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**ADVISORY ON SUPERFUND BENEFITS ANALYSIS**

**By Superfund Benefits Analysis Advisory Panel**

**Posted 4-25-05**

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**For any additional information about this teleconference, please contact:**

Holly Stallworth, Ph.D.  
Designated Federal Officer  
Science Advisory Board (1400F),  
U.S. Environmental Protection Agency  
1200 Pennsylvania Avenue, N.W.  
Washington, D.C. 20460  
E-Mail: [stallworth.holly@epa.gov](mailto:stallworth.holly@epa.gov)

**Letter to Administrator** --- to be written

**1.0 Executive Summary** --- to be written

**2.0 Background to the Advisory** ---- to be written

### **3.0 Overview of the SAB's Response to Charge Questions**

In the *Superfund Benefits Analysis* (SBA) the Agency presents an estimate of the economic benefits associated with the Superfund Program from 1980 to 2004 obtained from what it describes as a meta-analysis and benefits transfer based on studies of property values around Superfund sites and other hazardous waste sites. The Agency also describes how it proposes to quantify and monetize the benefits associated with three specific categories of effects and seeks the SAB's advice concerning its proposals. The three categories of effects are reductions in human health risks, reductions in injuries to ecological systems, and protection of ground water.

While the hedonic property value study is the most well developed of the four studies, there are major problems in the way the meta-analysis and benefits transfer have been conducted so far if the goal is to capture the historical benefits of cleanup. These problems are described in Section 3.1 below.

The Committee was asked for its recommendations regarding how to proceed with the three proposed approaches for estimating the benefits to health, ecosystems, and groundwater, given the state of the available data and methodologies for so doing, and the work done to date as presented in the draft SBA. The Committee concludes that the available literature and data will not support a comprehensive estimate of benefits in these three categories and recommends that the agency not move forward with any of the three individual efforts described in Chapter 5 of the report. In Sections 3.2 through 3.4 we explain our reasons for this conclusion and suggest ways that the limited data available might be used to provide a better picture of the likely benefits of Superfund.

The committee recommends that the Agency take the work done to date and use it to develop a starting point for future work. Specifically, we recommend that the work that went into the study be used to develop a comprehensive description of likely Superfund benefits while at the same time appraising the data and methodologies available and the extent to which these methods might be used to estimate portions of Superfund benefits. Full acknowledgement of the limitations and caveats of each particular method would be an integral part of this new report.

We believe that the report contains a lot of information that can be used to characterize the range of potential benefits of Superfund; but we do not believe that the current state of the science (economic, health, ecological, etc.) can support estimation of a single monetary value of Superfund benefits. Since the benefit assessment in this report is not being done in the context of a regulatory impact analysis or other formal cost-benefit analysis, the end product of the assessment does not necessarily have to be a number. Thus, given current methodological and data limitations, the committee feels that this report should not seek to estimate a single benefit

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estimate. Rather EPA should seek to provide an information set that reveals both the types of benefits resulting from Superfund and whatever information is available (in various forms) about the magnitude of those benefits, expressed either in dollars (where possible and appropriate) or in other meaningful units. Focusing on quantifiable impacts rather than trying to estimate monetary benefits for all impacts will help in identifying more clearly the associated benefits of Superfund. The Committee feels that some important benefits were left out (such as the benefits of the removals program and the deterrence impacts of the liability scheme, which were noted but not discussed much in the report) and that others were included that, from an economic perspective, probably should not have been.

The Committee believes that the Agency could make a major contribution by providing a coherent framework for thinking about the benefits of the Superfund program, that is by laying out an approach to benefits assessment in the specific context of Superfund. Figure 1.1 attempts to provide some structure for thinking about Superfund benefits, but it suffers from a number of shortcomings. For this reason, the Committee recommends that the Agency lay out an alternative framework for Superfund benefits assessment.

A beginning point for benefits assessment would be to think about the various impacts of Superfund, i.e., what changes have occurred (in physical terms) because of this legislation. One can then try to translate these "impacts" into measured "benefits" to the extent possible. Currently, the discussion of benefits in Chapter 1 appears to be focused on the different components of the Superfund program, not on a conceptual framework based on impacts. Two recent studies on ecosystem benefits can provide some guidance on a conceptual framework for

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benefits assessment (National Research Council, 2004, and Millennium Ecosystem Assessment, 2003).

In thinking about translating impacts into benefits, it is important to distinguish among the following: (i) those impacts that can be valued in monetary terms using standard economic valuation methods and available data, (ii) those that could be valued in this way if better data were available, and (iii) those that cannot be captured through economic valuation. For this latter category, it might still be possible to quantify the impacts in some way that provides information about the associated benefits, although in some cases even this may not be possible. The report should discuss clearly what kinds of approaches and data are available to estimate benefits, what the challenges are, and, from the authors' perspective, what are the best approaches that can be taken given the current state of the art.

In the rest of this section, we briefly describe the approaches used or proposed for each of the four categories of benefits, and we consider whether the available literature and data will support a defensible estimate of the monetary benefits generated by the Superfund Program from 1980 to 2004. We suggest ways in which the Agency might use the available literature and data on property values, health effects, ecological effects, and ground water protection to better characterize the beneficial effects of the Program.

### **3.1 Hedonic Property Values.**

We believe that the approach used in Chapter 4 provides some information on the benefit of living further away from a Superfund site, but it does not provide a credible estimate of the monetary value of the retrospective benefits of the Superfund program. There are three major problems with the approach that lead us to this conclusion.

1. *Limitations of the conceptual model.* Chapter 4 relies on hedonic property models, which attempt to estimate the marginal willingness to pay for a non-market housing amenity. One difficulty with such studies is finding an appropriate measure of the environmental disamenity to be valued. Most of the studies cited in chapter 4 use the distance to the Superfund site as a proxy for the environmental good to be valued. Furthermore, some of the studies are cross-sectional analyses that, coupled with the distance measure, effectively estimate the marginal willingness to pay for moving further from the site at a point in time. This measure is not easily adaptable to a measure of the benefits of eliminating the site altogether, let alone the benefits of the Superfund program (which, after all, does not lead to the equivalent results as complete removal of the disamenities associated with the site). Some of the other studies in the meta-analysis rely on panel data, which are better suited to estimating the marginal willingness to pay for changes in the status of the site (e.g., as the site progresses through clean up stages). However, none of the studies estimate price changes between discovery and completed clean-up. Further, the meta-analysis in chapter 4 still seems to rely on static estimates of the price-distance gradient even for the panel studies.

We could not discern how the estimated price-distance gradients were mapped into the aggregate benefit estimates. We believe that the estimated gradients were used to compute the price change that would result from moving all the neighborhood houses to a point where there no longer is a price impact stemming from the site. This assumes that the Superfund program leads to full recovery of housing prices. We believe that there is very limited evidence of a full price recovery. For the most part, the literature shows a price-distance gradient, which is evidence of a willingness to pay for distance from a site. But this does not necessarily imply that

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prices recover after EPA remediation. There is some evidence in the literature that the price  
gradient changes over time (which could be due to perceived rather than real changes caused by  
EPA), but it is still not clear that prices *fully* recover due to EPA activities. This is especially  
difficult to support given that most studies in the meta-analysis are either cross-sectional or use a  
narrow range of years of housing sales, neither of which can provide strong evidence of a full  
price recovery from Superfund actions.

A related concern of ours is how to determine which price to use as the baseline. Market  
prices should fluctuate through each of the many steps from discovery of a site to full clean-up.  
It is not clear which price to use as the baseline in a benefit estimate, and even if we agreed on a  
baseline price, it is even more difficult to estimate these prices based on the studies used in the  
meta-analysis.

As just one example, assume that a site is listed on the NPL, causing housing prices to  
drop. Assume also that prices then increase after the remedial investigation, which includes the  
baseline risk assessment. Should it then be assumed that after remediation, prices will return to  
pre-NPL listing, pre-remedial investigation or post-remedial investigation level? It could be that  
the initial decrease in prices was due to unfounded beliefs about contamination at the site, which  
was then mitigated with the release of the risk assessment. Doesn't this suggest that Superfund  
has caused a decrease in benefits by spurring the initial beliefs in the first place? Doesn't it also  
suggest that the appropriate baseline for the benefits measure is post-remedial investigation, after  
people were informed about the risks they face? Also, if pre-discovery is used as the baseline,  
doesn't that count any emergency removals as part of this benefits estimate? In sum, the report  
glosses over the loss in property values that occurs when a site is placed on CERCLIS or

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nominated to NPL. This loss would presumably be a cost of the Superfund program. The report misleadingly assumes that all price decreases are independent of Superfund and are only based on reliable perceptions, and that Superfund actions then fully recover prices from their lowest levels.

