Chapter 24
The "Renaturation" of Urban Rivers: The Case of the St Charles River in Quebec

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1 Introduction

In industrialized and developing countries during the nineteenth and twentieth centuries, most urban rivers were either channelled into canals, buried, or otherwise confined. The approach was designed both to improve urban hygiene and protect cities from flooding. In the 1950s, the growing use of cars in cities led to river banks being transformed into high-speed traffic lanes (e.g. the Manzanares in Madrid, the Seine in Paris). Due to pollution and the fact that river banks had become increasingly difficult to access, traditional uses (boating, bathing, fishing) disappeared. Cities gradually turned their backs on the rivers that they once relied on for their prosperity. Only major water shortages and floods reminded local authorities and residents of the presence (or relative absence) of water in the city.[1]

The management of river banks and beds and, on a larger scale, the urbanization of drainage basins, has had a wide range of consequences. In quantitative terms, these processes have altered the natural dynamic whereby groundwater is replenished and river levels are regulated. In qualitative terms, the capacity of water courses to clean themselves – although sometimes overestimated – has been reduced. In the 1960s and 1970s, in industrialized countries, substantial investments were made in storm water and sanitation schemes. But progress in this field has

[1] This was the case in Prague (Czech Republic) in August 2002 when the Vltava broke its banks, causing catastrophic floods, and in Spain where water shortages threaten the economies of entire regions.

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failed to offset damage to aquatic ecosystems caused by human interference.[2] In sum, it is not enough just to "wash the water". Public policies which focus exclusively on the fight against water pollution have revealed their limitations (Brun and Lasserre 2012).

Legislative bodies in most countries now consider water as both a 'resource' and part of the 'environment'. The destruction of fish habitat due to a range of operations (weirs, dikes, cleaning operations, the excavation of river beds, channelization, etc.) is recognized as a major cause of the degradation of natural aquatic environments. Development has also led to river beds becoming deeper, thus perturbing the spatio-temporal evolution of the rivers themselves, generating a large number of short-, medium-, and long-term consequences (e.g. impacts on hydraulic evolution, development of flora, use of drinking water, etc.). That is why, beginning in the 1970s and 1980s, contractors were obliged to carry out environmental impact studies, and, in the 1990s, environmental agencies focused on the central importance of guaranteeing the physical processes of river hydrosystems.

This change of paradigm can be at least partially explained by a growing interest in the 1980s and 1990s in the conditions and resources required to restore physical milieus, a research approach largely based on work initially carried out in the United States in the 1950s (Petts and Calow 1996; Malavoi and Bravard 2010). This research generated a great many promising projects, even if the notion of the 'renaturation' of rivers means very different things in different drainage basins.

There are opportunities for rehabilitation of urban rivers as cities have changed their strategies over water. Since the 1990s, the emergence of sustainable development has contributed to greener, more water-efficient buildings. Engineers have developed new storm water management techniques. Cities have rediscovered the value of the rivers around which they were originally organized and developed: the river was a strong element structuring urban development, particularly in the industrial era. This is why the ports and docks were rehabilitated during urban renewal in France (Nantes, Rouen, Paris…) and elsewhere in Europe (London, Bilbao, Lisbon, Genoa, Copenhagen, Oslo, Hamburg, Frankfurt Main…). Outside Europe, cities have transformed their port wastelands into vibrant urban spaces.

This article focuses on the reasons behind decisions to 'renature' urban rivers and on the conditions in which such projects are carried out. In effect, many municipalities launch renaturation projects not so much with a view to improving the quality of aquatic biotic milieus, but as a part of urban projects closely associated with the rivers running through their cities.

[2] The aquatic ecosystem or hydrosystem is "the specific eco-system of the aquatic milieus generally defined in reference to the living beings which are a part of it, the nature of the bed and the banks, the characteristics of the drainage basin, and the hydraulic regimes and the physico-chemical qualities of the water" (source: http://www.glossaire.eaufrance.fr/concept/ecosyst%C3%A8me-aquatique). The term describes a different reality to the one covered by the river hydrosystem. "The authors of this concept, elaborated and tested on the Rhône, explain that it is particularly suitable for major water courses, or at least those disposing of a flood plain large enough to accommodate a mosaic of geomorphological units and eco-systems, notably the subsystems of the high water bed" (Malavoi and Bravard 2010, p. 10).

After defining the concept of renaturation and presenting the issues that it encompasses, the case of the St Charles River in Quebec will be described with a view to illustrating the advantages and limitations of urban development projects linked to water. In its study of the renaturation of the lower reaches of the St Charles River in Quebec, the Franco-Canadian IDEAUX research programme (2008–2012) demonstrated that if the interests of the actors of urban planning (mayors, promoters, etc.) converge with those of water users, spectacular projects can be implemented.[3] The fact nevertheless remains that, in the absence of a global approach and taking into account the costs and duration of these kinds of urban projects, it would perhaps be more opportune to concentrate on the renaturation of rural rivers rather than urban ones.

2 The Concept of Renaturation: Definition, Evolution, and Issues

In the 1980s and 1990s, a number of restoration projects – first in rural milieus, then in urban settings – were successfully carried out, notably in Germany (Boutet 2006; Semrau and Hurck 2008). Since then, public and private contractors have viewed urban rivers as a factor in sustainable urban development. However, audacious programs – such as returning a great river to its original bed in the centre of an urban agglomeration, or bringing a buried stream back to the surface – are rare.

2.1 Renaturation: Definition and Principal Characteristics

Renaturation is defined as a management process whose objective is to restore to an aquatic milieu (a stream, a river, etc.) its main ecological and dynamic functions. Renaturation thus does not necessarily designate a return to a state considered as 'natural' for the water course – a process that presupposes a state of reference – but an approach designed to re-establish its natural functions (Adam et al. 2006; Bunusevac 2007; Brun 2011).

