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Turning brownfields into green space in the City of Toronto

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Abstract

Since the mid-1980s, policy makers and planners in North America and Europe have been paying significantly more attention to measures designed to foster sustainable development and improve the quality of life in urban areas. One issue that has received widespread political support has been the cleanup and redevelopment of under-utilized brownfield sites in urban areas. In Canada and the US, the focus of policy-making and redevelopment efforts has been on redeveloping brownfield sites for industrial, commercial, or residential uses that provide economic benefits through tax revenues and/or jobs. However, there has been a growing recognition among community groups and environmental organizations that brownfields hold enormous potential for "greening" city environments, through the implementation of parks, playgrounds, trails, greenways, and other open spaces. The objectives of the current research are to examine the issues, obstacles and processes involved in remediating potentially contaminated urban brownfield sites and converting them into green spaces, to identify the benefits that these green spaces can bring to the community and culture, and to understand the specific planning processes that it involves. Data for this study were collected through a review of 10 pertinent "greening" case studies and personal interviews with relevant stakeholders. Toronto's brownfield-to-green space redevelopment experience has implications for cities across North America undergoing brownfield planning and seeking to enhance urban quality of life.

Keywords: Brownfields; Green space; Urban environment; Planning

1. Introduction

Since the mid-1980s, policy makers and planners in North America and Europe have been paying significantly more attention to measures designed to foster sustainable development and improve the quality of life in urban areas. Of these, one that has gained widespread political support in the US and Canada is the redevelopment of under-utilized brownfield sites, which are often located in the core sections of urban areas and, as such, are prime targets for urban revitalization. Governments at all levels have, in fact, started implementing a wide range of innovative policies intended to lessen the costs and risks associated with brownfield redevelopment, so as to make it attractive and feasible. Such policies have led to a kind of "inner city recovery," as thousands of sites have been cleaned up and redeveloped. But, while many communities have started to realize the economic opportunities that derive from recycling brownfields into productive industrial, commercial and residential properties, few have taken full advantage of the potentially enormous social, environmental and economic opportunities that can accrue from using these sites to enhance a city's green space and overall green infrastructure.

In Europe, the greening movement has been playing a much more central role in the design of sustainable communities than it has in North America. For instance, between 1988 and 1993, over 19% of

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brownfield (derelict) sites in Britain were converted into green spaces—more than any other end-use (UK DETR, 1998). In North America, on the other hand, the focus has been put instead on the economic benefits that can be attained through public-sector support of private-sector redevelopment for industrial, commercial, and residential purposes (United States Conference of Mayors, 2000). However, there is a growing awareness in the US and Canada among many community groups and environmental organizations that the public sector should also be undertaking or at least supporting the greening of brownfields because it holds potentially enormous benefits of all kinds.

One city that has been particularly proactive in converting brownfields into green spaces over the last decade is Toronto, Canada. The Planning and Parks Departments of that city have focused on enhancing the green space inventory and overall quality of urban life in the city (Toronto Planning, 2000). On the basis of the results produced by this particular "greening experience," the main objective of the present paper is to discuss the implications that it may entail for brownfield redevelopment in comparable urban areas. To that end, this paper will critically examine:

- the issues, obstacles and processes involved in remediating potentially contaminated urban brownfield sites and converting them into green spaces;
- the kinds of benefits that such greening brings about;
- the types of planning activities that these public-sector driven projects involve.

Using data collected from pertinent case studies, as well as information compiled from personal interviews with relevant stakeholders, the objective of the present examination is to shed light on how brownfield-to-green space projects might be implemented and what role they could foreseeably play in improving environmental quality and revitalizing cities.

2. Brownfield redevelopment and green space management in Toronto

The City of Toronto is Canada's largest urban area. In 1998, it restructured its local government, merging seven previous municipalities (the former "City of Toronto, " North York, Etobicoke, Scarborough, York, East York, and Metro Toronto) into a mega city of over 2.4 million people, which is, in turn, surrounded by four regional municipalities (Durham, Halton, Peel, and York) adding 2.3 million people to the Greater Toronto Area (GTA). The former City of Toronto, where most of the brownfield-to-green space projects are currently located, has a population of over 650,000 (=14% of the GTA) spread over an area of 97 km^2.

The most widely accepted definition of brownfields is the one provided by the US EPA (1997, p. 1), which defines them as "abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination." The term is used to refer to both *known* contaminated sites and those only *suspected* of being so because of previous land-use activities (e.g. waste disposal, manufacturing, service stations, etc.). The problem is an extensive one in Toronto and other industrialized cities because of the gradual, but steady, migration of industries out of the city to peripheral greenfield areas since the mid-1970s that left the urban center with innumerable under-utilized or vacant industrial sites (Gertler, 1995). While much information on the scale of the problem is currently available in the US and Europe, only sporadic data can be found on Canadian cities where, according to some estimates, such as the 1995 one by Benazon (1995, p. 18), as much as 25% of the urban landscape is potentially contaminated as a result of previous industrial activities. However, a survey of such lands prepared for the City of Toronto in 1998 by Hemson Consulting (Hemson Consulting, 1998) found that there are 865 acres (350 ha) of brownfield, which, although substantial, is significantly less than Benazon's 25% estimate.

