A Preliminary Investigation
into the Economic Impact
of Brownfield Redevelopment Activities in Canada

Final Report
Prepared for:
The National Round Table on the Environment and the Economy

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Declaration:
This report was commissioned by the National Round Table on the Environment and the Economy (NRTEE) and it remains the property of the NRTEE.

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Note to reader: In this report, dollar amounts referenced are in U.S. dollars for U.S. examples and Canadian dollars for Canadian examples.

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Executive Summary

In support of its mandate to develop a National Brownfield Strategy, the National Round Table on the Environment and the Economy (NRTEE) commissioned this study into the potential benefits of brownfield redevelopment activities locally, regionally and nationally. To meet the needs of the NRTEE as expressed through their terms of reference, Regional Analytics identified five core research questions, and these are addressed in turn, with a summary of findings for each, in what follows below.

Core Question 1: Brownfields vs. Greenfields

A study comparing greenfield and brownfield development in a sample of U.S. cities provided empirical evidence to show that for every acre of brownfield land redeveloped, a minimum of 4.5 acres of greenfield land would be required to accommodate the same development. Numerous studies cite the potential for brownfield redevelopment to reduce urban sprawl and promote real smart growth.

The literature review and data from the City of Hamilton support the conclusion that there exists a serious “market mismatch” between greenfield and brownfield sites, making it significantly more expensive to develop a brownfield site. In the City of Hamilton, the costs of developing a moderately contaminated 2 acre brownfield site for industrial/commercial re-use can be between 14% and 34% more expensive than the same development on a 2 acre greenfield site. Therefore, if brownfield redevelopment is to take place in any significant way in Canada, these results point to the need for government intervention into the market to “level the financial playing field” between greenfield and brownfield development. This can be accomplished by policies that either increase the costs of greenfield development, decrease the costs of brownfield redevelopment, or both. This study contemplates only the use of financial incentives designed to decrease the costs of brownfield redevelopment.

The literature review and case studies also showed that a myriad of economic, social and environmental benefits flow from redeveloping brownfields, that do not necessarily result from greenfield development. These include: a reduction in urban sprawl and associated costs, such as the extension of infrastructure, traffic congestion and air pollution, as well as the revitalization of neighbourhoods, employment areas and urban cores, and an increase in community pride.

Clearly, when considered as a whole, the anecdotal and empirical evidence to suggest that brownfields should be redeveloped instead of greenfields is overwhelming.
Core Question 2: What Are the Key Impediments to Brownfield Redevelopment?

In a 2000 survey of 232 U.S. cities (U.S. Conference of Mayors), the lack of funds to clean up sites was cited as the number one impediment to brownfield redevelopment, finishing ahead of liability issues, which was the second most often cited impediment. The need for environmental assessments, demolition monies, environmental regulations and market conditions were also cited as significant impediments to brownfield redevelopment, but the lack of cleanup funds was the single most important impediment to brownfield redevelopment. Another study (ICF Consulting and E.P. Systems Group, 1999) concluded that liability issues were more important than the lack of funding for brownfields. While there is no clear consensus on this issue in the literature, it is clear that both the lack of funding for environmental assessments and cleanups and liability issues are considered to be the key impediments to brownfield redevelopment.

Core Question 3: What Are the Economic, Environmental and Social Benefits of Brownfield Redevelopment?

Numerous studies of brownfield redevelopment and the case studies examined here show that brownfield redevelopment produces significant economic benefits at all geographic scales (local, provincial, and national), regardless of size of project or type of re-use. These benefits include job creation, increased incomes and property taxes at the local level, and increased income and sales taxes at the provincial and federal levels.

An Input-Output analysis of the brownfield redevelopment cluster nationally revealed that every $1 spent on brownfield redevelopment in the Canadian economy generates an additional $3.80 in output of all industries Canada-wide (including direct, indirect and induced effects). This is a very high output multiplier, and is indicative of an industry that has a high degree of backward and forward linkage with the rest of the economy. Therefore, government investment in promoting brownfield redevelopment could potentially have a greater stimulatory effect on the Canadian economy than investment in other sectors of the economy. The potential of this cluster to generate benefits Canada-wide is underscored by the finding that every dollar of brownfield redevelopment activity generates nearly 22 cents in federal personal direct and indirect tax revenue.

The significant economic benefits of brownfield redevelopment are only one part of a three part story. The literature review and case studies clearly tell the other two parts of the story, i.e., the numerous environmental and social benefits of brownfield redevelopment. These include:

- neighbourhood, employment area and urban core revitalization
- reduction in urban sprawl and associated air quality problems (e.g. smog, greenhouse gas emissions)
- provision of affordable housing opportunities
- increased downtown population and housing opportunities
• improved aesthetic quality of the urban fabric
• creation of parkland and public open spaces
• improved public waterfront access
• elimination of significant environmental hazards
• protection of groundwater resources
• protection of wetlands and wildlife habitat
• protection and improvement of public health
• accessible and open community participation
• increased sense of civic and community pride

The environmental and social benefits of brownfield redevelopment should not be underestimated, nor should the strength of the relationships between the different types of benefits.

One conclusion that flows quite naturally from the analysis reported within is that brownfield redevelopment generates myriad economic, environmental and social benefits at all spatial scales in Canada.

**Core Question 4: What Financial Instruments Are Available to Promote Brownfield Redevelopment?**

Currently few financial instruments are being used in Canada to promote brownfield redevelopment. The Province of Ontario recently passed legislation establishing a form of tax freeze/cancellation to support brownfield cleanup, but there is no experience with this program as of yet. The Province of Quebec introduced the Revi-Sols Program in 1998 to promote brownfield cleanup and redevelopment. The program provides grants for the costs of environmental assessments and remediation work. The Revi-Sols program has been very successful in promoting brownfield redevelopment. In less than 5 years, the Revi-Sols program has funded the cleanup and redevelopment of some 140 projects in the Province of Quebec.

The U.S. federal government offers financial incentives to promote brownfield redevelopment. This includes programs such as demonstration pilot grants and revolving loan funds under the EPA, and the brownfield economic development initiative (BEDI) under HUD. These programs are targeted directly at brownfield redevelopment. Other U.S. federal government programs that are general economic and community development programs have also been used by U.S. cities and states to undertake brownfield redevelopment projects.

In 1997, the U.S. federal government introduced the Taxpayer Relief Act (TRA) which included a tax incentive that allows environmental cleanup costs to be fully deducted from income in the year they are incurred. But, the TRA incentive has not been widely used because of cumbersome procedural requirements as well as the amount of work required to obtain the credit.
The U.S. EPA provides three types of financial incentives.

1) Demonstration Pilot Grants of up to $200,000 each awarded to states, cities, towns, counties and tribes to conduct environmental assessment related activities and develop remediation and redevelopment plans;

2) Cleanup Revolving Loan Funds of up to $500,000 ($1,000,000 under the new Small Business Liability Relief and Brownfields Revitalization Act) awarded to states, cities, towns, counties and tribes to provide low-interest loans to carry out cleanup activities at brownfield sites; and,

3) Job Training Pilot Grants of up to $200,000 each to provide job training for residents of communities affected by brownfields.

U.S. federal programs focus heavily on providing site assessment and cleanup funding, targeted to state and local governments. Few of these programs are applicable directly to the private sector. In essence, the states and local governments have become “partners” in the delivery of federal programs. This approach has both been criticized as an inefficient and indirect means of providing funding, and on other hand, praised as a system that promotes greater accountability and flexibility to meet specific local community needs. Criticisms of the federal brownfield incentives in the U.S. found in the literature did not focus on the partnership delivery model. Instead, factors such as the special knowledge required to understand and access each program, the amount of work required to secure what can amount to an insignificant incentive, poor applicability and lack of program flexibility were cited as key deficiencies of U.S. federal programs.

The literature review suggested that an absence of site-specific environmental information significantly inhibited brownfield redevelopment. While the costs of these preliminary site investigations are usually small compared to cleanup and project construction costs, these studies must be done. It is difficult to attract a developer to a site if there is no environmental information. Therefore, funding for environmental site assessments is very important and is seen as an enabling mechanism.

The literature review also suggested that grants for site remediation were needed to allow cities to make brownfields as attractive to developers as greenfields. Most of those interviewed in a George Washington study (Deason et. al, 2001) indicated a preference for site clean-up grants over tax incentives.

The use of financial incentives by state governments in the U.S. to promote brownfield redevelopment is quite common. As of the end of 2000, at least 35 U.S. states (70%) offered some form of financial assistance to promote brownfield redevelopment. No less than a dozen different types of state-sponsored financial incentives were identified. This ranged from site assessment and remediation grants and loans, to property tax abatements, income and business tax credits, to job creation incentives, public infrastructure grants and environmental insurance subsidies. Several patterns and trends emerged from this analysis of financial incentives offered by U.S. states.
The most common types of assistance or programs offered by the state level of government in the U.S. include loans (23 states) and grants (19 states). This was followed by property tax abatement/deferral (15 states) and various income, business and sales tax credits (10 states). Clearly, direct funding mechanisms such as grants and loans are more popular than indirect funding mechanisms such as income and property tax abatement.

While about an equal number of states (12) use grants or loans to promote site assessment, far more states (23) use loans instead of grants (only 12 states) to promote site remediation. This suggests that either loans or grants can be used to promote site assessment, but loans seem to be the more popular incentive used by U.S. states for promoting site remediation.

Between 1998 and 2002, 5 states that did not offer brownfield financial incentives began doing so, and another 5 states added new incentives to the brownfield financial incentives they were already offering. This indicates that more and more U.S. states are seeing benefit in offering financial incentives to promote brownfield redevelopment. Of the 10 states starting new funding programs or adding funding programs, 8 introduced loan/grant programs, 4 introduced property tax abatement, while 2 introduced both. This trend reinforces the preference for loans and grants in existing state brownfield programs.

**Core Question 5: How Can the Relationship Between the Economic, Environmental and Social Benefits of Brownfield Redevelopment Be Conceptualized?**

The results of this study show that the economic, environmental and social benefits that flow from brownfield redevelopment and the interrelationships between these different types of benefits are very complex. Few studies have attempted to capture the nature of these relationships. Yet, it is important to do so from a policy perspective. Based on the analysis conducted in the study, Section 5 below presents a preliminary conceptualized framework for understanding the relationship between the economic, environmental and social benefits of brownfield redevelopment. The conceptual framework clearly shows that economic, environmental and social systems at all spatial scales in Canada are interrelated in very complex ways, and that changes to this system that encourage the re-use of brownfield sites will have benefits at all spatial scales. Indeed, the conceptual framework illustrates precisely why sustainable development must become and remain the prevailing development philosophy in Canada.
Key Findings

- A study comparing greenfield and brownfield development in a sample of U.S. cities provided empirical evidence to show that for every acre of brownfield land redeveloped, a minimum of 4.5 acres of greenfield land would be required to accommodate the same development.

- In a 2002 survey of 232 U.S. cities (U.S. Conference of Mayors), the lack of funds to cleanup sites was cited as the number one impediment to brownfield redevelopment, finishing ahead of liability issues, which was the second most often cited impediment.

- Since its inception in 1993, the U.S. EPA Brownfield program has provided over US$280 million in pilots and grants to spur brownfield projects. In terms of economic impacts, the EPA reports that this has leveraged US$4 billion in public and private investment and over 19,000 cleanup, construction and redevelopment jobs (U.S. EPA web site, May 2002 Press Release).

- Quebec’s Revi-Sols Program: In fewer than five years
  - Revi-Sols has funded the clean-up and redevelopment of 137 projects.
  - The total land area of the sites rehabilitated thus far is just under 2 million square metres or 200 ha (493 acres); using the mean brownfield/greenfield offset ratio of 4.5 calculated in the George Washington University study, this would have required a minimum of 900 ha or 2,220 acres of greenfields land had the same projects been located in greenfield areas.
  - $60 million in public sector funding has leveraged $1.6 billion in private and public sector investment, representing a leverage ratio in the order of 26.7. Therefore, every $1 of public sector funding invested in the Revi-Sols program by the Province of Quebec has leveraged $26.70 in private and public sector investment. *(information current at April 2002)*

- An Input-Output analysis of the brownfield redevelopment cluster nationally revealed that every $1 spent on brownfield redevelopment in the Canadian economy generates an additional $3.50 to $3.80 in output of all industries Canada-wide (including direct, indirect and induced effects).

- In Canada, every dollar of brownfield redevelopment activity can generate nearly 22 cents in federal personal direct and indirect tax revenue.
1.0 Introduction

1.1 Brownfields and the Economy

As Canada enters the 21st Century, its economy is becoming increasingly diversified and urban-focused. Experience is proving that distance still matters and that there is a limit to which urban areas can grow and remain efficient. Among the challenges associated with maintaining and increasing the efficiency of Canada’s urban-centred space economy is the challenge of urban sprawl and its negative impact on economies at every geographic scale. Key industrial regions in Canada, e.g., the Greater Toronto Area, are already experiencing significant problems associated with urban sprawl, such as increasing levels of traffic congestion on major highways, automobile related increases in air pollution, and the physical and economic deterioration of established urban cores.

The re-use of brownfield sites in urban areas represents an untapped opportunity to gain economic, social, and environmental benefits.

### What is a Brownfield?

According to the U.S. Environmental Protection Agency, a brownfield is an abandoned, idled, or underused industrial or commercial facility where expansion or redevelopment is complicated by real or perceived environmental contamination (U.S. EPA, 1997). Brownfields may be publicly and privately owned properties, “orphaned” (abandoned) properties, or sites held under trusteeship.

The definition adopted by the National Round Table on the Environment and the Economy is as follows: brownfields are abandoned, vacant, derelict or underutilized commercial and industrial properties where past actions have resulted in actual or perceived contamination; brownfields differ from other contaminated sites in that they hold active potential for redevelopment (November 2002).

Brownfields are often overlooked by developers in favour of greenfield sites for reasons such as cost differentials, development complexity, increased approval times, and liability issues. Experience in Canada and abroad has shown that if mechanisms can be put in place to level the financial and legal playing field between brownfields and greenfields, then brownfield sites will be redeveloped. Experience has also shown that significant economic, environmental and social benefits accrue locally, regionally and nationally as a result.
1.2 Study Purpose

The National Round Table on the Environment and the Economy (NRTEE) retained Regional Analytics Inc. to study the potential of brownfield redevelopment activities to generate economic benefits locally, regionally and nationally in Canada. The specific research questions that flow from the NRTEE’s terms of reference, and those which were used to guide the methodology, analytical approach, and structure of this report are listed below.

1.2.1 Brownfields vs. greenfields

1.2.2 What are the key impediments to brownfield redevelopment?

1.2.3 What are the economic, and by extension, environmental and social impacts and benefits of brownfield redevelopment?

1.2.4 What financial instruments are available to promote brownfield redevelopment and how do they compare in terms of cost and effectiveness?

1.2.5 How can the relationship between the economic benefits of brownfield redevelopment and broader environmental and social benefits be conceptualized?

1.3 Study Methodology

Each of the research questions will be addressed using a combination of a focused literature review, case studies of redevelopment projects in Canada and the United States (U.S.), and an Input-Output model of the Canadian economy. The literature review focused on studies of:

- brownfield versus greenfield development;
- key impediments to brownfield redevelopment;
- economic impacts of brownfield redevelopment; and,
- tools available to promote brownfield redevelopment.

The case studies were chosen to include a range of types and sizes of projects, as well as projects from across Canada and a few projects from the U.S. The availability of economic and other project data constrained the level of detailed analysis that could be performed for some of the case studies. Finally, an Input-Output analysis of the brownfield redevelopment cluster (BRC) was conducted to determine the existing and potential economic impact of brownfield redevelopment on the Canadian economy.
1.4 Scope of the Brownfield Problem

The U.S. General Accounting Office has concluded that there may be between 130,000 and 450,000 contaminated commercial and industrial sites located within the United States (Simons, R., 1998). According to a more recent estimate by Brownfields.com, as many as 650,000 brownfield sites may exist in the U.S. Reports indicate that more than $2 trillion worth of property within the U.S. is devalued due to the presence of environmental hazards (Colangelo et. al, 2001). The total cost of restoring these sites to productive use may be in excess of $650 billion (Deason et. al, 2001).

It has been estimated by the NRTEE that there could be as many as 30,000 brownfield sites in Canada. As Canada plays “catch-up” with our neighbours to the south, we may find just as they did, that original estimates of the number of brownfield sites are conservative. Certainly, at least for a number of years, more brownfield sites will be “discovered” through environmental testing than will be remediated.

One of the many positive consequences of brownfield redevelopment is that employment and revenues are created by the rehabilitation of sites. In fact, it has been estimated that $1.5 billion in goods and services are sold in the brownfield market each year in the U.S. and that the market is growing at 15%-20% a year (Colangelo et. al., 2001).

The opportunity costs associated with brownfields can also be viewed as potential benefits. For example, in a recent study undertaken by the U.S. Conference of Mayors (2000), 179 U.S. cites responding to a survey on brownfields indicated that if their brownfields were redeveloped, these cities would realize between $902 million (conservative estimate) to $2.4 billion (optimistic estimate) annually in additional tax revenues. This is an average of between $5.0 million and $13.4 million per city per year. In addition, 190 cities estimated that more than 587,000 jobs could be created on former brownfield sites. Clearly, local governments in the U.S. are losing billions of dollars per year in property tax revenues resulting from the failure to restore brownfields to economic viability. It is no surprise that the U.S. Conference of Mayors has made the redevelopment of brownfields its highest priority. Even if the brownfield problem in Canada is only a fraction of the size of the problem in the U.S., as indicated by the above estimates of total contaminated sites in each country, local and provincial governments in Canada are still losing hundreds of millions of dollars a year in tax revenues.

1.5 Benefits of Brownfield Redevelopment

Numerous studies have highlighted the benefits of brownfield redevelopment. Most of the benefits accrue at the local government level because all development, be it brownfield or greenfield, is inherently local. These local benefits include:

- Environmental restoration and the removal of threats to the health of locals;
- Improved soil, water and air quality;
- Revitalization of neighbourhoods and employment areas;
- Creation and retention of employment opportunities;
• Utilization of exiting infrastructure resulting in a reduction of urban sprawl, traffic congestion and related costs; and,
• An increase in property tax revenues.

The U.S. Conference of Mayors survey conducted in 2000 asked 232 cities across the U.S., ranging in population from 1,468 (Hope, NJ) to 7,380,906 (New York, NY) to identify the most important benefits to their city if their brownfields were redeveloped. The results are shown in Figure 1. Not surprisingly, increasing the city’s tax base was the most frequently cited benefit with 198 cities or 86% choosing this option. The next most frequently cited benefits were job creation (75%), neighbourhood revitalization (73%), and environmental protection (53%).

A 1999 Council for Urban Economic Development (CUED) study of 107 completed brownfield projects found that 23,330 jobs were created or retained by the 90 job generating redevelopment projects. About 60% were new jobs with the remaining 40% being retained jobs that were expected to relocate from the area if the property was not redeveloped. The median cost per job was $14,003 (adjusted to 1999 values). Gilliand (2000) notes that this cost per job figure compares very favourably with public initiatives to attract large corporations to a community, which can often result in cost per job figures in excess of $100,000 per job.

A study by George Washington University researchers also reviewed case studies of completed brownfield projects (Deason et. al., 2001). The benefit of brownfield redevelopment most frequently reported was job creation. Reversal of neighbourhood deterioration was the second most frequently mentioned benefit. This was followed by improvements to the area, surface clean-ups, increased property values and increased local tax revenues.

**Figure 1** Benefits of Brownfield Redevelopment: Survey Results

![Bar chart showing the percentage of cities responding to benefits of brownfield redevelopment.](chart.png)
Interestingly, the brownfield experts that were interviewed by the George Washington University researchers consistently emphasized that in addition to benefits commonly associated with brownfield redevelopment, such as the reduction of urban sprawl, reduction of traffic congestion, and improvements in the environment and air quality, less tangible social benefits also occur. These types of benefits include a higher level of citizen awareness, a sense of control and empowerment resulting from being part of the decision-making process, reduced crime, and restored safety and security, and a sense of community hope and pride (Deason et. al., 2001). While restoring neighbourhoods and employment areas, brownfield redevelopment projects can have a very positive effect on community pride. For example, these projects often involve the restoration of heritage properties. This provides a sense of place and improves the aesthetic and social quality of urban life in Canadian cities.