[3] The objective of IDEAUX – *Pour une Intégration des politiques de Développement, de l'Eau, d'Aménagement et d'Urbanisme en faveur des milieux aquatiques* (For the Integration of Policies on Development, Water, Planning and Urbanism in Favour of Aquatic Milieus) – is to study the mutual influence of so-called 'territorial' policies and water management policies. The project was initiated in 2008 by the Sogreah-Artelia consulting firm with the technical and scientific support of the Art-Dev Mixed Research Unit in response to the Eaux et Territoires call for projects launched conjointly by the French Ministry of Ecology, the CNRS, the Cemagref, and the Ministry of Natural Resources and Fauna of Quebec. IDEAUX is one of the 12 interdisciplinary projects selected for the Eaux et Territoires program (2008). The project is subsidized by the Ministry of International Relations of Quebec and the French General Consulate in Quebec. It also receives a subsidy from the Jacques Cartier Centre (2009).

Renaturation is an operative concept which has not yet been fully defined, an empirical approach at the crossroads between water management and the ecology of aquatic milieus. This explains why authors working in the field suggest a variety of typologies relative to the physical restoration of aquatic milieus. Nevertheless, four major levels of intervention can be schematically distinguished:

1. **Complete restoration** consists of redirecting the river back to its historical course in its original hydrodynamic conditions.[4] Insofar as major water courses are concerned, the objective is to provide the water course with a greater degree of freedom[5] by demolishing lateral (dams, weirs) and longitudinal (concrete anti-flood walls, levees) obstacles.
2. **Re-creation** is an approach applied to situations in which the original bed cannot be located, to ensure that the river follows its original course as closely as possible.
3. **Compromise** is an approach used when roads, buildings, etc., make scenarios such as those described above impossible. The objectives of this approach are to diversify habitats and achieve a dynamic equilibrium. Some structures (dikes, dams, etc.) can be demolished if no surrounding buildings are impacted.
4. **Diversification** applies to situations characterized by strongly constraining factors in which, for example, there is no freedom to build laterally (the areas on either side of the river have already been urbanized). Conditions can only be improved by introducing structured elements into the channel – by adding slightly sloping banks, placing obstacles in the channel, introducing flow deflectors, etc.

An analysis of projects in France and around the world reveals a number of constants. Renaturation is a voluntary, planned approach. In most circumstances, projects are organized and funded by municipalities, government agencies, or local residents associations. The cost of renaturation projects varies significantly depending on the characteristics of the site in question. For example, in Western Europe, the cost of studies and works per linear metre varies between a few dozen euros in rural areas to almost 1,000 euros in an urban context. The renaturation of an urban river is expensive, in part because it requires thoroughgoing studies encompassing a multitude of issues (real estate, hydraulics, ecology, etc.). Such projects also involve the acquisition of parcels of land next to the water course and, in many cases, compensation of local residents and companies whose properties and premises have been expropriated.

The renaturation of urban rivers is generally accompanied by other development projects (optimizing the management of rain water, modernizing waste water net-

[4] The approach consists in defining a point of reference based on core drilling and the diachronic analysis of old maps and plans. The present-day river bed is blocked off and the river redirected to its original bed.

[5] The high water bed within which the river channels provide lateral outlets for the movement of sediments, as well as hosting aquatic and terrestrial eco-systems. Source: http://www.glossaire.eaufrance.fr/concept/espace-de-libert%C3%A9-d'un-cours-d'eau

works, renovating residential buildings, public spaces, and public facilities, etc.). That is why such operations take a number of years to complete and are particularly complex in terms of organization. Furthermore, some projects are preceded by public information campaigns or the decontamination of land previously polluted by industry.

The concept of renaturation covers a wide variety of projects, ranging from redirecting rivers once channelled into canals back into their original courses, to infinitely more modest programs. In certain cases, projects described as exemplary – on the grounds that they focus on ecology rather than civil engineering – can be counter-productive. For example, when the banks of the Erveratte, in Switzerland, were reinforced using vegetal techniques (vegetal embankments, fascining), energy once dissipated laterally was concentrated into the channel of the water course. In fact, the river has dug its own bed so deeply that the banks have been undermined.

In France, it might have been expected that, due to the adoption of the European Framework Directive on Water (2000), attitudes to the concept of renaturation would have evolved towards an approach based on the efficient functioning of ecosystems. But an initial analysis reveals that, on the contrary, traditional concepts based on good water flow and flood protection continue to hold sway.[6] In places, traditional hydraulic projects are still funded by the French water agencies within the framework of the new renaturation policy.

Meanwhile, Idarraga (2010) lists over 160 completed and ongoing renaturation projects worldwide, three-quarters of them in Europe (79) and North America (43).[7] Nonetheless, the world's other regions are also active.[8] For example, in 2002, in Seoul, the then mayor, Lee Myung-bak, took the decision to launch a project to rehabilitate the Cheonggyecheon, a tributary of the Han River. Work on the project was commenced in 2003 after the demolition of the main road built over the tributary in 1968. A 5.8 km stretch of the river serving the city's commercial districts[9] has once again become a popular site for promenades and leisure activities.

Renaturation is a concept developed by ecologists, biologists, and water managers. However, the ecological and social aspects are inseparable, especially in urban areas where human densities are high and usage conflicts are many. "Actions to conserve or restore the river must maintain or restore the dynamics of the river to the greatest extent possible, identify and protect healthy parts of the ecosystem, link social patterns with ecological patterns, and develop management alternatives that are robust in the face of future uncertainty" (Gregory 2012).

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[6] Working within the framework of the IWRM-Net Forecaster project in 2009, B. Morandi listed 597 sites or projects relevant to the field of river restoration. According to Carré et al. (2009), the differences between such projects are mirrored by the geographical disparities of the sites on which they are carried out.

