Albert R. Wilson

Emerging Approaches to Impaired Property Valuation

The "engineering impaired value model" and the topovalue mapping technique are two tools introduced here for the valuation of environmentally impaired property. Current thought, concepts, and terminology used to analyze problems related to impaired property are discussed and evaluated.

Since the late 1980s, a number of papers have focused on techniques for the valuation of real property having environmental impairments. This paper examines current thought on this subject and provides some background on related concepts. The "engineering impaired value model" is introduced as both a complement to the case study approach,[1] and a quantitative business value impact assessment tool. Topovalue mapping as applied to a neighboring property and other geographically dependent value analysis problems is also introduced.

In order that the valuer may acquire a fuller understanding of the issues related to the valuation of properties having environmental impairments, the following definitions are provided.

Environmental Impairment: An environmental impairment results when the presence of an environmental risk has a negative economic impact on property. The impact of an environmental risk need not be negative. For example, if a wetland is used as an amenity in a development, the wetland may enhance the value of the subject and simultaneously present an environmental risk.

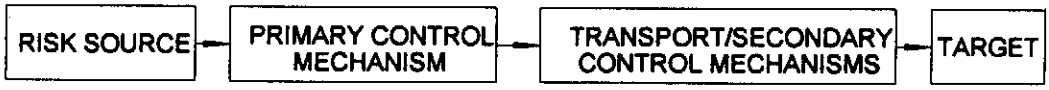
Environmental Risk: An environmental risk results when four components interact in a manner that results in a substantive risk to human beings or sensitive environments. The environmental risk system may be described as follows:

Risk Source: A risk source is something that, if allowed to come into sufficient proximity to the target, may damage it.

1. Peter J. Patchin, MAI, "Contaminated Properties and the Sales Comparison Approach," *The Appraisal Journal* (July 1994): 402–409.

Albert R. Wilson of Parker, Colorado, is a specialist in the development of valuation opinions for the assignment of environmental impairment damages to real property. He holds a BS in materials science engineering from Northwestern University, Evanston, Illinois, and an MBA from Bowling Green State University, Ohio.

FIGURE 1 Environmental Risk System



An environmental risk (risk source) belongs to the owner of the risk source at the time of release, the owner of the property on which the risk source was released, or the property on which the risk source was released.

Risk sources include hazardous substances, hazardous wastes, and human activities. Human activities are a particular concern with respect to endangered species and sensitive environments.

Primary Control Mechanism: A primary control mechanism acts to prevent the risk source from entering the transport mechanism and becoming an actual—as opposed to a potential—threat to the target.

Transport/Secondary Control Mechanisms: A transport mechanism is the means by which a risk source may come into proximity to the target. A secondary control mechanism may operate within the transport mechanism to retard or prevent movement.

Target: The target is an entity that may be damaged by the risk source. A target can be a human being, an endangered species, or a wetland for example.

Example of an Environmental Risk System: Suppose there is an above-ground fuel oil storage tank on a hill overlooking a river. The fuel oil is the risk source; the tank is the primary control mechanism; a transport mechanism is gravity; a secondary control mechanism is the dike surrounding the tank; and a target is the river. Note that under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, or Superfund), fuel oil is not a hazardous substance, and under the Resource Conservation and Recovery Act (RCRA), fuel oil is not hazardous waste. A risk source need not be legally defined as a hazardous substance or a hazardous waste although it is still a source of environmental risk according to the definition used in this paper.

With respect to impact on property values, environmental risks may be analyzed in terms of three categories of impairment. Each category has a different set of value-impacting characteristics and frequently requires different valuation approaches.

Contained Impairments: These are environmental risks wholly contained within well-defined and easily recognized boundaries. Probably the best-known example would be asbestos in a commercial office building. For valuation purposes, the key characteristics are that the environmental risk can be measured quite accurately, and an estimate of the mitigation cost can be developed that will closely approximate the actual mitigation cost.

Uncontained Impairment: These are environmental risks not contained within distinct, well-defined, and easily identified boundaries. An example would be a hazardous substance that has contaminated soils and groundwater. For valuation purposes, the key characteristic is that the extent of the environmental risk cannot be estimated with precision resulting in a possibly very wide variance between estimated and actual remediation costs. Further, it is almost impossible to achieve total mitigation of the condition, particularly over a short period of time.

Indirect Impairments: Value impacts, if any, result when a target is in proximity to a known risk source. No risk source is present on the subject property. An indirect impairment is generally a function of marketplace reactions.

Two additional definitions are essential.

Unimpaired Value: The unimpaired value is the value of the subject, assuming no environmental risks are present. The unimpaired value may be established using the three approaches to value as long as the valuer screens the comparables, income and expense, and cost data to ensure that environmental offsets are not included in the data.

Impaired Value: This is the value of the subject, given the presence of the environmental risk. The Impaired Value is related to the Unimpaired Value through the following general relationship.

Impaired Value = Unimpaired Value
LESS Remediation Costs and Stigma

To complete the background, it is necessary to understand several additional points. First, the reaction of the marketplace to the presence of an environmental risk is not always rational. Fear of damage may not be based on a rational assessment of the situation but can, nevertheless, negatively influence the value of a property. In

contrast, buyers may ignore rational assessments of environmental risks and their possible consequences and pay a price approximating unimpaired market value for property having significant risks. These reactions are in large part a function of demand for the subject, the buyer's familiarity with the environmental risk, and a lack of understanding of the financial and environmental consequences of the presence of the risk, among other factors.

Another important point to understand is the unusual nature of ownership of an environmental risk. An environmental risk, or more properly, the risk source, belongs to at least one of the following entities, possibly simultaneously:

- The owner of the risk source at the time of release.
- The owner of the property on which the risk source was released.
- The property on which the risk source was released.

The last statement may require some explanation. If title to the property is transferred, then title to the risk source passes to the new owner. But note that title to the risk source is also shared with previous owner(s) on a strict joint and several basis under CERCLA. If the risk source is partially removed then title to the risk source as it relates to the portion removed becomes frozen with the owner(s) at the time of removal, and a new owner of the property will acquire title to only that portion of the risk source remaining on the subject.

Note also the phrase ". . . on which the risk source was released." If a risk source is released on a parcel but a portion later migrates or moves to another parcel, liability for the risk source present on the second parcel remains with the first. Under CERCLA, at the time of release a "facility" was created. A facility[2] is defined to include all of the air, soils and waters contaminated by the risk source. A new owner of the originating property also acquires the facility. Put another way, title to the facility runs with the source property.

This fact gives rise to two additional definitions.

Source Property: A source property is the property on which the release of the risk source occurred. The source property has strict joint and several liability under CERCLA for the remediation costs of the facility created by the release without regard to legal parcel boundaries.

Non-Source Property: A nonsource property may contain a part of the facility created by the release of a risk source, but the owner of the nonsource property does not generally have liability for the costs of remediation.

The valuer would do well to keep these two definitions in mind whenever dealing with impaired property as the consequences of the existence of the impairment on value are very different between source and nonsource properties. Unfortunately the literature, case studies, and "comparable" property data have not always clearly identified whether a given property is a source or nonsource property.

