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Facilitating Brownfields Transactions Using Triad and Environmental Insurance

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Abstract

A significant hindrance to reuse of Brownfield properties is the risk associated with redevelopment, specifically the uncertainty associated with environmental cleanup. This paper explores an approach to managing environmental risk through a combination of risk quantification, environmental insurance and the Triad Approach to site sampling and data interpretation. Using the Marsh *Peer Review*SM risk quantification process that employs statistical techniques and highly experienced technical staff the expected costs of environmental liabilities are estimated. The outputs of the process indicate premiums and attachment points for insurance products, but they also point to "critical uncertainties" that drive the insurance premiums. Insurance premiums are often linked to site delineation deficiencies, such as the magnitude of impacted soil or the size of a groundwater plume. The Triad Approach is an integrated site characterization process developed by the Environmental Protection Agency that combines systematic planning, dynamic or adaptive field decision-making and field analytical methods (FAMs). The real time data produced by FAMs allow for in-field resolution of uncertainty about sample location, which in turn provides more representative delineation of contaminant distribution. The trade-off of using slightly less accurate but substantially lower cost FAMs, is an increase in sampling frequency or density thereby reducing the risk of incomplete detection or delineation while yielding a "data set" that is more powerful than fewer individual data points analyzed through traditional methods. Employing the Triad approach to analyze the "critical uncertainties" identified in the Peer Review Process can impact insurance premiums and allow for better terms of coverage. The combination of using the Triad Approach and environmental insurance products can lead to more predictable and profitable Brownfield transactions.

Introduction

One theme that has transcended administrations, ideology, and levels of government is the realization that Brownfields redevelopment provides positive economic benefits to communities. With bipartisan support, President Bush signed the Small Business Liability Relief and Brownfields Revitalization Act (SBLRBRA) of 2001 into law on January 11, 2002. Well before the passage of the new law, Presidents Bush and Clinton had pledged support for Brownfields (Clinton 1998, Bush 2001) in addition to Governors, County Officials, and Mayors (NGA 2000, NACo 1998, USCoM 2000). One reason for the overwhelming support is the shear magnitude of land that is represented by Brownfields. Brownfields estimates range from 500,000 to

1,000,000 sites (Bartsch et al 1991; OTA 1995; Simons 1998; Simons 1999) based on the pre-SBLRBRA working definition of Brownfields as "abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination" (USEPA 1997a). Under the broader definition of SBLRBRA the number of sites eligible to be considered Brownfields will likely increase. While the definition may continue to evolve, "real or perceived environmental contamination" will continue to influence property transactions that are clouded by the economic uncertainty stemming from such contamination.

Through a case study approach, this paper discusses how the use of Triad and environmental insurance, both useful in their own right, can be combined to reduce the uncertainty and costs to facilitate Brownfields transactions. We will provide a brief overview of the Triad methodology as well as a description of how environmental insurance can be used to provide risk protection for developers, lenders, and site owners. Finally, the case study will demonstrate how the application of targeted improved site characterization methods and technologies can be used to reduce risk by quickly and inexpensively increasing contaminant distribution knowledge and, thus, to manage insurance costs.

Human health risk, which has been a key remediation driver, has been broadly defined as a function of hazard and exposure modified by uncertainty (NRC 1983). As human health risks are identified , economic dimensions (such as time and cost) of a cleanup emerge and are continually modified by uncertainty. In other words, the economic risk of a remediation project is influenced by the degree of uncertainty surrounding the cleanup – the greater the uncertainty the greater the perceived economic risk. The logical extension of this line of reasoning is Brownfields – properties that have sat idle from the fear of the real or perceived economic consequences of cleanup. The literature, which has approached economic risk from a development perspective, identifies such concerns as barriers to re-development, due to the liability associated with (translate as cost to address) contamination (Bartsch et al 1991; Bartsch & Munson 1994; Silkowski-Hackett & Schiavo 1996; Arrandale 1997; Bartsch & Collaton 1997; USGAO 1996; USEPA 1997a; Alberini & Austin 1999; Van Horn et al 1999). States, which have responded to the groundswell of support for redevelopment of Brownfields, have attempted to address redevelopment barriers by offering liability relief through Voluntary Cleanup Programs (ELI 1998); and while the new federal law supports such state programs, the real costs of addressing contamination remains as does the potential for reopening the cleanups.

One tool that can be used to manage economic dimensions of risk, environmental insurance, is particularly sensitive to uncertainty. An insurance policy involves the transfer of economic risk from the insured to an insurance company. Environmental Remediation Stop Loss, also known as Cleanup Cost Cap, is an insurance product that transfers the risk of remediation cost overruns on a set scope of work from the insured to an insurance company. More accurate site understanding leads to more accurate estimates of site cleanup costs. Therefore, increased knowledge in the form of site characterization will decrease uncertainty and risk, which in turn reduces premiums and attachment points. And, therein lies the inherent tension of site characterization – the need to improve certainty through better site understanding is often at odds with the need to control upfront costs, which are usually those associated with site characterization. However, as this case study will demonstrate, targeted characterization, informed through planning and expert judgment, can be an effective approach to manage characterization costs and to reduce insurance premiums.

Triad Approach

Background

Traditional site characterization programs rely on federal or state approved analytical methods as the basis for providing data on the distribution of contaminants because it is commonly assumed that these analytical techniques are practically free of uncertainty. In contrast, data produced in the field are generalized as “screening” and considered inferior to support important project decisions and regulatory actions. Such generalizations are based upon 1) the current regulatory mindset that “high quality” analytical data are necessary to accurately depict site conditions and 2) lack of distinction between analytical method and the data sets that are produced by them (Crumbling, et al 2001). While these assumptions are inaccurate, they are pervasive enough to inhibit widespread use of field techniques for assessing Brownfield sites.

Because of the magnitude of the number of Brownfield sites and the complexity of contaminated site redevelopment, alternative site characterization strategies are being considered. These approaches are based upon the concept that greater confidence in site management and cleanup decisions can be had if field analytical methods (FAMs) are used as primary tools around which field programs are designed. This is driven by the recognition that the greatest sources of data uncertainty are issues related to sampling. The single most important component of any sampling characterization program is the selection and collection of samples that are representative of the features being investigated. Therefore, a program that overemphasizes laboratory management at the expense of collecting representative samples can produce information that does not accurately reflect site conditions. This can lead to inaccurate assumptions regarding cleanup costs.