As with other cities in North America, the reasons given by both public and private-sector stakeholders in Toronto for remediating and redeveloping these sites range considerably. Some of the key benefits pinpointed include reducing development pressure on greenfield sites, decreasing risks to public health and safety, restoring former landscapes, renewing urban cores, counteracting negative social stigmas associated with such sites, restoring the tax base of local government, and increasing the utilization of existing municipal services (De Sousa, 2000, 2001, 2002; Ontario Ministry of the Environment, 1996). Despite such perceivable benefits, it is surprising to note that

the management and redevelopment of brownfield sites in Toronto continues to be envisioned as largely a private-sector responsibility, with provincial and municipal governments playing only regulatory and advisory roles (De Sousa, 2001; Ontario Ministry of the Environment, 1996). Currently, the government of Ontario is in the process of implementing brownfield legislation (*Brownfields Statute Law Amendment Act*, 2001, Bill 56), which contains provisions aimed at reducing the costs and the risks associated with brownfield reuse. However, as with similar US policies, there is no provision in the legislation for encouraging the creation of green space from such lands. It should also be noted that although the regulation of these lands is a provincial responsibility, the City of Toronto and other municipalities in Ontario are responsible for managing their own brownfield sites, but have limited financial resources and political authority to do so.

With regard to green space, the City of Toronto has been described as a "city within a park." With more than 1500 parks (over 8000 ha), Toronto's green space inventory is extensive (City of Toronto, 1999). Over 12% of Toronto's urban area is comprised of green space managed by the City of Toronto and the Toronto Region Conservation Authority, with 71% classified as natural heritage land (valley lands, ravines, woodlots, trails along the waterfront, etc.). This proportion is higher than that for most US cities (=approximately 7.7%, see Harnik, 2000). Historically, Toronto's green space planning and development activities gained momentum back in 1954, when the city was ravaged by Hurricane Hazel. As a consequence, the city started acquiring "flood lands" in an effort to protect its residents from future natural disasters, in addition to enhancing recreational opportunities and protecting the natural environment

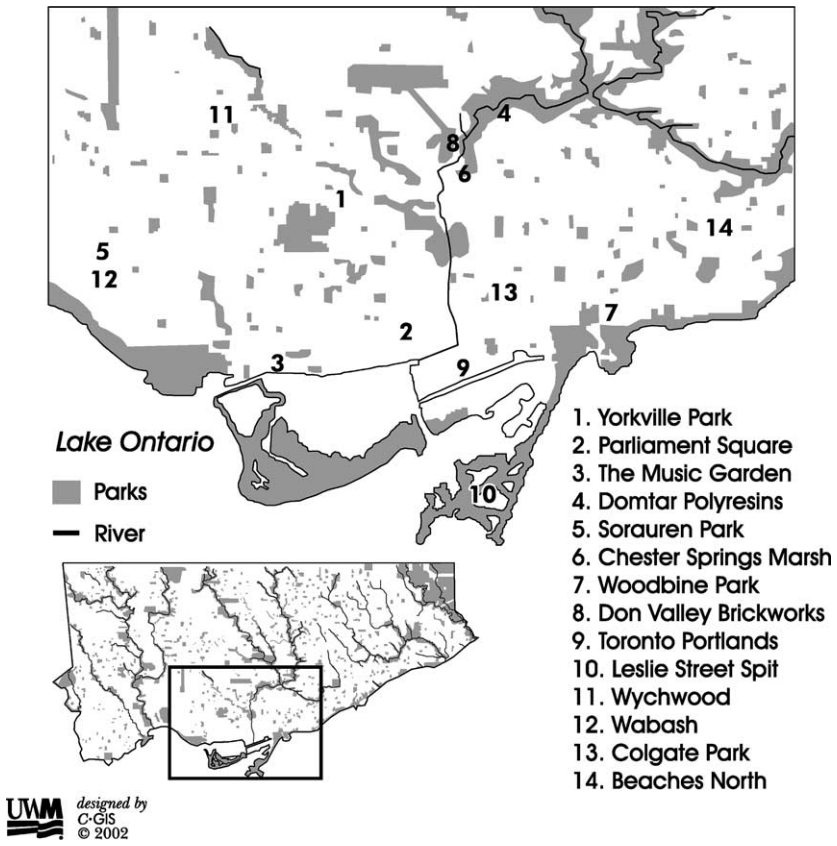

Fig. 1. Green space in Toronto (adapted from City of Toronto, 1999, p. 6).

generally. From an inventory of 67 ha in 1953, green space development spread rapidly, encompassing more than 8000 ha by 1999 (Metropolitan Toronto Planning, 1988; City of Toronto, 1999). Green space is now defined by the city as comprising of four distinct types of land:

- *parkettes*: small parks that offer passive recreational amenities (e.g. sitting areas, walking paths, etc.) for the surrounding neighborhoods;
- *local parks*: small parks that offer a range of passive and active recreational amenities (e.g. sports facilities, biking trails, etc.) for neighborhoods;
- *district/city parks*: large parks that provide passive and active recreational amenities for residents from across the city;
- *natural heritage areas*: green lands that contain historically and aesthetically important environmental features that require conservation and protection.

Despite the amount of available green space, it is not evenly distributed across the city. Most of Toronto's parks are located along the waterfront and ravine valleys, instead of in proximity to older and more populous localities of the inner city, where lands have been developed instead for other uses (see Fig. 1).

