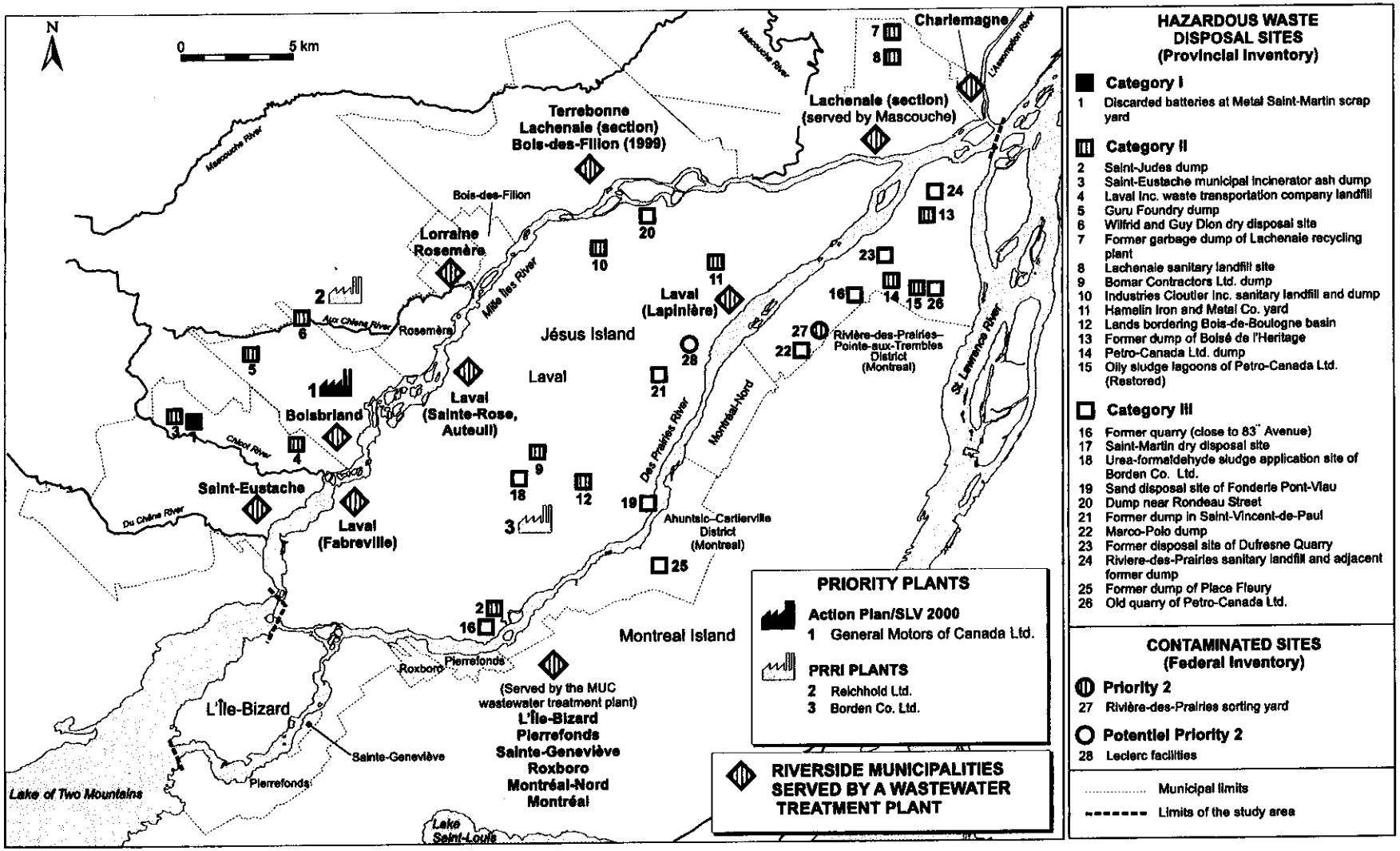
4.1 Contamination

For a long time, the St. Lawrence River was considered a convenient and inexpensive dump site for wastewater. Industries, municipalities and agricultural operations discharged effluents and drainage water into the river or its tributaries untreated, until the effects of the pollution could no longer be ignored. The magnitude of the problem forced governments to monitor industrial and urban effluents and establish standards for the concentrations of substances discharged into watercourses to protect the natural environment. However, many substances have persisted in the environment and continue to be a source of contamination many years after they were originally discharged.

The volume and type of effluent determines its impact on the environment. For example, industrial plants are usually the main sources of chemicals, including toxics, while municipal effluent discharges contribute to bacterial contamination and may, through nutrient enrichment, boost biological productivity considerably, which can lead to eutrophication and give water a foul odour that turns people off swimming and other recreational activities.

4.1.1 Sources of pollution

It is believed that local sources are primarily to blame for inputs of contaminants to the aquatic environment (Figure 9), in the sector of interest here. These inputs consist mainly of municipal effluents, industrial discharges, local tributaries with poor water quality or even diffuse pollution (atmospheric transport, contaminated sites and urban runoff).



Source: Jourdain et al., 1999; Fortin, 1999.

Figure 9 Main local sources of contamination and treatment facilities in the sector

Upstream loadings of contaminants — that is, contaminants that arrive from the Ottawa River basin via Lake of Two Mountains — appear to be minor for the most part, in comparison with inputs originating in the sector itself.

4.1.1.1 *Upstream loadings: Ottawa River and Lake of Two Mountains*

Forestry represents the main economic activity in the Quebec part of the Ottawa River basin; six pulp and paper mills and several sawmills are established there. Until 1994, logs were floated down this river and along several of its tributaries. Agriculture is a rather marginal activity in the Quebec part of the watershed, whereas it is more extensive on the Ontario side.

According to the available data, the water flow that reaches Carillon is of good quality. Phosphorus content is the only problematic parameter. Although the phosphorus level has decreased periodically over the past two decades, there are frequent exceedances of the criteria for protecting the aquatic environment from eutrophication. The waters of the Ottawa River contain fairly high concentrations of arsenic and certain metals, mainly because of the nature of the rocks and soils in the watershed; human activities constitute a very minor source of the concentrations of these substances in the water.

The annual flux of total polycyclic aromatic hydrocarbons (PAHs) at Carillon is roughly 1.1 tonnes per year. Some types of PAHs may be released in large quantities through natural phenomena; however, the PAH composition at Carillon suggests that an appreciable portion of the PAH resulted from the combustion of petroleum products and was transported by the atmosphere and eventually deposited in the aquatic environment.

In the case of PCBs, which do not occur naturally, the loading measured at Carillon is 14.6 kg/year, or about 9% of the total quantity transported by the St. Lawrence River as far as Quebec City. Most of this PCB input is from the atmosphere. Since the Ottawa River accounts for roughly 16% of the discharge of the St. Lawrence at this location, it can be inferred that the Ottawa River has a low PCB load.

4.1.1.2 *Municipal effluent discharges*

In the past, the discharge of untreated municipal wastewater was the main factor contributing to the water quality degradation in both rivers. The main drawbacks of this practice are the foul odours and phosphorus and nitrogen enrichment of the water, which promotes dense algal growth and poor bacteriological water quality and hence poses risks for recreational activities involving water contact.

Until the early 1990s, the worst degradation situations noted along Des Prairies River, with reference to certain parameters (suspended solids, biological oxygen demand and total phosphorus) were centred downstream from the discharge point for Laval's municipal effluents, which at the time were not treated prior to release, and near the outfalls used to discharge wastewater overflows from the MUC (Montreal Urban Community). With regard to the Mille Îles River, degradation of water quality was attributable to discharges of untreated urban effluents and to agricultural activities.

The impact of municipal effluents on the aquatic environment has declined considerably since then, with the establishment of a system of collectors connected to wastewater treatment plants. Since 1988, wastewater from areas on the north shore of the Island of Montreal has been channelled to the MUC's regional treatment plant. Other treatment plants have been brought on stream since then, and some are slated to start up in the near future (Table 3). It is forecast that 92% of the riverside population in the sector will be served by wastewater treatment facilities by the year 2000. In the case of isolated dwellings, sewage is stored in septic tanks, which must be emptied periodically.

Water quality monitoring in these rivers showed a marked improvement between 1990 and 1996. This improvement has been attributed to wastewater treatment (Table 4) and changes in agricultural practices. A certain volume of wastewater may still enter the aquatic environment during heavy rainfalls or storms, when the collector system becomes overloaded and sewage is discharged at overflow points.

Table 3
Status of municipal wastewater treatment

Wastewater treatment plant (other municipalities served)	*Volume treated in 1998 (m^3/d)*	*Population served*	*Discharge point*
MUC	2 786 000	326 679	St. Lawrence
Saint-Eustache	29 800	39 212	Mille Îles River
Lorraine *(Rosemère)*	21 343	22 000	Mille Îles River
Boisbriand	14 230	15 720	Mille Îles River
Terrebonne *(Mascouche, part of Lachenaie, part of Bois-des-Filion)*	29 007	44 364	Mille Îles River
Mascouche *(Lachenaie)*	18 100	13 941	Mille Îles River
Charlemagne *(Le Gardeur)*	11 290	5 739	L'Assomption River
Laval (Fabreville)	21 300	37 100	Mille Îles River
Laval (Lapinière)	220 000	266 827	Des Prairies River
Laval (Sainte-Rose-d'Auteuil)	31 439	26 466	Mille Îles River
Total	**3 161 166**	**776 048**	

Source: Jourdain et al., 1999, after MAM, 1998.

Table 4
Discharges from three wastewater treatment plants in the sector in 1995

Wastewater treatment plant	*Volume treated (m^3/s)*	*BOD (kg/day)**	*SS (kg/day)*	*Total phosphorus (kg/day)*	*Number of overflows/yr*
Laval (Fabreville)	32 530	651 (60%)	759 (67 %)	28.4 (66%)	14
Laval (Sainte-Rose-d'Auteuil)	29 613	434 (84%)	192 (96%)	17.5 (75%)	13
Boisbriand	14 245	525 (73%)	331 (79%)	18.3 (69%)	5

Source: Fortin, 1999, after MAM, 1996.

* The figures in parentheses indicate the percent abatement according to overflow parameters and frequency.

4.1.1.3 *Industry*

In the Des Prairies River basin, industrial activity is highly diversified, especially on the north shore of the Island of Montreal. In 1986, roughly 260 small and medium-sized enterprises in the region channelled their effluents (about 84 250 m^3/day) to the municipal sewer system. Most of the industrial plants are involved in the electronics, photography, veneering, chemicals, textiles, services and food sectors. On the south shore of Île Jésus, the largest volume of industrial wastewater comes from the food industry; the other industrial plants there operate in various sectors (clothing, chemicals, concrete, asphalt, and stone).

There are also a large number of industrial plants in Laval, on the Mille Îles River[10] side. The largest industrial centres[11] on the north shore of this river are located at Saint-Eustache, Sainte-Thérèse and Terrebonne.

Only one plant in the region, which belongs to General Motors of Canada Ltd., is part of the 106 facilities targeted under the industrial cleanup component of the SLV 2000 Action Plan. This plant assembles automobiles and carries out numerous operations necessitating the use of chemicals[12]. Part of the effluents from this facility (cleaning, preparation, etc.) undergo physico-chemical treatment, which removes some of the heavy metals and phosphates. The effluents are then filtered and discharged into the storm sewer. The rest of the process water (sealant tests, de-icing) and domestic effluents are channelled to the municipal sewer system and go to the Boisbriand treatment plant, which discharges its effluent into the Mille Îles River.

4.1.1.4 *Tributaries*

There are no major tributaries that empty into the Des Prairies River, only a few streams and drainage ditches containing water of mediocre quality.

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[10] Metal products, furniture, printing, textiles, clothing and food.

[11] The food sector is predominant in Boisbriand and Blainville; the industries in Sainte-Thérèse are engaged in furniture, chemicals and food manufacturing.

[12] Cleaning of vehicle bodies, application of various types of coatings, paints, oils and lubricants.

