FEATURES

Contaminated Waterways and Property Valuation

by Randall Bell, MAI

ABSTRACT

Throughout the United States, there are countless contaminated waterways, including lakes, rivers, and ocean coastlines. Indeed, it is difficult to find a waterway that is free of environmental issues. Contamination comes from factors that are purely natural as well as man-made. Some contamination comes from point sources, such as specific treatment plants or factories, while other contamination comes from general sources, such as storm water runoff. This article addresses the factors to consider when studying the effects, if any, that contaminated waterways have on the values of nearby properties. Further, it provides likely reasons as to why allegations rarely arise that contaminated waterways have caused a diminution in the value to nearby properties.

There are tens of thousands of contaminated natural water resources, such as rivers, streams, and lakes, throughout the United States. Furthermore, the Pacific Ocean, Atlantic Ocean, and Gulf of Mexico have had chronic environmental issues. Where there is contamination or natural resource damage (NRD), the question may arise, what is the impact on property values when properties are located in proximity to a contaminated waterway?

Categories of Contamination

There are basically four categories of environmental contamination: (1) air pollution; (2) surface contamination; (3) ground and groundwater contamination; and (4) waterways, such as rivers, streams, lakes, and oceans.

Air pollution impacts large regions, thus if there is an impact on property values, it would generally impact both a subject property as well as all of the nearby comparable properties. Any impacts on property values would inherently be reflected in the market data. Air quality regulations have greatly eliminated or reduced these types of environmental problems. Consequently, very little has been written or published on this topic in terms of property value impacts.

The second and third contamination categories, involving surface and ground contamination, are vast topics. Literally volumes have been published addressing the methodologies for measuring their related impacts on property values. The area of damage economics for surface and ground contamination rapidly developed from the time the Superfund legislation was signed into law by then President Jimmy Carter in December 1980[1] until the late 1990s. A combination of better remediation technologies, more reasonable risk-based regulatory oversight, and refined valuation methodologies now address these

1. *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), Pub. Law 96-510.

situations in a clearer and more consistent manner.[2] The Appraisal Standards Board's Advisory Opinion 9 illustrates the application of appraisal standards in the appraisal of property that may be impacted by environmental contamination, focusing on cost, use, and risk impacts.[3]

Polluted waterways are included in the fourth category of environmental contamination. Although little is published on this topic, the subject warrants examination as it relates to the effects, if any, that contaminated waterways have on the values of nearby properties.

Fundamentals of Contaminated Waterways

The term *waterways* is a general term that includes all sources of water. The vast majority of water is salt water that exists within oceans and seas. Fresh surface water includes rivers, lakes, streams, creeks, and ponds. Technically, the world's ice caps and glaciers, which contain vast amounts of fresh water, fall into this category. The majority of liquid freshwater is located in underground aquifers. Far from environmentally safe, extracted groundwater generally needs treatment before delivery into the potable water system.[4] This article focuses on surface waterways.

Waterway contamination can affect the surface of the water (such as oil sheen), be diluted within the water itself, or sink to the bottom as sediment. *Sedimentation zones* are broken down into three categories: (1) non-depositional zones (scoured regions where sediment does not permanently accumulate), (2) depositional zones (regions of high sedimentation), and (3) transitional zones (regions with thin layers of recently deposited materials). The contaminant amounts are often infinitesimal, but technology has improved to where science can define a contaminant level down to parts per billion or trillion.[5] A fraction of some contaminants can be removed by volatilization (a form of evaporation), some can be broken down in the water, and still others are buried as sediments. The rest can be removed by the slow flushing of the system.[6]

Decades ago, the United States's rivers and other surface waterways were polluted with industrial wastes, agricultural pesticides, fertilizers, and raw sewage. In the early 1970s, the Potomac River was too dirty for swimming and Lake Erie was dying. In 1970, the Cuyahoga River was so oily and polluted that it actually caught fire, sending a disturbing wake-up call to America. As a consequence of these and hundreds of other problem waterways, the Clean Water Act of 1972[7]—at the time the most expensive legislation in the country's history—ended the status quo, regulated dumping, mandated cleanup, and required municipalities to build sewage treatment plants. The primary goal of the Clean Water Act was to make the nation's waters "fishable and swimmable." As a result, many of America's dirtier rivers and waterways are cleaner today than they were over 30 years ago. However, thousands of waterways still do not meet the expected standards.

Despite considerable progress, virtually all surface waterways are still likely to have some environmental issues. It is dangerous to drink water from untreated, open water sources, and pure, potable water is rarely found in nature. Pure water generally only exists at some spring water sources, but even this is often filtered before distribution and consumption. Prior to drinking water from any stream, river or lake, an experienced hiker or outdoors enthusiast will either filter the water, bring it to a rolling boil, or use water purification tablets. Some anglers will either catch and release, or check fish advisories and only then carefully clean and cook their catch. Others may consider the seemingly never-ending barrage of environmental warnings, the practicalities of water movement, and the mobility of fish, and look at these advisories with some skepticism.