3. Schematic overview of the relevant literature

The scientific literature on the redevelopment of brownfields and contaminated lands in the US and Canada has been steadily expanding. To date, however, most of the research has concentrated either on technical aspects of the problem or on the viability of policies for regulating and/or stimulating economic redevelopment activities (Ford et al., 1994; Meyer et al., 1995; Asante-Duah, 1996; Page, 1997; Simons, 1998; De Sousa, 2001). The issue of converting urban brownfields into green spaces has received virtually no attention in the planning and economic development literature, although there has been some attention devoted to the greening of urban areas generally (Garvin and Berens, 1997; Harnik, 2000). The research that does exist on the conversion of brownfields into green spaces comes primarily from the field of landscape architecture (e.g. Hough, 1994; Thompson and Sorvig, 2000; Kirkwood, 2001).

Thus far, research on greening urban areas, including brownfields, has explored both the benefits and barriers associated with greening. Landscape architects tend to focus on the aesthetic and environmental benefits that green space oriented redevelopment can bestow on urban areas, such as improving environmental quality (e.g. air, water, microclimates), restoring natural habitats, enhancing recreational opportunities, and enhancing urban appearance (Hough, 1994; Hough et al., 1997; Thompson and Sorvig, 2000). In addition, recent environmentally focused research has been finding that urban greening improves the social well being of city residents in a variety of ways (e.g. in crime reduction, business enhancement, improved well being, stress reduction, and so on; Fried, 1982; Kaplan, 1993, 2001; Kuo et al., 1998; Cackowski, 1999; American Institute of Architects, 1999; Shafer et al., 2000). Similar findings are also starting to emerge from the research conducted by environmental economists (More et al., 1982; Lerner and Poole, 1999; Tyrvainen, 2001). For instance, Lerner and Poole (1999) found that greening projects in the US tend to reduce costs related to urban sprawl and infrastructure provision; attract investment, raise property values and invigorate local economies; boost tourism; preserve farmland; prevent flood damage; and safeguard environmental quality generally.

Identifying the numerous benefits associated with greening urban areas is essential for countering the numerous barriers, real or perceived, that are often associated with such spaces, including high maintenance costs, safety concerns, poor accessibility, insufficient recreational programming, and poor design (Garvin and Berens, 1997). This is particularly true in the case of urban brownfield sites, which are associated with a host of additional barriers, including health concerns related to soil contamination, costs related to demolition and remediation, negative social perceptions, and pressure from competing land-uses.

The existing literature from both landscape architecture and planning has gone a long way towards identifying the features of successful greening projects and thus suggesting frameworks for their implementation. A recent report by Hough et al. (1997), for instance, puts forward an insightful strategy for enhancing the visual, historical, and environmental quality of Toronto's Port Lands along the waterfront. The researchers profess that a "greening" project should: involve a multi-functional view of redevelopment that takes into account economic, environmental,

biological, recreational, and aesthetic issues; aim to protect and/or restore a healthy and biodiverse environment; create an interconnected infrastructure; and involve communities in the decision-making process. Recent studies sponsored by the Urban Land Institute and the Trust for Public Land assessing the quantity and quality of green space in American cities, offer similar proposals for successful green space development, including (Garvin and Berens, 1997; Harnik, 2000): getting the neighborhood involved in the decision-making; designing with a view towards promoting safety and usability; reviving under-used or unused spaces (parking garages, piers, etc.); programming park-based activities; maintaining public parks; implementing versatile programs for raising funds; using parks to create "a sense of space" in affected communities; and assigning a key role to park-based governmental agencies.

While the existing literature provides useful information on the benefits and strategies for greening urban areas generally, it is limited with respect to many of the practical issues that concern contaminated brownfield sites specifically, especially as they relate to project rationalization, implementation, funding, and management. The present study seeks to shed light on these issues in an attempt to gain a better understanding of why green space is often seen by planners in Toronto as the most worthy end-use for many brownfield sites and of how the barriers to project implementation can be overcome. As such, it will attempt to integrate the traditional economic purview of brownfield redevelopment with the more recent "landscape-oriented" one, as articulated by studies such as those cited above.

4. Methodology

Information and data for the present study were gathered from: (1) brownfield-to-green space projects in the City of Toronto, and (2) personal interviews with 12 primary stakeholders involved in implementing the projects (including five municipal civil servants working for the City of Toronto, three from the Toronto and Region Conservation Authority, and four private-sector and non-profit representatives; see Appendix A). The brownfield-to-green space projects examined in the present study were not selected at random, but rather were chosen to be representative of those that underwent complete development or extensive planning. These were the ones identified by those actively involved in park development in Toronto. Given that the city does not have a formal brownfields inventory, it is impossible to claim that the green space projects examined here represent a complete list of those undertaken during the time frame considered. They are, however, representative.

Overall, 14 brownfield-to-green space projects were identified, 10 of which emerged as particularly relevant to the discussion at hand (see Table 1). A questionnaire with 20 questions was designed to identify and/or establish: (1) the characteristics and history of a site; (2) the planning process involved (objectives, assessment, remediation activities, financing aspects, etc.); (3) the perceived impacts of a project; and (4) purported lessons learned from it (Appendix B). The relevant literature on the projects (e.g. Master Plan documents, project profiles, etc.) was also utilized (City of Toronto, 1998).

5. Results and discussion

5.1. Project characteristics

Overall, the greening projects generated new 614 ha (1520 acres) of green space in Toronto. These ranged in size from just under 0.5 ha (1 acre) to 471 ha (1164 acre). The median size of the projects was 2.7 ha (6.7 acres). Most of the redevelopment projects involved former industrial lands; a few involved former railway corridors and properties contaminated by previous landfilling and waste disposal activities. Most of the larger greening projects involved the redevelopment of sites that were near or within existing parklands (e.g. the waterfront, existing parks, greenway corridors, etc.); the smaller ones, instead, involved the more densely-populated areas of the inner city. Four were redeveloped primarily for ecological restoration purposes, two for local active and passive recreation purposes, two for parkettes, and two for multiple uses to serve local and city residents.

