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Risk Management of Liability Uncertainties to Facilitate Brownfield Redevelopment: Comparing the Situation of Canada with the US

Lizhong Wang
Department of Chemistry and Environmental Science
New Jersey Institute of Technology
Newark, New Jersey, USA
Lizhong.Wang@njit.edu

Liping Fang
Department of Mechanical and Industrial Engineering
Ryerson University
Toronto, Ontario, Canada
lfang@ryerson.ca

Keith W. Hipel
Department of Systems Design Engineering
University of Waterloo
Waterloo, Ontario, Canada
kwhipel@uwaterloo.ca

***Abstract*—The uncertainties associated with liability in brownfield redevelopment and relevant risk management tools are discussed based on a comparative review of the situation in Canada and the United States. The changes of regulations and policies, inherent uncertainties of site assessment and remediation techniques, incidents of contaminant transport and exposure, and variations of economic and financial conditions all lead to the uncertainties of environmental liability. The fear of liability especially the associated uncertainties is the key obstacle for owners or developers to undertake cleanup and redevelopment due to the subsequent unpredictability of economic profitability. Various risk management tools have been gradually developed in the last three decades to address liability uncertainties, both within Canada and the US, among which environmental insurance and innocent owner's shelter from liability are the two most viable instruments to reduce the fear of liability. Policy making and risk management have evolved more slowly in Canada than in the US and there is a trend for Canadian provinces to adopt the successful policies and tools used in the US rather than formulate their own.**

***Keywords*—Brownfield, redevelopment, liability, uncertainty, risk management.**

I. INTRODUCTION

Brownfield problems have been a longstanding dilemma for policy makers in Canada, the United States and European developed countries since the late 1970s. Such sites are defined as abandoned, idled, or under-used industrial and commercial sites, and are often contaminated by hazardous chemicals [22]. Pollution disasters which occurred in the late 1970s such as the Love Canal in the US and Lekkerkerk in the Netherlands, arouse wide public recognition of potential serious dangers associated with contaminated sites, especially those located in urban areas [6]. Policy makers and urban researchers in North America and Europe are becoming increasingly interested in remedying and redeveloping brownfields.

In the US many innovative policies sprouted at all of the federal, state and local levels in the 1990s. Superfund programs and other regulation incentives were developed to encourage private investors in brownfield revitalization [20]. Financial tools such as various types of environmental insurance were widely adopted by the market and successful stories had shown a promising way to attract private funds to the redevelopment of contaminated sites. By comparison, in Canada, there has been a lag in this area and this country has been slow moving compared to the US and other industrialized nations [14]. The Canadian governments at both the federal and provincial levels have not yet implemented effective efforts to tackle this problem. Critical comparative analyses of the differences in the policies and tools to management of brownfields between Canada and other countries are few, regardless of the evident gaps in policy making and research of brownfields in Canada. De Sousa [6] provides analysis of the Canadian situation of contaminated sites in an international context by comparing the differences of policy making among Canada, the US and Europe. However, risk management tools to overcome the fear of liability uncertainties are not included in that review.

The purposes of this paper are to examine the histories and effectiveness of policy making and risk management measures that have been taken or are being taken in Canada and the US, and to analyze why brownfield redevelopment evolves more slowly in Canada compared to the US. The second section of the paper describes the origin and scale of brownfield problems in Canada and the US, the benefits of redevelopment, common obstacles, and the uncertainties of liability impeding remediation or redevelopment. Section 3 compares the policy making structures, measures and programs pertaining to brownfields. Section 4 summarizes the risk management tools to reduce uncertainties of liability. The last section draws the conclusions.

II. BROWNFIELD PROBLEMS IN CANADA AND THE US

As a consequence of the gradual migration of industries from urban to suburban greenfield areas since the mid-1970s, brownfield problems have become an extensive one indeed in industrial countries [6]. It has been estimated that about 450,000 brownfield sites exist in the US and the costs of cleanup for these sites are in the $30 to $40 billion range [22]. The EPA recently estimated that there are over 1 million brownfield sites in the US [23]. According to some estimates,

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as much as 25% of the Canadian urban landscape is potentially contaminated as a result of previous industrial activities [2]. Although actual numbers of sites may vary considerably from the estimates, it has been recognized that brownfield sites pose one of the major sources of health and environmental risks.