This complex risk source and facility ownership situation is frequently misunderstood. An owner of a nonsource property, which nevertheless contains a part of a facility but having no other relationship to the risk source, does not generally have any financial liability with respect to remediation. There may be other impacts on the nonsource property owner, but direct responsibility for the cost of cleanup is not one of them. Virtually all of the discussion that follows is directed toward the source property, and many issues associated with the liability imposed on the source property are not germane to the nonsource property.

As a last set of background points, note that the liability associated with the presence of an environmental risk can only rarely be discharged in the sense of a mortgage or tax lien, and indemnification of a buyer by the seller may only be partially successful. CERCLA explicitly provides that the federal government is not obligated to recognize any private liability transfer mechanisms such as warranties, indemnifications and hold-harmless agreements. Note also that the courts have held that CERCLA liability is perpetually retro-

2. "Facility" is defined broadly to include, *inter alia*, "any site or area where a hazardous substance has . . . come to be located." 42 USC 9601 (9)(B). In construing the term "facility," courts have emphasized repeatedly that Congress intended this term to be interpreted broadly. See, e.g., *U.S. v. Northeastern Pharmaceutical and Chemical Co., (NEPACCO)* 810 F.2d 726, 743; 25 ERC 1385 (CA 8, 1986) cert. Denied, 484 U.S. 848, 26 ERC 1856 (1987). The cases concerning this issue uniformly state that as long as a hazardous substance is present at a site in question, the site will be considered a facility. EDDG 101.3(a).

active and prospective. Further, no agency will absolutely and unconditionally certify that a property is free of an environmental liability, particularly in the case of uncontained impairments, even though extensive remediation work indicates successful removal of the risk source.[3]

CONTAINED IMPAIRMENT VALUATION TECHNIQUES

In many respects, valuing a property having a contained impairment is relatively straightforward and generally within the range of appraisal experience. Suppose that during the course of examining the subject the appraiser notices a large cracked beam apparently supporting a portion of the structure. The presence of the cracked beam would drive the property's value down because most purchasers would require the seller to repair the beam or insist on having funds reserved from the unimpaired value to cover the estimated cost of repairs.

Except for certain kinds of risk sources—such as PCBs which have a tendency to penetrate the building materials—many forms of contained environmental risks are hardly different from the cracked beam for valuation purposes. It is necessary to obtain a competent estimate of the cost of remediation and to adjust the unimpaired value accordingly. Provided that the risk source is one with which the marketplace is familiar and to which it has become adjusted, little more is required.

The use of comparable sales should, however, be viewed cautiously. The cost of dealing with asbestos may be very different from one building to the next. The cost of removal is primarily a function of labor cost, and removing asbestos from steel decks is much less time consuming than doing so from bar joists or poured concrete.

One must also consider the issue of "stigma," or the negative impact of intangible factors. There are a number of sources for intangible impacts—for example, the unusual nature of ownership of a risk source. If asbestos is removed from a building the owner at the time of removal will forever hold title to the removed asbestos. If the removed asbestos ends up in a site that must be remediated under CERCLA, the owner at the time of removal will be asked to contribute toward the cost of the site remediation because of the asbestos. This perpetual liability risk can influence value.

In general, intangible impacts are a function of several factors such as the following:

- The demand for the subject in the marketplace and its corollary, the availability of substitutes. (The stronger the demand and the fewer the number of available substitutes, the weaker the impact will be.)
- The degree of familiarity of the marketplace with the condition. (Generally, the more common the condition, the less impact the condition will have.)
- The level of confidence the marketplace will have in remediation cost estimates. (In general, the higher the confidence level that the estimates accurately reflect the remediation cost, the less impact the condition will have.)
- The perception in the marketplace of the stability of regulatory decisions concerning the impairment. (If the regulatory agencies' remediation requirements are perceived as being unclear or changeable, or if the agencies are perceived to commonly reopen cases to which they have given prior approval of completed remediation work, the impact will be greater.)
- The availability of financing, given the presence of the impairment. (If financing is readily available at terms equivalent to those associated with unimpaired properties, then the impact will generally be less. Because lenders often do not understand the distinction between source and nonsource properties, the nonsource properties may be subjected to unnecessary penalty.)
- The possibility of "toxic torts" and other forms of public liability arising from the condition. (The less likely the possibility, the smaller the impact on value.)

3. As an example, consider the following form of the letter used by the Broward County, Florida, Department of Natural Resources Protection: "The Broward County Department of Natural Resource Protection (DNRP) has received and reviewed the (type of report) ___ dated ___ for the above referenced site. The ___ is accceptable. This case has been reclassified to inactive based solely on information submitted by your consultant . . . Should additional information become available which indicates that the site status has changed, DNRP reserves the right to reclassify the site to active and to require further investigation and/or remediation as appropriate."

UNCONTAINED IMPAIRMENTS

Uncontained impairments are inherently not comparable. For instance, a recent case involved two gas stations on opposite sides of the same intersection, each having essentially the same unimpaired value. Both experienced leaking underground storage tanks. Station A has an expected remediation cost of $450,000, but Station B has an expected remediation cost of $1,300,000. The difference is that Station B overlies an old streambed that allowed the gasoline to travel over a greater distance, contaminating a very large volume of soils and groundwater. Station A was built on clay that restricted the movement of the gasoline to a very small volume immediately underlying the station property itself.

In general, uncontained impairments are as unique as fingerprints and must be evaluated using newly developed methods such as the case study approach and the engineering impaired value model (EIVM).

Case study approach

The case study approach was described in a recent article[4] and is only briefly discussed here.

Fundamentally, this approach entails careful analysis of several cases analogous to the subject property. Frequently these are properties that were once on the market but did not sell. A factual relationship between these properties and the subject is identified, and an inference is drawn about the likely offset to the unimpaired value that would apply to the subject. This offset is generally stated as a percentage reduction in the unimpaired value.

The offset to value may cover a range of value-impacting factors, including the costs of remediation, costs of restrictions on use resulting from the condition, incremental costs of financing, value of probable recoveries, and the intangible factors. The result is a gross offset to the value based on the analogous cases.

The case study approach has the advantage of being based on market data and, in the hands of an experienced valuer, may provide a significant indication of the impaired value of the subject. It does not and generally cannot provide several kinds of information that may be important to the analyst.

First, the case study approach lacks detailed, property-specific quantitative information. Detailed information is normally not available in typical case data to allow for a direct comparison of the case environmental impairment to the subject impairment. This is not a fault of the technique, but a common problem of the data available to the valuer; owners are very reluctant to reveal detailed and specific information on their environmental condition. Even if they were willing to do so, the amount of data to be analyzed would be staggering.

Second, a gross percentage offset to value will not allow for an analysis of certain areas of financial impacts that may be of great importance to both the buyer and the seller. The supervisory financial analyst of the Federal Reserve Board's division of banking supervision and regulation, Stanley B. Redinger stated, "... [B]ankers should also think about 'solvency risk'—the risk that borrowers may have trouble paying back a loan because of an environmental problem they have, even if the bank itself has no liability."[5] Environmental remediation expenditures tend to come in lump sums that can create negative cash flows. These may jeopardize the financial viability of the subject property both for the debt and equity interests. Detailed cash flow information is generally not available through the case study approach.