While the conversion of brownfields to new residential, industrial and commercial uses generates economic, social and environmental benefits, the conversion of brownfields to open space and parks generates social and environmental benefits such as improved neighbourhood stability and sense of community, healthier residents through a cleaner environment, and enhanced recreational opportunities. Recent research has also shown that the conversion of brownfields to green space also has tangible economic benefits.

For example, a recent International Economic Development Council IEDC study (2001) notes that a vast amount of literature indicates that the creation of greenspace can serve to attract and retain residents and businesses, increase adjacent property values/rents, and act as a catalyst for residential redevelopment and renovation. The IEDC study examined 25 case studies of brownfields across the U.S. that had been converted to green space development. The study found that the assessed values for properties located adjacent to former brownfields that were converted to green space increased substantially after conversion. Properties adjacent to the 7 projects for which property value information was available experienced increases in property values ranging from 20% to 211%, with an average increase of 106%. By comparison, property value increases for the cities as a whole ranged from 1% to 70%, with an average increase of 25%. Therefore, the average increase in property values adjacent to former brownfields that had been converted to greenspace was more than four times the increase in citywide property values.

A 1998 Environment Canada study examined property values on Hamilton’s West Harbourfront near Bayfront and Pier 4 Parks. Bayfront Park is a 40 acre former brownfield site on Hamilton’s West Harbour that was developed as an open space park by the City of Hamilton and opened in 1994. Pier 4 is a smaller park on Hamilton’s West Harbourfront. The Environment Canada study compared property sale prices for houses within 3,500 feet of the parks with sale prices for a control group of similar houses farther than 3,500 feet away from the parks, for the period 1983-1996. For houses in the study group, the average house price was $41,942 in 1983. This had risen to $90,068 by 1996, an increase of 115%. In the control group, the average house price in 1983 was $55,889, increasing to $74,434 by 1996, an increase of only 33%. The study found that approximately 18.5% of the aggregate 1996 residential property values in the study area
was attributable to the development of the parks and improvements in water quality. The study also concluded that the increased property values brought about by the park developments could have contributed $560,000 more to the City of Hamilton’s property tax revenues in 1996, if market value assessment had been in place at the time.

Clearly, there are a myriad of complex and interconnected reasons for promoting brownfield redevelopment at all levels of government. For example, by returning brownfield sites to productivity, this increases property tax revenues and the funding available to local governments to provide essential public services. As municipalities in Canada rely in part on provincial governments and the federal government for funding of these services, this reduces the need for such funding from the senior levels of government, ceteris paribus.

The obvious benefits of brownfield redevelopment at the provincial level include an increase in employment and therefore income tax revenues, an increase in P.S.T revenues collected on goods and services within the brownfield sector, and increased P.S.T revenues associated with the construction of brownfield projects. But, there are also other benefits at the provincial level. As noted by Deason et al. (2001), brownfield projects that provide employment opportunities near areas where community residents live have the effect of reducing commuting needs. This reduces traffic congestion, the need for new provincial highways, local road construction and air pollution.

In one way or another, much of the financial assistance received by cities and towns in Canada still comes from the provincial and federal governments. The redevelopment of brownfields could reduce the need for such financial assistance. Deason et. al. take the view that the benefits at the national level are very similar to the benefits at the local level, i.e., an increase in employment, economic growth, an increase in property and income tax revenues, and a reduction in demand for new services and assistance. Similarly, the social and environmental benefits such as an improved environment and a safer and improved quality of life accrue at all geographic levels. Therefore, it is safe to say that while brownfield redevelopment is local, the benefits are national.

### 1.6 Basic Conceptual Framework for Understanding the Benefits of Brownfield Redevelopment

Based on the above review and analysis of the benefits that can result from brownfield redevelopment, a basic conceptual framework for understanding the benefits of brownfield redevelopment is shown in Figure 2. This framework is loosely based on a brownfield redevelopment induced benefit framework articulated by Deason et. al. (2001). The framework intentionally integrates economic, environmental and social benefits. It also incorporates the often overlooked connections and two-way relationships between these different types of benefits. For example, the economic benefits resulting from brownfield redevelopment such as increased incomes and property tax revenues can contribute to social benefits such as neighbourhood stability and quality of life.
Based on the analysis and results of this study, a more comprehensive conceptual framework for understanding the economic, social and environmental impacts and benefits of brownfield redevelopment is presented in Section 5. The framework in Section 5 builds on the basic framework above by providing a more detailed listing of economic, social and environmental benefits. The comprehensive framework can be used in two ways. First, it can help guide brownfield redevelopment policy efforts by providing a framework to evaluate the potential benefits of different financial and other policies. Second, it can be used to compare the potential impacts of alternative brownfield projects and allow users to identify those projects most likely to provide the greatest economic, environmental and social benefits. Therefore, the framework in Section 5.0 can be used in both a policy and project specific context to help guide brownfield redevelopment strategies in a way that achieves and maximizes economic, environmental and social benefits.

**Figure 2 Basic Conceptual Framework: Benefits of Brownfield Redevelopment**
2.0 Brownfields vs. Greenfields

It is important to answer the question: “why bother with brownfields at all”? This question has been at least partially answered above with reference to the benefits of brownfield redevelopment. But some of these economic benefits, e.g., jobs, income and property tax revenues, can also be realized through greenfield development. Therefore, the issue of developing brownfields instead of greenfields must focus on the benefit differential between brownfield redevelopment and greenfield development.

For this analysis, greenfields are considered to be vacant properties that have not been developed and that have no actual or perceived contamination. These are properties are usually located within urban areas and may or may not have municipal services.

A recent study of brownfield redevelopment conducted at the George Washington University (Deason, J.P. et al., 2001) examined the extent to which the redevelopment of brownfield sites can actually serve as check on urban sprawl. The research question was whether similar development projects require more land if located in a greenfield area than if located in a brownfield area? There are a number of reasons why development of a greenfield could require more land. In general, land-use requirements in greenfield areas are more land-consumptive than in brownfield areas. This includes setback and parking requirements, floor area ratios, lot coverage or density limitations and minimum lot sizes.

To answer this question, the researchers selected six study cities across the U.S and collected information on successful completed brownfield projects in each of the cities. Specific information collected included variables such as the nature of the redevelopment project, lot dimensions, total square footage, outside dimensions, number of floors, number of residents and units, etc…

The land use regulations for a minimum of three greenfield areas near each of the brownfield projects was then obtained. It was then possible to calculate the minimum amount of land that specific brownfield projects would have required if constructed in any of the proximate greenfield areas. This calculation is known as the “brownfield/greenfield offset”. It represents the amount of greenfield land that would be required for every acre of brownfield land if the same project had been built in a greenfield area. Because this calculation was intended to approximate the minimum amount of land that a brownfield redevelopment project would have required had it been constructed in a greenfield area, the land use requirement that minimized the land required was the one that was used.

While one would expect that the same project would use more land on a greenfield site than a brownfield site, the results of this study are staggering. Of the 142 samples (derived from 48 specific brownfield redevelopment projects) that were analyzed in the study, the overall mean brownfield/greenfield offset ratio was 4.5. In essence, this means that every brownfield acre redeveloped would have required a minimum of 4.5 acres of
greenfields land had the same project been located in a greenfield area. U.S. President George Bush cited this statistic in his speech accompanying his signing of the Small Business Liability Relief and Brownfields Revitalization Act on January 11, 2002.

The total area used by the 48-brownfield projects was 142.7 acres. Had these same projects been built in a greenfield area, a minimum of 645.9 acres would have been required. The offset ratio was 6.2 for industrial projects, 2.4 for commercial projects, and 5.6 for residential projects. Clearly, the redevelopment of brownfields has the potential to reduce the amount of greenfield land being consumed, thereby reducing urban sprawl.

Several studies have described a “market mismatch” that exists between greenfield and brownfield sites, making it significantly more expensive to develop a brownfield site. For example, costs were compared for developing a new 40,000 sq.ft. industrial manufacturing building on a vacant, moderately contaminated 2 acre brownfield site versus a 2 acre greenfield site in the City of Hamilton (see Appendix A). Both sites are serviced and there are no industrial development charges. It was estimated that depending on the purchase price of the brownfield site, development of the brownfield site (including remediation) would be between 14% and 27% more expensive than the greenfield site. If the brownfield site was also occupied by an obsolete 40,000 sq.ft. building that had to be demolished (a common occurrence on brownfield sites), the development of the brownfield site would be between 22% and 34% more expensive than the greenfield site. Appendix A also contains a generalized proforma evaluation comparing costs, revenues and profits for a recently remediated/redeveloped moderately contaminated site in Guelph with the same site as if it were clean. The results for this site show that even with only moderate site assessment and remediation costs of $575,000 on 125 residential units ($4,600 per unit), this lowers the profit margin from approximately 9% to approximately 4.9%, which is an entirely unacceptable profit margin.

Greenfield development provides larger and quicker profits than brownfield redevelopment. Greenfields and brownfields are not on a level playing field. It is for this reason that any government policy to encourage the redevelopment of brownfields should include financial incentives to level the playing field and remove the market mismatch.

Some have argued that the financial playing field should actually be tilted in favour of brownfield sites in order to overcome the stigma associated with these sites. While there may be some merit to this argument, at least in the initial implementation stages of a national brownfield redevelopment strategy, experience in the U.S. and U.K. has shown that the stigma associated with brownfield sites tends to lessen over time as these sites are redeveloped and the associated benefits are realized by residents, property owners and developers, alike. As well, education programs that promote brownfields as opportunities instead of liabilities can also help to reduce stigma over time. Attempting to skew the playing field in favour of brownfields may also create its own set of inequities.
3.0 Impediments to Brownfield Redevelopment

A question that needs to be answered prior to turning attention to the economic impacts and promotion of brownfield redevelopment is: “what are the impediments to brownfield redevelopment”?

A survey conducted by the U.S. Conference of Mayors in 2000 asked 232 cities across the U.S., ranging in population from 1,468 (Hope, NJ) to 7,380,906 (New York, NY) to identify the impediments to, and benefits of, brownfield redevelopment. Figure 3 displays the impediment results. For the third straight year in a row, the “lack of funds to clean-up sites” was the most frequently cited impediment to brownfield redevelopment with 208 or 90% of the cities identifying this as an impediment. The next most often cited impediments were liability issues (71%), the need for environmental assessments (60%), environmental regulation (45%), and market conditions (45%).

When the cities were asked to rank the impediments they identified with the highest ranking being 5 points and the lowest ranking being 1 point, the picture changed somewhat (see Figure 4). The lack of clean-up funds was selected by over half of the cities as the number one impediment to brownfield redevelopment and scored 842 points, far more than the second highest ranked impediment, liability issues with 462 points. The next highest ranked impediments were the need for environmental assessments (356 points), the need for demolition monies (258 points) and market conditions (235 points).

Clearly, municipalities across the U.S., some in states with strong liability limitation regimes and some in states without, have indicated that the lack of clean-up funds is the single most important impediment to brownfield redevelopment. Also, of the five highest ranking impediments, three (lack of clean-up funds, need for environmental assessments, and need for demolition monies) could be addressed via the provision of financial incentives.
Figure 3  Impediments to Brownfield Redevelopment: Survey Results

Figure 4  Impediments to Brownfield Redevelopment (Rank): Survey Results
A 1999 assessment of U.S. state initiatives to promote the redevelopment of brownfields reached a somewhat different conclusion than the U.S. Conference of Mayors study regarding the relative importance of financial incentives and regulatory reforms (see ICF Consulting and E.P. Systems Group Inc., 1999). The ICF and E.P. Systems Group study examined brownfield programs in three states (Massachusetts, Michigan and Pennsylvania) in detail. Through a combination of analysis of project cost data for a limited number of projects in only two states and interviews with developers and brownfield agencies, the study concludes “financial support was cited as helpful, and in some instances as critical to completion of a project, but the state intervention (regulatory reform) tended to be referenced as the factor motivating project initiation”.

The conclusion that can be reached on this issue as a result of the literature review is that financial incentives and liability issues are both key impediments to brownfield redevelopment and both of these impediments must be addressed in order to promote brownfield redevelopment. Colangelo et. al. (2002), Abdel-Aziz and Elliott (2001) and numerous other North American brownfield experts share this viewpoint.
4.0 Economic Impacts of Brownfield Redevelopment

4.1 Introduction

To provide the various levels of government in Canada with the information needed to make effective brownfield policy and funding decisions, it is important to understand the nature and scale of the potential economic impacts of brownfield redevelopment.

The literature review conducted for this study and an extensive literature review conducted for a George Washington University study (Deason et. al, 2001) found that much of the existing literature focuses on impediments to brownfield redevelopment such as liability or financial considerations, rather than focusing on the measurement of benefits induced by brownfield redevelopment efforts. In a series of telephone interviews conducted by the George Washington University researchers with experts in the area of economic redevelopment cost/benefit analysis, these experts agreed that brownfield projects provide major opportunities for revitalizing urban communities and may reduce health risks, create jobs, provide services, increase local tax revenues and improve the overall livability of urban neighbourhoods.

Based on available literature and information, this section examines the types of financial instruments employed by federal, provincial, state and local governments in Canada and the U.S. and the economic benefits that have been derived from brownfield redevelopment projects that have used these financial incentives. Much of the delineation of financial instruments available to promote brownfield redevelopment contained in this section is based on a detailed review of financial incentives available to promote brownfield redevelopment in the U.S. (see Colangelo et. al. (2002)). This section is not intended as a comprehensive review of these financial incentives. Instead, a review of these initiatives is presented in order to identify common observations with respect to the effectiveness of different types of incentives. Several case studies at the local level in Canada and the U.S. are used to highlight the economic and other benefits that can result from brownfield redevelopment at the local level. They are included in Appendix D.

4.2 Canadian and U.S. Federal Government Incentives

Other than the recently announced funding under the Municipal Green Funds for brownfield inventories and assessments, the Canadian federal government does not currently offer any direct funding to promote brownfield redevelopment. The U.S. federal government, on the other hand, provides a number of financial incentive programs to promote urban redevelopment. Some of these programs, such as the Environmental Protection Agency’s (EPA) Demonstration Pilot Grants (DPG) and Revolving Loan Funds (RLF), and the Department of Housing and Urban Development’s (HUD) Brownfield Economic Development Initiative (BEDI) are targeted directly at promoting brownfield redevelopment. Other federal government programs, such as HUD’s Community Development Block Grants (CDBG’s) and the Economic Development...
Administration’s (EDA) public works grants are general economic and community development tools that have been used by cities and states to undertake brownfield redevelopment projects.

Appendix B provides a summary of U.S. federal financial assistance programs applicable to brownfield reuse activities. More than 20 federal program offices are involved with brownfields and provide some form of incentives, funding or technical assistance. At first glance, the involvement of so many federal agencies in brownfields would seem a positive. However, the distribution of funding among so many federal agencies creates administrative and program inefficiencies. Colangelo et.al. (2002) have noted that understanding the different program requirements and processes for obtaining funding is difficult and they recommend a more streamlined approach at the federal level.

In general, U.S. federal brownfield incentives are targeted to state and local governments and few are applicable directly to the private sector. In essence, the states and local governments have become “partners” in the delivery of federal programs. This approach can be criticized as an inefficient and indirect means of providing funding, i.e., administrative structures are required at the federal, state and local government level in order to deliver brownfield incentive programs. On the other hand, such a system promotes greater accountability and flexibility to meet specific local community needs. Criticisms of the federal brownfield incentives in the U.S. found in the literature did not focus on the partnership delivery model. Instead, factors such as the special knowledge required to understand and access each program, the amount of work required to secure what can amount to an insignificant incentive, poor applicability and lack of program flexibility were cited as criticisms (Colangelo et. al, 2002).

The U.S. EPA provides three types of financial incentives.

1) Demonstration Pilot Grants of up to $200,000 each to states, cities, towns, counties and tribes across the U.S. to conduct environmental assessment related activities and develop remediation and redevelopment plans;

2) Cleanup Revolving Loan Funds of up to $500,000 ($1,000,000 under the new Small Business Liability Relief and Brownfields Revitalization Act) awarded to states, cities, towns, counties and tribes to provide low-interest loans to carry out cleanup activities at brownfield sites; and,

3) Job Training Pilot Grants of up to $200,000 each to provide job training for residents of communities affected by brownfields.

The Cleanup Revolving Loan Fund has been criticized by some (Colangelo et. al, 2002) for having onerous legal, environmental and administrative requirements that hamper its usefulness and effectiveness. The new U.S. brownfields law is expected to focus more on development financing, conventional development underwriting and loan evaluation. This should help to make the Cleanup Revolving Loan Fund program more useful. The key lesson that can be learned from this U.S. financial incentive program is the need for
harmony between federal legislation and the legal, environmental and administrative requirements of any financial incentive program.

Since its inception in 1993, the U.S. EPA Brownfield program has provided over $280 million in pilots and grants to spur brownfield projects. In terms of economic impacts, the EPA reports that this has leveraged $4 billion in public and private investment and over 19,000 cleanup, construction and redevelopment jobs (U.S. EPA web site, May 2002 Press Release).

In 1997, the U.S. federal government passed the Taxpayer Relief Act (TRA), which included a new tax incentive to spur the cleanup and redevelopment of brownfields (Kaiser, S. and E Bennett, 1999). The TRA allows environmental cleanup costs to be fully deducted from income in the year they are incurred. The $1.5 billion TRA incentive for brownfields was expected to leverage $6 billion in private investment and return 14,000 brownfields to productive use (Kaiser, S. and E Bennett, 1999).

But, the TRA incentive has not been widely used (Colangelo et. al, 2002) This was confirmed by interviews conducted by George Washington University Researchers (Deason et. al, 2001). Numerous reasons for this were cited, including: developer misunderstanding of the tax incentive, cumbersome procedural requirements, the tax credit was insignificant and did not justify the amount of work (and related costs) needed to obtain the tax credit, and finally, developers were more interested in “turning the property as quickly as possible” than in “expensing clean-up costs”. The conclusion is that a current income tax deduction for remediation expenditures may not be popular or effective in Canada unless the credits are significant and procedural requirements are minimal. Interviewees in the U.S. preferred other types of tax incentives such as tax increment financing (TIF), especially if extended to cover removing existing structures and rehabilitating infrastructure.

Access to capital is critical for developers and numerous sources cite the difficulty in obtaining financing for brownfield projects from traditional lending sources. A focus of financial assistance could be to help developers secure financing, e.g., a program to “backstop” developers by providing the developer with a surety (or equivalent) in order to make private capital available.

The literature review suggested that an absence of site-specific environmental information significantly inhibited brownfield redevelopment. While the costs of these preliminary site investigations are usually small compared to clean-up costs and project construction costs, these studies must be done. It is difficult to attract a developer to a site if there is no environmental information. Therefore, funding for environmental site assessments is very important and is seen as an enabling mechanism.
Finally, interviewees in the George Washington University study (Deason et. al, 2001) felt that grants for site remediation were needed to allow cities to make brownfields as attractive to developers as greenfields. Most of those interviewed indicated a preference for site clean-up grants over tax incentives. As one interviewee put it: “tax incentives are good, clean ground is better”.

4.3 Canadian Provincial and U.S. State Government Incentives

The only provinces in Canada that currently offer financial incentive programs to promote brownfield redevelopment are Quebec and Ontario. Under the recently passed Brownfields Statute Law Amendment Act, Ontario offers a form of property tax freeze/cancellation for the education portion of property taxes to cover the costs of site remediation. But, this education property tax freeze/cancellation must be matched by municipalities with the municipal portion of property taxes. The financial capability of municipalities to do this may limit the effectiveness of this incentive program. This program is not yet in effect as enabling regulations have not yet been adopted (Interview with L.P. Piccioni, 2002). Therefore, there is no experience to draw from with respect to the effectiveness of this program.