Brownfield redevelopment removes or reduces health and environmental risks and generates a range of environmental, economic and social benefits, including cleanup of contaminated lands, increase of property values, expansion of the tax base, creation of jobs, promotion of a revitalized and positive urban image, and improved quality of life in cities [8], [18].

Factors hampering the remediation or redevelopment of brownfields in Canada as well as the US have been identified in all aspects of policy making, remediation techniques, economic and financial conditions [6], [14]. Uncertainties of these factors pose big obstacles. They include: (1) changes of regulations and policies regarding brownfields; (2) inherent uncertainties of site assessment and remediation techniques, (3) incidents of contaminant transport and exposure environment, and (4) variations of economic and financial conditions. The changes of regulations and policies, such as cleanup criteria, will cause the reopening of an already completed remediation and the new burden of cleanup cost. Toxicity data on many chemicals is sparse or nonexistent; future site uses and circumstances cannot be predicted with absolute certainty; and remedial efforts themselves cannot offer guaranteed performance. The limitation or defect of site assessment and remediation techniques brings insufficient information about the locations and conditions of brownfields and confusion regarding cleanup levels and their effectiveness. Uncertainties in contaminant transport and exposure environment may cause unforeseen incidents and environmental liabilities. The variations of limited funding, interest rates and other economic and financial conditions directly affect the costs and benefits associated with the redevelopment projects.

In conclusion, all of the aforementioned uncertainties lead to the uncertainties of environmental liability. It is understandable that an owner or developer has a fear of liability and associated uncertainties, and this become the key obstacle to cleanup and redevelopment due to the subsequent unpredictability of economic profitability. There are additional costs associated with cleanup and redevelopment that often make brownfields uncompetitive with greenfields [8]. Inspite of numerous challenges, governments can encourage the redevelopment of brownfields by introducing regulatory incentives and risk management tools to reduce the uncertainties of environmental liability.

III. Policy Making towards Brownfield Redevelopment

Substantial studies comparing environmental policy making activities among different jurisdictions have been carried out since the 1980s in the US and the early 1990s in Canada, respectively. The studies focus on either the process [25] or the outcome [11] of policy making. However, analyses comparing these two countries are few in number [6].

A. Regulatory system

Environmental regulations in Canada follow a loose federal-provincial political structure. At the federal level, the Canadian Environmental Protection Act covers most environmental issues and federal property. Provincial and territorial governments are assigned legislative authority over the environment within their individual jurisdictions. Canada's first step in dealing with brownfield problems started in 1989 with the Canadian Council of Ministers for the Environment (CCME) initiating the National Contaminated Sites Remediation Program (NCSRP). The mission of NCSRP was to provide both human and financial resources to jurisdictions across the country for identifying, assessing and remediating high risk abandoned sites, and conducting research on remediation technology, cleanup criteria and liability policies. Thereafter, the provincial and territorial governments started to develop their own legislations for brownfield cleanup and redevelopment within the general framework under NCSRP, while making modifications that were tailored to their special needs. However, federal leadership was absent in 1995 when the NCSRP ended and the federal government did not pursue the development of comprehensive national legislation to deal with contaminated sites. Provincial governments had to take independent responsibility and employ divergent regulatory approaches to develop their own legislation and management policies, which caused the variability of policies that hampers the establishment of a coordinated policy-system in Canada. For example, the Province of British Columbia and Yukon Territory adopted a strong regulatory approach to develop comprehensive legislation and all aspects of the process of remediation and redevelopment projects are overseen by the environmental department. Other Canadian provinces and territories adopted non-enforceable guidelines that allow the private owners and developers to regulate their own activities for remediation and redevelopment. Local and municipal governments also have power to regulate environmental matters, which creates further inconsistency and complexity. This patchwork approach to regulation not only increases the costs of a project in the obtaining of knowledge and information required to comply with various laws and regulations, but also results in uncertainties for the parties involved in the remediation and redevelopment of brownfields. In the absence of a formal national brownfield strategy, organizations such as CCME and NRTEE (National Round Table on the Environment and Economy) have attempted to fill the void by developing proposals and recommendations aimed at integrating brownfield policy into a national cooperative and coordinated inter-jurisdictional approach [15]. In 2003, NRTEE released the report "Cleaning up the Past, Building the Future: A National Brownfield Redevelopment Strategy for Canada". This strategy encouraged the public sectors, including federal, provincial, territorial and municipal governments to establish an effective public policy regime and take a leadership role to address the barriers to brownfield redevelopment [15]. Five years later, there still did not appear to be any initiatives to develop a National Brownfield Redevelopment Strategy as recommended by the NRTEE. However, communication between the public and private sectors has improved significantly in many provinces through stakeholder engagement mechanisms and public-private sector initiatives.