All of the brownfield sites restored to ecological habitat were located adjacent to, or within, greenway and floodplain areas. Each envisaged an extensive re-introduction of native trees, shrubs, wildflowers, and herbaceous plants to enhance the ecological

Table 1
Brownfield-to-green space projects

Site	Status	Size (ha)[a]	Former use	Current/proposed use(s)
Village of Yorkville Park	Opened 1994	0.36 (0.9)	Houses were demolished in the 1950s to make way for a subway line that lies under the site. A parking lot then occupied the site	Upper-scale parkette with "artistic" design theme
Parliament Square	Opened 1995	0.5 (1.25)	Rail corridor situated just south of a former coal gasification plant and north of a former roofing and tar paper dipping facility	Active and passive recreation space
The Music Garden	Opened 1999	0.8 (2)	Industrial area with uses ranging from machine shops to warehouses and ship building	Upper-scale parkette with a waterfront garden named with classical music terms
Domtar Polyresins	Opened 2000	2.2 (5.5)	Facility for testing and manufacturing of polyresins	Ecological habitat
Sorauren Park	Opened 1995	2.3 (5.8)	Industrial uses including an armaments-manufacturing facility and a transit maintenance and garage establishment	Active recreation, ecological habitat
Chester Springs Marsh	Opened 1996	3 (7.4)	Ravine partially filled with municipal ash, rubbish, and cinders	Reconstructed wetland
Woodbine Park	Opened 2000	12 (30)	Racetrack and stables, contaminated by incinerator ash and leaking underground storage tanks	Ecological habitat, active and passive recreation space (includes amphitheater)
Don Valley Brickworks	Opened 1997	16.6 (41)	Brick-manufacturing facility	Ecological habitat
Toronto Port Lands	Ongoing as of 2001	101 (250)[b]	Industrial/commercial/park space containing industrial and petroleum refining industries	Active and passive recreation site and ecological habitat
Leslie Street Spit (Tommy Thomson Park)	Urban wilderness designation in 1989	471 (1164)	"Lakefill" consisting of earth, brick, asphalt, concrete, and rubble; disposal cells storing several hundred thousands cubic meters of dredge spoil	Ecological habitat and passive recreation
Wychwood	Early stages[c]	1.8 (4.5)	Tannery	Not specified as of yet
Wabash	Early stages[c]	0.6 (1.5)	Transit yard	Community center and local park
Colgate Park	Early stages[c]	0.14 (0.35)	Detergent factory	Local park
Beaches North	Early stages[c]	1.5 (3.7)	Industrial area	Local park

[a] The values given in parentheses represent the values in acres.
[b] Green space planned for 25% of port.
[c] Projects in the early stages of planning (not considered in the analysis).

integrity of the wider area. At the Domtar Polyresins site, for instance, a Carolinian forest was re-established, wildflowers, wet meadow and woody species planted, and a natural barrier created to protect the ecologically sensitive climax beech and maple forest connected to the site. The smaller projects aimed at providing both active and passive recreation activities were constructed in mid-density older neighborhoods. Sorauren Park, for example, has tennis courts, a baseball diamond, a small soccer field, a few "habitat" areas, and several grass play spaces surrounded by residential and industrial buildings, some of which are still abandoned (see Fig. 2). The smaller parkette sites were constructed in high-density regions of the city to serve a wide array of residential, commercial and retail users. Both involved elaborate design schemes—Yorkville was designed to simulate Canadian landscapes (i.e. pine grove, prairie, marsh, orchard and rock outcropping), and the Music Garden to represent the six movements of Johan Sebastian Bach's "Suites for Unaccompanied Cello." Lastly, the multiple-use parks are large areas planned to offer a wide range of passive and active uses to both local and city residents. When completed, Woodbine Park, for example, will contain a festival green band shell that can serve 22,000 people, garden gateway entrances, trails, a promenade, 15 acres of native plantings, an ornamental fountain, a children's storybook place, a memorial for the raceway formerly at the site, a storm-water retention pond, and a children's soccer field and playground.

As to the factors motivating these projects, nine of the interviewees identified the conversion of brownfields into ecological habitats as the key factor; of these, five ranked it as the most important, especially for projects involving sites that lay within, or were near, the waterfront or greenway corridors. Eight named the provision of recreational opportunities for under-serviced communities as significant; of these, three ranked it as the most important factor. Five singled out flood protection and storm-water control as a central goal of redevelopment; of these, only one ranked it as the most important. The interviewees also mentioned—in order of decreasing significance—

Fig. 2. Sorauren Park.

wetland rehabilitation, the improvement of the environment, the preservation of historically-significant space, the reduction of urban blight, and economic benefits. Interestingly, many of the interviewees pointed out that economically-based objectives are becoming increasingly important as an argument for justifying redevelopment projects in general.

All of the projects were carried out by the public sector, with the majority of sites redeveloped by the municipal government's Parks Department and each one taking from 3 to 5 years to complete. Other governmental agencies actively involved in planning and development activities included the Toronto and Region Conservation Authority (which concerned itself primarily with projects involving lands within floodplains), the Ontario Ministry of Natural Resources, and the Federal Government (which concerned itself with projects involving waterfront lands). Over half of the sites were already owned by the city or by some other level of government, while the remaining sites were privately owned. The latter were either donated to the city as part of a larger redevelopment deal between the city and the developers; or else they were purchased outright by the city. As several of the government employees interviewed noted, the city is starting to shy away from purchasing expensive sites due to budgetary constraints. They also pointed out that the strong real estate market in the city is making it more difficult and costly to expropriate property.

