Methods for Estimating the Social Benefits of EPA Land Cleanup and Reuse Programs

Summary Report of Workshop
September 28-29, 2006
4/13/2007

The following report summarizes discussions by participants at the workshop, Methods for Estimating the Social Benefits of EPA Land Clean Up and Reuse Programs, held September 28 and 29, 2006 in Arlington, Virginia and hosted by EPA's Office of Policy, Economics, and Innovation, National Center for Environmental Economics and Office of Solid Waste and Emergency Response, Land Revitalization Office. Workshop participants were chosen for their expertise in aspects of environmental economics relevant to the workshop content. Individual participants are identified in Appendix A to the document. Professor Kerry Smith chaired the workshop and coordinated and contributed to the summary report.

Preface added by Robin Jenkins, National Center for Environmental Economics, EPA.

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Final Version 4/13/2007*
(final version prepared by V. Kerry Smith)**

* This version is the third and final draft of the report. An initial draft was prepared following the workshop. A conference call was arranged allowing comments of the participants; a revision was prepared based on those suggestions. It was circulated and additional comments were requested. April 9, 2007 was selected as the fallback date for comments after several workshop participants requested extensions to the original deadline. One commentator did not submit comments.

** Appendix A lists the participants in the workshop. Everyone played a very constructive role in developing this report. As the previous note suggests the draft went thru several versions and each person patiently edited and commented. The chair made final decisions as to what was included. Thus, this should not be interpreted as a consensus document. The chair interpreted responses to a memo this week that this version of the report was the closest the group could come to consensus –which amounts to agreeing to disagree on some of the summary conclusions. These areas of disagreement are identified and the panel asked to submit separate comments to clarify any positions individuals felt were not adequately explained.

I. Objectives, Context and Process

The Environmental Protection Agency has faced a variety of challenges in developing policy evaluations that include measures of the social benefits of land clean up and reuse programs. In order to develop a policy-relevant summary of professional practices as well as emerging methods, the Office of Policy, Economics and Innovation's National Center for Environmental Economics, and the Office of Solid Waste and Emergency Response's Land Revitalization Office convened a workshop on risk assessment and benefit estimation methods in Washington, DC on September 28-29, 2006.[1] The agenda for the workshop and a list of the participants are provided in appendix A to this report.

Separate presentations were developed summarizing the state of the art in each of the four areas: risk assessment, stated preference methods, hedonic property value methods, and a general category labeled as broader approaches. Each presentation was organized as a brief summary of the method and asked to consider a series of issues. To initiate the discussion, Dr. Peter Eglinton of Abt Associates provided a "straw-man" proposal for conducting a risk assessment based benefits analysis for the Superfund and RCRA programs. Table 1 summarizes the discussion/charge questions for all methods as well as specific issues asked of each presenter. In addition to the individuals selected to provide overviews several other economists

Table 1

Charge Questions for Land Reuse Workshop

Applicable for all methods

1. How can this method be used to estimate the benefits of cleanup and reuse for a generic contaminated site, outside the context of any specific federal or state cleanup program? How might it be adapted to estimate the benefits of EPA programs that cleanup and promote reuse contaminated land (e.g., Superfund, RCRA, Brownfields, Underground Storage Tanks)? Is it more or less suited to one or another of these programs? Would it be feasible to use this method to estimate benefits at the national level? [You might consider various dimensions of cleanup and reuse, including uncertainty about future use, delayed and/or lengthy cleanups, removal versus remediation of Superfund sites.]
2. Is the method useful for retrospective analyses; that is for estimating the benefits that have accumulated over the years due to existing cleanup programs? Is it useful for estimating the additional benefits generated in the most recent year?
3. What types of benefits can be measured using this method (e.g., health effects, ecological effects, amenities, nonuse, other)?
4. What are the strengths and weaknesses of this method that are particular to measuring the benefits of cleanup and reuse?
5. Would this method be suitable for estimating the incremental benefits of different levels of cleanup or of extended periods of cleanup activity?
6. Are data readily available to use this method and if not, what data are needed?

Additional considerations for risk-assessment-based method:

The traditional risk-assessment based method of measuring benefits involves four steps (see Greenstone and Gallagher, 2005): 1) identifying toxics and pathways where they are found, 2) identifying the health/ecological risks associated with a toxic/pathway combination, 3) estimating the size of the affected population and their pathway specific exposure, and 4) estimating the willingness to pay for reduced exposure.

One of the major criticisms of this method is the lack of risk and exposure data. Also, valid willingness-to-pay estimates are thought to be lacking for most health endpoints. Are these criticisms legitimate? Can they be overcome?

[1] Professor Nancy Bockstael originally helped to plan the meeting but family health issues precluded her participation in the sessions. She was primarily responsible with EPA staff for the design and development of the workshop.

active in research areas related to the workshop objectives were invited and a number of EPA analysts also attended the workshop. One external (to the agency) economist was asked to summarize the discussion from each presentation.

After the workshop, Jared Creason, Robin Jenkins, Elizabeth Kopits, Kelly Maguire, and Stacy Swartwood prepared a set of short fact sheets for six of EPA's cleanup programs:
RCRA Corrective Action,
Superfund Removal Program,
Superfund Remedial Program,
Underground Storage Tank Program,
Brownfield Program, and
Federal Facilities Program
This description along with a short questionnaire developed by Anna Alberini and the workshop chair was sent to the non-EPA economists who participated in the workshop. Appendix B includes a copy of the questionnaire.

This report describes the results of the overall process. It is not intended to be a complete summary of the presentations, comments, and discussion.[2] Rather it seeks to provide a brief overview of what was discussed and to be responsive to the intended objective of the workshop – to provide an assessment of the valuation method/or methods among participants. The last section provides brief responses to each charge question and some suggestions for next steps in addressing the overall objectives of the workshop.

Table 1 Cont.

Additional considerations for stated preference method:

A key advantage of the stated preference methodology is the ability to capture nonuse benefits. What special difficulties might arise in attempting to develop a defensible estimate of nonuse benefits for cleanup and reuse using stated preference methods?

Other than nonuse, what types of effects might the stated preference method be most successful in capturing (health, aesthetics, any others)?

Additional considerations for hedonics method:

A criticism of the hedonic property value approach for estimating the benefits of land cleanup is the gap between perceived and actual risk reduction. For many contaminated sites, health benefits are the key pathway by which individuals are affected by cleanup activities, yet health risks from contaminated sites are poorly understood even by experts. Are these criticisms legitimate? Can they be overcome?

Hedonic analysis does not easily reveal welfare measures. Are there circumstances associated with cleanup and reuse that either exacerbate or mitigate the usual problems of recovering welfare measures? Are welfare approximations possible?

What is the baseline from which cleanup and reuse benefits are to be measured using this method?

Additional considerations for broader analyses:

What types of benefits from clean-up and reuse might be appropriate to count – beyond those captured in the more traditional methods discussed above- and are there ways to capture these empirically?

Is it possible to shed any light on broader land use effects of cleanup and subsequent redevelopment in urban areas, and on the extent of the often noted 'greenfield-saving' aspect of land reuse?

[2] A detailed transcript was prepared by Jessica Sloan.

II. Methods[3]

A. Risk Assessment[4]

A risk assessment conducted for a large scale program such as one of the EPA land cleanup and re-use programs must address a number of specific steps:

(a) The set of sites within the program must be organized by some criteria so that a sample can be selected. Practical considerations associated with limited time and resources for each evaluation preclude a policy analysis from evaluating the implications of potential alternatives for the universe of all sites. As a result, the criteria for defining important attributes of sites will be important to all subsequent stages of the analysis. The Abt presentation illustrated this point using Media/Contamination units (MCU). In their setting an MCU was not necessarily a site.

(b) Conditional on the definition of the unit of analysis for characterizing the risk-based outcomes of a policy the next step in the process involves hazard identification. This process identifies the substances (chemicals, metals, etc.) of concern.