Bertrand Stream drains the area around Dorval Airport and joins the river upstream from Île aux Chats. This watercourse, which drains a section of Félix-Leclerc Highway and an industrial zone, receives the discharges from seven storm collector pipes. It has mediocre water quality from a bacteriological standpoint and contains high concentrations of trace metals, notably copper and lead.

Montigny Stream is fed by a storage lake, which captures the rainwater from a number of residential and industrial sectors in Ville d'Anjou. The lake sediments are contaminated with oils, greases and metals. The stream itself is a source of bacteriological contamination for the Des Prairies River. It transports heavy loads of phosphorus and trace metals, notably copper, lead and chromium.

The marshes in the Pointe-aux-Prairies nature park, which are supplied with water from two sources, drain toward the Des Prairies River. The western branch is fed by Des Sœurs swamp, whereas the eastern branch drains part of the former Rivières-des-Prairies sanitary landfill site. The waters from the latter site contain elevated levels of ammonia nitrogen, phosphorus and metals (chromium, copper, lead and cadmium). The waters leaving the marshes have a low oxygen content, but they are loaded with sulphur dioxide.

No data are available for characterizing the inputs from tributaries that empty into the Mille Îles River. However, a variety of agricultural and industrial activities take place in the territory that drains into the river, particularly in the sub-basins of the Chicot and Chêne rivers, as well as on a large part of Île Jésus.

4.1.1.5 *Contaminated sites*

In addition to their effluents, industrial plants generate hazardous wastes that they dispose of at landfill sites. Over the long term, these sites can also contaminate the aquatic environment because wastes may be carried in runoff or migrate to the groundwater, eventually reaching watercourses.

Contaminated sites far from the aquatic environment may pose less of a risk to water bodies, but they still impose serious constraints on how the land is used.

In the study area, the Quebec Environment Ministry (MENVIQ) and Environment Canada have inventoried a number of contaminated sites posing a potential hazard for the environment or public health (Figure 9). Some of them have the potential to contaminate one river or the other (Table 5). Two federally-owned sites could be contaminated, but it is unlikely that they will affect the aquatic environment. One, the Rivière-des-Prairies marshalling yard in Montreal, may be contaminated with hydrocarbons; the second, the Leclerc Institution in Laval, may be contaminated with chemicals used in workshops.

Table 5
Contaminated terrestrial sites in the sector that pose a risk for the aquatic environment

Name	*Location*	*Class*	*Contaminants identified (potential)*
Des Prairies River			
Former dump	Laval, Saint-Vincent-de-Paul sector	3	Not specified
Former dump at the Dufresne quarry	Montreal	3	Phenols, sulphides, cyanides, BOD_5, COD (hydrocarbons)
Former dump, Boisé de l'Héritage	Montreal, Pointe-aux-Trembles and Rivière-des-Prairies	3	Lead, zinc
Former dump, Place Fleury	Montreal, Ahunstic sector	3	Not specified
Former quarry (near 83^e avenue)	Montreal, Rivière-des-Prairies sector	2	Hydrocarbons
Former quarry, Petro Canada Ltd.	Montreal, Pointe-aux-Trembles and Rivière-des-Prairies sectors	3	Hydrocarbons
Rivière-des-Prairies marshalling yard	Montreal, Rivière-des-Prairies sector	2	Hydrocarbons
Marco-Polo dump	Montreal, Rivière-des-Prairies sector	3	Hydrocarbons
Saint-Judes dump, City of Laval	Laval	2	Toluene, benzene, chloroform, metals, PAHs, PCBs
Dump, Bomar Contractors Ltd.	Laval, Saint-Martin Parish	2	Ammonia, PCBs, greases, oils, phenols and heavy metals

Name	*Location*	*Class*	*Contaminants identified (potential)*
Dump, Petro Canada Ltd.	Montreal, Pointe-aux-Trembles and Rivière-des-Prairies sectors	2	Hydrocarbons, heavy metals
Sanitary landfill and former dump nearby, Rivière-des-Prairies	Montreal, Rivière-des-Prairies district	3	Hydrocarbons, heavy metals
Rivière-des-Prairies sanitary landfill and adjacent dump	Montreal, Rivière-des-Prairies district	3	Heavy metals (other contaminants)
Leclerc Institution	Laval	-	Hydrocarbons, solvents, heavy metals
Lagoons for oily sludge, Petro Canada Ltd.	Montreal, Pointe-aux-Trembles and Rivière-des-Prairies sectors	2	Hydrocarbons, heavy metals
Disposal site, Fonderie Pont-Viau	Laval, Pont-Viau sector	3	Foundry sands (phenols)
Site used to spread urea formaldehyde sludges, Borden Co. Ltd.	Laval, Duvernay sector	3	Urea formaldehyde
Dry waste disposal site, City of Laval	Laval, Saint-Martin Parish	3	Foundry sands (phenols)
Land owned by Hamelin Fer et Métaux	Laval, Duvernay sector	2	Heavy metals
Land, Bassin du Bois de Boulogne	Laval, boul. Saint-Martin	2	Heavy metals, lead, phenols, oils and mineral greases, PAHs, PCBs
Mille Îles River			
Former dump, recycling plant Lachenaie	Lachenaie	2	Household waste, industrial waste, drums of spent oil and solvents
Landfill, Transport de Déchets Liquides Laval	Ville de Saint-Eustache	2	Industrial waste (hydrocarbons, phenols, lead and chromium)
Ash dump, municipal incinerator	Saint-Eustache	2	Heavy metals
Dump, Fonderie Guru	Boisbriand	2	Phenols
Dry waste dump, Wilfrid et Guy Dion	Boisbriand	2	Not specified
Dump near Rondeau Street	Laval, Saint-François sector	3	Not specified
Dump, Industries Cloutier	Laval, Saint-François-de-Salle Parish	2	Household waste and industrial waste
Lachenaie sanitary landfill	Lachenaie	2	Household waste and toxic waste
Battery waste, Métal Saint-Martin	Saint-Eustache	1	Heavy metals, hydrocarbons

Source: MENVIQ, 1991a and b; D'Aragon et al., 1992; Martel, 1998..

Classification: 1 = high risk; 2 = moderate risk; 3 = low risk.

4.1.1.6 *Snow dumping*

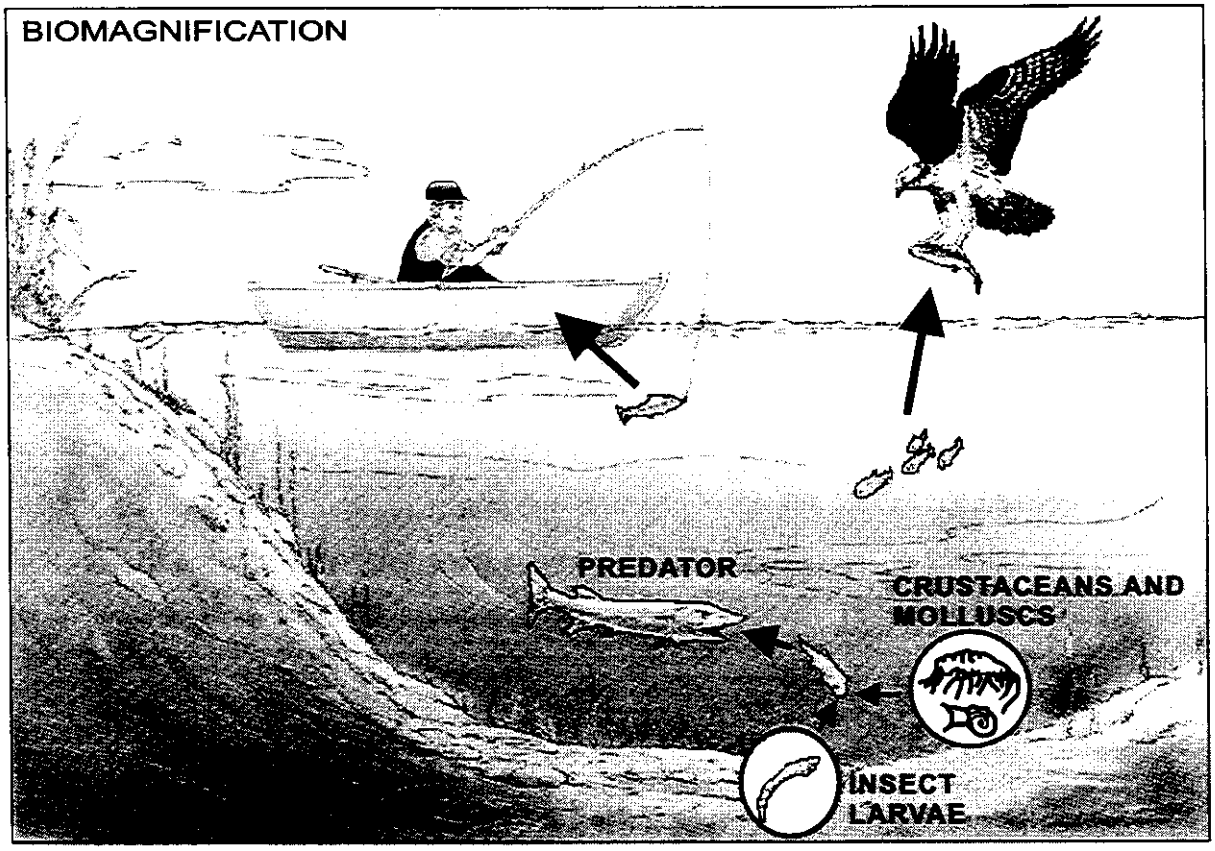
According to a study conducted in the Montreal area (LaSalle, Verdun and Lachine), snow removed from city streets after storms is too contaminated with chloride ions and suspended solids to be dumped directly into watercourses.

Some municipalities in the sector dump at least part of the snow in the aquatic environment or in adjacent areas. The Quebec Environment Ministry intends to put a stop to this practice by the year 2000, when the disposal of all snow into watercourses or adjacent areas will be prohibited.

4.1.2 Effects of contamination on the aquatic environment

Whatever their origin, the pollutants found in the aquatic environment present varying degrees of risk to the normal functioning of living organisms. Certain types of pollution have no lasting effects, and the quality of the environment improves rapidly as soon as the discharges stop. This is the case, for example, with bacterial pollution, nutrient enrichment of waters or highly soluble substances that are carried to the sea by the current. Some fairly insoluble pollutants that are chemically stable in their original forms or as environmental degradation products can adsorb to suspended particles and then accumulate in sediments over long periods of time. These persistent substances can be found in high concentrations in living organisms.

The concentration of a toxic substance may increase in an organism throughout its life, a phenomenon known as *bioaccumulation*. It can also increase from one link in the food chain to another by the process of *biomagnification*. Substances are thus gradually transferred to predators (fish, birds or mammals) occupying higher levels of the food web, reaching higher concentrations in these animals (Figure 10).



Many invertebrates such as aquatic insect larvae, molluscs and crustaceans live on the bottom of waterways. They accumulate in their tissues the toxic substances attached to the sediments or adsorbed to suspended matter. They are then eaten by organisms that occupy a higher position in the food chain, such as Yellow perch, which are in turn eaten by larger predators such as Northern pike or Walleye, by fish-eating birds such as Osprey, or by humans. From one link to the next in the food chain, toxic substances accumulate in increasingly larger concentrations.

Source: *Toxics in the St. Lawrence: An Invisible but Real Threat.* "St. Lawrence UPDATE" Series. St. Lawrence Centre, Environment Canada, Conservation Branch, Quebec Region. June 1990.

Figure 10 The phenomenon of biomagnification

4.1.2.1 *Water*

According to data collected along the two rivers in 1990 and 1991, although water quality was good at the outlet of Lake of Two Mountains, it deteriorated rapidly as the flow moved from west to east. Urban discharges were the main source of contamination of both watercourses in that location and during that period. In the Des Prairies River, the loads of phosphorus and fecal coliforms were found to come mainly from Laval's municipal outfalls. During heavy rains, overflows of wastewater from the northern collector on the Montreal side added to the pollution problem.

By contrast, the Mille Îles River was subject to eutrophication caused by municipal effluents and runoff of fertilizers from farmland on the north shore. In stillwater areas, excessive plant growth sometimes caused deficits of dissolved oxygen.