5.2. Overcoming the barriers to greening brownfields

Predictably, the greening of brownfields has been hindered by a variety of real and perceived costs and risks that scare off many would-be private-sector developers. The interviewees were asked to discuss what factors they perceived as being the key barriers to the greening of brownfield sites. The single most important factor mentioned by virtually all of the interviewees was the lack of financial resources for planning, coordinating and undertaking remediation and redevelopment. The second most-mentioned factor was the perception that the economic benefits of such projects (and in some cases its environmental benefits, as well) were debatable at best. Other factors mentioned in order of importance were: a lack of knowledge on the impacts of soil contamination on human health and the environment and of the appropriate scientific methods for dealing with such contamination; a lack of government leadership and poor coordination among governmental agencies; a lack of similar greening models to replicate; and the existence of a mistrust between public and private-sector stakeholders.

The factor that makes urban brownfield redevelopment particularly challenging involves the costs and risks associated with managing contamination problems. As mentioned above, the projects in question were contaminated primarily because of former industrial and landfilling activities on the sites. Sites affected by landfilling were generally less contaminated and costly to cleanup than were those that had industrial uses on them. Overall, the average cost of site assessment and remediation was approximately CDN$ 430,000 per project, or CDN$ 200,000 ha^{-1} (CDN$ 80,000 per acre, excluding the Leslie Street Spit and the Port Lands).

As in the case of more and more private-sector redevelopment efforts, a site-specific risk assessment (SSRA) approach was employed to establish cleanup levels for most of the properties examined because it typically yields the lowest cleanup cost estimates (see Table 2). Under this commonly used approach, cleanup levels for contaminants in the soil are not based on generic criteria set by governmental regulations for different land uses (i.e. residential/park, commercial, industrial), but on criteria established for a specific site or for a level of exposure protection based on risk (typically human risk). Those assessing the site, therefore, can take into account the usage characteristics of different types of green space in estimating cleanup levels (e.g. the risks at an ecological habitat site versus a neighborhood park). At Woodbine Park, for instance, the cleanup criteria for the site were based on the likely exposure of a 5-year-old child to contaminants—to be extra prudent, it was assumed that the exposure levels of the child would not change considerably in adulthood.

In selecting remediation strategies, the interviewees insisted on options that were safe, cost effective, and allowed contaminants to be managed on site as much as possible. These included so-called "capping" (four sites), monitoring/isolation (two sites), innovative technology (two sites), and off-site "dig-and-dump" disposal (two sites). The most common method used was the utilization of soil, concrete or other materials to cover ("cap") contaminants in situ. This approach

Table 2
Contamination and remediation

Site	Contaminants	Approach
Village of Yorkville Park	Metals, oils, lubricants	Dig-and-dump (removal and disposal of 800 m^3 of contaminated fill at an appropriate facility) 800 m^3 of contaminated fill removed
Parliament Square	Heavy metals, coal tar, polyaromatic hydrocarbons (PAHs)	SSRA Composite geo-membrane/clean soil cap (on top of contaminated soil)
Spadina Gardens/ The Music Garden	Heavy metals, PAHs	SSRA Contaminated soil used as roadbed Integrated landscape surfacing/clean soil cap
Domtar Polyresins	Ethyl benzene, toluene, styrene, PAHs	SSRA Innovative bioremediation approach
Sorauren Park	Heavy metals, hydrocarbons, chlorinated solvents	SSRA Concrete slab preserved to cap contaminants/integrated landscape and clean soil cap
Chester Springs Marsh	Cinder, rubble, heavy metals	SSRA Monitoring of heavy metals is ongoing
Woodbine Park	Heavy metals, hydrocarbons	SSRA Removal of coal and clinker ash Bio-pad treatment of hydrocarbons X-ray fluorescent technology for soil testing and treatment 500,000 m^3 of engineered fill brought to the entire site Demolition of buildings and parking lot
Don Valley Brickworks	Heavy metals, asbestos, PAHs	Site filled with clean soil in anticipation of a residential redevelopment project PAH area has been isolated
Toronto Port Lands	Contaminants and heavy metals	Ongoing
Leslie Street Spit	Heavy metals, PCBs	Clean fill/wetland cap

turned out to be very cost effective and, in many cases, was creatively integrated with park design (i.e. in the location of berms, parking areas, roads, tennis courts, etc.). To mention two cases in-point, capping techniques reduced initial cleanup cost estimates for Sorauren Park and Parliament Square by 90%, leading to the decision to realize the park projects. At two other sites, contaminants were deemed to pose minimal risk and, thus, were left on site, with the proviso that they undergo monitoring. In two other cases, contaminated soils were removed and hauled away to a landfill site. Innovative technologies were also employed at two sites where cleanup posed a particularly challenging engineering problem. An experimental bioremediation technique—funded partly by the developers of the new technology together with the Federal Government—was employed at the Domtar Polyresins site to deal with the high contamination levels at the site. At Woodbine Park, bio-pad treatment was used to treat petroleum contamination, and a new X-ray fluorescent technology was used to reduce the amount of non-contaminated fill being removed from the site by carefully identifying only the contaminated soils that required treatment (still, over 500,000 m^3 of engineered fill had to be brought in to raise the site to grade). Interestingly, remediation at the Woodbine Park site was carried out by the developer of an adjacent residential project. This made cleanup more cost effective for the city and, according to the developer, sped up the greening process so that the site would act as an aesthetic benefit for their project, as opposed to an unsightly liability (see Figs. 3 and 4).

