CHAPTER 29

Valuation of Brownfields Properties

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SCOPE

This chapter examines the valuation considerations for brownfields and other contaminated real estate, including issues such as stigma, appraisal standards and methods, and incorporates the impacts of the 2002 Brownfields Amendments on valuation practice. Additionally, this chapter presents examples of value-added opportunities in brownfield development, with a focus on aiding the brownfield investor, developer, or attorney with useful tools in the brownfield finance arena.

The basic valuation paradigm for brownfields was summarized by the Appraisal Standards Board in its Advisory Opinion 9, issued in October, 2002. The process begins with an estimate of the value of the property in the "as if uncontaminated" condition, and then uses this as the launch pad for an estimate of the "as-is contaminated" value. Traditional appraisal methods may be used (e.g., sales comparison, income capitalization) but with the necessity of somewhat more advanced techniques (e.g., hedonic modeling, survey research, options models, academic and practitioner case studies). Application of a rigorous, methodical process provides opportunities to carefully analyze the value-enhancing aspects of brownfield redevelopment, and to recognize the opportunities for significant "ramp-up" in market value.

There is widespread agreement that the cost approach to value is found wanting if no consideration is given to the impact of stigma. Stigma is the term of art in appraisal applied to the disruption in market value, caused by an impairment such as contamination, which is over and above the engineering costs of remediation. As such, remediation can and often does persist after

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brownfield remediation is completed. Stigma arises from both a change in the income stream or usability of the property as well as a change in marketability. While generally accepted appraisal methods are usually good at accounting for both stigma and remediation costs as of a point in time, stigma may change over time, and various longitudinal models, such as repeat sales analysis, are necessary to estimate these changes over time. Recognition of stigma-related phenomena in brownfields and understanding of the ways to ameliorate stigma are key to many of the value-enhancing opportunities.

SYNOPSIS

§ 29.01 Appraisal Standards and Overview of Basic Valuation Methods

Real estate appraisal must adhere to a widely accepted set of standards and peer-reviewed methodologies. This is particularly the case in contentious situations or situations which are potentially or actually litigious. This section provides a brief overview of those standards and methods. Subsequent sections deal with more detailed applications in the valuation of contaminated or remediated real estate.

[1] There Are Regulatory Standards That Are Generally Applicable to Real Estate Appraisals

The governing paradigm for property valuation in the United States is the Uniform Standards of Professional Appraisal Practice (USPAP), which has been adopted by law or regulation throughout the United States. USPAP is produced by the Appraisal Standards Board (ASB), a part of the federally chartered Appraisal Foundation (AF), headquartered in Washington, DC. Appraisers are licensed or certified by individual states with requirements set forth by the Appraisal Qualifications Board (AQB), also part of the AF.

Real estate valuation in litigation matters has generally been held by the courts to be admissible in evidence under the requirements established in *Daubert v. Merrell Dow Pharmaceuticals*[1] only if it conforms to USPAP standards. In *Daubert,* the U.S. Supreme Court set out four nonexclusive factors for courts to consider when determining whether expert testimony is reliable:

(1) whether the theory or technique propounded by the expert has been or could be tested;

(2) whether the theory or technique has been subject to peer review or publication;

(3) the known or potential rate of error; and

(4) the general acceptance of the technique by the relevant community of experts.

Note that compliance with USPAP is not a sufficient condition for passing the *Daubert* hurdle, but is a necessary one. Note also that the necessity of compliance

[1] 509 U.S. 579, 113 S. Ct. 2786, 125 L. Ed. 2d 469 (1993). *See also* Kumho Tire Co. Ltd. v. Carmichael, 526 U.S. 137, 119 S. Ct. 1167, 143 L. Ed. 2d 238 (1999).

with these universally accepted standards has also been held in "*Frye* states." The rule in *Frye v. United States*[2] that scientific evidence is admissible only where it is "sufficiently established to have gained general acceptance in the particular field,"[3] rejected by some courts as overly strict,[4] is still observed in some states.[5]

Adherence to USPAP is required for all federally regulated real estate lending, under Title XI of the Financial Institutions Reform Recovery and Enforcement Act (FIRREA) and is generally required by laws or regulations of the various states for other types of appraisal. Supplemental standards may also apply in other types of appraisal situations. For example, federally funded land acquisition, such as for highway construction, must also adhere to the Interagency Land Acquisition Standards.[6]

The "Guidance for Valuation of Contaminated Property" was issued by the ASB in 2002 in the form of USPAP Advisory Opinion 9, which provides technical assistance to appraisers and which has been widely accepted as authoritative guidance by the courts.[7]

[2] There Are Established Appraisal Methodologies

Appraisal methodologies are generally categorized into three approaches: the Sales Comparison Approach, the Income Approach, and the Cost Approach. USPAP provides substantial leeway for appraisers to choose methodologies within one or more of these approaches which are deemed applicable in a given situation. A thorough understanding of these leads to Value-Creation Opportunities, which are innovative ways of finding hidden values in brownfields. All of these approaches are discussed below.

Practice Note

[2] 293 F. 1013 (D.C. Cir. 1923)

[3] 293 F. at 1014 (D.C. Cir. 1923).

[4] *See, e.g.,* United States v. Downing, 753 F.2d 1224 (3d Cir. 1985); *In re* Agent Orange Product Liability Litigation, 611 F. Supp. 1223 (E.D.N.Y. 1985), *aff'd,* 818 F.2d 187 (2d Cir. 1987); State v. Walstad, 119 Wis. 2d 483, 351 N.W.2d 469 (1984).

[5] *See* John A. Kilpatrick, *Daubert Raises It's Ugly Head Again,* ABA Inhouse Counsel Committee Newsletter, Feb. 2003; Dave McLean, Bill Mundy, and John A. Kilpatrick, *Summation of Evidentiary Rules,* Real Estate Issues, Fall 1999.

[6] *Uniform Appraisal Standards for Federal Land Acquisition* (Chicago: Appraisal Institute under authority of the U.S. Dept. of Justice and the U.S. Interagency Land Acquisition Conference, 2000).

[7] Advisory Opinion 9 can be found at http://commerce.appraisalfoundation.org/html/USPAP2005/ao9.htm.

Value creation opportunities in brownfields redevelopment primarily come from two sources: reduction of stigma through remediation and adaptive re-use. The former results in value creation through the reduction of risk and uncertainty attached to the brownfield value prior to remediation. The latter comes from improving the use of the site from a lower-value use (e.g., exhausted industrial) to a higher use (e.g., inner city housing or commercial). While there are certainly other profit opportunities in brownfields, these two are typically the most promising.

Appraisal data are gathered and methodologies applied within the rubric of an applicable definition of value. The most common definition of value used in the United States is commonly called "*market value*," and presumes arms-length transactions between knowledgeable market participants acting prudently and in their own best interests. This definition also explicitly assumes that the transaction is conducted in U.S. dollars (or is adjusted for their equivalent) and is not influenced by any special financing arrangements. Similar definitions may be specified in litigation by state law or model jury instructions. Also, the Inter-agency Land Acquisition Standards proffer a similar definition. Appraisals may also be conducted at other valuation standards, such as foreclosure value, which would require different data and methodologies. Finally, data gathering and methodological choice are also influenced by the interests to be appraised (e.g., fee simple interest, minority partial interest).

Market value is always estimated under the assumption that the property is utilized or is to be utilized at its "*highest and best use*." This is usually defined as the single maximally productive use from among the set of potential uses which are financially feasible, physically possible, and legally permissible for the site.

[3] The Sales Comparison Approach Analyzes Transactions of Properties That Have Several Comparable Elements

This approach includes all of those methodologies in which the value of a subject property is determined by comparing the characteristics of that property to other comparable properties which have recently transacted. While there are many definitions of "comparability," it is generally accepted that the data be comparable in terms of conditions of sale, market conditions, interests transacted, financing terms, and physical characteristics.

[a] Conditions of Sale

Conditions of sale include such factors as arms-length transactions, distress sale transactions, agglomeration transactions, or foreclosure transactions, to list a few. Market value appraisals generally require comparables which are arms-length transactions. If no such transactions are available, then the appraiser will need to

adjust the sales prices to account for discounts or premiums paid under non-arms-length conditions.

Practice Note

Significant care must be taken by the appraiser when identifying brownfields comparables which frequently are not arms-length transactions. For example, many brownfields sellers are distressed, in or near bankruptcy, or the subject of foreclosure or regulatory action.

On the other hand, this offers significant investment opportunities for brownfield developers. Valuation of a prospective brownfield acquisition should take into account the potential for such distress-sale discounts.

[b] Market Conditions

Market conditions adjustments account for changing market conditions over time. Comparable data from the past may need to be adjusted for systematic price level changes. Market conditions adjustments are fairly common in rapidly moving markets, and may be estimated by such techniques as matched pairs, trend analysis, or time-series studies.

Matched-pairs are comparisons of sales of two or more comparable properties which differ only by the factor being analyzed. The difference between the sales prices should approximate the marginal value of the factor. For example, if two properties, identical in all respects, sell exactly one year apart, then the difference in the sales price, as a percentage, should indicate the systematic annual change in market prices — the market conditions adjustment.

Similarly, a *trend analysis* allows for the comparison of many similar property sales over time. Simple trend-analysis software allows for the determination of periodic market trends.

Finally, more sophisticated *time-series studies*, such as time-series regression, allow for non-comparable properties to be analyzed over a time-span to extract the marginal value growth over that time-span.

Studies have shown that contaminated and uncontaminated properties have different value trends over time, and this should be taken into consideration when using uncontaminated comparables to value a brownfield. For example, in a market where uncontaminated properties are growing in value at some positive rate (say, 5% per year), the value trend of unremediated brownfields may be flat or in some cases even negative over time.

[c] Interests Transacted

If a fee-simple interest is being determined, and comparable data is for minority, non-controlling, or limited market interests, then adjustments may be necessary to account for the discount inherent in those transactions. However, when fee-simple transactions are being used to estimate the value of a partial interest, appraisers typically value the whole property via various approaches and then apply an estimate of a partial-interest discount to this estimate of the whole. Brownfields transactions frequently require assumptions of restrictions or covenants which imply interests other than fee simple or its equivalent.

[d] Financing Terms

Market value appraisals assume cash transactions denominated in dollars. If comparable transactions included favorable financing, or were subject to an assumption of less-than-favorable financing, then appropriate cash-equivalency adjustments are necessary. Brownfields are typically subject to financing constraints not experienced with other properties. Thus, use of brownfield comparables to estimate market value of uncontaminated properties should consider this issue.

[e] Physical Characteristics of the Properties

Physical characteristics include property size, structural characteristics, age, depreciation, etc. Adjustments are usually not linear, since most characteristics entail diminishing marginal utility. For example, a particular industrial use for a site may require 25 acres. Comparable sites used in the analysis vary in size from 25 acres (the minimum needed) up to 35 acres. Upon close analysis, it is found that the first 25 acres contribute full value to the overall property, but additional acreage above 25 contributes significantly lower value, to the point where the 34th and 35th acre of comparables that size contribute almost no value at all to the overall property. Adjustments are made to determine equivalent utility, and thus must take into account the substitutability of many physical and functional components of comparables and the subject property.

Practice Note

Diminishing marginal returns for site size — sometimes referred to as *plattage* — provides an excellent opportunity to extract hidden values from an adaptive re-use of an industrial site with excess land. Often, the additional land is nearly valueless, since it contributed little to the former utilization of the site. However, in adaptive re-use situations, this may not be the case. For example, a site may be subdivided, with the extra portion adapted for some other use. This hidden value can be substantial, depending on the specifics of

the adaptive re-use.

[f] Sales Comparison Methodologies

Sales comparison methodologies include the traditional sales adjustment grid (the most common for financing appraisals), cross-sectional hedonic models, survey research, time-series (longitudinal) statistical models, matched-pairs analysis, repeat sales analysis, and meta-analysis of case studies and comparable transaction data bases. Statistical models of large-scale appraisals (mass appraisals) are often referred to as automated valuation models, and are commonly used in tax assessment and class-action litigation.

Cross-sectional hedonic models are multiple regression models which use data from two different sources (for instance, a contaminated area versus a non-contaminated area) to measure the marginal value difference between those two sources.

Repeat sales analysis involves comparing two different sales of the same property on different dates. If the property has not physically changed during the time between the two sales (a matter for empirical investigation) and both sales are arms-length transactions under similar conditions, then the pricing difference gives a good indication of market trends. Conversely, if market conditions trends are known, the repeat sales model can be used to extract other pricing information, such as the marginal value of any changes to the property or other conditions.

Meta-analysis of case studies is a qualitative compiliation of data from a variety of disparate but similar sources, such as a review of academic literature on brownfields, to infer a range of value from similiar situations.

[4] The Income Approach Uses Established Methods for Appraising Income-Producing Properties

Income producing property is usually transacted at a price determined by the discounted present value of future cash flows. Appraisals of income-producing properties usually take into account one or more income approach methodologies, such as the discounted cash flow model, direct capitalization, or a gross rent multiplier.

[a] Discounted Cash Flow Models

Discounted cash flow (DCF) models take into account the anticipated periodic cash flows in each future period. This method is best used when there are a finite number of periods and cash flow is expected to vary from period to period. When the number of periods cannot be determined, the appraiser may assume a terminal value at some point in the future, say ten years, and estimate that terminal value using some anticipated perpetuity cash flow (i.e., the assumption of a cash flow in perpetuity) and a terminal capitalization rate (see § 29.04[3][b] below).

Discount rates are determined by examining the internal rate of return (IRR) for comparable projects or properties. The IRR is simply the discount rate at which the sum of the present values of the net cash inflows and outflows, including the purchase price, equal zero. Extraction of IRRs from the net present value of comparables is subject to the complexity that projects with multiple sign-changes in cash flows (negative flows in some periods, positive in others). There will be multiple solutions to the IRR equation. However, for brownfield remediation situations, the DCF model best approximates the behavior of investors. Typically, real estate investors seek out projects which achieve or exceed some minimum risk-adjusted required rate of return. The DCF model is favored for measuring this. (See the example of a DCF analysis in § 29.04[5][g] below.)

Practice Note

The DCF is the primary model used when developing feasibility studies or business plans for proposed investments. It has the advantage of being consistent with other types of asset analysis (e.g., portfolio analysis) and directly measures or uses important metrics, such as required rates of return, net present value, and residual value. In addition, DCF analysis allows for realistic sensitivity analyses, particularly testing for changes in remediation time assumptions, so that investors may look at "what-if" scenarios with confidence.

Sensitivity analysis allows for a measure of how the value of the project is affected by slight changes in key variables. For example, the value of an income producing property depends on certain assumptions about the rate of return, which is an input into the discounted cash flow analysis. What if these assumptions are wrong? By what percentage does the value change if the rate-of-return is, say, one percentage point higher or one percentage point lower? The valuation analysis is a point-estimate, and so does not easily accomodate such a sensitivity analysis. However, a robust feasiblity study should include some tests of the sensitivity of the value estimate to such changes in key variables.

[b] Direct Capitalization

Direct capitalization assumes constant cash flows or constantly changing perpetual cash flows. The valuation model is a simple value-of-a-perpetuity, which is the ratio of the perpetual cash flows to an applicable capitalization (cap)

rate. Cap rates may be derived in several ways. The most common is to analyze comparable transactions of income producing property with similar cash flow characteristics (constant or constantly changing perpetuities). The cap rates may be derived from the ratios of the single-period cash flow on each comparable property to its arms-length sale price. In the absence of such perpetuity comparables, appraisers may examine non-perpetuity transactions to extract IRRs and adjust those for the anticipated rate of change over time (cap rate equals IRR minus expected rate of change). In the absence of any market transaction comparables, the appraiser may estimate a cap rate through a band-of-investments technique (a weighted average of equity dividend rates and fully amortizing financing factors) or a built-up technique (real returns plus factors for risk and inflation). In any case, appraisal of contaminated property should use cap rates which include a factor for risk. Market-derived cap rates from non-contaminated properties should be adjusted upward to account for risk.

Figure 1
Example of a Cap Rate via a Band-of-Investments Method

Required Equity Cash-on-Cash Return	9.75%	
X Equity Percentage of Overall Funding	X 40%	
Interest Rate on Debt	8.75%	0.0390
Amortization Term of Debt	25 years	
Full Amortization Payment Factor, 0.0875 @ 300 months	0.098657	
X Debt Percentage of Overall Funding	X 60%	0.0592
Sum of the two (cap rate)		9.82%

Figure 2
Example of a Cap Rate via a Build-Up Method

		Note
Required Real Rate of Return, Risk-Free	4.0%	A
Inflation Adjustment Factor	3.5%	B
Real Estate Risk Factor	2.5%	C
Brownfield Risk Factor	5.0%	D
Indicated Cap Rate	15.0%	

Notes:

A: The base risk-free rate, often proxied by the short-term t-bill rate

B: The current annualized expected inflation rate

C: The market premium for investment-grade real estate, usually proxied by investment grade returns over the 10-year t-bill rate.

D: The risk factor for brownfields, often proxied by the spread between investment-grade bonds and high-yield "junk" bonds.

[c] Gross Rent Multipliers

Gross rent multipliers are applied in simple cases, such as rental apartments or rented single-family detached dwellings. This is a simplistic approach to value, and depends on a market estimate of the ratio of sales prices to monthly or annual rents. While this method may give a good indication of unimpaired values, it is generally not useful for estimating impaired brownfield values.

[d] Other Cash-Analysis Methods

Other cash-analysis methods, such as options pricing models, allow more flexibility in dealing with a probability distribution of future redevelopment opportunities.

Practice Note

Options pricing is widely used to value financial assets, particularly derivative instruments. While variants in options pricing have been used in real estate analysis for many years, only recently have specific real asset options pricing software tools become available, making the process easy and more straight forward. Options pricing is a variant on DCF and allows multiple potential scenarios to be valued simultaneously. Each scenario has a DCF-determined value, and then a probability is attached to each scenario. The sum of the probability-weighted DCF values is the value via the options pricing model. More complex models allow for such variants as Monte-Carlo simulation, interaction between scenarios, and sensitivity analysis. *Monte Carlo simulation* is a computerized, mathematical process that estimates the output of (or solution to) a model by randomly applying values (using statistical sampling techniques) in each variable of the model, during each repetition.