4.3.1 Quebec Revi-Sols Program

The Province of Quebec’s program is known as Revi-Sols and has been in place since 1998. It is the only brownfield incentive program of its kind at the provincial level in Canada. This program has produced an extensive data base on program usage and results. This data is analyzed below.

The goals of the Revi-Sols program include:

- rehabilitating contaminated sites;
- improving the quality of the environment and resident’s health;
- reducing urban sprawl;
- increasing economic activity; and,
- promoting the use of treatment technologies for the decontamination of soils and groundwater.

Revi-Sols is a program of grants to cover the costs of preparatory studies (environmental assessments) leading to rehabilitation work and the actual costs of the rehabilitation work. Proponents eligible for grants include private developers, municipalities or a combination of the two. Eligible sites must be intended for development after rehabilitation, i.e., grants are provided only if there is a concrete development project.

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The Quebec government will fund 50% of characterization and rehabilitation costs, 70% if the soils and groundwater are treated using proven technologies.

Phase I of the Revi-Sols program was launched in 1998. The program targeted the cities of Montreal and Quebec where $40 million was earmarked to help finance the study and rehabilitation of contaminated sites between 1998 and 2003 ($30 million for Montreal and $10 million for Quebec City). There was so much interest and uptake in Phase I that in 2000, the Quebec government launched Phase II (2000-2005) with $50 million aimed at all other urban municipalities in the Province of Quebec. In total, $90 million has been budgeted and this will be matched by a contribution of $90 million from the private and municipal sectors, for a total of $180 million over 7 years directed to the rehabilitation of contaminated sites in the Province of Quebec.

In less than 5 years, the Revi-Sols program has funded the clean-up and redevelopment of 137 projects (89 in Montreal, 19 in Quebec, and 29 in other municipalities). This is an average of some 30 projects per year. The total land area of the sites rehabilitated thus far is just under 2 million square metres or 200 ha (493 acres). If the mean brownfield/greenfield offset ratio of 4.5 calculated in the George Washington University study is applied to the 493 acre figure, it would have required a minimum of 900 ha or 2,220 acres of greenfields land had the same projects been located in greenfield areas.

To date (April 1, 2002), the City of Montreal has used $24.9 million (83%) of its $30 million, the City of Quebec has used $1.8 million (18%) of its $10 million, and all other municipalities have used $32.8 million (66%) of their $50 million. In total, approximately $60 million (66%) of the $90 million allocated for the 7 year period (1998-2005) has already been used. In fact, Montreal and the other municipalities may use up their allotment funds before the program end date.

As of April 1, 2002, the total invested in rehabilitated sites (buildings, improvements, etc.) was $1.6 billion ($953 million in Montreal, $103 million in Quebec, and $55 million in other municipalities). Most of this investment was made by the private sector. Therefore, $60 million in public sector funding has leveraged $1.6 billion in private and public sector investment in 137 projects, an average of $11.3 million per project. This represents an impressive leverage ratio in the order of 26.7. Therefore, every $1 of public sector funding invested in the Revi-Sols program by the Province of Quebec has leveraged $26.70 in private and public sector investment.

In Montreal, $24.9 million invested in the Revi-Sols program (89 projects and $953 million invested) has resulted in an increase in municipal property taxes paid of $20 million. In the other municipalities, $32.8 million (29 projects and $55 million invested) has resulted in an increase in municipal property taxes paid of $10 million.

The above analysis indicates that the program is being well utilized and is meeting a genuine need in many Quebec municipalities. The analysis of economic impacts resulting from projects utilizing the program indicated that the induced economic impacts of the
program (number of projects, land area rehabilitated, level of private sector investment, and increased property tax revenues) are very impressive.

An argument can be made that some of the 137 projects under the Revi-Sols program may have taken place regardless of the program. This may be true, but because of the “market mismatch” between greenfields and brownfields, the projects that would have taken place even without the program would have likely been built on greenfield sites, consuming far more land than on a brownfield site. Therefore, the Revi-Sols program has had the effect of not only inducing new investments, but also directing that investment in a sustainable manner to urban areas that are already built-up and well serviced.

4.3.2 U.S. State Government Incentive Programs

Numerous U.S. states offer brownfield financial incentives, and some, such as Massachusetts, Michigan and Pennsylvania have had brownfield financial assistance in place since the mid-1990’s (ICF Consulting et. al, 1999). Assessments of state programs were reviewed to identify common observations with respect to the effectiveness of different types of incentives and recent changes to state programs. Surprisingly, most states have yet to gather hard economic information on their programs. As noted by Bartsch and Dorfman (2001), many programs are still too new to gain a handle on impacts. Other states have not been able to find the resources to collect any data beyond the number of sites in their programs. Increasingly, though, states are beginning to turn their attention to tracking program impacts and the benefits of brownfield redevelopment (Bartsch, C. and B. Dorfman, 2001). The results of the review of available assessments for U.S. state programs are presented below.

As of the end of 2000, at least 35 U.S. states offered some form of financial assistance to promote brownfield redevelopment (see Appendix C, Piccioni, L.P. adapted from Bartsch, C. and B. Dorfman. 2001). No less than a dozen different types of state-sponsored financial incentives were identified. This ranged from site assessment and remediation grants and loans, to property tax abatements, income and business tax credits, to job creation incentives, public infrastructure grants and environmental insurance subsidies. Several patterns and trends emerged from this analysis of financial incentives offered by U.S. states.

First, this data clearly shows that the use of grants and loans at the state level of government in the U.S. to promote brownfield site assessment/remediation activities is quite common, with at least 35 states (70%) offering some form of financial incentive to promote brownfield redevelopment. The most common types of assistance or programs offered by the state level of government includes loans (23 states) and grants (19 states). This was followed by property tax abatement/deferral (15 states) and various income, business and sales tax credits (10 states). Clearly, direct funding mechanisms such as grants and loans are more popular than indirect funding mechanisms such as income and property tax abatement.
While 19 states in total offered some form of grant for site assessment/remediation/demolition and construction activities, 12 offered grants for site assessment, 12 offered grants for site remediation, and 5 states offered grants for both. Only 2 states (Pennsylvania and Wisconsin) offered grants for site assessment, remediation, demolition, and construction.

Of the 23 states that offered loans for site assessment, remediation and demolition activities, all 23 offered loans for site remediation, while 12 offered loans for site assessment. Only 4 states (Illinois, Indiana, Michigan and Pennsylvania) offered loans for site assessment, remediation and demolition.

While about an equal number of states (12) use grants or loans to promote site assessment, far more states (23) use loans instead of grants (only 12 states) to promote site remediation. This suggests that either loans or grants can be used to promote site assessment, but loans seem to be the more popular incentive used by U.S. states for promoting site remediation.

Comparing the year-end 2000 State of the States report to the year-end 1998 report (see Bartsch, C. and C. Anderson, 1999) shows that over this short 2 year period, 5 states that did not offer brownfield financial incentives began doing so, and another 5 states added new incentives to the brownfield financial incentives they were already offering. This indicates that more and more U.S. states are seeing benefit in offering financial incentives to promote brownfield redevelopment. Of the 10 states starting new funding programs or adding funding programs, 8 introduced loan/grant programs, 4 introduced property tax abatement, while 2 introduced both. This trend reinforces the preference for loans and grants in existing brownfield programs. Another trend that was identified was that more states are starting to link more diverse programs to promote brownfield redevelopment. For example, Florida is using part of its “Quick Response Training Program” to fund instructional programs for businesses located in designated brownfield areas.

4.4 Local Government Incentives

The discussion of local government brownfield redevelopment incentives in Canada, and particularly Ontario, is based largely on research conducted by RCI Consulting for the Regional Municipality of Niagara (RCI Consulting, 2002). Local governments in Canada, and particularly Ontario, have begun to consider the use of financial incentives to promote brownfield redevelopment. Several municipalities in Ontario have become leaders in terms of offering financial incentive programs to promote brownfield redevelopment. For example, the cities of Thunder Bay and Hamilton offer a tax-increment based grant program to fund eligible brownfield project costs, including site remediation and building demolition costs. This grant is paid to the developer once the project is complete in the form of an annual rebate of part or all of the municipal portion of the property tax increase resulting from the project. The Ontario Brownfields Statute
Law Amendment Act (Bill 56) allows the provincial education portion of property taxes to be treated in a similar fashion.

Some municipalities have set aside dedicated funding for brownfield pilot projects in order to demonstrate the feasibility of and showcase brownfield redevelopment. These funds can be used by municipalities to cleanup municipally owned brownfield sites or to partner with the private sector to cleanup and promote the redevelopment of a privately owned site. The City of Brantford set aside $800,000 for pilot projects and has used the funds to cleanup three problem brownfield properties. The City of Hamilton has set aside $500,000 and is currently investigating the use of these funds to participate in public-private partnerships to cleanup and redevelop brownfield sites.

Some Ontario municipalities will cancel part or all of the property tax arrears on contaminated and abandoned properties in order to promote the purchase, cleanup and redevelopment of such properties by a bona-fide arms length purchaser. Both the City of Windsor and the City of Cambridge in Ontario utilize such programs.

Several cities in Ontario, including Kitchener, Thunder Bay and Hamilton, offer grants to pay for part of the cost of conducting environmental assessments. These grants are offered in order to generate all important environmental information on sites. Some municipalities such as Kitchener, Cambridge, Thunder Bay and Hamilton offer rebates of planning and building fees on brownfield developments.

The City of Cambridge offers a grant of up to $1,500 per residential unit constructed on a restored contaminated property in their core area. The City of Cambridge also provides a credit against development charges equal to remediation costs of the property.

In order to offer the types of local government incentives described above, municipalities in Ontario must develop and adopt community improvement plans under Section 28 of the Planning Act. This section of the Planning Act allows municipalities with a community improvement plan in place to make grants or loans and acquire, hold, clear, lease and sell land for the purposes of community improvement, e.g., brownfield redevelopment, within a designated community improvement project area. Hamilton and Thunder Bay have developed and adopted such comprehensive plans to promote brownfield redevelopment. As a result of changes introduced in the Ontario Brownfields Statute Law Amendment Act (Bill 56), a community improvement project area can now include the entire municipality.

At least in Ontario, the use of Section 28 of the Planning Act provides a vehicle and a framework for municipalities to address the brownfield issue in a comprehensive manner. However, the ability of local governments across Canada to offer financial inducements to promote brownfield redevelopment is limited by provincial legislation prohibiting bonusing and the financial constraints of local governments. Furthermore, as seen in the U.S., without a significant financial contribution from the upper levels of government
(provincial and federal), the ability of local governments to address the brownfield problem is severely limited.

Numerous U.S. municipalities provide direct and indirect funding for brownfield redevelopment. Of the 107 brownfield projects in the CUED study, the largest amount of public funding came from local sources (51%). This includes a wide range of financing tools such as municipal debt, tax increment financing, general municipal expenditures, equity and loans from local economic development organizations. State programs followed with 38% of funding sources, divided between grants and loans. Finally, federal programs made up 11% of the public funding sources. This was divided between loans, grants and tax credits.

For the 107 projects reviewed in the CUED study, cleanup represented 8% of total project cost. The median remediation cost was $56,945 per acre (1999 U.S.$). But overall, public sources represented close to 30% of total project costs. Robert Simons gathered data from 13 brownfield projects in the U.S., U.K., and New Zealand. The average public subsidization was 20% (Simons, 1997). In a survey of 67 cities in the Great Lakes region with a population greater than 25,000, Simons concluded that “about half the funds invested in brownfield projects are public money” (Simons, 1997). This indicates that while cleanup costs may not represent a large share of total project costs on brownfield projects, government funds represent a fairly large proportion of the total project costs.

U.S. municipalities have far more experience with financial incentives to promote brownfield redevelopment than Canadian municipalities. For example, the City of Chicago has an extensive history with its very successful Tax-Increment Financing (TIF) Program, established in 1984. The program now applies to some 44 districts across the City ranging from deteriorated areas in the downtown to old industrial areas and blighted neighbourhoods. Chicago’s TIF program also covers a wide range of eligible costs including study costs, environmental remediation, rehabilitation of buildings, site preparation, and construction/upgrading of public services. The City of Chicago has developed a TIF program that is flexible. It applies across the parts of the City that require urban improvement and to a range of redevelopment types. This type of flexibility should be incorporated into any proposed municipal tax-increment based redevelopment incentive programs proposed by Canadian municipalities. The City of Chicago is also very aggressive and directly involved in acquiring, remediating, marketing and redeveloping brownfield sites. This strategy has allowed the City to lead by example and to control development on these sites. Again, where permitted and supported by legislation, this is a strategy that could be considered by Canadian municipalities.

Cuyahoga County in Ohio has a Brownfield Redevelopment Fund (BRF) which provides loans of up to $1,000,000 per project to pay for land acquisition, environmental studies, site clearance and demolition. The program is available to private developers and municipal corporations within Cuyahoga County.
The City of Cleveland provides direct tax abatements (60%) for industrial and non-retail commercial business projects located in distressed areas outside the central business district. A form of tax abatement is now permitted in Ontario in the form of a tax freeze/cancellation under the Brownfields Statute Law Amendment Act. Tax abatement is potentially a very effective tool, but it has a much greater impact on the general tax base at the local government level than tax-increment financing (TIF).

The City of Phoenix provides grants for environmental assessment studies and a $500,000 revolving loan fund for brownfield clean-ups. The Phoenix Brownfield Program provides a single point of access and priority access to City departments and development approvals. This is very important because no amount of funding can compensate for a program and development approvals process that is slow and cumbersome. The success of redevelopment incentive programs is directly linked to the administration of those programs and a streamlined development approvals process. The Phoenix Brownfield Program is also very well marketed.

4.5 Case Studies Review

4.5.1 Introduction

Appendix D contains several case studies from across Canada and the U.S. that show the significant economic, environmental and social benefits that can be derived from brownfield redevelopment. The case studies profiled were chosen to provide a cross-section of project types (residential, industrial/commercial, and mixed use) and project sizes. Over 20 individuals were contacted in an attempt to obtain case study information. (Contact information for each of the case studies profiled here is provided in Appendix E.) In Canada, the relatively fewer number of sites that have been redeveloped, the overall lack of economic impact data and confidentiality issues, combined to produce less than complete information for some case studies. The U.S. case studies were taken from the U.S. Environmental Protection Agency Superfund site which contains detailed information of economic, environmental and social impacts of Superfund sites that have been redeveloped.

Most of the projects profiled here are either already under construction or complete. Where available, most of the project costs and economic benefits data was provided directly by the developers, or by a government agency, published source or a web-based source (see Appendix E). Where information was not provided, “not available” is indicated. The case studies are analyzed and presented using a standardized format. The economic benefits data presented in the case studies assumes project completion (unless otherwise indicated) and is based on estimates provided by the developer (unless otherwise indicated in Appendix E).
4.5.2 Case Study Findings

Many of the Canadian cases examined were not yet complete in terms of redevelopment. Therefore, in most cases, economic impacts were projected based on the economic impacts of development that has taken place so far and an estimate of the economic impacts that will result from redevelopment as planned. While the number of case studies examined was limited by data availability, certain trends are evident.

First, regardless of project size or type of re-use, there are significant economic benefits at every geographic scale (local, provincial/state, and national). Even small projects such as the residential/commercial mixed use Barton and Crooks project in Hamilton can generate additional employment and increases in personal income, income taxes paid, P.S.T and G.S.T revenues in the hundreds of thousands of dollars, as well as additional property tax revenues for municipalities and provinces. Larger projects such as Moncton Shops in Moncton, New Brunswick, the Voisey’s Bay Project in Argentia, Newfoundland, and the Spencer Creek Village project in Hamilton, Ontario will generate hundreds of redevelopment and permanent jobs and millions of dollars in additional income, income taxes, GST, and PST revenues, as well hundreds of thousands in additional property tax revenues.

But, the significant economic impacts are only one side of the story. The case studies clearly demonstrate the numerous other benefits (environmental and social) of brownfield redevelopment. These include:

- neighbourhood, employment area and urban core revitalization
- provision of affordable housing opportunities
- increased downtown population and housing opportunities
- improved aesthetic quality of the urban fabric
- creation of parkland and public open spaces
- improved public waterfront access
- elimination of significant environmental hazards
- protection of groundwater resources
- protection of wetlands and wildlife habitat
- protection and improvement of public health
- accessible and open community participation
- increased sense of civic and community pride

The case studies serve to reinforce the results of the literature review with respect to the benefits of brownfield redevelopment. There are a myriad of significant economic, environmental and social benefits that result from brownfield redevelopment. This is the case regardless of size or type of development. The data from the case studies shows that while environmental and social benefits accrue primarily (but not solely) at the local level, economic benefits accrue at all geographic levels (local, provincial, and national). The long-term benefits of brownfield redevelopment, such as a reduction in urban sprawl, traffic congestion and related air pollution, will also accrue at all geographic levels.
5.0 Input-Output Analysis of the Brownfield Redevelopment Cluster

5.1 Introduction

Previous sections of this report have shown that brownfield redevelopment activities have the potential to generate economic and social benefits locally, regionally and, to some extent, nationally (through the generation of tax revenues primarily). While the evidence presented thus far is compelling, the system that generates these economic and social benefits has not been completely articulated. As a result, the magnitude of the economic and social benefits of brownfield redevelopment activities in Canada have, to this point, been under-reported. Missing are the multiplier effects associated with the “Brownfield Redevelopment Cluster” (or BRC). The objective of this section is to define the BRC in terms of national economic sectors and commodities, and to model the income multiplication process associated with the BRC.

5.2 Income Multiplication and the Brownfield Redevelopment Cluster

The process of income multiplication is commonly referred to as the “multiplier effect”. Indeed, as seen in the literature review, some announcements of projects at local, regional and national scales are accompanied by estimates of the potential multiplier effects of the project at a variety of spatial scales. In the context of the BRC it is instructive to review the concept of income multiplication prior to discussing the methodology used to model the process.

Figure 5 consists of a significantly truncated picture of this process as it pertains to the BRC. One dollar spent by the BRC (a precise definition of the BRC will follow in Section 5.3) is allocated to all of those service sectors that provide critical “front-line” inputs to the BRC such as environmental consulting firms, remediation contracting firms, engineering consulting firms, planning consulting firms, legal services and insurance providers. The original dollar of BRC expenditure is allocated to these front-line input providers (note that this listing of front-line service providers in Figure 5 is not exhaustive) and each of these firms uses the income to purchase their critical front-line inputs, and the process continues until the original dollar is consumed. Along the way, each firm, in buying inputs, stimulates production and activity in the economy, and multiplies the effect of the original dollar.

As an example, if the BRC cluster hires an environmental consulting firm to conduct a site assessment for a specific project, employees of the environmental consulting firm receive remuneration for their work (assume for the time being that the income of the employees is the direct result of the project the firm is hired to address). Employees of the firm can use this income to purchase a new vehicle, food, entertainment, orthodontic services for children, and pay taxes. In this way, the wages paid by the environmental consulting firm stimulate demand for the output of the automotive sector, the food
services sector (which links back to retailing, wholesaling, processing, storage and ultimately to agriculture), the professional services sector (i.e., orthodontics) and the government sector (i.e., taxes). Keeping in mind the idea that this is happening within each firm in each layer of the process as represented in Figure 5, then the notion of the original dollar of BRC expenditure being multiplied is clear.

This section seeks to articulate the nature of this web of transactions stimulated by the expenditures of the BRC, to model the process by which each sector (where a sector is defined as a grouping of firms engaged in a similar type of activity) of the economy interacts in satisfying the demands stimulated by the BRC, and to quantify the total impact of all rounds of spending stimulated by BRC expenditures on the Canadian economy.
Figure 5  A Truncated Representation of the BRC Income Multiplication Process
5.3 Statistical Definition of the Brownfield Redevelopment Cluster

Statistics Canada has been tracking the performance of what it calls the “Environment Industry” since 1995. Table 1 shows that over the period from 1995 to 2000, activity levels in the environment industry have been increasing both in terms of revenues, the percentage of total revenues accounted for by environment-related activity, and total employment. Table 1 suggests that the Canadian economy is benefiting from increasing pressure from federal, provincial and local governments on firms to perform in a more sustainable manner.