In addition to the costs associated with contamination, one of the problems with converting brownfields

Fig. 3. Woodbine Park and the Beach Residential Projects, 1999.

into green spaces is the fear that children and wildlife will be exposed to residual contamination. As the interviewees stated, this concern was raised at several sites; but most residents were nonetheless reassured by the fact that the remediation measures were adequate. This is typically not the case for other types of brownfield redevelopment projects, which are often plagued by public suspicion and mistrust regarding exposure levels to contamination. Several possible explanations for this difference according to those interviewed include: (1) the fact that exposure is considered to be minimal because people only spend a short amount of time there; (2) the fact that the sites would be cleaner than they were before; and (3) the fact that natural processes might actually contribute, over time, to the cleanup of the site. In general, the public also seemed to have faith in the public sector's ability to carry out and/or oversee appropriate remediation.

In addition to site assessment and remediation costs, funding the planning and implementation of these urban greening projects also represents a major challenge. Indeed, the average capital cost for the projects examined was CDN$ 1.8 million ha^{-1} (CDN$ 660,000 per acre) and the median cost was CDN$ 580,000 ha^{-1} (CDN$ 211,000 per acre; see Table 3). The discrepancy between the two statistical measures is due to the high construction costs connected to two specific upper-scale urban parkette projects: namely, the Yorkville and Music Garden ones. On average, capital costs represented approximately 75% of total project costs, and site assessment/cleanup the remaining 25%.

Needless to say, most green space projects are designed to serve the general public and thus do not generate private revenue. Consequently, the public sector typically assumed 90–100% of costs for the projects examined. Only in the case of the Music Garden, a project strongly promoted by internationally-renowned cellist Yo-Yo Ma and local philanthropist James Flick, did private funding exceed public funding

Fig. 4. Woodbine Park and the Beach Residential Projects, 2001.

(see Fig. 5). Neighborhood parks built for recreation purposes were paid for by the City of Toronto, while many of the larger parks were sponsored by various levels of government. To deal with the cost issues, project managers and other interested parties sought out funds from a wide variety of organizations for different aspects of a project (site assessment, design, construction, etc.). At Chester Springs Marsh, for instance, site acquisition was sponsored by public funds, site assessment by private funds, and design and implementation by public funds provided by five different agencies from the three levels of government. Plantings, maintenance, monitoring, and education activities are currently funded by the city, the Conservation Authority, and various private sources. According to most of the interviewees, attracting a multiplicity of funding partners is becoming increasingly necessary for bringing such projects to fruition and maintaining them over the long term.

In general, the City of Toronto generates funds for green space projects from development activities. A construction project is required by law to: apportion 5% of its site to the city or pay the city a 5% tax on construction costs, or else to provide a combination of both. Fortunately, an extensive amount of brownfield redevelopment has taken place in Toronto over the last half decade, especially in the area of residential redevelopment, which has helped generate funds and justify the need for additional green space.

In addition to the direct costs and risks described above, the interview sessions revealed that another key barrier to implementing greening projects is the perception that the economic benefits ensuing from them (and in some cases the environmental benefits as well) are doubtful. This view seems particularly common when there is pressure to redevelop a brownfield for some other type of use. To help justify the merit of these projects, to overcome cost and risk barriers, and to bring disparate stakeholders together, the interviewees pointed to the central role that was played by local communities and, in some cases, their political representatives. Unlike most private-sector

Table 3
Projects costs and funding

Site	Remediation costs	Capital costs (CDN$)	Funding sources
Village of Yorkville Park	CDN$ 65,000	3,000,000	City of Toronto
Parliament Square	CDN$ 200,000	520,000	City of Toronto
The Music Garden	Undisclosed	2,500,000	City of Toronto (CDN$ 1 million) Private fundraising (CDN$ 1.5 million)
Domtar Polyresins	CDN$ 1,330,000	1,630,000	Remediation paid for by: Conservation Authority, provincial government, private cleanup firm (with federal funding); park development paid for by the city
Sorauren Park	CDN$ 300,000	600,000	City of Toronto
Chester Springs Marsh	CDN$ 40,000 (for site assessment and related costs)	440,000	Federal Government (30%) Provincial government (30%) City (29%) Conservation Authority (1%) Private sources (10%)
Woodbine Park	CDN$ 3,000,000 (for park site preparation; approximately 1/3 for remediation)	5,000,000	City of Toronto
Don Valley Brickworks	Master Plan estimated that CDN$ 80,000 will be needed for environmental assessment reporting	5,000,000	TRCA (45%) City of Toronto (45%) Private (10%)
Toronto Port Lands	SSRA will probably reach CDN$ 13.75 million (25% of the CDN$ 55,000,000 estimated for entire site)	Estimated 5–6 billion (for the entire project)	Unknown
Leslie Street Spit	Undisclosed	Undisclosed	All levels of government

driven brownfield redevelopment projects, decisions at every stage of the project, from acquisition to post-construction management, were strongly influenced by public pressure.