In the United States, the federal and state governments play their respective roles in brownfield management. The federal government is mainly responsible for administrative policy making through its agencies, among which the USEPA is the most important one. State governments also have policy making powers, but must keep in line with federal policies. This political structure ensures the leadership of federal government in brownfield remediation, which is notably different from the situation in Canada. In response to catastrophic contamination incidents such as the Love Canal, Times Beach and the Valley of Drums, the US federal government passed the Comprehensive Environmental Response, Compensation, and Liabilities Act (CERCLA) in 1980, later referred to as Superfund Act because the law made provisions for a specific remediation fund and it gave state governments and federal EPA strong regulatory powers. The Superfund Amendments and Reauthorization Act (SARA), which passed in 1986, broadened EPA's mandate to include research and remediation activities [20]. Within the CERCLA framework, state administrations are assigned responsibility for enacting and implementing their own contaminated site legislation. But unlike Canadian provinces, the state governments must have their regulations consistent with federal CERCLA legislation as well as other applicable, relevant and appropriate requirements set out in federal law.

The Superfund apparatus turned out to be inefficient and costly [19] and the Superfund liability discouraged the purchase of contaminated property [4]. To ignite interest in the redevelopment of brownfields, the USEPA introduced the Brownfields Action Agenda in 1995 to clarify which level of government should assume liability and cleanup responsibilities for a specific site, and restrain EPA's activities on the management of the high-risk contaminated sites. In 2001, the Brownfields Revitalization and Environmental Restoration Act (BRERA) was amended to CERCLA to provide qualified immunity from CERCLA liability to bonafide prospective purchasers (BFPPs) of contaminated sites, and to innocent landowners of adjacent properties from suffering from passive migration of historic contamination. To be a qualified BFPP, one should exercise appropriate care by using reasonable steps to prevent future contamination based on existing conditions – generally by capping or containing existing soil contamination, without obligation to remediate significantly more costly groundwater contamination problems [20].

By 2000, all states participated in the federal government's brownfield program. Moreover, each state has its own laws governing the cleanup of contaminated sites in addition to the federal Superfund law. Many states' rules mimic the CERCLA liability provisions, but some states use different rules [4]. Over 45 states implemented so-called Voluntary Cleanup Programs (VCPs) to loosen the prescriptive structures that both federal and state Superfund-style legislation imposed, and offered various incentives for prospective purchasers and developers, including "comfort" or "no further action" letters and covenants not to sue [4]. This has led to substantial increase in brownfield redevelopment throughout the US in the last decade.

B. Data collection

Due to the lack of federal government leadership, there is no systematic nation-wide approach for collecting, storing and disseminating information regarding the locations and extent of the brownfield problem in Canada. Ontario, Saskatchewan, Newfoundland and the Northwest Territory do not have a formal program. Other provinces do have formal programs that collect data for identifying and classifying contaminated sites for inventory purposes on contamination. However, their procedures of collection, identification and classification differ extensively from each other [13], [14].