An estimate of the nitrogen and phosphorus mass balances along the St. Lawrence, conducted in 1990 and 1991, showed a pronounced increase in these two parameters near Repentigny, downstream from the mouth of the Des Prairies and Mille Îles rivers.

The situation of the two watercourses appears to have improved somewhat, with respect to total phosphorus and fecal coliform levels at least, as a result of the urban cleanup efforts undertaken since the early 1990s (see Section 4.1.1.2).

Surveys done in 1995–96 indicated that an increase could still be detected in the levels of phosphorus, orthophosphates, nitrites-nitrates and suspended solids in the rivers as the water mass flowed downstream, a finding which points to significant local inputs of these substances. Resuspension of sediments, urban and agricultural runoff, sewers that are not connected to treatment plants and occasional sewage overflows are believed to be to blame for the observed degradation of water quality in the Ottawa River as it flows into the two rivers.

With respect to toxic substances (metals and organic substances), not enough measurements are available to determine the relative importance of local inputs along the entire length of the two rivers; however, they too are presumed to be considerable.

4.1.2.2 *Sediment*

A number of contaminants bind to suspended particles in the water, which tend to settle to the bottom in areas where the current is slower. This is how deposits of contaminated sediment form on the riverbed, creating a potential source of contamination for living organisms. Depositional zones often correspond to aquatic beds, which are frequently home to benthic organisms occupying the base of the food chain. The presence of contaminated sediments represents a potential threat to the fish, birds and mammals that feed at these sites, and ultimately for the hunters and fishers who eat them.

The most complete data set on sediment quality dates back to 1976; it covers only Lake of Two Mountains and the Des Prairies River. The samples collected in the lake at that time were used to evaluate the quality of sediments transported to the Des Prairies and Mille Îles rivers. The results showed that trace metal levels (copper, chromium, nickel and zinc) in the lake were similar to the concentrations that could be found in comparable sediments in the Canadian Arctic, with the exception of lead and mercury.

Lead contamination of sediments is a well-known phenomenon, and it has been documented for water bodies situated leeward of large urban centres. This contamination is associated with leaded gasoline, which was used until the 1970s. The phase-out of leaded gas resulted in a decline in atmospheric emissions of lead and in sediment contamination in the St. Lawrence River; however, a similar reduction was not observed in the areas bathed by the brown waters of the Ottawa River.

Mercury is a metal that is naturally abundant in the rocks of the Canadian Shield. The filling of hydro-electric reservoirs sometimes causes mercury to be put back into circulation in the aquatic environment. Human activities have probably increased the concentrations of mercury that are naturally present in the water and sediments, through atmospheric deposition. In addition, mercury was used as a bactericide by pulp and paper mills until 1978.

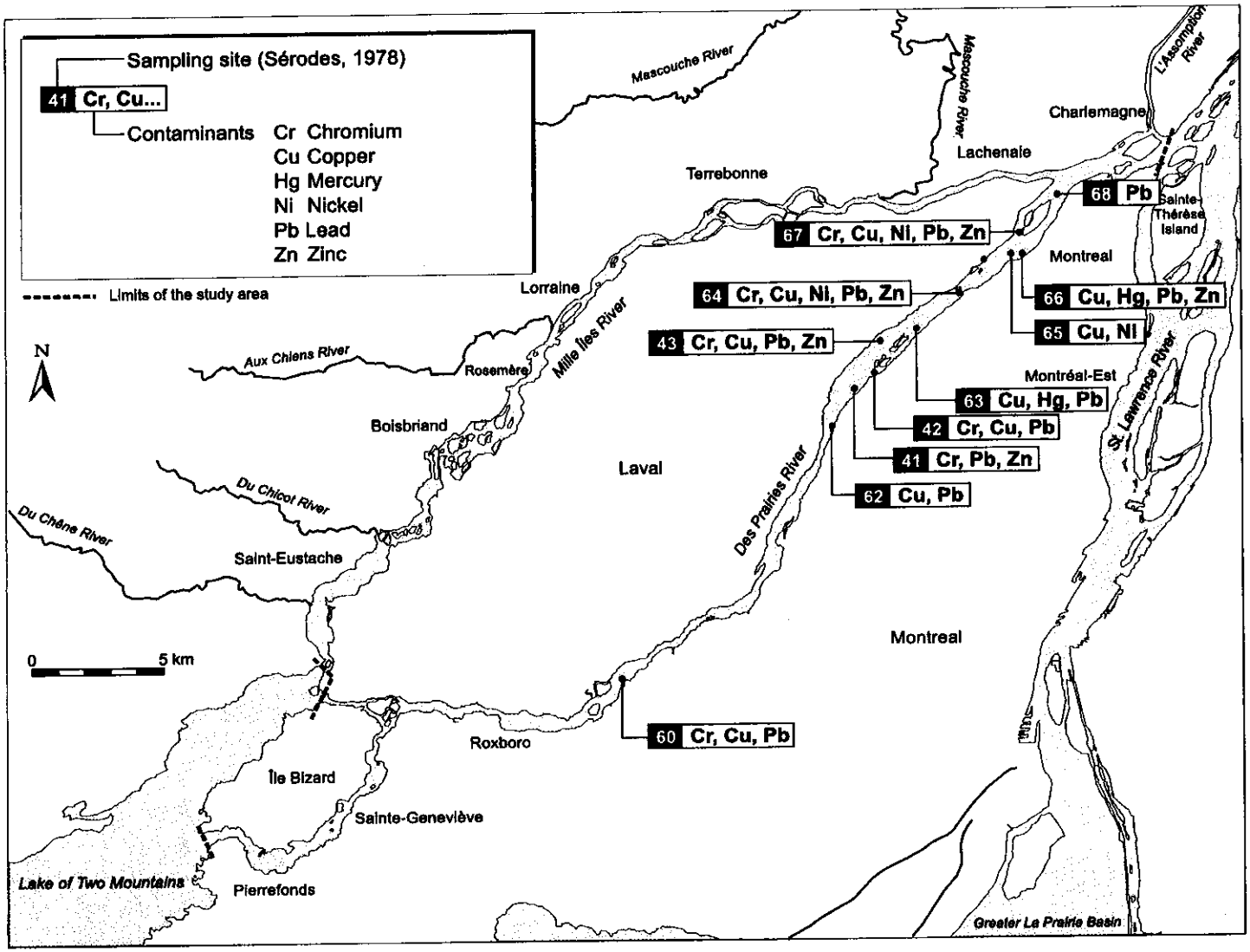
There is little information on the magnitude of sediment contamination in the lower reaches of the Ottawa River, except for a site in Vaudreuil Bay in Lake of Two Mountains.

Figure 11 shows the location of sites in the Des Prairies River that were sampled in 1976 and where the sediments contained contaminant levels significantly higher than the ambient level characteristic of the Ottawa River. These localized degradations often correspond to local contamination sources, whether past or present.

4.1.2.3 *Aquatic organisms*

The zoobenthos, or animal benthos, is the group of organisms that best lends itself to an assessment of the integrity of aquatic habitats within a body of water. Since these organisms are not very mobile, their degree of contamination is a good indicator of the distribution of toxic substances in the environment. Furthermore, changes in the composition of benthic communities in disturbed habitats can also be more easily quantified than among higher, more mobile, animals.

A study done in the 1970s showed that the benthic communities of the Des Prairies River were heavily degraded. This degradation was reflected in a decrease in species diversity in a downstream direction and in a predominance of tubificid worms (class Oligochaeta), organisms used as indicators of organic pollution. No information is available on the state of the benthic communities in the Mille Îles River during that period. However, nutrient enrichment of the water associated with urban discharges, combined with the presence of filamentous algae and the severe low-water conditions during the summer period, suggest that the benthic communities were degraded.



Source: Fortin, 1999, after Sérodes, 1978.

Figure 11 Localized degradation of sediment in the Des Prairies River

Fish sampling during the 1970s in the waters around the Montreal archipelago showed frequent exceedances of the permissible mercury concentration for marketing of fish products, notably in Walleye, Smallmouth Bass and Northern Pike. The lead concentrations measured in White Suckers and Lake Sturgeon in the Des Prairies River reached the authorized limit for the sale of fish. Other analyses of metal concentrations in fish flesh, conducted by the MUC in the mid-1980s, provided confirmation of mercury and lead contamination. During this time, only Northern Pike, Walleye and Channel Catfish specimens longer than 50 cm exhibited mercury levels higher than the criterion set for the sale of fish products (i.e. 0.5 mg/kg). In the 1970s, certain fish species, including Lake Sturgeon and Smallmouth Bass were contaminated with PCBs at levels above 2.0 mg/kg.

We do not have a complete picture at present of the extent to which fish species in the sector are contaminated with metals and toxic organic substances. However, there has been a substantial decrease in mercury and PCB contamination of fish flesh in the St. Lawrence River and in the Great Lakes. A similar situation should therefore exist in the Des Prairies River and the Mille Îles River.

The situation of contamination in birds has not been examined in the sector itself. We have only fragmentary information on the situation in Lake of Two Mountains. The organochlorine levels measured in the eggs of Great Blue Herons on Carillon Island in the early 1980s were the lowest found among all the heron colonies in southern Quebec. Analyses done on four ducks (a Ring-necked Duck, a Bufflehead, and two Red-breasted Mergansers) taken in the downstream part of Lake of Two Mountains in fall 1991 revealed low levels of most contaminants in the breast, except for PCBs and mercury. These were migratory birds, however, and their levels of contamination probably did not reflect local conditions. It would therefore be presumptuous to extrapolate these data to the aquatic avifauna that live and feed in the study area, given what is known about the magnitude of local sources of contamination.

In summary, the information on levels of contamination in most living organisms dates back a number of years. Most of it was collected before industrial cleanup programs were instituted and before many municipal outfalls were connected to wastewater treatment plants.

Hence, the picture we can get of the situation does not necessarily reflect the current state of affairs and updated information is needed.

4.1.3 Risks to human health

According to the information available, pollution currently poses little threat to human health, to the extent that the recommendations applicable to specific activities are followed.

4.1.3.1 *Water consumption*

In all, 88% of the population was served by water supply systems in 1997 (see Section 5.3.1). Based on data collected from 1995 to 1997, the water distributed from systems whose intakes are located in the Des Prairies and Mille Îles rivers is of good quality and meets provincial standards and federal recommendations. No epidemics linked to drinking water were reported between 1989 and 1997.

A number of municipalities have water treatment systems that include chlorination, which releases certain by-products, among them trihalomethanes (THM), substances of particular concern to public health authorities. It is believed that long-term exposure to these compounds may increase the risk of bladder cancer. However, only fragmentary data are available on this topic. A few tests conducted on the water distributed by the water supply system show that THM concentrations are generally lower than the federal standard of 100 µg/L. Moreover, a number of riverside municipalities have modified their treatment processes to minimize the formation of these by-products.

4.1.3.2 *Fish and game consumption*

The consumption of fish is the primary way recreational fishermen may become exposed to the contaminants present in the Des Prairies and Mille Îles rivers (see Section 5.1.2). Regular consumption of large amounts of certain species of fish caught in contaminated bodies of water may pose health risks. In Quebec, mercury is often the most worrisome substance.

However, the health risk associated with eating fish from the study area may be considered negligible, provided official consumption advisories are complied with.

According to a brochure on the topic[13], recreational fishers may eat the fish they catch in the study area, but they should limit their consumption of large piscivorous species (bass, pike, Muskellunge, Walleye) to two meals per month. They may, however, eat up to four meals per month of catfish, Lake Sturgeon, Rock Bass, Burbot, sucker and Yellow Perch. No restrictions apply to the other species.

As long as people abide by the recommendations concerning consumption (number of meals) and preparation of fish[14] and also avoid eating specimens with external lesions[15], the health risks are negligible, based on current knowledge.