(c) Step three in the process involves developing a framework that characterizes the processes of contaminant release, fate and transport. The objective is to identify and represent the pathways of exposures and the people or systems (e.g. ecosystems) that are receptors.

(d) Once the exposures are fully described, the risk assessment stage involves measuring the cancer and non cancer risks and other risk related outcomes for each receptor and exposure profile. These can be developed in probabilistic terms so that they reflect the quantifiable sources of uncertainty.

(e) Programmatic evaluations can require extrapolation from a specific set of case studies to a national level.

(f) The final step in an analysis of the benefits from a policy requires monetization of the changes in risk outcomes implied by program related actions.

The advantages of the method were discussed as: the tangible description of the process linking the substance(s) to be influenced by policy; and the direct specification and measurement of the outcomes affected by each proposed policy alternative. The disadvantages discussed were associated with the fact that it is limited to health effects and does not take into account the role for private mitigation. In this context mitigation involves the activities of individuals seeking to avoid exposure to the substances involved in a risk assessment or in acting to mitigate their effects. Both of these types of activities influence the relationships used in a risk assessment. They impart a behavioral content to what are usually considered to be technical relationships.

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[3] There are a large number of primary sources for each of the methods described. A few example citations are listed for each method.

[4] See NAS (1983) Morgan and Henson (1990) for background

Behavior can be incorporated though it usually isn't. Other advantages stem from the ability to estimate risk conditional on various policies.

B. Stated Preference Methods[5]

Stated preference methods rely on presenting hypothetical situations to individuals. These descriptions are part of surveys that describe an object of choice and a set of conditions that are associated with a choice. The objects of choice can be anything. In the case of cleanup and land revitalization programs, they could be defined using the reductions in health risk estimated to be associated with these programs, the estimated effects on ecosystems, specific improvements to spatially delineated amenities, as well as a variety of other well defined changes due to a policy. They must be understandable and plausible. Under these conditions stated preference methods allow any type of good or service, a public or private program or policy to be considered. The set of conditions associated with the choice typically include the cost of implementing the policy to the respondent, how this cost is incurred (e.g., via higher prices of products, higher utility bills, change in property values, or taxes), the frequency of the payment (one-time payment or regular payments over a specified number of periods), what would happen if the program or change is not implemented, etc.

The method is implemented through a survey that can be conducted in a variety of ways (in- person, mail, telephone, or using the internet). The mode for the survey administration influences both how the material is presented and how economic valuation information is elicited. Stated preference methods present respondents with a change in the quality or quantity of a good which can be public or private, in an aspect of environmental service, or they can describe a change in a probability of a positive or negative outcome(for example, a change in the risk of dying from certain causes, such as cancer). The details of the change can be specified to involve time, the spatial extent of the effect, as well as a wide variety of considerations that can be associated with the context for a respondent's choice. As a rule, the change is described as hypothetical but the description itself is developed to assure it can be regarded by each respondent as realistic. In some studies, the change has been described as a plan that is intended to be as close as possible to policies that survey respondents would expect to take place. For the proposed change and the choices based on it to provide information that allows consistent economic tradeoffs to be measured, the change must have some resource related consequences which are also presented to each respondent: for example, the change would cost them a specified amount of money over a certain period and in a specified form (higher taxes, higher prices of product or result in higher property prices). Moreover, the respondents must be asked about the change with recognition of these consequences in a way that allows their answers to be related to an economic model for their choice process. These responses can be choices, ranks, explicit requests for payments they would be prepared to make, or any of a variety of other actions or answers that can be related, through an economic model of the decision process, to an implied tradeoff or the consistent selection of an action or alternative.

[5] There are many texts available. A primer by Champ et al [2003] provides a general overview of the method with detailed discussion of implementation issues. Kanninen [2007] provides a more technical companion volume discussing how stated preference methods might be estimated and evaluated. It focuses especially on the design and estimation of choice models.

The summary of stated choice methods by Alberini compared conjoint choice questions to discrete choice and "open ended" contingent valuation questions. The former describes the object of choice through a set of characteristics that are usually varied across choice alternatives. The latter often uses a single (or a small number of) "vignette(s)" that describe the features of an object of choice that would change from a baseline set of conditions to a new set due to a specific action or plan. Moreover, the question describes a process that would allow the individual's decision to be perceived as consequential.

The summary discussed the specific details of each process highlighting the importance of the implementation issues including:

- the design of the questions and materials describing the object of choice;
- mode of interview, sampling process and attention to selection effects;
- experimental design governing variation in the attributes (for conjoint), price (for discrete contingent valuation), baseline and default conditions (including scope test and importance of substitutes);
- the relationship between individual choices and the decision process; and
- the perceived likelihood plan or policy would be successful.

The advantages of the method were described as its flexibility and ability to consider both use and nonuse values. Disadvantages are of two types: (a) technical questions that relate to the implementation and ability to assure respondents understood and took the survey tasks seriously and (b) professional skepticism among many economists with stated choice methods[6]. The latter will be discussed in more detail in the next section.

It is possible to link stated preference methods with risk assessments in a variety of ways. One possibility involves asking for the adaptations in behaviors that are related to their likelihood of exposure or to the extent of exposure to substances associated with a risk. The actions that respondents would propose to take in response to a description of some external change would be the subject of the survey. To the extent these stated behaviors are intended to mitigate risks and their effects on risk are known (or can be estimated), then these types of responses would allow the stated behaviors to be used in adjusting the estimates from a risk assessment.

A second possibility comparable to Cameron and De Shazo [2005] involves describing an integrated sequence of changes that include morbidity and mortality effects that more closely resemble actual changes due to external influences.

C. Hedonic Methods

Hedonic property value models provide one of the oldest and most established methods for measuring the tradeoffs people reveal they would make for site-specific environmental services. While the hedonic pricing model finds its roots in early agricultural applications (see

[6] There are an extensive set of technical issues that have been raised with the design, implementation, and analysis of contingent valuation and stated choice surveys. Many of the initial issues were summarized in the NOAA Panel report in 1993. An extensive program of research has documented research responding to these issues. Summaries providing access to this research can be found in Champ et al.[2003], Carson and Hanemann [2005], Alberini and Kahn [2006], and Kanninen[2007].

Palmquist [2005] for a review), applications to property value markets began about forty years ago with Ridker and Henning [1967].

The overview of the hedonic framework described the price function as an equilibrium relationship. It is a description of the equilibrium relationship that exists between housing prices and the structural and site characteristics to assure there are no incentives for anyone to change locations. At the margin these functions describe what "people think they are obtaining by selecting a house (and a location) to purchase or rent." Of course, that revelation does not assure the laypersons' assessments of the importance of site specific effects are correct. It is important to also recognize that the hedonic model assumes reasonably complete information among market participants. Several conceptual studies have considered the influence of incomplete and asymmetric information among participants. Nonetheless, specific tests of the influence of differences in the state of information across participants in markets used for estimating hedonic price functions are quite limited.

Where several analysts have considered the effects of different patterns of public announcements (see McCluskey and Rausser [2003] and Dale et al [1999]), these studies have assumed that changes in the hedonic price function arise from the introduction of information (as part of the disclosures associated with policy), updating expectations, and responses of buyers and sellers in the market. In interpreting these results it is important to acknowledge that the analyses generally have records of housing prices and not measures of individual households' risk perceptions or of any information they had at the time of their decisions.

Palmquist's summary of the implementation issues focused on the characterization of risk as an attribute of a property, the size of the area affected by a site, the treatment of multiple sites, the size of the housing market, asymmetries in the information available to buyers and sellers, the timing of both the policy change and interpretation of what can be recovered from a hedonic model for housing prices versus rents. Finally his summary also discussed the issues in using hedonics models to estimate willingness to pay for risk changes as well as the feasibility of benefits transfer.