A tiered system exists in the US in that the federal, state and local governments collect, compile and manage different kinds of information of contaminated sites in a complementary fashion, making the coordination of information much more practical than in Canada. Sites that are deemed to pose the greatest risk to human health and the environment are placed in EPA's inventory system (CERCLIS) under the jurisdiction of Superfund program. Of these, sites that exceed a designated hazardous ranking are then put on the National Priorities List, and those that do not are assigned to state inventories instead. The Resources Conservation and Recovery Act also created the RCRIS system tracking hazardous materials from cradle to grave, which requires states to track underground tanks, solid waste facilities and hazardous waste sites. In addition to federal and state inventories, many local governments also developed their own inventories and developed their own approaches for classifying sites based on hazardous and economic development potential to better target technical assistance and government funds as well as attract private investment [6].

C. Cleanup criteria

Two types of cleanup criteria are adopted internationally as a consensus to protect the public health: generic numerical soil quality criteria and site specific risk assessment and management [6]. The former ones are numerical indices derived from toxicological studies that identify levels according to a tolerable health risk. This kind of cleanup criteria is consistent and uniform when applied to various sites. The latter ones are less uniform and more adaptable since they are set by taking into account each site's characteristics regarding soil property, land use, type of contamination, exposure, cleanup cost, etc.

In Canada, cleanup criteria are in the form of legally-binding standards in British Columbia and Yukon Territory, while other provinces employ administrative or regulatory guidelines. The regulatory authority assumed by provincial government agencies vary in different provinces. In provinces of western Canada, including British Columbia, Alberta, Yukon Territory, Northwest Territory and Manitoba, environmental agencies work closely with developers, provide technical guidance and supervision throughout the whole remediation process, and conduct a comprehensive review to ascertain that cleanup criteria have been achieved. Environmental agencies in Saskatchewan, Nova Scotia, Prince Edward Island and Newfoundland mainly focus on a review of completed work, and only provide limited guidance to developers during the early stage of remediation. In Ontario, New Brunswick, and Quebec the regulatory authority is

weaker. Environmental agencies allow professionals to undertake remediation and to present evidence of completed work to them; however, the reviews are determined at discretion [6]. The provinces across Canada are moving towards the site-specific assessment and approval regime. In particular, British Columbia and the Atlantic provinces have been using risk based approaches for over a decade, while others such as Ontario and Alberta have made relatively recent changes to their approval regimes to include site-specific standards based on risk assessment [16].

The same generic criteria and site-specific risk assessment procedures are adopted in the US. However, they are much more stringent than Canadian ones and more standardized among states [13], because they have to be developed in a manner consistent with EPA regulations. The review of non-Superfund sites is under the jurisdiction of state governments. Like Canadian provinces, state governments have variable regulatory authority, and their environmental agencies take a more active role in technical assistance and review activities.

D. Liability allocation

Who is liable for the cleanup of a contaminated site? The assignment of environmental liability is one of the most contentious questions in brownfield remediation and redevelopment. Two approaches are generally adopted by governments in various countries. A *joint and several liability system* hold a current owner liable for the entire site cleanup regardless of his/her contribution to the contamination of the site. It is the responsibility of this party to seek recovery payment from other associated parties responsible for the pollution. One party might face liability for the entire costs of remediation in the event that other responsible parties cannot be found or are insolvent [17]. In such cases, liability is imposed regardless of how much or little contamination each party caused. The second one is an *allocated or apportioned liability system*, under which all associated parties are held liable for remediation in accordance with their respective contribution to the contamination.