No specific studies have been done on consumption of fish caught in the two study area rivers. However, a study involving 192 sport fishermen in the Montreal region (Lake Saint-François and Lake Saint-Louis) showed that slightly higher levels of mercury, PCBs and other toxic substances can be detected in the tissues of people who eat large amounts of fish from the St. Lawrence River (about 6 meals of 230 g per month) than in people who eat, say, one meal per month. People who ate fish regularly did not exhibit excessive levels of chemical contaminants.

In short, the risk of contamination from eating fish is low, provided that people abide by consumption advisories. In addition to being a good dietary source of proteins, vitamins and minerals, fish offers some protection against cardiovascular disorders. Moreover, for pregnant and nursing women, the polyunsaturated fatty acids and nutrients in fish meet essential requirements for the fetal nervous system.

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[13] The brochure entitled *Connaissez-vous les Oméga-3? Moi, oui...* has been produced jointly by the Quebec ministries of Agriculture, Fisheries and Food (MAPAQ), Environment and Wildlife (MEF) and Health and Social Services (MSSS).

[14] Since organochlorines tend to concentrate in the fatty parts of fish, it is possible to reduce the quantity ingested by not eating the skin, viscera and fatty parts. It is recommended that the cooking juices not be eaten either.

[15] Parasites and external abnormalities may sometimes be prevalent in fish taken from the St. Lawrence River. Most fish parasites present no danger for humans. As a precaution, however, the flesh should be thoroughly cooked and the skin and viscera should not be eaten. It is also recommended that people not eat fish that have external abnormalities (ulcerating dermatitis, dermal growths, oral papillomas, etc.).

With regard to waterfowl, it appears that only mergansers contain high enough mercury levels in their flesh to pose a threat when consumed on a regular basis (more than four meals a month over a number of years). In other species, contaminant concentrations have not been found to be high enough to warrant restrictions on consumption. Although contaminant concentrations may be low, as an additional precaution people should use cooking methods that remove as much fat as possible. To eliminate all risk of parasitic or microbiological contamination, meat should be well cooked.

It should be kept in mind that hunting and fishing enthusiasts derive benefits from these sports, which can be relaxing and good for their well-being.

4.1.3.3 *Recreational activities*

The bacteriological quality of the water, albeit excellent at the head of the two rivers, degrades rapidly along their course. Cap Saint-Jacques and Île Bizard, the only spots where recreational activities involving direct water contact (swimming, personal watercraft use, windsurfing and water skiing) can be carried out, are located in the westernmost part of the sector. Water quality analyses are conducted there regularly under the provincial Environment Ministry's beach water quality program. There is a marked increase in fecal coliform concentrations downstream from those locations; direct water contact thus poses a health hazard there. Swimming in contaminated water exposes people to such health problems as gastro-enteritis, and skin, eye and ear infections.

4.2 Habitat Modification and Encroachment

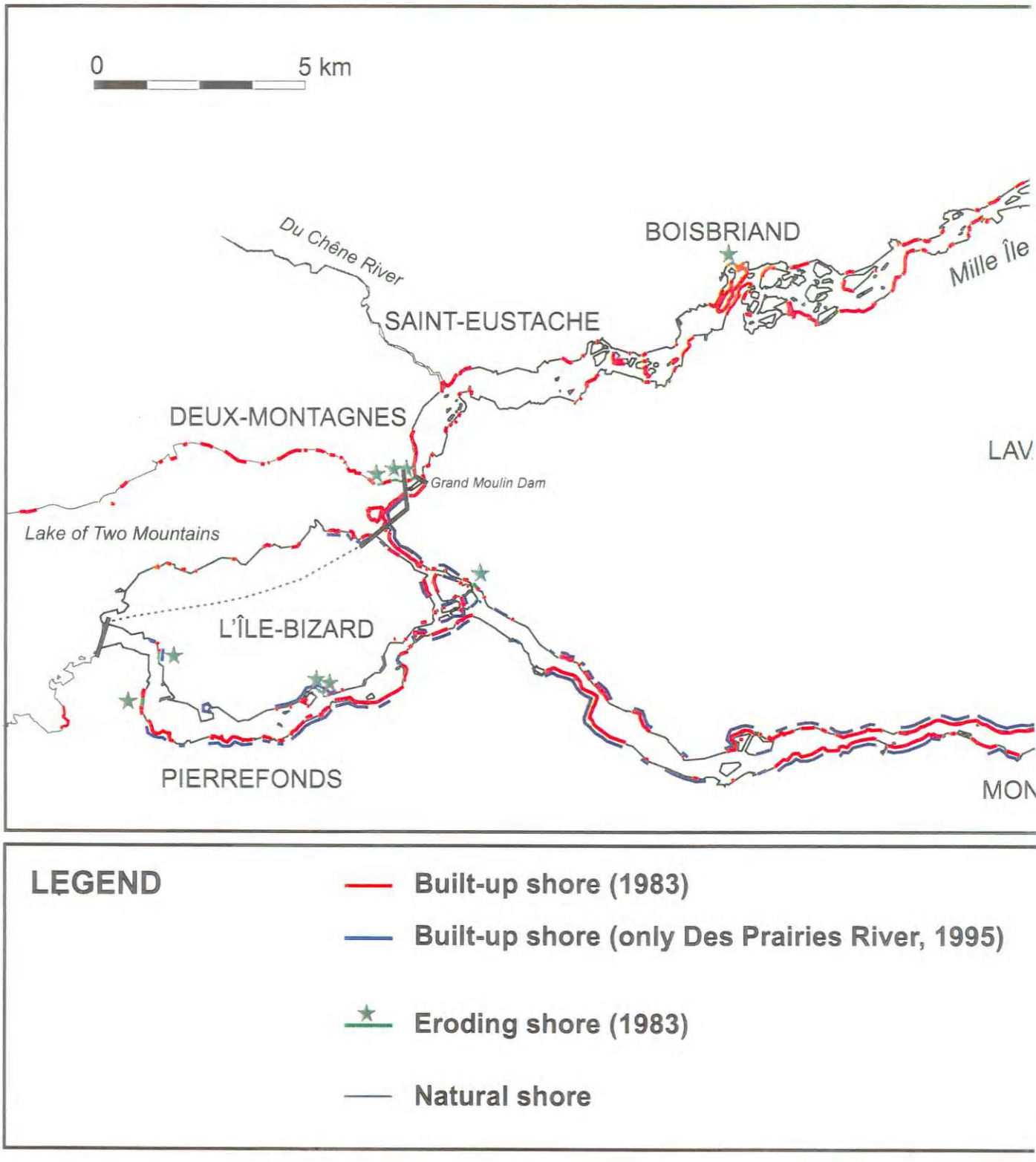
There are many locations in the study area where habitats in the aquatic environment, especially riparian ones, have been altered or destroyed by human activities such as filling, diking or the construction of various works (Figure 12).

These changes have the effect of reducing diversity, since the affected habitats are among the most crucial for flora and fauna along the river. Natural riverbanks usually slope

gently, with successive zones of substrates and vegetation providing a gradual transition from dry ground to the water. These shoreline fringes are very rich in fauna, providing food and shelter and a place to breed for mammals, birds, fish, amphibians and reptiles.

Filling and the construction of wharves, retaining walls and other artificial shoreline enhancements tend to destroy these habitats, since they make the slope steeper and eliminate the transition zone. Coarse fill materials interfere with the growth of vegetation. Not only do flora and fauna disappear from the altered areas proper, but their abundance and diversity is diminished in adjacent terrestrial and aquatic environments. Built-up or artificial segments of shoreline — those that have been reworked or on which permanent structures have been built — are habitats with a markedly lower diversity and productivity than sections preserved in their natural state.

The proportion of artificial shoreline along the two study area rivers (Table 6) does not differ much from the patterns observed in the Montreal archipelago as a whole. However, the extent of alteration varies throughout the sector. The Des Prairies River exhibits the greatest loss of natural shoreline areas, particularly on its right bank. According to surveys conducted in 1983, nearly 60% of the banks had disappeared as a result of the construction of artificial structures (wharves, retaining walls, rip-rap). More recent surveys dealing solely with this river confirmed that particularly high losses of natural shoreline have occurred in Roxboro, Montreal-North and between the Sault-au-Récollet rapids and the Rivière-des-Prairies generating station. The subsisting sections of natural shoreline are located mainly south of Île Bizard, between Monk Point and a point downstream from Théoret Point.



Source: Armellin and Mousseau, 1999, after Clavet, 1983; MLCP, 1983; SLC, 1998; Tecsult Inc., 1995.

Figure 12 Modification of aquatic habitats and shores

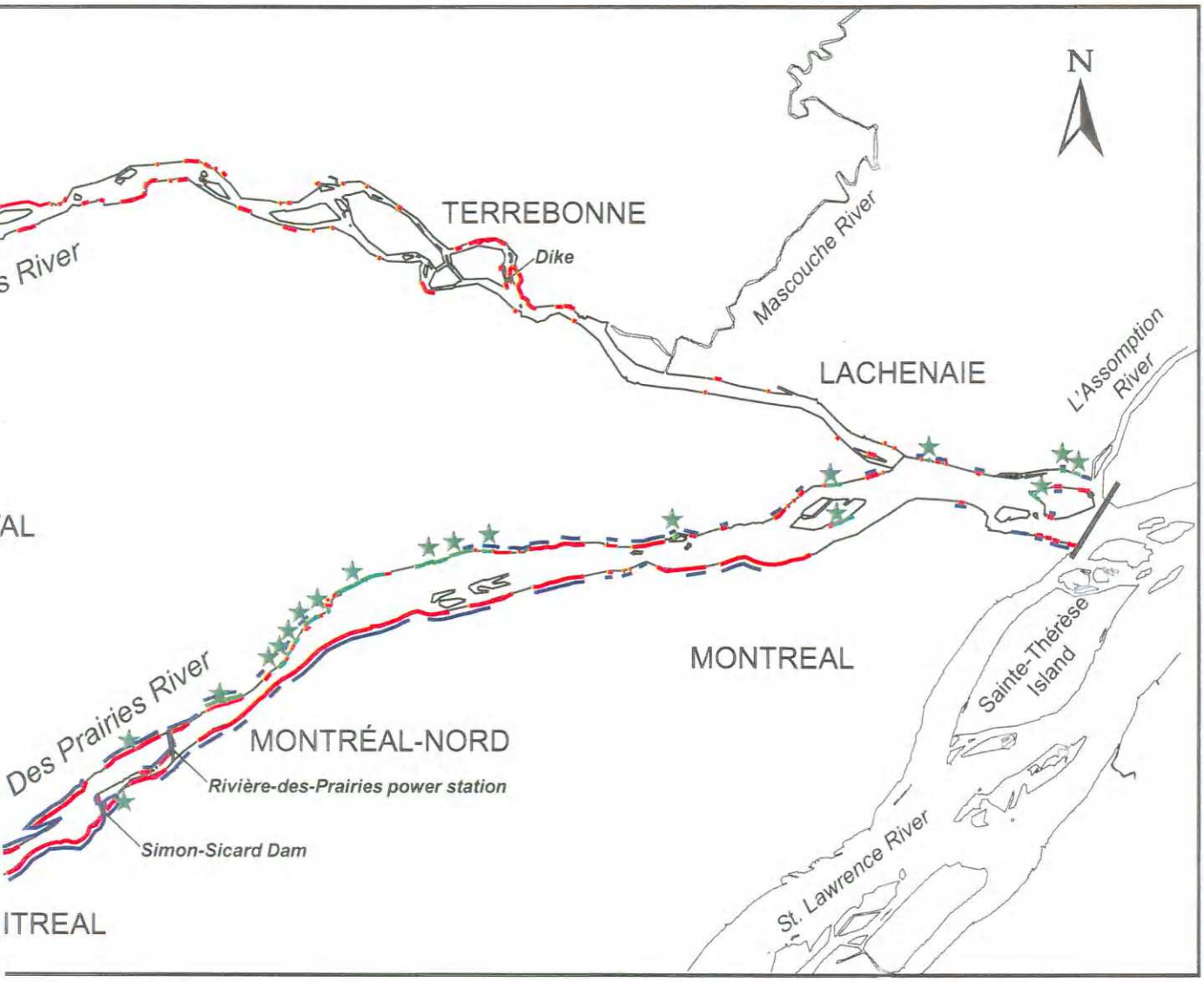

N
TERREBONNE
Dike
Mascouche River
LACHENAIE
L'Assomption River
MONTREAL
Sainte-Thérèse Island
Des Prairies River
MONTRÉAL-NORD
Rivière-des-Prairies power station
Simon-Sicard Dam
St. Lawrence River
Limits of the study area

Table 6
State of riverbanks in the Des Prairies River and Mille Îles River sector

	Length of shoreline (km)			
	Natural	*Artificial*	*Total*	*% alteration*
Des Prairies River				
North shore	37.4	22.3	59.7	37%
South shore	22.7	32.0	54.7	59%
Islands	29.2	3.0	32.2	9%
Sub-total	*89.3*	*57.3*	*146.6*	*39%*
Mille Îles River				
North shore	36.2	12.1	48.3	25%
South shore	33.2	12.8	46.0	28%
Islands	44.5	5.5	50.0	11%
Sub-total	*113.9*	*30.4*	*144.3*	*21%*
Total, study area	**203.2**	**87.7**	**290.9**	**30%**
Montreal archipelago	**579.7**	**370.3**	**950.0**	**39%**

Source: Modified from Armellin and Mousseau, 1999, after Clavet, 1983; SLC, 1998.