A number of issues were discussed including how the presence of hazardous substances and their cleanup at specific locations can influence adjacent sites and other uses of land in hedonic models. The link used to describe the physical association between a home's location and a measure of the risks of health effects or some other event (e.g. exposure to substances with long latency effects) that is attributed to a site with hazardous substances was identified as especially important. The differences in the timing of discovery and cleanup events related to a site with hazardous substances versus the role of timing in interpreting asset prices for homes or other uses of land was also a key consideration. Finally the prospect for correlation between site attributes and hedonic price function's error was identified as a concern. This potential was described due to several sources: (a) omitted variables that are correlated with the included characteristics or (b) a selection process that envisions some types of individuals, with a strong preference for one or more of the site attributes of interest, choosing locations on the basis of the characteristics of interest and other unobserved attributes. Either of these processes can result induce correlation between the included attribute of interest and the model's error.

Nonetheless, hedonic models estimated with individual housing sales information were described by several participants as promising models for these types of policy analyses. Other participants suggested that it is possible to use more aggregated data (e.g. census tract information) to make progress in estimating the benefits of land cleanup and reuse programs. Careful attention to the potential for spatial and temporal confounders was also identified as an estimation challenge.

D. Broader Land Use Methods

The presentation of broader strategies for evaluating the social benefits of land cleanup and re-use was motivated by two strands of research. The first consists of extensions to structural models of household location. These models follow the same basic logic as the hedonic framework. They assume environmental amenities or services are conveyed to people who live in specific areas. These models use this structure to impute values for the attributes (or services) that influence market equilibrium.

The primary difference between these models and hedonic models is that they seek to include sufficient information (usually in the form of assumptions about preferences and constraints on choices) to: (i.) recover estimates of the preference parameters accounting for the fact that many attributes are determined in equilibrium; (ii.) relax many of the mobility assumptions underlying the standard hedonic model; and (iii.) account for equilibrium effects in related markets (e.g. markets for labor, or for residential land in the outskirts of a town). These models can also be used to simulate new equilibria.

The second set of factors motivating this presentation was the Jenkins et al [2006] summary of the sources of social benefits from cleanup and reuse that EPA's research program seeks to measure. These include:

- Conventional sources of benefits - such as changes in health risks, amenities and ecosystem services.
- Enhanced productivity of factor inputs and/or local agglomeration economics that might arise from cleanups.
- Reductions in distortion to land supply that would be associated with liability and other restrictions on uses of vacant land.
- Improving the accuracy of lay persons' information about the hazards (health and other risks) associated with sites that had some hazardous substances prior to cleanups.

To describe in formal terms the welfare gain associated with improved information, we must specify the baseline state of information and how greater information that may imply "bad news" improves well-being. In a static framework, Foster and Just [1989] have proposed the use of a rationing model to describe how "bad news" improves well-being. The "old" information regime implies commitments to quasi-fixed goods that would be different with the "new" information. Thus, there can be a welfare gain with bad news. To evaluate it consistently requires an analytical framework describing how information affects choices and a specification of the state of the information before and after the policy. This process necessarily implies the set of choices that would be altered.

This summary, developed by Smith, did not attempt to summarize all the details of the various types of sorting models. It began by summarizing a distinction emphasized in applied welfare economics between partial and general equilibrium measures of consumer surplus in response to policies that lead to simultaneous price changes (see Just, Hueth, and Schmitz [2004], Mohring [1971], and Kokoski and Smith [1987]). This distinction focuses exclusively on adjustments through product and factor markets. The reason for identifying it stems from the fact that some of the responses discussed in Jenkins et al. [2006] are non-market general equilibrium adjustments similar in concept to the market based price adjustments discussed in the earlier literature. Sorting models provide the opportunity to begin to include them in multi-market representatives that underlie location adjustment of people to spatially differentiated environmental goods (amenities) and "bads" (risks).

The basic idea is reasonably straight forward. It can be illustrated with an example. If people know a street will be congested when they want to use it, then they select alternatives during that time but may use it in other times. There is not a formal price that induces the response. Modeling these activities can be complex and is beginning to take place in environmental economics.[7]

As a result, the bottom line recommendation of this presentation was to develop small prototype sorting and related models that could be used to evaluate the potential importance of the types of general equilibrium effects identified in the Jenkins et al summary. There has been little or no experience in using the methods associated with sorting models for practical policy analysis.

III Summary of Discussion

This section is organized in three parts. The first discusses highlights of the discussion of each method in the order they were presented. It extracts comments from each rapporteur's summary and adds context. Following that discussion, the results from the survey are presented. Finally a few key areas of agreement and disagreement are reviewed.

A. Reactions to Method Summary

Four issues were discussed at length after the two presentations associated with the risk assessment methodology. The first concerned the unit of analysis - MCU's in the Abt example, sites or sources of contaminants in others. Important to this discussion was the relationship between the unit of analysis and the sampling criterion that would be required to develop a national assessment of any large scale program. This relationship is, in principle, relevant to any method for benefit assessment. In the Abt example the selection was organized based on treating the policy outcome as a risk change. For other methods, the policy could be defined as altering another set of outcomes such as amenities at sites, groundwater quality, or ecosystem services. For a national assessment these choices have implications for decisions about the unit of analysis and the sampling criteria to conduct a national study. While they would not necessarily be the

[7] See Phaneuf et al [2007] for another recent discussion of general equilibrium adjustments outside markets.

same as those discussed in the Abt presentation of MCU's, they would raise parallel questions for the design of the policy evaluation.

A second focus was the exposure relationships within the risk assessment paradigm. Most of the participants felt this area was a weak component of risk assessment methods - both because of the difficulty of measuring the accumulated actual exposure even if individuals do not undertake averting behaviors and the fact that economic analysis implies it would be incorrect to assume these behaviors are irrelevant.

A third discussion point was the lack of attention to alternatives to VSLs for measuring the monetary consequences of the risk outcomes.

A fourth discussion point was the skepticism about the toxicological estimate used as inputs in the cancer risk assessments. This skepticism is fueled by concerns about the functional form of the dose-response relationship and the methods used to extrapolate from animal studies to effects on human populations.

Finally, the participants felt that non-cancer health consequences and non-health effects of exposure were poorly developed. As a result, the methodology provided an incomplete picture of the effects of policies. Concerns about general equilibrium responses to large scale policies were simply not discussed.

When the group discussed how a new research for the Superfund program would improve upon the Hamilton and Viscusi [1999] analysis, the main point that seemed to emerge from these discussions concerned judgments about whether the full sample of ROD sites they considered offers a sample that would be considered representative for current sites requiring cleanup decisions as part of current policy decisions.

Discussion of stated preference methods considered four areas. The first might be termed questions and disagreement over the extent of clear guidance from the literature on implementation decisions. For example, with complex programs would the required design space exceed respondents' cognitive capacity? Careful advance preparation of survey respondents with background information describing sites in baseline conditions and after proposed policy interventions does not guarantee there won't be unintended interpretations of survey related materials.

The most important issue raised with stated preference methods was a continuing point throughout the discussion. Despite significant advances in the "state of the art" since the widely cited Diamond-Hausman [1994] critique, the results from stated preference surveys are viewed as unreliable by a significant portion of the economics profession. As a result, any SP survey will need to include evidence of specific validity checks. Nonetheless, even with these consistency checks, there remained doubts among the workshop participants as to the acceptability of results from these surveys for high profile policy evaluations.

The remaining two comments discussed by the group were the flexibility of the method to accommodate a wide range of policy alternatives. This flexibility could not be assured with revealed preference methods. It does place increased burden at the design stage of the analysis

to assure that the hypothetical plans or programs presented in SP surveys include the *actual* expected program outcomes[8]. Without this overlap an extra burden would be placed on benefits transfer. This added step in policy evaluation was identified as important because it was acknowledged that the performance record of current benefit transfer methods is poor. As noted earlier, the tendency in several earlier SP studies is to consider risk changes (reductions) related to human health as the outcome of cleanup policies. It is also possible to consider other changes that might arise. For example, this could include changes in land attributes that would allow reuse (see Alberini et al [2007]).