2. *What drives the price-distance relationship?* One of the biggest problems with hedonic studies of hazardous waste sites is that misperceptions could be driving some or all of the price effects. There is no clear way to tell whether the price gradient post-discovery reflects WTP for risk reduction or amenity improvements, or whether it reflects an irrational or ill-informed response. Similarly, any estimated price recovery from Superfund activity may be due to misperceptions about whether the risk or amenity was actually addressed. In the case of the studies used for this meta-analysis, it is largely assumed that a price-distance gradient implies that prices will recover after EPA remedial actions. However, this may not happen because of misinformation about what EPA actually does, or it may happen even if EPA does not actually address the risk or disamenity. As an extreme (and hypothetical) example, it might be the case that a low-cost effort to "demonstrate" action without actually doing anything substantive on the site leads to the same benefits as a real clean-up. More generally, most of the studies used in the meta-analysis in fact address a much different question than is appropriate for this report. Those studies (primarily) either estimate the relationship between housing prices and distance (this is especially the case for the cross-sectional studies), or they estimate how the price-distance relationship changes as information is released or events occur. Neither of these estimates are clearly transferable to an estimate of the benefits of Superfund actions. Such an estimate would



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need to estimate price changes over each stage of the Superfund process, with the added assumption that those changes are motivated by accurate perceptions of Superfund activities.

2. *Weakness of the meta-analysis/benefits transfer.* We are unconvinced that the sample studies used in the meta-analysis are representative of the full population of Superfund sites and that they can therefore be credibly used to estimate the full benefits of the 25 years of Superfund activities.

Chapter 4 states that a review of the literature produced 30 hedonic studies. In the end, only 9 of them were used in the meta-analysis. Chapter 4 does not discuss in detail the selection process that led to only 9 studies being used. We were unable to assess the studies that were not used for the meta-analysis; however, we do question the appropriateness of some of the selected studies. For example, the McClelland et al. (1990) article seems like an odd choice for this meta-analysis. First, the study only has 178 observations. What's more, the variable of interest is a "neighborhood" measure, so identification comes from even fewer observations (and thus the standard errors are biased upwards). Aside from the econometric issues, the article's main claim is that housing prices respond to subjective risk and that subjective risk differs greatly from objective risk. It does not seem appropriate to blend this study with others where the maintained assumption of the meta-analysis is that perceived and objective risks are equal. Finally, McClelland et al. attempt to estimate how housing values vary by subjective risk. They do not estimate a distance gradient, nor do their findings suggest that benefits would accrue from Superfund remediation.

Also, the Gayer et al. (2000) study estimates how the price-risk gradient changes when new information becomes available. It is not clear how this is incorporated into the meta-

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analysis of the benefits of Superfund remediation. Finally, the Mendelsohn et al. (1992) study  
does not use distance to the site as the variable of interest, so it is not clear how these estimates  
were incorporated in the meta-analysis.

In summary, the meta-analysis is based on a limited number of applicable studies. Given  
the small sample of housing price estimates from local markets, we are not comfortable  
extrapolating benefits to the full population of sites. There are many reasons why these studies  
may not be representative. For example, the study sites tend to be old and early NPL sites, they  
tend to be in places with high population density, and they tend to be larger sites. Chapter 4 does  
not contain enough information to assess whether the locations, chemicals and pathways, and  
other site characteristics are representative of the full population of NPL sites. All of these  
differences lead to potential problems with benefits transfer. Furthermore, the meta-analysis  
does not control for study characteristics or study site characteristics, which is necessary to  
obtain unbiased estimates.

Given these reservations about the estimation of national benefits from the meta-analysis  
and benefits transfer, we see two possible paths for inclusion of property value based data in the  
report. One involves dealing the issues we have raised above by:

- being explicit about the qualifications and caveats that are necessary in using this  
approach to estimate benefits;
- providing a richer discussion of the conceptual issues involved (baseline price level, real  
vs. perceived risks, relevance of the price-distance gradient for examining the behavior of  
house prices over time, assumption of full recovery of prices);

- revising the selection criteria and basing the benefits transfer on a different and possible larger set of studies;
- providing a more complete discussion of the selection criteria for studies to include in the meta-analysis;
- de-emphasizing the final figure from the extrapolation; and
- placing this chapter after those on health, ecological and other effects.

The results of this benefits transfer should not be described as an estimate of national benefits of Superfund, since at best it is an estimate of the aggregate housing price effects based on a particular set of assumptions, none of which have been or can be verified.

The second path is simply to review the existing empirical literature on housing prices near Superfund sites (with proper attention to the difficulties in interpretation) to demonstrate the significance that people apparently place on the presence of Superfund sites near their homes. If the work by Gallagher and Greenstone that was described to us during the public comment period at our February 24-25, 2005 meeting is available in the peer-reviewed literature, their results could be included in this discussion.<sup>1</sup>

### **3.2 Health Benefits.**

The Agency proposed to estimate the health benefits of reductions in 5 health endpoints:

- acute accidents and injuries,
- birth defects,
- lead induced health effects (cognitive deficits and cardiovascular disease),

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<sup>1</sup>However, if this work is to be discussed in the report, we would want to offer some more detailed comments on the paper as suggestions for the discussion.

- other chronic non-carcinogenic effects, and
- adult cancer.

The proposed approach for the first four endpoints is based on Lybarger, et al. (1998). This paper used existing epidemiological studies of the health effects of exposure to volatile organic compounds in drinking water to quantify health effects for seven endpoints associated with living in proximity to NPL sites. and valued these effects using available direct cost-of-illness data. For adult cancer, no specific method was proposed; but one of our specific charge questions suggests that extrapolation from a study by Hamilton and Viscusi (1999) was being considered..

In our judgment, a comprehensive and defensible estimate of health benefits from Superfund is not possible at this time for several reasons. The first concerns the epidemiology data. Superfund sites contain a variety of substances of concern, exposure routes, and numerous potential adverse health outcomes. The epidemiologic literature is too sparse to allow a complete assessment of health outcomes attributable to exposures in communities adjacent to sites. Lybarger *et al.* (1998) provides an estimate for one of the few classes of chemicals at superfund sites for which relevant data exist. The second reason is the limitations of the data on exposure. Lybarger, et al. (1998) used proximity to an NPL site as an indicator of exposure. But there was no direct measure of the amount of exposure or dose. Hence variation in degree of exposure across sites and within the population around any single site were not taken into account. And it would not be feasible to attempt to develop direct measures of exposure for the large number of sites affected by Superfund over the past 25 years.

The third reason is difficulties in obtaining values for many of the health endpoints in question. The Report correctly notes that the direct medical costs as estimated in the EPA Cost of Illness Handbook (2002) represent a lower bound on the true social cost of illness. There are both revealed preference and stated preference methods for estimating the willingness to pay to avoid morbidity effects (See Freeman (2003), Dickie (2003), or EPA's Handbook for Non-cancer Health Effects Valuation (2000)). But we are not aware of empirical estimates based on these methods for most of the health effects of interest here. We also note that the EPA Cost of Illness Handbook does not give cost of illness data for accidents and injuries or chronic non-cancer effects. We do not know whether there are cost of illness data for these effects from other sources.

We are also skeptical of the use of the Hamilton and Viscusi (1999) study (H&V hereafter) to obtain estimates of the numbers of cancer cases avoided. H&V studied a nonrandom sample of 150 sites on the NPL where RODs were signed during 1991-2. Rather than the upper-bound estimates used by EPA, H&V used mean values for ingestion rate, exposure duration, and chemical concentration to estimate individual and population risks of cancer for each site. H&V combined the estimates of population risk with data on populations within 1 mile of each site to estimate the numbers of cancer cases over an assumed 30 year time horizon. On the assumption that these excess cancer cases would be avoided with site remediation, this could be the basis for an estimate the benefits of Superfund remediation at these site.