[5] The Cost Approach Analyzes the Cost of Land, Plus Replacement Costs, Less Various Obsolescence Factors

In the early part of the 20th Century, this was the prevalent method for valuing real estate in the United States, and is still widely used in other countries. Moreover, it is still used in the U.S., particularly for special purpose properties (such as public facilities, marinas, energy generating facilities, and refineries) and for properties without a regularly traded market. However, for other properties it is generally not favored compared to the other two approaches.

The cost approach generally begins with an estimate of the raw land value, typically derived from a sales comparison approach. To this, the appraiser adds the

cost of either replacing or reproducing the utility of the improvements as if new, and from this deducts factors for physical, functional, or external (sometimes called economic) obsolescence. The result is the appraised value of the property using the cost approach.

[a] Physical Depreciation

Physical depreciation includes any wear-and-tear to the improvements, and may include both curable and incurable (permanent) physical obsolescence. On-site contamination and other impairment may constitute a physical impairment, either curable or incurable.

[b] Functional Obsolescence

Functional obsolescence estimates the diminution in value to the property resulting from a lack of typically expected components. For example, a tall building without an elevator would suffer from functional obsolesce. Older buildings without Americans with Disability Act accommodations would also suffer functional obsolescence. Brownfield properties are frequently older properties and suffer from functional problems along with contamination problems.

Practice Note

While it matters little in the final outcome, there is substantial confusion even among practicing appraisers over the difference between "physical" and "functional" obsolescence. In lay terms, "physical" obsolescence pertains to diminishment in value of that which is in place, while "functional" pertains to diminishment resulting from that *which is not there*. Environmental contamination on the property itself would be properly classified as physical obsolescence, while lack of some functionality (e.g., lack of usability of some of the improved space due to asbestos contamination) might also be present. Thus, a contaminated property may be both physically and functionally contaminated.

While the final value would be the same regardless of how this is classified, proper understanding and classification of the physical diminishment to the improvements is useful for recognizing value-enhancing opportunities in adaptive re-use. In the asbestos example, finding economically efficient ways to contain the asbestos may allow for use of formerly valueless space, hence providing a significant and inexpensive ramp-up in value.

[c] External or Economic Contamination

External contamination may result in external obsolescence. Additionally, remediated sites may suffer from long-term or permanent stigma, which is typically accounted for as economic obsolescence.

Practice Note

Some texts use "external" and "economic" depreciation synonymously, and most appraisers categorize such depreciation in the same fashion. In fact, these arise from two somewhat different phenomena. For example, on-site soil or groundwater contamination would result in "economic" depreciation of the property, while off-site environmental contamination, resulting in proximate stigma (e.g., being across the street from an air pollutant source) would be properly categorized as "external" depreciation. Stigma resulting from the former, economic, can be ameliorated, while the stigma resulting from the latter would be more problematic from a brownfield redevelopment perspective. In contaminated neighborhoods, such as old industrial parks or waterfront zones, individual properties may suffer from both types.

[6] Value-Creation Opportunities

[a] The Apparent Obstacles or Limitations Associated With the Potential Value of the Property Are Identified and Quantified

The difficulty in approaching brownfield sites using strict traditional real estate strategies lies in overlooking community value in a holistic site vicinity context. Like each "traditional parcel" of real estate, each brownfield site has unique attributes. However, brownfields have more distinct attributes in terms of societal health and community benefit. Divergent stakeholder objectives (i.e., those of buyer, seller, regulator, lender, community, etc.), for example, often lead to consternation regarding what constitutes an acceptable cleanup standard for a site. This situation often becomes fragmented because the future use of the brownfield site has not met with stakeholder consensus. Divergent perceptions of the value, standards, re-use, and costs regarding cleanup are also potential obstacles or limitations that can further detain the ability to obtain or identify cleanup funding sources. Many stakeholders also fear issues such as liability and exposure to risk instead of addressing these issues as integrated aspects of the site redevelopment and re-use process. In many cases, the process itself, including governmental acquisitions and dispositions, delay the transfer of brownfields sites. In short, all these issue have an economic component associated with them that needs to be identified and quantified, as well as their economic influences on other sites in that vicinity.

[b] Each Obstacle or Limitation Correlates to Each Other in an Integrated Context to Identify and Quantify the Catalysts Required to Create Potential Value for the Property

The challenge of expediting brownfield site transfer lies in integrating site cleanup and redevelopment. The value creation approach correlates each potential obstacle or limitation with cleanup cost reductions and public subsidies for community improvement. This integrated approach, beginning with a full site characterization, includes environmental, economic, market, demographic, community input, political climate, tax structure, and many other components. Stakeholders' alliances thereby have a context for accessing public capital, such as subsidies for infrastructure improvements, to attract market interest in the site. Property transfers are then completed more expediently, with the environmental issues being evaluated in the framework of all the real estate considerations required to achieve transfer. This approach also answers a key question: what has to be done to the real estate at a particular site and/or its surrounding sites to create high value and cost savings for achieving its transfer and re-use?

[c] The Benefits of Acquiring and Applying the Catalysts to Create Value for the Property Are Quantified and Justified

There are several major benefits associated with a value-creation approach to brownfield properties. One, real estate, not remediation, drives the property transfer and redevelopment process. Prospective sellers, buyers, regulators, community leaders, and other stakeholders collaborate on a fully integrated plan for remedy and re-use, including (as appropriate) institutional controls and end dates. Secondly, the value creation approach implements remedies that are compatible with the specific end uses of properties. Thirdly, the approach generates incentives for stakeholders to support each other in securing public funding and regulatory approvals for cleanup and redevelopment plans. In summary, value for a site is created by repositioning it to excite market interest. Brownfields financial incentives and infrastructure improvements can be leveraged for this purpose. Value is also increased by obtaining entitlements and permitted zoning uses. The approach includes working with municipalities on these issues to unlock value and attract end users and uses. The hard work comes into play when the value creation approach is applied to a project-specific opportunity. However, site transfer and transformation can be accomplished more readily by repositioning negative economic components of a property into an integrated context that will derive positive value.

§ 29.02 Scope of the Appraisal Analysis

[1] Changes Brought by USPAP 2006

Prior to the effective date of USPAP 2006, July 1, 2006, an appraisal analysis was considered "complete" if the appraiser used all relevant approaches to value and used both the mandatory and non-mandatory (i.e., "specific") USPAP rules. An appraiser could have chosen to perform a limited appraisal (one without all relevant approaches to value or which did not use certain specific, non-mandatory USPAP rules) by invoking what was called the "departure provision" of USPAP.

USPAP 2006 significantly rewrote and expanded the scope of work determination and reporting requirements. At the same time, USPAP 2006 eliminated the differentiation between a "complete" and "limited" appraisal analysis and also eliminated the departure provision. Thus, for appraisal analyses performed after July 1, 2006, and for reports dated after July 1, 2006, USPAP places a greater burden on the appraiser to carefully determine the appropriate scope of work needed to complete an assignment and to clearly delineate both that scope of work and the rationale for the scope decisions. In a brownfield valuation, due to the unique characteristics of the property, its utility, and the varying restrictions resulting from the contamination, this becomes much more important than in the past for producing a credible analysis and appraisal report.

[2] Factors That Determine the Scope of the Analysis

Factors to be considered in the scope of work decision, and explained in the report, include the nature of the client, the intended use and users of the information, the type and definition of value being applied (e.g., market value), the effective date of the analysis, and the relevant property characteristics. Scope of work decisions should be made with consideration both to the expectations of market participants (e.g., clients and other intended users) as well as the choices made by other appraisers in similar situations (e.g., peer reviewed literature on brownfield valuation).

[a] The Nature of the Client

The scope of work may be different for different clients. For example, federally regulated lenders typically place greater emphasis on the sales comparison approach to value while equity investors usually rely more heavily on discounted cash flow or direct capitalization. Survey research has shown that different investors require different assumptions about cash flow projection in the income approach.[8]

[b] The Intended Use of the Appraisal

If the intended use of an analysis is for investment or financing purposes, then

[8] *See, e.g.*, William Kinnard & Elaine Worzala, "Attitudes and policies of institutional investors and lenders towards on-site and nearby property contamination," available at www.rics.org/RICSWEB/getpage.aspx?p=hBfMN3AsKE2qULrd-dJ61Q.

a more rigorous development of certain factual issues may be necessary by the valuation analyst. On the other hand, a valuation prepared for litigation may rely on factual analyses (via explicitly expressed assumptions) developed by other experts (e.g., engineers, hydrologists, toxicologists, etc.). Further, the level of detail contained in the report may differ according to the anticipated users. For example, in a self-contained report for investors, the appraiser would be expected to develop a rigorous discussion of the nature of the contamination and other environmental conditions at the site and on surrounding properties, usually referencing or including reports by physical science experts. In a courtroom, however, the appraiser would rarely be expected to testify to the physical contamination attributes of the property, and instead would simply assume those matters of fact which were to be determined by the court.

As discussed below, a market value appraisal requires a robust development and explanation of the highest and best use. Other definitions of value (e.g., foreclosure value) may or may not require this analysis. However, highest and best use may be affected by the brownfield contamination, and so this may need to be addressed regardless of the definition of value used. The determination of the necessity and/or extent of the highest and best use analysis is part of the scope of work decision process. For example, a property with limited or special uses may require a less rigorous analysis. However, most value-enhancement opportunities for brownfield redevelopment require some adaptive re-use, including an improvement in the highest and best use. Hence, a detailed analysis and discussion of this aspect is necessary for a full understanding of the value implications and opportunities for a change in the use of the property.

§ 29.03 Implications for the Highest and Best Use (HBU) of the Property

[1] Analysis of the HBU Is Often Required

As noted previously, USPAP requires that all market value appraisal values be estimated assuming the highest and best use (HBU) of the property in question. Further, many jurisdictional definitions of value other than market value may still require an HBU analysis. Finally, many "as-is" appraisals, conducted without regard to HBU, may require an HBU analysis as a base-line for determination of the non-HBU use to which the property is currently placed.

[2] HBU Analysis Is Generally Conducted on the Basis of the Property as Vacant and As-Is-Improved

HBU analysis is generally conducted twice: once in the ideal condition assuming that the property is vacant and available for optimal development and once again in the "as-is-improved" condition. Any difference between the two should take into account costs of demolition and restoration of the property to the "ideal" (or near ideal) state.

[3] HBU Analysis in the Ideal State Can Yield Multiple Results

For a brownfield, the HBU analysis in the ideal state can arrive at multiple values, e.g., "vacant-and-never-contaminated," "vacant-and-remediated," "vacant-and-contaminated," along with varying values at varying degrees of contamination. All of these invoke one or more hypothetical conditions or extraordinary assumptions, and USPAP requires explicit disclosure of all such modifying conditions and assumptions.

USPAP Advisory Opinion 9 recommends a two-stage analysis: one under the hypothetical condition that the property is and never was affected by contamination and the other under the "as-is" actual condition of contamination or remediation. A proper HBU in each of those states should take into account both the "ideal-vacant" value and the "as-is-improved" value to arrive at a HBU in each of the two circumstances.

Practice Note

In fact the Brownfield HBU analysis process may actually result in six or more different HBUs: "vacant-ideal" and "as-improved" in each of three circumstances: as-if never contaminated, as-is (contaminated) and as-when remediated. The first pair of HBUs ("vacant-as-if-never-contaminated" and "as-improved-as-if-never-contaminated") is performed to provide a base-line set of values only. These are hypothetical values which probably cannot be achieved even after remediation. However, comparison of all six of these HBUs provides a helpful focus on reutilization opportunities. Indeed, since remediation may frequently be performed to varying standards depending on the desired post-remediation use of the property, multiple HBU analyses may be conducted in the as-when remediated state to allow for multiple cost/benefit studies and thus to optimize the economic benefits of remediation.

[4] HBU Analysis in General Is a Four-Step Process

[a] Determining Legally Applicable Uses

The first step of the HBU analysis is a determination of all of the uses to which the property may legally be applied. This takes into account such aspects as zoning, restrictive covenants, and both government and private restrictions on

land use. In the "ideal-never-contaminated" analysis, the analysis relaxes any legal restrictions necessitated by the contamination and any extraordinary development enablements granted by local authorities to promote brownfield redevelopment. Legal restrictions in the as-is condition may include covenants and restrictions, environmental liens, limited zoning, or easements. Extraordinary development enablements for brownfields may include tax abatements, zoning enhancements for public-benefit uses (e.g., low-income housing), or other economic inducements which may vary according to the type of use proposed. In the "as-is" analysis, these restrictions and/or promotions should be considered. Further, if a zoning or comprehensive plan change or other legal status change is reasonably possible, the analysis should take this into account along with the time and costs necessary to do so. Note that USPAP requires explicit disclosure of any and all assumptions made in arriving at the HBU determination.

[b] Determining Physically Possible Uses

The next step is to determine, of all of the uses to which the property may legally be applied, which uses are physically possible. Again, in the "ideal" condition, the analysis assumes away any physical restriction imposed by contamination, but restores such restrictions in the "as-is" analysis. Often, steps [a] and [b] require land planning, engineering, hydrological, or other specialized assistance.

[c] Determining Financially Feasible Uses

The third step is to determine, of the uses which are legally permissible and physically possible, which uses are financially feasible. Note that in practice, financial feasibility determination requires first a determination of market feasibility (positive utility) and second a determination of economic feasibility (a positive utility which can be priced other than a public good). Financial feasibility is the subset of economically feasible uses which are actually profitable. Thus, the mere ability to charge rent for a given use does not ensure financial feasibility or a positive net present value to the property. Only financially feasible uses have a positive net present value.

Practice Note

The question of "market feasibility" can be summed up by "if you build it, will they come?" Properties which are *market feasible* enjoy positive demand in the marketplace, but consumers won't necessarily expect to pay rents to enjoy that good. An example is a park. Park space enjoys positive demand, but consumers generally expect parks to be "public goods," which are provided for free. *Economic feasibility* refers to goods with both positive demand *and* for which consumers expect to pay rent. However, economically feasible properties may not be financially feasible, as market rents may not necessarily cover the costs of operation or provide a return on investment. Examples of such enterprises are publicly owned theaters, symphonies, operas, ballets, etc. which charge admission for tickets, but still require public subsidies for support. *Financially feasible properties* have positive demand (they have market feasibility), can charge positive rents (they are economically feasible) *and also* cover all operating costs and provide a positive return on investment.

This is significant for brownfield redevelopment, since many remediatable properties may have positive market or economic feasibility post-remediation evidenced by positive demand, but may not be financially feasible investments.

[d] Determining Optimum Productive Use

The fourth step is a determination of the maximally productive use of the site, both in the "ideal" assumed condition and the "as-is" condition. The process then reconciles those two determinations into one recommended highest-and-best use of the site. Due to special site-specific conditions or regulations, an HBU determination may be very specific (e.g., "single family detached residential between 1000 and 1500 square feet on one-quarter-acre lots"). On the other hand, in areas with broad zoning or comprehensive plan rules, an HBU determination may be quite general (e.g., "commercial use").

[5] Brownfield Contamination Will Probably Affect the HBU in Many Ways

[a] Legal or Physical Restrictions May Be Imposed

Unremediated contamination may place legal or physical restrictions on the property. These restrictions may or may not impact HBU. For example, under the "ideal-and-never-contaminated" assumptions, a site may have been optimally used for industrial purposes. As contaminated and "as-is-improved," the site may still be optimally used for industrial purposes. However, in many other cases, property "as-contaminated" may be severely restricted, depending on the nature and degree of contamination, local regulatory requirements, anticipated future regulatory burdens, or other limitations on the utility of the site.

[b] Financial Feasibility May Be Affected

Unremediated contamination may affect the financial feasibility of a property via several mechanisms. Most notably is the change in financing of the property. While appraisal analysis is conducted without respect to financing (e.g., cash or

cash equivalency), the lack of "as-if-uncontaminated" financing will result in a diminution in value relative to other, uncontaminated comparable properties. Also, even when anticipated costs to remediate are taken out of the equation, the financial feasibility may be impacted by additional testing, monitoring, insurance, management, or legal costs.

Financial feasibility is achieved only when a particular use results in a positive net present value. Discounted present values take into account both cash flows as well as discounting rates. The latter will be affected, relative to unimpaired properties, by increased risk and stigma. Thus, certain uses which may have been feasible in the "uncontaminated" state will not be feasible either in the contaminated or remediated state.

[c] Net Present Value May Not Be Optimal

Net present value, leading to a determination of financial feasibility, will not be affected for all uses in the same way. As such, a use which may have been maximally productive in the "as-if uncontaminated" state may still be financially feasible but may no longer be maximally productive.

§ 29.04 Estimation of Brownfield Value

[1] A Direct Appraisal of a Brownfield Property May Be Misleading

While direct estimation of the brownfield value is intuitively pleasing, it carries significant shortcomings. For one, direct brownfield comparables are rarely available, and adjustments may be subject to significant levels of qualitative (i.e., unquantified) factors, such as the degree of stigma loss, locational adjustments, and marginal values of hedonic components. *Hedonic components* are the attributes of the property that contribute to value. Second, the purpose of a brownfield valuation is often either the estimation of the amount or percentage of diminution in value relative to uncontaminated properties or an estimation of the baseline value of the property in the "as-if uncontaminated" state.

Practice Note

Any appraisal based on sales comparison requires estimation of marginal values of various hedonic components. The word "hedonic" is more commonly used in the context of a regression model (e.g., hedonic multiple regression), but in fact a simple sales adjustment grid model is a hedonic pricing tool, albeit a simple one.