Finally, the discussion of SP methods suggested that not many surveys had taken advantage of the purchase of a house as a vehicle for presenting the plans and outcomes. This proposal led to a discussion of the use of a housing purchase or decisions to modify a home as a more tangible context for describing these stated choice questions. However there were reservations stated with the marginal values measured with this formulation of the choice process because this approach would preclude measurement of non-use values.

Discussion of hedonic property value methods was especially active with a clear contrast between applications that focus on the use of the framework of quasi-random design to attempt to control for spatial and temporal confounders that might cause hedonic assessments to be biased. The approach of the natural experiment argument held that estimates attributed to the effects of cleanups in conventional approaches are biased. This conclusion was based on the assumption that other influences on housing values, arising from specific features of their locations which are unrelated to the changes in their status due to any cleanup of hazardous substances were responsible for the changes in their values. Past studies have not assured these factors were separately controlled in the view of those workshop participants advocating the quasi random logic for hedonic analyses.

In addition there is the prospect of correlation between distance-based measures of amenities or dis-amenities with the hedonics model's error due to the matching process that serves to define the equilibrium price schedule (i.e. the hedonic equilibrium implies each buyer selects a house at the price acceptable to the seller that provides no incentive to change). For example, when the unobserved features of buyers imply some types of individuals will select neighborhoods for amenities as well as for other unmeasured attributes then the selection process together with the omissions can lead to correlations and biased estimates.

The example used in these discussions to illustrate the importance of this strategy for analysis was a recent paper by Greenstone and Gallagher [2006]. It was suggested that conventional hedonic analysis are largely incorrect due to their failure to account for confounding influences that can lead to correlation between the included measures of the effects of hazardous waste sites and the hedonic model's error. For example, these authors note that:

"The empirical challenge is the NPL sites are the most polluted sites in the US, so it is likely that there are unobserved factors that covary with both proximity to hazardous waste sites and housing prices. Although this possibility cannot be tested directly, it is notable that proximity to a hazardous waste site is associated with lower population densities, lower household

[8] See Braden , Taylor, and Won [2007] for discussion of the use of distance in hedonic models versus stated preference (conjoint) based measures of the effects of environmental amenities.

incomes, higher percentages of high school dropouts, and a higher fraction of mobile homes among the housing stock" (p.5)

By contrast, conventional analyses emphasize the resolution in isolating the effects of locations with hazardous substances. The unit of analysis in Greenstone and Gallagher was the census tract. It was suggested by some participants this coarse level of resolution may bias the measured effect of proximity to hazardous waste sites. This argument suggests the bias was due to the available measures for the housing price (often the median)[9] and the inability for this unit of analysis to narrow the scope of hypothesized effect of these sites to the nearby properties. There was no resolution in the sharp difference in views and assessment of what was important to the method's results. Greenstone suggested it was straightforward to demonstrate that summary price measures would be capable of testing (within the quasi-random design used to control for the effects of confounders) for the effects of hazardous waste sites. The other hedonics analysts (Palmquist and Smith) suggested that the process of developing summary measures for house values over a geographic unit of analysis, such as the census tract, influences the ability to detect the effects of a site with hazardous substances on the summary measures involved. Their argument was suggested as relevant whether the measure for the home value was a median or a mean. Smith suggested that an implicit assumption of the Greenstone argument seemed to be the local constancy in the marginal effect of a hazardous waste site on all properties within the spatial aggregate providing the unit for analysis.[10] One source of the difference in views arises from the use of the estimates from a hedonic model for a marginal willingness to pay for cleanup as part of a benefits transfer that would be need to evaluate the benefits from a proposed cleanup of sites with hazardous substances versus measures of the mean treatment effect. The later measure the effects of listing or cleanups that have taken place on housing values. The Greenstone and Gallagher argument is primarily related to the effects of past actions with the listing of a site on the NPL taken as an indication of the intention to clean it up. Gayer argued that the identifying controls were especially important but did not take a position on the assumptions about the properties of the marginal effect of proximity to a site with hazardous substances.

[9] Their analysis does report the sensitivity of their findings to the use of the mean instead of the median and found their conclusions were qualitatively equivalent. The authors note that:
"We conducted a number of specification checks. These included using the ln of the mean (rather than the median) house price as the dependent variable, using a fixed effects style approach where the difference between the lns of 2000 and 1980 house prices is the dependent variable (rather than controlling for the 1980 ln prices), controlling for the fraction of census tracts within the 2-mile circles with a boundary change between 1980 and 2000, and adding the 1970 values of the controls(including the ln of 1970 housing prices) as separate covariates to adjust for mean reversion or pre-existing rends in the subsample where these variables are available. These specification checks all lead to the same qualitative finding that a site's addition to the NPL has little effect on the growth of nearby housing prices nearly 20 years later"(p. 30). This quote and the report treats homeowners' reports of what they believe their home would sell (the house value reported in the census) and a market price as synonymous. They are different measures. The report follows Greenstone and Gallagher and uses the two as price measures, referring to them as prices to avoid unnecessary complexity in the description.

[10] The regression discontinuity design can result in a small sample size. In the presence of applications where a relatively small effect is being estimated and there may be many sources of variation in the price measure, it may be difficult to determine if an insignificant estimate is simply the result of a small "true" effect and a small sample size. In addition, it is difficult to asses whether the effect identified with the regression discontinuity applies to the remainder of the sites with hazardous substances. To resolve such issues requires added assumptions.

The above summary is somewhat controversial. It was acknowledged that nonlinearity in hedonic equations could cause bias. However, it was suggested that a quasi-experiment that balances covariates across "treatment" and "control" units would eliminate all of these functional form concerns. Moreover, those supporting the use of census tract level data argued that the level of resolution in the data and measurement of the effects of sites was not correct. The summary of approximate constancy of the effect of distance on the homeowners' housing values was also suggested to be incorrect. The assumption underlying the Greenstone - Gallagher approach was that it tests for the average impact across all houses in the sample. Since the analysis reported in Greenstone and Gallagher [2006] is based on the median value of homeowner's reports of the price their homes would sell for (see footnote #9 for discussion of their sensitivity analysis using the mean values), it was difficult to reconcile these comments. Finally it was argued that the Greenstone and Gallagher finding of small to zero changes in the log of the median prices (or the log of the mean prices) suggests that consumers place a small value on the cleanups and thus this outcome obviates the concern about measuring the marginal willingness to pay for cleanups. One aspect of the discussion was the assumed equivalence between placement of a site on the NPL and cleanup[11]. Sites evaluated for the NPL but not actually placed on the list may well have been cleaned up under other programs. As a result, this interpretation cannot be assured without checking the control groups to assure that cleanups did not take place thru other means. Equally important not all the sites have been cleaned up by the time of this analysis even when they have been placed on the NPL. The panel could not come to agreement on many of the issues discussed with respect to the importance of all assumptions and interpretation of this study.

Areas where there was agreement include the difficulty in using spatial and temporal measures to capture the heterogeneity in information and risks perceptions of individuals. As a result, using the estimates from a hedonic property value model to recover marginal willingness to pay for risk changes seemed to be an area requiring significant new research. This point was identified in Palmquist's summary and found broad agreement.

Further concern was in constructing the counterfactual if all sites are to be cleaned. In this case the treatment of expectations and their effects on assets markets were suggested to be clearly important to interpreting hedonic estimates.

Discussion of the last unit on broader models was more limited due to the lack of time. Timmins' summary of the discussion highlights several points that were not completely covered in earlier discussion of modeling strategies.