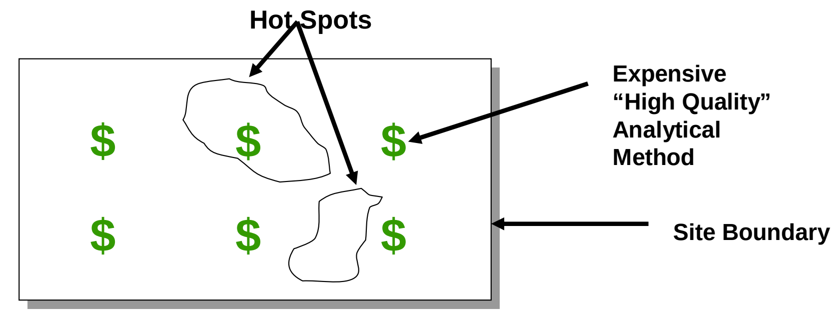
Triad Concept of Site Characterization

Representative Data Sets

The use of FAMs in a dynamic field decision-making mode allows collection of representative samples because applicators can decide when and where to take the next sample. Additionally, because less expensive FAMs are used, more samples can be taken, which builds a data set that is more expansive than traditional investigations. Thus, while the data quality for each data sampling point may be slightly less than that if standard analytical methods are applied, the data set is more powerful and representative of the site conditions because sampling density is substantially increased and each data point has been purposely chosen in the field to provide the required information.

Figures 1, 2 and 3, illustrate this concept. Figure 1 illustrates an idealized site where a conventional sampling approach was applied that relied on high quality analytical data to locate hot spots. Under this scenario, few but good quality analytical data points would actually form a poor quality data set. This would produce a misleading interpretation of the data, because budget constraints limit the number of samples for defining site conditions. If this were a site where the whole site was to be redeveloped, beginning remediation based upon conclusions obtained from a conventional data set approach could have serious cost implications. Under the Triad Approach (Figure 2), using slightly less accurate and less costly analytical data allows substantially more samples to be analyzed, which yields more confidence that the data set is representative of the site condition. This situation would specifically benefit Brownfield sites where redevelopment usually requires use of the whole property. Figure 3 provides a simplified illustration of the overall decision uncertainty between conventional and Triad approaches as the sum vector of the sampling and analytical components (Crumbling et al, 2001).

Figure 1



Conventional Data Quality Approach: **Analytical uncertainty minimized with expensive "high quality" methods, but overall data set representativeness reduced because of low sampling density due to high cost of analysis.**

(After Crumbling, et al 2001)

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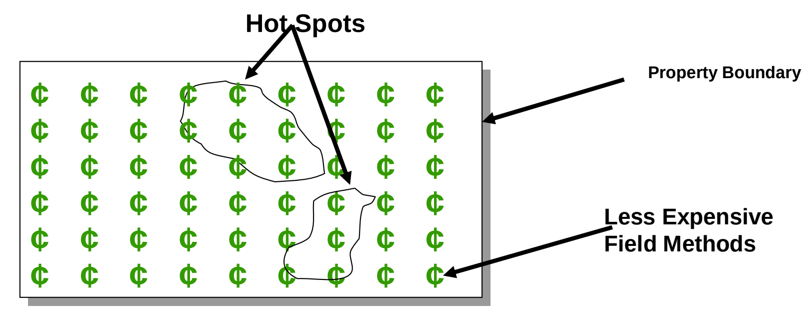
Figure 2



Uncertainty Management Using Triad: **Unit analysis cost decreases, so sampling density increases, and the overall data set is more representative of site conditions.**

(After Crumbling, et al 2001)

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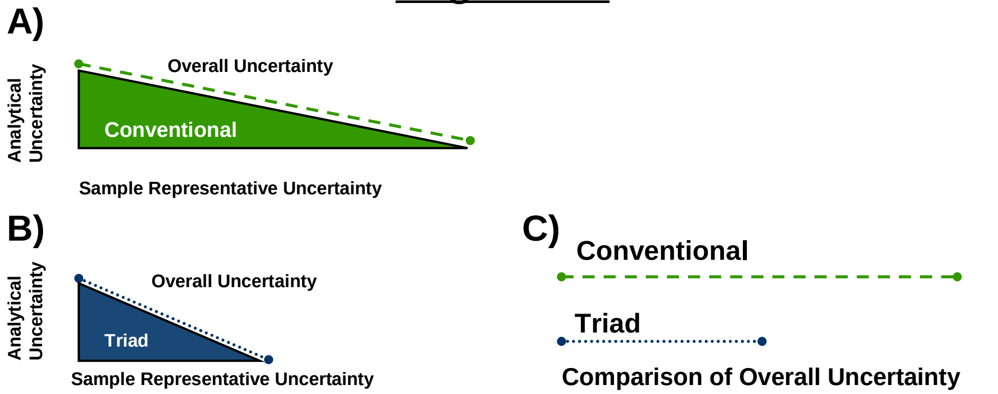
Figure 3



Comparison of Uncertainty: A) analytical uncertainty reduced, however low sample density produces significant sample representative uncertainty, resulting in high overall uncertainty (vector sum of components); B) while using Triad analytical uncertainty slightly increases, but sampling uncertainty is substantially decreased, reducing overall uncertainty, C) illustrates how the vector sum uncertainty decreases as a result of Triad

(After Crumbling, et al 2001)

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Field Analytical Methods

The most common FAMs are X-ray fluorescence for metals; field gas chromatograph (GC and GC/MS) for volatile organic compounds (VOCs); immunoassay test kits for pesticides, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and total petroleum hydrocarbons (TPH); and UV fluorescence for TPH and diesel. Also certain geophysical methods such as conductivity probes can be integrated into sampling strategies. Additionally, new probes have been developed that combine push technology with chemical sensors that allow continuous subsurface profiling of VOCs in soil and groundwater. However, it is recognized that FAMs alone are not sufficient because of certain data quality limitations, and that is why the Triad Approach integrates FAMs with mobile laboratories running standard methods. The skill is in balancing the two types of analysis so that sample flow and data quality are not compromised. Thus, the Triad Approach requires that experienced field personnel implement the work, make field decisions and interpret the data.