[7] An analysis of the data collected by Idarraga (2010) for Canada and France suggests that the author has underestimated the number of projects in the field. Nevertheless, his work does provide an insight into the number of projects undertaken in individual countries and the disparities between various continents.

[8] Idarraga (2010) lists 21 projects in Asia, 12 in Latin America, 9 in Oceania, and 1 in Africa.

[9] Source: http://shadowrun.over-blog.com/article-18979076.html

Fig. 24.1 The banks of the Rhône in Lyon were built for cyclists and pedestrians, Brun 2010

2.2 The French Experience: Renaturation Limited to the Landscaping of River Banks in Urban Milieus

Case studies carried out in France show that, unlike in rural territories, projects carried out in urban contexts tend to be limited to 'landscaping' the river banks. For example, in Lyon, 5 km of Rhône quays were recently redeveloped for €44.1 million by the Greater Lyon municipality in partner with the agency, In Situ, creating accessible pedestrian walkways with a large number of trees and providing shelter from the roadways built over them. The redevelopment of the quays, which took their current form in the nineteenth century, was rated a success by the public because of the linking of certain of the city's public facilities (see Fig. 24.1).[10] Indeed, the city has initiated a study for a project entitled Rives de Saône, involving artists and landscape designers working on the other major river that flows through Lyon. According to projections, 15 km of the 22 km project will have been completed by 2013.[11]

Between 2000 and 2009, in Bordeaux in south-west France, after a preparatory period of 20 years during which numerous old riverside buildings were demolished, the quays on the left bank of the Garonne were redeveloped at a cost of tens of millions of euros. Overseen by the landscape designer, Michel Corajoud, the 45 ha development made a major contribution to the urban renewal of the Bordeaux

[10] Interview with the geographer, J.-P. Bravard, Le Rhône: plus qu'un atout de marketing urbain, Diagonal, No. 177, 2008, pp. 34–36.

[11] http://www.grandlyon.com/Rives-de-Saone.3531.0.html. Accessed 6 Mar 2012.

agglomeration.[12] There are similar examples in the Paris region where most major urban projects involving the Seine include the redevelopment of the river banks. This is true of the Ardoines (280 ha) in Vitry-sur-Seine developed by the Orly-Rungis-Seine Amont Public Development Establishment (Brun and Adisson 2011).[13] And it is also true of the river eco-neighbourhood of Ile-Saint-Denis (22 ha) developed by the Plaine Commune, and of the eco-neighbourhood of the Docks Park in Saint-Ouen (12 ha) developed by Séquano Aménagement, an agency dependent on the Paris municipality.

In most cases, these riverbank redevelopment projects are reminiscent of approaches generally applied by urbanists to public spaces: the use of suitable public lighting, the development of safer and more peaceful access-ways, the planting of riverside vegetation, the creation of new urban neighbourhoods, etc. The list is not exhaustive. Such projects in fact generate results that combine aesthetic, functional, and sewerage objectives with the intention of returning cities to their rivers, often focusing on formerly industrial riverside areas (Docklands in London) or on outstanding heritage sites (the Rideau Canal in Ottawa). However, these projects do not strictly involve a process of complete renaturation, since the density of urban developments often makes it impossible to redirect rivers to their original courses. This problem rarely arises in rural situations.

2.3 An Operational Concept in Rural Milieus, But the Number of Major Projects Remains Low

The Drugeon is a 35 km long stream in the east of France. Its renaturation was one of the most successful projects of recent years. In 1951, under pressure from the farming community, local municipalities, in conjunction with the French Ministry of Agriculture, commenced drainage work on the marshland around the stream. Although the Drugeon lost 30 % of its length, the project ended in failure: only around 200 ha of land, or 10 % of the initial objective, were reclaimed. More than 40 years after it had been channelled into a canal, local municipalities, working within the framework of an inter-municipal structure, decided to direct the Drugeon back to its original course. The renaturation of the Drugeon began in 1993 and was completed in the early 2000s. Initial assessments were positive in that experts were able to observe that certain species were gradually recolonizing the sections of the stream that had been redirected to its original course. The ecological re-conquest was, moreover, preceded by a reappropriation of the river's banks on the part of local inhabitants and fishermen.[14]

[12] Ville d'Angers, La reconquête des quais à Bordeaux. http://www.angers.fr/fileadmin/plugin/tx_dcddownloads/La_reconquete_des_quais_a_Bordeaux.pdf May 29, 2010. Accessed 26 Jan 2013.

[13] The overall cost of the Ardoines project, which will take 20–30 years to complete, has been estimated at over a billion euros.

[14] The advantages and disadvantages of partially renaturing the Drugeon have been discussed in a large number of scientific articles. Representatives of local missions have also contributed valuable comments regarding the phasing of the project and its financial and administrative organization

The renaturation of the Drugeon was exceptional in terms of the scope of the project. However, in Europe, almost all rural rivers have been channelled into canals, either for agricultural purposes or as an anti-flooding measure. After a long period of land acquisition in the 1990s, a few kilometres of the Ouche, a small river in Burgundy, were reintroduced to the river's original course. In the case of the Veyle, a river flowing 67 km across a plain to the north of Lyon, local municipalities created a new river bed that was as natural as possible for a water course that had been destroyed due to the extraction of gravel in the minor bed, a process that had commenced in the 1960s.[15]

Thus, a number of ambitious projects have been successfully completed in rural milieus. However, in regard to the number of water courses in France and the rest of Europe, relatively few rivers have been the object of hydromorphological restoration programs and, with rare exceptions such as the Isar (Germany), the rivers concerned were small. In European cities, renaturation, even when combined with urban projects, as in Lyon and Bordeaux, is often confused with the landscaping of river banks. In effect, the urbanization of riverside lots limits the legal, technical, and financial margins of manoeuvre of contractors.