There are two problems with using these data to estimate the benefits for all sites covered by the remediation program. First, it is not clear that the estimate for the 150 sites in H&V can

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be the basis for extrapolation to the universe of sites covered by the Program. H&V report that almost 90% of the predicted cancer cases in the sample came from one site, indicating a high degree of variability across sites. And second, H&V used the Agency's estimates of cancer risk factors in their own calculation. But at least for those chemicals where the risk factor is based on animal test data rather than epidemiology, the risk factors are 95% upper confidence levels rather than maximum likelihood values. Thus an estimate of cancers avoided based on H&V would still be biased upward perhaps by as much as an order of magnitude.

Although, as we have said, estimates of the aggregate health benefits of Superfund are not possible, it is possible to present illustrative calculations of some important components of the benefits to human health. For example, we recommend that Lybarger, et al.'s (1998) estimates of reductions in several categories of health effects associated with exposures to VOCs be described. Their estimates of the reductions in the costs of these illnesses should also be described along with the comment that cost-of-illness is an underestimate of the true social value of reduced adverse health effects. Some authors have reported evidence that true social values for some health effects appear to be several times the direct cost-of-illness avoided (see Dickie, 2003, p. 439, and Alberini and Krupnick, 2000). We suggest that the Agency present a sensitivity analysis of the Lybarger, et al. results based on this evidence.

We also recommend that the Agency consider an analysis of the benefits related to reduced lead exposure. EPA should develop a model to quantify the full range of toxic effects that may result from exposure to lead, including cognitive changes; behavioral changes that may produce increased rates of criminality, drug abuse, and incarceration; and cardiovascular disease and stroke related to elevated blood pressure in adults. An example of

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this approach is available in Landrigan (2002). See also the EPA lead benefits assessment model used in its Retrospective Benefit Cost Analysis of the Clean Air Act (EPA, 1997).

These two approaches should be included as examples of estimates of benefits for a few of the many chemicals of concern. The report should go on to explain that due to lack of adequate data for many chemicals and for exposures to individuals residing near superfund sites, a complete economic benefits analysis is not possible. Also, support by Superfund of the planned "National Children's Study" and of oversampling of populations at strategic Superfund locations will aid in developing more complete future analysis.

### **3.3 Ecological Benefits.**

The Agency proposed to define the ecological benefits associated with restoration at sites undertaken because of Superfund as the decrease in the discounted present value of interim lost use value brought about by restoration compared to the counterfactual scenarios: either natural recovery or no recovery (as appropriate). Under the law as we understand it, interim lost use value includes passive use value (or what is sometimes called nonuse or existence value). We endorse this definition of ecological benefits. To make use of this definition, the Agency needs to have an estimate of interim lost use value for each site at the time that the restoration action begins, as well as estimates of the time paths of interim lost use value under natural recovery and under active restoration. To obtain estimates of interim lost use value the Agency proposes first to obtain the dollar values of the natural resource damage assessment (NRDA) settlements for those approximately 130 sites (including 70 NPL sites) where settlements have occurred. For some of these sites, the Trustee's estimates of interim lost use value can be obtained from the NRDA documents. For these cases, the Agency proposes to determine the relationship between

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the NRDA estimate of interim lost use value and the settlement amount. For those sites for  
which interim lost use value is not available, the Agency would use the ratio of interim lost use  
value to the settlement amount to calculate an estimate of interim lost use value as a percentage  
of the known settlement amount.

We applaud the Agency's effort to find a way to include ecological benefits in its  
accounting of the benefits of Superfund. But we doubt that what is proposed here will result in  
defensible estimates of the aggregate benefits of the Superfund program. We doubt that interim  
lost use value as a percentage of the settlement is constant across sites. NRD settlements – like  
any legal settlement – are products of negotiation as much as they are the products of calculation  
or analysis. Also, trustees are authorized by law to include restoration costs and replacement  
costs of lost resources in their claims. Replacement cost can not be considered as a proxy for  
interim lost use values. NRD remedies often include dollar claims for other remedies besides  
restoration of damaged resources. For instance, settlements may be used to construct trails,  
docks, or other facilities to compensate for losses. Thus, the dollar value of an NRD settlement  
is not, and should not be construed as the "value" of ecological impacts. Finally, the Agency has  
not identified a way to determine which of those sites for which settlements have not already  
occurred can be expected to have ecological benefits.

If our suggestion to move away from an effort to generate an aggregate benefits number  
for Superfund is accepted, we recommend the following as ways to provide illustrative and  
qualitative information on the potential ecological benefits of the Program. We recommend that  
the authors of the SBA more fully describe the various ecological consequences of cleanup and  
removal and then translate those into descriptions of beneficial effects that the public can



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understand. This will be a qualitative exercise, but it is a way to convey the range of improvements to well-being that can result from site cleanups.

In addition depending on the resources and time available, the Agency could conduct quantitative, but non-monetary assessment of ecological benefits. This would involve the development of ecological benefit indicators. This method was described and recommended in the report of the Panel to Examine Benefits, Costs, & Impacts to the Underground Storage Tanks (UST) and Resource Conservation Recovery Act (RCRA) Subtitle C Program, in 2002.

#### **3.4. Ground Water Protection Benefits.**

The Agency proposes to quantify "the amount of ground water protected by Superfund ..." (p. 5-33), and to use benefits transfer to estimate the monetary value of ground water protection. The Superfund Program can affect ground water quality and yield benefits through three channels:

1. Restoration of the quality of contaminated ground water through remediation;
2. Clean up of sites so as to prevent contaminants from migrating from the sites into ground water resources; and
3. Deterrence of poor disposal practices so as to prevent the contamination of ground water.

The discussion of the areas of NPL sites with contaminated ground water (p. 5-38) suggests a focus on the first two of these channels. But a sentence on the next page suggests that the concern is with the third channel.<sup>2</sup>

The Committee believes that it would be possible to obtain a ball park estimate of the quantity of groundwater that is affected by Superfund through the first channel. However, this would require an examination of the conceptual models for each site individually to see how much cleanup has occurred in three dimensions. For a given site, the cleanup criteria for that site may differ. It is strongly suggested that the Agency use more carefully crafted case studies showing Superfund's impact on groundwater. There are a number of case studies that can be used to estimate the quantity of ground water cleaned up, for example, the Fairchild Semiconductor Case; the Ft. Devons Case; the Industri-Plex Case. The Panel does not know of any reliable ways to estimate the quantities of ground water affected through the second and third channels above.

Regarding the valuation of protected ground waters, the Agency proposes to do "... a meta-analysis of individual studies to get a range of willingness to pay for ground water quality, and possibly placing states into groups based on relevant metrics." Based on our examination of

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<sup>2</sup>Quoting from the Report, "Many of these areas ... have been controlled or reversed through Superfund response actions, and there may be some sites where removal actions or state actions may have prevented potential ground water contamination (p. 5-38)." And, "It might be possible ... to estimate the amount of ground water that will not be contaminated because of Superfund, but would have been in the baseline case where no Superfund Program had ever come into being. (P. 5-39).

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the 13 studies listed in Table 5.6, there is not at the present time an adequate basis for doing a  
meta-analysis or benefits transfer. As the Agency points out (p. 5-34), two of the studies cited in  
Table 5.6 cast doubt on the feasibility of benefits transfer. And 7 of the 13 studies are about  
either surface water or nitrate contamination of ground water, making them of questionable  
relevance for the purpose of valuing Superfund.

#### 4.0 RESPONSES TO SPECIFIC CHARGE QUESTIONS

In this section we provide responses to the specific charge questions not already answered in Section 3. [Note to the Panel: What follows is largely a cut and paste of the individual submissions with only a minimal editing for consistency.]

**4.1. Charge Question 1: Chapter 1 provides a framework for capturing the benefits of the Superfund program in the *Superfund Benefits Analysis* (SBA). Chapter 2 reviews the literature relevant to the SBA; and Chapter 3 describes the structure of the Superfund program. Please comment on the adequacy and appropriateness of these introductory chapters as a foundation for the SBA.**

The committee recommends that this chapter receive major revisions. The chapter does a nice job of introducing the reader to the Superfund program, but the language in the first few pages reads more like a public relations document than an objective description of the program. In addition, there are a few misstatements about the program that should be corrected, such as the statement (page. 1-4) that many of the worst sites are now addressed by state programs and that Superfund addresses "abandoned" hazardous waste sites (p-1-7).