Components of the Triad Approach

The Triad Approach envisions a three-pronged approach to the investigation strategy. These three pieces, systematic planning, dynamic work strategies and real-time measurements, are explained in detail below.

Systematic Planning This critical first step for all site activities ensures that project end goals are clearly articulated and all stakeholders agree on the desired decision confidence. A multidisciplinary technical team translates the project goals into realistic technical objectives. The most important planning tool is the conceptual site model (CSM). This planning tool allows the project team to organize what is already known about the site and what is needed to achieve the project goals. It also strengthens communication and cooperation between stakeholders involved in the effort to redevelop the property. The systematic planning process ties project goals to individual activities necessary to reach these goals by identifying data gaps in the CSM. The team uses the CSM to direct fieldwork to gather the needed information. The CSM evolves and matures as site work progresses and data gaps are filled.

Dynamic Work Strategies (DWS) This element of the Triad Approach is the basis for making real time decisions in the field. It consists of stakeholder approved decision trees and decision logic that are tied to the CSM. It is supported by the rapid turnaround of data collected, analyzed and interpreted in the field so that additional sample locations can be selected “on the spot”. Success of the dynamic process hinges on the execution of the program by experienced staff that are empowered to “call the shots” based upon the decision logic and can also rely on their skills to cope with unanticipated conditions. Field staff must maintain close communication with stakeholders during the implementation of the DWS.

Real-time Measurement Technologies The final component of the Triad is the use of analytical methods and data management tools that will generate and interpret real time data. These include rapid sampling platforms, such as push technologies, field analytical methods and mobile laboratories, and software for storing and mapping data. Analytical methods must be appropriate to the matrix being sampled, and appropriate QA/QC procedures must be developed. Methods should be integrated to control data quality but must produce information quickly and inexpensively to support the dynamic decision making process.

If used correctly, the Triad Approach, which consists of innovative rapid turn around field analytical and software tools coupled with on site decision making, can provide data that are more representative of site conditions than traditional sampling methods produce, thus, allowing for more certainty in critical planning decisions about remediation and redevelopment costs.

Environmental Insurance

Risks in Brownfields Transactions

The four key risk factors associated with Brownfields transactions include third-party or “toxic tort” liability risk, regulatory risks, timing risks, and financial exposures.

Third-party liability risk is the risk of exposure to contaminants. These exposures could include the bodily injury of people both on- and off-site as well as property damage or diminution of property value for adjacent properties. Additionally, there could be liability related to non-owned disposal sites or during transport of hazardous substances. Site owners, buyers, developers, and contractors face third-party liability exposures (Bressler and Hannah 2000).

Regulatory risks include the threat of regulatory re-openers of a site that previously received closure by the regulatory body or changes to clean-up standards during site remediation. The re-opener could result from EPA involvement in a previously state-regulated site; enactment of stricter cleanup standards; the discovery of previously unknown, preexisting or new contamination; or involvement with non-owned disposal sites. Regulatory risks could impact site owners, buyers, developers and contractors (Bressler and Hannah 2000).

Timing risks describe the risk of delays during development and delays in ultimate site occupation. The delays may be due to the discovery of previously unknown, preexisting contamination that extend the remediation time and expand the scope of work. Failure to pass zoning requirements or to secure permits for development also could cause delays. The financial impact of timing risks include direct effects, such as loss of revenue, as well as indirect costs, such as loan interest, that must be paid throughout the delay (Bressler and Hannah 2000).

Financial exposures to the site developer or owner could result from under-estimated remediation costs due to incomplete delineation or regulatory changes; third-party liability; or insolvency of parties that offered indemnity for the site. Lenders face financial exposures because the contamination may affect the borrower's ability to repay loans, diminish the value of the collateral, and/or create third-party liability exposures (Bressler and Hannah 2000). Additionally, inflation and return on investment are major risks, especially when considered with timing risks.

Environmental Insurance Products to Facilitate Brownfields Transactions

The risks described above often impede Brownfields redevelopment. All parties involved must be comfortable that the risks are controlled before a transaction can proceed. Environmental insurance has developed as a tool to control the risks in Brownfields transactions. Different insurance products address different risks and can be combined to provide protection to parties involved in a site redevelopment. The most common environmental insurance products are Cleanup Cost Cap and Pollution Legal Liability, which are discussed below.

Environmental Remediation Stop Loss or Cleanup Cost Cap (CCC)

CCC policies allow companies to limit the costs related to the cleanup of "known" conditions at contaminated sites. The policy is underwritten based on a Remedial Action Work Plan, which outlines the remediation approach for the project. CCC "caps" the cost of cleanup when the actual project costs exceed the original budget. The dollar value at which the CCC policy provides a cap is called the "attachment point", and the amount below the attachment point that is paid by the insured is called the "self-insured retention".

A CCC policy can be designed to cover broad deviations from the anticipated scope of work that would affect the costs incurred. Examples of such situations include but are not limited to 1) when the actual extent of contamination is greater than estimated; 2) when the actual degree of contamination is greater than anticipated; 3) when unit rates for treatment and disposal are higher than anticipated; 4) when previously unidentified contaminants are discovered; 5) when the time for remediation (capital implementation and O&M) is greater than anticipated; 6) when offsite cleanup of contamination adjacent to the covered site is assumed; 7) when there are changes in the cleanup standards; and 8) when governmental involvement dictates a change in cleanup requirements and/or remedy.

Environmental Impairment Liability or Pollution Legal Liability (PLL)

PLL policies transfer the risk of cleanup for "unknown" pollution conditions at a site. PLL policies limit the universe of risks that the owner or developer must manage and ultimately reduce the financial uncertainty and impact from unforeseen one-time events.