Third, if the subject property is likely to be owned by a registrant under the Securities and Exchange Acts, some reporting requirements may need to be addressed as a point of concern for the owner. In 1993, the Securities and Exchange Commission (SEC) published Staff Accounting Bulletin 92 (SAB 92)[6], which outlined the environmental liability reporting requirements for registrants. In part, those requirements state that for material environmental liabilities the registrant must disclose the following:

- The estimated amount of the liability, even if that estimate is known only over a range or the liability would be experienced only on sale, disposal or abandonment of the underlying asset.

Uncontained impairments are as unique as fingerprints and must be evaluated using the case study approach and the engineering impaired value model (EIVM).

4. Patchin, 402–409.
5. BNA, *Environmental Due Diligence Guide* (April 1994): 29.
6. Securities and Exchange Commission, *Staff Accounting Bulletin 92*, 17CFR Part 211, (SAB 92) 58 FR 32843 (June 14, 1993).

(If only a range is known, the most likely value within the range must be disclosed; if no one value is more likely than another, the minimum of the range must be disclosed. If sale, disposal, or abandonment is not planned, it must be assumed.)

- The discount rate to be used in evaluating a future liability must be a safe rate of return.
- Liabilities may not be netted against possible recoveries.

The longer major remediation expenditures can be delayed, the less the impact on present worth.

Fourth, the recent IRS Revenue Ruling 94-38[7] contains provisions important to the balance sheet, profit and loss, and cash position of many owners or buyers. This ruling at least partially reverses earlier IRS policy by allowing the deduction of some remediation costs as expenses against current income. However, investments in remediation equipment such as groundwater pump and treatment facilities, remediation of asbestos, removal of underground storage tanks, and *remediation costs for contaminated property purchased by the taxpayer* [emphasis added] must generally be capitalized. The type of analytical data necessary to evaluate these factors is generally not available through the case study approach.

Even though these issues most frequently come up in business enterprise valuation, they should never be ignored. The SEC and IRS positions provide valuation guidance. The valuer should consider at least these specific points: Some remediation costs are expenses of operation; other costs must be capitalized, including capitalization against nondepreciable assets such as land; future costs should be conservatively discounted; and recoveries are sufficiently speculative that they should be separately evaluated.

The timing of remedial actions is another common concern of the valuer. The longer major remediation expenditures can be delayed, the less the impact on present worth. However, the major environmental laws are "strict joint and several." It would be misleading to say that remediation need not be undertaken before some governmental action has taken place. The Washington Supreme Court recently ruled that "Environmental statutes that feature strict liability . . . impose liability on polluters without further governmental action . . ."[8] In the proposed amendments to CERCLA currently before Congress are a number of provisions designed to encourage voluntary remediation.

If these and other issues specific to the subject property are important in valuing the subject, the case study approach by itself will rarely provide sufficient quantitative data for analysis of their specific impacts. In any event, two indications of value are generally better than one as some situations may simply have no analogous cases, hence the need for a second approach—the engineering impaired value model (EIVM).

EIVM

The EIVM was briefly introduced by the author in a published article written more than two years ago.[9] Since then, significant improvements in the model have been made, important additional information has been gathered, and the model has been successfully applied in litigation and negotiations.

Expected cost of remediation

CERCLA contains a set of provisions generally known as the National Contingency Plan (NCP).[10] The NCP defines the methodology for evaluating an environmental risk and selecting appropriate remedial actions at a Superfund site.[11] The courts have uniformly held that the recovery of costs for remedial actions from a third party or Superfund can occur only when those actions have been consistent with the requirements of the NCP. Other state and federal laws contain similar provisions for the evaluation and selection of remedial actions.

7. Internal Revenue Service, Revenue Ruling 94-38 (June 1994).
8. *Weyerhouser v. Aetna Casualty and Surety Co.*, 61000-2 (Wash. Sup. Ct. 1994).
9. Albert R. Wilson, "The Environmental Opinion: Basis for an Impaired Value Opinion," *The Appraisal Journal* (July 1994): 410–423.
10. Comprehensive Environmental Response, Compensation and Liability Act, 40 CFR Part 300, National Oil and Hazardous Substance Pollution Contingency Plan; Final Rule, March 8, 1990.
11. There is a legal difference between a remedial action and a removal action. That difference will be ignored here, but it can be very important in certain circumstances.

The point is that these laws and regulations form, in essence, a set of environmental building codes that define the "typical" cost of remediation. The EIVM will refer to the expected costs developed in conformance with these rules and regulations as C_{NCP} in honor of the NCP, even when CERCLA is not involved in the specific situation.

In proposed amendments to CERCLA recently presented before Congress is a provision designed explicitly to recognize a concept already in effect in some states: Different levels of cleanliness are required based on highest and best use. Michigan, for example, distinguishes between three levels of cleanliness based on whether the site has a residential, commercial or industrial use. A change in the cleanliness requirements can increase or decrease remediation costs significantly and C_{NCP} may therefore be at least partially dependent on the highest and best use.

Expected cost of restrictions on use

An environmental risk may result in a change in the highest and best use. In one case, a site had an unimpaired highest and best use ". . . for light industrial development" and was valued at $1.75 per square foot. However, because the site was a former municipal solid waste landfill, subsidence and methane gas generation concerns would increase construction costs to achieve this highest and best use so significantly that an altogether different highest and best use would be indicated. The impaired highest and best use was determined to be for ". . . outdoor storage" and the indicated value was $0.75 per square foot. The difference, $1.00 per square foot, is the cost of a restriction on use resulting from the presence of the environmental risk.

The presence of an environmental risk may also restrict the use of a property in terms of income generation. For example, revenue may decrease because a portion of the available space had to be dedicated to remediation activities. (Examples of this would be a floor of a building dedicated for asbestos removal or a portion of the land for a pump and treat facility.) The costs resulting from a change in highest and best use, and those resulting from other restrictions on use are addressed in the EIVM as C_R.

Incremental financing costs

The presence of an environmental risk may prompt debt and equity participants to change financing terms and conditions. The debt participant may require a lower loan-to-value ratio, a shorter term, increased reporting requirements, increased closing costs, and, possibly, increased interest rates. Occasionally debt participation may not be available at all.

Equity participants may seek a higher rate of return. It has been reported that in some instances equity sought 25% to 50% rates of return. An article in the *Denver Business Journal* (November 11, 1994) reported that the Cherokee Real Estate and Environmental Fund, an active investor in contaminated properties, sought an 8% to 10% incremental rate of return over a "normal" real estate return of 8% to 10%. The difference between the costs of financing an unimpaired property and financing the property as impaired (e.g., the incremental 8% to 10%) is addressed in the model as CF, the incremental cost of financing.

In addition, there is the cost of financing the remediation project itself. This cost may require financing from pure equity sources or from the working capital of the organization and may carry risk rates of return, significantly adding to the total costs of remediation.