In the US, the "polluters pay" principle is applied retroactively and the joint and several system is employed under the Superfund legislation to charge those responsible for contamination. Courts have interpreted CERCLA to impose joint and several liability on all potentially responsible parties, including the current owner, generators and transporters of hazardous waste, and prior owners of this site, for any indivisible harm caused by hazardous substances at the site. Under Superfund, EPA attempts to identify the potential responsible parties (PRPs) to extract from them the cost of remediating the contaminated site, regardless of the issue of equitable share of liability among parties. If PRPs cannot be initially identified or the PRPs are recalcitrant, EPA may proceed with the cleanup with federal government expense, and later sue the PRP in order to recover the costs. Therefore, this system gave rise to a high amount of litigation. Under Voluntary Cleanup Programs, cleanup is a largely voluntary activity. States intervene to compel parties to cleanup a site only when it is deemed to be hazardous to public health and safety. To counteract the litigation problem and protect investors, the state legislatures have No-Further Action and Covenants Not to Sue certificates are designed to prevent future liability litigation [6].

In Canada, Alberta, Manitoba, Prince Edward Island, Nova Scotia and Yukon Territory have adopted the allocated liability approach following the "polluter pays" principle recommended by CCME in 1993 [13], but other regions employ a joint and several liability approach instead. There is a general phenomenon that Canadian governments are unwilling to impose liability on those responsible for contamination and force a remediation unless the site imposes severe human health or environmental risk. The policies do not protect parties undertaking a current remediation from future liability.

The fear of future liability if standards change makes owners and developers reluctant to cleanup or redevelop brownfield sites. Several provinces have taken steps to reduce and clarify regulatory liability risk since the release of NRTEE Brownfield Strategy [16]. For instance, in British Columbia, the Environment Management Act (EMA) and Contaminated Sites Regulation (CSR) provide limited exemptions for innocent purchasers, owners and operators from liability if certain conditions are met. However, British Columbia's EMA is insufficient in terms of prospective liability [17]. Although certificates of remediation are issued to provide immunity to parties who completed cleanup if the same kind of contamination is discovered in the future. Unfortunately, the protection is limited because liability can be reopened for a wide variety of reasons that are often derived from changes in standards and changes in site use. Ontario's Brownfields Statute Law Amendment Act (BSLAA) 2001, which came into effect in 2003, provides five-year liability protection from environmental orders for municipalities, secured creditors, receivers, trustees in bankruptcy, fiduciaries, and property investigators [17]. However, different from most U.S. brownfields legislation, the BSLAA and the Regulation do not provide protection from civil liability to those who have filed Records of Site Condition (RSCs) or who rely on the accuracy of RSCs in purchasing, occupying or developing land [10].

E. Funding programs

State and federal laws in the US and some other countries can require the assessment and remediation of a contaminated site. As a result, landowners, developers and other private sector stakeholders are often reluctant to put former industrial and commercial properties back into productive use for fear that they may be contaminated and thus too expensive, time-involving and risky to redevelop profitably. In order to entice investment in brownfield redevelopment, governments at all levels in the US and Europe have implemented a variety of policies and programs to offer a package of financial and in-kind assistance to make the private sector interested in purchasing and cleaning up a site, including grants, loans, tax incremental financing, technical assistance, acquisition assistance and insulation from liability [18].

However, Canada has been moving slower than the US and Europe in brownfield redevelopment, which has just started to receive more attention [5]. There was a federal/provincial funding program (NCSRP) but that ended in 1995. In 2005, the Federal government established a $150 million revolving fund for brownfield projects through the Federation of Canadian

Municipalities (FCM) Green Municipal Fund (GMF). FCM's GMF loan is currently only available to municipalities, providing grants up to $350,000 to support municipal governments and their partners with feasibility studies and field tests. At the provincial level, only a few provinces in Canada offer funding programs. Quebec's Revi-Sols program, introduced in 2001, funds up to 70 percent of site assessment and cleanup costs [8]. Ontario's Brownfields Statute Law Amendment Act of 2001 allows municipalities to provide grants and loans to brownfield owners and to freeze or cancel the municipal portion of the property tax on contaminated sites through financing tools such as the Brownfield Financial Tax Incentive Program and Tax Incremental Financing [15]. Alberta also has implemented a Tax Incremental Program. In recent years, increased awareness of brownfields and improved regulatory certainly has started to open up the brownfield redevelopment market. Private lending institutions such as the Royal Bank of Canada and the Canadian Imperial Bank of Commerce have begun to offer lending and project finance products for brownfield remediation and redevelopment [16].