As to Smith's proposals for broader modeling issues, the group as a whole was not as optimistic as he was about the prospect for implementing structural sorting models for policy evaluation. Even the prospect for small prototype models to gauge the implications of general

[11] Greenstone and Gallagher investigated this possibility and report that:
"…we were unable to find evidence of any remediation activity at roughly 60% of the sites with scores below 28.5. Further, among the 40% of the sites where there was evidence of clean-up efforts, the average expenditure was roughly $3 million. This is about $40 million leass than our estimate fo the average cost of a Superfund clean-up. … Nevertheless, some remediation took place at these sites, so it may be appropriate to interpret the results as the impact of the extra $40 million that a Superfund cleanup costs."

equilibrium effects was considered a longer term goal. Timmins raised in the discussion concern about the ability to establish existence conditions for unique equilibrium when these models are used in policy scenarios. Bayer and Timmins [2005] provide an existence proof for the case of a variant of the Berry, Levinsohn, and Pakes [2005] model, but these results are not assured to hold under more general conditions. A related argument for general uses of contraction mappings to establish the conditions for existence and uniqueness of Nash equilibria has been developed in the context of the public goods literature and should be considered in further research (see Cornes, Hartley and Sandler [1999] and Cornes and Hartley [forthcoming]).

Timmins' discussion identified other specific points that could not be discussed due to time constraints. The main highlights of his comments are:

- The distinction between vertical and horizontal differentiation in the assumed structure for preferences in sorting models is important. One formulation assumes all people evaluate bundles of spatially differentiated public goods (or attributes) the same way (vertical); the other allows different people to evaluate the various components of the bundle in different ways (horizontal). The main advantage of these structural models arises in their ability to predict how heterogeneous individuals would behave in response to a large scale policy and to consistently account for general equilibrium effects. This distinction in preferences was judged to be potentially important to the objectives that would underlie accounting for general equilibrium effects of policy.
- Sorting models are not well suited to taking account of nonuse benefits.
- Sorting models do have advantages for policies involving cleanup and reuse when many markets may be affected. They are best suited for describing long run behavior. These models offer insights (subject to the maintained assumptions associated with their structure) on the processes giving rise to the endogeneity of spatial and neighborhood variables often identified as problematic with hedonic models. Finally there may be features of a housing market that are incompatible with a hedonic that can be accommodated in a sorting framework. Some examples include transaction costs and idiosyncratic tastes (e.g. households prefer to live in areas close to their jobs).

B. Insight From Survey of Participants

The survey highlights the diversity in judgments about the various methods for measuring the benefits from each program. Table 2 summarizes the responses to the questions asking for a rating of the method's likely success in reliably estimating the national benefits for each program. The formulation of the questionnaire also identified a time horizon of 6-18 months with existing information and available research. Six participants responded using ratings of low to high. Two rejected the survey and preferred to send a memo outlining a recommendation that is discussed below. Smith omitted his ratings from the survey because he was summarizing and distilling the information for this report.

Table 2

Summary of Survey Ratings
Prospects for National Benefits Analysis of Each Program

METHODS

Program	Ratings	Risk Analysis	Stated Preference	Helonic Property Value
RCRA				
	LOW	3	1	2
	LOW TO MEDIUM	1		2
	MEDIUM	1	3	1
	HIGH		2	1
	UNABLE TO RATE	1		
	NO RESPONSE	2	2	2
SUPERFUND REMOVAL				
	LOW	3	1	3
	LOW TO MEDIUM	1	1	
	MEDIUM	1	2	1
	MEDIUM TO HIGH			2
	HIGH		2	
	UNABLE TO RATE	1		
	NO RESPONSE	2	2	2
REMEDIAL				
	LOW	3	1	2
	LOW TO MEDIUM	1		
	MEDIUM	1	3	1
	MEDIUM TO HIGH			2
	HIGH		2	1
	UNABLE TO RATE	1		
	NO RESPONSE	2	2	2
UNDERGROUND STORAGE				
	LOW	2	1	2
	LOW TO MEDIUM	1		2
	MEDIUM	1	2	2
	MEDIUM TO HIGH			
	HIGH	1	3	
	UNABLE TO RATE	1		
	NO RESPONSE	2	2	2
BROWNFIELDS				
	LOW	4		
	LOW TO MEDIUM	1	1	2
	MEDIUM		3	2
	MEDIUM TO HIGH			2
	HIGH		2	
	UNABLE TO RATE	1		
	NO RESPONSE	2	2	2

The survey succeeded in two important respects. First, it provides a tangible description of the diversity of opinions among the workshop participants. Second, the reasons offered for the ratings helped to isolate some additional issues that were not captured in summaries of the discussion. No doubt some of these were follow-up comments that participants wanted to include after having listened to other comments at the workshop. Moreover, they reflect the opportunity to reflect on the background information prepared by EPA staff about specific programs.

The first such suggestion comes from the participants who did not offer specific ratings of the methods for particular program evaluations. They noted that the exercise would be too hypothetical to provide meaningful ratings. Their recommendation was that the group should agree upon criteria to be used to judge the suitability of current and future studies. Table 3 summarizes their criteria, proposed as a starting point for discussion and refinement. They also observed that given the time horizon for analysis (approximately one year) the Hamilton-Viscusi [1999] book offers the best existing risk assessment and the Greenstone Gallagher [2006] hedonic analysis the most suitable for policy. It is important to note that these proposed summary judgments were not presented to all the participants for the purpose of developing a consensus. They represent opinions of two participants in the workshop.

Other comments made in preparing the responses to the questionnaire focused on specific aspects of individual methods. For example, one participant noted that wage and property value

Table 3

Criteria for Evaluating Analyses of Clean Up and Reuse Programs[a]

1 Internal Validity

- Is there plausibly exogenous variation in the variable of interest?
  - → The study should provide evidence that the distributions of ex-ante observational characteristics are similar for the "treatment" and control groups

2 External Validity

- Can the study's results be generalized to the overall population of interest?
  - → Is the sample of sites representative of the population of sites?
- Can the study's results be generalized to the time period of interest?
- Is the study's treatment relevant for the program that is under consideration?
  - → For example, a cross-sectional analysis of the price-distance gradient probably cannot be generalized to the effect of a clean up that occurs over time.

3 Theoretical Validity

- Can the study's results be interpreted as a measure of willingness-to-pay (or a bound on WTP)?

a. These criteria were suggested by Ted Gayer and Michael Greenstone.

markets in a national sorting model would be best suited to capturing the health and non-health effects of cleanup programs (but not non-use).

In the discussion of risk assessment several questionnaires noted the importance of the exposure and risk information as well as the composition of the sample of sites used to construct a representative set of experiences to meet the objective of a national assessment.

One participant offered an interesting dichotomy in assessing the feasibility of using some of the methods for all programs. On the one hand a method may, in principle, be able to address the demands for evaluation of a program, but the time required for results (a constraint noted to participants that was to condition their responses) or the available data may make the assessment on purely conceptual grounds unrealistic. For example, stated preference was described as having high likelihood of reliable benefit measures in all categories (and that is the conclusion one might draw from the counts taken from the survey responses for specific programs). However, limiting the time horizon to 6 to 18 months for completing the research implies the feasibility of conducting a new stated preference study that would be designed to realize the quality level for professional acceptance (given the complexity of the hazardous waste policies as commodities) was regarded as being very low. Stated preference methods were also described as avoiding the endogeneity issues that can plague hedonic models (due to the explicit control over how the object of choice is presented and the ability to assign randomly different variations in that commodity or the terms of its availability to survey respondents).

Hedonic methods were limited by the fact that recorded sales and information that can be assembled is so sparse as to preclude reliable measures. Facility diversity, a small number of sales transactions near sites, and careful delineation of what can be assumed to be known were all highlighted.

Overall the survey revealed that the constraints of time (and required use of existing research resources) were important factors in the ratings given. In addition, the participants could not make consistent distinctions between all the programs that were included in the summary material the EPA staff provided. Indeed, some participants simply repeated their initial responses, indicating that an overview of each program was not sufficient to evaluate the effects of specific features on the perceived performance of the methods.

C. Areas of Agreement and Disagreement

As a rule participants with significant research experience with a specific method tended to have more confidence in its ability to address policy needs. The proposed time and resource constraints were among the most important reasons for lower appraisals for the likelihood of success. The diversity of experiences at sites likely to be affected by each program as well as the limitations in the existing literature in each area were the primary factors underlying these judgments. Often the explanations cited limited prospects for benefits transfer.