Table 1 Recent Performance of Canada’s Environment Industry (billions of $)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Environment Industry Revenue</th>
<th>Environmental Revenues</th>
<th>Environmental Goods</th>
<th>Environmental Services</th>
<th>Environment-related Construction</th>
<th>Employees³</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>$19.4</td>
<td>$10.2 (53%)</td>
<td>$4.2</td>
<td>$3.9</td>
<td>$2.1</td>
<td>149,957</td>
</tr>
<tr>
<td>1996</td>
<td>$21.2</td>
<td>$11.0 (52%)</td>
<td>$5.0</td>
<td>$4.4</td>
<td>$1.6</td>
<td>138,668</td>
</tr>
<tr>
<td>1997</td>
<td>$22.4</td>
<td>$11.5 (51%)</td>
<td>$5.3</td>
<td>$4.7</td>
<td>$1.5</td>
<td>159,932</td>
</tr>
<tr>
<td>1998</td>
<td>$24.7</td>
<td>$14.3 (58%)</td>
<td>$5.7</td>
<td>$6.3</td>
<td>$2.3</td>
<td>164,341</td>
</tr>
<tr>
<td>2000</td>
<td>$26.1</td>
<td>$14.4 (55%)</td>
<td>$6.2</td>
<td>$6.3</td>
<td>$1.9</td>
<td>159,269</td>
</tr>
</tbody>
</table>

Also evident in Table 1 is the fact that environmental services (see Table F1 in Appendix F for a description of what is included in this category) are accounting for a growing share of total environmental revenues in Canada, with the environmental goods and environment-related construction categories making up the remainder (see Tables F2 and F3 in Appendix F). It is important to note that the rounds of spending stimulated by the activities of the BRC (as partially illustrated in Figure 5) culminate in a portion of these total revenues. For example, any excavation work conducted by a remediation contracting firm would yield revenue to the remediation contractor and this would be counted as environmental services revenue. Additionally, any revenues earned by firms sub-contracted by the remediation contractor would also qualify as environmental revenue of one form or another (see Tables F2 and F3).

Clearly, environmental activities, including those of the BRC, are having a substantial impact on the Canadian economy. Given the trends evident in Table 1, in addition to the results of the literature review and case studies above, these trends will likely continue, and even accelerate, into the foreseeable future.

³ These numbers reflect the number of employees employed in establishments that reported environmental activities in 1998. Not all of these employees were involved in environmental activities.


To model this process, and to be able to measure the unique impact of the activities of the BRC on the Canadian economy, it is necessary to specify the nature of the BRC, and then to define it in commodity terms palatable to the System of National Accounts.

Anecdotal evidence taken from discussions with several experts in the field of brownfield redevelopment suggests that the process of brownfield redevelopment begins with the developer. A developer conceives a development project, commissions studies by environmental consulting firms to assess the degree to which the site needs to be remediated, secures financing, and then hires remediation contractors, engineering firms, planning firms and construction firms etc. to see the project to fruition. Based on this, it appears as though the process of income multiplication as it pertains to the BRC starts with the developer. These expenditures then ripple through the economy as each firm engaged by the developer conducts its business, buys its inputs, pays its workforce, and remits taxes and levies to various levels of government. The exercise at hand therefore is one of measuring the economic impact of that portion of the development industry that focuses on the redevelopment of brownfield sites.

As will be discussed below, a technique referred to as “Input-Output Analysis” will be used to measure the economic impact of the BRC on the Canadian economy. Input-Output (IO) analysis relies on Input-Output (IO) transaction tables which are compiled by Statistics Canada for the country as a whole, and for each of the provinces and territories. These tables show, for the national economy, how each sector of the economy interacts with every other sector of the economy through the sale of outputs and purchase of inputs. Also tracked in this system are the interactions between consumers and these industrial sectors. The measurement of the impacts of the BRC on the national economy required that the brownfield redevelopment industry (i.e., that portion of the overall development industry that focuses on brownfields) be defined in terms of the commodities tracked in the IO accounts.

To facilitate this definition, a survey of developers and agencies involved in the redevelopment of brownfield sites was completed. The survey focused on the identification of the input and output profiles of that portion of the development industry that is redeveloping brownfield sites. Each developer was asked to indicate the percentage of their total input costs represented by several categories of expenditure (and these categories of expenditure were cross-referenced to IO commodities), and to indicate the percentage of their total revenues accounted for by several categories of sales (these were also cross-referenced, where possible, to IO commodities). Table 2 contains an average of collected responses.

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8 It is very important to note that this survey was unscientific in that the sample was not random and the sample size is small (12 questionnaires sent out, and 7 returned). A recommendation for future work would be to focus on a survey of developers in order to determine the structure of the industry, and the key dynamics that influence this structure.
Table 2, while based on a small sample, does provide some support for the working hypothesis that developers represent the beginning of the income multiplication process as it pertains to the BRC. That is, the developer initiates this process by hiring other specialized service providers to assess, remediate and ultimately develop the site. The information contained in the completed questionnaires, in addition to information obtained from numerous discussions with developers and other experts, was used to form two “experimental” input profiles for the BRC.

Also evident in Table 2 is the fact that developers (i.e., those surveyed) see the bulk of their revenues coming from the sale of land, and not from the construction of buildings. This is problematic in that, by definition land is a capital item, and it is not treated in the IO accounts as a current period expense or revenue item (i.e., the sale and purchase of land is not tracked in the IO accounts). While the revenue of the developers who responded to the questionnaire may indeed flow largely from the sale of land, as far as the IO accounts are concerned, only the difference between the purchase price of the land and the price for which it was sold matter.

This finding, while concurring with anecdotal evidence gathered through various discussions with developers and other experts, was contradicted by one developer who kindly returned a completed questionnaire. In this case, the developer noted that the majority of her/his revenues flowed from the sale of residential dwellings. This stark deviation from the trend is an example of why it is dangerous to draw inferences from a small sample. It could be that this developer is structurally distinct from the others in the sample, and as such caters to a different market, with different sorts of inputs and outputs. Should the NRTEE or other federal agency decide to fund a subsequent phase of this research, a significant portion of the funds should be allocated to an extensive survey of actors within the development industry.
The fact that developers allocated nearly 100 percent of their revenue to output categories involving the sale of land is likely due to the short time frame available for the design and implementation of the survey. A finer survey instrument combined with sufficient time to conduct the survey directly would likely elicit a finer set of responses. To get around this problem, the output profile for the BRC was based on the profile of the 1998 National Finance, Insurance and Real Estate sector (i.e., that sector in the IO accounts that subsumes all forms of real estate development and related activities). These profiles for the BRC are shown in Table 3.  

<table>
<thead>
<tr>
<th>IO Commodities</th>
<th>Scenario 1 (%)</th>
<th>Scenario 2 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input Side</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-residential Construction</td>
<td>36</td>
<td>0</td>
</tr>
<tr>
<td>Retailing Margins</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gross Imputed Rent</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other Finance, Insurance &amp; Real Estate</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Business &amp; Computer Services</td>
<td>53</td>
<td>89</td>
</tr>
<tr>
<td>Other Services</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Government Sector Services</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td><strong>Output Side</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-residential Construction</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Retailing Margins</td>
<td>0.13</td>
<td>0.13</td>
</tr>
<tr>
<td>Gross Imputed Rent</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Other Finance, Insurance &amp; Real Estate</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td>Business &amp; Computer Services</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Other Services</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Government Sector Services</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

10 If a developer does sell $1 million in land, and she/he spent $500,000 to develop the land, the $500,000 in expenses is treated as inputs (unless they are capitalized) and the profit is included in the value-added commodity “Operating Surplus” or profit. The land itself does not show up in the tables. Hence, to get an accurate picture of the output side of the BRC would require a more involved questionnaire. In its stead, the input profile of the 1998 National Finance, Insurance & Real Estate sector (i.e., the sector which subsumes all real estate development activities) is used as a surrogate.

11 This commodity group contains all construction activities other than those relating to the building of homes. Included in this commodity is a sub-category which captures items such as site excavation, grading, etc. all of which would be purchased as inputs by the BRC.

12 This aggregate commodity includes the activities of insurers, financial institutions, and all activities related to the sale and lease of real estate. Environmental insurance, as well as activities relating to the sale and purchase of land are tracked in this commodity.

13 This commodity group includes many of the specialized services that the BRC would purchase in redeveloping a site including architects, engineers, accountants, lawyers, environmental scientists, laboratories, marketing firms, etc. The actual commodity names from the IO accounts have been retained as these profiles are actually read in by custom software written by this author to compute the impacts of BRC activity on the Canadian economy.
The input profile associated with the first scenario in Table 3 is based on the average of all returned questionnaires, and represents a possible picture of how the BRC buys inputs and sells outputs. Notable in this scenario is the fact that over one third (36%) of all expenditures are accounted for by the commodity “Non-residential Construction” which includes many subordinate commodities including “Other Activities of the Construction Industry”. This subordinate commodity includes excavation, grading, demolition, and other activities that could be purchased directly by the developer (alternatively, these could be entirely spent by remediation contractors hired by the BRC). Direct purchases of this commodity were retained in the input profile on the basis of feedback from some developers who noted that they do purchase these services directly, and that not all of these purchases are made by remediation and other contractors. Given the small sample, it is impossible to know if this is common in the industry, or if the developers who do make such direct purchases of “Non-residential Construction” represent an anomaly.

In the IO accounts, there are no current period purchases or sales of “Non-residential Construction”. Rather, all purchases of this commodity are treated as investment. This makes sense since, as noted above, the IO accounts (at least the inter-industry portions of them) only track non-investment related sales and purchases (leaving investment purchases in the exogenous final demand category). Normally, when excavation or other such activities are undertaken, it is in support of new construction (the cost of which is amortized by the developer purchasing the construction).

In the current context however, these services are used as a current period input in that if a developer sees his/her primary output to be land, then the excavation and remediation services that fall under this commodity classification are not in support of new construction per se. In discussing this with a construction sector expert and Statistics Canada’s Input-Output Division, it was agreed that the experimental input profile for the BRC could logically include current period expenditures on “Non-residential construction”. Also noteworthy in scenario 1 is the fact that the commodity “Business & Computer Services” accounts for more than one half (53%) of total expenditures made by the BRC. This commodity group includes subordinate commodities such as architectural, engineering and scientific services, accounting and legal services, advertising services, and other professional, scientific and technical services. Among those firms offering these commodities for sale would be remediation contractors, surveyors, geophysical consulting firms, firms specializing in environmental chemical analysis, environmental consulting firms, engineering consulting firms, data processing and custom software development firms, environmental law firms, among others. The bulk of the inputs to the BRC should logically originate in this commodity group, and this is borne out to some extent in the survey responses shown in Table 2.

\[14\] If the developer is buying the services of a firm that specializes in remediating soil and ground water by removing soil, trucking it to a dump, and digging trenches to drain water etc., and the developer is doing this to build a new condominium complex, then this purchase of non-residential construction is considered to be an investment purchase. If however, the developer is doing this same activity to “repair” the site so that it can be sold and used in some fashion then the same purchase of non-residential construction is considered to be a current period expense.
Scenario 2 represents a shift away from direct purchases of non-residential construction by the BRC. All purchases of this commodity that are allocated to the BRC in scenario 1 are allocated to “Business and Computer Services” in Scenario 2. This is meant to represent the situation where a remediation contractor (or other service provider) retained by the BRC is the agent that purchases the non-residential construction.

Scenarios 1 and 2 represent two possible pictures of the input and output structures of the BRC. It is important to note that these are scenarios, or pictures of possible realities, and not predictions of the actual real-world structure of the BRC. Given all of the information available at the time of writing, these scenarios appear to be reasonable.

5.4 Estimating the Magnitude of the BRC

The IO profiles discussed above are in percentage terms. That is, for a dollar of BRC output, the profiles show how that dollar is allocated amongst the various commodities on the input and output sides. While this analysis would be very instructive if we focused only on the impact of a single dollar of BRC activity (i.e., focusing on multipliers only), it would be useful to also be able to illustrate the sheer magnitude of the impact of the BRC on the Canadian economy. The numbers pertaining to Canada’s environment industry referred to above are not terribly helpful in this regard as they pertain to any and all sectors of the economy which produce goods or services which can be used in an environmental application. So, while telling in one sense (i.e., that a growing proportion of GDP in Canada is attributable to environment-related activities), they do not shed light on the magnitude of the BRC.

Insurers were approached in an attempt to establish whether or not the providers of environmental cost cap insurance (in addition to other types) had made estimates of the size of the brownfield redevelopment market prior to offering these products. The best information available to date suggests that these companies either do not have such a number, or are unwilling to share such an estimate, if it exists.

Colangelo et al. (2002) in a report produced for the National Round Table on the Environment and the Economy (NRTEE) estimate that brownfield redevelopment activities in the U.S. amount to at least $1.5 billion annually, and that this market is growing by 15 to 20 percent each year. In discussions with the lead author, Mr. Robert Colangelo, Executive Director of the National Brownfields Association in the U.S., noted that he thought the standard 10 percent rule of thumb (for U.S. to Canadian translations of socioeconomic variables) was likely optimistic (i.e. $150 million) as an estimate of the size of the market in Canada, given the nascent stage of the Canadian brownfield redevelopment industry.
Alternatively, Mr. Luciano Piccioni\textsuperscript{15}, Brownfield Coordinator for the City of Hamilton and President of RCI Consulting, notes that an unnamed remediation firm he interviewed captures between 1 and 5 percent of the Canadian market, and averages $3 million in yearly revenues. Based on this information, the market could be as large as $300 million per year if this firm is capturing 1 percent of the total market, or as small as $60 million per year if this firm is capturing 5 percent of the total market.

It appears reasonable to conclude therefore that the Canadian BRC likely accounts for somewhere between $50 million per year (a very conservative estimate) and $300 million per year (a very optimistic estimate). These magnitudes however appear to represent reasonable bounds for the actual value.

5.5 Modelling the Economic Impact of the Brownfield Redevelopment Cluster on the Canadian Economy.

One of the objectives of this research, as mentioned in the introduction, is to model the impact of the BRC on the Canadian economy. To conduct such an assessment, the nature of the relationship between the BRC and the broader Canadian economy must be established. Reasonable approximations of this relationship are presented in Table 3.

The degree to which a given sector of the economy has a multiplier effect on the rest of the economy (i.e., has the potential to stimulate income multiplication) is dependent on the degree to which that sector buys inputs from, and sells output to, other sectors in the economy. For example, a firm operating in Canada but importing all (or most) of its labour and materials from other countries has little impact on the Canadian economy (i.e., it does not contribute to income multiplication in Canada) because it does not buy inputs from Canadian producers. As these imports are replaced by domestically produced goods, and domestic labour the multiplier effect of that industrial firm will increase considerably.

To model the impact of the BRC on the Canadian economy, the IO profiles of table 3 were impressed upon the 1998 National Input-Output tables (most recent available) for Canada.\textsuperscript{16} Once the BRC was added to this system of accounts, each input and output profile combination was used in the estimation of a model that computes total impacts on domestic production inclusive of feedbacks from personal consumption (see Technical Appendix for model details).\textsuperscript{17}

\textsuperscript{15} Mr. Piccioni is a widely acknowledged expert in the field. Contact information: City of Hamilton, Economic Development Department, 1 James Street South, 8th Floor, Hamilton, Ontario L8P 4R5; Phone 905.546.4381. or 1.800.263.8590.

\textsuperscript{16} The “Small” level (or S-level) of sector and commodity aggregation was used due to confidentiality problems with the “Medium” level tables. The S-level tables consist of 25 aggregate sectors and 48 aggregate commodities.

\textsuperscript{17} The model was designed to compute only that production which could reasonably be expected to be assigned to Canadian sectors (based on existing import patterns in 1998). It also computed the additional income multiplication effects associated with the consumer spending stimulated by the BRC’s impacts on Canadian regional economic activity.
5.6 The Results

Table 4 presents a listing of total output multipliers for each industry in the Canadian economy (at the S-level of aggregation) in addition to one for each of the BRC and household sectors respectively. A total output multiplier for the BRC is interpreted as the total output required from all sectors in the economy to produce an additional dollar’s worth of BRC output.

Table 4 Total Output Multipliers by Sector, Scenarios One and Two

<table>
<thead>
<tr>
<th>No.</th>
<th>Sector Title</th>
<th>Total Output Multipliers Scenario 1</th>
<th>Total Output Multipliers Scenario 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crop and Animal Production</td>
<td>2.7</td>
<td>2.7</td>
</tr>
<tr>
<td>2</td>
<td>Forestry and Logging</td>
<td>2.9</td>
<td>2.9</td>
</tr>
<tr>
<td>3</td>
<td>Fishing, Hunting and Trapping</td>
<td>2.4</td>
<td>2.4</td>
</tr>
<tr>
<td>4</td>
<td>Support Activities for Agriculture and Forestry</td>
<td>3.1</td>
<td>3.1</td>
</tr>
<tr>
<td>5</td>
<td>Mining and Oil and Gas Extraction</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>6</td>
<td>Utilities</td>
<td>1.9</td>
<td>1.9</td>
</tr>
<tr>
<td>7</td>
<td>Construction</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>8</td>
<td>Manufacturing</td>
<td>2.8</td>
<td>2.8</td>
</tr>
<tr>
<td>9</td>
<td>Wholesale Trade</td>
<td>2.9</td>
<td>2.9</td>
</tr>
<tr>
<td>10</td>
<td>Retail Trade</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>11</td>
<td>Transportation and Warehousing</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>12</td>
<td>Information and Cultural Industries</td>
<td>2.7</td>
<td>2.7</td>
</tr>
<tr>
<td>13</td>
<td>Finance, Insurance, Real Estate and Renting and Leasing</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>14</td>
<td>Professional, Scientific and Technical Services</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>15</td>
<td>Administrative and Support, Waste Management and Remediation Services</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>16</td>
<td>Education Services</td>
<td>2.7</td>
<td>2.7</td>
</tr>
<tr>
<td>17</td>
<td>Health Care and Social Assistance</td>
<td>2.4</td>
<td>2.4</td>
</tr>
<tr>
<td>18</td>
<td>Arts, Entertainment and Recreation</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>19</td>
<td>Accommodation and Food Services</td>
<td>3.1</td>
<td>3.1</td>
</tr>
<tr>
<td>20</td>
<td>Other Services (Except Public Administration)</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>21</td>
<td>Operating, Office, Cafeteria, Laboratory Supplies</td>
<td>2.8</td>
<td>2.8</td>
</tr>
<tr>
<td>22</td>
<td>Travel, Entertainment, Advertising and Promotion</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>23</td>
<td>Transportation Margins</td>
<td>3.7</td>
<td>3.7</td>
</tr>
<tr>
<td>24</td>
<td>Non-Profit Institutions Serving Households</td>
<td>3.3</td>
<td>3.3</td>
</tr>
<tr>
<td>25</td>
<td>Government Sector</td>
<td>3.1</td>
<td>3.1</td>
</tr>
<tr>
<td>26</td>
<td>Brownfield Redevelopment Cluster</td>
<td>3.8</td>
<td>3.6</td>
</tr>
<tr>
<td>27</td>
<td>Households</td>
<td>2.4</td>
<td>2.4</td>
</tr>
</tbody>
</table>

industries (i.e., induced impacts). In technical terms, the model treated imports and personal consumption endogenously.

18 By treating personal consumption expenditures endogenously, it is as if households represent an additional industrial sector buying inputs (i.e., personal consumption expenditures) and selling output (i.e., labour).
Table 4 shows that the multiplier for the BRC under scenario 1 is 3.8 meaning that a $1 increase in the output of the BRC generates an additional $3.8 worth of output economy-wide. \(^{19}\) It is interesting to note that the BRC has the highest output multiplier of all sectors in the economy. Such a finding is not surprising given the high service-content of the BRC and the large number of inter-firm linkages that typify this sort of activity (i.e., note that most service industries have multipliers that exceed 3.0). In this context, this result means that monies dedicated to funding brownfield redevelopment have a larger stimulatory effect on the Canadian economy than would investment in any other sector.