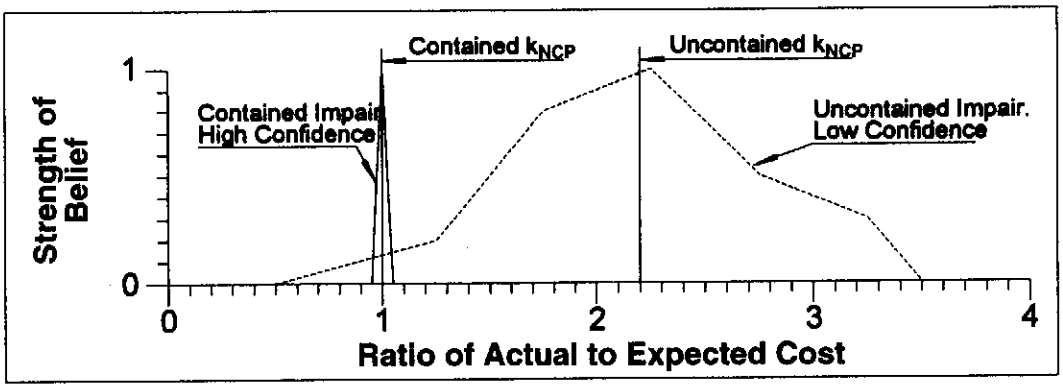
Most likely cost

In the literature, the term "stigma" is often used to identify environmentally related offsets to value. Usually what is referred to as stigma is the impact of the risks and uncertainties associated with the environmental problem as perceived by the marketplace. These risks and uncertainties result from two factors: (1) the risk that the estimated costs will understate the actual remediation costs (i.e., the total cost as identified after all work has been completed), and (2) uncertainty as expressed through the intangible factors to be addressed separately under "Market Factors."

The author has conducted two surveys of environmental remediation experts[12] and is currently engaged in a third survey. The purpose of these surveys is to obtain a

12. Defined as individuals active in the management of remediation projects for at least the past five years in the private sector.

FIGURE 2 Illustration of the Cost of Remediation for a Given State of Knowledge and Condition



measurement, based on experience, of the relationship between the expected remediation cost[13] developed at a specific state of knowledge for a specific type of environmental risk, and the actual remediation cost. State of knowledge refers to the knowledge available from investigative work performed before the estimate was developed, such as after completion of an ASTM Phase I Environmental Site Assessment, or after completion of a Remedial Investigation/Feasibility Study (RI/FS) under CERCLA.

Figure 2 provides the survey results for two extreme situations: expected cost of asbestos remediation formed after a thorough engineering survey of the building (a contained impairment with a high level of confidence in the estimate), and the expected cost of soil/groundwater remediation after an ASTM Phase I Environmental Site Assessment (an uncontained impairment with a low level of confidence in the estimate). Note the axes of the graph are strength of belief versus the ratio of expected cost to actual cost. If the ratio of expected to actual cost is 2, then the experts believe the actual cost will be twice the expected cost developed at a given state of knowledge. The ratio between actual and expected cost will be referred to in the model as the k_X factor, with one k_X factor for each of the C_X components introduced above. The combined factor, $k_X{}^*C_X$ is the most likely cost.

The two vertical straight lines are labeled "Contained k_{NCP}" and "Uncontained k_{NCP}." Contained and uncontained refer to the earlier definitions. Note that for the contained impairment the experts have indicated a high level of confidence that the estimate will accurately reflect the actual cost while for the uncontained impairment the experts have indicated a low level of confidence. These same ideas and similar data can be applied to the costs of restrictions on use and financing.

Suppose that the expected remediation cost were $100,000. Then:

1) For the contained impairment the actual cost will most likely be $100,000 (most likely cost calculated as (Contained k_{NCP} = 1.00) × $100,000) with a range from $95,000 (minimum likely cost) to $105,000 (maximum likely cost).

2) For the uncontained impairment the actual cost will most likely be $220,000 (most likely cost calculated as (Uncontained k_{NCP} = 2.2) × $100,000) with a range from $50,000 (minimum likely cost) to $350,000 (maximum likely cost).

The difference between the most likely and the maximum likely cost of remediation assumes great importance as one of the major contributing elements of stigma. The buyer who is well informed or well advised will recognize that the most likely cost of remediation, restrictions on use, or incremental cost of financing is soundly based on the best available, current information, but that it may be and has in the past been an understatement of the actual costs. The risk that the cost will be greater is properly a component of stigma and the difference between the most likely and the maximum likely cost is a quantitative measure of the amount of exposure. Market forces may exaggerate or diminish the impact of this difference on the impaired market value, but the fact that the risk exists and its magnitude will be given serious consideration by the buyer and is a component of stigma.

13. Expected cost is defined as the estimated cost multiplied by the probability that the cost will occur as estimated.

Recoveries from third parties

There may be a number of possible sources for the recovery of remediation costs for the current owner of a property. Such sources may include public or private insurance funds and other potentially responsible parties to the release. First, it should be noted that these sources of funding may be limited to the recovery of the direct cost of remedial activities conducted in accordance with the requirements of the NCP, the amount already identified as C_{NCP} in the model. When so limited the owner will remain exposed to the other cost factors without a source of third-party funding. In addition, some sources of funding may only be available to the owner at the time of release, not to a successor, or may require a difficult and lengthy process, including the possibility of protracted litigation in order to effectuate recovery.

For these reasons, the SEC in SAB 92 clearly states that recoveries should not be netted against the environmental liability—the amount, timing and success of recovery of remediation costs is often problematical. From the point of view of the marketplace, any possible recovery will be tempered by consideration of these and other factors, including the cost of the litigation required to recover from a third-party and the present worth of delayed recoveries. The net most likely amount of possible recoveries is addressed in the model as $k_{REC}{}^*R_{REC}$, where R_{REC} is the present worth of the net amount of the possible recovery and k_{REC} is the probability of the successful recovery of that amount.

Market factors (a portion of "stigma")

A knowledge of the costs is important, but the intangible factors exert a strong, and sometimes contrary, influence. Take, for example, two gas stations having similar unimpaired value and very similar environmental conditions resulting from leaking underground tanks with contamination offsite under neighboring commercial property. Both stations had an unimpaired value of $420,000, and after thorough investigation, both had an estimated remediation cost of $350,000. Station A sold for $430,000, and the neighboring commercial property owner believes—with good reason—that its value is unaffected. Station B and the adjoining commercial property cannot be sold at all. The differences lie in two areas:

- The oil marketing firm that owned Station A undertook aggressive remedial actions perceived to be, and that indeed are highly effective; offered substantial indemnifications and warranties to the purchaser, the purchaser's lender, and any successor purchaser or lender; and publicly acknowledged responsibility. The firm that owned Station B did none of the above.
- The properties associated with Station A are in high demand, with relatively few available substitutes; Station B does not enjoy these advantages.
- The point is that the intangible factors may act to offset, partially or totally, the impact of the objectively defined costs associated with the environmental risks, or they may act to multiply the impact depending on the specific circumstances of the marketplace and the situation. These market factors will be referred to in the model as M_F.

The model statement

The EIVM may be stated as follows:

$$I = U - k_{NCP}{}^*C_{NCP} - k_R{}^*C_R - k_F{}^*C_F + k_{REC}{}^*R_{REC} \pm M_F$$

Where

I = Impaired value

U = Unimpaired value

$k_{NCP}{}^*C_{NCP}$ = Most likely cost of remediation

$k_R{}^*C_R$ = Most likely cost of restrictions on use

$k_F{}^*C_F$ = Most likely incremental cost of financing

$k_{REC}{}^*R_{REC}$ = Most likely net present worth of recoveries

M_F = Net impact of intangible market factors (stigma)

An alternative statement of the EIVM would be as follows:

"The impaired value is equal to the unimpaired value less: (1) the most likely cost of remediation in accordance with the appropriate or relevant and applicable requirements; (2) the most likely cost of restrictions on use; (3) the most likely incremental cost of financing; plus the most likely net present worth of any recoveries from third parties; tempered by the influence of the market factors."