Certain control works, either established in the sector or outside of it, have had impacts on the state of local resources. Beginning in the 18th century, water mills were built along the Des Prairies and Mille Îles rivers, both of which had an adequate discharge and a rocky bed. All of these works, which were run-of-river facilities, featured a milldam that was built between the shore and an island; this structure did not impede either the upstream or downstream movement of fish. However, the Rivière-des-Prairies hydro-electric power station, constructed at Gros Sault between 1928 and 1932, blocked the river completely, thus preventing certain fish species, notably American Shad, from swimming upstream.

The only known shad spawning ground in Quebec is located in Lake of Two Mountains, downstream from the Carillon power station. To reach this spot, this fish species,

which swims upriver from the sea in the spring, must go around the Montreal archipelago. Of the three routes that once existed—Mille Îles River, Des Prairies River and the Vaudreuil–Sainte-Anne canals—only the last one is still available today. The Des Prairies River, the main route, was blocked by the Rivière-des-Prairies generating station. All of the efforts devoted to permitting the passage of shad, including the construction of a fishway in 1985, have proven fruitless. On the Mille Îles River side, which constitutes a less important migratory corridor, American Shad theoretically can make their way upriver under certain hydrological conditions. In reality, however, a number of flow-control structures present an impediment in this regard.

In spite of everything, shad do manage to reach the spawning ground at Carillon. However, the downstream migration of spawners in June, and juveniles in August, takes place primarily via the Des Prairies River. Some of these fish end up getting killed in turbines[16].

Furthermore, the structures built along the Mille Îles River to minimize flooding in the spring have reduced the local abundance of certain fish species that normally spawn on the floodplains.

4.3 Other Pressures on Resources

Other processes may undoubtedly have an impact on the natural environment of the study area. However, it is difficult at this time to assess the effects.

4.3.1 Introduced and expanding species

Today, it is known that the voluntary or accidental introduction of new species into an ecosystem can have a significant impact on the indigenous flora and fauna. Many people are familiar with the cases of the House Sparrow and the European Starling, introduced species that are now integrated with the local fauna. Some examples of fish species that have been introduced locally are Brown Trout, Rainbow Trout and carp.

[16] Certain operational adjustments at the power plant help to minimize losses among adults. For example, a sluice in the spillway can be opened at the end of the afternoon to facilitate the downstream passage of shad.

With regard to some more recent invaders, the process of colonization or expansion is still ongoing and the overall consequences of their advent have not yet been assessed.

Purple loosestrife is an introduced plant species that is currently expanding. It tends to colonize marshes and wet meadows, displacing indigenous plants such as reed canary-grass, prairie cordgrass and bluejoint.

Two invertebrates, the Zebra Mussel and the Quagga Mussel, are currently invading the St. Lawrence River and the Great Lakes. It is feared that these newcomers will harm indigenous bivalves (e.g. the family Unionidae). The abundance of Zebra Mussels, reported for the first time in Des Prairies River in 1991, has not increased since then. With regard to the Quagga Mussel, it appears to be absent from the study area. These exotic mussels probably have not yet invaded the Ottawa River basin, because conditions are not favourable for them there.

Among the region's bird species, the Ring-billed Gull is the one that has expanded its range the most in the Montreal region over the past 20-odd years. The colony on Deslauriers Island, located about 3 km downstream from the study area, is the largest in Quebec. In 1997, 48 000 pairs nested there. This opportunistic species has learned to take advantage of human-induced alterations to the environment; some individuals feed on refuse and groups of gulls are often seen on farms following the plough. When the gulls gather in large numbers, their droppings may cause local water pollution problems. The birds forage along the two rivers or scavenge in nearby garbage dumps, such as the sanitary landfill site at Lachenaie.

4.3.2 Environmental accidents

In the sector, a majority of the tracts of land located near the water are subject to flooding, because the Ottawa River is only partially regulated.

The flood of 1974 caused substantial damage to many properties in the Montreal region and prompted the construction of control structures (e.g. at the head of the Mille Îles River). As part of the Archipelago Project, a plan was devised to harness the hydro-electric potential of the waters in the Montreal area and stop the flooding once and for all through a series

of control structures. As this project was abandoned in 1985, the sector is still exposed to the floods that occur on the Ottawa River. To minimize the risk of flooding around Montreal, a special committee on regulating the Ottawa River has been mandated to manage the operations of all the works within the river's watershed.

No specific information is available on public health problems related to flooding in the sector over the past few years. However, such episodes represent a risk not only to the safety of riverside residents, but also to their health, since victims may have to survive for some time in unhygienic conditions. The most common problem is respiratory difficulties caused by the growth of mould in recently-flooded houses. Although the residents' physical health is not affected every time the river overflows its banks, the social and psychological impacts associated with property losses and evacuations can sometimes be serious.

CHAPTER 5 Sector Resources and Assets

Despite the alterations to the natural environment from intensive human activities, the sector still has many amenities that are intricately associated with the proximity of the watercourses. These assets need to be factored into the overall picture, since development in the sector is partially dependent on them.

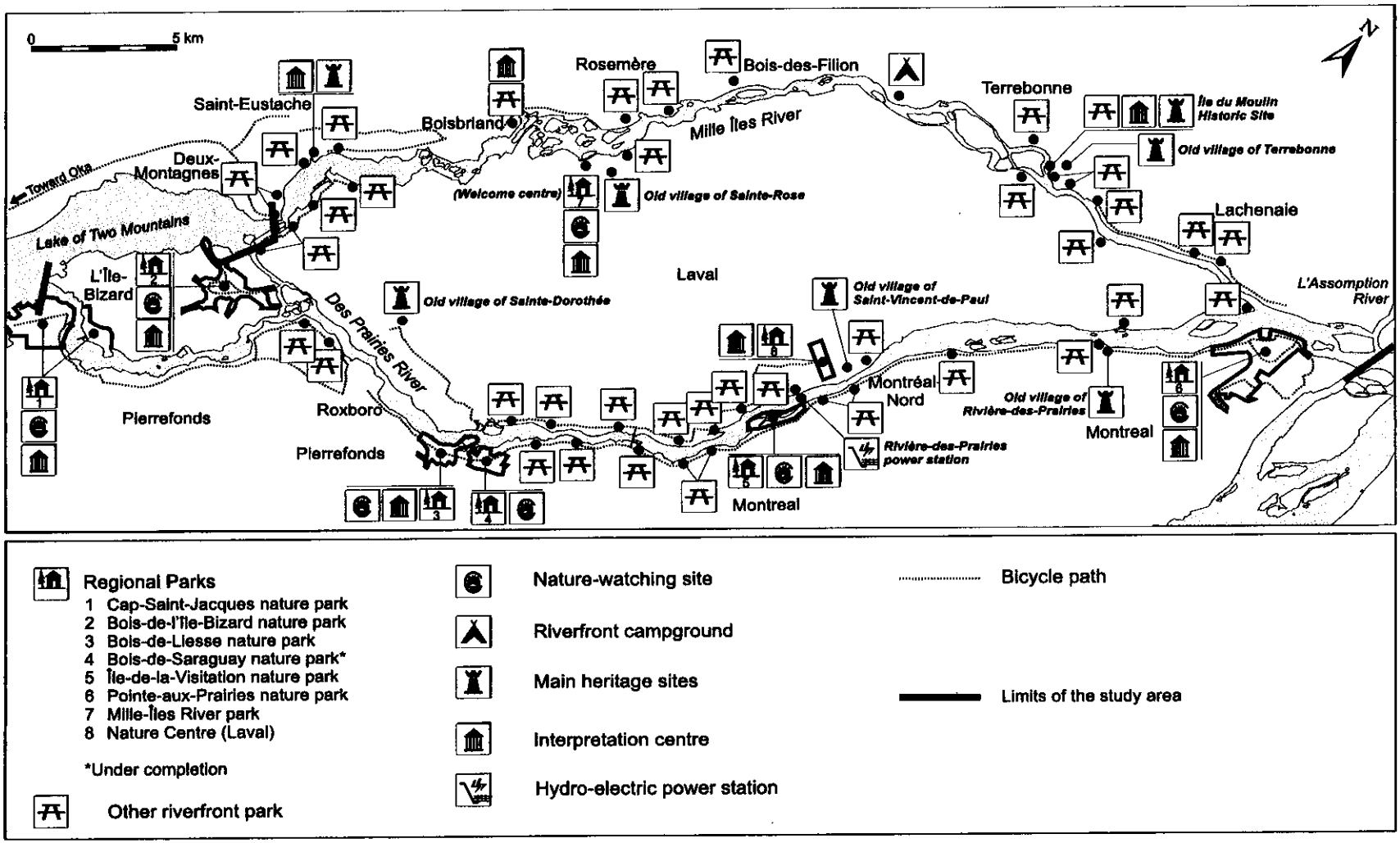
5.1 Recreation and Tourism

On account of its location in the metropolitan area of Montreal, the sector offers a wide range of recreational and tourist activities. Our interest in this case is those activities related to the presence of the water resource. Figure 13 provides an overview of the recreational facilities situated near the two rivers.

5.1.1 Pleasure boating

One of the water bodies in the Montreal area that is best suited to recreational boating is located at the gateway to the Des Prairies River and Mille Îles River study area. Lake of Two Mountains offers pleasure boaters 118 km^2 of navigable area, which is especially suitable for sailing. Whatever the type of boat, this lake does not present any notable navigation hazards (currents, shoals) and, even better, commercial ships do not ply its waters. By going through the Carillon lock, boats can travel up the Ottawa River toward Ottawa, and from there they can reach Kingston via the Rideau Canal.

The Des Prairies River is also navigable along its upper reaches as far as the Rivière-des-Prairies generating station. Light-draught boats (draught less than 90 cm) can go from the lake to the river and traverse the rapids. Although there is no lock at the generating station, various associations of riverside residents and recreational boaters have for many years been demanding that this type of facility be provided so that the river can be used for pleasure boating.



Source: Jourdain et al., 1999, after Tecsult Inc., 1995; Office du Tourisme Laval Inc. and Tourisme Québec, 1998; ATR de la Montérégie and Tourisme Québec, 1998; ATR des Laurentides and Tourisme Québec, 1998; ATR de Lanaudière and Tourisme Québec, 1998.

Figure 13 Tourist attractions and recreational facilities located along the water

The Mille Îles River is navigable along its full length, although the spillway at its head blocks access to Lake of Two Mountains. The river channel configuration and the many islands present obstacles to sailing.