A standard national IO model treats all the usual sectors (i.e., the NAICS aggregate categories tracked in my tables above) as being the productive component of the economy that reacts to the final demand category which includes personal consumption, government expenditures, exports etc. Deriving a model from the data in this way gives you a model that treats personal consumption expenditures (i.e., purchases by the household sector) as being exogenous or completely unrelated to what is going on in the productive core of the economy. If you think about it, this is accurate...the amount people spend on consumption is a function of their income level, and their income level is a function of the extent to which they are employed by the productive sectors. So, personal consumption expenditures are not really exogenous, but rather they are endogenous. Using this logic, we need to establish a link from industrial activity to labour income to personal consumption purchases in the balance equations used to derive the model. To do this, the household sector is removed from final demand and added to the productive core of the economy as the (n+1)th sector. The inputs of the household sector are the personal consumption purchases tracked in final demand (i.e., these are the things households require to produce their principal product – labour), and the output of this sector is tracked as sales of labour to individual sectors. Once this is established, a final demand shock of any sort will trigger industrial activity, which will require labour, and this labour is paid, they then spend a portion of their earnings, and this personal consumption activity must be satisfied by more production – the induced effect. As you can imagine, this effect can be substantial, especially when you consider that nearly two thirds of national GDP is generated by personal consumption expenditures.

A common use for total output multipliers is in the ranking of industrial categories by local, regional and/or national economic and policy planners. Those sectors with large multipliers are the ones that, if stimulated (for example through a government contract), would generate the largest spin-off effect in the economy. Sectors with large multipliers represent logical choices for investment if governments wish to stimulate overall economic activity in a region or nation. Such sectors are also worthy of in-depth analysis, and policy attention. The BRC is undoubtedly a candidate for both.

It is important to reiterate that these multipliers are inclusive of the “induced effect” of personal consumption expenditures. That is to say, given the way in which the model is

\(^{19}\) These multipliers are inclusive of the induced effects of household spending, and as such are higher than multipliers computed in a standard model that does not make the household sector endogenous. The same multiplier for the BRC generated using an “open” model is 2.6.
structured, a feedback from industrial activity, to personal consumption and back to industrial activity is incorporated into the multipliers. To illustrate, consider the scenario where the demand for the output of the BRC increases $1 million. The total output multipliers show that this will generate $3.8 million in additional output economy-wide. This additional $3.8 million is composed of all of the rounds of spending discussed above when the notion of income multiplication was introduced (refer back to Figure 5.1). In addition to this however is output triggered to satisfy the personal consumption purchases enabled by the initial increase in output.

To illustrate further, consider an example. Assume that Mr. Doe is hired by a remediation contracting firm (a firm that is reaping the benefits of this additional $3.8 million of output referred to above) to help the firm meet the increase in demand for its services. Mr. Doe will save some of his wages, some will be taken away in the form of taxation, but the remainder will be used by Mr. Doe for personal consumption. If Mr. Doe decides to buy a new car with his new-found wealth (wealth which is entirely due to the original shock to the BRC). This represents a feedback from the BRC to personal consumption and on to manufacturing (i.e., since the manufacturing sector must produce the car). So, the original shock to the BRC generated increased income for Mr. Doe, which in turn further increased the demand for the output of the manufacturing sector. This is an example of an induced effect.

Induced effects like the one described above can be substantial. In the case of the Canadian BRC, their inclusion causes the BRC multiplier to increase from approximately 2.6 in an open model to 3.8 in the closed model.\textsuperscript{20} Research has shown that open models under-estimate the impact of a given change in demand (because they fail to capture induced effects), and that the degree of under-estimation is highest in diversified economic regions like Canada.

Table 5 presents a summary of the results of running both IO profiles through the IO model for assumed BRC output levels of $50 million, $100 million, $150 million and $200 million respectively. The large multiplier effect of the BRC is illustrated in Table 5. To sustain an output level in the BRC of $100 million (a reasonable estimate of the size of the Canadian BRC), the economy as a whole must produce an additional $375 million in output. In addition, it will also generate $79 million in labour income.

Tables 4 and 5 show that even though the input profiles of the BRC are quite different in moving from scenario 1 to scenario 2, the overall impact of this change on multiplier values and total output and labour income effects is negligible.

Table 5 also distinguishes direct, indirect and induced effects (all of which sum to the total output impact). The direct effects represent those expenditures of the BRC which go to the “front-line” input providers, and these are often local (e.g., a direct impact of increasing the output of the BRC by $1 could be an additional $0.20 worth of environmental consulting time/activity). The indirect effects represent all rounds of spending after the direct effects

\textsuperscript{20} The term “open model” is used to refer to a model which does not capture this feedback. “Closed models” however do incorporate this feedback.
(from round 2 until the dollar value of the initial shock approaches zero). Induced effects, as discussed above, represent those output impacts that are due to the induced personal consumption expenditures in the economy which flow from the initial shock. Information on induced effects can be especially useful in comparing development options in an attempt to choose one which offers the greatest possible return in the form of consumption tax revenues.

Table 5  
Impact of BRC Activity on the Canadian Economy

<table>
<thead>
<tr>
<th>Assumed BRC Output Level</th>
<th>Total Labour Income Impact</th>
<th>Total Industry Output Impact</th>
<th>Total Direct Output Impact</th>
<th>Total Indirect Output Impact</th>
<th>Total Induced Output Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>$50</td>
<td>$40</td>
<td>$188</td>
<td>$47</td>
<td>$83</td>
<td>$58</td>
</tr>
<tr>
<td>$100</td>
<td>$79</td>
<td>$375</td>
<td>$93</td>
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<td>$150</td>
<td>$119</td>
<td>$563</td>
<td>$140</td>
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<td>$174</td>
</tr>
<tr>
<td>$200</td>
<td>$159</td>
<td>$751</td>
<td>$186</td>
<td>$332</td>
<td>$233</td>
</tr>
</tbody>
</table>

(all figures in millions of 1998 Canadian dollars)

In devising a model that is capable of capturing induced effects households are essentially added as an additional producing sector whose inputs are consumption purchases and whose output (labour) is sold to industries. As such, any change in the demand for the output of any sector will lead to a response by all sectors, and all sectors use labour in producing their output. So, labour income is earned by households in each round of spending – through direct, indirect and induced effects – these total labour income effects represent the total labour income earned by households through all rounds of spending. This information was used to derive the income tax implications (i.e., the 22 cents per dollar of output figure).
In addition to generating substantial output and labour income effects Canada-wide, Table 6 shows that the BRC has the potential to generate substantial tax revenues for the federal government.\(^{21}\) The information presented in Table 6 was obtained by running the labour income impact vectors presented in Table 5 (for all assumed BRC activity levels) through a specially designed tax model.\(^{22}\)

**Table 6. Federal Personal Direct and Indirect Tax Revenue Impacts of BRC Activity\(^{23}\)**

<table>
<thead>
<tr>
<th>Assumed BRC Activity Levels</th>
<th>$50 million</th>
<th>$100 million</th>
<th>$150 million</th>
<th>$200 million</th>
</tr>
</thead>
</table>
| Federal Indirect Taxes (e.g.,
GST, Gas Tax etc.) | $1.045      | $2.090       | $3.135       | $4.180       |
| Employer & employee contributions to CPP | $3.070   | $6.140       | $9.120       | $12.280      |
| Employer & employee contributions to EI | $2.142 | $4.284       | $6.426       | $8.568       |
| Other Transfers from persons to Government | $0.005  | $0.009       | $0.014       | $0.018       |
| Total Impact on Federal Revenues | $10.810 | $21.619      | $32.359      | $43.238      |

(all figures in millions of 1998 dollars)

Table 6 shows that $100 million of BRC activity Canada-wide will generate nearly $22 million in personal direct and indirect tax revenue for the federal government. Interpreted another way, every dollar of BRC activity generates nearly $0.22 (or 22 cents) in federal tax revenue. The tax revenues that would flow from all of the corporate/business sector activity stimulated by the BRC would surely be significant, in addition to the personal tax revenues reported in table 5.\(^{24}\)

This result (taken on top of all of the evidence presented above regarding the benefits of brownfield redevelopment) should make it even easier for the federal government to consider using public monies to stimulate the BRC. Not only will a host of environmental, social and

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\(^{21}\) The case studies discussed previously show that both the local and provincial levels of government in Canada stand to benefit in terms of tax/levy revenues flowing from BRC activities. The model used to generate the results shown in table 6 however only considered federal personal direct and indirect tax revenues—not corporate taxes.

\(^{22}\) Regional Analytics Inc. provided NRTEE impact vectors to Ellis Consulting Services to be run through a tax model. Contact information: Ellis Consulting Services, 2021 Finlayson Drive, NWT X1A 3C7.

\(^{23}\) The tax impacts discussed below were generated using 2001 contribution rates and an assumed average wage of $35,000 (in 2001 dollars). These tax impacts, while generated by an elaborate model, are very close to what would have been obtained by multiplying labour income values by an assumed marginal tax rate of 27%.

\(^{24}\) It is important to note that given the time available, a model that incorporated taxes paid by corporations in Canada was not feasible. Regional Analytics Inc. is in the process of developing such a tax model.
economic benefits be realized as a result of the expenditures, but these expenditures would, to some extent, be self financing. Had this analysis been carried out with a multi-regional version of the IO model (i.e., one which treated Canada as a set of interacting regions as opposed to one large region) these results would have been region-specific. As it stands now, these results pertain to Canada as a whole. However, given that Ontario and Quebec account for the majority of Canada’s population, manufacturing capacity, and brownfields, it would be reasonable to assume that the majority of the output and labour income effects presented above would be concentrated in these two provinces. So, while the impacts discussed above do pertain to Canada as a whole, they will be largely concentrated in the provinces of Ontario and Quebec, and specifically within the Windsor-Quebec City Corridor portion of these two provinces.\(^{25}\)

\(^{25}\) The Windsor-Quebec City Corridor represents the manufacturing heartland of Canada, and not surprisingly specialized services such as those which attend BRC activities will be concentrated in this region as well.
6.0 Conclusions

6.1 Summary of Findings

In order to address the five core research questions that flowed from the NRTEE terms of reference for this study, a combination of analytical tools were utilized to examine the economic and other impacts of brownfield redevelopment in Canada. These tools include: a literature review, examination of case studies, interviews with brownfield experts, a survey of brownfield developers, and an Input-Output (I-O) analysis of the economic impact of the brownfield redevelopment cluster (BRC) in Canada. The study drew heavily on literature from the U.S. because of the greater experience that the U.S. has dealing with brownfields and the lack of pertinent literature in Canada. The findings of this study with respect to the five core research questions are summarized below.

6.1.1 Brownfields vs. Greenfields

A study comparing greenfield and brownfield development in a sample of U.S. cities provided empirical evidence to show that for every acre of brownfield land redeveloped, a minimum of 4.5 acres of greenfield land would be required to accommodate the same development. Numerous studies cite the potential for brownfield redevelopment to reduce urban sprawl and promote real smart growth.

The literature review and data from the City of Hamilton support the conclusion that there exists a serious “market mismatch” between greenfield and brownfield sites, making it significantly more expensive to develop a brownfield site. In the City of Hamilton, the costs of developing a moderately contaminated 2 acre brownfield site for industrial/commercial re-use can be between 14% and 34% more expensive than the same development on a 2 acre greenfield site. Therefore, if brownfield redevelopment is to take place in any significant way in Canada, these results point to the need for government intervention into the market to “level the financial playing field” between greenfield and brownfield development. This can be accomplished by policies that either increase the costs of greenfield development, decrease the costs of brownfield redevelopment, or both. This study contemplates only the use of financial incentives designed to decrease the costs of brownfield redevelopment.

The literature review and case studies also showed that there are a myriad of economic, social and environmental benefits that result from redeveloping brownfields, that do not necessarily result from greenfield development. These include: a reduction in urban sprawl and associated costs, such as the extension of infrastructure, traffic congestion and air pollution, as well as the revitalization of neighbourhoods, employment areas and urban cores, and an increase in community pride.

Clearly, when considered as a whole, the anecdotal and empirical evidence to suggest that brownfields should be redeveloped instead of greenfields, is overwhelming.
6.1.2 What Are the Key Impediments to Brownfield Redevelopment?

In a 2000 survey of 232 U.S. cities (U.S. Conference of Mayors), the lack of funds to cleanup sites was cited as the number one impediment to brownfield redevelopment, finishing ahead of liability issues, which was the second most often cited impediment. The need for environmental assessments, demolition monies, environmental regulations and market conditions were also cited as significant impediments to brownfield redevelopment, but the lack of cleanup funds was the single most important impediment to brownfield redevelopment. Another study (ICF Consulting and E.P. Systems Group, 1999) concluded that liability issues were more important than the lack of funding for brownfields. While there is no clear consensus on this issue in the literature, it is clear that both the lack of funding for environmental assessments and cleanups and liability issues are the key impediments to brownfield redevelopment.

6.1.3 What Are the Economic, Environmental and Social Benefits of Brownfield Redevelopment?

Numerous studies of brownfield redevelopment and the case studies examined here, show that brownfield redevelopment produces significant economic benefits at all geographic scales (local, provincial, and national), regardless of size of project or type of re-use. These benefits include job creation, increased incomes and property taxes at the local level, and increased income and sales taxes at the provincial and federal levels.

The I-O analysis showed that every $1 spent on brownfield redevelopment in the Canadian economy generates approximately $3.80 in total economic output of all industries in the Canadian economy (including direct, indirect and induced effects). This is a very high economic multiplier indicative of an industry that has a high degree of backward and forward linkage with the rest of the economy. Therefore, government investment in promoting brownfield redevelopment could potentially have a greater stimulatory effect on the Canadian economy that investment in other sectors of the economy.

The significant economic benefits of brownfield redevelopment are only one part of a three part story. The literature review and case studies clearly tell the other two parts of the story, i.e., the numerous environmental and social benefits of brownfield redevelopment. These include:

- neighbourhood, employment area and urban core revitalization
- provision of affordable housing opportunities
- increased downtown population and housing opportunities
- improved aesthetic quality of the urban fabric
- creation of parkland and public open spaces
- improved public waterfront access
- elimination of significant environmental hazards
- protection of groundwater resources
- protection of wetlands and wildlife habitat
• protection and improvement of public health
• accessible and open community participation
• increased sense of civic and community pride

The environmental and social benefits of brownfield redevelopment should not be underestimated, nor should the strength of the relationships between the different types of benefits.

The conclusion of the analysis conducted here is that there are a myriad of significant economic, environmental and social benefits that result from brownfield redevelopment. This is the case regardless of size or type of development. The literature review and case studies show that while the environmental and social benefits accrue primarily (but not solely) at the local level, the economic benefits accrue at all geographic levels (local, provincial, and national). The long-term benefits of brownfield redevelopment, such as the reduction in urban sprawl, traffic congestion and related air pollution will also accrue at all geographic levels.

6.1.4 What Financial Instruments Are Available to Promote Brownfield Redevelopment?

There are currently few financial instruments being used in Canada to promote brownfield redevelopment. The Province of Ontario recently passed legislation establishing a form of tax freeze/cancellation to support brownfield cleanup, but there is no experience with this program as of yet. The Province of Quebec introduced the Revi-Sols Program in 1998 to promote brownfield cleanup and redevelopment. The program provides grants for the costs of environmental assessments and remediation work. The Revi-Sols program has been very successful in promoting brownfield redevelopment. In less than 5 years, the Revi-Sols program has funded the cleanup and redevelopment of some 140 projects in the Province of Quebec.

The U.S. federal government offers financial incentives to promote brownfield redevelopment. This includes programs such as demonstration pilot grants and revolving loan funds under the EPA, and the brownfield economic development initiative (BEDI) under HUD. These programs are targeted directly at brownfield redevelopment. Other U.S. federal government programs that are general economic and community development programs have also been used by U.S. cities and states to undertake brownfield redevelopment projects.

In 1997, the U.S. federal government introduced the Taxpayer Relief Act (TRA) which included a tax incentive that allows environmental cleanup costs to be fully deducted from income in the year they are incurred. But, the TRA incentive has not been widely used because of cumbersome procedural requirements as well as the amount of work required to obtain the credit.

The U.S. EPA provides three types of financial incentives:
1) Demonstration Pilot Grants of up to $200,000 each awarded to states, cities, towns, counties and tribes to conduct environmental assessment related activities and develop remediation and redevelopment plans;

2) Cleanup Revolving Loan Funds of up to $500,000 ($1,000,000 under the new Small Business Liability Relief and Brownfields Revitalization Act) awarded to states, cities, towns, counties and tribes to provide low-interest loans to carry out cleanup activities at brownfield sites; and,

3) Job Training Pilot Grants of up to $200,000 each to provide job training for residents of communities affected by brownfields.

U.S. federal programs focus heavily on providing site assessment and cleanup funding, targeted to state and local governments. Few of these programs are applicable directly to the private sector. In essence, the states and local governments have become “partners” in the delivery of federal programs. This approach has both been criticized as an inefficient and indirect means of providing funding, and on other hand, praised as a system that promotes greater accountability and flexibility to meet specific local community needs. Criticisms of the federal brownfield incentives in the U.S. found in the literature did not focus on the partnership delivery model. Instead, factors such as the special knowledge required to understand and access each program, the amount of work required to secure what can amount to an insignificant incentive, poor applicability and lack of program flexibility were cited as key deficiencies of U.S. federal programs.

The literature review suggested that an absence of site-specific environmental information significantly inhibited brownfield redevelopment. While the costs of these preliminary site investigations are usually small compared to cleanup and project construction costs, these studies must be done. It is difficult to attract a developer to a site if there is no environmental information. Therefore, funding for environmental site assessments is very important and is seen as an enabling mechanism.

The literature review also suggested that grants for site remediation were needed to allow cities to make brownfields as attractive to developers as greenfields. Most of those interviewed in the George Washington University study (Deason et. al, 2001) indicated a preference for site clean-up grants over tax incentives. As one interviewee put it: “tax incentives are good, clean ground is better”.

The use of financial incentives by state governments in the U.S. to promote brownfield redevelopment is quite common. As of the end of 2000, at least 35 U.S. states (70%) offered some form of financial assistance to promote brownfield redevelopment. No less than a dozen different types of state-sponsored financial incentives were identified. This ranged from site assessment and remediation grants and loans, to property tax abatements, income and business tax credits, to job creation incentives, public infrastructure grants and environmental insurance subsidies. Several patterns and trends emerged from this analysis of financial incentives offered by U.S. states.
The most common types of assistance programs offered by the state level of government in the U.S. includes loans (23 states) and grants (19 states). This was followed by property tax abatement/deferral (15 states) and various income, business and sales tax credits (10 states). Clearly, direct funding mechanisms such as grants and loans are more popular than indirect funding mechanisms such as income and property tax abatement.

While about an equal number of states (12) use grants or loans to promote site assessment, far more states (23) use loans instead of grants (only 12 states) to promote site remediation. This suggests that either loans or grants can be used to promote site assessment, but loans seem to be the more popular incentive used by U.S. states for promoting site remediation.

Between 1998 and 2002, 5 states that did not offer brownfield financial incentives began doing so, and another 5 states added new incentives to the brownfield financial incentives they were already offering. This indicates that more and more U.S. states are seeing benefit in offering financial incentives to promote brownfield redevelopment. Of the 10 states starting new funding programs or adding funding programs, 8 introduced loan/grant programs, 4 introduced property tax abatement, while 2 introduced both. This trend reinforces the preference for loans and grants in existing state brownfield programs. Another trend that was identified was that more states are starting to link more diverse programs to promote brownfield redevelopment.

6.1.5 How Can the Relationship Between the Economic, Environmental and Social Benefits of Brownfield Redevelopment Be Conceptualized?

The results of this study show that the economic, environmental and social benefits that flow from brownfield redevelopment and the interrelationships between these different types of benefits are very complex. Few studies have attempted to capture the nature of these relationships. Yet, it is important to do so from a policy perspective. Based on the analysis conducted in the study, Section 6.2 below presents a preliminary conceptualized framework for understanding the relationship between the economic, environmental and social benefits of brownfield redevelopment.