The well-informed buyer will recognize that the most likely cost of remediation, restrictions on use, or incremental cost of financing is based on the best available, current information, and may be an understatement of the actual costs.

TABLE 1 Expected Cost of Remediation

Activity	Estimated Cost	Likelihood	Probability	Expected Cost
Tank removal	$30,000	Certain	1.00	$30,000
Soil removal	20,000	High	0.84	16,800
Pump and treat	100,000	High	0.84	84,000
Total	$150,000			$130,800

It is worth noting that the predictions made of the impaired value using the EIVM have, whenever sales data has been available, proven to be quite accurate. Generally, the sale price has been within 20% of the predicted impaired value, with results falling on both sides of the prediction.[14] The EIVM has proven to be particularly useful in the evaluation of business enterprise impacts and for exposition in a litigation setting.

EIVM example

To illustrate, suppose that after an ASTM Phase I Environmental Site Assessment and some limited testing, an environmental remediation expert makes the following statements concerning a gas station site: (Note that the underlined portions of the statements are not often explicitly provided, but are always present.)

- Two underground storage tanks (UST) require removal. A flat fee contract of $30,000 for removal can be obtained.
- The removal and disposal of 400 cubic yards of soils as petroleum contaminated at an estimated cost of $20,000 will be required with a high likelihood of occurrence as estimated.
- A groundwater pump and treatment system at an estimated present value cost of $100,000 will be required with a high likelihood of occurrence as estimated.
- Given the limited amount of analytical data available, only a low level of confidence in the estimates accurately reflecting the actual cost can be expressed.

The expected cost of remediation, based on the author's survey results and on the above statements, is developed in Table 1. Note that the probabilities are for illustration purposes only and should not be used in an actual analysis.

The estimated cost for dealing with this situation, given the current state of knowledge, is $150,000. The expected cost, including the data concerning the probability that events will proceed as currently estimated, is $130,800. The $130,800 is the C_{NCP} in the EIVM. If no additional information were applicable, C_{NCP} would be the most likely cost of remediation.

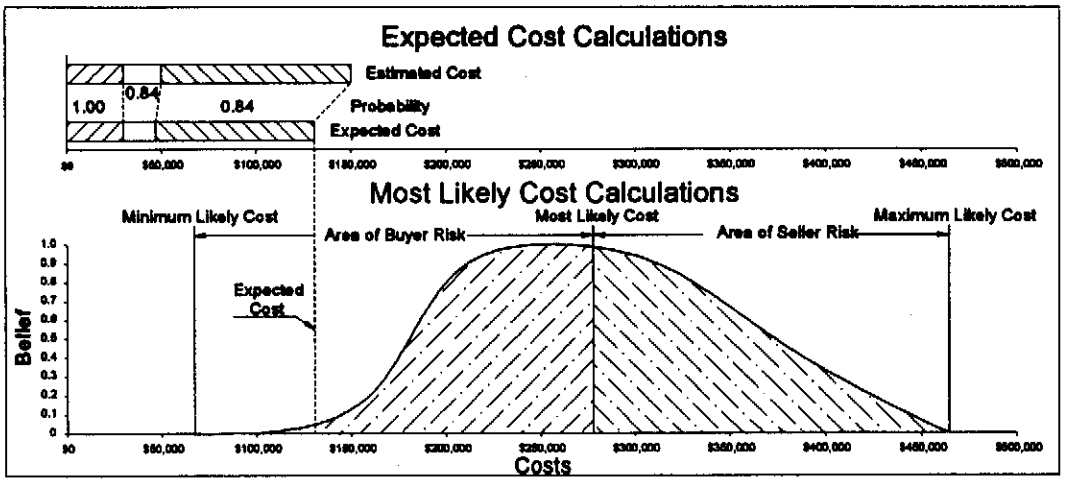
However, the expert states that the level of confidence is low that the current estimate will accurately reflect the actual cost, an issue that becomes critically important in the analysis. With regard to soils and groundwater contamination problems, the experts have indicated a broad range of actual-to-expected cost ratios for the low confidence case, from 0.50 to 3.5 times the expected cost (see Figure 2). The central tendency of the data indicates that the most likely ratio is 2.2. Based on this information, the most likely cost of remediation would be developed as shown in Table 2.

TABLE 2 Most Likely Cost of Remediation

Activity	Expected Cost (C_{NCP})	Level of Confidence	Most Likely Ratio (k_{NCP})	Most Likely Cost (k_{NCP}*C_{NCP})	Minimum Likely Cost	Maximum Likely Cost
Tank removal	$30,000	Certain	1.0	$30,000	$30,000	$30,000
Soil removal	16,800	Low	2.2	36,960	8,400	58,800
Pump and treat	84,000	Low	2.2	184,800	42,000	294,000
Total	$130,800			$251,760	$80,400	$382,800

14. See the article by Gene Dilmore, MAI, SREA, "Appraising Houses," *The Real Estate Appraiser* (Chicago: Society of Real Estate Appraisers, July-August 1974): 21–32. Depending on appraisal methodology used, 100% of the appraisals of houses would be within 24% of the sale price with an average error of up to 6.1%. The author knows of no comparable study of commercial or industrial property that would be more analogous to the application of the EIVM.

FIGURE 3 Development of the Most Likely Cost of Remediation



The most likely cost of remediation in this situation, the $k_{NCP}{}^{*}C_{NCP}$ value in the EIVM, is $251,760. If there were no influences on the value of the subject from restrictions on use, incremental financing costs, recoveries, or the market factors, the impaired value would be:

$$I = U - \$251{,}760$$

Naturally, a seller would argue for the minimum likely cost as the offset to value, while the buyer would argue for the maximum likely cost absent any other factors or conditions of concern. Assuming the conditions of market value,[15] the bargaining should result in an offset approximating the best available knowledge and information concerning the most likely cost, the $k_{NCP}{}^{*}C_{NCP}$ value as calculated above. The entire analytical process is shown in Figure 3.

The area between the minimum likely cost and the most likely cost has been identified as the area of "buyer risk," while the area between the most likely cost and the maximum likely cost has been identified as the area of "seller risk." The reason is simple. If the buyer deducts from the unimpaired value an amount less than the most likely cost, the buyer is taking increasingly greater risks with decreasing purchase price compensation that the actual cost will exceed the compensation. The opposite is true for the seller.

The area of seller risk is also the area of the contribution to stigma resulting from the risk that the actual cost will exceed the most likely cost. To the extent that the marketplace will allow, the buyer will naturally seek to transfer this risk to the seller by demanding a greater offset to the unimpaired value.