Contributors to Contamination

Virtually all water supplies are naturally contaminated. Even without man-made contamination, wa-

2. Richard A. Neustein and Randall Bell, "Diminishing Diminution—A Trend in Environmental Stigma," *Environmental Claims Journal* 11, no. 1 (Autumn 1998): 47–59.
3. Appraisal Standards Board, Advisory Opinion 9, "The Appraisal of Real Property That May Be Impacted by Environmental Contamination," *USPAP Advisory Opinions*, 2008–2009 ed. (Washington, DC: The Appraisal Foundation, 2008), A-16–A-20.
4. Western Municipal Water District, *Report on Water Quality Relative to Public Health Goals,* July 2004, http://www.wmwd.com.
5. Terrence J. Collins and Chip Walter, "Little Green Molecules," *Scientific American* 294, no. 3 (March 2006): 62–69. One part per billion is roughly equivalent to one grain of salt dissolved in a swimming pool.
6. Tiernan Henry, *Contaminated Sediments and the Great Lakes*, University of Wisconsin Sea Grant Institute, updated 22 February 2001, http://www.seagrant.wisc.edu/Communications/Publications/One-pagers/contamSed.html.
7. 33 U.S.C. §1251 et seq.

terways have a host of naturally occurring conditions that result in substantial environmental risks. These contaminants include salts, biological matter, disease-carrying organisms, animal wastes, alkaloids, pathogenic bacteria, viruses, and parasites. Arsenic, copper and lead also occur naturally in sediment. Ocean waters commonly have petroleum, tar, and hydrocarbon contamination from natural underwater seeps on the seabed. Indeed, for North American ocean waters, 60% of all hydrocarbon contamination comes from sources that are entirely natural.[8]

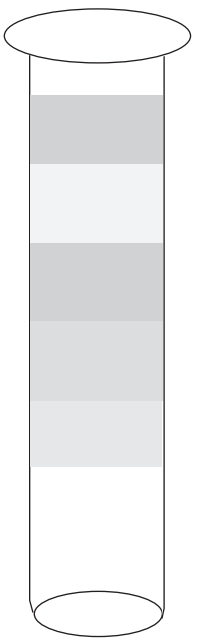
Many waterways also are contaminated with historical industrial wastes from unregulated periods long ago. For example, mercury was once used indiscriminately in gold mining and speculation. Even today, thousands of tons of industrial wastes are legally discharged daily into lakes, rivers, and streams. These wastes include everything from treated sewage effluent to permitted levels of industrial waste.

The bulk of historical contamination is *point contamination,* which can be pinpointed to specific pipes or factories. Much of today's contamination comes from *non-point source pollution*; meaning that the much of the pollution does not come from a specific location, but rather from many various places. Non-point contaminants include surface runoff (particularly storm water), pesticides, and fertilizers. Continued grading and development contributes to vast amounts of sediments. Atmospheric deposition is another major source of non-point contamination, and accounts for 50% of the pollution of the Great Lakes. (Figure 1)

The American Highway Users Alliance states that there are 956,000 miles of federal interstates and surface roads in the United States, amounting to some 9.4 million acres of pavement. Storm water from payment carries pollutants such as deicing chemicals, automotive fluids and fragments, salt, nutrients, and sediment into local waters. In many urban and suburban areas, storm water is the leading source of water pollution.

According to the U.S. Environmental Protection Agency (EPA), an estimated 1.3 trillion gallons of raw sewage and industrial waste escape each year from sewer systems that combine sanitary and storm water in a single pipeline. A new contamination issue being studied is water pollution by drugs. Twenty years ago, EPA scientists examining the sludge from a U.S. sewage-treatment plant found that the incoming sewage contained excreted aspirin, caffeine, and nicotine. Those findings were written off

Figure 1 Contributors to Water Pollution



6. Point Contamination - Specfic wastes from a specific source.

5. Permitted Discharges - Treated sewage, permitted industrial wastes, etc.

4. Non-Point Contamination - Accumulated from multiple nonspecific sources, such as runoff.

3. Historical Contamination - Mercury used in gold mining, tailings, etc.

2. Natural Contamination - Bacteria, animal wastes, salts, alkalies, etc.

1. Pure Water - Rarely found in nature

8. National Research Council, *Oil in the Sea III: Inputs, Fates and Effects* (Washington, DC: National Academies Press, 2002), http://www.nap.edu.

as a curiosity and all but forgotten. However, more recent studies have detected these and other drugs, such as cholesterol-lowering clofibric acid, anticancer agents, psychiatric drugs, and anti-inflammatory compounds, in America's waterways.[9]

Valuation Methodologies

The valuation of any contaminated real estate is a challenging assignment. Fortunately, over the last few years there have been many advances that facilitate a reliable analysis.