This chapter should have two primary goals: (1) to lay out a framework for the report and (2) to provide a coherent framework for thinking about the benefits of the Superfund program. These two goals are not independent, however, since the framework for thinking about benefits should in turn inform the framework for the report.

In terms of the first goal, the introduction should provide a motivation for the report, a discussion of the analytical approach taken, any critical caveats, and a roadmap to the remainder of the report. The introduction should also make clear the purpose of the report and any time or money constraints, as well as the fact that much of the work here is based on earlier studies and is not original research. It should be organized to clearly distinguish the following components:

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roadmap for the report, overview of the Superfund program, definition of how the term "benefit"  
is used in the report, description of benefits, and methodology or approach for estimating  
benefits.

The Committee did not find the delineation of either "approaches" or "benefits" in Figure 1.1 very useful, and the mapping between the two was unclear. Likewise, the Committee did not find the distinction between fundamental and embedded benefits, or their definitions, to be very helpful as an organizing principle. For example, why is "community involvement" a separate approach (rather than part of "response") and why is "empowerment" per se a benefit category (rather than a means toward an end, namely, better outcomes)? Why is reduced uncertainty about the nature and extent of the actual health risks associated with releases considered part of the amenities benefit, and why aren't deterrence and emergency preparedness simply means toward an end (reduced damages)?

Much of Chapter 1 appears to follow EPA's *Guidelines for Preparing Economic Analyses* (2000). However, the central focus on this guidance detracts rather than adds to this section, and hence the committee recommends eliminating the discussion of this guidance. This guidance was developed for prospective analyses, not retrospective ones, and is probably not even appropriate for this kind of study. For example, starting a section on "Problem Definition" after already discussing Superfund and introducing a basic approach to be taken (through Figure 1.1) seems backwards. Likewise, in the context of this retrospective analysis, which considers only benefits and no costs, the section on "Reasons for Market Failure and the Need for Federal Action" adds little. The chapter then goes on to define Superfund approaches and Superfund benefits, but this is several sections after these concepts have already been introduced as a basic

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organizational framework for the report in Figure 1.1. The section on "Methodology" is a combination of a discussion of methods and a discussion of some benefit categories. For example, the paragraphs on p. 1-17 say very little, if anything, about methodologies that will be used in the assessment. It is useful to have a mapping between benefits and methods, but the Committee generally found the attempt to do this through Figure 1.2 confusing.

The literature review in Chapter 2 is a thorough review of the literature that it covers. However, much of the paper-by-paper description is tedious and might be better put in an appendix. The text should focus on general conclusions from the literature, rather than a detailed description of a list of individual studies. The purpose should be to draw from the literature to identify gaps in our understanding, both in benefits estimation more generally and in the specific context of Superfund, and to provide some direction for the analysis in the report, i.e., where we go from here.

In addition, the Committee feels that Chapter 2 omits some relevant literature. For example, the chapter should include the literature on methods benefit estimation as well as on previous studies of the Superfund program. There is little in this chapter, or in the rest of the report, about the promises and pitfalls of the hedonics approach for capturing benefits, nor on some of the other approaches. Another example is the recent literature on ecosystem valuation (e.g., NRC report, Millenium Assessment). This literature provides both a logical framework for thinking about benefits assessment of ecosystem services, and reviews of the current state of knowledge in this area. A third neglected literature relates to uncertainty. In general, the report needs to acknowledge the uncertainty inherent in both the benefits of Superfund and their estimation, and discuss how uncertainty can and should be treated.

Finally, the case studies need to be tied more to text or eliminated. They are well-written but not well integrated into the report or used as support for the text.

**4.2 Charge Question 2: The latter part of Chapter 3 discusses the data used for the SBA. With regard to this data discussion, please address the following.**

Chapter 3 of the Report covers two distinct topics: (1) a description of the Superfund program (pages 31- through 3-25) and (2) methods for characterizing NPL boundaries and potentially affected populations for use in subsequent chapters (pages 3-26 – through 3-49). Charge questions 2a – 2d pertain to the latter topic, but the Committee believed it was important to provide comment on the first part of this Chapter.

The Committee's discussion of this part of Section 3 centered on three questions:

- 1) Is there a clear link between the Problem Definition (Section 1) and the Description of Superfund Responses (Section 3)?
- 2) Is the Superfund process adequately and accurately represented?
- 3) Are the appropriate Superfund responses used in subsequent sections to characterize Superfund benefits?

**Question 1: Is there a clear link between the Problem Definition (Section 1) and the Description of Superfund Responses (Section 3)?**

Section 1 casts a broad net over CERCLA benefits that includes not only the response sections of the Superfund program, but also lists as approaches (Table 1.1)

- Community Involvement
- Enforcement
- Research and Development
- Training

- Natural Resource Damage Assessments

Yet, the *Description of Superfund Responses* section deals principally with Response Actions, and does so without being clear as to its overall role in the Benefits Analysis. While a description of the Superfund program is of course useful to this report, it is unclear if the reader needs, for example, to know the details of the site screening process and the remedy selection process in order to understand and estimate the benefits of the program.

As mentioned in the comments on Chapter 1, the core focus of the report is on "benefits" and the rest of the report needs to provide the information needed for that purpose. The reader needs to understand CERCLA's basic authorities and goals, and something about how the program functions, but whether it is necessary to describe the remedial process in such detail is unclear. More useful would be to discuss what the law requires in terms of protection of public health and the environment, a very brief overview of the removal, remedial and enforcement program, summary data on the number of different kinds of actions, information on the evolution of the program over time, program accomplishments to date, and the heterogeneity among NPL sites, specifically noting how Federal Facilities are different from other NPL sites, and perhaps also discussing what kinds of sites are on the NPL.

**Question 2: Is the Superfund process adequately and accurately represented?**

In general, the Committee believes that the overall description is a reasonable representation of the Superfund process. However, the Committee recommends that this chapter be reviewed in detail by someone expert in the detailed workings of the Superfund program in order to correct a number of statements throughout this section. Some examples are: the discussion of EPA enforcement does not seem fully cognizant of the critical role that settlements



play, the description of state capabilities is not accurate, there is no mention of the fact that Superfund liability is retroactive, and the text incorrectly states that sites must be on the NPL for the liability scheme to be invoked. Also, it is unclear what the basis is for many of the statements in this chapter. For example, the Remedial Investigation and Feasibility Study process is described on pages 3-12 and 3-13 of the report. A good reference document for this section is EPA's 1988 *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*.

The role of risk assessment in the remedy-decision process should be better represented in this section. Ultimately, all remedies are based to a large part upon protection of human health and the environment, so the ties between the Human Health and Ecological Risk Assessment processes (EPA 1989, 1995a, 1997) need to be better explained and documented.

[Note to Panel: The next two paragraphs may need some revision in light of the SAB Comm. On Valuing the Protection of Ecological Systems and Services having adopted the anthropocentric position that ecosystem benefits are increases in ecosystem services to people.] . A central premise that runs through the report is that ecological values under CERCLA are tied implicitly and explicitly with services to humans (see Table 1.2). Examples of ecological benefits included fishing, harvestable forests, water filtration, and even golf courses. While economists may effectively argue that these are the best indicators for valuing ecological resources, the Committee points out that ecological resources and risks under CERCLA are valued in-and-of themselves, and not solely on their potential to bring benefits to humans (NRC 2001; EPA 1992, 1995a,b, 1997b, 1999). The danger in not making this distinction is that the

report implies that unless human services from ecological resources are shown to be negatively impacted, there would be no ecological benefits from a CERCLA remedial response action.

A case-in-point is for wildlife that is protected under the Endangered Species Act (EPA 1997). For example, the 1999 listing of bull trout (*Salvelinus confluentus*) under the Endangered Species Act<sup>1</sup> requires consideration of risks to bull trout not only in the ecological risk assessment, but also in the Remedy Selection process as an Applicable or Relevant and Appropriate Requirement (ARAR) under Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act of 1899<sup>2</sup>. The Committee believes that this distinction between ecological risks under CERCLA, and ecological benefits should be made very clear in the document.