6.2 Comprehensive Conceptual Framework for Understanding the Benefits of Brownfield Redevelopment

Figure 6 is a comprehensive (advanced) conceptual framework for understanding the benefits of brownfield redevelopment. The framework in Figure 6 builds on the basic framework presented in Figure 2 of Section 1.6. While the comprehensive framework is preliminary in nature, and is provided to demonstrate the complexity of the relationships between the myriad of benefits that can and do result from brownfield redevelopment, this framework is supported by the findings of the literature review (particularly Deason et. al., 2001), the case studies and the I-O analysis.
Figure 6  Comprehensive Conceptual Framework for Understanding the Benefits of Brownfield Redevelopment

**Economic Benefits**
- Job creation (short-term and long-term) and increased incomes
- Increased spending (spin-off effects)
- Increased provincial and federal tax revenues
- Improved financial position of provincial and federal government
- Stimulation of new economic activity
- Increased diversification of local economy
- Increase in property values of redeveloped and adjacent properties
- Improved financial position of local government
- Reduction of urban sprawl and associated costs (reduced demand for extension of municipal services)
- Improved labour market efficiency

**Environmental Benefits**
- Creation of open space and recreation opportunities
- Protection of groundwater resources
- Protection of greenfields, wetlands and wildlife
- Removal of contaminant from the environment
- Reduction in greenhouse gas emissions resulting from the reduction of urban sprawl
- Increased spending (spin-off effects)
- Improved financial position of provincial government

**Social Benefits**
- Revitalization of neighborhoods, employment areas and urban cores
- Increased aesthetic quality of urban fabric
- Increased in affordable housing opportunities
- Increase in parkland and open spaces, including waterfront access
- Improved quality of life

**Brownfield Redevelopment**
- Increased provincial and federal tax revenues
- Improved financial position of provincial and federal government
- Improved quality of life
Just as with the I-O analysis, brownfield redevelopment is seen in Figure 6 as the catalyst that sets in motion or triggers a large number (no less than 14 types) of economic, environmental and social benefits. These benefits are connected in many ways, both within the three categories of benefits (economic, environmental and social), and between the three categories of benefits. The complexity and two-way nature of these interrelationships is shown in Figure 6 at an upper level by the arrows between the three categories of benefits (economic benefits, environmental benefits and social benefits). The more detailed relationships between different types of benefits is shown by arrows between the different benefits, both within and between benefit categories, and the direction of the relationships is also shown.

For example, many economic, environmental and social benefits of brownfield redevelopment directly or indirectly improve the financial position of local, provincial and federal governments. This happens in many ways, from increases in incomes and property values, to a reduction of urban sprawl and its associated infrastructure costs, to improvements in human health and quality of life. While the conceptual framework in Figure 6 may not capture every single relationship between the benefits of brownfield redevelopment, it certainly supports the complexity and significance of the numerous benefits of brownfield redevelopment.

While the three benefit categories in Figure 6 are separated by dashed lines, it is clear that the quantity and quality of the interrelationships between the three categories suggests that attempts to study and understand only one category of benefits are necessarily incomplete. In fact, it is clear from Figure 6 that brownfield redevelopment and the relationship between the benefits of brownfield redevelopment should be conceptualized in a holistic manner. While the comprehensive conceptual framework can be utilized to do this, it can also be utilized in several other ways. For example, it can be used to help guide brownfield redevelopment policy efforts by providing an organizational framework to evaluate the potential benefits of different financial, legislative and other policies. It can also be used to help compare the potential impacts of alternative brownfield projects and allow users to identify those projects most likely to provide the greatest economic, environmental and social benefits. Therefore, this framework can potentially be used in both a policy context and project specific context to help guide brownfield redevelopment strategies in a way that achieves and maximizes economic, environmental and social benefits.

Part of future work suggested to the NRTEE is to further refine this conceptual framework and gather further empirical evidence to support and better define the cause and effect relationships between benefits. This work would also include developing indices of economic impact which are more comprehensive and meaningful than traditional economic indicators such as employment or income. The goal would be to develop a multi-purpose evaluative policy tool that could be used at any geographic scale to evaluate proposed and actual brownfield redevelopment policies, programs and projects.
6.3 Limitations of the Study Directions for Future Research

While the results of this research are compelling in terms of the clarity with which they illustrate the economic, environmental and social desirability of accelerated brownfield redevelopment in Canada, they are subject to certain caveats and assumptions which should be stated explicitly. It is important to note that any analysis of this sort, be it analytical or otherwise, involves the use of assumptions either explicitly or implicitly.

A significant portion of the results reported above are based on interviews with developers, brownfield experts, government staffers, and reviews of several bodies of literature. In all of this, the potential for the introduction of bias is minimal. However, as noted above, the survey of developers upon which the macroeconomic analysis is based, was unscientific and certainly not generalizable in statistical terms. This information in combination with anecdotal evidence was used to create “experimental” input and output profiles of the BRC in Canada. As discussed, much remains to be done in terms of accurately representing the input and output structures of the Canadian BRC, but the experimental profiles used above appear to represent a reasonable first step. The fact that the results reported above are robust over these assumptions is illustrated by the fact that two different structural scenarios for the input-side of the BRC yield nearly identical multipliers.

The level of sectoral and commodity aggregation in the raw Input-Output data used for this analysis also made it more difficult to differentiate the BRC from the development industry generally. While this does not generate inaccuracies per se, in combination with the small survey component discussed above, this does illustrate the fact that we are only beginning to understand how to differentiate the BRC from the development industry generally. Further work in this regard, as noted above, should start with a thoughtful and extensive survey of developers generally, and of those involved in the BRC, in an attempt to accurately describe their structures.

Also, whenever IO analysis is used, a suite of caveats must be kept in mind. These include the assumption of constant returns to scale in production, and the assumption of static inter-sectoral relationships. The first of these means that an IO model will, for a given shock, assign output to sectors of the economy in the same manner no matter how large the shock happens to be (i.e., dollar value of sector i output used per dollar of sector j output is the same regardless of how much output j is called to produce, or at what scale sector j is already operating.) The second caveat emanates from the use of fixed proportions (often referred to as technical coefficients) to derive the actual model from the observed data. These proportions dictate how one sector buys from all others in producing its output. If the IO model is used to forecast into the future then this issue is critical. However, this caveat comes into play in this context to some extent as well in that the 1998 national IO data is used as an approximation of the current Canadian economy. Given that the data is very aggregate in terms of sectors and

26 A more elaborate production function than the one that underlies the IO model would allow for economies of scale (i.e., where the use of i per dollar of j output is a function of the level of sector j output.)
commodities, and given that the data pertains to the entire country, most of the distortions introduced by this limitation would be eliminated over space and through aggregation.

Finally, another limitation of this research stems from its limited scope. That is, questions still remain regarding what the opportunity cost to governments (federal, provincial and local) of doing nothing on the brownfield redevelopment front would be. While the results above speak to this somewhat, a true cost-benefit analysis is required to delve deeper into this issue of opportunity costs. Future work should build on this foundation, by broadening the definition of benefits to include many of the items shown in Figure 6, and by quantifying the cost-side of the equation to facilitate a full CBA. Specifically, the view that monies directed to brownfield redevelopment incentives must be taken from some other use, must be incorporated. However, the finding reported above that brownfield redevelopment incentives would be partially self-financing, reduces the impact an incentive campaign would have on existing entitlement and other federal expenditures. Regional Analytics is well equipped to tackle this task should the opportunity present itself.

In closing, the BRC is one of the most propulsive “sectors” of the Canadian economy, and one which has the potential to generate significant spin-offs in the environmental and social spheres.
7.0 References


Appendix A

Comparison of Development Costs – Brownfields vs. Greenfields
Cost Comparison of Brownfield vs. Greenfield Development
New 40,000 sq.ft. Industrial Manufacturing Facility on a 2 Acre Site in Hamilton, ON.

Scenario 1 – Land Purchased for $1

**Assumptions:**
- Moderate level of contamination - $450,000 in clean-up costs
- Property already serviced/zoned for Industrial use
- No Industrial Development Charges
- No Parkland Dedication for Brownfield Site

### Scenario 1 - Land Purchased for $1

<table>
<thead>
<tr>
<th>Item</th>
<th>Brownfield (BF) (Burlington Street)</th>
<th>Greenfield (GF) (Stoney Creek Business Park)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Purchase</td>
<td>$1.00</td>
<td>$160,000.00</td>
</tr>
<tr>
<td>Building Construction @$45/sq.ft.</td>
<td>$1,800,000.00</td>
<td>$1,800,000.00</td>
</tr>
<tr>
<td>Building Permit Fee</td>
<td>$23,600.00</td>
<td>$23,600.00</td>
</tr>
<tr>
<td>Site Plan Control Application</td>
<td>$1,000.00</td>
<td>$1,000.00</td>
</tr>
<tr>
<td>Parkland Dedication (2% of Land Value)</td>
<td>$450,000.00</td>
<td></td>
</tr>
<tr>
<td>Clean-up of property with medium level contamination</td>
<td>-</td>
<td>$3,200.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$2,274,601.00</td>
<td>$1,987,800.00</td>
</tr>
</tbody>
</table>

Increase in Development Costs of BF over GF $286,801.00 14.4%

Scenario 2 - Land Purchased for $120,000
(50% of clean market value)

<table>
<thead>
<tr>
<th>Item</th>
<th>Brownfield (BF)</th>
<th>Greenfield (GF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Burlington Street)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land Purchase</td>
<td>$120,000.00</td>
<td>$160,000.00</td>
</tr>
<tr>
<td>Building Construction @$45/sq.ft.</td>
<td>$1,800,000.00</td>
<td>$1,800,000.00</td>
</tr>
<tr>
<td>Building Permit Fee</td>
<td>$23,600.00</td>
<td>$23,600.00</td>
</tr>
<tr>
<td>Site Plan Control Application</td>
<td>$1,000.00</td>
<td>$1,000.00</td>
</tr>
<tr>
<td>Parkland Dedication (2% of Land Value)</td>
<td>-</td>
<td>$3,200.00</td>
</tr>
<tr>
<td>Clean-up of property with medium level contamination</td>
<td>$450,000.00</td>
<td>-</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$2,394,600.00</strong></td>
<td><strong>$1,987,800.00</strong></td>
</tr>
</tbody>
</table>

Increase in Development Costs BF over GF $406,800.00 20.5%

Scenario 3 - Land Purchased for $240,000
(100% of clean market value)

<table>
<thead>
<tr>
<th>Item</th>
<th>Brownfield (BF)</th>
<th>Greenfield (GF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Stoney Creek Business Park)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land Purchase</td>
<td>$240,000.00</td>
<td>$160,000.00</td>
</tr>
<tr>
<td>Building Construction @$45/sq.ft.</td>
<td>$1,800,000.00</td>
<td>$1,800,000.00</td>
</tr>
<tr>
<td>Building Permit Fee</td>
<td>$23,600.00</td>
<td>$23,600.00</td>
</tr>
<tr>
<td>Site Plan Control Application</td>
<td>$1,000.00</td>
<td>$1,000.00</td>
</tr>
<tr>
<td>Parkland Dedication (2% of Land Value)</td>
<td>-</td>
<td>$3,200.00</td>
</tr>
<tr>
<td>Clean-up of property with medium level contamination</td>
<td>$450,000.00</td>
<td>-</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$2,514,600.00</strong></td>
<td><strong>$1,987,800.00</strong></td>
</tr>
</tbody>
</table>

Increase in Development Costs of BF over GF $526,800.00 26.5%

**Cost Comparison of Brownfield vs. Greenfield Development**

New 40,000 sq.ft. Industrial Manufacturing Facility on a 2 Acre Site in Hamilton, ON.

**Scenario 1 – Land Purchased for $1**

**Assumptions:**
- Moderate level of contamination - $450,000 in clean-up costs
- Demolition of 40,000 sq.ft.@$3.50 per sq.ft.
- Property already serviced/zoned for Industrial use
- No Industrial Development Charges
- No Parkland Dedication for Brownfield Site

<table>
<thead>
<tr>
<th>Item</th>
<th>Brownfield (Burlington Street)</th>
<th>Greenfield (Stoney Creek Business Park)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Purchase</td>
<td>$1.00</td>
<td>$160,000.00</td>
</tr>
<tr>
<td>Demolition</td>
<td>$140,000.00</td>
<td>$-</td>
</tr>
<tr>
<td>Building Construction @$45/sq.ft.</td>
<td>$1,800,000.00</td>
<td>$1,800,000.00</td>
</tr>
<tr>
<td>Building Permit Fee</td>
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<td>Site Plan Control Application</td>
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</tr>
<tr>
<td>Parkland Dedication (2% of Land Value)</td>
<td>$-</td>
<td>$3,200.00</td>
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<tr>
<td>Clean-up of property with medium level contamination</td>
<td>$450,000.00</td>
<td>$-</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$2,414,601.00</strong></td>
<td><strong>$1,987,800.00</strong></td>
</tr>
</tbody>
</table>

**Increase in Development Costs of BF over GF** $426,801.00 21.5%

### Scenario 2 - Land Purchased for $120,000  
(50% of clean market value)

<table>
<thead>
<tr>
<th>Item</th>
<th>Brownfield (Burlington Street)</th>
<th>Greenfield (Stoney Creek Business Park)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Purchase</td>
<td>$ 120,000.00</td>
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</tr>
<tr>
<td>Demolition</td>
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<td>$ -</td>
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<td>Building Construction @$45/sq.ft.</td>
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<td>$ -</td>
<td>$ 3,200.00</td>
</tr>
<tr>
<td>Clean-up of property with medium level contamination</td>
<td>$ 450,000.00</td>
<td>$ -</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$ 2,534,600.00</td>
<td>$ 1,987,800.00</td>
</tr>
</tbody>
</table>

**Increase in Development Costs of BF over GF**  
$ 546,800.00  27.5%

---

### Scenario 3 - Land Purchased for $240,000  
(100% of clean market value)

<table>
<thead>
<tr>
<th>Item</th>
<th>Brownfield (Burlington Street)</th>
<th>Greenfield (Stoney Creek Business Park)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Purchase</td>
<td>$ 240,000.00</td>
<td>$ 160,000.00</td>
</tr>
<tr>
<td>Demolition</td>
<td>$ 140,000.00</td>
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<tr>
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<tr>
<td>Clean-up of property with medium level contamination</td>
<td>$ 450,000.00</td>
<td>$ -</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$ 2,654,600.00</td>
<td>$ 1,987,800.00</td>
</tr>
</tbody>
</table>

**Increase in Development Costs of BF over GF**  
$ 666,800.00  33.5%

Impact of Site Assessment/Remediation Costs on Feasibility – City of Guelph Example

<table>
<thead>
<tr>
<th>COST ITEM</th>
<th>BASE SCENARIO</th>
<th>WITHOUT SITE ASSESSMENT/REMEDIATION COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft Costs (Fees/Studies)</td>
<td>$714,669</td>
<td>$714,669</td>
</tr>
<tr>
<td>Land Costs</td>
<td>$1,002,238</td>
<td>$1,002,238</td>
</tr>
<tr>
<td>Construction/Site Development</td>
<td>$12,093,246</td>
<td>$12,093,246</td>
</tr>
<tr>
<td>Site Assessment/Remediation</td>
<td>$575,000</td>
<td>$0</td>
</tr>
<tr>
<td>Development Charges</td>
<td>$1,004,785</td>
<td>$1,004,785</td>
</tr>
<tr>
<td>Taxes</td>
<td>$26,210</td>
<td>$26,210</td>
</tr>
<tr>
<td>TOTAL COSTS</td>
<td>$15,456,148</td>
<td>$14,881,148</td>
</tr>
<tr>
<td>REVENUE (20 semi-detached and 105 townhouses)</td>
<td>$16,215,000</td>
<td>$16,215,000</td>
</tr>
<tr>
<td>PROFIT</td>
<td>$758,852</td>
<td>$1,333,852</td>
</tr>
<tr>
<td>PROFIT (%)</td>
<td>4.9</td>
<td>9.0</td>
</tr>
</tbody>
</table>

Appendix B

U.S. Federal Financial Assistance Programs Applicable to Brownfield Reuse Activities
Loans
EDA’s Title IX (capital for local revolving loan funds)
HUD funds for locally determined CDBG loans and “floats”
EPA capitalized brownfield revolving loan funds
SBA’s microloans
SBA’s Section 504 development company debentures
EPA capitalized clean water revolving loan funds (priorities set/programs run be each state)

Loan guarantees
HUD’s Section 108 loan guarantees
SBA’s Section 7(a) and Low-Doc programs

Grants
HUD’s Brownfield Economic Development Initiative (BEDI)
HUD’s Community Development Block Grants (for projects locally determined)
EPA assessment pilot grants
EDA Title I (public works) and Title IX (economic adjustment)
DOT (various system construction and rehabilitation programs)
DOT’s transportation/community system preservation (TCSP) pilots
Army Corps of Engineers (cost-shared services)

Equity Capital
SBA’s Small Business Investment Companies

Tax incentives and tax-exempt financing
Targeted expensing of cleanup costs (through 12/31/03)
Historic rehabilitation tax credits
Low-income housing tax credits
Industrial development bonds

Tax-advantaged zones
HUD/USDA Empowerment Zones (various incentives)
HUD/USDA Enterprise Communities (various incentives)

Source: Colangelo et. al., 2002, Chart 3, p. 27
Appendix C

Summary of State of the States Survey Report
# State Financial Incentives

| STATE     | 1a | 1b | 1c | 1d | 2a | 2b | 2c | 3a | 3b | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 |
|-----------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Alabama   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Alaska    | X  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Arizona   | X  | X  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Arkansas  | X  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| California| X  | X  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Colorado  | X  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Connecticut| X | X  | X  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Delaware  | X  | X  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Florida   | X  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Georgia   | X  | X  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Hawaii    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Idaho     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Illinois  | X  | X  | X  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Indiana   | X  | X  | X  | X  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Iowa      | X  | X  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Kansas    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Kentucky  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Louisiana |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Maine     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Maryland  | X  | X  | X  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Massachusetts| X | X  | X  | X  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Michigan  | X  | X  | X  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Minnesota | X  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Mississippi|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Missouri  | X  | X  | X  | X  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Montana   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Nebraska  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Nevada    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

(see Legend below)
| STATE          | 1a | 1b | 1c | 1d | 2a | 2b | 2c | 3a | 3b | 4  | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13   | 14   |
|---------------|----|----|----|----|----|----|----|----|----|----|------|------|------|------|------|------|------|------|------|
| 29 New Hampshire |    |     |    |    |    |    | X  |    |    |    |      |      |      |      |      |      |      |      |      |
| 30 New Jersey   | X  |     | X  |    |    |    |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 31 New Mexico   | X  |     | X  |    |    |    |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 32 New York     | X  | X  |    |    |    |    |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 33 North Carolina|    |     |    |    |    |    |    |    |    |    | X    |      |      |      |      |      |      |      |      |
| 34 North Dakota |    |     |    |    |    |    |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 35 Ohio        | X  |     | X  |    |    |    |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 36 Oklahoma     |     | X  | X  |    |    |    |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 37 Oregon       | X  | X  | X  |    |    |    |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 38 Pennsylvania | X  | X  | X  | X  | X  | X  |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 39 Puerto Rico  |    |     |    |    |    |    |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 40 Rhode Island |     | X  |    |    |    |    |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 41 South Carolina|    |     |    |    |    |    |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 42 South Dakota |    |     |    |    |    |    |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 43 Tennessee    |    |     |    |    |    |    |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 44 Texas        |    |     |    |    |    |    |    |    |    |    | X    |      |      |      |      |      |      |      |      |
| 45 Utah         |    |     |    |    |    |    |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 46 Vermont      |    |     |    |    |    |    |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 47 Virginia     |    |     |    |    |    |    |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 48 Washington   | X  |     | X  |    |    |    |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 49 West Virginia|    |     |    |    |    |    |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 50 Wisconsin    | X  | X  | X  | X  | X  | X  |    |    |    |    |      |      |      |      |      |      |      |      |      |
| 51 Wyoming      |    |     |    |    |    |    |    |    |    |    |      |      |      |      |      |      |      |      |      |
| TOTAL | 12 | 12 | 2  | 2  | 23 | 12 | 4  | 3  | 15 | 7  | 4   | 3   | 2   | 2   | 4   | 1   | 1   | 3   |      |

**Legend:**

<table>
<thead>
<tr>
<th>Grant Type</th>
<th>1a Remediation grants</th>
<th>1b Assessment grants</th>
<th>2b Remediation loans</th>
<th>2c Demolition loans</th>
<th>3a Loan guarantee</th>
<th>3b Partial loan forgiveness</th>
<th>4 Property tax abatement/deferral/credit/cancellation</th>
<th>5 Income tax credit</th>
<th>6 Business tax credit</th>
<th>7 Capital investment tax credit</th>
<th>8 Sales and use tax refund on machinery and equipment</th>
<th>9 Cost-sharing</th>
<th>10 Direct funding for acquisition, investigation, remediation, redevelopment</th>
<th>11 Job creation incentive payments</th>
<th>12 Brownfield inventory grant</th>
<th>13 Public infrastructure grant</th>
<th>14 Environmental insurance fund/subsidy</th>
</tr>
</thead>
</table>
Appendix D

Case Studies

List of Case Studies

Barton and Crooks Streets, Hamilton, Ontario
Spencer Creek Village, Hamilton (Dundas), Ontario
West Harbour Lands, Cobourg, Ontario
Courtauld’s Fibres Project, Cornwall, Ontario
Finishing Mill Lofts, Cornwall, Ontario
Stelco Swansea Works Project, Toronto, Ontario
Moncton Shops Project, Moncton, New Brunswick
Voisey’s Bay Project, Argentia, Newfoundland
Angus Shops, Montreal, Quebec
ICI, Shawinigan, Quebec
Centre de la Petite Enfance, Ville La Salle, Quebec
Denver Radium, Denver Colorado
MacGillis & Gibbs Co./ Bell Lumber and Pole Co., New Brighton, Minnesota
1. Barton and Crooks Streets, Hamilton, Ontario

Developer
Kimshaw Holdings

Location
West Harbour front, Hamilton

Site Area
3.5 acres

Proposed Use
Mixed use development with:
- 10 single detached residential units
- 17 residential townhouse units
- 10,000 sq.ft. commercial space

Site History
- Site previously owned by CN Rail. Part of site used for a gasoline/automobile service station from 1956-1995. The site was also subject to placement of contaminated fill.