When CERCLA was first enacted, some reactions in the real estate and lender markets bordered hysteria. While still a significant and complex issue, environmental science has improved significantly, with both better assessment and evolved remediation measures. Government agencies have also instituted more sensible oversights and valuation methodologies have become far more refined.

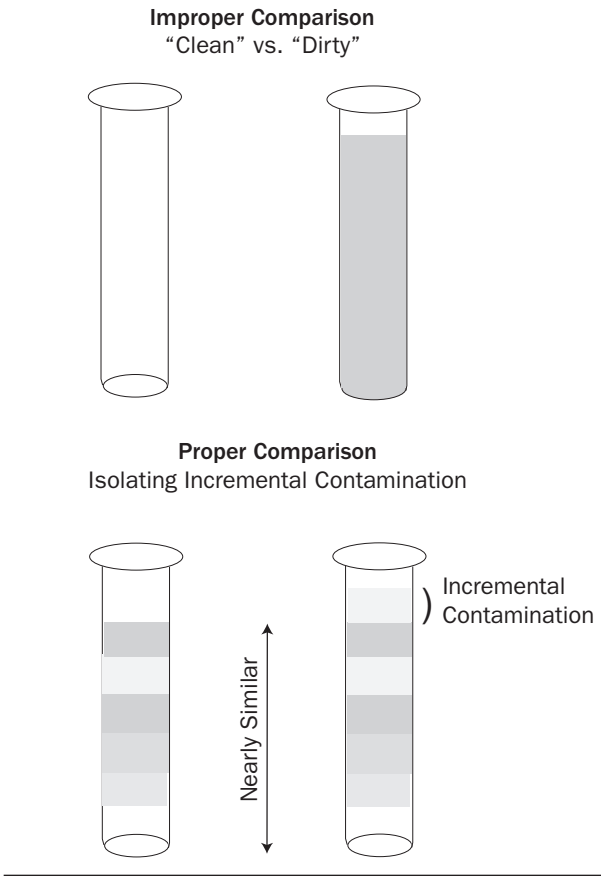
When faced with an assignment to measure the impacts, if any, that a specific waterway contaminant has on property values, it is important to consider the condition in the context of any other contamination that exists within that waterway. In other words, in most cases, the assignment is not to measure the impacts of a contaminated waterway to the impacts of an uncontaminated waterway. More accurately, the assignment is to measure the impact of the *incremental* contamination where there is an already contaminated waterway (see Figure 2).

Furthermore, the presence of contamination must be considered in the context of the overall purchasing decision criteria, and the realities of industrialized society. While nobody goes out of their way to live or work near a contaminated waterway, the larger question is whether or not the issue has a material impact in the market, when considered along with the host of other relevant real estate issues. This could include location, square footage, amenities, access, and the proximity to work, schools, shopping, and places of worship. With waterways, clearly the view amenity itself is an important valuation consideration, as is the fact the many waterways are already contaminated, naturally or otherwise. Contamination does not automatically translate into a diminution in value; indeed, "a property is innocent until proven guilty. For a property to be 'guilty' of any diminution in value, there must be clear, relevant, and objective market data."[10]

Damage Economics

The scope of a real estate damage assignment typically includes (1) determining the unimpaired value using the traditional appraisal approaches and assuming that the detrimental condition does not exist, if necessary; (2) proficiency in the accepted real estate damage economics methodologies; (3) reviewing the specific environmental or NRD factors, which with waterways specifically involves a clear environmental study of all the environmental issues and the incremental contaminant involved; (4) identifying the appropriate valuation methodology, and collecting and analyzing environmental market data; and (5) concluding the impact, if any, on the unimpaired condition of the subject property resulting from the detrimental condition.

Figure 2 Isolation of Relevant Waterway Factors



9. Janet Raloff, "More Waters Test Positive for Drugs," *ScienceNews* 157, no. 14 (April 1, 2000): 212.
10. Orell C. Anderson, "Environmental Contamination: An Analysis in the Context of the Detrimental Conditions Matrix," *The Appraisal Journal* (July 2001): 323.

Unimpaired Valuation

A diminution in value study is often expressed as a percentage of the baseline, unimpaired value, or the value without the incremental condition. Accordingly, the first step often involves determining the value of the subject property, using the traditional approaches to value, under the hypothetical assumption that the detrimental condition does not exist. However, if the market data shows that there is no diminution in value, this step may not be necessary.

Detrimental Conditions Analysis

The basic framework for valuing any alleged real estate damages begins with the Detrimental Conditions (DC) Matrix shown in Table 1.[11] While the nine quadrants within the matrix may not all be applicable, they should each be considered in the context of every assignment.

In 2003, the *USPAP Advisory Opinions* adopted the cost, use, and risk framework, set forth within the DC Matrix, specifically for dealing with environmental issues.[12] Considered within the assessment, remediation, and ongoing stages, the nine quadrants of the matrix should be researched carefully in the context of environmental issues.