As noted previously, the report would benefit by a careful reading by someone within EPA who is knowledgeable on the overall Superfund process. For example, the discussion of the CERCLA Remedy Selection Criteria (EPA 1988) is given on page 3-13, and the report goes on to state under Selection of Remedy that the "FS identifies the best response options". The Feasibility Study evaluates a range of alternatives and compares them to the first seven selection criteria. The criteria of State and Community Acceptance are evaluated by the EPA, in consultation with stakeholder (states, Tribes, U.S. Fish and Wildlife Service), public input, and in consideration of environmental justice issues (1997a, 1999).

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1 Federal Register, Volume 64, Number 210, Thursday, October, 28, 1999.

2 The CWA Section 404(b)(1) Guidelines are contained in 40 CFR §230.12(a), while the Rivers and Harbors Act requirements are listed in Regulatory Programs of the U.S. Army Corps of Engineers [33 CFR §320.4(a)].

**Question 3: Are the appropriate Superfund responses used in subsequent sections to characterize and quantify Superfund benefits?**

The majority of the SBA focuses on actions at NPL sites. There are two issues regarding this decision. First, NPL sites are anything but homogeneous. To the extent that the study relies on a subset of sites it is critical to assess how this subset represents the full NPL, and what types of sites should be analyzed in separate categories. These categories, we would note, might be different for different types of benefits analyses (e.g. for the hedonic study vs. the cost of illness study.) Still, it seems clear that, at a minimum, federal facilities should be kept separate from non-federal facility sites. In addition, it is important to acknowledge that the benefits of so-called "redevelopment" sites, of which Industri-Plex is a good example, as captured in a hedonics approach, would capture not only the benefit of cleanup, but also the benefits of redevelopment. This must be addressed somehow in the study. Perhaps most troubling, though, is the fact that while the authors note that removal actions may well result in much of the decrease in current risk, these actions appear to be ignored in the remainder of the report.

One small but important point in the description of the process is to note that some percentage of RODs are what are called "no action RODs" meaning that EPA determines that no remedy is needed at the site. A second important point about RODs, in terms of assessing site progress, is that a larger percentage of NPL sites have more than one remedy, and more than one ROD. While this is mentioned, it is unclear how this is addressed in terms of assessing site progress. We would note that it would be worth finding out what number or percentage of deleted and construction complete sites are "no action ROD" sites.

Substantively, the Committee's greatest concern related to the description of the roles of the states. While it is true that CERCLA requires states to pay for 10% of FUND-lead remedial

actions (and 100% of operations and maintenance for these actions, i.e. not at RP-lead actions), we are not sure if most states would say that CERCLA provides a 'substantial role' for states. When states do carry out actions, all decision-making powers still are with the EPA, and not the states. At a more general level, the discussion of state funding and capabilities does not comport with the research of others about state capabilities and capacity for NPL-level cleanups. More weight is given to the report from ECOS, which is not specifically about Superfund, than the Environmental Law Institute and Resources for the Future research that is more focused on cleanup activity. The assumption that 25% of state cleanups are paid for with federal dollars seems highly speculative. Also, we would recommend against including a chart, as in Figure 3.4 where state and EPA actions, and actions as varied as removal and remedial actions, are all put on one chart. These are truly apples and oranges in terms of their costs and their accomplishments.

Also, the ELI report must be examined quite carefully as it includes cleanups under a variety of programs, not just Superfund (need to check this). We would also strongly recommend taking proposed NPL sites out of the statistics (would note that the RFF 2001 Report includes a site by site description of the status NPL "proposed" sites at that time), and separating federal facility sites from other NPL sites. As an example, the Report makes mention of the Lower Fox River site in Wisconsin as an NPL site; that site is nominated, but not listed. The Lower Fox River remains a Wisconsin state-lead project. It is true that the EPA is an active participant, and that some benefits may be construed from the Agency's participation, but the distinction needs to be clear.

Turning to the part of Chapter 3 starting on page 3-25, the report does sound GIS work on mapping the sites and the boundaries. The main problem with this chapter is that it does not provide enough information in which to assess whether the sites from the hedonic studies are representative of the universe of sites. It also misleadingly defines the universe of sites as ROD sites (including no-action RODS), which seems inappropriate for a retrospective study. The extent of these problems depends on whether the report moves forward with the current meta-hedonic analysis. If the hedonic analysis is to be de-emphasized, then chapter 2 can be re-written to provide much more information about each of the types of sites listed in Table 3.3, as a means of explaining the different type of remedial work that Superfund does. But with the hedonic analysis de-emphasized, it would no longer be necessary to show that the hedonic sites are representative of the universe of sites (however defined).

**2a. The lack of NPL site boundary information makes it necessary to estimate the numbers of nearby residents and homes at various distances from NPL sites; these are needed for the analyses in Chapters 4 and 5. Is the use of circular areas based on site size, as illustrated in Figures 3.5-3.8, an adequate approach?**

Yes, this is an adequate approach. Of course, this measure ignores the possibility that risk varies across sites, but there are no easy ways to account for differential risk. At any rate, the authors do not have any information about contamination pathways, contaminant plumes, etc.

To our knowledge, the use of circular buffers is widespread in GIS-based type of studies in the absence of more detailed information about property boundaries. This is probably sufficient for the purposes of the report, and it would seem reasonable if the site is small relative to the 2.5-mile or 5-mile buffer.

As a related thought, we note from Figure 3.10 that most of the exposed U.S. population lives near a small fraction of the sites. Given that the benefit analysis is based on a limited number of sites, it isn't possible to calculate benefit estimates by population density. However, Figure 3.10 can be improved (and some clarification can be added to the text of the report) describing how population is concentrated around a limited subset of sites.

**2b. Is it appropriate to ignore proximity to more than one NPL site? What methods might be used to account for effects associated with proximity to two or more NPL sites?**

If one wishes to develop a measure of exposure to contaminants, it seems possible that a receptor could be exposed to pollution coming from more than one site. Accounting for this, however, requires extensive information about pollution plumes and pathways, which is not possible within the scope of this study.

We conclude that it is acceptable to ignore proximity to more than one NPL site because there is no clear means to account for multiple sites. An alternative measure was used in Gayer, Hamilton, and Viscusi (2000, 2002), which aggregated the lifetime excess cancer risk estimates of the neighborhood sites. This would be prohibitively difficult to replicate on a nation-wide scale, and would not be amenable to a benefits-transfer estimate using the distance gradients.<sup>3</sup>

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Regarding proximity to the site in hedonic property models (HPMs), most of the previous studies have looked at the distance to the nearest Superfund site, ignoring the presence of others. Ihlanfeldt and Taylor (2003) have also looked at the second-closest site, which became important when they calculated the TIF revenue afforded by the cleanup (which changed the value of a property). It should be borne in mind, however, almost all of the sites considered by these authors at their study locale (Fulton County, Georgia) are CERCLIS, not NPL, sites. In a recent (and unpublished) study, Longo and Alberini control for the distance to the second-closest listed site, and also include among the independent variables of the HPM the number of the sites within a specified buffer. It should be kept in

**2c. Are the correct inferences about comparability between the NPL site groups in Table 3.3 correctly drawn? Are there other groups that it might be useful to define and analyze?**

We are not sure we understand this question. We do think a retrospective study of benefits should include only the sites in which remediation is completed, especially given the mixed evidence that prices fully recover from Superfund actions. Many of the ROD sites are not completed, so they should not be included in a benefits estimate that assumes full price recovery (or, at the very least, the benefits of unfinished sites should be discounted). What's more, some RODs recommend no-action, which suggests no benefit of remediation. We think it would be especially interesting and informative if benefits by different types of sites (by population density; by remediation strategy; by removal vs. remediation, etc.) could be estimated, but this is not possible given the benefits-transfer method used in this study.

[Note to the Panel: I am not sure what statement in the Report this paragraph refers to. Do we need to get into this? Rick] Turning to the attributes of the sites in the various groups of Table 3.3, we wish to point out that one does expect to see that the proportion of ROD sites that have construction completed should be higher than the entire NPL universe, as the construction of the remedies on site will be initiated and completed only after its ROD has been issued. That a lower percentage of federal sites has CC complete is consistent with the idea that federal sites are large and complex. HV chose sites with well-developed ROD and contamination characterizations, as these were needed to develop the data. The HPM sites probably looked at complex sites.