Disagreement was focused on three areas:

- Limitations in the available hedonic models using data based on individual housing (or commercial/industrial) transactions to adequately separate the effects of hazardous waste sites from other special and temporal confounders.

- The ability of Greenstone and Gallagher's analysis at the census tract level to test for the effects of cleanup involving individual sites using data that are based on summary statistics for the owners' assessments of their home values. Concerns were also raised about the coarse spatial records as a limitation in detecting relationships.
- The likelihood of developing professionally acceptable stated preference estimates for these programs, given the current views of the economics professional as a whole on these methods.

While there was significant discussion of the first two points during the workshop, there appeared to be little movement among the various groups arguing each position.

IV Research Directions and Responses to Charge Questions

The format of the workshop was intended to focus the discussion of benefit methods around specific questions with the objective of providing an assessment of which valuation methodology is best suited to a generalized cleanup and reuse scenario. There was also an expectation that the rationale for those recommendations would be presented. This section distills from the presentations, rapporteurs' notes, survey materials, and the transcript for the group's discussion. Two types of responses seemed to emerge. The first is indirect and was not necessarily called for in the outline of objectives for the workshop. It concerns some research opportunities. The second response offers the summary that provides the closest summary to a consensus judgment of the participants.[12] It is important to acknowledge that the judgments are based on the participants' assessment of both the properties of each method and on the time constraints described as relevant for the results to be available for policy evaluations.

A. Research Opportunities

Three broad areas of research emerged from the disagreement among participants.

1. Hedonic Analysis

As noted earlier, there was a clear disparity in the workshop participants' perceptions of the existing hedonic literature dealing with proximity to sites with hazardous substances. The differences can be organized around four questions/themes:
Have the past studies of individual sites or a small number of sites adequately controlled for spatial and temporal confounders and endogeneity in the measures used to represent the influence of sites with hazardous substances on other residential locations?

Can the temporal pattern of price movements in response to cleanup or news about the sites be used to recover information about risk perceptions? Given one's answer to this question can market adjustments observed in one location be assumed to be relevant to other sites? And, finally do these price changes in response to variations in indexes of the site attributes offer unbiased estimates for the incremental value of cleanup and other policy relevant variables?

[12] Individuals who don't agree with components were given the option of being identified as disagreeing with the summary.

Does an analysis of summary measures for housing values, with their associated limited ability to provide a finely delineated description of how sites with hazardous substances influence housing values for proximate locations, provide the basis for testing the effects of cleanup programs and measuring their incremental benefits?

What is the relationship between the incremental benefits (if adequately measured) from a hedonic property framework and those derived from a risk assessment or stated preference analysis?

Two specific research projects can address the first and third questions. After the workshop, a paper by Kiel and Williams [2007] came to the attention of panel members and it was suggested we should identify the study for further review. The comments summarizing the study are intended to be information on it content. The study was not specifically evaluated by the committee. The Kiel and Williams paper reports hedonic price models estimated with micro level housing transaction for 57 NPL sites. The analysis began by considering 74 sites in 13 counties to evaluate whether proximity to Superfund sites with hazardous substances negatively affected housing values and whether the incremental effect was approximately constant. Seventeen of the seventy-four sites were eliminated for a variety of reasons including: low population density within three miles radius and an insufficient number of house sales that could be associated to a site.

The remaining fifty-seven sites had sufficient home sales. The records were classified into six time periods: prior to discovery; the time from discovery to being proposed for listing on the NPL; time from official listing to official commencement of cleanups; time from commencement to removal from the NPL listing; and the period following removal. Not all sites had records that would fall in all periods. A comparable hedonic specification was used for all sites, based on a semi-log equation with the log of the sales price as the dependent variable, structural characteristics of the house, variables describing the timing of the sale in relation to cleanup activities related to each site, census attributes for the tract where the house was located, and the log of the distance of the house to the closest site. Each of the models also included fixed effects for the sale year.

Eighteen of the 57 sites provided a negative and significant relationship between price and proximity to the site. That is, based on the Kiel – Williams' formulation of the variable intended to measure the effect of a site with hazardous substances, this means a positive and significant relationship between the log distance and the log of price. There is a wide variation in the estimated effect ranging from 0.94% to 92.06% for the percentage charge in distance. Thirty-three sites had some significant negative effects for proximity to sites with hazardous substances for at least one of the time intervals identified for the actions at each site. These authors overall conclusion was that:

> "…..due to the widely varying effects that NPL sites have on nearby housing prices, it may not be in the best interest of EPA to adopt a "one size fits all" formula for estimating the financial benefits from the cleanup of a given site."(P 191)

Their data sets would seem to offer a basis for comparing the Greenstone - Gallagher [2006] approach with conventional hedonic methods. Adding micro records for sites that were just below the NPL threshold and comparing the results using actual housing sales with median values for homeowners' assessments of the sales price at the tract level could be undertaken with limited effort developing the supplementary sites (and obtaining access to the Kiel and Williams data).

A second project would be a straightforward exercise to select one or more areas with existing hazardous waste sites, records of the housing transactions and design a counterfactual analysis of the equilibrium process using an assignment model (Koopmans and Beckmann [1957] and Wheaton [1974]) and specific preference assumptions, comparable to Cropper, Deck, and McConnell [1988]. Reproduce the conditions for the influence of localized effects and spatial confounders and evaluate the importance of micro-level case study analysis versus evaluation of outcomes with summary statistics at a geographic resolution consistent with the proposed methods of Greenstone and Gallagher [2006]. One or a small number of these exercises does not guarantee an unambiguous resolution of the question. It is likely to provide bounds on the size of the mistakes from each method, conditional on the importance assigned to the effect of hazardous substances.

With access to a number of available micro level housing data sets and the logic of solving the assignment problem within GAMS well documented, this effort is "doable" on a short time horizon and could be used as a platform for a wider range of policy relevant experiments. There are a number of specific issues that would need to be resolved to implement this research proposal (as there are for the first). Nonetheless, it would be possible to mimic the Cropper et al logic simply using the census economics characteristics to set up a set of households that match the census joint distribution of income and commuting times once an area is selected for the housing stock measures. The overall objective would be to select sites with hazardous waste sites and then use the homes at varying distances along with distributions for household incomes and preference attributes to solve for different hedonic equilibria. Micro analysis could be compared with summaries at the tract or block group level with a large enough number of properties included in the original assignment problem. While this analysis would not "prove" that one method was superior to another, if it were used in conjunction with an extension to the Kiel-Williams analysis (as outlined with the first research problem) the results would help to identify the features of actual situations that are likely to affect the performance of the hedonic model and the Greenstone-Gallagher strategy.

We believe these questions are sufficiently important that at least one of the proposed efforts should be undertaken to provide a benchmark for comparing existing and future results.

At present the second question cannot be answered in a convincing way, given the time horizon for policy, the state of our understanding of the formation of risk perceptions in this area, and the formal models for housing market adjustments. So it is regarded as a problem for longer term research that will not be resolved satisfactorily for intermediate policy analysis.

The last question can only be answered if we are prepared to add structure – assume something about the individual choice process, risk perception, and health effects, and mitigation

behaviors. Such an analytical framework can be developed based on past research. It would offer one set of maintained hypotheses and could be tested using a research design that collected housing data and stated preference responses from a common set of respondents. This would be a large scale project but need not have a long time horizon. There are, however, no guarantees it would provide transferable benefit measures. Its primary objective would be to test hypotheses that might later be incorporated in a preference calibration strategy for benefit transfer.

2. Stated Preference Analysis

The level of sustained professional uneasiness with contingent valuation and conjoint measures of economic values based on presenting proposed policies involving complex sources of risk to laypersons necessarily affects recommendations about using it in the analysis of significant national policies. As the summary table suggests, most panelist felt that SP methods were the most flexible and offered the prospects for considering the widest range of outcomes of cleanup policies. The professional acceptance of the method and the role of the research results for policy analysis conditioned what appeared to be the overall recommendations of the group for methods. It seemed that the workshop participants could not uniformly endorse research in this area as being ready now for developing benefit measures for large significant policies. This conclusion does not reduce the importance of sustained research in this area to learn how to improve practices so the issues that are associated with the concerns many economists have with stated preference methods can be overcome.