Sales adjustment pricing requires comparing the subject property to various comparable properties that have been sold. One important implicit assumption is that marginal prices of hedonic components are constant. For example, if the improved square footage of the subject property is 10,000 square feet, and the comparables range in size from 8,000 to 12,000 square feet, the model assumes that these differences in size all carry the same or nearly the same adjustment factor per square foot (the marginal price of this hedonic factor).

In fact, in the case of contaminated or other impaired property, sales prices are often inconsistent with respect to these hedonic components. As a result, the preferred method, consistent with good appraisal practice as outlined in Advisory Opinion 9, is to begin with a baseline value (the unimpaired value) using unimpaired comparable data, and then adjust according to the stigma and/or remediation costs determined to be applicable in the appropriate situation.

[2] An Estimate of the Percentage or Amount of Diminution Is Often Advisable

Prevailing appraisal literature and USPAP Advisory Opinion 9 call for a three-step process:

(1) estimation of the value as-if uncontaminated;

(2) estimation of the diminished value; and

(3) estimation of the difference between these two (the percentage or amount of diminution in value).

In practice, appraisers often begin with the as-if unimpaired value, estimate the percentage or amount of diminution, and impute the diminished value from that.

Estimation of the unimpaired value follows traditional appraisal methodology, as outlined in § 29.01 above. The remainder of this section will deal with specific valuation techniques applicable and useful in the impaired value estimation or estimation of the percentage or amount of diminution typically present in brownfields.

[3] The Sales Adjustment Approach

[a] A Sales Adjustment Grid Is Typically Used

Sales adjustment approach techniques traditionally follow the sales adjustment grid, which is a spreadsheet of comparables and adjustment factors. Typically, the appraiser gathers several comparable transactions which meet the explicit assumptions of the salient definition of value and, sequentially, compares each one's characteristics to the subject property.

Figure 3
Example of a Simple Sales Adjustment Grid

	Subject	Comparable #1	Comparable #2	Comparable #3
Description	24.0 acres	10.0 acres	32.0 acres	24.0 acres
Sales Price		$500,000	$1,800,000	$2,400,000
Price/Acre		$50,000	$56,250	$100,000
Conditions of Sale	Fee Simple	Subject to Easement	Fee Simple	Fee Simple
Adjustment*		+6,250	-0-	-0-
Financing	Cash Equivilent	Cash Equiv.	Cash Equiv.	Cash Equiv.
Adjustment		-0-	-0-	-0-
Location	Industrial Park	Similar	Similar	Similar
Adjustment		-0-	-0-	-0-
Date of Sale	Current	Current	Current	Current
Adjustment		-0-	-0-	-0-
Physical Cond.	Brownfield	Brownfield	Brownfield	Remediated
Adjustment**		-0-	-0-	-$43,750
Sum		$56,250	$56,250	$56,250
Indicated Value				
Per Acre	$56,250			
Total	$1,350,000			

* Determined through matched pair analysis between #1 and #2

** Determined through matched pair analysis between #2 and #3

This simple analysis is provided to demonstrate the format, rather than an actual sales adjustment grid. In practice, a raw land appraisal will typically use 10 or more comparable sales. Additional sales, not reflected in the sales adjustment grid, may be used as matched pairs or trend analyses.

Other techniques, such as regression modeling, are fundamentally congruent extensions of the sales adjustment grid. The sales adjustment grid compares the hedonic components of a subject property to each of several comparables, making adjustments one comparable at a time to arrive at a value based on the marginal value of these hedonic components. Regression models, on the other hand, examine the comparables together as a group, using statistical techniques to directly measure the marginal values of the hedonic components.

Practice Note

Even a rudimentary discussion of regression modeling would be both lengthy and beyond the scope of this text. A simple one-factor regression, often called a 'linear regression', consists of a single explanatory variable and a single dependent variable. Say, we want to know the impact of square footage on the price of a home. The regression equation would take the form of:

sales price = constant + (price per square foot) X (size of home) + error term

This would usually be re-expressed in "math-speak" as:

$$Y = \alpha + \beta X + \epsilon$$

although the two equations mean identically the same thing. The appraiser would then gather a large number of recent sales, for which Y and X were known. The linear regression technique, almost always performed using a computer, "best fits" a linear X-Y plot of sales prices (the Ys) and the square footages (the Xs). The decision rule for determining the best fit equation is to minimize the sum of the squared error terms — "error" being defined as the unexplained variance. Two famous mathematicians, Gauss and Markov, working in the late 1800s, determined that minimizing the sum of the squared errors would result in the best linear unbiased estimator.

In practice, regression models for real estate pricing require many more variables (Xs) and somewhat more complex adjustments for non-linearity and other issues. Fortunately, there are many well-developed and easily-utilized computer-based routines for regression modeling. As a result, nearly all academic real estate pricing models depend on some variant of a regression model or other multi-variate statistical model.

[b] Adjustable Characteristics

Adjustable characteristics include:

- Conditions of sale;
- Market conditions (market timing);
- Financing conditions;
- Location; and
- Physical characteristics.

Conditions of sale adjustments may be made for non-arms-length transactions, partial interests, or other issues affecting the nature of the transaction itself. Market conditions adjustments are made to compensate for systematic changes in property price levels between the date of sale of the comparable and the effective date of the transaction. Financing conditions adjustments may be made if the

comparable property was sold with other than market-normal financing conditions. Location adjustments may be made to compensate for the value of any differential utility between the comparable location and the subject location.

Physical characteristics adjustments should be analyzed for all salient items that have economically significant marginal value. Marginal values typically do not have linear relationships, and so linear approximations are only applicable over short ranges of value discrimination. For example, a 50,000-square-foot industrial site may sell for $100,000, or an average value per square foot of $2. However, the difference in value between a 50,000-square-foot site and a 51,000-square-foot site may only be $1,000 ($1 per square foot), because small differences in marginal values do not have the same marginal cost as the overall average cost. (This specific example harkens back to the plattage discussion earlier in this chapter.) As such, appraisers are cautioned to find comparable transactions requiring only small adjustments.

Adjustment amounts may be determined using a number of different methodologies. For example, continuous variables (e.g., time, square footage) may be estimated using some simple trend analysis. (Trend analysis is described below.) Repeat sales analyses are frequently used to determine market conditions adjustments. (Repeat sales analysis is described below.) Discrete variables (location, any variable which can be counted) may be analyzed with a simple matched pairs or other discrete determinant model, such as a "dummy" variable in a regression or a conjoint measurement output from survey research.

Practice Note

Reflecting back on the regression model presented in the previous practice note, a discrete or "dummy" variable may be used when the data set includes transactions which either do or do not have a particular characteristic — such as either "brownfield" or "not-brownfield". A simple example would be:

$$Y = \alpha + \beta_1 X + \beta_2 Z + \epsilon$$

In this example, Y and X may represent the selling prices and square footages, respectively, of industrial properties in the neighborhood while Z would equal "1" if the site was contaminated and "0" if not. The regression model would be expected to produce a value for β_1 which was the price per square foot of an uncontaminated site and a value for β_2 which was the discount (measured in dollars per square foot) for contaminated sites in the area.

Caution: this is an overly simplistic presentation for illustrative purposes only. In practice, other controls and analyses would be in order before this simple model would meet standards for statistical reliability.

[c] Trend Analysis

A simple trend analysis plots sales on a per-unit basis (e.g., per square foot) over time to estimate pricing trends in the market. While widely used when sufficient data is available and efficient markets prevail, this technique may be overly simplistic when faced with small data sets or inefficient market problems. In practice, most computer spreadsheet programs have routines for estimating simple linear trends.

[d] Repeat Sales Analysis

The repeat sales model is constructed using paired sales of the same property, in the same state (e.g., no significant physical changes) over a period of time. For each property in the sample, a rate-of-return (typically annualized) is determined over time. These are then averaged to estimate a market-wide periodic rate-of-return.

Repeat sales analysis allows for the development of a trend-line in values, assuming that the underlying transactions are representative of the explicit assumptions in the salient definition of value. Repeat sales methods have the benefit of controlling for endogenous factors (e.g., depreciation, changes in marginal values) and allowing direct measure of the exogenous factors (e.g., local economy, macro-economic trends) which over time systematically affect property values via market conditions.

Note that repeat sales analyses are useful for both brownfield and non-brownfield circumstances. Repeat sales models have also been shown to be statistically robust even when relatively small samples are used.

If two repeat sales data sets are used — brownfields versus non-brownfields — then a differential rate-of-return can be computed which provides input into an impaired discounted cash flow model. If brownfield properties are shown to grow in value at a slower rate than non-brownfield properties, then this differential is directly input into the discount rate or capitalization rate used in the income approach valuation.

[e] Adjustments Are Made to Account for the Marginal Prices of the Variable

Discrete adjustments are frequently determined using matched pairs, although with larger data sets, hedonic models — the common name for multiple regression models applied to real estate pricing — are more statistically robust than matched pairs. Matched pair analysis is used to compare the transaction prices (or per-unit prices) of two properties that are identical in all respects but for the variable in

question. Unfortunately, matched pairs analysis has an implicit assumption that the marginal value of the variable in question is not co-variant with the marginal values of other variables. For example, a 10,000-square-foot industrial building may have two restrooms. Restrooms are valuable, so measuring the marginal value of the restrooms is important. However, a 20,000-square-foot industrial building may have four restrooms. Hence, some of the value of the restrooms is captured in the marginal value of additional square footage of the building.

Thus, when possible, a multi-variate regression model, such as a hedonic model, is preferred, so that co-variant properties may be directly examined. Well developed hedonic regression models allow for examining these co-variant factors. From a brownfield redevelopment perspective, this can be very important. For example, as noted, a larger building may have more restrooms than a smaller building. A large brownfield building redeveloped but with only a few restrooms may have a diminished value relative to other large buildings with a more "market-acceptable" number of bathrooms. While this is a simple, and somewhat intuitive example of the information hidden in co-variant variables, it is illustrative of the sort of less intuitive gems of information which may be hidden in the interaction between hedonic components.

[f] Adjustments for Stigma

Adjustments for stigma may be determined in a variety of ways. Survey research has been found to be useful in contaminated property situations for determining stigma adjustments. Typical survey techniques include perceived diminution, conjoint analysis, and contingent valuation. *Perceived diminution* involves surveys of property owners, tenants, and other stakeholders to directly measure perceptions of diminution in value. *Contingent valuation* involves surveys of non-stakeholders for those same measurements. *Conjoint analysis* is particularly useful in situations where direct measurements of contamination economic impacts cannot be determined. It uses a survey of various tradeoffs to rank-order the diminution associated with a brownfield relative to other property amenities or disamenities. Guidance for use of survey research has been provided in both the peer-reviewed real estate literature as well as the legal press.[9]

Stigma adjustments are often developed using meta-analysis of peer-reviewed

[9] Marcus Allen & Grant Austin, *The Role of Formal Survey Research Methods in the Appraisal Body of Knowledge*, The Appraisal Journal, 2001, 394-99; Bill Mundy & Dave McLean, *Using the Contingent Valuation Approach for Natural Resource and Environmental Damage Applications,* The Appraisal Journal, 1998, 290-97; Bill Mundy & Dave McLean, *Addition of Contingent Valuation and Conjoint Analysis to the Required Body of Knowledge for the Estimation of Environmental Damages to Real Property,* Journal of Real Estate Practice and Education, 1999, 1-19; Shari Seldon Diamond, *Guidance for Survey Research*, Handbook for Evidence (Washington, DC: Federal Judicial Center, 1999).

empirical studies (explained below), comparable case studies from other contamination situations, or appraisals of similar properties. All of these methods, when used in a manner consistent with the peer-reviewed literature, have been accepted by various courts and other jurisdictions.[10]

In the valuation literature, the term "meta-analysis" as applied to case studies and academic empirical studies has only recently come into vogue. It describes the phenomenon that, despite various idiosyncratic factors, the impairment and/or stigma resulting from contamination tends to have similar valuation results across a variety of circumstances, such as geographic location, type of contamination, or even property use. As such, this sort of secondary research, while not a full substitute for primary empirical research, nonetheless provides an important supportive tool in the brownfield valuation problem.

Because brownfields typically have significant idiosyncrasies, traditional sales adjustment grid analysis may fail. Generally, these idiosyncrasies are overcome by the use of sufficiently large data sets such that parametric statistical inference methods may be used. Traditional sales adjustment grids are poor at quantifying large data sets. Hedonic modeling, a form of multiple regression analysis, is more commonly used and is one of the predominant analytical techniques. It is fundamentally part of the sales comparison approach, but uses regression methods to cure the flaws in a manual sales adjustment grid.

Marginal values of hedonic factors may be non-linear. For example, if demand for larger industrial properties in a market is greater than demand for smaller properties, then the value per-square-foot may increase with size. On the other hand, since excess land is nearly worthless to industrial sites, the value per-square-foot of the site may decrease rapidly after a certain optimal size. Hedonic modeling is also useful for dealing with this observed non-linearity in marginal values, a flaw of linearly determined matched pairs which becomes statistically troublesome when large adjustments are necessary.

Using a hedonic or other large-data-set statistical model, the value of a brownfield may be determined directly using a data set made up exclusively of recent comparable brownfield transactions. However, while this may be preferred in theory, in practice this technique is usually difficult due to a lack of recent comparable transactions. As such, a preferred method is to construct a hedonic model with both brownfield and non-brownfield properties. Included in the data set is a binary variable (equal to 1 or 0 — often called a "dummy" variable) which indicates whether the specific property in the data set is a brownfield transaction

[10] Robert Simons & Jesse Saginor, *A Meta-Analysis of the Effect of Environmental Contamination and Positive Amenities on Residential Real Estate Values*, Journal of Real Estate Research, forthcoming, 2006.

or not. In the resultant analysis, the coefficient on the binary variable measures the degree of discount applicable to the brownfield relative to the non-brownfield transactions. With this method, a robustly large data set can be constructed using only a few brownfield transactions. Further, this methodology allows the use of a single model to conform to both the "before" and "after" model outlined in Advisory Opinion 9.

The hedonic, multiple regression model is a significant improvement over the sales adjustment grid in several fundamental ways. For example, marginal prices are the adjustment factors in the grid and must be determined by some other means (e.g., matched pairs, trend analysis) before the grid can be constructed. However, these marginal prices are the output coefficients in the hedonic model, and are statistically determined using the pricing data from the comparables themselves. Second, the hedonic model allows for analysis of non-linear relationships between the explanatory variables and value, which is important since real estate values have consistently been shown to be non-linear in the academic literature. Also, in litigious matters, *Daubert* issues require that the model have characterizable statistical qualities, such as confidence intervals and error rates. Hedonic model statistical properties may be directly measured. However, sales adjustment grids do not have such well-defined statistical properties.

Shortcomings of regression techniques include non-linearity of both the data and real estate values, assumptions about the statistical behavior of non-explained and idiosyncratic factors, and model specification. Techniques exist for dealing with all of these, but their use requires an advanced level of training and sophistication regarding econometric models.

Figure 4
Simple Hedonic Model - Land Sale Equation

Ln(Value per acre) = $\alpha + \beta_1$ X (time since sale) + β_2 X (1 if Brownfield, 0 if Clean) + ϵ

Notes: This simple hedonic model only uses two explanatory variables — time since sale and a "dummy" indicating if the comparable sale is a brownfield or not. The dependent variable (value per acre) comes into the equation as a natural logarithm to accommodate the known non-linearity in real estate values. The hedonic equation takes on what is commonly called a semi-log-form (only the dependent variable uses a logarithm function) indicating that the analysis assumes linearity in the explanatory variables. More complex hedonic models frequently use a log-log form, in which all variables come into the equation as logarithms.

The first explanatory variable, alpha (α), represents the base value of clean real estate as-of today. The second set of terms, beta-sub-1 (β_1) times the time since sale, is analogous to the market conditions adjustment in the sales adjustment grid. Since the comparables will probably have been in the past, the time since sale will be a positive number and the coefficient (β_2) will represent the rise in prices over time. If "time since sale" is measured in days, then β_2 will also represent a daily factor.

The third explanatory variable, beta-sub-2 (β_2) times a dummy variable equal to 1 if the property is a brownfield and zero otherwise, represents the stigma loss imposed by the market for known brownfields. In this equation, it will be reported as a negative dollar amount per acre.

The final term on the right side, epsilon (ϵ) is an error term which contains all of the idiosyncratic variation in prices not explained by the rest of the equation. Since the equation is an ordinary least squares linear regression, one underlying assumption is that epsilon is normally distributed with a mean of zero and a standard deviation of one. Since this assumption is usually not true in real estate hedonics, certain econometric accommodations need to be made in practice to account for the non-normalcy and other less desirable properties of epsilon.

[4] The Cost Approach

[a] Often Inadequate for Brownfields Due to Stigma

For older properties or those with substantial disamenities, such as brownfields, cost approach techniques to establish value may not properly account for these disamenities or may require substantial unquantified adjustments.

The cost approach provided one of the early signals of the existence of stigma. Prior to the early 1990s, appraisers considered that the market value of a contaminated site was the unimpaired value less the cost of remediation. In the case where remediation costs were known with certainty, or where remediation was complete (and hence remediation costs equaled zero), the cost-less-depreciation calculation should result in a reasonable approximation of observed prices in the market. However, appraisers observed that actual prices of contaminated sites, both pre- and post-remediation, were lower than this simple cost calculation predicted. This phenomenon lead observers to realize that other risk factors were at work, which they labeled as stigma.[11]

As described in Section 29.01, the basic method for the cost approach is to determine the value of the land as if vacant and as if ready for development for its highest and best use, add to this the replacement or reproduction cost of the improvements as if new, and deduct for obsolescence (physical depreciation, functional obsolescence, and economic or external obsolescence).

Typically, the land value is determined via a sales comparison approach. In

[11] Bill Mundy, *Stigma and Value*, The Appraisal Journal, 1992, at 7-13; Peter J. Patchin, *Contaminated Properties — Stigma Revisited*, The Appraisal Journal, 1991 at 167-172.

brownfield valuation, contamination problems and stigma are frequently more of a problem for land value than for improvements value. Indeed, in many unremediated situations, the property will have a positive "value in use" even though the land, if vacant, may have a negative "market value" as a result of the present value of future remediation costs and inherent stigma. Properly accounting for this requires estimation of not only the engineering costs to remediate but also the long-term stigma effects and parsing those costs between the land and the improvements.