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mind, however, that both of these studies focus on properties slated for commercial and industrial use, and not on homes.

The authors of the report are correct in pointing out that population density in the HPM group of sites is higher than in the other group. This is consistent with high population densities and numerous homes being sold at a continuum of distances from the site, as one would typically want when doing an HPM study. The average size of NPL sites tend to be smaller in the HPM studies, but the median in this group is perfectly aligned with that of the NPL, ROD, MROD. Federal sites are very large and HV tend to be smaller.

Other possible groups could be formed on the basis of the type of contaminant, the contaminated media (e.g., groundwater), or of the possible involvement of the PRPs. We think it is critically important that the report provide much more information on the characteristics of the study sites, as well as the sites in each of the groups listed in Table 3.3. To the extent that the report relies on the estimates of the study sites, it is essential to get a sense of how representative those sites are of the universe of sites.

Comment: Ask Kate which characteristics should be reported.

**2d. Is it appropriate to assume a uniform distribution of populations and residences across census blocks? What other approaches could be taken?**

We agree that the approach is appropriate, especially given the relatively refined measure of census blocks.

We want to make two additional points regarding Charge Question 2:

1. The use of 2.5-mile rings seems reasonable, but it would be good to provide some more support for this decision. Many studies estimate a price gradient, but don't assess the distance at which price effects go to zero. As a result, many studies arbitrarily assume a distance in which the price effect goes to zero, or they choose a distance based on the data they have. To the extent that the hedonic analysis moves forward, it would be useful to discuss this issue in more detail.



2. There is a possible benefits-transfer problem because the hedonic property studies used in the meta-analysis are located in more populated areas than the typical NPL site. Larger populations mean more and larger housing markets, which could affect the gradient estimate. Riechert, Small, and Mohanty (1992) find some evidence property values in rural areas are not responsive to distance to a landfill. Similarly, the studies used in the meta-analysis take longer to clean up, suggesting that they are more problematic (perhaps higher risk). More generally, a benefits transfer problem will exist to the extent that the study sites are not representative of the full population of sites. This is one of our reservations about using the meta-hedonic approach.

**4.3 Charge Question 3:** Chapter 4 presents a benefits transfer analysis applied to all those NPL sites where the benefits are expected to occur from 1980 – 2024. With regard to this chapter, please address the following.

**3a. Are the challenges associated with the benefits methodology as applied to hedonic price studies in Chapter 4 satisfactorily met?**

In addition to the comments related to this question in Section 3, we offer the following:

- *Using ROD sites:* We discussed this in Chapter 3. We think it is misleading to use all ROD sites as the basis for the benefits estimate. Many of the ROD sites are not yet cleaned up, so the uncertainty of whether they will happen and the discounted benefits of the delay would reduce the estimate of retrospective benefits of Superfund.

- *Omitted-variable bias:* Omitted-variable bias is potentially a big problem with hedonic property studies and needs to be mentioned. The NPL sites are likely located in unattractive areas, so the price-distance gradient could be picking up un-measurable characteristics of the neighborhood. Atkinson and Crocker (1987) and Graves et al. (1988) both find evidence of a problem with omitted variables. This problem would be especially acute for the cross-sectional

studies used in the meta-analysis. The Greenstone and Gallagher that was described to us during the public comment period on March 24 provides a research design that can potentially address this problem.

- *Inferences about infra-marginal changes:* The report should be more explicit about about the difficulty of using estimates of the hedonic price function to make inferences about infra-marginal changes.

- *Market size and market segmentation:* Considerable space is dedicated to discussing the issue of the size of the market, and of whether there are separate housing markets. Unfortunately, the criteria used to identify the size of the market (40% of the homes in Middlesex Co. are within 2.5 miles of the NPL site; commuting times) are unconvincing. We don't think the discussion on page 4-4 clearly addresses concerns about what is the appropriate market size and segmentation. In all honesty, we found this discussion rather confusing.

- Also, it is unclear why using a single market would underestimate benefits. This might be the case with Michaels and Smith (1990), but we question whether this claim is applicable to all hedonic property studies. To elaborate on this, consider the claim made by the authors that if the disamenity impacts are stronger on the high-end homes, then single-pooled hedonic regressions will likely give underestimates of the effects. It seems to us that the effect estimated from single-pooled data would be some sort of a weighted average of the two effects, which may or may not be an underestimate, depending on the specific market.

**3b. Both Circular A-4 (Office of Management and Budget 2003 pp. 24-26) and the recent comments on the *Underground Storage Tanks (UST) Cleanup & Resource Conservation & Recovery Act (RCRA) Subtitle C Program Benefits, Costs, & Impacts (BCI) Assessments: An SAB Advisory* (Science Advisory Board 2002 pp. 20-22) contain specific comments associated with the methodology used in Chapter 4. Have these comments been addressed**

adequately? In light of these comments, has the benefits transfer methodology been applied correctly?

This is difficult to answer. Circular A-4 is meant to guide prospective studies not retrospective studies. This retrospective study does not consider costs or alternative policies. Perhaps it would be better not to refer to the circular, since it really is not appropriate for this type of analysis.

**3c. Are the estimates of the price effect (Figures 4.3 and 4.4 and Tables 4.4 and 4.5) based on the best available data and a sound methodology?**

As mentioned earlier, we are not convinced that the authors picked a good sample of studies. To further elaborate on this, we wish to point out that:

- The literature review produced a total of 30 studies, including book chapters, reports, and journal articles. In the end, only 9 of them are used for the benefit transfer. The authors must explicitly discuss the reasons why the others were dropped and these were selected.

- Was a subjective assessment of the quality of the study ever a consideration in the selection of these nine studies? None of these studies control, for example, for whether the homes in an area that are sold are representative of those that did not sell. In other words, none ask the question whether proximity to the site altered the frequency at which homes are sold, in addition to the sale price. Moreover, only two of the studies in the sample of nine use panel data, in spite of the accepted notion that cross-sectional studies are inadequate in this type of analysis.

- Nine is a very small sample, and we would not feel comfortable extrapolating much out of such a small set of studies. Perhaps the results based on this sample could be compared with those from a broader sample, where the studies selected by the authors are supplemented with

others, even if the latter do not focus on NPL sites, as long as a comparable announcement event is identified.

- Table 4.2 is completely unclear. What is the "absolute effect" in column 2? What distance does this price effect refer to?

- Do the studies' sites differ for type of contaminated site, type of contaminant, PRP participation and state government involvement? More information needs to be provided on this.

- Most of the studies used in this chapter are old and refer to early NPL sites. Would they be still suitable for sites more recently nominated to the NPL, which have been described as being larger and more complex than earlier sites? This raises an issue of temporal stability of the benefits/benefit transfer.

- Table 4.4 is unclear.

- Once the selected studies are used to estimate an appreciation effect associated with the issue of the ROD, such appreciation is aggregated over the housing units within the specified distance of each Superfund site. Doing so, however, in some cases assumes that the size and structural characteristics of the dwellings are similar across locales. Is it possible to obtain information about the typical housing size at the various locales, perhaps using the Census or the American Housing Survey, express prices and appreciation on a per square foot basis, and then multiply the latter by the size of the typical dwelling in the vicinity of each Superfund site to get a better sense of the total benefits?

In sum, we feel that the authors need to provide more information about the selection criteria and about the studies (See 3a above for concerns about inferences drawn from the

studies). We also feel that it is important that the assumed causal link between the issuance of the ROD and a rebound effect be clearly detailed.

**3d. Does the application of the price effect to estimate the value of Remedial Actions at NPL sites match the relevant theoretical principles? In particular, does the analysis of reversals of the negative price effect found in the literature (and associated with Figure 4.3) provide a sound basis for assuming that reversals always occur?**

We think there are problems with the inferences, and question using full reversals of negative price effects as a basis for the benefits estimate. See all the points listed under 3a and under 3c.

**3e. Are the four model specifications (Equations 4.2 through 4.5) appropriate? In particular, these models calibrate the basic benefits transfer model (Equation 4.2) for non-linear effects and/or differences in home values. Are these calibrations appropriate? Are there other calibrations that could be made to improve the estimate?**

Yes, they seem to be correct.