A further related area for research that is indirectly relevant for benefits assessment but not directly addressed in the workshop concerns the importance of research on individuals' risk perceptions for these types of facilities and how they change with cleanups.

In the short term the most directly relevant area for stated preference policy relevant research is with developers based on very specific descriptions if not actual projects where there are no strategic incentives for these responses. Alberini's research cited earlier (i.e. Alberini et. al. [2007]) suggests this strategy can be effective.

A recent independent discussion of the processes using developers' insights to measure land values for commercial projects at the Lincoln Land Institute confirms that experience. This type of focus takes advantage of the opportunity to use the expertise of commercial and residential developers as efficient "aggregators" of the relevant market information and to recover from this process an assessment of what is important. Stated preference in this context could be used to present them information and elicit choices that measure economic values based on their assessment of how markets would respond. In principle, this type of exercise could be a much lower cost activity (in terms of the costs associated with survey scale), but would require pairing economists with appraisers or others who know the developer markets in specific locations.

3. General Equilibrium Adjustment

The majority of the questions that were raised about new or uncounted benefits of land cleanups and reuse policies were reflections of general equilibrium responses. None of the

methods currently being studied has any prospect of addressing them. The workshop group endorses the potential importance of increasing our understanding of the importance of non-market factors influencing general equilibrium market outcomes. The prospect of a defensible model for policy was viewed as unlikely.

This research proposes a prototype study using a sorting model of an actual cleanup situation using historical data to evaluate whether the methodology can reproduce at some level observed market outcomes in response to policy. It also offers the opportunity to compare the model's description of the hedonic price outcome with the actual outcomes.

B. Discussion Questions

1) In general, does any one method, or combination of methods, stand out as better suited to the task of valuing the social benefits of land cleanup and reuse? Why or why not?

Response:

At present we believe the hedonic method with existing data (but not necessarily existing studies) offers the best prospect for defensible studies of the social benefits of land cleanup and reuse. New analyses of existing micro-level data are necessary to develop a more systematic record of what is known under a singe organizing structure. There are important qualifications to this summary judgment. Estimates based on hedonic methods will not capture non-use values; they should be used in concert with estimates from existing risk assessment models; and when using these technical measures for the risks they assume that buyers and sellers of properties are aware of them. In addition in the absence of a specifically designed study, it is generally impossible to disentangle the different components of the benefits of cleanup and reuse that enter into the measured changes in housing values (e.g. reductions in human health risks, reductions in ecological risks, aesthetics, etc.). Hedonic methods are well suited for estimating the benefits associated with the land cleanup and reuse actions that have already occurred at specific sites. To estimate the benefits of prospective cleanup and reuse at other sites where the activities have not yet been undertaken will require careful attention to the methods for transferring benefit measures from existing situations to these proposed sites. This process necessarily includes description and careful comparison of the attributes of these new sites and the surrounding communities in comparison to the situations where benefit measures have been developed.

2) Are there specific benefit categories that might be better measured using one or another of the methods? Please explain.

Response:

Hedonic property (and wage) and risk assessment provide use-related benefit measures. Careful modeling of housing values and rent and land use decisions may also allow researchers to study the long-term benefits of having options for land uses that are permitted with cleanup but would be precluded otherwise.

Stated preference methods are flexible. They seem to hold promise when it comes to studying certain aspects of cleanup (for example, lengthy cleanups and permanent cleanup versus alternatives such as partial cleanup or pollutant containment methods) in that they may offer the only route when there has not been experience with the potential options being considered.

Nonetheless, there remains professional skepticism (among mainstream economists and some environmental economists) about them. In addition it would be difficult to apply these methods reliably within the short time frame this Panel has been asked to consider (6-18 months). Some of the ambivalence about SP methods might be reduced if research was conducted to study the relationship between SP and RP measures of the effects of cleanup of hazardous waste sites (see Braden et. al. [2007] as an example). This research would need to incorporate measures of the information sources home buyers use in formulating assessment of these types of risks and analyses of how these assessments change when the sites are cleaned up.

Greater attention to modeling housing values and rents may help to incorporate the effects attributed to long term benefits from having expanded options for land uses that are permitted with cleanup but would be precluded otherwise.

Given professional views of stated preference methods for these types of risks and sites, the prospects of using them with laypersons for nonuse values over any time horizon relevant for policy seems dim. Research that considered the relationship between SP and RP measures of the effects of the cleanup of hazardous waste sites would help to reduce the ambivalence about SP findings. This work would need to incorporate measures of the information sources homebuyers use in formulating assessment of the types of risks and analysis of how these assessments change when sites are cleaned up.

2a) Is one or another of the methods better suited to measuring cleanup and reuse activities with different specific attributes; for example, lengthy cleanups, cleanups of sites for which the future reuse is known, or Superfund program cleanups? Please explain.

Response:

The short term research recommended for the hedonic, especially the assignment model exercise, the stated preference study with developers, and the research small prototype sorting model would allow this question to be answered. At present the diversity of responses to the survey suggests relying on the existing literature to isolate benefit measures that adequately capture subtle technical differences in these programs would not be prudent. A specific program of research organized to highlight how the program attributes contribute to outcomes that people can recognize (and respond to) would help in re-interpreting how the existing literature might be used to evaluate the performance of these programs.

3) Provide an overall assessment of the usefulness of the different methods for assessing welfare effects of EPA cleanup and reuse programs. If possible include a discussion of the limitations imposed by data constraints.

Response:

The data limitations are not as great as the failure to use consistent methods across the available micro data sets from hedonic studies in this area. The summaries provided earlier in this report provide the context for this brief summary conclusion. Our proposed research seems essential given a basic conclusion of the workshop. The participants in the workshop evaluated the same record of experience in the literature differently. These differences will not be resolved simply thru the force of argument with one group convincing the other. What is needed is new

information such as what would be generated by the project involving the assignment model. The results from this exercise may allow a return to the earlier literature for re-evaluation and adaptation for policy applications.

4) Based on the discussions at the workshop and on your collective expertise, how would the EPA best go about estimating the social benefits of its cleanup and reuse programs? Provide as much detail as possible. Include a discussion of data requirements and preferred methodology. Assess the feasibility of moving forward with the preferred methods. Include a consideration of available data.

Response:

The research tasks identified under the hedonic category above, combined with an analysis by the issues raised under the stated choice question, address this question.

As implied by the discussion of research opportunities, we believe there is the prospect to move forward on four points simultaneously:

- evaluation of the importance of spatial delineation versus quasi-random control within an experimental and pilot framework.
- strategic use of existing case studies for development of a more comparable set of summary results for use related values that can be evaluated for transferability.
- development with existing data on a pilot sorting model to evaluate the potential importance of GE response.
- evaluation, using either a series of small group cognitive interviews or a small scale stated preference survey, whether it is possible to elicit developer information on their assessments of the likely market valuation of cleanup related outcomes.