There is always a danger in illustrating a situation like this. Readers tend to assume that because the data for a particular situation is illustrated, that data is equally applicable to all other situations. This is not the case in environmental analyses. The surveys show that very different k_X values apply to different situations as shown in Figure 2. Asbestos in buildings, underground storage tank remediation, and general soils and groundwater remediation all

15. "Market value" means: (1) The most probable price which a property should bring in a competitive and open market under all conditions requisite to a fair sale, the buyer and seller, each acting prudently, knowledgeably, and assuming the price is not affected by undue stimulus. Implicit in this definition is the consummation of a sale as of a specified date and the passing of title from seller to buyer under conditions whereby: (a) buyer and seller are typically motivated; (b) both parties are well informed or well advised, and each acting in what he or she considers his or her own best interest; (c) a reasonable time is allowed for exposure in the open market; (d) payment is made in terms of cash in U.S. dollars or in terms of financial arrangements comparable thereto; and (e) the price represents the normal consideration for the property sold and unaffected by special or creative financing or sales concessions granted by anyone associated with the sale.

(2) Adjustments to the comparables must be made for special or creative financing or sales concessions. No adjustments are necessary for those costs that are normally paid by sellers as a result of tradition or law in a market area; these costs are readily identifiable since the seller pays these costs in virtually all sales transactions. Special or creative financing adjustments can be made to the comparable property by comparisons to financing terms offered by a third-party institutions lender that is not already involved in the property or transaction. Any adjustment should not be calculated on a mechanical dollar-for-dollar cost of the financing or concession, but the dollar amount of any adjustment should approximate the market's reaction to the financing or concessions based on the appraiser's judgment. See Office of Thrift Supervision, OTS Regulation 564.2(f).

have very different k_X values and these values further diverge, depending on the level of confidence in the estimate (high, moderate, or low). In addition, governmental remediation appears to have larger k_X values compared to privately funded remediation.

Section summary

Two approaches to value for the uncontained impairment case are gaining acceptance—the case study approach and the EIVM. Whenever possible, both should be used and a conclusion drawn based on the indications. It will not always be possible to apply the case study approach simply because there may be no comparable cases sufficiently analogous to the subject to allow reasonable inferences to be drawn. The EIVM is always available but requires a high level of technical expertise and a relatively large quantity of technical data concerning the environmental risk. Generally, the EIVM requires the combined experience of the appraiser and the environmental impact expert. In cases where cash flow, profit and loss, and balance sheet information is needed, the EIVM can supply the necessary data.

In the case of indirect impairments, impairments are not as great as commonly believed and are much more geographically restricted than commonly believed. Also, the degree of impairment is hard to establish quantitatively.

Stigma

An additional word about stigma and environmental impairments in general is warranted. Their impacts on value are highly time dependent. As already noted, the remediation cost is dependent on the state of knowledge at a particular point in time. Stigma exhibits an apparently greater time dependency because it is related to market perceptions as well as the state of knowledge concerning the remediation costs.

Stigma may, in fact, have three distinct time-dependent phases or parts. These might be thought of as:

(1) Post-remediation stigma or the impact on value after remediation has been completed and resulting from such factors as the uncertainty generated by the example Broward County, Florida, reclassification letter quoted earlier. This stigma impact may dissipate to an undetectable level over time.

(2) Pre-remediation stigma, or the influence of the post-remediation stigma plus the impact of the risks associated with the possible difference between estimated and actual costs plus other market factors.

(3) During-remediation stigma, an interim or transition phase stigma impact that is generally less than pre-remediation but more than post-remediation stigma impacts.

Remediation costs are also time dependent given that increasing knowledge generally accrues with time, allowing greater confidence in the estimates accurately reflecting the actual costs. Further, as time passes, more of the actual remediation costs become known as the work is performed, reducing the amount of the estimated cost remaining and subject to the risk of error.

Obviously great care in the analysis of stigma and remediation costs is required, paying particular attention to the state of knowledge associated with the environmental condition on the date of valuation and the differences between source and nonsource liability exposures.

INDIRECT IMPAIRMENTS

One of the most frequent situations involving environmental impairments is the case of a property value allegedly influenced by a nearby known environmental risk such as a Superfund site. The indirect impairment case is usually the most difficult analytical situation of all and one in which popular perceptions are frequently not supported by the data. An analysis of cases involving indirect impairments indicates the following:

- The impairments are generally not as great as commonly believed.
- The impairments are generally much more geographically restricted than commonly believed.
- The actual degree of the impairment is much more difficult to establish quantitatively due to limitations in the data and the analytical techniques normally employed.

None of the foregoing implies that indirect impairments do not occur. They do, and with some frequency. They simply do not seem to occur to the extent that popular belief would indicate. Further, indirect impairments, by definition, occur only on nonsource properties.

To date, several techniques have been used to attempt to quantify the indirect impairment. These have included multiple regression on values in segmented areas radiating outward from the known environ-

mental risk site; study techniques adapted from market analysis, such as multifactor purchasing studies; and analyses of the sale price and time on the market for individual properties offered in the assumed impact area versus a control area. All of these have met with varying degrees of success, and all have offered some insight into the dynamics of the indirect impairment.

Assuming the environmental risk is obvious to the participants in the marketplace, meaning clear indications of the impairment can be seen, smelled, heard, or are well documented to the potential purchaser, the studies generally indicate that those properties immediately adjoining the problem site may have impaired values. In some limited cases, the next property away from the risk may also be impaired. In a very limited number of cases where the risk is particularly obvious over a distance, a reduction in value in decreasing amounts with greater distance has been indicated.

The type of environmental risk also seems to be an influencing factor. Well-known risks, such as a closed landfill, seem to have a lesser influence on value[16] when they are compared with, for example, the presence of a nuclear facility with a history of problems. However, an event such as the destruction of a home by a methane explosion apparently emanating from a nearby landfill is likely to alter this relationship.

Beyond generalizations such as the above, it is difficult to quantify indirect impairments using the analytical tools with which the valuer is generally familiar. There is, however, a set of mathematical tools that may offer significant quantitative insight into the situation. These tools are based on the mathematics of geostatistics, a branch of statistics developed for the economic analysis of ore bodies in mining.

To analyze the indirect impairment the factors associated with the real estate adage of "location, location, location" must be measured. Geostatistics makes several assumptions that are pertinent. First, it assumes that the available data is from randomly located points in space. Second, it assumes that the relationship between the values at two points is partially dependent on an inverse (declining) relationship to increasing distance between the points, except when a sample point lies very close to another point—the "nugget" effect. Third, because of the inverse relationship with distance, geostatistics assumes that beyond some distance, one data point no longer has a detectible influence on another.

In a test of geostatistics applied to real estate, the author analyzed commercial office space rental rate data for the northern half of Franklin County (Columbus), Ohio, based on published listings from spring 1989. One of the outputs of a geostatistical analysis is a map of likely values. This map looks very much like a topographic map with the lines of equal value representing, in this case, the rental rate per square foot (see Figure 4), with the topovalues lines overlying a street map for orientation. Note that this map can also be developed in a three-dimensional format, portraying the "lay of the land" with respect to value even more clearly than the two-dimensional map shown.

Suppose we slice through the rental rate hills and valleys and examine the resulting rental rate profiles along the section lines N-S and W-E. The graphs of the rental rate profiles along these section lines are shown in Figures 5 and 6.