The situation is similar in the United States, where dozens of projects have been carried out, particularly in cities on the shores of oceans and major lakes. The same applies in Canada, where, for example, 6 km of the banks of the River Outaouais in Gatineau have been redeveloped.[16] This project, the intention of which was to bolster trade and tourism, differs from the renaturation of the upriver section of the St Charles River in Quebec (1996–2009), an approach which marks a turning point in water policies at the municipal level (Brun 2011).

In the 1990s, the City of Quebec came to the conclusion that projects carried out in the past (the construction of embankments, the concreting of the banks, etc.) had perturbed the functioning of the aquatic ecosystem and failed to have the desired effect on potential users, who continued to avoid the riverbank. The municipality therefore decided to develop a restoration policy for the St Charles River, while simultaneously pursuing the urban renewal of the riverside neighbourhoods in the old town neighbourhood of the city. The project was a success. The ecological and landscape improvements made to the river resulted in a jump in the value of river-

(see http://www.liferuisseaux.org/rencontre_colloques/Colloque_2009/10-06-09/restauration_drugeon_Resch.pdf).

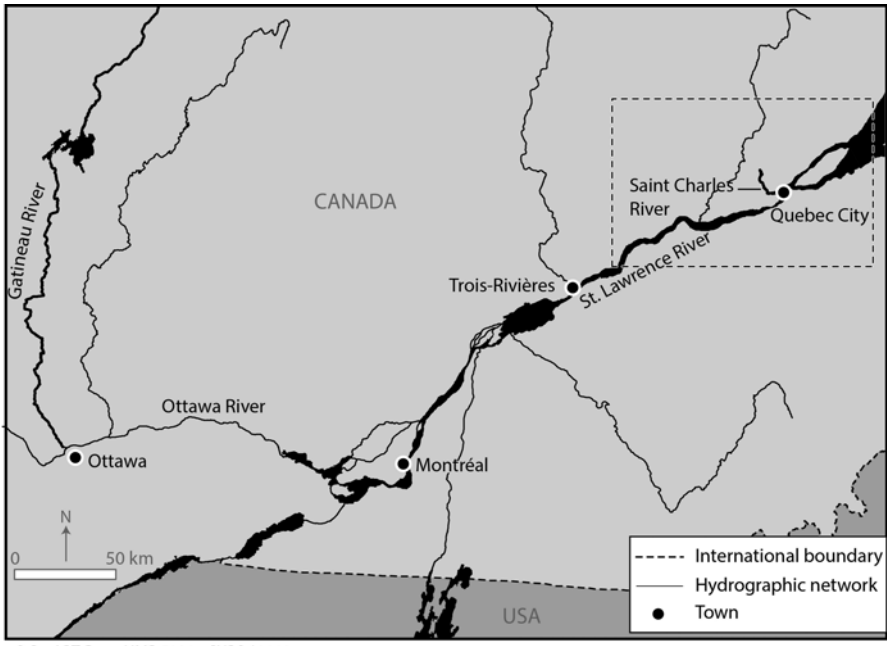
[15]The objective of the project was to reduce the impact of a former gravel pit located at Saint-Denis-les-Bourgs on the river's ecosystems and hydrosystems. Costing an estimated €860,000, the project consisted in redirecting the course of the river into a minor bed running in parallel for approximately 2,000 m. Source http://www.veyle-vivante.com/. Accessed 26 Jan 2013.

[16]The project, entitled Destination Gatineau, is located not far from Ottawa. Supported by the mayor of Gatineau, Marc Bureau, it is set to be completed in time for the 150th anniversary of the Canadian confederation in 2017. The project will require an initial investment of CA$135 million and will attract an estimated three million visitors a year to the Quebecois side of the Outaouais River. According to its promoters, the project will generate CA$170 million per annum. Source: http://www.radio-canada.ca/regions/ottawa/2012/03/01/002-destination-gatineau-devoilement.shtml. Accessed 26 Jan 2013.

side property. In addition, the experience is remarkable because it precedes the birth of several years of water policy in Quebec.[17]

3 The Case of the Renaturation of the St Charles River in Quebec

The St Charles River occupies a drainage basin of 550 km^2. The area is among the first to have been colonized by European settlers and is one of the most densely populated areas of its kind in Quebec (350,000 inhabitants). Its 35 km length, from its source in Lake St Charles to its mouth in the St Lawrence, traverses various geological formations from the Canadian Shield to the St Lawrence Lowlands (Figs. 24.2 and 24.3). The course of the river can be divided into three segments: the



Source : adapted from "Département de Géographie, Université Laval".

Fig. 24.2 The location of the St Charles River in Canada

[17] Among other things, the Politique Nationale de l'Eau du Québec (Quebec National Water Policy) introduced water master plans (portraits of drainage basins and recommendations) for 33 sub-basins of the St Lawrence, suggesting that local drainage basin bodies should encourage the development of basin contracts (action programs) in those sub-basins. Since then, the Quebec government has set up Integrated Management Zones (2009) to cover the whole of southern Quebec, while simultaneously recognizing the growing role of drainage basin bodies. On 11 June 2009, the government also passed a law "affirming the collective nature of water resources aimed at reinforcing their protection".