Further, one of the basic considerations relating to contamination and liability under the law is whether a property is a source of a release that poses a risk, a non-source or adjacent property onto or into which the contamination has migrated, or merely proximate to the contamination.[13] Making this distinction is essential, as there are varying costs, liabilities, and risks, depending upon which category the subject property fall into. Generally, a source property has more potential for risk than a nonsource, adjacent, or proximal property.

As such, a critical factor in evaluating an environmental condition is called *SNAP*.[14] Specifically, this means determining if the subject is one of the following:

- *Source property* from which the contamination was emitted
- *Non-source property* contaminated by the adjoining property owner
- *Adjacent property* that is not contaminated, but that shares a property boundary with one that is
- *Proximal property* that is not contaminated, is not adjacent to one that is, but is located in the same general area as contaminated property.

With contaminated waterways, the properties being studied generally come under the adjacent or proximal category of SNAP.

Of all the quadrants of the DC Matrix, costs related to remediation are often the most obvious, but with contaminated waterways the responsibility for cleanup costs often is not a factor as another party is paying for the remediation. For example, if a sewage plant discharges a large amount of untreated sewage into a waterway, the cleanup costs are not deducted from the value of a waterfront house, as the responsibility for the cleanup belongs to the sewage treatment plant, and not the homeowner.

An analysis of the use impacts may include studying what practical impacts the waterway contamination has on the surrounding residents. For example, if the water is safe for swimming or fishing, and for what period of time.

An analysis of stigma, which is better termed *risk*, reflects any discounts by the marketplace as a result of the detrimental condition. When the term *stigma* is used, it is most often in the context of an ongoing risk. *The Dictionary of Real Estate Appraisal* defines *stigma* as "an adverse public perception regarding a property…which extracts a penalty on the marketability of the property and hence its value."[15] While the term *stigma* is still used, there has been a trend in the real estate community to refer to this risk factor as *market resistance*. Diminution in value tends to be greatest immediately after the loss or damage is identified, before the nature and extent of the difficulty is fully known.[16]

When conducting a damage study, analysts must look to the marketplace for answers and analyze what the marketplace data is actually saying. Scientific conclusions about persistence of contaminants

11. Randall Bell, *Real Estate Damages: An Analysis of Detrimental Conditions* (Chicago: Appraisal Institute, 1999), 8–15. Also see Randall Bell, "The Impact of Detrimental Conditions on Property Value," *The Appraisal Journal* (October 1998): 380–391.
12. Appraisal Standards Board, Advisory Opinion 9.
13. Bell, *Real Estate Damages*, 128–129.
14. Anderson.
15. Appraisal Institute, *The Dictionary of Real Estate Appraisal*, 4th ed. (Chicago: Appraisal Institute, 2002), 277.
16. Michael V. Sanders, "Post-Repair Diminution in Value from Geotechnical Problems," *The Appraisal Journal* (January 1996): 63.

do not necessarily correlate with the marketplace's conclusion about the duration of economic impact on real estate.[17] Accordingly, the reliability of the analyst's results must be demonstrated and supported by credible market evidence.[18] For waterways, it would be critical to have studies that identify the full spectrum of contaminants for waterways impacting both the subject (test) areas as well as the comparable (control) data.

Environmental Valuation Methodologies

The DC Matrix outlines the issues that must be considered with every assignment involving contamination or other real estate damage issue. The valuation methodologies applied must address these issues.

Advisory Opinion 9 specifically provides that any deduction from the unimpaired value for environmental issues must be supported by market data. In other words, an appraiser or economist may not use a figure that is based solely upon their experience.[19] In the context of the environmental issues that must be addressed within the DC Matrix, there is a clear contrast between a standard appraisal, which hypothetically dismisses any environmental issues, and an environmental valuation, which does address the realities of the environmental conditions of the property.

Detrimental Conditions and the Cost Approach

With contaminated properties, the cost approach can be utilized by deducting the costs related to the contamination issues from the unimpaired value.[20] However, this approach is generally not applicable with contaminated waterways, as the costs for cleanup do not typically go to individual, nonresponsible parties.

Detrimental Conditions and the Income Capitalization Approach

With income-producing contaminated properties, the objective is to examine the income and expenses to determine if the contamination has any impact on the income, expenses, or the capitalization rate. When the income capitalization approach is used, there are various factors that should be considered, including lost rents; increased vacancy; projected costs and time of the cleanup; indemnity payments; mortgage and equity yield rates; and financing costs.

When using this approach, there are two key questions that should be asked. First, has the net operating income been impacted by proximity to waterway contamination, i.e., lower rents, higher vacancy, one-time expenses, higher ongoing expenses, and so forth? Second, has the capitalization rate been impacted as a result of the contamination issues?

Detrimental Conditions and the Sales Comparison Approach

A waterway contamination assignment typically would focus on application of the sales comparison approach, where market data with the incremental factor is compared to data on properties without the incremental factor. This could take the form of paired sales analyses, time-value studies, case studies, regression analysis, and perhaps survey techniques for market data backup (see Figures 3a and 3b).