These rental rate profiles lie approximately along High Street and Broad/Main Streets in Columbus. The intersection of Broad and High is in the heart of the central business district (CBD) where the state capital building stands on the southeast corner of the intersection. The immediate downtown area of Columbus is the site of a number of newer Class A office buildings, including the headquarters of Nationwide Insurance, BankOne, Borden Chemical, and Huntington Banks.

The trend lines drawn in Figures 5 and 6 start roughly at the Broad and High intersection. The trend line that measures the rate of change in rental rate going north from Broad and High (shown in Figure 5) indicates a rate of decline of $1.00 per square foot per mile. Although not shown here, a related map of occupancy rates was available at the same scale and indicated that occupancy declined from 90% in the CBD to 50% at the low point in rental rates just north of the CBD. The trend line going east from Broad and High (shown on Figure 6) has a rate of decline of $0.83 per square foot per mile although lower rental rates eventually are found in an area where the occupancy rate is 40%.

16. In at least one case, a partially closed landfill has been cited as a positive amenity.

FIGURE 4 Commercial Rental Rate Topovalue Map

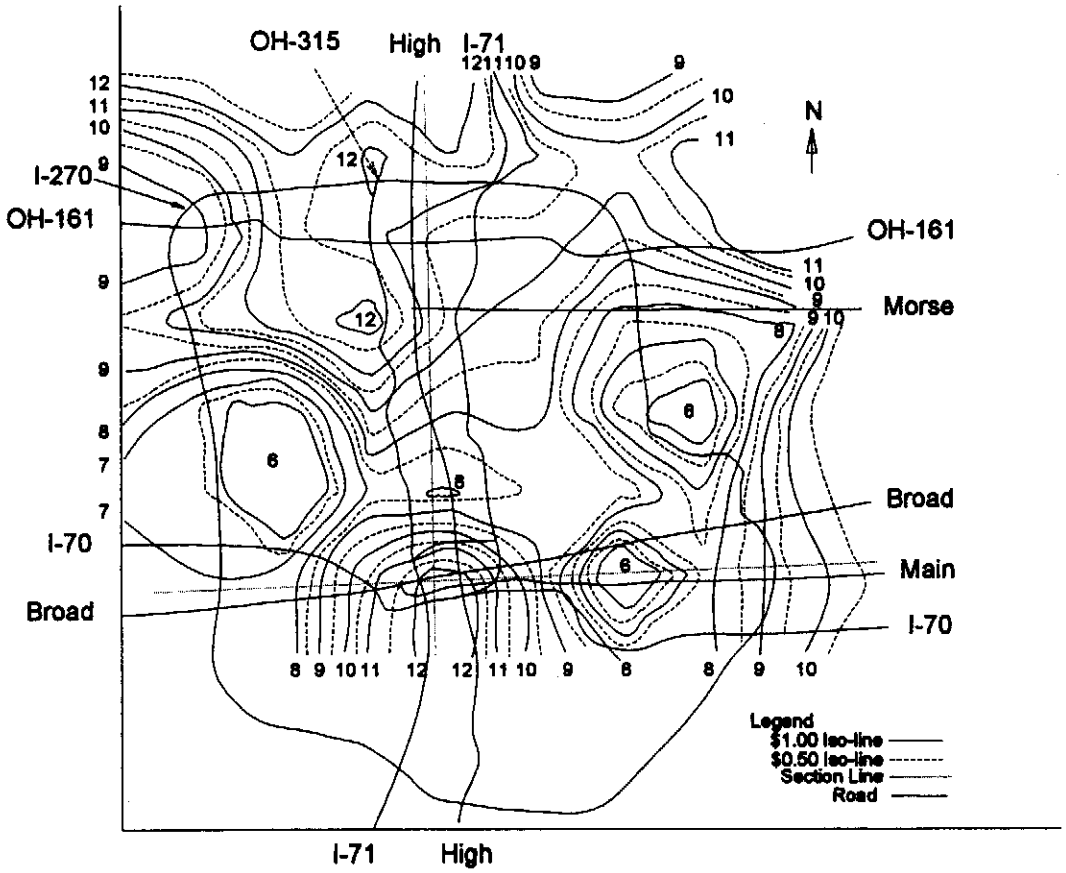


FIGURE 5 Rental Rate Profile, Section N-S

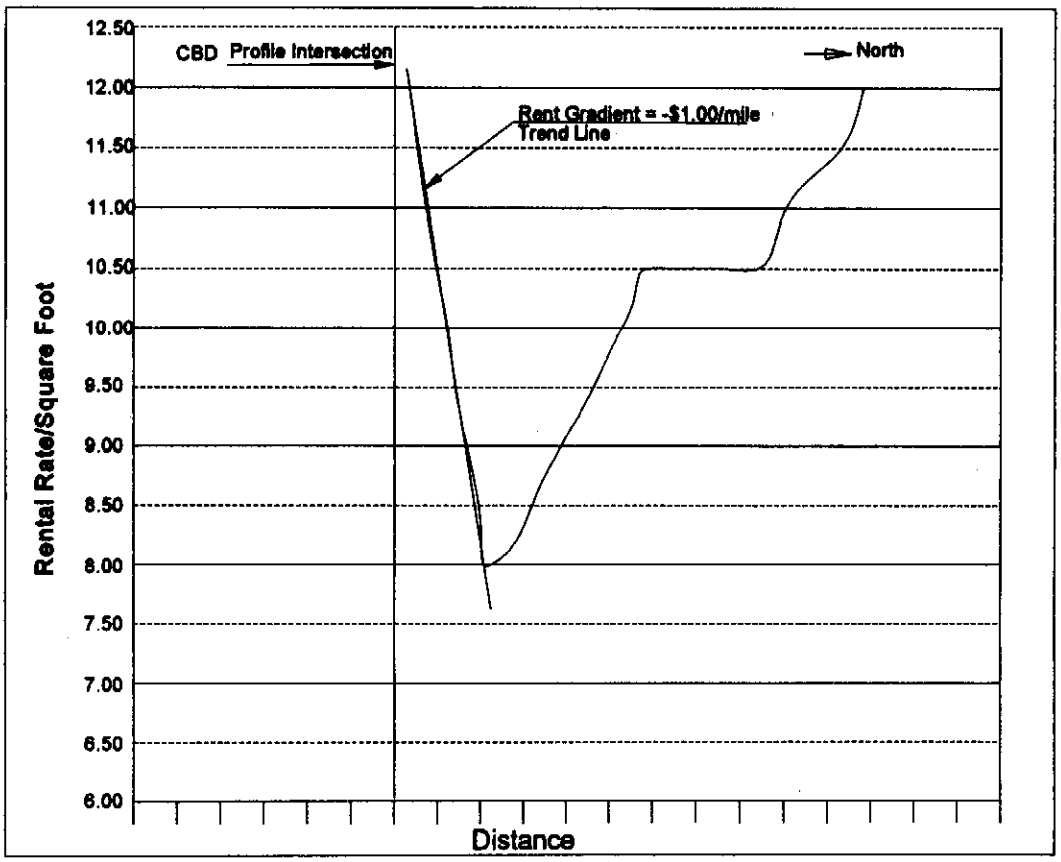
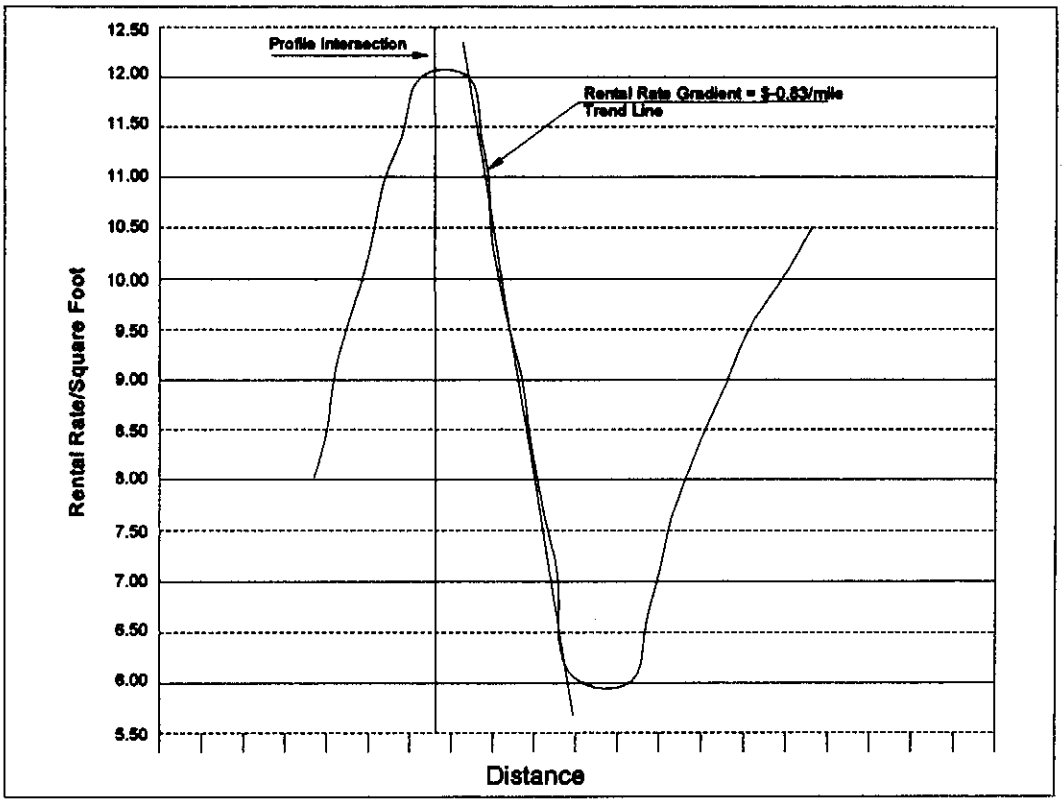