Site Condition
- Contaminants included oil and lead.

Cleanup
- Residential component of site cleaned using generic stratified approach (top 2.4 m. cleaned to residential standards). Soils below 2.4m cleaned to industrial/commercial standards
- Excavation of soils and off-site disposal
- Sorting and retention on-site of soils meeting industrial/commercial standards for use below 2.4 m.

Costs
- Cleanup (remediation) = $250,000
- Servicing = $225,000
- Construction = $2,950,000
- Development Charges and Building Permit Fees = $216,500

Progress to Date
- 7 of 10 single detached residential units completed or under construction.
- 17 townhouse units and commercial space nearing completion of the planning approvals stage.
Economic Benefits

- Private Sector Investment (Project Cost) = $3,641,490
- Personal Income from on-site remediation and construction jobs = $720,000
- Income tax paid on on-site remediation and construction jobs = $216,000
- Increase in G.S.T revenues = $240,000
- Increase in P.S.T revenues = $274,000
- Permanent jobs = 10
- Increase in annual property taxes collected by municipality = $77,500
- Development charges collected by municipality = $183,900
- 27 residential units built
- 10,000 sq.ft. commercial space built

Other Benefits

- Provision of housing close to public waterfront parks and amenities
- Neighbourhood stabilization and revitalization
2. Spencer Creek Village, Hamilton (Dundas), Ontario

Developer
Urban Horse Developments

Location
Downtown Dundas

Site Area
12 acres

Proposed Use
- Adult lifestyle community
- 498 residential units including 100 retirement units
- 40,000 sq.ft. commercial space, including Eurohotel/medical services, clubhouse and community centre

Site History
- Site of the former Bertram Steel Foundry established before the turn of the 20th century.

Site Condition
- Contaminants included creosote, foundry sand, PCBs, and hydrocarbons.
- Substantial amount of surface waste.

Cleanup
- Excavation and disposal of soils, on-site sorting of soils, and some bio-remediation used to remove hydrocarbons.
- Extensive recycling of demolition materials include reclamation of bricks, steel beams and wood beams.

Costs (to date)
- Cleanup = $1,850,000
- Environmental Consulting Fees $270,000
- Planning/Civil Engineering Fees = $130,000
- Servicing = $600,000

Progress to Date
- First phase (48 residential units) of eight phases is complete and occupied.
- Construction on second phase to begin soon.
- Projected build out of project = 6 years.
Economic Benefits

- Private Sector Investment (Project Cost) = $94,420,000
- Personal Income from on-site remediation and construction jobs = $12,000,000
- Income tax paid on on-site remediation and construction jobs = $3,600,000
- Increase in G.S.T revenues = $6,609,000
- Increase in P.S.T revenues = $7,554,000
- Permanent full-time and part-time jobs = 40
- Increase in annual property taxes collected by municipality = $1,760,000 (based on an actual increase of $175,000 for the 48 residential units in Phase One)
- 498 residential units built
- 40,000 sq.ft. commercial space built
- 2 ½ acres of parkland created

Other Benefits

- Increase in downtown population by 1,000 people
- Meeting demand for retirement residences in a downtown location close to services
- New public walkways, access along Spencer Creek and large open space to be conveyed to town
3. West Harbour Lands, Cobourg, Ontario

Developer
Cobourg Harbour Development Corporation (CHDC)

Location
Lake Ontario Waterfront, Cobourg

Site Area
Not available

Proposed Use
- Residential condominiums
- Parkland/open space
- Beach area
- Waterfront trail
- Campground

Site History
- Cobourg’s West Harbour Lands were once a busy port from which ore and other products were shipped. Several rail spur lines, as well as bulk gasoline and furnace oil storage operations were located in the West Harbour area.

Site Condition
- As a former industrial area comprised of several properties used for different purposes, there was a wide variety of contaminants including: heavy metals such as lead, arsenic and mercury, and petroleum hydrocarbons

Cleanup
- Numerous cleanup methods employed, including: excavation and off-site disposal, air sparging, bio-remediation.
- Groundwater monitoring employed to ensure water would be acceptable for public use.

Costs
- Cleanup = $2,000,000
Progress to Date

- First residential condominium project initiated by Canada Housing and Development Corporation (CHDC) in 1993 on land formerly owned by Mac Asphalt Ltd. And Shell Canada. Project was completed and occupied in 1994.
- Second phase of residential development completed on former Ultramar Canada Lands in 1997.
- Restoration of former Imperial Oil site completed in 1997. Site purchased by Town of Cobourg for public use and waterfront activities.
- To date, municipality has invested $2,300,000 in waterfront improvements

Economic Benefits

- Residential construction will generate $162,000,000 investment.
- Increase in G.S.T revenues = $8,000,000
- Building and construction fees paid to the municipality = $2,000,000
- New Marina will generate $3.1 million annually for the community by 2008.
- 100-200 new construction jobs.
- Annual waterfront festival now attracts 80,000 people over 3 days and generates approximately $3.6 million in local economic impact.

Other Benefits

- Downtown waterfront revitalization.
- Increased and improved land for public open space, park and recreational uses.
- Elimination of significant environmental hazards.
- Waterfront now a major destination for residents and visitors – improved tourism business and future tourism potential.
4. Courtald’s Fibres Project, Cornwall, Ontario

**Developer**
Noyar Development, Inc. (Phase I)

**Location**
Cornwall, ON.

**Site Area**
Phase I - 9.8 acres  
Total site = 100 acres

**Proposed Use**
- Phase I - 44 lot residential subdivision
- Majority of remainder of site remediated to open space/residential levels and some industrial/commercial levels
- Future development concepts/potential undetermined at this time

**Site History**
- Site was used as Courtald’s Fibres main complex from 1925-1992 producing synthetic fibres (rayon) for the garment and textiles industries.

**Site Condition**
- Industrial processes utilized dozens of chemicals, including: caustic soda, carbon disulfide, acid, derivatives of benzene, fluorene, pyrene, naphthalene, petroleum hydrocarbons, toluene and chromium tetrahydrofurans.
- Contaminants in Phase I related primarily to long-term use as former Courtald’s Fibres employee parking lot – cinders, oil, grease, and suspended solids. Some areas contained higher levels of arsenic.

**Cleanup**
- Use of storm water interceptor or oil/grit separator prior to storm water outletting to the river.
- Removal of arsenic (levels now acceptable for residential and parkland use).
- Soils containing cinder were covered with a substantial layer of topsoil.

**Costs**
- Cleanup costs unavailable.

**Progress to Date**
- Construction of 44 single detached residential units is underway. Approximately 12 units have been completed.
Economic Benefits

- Property Tax increase of approximately $98,100 (44 units @ approximately $2,230 per unit based on average of units already constructed).
- Employment opportunities for local contractors
- No other economic impact data available at this time.

Other Benefits

- Waterfront revitalization – St. Lawrence River.
- Major public open space along the waterfront.
- Provision of additional housing.
5. Finishing Mill Lofts, Cornwall, Ontario

Developer
Renaissance Group (a not-for-profit corporation)

Location
Located on Waterfront, Cornwall

Site Area
Finishing Mill Lofts Project - 4 acres
Entire site - 12 acres

Proposed Use
- Finishing Mill Lofts - 48 unit affordable housing project with ancillary office/commercial space on first floor.

Site History
- Site of the former Canada Cotton Mills Complex, including several large multi-storey buildings (Finishing Mill East and West Buildings, Weave Shed, and several other buildings).

Site Condition
- Some contaminated soils
- Oil remaining in a bunker under one of the buildings
- Pigeon droppings
- Overall structural condition of the buildings is good, but buildings must be retrofitted and upgraded to resist seismic loads (Thompson Rosemont Group, 2002).
- Some demolition required.

Cleanup
- Removal of contaminated soils
- Removal of oil remaining in bunker

Costs (to date)
- Cleanup = $500,000
- Feasibility Study (including environmental) = $120,000
- Demolition = $380,000
- Construction = $19,500,000
- Parking construction = $1,300,000
- Development charges waived
**Progress to Date**
- Finishing Mill Lofts (48 units) has completed the planning and detailed study stage.

**Economic Benefits**
- Private Sector Investment (Project Cost) = $19,500,000
- Increase in annual property taxes collected by municipality (just for Finishing Mill Lofts Building) = $88,000
- 48 residential units constructed
- 10,000 sq.ft. commercial space built

**Other Benefits**
- Provision of affordable housing close to the waterfront and an underutilized adjacent public park.
6. Stelco Swansea Works Project, Toronto, Ontario

Developer
REON Development Corporation

Location
Humber River and Gardiner Expressway, Toronto

Site Area
12 acres

Proposed Use
• 850 residential units in a mixture of townhouses and 3 residential towers.
• Small parkettes and green space along southern boundary of site

Site History
• Site housed Stelco’s main fastener production operations between 1885 and 1990. Facility closed in 1990 and remained vacant for over 10 years until purchased by REON in 2001. Main production operations were located on the West property (8 acres) and an office building, parking and materials storage was located on the East property (4 acres).

Site Condition
• Two large ponds/wetlands on the site were filled between 1940 and 1990 with assorted materials including blast furnace clinker, coal ash, building and demolition wastes, assorted waste soils and other debris.
• Surface soils on West property contaminated with petroleum products.
• Some surface soils on East and West properties were mildly contaminated with metals.

Cleanup
• Off-site disposal of soils with exceedances in metal concentrations.
• Bio-remediation of most soils containing elevated levels of petroleum hydrocarbons without excess concentrations of metals
• On-site analytical procedures and rapid laboratory turnaround enabled extensive sorting of materials on site, thus minimizing amount of clean soil removed from site.

Costs (to date)
• Not available
Progress to Date
• East property remediation complete
• West property remediation is one-third complete.
• Zoning application approved
• Detailed site plan submitted to City

Economic Benefits
• Estimated annual property taxes collected by municipality = $2,500,000
• Construction of 850 residential units

Other Benefits
• Contribution of funds for construction of a boat house on the Humber River.
• Contribution of funds for playground equipment for four schools in the Swansea area.
• Accessible and open community participation process
7. Moncton Shops Project, Moncton, New Brunswick

Developer
Canada Lands Corporation (CLC)

Location
Downtown Moncton

Site Area
265 acres

Proposed Use
Mixed use development with:
- 60 acres (500,000 square feet) high technology Emerson Business Park
- 110 acres Moncton Common recreational area includes 10 baseball diamonds, 2 football fields, and 4 soccer fields
- Sportsplex (4 NHL size hockey rinks)
- 64 acres (450-550) residential units

Site History
- Former Canadian National Railway Co. repair shops for Eastern Canada.

Site Condition
- Numerous industrial contaminants

Cleanup
- Innovative site assessment/remediation methodology engaged the University of Moncton Chemistry Department to conduct the bulk of the site assessment
- $100,000 invested by company into laboratory facilities at University of Moncton
- Site assessment results indicated areas where contamination could be managed on site by modifying land uses and areas where soils required remediation.
- Site Assessment phase (including testing) cost one-tenth what it would have if University of Moncton had not been engaged

Costs (to date)
- Initial estimates of clean-up costs = $50,000,000 - $100,000,000
- Actual clean-up costs = $12,000,000 - $15,000,000

Progress to Date
- Moncton Commons recreational area and Sportsplex complete.
- Construction to begin in September 2002 on first commercial building in Emerson Business and Technology Park. Park will take 10 years to build out.
Economic Benefits
• Not available.

Other Benefits
• Enhanced recreational opportunities for residents of Moncton
• Economic diversification
• Citizen participation and buy-in to concept – citizen environmental committee oversaw site planning.
• Contribution to the City of Moncton’s resurgence.
8. Voisey’s Bay Project, Argentia, Newfoundland

Developer
Argentia Management Authority

Location
Newfoundland

Site Area
9,000 acres

Proposed Use
• Industrial/commercial

Site History
• Former military base.
• Decommissioning began in 1995.

Site Condition
• Not available

Cleanup
• Extensive cleanup

Costs
• Cleanup costs = $81,000,000 total for 9,000 acres- site decommissioning and remediation plan currently in phases 4 and 5
• Environmental consulting fees (phases 1 and 2) = $7,000,000
• Planning and civil engineering fees = $250,000
• Survey costs = $9,400,000
• Renovations = $2,370,000
• New construction = $3,250,000
• Public money = $5,000,000 to promote and market a 9,000 acre site
• Maintenance of site = $9,400,000

Progress to Date
• 3,000 acres of land remediated.
• 6,000 acres of land classed as rural/recreational.
• 149,000 sq.ft. industrial/commercial space renovated
• 57,000 sq.ft. industrial/commercial space built
• Granite and stone cutting operation - $20,000,000 invested
Economic Benefits

- Private Sector Investment to date = $25,800,000
- Projected private sector investment = $930,000,000 (Voisey’s Bay Nickel will be building a $130,000,000 plant in Argentia by 2006 and an $800,000,000 plant by 2011.
- Personal Income from on-site remediation and construction jobs = $720,000
- Income tax paid on on-site remediation and construction jobs = $216,000
- Increase in G.S.T/H.S.T revenues = $900,000
- 630 construction jobs created
- Average construction wage = $10-$12 per hour
- Increase in annual property taxes collected by municipality = $195,000

Other Benefits

- 3,000 acres of land remediated
9. Angus Shops, Montreal, Quebec

Developer
Canadian Pacific Railroad (CPR)

Location
Montreal, Quebec

Site Area
Total 1,240 acres
Contaminated area = 309 acres

Proposed Use
- 800 houses
- Light industrial and commercial development
- Development of 9 parks and other green spaces of different sizes
- Linear park at the west end of the site, which will be connected to the existing City of Montreal bicycle path network

Site History
- Site used between 1904 and 1992 for maintenance and repairs of rolling stock in use on eastern half of the Canadian Pacific Railway network. These facilities also used for construction of new railway equipment, as well as armament and military equipment during both World Wars. At its peak, the Angus Shops employed 12,000 people and consisted of 31 main and 35 ancillary buildings.

Site Condition
- Site was heavily contaminated with heavy metals, petroleum hydrocarbons, PAH's

Cleanup
- Removal and off-site disposal of hazardous waste
- In residential area and central park, removal of all soil exceeding residential generic criteria, slag and cinder and demolition debris
- In industrial area, removal of all recyclable material and backfill with 0.3 m of «B-C» soils from onsite source
- In commercial area, removal of waste and «C+» soil within the infrastructure trenches

Costs
- Clean up $12,000,000
- Residential development = $204,000,000
- Commercial development = $20,000,000
- Industrial development  = $250,000,000

Progress to Date
• 500 houses have been built
• Food supermarket and industrial mall built
• Biotechnology centre under construction

**Economic Benefits**

- $12,000,000 has been invested to clean up the environment ($8,643,000 invested by private parties and $3,357,000 provided by Revi-Sols)
- $391,600,000 invested to date by private parties to build up a residential neighbourhood, supermarket, light industry and a biotechnology centre
- Property taxes have increased to $2,190,000 a year and there is still other developments to come

**Other Benefits**

- Transformation of a vast non-productive former industrial site into a new dynamic neighbourhood, integrating commercial development and a light industrial park.
- New social and economical development of the area.
10. ICI, Shawinigan, Quebec

Developer
The City of Shawinigan, ICI Canada

Location
Shawinigan, Quebec

Site Area
3 acres

Proposed Use
• Shopping Mall

Site History
• ICI operated a chlore-alcali manufacturing plant and a solvent manufacturing plant on this site from 1936 to 1985.

Site Condition
• Soils heavily contaminated by mercury and organo-chloride solvents
• Groundwater in area was severely contaminated by chlorinated organic compounds.

Cleanup
• The company had already spent $10 million cleaning up the site between 1985 and 1999. The mercury-contaminated soil exceeding the industrial/commercial generic criteria had been excavated. 650,000 litres of free solvents had been pumped out of the site during the 1990's
• Revi-Sols allowed company to complete the cleanup by excavating areas still heavily contaminated with solvents. Those areas were 400 meters wide and reached up to 14 meters depth
• To minimize impacts on citizens of the nearby residential area, only small surfaces excavated at a time and volatilized solvents recuperated. In total, 7,000 kilograms of condensed solvents were recuperated.

Costs
• Assessment and Cleanup = $ 5, 567, 000 (Revi-Sols paid for half)
• Construction = $10,000,000

Progress to Date
• The site has been cleaned up. The mall has been constructed.
Economic Benefits

• Private Sector Investment (Project Cost) = $12,783,500
• Increase in annual property taxes collected by municipality

Other Benefits

• A massive source of volatile organo-chloride solvents located next to a residential area has been cleaned up, protecting the health of the citizens in that area
• Redevelopment of a property that had been derelict for over 25 years
• Addition of commercial space near a residential area
11. Centre de la Petite Enfance (Familigarde), Ville La Salle, Quebec

Developer
Not-for-profit corporation

Location
City Center, Ville La Salle, Quebec

Site Area
4.8 acres

Proposed Use
• Kindergarten for 60 children and administrative offices

Site History
• The site was filled in the past with rubble of unknown origin, including foundry waste and coal.

Site Condition
• PAH contaminated soil and various solid wastes

Cleanup
• Removal of all solid waste and soil contaminated beyond the generic criteria

Costs
• Assessment and Cleanup = $101,500 ($50,750 paid by Revi-Sols)
• Construction = $898,500

Progress to Date
• The site has been cleaned up
• Construction of the Kindergarten is almost completed.

Economic Benefits
• New building on a former derelict property
• 30 full time jobs

Other Benefits
• Provision of much needed kindergarten places next to a residential area, strengthening the cohesion of the neighbourhood.
12. Denver Radium, Denver, Colorado

Developer
U.S. EPA
State of Colorado
Home Depot

Location
South of Denver’s Central Business District

Site Area
17 acres

Proposed Use
130,000 sq.ft. Home Depot Store

Site History
- A radium processing plant was constructed here in the early 1900’s because of the City’s proximity to the mountains of Colorado. In the late 1920’s, the plant closed leaving behind property contaminated with radioactive soils and debris. The site was subsequently used for other uses, including most recently, a tile and brick manufacturer. Property sat vacant from mid-1980’s until 1995 when it was purchased by Home Depot.