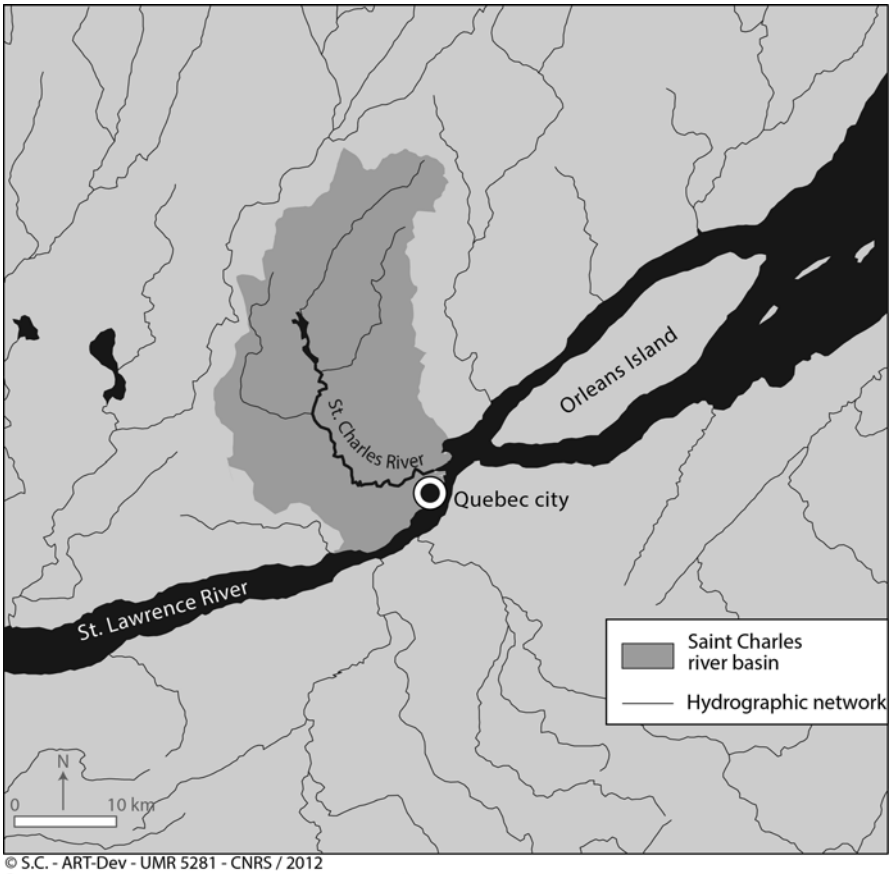


Fig. 24.3 The location of the St Charles River Basin in relation to Quebec city

first, slightly sloping, and beginning in a humid, semi-forest milieu and running to the Kabir Kouba Falls near Wendake; the second, steeply banked and torrential and with a more pronounced inclination, from the Falls to the Parc des Saules; and the third, running through an urban milieu and with a gentle slope, from the Parc des Saules to the river mouth. It is this third segment which, in undergoing a process of renaturation, has constituted a major axis of urban development.

3.1 The Lower St Charles: The Major Axis of Urban Development

Samuel de Champlain founded Quebec City in 1608, almost a century after Jacques Cartier first set foot in the area. The settlement initially developed around the Abitation (Place Royale), and later along the banks of the St Charles River (Pouliot

2005). The upstream section of the river was the object of successive projects associated with the development of the lower part of Quebec City. In the second half of the seventeenth century, the river bed was excavated in order to provide adequate depth for shipping, and the banks were partially reinforced following the construction of the first dockyards. After American independence and following Napoleon's continental blockade, the British Empire chose to secure timber supplies in eastern Canada and industrialize shipbuilding in Quebec.

Between 1820 and 1899, 1,760 ships were built in the dockyards of the St Charles estuary. During this period, the population of Saint-Roch (a town near the St Charles River) increased from 829 inhabitants in 1795 to 10,760 in 1842. Floating timber and industrial and domestic waste negatively impacted the quality of the river's water and significantly reduced biological diversity. From 1870, the dockyards were gradually replaced by factories, and in 1878, with the opening of the Canadian Pacific railway station, the neighbourhood of Saint-Roch became more attractive. Stench and disease were attributed to the poor quality of the river water. Drinking water was the reason the municipality built, in 1872, the first section of an aqueduct from Lake St Charles.

In an alarming report published in 1936, the Surveyor Commission described the river as one of the most polluted in the province (Quebec Chamber of Commerce 1962). The main outlet for the agglomeration's waste water and a backyard for declining industries, the St Charles River became a thorny issue for the municipality beginning in the inter-war period.[18] In 1966, in the wake of a tri-partite agreement between the municipal, provincial, and federal governments, a decision was taken to concrete over the banks (Dumont 1998). After a major embankment construction project (1957) designed to increase the amount of land available for construction purposes, the municipality of Quebec City concreted over the banks of the St Charles River between 1969 and 1974 in an attempt to make them more attractive.[19] The municipality also erected an anti-tidal dam in the early 1970s (Samson Dam) in order to stabilize the water table in the urban area.

The objective of these projects was to improve water management in terms of hygiene, while simultaneously modernizing the historic neighbourhoods that the river runs through. At the time – the time of the Gréber-Fiset Plan – functionalism was the order of the day. Between Scott Bridge in the west of the city and the confluence with the St Lawrence in the east, roads supplanted the natural corridor represented by the St Charles River. Urban development strategies carried out in Quebec City echoed European 'models' such as the quayside roadways in Paris. "We have stopped dreaming in colour; now we're dreaming of concrete", Gilles Lamontagne, mayor of Quebec City, said at the time.[20]

[18] The tributaries of the St Charles River were also of concern to the public authorities during this period (see: Fuites souterraines inattendues. Enfouie dans les années 1960, la rivière Lairet laisse ses traces à l'Hôpital Saint-François d'Assise, *Le Soleil*, Quebec City, 24 May 2012).

[19] The municipality was also responsible for the construction of a purification station and for improving the management of urban water in order to address the manifest shortcomings in the field of sanitization in the Saint-Roch and Limoilou neighbourhoods of the Old Town (Quebec City Town Planning Department 1973).

[20] Lamontagne: Québec deviendra l'une des plus belles capitales du monde, *Le Soleil*, Quebec City, 21 November 1966. Cited by Dumont (1998).

Thanks to the projects completed in the *Trente Glorieuses* – the period of economic growth between 1945 and 1975 – the most urban section of the St Charles River was no longer the "gutter transporting waste and debris, exposing a stinking, muddy bed" described by Gréber and Fiset in (1956, p. 49). However, the water quality was still very bad due to poor management of storm water. Furthermore, far from making the river more attractive, development projects had succeeded only in making it less so. The municipality of Quebec City therefore resolved, 30 years on, to make another attempt by pursuing the same objectives while adopting a radically different approach.