Table 1 Detrimental Conditions Matrix

	Detrimental Condition Stage		
Issue	**Assessment**	**Repair**	**Ongoing**
Cost	Cost to assess damage	Cost to repair or remediate	Ongoing costs i.e., monitoring
Use	Impact on use while assessed	Impact on use while repaired or remediated	Ongoing impact on use or impact on highest & best use
Risk	Uncertainty factor	Project incentive	Market resistance

17. Richard J. Roddewig, "Temporary Stigma: Lessons from the *Exxon Valdez* Litigation," *The Appraisal Journal* (January 1997): 100.
18. John D. Dorchester, Jr., "The Federal Rules of Evidence and *Daubert*: Evaluating Real Property Valuation Witnesses," *The Appraisal Journal* (July 2000): 306.
19. Appraisal Standards Board, Advisory Opinion 9, Lines 171–173.
20. It should be noted that the cost approach for contaminated property, like conventional appraisals, has a more limited role in actual valuation assignments. Furthermore, elements of the sales comparison approach or the income capitalization approach are used in some of the calculations of the cost approach.

Figure 3a Damage Analysis—Waterway Contamination Test and Control Areas, Same River

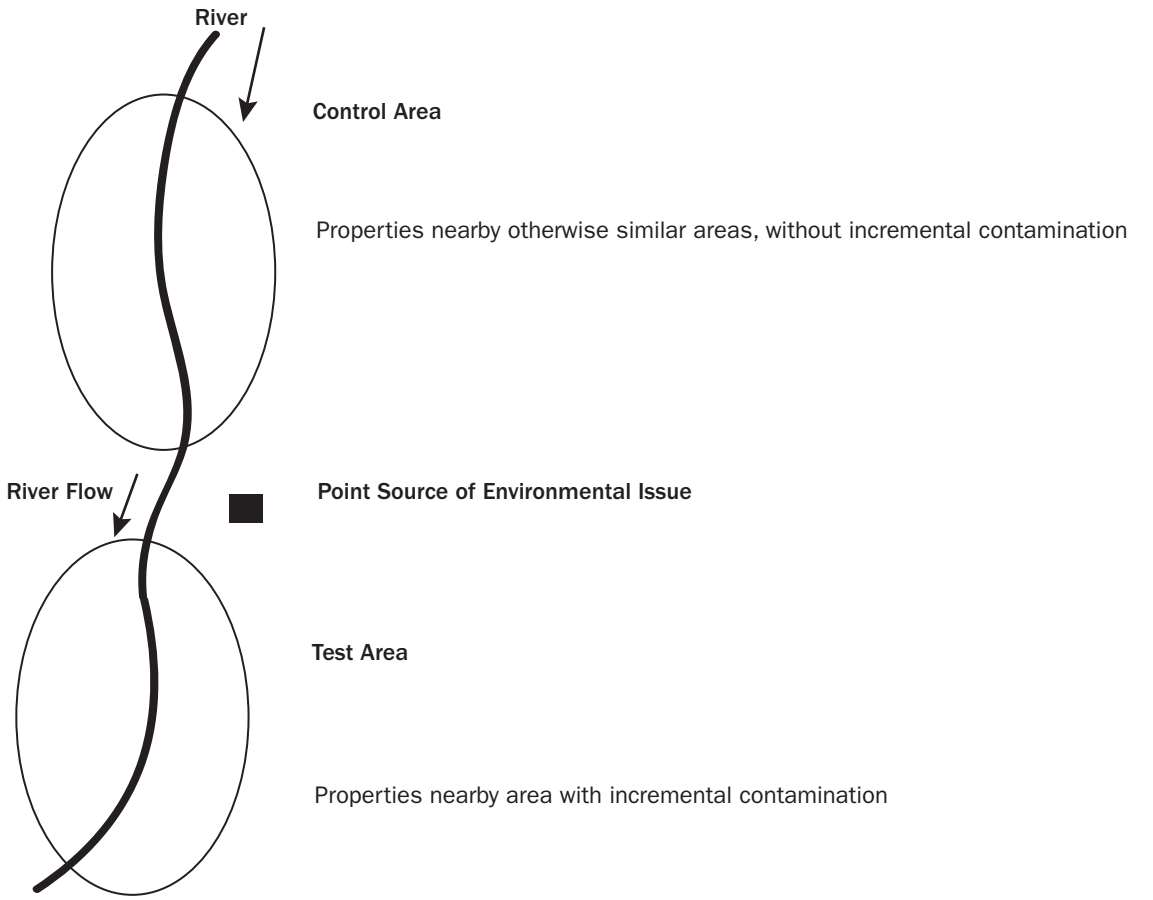
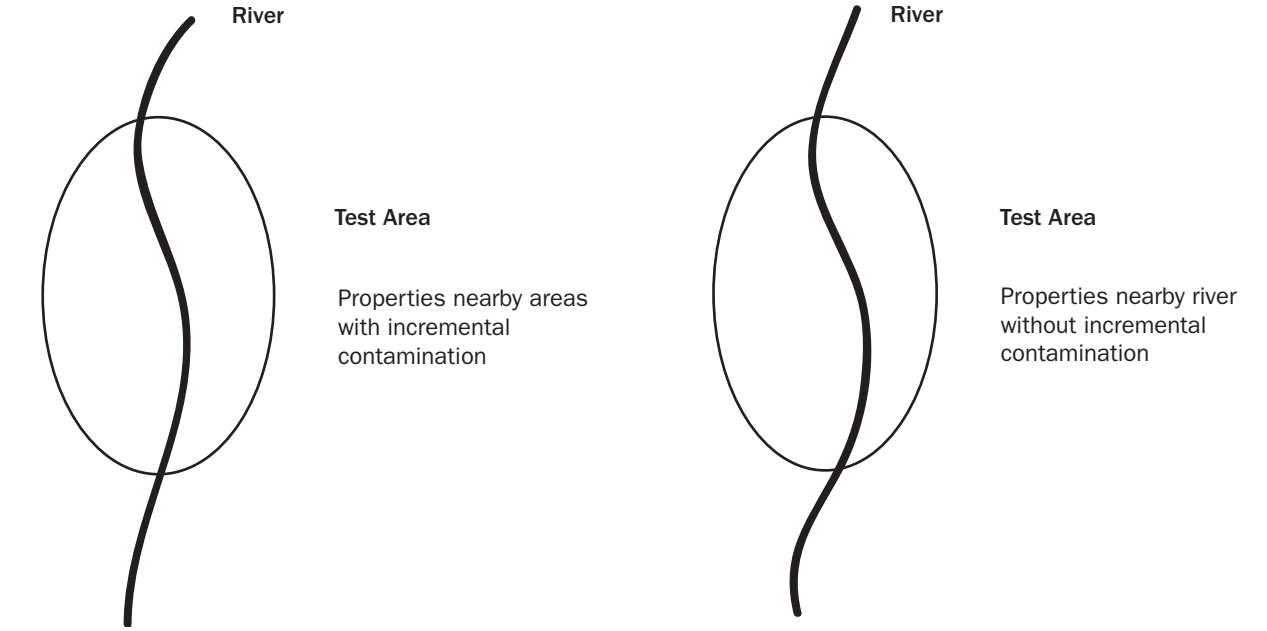