[b] Estimating Stigma Impacts

Stigma impacts may be estimated using the techniques outlined in the preceding § 29.04[3], The Sales Adjustment Approach. Survey research has proven very useful for determining land discounts. Comparables of impaired raw land sales — either nearby analyzed via a matched pairs model or at a distance discovered by meta-analysis of national comparables, case studies, or academic studies — may also prove useful. Generally, though, some type of large-scale data land base will be the best, if data is available, and some large-scale statistical analysis, such as hedonic modeling, will prove to be the most reliable.

Often in brownfield situations, the improvements have no contributory value to the "as if remediated" market value. The improvements may have continued "value in use" until remediation begins, either from net rents received from tenants (typically at lower-than-market rates with higher-than-market expenses) or from use by an owner-occupant. However, site remediation often requires demolition of the improvements. Also, improvements in brownfield situations are frequently physically depreciated or functionally obsolete to the point where salvage is not economically viable. Finally, even if the improvements can remain in place during remediation, the process may require a period of time where the improvements are unoccupiable and ownership entails cash out-flows to cover fixed costs with no rents incoming. This period of negative net-present-value must be accounted for in the cost approach as a functional or economic disutility, and constitutes one of the mechanisms whereby stigma impacts the improvements, even when those improvements themselves are not physically damaged by the contamination.

Contamination that does impact the improvements may do so in several different ways. The physical structures may be impacted and not remediable. In this situation, the improvements may either be useable for a period of time or wholly unusable. In both of these cases, the physical depreciation — which will be all or nearly all of the current value of the improvements — should also include the cost of demolition. The result of this exercise may be a negative current value for the improvements, even though those improvements are currently rented at a positive net operating income. However, the negative value may be the optimum interim solution for the property, given that alternative solutions (e.g., immediate demolition) may have an inferior net present value.

Contamination that impacts the improvements may also be remediable. In this case, the cost of the remediation constitutes a curable physical depreciation item. However, the impact of the contamination and/or the remediation itself may result in certain incurable physical depreciation items as well. An example of this would be stress and strain on structural elements or exposure to the weather which shortens the expected life of the physical structure. Usually, this foreshortening can be physically determined by an architect or structural engineer and the value impact estimated as part of the appraisal process through a present-value calculation.

Incurable physical depreciation is just one component of stigma impacting the structure. Additionally, stigma — even post-remediation — impacts the overall utility, compared with other non-impacted structures, as shown in surveys of landlords and tenants over the years. A percentage-of-value adjustment can be made as part of the economic depreciation component of the cost approach.

A brownfield's value may be impacted by contamination which is totally external — a situation often referred to as proximate stigma. An example would be a property which is impacted by odors or fumes from a facility next door. In this case, the negative impact on value should be determined and accounted for in the cost approach as external obsolescence. For example, the degree of diminished present value of future rents can be used, taking into account the increased risk and horizon for diminished growth in out-years, manifested in the increased discount and/or capitalization rate.

Practice Note

Remediation of a contaminated site may seem to necessitate demolition of otherwise useable improvements, such as warehouses or industrial buildings. Remediation which leaves these buildings in place may at first appear to be more expensive. However, a cost-benefit analysis, between the engineering team and the valuation team, may reveal a net benefit to a non-destructive remediation. For example, many communities have used old warehouses for residential or mixed-uses. Adaptive re-use of these structures may be more economical than demolition and re-building, may take advantage of larger footprints than would currently be allowed (under current zoning or comprehensive plans) and may qualify for historic preservations credits or other tax advantages. Hence, the valuation component of brownfield redevelopment suggests a multi-faceted approach as early as possible in the brownfield rehabilitation process.

Figure 5
Simple Cost Approach Analysis

Land Value (as if clean)		
10.0 Acres		
$100,000 per acre (using uncontaminated comps)	$1,000,000	
Stigma Impact:		
25% to Land Alone, assuming remediation completed	-250,000	
Net Land value		$750,000
Improvements (as if new)		
100,000 square feet		
$65.00 per square foot		6,500,000
Depreciation/Obsolescence		
Physical - via age/life		
25 year old building, average condition = 50%	-3,250,000	
Functional: Loss of usability during remediation phase	-1,000,000	
Economic: Residual stigma to building post-remediation	-650,000	
Net Depreciation		-4,900,000
Value Indicated via cost approach		$2,350,000

Assumptions in this model: A brownfield site ready for immediate remediation. The building, with average upkeep, is about half-way through its economically expected lifespan. The building cannot be occupied during the remediation, but will have a holding cost, including additional depreciation, of $1,000,000 during that period. Post-remediation, the land will suffer a 25% stigma loss and the building will suffer a 10% stigma loss. Stigma losses are determined from case studies, survey research, and other similarly acceptable methods.

What is the pre-remediation stigma for this property? In the uncontaminated state, the property would be worth the sum of the land and building "as-if-new" minus the physical depreciation, which totals $4,250,000. Hence, the total pre-remediation stigma is $1,900,000, or about 45% of the otherwise unimpaired value. The post-remediation stigma is $900,000, or about 21% of the otherwise unimpaired value.

[5] The Income Approach

[a] Direct Capitalization and Discounted Cash Flow

Most income producing property is purchased on the basis of the present value of future benefits, typically cash flows. There are two common sets of methods for determining present value: direct capitalization (DC) and discounted cash flow (DCF). The former presumes that benefits (cash flows) will occur as a perpetuity. DCF is more flexible, allowing for differential cash flows in different periods.

Brownfields have reduced — or even negative — cash flows and increased capitalization or discount rates. The remainder of this section discusses methods for estimating cash flows and capitalization or discount rates in brownfield analysis.

[b] Net Operating Income

In either DC or DCF analysis, the base cash flow to be discounted or capitalized is net operating income (NOI). This is a proxy for expected cash flows from the assets, pre-debt-service, and includes typical cash income (without accounting for depreciation) and also a factor for replacement reserves. Forward looking NOI includes a provision for anticipated vacancy and collection problems, even if the property has been fully rented in the past.

[c] Adjusted Funds from Operations

When analyzing a portfolio of properties, the cash-flow proxy is funds from operations (FFO). In recent years, in response both to accounting regulations as well as demands by the investment community to better integrate valuation metrics with accounting metrics, the measure of choice has been adjusted funds from operations (AFFO). AFFO begins with net income, as defined by the Generally Accepted Accounting Principles (GAAP), and adds back factors for debt service and depreciation but deducts a factor for replacements accrual.

[d] Future Cash Flows

DCF analysis is the most flexible method for analyzing future cash flows or other cash-equivalent benefits. Future flows are discounted to the present at a rate of return commensurate with investor requirements. In the unimpaired condition, the discount rate or rates may either be required equity returns (equity dividend rates) or a weighted average cost of capital (WACC) which is risk-adjusted to reflect expected asset risk. Hence, discount rates usually vary for particular sub-classes of real estate (e.g., retail, hospitality, apartments, industrial, office, etc.) according to market risk expectations and core required rates of return.

[e] The Advantages of Discounted Cash Flow Analysis

In brownfield situations, DCF analysis provides the flexibility to deal with time-varying cash flows. DCF analysis also has the advantage of allowing for direct estimation of the internal rate of return on a project — usually a key metric for brownfield investors. As stated above, the IRR is simply the discount rate at which the sum of the present values of the net cash inflows and outflows, including the purchase price, equal zero. Thus, for a target IRR, the investment solution can be arrived at by simply discounting the future cash in-flows and outflows at the target rate. The net present value, discounted at the IRR, is the investment value.

One shortcoming of DCF analysis arises when the process is used to estimate

IRR at a given investment value, and the periodic cash flow changes from positive to negative several times during the ownership period. This is a fairly common occurrence, when a property with current positive cash flow is acquired, but remediation requiring cash outflows is anticipated after one or more periods of positive returns. After remediation, the property will return to positive returns. IRR analysis under those circumstances may produce multiple results, only one of which is the actual IRR and the others are spurious. In those situations, additional research is necessary to determine which result is the actual IRR.

DCF analysis also provides an excellent platform for sensitivity analysis. For example, using DCF analysis, the net present value (any positive returns over and above the required IRR) can be easily partitioned among operating cash flows and residual returns (returns enjoyed upon sale or conversion of the brownfield in out-years). Additionally, with the use of electronic spreadsheet programs or proprietary DCF software packages, the analyst can perform sophisticated "what-if" analyses to estimate probabilities of less-than-desirable outcomes. Investors acquiring multiple brownfields in a portfolio can use these tools to optimally schedule cash flows, minimize debt requirements, and estimate opportunities for minimization of overall portfolio risk through amelioration of idiosyncratic risk inherent in individual portfolio components.

[f] The "Cap Rate"

Value via direct capitalization (DC) is simply the ratio of net operating income (NOI) to a capitalization rate, often called "cap rate" for short. A mandatory assumption of DC is that cash flows are a constant perpetuity or are changing at a constant rate, which is frequently not the situation in pre-remediation brownfields but may be a reasonable assumption in some post-remediation situations. Also, as is inherent in any perpetuity analysis, the use of a single cap rate limits the analytical ability to do multi-period sensitivity analyses.

In practice, in non-brownfield situations, the cap rate is estimated by observing the ratio of NOI to sales price for comparable transactions. In brownfield situations, however, lack of comparable data will encumber empirical estimation of the cap rate. In those cases, the cap rate may be imputed in a number of ways. Cap rates on uncontaminated properties may be scaled up by a risk-adjustment factor in a manner consistent with corporate finance formulation of risk adjusted discount rates. For example, in many situations the risk-adjustment factor can be proxied by the premium between investment-grade bonds and high-yield "junk" debt. Also, mathematically, the cap rate is the difference between required rates of return on projects of equivalent risk levels minus then anticipated periodic growth rate in cash flows (NOI). As a result, if required IRRs can be determined from investor surveys, then cap rates may be inferred for perpetuity cash flows.

[g] Options Valuation Models

Either DC or DCF analysis of a brownfield assumes a single known remediation or redevelopment plan for the property. In practice, however, remediation plans may not be fully known or knowable and, as of the time of the valuation, only a set of alternatives are available. In such situations, an options valuation model may be useful, combining several DC or DCF analyses along with a probability estimate for each. Notably, some of the options may have different discount rates as some options may require different levels of debt (assuming debt carries a different rate than equity). Options pricing provides a handy method to apply the tools of DCF analysis to contaminated raw land, as is frequently the case in brownfield situations. Options pricing models provide the mechanism to deal with multiple potential outcomes from the remediation as well as multi-tiered remediation levels.[12]

Figure 6
Example of a Discounted Cash Flow Analysis

Assumptions:

A brownfield is currently available for investment at a price to be determined. The property will have no income during the remediation period, but will have holding costs of $100,000 per year (e.g. — taxes, insurance, management, legal). Remediation costs are estimated at $250,000 the first year and $1,000,000 each of years 2 and 3 (assume remediation costs are to be funded at the beginning of each year). At the end of year 3, the site can be sold for an estimated $6,000,000. Investors require a 20% return on their investments, and forward-period outflows may be discounted at a certainty-equivalent rate of 6%.

Period	Cash out-flow	Present Value Factor	Present Value
0	-350,000	1.0	-350,000
1	-1,100,000	$(1/1.06)^1=0.9434$	-1,037,740
2	-1,100,000	$(1/1.06)^2=0.8900$	-979,000
3	+6,000,000	$(1/1.20)^3=0.5787$	+3,472,200
		Net Present Value:	$1,105,460

Figure 7
Direct Capitalization of a Remediated Brownfield

Assumptions:

A brownfield site continues to suffer from persistent stigma in two forms. First, net

[12] George Lentz & K.S.M. Tse, *An Options Pricing Approach to the Valuation of Real Estate Contaminated by Hazardous Materials*, Journal of Real Estate Finance and Economics, 1995, 121-44.

operating income is diminished by 10% compared to comparable but never contaminated sites as a result of ongoing monitoring and testing costs as well as increased legal and management costs. Second, similar but never contaminated sites have cap rates in the range of 7%, but case studies indicate that remediated brownfield cap rates are about 2% higher, to accommodate increased risk and decreased marketability.

NOI for a comparable but uncontaminated site would be $1,200,000 per year.

$$Value = \frac{1{,}200{,}000\ X\ 0.90}{0.07 + 0.02} = \$12{,}000{,}000$$

If never contaminated, the value of the site would have been:

$$Value = \frac{1{,}200{,}000}{0.07} = \$17{,}143{,}000 \quad (rounded)$$

Hence, the post-remediation stigma loss suffered by the property is:

$$stigma = \frac{17{,}143{,}000 - 12{,}000{,}000}{17{,}143{,}000} = 30\%$$

[6] Reconciliation of Value Estimates

Appraisal practice makes no explicit assumptions that multiple approaches to value will arrive at the same solutions. In the reconciliation phase of the analysis, the appraiser makes a determination of the quality of the available data used in each approach, the reliability of the assumptions implicit in each approach, and the common methodology used by practitioners and investors in the market place. The reconciled value may be a weighted-average of the results of the various approaches, or in fact the appraiser may place no weight at all on a given approach.

In general, for income producing property, the various income approach methods are given the greatest weight because they more closely represent the decision-making processes of potential investors. DCF analysis may also be used for raw land when the cash flows are known and there is a reliable measure of required IRRs for similar investments.

The sales comparison approach methods are typically given the greatest weight in raw land analyses, unless the cash flows are known with a reasonable degree of certainty. While land values vary widely from one location to another, matched pairs or hedonic modeling can typically provide a good location adjustment, so that brownfield transactions outside of the immediate area can be used as comparables.

Due to the large adjustments for various components of obsolescence, cost approach methodologies are usually viewed as the least reliable. However, for special purpose properties, such as public facilities and power plants, or other properties for which good sales comparison or income data is unavailable, the cost approach may in fact be the most reliable of the three.

§ 29.05 Time Characteristics of Brownfield Stigma

[1] Stigma Is Particularly Persistent and Long-Lived

Observers had theorized that post-remediation stigma would ameliorate over time.[13] Their purpose in this was to stimulate thinking into best practices for determining either risk-adjusted discount rates or cap rates over time if stigma was in fact changing. Since that time, other authors have explored the temporal characteristics of stigma. While it has been theorized that stigma might quickly ameliorate after remediation or after the announcement of a contamination event, recent empirical studies indicate that stigma is particularly persistent and long-lived.[14]

[2] Pre-remediation Stigma

Pre-remediation, stigma may arise either from a long-lived and well-known circumstance or from an event — or the revelation of an event — which impacts market behavior with respect to the value of the brownfield.

In the case of a long-lived event, the impact of the stigma over time may be manifested in either or both of two different ways. One way is for the value at any point in time to be lower than comparable unaffected properties but growing at the same rate over time. The differential value at any point in time can be measured via some cross-sectional (e.g., sales comparison type) modeling. Also in this condition, the cap rate for the brownfield is the same as for non-brownfields but with the addition of a factor for risk. The projected NOI may or may not be the same as for an uncontaminated site.

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[13] *See* Bill Mundy, *The Impact of Hazardous Materials on Property Value: Revisited,* The Appraisal Journal, 1992, at 463-471; Peter J. Patchin, *Contaminated Properties — Stigma Revisited,* The Appraisal Journal, 1991 at 167-172.

[14] Kimberly, Winson-Geideman, *The Effects of Contamination on Post-Remediation Residential Property Values* (Cleveland: Cleveland State University Doctoral Dissertation, 2003).

The other way would be value at a lower point at any point in time and also growing at a lower rate. In that case, the cap rate not only has an additional factor for risk but also an additional factor for lower growth. Empirically, these two additional factors are frequently combined into one.

In either circumstance, the aggregate impact to the property is measured via some present value exercise. However, the long-term modeling is necessary to show that the long-term present value modeling has reasonably consistent behavior into the future.

In an event or the revelation of an event, the value differential is measurable at a specific point in time. This measurement is frequently important in litigation. However, real estate markets are significantly inefficient, and so the full impact on the value of a brownfield by a contamination event may "leak" into the market prior to the event and may not be fully captured by the market until well after the event.

In an event-type circumstance, the challenge of the analysis is to measure value well before and well-after the event. The difference between these two, after accounting for systematic price-level changes, is the impact of the contamination event. The systematic price-level changes, and the price-level trends before and after the event, can be easily and simply determined by creating a long-term value index for the market, via a repeat sales index or other trend analysis. Note that such indices are compounded, so extracting short-term trends requires a geometric mean rather than an arithmetic average.

[3] Post-remediation Stigma

Post-remediation, stigma may ameliorate over time. However, empirical research has shown that this time frame is quite long.

If stigma ameliorates over time, then why doesn't the present value immediately after the remediation capture the positive impacts of this amelioration? It does, but only in a risk-adjusted way. In the absence of possible amelioration, values would actually be lower. The value captures the future possibility of amelioration, discounted at a risk-adjusted rate to accommodate the unknown and unknowable amelioration patterns. Hence, attempts to theoretically impose a probable or possible amelioration pattern run counter to actual empirical market information, which already captures the possibility of amelioration over time.

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The Cleanup and Redevelopment of Contaminated Land

VOLUME 1A

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MATTHEW BENDER

CHAPTER 29

Valuation of Brownfields Properties

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SCOPE

This chapter examines the valuation considerations for brownfields and other contaminated real estate, including issues such as stigma, appraisal standards and methods, and incorporates the impacts of the 2002 Brownfields Amendments on valuation practice. Additionally, this chapter presents examples of value-added opportunities in brownfield development, with a focus on aiding the brownfield investor, developer, or attorney with useful tools in the brownfield finance arena.