3.2 From the "Kabir-Kouba Plan" to the "Renaturation" of the St Charles River

A development plan by the name of Kabir-Kouba (a Huron-Wendat name meaning "river of a 1,000 meanders") was conceived in 1974 with the aim of once more placing the river at the centre of the city's urbanization project. In this regard, a number of ecological objectives were added, and the plan was updated in 1995 (Paulin 2001). From the technical point of view, civil engineering had to some degree been replaced by vegetal engineering: the 8 km stretch of river bank concreted over for CA$16 million a few decades earlier was demolished and 'renatured' (City of Quebec 1996; Paulin 2001).

The project consisted in developing a variety of fauna habitats and encouraging the redevelopment of riverside vegetation, while at the same time reinforcing the river's role as a centre for recreation accessible to the local population (Paulin 2001; Pronovost 2009). A 32 km network of pedestrian walkways, frequently accompanied by cycle paths, now links the restored sectors to Lake St Charles. Partaking of a more traditional approach, the 12 rainwater collection basins (underground concrete structures) near the outlets in the wooded areas, now capture 90–95 % of the volume of water overflowing the gutter system, thus helping to reduce the number of times water is released into the river in cases of heavy rain from 55 to 4 times a year. The overall cost of the project, shared between the municipality of Quebec and the provincial and federal governments, was approximately CA$115 million (Figs. 24.4 and 24.5).

Infrastructure designed to collect and transport rain water to the main storage facilities accounted for over 80 % of public expenditure. Rain water and waste water networks were diverted and modernized; according to the technical services of the City of Quebec, municipal management of water in the riverside neighbourhoods was substantially improved. On the other hand, according to a number of environmental associations, in regard to the tributaries of the St Charles River, waste water treatment and the management of rain water still leaves a good deal to be desired.[21]

[21] To our knowledge, no precise assessment of the project has been carried out in terms of urban sanitation concerning the renatured section, the other upstream sections, and the tributaries, some of which are still used as outlets for domestic and industrial waste.

Fig. 24.4 Downstream of the St. Charles River in Quebec City, Brun 2010

The urban scheme developed by the City of Quebec between 1996 and 2009 after a series of public consultations included a number of spectacular projects (Pronovost 2009). If the ‘social’ benefits are hard to quantify, the presence of an increasing number of promoters on the plots of industrial wasteland sites next to the St Charles Linear Park bears witness to an urban revitalization (Fig. 24.6); the Old Town is being transformed into a mixed-use, pedestrianized area; to the social habitat of the working class neighbourhoods will be added more opulent plots with ‘a river view’ (Boutet 2006). The scheme encompasses the usual imperatives of security and accessibility for the handicapped which pertain in major cities and agglomerations. For example, particular attention is paid to public lighting and to the height of vegetation, so that people taking a stroll always have a clear and unimpeded view. The urban furniture is adapted to inclement weather, flooding, and vandalism. The inclination of the paths along the river banks are sufficiently slight that they can be easily used by people with reduced mobility (Pronovost 2009).

The urban project benefitted from a ‘window of opportunity’ which opened in the 1990s. Leading up to the 400th anniversary of the founding of Quebec City (2008), the Provincial government had, in effect, selected three priority projects in the spring of 2000, foremost among which was the depollution of the St Charles River. The capital of the Francophone province was to become the shop window of the nation in the upcoming international festivities, and large amounts of funding were made available with the aim of removing the river from the blacklist of the most polluted water courses in North America. Around the world, rivers were regu-

Fig. 24.5 Property developers return on the banks of the St. Charles River to build housing, Brun 2009

larly featured in major events which gave a boost to improvement work (Fig. 24.7). For example, the transformation of the quays of the Thames underwent two sudden accelerations, the first due to Year 2000 celebrations, the second to the 50th anniversary of the reign of Queen Elizabeth II (Lemonier 2003).[22]

[22] In the west of Canada, the small town of Whitehorse, the capital of the Yukon Territory, partially renovated its waterfront to mark Elizabeth II's Golden Jubilee (Jubilee Park was opened on 25 May 2002).

Fig. 24.6 A trail connects the upstream and downstream of the St. Charles River, Brun 2010

The St Charles project also benefitted from experience acquired by the municipality a few years earlier from meetings on the urban renewal of the Saint-Roch neighbourhood. The symbol of a decline in the city’s commercial industrial centre which lasted until the early 1990s, Saint-Roch now provides an example of negotiated urbanism. Following the election of Jean-Paul L’Allier’s Rassemblement Populaire party in 1989, the municipality succeeded (after having vainly attempted for a number of years to modernize the neighbourhood by means of ‘grands projets’ based on a highly controversial top-down model of urban planning) in completing a number of projects in conjunction with local actors. The new government emphasized a policy based on popular consultation and focused on developing the

Fig. 24.7 Whitehorse waterfront, Brun and Lasserre 2012

neighbourhood based on its existing architectural heritage and on its history, rather than by parachuting in major infrastructural projects. During consultations on the renaturation project, the municipality followed this precept, even going so far as to appropriate some of the ideas of critical associations at the expense of its own technical departments (as the report of the association, Rivière Vivante, suggests; 1999, p. 6).

Generally speaking, the Quebec City municipal government was able, thanks to the favourable political context that pertained in the 1990s, to introduce a new approach. According to Scherrer (2004), writing on the subject of the increase in the value of riverside plots in urban areas, the new approach consisted in limiting anthropic pressure on a reconstituted natural milieu and considering the overall quality of the urban river as an inherent factor in urban amenities. Although the Samson Dam in Quebec City prevents fish from migrating, the return of certain species bears witness to the ecological interest of the renaturation of the downstream section of the St Charles River. The physico-chemical quality of the surface water will probably get better over the course of the next few years thanks to gradual improvements in rain water collection systems. This is also true for the rest of Quebec (Duchesne 2009).