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Appendix A

Methods for Estimating the Social Benefits of EPA Land Clean Up and Reuse Programs

Potomac Yard **North** Building
Room 4830
2733 Crystal Drive (Two Potomac Yard)
Arlington, VA 22202
(directly behind the Hyatt Regency Crystal City)

Hosted by EPA's
Office of Policy, Economics, and Innovation, National Center for Environmental Economics
and Office of Solid Waste and Emergency Response, Land Revitalization Office
September 28 – 29, 2006

Agenda

Thursday, September 28, 2006

8:30 – 8:40	**Coffee and check-in**	
8:40 – 9:30	**Opening Session**	
	8:40 – 8:50	*Welcoming Remarks and Introductions* V. Kerry Smith, Arizona State University
	8:50 – 9:10	*Opening Remarks* Brian Mannix, Associate Administrator, EPA, Office of Policy, Economics and Innovation Susan Bodine, Assistant Administrator, EPA, Office of Solid Waste and Emergency Response
	9:10 – 9:15	Q&A
	9:15 – 9:30	*Background on EPA Cleanup and Reuse Programs* Ed Chu, Director, EPA, Land Revitalization Office
9:30 – 12:00	**Risk Assessment Methods**	
	9:30 – 9:50	*Fate and Transport Models for Assessing Benefits of Cleanup and Reuse Programs* Peter Eglinton, Abt Associates
	9:50 – 10:00	Break
	10:00 – 10:20	*Response to Charge Questions on Risk Assessment Methods*

James Hammitt, Harvard University

10:20 – 12:00 Discussion

12:00 – 1:00 **Lunch**

1:00 – 3:00 **Stated Preference Methods**

1:00 – 1:20 *Response to Charge Questions on Stated Preference Methods*
Anna Alberini, University of Maryland

1:20 – 3:00 Discussion

3:00 – 3:10 **Break**

3:10-5:00 **Hedonic Property Value Methods**

3:10 – 3:30 *Response to Charge Questions on Hedonic Property Value Methods*
Ray Palmquist, North Carolina State University

3:30 – 5:00 Discussion

6:30 Dinner, Landini Brothers, Alexandria

Friday, September 29, 2006

8:30 – 8:45 **Coffee and discussion of plan for the day**

8:45 – 10:30 **Broader Land Use Related Methods**

8:45 – 9:05 *Response to Charge Questions on Broader Approaches*
Kerry Smith, Arizona State University

9:05 – 10:30 Discussion

10:30 -10:45 **Break**

10:45 – 12:00 **General Discussion**

10:30 – 10:45 *Summary and Highlights*
Kerry Smith, Arizona State University

10:45 – 11:50 *General Discussion of Valuation Methods and Application to Land Cleanup and Reuse*

11:50 – 12:00 *Closing Remarks*
Barry Breen, Deputy Assistant Administrator, EPA, Office of Solid Waste and Emergency Response

12:00- 1:00 **Lunch**

1:00 – 2:30 **Compose Draft Responses to Discussion and Charge Questions**

2:30 **Close**

Methods for Estimating the Social Benefits of EPA Land Clean Up and Reuse Programs

Hosted by EPA's
Office of Policy, Economics, and Innovation, National Center for Environmental Economics
and Office of Solid Waste and Emergency Response, Land Revitalization Office

September 28 – 29, 2006
Participant List

We express gratitude and great appreciation for the close involvement of Dr. Nancy Bockstael, University of Maryland, in the development of this workshop.

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Appendix B

Estimating the Benefits of EPA's cleanup programs:
A Summary of Experts' Judgments

Part A. What type of benefits of EPA's cleanup programs can be measured using various methods? We have summarized the answer to this question in the table below. Please review it and tell us if you agree or disagree, and if and how you would like to amend it.

Approach	Health benefits	Other use benefits	Non-use benefits	Other benefits not included in the other categories	Is this just a composite measure of benefits?
Risk assessment methods	Yes (physical effects only)				
Stated-preference methods	Yes	Yes	Yes	Yes	
Hedonic pricing methods	Yes	Yes	No	Yes	Yes
Computable general equilibrium models			No		

Part B1. In this section, we would like you to **rate** each method's potential for success in providing reliable estimates of the national benefits of each of EPA's six cleanup programs within 6-18 months, given existing information and studies. This panel is repeated for each of six programs. Please note the name of the program at the top of each panel. In addition, we would like you to **provide one or two reasons** (or clarifications) for your judgment.

RCRA Corrective Action

Approach	This method's likely success in reliably estimating the national benefits of the program (low, medium, high)	Please type here one or two reasons for this rating/assessment
Risk assessment methods		
Stated-preference methods		
Hedonic pricing methods		

Computable general equilibrium models		

Part C1. In this section, we would like you to tell us which approaches (new or existing) or combination of approaches have the best future prospects for producing reliable estimates of the national benefits of the **Superfund** program? Please be succinct.

Part B2. In this section, we would like you to **rate** each method's potential for success in providing reliable estimates of the national benefits of each of EPA's six cleanup programs within 6-18 months, given existing information and studies. This panel is repeated for each of six programs. Please note the name of the program at the top of each panel. In addition, we would like you to **provide one or two reasons** (or clarifications) for your judgment.

Superfund Removal Program

Approach	This method's likely success in reliably estimating the national benefits of the program (low, medium, high)	Please type here one or two reasons for this rating/assessment
Risk assessment methods		
Stated-preference methods		
Hedonic pricing methods		
Computable general equilibrium models		

Part C2. In this section, we would like you to tell us which approaches (new or existing) or combination of approaches have the best future prospects for producing reliable estimates of the national benefits of the **Superfund** program? Please be succinct.

Part B3. In this section, we would like you to **rate** each method's potential for success in providing reliable estimates of the national benefits of each of EPA's six cleanup programs within 6-18 months, given existing information and studies. This panel is repeated for each of six programs. Please note the name of the program at the top of each panel. In addition, we would like you to **provide one or two reasons** (or clarifications) for your judgment.

Superfund Remedial Action Program

Approach	This method's likely success in reliably estimating the national benefits of the program (low, medium, high)	Please type here one or two reasons for this rating/assessment
Risk assessment methods		
Stated-preference methods		
Hedonic pricing methods		
Computable general equilibrium models		

Part C3. In this section, we would like you to tell us which approaches (new or existing) or combination of approaches have the best future prospects for producing reliable estimates of the national benefits of the **Superfund** program? Please be succinct.

Part B4. In this section, we would like you to **rate** each method's potential for success in providing reliable estimates of the national benefits of each of EPA's six cleanup programs within 6-18 months, given existing information and studies. This panel is repeated for each of six programs. Please note the name of the program at the top of each panel. In addition, we would like you to **provide one or two reasons** (or clarifications) for your judgment.

Underground Storage Tank Program

Approach	This method's likely success in reliably estimating the national benefits of the program (low, medium, high)	Please type here one or two reasons for this rating/assessment
Risk assessment methods		
Stated-preference methods		
Hedonic pricing methods		
Computable general equilibrium models		

Part C4. In this section, we would like you to tell us which approaches (new or existing) or combination of approaches have the best future prospects for producing reliable estimates of the national benefits of the **Superfund** program? Please be succinct.

Part B5. In this section, we would like you to **rate** each method's potential for success in providing reliable estimates of the national benefits of each of EPA's six cleanup programs within 6-18 months, given existing information and studies. This panel is repeated for each of six programs. Please note the name of the program at the top of each panel. In addition, we would like you to **provide one or two reasons** (or clarifications) for your judgment.

Brownfields Program

Approach	This method's likely success in reliably estimating the national benefits of the program (low, medium, high)	Please type here one or two reasons for this rating/assessment
Risk assessment methods		
Stated-preference methods		
Hedonic pricing methods		
Computable general equilibrium models		

Part C5. In this section, we would like you to tell us which approaches (new or existing) or combination of approaches have the best future prospects for producing reliable estimates of the national benefits of the **Superfund** program? Please be succinct.

Part B6. In this section, we would like you to **rate** each method's potential for success in providing reliable estimates of the national benefits of each of EPA's six cleanup programs within 6-18 months, given existing information and studies. This panel is repeated for each of six programs. Please note the name of the program at the top of each panel. In addition, we would like you to **provide one or two reasons** (or clarifications) for your judgment.

Federal Facilities Program

Approach	This method's likely success in reliably estimating the national benefits of the program (low, medium, high)	Please type here one or two reasons for this rating/assessment
Risk assessment methods		
Stated-preference methods		
Hedonic pricing methods		
Computable general equilibrium models		

Part C6. In this section, we would like you to tell us which approaches (new or existing) or combination of approaches have the best future prospects for producing reliable estimates of the national benefits of the **Superfund** program? Please be succinct.