Support for ecological restoration projects typically came from established community-based environmental groups, such as the Task Force to Bring Back the Don (river); while support for green space in under-serviced neighborhoods typically came from smaller, ad-hoc groups that were united by a community leader (or leaders). As a consequence, a variety of opportunities and frameworks for public consultation and involvement emerged during the planning and redevelopment process, including meetings, work groups, committees, site visitations and "educational tours." In addition, community advocates pushed for a park design that would be conducive to public participation in the site's long-term management and maintenance (e.g. planting events, walking tours, educational programs, monitoring of habitat, coordination of cleanup activities, etc.). One of the downsides of this extensive community involvement at many sites, however, was the emergence of a debate over what type of green space was to be implemented. At Woodbine Park, for instance, several groups pressured the city to turn the site into an ecological habitat, while others lobbied for soccer fields, baseball diamonds, a marina and other recreational uses.

In sum, when asked what facets of a project played a central role in facilitating its implementation, most interviewees pointed to the importance of community and political involvement (see Table 4 for a

Fig. 5. The Music Garden.

Table 4
Factors facilitating the conversion of brownfield-to-green spaces

Factors facilitating development	Frequency
Community involvement and collaboration	8
Political leadership	5
Government funding	4
Private funding and partnership	4
Brownfield location (near floodplain or greenway)	2
SSRA and environmental technology made remediation feasible	2

breakdown). As mentioned, the role of the communities, whether through environmental groups, ad-hoc associations, or residents rallying behind a local politician, emerged as crucial in all aspects and phases of the projects. The availability of public and private funds was considered next in level of importance. Local government dollars were clearly central to most projects, given that they constituted the bulk of the funds. However, public funds from other levels of government and private sources were important for several projects, especially the ecological habitat ones where other government bodies supported site assessment, remediation, and various other kinds of costs. Private funds for these projects were also identified as important as a sign of community support—as in the case of the Music Garden and the Chester Springs Marsh (where an environmental group got the project moving by paying for the initial site assessment). The location of a site was also singled out as extremely important, especially in areas where the project would likely enhance an existing greenway or would provide parks for under-serviced communities in the inner city. Lastly, the ability to reduce project costs through an appropriate technology or risk assessment procedure was also perceived as highly important.

5.3. The benefits of turning brownfields green

When asked what kinds of benefits ensued from the greening projects discussed above, nine of the interviewees identified the creation of new ecological

Table 5
Project benefits

Key project benefits	Frequency
Creation/expansion of ecological habitat spaces	9
Public and community collaboration and involvement	7
Increasing areas for public recreation and use	6
The projects could be used as an overarching model for future brownfield redevelopment	6
Education	6
Flood control	3
Environmental renewal (e.g. soil and groundwater quality)	3
Economic stimulation	3
Improvement of neighborhood "aesthetics"	2
Identifying what underlies the sense of community in urban areas	2
Testing and promoting remediation technology	2
Preservation of historically-significant sites	2

habitats as a primary one (see Table 5 for a breakdown). Seven claimed that the context of collaboration created among disparate groups—from community groups to governmental agencies—was another primary benefit. Six pointed out that the provision of recreational places and the opportunity for educating central city residents about restoration and habitat were also among the main benefits. Other benefits mentioned included flood control, environmental renewal, economic stimulation, improvement of neighborhood aesthetics, enhancement of the sense of community and place, and preservation of historically-significant buildings and/or landscapes.

The creation of new ecological habitats was considered particularly important for those sites constructed to enhance the biodiversity potential of existing greenway corridors. Notably, the city and local community groups continue to monitor the ecological outcome of those brownfield projects. The Chester Springs Marsh Monitoring Program (Task Force to Bring Back the Don, 2000, Part 2), for instance, established an environmental audit of the site through a combination of professional and community-based monitoring techniques that check for biological responses to the restoration project over time (re-colonization and natural succession). So far, a considerable increase in the number and diversity of plant, bird, mammal, amphibian and insect species has been documented. In addition to the creation of habitat, the extensive use of interpretive signs at these sites has been seen to help educate the public about the viability and importance of habitat in urban areas.

Notably, most of the other key benefits identified were "human-oriented," i.e. they were seen as motivating stakeholder collaboration and involvement, providing more recreational spaces, offering models for future redevelopment and enhanced educational opportunities, etc. Although it was not initially considered as a primary goal of these projects, many stakeholders praised the social networks that emerged and the long-term interaction that was evidenced (often leading to new greening projects). Even the private developer pointed out that initial apprehensions quickly dissolved as site development progressed. Stakeholder interaction and capacity building are perceived as central to the process of building so-called social capital, which is becoming an increasingly sought after objective of community economic development (CED) initiatives. Indeed, as Armstrong et al. (2002, p. 465) point out, "in the event of CED initiatives failing to create traditional economic benefits via community linkage (such as permanent jobs), it is likely that proponents will argue that the creation of social capital will have been worthwhile in its own right."

The development of brownfields to enhance alternative types of green space in the central city is also viewed as important for achieving parkland objectives, both in terms of the number of such sites and their accessibility. Another noteworthy offshoot benefit is that greening projects act as "flagship" or "marquee" demonstration "experiments" that serve as models for future greening endeavors—something that many interviewees pointed out was initially lacking to support the projects. As one interviewee put it: "these projects advertise the potential that greening has to heal brownfields and improve inner-city communities." Overall, it is obvious that the success of these projects has made park planners and other stakeholders more confident in pursuing, supporting and acquiring other brownfield sites throughout the city for greening purposes, even if, as one interviewee put it: "this may involve having to wrangle over such sites with those who see them as having other uses."