Furthermore, the creation of islands, beaches, and rocky breakwaters are now among the most audacious projects in an urban water course that is very 'corseted'.[23]

[23] In comparison, the drainage and reforestation project carried out in the valley of the Saint-François River over the past 30 years, described by Castonguay and Samson (2010), seems to be lacking in ambition.

However, while such projects mark turning points in terms of urban development in Quebec, the issue of urban sprawl characterizing North American cities remains problematic. Badly managed urbanization, particularly at the head of a drainage basin, can have negative consequences on water quality and, consequently, on the attractiveness of the upstream sector of the drainage basin in which the public authorities have invested a great deal of time and money.

3.3 The Fight Against Urban Sprawl: A New Environmental Priority for the Municipality of Quebec City?

Between 1950 and 2000, the surface area of the *continuous urban habitat zone* (measured according to the 1:50,000 topographical maps published by the Canadian Ministry of Natural Resources) of the Quebec City region increased by 630 % (from 36.9 to 269.3 km^2), while its population grew by only 35 % in the same period (Mercier 2006). In certain areas at the head of the drainage basin, periurban development has expanded dramatically. This is true of the sub-basins of the Hibou River and of the stream in the St Charles River basin (Conseil du bassin-versant de la rivière Saint-Charles 2007). Many well-off households have been attracted by the nearby ski slopes and the 'natural' character of the Quebec countryside, which is relatively well connected to the city. "[However], the approach employed by developers, who build houses in the middle of plots, takes up a lot of space", says a local politician, who adds that "demand must be met".[24]

According to environmental associations, "there are many environmental consequences of urban sprawl in the drainage basin of the St Charles River" (e.g. domestic waste at the origin of the degradation of the quality of the water course, acute riparian erosion after the clearing of plots of land following the destruction of woodland, destruction of fauna habitats, etc.). Most lakes in the drainage basin of the St Charles River have also been impacted due to residential developments. At certain periods of the year, the bacteriological quality of the water in Lake Durand makes bathing impossible. The lake's water is not used for drinking purposes, and local residents use their own systems to cater to their needs. Not all local residences are linked to a municipal system for taking away waste water and therefore need to employ individual systems (Gérardin and Lachance 1997; Bolduc 2002). Indeed, it is impossible to verify the conformity of all these installations.

Upstream, forested areas in the drainage basin of the St Charles River are becoming increasingly scarce. While residential development and recreational tourism have caused a number of ecological problems, the same can be said for newly built roads. For example, in 1973, the reinforcement of 500 m of the banks of the River Berger north of the Boulevard Père-Lelièvre as part of the construction of the Le Vallon motorway and, later, the canalization of another part of the river following

[24] Source: interview with a local politician in charge of planning in January 2010 in the city of Quebec.

the construction of the La Capitale motorway, modified the natural direction of the water course, destroyed the fish habitat, and rendered riverside land more vulnerable to flooding (Conseil du bassin-versant de la rivière Saint-Charles; 2007, p. 22).[25] According to the association, Vivre en Ville, "Over the course of the last 10 years, 75 km of new streets have been built in Quebec City".[26]

The municipality is responsible for sanctioning or prohibiting specific approaches to land use and building projects, while taking into account their environmental and public safety impacts on nearby rivers and lakes, and flood plains. In taking the issue of public safety into account, legislation on the regulation of flood plains also subjects land use to severe constraints. The municipality's urban land use plan includes provisions for dividing its territory, establishing use categories, deciding which construction projects to allow or reject, and decreeing prohibitions or rules – and all of these vary according to locations within the territory, established categories, or any combination of those selection criteria. Nevertheless, to paraphrase a regional planning expert, everyone agrees that "today, it's the law on the protection of agricultural land that provides the most effective rampart against the urbanization of rural areas".[27]

The absence of an overall territorial strategy covering the metropolitan area as a whole is, from the point of view of associations like Vivre en Ville, patently obvious, particularly in terms of urban public transport which is limited to bus services. Furthermore, according to a politician from the Quebec City suburbs, this explains why, "since we haven't really got to grips with the urbanization of the territory, we have opted for more ecological buildings in the Quebec region."[28] The reasons for the difficulty of implementing territorial planning based on solidarity between municipalities should be sought in the predominance of the city centre, which wants "everything its own way".[29] Furthermore, "there's no shortage of space; that's why it's not easy to change the way developers act and how municipalities think… densification is a dirty word in North America!".[30]

In this context, in spite of the implementation of a theoretically 'integrating' local governance system for water, development actors find it hard to accept the principles of water management based on drainage basins dictated by the Politique Nationale de l'Eau du Québec (Quebec National Water Policy) presented in 2002 by

[25] See too Brodeur, C., Cuff, D., Dionne, N., Laberge, V., Labrecque, R., Trepanier, J., & Turmel, P. (2012). Portrait Watershed Capital. Body Watershed Capital. Published in March 2012, ongoing review. http://www.obvcapitale.org/plans-directeurs-de-leau-2/2e-generation/diagnostic

[26] Source: interview with the director of the association "Vivre en Ville" in Quebec City in January 2010.

[27] Source: interview with a planner of the Ministry of Planning and Municipal Affairs Quebec in January 2010 in Quebec City.

[28] Source: interview with a local politician in charge of planning in January 2010 in the city of Quebec.

[29] Source: interview with the director of the association "Vivre en Ville" in Quebec City in January 2010.