FIGURE 6 Rental Rate Profile, Section W-E



Compare this to the physical reality. If the valuer goes north on High from Broad, he or she will have first passed through an area being redeveloped into Class A commercial office space and anchored on the north by the new Nationwide Insurance headquarters buildings. Immediately after the Nationwide complex however, an area of rundown storefronts located across from the old rail yards is encountered, followed by a stretch of older commercial buildings eventually leading to the main campus of The Ohio State University. Thereafter, the quality of the area and buildings increases gradually to the high-quality professional area of Worthington.

Going east from Broad and High for the first mile or so are the headquarters of BankOne and Borden Chemical and new highrise office buildings. Then comes an area of mansions converted into high-quality office space and smaller Class A and B office buildings, declining to an area of older industrial properties, some of them abandoned. Increasingly attractive areas are then encountered and stretch to the outer-belt expressway where major new commercial office space is under development.

How would one measure the impact of the old rail yards on the commercial rental rate? It seems that the gross impact is the incremental rate of decline in rental rate per square foot of $0.17 per mile—the difference between going east on Broad where no equivalent to the rail yards exists for several miles and going north on High where the rail yards are located within a mile. On a larger-scale topovalue map, the impact can be more closely estimated, especially when other influences are examined by using topovalue data from other areas in the city to eliminate influences such as building quality or proximity to especially high-valued residential areas.

A similar study of residential properties found that major arterial street frontage tends to reduce value. No surprise there. However, if attractive sound barriers are placed between the street and the houses, the effect is much the same as if the street were replaced with a park. Surprised?

CONCLUSIONS

Contained Impairments: Generally, contained impairments are the simplest to deal with and the most amenable to standard appraisal practice. While caution must be exercised, particularly in the application of the sales comparison approach or when an

unusual risk source is involved, practical appraisal experience may well serve the needs of the valuer.

Uncontained Impairments: Uncontained impairments generally present a very different valuation situation from the contained impairment case. First, the unusual nature of the ownership characteristics of the risk source presents new legal and intellectual problems for the valuer. Although these same problems generally exist for any impaired property, they are particularly important in the uncontained case because they are essentially a new stick in the bundle of rights that must be analyzed, with respect to the facility. The ownership characteristics affect the value of the property from which the risk source originated (the source property) and the value of the source property may be directly and strongly influenced by the presence of that risk source on other properties (the nonsource properties). In a sense, the source property "owns" the facility created by the risk source and is explicitly responsible for its remediation, even when it is not on the source property.

Second, given a specific state of knowledge, there can be a very large spread in the possible costs of remediation, leading to greater risks and uncertainty. Often the risks and uncertainties result in value offsets much greater than the estimated costs of dealing with the facility.

Third, standard appraisal techniques will not work adequately in most uncontained impairment situations. The new techniques of case study analysis and the engineering impaired value model must be employed, all of which frequently require expertise not normally within the appraiser's domain.

Indirect Impairments: Quantifying the amount of an indirect impairment is the most difficult task in the field. A number of techniques have been tried with varying degrees of success and the application of geostatistics shows promise.

In general, popular perceptions of the amount and geographic extent of an indirect impairment impact are usually exaggerated. The geographic range of impact appears very short. In residential cases, the detectible impact may not extend even to the property immediately adjoining the site of the impairment. If the impairment is notorious, meaning well publicized in the media, or can be clearly identified by sight, smell, or sound or otherwise explicitly called to the attention of the participants in the marketplace to impact may extend to the adjoining property or beyond. If the impairment lacks these characteristics, demonstrating an impaired value becomes difficult or simply not possible. In the case of commercial and industrial properties, the range of impact generally appears to be isolated to the source property although there are some exceptions, particularly if local lenders do not adequately understand the environmental rules and regulations.

Source Versus Nonsource Properties: The magnitude of the impact of an environmental risk on a source property is significantly different from the impact of that same environmental risk on a nonsource property, even if the nonsource property contains a part of the facility created by the release of the risk source. Some of the differences are:

- The source property has strict joint and several liability for the remediation of the total facility, including that portion that may lie on the nonsource property. The nonsource property does not have this liability and the most likely cost of remediation tends toward zero although there may be restrictions on use cost impacts (which may be recoverable from the source property).
- Because the nonsource property does not have remediation liability, the more sophisticated lenders tend not to penalize the nonsource property in the provision of debt financing, hence the incremental financing cost tends toward zero.
- Depending on the financial resources of the source property owner or the party responsible for remediation and insurance coverage for example, indemnifications or sources of recovery may be available to the nonsource property owner that tend toward making that owner whole.

These and other factors result in a strong need to distinguish clearly between the value impacts of an environmental risk on a source versus a nonsource property.