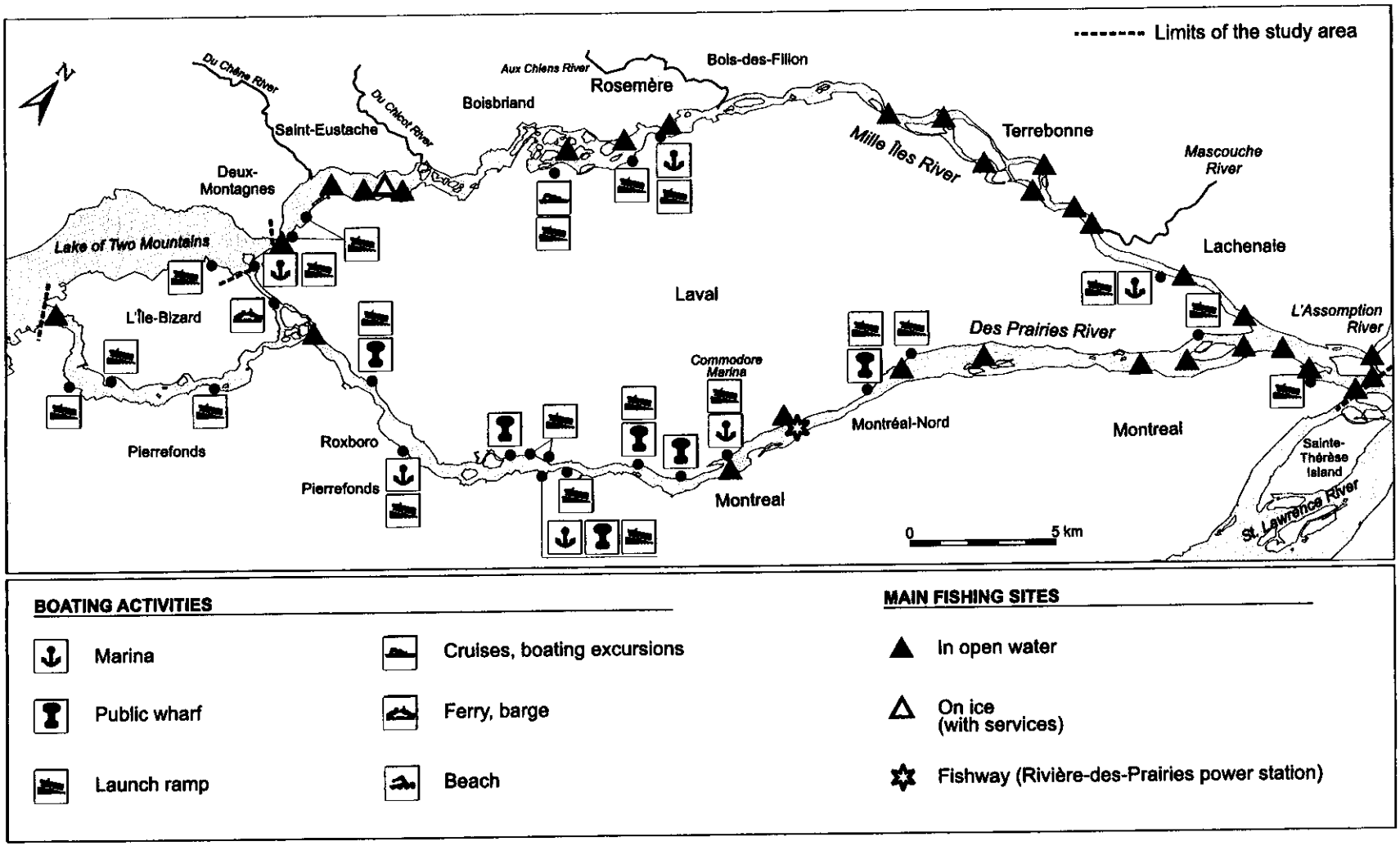
While there are no recent estimates of pleasure craft traffic on the two rivers, the number of boats involved seems high, in spite of the navigational constraints. In the early 1980s, some 8300 people navigated the Mille Îles River in small craft; the corresponding number in 1994 was about 17 000. A breakdown of the boating facilities is given in Figure 14.

Boating in these waters demands a degree of caution. In 1997, the Canadian Coast Guard was called out to deal with 31 incidents on the Des Prairies River involving pleasure boats, chiefly motor boats. The most common problems were mechanical failure and grounding, usually due to negligence: ignorance or poor judgment, inebriation or failure to wear flotation devices. In some instances, injuries, hypothermia, psychological distress and even drownings were the outcome. Between 1990 and 1997, 11 drownings were reported in connection with recreational activities along the two rivers.

5.1.2 Sport hunting and fishing

The presence of anglers along the two rivers, which are so close to the urban environment, may seem surprising at first; however, it merely indicates that these water bodies still contain popular fish species. Some people, knowing the rivers' secrets, have made fishing their pastime.

On the Des Prairies River, the main sport fishing sites are located downstream from the Rivière-des-Prairies generating station. The most popular sites on the Mille Îles River are between Île Roussin and the Highway 15 bridge, as well as between Île aux Pins and the Highway 125 bridge.



Source: Jourdain et al., 1999, after Tecsult Inc., 1995; Office du Tourisme Laval Inc. and Tourisme Québec, 1998; Mongeau and Massé, 1976. MLCP, 1991.

Figure 14 **Boating infrastructure and main access points for fishing in the sector**

On both rivers, fishermen catch mainly Walleye, Sauger, Smallmouth Bass, Brown Bullhead, Channel Catfish and the local specialty, American Shad. During the period in spring when shad undertake their long migration, large numbers of anglers appear on a platform erected at the foot of the Rivière-des-Prairies generating station. American Shad can also be caught in Île-de-la-Visitation nature park and in a few other sets of rapids along the two rivers.

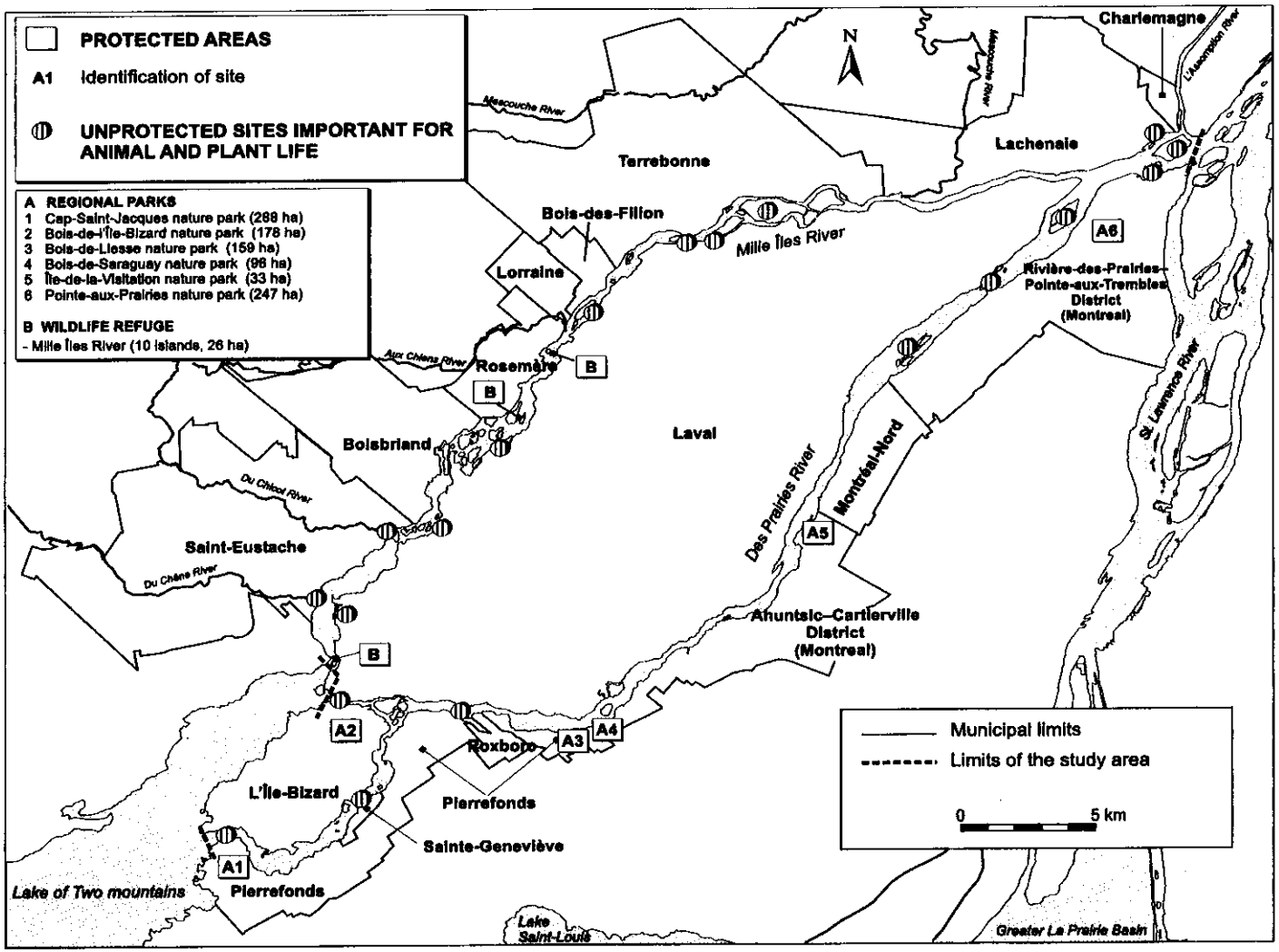
Duck hunting is carried out at a few spots along the two rivers; however, this activity is marginal compared to the hunting that is done on the riverine lakes of the St. Lawrence. Some 20 000 people hunted or fished on the Des Prairies River in 1994. According to estimates made in the 1980s, there were 8200 people hunting or fishing on the Mille Îles River.

5.1.3 Sites suitable for wildlife interpretation and observation

Every year the number of bird-watchers grows. At the start of the 1980s, an estimated 10 400 people engaged in bird-watching annually in the vicinity of the Des Prairies River, with another 10 400 doing the same along the Mille Îles River. The sector contains a number of favourable sites for bird-watching: the most popular sites are nature parks, municipal parks in Laval (Berge du Vieux-Moulin and Berge Olivier-Charbonneau), the Île du Mitan archipelago, the Rivière-des-Mille-Îles park and Île des Moulins. The group Éco-Nature and four bird-watching clubs (Quebec Society for the Protection of Birds, Club d'Ornithologie d'Ahuntsic, Club d'Observateurs d'Oiseaux de Laval and Club d'Ornithologie de la Région des Moulins) are all active in the region.

5.2 Biodiversity and Conservation

Roughly 2% of the territory is dedicated to conservation (figures 8 and 15). Four nature parks located along the Des Prairies River enjoy protected status: the parks called Bois-de-Liesse, Île-de-la-Visitation, Pointe-aux-Prairies and Bois-de-Saraguay, including Île aux Chats. These green spaces cover a total of 535 hectares.



Source: Armellin and Mousseau, 1999; Jourdain et al., 1999.

Figure 15 Protected areas and other important wildlife sites

The Mille Îles River has few protected sites. The Rivière-des-Mille-Îles wildlife refuge, created in 1998, comprises 10 islands[17] that are part of the Sainte-Rose archipelago and are known habitats of the Map Turtle and the Brown Snake. This refuge, managed by Éco-Nature, comprises 26 ha and is located in the municipalities of Laval, Deux-Montagnes, Rosemère and Boisbriand.

On both rivers, the aquatic environment and part of the shoreline[18] are recognized as wildlife habitat. This status was conferred under the Quebec *Act respecting the Conservation and Enhancement of Wildlife*; it prohibits all activities likely to alter this habitat. Moreover, three shoals downstream from the Rivière-des-Prairies generating station were partially enhanced when the spillway was repaired in 1985 in order to promote spawning by suckers and Lake Sturgeon.

Rare, threatened and sensitive species are key elements of biodiversity owing to their unique character or precarious situation. In the study area there are 18 plant species, 4 fish species, 1 amphibian species, 5 reptile species and 13 bird species (including 6 nesting species) which are considered priorities under the SLV 2000 Action Plan (Appendix 1).

5.3 Utilitarian Use of the Water Body

Proximity to a waterway provides numerous benefits to human communities that are easily forgotten.