[30] Source: interview with the director of the association "Vivre en Ville" in Quebec City in January 2010.

the government led by Bernard Landry (Parti Québécois). To simplify greatly, for the municipal government the local governance of water does not constitute a lever for development in any way. Firstly, the drainage basin is still relatively unfamiliar to local politicians and developers, whence the difficulty of combining urban planning with water planning.[31] Secondly, local water governance is based on associative organizations whose financial, human, and technical resources pale in comparison with those of professional development and urban planning bodies.[32] Lastly, those associative organizations have no political legitimacy since they come under the aegis of the Ministry of the Environment and their members are not elected. That explains the limited role of the St Charles River Drainage Basin Council.

4 Discussion

In the case of the drainage basin of the St Charles River, an Association for the Protection of the Environment (APEL) was set up in 1980 by volunteers living near Lake St Charles, 20 years before the creation of the St Charles River Drainage Basin Council. In 1997 the APEL began a gradual process of 'professionalization' and now has several full-time employees. The Association's budget varies between CA$250,000 and 500,000 per annum. It carries out maintenance work and manages the Northern Swamps of Lake St Charles, which it co-owns with the City of Quebec. Founded in 2003, the St Charles River Drainage Basin Council has, up until now, been more of an observer than an actor, since the government has restricted it to that role. According to its statutes, the principal mission of the Council is to provide

[31] The Law on Planning and Urban Development (LAU) introduced in 1979 does not include a section specifically focusing on water management based on drainage basins. On the other hand, it does include the elaboration of the land use development plans published by all the Regional County Municipalities (MRCs), which often facilitate the articulation between urban planning and planning in the field of water management.

[32] The Government of Quebec, the main provider of funds for the drainage basin bodies, underestimated the needs of basin organizations, some of which, in spite of the recent increase in government subsidies, are no longer operating due to a lack of money. As a result, the bodies are not only experiencing operational difficulties (limited professional travel for employees, insufficient access to conferences and socio-professional meetings, etc.), but also difficulties in terms of recruitment (only people with relatively little experience are now hired due to the kind of salaries that can be offered). Furthermore, the financial fragility of the drainage basin bodies has had the effect of increasing competition between them. Initially announced in 2002, and then again in 2004 by the former Liberal minister, Thomas Mulcair, then again in the 2006–07 and 2010 budgets, the water charge was finally introduced on 1 January 2011 after a draft regulation was passed by the Council of Ministers on 2 December 2010. Quebec was thus late in introducing charges for water use, doubtless because measures of this kind continue to be unpopular. It is hard, especially in a country in which water is abundant and almost free, to make people pay for it in one way or another. However, the fact remains that water management based on drainage basins, which has been a central platform of public water policy in Quebec for some years now, demands that a scale of charges be implemented.

information to users and managers. Thus, the Council wields less influence with local actors than the APEL.[33] Like any other association, it has the right to point out potential incoherencies in municipal policies, but even this capacity is limited by the fact that some of its members (politicians, developers) represent municipalities.

Furthermore, the City of Quebec is unwilling to delegate competences to the drainage basin body since, internally, the municipal unions are strongly opposed to it: water management is the responsibility of the city government. This means that the Council can neither act as contractor, nor as delegate contractor, even if it disposed of the necessary human, material, and financial resources. Neither does the Council make any substantial contribution to the development of urban planning tools. Consultations with local people and users (in terms of information meetings) have been organized by the municipality rather than the Drainage Basin Council. Furthermore, a number of questions need to be answered: What kind of participation should be encouraged? Who should organize it? How can local people, concerned about depreciation in the value of their properties or an attack on their property rights, be reassured?

In 2008, the Federation of Canadian Municipalities (FCM) awarded a prize to Quebec City (sewage). Quebec should nevertheless develop indicators relating to the rehabilitation program of the St Charles River. There is a clear gap in terms of evaluation. What expertise does it develop? Should it be limited to ecological indicators or should it experiment with economic and social indicators? In coming years, the City of Quebec must also 'finish the job' by recommending that wastewater must not be discharged into the tributaries of the St Charles River (the de Lorette, for example). Should untreated effluents be discharged, indicators of water quality in the St Charles will always be bad.

In the City of Quebec, the inability of poorly funded water associations to play the role of contractor in the development and management of water courses means that they wield little influence on local politicians and urban developers, some of whom do not even know that they exist. In other words, the local governance of water as gradually implemented since the turn of the millennium has had little influence on better established and politically more legitimate municipal executives.

Beyond Quebec too, municipalities rather than the actors of the water sector are responsible for urban river renaturation projects. How should they be encouraged to develop urban projects which are more integrated with their environment (short-term), as well as a form of territorial planning which makes it possible to fight more

[33] The APEL notably contributed to the adoption, on 8 November 2010, of *Interim Control Measure to limit human intervention in the drainage basins of the water supply points of Quebec City installed in the Saint-Charles River and the Montmorency River*. This shows that the theme of the preservation of water as a resource is now a matter of concern to the city government. Although the objective of the Interim Control Measure is not to put an end to new housing developments, it does impose precise technical and architectural parameters in terms of sanitation with a view to affording a higher level of protection to water supply points in the Quebec City region. Does this suggest that the municipal policy is now favouring a more integrated approach to water management? Will it provide a genuine articulation between planning instruments used in the water sector and town planning policy?

effectively against urban sprawl while respecting the principle of ecological continuity (long-term)? The question is not a marginal one, since the urbanization of strategic sectors (flood risk zones, drinking water catchment areas, etc.) may have the effect of reducing the current emphasis on renaturation programs.

Lastly, since it is difficult to do more than simply diversify urban rivers (the *compromise* scenario presented in Sect. 2), perhaps more emphasis should be placed on rural milieus in which more ambitious projects are possible. But, then again, perhaps not. As interviews with architects, urbanists, municipalities, developers, etc. working within the framework of the IDEAUX programme suggest, the success of renaturation projects focusing on urban rivers may encourage municipalities to take a systematic attitude towards such approaches and optimize urban water management by developing projects combining water and territory to a greater degree.

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