Figure 3b Damage Analysis—Waterway Contamination Test and Control Areas, Different Rivers



These variations of the sales comparison approach are often employed by cross-referencing the impacted properties with public records that indicate whether or not properties have sold. If so, additional information can then be gathered as to the types and levels of contaminants, the property's proximity to incremental waterway contamination, any discounts to the sale prices as a result of the waterway proximity, and so forth.

Like a conventional sales comparison approach, adjustments can be made for differences between the contaminated property's characteristics and those of the subject property.[21] For example, if several similarly contaminated properties sold in a post-remediated condition for full value, then that market data indicates there would be no ongoing risk or market resistance involving the subject property (Figure 4).

Supplemental or Alternative Valuation Methodologies

Contamination-related damages may include health claims, business losses, punitive damages, or liquidated damages. However, economically significant NRD claims will typically be accompanied by measurable damages to the impacted real estate. For example, if a lake is contaminated to the point where swimming and fishing are prohibited, a question arises as to whether or not the condition has a negative impact on nearby properties. If so, one would expect to be able to definitively measure differences in value between properties near this lake and properties in proximity to lakes where no such problem exits. In other words, these conditions are ultimately an empirical question that requires the application of one or more of the three traditional approaches to value.

Table 2 summarizes a variety of supplemental or alternative NRD valuation methodologies. This is only a summary of other methodologies, and further study would be required to obtain a complete understanding of them. Further, these methodologies may or may not be applicable to measuring actual real estate or economic impacts.

Conclusion

Everyone would like to have clean, pristine natural resources and waterways, and fortunately, the Clean Water Act and subsequent legislation have resulted in considerable cleanup efforts. However, the realities of both nature and industrialized society are such that pristine and clean waterways rarely exist. Accordingly, the question of whether a property owner would want to buy next to a clean river or a contaminated river is not based in reality, as virtually all waterways have periods of natural or man-made environmental contamination.