From the above comparison of the policy making situations of different jurisdictions in Canada and the US, it is evident that in the US the federal government takes a more active role in the overall process. The absence of federal leadership results in greater variability among Canadian provinces and make many of them look to states in the US for guidance. There is a convergence of contaminated site policies and programs in the Canadian provinces and American states. One of the examples is the move towards generic and site-specific risk based approaches for investigating, assessing and remediating contamination.

IV. Risk Management Tools Tackling Uncertainties Associated with Liability

There is a common realization among policy makers that it is impossible for governments to remediate and redevelop the large number of contaminated sites in their jurisdictions due to limited public funds availability. Therefore, it is required to almost entirely depend on private sector investment [20]. The key obstacle to redeveloping brownfields is the automatically forced assumption of strict joint and several liabilities for the historic contamination by every new brownfield property purchaser [20] which then puts them into a long and costly litigation process to allocate liability among the responsible parties and create substantial disincentives to investment. Another big obstacle is the lack of certainty in predicting the final remedy required by the regulatory oversight agency at any particular site which makes it difficult for any potential brownfield investor to accurately estimate the duration and cost of the remediation project, and hence greatly increases the risks associated with the financial investment at the sites.

In order to stimulate private investment in brownfield remediation and redevelopment, governments are seeking to implement policies and programs that reduce the associated costs and risks and fear of the uncertainties of liability for preexisting and new contamination. As a consequence of incentive policies and regulations, the environmental insurance industry has also actively developed a number of risk management tools for tackling uncertainties associated with liability which will allow more private investment in brownfields. A number of risk management tools have been developed in the US to minimize the risks associated with brownfield cleanup and redevelopment, thereby easing the fear of uncertainties of environmental liability and facilitating private investment. These tools are summarized in Table I. In the previous section, the comparison of policy making in brownfield redevelopment has already addressed the measures that are available to reduce liability risks, including the statutory law recourse (joint and several liabilities), federal and states regulatory protections, and financial assistances. They are not discussed further in the following subsections.

TABLE I. Risk Management Tools for Brownfield Remediation and Redevelopment

Type	Risk management tool
Statutory law recourse	Potential responsible parties can be sued to seek reimbursement or to share liability
Federal and state regulatory protections	Comfort letters No further action letters
Financial tools	Escrow accounts Purchase price adjustment Grants and loans Tax credit or subsidy
Due diligence and remediation techniques	Conduct all appropriate inquiry Understand pre-existing conditions and impacts on development
Private party contractual protections	Indemnities (compensation) Representation and warranties Covenants (binding agreements) Releases Fixed price and risk transfer contracts with contractors
Environmental insurance	Pollution liability coverage Cost cap coverage Lender pollution liability coverage Finite/blended risk coverage

Adapted from Anderson and Harrington [1], p.1.1.

A. Due diligence and remediation techniques

Most existing decision approaches for site remediation focus on the technical advantages and disadvantages of different remediation techniques. More advanced methodologies use dose-response data in a risk-based approach, while the most sophisticated ones integrate risk assessment, engineering design, economics and uncertainties into decision making [21]. A well designed sampling plan, compounding utilization of laboratory and field analytical methods can increase knowledge in site characterization and assessment thereby decreasing liability uncertainty and risk [12].

B. Private party contractual protections

An indemnification is an agreement that provides for one part to bear the costs, either directly or by reimbursement, for damages or losses incurred by a second party [24]. Environmental indemnifications must be drafted with care and specificity in order to be upheld and enforceable in court actions. An indemnification is used to define the allocation of risks and liabilities between sellers and buyers. However, this does not prevent a government agency from asserting liability claims for remediation costs or other environmental enforcement actions against indemnified party. All potential responsible parties as a whole group will be requested to cover

the cleanup cost. Various financial mechanisms such as escrow funds, hold backs, letters of credit, bonds and environmental insurance policies can be used to support indemnification.