The basic valuation paradigm for brownfields was summarized by the Appraisal Standards Board in its Advisory Opinion 9, issued in October, 2002. The process begins with an estimate of the value of the property in the "as if uncontaminated" condition, and then uses this as the launch pad for an estimate of the "as-is contaminated" value. Traditional appraisal methods may be used (e.g., sales comparison, income capitalization) but with the necessity of somewhat more advanced techniques (e.g., hedonic modeling, survey research, options models, academic and practitioner case studies). Application of a rigorous, methodical process provides opportunities to carefully analyze the value-enhancing aspects of brownfield redevelopment, and to recognize the opportunities for significant "ramp-up" in market value.

There is widespread agreement that the cost approach to value is found wanting if no consideration is given to the impact of stigma. Stigma is the term of art in appraisal applied to the disruption in market value, caused by an impairment such as contamination, which is over and above the engineering costs of remediation. As such, remediation can and often does persist after

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brownfield remediation is completed. Stigma arises from both a change in the income stream or usability of the property as well as a change in marketability. While generally accepted appraisal methods are usually good at accounting for both stigma and remediation costs as of a point in time, stigma may change over time, and various longitudinal models, such as repeat sales analysis, are necessary to estimate these changes over time. Recognition of stigma-related phenomena in brownfields and understanding of the ways to ameliorate stigma are key to many of the value-enhancing opportunities.

SYNOPSIS

§ 29.01 Appraisal Standards and Overview of Basic Valuation Methods

Real estate appraisal must adhere to a widely accepted set of standards and peer-reviewed methodologies. This is particularly the case in contentious situations or situations which are potentially or actually litigious. This section provides a brief overview of those standards and methods. Subsequent sections deal with more detailed applications in the valuation of contaminated or remediated real estate.

[1] There Are Regulatory Standards That Are Generally Applicable to Real Estate Appraisals

The governing paradigm for property valuation in the United States is the Uniform Standards of Professional Appraisal Practice (USPAP), which has been adopted by law or regulation throughout the United States. USPAP is produced by the Appraisal Standards Board (ASB), a part of the federally chartered Appraisal Foundation (AF), headquartered in Washington, DC. Appraisers are licensed or certified by individual states with requirements set forth by the Appraisal Qualifications Board (AQB), also part of the AF.

Real estate valuation in litigation matters has generally been held by the courts to be admissible in evidence under the requirements established in *Daubert v. Merrell Dow Pharmaceuticals*[1] only if it conforms to USPAP standards. In *Daubert,* the U.S. Supreme Court set out four nonexclusive factors for courts to consider when determining whether expert testimony is reliable:

(1) whether the theory or technique propounded by the expert has been or could be tested;

(2) whether the theory or technique has been subject to peer review or publication;

(3) the known or potential rate of error; and

(4) the general acceptance of the technique by the relevant community of experts.

Note that compliance with USPAP is not a sufficient condition for passing the *Daubert* hurdle, but is a necessary one. Note also that the necessity of compliance

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[1] 509 U.S. 579, 113 S. Ct. 2786, 125 L. Ed. 2d 469 (1993). *See also* Kumho Tire Co. Ltd. v. Carmichael, 526 U.S. 137, 119 S. Ct. 1167, 143 L. Ed. 2d 238 (1999).

with these universally accepted standards has also been held in "*Frye* states." The rule in *Frye v. United States*[2] that scientific evidence is admissible only where it is "sufficiently established to have gained general acceptance in the particular field,"[3] rejected by some courts as overly strict,[4] is still observed in some states.[5]

Adherence to USPAP is required for all federally regulated real estate lending, under Title XI of the Financial Institutions Reform Recovery and Enforcement Act (FIRREA) and is generally required by laws or regulations of the various states for other types of appraisal. Supplemental standards may also apply in other types of appraisal situations. For example, federally funded land acquisition, such as for highway construction, must also adhere to the Interagency Land Acquisition Standards.[6]

The "Guidance for Valuation of Contaminated Property" was issued by the ASB in 2002 in the form of USPAP Advisory Opinion 9, which provides technical assistance to appraisers and which has been widely accepted as useful guidance by the courts.[7]

[2] There Are Established Appraisal Methodologies

Appraisal methodologies are generally categorized into three approaches: the Sales Comparison Approach, the Income Approach, and the Cost Approach. USPAP provides substantial leeway for appraisers to choose methodologies within one or more of these approaches which are deemed applicable in a given situation. A thorough understanding of these leads to Value-Creation Opportunities, which are innovative ways of finding hidden values in brownfields. All of these approaches are discussed below.

Practice Note

Value creation opportunities in brownfields redevelopment primarily come from two sources: reduction of stigma through remediation and adaptive re-use. The former results in value creation through the reduction of risk and uncertainty attached to the brownfield value prior to remediation. The latter comes from improving the use of the site from a lower-value use (e.g., exhausted industrial)

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[2] 293 F. 1013, 54 App. D.C. 46 (D.C. Cir. 1923).

[3] 293 F. at 1014 (D.C. Cir. 1923).

[4] *See, e.g.,* United States v. Downing, 753 F.2d 1224 (3d Cir. 1985); *In re* Agent Orange Product Liability Litigation, 611 F. Supp. 1223 (E.D.N.Y. 1985), *aff'd,* 818 F.2d 187 (2d Cir. 1987); State v. Walstad, 119 Wis. 2d 483, 351 N.W.2d 469 (1984).

[5] *See* John A. Kilpatrick, *Daubert Raises It's Ugly Head Again*, ABA Inhouse Counsel Committee Newsletter, Feb. 2003; Dave McLean, Bill Mundy, and John A. Kilpatrick, *Summation of Evidentiary Rules*, Real Estate Issues, Fall 1999.

[6] *Uniform Appraisal Standards for Federal Land Acquisition* (Chicago: Appraisal Institute under authority of the U.S. Dept. of Justice and the U.S. Interagency Land Acquisition Conference, 2000).

[7] Advisory Opinion 9 can be found at http://commerce.appraisalfoundation.org/html/USPAP2005/ao9.htm.

to a higher use (e.g., inner city housing or commercial). While there are certainly other profit opportunities in brownfields, these two are typically the most promising.

Appraisal data are gathered and methodologies applied within the rubric of an applicable definition of value. The most common definition of value used in the United States is commonly called "*market value*," and presumes arms-length transactions between knowledgeable market participants acting prudently and in their own best interests. This definition also explicitly assumes that the transaction is conducted in U.S. dollars (or is adjusted for their equivalent) and is not influenced by any special financing arrangements. Similar definitions may be specified in litigation by state law or model jury instructions. Also, the Interagency Land Acquisition Standards proffer a similar definition. Appraisals may also be conducted at other valuation standards, such as foreclosure value, which would require different data and methodologies. Finally, data gathering and methodological choice are also influenced by the interests to be appraised (e.g., fee simple interest, minority partial interest).

Market value is always estimated under the assumption that the property is utilized or is to be utilized at its "*highest and best use*." This is usually defined as the single maximally productive use from among the set of potential uses which are financially feasible, physically possible, and legally permissible for the site.

[3] The Sales Comparison Approach Analyzes Transactions of Properties That Have Several Comparable Elements

This approach includes all of those methodologies in which the value of a subject property is determined by comparing the characteristics of that property to other comparable properties which have recently transacted. While there are many definitions of "comparability," it is generally accepted that the data be comparable in terms of conditions of sale, market conditions, interests transacted, financing terms, and physical characteristics.

[a] Conditions of Sale

Conditions of sale include such factors as arms-length transactions, distress sale transactions, agglomeration transactions, or foreclosure transactions, to list a few. Market value appraisals generally require comparables which are arms-length transactions. If no such transactions are available, then the appraiser will need to adjust the sales prices to account for discounts or premiums paid under non-arms-length conditions.

Practice Note

Significant care must be taken by the appraiser when identifying brownfields comparables which frequently are not arms-length transactions. For example, many brownfields sellers are distressed, in or near bankruptcy, or the subject of foreclosure or regulatory action.

On the other hand, this offers significant investment opportunities for brownfield developers. Valuation of a prospective brownfield acquisition should take into account the potential for such distress-sale discounts.

[b] Market Conditions

Market conditions adjustments account for changing market conditions over time. Comparable data from the past may need to be adjusted for systematic price level changes. Market conditions adjustments are fairly common in rapidly moving markets, and may be estimated by such techniques as matched pairs, trend analysis, or time-series studies.

Matched-pairs are comparisons of sales of two or more comparable properties which differ only by the factor being analyzed. The difference between the sales prices should approximate the marginal value of the factor. For example, if two properties, identical in all respects, sell exactly one year apart, then the difference in the sales price, as a percentage, should indicate the systematic annual change in market prices—the market conditions adjustment.

Similarly, a *trend analysis* allows for the comparison of many similar property sales over time. Simple trend-analysis software allows for the determination of periodic market trends.

Finally, more sophisticated *time-series studies*, such as time-series regression, allow for non-comparable properties to be analyzed over a time-span to extract the marginal value change over that time-span.

Studies have shown that contaminated and uncontaminated properties have different value trends over time, and this should be taken into consideration when using uncontaminated comparables to value a brownfield. For example, in a market where uncontaminated properties are growing in value at some positive rate (say, 5% per year), the value trend of unremediated brownfields may be flat or in some cases even negative over time.

[c] Interests Transacted

If a fee-simple interest is being determined, and comparable data is for minority, non-controlling, or limited market interests, then adjustments may be necessary to account for the discount inherent in those transactions. However, when fee-simple transactions are being used to estimate the value of a partial interest, appraisers typically value the whole property via various approaches and then apply an estimate of a partial-interest discount to this estimate of the whole. Brownfields transactions frequently require assumptions of restrictions or covenants which imply interests other than fee simple or its equivalent.

[d] Financing Terms

Market value appraisals assume cash transactions denominated in dollars. If comparable transactions included favorable financing, or were subject to an assumption of less-than-favorable financing, then appropriate cash-equivalency adjustments are necessary. Brownfields are typically subject to financing constraints not experienced with other properties. Thus, use of brownfield comparables to estimate market value of uncontaminated properties should consider this issue.

[e] Physical Characteristics of the Properties

Physical characteristics include property size, structural characteristics, age, depreciation, etc. Adjustments are usually not linear, since most characteristics entail diminishing marginal utility. For example, a particular industrial use for a site may require 25 acres. Comparable sites used in the analysis vary in size from 25 acres (the minimum needed) up to 35 acres. Upon close analysis, it is found that the first 25 acres contribute full value to the overall property, but additional acreage above 25 contributes significantly lower value, to the point where the 34th and 35th acre of comparables that size contribute almost no value at all to the overall property. Adjustments are made to determine equivalent utility, and thus must take into account the substitutability of many physical and functional components of comparables and the subject property.

Practice Note

Diminishing marginal returns for site size—sometimes referred to as *plattage*—provides an excellent opportunity to extract hidden values from an adaptive re-use of an industrial site with excess land. Often, the additional land is nearly valueless, since it contributed little to the former utilization of the site. However, in adaptive re-use situations, this may not be the case. For example, a site may be subdivided, with the extra portion adapted for some other use. This hidden value can be substantial, depending on the specifics of the adaptive re-use.

[f] Sales Comparison Methodologies

Sales comparison methodologies include the traditional sales adjustment grid (the most common for financing appraisals), cross-sectional hedonic models, survey research, time-series (longitudinal) statistical models, matched-pairs analysis, repeat sales analysis, and meta-analysis of case studies and comparable transaction data bases. Statistical models of large-scale appraisals (mass appraisals) are often referred to as automated valuation models, and are commonly used in tax assessment and class-action litigation.

Cross-sectional hedonic models are multiple regression models which use data from two different sources (for instance, a contaminated area versus a non-contaminated area) to measure the marginal value difference between those two sources.

Repeat sales analysis involves comparing two different sales of the same property on different dates. If the property has not physically changed during the time between the two sales (a matter for empirical investigation) and both sales are arms-length transactions under similar conditions, then the pricing difference gives a good indication of market trends. Conversely, if market conditions trends are known, the repeat sales model can be used to extract other pricing information, such as the marginal value of any changes to the property or other conditions.

Meta-analysis of case studies is a qualitative compiliation of data from a variety of disparate but similar sources, such as a review of academic literature on brownfields, to infer a range of value from similiar situations.

[4] The Income Approach Uses Established Methods for Appraising Income-Producing Properties

Income producing property is usually transacted at a price determined by the discounted present value of future cash flows. Appraisals of income-producing properties usually take into account one or more income approach methodologies, such as the discounted cash flow model, direct capitalization, or a gross rent multiplier.

[a] Discounted Cash Flow Models

Discounted cash flow (DCF) models take into account the anticipated periodic cash flows in each future period. This method is best used when there are a finite number of periods and cash flow is expected to vary from period to period. When the number of periods cannot be determined, the appraiser may assume a terminal value at some point in the future, say ten years, and estimate that terminal value using some anticipated perpetuity cash flow (i.e., the assumption of a cash flow in perpetuity) and a terminal capitalization rate (see § 29.04[3][b] below).

Discount rates are determined by examining the internal rate of return (IRR) for comparable projects or properties. The IRR is simply the discount rate at which the sum of the present values of the net cash inflows and outflows, including the purchase price, equal zero. Extraction of IRRs from the net present value of comparables is subject to the complexity that projects with multiple sign-changes in cash flows (negative flows in some periods, positive in others). There will be multiple solutions to the IRR equation. However, for brownfield remediation situations, the DCF model best approximates the behavior of investors. Typically, real estate investors seek out projects which achieve or exceed some minimum risk-adjusted required rate of return. The DCF model is favored for measuring this. (See the example of a DCF analysis in § 29.04[5][g] below.)

Practice Note

The DCF is the primary model used when developing feasibility studies or business plans for proposed investments. It has the advantage of being consistent with other types of asset analysis (e.g., portfolio analysis) and directly measures or uses important metrics, such as required rates of return, net present value, and residual value. In addition, DCF analysis allows for realistic sensitivity analyses, particularly testing for changes in remediation time assumptions, so that investors may look at "what-if" scenarios with confidence.

Sensitivity analysis allows for a measure of how the value of the project is affected by slight changes in key variables. For example, the value of an income producing property depends on certain assumptions about the rate of return, which is an input into the discounted cash flow analysis. What if these assumptions are wrong? By what percentage does the value change if the rate-of-return is, say, one percentage point higher or one percentage point lower? The valuation analysis is a point-estimate, and so does not easily accomodate such a sensitivity analysis. However, a robust feasiblity study should include some tests of the sensitivity of the value estimate to such changes in key variables.

[b] Direct Capitalization

Direct capitalization assumes constant cash flows or constantly changing perpetual cash flows. The valuation model is a simple value-of-a-perpetuity, which is the ratio of the perpetual cash flows to an applicable capitalization (cap) rate. Cap rates may be derived in several ways. The most common is to analyze comparable transactions of income producing property with similar cash flow characteristics (constant or constantly changing perpetuities). The cap rates may be derived from the ratios of the single-period cash flow on each comparable property to its arms-length sale price. In the absence of such perpetuity comparables, appraisers may examine non-perpetuity transactions to extract IRRs and adjust those for the anticipated rate of change over time (cap rate equals IRR minus expected rate of change). In the absence of any market transaction comparables, the appraiser may estimate a cap rate through a band-of-investments technique (a weighted average of equity dividend rates and fully amortizing financing factors) or a built-up technique (real returns plus factors for risk and inflation). In any case, appraisal of contaminated property should use cap rates which include a factor for risk. Market-derived cap rates from non-contaminated properties should be adjusted upward to account for risk.

Figure 1
Example of a Cap Rate via a Band-of-Investments Method

Required Equity Cash-on-Cash Return	9.75%	
X Equity Percentage of Overall Funding	X 40%	0.0390
Interest Rate on Debt	8.75%	
Amortization Term of Debt	25 years	
Full Amortization Payment Factor, 0.0875 @ 300 months	0.098657	
X Debt Percentage of Overall Funding	X 60%	0.0592
Sum of the two (cap rate)		9.82%

Figure 2
Example of a Cap Rate via a Build-Up Method

		Note
Required Real Rate of Return, Risk-Free	4.0%	A
Inflation Adjustment Factor	3.5%	B
Real Estate Risk Factor	2.5%	C
Brownfield Risk Factor	5.0%	D
Indicated Cap Rate	15.0%	

Notes:

A: The base risk-free rate, often proxied by the short-term t-bill rate

B: The current annualized expected inflation rate

C: The market premium for investment-grade real estate, usually proxied by investment grade returns over the 10-year t-bill rate.

D: The risk factor for brownfields, often proxied by the spread between investment-grade bonds and high-yield "junk" bonds.

[c] Gross Rent Multipliers

Gross rent multipliers are applied in simple cases, such as rental apartments or rented single-family detached dwellings. This is a simplistic approach to value, and depends on a market estimate of the ratio of sales prices to monthly or annual rents. The gross rent multiplier technique is very useful both in unimpaired and impaired valuation situations. When valuing a brownfield, comparable rental property multipliers can be derived from market data and unimpaired multipliers can be compared to impaired ones to develop an indication of the market risk premium for impaired property. This market premium can then be useful in direct capitalization or discounted cash flow models, or may be directly applied to prospective brownfield rents to develop an indication of impaired or post-remediation value.

[d] Other Cash-Analysis Methods

Other cash-analysis methods, such as options pricing models, allow more flexibility in dealing with a probability distribution of future redevelopment opportunities.

Practice Note

Options pricing is widely used to value financial assets, particularly derivative instruments. While variants in options pricing have been used in real estate analysis for many years, only recently have specific real asset options pricing software tools become available, making the process easy and more straight forward. Options pricing is a variant on DCF and allows multiple potential scenarios to be valued simultaneously. Each scenario has a DCF-determined value, and then a probability is attached to each scenario. The sum of the probability-weighted DCF values is the value via the options pricing model. More complex models allow for such variants as Monte-Carlo simulation, interaction between scenarios, and sensitivity analysis. *Monte Carlo simulation* is a computerized, mathematical process that estimates the output of (or solution to) a model by randomly applying values (using statistical sampling techniques) in each variable of the model, during each repetition.