A PLL policy can provide coverage for the following risks: 1) cleanup of unknown pre-existing pollution conditions and new releases; 2) 3rd party liability (bodily injury, property damage, and diminution in value); 3) contractual risk; 4) regulatory "reopeners"; 5) changes in environmental regulations; 6) Natural Resource Damages; 7) environmental risks of transportation and non-owned disposal sites; 8) business interruption; and 9) the legal defense costs for all these risks. PLL may also cover timing risks, including delay in opening, and the resulting financial exposures, including development soft costs, losses of income, and extra expenses. A PLL policy can be structured with a relatively small deductible and with a range of limits of cover. Typical deductible range from $50,000 to $200,000 per claim, but can be as low as $25,000 or as high as $500,000 per claim.

In Brownfields transactions, CCC and PLL policies are often integrated to form a solid wall of protection for cleanup of both known and unknown environmental conditions and their associated liabilities for the property owner and developer. The CCC caps the remediation costs associated with "known" pollution conditions, while the PLL provides coverage for other environmental liabilities resulting from "unknown" pollution conditions and third-party liability issues. Figure 4 shows how the two policies work together to protect the insured.

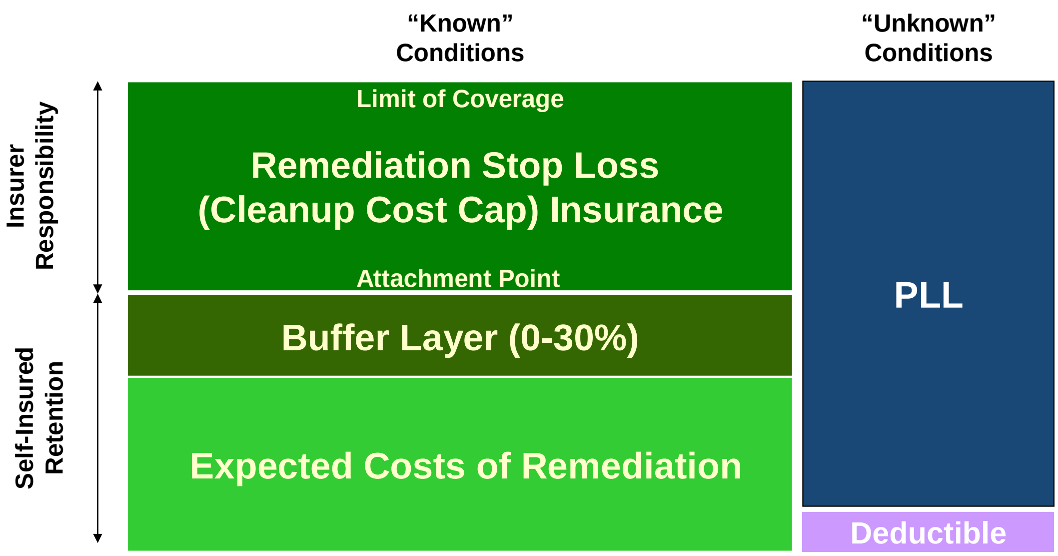
Pricing of Environmental Insurance Products

Insurers balance the risk of having to pay a loss on a policy they write with the income they receive for underwriting the risk. An insurer must collect more premium than the losses they pay out in the aggregate to remain financially viable. Thus, loss forecasting is a core competency for underwriting individual risks relative to designing coverage terms and including expected losses within pricing. Insurers use complex rating and statistical models to evaluate and price individual risks given the available and applicable information relative to the coverage being sought.

Pricing of PLL policies is dependent upon a variety of factors including coverage elements, term, deductibles offered and limits purchased. In addition, the underwriter must access the likelihood of a loss given a myriad of factors, including but not limited to the history and nature of operations, facility size, quality of environmental management, claim history, surrounding receptors and site use going forward. PLL policies are typically not designed to cover "known" environmental conditions. These "known" conditions are typically scheduled out for either management by the company or for coverage under the CCC policy.

Pricing of PLL policies is directly dependent on how well potential sources of contamination have been identified and investigated at the time of policy inception. The underwriter will assess the availability, quality and thoroughness of any Phase I/II investigations, or equivalent under State or Federal cleanup programs. Ultimately, the underwriter uses the rating model and his or her professional judgement to assess the amount of uncertainty regarding the site conditions and to forecast expected loss less deductibles that may arise during the policy period from discovery. Where risks are unacceptably high due to poorly defined site conditions, the underwriter may either exclude or restrict coverage offered, or increase premium to reflect the increased risk from higher than expected losses.

Figure 4



Integrated Insurance Program Structure: The CCC provides coverage for known contamination conditions at the site, while the PLL covers the insured for unknown conditions and third-party liability.

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The CCC policy, on the other hand, is priced around a defined scope of work and proposed budget in a Remedial Action Work Plan (RAWP) for the site. The budgets in RAWPs often are conservative, single point estimates of very complex remediation alternatives. They often oversimplify the actual site situation. For instance, these single point estimates cannot account for interdependence of possible remedial milestones or outcomes. Nor can they consider variations in unit prices. The RAWP budget estimates are an example of a pervasive problem throughout business – the desire to represent complex scenarios with a single number (Savage 2002).

For CCC policies, the underwriter must access the risk that a project's costs will exceed those forecasted for the defined scope of work. Expected losses are determined based on a detailed, independent engineering analysis that identifies implementation risks or "gaps" that could cause an increase in cost to be incurred. Examples, include but are not limited to:

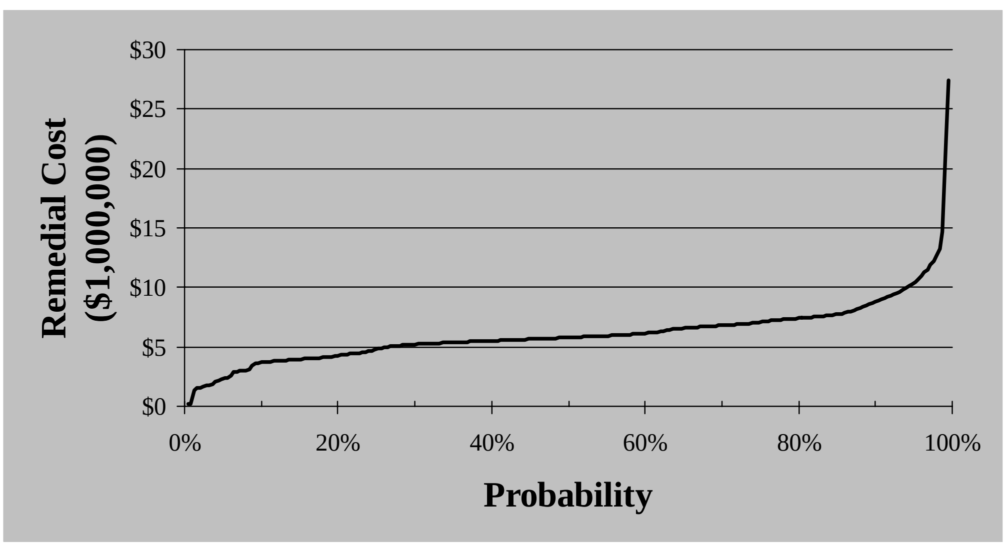
- Applicability and efficacy of remedial technology(s) to achieve performance goals;
- Risk of a change in remedy during implementation;
- Inaccurate estimation of volumes/areas to be remediated;
- Under-priced unit rates for prices;
- Underestimation of length or longevity of remediation
- Incomplete accounting of tasks, activities and costs to be completed & incurred;

One of the most common CCC policy risks is also one of the most basic elements of a cost estimate – inaccurate estimation of volumes to remediate. There is always a significant amount of professional judgment in determining when sufficient data points have been collected and where to interpolate the boundary of remediation between clean and impacted samples. Small inaccuracies can have a pronounced, exponential affect on volumes and associated costs due to the three dimensional nature of the problem. Where gaps are identified, the underwriter will utilize statistical cost models to project likely remedial costs and associated pricing. Identified uncertainties will result in a combination of either coverage restrictions, increase in buffer and attachment point or increase in pricing.

For redevelopment projects, the economics of the venture can be materially affected by uncertainties that increase PLL and CCC pricing, and the CCC attachment point. The challenge is to cost-effectively reduce uncertainty to gain the best combination of policy terms and pricing.

Marsh, the largest broker of environmental insurance, has found that site owners and developers greatly benefit from analyzing the FS or RAWP budget in terms of the statistic model. Marsh has developed a process called *Peer Review*^{SM} that quantifies risk using available site information. A panel is assembled during the *Peer Review* Process. The Expert Panel is often made up of the site owner or developer, consultants, attorneys, and others who have valuable knowledge about the site. The Expert Panel evaluates the information using decision tree analysis, and the outcome of the analysis is a remedial cost probability curve similar to the one in Figure 5. It shows the probability that the cost to remediate a site will be X dollars or below. For example, Figure 5 indicates that there is an 80% chance that this site will be remediated for $7.5 million or less. This remedial cost probability curve is similar to what underwriters use to price CCC policies.

Figure 5



Remedial Cost Probability Curve: This curve shows the outcome of the Peer Review Process. The curve shows that there is an 80% probability that this site can be remediated for $7.5 million or less. This curve describes the results of the feasibility study conducted at the case study site.

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The shape and the magnitude of the curve in Figure 5 are used to determine insurance coverage and costs. A rapid change in slope or steep slope indicates an area of uncertainty. In this example, which is the curve for the case study discussed below, the insurance carriers would most likely look to provide coverage above or in the middle of the large spike at the end of the curve. This spike represents about 10% of the total curve and peaks at around $27.5 million.

Case Study

The case study site underwent years of traditional investigation culminating in preparation of a FS that evaluated possible remedial options. In 2002, the Triad Approach was implemented at the site to clarify and refine the understanding of the site conditions. Marsh applied the *Peer Review* Process to the information contained in the FS to produce a desk quote of insurance premiums. Marsh then added the information gathered through the Triad approach to the *Peer Review* and produced a second desk quote for the same insurance products. The information about the site, the outcomes of the *Peer Review* Process, and the quotes to place insurance for the site are discussed below. The reader will see that the additional investigation data provided by the Triad Approach significantly reduced the uncertainty associated with the remediation costs, which in turn impacted the insurance premiums.

Site Background

The 13.7-acre case study site is located in Newark, New Jersey. Currently, the site is vacant. However, the site has been industrialized since the early 1900s. Aerial photography revealed that by 1951 the site was occupied by numerous industrial buildings. Pesticide manufacturing and a drum cleaning and recycling operation eventually used these buildings. These companies operated at the site from 1956 to 1977. The site was purchased in 1980 by a local economic development authority with the intention of rehabilitating the property for future industrial activities and sold to the current owner in 2000.

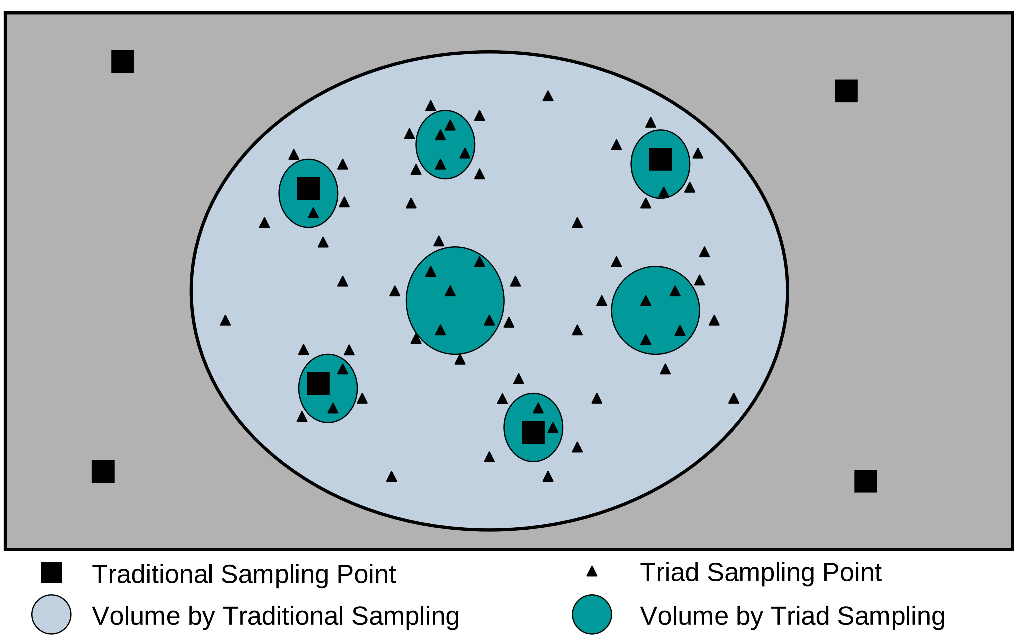
The site has a long history of environmental investigation and remediation. Initial Site investigations began in 1980 when the state environmental regulatory department installed soil borings and collected soil samples. From 1987 to 1993, a RI/FS was conducted at the site. This effort included two phases of investigation and a FS. Volatile organic compounds, PAHs, pesticides, PCBs and metals were detected in the soil. Based on the results of the sampling, several subsurface and surface “hot spots” were identified. A Decision Document recommended cleanup activities including excavation of VOC contaminated subsurface soil “hot spots” with treatment and disposal and construction of a 1.5 foot thick cap.