5.3.1 Water supply

An abundant supply of good-quality water is truly an asset for urban centres and industrial and agricultural activities.

[17] The islands are called Île aux Moutons, Île des Juifs, Île Gaudette, Île Darling, 926, Île des Gardes, Île Clermont, Île Chabot, 439 and Île Turcotte.

[18] The limit of wildlife habitats, on the riverbanks, corresponds to the level reached by floods (2-year recurrence interval).

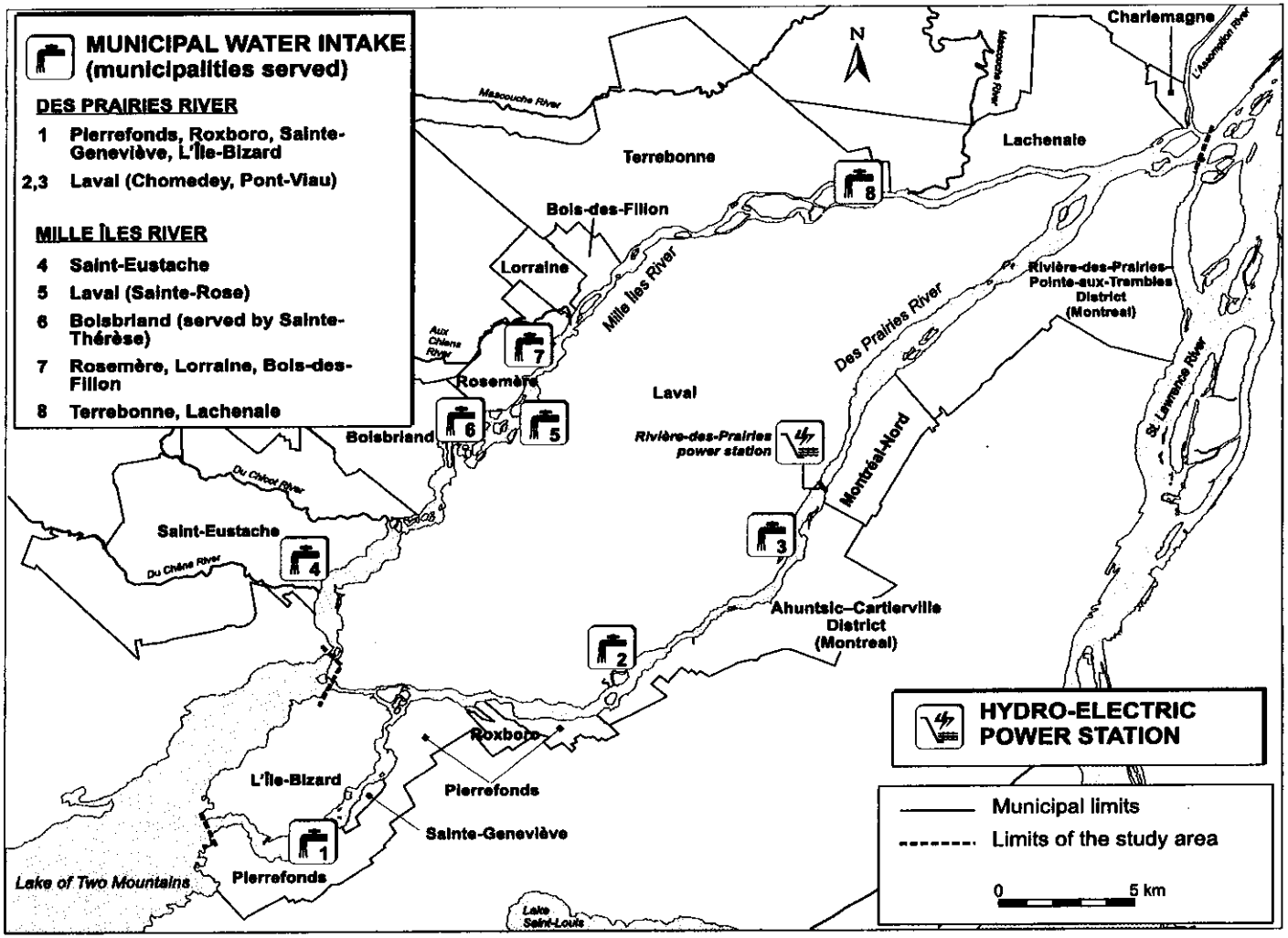
Most of the residents in the sector (88%) are hooked up to water supply piped from one of the seven stations located in Pierrefonds, Montreal, Saint-Eustache, Sainte-Thérèse, Rosemère, Terrebonne and Laval (Figure 16). Total water withdrawals by riverside municipalities from the two rivers stood at 422 000 m^3/day in 1997. Districts located south of the Des Prairies River are served by the MUC's water supply system, which draws its water from the St. Lawrence River. Residents of the study area who are not hooked up to the water supply system have their own wells.

The very presence of some industries depends on a steady water supply, which is needed for a multitude of processes. It is estimated that during 1991, the 48 largest manufacturing plants in the sector withdrew between 2.5 and 3.2 million m^3 of water. Only six facilities used more than 100 000 m^3.

5.3.2 Hydro-electricity

At several locations within its watershed, the Ottawa River offers conditions conducive to the generation of hydro-electricity. There are two generating stations on its lower reaches, namely Carillon and Rivière-des-Prairies.

The Rivière-des-Prairies generating station was built at Gros Sault in 1928. This small 48-MW facility has six propeller turbines; the head is 8 m. A fishway, intended mainly for shad but which has so far been ineffective, was built in 1985 during repairs to the spillway. The generating station does not have a lock permitting navigation.



Source: Jourdain et al., 1999.

Figure 16 Utilitarian uses of the water

CHAPTER 6 Strategies for Sustainable Development

Sustainable development of the Des Prairies River and Mille Îles River portion of the Lake of Two Mountains–Des Prairies River and Mille Îles River study area entails protecting the remaining biodiversity and promoting a variety of water-related uses, thus enhancing the quality of life for riverside residents.

6.1 Main Issues

It is imperative that certain key issues in the sector be taken into consideration in drawing up action plans.

6.1.1 Reducing contamination

An essential condition for preserving some of the present uses of the rivers and restoring others, which have long since disappeared, is improving water quality to a greater extent.

Considerable progress has been made over the past decade, partly as a result of the connection of several municipal sewer systems to wastewater treatment plants. However, it is imperative that these efforts be continued and the support of local stakeholders be secured to this end.

There is still room for improvement in the operation of wastewater treatment facilities. Municipal effluents remain the primary cause of degradation of water quality in both rivers owing to nutrient enrichment of the water, massive inputs of suspended solids and bacteriological contamination. Another important goal is to minimize the overflows from sewer systems that occur during heavy rainfall.

Agricultural practices need to be adjusted to curb soil losses and runoff of fertilizers and pesticides and hence the associated impacts on the aquatic environment. The outlook with

regard to industrial pollution abatement is quite good. The sector does not have any major polluting industrial plants. However, a large number of small facilities channel their effluents to the municipal sewer systems. The cumulative effect of all these small inputs cannot be assessed, because of the lack of information on toxic substances in the water.

Other improvements are feasible if steps are taken to reduce the contaminant loads in a number of streams and ditches that drain industrial and residential zones.

In short, the two rivers cannot truly be restored until they stop being used as a dump site for wastes of every type. Although the restoration efforts that are required may seem enormous, the initial results provide encouragement for continuing the battle.

And the results are certainly worth the effort. Once the predominantly local discharges cease, the people who live and work along the rivers will have access to water of a quality comparable to that in Lake of Two Mountains.

6.1.2 Protecting wetlands and biodiversity

Despite the loss of many kilometres of shoreline along both rivers, the sector still has a diverse assemblage of aquatic and riparian habitats, which are of inestimable value for biodiversity conservation. A number of islands harbour plant communities that are unique not just in the Montreal archipelago as a whole, but in the province, too. Both rivers feature zones of fast-flowing water which help to diversity the aquatic habitats and hence the fish fauna as well.

Naturalists and hikers alike still have a chance of encountering plants, amphibians, reptiles, birds and fish species that have become a rare commodity elsewhere in the Montreal region. The two rivers are practically the only location in Quebec where anglers can catch American Shad, an anadromous fish species that still swims up the St. Lawrence River every spring. In addition, they are still frequented by the Copper Redhorse, a threatened species and the only fish species whose geographic range is limited to Quebec.

It is imperative that steps be taken to preserve these unique components of Quebec's natural heritage for the benefit of future generations. The main threat to the integrity of these resources is not pollution, as one might think, but the disappearance or alteration of aquatic and

riparian habitats. The residual wetlands along the two rivers must be protected from the dangers posed by urban development and shoreline conversion.

Local enhancements have been provided to promote spawning by certain fish species, such as downstream from the Rivière-des-Prairies generating station. Nonetheless, there are still impediments to the passage of certain species, such as American Shad and Lake Sturgeon. This is the case throughout the Montreal archipelago and particularly in the Des Prairies and Mille Îles rivers.

Last but not least, additional efforts should be devoted to increasing our knowledge of natural habitats and resident species in the sector, since the present knowledge gaps represent a hindrance to protection efforts.

6.1.3 Enhancing water-associated recreation and tourism

Lake of Two Mountains has long been a popular vacationing and outdoor recreation area within the Greater Montreal region. Two of its outlets, the Des Prairies and Mille Îles rivers, would under natural conditions constitute extensions of this lake reaching right to the city, but this is not the case. The current separation between the lake and rivers, just like the highly differing uses attributed to them, may also stem from the impression that these water bodies are cut off from one another.

Consequently, the potential provision of locks and boating links between the lake and the river should not be regarded solely as a response to the whims of pleasure boaters, but rather as a practical way of gradually reclaiming the use of these watercourses for recreation and conservation, from their upstream end to their downstream end.

Facilities for recreational boating, which should be established in keeping with conservation objectives for natural habitats, may provide an impetus for efforts to improve water quality.

6.2 Taking Action

To refocus planning related to the uses of these two rivers in accordance with sustainable development objectives, many aspects of the above-mentioned problems should be kept in mind. Besides the limitations that certain uses impose on resources, leading inevitably to conflicts among users, the permanency of certain changes that have taken place (and cannot realistically be reversed) must be taken into account. Existing roads, docks and other structures constrain planning in ways that may be considered irrevocable. Yet, more importance can be given to the protection of subsisting natural habitats, the restoration of degraded habitats and reducing pollution.

To ensure that habitats are not degraded further as a result of short-sighted decisions made in response to the concerns of special interest groups, it is important to weigh land development options very carefully.

These issues need to be assessed and discussed, in full knowledge of the facts, by all groups interested in the St. Lawrence River and the local quality of life, so that the strategies that are eventually adopted suit the entire community. Table 7 provides a preliminary outline for discussing suitable development options for the sector.

Following such discussions, it should be possible to co-ordinate uses in keeping with the goal of preventing further degradation of natural habitats and restoring sites on both rivers. Once a consensus has been reached on priorities for action, it will be easier to come up with a concrete action plan with which partners will be happy to comply.

Conservation of the remaining intact aquatic and riparian habitats and restoration of those that have been degraded constitutes an exciting challenge. It is to be hoped that future generations will also be able to enjoy the rich diversity of these unique habitats, in full awareness of their fragility and with concern for preserving them. Collaboration remains the key to the success of this undertaking.