[5] The Cost Approach Analyzes the Cost of Land, Plus Replacement Costs, Less Various Obsolescence Factors

In the early part of the 20th Century, this was the prevalent method for valuing real estate in the United States, and is still widely used in other countries. Moreover, it is still used in the U.S., particularly for special purpose properties (such as public facilities, marinas, energy generating facilities, and refineries) and for properties without a regularly traded market. However, for other properties it is generally not favored compared to the other two approaches.

The cost approach generally begins with an estimate of the raw land value, typically derived from a sales comparison approach. To this, the appraiser adds the

(Text continued on page 29-13)

cost of either replacing or reproducing the utility of the improvements as if new, and from this deducts factors for physical, functional, or external (sometimes called economic) obsolescence. The result is the appraised value of the property using the cost approach.

[a] Physical Depreciation

Physical depreciation includes any wear-and-tear to the improvements, and may include both curable and incurable (permanent) physical obsolescence. On-site contamination and other impairment may constitute a physical impairment, either curable or incurable.

[b] Functional Obsolescence

Functional obsolescence estimates the diminution in value to the property resulting from a lack of typically expected components. For example, a tall building without an elevator would suffer from functional obsolesce. Older buildings without Americans with Disability Act accommodations would also suffer functional obsolescence. Brownfield properties are frequently older properties and suffer from functional problems along with contamination problems.

Practice Note

While it matters little in the final outcome, there is substantial confusion even among practicing appraisers over the difference between "physical" and "functional" obsolescence. In lay terms, "physical" obsolescence pertains to diminishment in value of that which is in place, while "functional" pertains to diminishment resulting from that *which is not there*. Environmental contamination on the property itself would be properly classified as physical obsolescence, while lack of some functionality (e.g., lack of usability of some of the improved space due to asbestos contamination) might also be present. Thus, a contaminated property may be both physically and functionally contaminated.

While the final value would be the same regardless of how this is classified, proper understanding and classification of the physical diminishment to the improvements is useful for recognizing value-enhancing opportunities in adaptive re-use. In the asbestos example, finding economically efficient ways to contain the asbestos may allow for use of formerly valueless space, hence providing a significant and inexpensive ramp-up in value.

[c] External or Economic Contamination

External contamination may result in external obsolescence. Additionally, remediated sites may suffer from long-term or permanent stigma, which is typically accounted for as economic obsolescence.

Practice Note

Some texts use "external" and "economic" depreciation synonymously, and most appraisers categorize such depreciation in the same fashion. In fact, these arise from two somewhat different phenomena. For example, on-site soil or groundwater contamination would result in "economic" depreciation of the property, while off-site environmental contamination, resulting in proximate stigma (e.g., being across the street from an air pollutant source) would be properly categorized as "external" depreciation. Stigma resulting from the former, economic, can be ameliorated, while the stigma resulting from the latter would be more problematic from a brownfield redevelopment perspective. In contaminated neighborhoods, such as old industrial parks or waterfront zones, individual properties may suffer from both types.

[6] Value-Creation Opportunities

[a] The Apparent Obstacles or Limitations Associated With the Potential Value of the Property Are Identified and Quantified

The difficulty in approaching brownfield sites using strict traditional real estate strategies lies in overlooking community value in a holistic site vicinity context. Like each "traditional parcel" of real estate, each brownfield site has unique attributes. However, brownfields have more distinct attributes in terms of societal health and community benefit. Divergent stakeholder objectives (i.e., those of buyer, seller, regulator, lender, community, etc.), for example, often lead to consternation regarding what constitutes an acceptable cleanup standard for a site. This situation often becomes fragmented because the future use of the brownfield site has not met with stakeholder consensus. Divergent perceptions of the value, standards, re-use, and costs regarding cleanup are also potential obstacles or limitations that can further detain the ability to obtain or identify cleanup funding sources. Many stakeholders also fear issues such as liability and exposure to risk instead of addressing these issues as integrated aspects of the site redevelopment and re-use process. In many cases, the process itself, including governmental acquisitions and dispositions, delay the transfer of brownfields sites. In short, all these issue have an economic component associated with them that needs to be identified and quantified, as well as their economic influences on other sites in that vicinity.

[b] Each Obstacle or Limitation Correlates to Each Other in an Integrated Context to Identify and Quantify the Catalysts Required to Create Potential Value for the Property

The challenge of expediting brownfield site transfer lies in integrating site cleanup and redevelopment. The value creation approach correlates each potential obstacle or limitation with cleanup cost reductions and public subsidies for community improvement. This integrated approach, beginning with a full site characterization, includes environmental, economic, market, demographic, community input, political climate, tax structure, and many other components. Stakeholders' alliances thereby have a context for accessing public capital, such as subsidies for infrastructure improvements, to attract market interest in the site. Property transfers are then completed more expediently, with the environmental issues being evaluated in the framework of all the real estate considerations required to achieve transfer. This approach also answers a key question: what has to be done to the real estate at a particular site and/or its surrounding sites to create high value and cost savings for achieving its transfer and re-use?

[c] The Benefits of Acquiring and Applying the Catalysts to Create Value for the Property Are Quantified and Justified

There are several major benefits associated with a value-creation approach to brownfield properties. One, real estate, not remediation, drives the property transfer and redevelopment process. Prospective sellers, buyers, regulators, community leaders, and other stakeholders collaborate on a fully integrated plan for remedy and re-use, including (as appropriate) institutional controls and end dates. Secondly, the value creation approach implements remedies that are compatible with the specific end uses of properties. Thirdly, the approach generates incentives for stakeholders to support each other in securing public funding and regulatory approvals for cleanup and redevelopment plans. In summary, value for a site is created by repositioning it to excite market interest. Brownfields financial incentives and infrastructure improvements can be leveraged for this purpose. Value is also increased by obtaining entitlements and permitted zoning uses. The approach includes working with municipalities on these issues to unlock value and attract end users and uses. The hard work comes into play when the value creation approach is applied to a project-specific opportunity. However, site transfer and transformation can be accomplished more readily by repositioning negative economic components of a property into an integrated context that will derive positive value.

§ 29.02 Scope of the Appraisal Analysis

[1] Changes Brought by USPAP 2006

Prior to the effective date of USPAP 2006, July 1, 2006, an appraisal analysis was considered "complete" if the appraiser used all relevant approaches to value and used both the mandatory and non-mandatory (i.e., "specific") USPAP rules. An appraiser could have chosen to perform a limited appraisal (one without all relevant approaches to value or which did not use certain specific, non-mandatory USPAP rules) by invoking what was called the "departure provision" of USPAP.

USPAP 2006 significantly rewrote and expanded the scope of work determination and reporting requirements. At the same time, USPAP 2006 eliminated the differentiation between a "complete" and "limited" appraisal analysis and also eliminated the departure provision. Thus, for appraisal analyses performed after July 1, 2006, and for reports dated after July 1, 2006, USPAP places a greater burden on the appraiser to carefully determine the appropriate scope of work needed to complete an assignment and to clearly delineate both that scope of work and the rationale for the scope decisions. In a brownfield valuation, due to the unique characteristics of the property, its utility, and the varying restrictions resulting from the contamination, this becomes much more important than in the past for producing a credible analysis and appraisal report.

[2] Factors That Determine the Scope of the Analysis

Factors to be considered in the scope of work decision, and explained in the report, include the nature of the client, the intended use and users of the information, the type and definition of value being applied (e.g., market value), the effective date of the analysis, and the relevant property characteristics. Scope of work decisions should be made with consideration both to the expectations of market participants (e.g., clients and other intended users) as well as the choices made by other appraisers in similar situations (e.g., peer reviewed literature on brownfield valuation).

[a] The Nature of the Client

The scope of work may be different for different clients. For example, federally regulated lenders typically place greater emphasis on the sales comparison approach to value while equity investors usually rely more heavily on discounted cash flow or direct capitalization. Survey research has shown that different investors require different assumptions about cash flow projection in the income approach.[8]

[b] The Intended Use of the Appraisal

If the intended use of an analysis is for investment or financing purposes, then

[8] *See, e.g.*, William Kinnard & Elaine Worzala, "Attitudes and policies of institutional investors and lenders towards on-site and nearby property contamination," available at www.rics.org/RICSWEB/getpage.aspx?p=hBfMN3AsKE2qULrd-dJ61Q.

a more rigorous development of certain factual issues may be necessary by the valuation analyst. On the other hand, a valuation prepared for litigation may rely on factual analyses (via explicitly expressed assumptions) developed by other experts (e.g., engineers, hydrologists, toxicologists, etc.). Further, the level of detail contained in the report may differ according to the anticipated users. For example, in a self-contained report for investors, the appraiser would be expected to develop a rigorous discussion of the nature of the contamination and other environmental conditions at the site and on surrounding properties, usually referencing or including reports by physical science experts. In a courtroom, however, the appraiser would rarely be expected to testify to the physical contamination attributes of the property, and instead would simply assume those matters of fact which were to be determined by the court.

As discussed below, a market value appraisal requires a robust development and explanation of the highest and best use. Other definitions of value (e.g., foreclosure value) may or may not require this analysis. However, highest and best use may be affected by the brownfield contamination, and so this may need to be addressed regardless of the definition of value used. The determination of the necessity and/or extent of the highest and best use analysis is part of the scope of work decision process. For example, a property with limited or special uses may require a less rigorous analysis. However, most value-enhancement opportunities for brownfield redevelopment require some adaptive re-use, including an improvement in the highest and best use. Hence, a detailed analysis and discussion of this aspect is necessary for a full understanding of the value implications and opportunities for a change in the use of the property.

§ 29.03 Implications for the Highest and Best Use (HBU) of the Property

[1] Analysis of the HBU Is Often Required

As noted previously, USPAP requires that all market value appraisal values be estimated assuming the highest and best use (HBU) of the property in question. Further, many jurisdictional definitions of value other than market value may still require an HBU analysis. Finally, many "as-is" appraisals, conducted without regard to HBU, may require an HBU analysis as a base-line for determination of the non-HBU use to which the property is currently placed.

[2] HBU Analysis Is Generally Conducted on the Basis of the Property as Vacant and As-Is-Improved

HBU analysis is generally conducted twice: once in the ideal condition assuming that the property is vacant and available for optimal development and once again in the "as-is-improved" condition. Any difference between the two should take into account costs of demolition and restoration of the property to the "ideal" (or near ideal) state.

[3] HBU Analysis in the Ideal State Can Yield Multiple Results

For a brownfield, the HBU analysis in the ideal state can arrive at multiple values, e.g., "vacant-and-never-contaminated," "vacant-and-remediated," "vacant-and-contaminated," along with varying values at varying degrees of contamination. All of these invoke one or more hypothetical conditions or extraordinary assumptions, and USPAP requires explicit disclosure of all such modifying conditions and assumptions.

USPAP Advisory Opinion 9 recommends a two-stage analysis: one under the hypothetical condition that the property is and never was affected by contamination and the other under the "as-is" actual condition of contamination or remediation. A proper HBU in each of those states should take into account both the "ideal-vacant" value and the "as-is-improved" value to arrive at a HBU in each of the two circumstances.

Practice Note

In fact the Brownfield HBU analysis process may actually result in six or more different HBUs: "vacant-ideal" and "as-improved" in each of three circumstances: as-if never contaminated, as-is (contaminated) and as-when remediated. The first pair of HBUs ("vacant-as-if-never-contaminated" and "as-improved-as-if-never-contaminated") is performed to provide a base-line set of values only. These are hypothetical values which probably cannot be achieved even after remediation. However, comparison of all six of these HBUs provides a helpful focus on reutilization opportunities. Indeed, since remediation may frequently be performed to varying standards depending on the desired post-remediation use of the property, multiple HBU analyses may be conducted in the as-when remediated state to allow for multiple cost/benefit studies and thus to optimize the economic benefits of remediation.

[4] HBU Analysis in General Is a Four-Step Process

[a] Determining Legally Applicable Uses

The first step of the HBU analysis is a determination of all of the uses to which the property may legally be applied. This takes into account such aspects as zoning, restrictive covenants, and both government and private restrictions on land use. In the "ideal-never-contaminated" analysis, the analysis relaxes any legal restrictions necessitated by the contamination and any extraordinary development enablements granted by local authorities to promote brownfield redevelopment. Legal restrictions in the as-is condition may include covenants and restrictions, environmental liens, limited zoning, or easements. Extraordinary development enablements for brownfields may include tax abatements, zoning enhancements for public-benefit uses (e.g., low-income housing), or other economic inducements which may vary according to the type of use proposed. In the "as-is" analysis, these restrictions and/or promotions should be considered. Further, if a zoning or comprehensive plan change or other legal status change is reasonably possible, the analysis should take this into account along with the time and costs necessary to do so. Note that USPAP requires explicit disclosure of any and all assumptions made in arriving at the HBU determination.

[b] Determining Physically Possible Uses

The next step is to determine, of all of the uses to which the property may legally be applied, which uses are physically possible. Again, in the "ideal" condition, the analysis assumes away any physical restriction imposed by contamination, but restores such restrictions in the "as-is" analysis. Often, steps [a] and [b] require land planning, engineering, hydrological, or other specialized assistance.

[c] Determining Financially Feasible Uses

The third step is to determine, of the uses which are legally permissible and physically possible, which uses are financially feasible. Note that in practice, financial feasibility determination requires first a determination of market feasibility (positive utility) and second a determination of economic feasibility (a positive utility which can be priced other than a public good). Financial feasibility is the subset of economically feasible uses which are actually profitable. Thus, the mere ability to charge rent for a given use does not ensure financial feasibility or a positive net present value to the property. Only financially feasible uses have a positive net present value.

Practice Note

The question of "market feasibility" can be summed up by "if you build it, will they come?" Properties which are *market feasible* enjoy positive demand in the marketplace, but consumers won't necessarily expect to pay rents to enjoy that good. An example is a park. Park space enjoys positive demand, but consumers generally expect parks to be "public goods," which are provided for free. *Economic feasibility* refers to goods with both positive demand *and* for which consumers expect to pay rent. However, economically feasible properties may not be financially feasible, as market rents may not necessarily cover the costs of operation or provide a return on investment. Examples of such enterprises are publicly owned theaters, symphonies, operas, ballets, etc. which charge admission for tickets, but still require public subsidies for support. *Financially feasible properties* have positive demand (they have market feasibility), can charge positive rents (they are economically feasible) *and also* cover all operating costs and provide a positive return on investment.

This is significant for brownfield redevelopment, since many remediatable properties may have positive market or economic feasibility post-remediation evidenced by positive demand, but may not be financially feasible investments.

[d] Determining Optimum Productive Use

The fourth step is a determination of the maximally productive use of the site, both in the "ideal" assumed condition and the "as-is" condition. The process then reconciles those two determinations into one recommended highest-and-best use of the site. Due to special site-specific conditions or regulations, an HBU determination may be very specific (e.g., "single family detached residential between 1000 and 1500 square feet on one-quarter-acre lots"). On the other hand, in areas with broad zoning or comprehensive plan rules, an HBU determination may be quite general (e.g., "commercial use").

[5] Brownfield Contamination Will Probably Affect the HBU in Many Ways

[a] Legal or Physical Restrictions May Be Imposed

Unremediated contamination may place legal or physical restrictions on the property. These restrictions may or may not impact HBU. For example, under the "ideal-and-never-contaminated" assumptions, a site may have been optimally used for industrial purposes. As contaminated and "as-is-improved," the site may still be optimally used for industrial purposes. However, in many other cases, property "as-contaminated" may be severely restricted, depending on the nature and degree of contamination, local regulatory requirements, anticipated future regulatory burdens, or other limitations on the utility of the site.

[b] Financial Feasibility May Be Affected

Unremediated contamination may affect the financial feasibility of a property via several mechanisms. Most notably is the change in financing of the property. While appraisal analysis is conducted without respect to financing (e.g., cash or cash equivalency), the lack of "as-if-uncontaminated" financing will result in a diminution in value relative to other, uncontaminated comparable properties. Also, even when anticipated costs to remediate are taken out of the equation, the financial feasibility may be impacted by additional testing, monitoring, insurance, management, or legal costs.

Financial feasibility is achieved only when a particular use results in a positive net present value. Discounted present values take into account both cash flows as well as discounting rates. The latter will be affected, relative to unimpaired properties, by increased risk and stigma. Thus, certain uses which may have been feasible in the "uncontaminated" state will not be feasible either in the contaminated or remediated state.

[c] Net Present Value May Not Be Optimal

Net present value, leading to a determination of financial feasibility, will not be affected for all uses in the same way. As such, a use which may have been maximally productive in the "as-if uncontaminated" state may still be financially feasible but may no longer be maximally productive.

§ 29.04 Estimation of Brownfield Value

[1] A Direct Appraisal of a Brownfield Property May Be Misleading

While direct estimation of the brownfield value is intuitively pleasing, it carries significant shortcomings. For one, direct brownfield comparables are rarely available, and adjustments may be subject to significant levels of qualitative (i.e., unquantified) factors, such as the degree of stigma loss, locational adjustments, and marginal values of hedonic components. *Hedonic components* are the attributes of the property that contribute to value. Second, the purpose of a brownfield valuation is often either the estimation of the amount or percentage of diminution in value relative to uncontaminated properties or an estimation of the baseline value of the property in the "as-if uncontaminated" state.

Practice Note

Any appraisal based on sales comparison requires estimation of marginal values of various hedonic components. The word "hedonic" is more commonly used in the context of a regression model (e.g., hedonic multiple regression), but in fact a simple sales adjustment grid model is a hedonic pricing tool, albeit a simple one.

Sales adjustment pricing requires comparing the subject property to various comparable properties that have been sold. One important implicit assumption is that marginal prices of hedonic components are constant. For example, if the improved square footage of the subject property is 10,000 square feet, and the comparables range in size from 8,000 to 12,000 square feet, the model assumes that these differences in size all carry the same or nearly the same adjustment factor per square foot (the marginal price of this hedonic factor).