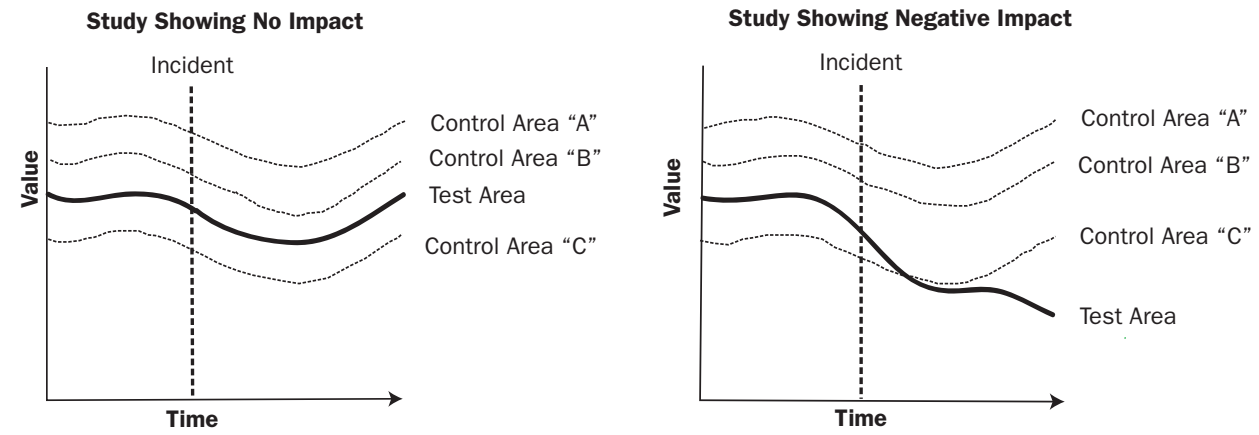
Clearly some waterways are better than others. In conducting a damage analysis, such as paired sales analysis, due to the strong positive effects of a water-view amenity, it is critical to compare the subject property, or test area, in proximity to the waterway to a control area that is also on a waterway, and carefully segregate out the *incremental* environmental issue. This is no small undertaking given the cocktail of contaminates that routinely impact waterways and their ever-changing status.

If the tens of thousands of contaminated waterways throughout the United States did result in a measurable diminution to nearby property values, it would impact billions of dollars of property values. This news would certainly be a major media event. However, such reactions to contamination and allegations of property damage rarely arise. There are many possible explanations for this:

- While waterways commonly have negative environmental issues, they also have strong positive characteristics for view amenities as well as recreational activities like boating.
- Waterway contamination is so common that real estate markets may simply consider it an unfortunate sociological reality that does not get factored into real estate prices. In other words, people may look to government regulation and cleanup as the solution to waterway contamination, rather than adjusting individual property values.
- The status of waterways seems to be in a constant state of flux. Unlike soil or groundwater contamination that impact one general area and remain there for some time, waterways are constantly moving, diluting, draining, and changing. By the time a study is done, the waterway's contamination may have completely changed.
- More seriously contaminated waterways are often cleaned up either through natural biore-

21. Thomas Jackson and Randall Bell, "The Analysis of Environmental Case Studies," *The Appraisal Journal* (January 2002): 87.

Figure 4 Waterway Time-Value Studies



mediation or conscientious efforts, thus those whom the contamination potentially impact may consider the problem a temporary one.

- Some market participants, seeing the barrage of environmental warnings, may view contamination advisories as old news or believe that it is sufficient simply to drink bottled water, shower after swimming, or eat limited amounts of fish; others may choose not worry about the waterway contamination at all.
- The real estate in proximity to contaminated waterways usually is non-source property, meaning that the property owners do not own the source of contamination and have no financial liability for cleanup. Generally, the possibility of paying cleanup costs alone is a major factor in determining the impact that environmental issues have on property values. As cleanup risk is usually not applicable to individual property owners adjoining waterways, the market may not factor these non-source contamination issues into the prices paid.
- The question, what is the impact on property values? may naturally arise when properties are located in proximity to a contaminated waterway. However, a fairer question may be, compared with what? With so many contaminated waterways, what other choice is there? In other words, moving from proximity to one waterway to another may simply be changing one set of problems for another, with no net positive effect.

The diminution of property value caused by waterway and other contamination goes far beyond the conventional appraisal process. Ultimately, the value of properties in proximity to contaminated surface waterways is an empirical question that requires the application of one or more of the three traditional approaches to value, as refined to address the unique aspects of damaged properties. Market data is always required to support any diminution in value conclusion.

While polluted waterways are a major concern as an environmental matter, there is no evidence that these conditions cause an automatic diminution in property values. However, if such allegations do arise, there are established valuation methodologies to test their validity.