**3f. Are the study sites reasonably representative of the policy sites?**

Part of our answer to this charge sounds common themes with that of charge question 3c. We feel that the report needs to provide a more informative discussion on how the 9 studies were chosen and why the other 21 were dropped out of the initial sample of 30. In addition, the Gayer et al. (2002) ReStat paper seems more appropriate for this report than does the Gayer et al. (2000) Southern Journal of Economics paper. Finally, as to whether the study sites are reasonably representative of the NPL sites, the report does not contain enough information about locations, chemicals and pathways, PRP involvement, community involvement, role of the State and the EPA, etc. to allow us to conclude whether the study sites are or are not representative of

the universe. If housing price depreciation/appreciation is affected by these factors (which we also do not know), it is unclear how the benefit transfer can be applied to the universe.

**3g. Although there are no federal facilities among the study sites, federal facilities (e.g., the Camp Pendleton and Savannah River sites) are included among the policy sites. The analysis of NPL site groups in Chapter 3 suggests there may be no significant differences in relevant characteristics (e.g., nearby population, cost of nearby homes, and the price effect). Should federal sites be included in this analysis or not? If so, how? Can estimates both with and without federal sites be included, and which one does the Panel think would be more reliable?**

Earlier evidence suggests that federal sites take longer than non-federal sites to transition through the different phases of the Superfund program. In many cases, we would expect them to be large sites with complex pollution problems and heavy "dread" effects (radioactive waste, nuclear plants, etc.). Absent studies that specifically looked at the property price effects of the proximity to federal NPL sites, or that at least controlled more carefully for the type of contamination, we would not feel comfortable assuming that the depreciation/appreciation mechanism associated with the ROD applies to federal sites as well.

In addition, there are two other points we wish to make. First, regarding the question of "Market Size" (pp. 4-4 to 4-6), the concern of the earlier SAB Panel was whether or not the hedonic price function (HPF) would shift as a result of a change in the vector of characteristics. If it does, then using the sum of the predicted changes in prices would lead to biased a estimate of the welfare change. The Report is not clear on this point. Also, we know of no guidelines for determining in advance whether to expect the HPF to shift. So we are not convinced by the discussion in the Report that this will not be a problem.

Second, regarding "Ex Ante Data" pp. 4-6 to 4-7), the Report misstates the Bartik conclusion. What Bartik wrote was, "... the WTP for the improvements of households originally at improved sites will underestimate benefits. (Bartik, 1988, p. 176, emphasis added)."

**4.4 Charge Question 4: Chapter 5 presents a proposed analysis for capture health effects of Superfund. Should the health effect-by-effect analysis proposed in Chapter 5 proceed?**

**4a. Is the epidemiology-based approach adapted from Lybarger et al. (1998) appropriate? If so, does the Panel have any specific recommendations for implementing it?**

See Section 3.2.

**4b. Are there other feasible methods for monetizing the value of avoided morbidity besides Cost of Illness? Of these other methods, how can they be prioritized (i.e. which ones should EPA investigate first)?**

See Section 3.2.

**4c. Have the content and limitations of the literature on the epidemiology of hazardous substances in the environment and related material been described adequately?**

The review does an adequate job of delineating the limitations of the epidemiologic literature. In view of the limited exposure data, the lack of the ability to address additive or synergistic exposures, and limitations of sample size related to the sometimes small populations involved, it should be pointed out that it is remarkable that some studies have found elevated (and sometimes statistically significant) risks.

**4d. What recommendations does the Panel have for using the Integrated Exposure Uptake Biokinetic model for lead?**

The EPA Integrated Exposure Uptake Biokinetic (IEUBK) model is proposed for use in this analysis. A modeling approach to evaluate lead blood levels was initiated in 1985 and has

been developed to its present state as the IEUBK model. The current model provides many advantages over the previous explicit mathematical methods used for estimating the potential for adverse health risks as a result of exposures to lead. However, the model has definite limitations that if violated will potentially jeopardize the accuracy of predictions provided by simulations.

The IEUBK model for children exposed to lead was developed for ages 0 to 84 months that may potentially be exposed through a range of possible pathways. It is a probability based model rather than a deterministic mode, which has the advantage of providing estimates of outcomes within a range of conditions. Long term exposures are used to estimate a geometric mean blood level for the exposed children. This model was developed for individual estimates, but can be used to evaluate neighborhood exposures to predict blood lead levels. The model can be used at several scales including a single location or a neighborhood. Single locations, such as a single dwelling, are used to estimate exposures for a single child. Multiple locations within a single neighborhood that has homogeneous media or a heterogeneous media are two other scales. This can be extended to more than one neighborhood with heterogeneous media. The multiple locations are appropriate for exposure of a population of children.

Advantages of the IEUBK model include a predictive capability to estimate blood lead levels and evaluate effects of efforts to reduce exposures. The deterministic models rely on slope factors that are not universal constants. Slope factors change due to differences in uptake, site characteristics, among other conditions. The IEUBK model allows for multiple media exposure and multiple pathways. Model simulations can be run to evaluate the effect of mitigation strategies to reduce risks. Isolation of key pathways of exposure can be used to guide more



effective remediation strategies and set clean up targets. Individual or neighborhood blood levels can be predicted as a consequence of remediation alternatives. Such an approach can reduce removal and remediation costs associated with lead contamination.

There are significant limitations to the model, notably that the model was developed for children and most childhood exposures to lead are the result of household exposures. Any model is only as good as the data available and assumptions made in its execution and the IEUBK model is no different. There are few pathways through which such young children would be exposed to NPL sites. However, the model has been adapted for adult lead exposures and this development has potential, especially related to fetal exposures to lead which are known to potentially have significant adverse health effects. If the model is applied within its limitations, the error of the analysis can be determined which provides an analysis of associated uncertainty.

The IEUBK model should be used in this analysis. It represents the direction in which risk assessments are developing, that of probabilistic based estimates which provide a more realistic predication of potential outcomes due to exposures.

**4e. What recommendations does the Panel have for using the results from "*Calculating Risks*?" for estimating the benefit of avoided adult cancers?**

See Section 3.2. In addition, we offer the following. Hamilton and Viscusi develop the thesis that the current risk assessment practice is overly conservative. They provide quantitative evidence to support this assertion. They focus on the effect that parameters have on the estimated risks according to the following equation:



where ED is exposure duration; EF is exposure frequency; IR is the ingestion rate; i is the contaminant; j is the pathway; AT is the averaging time, BW is the body weight, CC is the contaminant concentration; and TOX is the toxicity.

By varying the values for the 'constants' the estimated LECR can vary several orders of magnitude. They argue that using the reasonable maximum exposure (RME) is overly conservative. They recommend using mean or median values for CC instead of the RME. They further argue that EPA recommended ED, EF, and IR default values exceed those observed at several sites. They evaluate the use of probabilistic approaches to estimates of risk.

They do not address the TOX values and how these can vary. The uncertainty of this parameter can be significant. This value can be adjusted by uncertainty factors (UF) or modifying factors(MF) that reflect uncertainties in extrapolating toxicity values determined for different species, between organisms within the same species, among several other adjustments. These adjustments could surpass those of the uncertainty in the constants factors. The equation must be considered in its entirety. The magnitude of variability of all parameters must be evaluated.

The value of this approach is to adopt more widely a probability based risk assessment approach. This approach will result in estimates that reflect the range imposed by the uncertainties in the approximation. Such results can help identify those parameters most responsible for creating the uncertainty.

**4.5 Charge Question 5: 5. Chapter 5 also presents a proposed method for capturing the ecological benefits of Superfund. Should the ecological benefit analyses proposed in Chapter 5 proceed?**

**5a. Is the method of using data from detailed Natural Resource Damage Assessments to estimate benefits on a site-specific basis appropriate and in accordance with accepted theory?**

See Section 3.3.

**5b. Will the method of investigating NRDA's proposed on pages 5-31 through 5-33 provide insight into the value of ecological benefits created by CERCLA and SARA? In particular, will an investigation of specific NRDA examples, be helpful? Will the proposed comparison of settlement amounts and estimated benefits be helpful? If not, what better approaches might be used to understand these benefits?**

See Section 3.5.

**5c. In cases where natural recovery would otherwise take place over finite but lengthy periods (decades to centuries), the benefits of active restoration accrue over similar periods. It is not clear whether these should be considered *intra*-generational or *inter*-generational. Is there a way to decide, or perhaps to avoid making this decision?**

The approach taken by the report is appropriate: namely, the use of 3 alternative discount reference points – a zero, three, and seven percent discount rate. This allows for “sensitivity analysis” of results and is consistent with accepted federal and economic practice.