In fact, in the case of contaminated or other impaired property, sales prices are often inconsistent with respect to these hedonic components. As a result, the preferred method, consistent with good appraisal practice as outlined in Advisory Opinion 9, is to begin with a baseline value (the unimpaired value) using unimpaired comparable data, and then adjust according to the stigma and/or remediation costs determined to be applicable in the appropriate situation.

[2] An Estimate of the Percentage or Amount of Diminution Is Often Advisable

Prevailing appraisal literature and USPAP Advisory Opinion 9 call for a three-step process:

(1) estimation of the value as-if uncontaminated;

(2) estimation of the diminished value; and

(3) estimation of the difference between these two (the percentage or amount of diminution in value).

In practice, appraisers often begin with the as-if unimpaired value, estimate the percentage or amount of diminution, and impute the diminished value from that.

Estimation of the unimpaired value follows traditional appraisal methodology, as outlined in § 29.01 above. The remainder of this section will deal with specific valuation techniques applicable and useful in the impaired value estimation or estimation of the percentage or amount of diminution typically present in brownfields.

[3] The Sales Adjustment Approach

[a] A Sales Adjustment Grid Is Typically Used

Sales adjustment approach techniques traditionally follow the sales adjustment grid, which is a spreadsheet of comparables and adjustment factors. Typically, the appraiser gathers several comparable transactions which meet the explicit assumptions of the salient definition of value and, sequentially, compares each one's characteristics to the subject property.

Figure 3
Example of a Simple Sales Adjustment Grid

	Subject	Comparable #1	Comparable #2	Comparable #3
Description	24.0 acres	10.0 acres	32.0 acres	24.0 acres
Sales Price		$500,000	$1,800,000	$2,400,000
Price/Acre		$50,000	$56,250	$100,000
Conditions of Sale	Fee Simple	Subject to Easement	Fee Simple	Fee Simple
Adjustment*		+6,250	-0-	-0-
Financing	Cash Equivilent	Cash Equiv.	Cash Equiv.	Cash Equiv.
Adjustment		-0-	-0-	-0-
Location	Industrial Park	Similar	Similar	Similar
Adjustment		-0-	-0-	-0-
Date of Sale	Current	Current	Current	Current
Adjustment		-0-	-0-	-0-
Physical Cond.	Brownfield	Brownfield	Brownfield	Remediated
Adjustment**		-0-	-0-	-$43,750
Sum		$56,250	$56,250	$56,250
Indicated Value				
Per Acre	$56,250			
Total	$1,350,000			

* Determined through matched pair analysis between #1 and #2

** Determined through matched pair analysis between #2 and #3

This simple analysis is provided to demonstrate the format, rather than an actual sales adjustment grid. In practice, a raw land appraisal will typically use 10 or more comparable sales. Additional sales, not reflected in the sales adjustment grid, may be used as matched pairs or trend analyses.

Other techniques, such as regression modeling, are fundamentally congruent extensions of the sales adjustment grid. The sales adjustment grid compares the hedonic components of a subject property to each of several comparables, making adjustments one comparable at a time to arrive at a value based on the marginal value of these hedonic components. Regression models, on the other hand, examine the comparables together as a group, using statistical techniques to directly measure the marginal values of the hedonic components.

Practice Note

Even a rudimentary discussion of regression modeling would be both lengthy and beyond the scope of this text. A simple one-factor regression, often called a "linear regression," consists of a single explanatory variable and a single dependent variable. Say, we want to know the impact of square footage on the price of a home. The regression equation would take the form of:

sales price = constant + (price per square foot) X (size of home) + error term

This would usually be re-expressed in "math-speak" as:

$$Y = \alpha + \beta X + \epsilon$$

although the two equations mean identically the same thing. The appraiser would then gather a large number of recent sales, for which Y and X were known. The linear regression technique, almost always performed using a computer, "best fits" a linear X-Y plot of sales prices (the Ys) and the square footages (the Xs). The decision rule for determining the best fit equation is to minimize the sum of the squared error terms—"error" being defined as the unexplained variance. Two famous mathematicians, Gauss and Markov, working in the late 1800s, determined that minimizing the sum of the squared errors would result in the best linear unbiased estimator.

In practice, regression models for real estate pricing require many more variables (Xs) and somewhat more complex adjustments for non-linearity and other issues. Fortunately, there are many well-developed and easily-utilized computer-based routines for regression modeling. As a result, nearly all academic real estate pricing models depend on some variant of a regression model or other multivariate statistical model.

The use of multiple regression modeling in the appraisal context has been outlined in innumerable authoritative contexts, most recently in Colwell, et al. (2009).[9] The standards for admissibility of regression modeling in federal court are covered by Rubenfeld (2000).[10]

[b] Adjustable Characteristics

Adjustable characteristics include:

- Conditions of sale;
- Market conditions (market timing);
- Financing conditions;
- Location; and
- Physical characteristics.

Conditions of sale adjustments may be made for non-arms-length transactions, partial interests, or other issues affecting the nature of the transaction itself. Market conditions adjustments are made to compensate for systematic changes in property price levels between the date of sale of the comparable and the effective date of the transaction. Financing conditions adjustments may be made if the comparable property was sold with other than market-normal financing conditions. Location adjustments may be made to compensate for the value of any differential utility between the

[9] Peter F. Colwell, John A. Heller & Joseph W. Trefzger, Expert *Testimony: Regression Analysis and Other Systematic Methodologies*, The Appraisal Journal 253–262 (Summer 2009).

[10] Daniel L. Rubenfeld, *Reference Guide on Multiple Regression*, Reference Manual on Scientific Evidence 2nd, at 179–227 (Washington, DC: Federal Judicial Center, 2000).

comparable location and the subject location.

Physical characteristics adjustments should be analyzed for all salient items that have economically significant marginal value. Marginal values typically do not have linear relationships, and so linear approximations are only applicable over short ranges of value discrimination. For example, a 50,000-square-foot industrial site may sell for $100,000, or an average value per square foot of $2. However, the difference in value between a 50,000-square-foot site and a 51,000-square-foot site may only be $1,000 ($1 per square foot), because small differences in marginal values do not have the same marginal cost as the overall average cost. (This specific example harkens back to the plattage discussion earlier in this chapter.) As such, appraisers are cautioned to find comparable transactions requiring only small adjustments.

Adjustment amounts may be determined using a number of different methodologies. For example, continuous variables (e.g., time, square footage) may be estimated using some simple trend analysis. (Trend analysis is described below.) Repeat sales analyses are frequently used to determine market conditions adjustments. (Repeat sales analysis is described below.) Discrete variables (location, any variable which can be counted) may be analyzed with a simple matched pairs or other discrete determinant model, such as a "dummy" variable in a regression or a conjoint measurement output from survey research.

Practice Note

Reflecting back on the regression model presented in the previous practice note, a discrete or "dummy" variable may be used when the data set includes transactions which either do or do not have a particular characteristic—such as either "brownfield" or "not-brownfield". A simple example would be:

$$Y = \alpha + \beta_1 X + \beta_2 Z + \epsilon$$

In this example, Y and X may represent the selling prices and square footages, respectively, of industrial properties in the neighborhood while Z would equal "1" if the site was contaminated and "0" if not. The regression model would be expected to produce a value for β_1 which was the price per square foot of an uncontaminated site and a value for β_2 which was the discount (measured in dollars per square foot) for contaminated sites in the area.

Caution: this is an overly simplistic presentation for illustrative purposes only. In practice, other controls and analyses would be in order before this simple model would meet standards for statistical reliability.

[c] Trend Analysis

A simple trend analysis plots sales on a per-unit basis (e.g., per square foot) over time to estimate pricing trends in the market. While widely used when sufficient data is available and efficient markets prevail, this technique may be overly simplistic when faced with small data sets or inefficient market problems. In practice, most computer spreadsheet programs have routines for estimating simple linear trends.

[d] Repeat Sales Analysis

The repeat sales model is constructed using paired sales of the same property, in the same state (e.g., no significant physical changes) over a period of time. For each property in the sample, a rate-of-return (typically annualized) is determined over time. These are then averaged to estimate a market-wide periodic rate-of-return.

Repeat sales analysis allows for the development of a trend-line in values, assuming that the underlying transactions are representative of the explicit assumptions in the salient definition of value. Repeat sales methods have the benefit of controlling for endogenous factors (e.g., depreciation, changes in marginal values) and allowing direct measure of the exogenous factors (e.g., local economy, macro-economic trends) which over time systematically affect property values via market conditions.

Note that repeat sales analyses are useful for both brownfield and non-brownfield circumstances. Repeat sales models have also been shown to be statistically robust even when relatively small samples are used.

If two repeat sales data sets are used—brownfields versus non-brownfields—then a differential rate-of-return can be computed which provides input into an impaired discounted cash flow model. If brownfield properties are shown to grow in value at a slower rate than non-brownfield properties, then this differential is directly input into the discount rate or capitalization rate used in the income approach valuation.

[e] Adjustments Are Made to Account for the Marginal Prices of the Variable

Discrete adjustments are frequently determined using matched pairs, although with larger data sets, hedonic models—the common name for multiple regression models applied to real estate pricing—are more statistically robust than matched pairs. Matched pair analysis is used to compare the transaction prices (or per-unit prices) of two properties that are identical in all respects but for the variable in question. Unfortunately, matched pairs analysis has an implicit assumption that the marginal value of the variable in question is not co-variant with the marginal values of other variables. For example, a 10,000-square-foot industrial building may have two restrooms. Restrooms are valuable, so measuring the marginal value of the restrooms is important. However, a 20,000-square-foot industrial building may have four restrooms. Hence, some of the value of the restrooms is captured in the marginal value of additional square footage of the building.

Thus, when possible, a multi-variate regression model, such as a hedonic model, is preferred, so that co-variant properties may be directly examined. Well developed hedonic regression models allow for examining these co-variant factors. From a brownfield redevelopment perspective, this can be very important. For example, as noted, a larger building may have more restrooms than a smaller building. A large brownfield building redeveloped but with only a few restrooms may have a diminished value relative to other large buildings with a more "market-acceptable" number of bathrooms. While this is a simple, and somewhat intuitive example of the information hidden in co-variant variables, it is illustrative of the sort of less intuitive gems of information which may be hidden in the interaction between hedonic components.

[f] Adjustments for Stigma

Adjustments for stigma may be determined in a variety of ways. Survey research has been found to be useful in contaminated property situations for determining stigma adjustments. Typical survey techniques include perceived diminution, conjoint analysis, and contingent valuation. *Perceived diminution* involves surveys of property owners, tenants, and other stakeholders to directly measure perceptions of diminution in value. *Contingent valuation* involves surveys of non-stakeholders for those same measurements. *Conjoint analysis* is particularly useful in situations where direct measurements of contamination economic impacts cannot be determined. It uses a survey of various tradeoffs to rank-order the diminution associated with a brownfield relative to other property amenities or disamenities. Guidance for use of survey research has been provided in both the peer-reviewed real estate literature as well as the legal press.[11]

Stigma adjustments are often developed using meta-analysis of peer-reviewed empirical studies (explained below), comparable case studies from other contamination situations, or appraisals of similar properties. All of these methods, when used in a manner consistent with the peer-reviewed literature, have been accepted by various courts and other jurisdictions.[12]

In the valuation literature, the term "meta-analysis" as applied to case studies and academic empirical studies has only recently come into vogue. It describes the phenomenon that, despite various idiosyncratic factors, the impairment and/or stigma resulting from contamination tends to have similar valuation results across a variety of circumstances, such as geographic location, type of contamination, or even property use. As such, this sort of secondary research, while not a full substitute for primary empirical research, nonetheless provides an important supportive tool in the brownfield valuation problem.

Because brownfields typically have significant idiosyncrasies, traditional sales adjustment grid analysis may fail. Generally, these idiosyncrasies are overcome by the use of sufficiently large data sets such that parametric statistical inference methods may be used. Traditional sales adjustment grids are poor at quantifying large data sets.

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[11] Marcus Allen & Grant Austin, *The Role of Formal Survey Research Methods in the Appraisal Body of Knowledge*, The Appraisal Journal, 2001, 394–99; Bill Mundy & Dave McLean, *Using the Contingent Valuation Approach for Natural Resource and Environmental Damage Applications*, The Appraisal Journal, 1998, 290–97; Bill Mundy & Dave McLean, *Addition of Contingent Valuation and Conjoint Analysis to the Required Body of Knowledge for the Estimation of Environmental Damages to Real Property*, Journal of Real Estate Practice and Education, 1999, 1-19; Shari Seldon Diamond, *Reference Guide for Survey Research*, Reference Manual on Scientific Evidence 2nd (Washington, DC: Federal Judicial Center, 2000).

[12] Robert Simons & Jesse Saginor, *A Meta-Analysis of the Effect of Environmental Contamination and Positive Amenities on Residential Real Estate Values*, Journal of Real Estate Research, forthcoming, 2006.

Hedonic modeling, a form of multiple regression analysis, is more commonly used and is one of the predominant analytical techniques. It is fundamentally part of the sales comparison approach, but uses regression methods to cure the flaws in a manual sales adjustment grid.

Marginal values of hedonic factors may be non-linear. For example, if demand for larger industrial properties in a market is greater than demand for smaller properties, then the value per-square-foot may increase with size. On the other hand, since excess land is nearly worthless to industrial sites, the value per-square-foot of the site may decrease rapidly after a certain optimal size. Hedonic modeling is also useful for dealing with this observed non-linearity in marginal values, a flaw of linearly determined matched pairs which becomes statistically troublesome when large adjustments are necessary.

Using a hedonic or other large-data-set statistical model, the value of a brownfield may be determined directly using a data set made up exclusively of recent comparable brownfield transactions. However, while this may be preferred in theory, in practice this technique is usually difficult due to a lack of recent comparable transactions. As such, a preferred method is to construct a hedonic model with both brownfield and non-brownfield properties. Included in the data set is a binary variable (equal to 1 or 0—often called a "dummy" variable) which indicates whether the specific property in the data set is a brownfield transaction or not. In the resultant analysis, the coefficient on the binary variable measures the degree of discount applicable to the brownfield relative to the non-brownfield transactions. With this method, a robustly large data set can be constructed using only a few brownfield transactions. Further, this methodology allows the use of a single model to conform to both the "before" and "after" model outlined in Advisory Opinion 9.

The hedonic, multiple regression model is a significant improvement over the sales adjustment grid in several fundamental ways. For example, marginal prices are the adjustment factors in the grid and must be determined by some other means (e.g., matched pairs, trend analysis) before the grid can be constructed. However, these marginal prices are the output coefficients in the hedonic model, and are statistically determined using the pricing data from the comparables themselves. Second, the hedonic model allows for analysis of non-linear relationships between the explanatory variables and value, which is important since real estate values have consistently been shown to be non-linear in the academic literature. Also, in litigious matters, *Daubert* issues require that the model have characterizable statistical qualities, such as confidence intervals and error rates. Hedonic model statistical properties may be directly measured. However, sales adjustment grids do not have such well-defined statistical properties.

Shortcomings of regression techniques include non-linearity of both the data and real estate values, assumptions about the statistical behavior of non-explained and idiosyncratic factors, and model specification. Techniques exist for dealing with all of these, but their use requires an advanced level of training and sophistication regarding econometric models.

Figure 4
Simple Hedonic Model - Land Sale Equation

Ln(Value per acre) = $\alpha + \beta_1$ X (time since sale) + β_2 X (1 if Brownfield, 0 if Clean) + ϵ

Notes: This simple hedonic model only uses two explanatory variables—time since sale and a "dummy" indicating if the comparable sale is a brownfield or not. The dependent variable (value per acre) comes into the equation as a natural logarithm to accommodate the known non-linearity in real estate values. The hedonic equation takes on what is commonly called a semi-log-form (only the dependent variable uses a logarithm function) indicating that the analysis assumes linearity in the explanatory variables. More complex hedonic models frequently use a log-log form, in which all variables come into the equation as logarithms.

The first explanatory variable, alpha (α), represents the base value of clean real estate as-of today. The second set of terms, beta-sub-1 (β_1) times the time since sale, is analogous to the market conditions adjustment in the sales adjustment grid. Since the comparables will probably have been in the past, the time since sale will be a positive number and the coefficient (β_2) will represent the rise in prices over time. If "time since sale" is measured in days, then β_2 will also represent a daily factor.

The third explanatory variable, beta-sub-2 (β_2) times a dummy variable equal to 1 if the property is a brownfield and zero otherwise, represents the stigma loss imposed by the market for known brownfields. In this equation, it will be reported as a negative dollar amount per acre.

The final term on the right side, epsilon (ϵ) is an error term which contains all of the idiosyncratic variation in prices not explained by the rest of the equation. Since the equation is an ordinary least squares linear regression, one underlying assumption is that epsilon is normally distributed with a mean of zero and a standard deviation of one. Since this assumption is usually not true in real estate hedonics, certain econometric accommodations need to be made in practice to account for the non-normalcy and other less desirable properties of epsilon.

[4] The Cost Approach

[a] Often Inadequate for Brownfields Due to Stigma

For older properties or those with substantial disamenities, such as brownfields, cost approach techniques to establish value may not properly account for these disamenities or may require substantial unquantified adjustments.

The cost approach provided one of the early signals of the existence of stigma. Prior to the early 1990s, appraisers considered that the market value of a contaminated site was the unimpaired value less the cost of remediation. In the case where remediation costs were known with certainty, or where remediation was complete (and hence remediation costs equaled zero), the cost-less-depreciation calculation should result in a reasonable approximation of observed prices in the market. However, appraisers observed that actual prices of contaminated sites, both pre- and post-remediation, were lower than this simple cost calculation predicted. This phenomenon lead observers to realize that other risk factors were at work, which they labeled as stigma.[13]

As described in Section 29.01, the basic method for the cost approach is to determine the value of the land as if vacant and as if ready for development for its highest and best use, add to this the replacement or reproduction cost of the improvements as if new, and deduct for obsolescence (physical depreciation, functional obsolescence, and economic or external obsolescence).