Randall Bell, MAI, is the CEO of Bell Anderson & Sanders, LLC, which specializes in real estate damage economics and conducts studies nationwide. A course developer and instructor for the Appraisal Institute, he is also the author of seven books, including *Real Estate Damages*, published by the Appraisal Institute, and a recently released business management book, *Strategy 360*. Bell is a graduate of the Anderson School of Management at UCLA. **Contact: T: 949-497-7600; E-mail: bell@realestatedamages.com**

Table 2 Supplemental or Alternative Natural Resource Damage (NRD) Methodologies

Methodology	Overview	Key Attributes and Limitations
Market Price Approach	A business valuation approach that determines the extent of an economic loss. For example, a dam failure at a ski resort may result in loss of ski days, lift tickets, rentals, condo fees, restaurant sales, wages, etc.	The key attribute of this approach is that it is tied to the market and can accurately measure business losses. A limitation of this approach is that it may not directly measure real estate damages or other issues, such as good will.
Resource Replacement Cost	Determines the cost to replace or restore a natural resource that has been lost or destroyed, such as water, fish, or wildlife.	The key attribute of this approach is that it can be useful in calculating the value of certain commodities that have been lost. A limitation of this approach is that the cost of replacement may not reconcile with the economic value created by the resource in the first place.
Travel Cost Method	Estimates the loss of consumer benefits as measured by costs to travel. For example, in a case where a section of the Colorado River is rendered inaccessible due to contamination, this method could estimate the damages as a function of the number of tourists, cost of gas, and other travel costs related to visiting this area of the Colorado River.	The key attribute of this approach is that it is relatively easy to calculate. A limitation of this approach is that it is theoretical in nature and does not take into account the other options that tourists have if a particular resource is not available. Accordingly, this would likely not be a valid indicator of real estate, economic, or business damages.
Random Utility Model	This model is conceptually linked with the travel cost method in that both seek the same sorts of values and use a similar logic. However, instead of looking at time actually foregone, this model measures the opportunity cost lost. For example, if one wanted to go to the beach, but it was closed due to environmental issues, one could visit the park instead. The price differential between trips is intended to determine any loss.	The key attribute of this approach is that it is relatively easy to calculate. A limitation of this approach is that it is theoretical in nature and does not take into account the other options that tourists have if a particular resource is not available. Accordingly, this would not be a valid indicator of real estate, economic, or business damages.
Hedonic Price Method	This method is a form of the multiple regression model. It can be used to estimate the contributory value of one aspect of a property, such as how much lake frontage adds to home values in a given market. With a hedonic price model, the analyst selects the variables appropriate for the study (e.g., square footage, lot size, bedroom count) and makes conclusions as to the functional form of the relationship between the model's variables and price.	The key attribute to this approach is that it can generate credible results if done correctly. The limitations of this approach include a need for large data sets and information concerning the variables to build a credible model, and the complexity involved in building a valid and reliable model.
Ecological Valuation Approach	This approach looks at the value of a natural resource as it contributes to an entire food chain. For example, wetlands breed insects, which are eaten by fish, which are eaten by bears.	An attribute of this approach is that it is easily understood and anecdotal in nature. A limitation of this method is that it may not be well understood as to whether the species in a particular food chain have equal values or whether there are substitute values (e.g., if there is no fish, can a bear just eat something else?). Consequently, it would be difficult to use this approach to actually quantify economic damages.

Table 2 Supplemental or Alternative Natural Resource Damage (NRD) Methodologies (*continued*)

Methodology	Overview	Key Attributes and Limitations
Factor Income Approach	A business valuation model, this approach determines the increase in costs in a unit of production as it affects overall prices.	The key attribute of this approach is that it may be suited for analyses of surface and groundwater resources, forests, and commercial fisheries. For example, surface and groundwater resources may be inputs for agriculture irrigation, manufacturing, or municipal water systems. The products (agricultural crops, logs, manufactured goods, and municipal water), in turn, may have market prices. Similarly, commercial fishery resources (fish populations or stocks) are inputs to the production of a catch of saleable fish. A limitation of this approach is that it may not be directly applicable to real estate damages.
Contingent Valuation Method	A survey approach to determine how much someone would be willing to pay, give up, or discount a property for a particular condition.	The key attribute of this approach is that it provides some indication of value in the absolute absence of primary transactional market data or it serves as a secondary approach to transactional market data. A limitation of this approach is that it is not based on actual transactional market data and is particularly prone to manipulation.
Cross-Cutting Methods	A mix of both market and nonmarket methods. Essentially these methods involve case studies with contingent valuation.	The key attribute of this approach is that case studies are market-derived data, which illustrates the effect on value from actual cases where the condition has occurred before. A limitation of this approach is that it can sometimes be difficult to find comparable case studies, and contingent valuations themselves are not based on actual transactional market data.
Benefit-Transfer Method	This is a case study methodology where the benefits or damages in a similar situation are applied to the subject property where no site-specific study or market data is available. This can be an application of the sales comparison approach.	The key attribute of this approach is that it is market-derived market data that demonstrates the effect on value from actual cases where the condition has occurred before. A limitation of this approach is that it can be difficult to find comparable case study market data.
Unit-Day Value Method	The use of prior studies involving similar circumstances, and application of those results.	The key attribute of this approach is that, for some detrimental conditions that have been widely studied, prior studies may have been published and may be easily accessible. A limitation of this approach is that the studies used may be outdated, improperly performed, or not directly comparable.