Representations and warranties are statements of fact (representations) and promises (warranties) that a seller makes to a buyer. They are typically provided by a seller to disclose the risks associated with acquisition of a business or all of its assets. Assumption, retention, and release provisions mean that a buyer accepts, or a seller retains, the responsibility for the known or unknown environmental conditions and releases the other party from liability for current and future claims arising from the specified conditions. Typically this kind of contractual protection is used to allocate the risk of future liability for currently existing but unknown conditions. A covenant is a promise or agreement by a seller or a buyer to do or refrain from doing an act. It is used to allocate responsibility for tasks, particularly elements of cleanup, transferring permits, continued operations of assets, and compliance with environmental law, or not to take any action such as dispose of hazardous substances after a specified date. A seller may also restrict the buyer not to use the property for certain purposes such as residential or not to withdraw groundwater. With a fixed price and risk transfer contracts with contractors, a seller makes no representation or warranties about the conditions of the property. The contract is intended to preclude a buyer from recovering damages from a seller for known or unknown conditions at the time of sale. Specific environmental condition, including latent defects, should be disclosed to a buyer, and indemnification should expressly state that the property transfer includes all risks associated with the listed federal and state environmental laws.

C. Environmental insurance

Environmental insurance (EI) policies are individually tailored for each project, and can be purchased by property buyers, sellers, and intermediary owners such as redevelopment authorities. There are dozens of types of EI policies available, which can be classified into four main categories as listed in Table II.

In the last ten years in the US, environmental insurance products have become standard risk management tools that facilitate the cleanup and redevelopment of brownfields [26]. Pollution liability (PL) policies are the most widely used brownfield insurance product. They provide protection against claims for third party cleanup costs, bodily injury, and property damage arising out of pollution conditions on, under or migrating from an insured site; legal defense expenses arising from third party claims, and cleanup of pollution conditions discovered by the insured at an insured site. Cost cap (CC) policies help protect against costs incurred by an insured party that exceed the estimated cleanup costs based on a remediation plan. The CC market is relatively new and small [26]. The policies are not appropriate for small projects with cleanup costs of less than $1 million, because it is easy for cost overruns to occur on small projects and thus the relative premium an insurer would need to charge makes the CC policies cost-ineffective for small projects. Lender pollution liability policies protect lenders from losses due to pollution conditions at properties used to secure loans. Owners or developers benefit in that the policies may increase lender willingness to provide capital. Finite or blended risk programs are also referred to as Pre-Funded programs. As the name indicates, they entail pre-funding of the anticipated expense at a brownfield site where a cleanup is planned. They include a CC coverage, and in many policies, also PL coverage. Like CC policies, the finite/blended risk programs require extensive site assessments and individually structured for specific projects. Additional policies include liability protection for professional consultants and contractors and products surety bonds to guarantee the performance and payment obligations of contractors.

TABLE II. FOUR CATEGORIES OF ENVIRONMENTAL INSURANCE FOR BROWNFIELD SITES

Category	Main coverage	Typical terms
Pollution liability	Cleanup of unknown preexisting and new pollution conditions at or emanating from the site Third party bodily injury and property damage claims caused by pollution conditions at or emanating from the site	Typically 5 to 10 years Premium usually $50,000 to $100,000 Coverage limit usually $5 million to $ 20 million Minimum deductibles typically $5,000 to $10,000 each incident.
Cost cap	Unanticipated increase in costs of a known cleanup due to: Cost overruns for remediation expense, Changes in regulatory standards or laws, Discovery of new contaminants or the same contaminants onsite and offsite.	Period is the length of the cleanup project Premiums range from 8 to 20% of the limit purchased Limits maybe capped at 2 to 3 times of the expected cleanup costs Self-insured retention (deductible) above cleanup costs of 10-30% Co-insurance may be necessary where the insured pays a proportion of all costs above the deductible or self-insured retention
Lender pollution liability	Policy pays for covered loans once a loan default occurs where pollution conditions exist, which may include: Collateral value Loan balance Cleanup costs Legal defense Contract damages Bodily injury and property damage Business interruption	Period and premium are negotiable Limits are typically $5 million to $10 million Deductibles start at $25,000
Finite/ blended risk	Insurer takes on the financial responsibility for cleaning up the site Combines coverage from known and unknown environmental liabilities Incorporates pollution liability (PL) and cost cap (CC) insurance elements Preferred insurance for longer cleanups	Period is negotiable, but is typically more than 10 years Most terms are project specific

Adapted from Anderson and Harrington [1], p.1.2-1.4.