Typically, the land value is determined via a sales comparison approach. In brownfield valuation, contamination problems and stigma are frequently more of a problem for land value than for improvements value. Indeed, in many unremediated situations, the property will have a positive "value in use" even though the land, if vacant, may have a negative "market value" as a result of the present value of future remediation costs and inherent stigma. Properly accounting for this requires estimation of not only the engineering costs to remediate but also the long-term stigma effects and parsing those costs between the land and the improvements.

[b] Estimating Stigma Impacts

Stigma impacts may be estimated using the techniques outlined in the preceding § 29.04[3], The Sales Adjustment Approach. Survey research has proven very useful for determining land discounts. Comparables of impaired raw land sales—either nearby analyzed via a matched pairs model or at a distance discovered by meta-analysis of national comparables, case studies, or academic studies—may also prove useful. Generally, though, some type of large-scale data land base will be the best, if data is available, and some large-scale statistical analysis, such as hedonic modeling, will prove to be the most reliable.

Often in brownfield situations, the improvements have no contributory value to the "as if remediated" market value. The improvements may have continued "value in use" until remediation begins, either from net rents received from tenants (typically at lower-than-market rates with higher-than-market expenses) or from use by an owner-occupant. However, site remediation often requires demolition of the improvements. Also, improvements in brownfield situations are frequently physically depreciated or functionally obsolete to the point where salvage is not economically viable. Finally, even if the improvements can remain in place during remediation, the process may require a period of time where the improvements are unoccupiable and ownership entails cash out-flows to cover fixed costs with no rents incoming. This period of negative net-present-value must be accounted for in the cost approach as a functional or economic disutility, and constitutes one of the mechanisms whereby stigma impacts the improvements, even when those improvements themselves are not physically damaged by the contamination.

Contamination that does impact the improvements may do so in several different

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[13] Bill Mundy, *Stigma and Value*, The Appraisal Journal, 1992, at 7–13; Peter J. Patchin, *Contaminated Properties—Stigma Revisited*, The Appraisal Journal, 1991 at 167–172.

ways. The physical structures may be impacted and not remediable. In this situation, the improvements may either be useable for a period of time or wholly unusable. In both of these cases, the physical depreciation—which will be all or nearly all of the current value of the improvements—should also include the cost of demolition. The result of this exercise may be a negative current value for the improvements, even though those improvements are currently rented at a positive net operating income. However, the negative value may be the optimum interim solution for the property, given that alternative solutions (e.g., immediate demolition) may have an inferior net present value.

Contamination that impacts the improvements may also be remediable. In this case, the cost of the remediation constitutes a curable physical depreciation item. However, the impact of the contamination and/or the remediation itself may result in certain incurable physical depreciation items as well. An example of this would be stress and strain on structural elements or exposure to the weather which shortens the expected life of the physical structure. Usually, this foreshortening can be physically determined by an architect or structural engineer and the value impact estimated as part of the appraisal process through a present-value calculation.

Incurable physical depreciation is just one component of stigma impacting the structure. Additionally, stigma—even post-remediation—impacts the overall utility, compared with other non-impacted structures, as shown in surveys of landlords and tenants over the years. A percentage-of-value adjustment can be made as part of the economic depreciation component of the cost approach.

A brownfield's value may be impacted by contamination which is totally external—a situation often referred to as proximate stigma. An example would be a property which is impacted by odors or fumes from a facility next door. In this case, the negative impact on value should be determined and accounted for in the cost approach as external obsolescence. For example, the degree of diminished present value of future rents can be used, taking into account the increased risk and horizon for diminished growth in out-years, manifested in the increased discount and/or capitalization rate.

Practice Note

Remediation of a contaminated site may seem to necessitate demolition of otherwise useable improvements, such as warehouses or industrial buildings. Remediation which leaves these buildings in place may at first appear to be more expensive. However, a cost-benefit analysis, between the engineering team and the valuation team, may reveal a net benefit to a non-destructive remediation. For example, many communities have used old warehouses for residential or mixed-uses. Adaptive re-use of these structures may be more economical than demolition and re-building, may take advantage of larger footprints than would currently be allowed (under current zoning or comprehensive plans) and may qualify for historic preservations credits or other tax advantages. Hence, the valuation component of brownfield redevelopment suggests a multi-faceted approach as early as possible in the brownfield rehabilitation process.

Figure 5
Simple Cost Approach Analysis

Land Value (as if clean)		
10.0 Acres		
$100,000 per acre (using uncontaminated comps)	$1,000,000	
Stigma Impact:		
25% to Land Alone, assuming remediation completed	-250,000	
Net Land value		$750,000
Improvements (as if new)		
100,000 square feet		
$65.00 per square foot		6,500,000
Depreciation/Obsolescence		
Physical - via age/life		
25 year old building, average condition = 50%	-3,250,000	
Functional: Loss of usability during remediation phase	-1,000,000	
Economic: Residual stigma to building post-remediation	-650,000	
Net Depreciation		-4,900,000
Value Indicated via cost approach		$2,350,000

Assumptions in this model: A brownfield site ready for immediate remediation. The building, with average upkeep, is about half-way through its economically expected lifespan. The building cannot be occupied during the remediation, but will have a holding cost, including additional depreciation, of $1,000,000 during that period. Post-remediation, the land will suffer a 25% stigma loss and the building will suffer a 10% stigma loss. Stigma losses are determined from case studies, survey research, and other similarly acceptable methods.

What is the pre-remediation stigma for this property? In the uncontaminated state, the property would be worth the sum of the land and building "as-if-new" minus the physical depreciation, which totals $4,250,000. Hence, the total pre-remediation stigma is $1,900,000, or about 45% of the otherwise unimpaired value. The post-remediation stigma is $900,000, or about 21% of the otherwise unimpaired value.

[5] The Income Approach

[a] Direct Capitalization and Discounted Cash Flow

Most income producing property is purchased on the basis of the present value of future benefits, typically cash flows. There are two common sets of methods for determining present value: direct capitalization (DC) and discounted cash flow (DCF). The former presumes that benefits (cash flows) will occur as a perpetuity. DCF is more flexible, allowing for differential cash flows in different periods.

Brownfields have reduced—or even negative—cash flows and increased capitalization or discount rates. The remainder of this section discusses methods for estimating cash flows and capitalization or discount rates in brownfield analysis.

[b] Net Operating Income

In either DC or DCF analysis, the base cash flow to be discounted or capitalized is net operating income (NOI). This is a proxy for expected cash flows from the assets, pre-debt-service, and includes typical cash income (without accounting for depreciation) and also a factor for replacement reserves. Forward looking NOI includes a provision for anticipated vacancy and collection problems, even if the property has been fully rented in the past.

[c] Adjusted Funds from Operations

When analyzing a portfolio of properties, the cash-flow proxy is funds from operations (FFO). In recent years, in response both to accounting regulations as well as demands by the investment community to better integrate valuation metrics with accounting metrics, the measure of choice has been adjusted funds from operations (AFFO). AFFO begins with net income, as defined by the Generally Accepted Accounting Principles (GAAP), and adds back factors for debt service and depreciation but deducts a factor for replacements accrual.

[d] Future Cash Flows

DCF analysis is the most flexible method for analyzing future cash flows or other cash-equivalent benefits. Future flows are discounted to the present at a rate of return commensurate with investor requirements. In the unimpaired condition, the discount rate or rates may either be required equity returns (equity dividend rates) or a weighted average cost of capital (WACC) which is risk-adjusted to reflect expected asset risk. Hence, discount rates usually vary for particular sub-classes of real estate (e.g., retail, hospitality, apartments, industrial, office, etc.) according to market risk expectations and core required rates of return.

[e] The Advantages of Discounted Cash Flow Analysis

In brownfield situations, DCF analysis provides the flexibility to deal with time-varying cash flows. DCF analysis also has the advantage of allowing for direct estimation of the internal rate of return on a project—usually a key metric for brownfield investors. As stated above, the IRR is simply the discount rate at which the sum of the present values of the net cash inflows and outflows, including the purchase price, equal zero. Thus, for a target IRR, the investment solution can be arrived at by simply discounting the future cash in-flows and outflows at the target rate. The net present value, discounted at the IRR, is the investment value.

One shortcoming of DCF analysis arises when the process is used to estimate IRR at a given investment value, and the periodic cash flow changes from positive to negative several times during the ownership period. This is a fairly common occurrence, when a property with current positive cash flow is acquired, but remediation requiring cash outflows is anticipated after one or more periods of positive returns. After remediation, the property will return to positive returns. IRR analysis under those circumstances may produce multiple results, only one of which is the actual IRR and the others are spurious. In those situations, additional research is necessary to determine which result is the actual IRR.

DCF analysis also provides an excellent platform for sensitivity analysis. For example, using DCF analysis, the net present value (any positive returns over and above the required IRR) can be easily partitioned among operating cash flows and residual returns (returns enjoyed upon sale or conversion of the brownfield in out-years). Additionally, with the use of electronic spreadsheet programs or proprietary DCF software packages, the analyst can perform sophisticated "what-if" analyses to estimate probabilities of less-than-desirable outcomes. Investors acquiring multiple brownfields in a portfolio can use these tools to optimally schedule cash flows, minimize debt requirements, and estimate opportunities for minimization of overall portfolio risk through amelioration of idiosyncratic risk inherent in individual portfolio components.

[f] The "Cap Rate"

Value via direct capitalization (DC) is simply the ratio of net operating income (NOI) to a capitalization rate, often called "cap rate" for short. A mandatory assumption of DC is that cash flows are a constant perpetuity or are changing at a constant rate, which is frequently not the situation in pre-remediation brownfields but may be a reasonable assumption in some post-remediation situations. Also, as is inherent in any perpetuity analysis, the use of a single cap rate limits the analytical ability to do multi-period sensitivity analyses.

In practice, in non-brownfield situations, the cap rate is estimated by observing the ratio of NOI to sales price for comparable transactions. In brownfield situations, however, lack of comparable data will encumber empirical estimation of the cap rate. In those cases, the cap rate may be imputed in a number of ways. Cap rates on uncontaminated properties may be scaled up by a risk-adjustment factor in a manner consistent with corporate finance formulation of risk adjusted discount rates. For example, in many situations the risk-adjustment factor can be proxied by the premium between investment-grade bonds and high-yield "junk" debt.[14] Also, mathematically, the cap rate is the difference between required rates of return on projects of equivalent risk levels minus then anticipated periodic growth rate in cash flows (NOI). As a result, if required IRRs can be determined from investor surveys, then cap rates may be inferred for perpetuity cash flows.

[g] Options Valuation Models

Either DC or DCF analysis of a brownfield assumes a single known remediation or redevelopment plan for the property. In practice, however, remediation plans may not be fully known or knowable and, as of the time of the valuation, only a set of alternatives are available. In such situations, an options valuation model may be useful, combining several DC or DCF analyses along with a probability estimate for each.

[14] While this technique dates back to the early works of Mundy, *supra* note 13, it is more recently described in Sheridan Titman, Stathis Tompaidis & Sergey Tsyplakov, ***Determinants of Credit Spreads in Commercial Mortgages***, Real Estate Economics 711–738 (Winter 2005).

Notably, some of the options may have different discount rates as some options may require different levels of debt (assuming debt carries a different rate than equity). Options pricing provides a handy method to apply the tools of DCF analysis to contaminated raw land, as is frequently the case in brownfield situations. Options pricing models provide the mechanism to deal with multiple potential outcomes from the remediation as well as multi-tiered remediation levels.[15]

Figure 6
Example of a Discounted Cash Flow Analysis

Assumptions:

A brownfield is currently available for investment at a price to be determined. The property will have no income during the remediation period, but will have holding costs of $100,000 per year (e.g.—taxes, insurance, management, legal). Remediation costs are estimated at $250,000 the first year and $1,000,000 each of years 2 and 3 (assume remediation costs are to be funded at the beginning of each year). At the end of year 3, the site can be sold for an estimated $6,000,000. Investors require a 20% return on their investments, and forward-period outflows may be discounted at a certainty-equivalent rate of 6%.

Period	Cash out-flow	Present Value Factor	Present Value
0	-350,000	1.0	-350,000
1	-1,100,000	$(1/1.06)^1$=0.9434	-1,037,740
2	-1,100,000	$(1/1.06)^2$=0.8900	-979,000
3	+6,000,000	$(1/1.20)^3$=0.5787	+3,472,200
		Net Present Value:	$1,105,460

Figure 7
Direct Capitalization of a Remediated Brownfield

Assumptions:

A brownfield site continues to suffer from persistent stigma in two forms. First, net operating income is diminished by 10% compared to comparable but never contaminated sites as a result of ongoing monitoring and testing costs as well as increased legal and management costs. Second, similar but never contaminated sites have cap rates in the range of 7%, but case studies indicate that remediated brownfield cap rates are about 2% higher, to accommodate increased risk and decreased marketability.

NOI for a comparable but uncontaminated site would be $1,200,000 per year.

$$Value = \frac{1{,}200{,}000\ X\ 0.90}{0.07 + 0.02} = \$12{,}000{,}000$$

If never contaminated, the value of the site would have been:

[15] George Lentz & K.S.M. Tse, *An Options Pricing Approach to the Valuation of Real Estate Contaminated by Hazardous Materials*, Journal of Real Estate Finance and Economics, 1995, 121-44.

$$Value = \frac{1{,}200{,}000}{0.07} = \$17{,}143{,}000 \quad (rounded)$$

Hence, the post-remediation stigma loss suffered by the property is:

$$stigma = \frac{17{,}143{,}000 - 12{,}000{,}000}{17{,}143{,}000} = 30\%$$

[6] Reconciliation of Value Estimates

Appraisal practice makes no explicit assumptions that multiple approaches to value will arrive at the same solutions. In the reconciliation phase of the analysis, the appraiser makes a determination of the quality of the available data used in each approach, the reliability of the assumptions implicit in each approach, and the common methodology used by practitioners and investors in the market place. The reconciled value may be a weighted-average of the results of the various approaches, or in fact the appraiser may place no weight at all on a given approach.

In general, for income producing property, the various income approach methods are given the greatest weight because they more closely represent the decision-making processes of potential investors. DCF analysis may also be used for raw land when the cash flows are known and there is a reliable measure of required IRRs for similar investments.

The sales comparison approach methods are typically given the greatest weight in raw land analyses, unless the cash flows are known with a reasonable degree of certainty. While land values vary widely from one location to another, matched pairs or hedonic modeling can typically provide a good location adjustment, so that brownfield transactions outside of the immediate area can be used as comparables.

Due to the large adjustments for various components of obsolescence, cost approach methodologies are usually viewed as the least reliable. However, for special purpose properties, such as public facilities and power plants, or other properties for which good sales comparison or income data is unavailable, the cost approach may in fact be the most reliable of the three.

§ 29.05 Time Characteristics of Brownfield Stigma

[1] Stigma Is Particularly Persistent and Long-Lived

Observers had theorized that post-remediation stigma would ameliorate over time.[16]

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[16] *See* Bill Mundy, *The Impact of Hazardous Materials on Property Value: Revisited*, The Appraisal

Their purpose in this was to stimulate thinking into best practices for determining either risk-adjusted discount rates or cap rates over time if stigma was in fact changing. Since that time, other authors have explored the temporal characteristics of stigma. While it has been theorized that stigma might quickly ameliorate after remediation or after the announcement of a contamination event, recent empirical studies indicate that stigma is particularly persistent and long-lived.[17]

[2] Pre-remediation Stigma

Pre-remediation, stigma may arise either from a long-lived and well-known circumstance or from an event—or the revelation of an event—which impacts market behavior with respect to the value of the brownfield.

In the case of a long-lived event, the impact of the stigma over time may be manifested in either or both of two different ways. One way is for the value at any point in time to be lower than comparable unaffected properties but growing at the same rate over time. The differential value at any point in time can be measured via some cross-sectional (e.g., sales comparison type) modeling. Also in this condition, the cap rate for the brownfield is the same as for non-brownfields but with the addition of a factor for risk. The projected NOI may or may not be the same as for an uncontaminated site.

The other way would be value at a lower point at any point in time and also growing at a lower rate. In that case, the cap rate not only has an additional factor for risk but also an additional factor for lower growth. Empirically, these two additional factors are frequently combined into one.

In either circumstance, the aggregate impact to the property is measured via some present value exercise. However, the long-term modeling is necessary to show that the long-term present value modeling has reasonably consistent behavior into the future.

In an event or the revelation of an event, the value differential is measurable at a specific point in time. This measurement is frequently important in litigation. However, real estate markets are significantly inefficient, and so the full impact on the value of a brownfield by a contamination event may "leak" into the market prior to the event and may not be fully captured by the market until well after the event.

In an event-type circumstance, the challenge of the analysis is to measure value well before and well-after the event. The difference between these two, after accounting for systematic price-level changes, is the impact of the contamination event. The systematic price-level changes, and the price-level trends before and after the event, can be easily and simply determined by creating a long-term value index for the market, via a repeat sales index or other trend analysis. Note that such indices are compounded, so extracting short-term trends requires a geometric mean rather than an arithmetic average.

Journal, 1992, at 463–471; Peter J. Patchin, *Contaminated Properties—Stigma Revisited*, The Appraisal Journal, 1991 at 167–172.

[17] Kimberly, Winson-Geideman, *The Effects of Contamination on Post-Remediation Residential Property Values* (Cleveland: Cleveland State University Doctoral Dissertation, 2003).

[3] Post-remediation Stigma

Post-remediation, stigma may ameliorate over time. However, empirical research has shown that this time frame is quite long.

If stigma ameliorates over time, then why doesn't the present value immediately after the remediation capture the positive impacts of this amelioration? It does, but only in a risk-adjusted way. In the absence of possible amelioration, values would actually be lower. The value captures the future possibility of amelioration, discounted at a risk-adjusted rate to accommodate the unknown and unknowable amelioration patterns. Hence, attempts to theoretically impose a probable or possible amelioration pattern run counter to actual empirical market information, which already captures the possibility of amelioration over time.