However, a major issue of uncertainty still remained with regard to the remediation cost estimates. The previous work had identified “hot spots” based on just one or two samples and, therefore, the soil volume estimates were highly speculative. This is a common problem with many contaminated sites where, because of the cost of analysis and the lack of real time data, limited sampling is performed and it is only after the laboratory results are returned weeks or months later that “hits” above standards are discovered. Thus, remediation planners are forced to either make conservative estimates about the magnitude of impacts or provide broad ranges that generate large cost variances.

When the *Peer Review* process was applied using the FS data, cost curves as shown on Figure 5 were generated and used to price a policy. Insurance companies protect their investment by minimizing their risk through conservative "attachment points" along the cost probability curve. At steep points on the curve, small probability changes can result in significant cost projection changes. Since the probability curve is influenced by uncertainty, increasing certainty will improve the cleanup cost profile.

In this case, the financial implications were significant. The site is located within the Newark Airport/Sea Port sub market of the Northern New Jersey industrial real estate market. The key market aspect of this site is its proximity to the Newark/Elizabeth Sea Port complex and the ease of access to major regional roadways including a planned high-weight bearing artery dubbed Portway. Thus, this site holds tremendous potential for constructing a modern value added distribution center that can service the New Jersey /New York region's air and seaports. However, environmental uncertainty has been a barrier to redevelopment. As part of a regional study to evaluate freight related reuse of Brownfield sites, the site was chosen to determine if by reducing environmental uncertainty through the application of Triad, remediation and insurance costs could be reduced, inducing developer interest. The concept behind uncertainty reduction is depicted in Figure 6. Conventional area of concern (or "hot spot") sampling approaches result in large volume estimates because cost limitations usually prohibit higher density sampling. Because resolution increases as sampling density increases, delineation of contamination is

Figure 6



Triad Versus Conventional: Illustration of how Triad provides more accurate delineation of "hot spots" than conventional sampling methods. The volumes are the volumes of contaminated material that must be treated.

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improved. For "hot spots", Triad can be used to provide a more accurate determination of the horizontal and vertical extent of contamination.

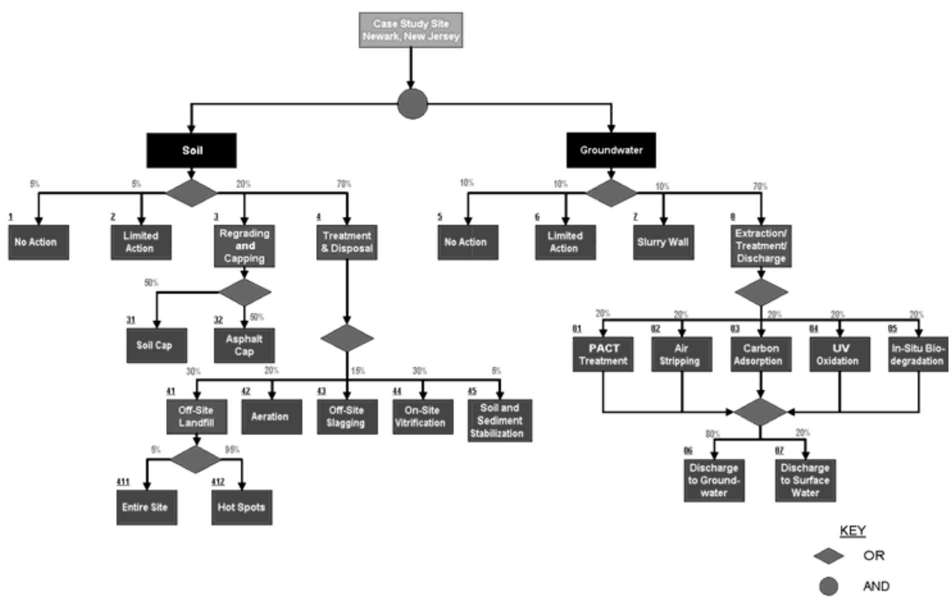
Peer Review Process Applied to Case Study Site

In order to evaluate the effectiveness of the Triad Approach in reducing the impact of uncertainty from insurance cost analysis, the site was subject to two *Peer Review* analyses. The first *Peer Review*, identified as PR1, was developed using the information provided in the FS. The second, identified as PR2, was performed using the additional information provided by the Triad investigation. From the results of the *Peer Review* analyses, desk quotes were prepared for the two scenarios. The following sections will discuss the results of the individual *Peer Reviws.*

PR1 Analysis

A *Peer Review* decision tree based upon the remedial options contained in the FS is shown in Figure 7. There are three main elements to a decision tree: the remedial options, the percent likelihood that each option will be implemented and the costs of implementing each option. The percent likelihood describes the probability that the particular remedial option will be implemented and is based on input from the Expert Panel. The cost associated with each remedial option (not shown on the decision tree) takes into account the variability of volumes of contaminated materials, of unit costs and of time frames. As shown in Figure 7, because of the lack of detail regarding site environmental conditions, PR1 considered a wide range of remedial options with an associated wide range in costs.