Table 7

Main issues in the sustainable development of the Des Prairies River and Mille Îles River sector (ZIP 25) of the study area

Issue	*Main effects on the water body and its resources*	*Assessment of the current situation in light of sustainable development objectives*	*Guidelines for sustainable development*
Reducing contamination (municipal and industrial effluents; tributaries)	For decades, the two rivers have been subject to severe pollution from municipal effluents, industrial activities and agriculture. The situation appears to have improved with the advent of clean-up and abatement measures. However, although the water quality of the Lake of Two Mountains is excellent at the head of the two rivers, it degrades rapidly as the water flows downstream.	The main problematic parameters (oxygen demand, phosphorus, suspended solids) are the result of inputs from wastewater treatment plants and occasional sewer overflows. Inputs of toxic substances may also be important. In a few spots, there may be sediment deposits that are contaminated with metals. **Biodiversity:** Pollution can reduce the numbers of many species and alter the structure of living communities. Organisms that tolerate this degradation become predominant. **Uses:** The pollutants discharged into the aquatic environment adversely affect a variety of uses (restrictions on recreational activities involving water contact and on fish consumption, etc.). **Quality of life:** Pollution jeopardizes enjoyment of the waterbody for local residents and has an impact on recreational potential, hindering certain activities.	Municipal, industrial and agricultural pollution abatement programs appear to have reduced nutrient enrichment of the water. Additional improvements appear feasible, however. It is essential to continue these efforts and build on the progress achieved. **Biodiversity:** Disturbances caused by pollution can be reversed over varying time periods, depending on the nature of the contaminants and how long they stay in the environment or in the tissues of aquatic organisms. **Uses:** The most effective measure for limiting loss of use due to pollution is controlling discharges at source: introduction of less polluting practices, treatment of municipal and industrial effluents, etc. Even if some of these changes may appear costly *a priori*, they are economically advantageous in the long term, compared with the indirect costs associated with a *laissez-faire* approach. **Quality of life:** Controlling pollution gives communities all the benefits of their proximity to the water. Enhancement of the rivers would generate economic spinoffs locally.

Table 7 (cont'd 1)

Issue	*Main effects on the water body and its resources*	*Assessment of the current situation in light of sustainable development objectives*	*Guidelines for sustainable development*
Protecting wetlands and biodiversity	The most common alterations in the sector appear to be shoreline encroachments, initially associated with cottages and then urban expansion. This appears to be an acute problem, particularly in the Des Prairies River. Construction of the Rivière-des-Prairies generating station blocked the passage of certain fish species, such as American Shad. The fishway built to offset this impediment has had very little success.	**Biodiversity:** The disappearance of natural shorelines spells a degree of impoverishment of the environment. Some plant communities that are unique to Quebec have been reduced to just a few patches covering a small area. The status of a number of plant and animal species, which may be at risk, is not well known. **Uses:** Certain uses of the water body, for instance, fishing or wildlife observation, are affected by the increasing extent of artificial (built-up) shorelines or by the associated impoverishment of certain resources. **Quality of life:** Artificial shorelines have a permanent effect on the landscapes accessible to riverside residents.	**Biodiversity:** The most urgent measure consists of containing shoreline encroachment. To ensure informed decision-making about conservation of the environment, it is necessary to increase knowledge of local ecosystems and their flora and fauna. Some actions may permit an increase in diversity: restoration of degraded riverbank areas, protection against erosion, conservation of natural habitats, and enhancements for wildlife. **Uses and quality of life:** The conservation and enhancement of natural habitats along the two rivers can improve the quality of life for riverside residents and other users.

Table 7 (cont'd 2)

Issue	*Main effects on the water body and its resources*	*Assessment of the current situation in light of sustainable development objectives*	*Guidelines for sustainable development*
Improving the choice of water-related recreational and tourism activities	The artificial structures built on both rivers have cut them off (in the minds of riverside residents) from Lake of Two Mountains, a quality water body considered a jewel among resort facilities in the Montreal archipelago.	**Biodiversity:** Many of the obstacles to boating also hinder the movements of certain fish species, including American Shad and Lake Sturgeon. **Uses:** Recreational boaters can navigate on Lake of Two Mountains or the rivers, but cannot readily move among them. This perception of three distinct water bodies (a lake of excellent quality, but two environmentally-degraded rivers) is not conducive to restoration efforts directed at the rivers. **Quality of life:** The reputation that the watercourses have of being degraded, locked in the urban environment and cut off from the lake, is an impediment to restoration efforts. The poor state of the rivers may thus be viewed as an inevitable and unfortunate situation linked to their presence in the city.	**Uses:** Establishing boating links between the lake and rivers would create the impression that the water bodies are an integrated whole. Recreational and tourist facilities associated with the water would encourage people to actively participate in restoring the rivers. Planning of such facilities must take into account conservation objectives for natural habitats. **Biodiversity:** The establishment of navigation links (e.g. locks) could be combined with measures promoting the passage of fish (fishways). In cases where recreation and tourist activities may affect the natural environment, it generally suffices to set preventive guidelines and sensitize users to the importance of conservation. **Quality of life:** Various activities centring on boating, the out-of-doors and nature observation may promote the development of tourist attractions. The choice of recreation and tourist facilities, their location and their operating characteristics must be carefully assessed to prevent degradation of the natural and human environment.

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Appendices

1 St. Lawrence Vision 2000 (SLV 2000) Priority Species Found in the Lake of Two Mountains–Des Prairies River and Mille Îles River Study Area (ZIPs 24 and 25)

Name	*Type of distribution or status in the study area*
Plants (18 of the 110 priority species)	
Agastache nepetoides (Yellow giant hyssop)	Peripheral, north LTM only
Allium tricoccum (Wild leek)	Peripheral, north, PR only
Arisaema dracontium (Green dragon)	Peripheral, north, PR only
Carex formosa (Handsome sedge)	Peripheral, north, LTM and MIR only
Carex lupuliformis (False hop sedge)	Peripheral, north, LTM only
Justicia americana (American water-willow)	Peripheral, north, PR and MIR only
Lycopus virginicus (Virginia waterhorehound)	Peripheral, north, MIR only
Lysimachia quadrifolia (Whorled yellow loosestrife)	Peripheral, north, LTM only
Panicum virgatum (Switchgrass)	Peripheral, north, MIR only
Podophyllum peltatum (Mayapple)	Peripheral, north, LTM only
Polanisia dodecandra (Clammyweed)	Peripheral, north, LTM only
Polygonum punctatum var. *majus* (Stout smartweed)	Peripheral, north, PR only
Pycnanthemum virginianum (Virginia mountainmint)	Peripheral, north, LTM and MIR only
Saururus cernuus (Lizard's tail)	Peripheral, north, LTM and MIR only
Sorghastrum nutans (Yellow Indiangrass)	Peripheral, north, LTM only
Taenidia integerrima (Yellow pimpernel)	Peripheral, north, LTM only
Torreyochloa pallida var. *pallida* (Pale false mannagrass)	Peripheral, north, LTM only
Wolffia borealis (Northern watermeal)	Peripheral, north, PR only
Fish (4 of the 14 priority species)	
Lake Sturgeon	Migratory, fresh water
American Shad	Migratory, anadromous
American Eel	Migratory, catadromous
Copper Redhorse	Resident, fresh water
Amphibians and reptiles (6 of the 6 priority species)	
Western Chorus Frog	Presence confirmed, current status unknown
Brown Snake	Presence confirmed, current status unknown
Wood Turtle	Presence confirmed, current status unknown
Spotted Turtle	Presence confirmed, current status unknown
Spiny softshell Turtle	Presence confirmed, current status unknown
Map Turtle	Presence confirmed, current status unknown

Name	*Type of distribution or status in the study area*
Birds (13 of 19 priority species)	
Horned Grebe	Migrant
Least Bittern	Possible nester on LTM
Northern Pintail	Confirmed nester, except along MIR
Blue-winged Teal	Confirmed nester on LTM and along PR, probable nester along MIR
Barrot's Goldeneye	Migrant
Bald Eagle	Possible nester on LTM
Peregrine Falcon	Probable nester along PR
Common Moorhen	Confirmed nester, except along MIR
Caspian Tern	Possible nester on LTM
Red-headed Woodpecker	Confirmed nester on LTM
Sedge Wren	Probable nester on LTM
Loggerhead Shrike	Possible nester, except along MIR
Grasshopper Sparrow	Possible nester on LTM

Abbreviations: LTM: Lake of Two Mountains; PR: Des Prairies River, MIR: Mille Îles River.

2 Environmental Quality Criteria (for assessing loss of use)

Ecosystem Component	*Reference Criterion*	*Objective*
WATER	Raw water (untreated water taken directly from a body of water) (MENVIQ, 1990)	Protect the health of persons who may both drink water directly from a body of water and eat aquatic organisms caught there throughout their lives.
	Contamination of aquatic organisms (MENVIQ, 1990)	Protect human health from the risks associated with consumption of aquatic organisms.
	Aquatic life (chronic toxicity) (MENVIQ, 1990)	Protect aquatic organisms and their offspring and wildlife that feed on such organisms.
	Recreational activities (primary contact) (MENVIQ, 1990)	Protect human health in the context of recreational activities involving total body contact with the water (e.g. swimming and windsurfing).
SEDIMENTS	No effect threshold (NET) (SLC and MENVIQ, 1992)	Contaminant levels are below those at which any effects on benthic organisms are observed.
	Minor effect threshold (MET) (SLC and MENVIQ, 1992)	Contaminant levels exceed those at which minor but tolerable effects are observed in most benthic organisms.
	Toxic effect threshold (TET) (SLC and MENVIQ, 1992)	Contaminant levels exceed those at which harmful effects are observed in most benthic organisms.
AQUATIC ORGANISMS	Protection of aquatic life (IJC, 1987)	Protect the health of fish-eating aquatic organisms.
	Fish and poultry marketing guidelines (HWC, 1985)	Maximum acceptable contaminant levels in the tissues of fish, molluscs, crustaceans and poultry sold for consumption.
	Freshwater sport fish consumption guidelines (MSSS and MENVIQ, 1993)	Prevent harmful effects on human health from eating contaminated fish, molluscs and crustaceans.

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3 Glossary

Anthropogenic: Effect resulting from human activity that transforms the natural environment.

Benthos: All organisms living in contact with the bottom of a body of water, divided into phytobenthos (plants) and zoobenthos (animals).

Biocenosis (or biological community): All the animals and plants living in a biotope.

Biomass: Total mass of living organisms, taken either globally or in systematic groups by surface or volume unit, in a given biotope at a given moment (e.g. plant, insect, herbivore, carnivore biomass).

Biotope: A limited region characterized by certain physical and chemical characteristics that provide an environment suitable for the development of living organisms (i.e. a biocenosis).

Community: All the living organisms, both plant and animal, occupying the same biotope.

Discharge: Volume of water carried by a watercourse, conduit, etc., in a given unit of time, generally expressed in cubic metres per second (m^3/s).

Distribution – peripheral: Refers to a species that lives at the edge of its geographic range.

sporadic (or disjunct): Refers to species found in an area or areas remote from their main range.

endemic: Refers to a species that is confined to a particular area.

Drainage basin: The entire continental land area drained by a river system; that is, the total precipitation catchment and drainage area.

Ecosystem: An entire physical and chemical environment (biotope) and all the living organisms (biocenosis) living there and able continue doing so indefinitely by virtue of matter and energy inputs.

Effluent: Any liquid released from a source of pollution, whether a residential area (domestic outfall) or industrial plants (industrial outfall). Point-source effluents (sewers): liquid pollutants discharged at a given location.

Habitat: Ecological framework in which an organism, species, population or group of species lives.

Marsh: Wetland habitat where plants emerge above the water surface.

Minimum flow: Lowest level of water flowing in a watercourse.

Nonpoint-source pollution: Diffuse discharge of pollutants into a given environment. Agricultural runoff is nonpoint-source pollution, since fertilizers and pesticides are spread over large areas.

Nutrient: Simple substance absorbed by plants and used in photosynthesis. Basic nutrients are nitrates, phosphates and silicates.

Sediment: Particles of soil and other solids formed by the weathering of rocks and other chemical or biological processes, and transported by air, water or ice.

Sediment regime: Set of streamflow characteristics that influence sediment transport, deposition and erosion..

Spawning ground: Place where fish gather to breed.

Suspended solid: Small particles of solid matter (> 0.45 m) floating in a liquid. Also called *suspended sediments* (see *Sediment*).

Tributary: Watercourse that empties into a larger river, or into a lake.

Turbid: Refers to water containing a high concentration of suspended matter.

Turbidity: Cloudiness of a liquid due to the presence of fine suspended matter (clay, silt or micro-organisms).

Waterfowl: Collective term for ducks and geese.

Water mass: Volume of water having relatively homogeneous physical and chemical properties.

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