Five key stages can be distinguished in the process of brownfield redevelopment: site selection, remediation, new construction/rehabilitation, ongoing operations, and refinancing. For each stage, there are appropriate types of environmental insurance to reduce associated uncertainties and risks [9]. For example, during the site selection stage, a would-be developer will involve CERCLA-type site assessment efforts, and thus benefit from professional liability coverage by being released from the protection of profession errors made by engineering and legal firms. Third party liability coverage and cost cap insurance will reduce the uncertainties in third party liability and remediation overruns. During the new construction/rehabilitation stage, owners or developers will have more certainty about their expenses if owner/operator liability coverage is available, and architects and engineers may also benefit from professional liability coverage. The ongoing operations stage involves uncertainties that are reduced by the availability of owner/operator liability coverage and long-term regulatory reopener coverage. The refinancing and lender sale or securitization of a mortgage should tend to be easier if long-term and guaranteed renewable owner/operator and reopener insurance coverage is available.

There are some shortcomings of EI market. Demands for EI protection are overwhelmingly from the private sector, one part of which is from major firms with multiple brownfield sites, for protection of their portfolio of properties, and another part of which is from developers of major projects, for coverage of their individual investments. Demands from small firms and developers are few due to the relative high underwriting fee of EI policies. No specialty products have been developed specifically for municipalities or other possible public parties, simply because of lack of demand. One possible solution to stimulate the redevelopment of small-scale brownfields is the creation of pools of brownfields. More specifically, municipal or economic development agency coordinate the creation of pools, purchase insurance for such pools, and then provide such coverage to would-be redevelopers and their financiers. The provision could be free of charge as a full subsidy, partial cost as a partial subsidy, or full cost without subsidy. Provision of pooled insurance would reduce the cost burden for small-scale brownfield redevelopment and have owners or developers benefit from risk sharing [9].

In Canada, as discussed in the previous section, there is no federal leadership and provinces have their own regulations with regard to brownfields, which are mainly adopted from American states. In general, the provincial government authority in remediation and funding support is limited in Canada. The brownfield transactions are fewer in the market. Private party contract protection and environmental insurance industry are still at their early stage of growth in Canada [15], [16]. In many ways, Canada is in a position similar to that of the US. The most significant difference between these two countries is the certification provided to developers or owners who cleanup the sites. While Canadian laws only provide for certification and exemption from liability after cleanup is completed, the US Federal Brownfields Amendments allow for exemption from liability for one who qualifies as a BFPP prior to undertaking a remediation.

V. CONCLUSIONS

While the Canadian federal government does not show leadership in developing a national consistent policy and strategy for brownfield redevelopment as compared to the United States, provinces and municipalities do have some latitude to provide financial incentives within existing legislation. The risk management tools for brownfield redevelopment are a key factor to reducing the uncertainties associated with redevelopment for site owners or developers, and hence stimulate private investment in this area. The two most important uncertain factors are the regulatory liability risk and regulatory delay which often lead to failures in the brownfield redevelopment market. A recent survey of the state of Canada's brownfield redevelopment industry indicated that the lack of access to capital, insurance protection and civil liability were no longer a major issue because market forces can deal with these issues once the others barriers such as regulatory liability are removed [16].

Most studies of risk management are mainly experimental based on industry practice. There are few studies undertaking quantitative analyses of the liability and uncertainty issues in brownfield remediation and redevelopment [3],[4],[21]. Formal mathematical models for analyzing the liability under various regulatory systems and transactions should be helpful in developing regulatory policies and incentives for private investment and formulating more effective risk management tools.

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