Figure 7



Peer Review Decision Tree Post-Feasibility Study: Decision tree showing the remediation plan described in the feasibility study. The percentages for each branch represents the likelihood that remedial action or alternative will be ultimately chosen. The costs for each remedial action are not shown.

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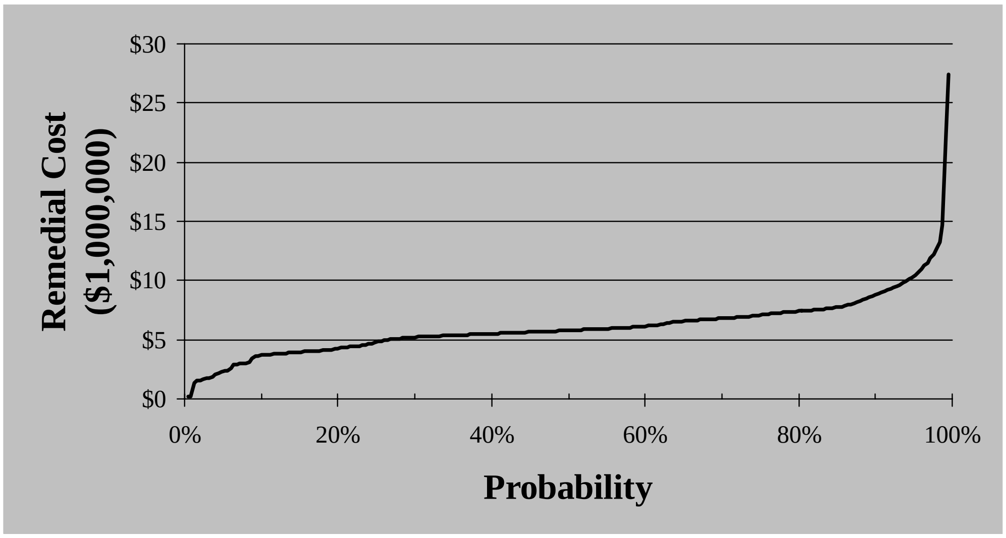
From the PR1 decision tree, a remedial cost probability curve was developed, which is shown in Figure 8.

Figure 8



Remedial Cost Probability Curve Post-Feasibility Study: This curve describes the outcome of the Peer Review Decision Tree based on the information contained in the feasibility study (Figure 7) conducted at the Site.

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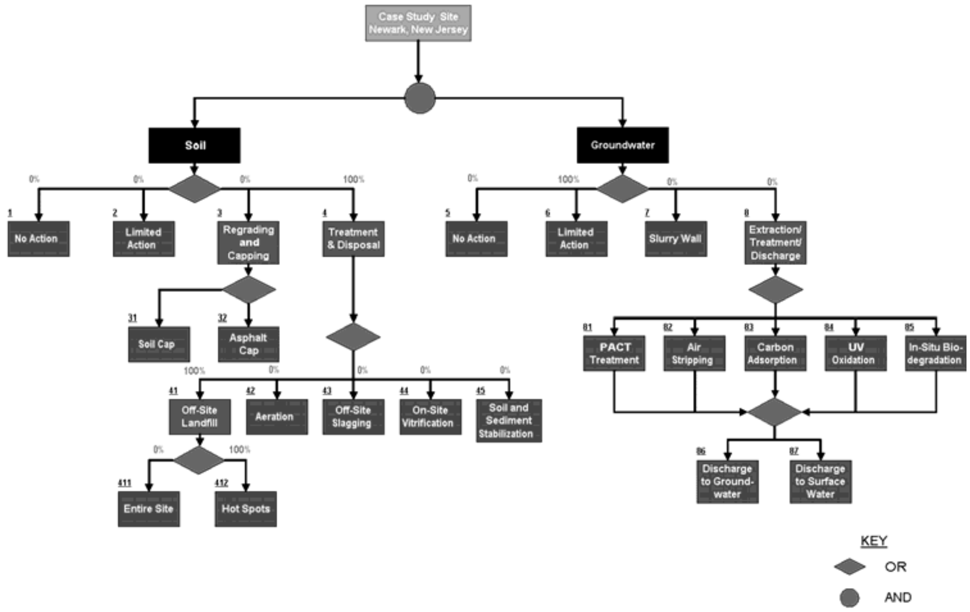
This curve shows the implementation cost associated with the most likely remedy scenario under PR1, which for soil was excavation and off site disposal and for groundwater was limited action consisting of quarterly monitoring. Note that Figure 8 shows a steep spike at the end of the curve. This is due to the slight chance that the soil from the entire site could be sent to a hazardous waste landfill, which would be extremely expensive. This option is the path of Box 4 to Box 41 to Box 411 on Figure 7. Overall, the potential remedial costs for PR1 range from less than $1 million to over $25 million.

PR2 Analysis

A new *Peer Review* decision tree analysis was performed after the Triad Approach was applied to the site. Specifically, Triad was used to more accurately define the location, dimensions and soil volumes of the hot spots in a quick and inexpensive manner. The RI sampling upon which the FS was based had identified several hot spots of VOC and PCB impacted soil, but the magnitude of these areas was unknown. The PR1 analysis pointed to Triad sampling opportunities that should be performed at these hot spots, which would enable the Expert Panel to revisit the *Peer Review* analysis and adjust the decision tree. The additional data collected using the Triad Approach eliminated all but one of the remedial options and, more importantly, significantly improved estimated volume and characteristics of contaminated soil, thereby substantially reducing the range of remedial costs. This is reflected in the PR2 decision tree analysis contained in Figure 9.

Figure 9



<u>Peer Review Decision Tree Post-Triad</u>: Decision tree showing the remediation plan after incorporating data collected through the Triad sampling. Note that the percentages assigned to the branches changed from Figure 7. Additionally, the cost associated with the treatment options changed because the quantities of soil to be removed was more precisely defined.