As for social benefits, several of the interviewees commented on the marked improvement in neighborhood aesthetics resulting from the removal of abandoned industrial buildings. A few others identified the flood-control infrastructure benefits that such

Fig. 6. The Brickworks.

projects brought about. Some projects also provided new technological opportunities. The Domtar Polyresins and the Woodbine Park projects, for example, involved the use of innovative remediation technologies that have since been used in other brownfield redevelopment projects within the city. Lastly, projects such as the Brickworks one have been able to preserve historic buildings, landscapes and geological features that add character to their neighborhoods and preserve the history of the city's urban environment (see Fig. 6).

6. Concluding remarks

The Toronto "greening experience" makes it obvious that the redevelopment of brownfield sites constitutes a valuable opportunity for increasing green spaces in urban areas and, thus, bringing about benefits such as soil quality improvement, habitat creation, recreational opportunity enhancement, economic revitalization of neighborhoods, and so on. Such redevelopment, however, requires extensive public-sector involvement and is not inexpensive or easy to carry out. As the Toronto experience demonstrates, it requires a concerted effort among people from various domains in the social landscape of the city (from planners to community representatives). The obvious implications that the Toronto experience holds for similar jurisdictions in North America can be listed as follows:

- The involvement of communities in the whole redevelopment process is crucial, in both the short and long term.
- Green space and brownfield inventories need to be established and used in tandem to identify where greening opportunities exist.
- Potential funding sources must be identified and/or created through the involvement of public and private interest groups.
- Municipal departments involved in the administration of parklands should be consulted and involved directly in all greening projects.
- Greening projects should be encouraged because they tend to revitalize "blighted" neighborhoods,

with an eye toward enhancing their economic and social appeal.
- An appropriate risk assessment method that integrates elements of landscape design with available site remediation technology should be used, since this will enhance the feasibility of greening projects.
- Greening projects present greater challenges than other forms of redevelopment in justifying end-use and project funding, but are more easily accepted by affected communities.
- Funding for all stages of the conversion process, as well as for long-term maintenance of the green spaces, must be actively sought from both the private and public sectors.

Needless to say, more data must be collected from similar greening experiences in order to validate the findings of the present study and, thus, to support the applicability of the above "lessons from the field." Without taking greening into account, it is unlikely that the process of "inner city recovery" will become permanent in most major cities. In a phrase, the "greening of brownfields" in the redevelopment schemes of urban centers throughout North America should be given a high priority in the policy, planning and community economic development process, if the quality of life within these centers is to be maintained or improved.

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Appendix A. Interviewees/survey respondents

A.1. Interviewees

- Adele Freeman, Watershed Specialist, Toronto & Region Conservation Authority;
- Thomas Albani, Project Manager, Metrus Development Inc.;
- Beth Benson, Director, Waterfront Regeneration Trust;
- Beth Cragg, Natural Environment Specialist, City of Toronto, Parks & Recreation, Economic Development, Culture & Tourism;
- David Stonehouse, Planner, City of Toronto, City Planning, Urban Development Services;
- David O'Hara, Parks & Recreation Planner, City of Toronto, Policy & Development, Economic Development, Culture & Tourism;
- Moranne Hagey, Engineering Technician, Toronto & Region Conservation Authority;
- Nick Siccione, Manager, Environmental Services, Toronto & Region Conservation Authority;
- Melanie Hare, Planner, Urban Strategies;
- Garth Armor, Natural Environment Coordinator, City of Toronto, Parks & Recreation, Economic Development, Culture & Tourism;
- Murray Boyce, Private Consultant;
- Leslie Coates, Special Projects Coordinator, City of Toronto, Parks & Recreation, Economic Development, Culture & Tourism.

A.2. Additional information providers

- Tim Park, Supervisor, Land Acquisition & Development Applications, City of Toronto, Policy & Development, Economic Development, Culture & Tourism;
- Bob Duguid, Landscape Architect, City of Toronto, Policy & Development, Economic Development, Culture & Tourism.

Appendix B. Interview questions

Site name:
Location:
Size:

1. The history of the brownfield site being examined:
   (a) How did this site become a brownfield and why was it targeted for reuse?
2. The planning process, including:
   (a) Project administration:
      (i) What organizations were responsible for planning and administering the project? Describe their roles and responsibilities.
      (ii) Please describe the project timeline.
      (iii) Who will be responsible for managing the project over the long term?

(b) Project objectives and goals:
  (i) What factors (economic, environmental, social) motivated you to undertake the project? (Rank them from the most important to the least important.)
(c) Assessment and remediation activities:
  (i) What contaminants were found at the site?
  (ii) How were they remediated?
  (iii) Were there any concerns expressed by the community regarding the development of this park on a brownfield site?
(d) Community involvement:
  (i) Describe the role of the local community in planning and implementing the project.
  (ii) Was there any conflict over how the land was to be used?
(e) Project funding (cost, funding sources):
  (i) How was the project funded?
  (ii) To what extent were cleanup and redevelopment activities funded by the government and/or by the private sector? Why?

3. Project impacts (e.g. neighborhood revitalization, increased real estate value, economic benefits, environmental quality benefits, etc.):
  (i) What benefits do you think resulted from remediating and redeveloping this brownfield site into green space? Describe and rank in order of importance.
4. Lessons learned:
  (i) What mechanisms would help promote and facilitate future redevelopment projects (e.g. public/private partnerships, community fund raising and involvement, federal support)?
  (ii) What do you perceive as the main factors limiting the implementation of brownfield-to-green space projects in your jurisdiction? Please rank them in order of importance. How can these be overcome?

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