Site Condition
- Contaminants included radium-226, arsenic, zinc and lead. EPA Superfund listed hazardous waste site.

Cleanup
- Almost 97,000 tons of radioactive soil and demolished building materials were excavated and shipped to an EPA-approved facility equipped to handle radioactive wastes.
- Metals contaminated soils covered with protective cap.

Costs (to date)
- Not available

Progress to Date
- The 130,000 sq.ft. Home Depot store was completed and open for business in 1996.
Economic Benefits

- 130+ jobs during 8 years of cleanup
- Personal Income from on-site remediation jobs during 8 years of clean-up = $25,600,000
- 15 jobs during 1 year of redevelopment
- Personal Income from on-site redevelopment jobs during 1 year of redevelopment = $480,000
- 113 permanent full-time and part-time jobs with Home Depot
- $1,900,000 in total annual income and $1,500,000 in total annual spending by employees of Home Depot
- Annual state income tax from permanent jobs at redeveloped site = $93,000
- Annual state sales tax revenue from sales at Home Depot = $1,250,000
- Increase in value of Home Depot property = $2,000,000
- Estimated potential increase in residential property values within 2 miles (3.2 km.) of the site = $65,500,000 or an average of $755 per household

Other Benefits

- Protected public health in a busy commercial region
- Prevented spread of radioactivity and heavy metals to surrounding areas
- Continued protection of public health and the environment by ongoing monitoring
- Increased access to retail shopping
- Improved aesthetic quality of the area
13. MacGillis & Gibbs Co./Bell Lumber & Pole Co., New Brighton, Minnesota

Developer
U.S. EPA
City of New Brighton
Minnesota Pollution Control Agency
Donatelle Plastics

Location
New Brighton, Minnesota

Site Area
Not available

Proposed Use
• Urban center, office complex, and a 77,000 sq.ft. plastics manufacturing facility

Site History
• Two adjacent wood treatment facilities began operations in the 1920’s and treated telephone poles and landscape timbers with chemicals for over 70 years.

Site Condition
• 5,000 gallons of chemical preservatives spilled in 1979 during plant operations.
• Soil and groundwater contaminated with toxic chemicals and heavy metal carcinogens such as copper, chromium and arsenic
• Plume of toxic chemicals in the underlying aquifer migrating off-site – 9,300 households located within 2 miles (3.2 km.) of site, many of them dependant on groundwater for drinking water
• Abandoned tanks and pipes containing oil and hazardous wastes
• On-site pond contaminated with sludge, wood scrap, and steel drums

Cleanup
• Removed leaking drums and tanks
• Disposed of contaminated soils and debris off-site
• Treatment system installed to cleanup contaminants in groundwater
• Treatment system will continue to operate until groundwater is safe

Costs (to date)
• Not available

Progress to Date
• 77,000 sq.ft. plastics manufacturing facility is complete.
Economic Benefits

- 440 jobs during 10 years of cleanup
- Personal Income from on-site remediation jobs during 10 years of clean-up = $17,000,000
- 200 permanent full-time jobs projected
- $5,300,000 in total annual income and $4,200,000 in total annual spending by permanent employees
- Annual state income tax from permanent jobs at redeveloped site = $381,000
- Annual state sales tax revenue from personal spending by permanent employees = $137,000
- Estimated potential increase in residential property values within 2 miles (3.2 km.) of the site = $3,100,000

Other Benefits

- Expected to attract new businesses and services to local area thereby increasing local commerce
- Protected human health in a heavily populated area
- Prevented spread of contamination to additional groundwater sources
- Protected wetland and wildlife habitat
- Revitalized industrial section of town
- Enhanced aesthetic quality of area
- Increased sense of civic and community pride
Appendix E

Source and Contact Information for Case Studies and Input-Output Analysis
<table>
<thead>
<tr>
<th>Contact</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr. Paul Antle, Island Waste Mgmt., Nfld.</td>
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<tr>
<td>Mr. Larry Beasley, City of Vancouver, BC.</td>
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</tr>
<tr>
<td>Mr. Ken Bedford, Senior Planner, Town of Cornwall, ON</td>
<td>*</td>
</tr>
<tr>
<td>Mr. Michel Beaulieu, Revi-Sols, QC</td>
<td>*</td>
</tr>
<tr>
<td>Mr. Ken Browne, Argentia Mgmt Authority, Nfld.</td>
<td>* **</td>
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<tr>
<td>Mr. Chuck Charlebois, Renaissance Group, ON</td>
<td>*</td>
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<tr>
<td>Mr. Don MacCallum</td>
<td>* **</td>
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<tr>
<td>Mr. Jim McLean, British Pacific Properties, BC</td>
<td>* **</td>
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<tr>
<td>Mr. Mark McCollough, Canada Lands Corp., AB.</td>
<td>* **</td>
</tr>
<tr>
<td>Mr. Mitch Fasken, Jannock Properties, ON</td>
<td>* **</td>
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<tr>
<td>Mr. Michael Hanrahan, Irving Oil, NB</td>
<td>* **</td>
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<tr>
<td>Mr. Colin Kirkman, Nayor Development, ON</td>
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<tr>
<td>Mr. Richard Liebtag, Urban Horse Developments, ON</td>
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<tr>
<td>Mr. Ron Pachal, Canada Lands Corp., NS.</td>
<td>* **</td>
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<tr>
<td>Mr. Eric Partridge, Min. Water, Land &amp; Air Protection, BC</td>
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<tr>
<td>Mr. Dick Stephens, MA</td>
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<tr>
<td>Mr. Rob Willes, Reon Development Corp., ON</td>
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</tr>
<tr>
<td>Ms. Judy Williams, MacKenzie Fujisawa, BC</td>
<td>*</td>
</tr>
<tr>
<td>Mr. Mike Zemanek, Alberta Environment, AB.</td>
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</tbody>
</table>

* denotes that a case study questionnaire was sent.
** denotes that an input-output questionnaire was sent.
Appendix F

Statistics Canada Tables
<table>
<thead>
<tr>
<th><strong>Table F1. Statistics Canada’s Environmental Services</strong></th>
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<tbody>
<tr>
<td><strong>Water</strong></td>
</tr>
<tr>
<td><strong>Water Supply and Conservation</strong> - services related to water purification, water delivery and water handling systems, including maintenance, repair, related consulting engineering and analytical services.</td>
</tr>
<tr>
<td><strong>Wastewater Management and Sewage treatment</strong> - operation of water treatment facilities, storm water management, water and wastewater system assessment, Planning and design management, related consulting engineering and analytical services.</td>
</tr>
<tr>
<td><strong>Air</strong></td>
</tr>
<tr>
<td><strong>Air Pollution Control (Indoor or Outdoor)</strong> - emission monitoring, assessment/ evaluation and planning, related consulting engineering and analytical services.</td>
</tr>
<tr>
<td><strong>Waste</strong></td>
</tr>
<tr>
<td><strong>Hazardous and Non-Hazardous Waste Management</strong> - waste handling, collection, transport and disposal, operation of sites, ownership or management of sites, recycling (sorting, baling, cleaning), operation of materials recovery facilities, hazardous waste management services, including related consulting engineering and analytical services.</td>
</tr>
<tr>
<td><strong>Remediation and Treatment of Soil, Surface Water, Seawater and Groundwater</strong> - cleaning for facilities and tanks, emergency response and spills cleanup systems, site reclamation and remedial action services, maintenance and repair of remediation or treatment systems, including related consulting engineering and analytical services.</td>
</tr>
<tr>
<td><strong>Research and Development</strong></td>
</tr>
<tr>
<td><strong>Environmental Research and Development</strong> - development, evaluation and implementation of clean process technologies and/or end-of-pipe pollution abatement and control technologies, including related consulting engineering and analytical services, and related research to improve knowledge on ecosystems and the impact of human activities on the environment.</td>
</tr>
<tr>
<td><strong>Renewable Energy</strong></td>
</tr>
<tr>
<td><strong>Energy Efficiency and Renewable Energy</strong> - installation, maintenance, repair and related consulting and analytical services for alternative energy systems or renewable energy production (solar, biomass, wind, other), energy audit, energy resource management, related consulting engineering and analytical services.</td>
</tr>
<tr>
<td><strong>Other Environmental Consulting Engineering Services</strong> - other environmental advisory and/or design, services not listed in the preceding categories.</td>
</tr>
<tr>
<td><strong>Analytical</strong></td>
</tr>
<tr>
<td><strong>Other Analytical Services, Data Collection and Analysis</strong> - other analysis services not listed in the preceding categories.</td>
</tr>
<tr>
<td><strong>Management Consulting and Legal Services</strong> - general environmental impact assessment, resource management planning, environmental risk management, environmental law and legal services, other environment-related general consulting and legal services not listed in any other categories.</td>
</tr>
<tr>
<td><strong>Environmental Education, Training and Information</strong> - environmental education, training and information management for the general public and specific environmental workplace education, environmental information searching services, environmental emergency response planning, conservation and resource management, ISO 9000/14000 support services, including related consulting engineering and analytical services.</td>
</tr>
<tr>
<td><strong>Other</strong></td>
</tr>
<tr>
<td><strong>Noise and Vibration Abatement</strong> - assessment and monitoring; design and management services for acoustic and soundproof screens and street covering; and related consulting engineering and analytical services.</td>
</tr>
</tbody>
</table>

(Source: Statistics Canada, 2002)
<table>
<thead>
<tr>
<th>Environmental Goods</th>
</tr>
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<tbody>
<tr>
<td>WATER</td>
</tr>
<tr>
<td>Water Supply and Conservation - equipment or technology used for fresh water supply and delivery, water purification equipment, water handling equipment parts (pumps, pipes and valves), oil/water separation systems, wastewater reuse equipment, wastewater treatment chemicals, water pollution control equipment, screens, strainers, clarifiers, filters and filter media.</td>
</tr>
<tr>
<td>AIR</td>
</tr>
<tr>
<td>Air Pollution Control (Indoor or Outdoor) - catalytic converters, chemical recovery systems, dust collectors, separators, precipitators, scrubbers, odour control equipment</td>
</tr>
<tr>
<td>WASTE</td>
</tr>
<tr>
<td>Hazardous and Non-hazardous Waste Management - hazardous waste storage/treatment equipment, waste collection equipment, waste disposal machinery and equipment, waste handling equipment, waste separation equipment, recycling equipment, and incineration equipment.</td>
</tr>
<tr>
<td>Remediation/Treatment of Soil, Surface Water, Seawater and Groundwater - absorbents, bioremediation equipment, soil vapour extraction equipment, spill equipment, containment systems, chemicals and bioremediators.</td>
</tr>
<tr>
<td>RENEWABLE ENERGY</td>
</tr>
<tr>
<td>Energy Efficient Equipment - energy management equipment, energy recovery equipment.</td>
</tr>
<tr>
<td>Solar Energy Systems and Equipment - active and passive solar systems, photovoltaics, solar-thermal generators, solar water and space heating systems.</td>
</tr>
<tr>
<td>Biomass Energy Systems and Equipment - landfill gas collection systems, other systems and equipment that use organic matter (forest and agricultural Residues) to produce electricity, chemicals or transportation fuels.</td>
</tr>
<tr>
<td>Wind Energy Systems and Equipment - horizontal axis turbines, vertical axis turbines, other types of windmills used to generate energy and electricity.</td>
</tr>
<tr>
<td>Other Renewable Energy Systems and Equipment - wave, tidal and ocean thermal energy conversion systems, geothermal energy.</td>
</tr>
<tr>
<td>ALTERNATIVE FUEL SYSTEMS</td>
</tr>
<tr>
<td>Alternative Fuel Systems - clean fuel systems (reformulated fuels and oxygenated fuels), fuel cell technologies, hydrogen systems and advanced batteries.</td>
</tr>
<tr>
<td>Clean Technologies and Related Components - integrated process technology; and materials recovery technology.</td>
</tr>
<tr>
<td>ANALYTICAL</td>
</tr>
<tr>
<td>Environmental Monitoring, Analysis and Assessment - measuring and monitoring equipment, sampling systems, data acquisition equipment, environment information systems and analytical software such as laboratory, remote sensing and GIS management software.</td>
</tr>
<tr>
<td>OTHER</td>
</tr>
<tr>
<td>Noise and Vibration Abatement - mufflers/silencers, noise deadening equipment, noise and vibration control systems, highway barriers.</td>
</tr>
<tr>
<td>Recyclable materials - metals (ferrous and non-ferrous scrap metal, including automobiles for scrap), paper and paperboard and other recyclable materials(plastic, glass, textiles, liquids and sludges).</td>
</tr>
</tbody>
</table>

(Source: Statistics Canada, 2002)
<table>
<thead>
<tr>
<th>Environment-related Construction</th>
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</tr>
<tr>
<td><strong>Hazardous and Non-hazardous Waste Management</strong></td>
</tr>
<tr>
<td>- hazardous waste management; solid waste treatment, storage and disposal; recycling.</td>
</tr>
<tr>
<td><strong>Remediation and Treatment of Soil, Surface Water, Seawater and Groundwater</strong></td>
</tr>
<tr>
<td><strong>Noise/Vibration Abatement</strong></td>
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</tbody>
</table>

(Source: Statistics Canada, 2002).
Appendix G

Technical Appendix – Input-Output Model
Commodity by Industry Input-Output Data

Statistics Canada, like most other statistic agencies in developed countries, produces commodity by industry input-output accounts. For reasons discussed in several texts, commodity by industry (or rectangular) accounts are superior to industry by industry (or square) accounts.\(^{27}\)

Commodity by industry accounts for a given region (or nation) consist of three matrices; the input or absorption matrix, the output or make matrix and a final demand matrix. The input matrix has \(m\) commodity rows and \(n\) industrial sector columns. Elements in each column denote how the sector identified by the column buys inputs for production from other sectors in the economy. The output matrix, having the same dimensions, details each sector’s production in terms of commodities. Lastly, the final demand matrix consists of the same \(m\) commodity rows as the input and output matrices, but includes \(k\) final demand category columns (where these columns include uses of commodities that are outside of the inter-industry block such as personal consumption, government consumption, investment, and exports and imports). All three matrices, in concert, describe the inner workings of the economy to which they pertain. In the model developed for this project, the input, output and final demand matrices for Canada as a whole (in 1998) were utilized.

Derivation of the Input-Output Model

Input-Output (IO) models are derived from the basic accounting identities which hold in the IO data (i.e., the total supply of a given commodity in the economy must be equal to the total use of the commodity in the economy including exports). This equality appears as follows for commodity by industry data (where \(i\) denotes commodities and \(j\) denotes industries).

\[
\sum_{j=1}^{n} u_{ij} + C_i + G_i + I_i + E_i = Q_i + M_i
\]

The left-hand side of equation 1 represents the total use of commodity \(i\) in the economy. The \(u_{ij}\) terms denote uses of commodity \(i\) by all industries, \(j\) (n.b., these elements come from the input matrix discussed above), and \(C, G, I,\) and \(E\) denote uses of commodity \(i\) by consumption, government, investment, and exports respectively (n.b., these elements come from the final demand matrix discussed above). The right-hand side of equation 1 above represents the total supply of commodity \(i\) in the economy. \(Q_i\) denotes the total production of commodity \(i\) in the economy, and \(M_i\) denotes imports of commodity \(i\). Together, these sum to the total available supply of commodity \(i\) in the economy. So, for the left-hand side (LHS) to

equal the right-hand side (RHS), total use must equal total supply for each commodity (i) in the economy.\textsuperscript{28}

If it is assumed that sectors use commodities in fixed proportions, and that the proportion of each sectors’ output accounted for by a given commodity is constant, then the previous identity can be re-written as follows;

\textbf{Equation 2}

\[
\sum_{j} b_{ij} X_{j} + C_{i} + G_{i} + I_{i} + E_{i} = Q_{i} + M_{i}
\]

where;

\textbf{Equation 3}

\[
b_{ij} = \frac{u_{ij}}{X_{j}}
\]

The $b_{ij}$ coefficients denote the dollar value of commodity i used per dollar of sector j output, and as such, these represent technical coefficients.

Equation 2 is referred to as the \textit{commodity balance equation}. An industry balance equation expresses the equality between supply and disposition of sectoral outputs, as opposed to commodity outputs. The industry balance equation can be written as follows:

\textbf{Equation 4}

\[
X_{j} = \sum_{i} d_{ij} Q_{i}
\]

where;

\textbf{Equation 5}

\[
d_{ij} = \frac{v_{ij}}{Q_{i}}
\]

Equation 5 simply allocates commodity output to producing sectors based on the observed share of each sectors’ total output accounted for by each commodity (by specifying equation 4 as shown above, it is being implicitly assumed that $d_{ij}$ is constant for all i and j pairs).

The commodity balance equations can be further altered to focus solely on domestic production. In open economies, failure to account for leakages such as imports can cause erroneous output values to be assigned to domestic sectors. To incorporate import leakages, a domestic share of production, $q_{i}$, is computed for each commodity as follows;

\textsuperscript{28} It is possible for an economy to show a high degree of usage of a given commodity and not produce any of that commodity domestically. In such a case, use will equal supply because the imports of this commodity will be captured in the final demand matrix.
Equation 6

\[
q_i = \frac{Q_i}{Q_i + M_i}
\]

where \(Q_i + M_i\) denotes the total supply of commodity \(i\) available for use in the economy. The share \(q_i\) represents that proportion of the total supply which comes from domestic production \((Q_i)\). Based on this, the commodity balance equation shown in equation 1 above can be re-written as follows:

Equation 7

\[
q_i \left( \sum_j b_{ij} X_j + F_i^* \right) = Q_i
\]

where \(F_i^*\) refers to total final demand (i.e., \(C+I+G+X\)) less imports \((M)\) which are usually included in the final demand matrix (n.b., imports were placed on the RHS of equation 1 above for the purposes of showing the equality of supply and use. Now that all final demand elements are being summed to a total, the fact that imports are not present in final demand must be acknowledged, hence the superscripted asterisk \(*\)).

By adopting matrix notation, equation 7 can be expressed more compactly as follows:

Equation 8

\[
Q = \hat{q} \left[ BX + F^* \right]
\]

where \(Q\) is an \(m\times1\) matrix of commodity outputs, \(B\) is an \(m\times n\) matrix of \(b_{ij}s\), and \(F^*\) is an \(m\times1\) matrix of final demand values by commodity, and \(\hat{q}\) is a diagonal matrix of domestic share coefficients. It should be noted that equality between supply and use is retained.\(^{29}\)

Likewise, the industry balance equation can be re-written as follows:

Equation 9

\[
X = D^\prime Q
\]

By substituting equation 10 into equation 9 the final commodity by commodity IO model can be written as follows:

---

\(^{29}\) This is a fundamental requirement of Input-Output Analysis as the model outputs can only be considered accurate if the data the model is based is perfectly balanced. Once in balance, a shock to the system is met with output required to meet that shock. Only if total supply and total use are equal initially can this output impact be considered valid. Hence, the inordinate amount of attention to the word “balance” in any Input-Output text.
Equation 10

\[ Q = \left[ I - \hat{q}BD' \right]^{-1} \hat{q}F^* \]

and by substituting equation 10 into equation 9, an industry by industry version of the same model can be derived as follows:

\[ X = \left[ I - D'\hat{q}B \right]^{-1} D'\hat{q}F^* \]

The model shown in equation 10, for a given change in final demand (\( F^* \)) will compute the total impact on all sectors of the economy (i.e., it will compute the output levels in all sectors of the economy required to meet the direct and indirect input requirements associated with all rounds of spending stimulated by the original final demand shock.)

The model used in this report is a stylized version of equation 10. Further enhancements were made to industry and commodity balance equations to remove personal consumption expenditures from the final demand matrix, and to make them dependent upon activity levels in the inter-industry portion of the economy (i.e., endogenous).