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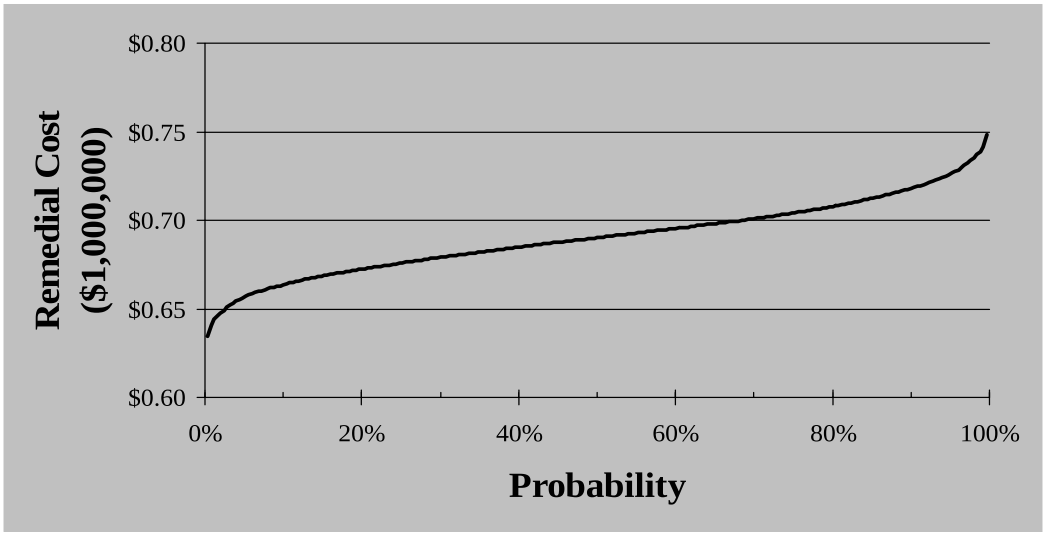
Figure 10 shows that with the data gained from the Triad sampling, the remedial costs were predicted to be less than $1 million. This drastic reduction was due to the selection of a remedial option as well as better quantification of the soil volume that must be removed. In addition, the Triad data showed that some of the soil that was previously thought to be hazardous could be disposed of at a lower cost in a non-hazardous landfill due to the low contaminant levels.

Insurance Desk Quotes

Marsh used Figures 8 and 10 as well as the site history to create desk quotes for CCC and PLL policies. Desk quotes are estimates of what an insurance product would cost given the available information. They are *not* bindable quotes from the insurance carriers. The PLL desk quote did not change as a result of the Triad data as it is based mostly on historic and future site operations, as discussed previously.. The CCC desk quote, on the other hand, was significantly impacted by the reduced uncertainty about the site conditions.

Table 1 shows the cost of the conventional investigation sampling methods versus the Triad approach, compares the two CCC desk quotes based on Figures 8 and 10, and displays the PLL desk quotes.

Figure 10



Remedial Cost Probability Curve Post-Triad: This curve describes the outcome of the Peer Review Decision Tree after incorporating the results of the Triad sampling (Figure 9) conducted at the Site.

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The Triad sampling was much less expensive to implement than the conventional investigation that took place at the site. It is important to recognize that the costs to implement Triad would have been greater than $30,000 if the data from the conventional investigation were not available.

The major differences between the CCC desk quotes are the premiums, attachment points, and limits of cover. The premiums for the CCC as well as the attachment points are much lower based on PR2. This lower cost profile is due to the reduced remedial costs stemming from a more comprehensive data set that resulted in a higher level of certainty. The limits of coverage, or how much the insurers will pay for a loss, are one times the attachment points for both CCC quotes.

The information gained through the Triad approach has improved the site's risk profile and, therefore, its investment potential. Not only does it make insurance affordable and useful, it also allows a potential buyer or developer to understand what the level of total expenditure is likely to be.

Table 1

	Incremental Investigation Cost	Remedial Cost	Cleanup Cost Cap (CCC) ($1,000,000)		
			Premium	Attach Pt. & Limit	Term (Years)
Conventional Investigation (PR1)	$400,000	$14.35 MM (98% Certainty)	$1.58 - $1.89	$15.79	10
Triad Investigation (PR2)	$30,000	$0.76 MM (95% Certainty)	$0.08 - $0.10	$0.84	10
Delta	$370,000	$13.59 MM	$1.50 – $1.79	$14.95	0
Pollution Legal Liability (PLL) Coverage			$0.24 MM Premium $0.10 MM Deductible		$15 MM Limit 10 Year Term

Insurance Desk Quote Comparison: Comparison of the terms of coverage and premiums for PLL and CCC policies based on *Peer Review* outcomes

Discussion and Conclusion

The major differences between the PR1 and PR2 decision trees are the percent likelihood assigned to each remedial option and the cost to implement the remedial option. As Figure 7 shows, PR1 considered a number of remedial options with wide cost ranges. This created a rapid change in slope in the remediation cost probability curve shown on Figure 8, indicating that substantial uncertainty remained in the environmental data used to generate the decision tree and cost curve. The additional data collected through Triad enabled the Expert Panel to better understand the remediation risk, which in turn translated into a new decision tree analysis with different likely outcomes and remediation cost probability curve. This then lead to a reduced premium for a CCC policy.

We believe this case study is a first attempt to investigate how improved sampling strategies and technologies can be used in combination with Marsh's *Peer Review* Process to affect the cost of environmental insurance (primarily CCC) coverage for Brownfield sites. This has important implications for the Brownfield redevelopment initiative that is sweeping the nation, particularly now that the new federal SBLRBRA allows for a portion of grants to be used to purchase environmental insurance. It appears, based on this case study, that strategic application of the Triad Approach, as directed by the *Peer Review* Process, can have an important impact on environmental insurance. Ultimately, this will make Brownfield redevelopment less risky and more profitable.

However, this concept needs to be investigated further. In particular, more case studies need to be implemented to determine how and when Triad should be applied based upon change in slope of the remediation probability curves. By building a catalog of case studies, the relationship between these two tools can be fully understood, thus, maximizing their ability to work collectively to facilitate Brownfield transactions.

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