**4.6 Charge Question 6: Are each of the non-quantified benefits discussed in Chapter 6 presented appropriately and sufficiently?**

This chapter of the report presents these benefits in a very cursory manner. The committee recommends either presenting a more thorough discussion of these benefits and how they might be captured, or noting that they are really just being “mentioned” here and are not truly addressed in this benefits analysis. Also, depending on how the description of Superfund benefits is revised (see comments on Charge question #1) it is not clear if these particular “benefits” will still be included in this section of the report.

Amenities: This section correctly points out that a benefit of the Superfund program is the "removal of unsightly, often abandoned facilities." This is likely to be a significant component of the benefits of Superfund. It's less clear that "psychological benefits associated with reducing the uncertainty and fear of unknown risks" constitute an amenity component of the benefits. If anything, this constitutes a health or information component of benefits. But one must also consider the possibility of negative "psychological" effects of the program. At any rate, we do not think this belongs in the "amenities" category.

We also do not understand why amenities are considered "non-quantified," since we believe that they are captured in the hedonic property models used in chapter 4 (along with perceived health benefits). Indeed, they may be over-estimated in the hedonic framework. Chapter 4 uses the estimated price gradients from the HPM studies and assumes that remediation leads to a full recovery of the housing prices. For the cross-sectional studies, this means that the estimate is based on the assumption that remediating a site is the same as moving a house to a distance in which there is no price drop-off. This implies that the remediation eliminates all health risks and removes the entire disamenity of living near the site. If anything, this over-states the amenity benefits of the Superfund program, because remediation does not necessarily rid the site of all its visual disamenities.

Materials: The Report claims that "In terms of avoiding material damages, the Superfund program often helps convert unusable commercial properties back into productive real estate. In many cases, the avoided damage is associated with removal of both uncertainty about the presence of hazardous substances and with uncertainty about the cost of restoring the site to a usable condition." Clearly, this claim is in sharp contrast with the widely held view that the

Superfund program actually *created* abandoned and underused previously used properties because of fear of possible liability associated with the cost of cleaning up the site (Simons, 1998). Others (Bartsch, DATE) have even claimed that listing in CERCLIS alone creates stigma, and it is often felt that the purpose of many state and local legislation and programs passed in the 1990s (e.g., voluntary cleanup programs, brownfield programs) and offering relief from liability and various incentives to parties that voluntarily clean up sites was to offset the perverse incentives over real estate created by the liability features of the Superfund program. The report needs, therefore, to be careful about this kind of claim, and to justify carefully any statements made in this regard.

Regarding uncertainty, we would argue that uncertainty exists about (i) the existence and severity of contamination at the site, and (ii) about possible changes in cleanup requirements and standards, both of which translate into uncertainty about the liability for cleanup at the site. Unfortunately, the report is not clear about which aspect of the Superfund removes the uncertainty, assuming that it does, and the reader is left wondering whether perhaps the authors meant to apply earlier claims about the ROD and rebounding of property values to commercial and industrial properties as well. (We are not aware of any studies documenting such an effect.)

In general, the report does a good job emphasizing that the market for commercial and industrial real estate has a completely different nature from the residential property market. Specifically, the size of the market and the number of players are much smaller, there are far fewer transactions, and there are different rates of property turnover. It would be useful to see some statistics, perhaps drawn from national statistics, to support these claims. Similarly, it would be useful to cite formal studies to support the report's claims that commercial and

industrial developers and end users are interested in a different set of amenities than homeowners. There is, for example, a vast literature that has used the hedonic pricing approach to establish the importance of infrastructure, distance to roads, distance to the central business district etc. on commercial property values. The report is also correct in pointing out that there have been very few studies documenting the impact of contamination on commercial and industrial property values, but has missed the article by McGrath (2000).

The report does not adequately discuss and characterize the effects of liability on commercial property prices and turnover. In a revised draft that addresses this point, it would be useful to organize the effects of liability into direct effects (e.g., cost of cleanup, lower sale prices of development projects, but also lower cost of acquiring potentially contaminated properties for real estate developers) and indirect effects (through the lenders).

The report needs to acknowledge that there may be much heterogeneity in the effects of the Superfund program across different areas, due to the different economic and growth conditions, as well as within the same city. An example of the former is the difference in conditions (and study findings) across Atlanta, studied by Ihlanfeldt and Taylor (2003), and Baltimore, studied by Howland in 2004. The latter's results are, in turn, different from those found by Schoenbaum (2002) for the same city, but different areas.

The report needs to acknowledge that there may be much heterogeneity across developers in their responses to the incentives created by the Superfund program. See, for example, Alberini et al. (forthcoming), who find that developers experienced with projects at contaminated sites are much more responsive to financial incentives offered by the government than inexperienced developers, who instead respond more to offers of liability relief.

It is also important to examine whether (dis-)incentives and effects have changed over time, as the US Environmental Agency became more efficient at recognizing and addressing contaminated sites, and potentially responsible parties became better acquainted with the expectations imposed upon them by the agency. (The type of sites and the effects on neighboring properties may have changed too.)

We urge the authors to drop or rewrite the concluding sentence "It is important to consider if and how the materials benefit would appear in the policy case (i.e., no Superfund program). Similar to other benefit categories, the fact that without Superfund fewer responses would occur and uncertainty associated with toxic contamination of real property would be greater suggests that a large fraction of the materials benefits should be assigned to Superfund." This should be done for two reasons. First, the authors do not have or provide enough evidence for these assertions. Second, what do they mean in the second part of this sentence?

Empowerment: The committee has some concerns about the use of the word "empowerment" to describe this particular set of "benefits" of the Superfund program. (This refers as well to the use of "empower" throughout the text.) Public education and involvement may well be more appropriate terms to referring to the set of activities described here. This raises a second point, which is that much of this section describes activities and programs of EPA and ATSDR, and while these are important "inputs" to the full range of Superfund benefits, they are not, in and of themselves "benefits." This relates to a point made under our comments on Chapter 1 suggesting ways in which the overall description of Superfund benefits might be improved.

As noted just above, this section appears to be more a description of program activities than of the benefits that result, without an explanation of how these activities are benefits of the Superfund program. This section also appears to be written from the perspective of an agency advocate, in that it describes all the public activities in glowing terms, rather than in a more objective and analytical fashion. For example, on page 6-9 the text reads "EPA maintains a substantial outreach and information effort..." and in the paragraph that follows "The Superfund program also uses its community outreach mechanisms to create partnerships..." While these statements are likely true for some sites, it is well documented (as shown in the number of sites with and without TAGs) that at some sites there are very active communities, and at others, not. In addition, most likely the intensity and quality of community involvement activities vary according to EPA region, and to the individual conducting these activities. None of this variation is alluded to, much less documented, in this section.

The superfund program has several programs intended to provide information to communities. In addition to the Technical Assistance Grant (TAG) program, which provides up to \$50,000 for communities to procure technical advice on site documents related to final and proposed NPL sites, there is a similar program, the Technical Outreach Services to Communities (TOSC) program, which is similar to TAGs but is for communities with non-NPL sites. Other mechanisms for providing information to the community and the general public include the Superfund website and various outreach activities, as well as the Superfund Job Training Initiative (Super JTI) which provides information on all sites, investigates sites, and makes recommendations. Other efforts in community outreach are required as part of the Superfund



Basic Research Program. The outreach efforts in these Superfund Centers take many forms from education to children, museum displays, community programs, among many others.

**Comment:** This is a suggested additional source to demonstrate the benefits through outreach programs.

These efforts provide information to people. If risks do exist, people can learn how they can protect themselves. If the public is educated on the issues, they are better able to participate in the decision making processes.

Perhaps more importantly, it is unclear exactly what the "benefits" to be discussed are. While community education is a good thing, should it really be considered a "benefit" of the Superfund program? How effective these programs are is difficult to determine. This section would benefit from a more nuanced discussion about community education and involvement benefits, and which of these should be considered benefits of the program, in comparison to important components of, for example, the remedy selection process. Once the section is revised to focus on benefits, the next challenge would be to discuss what metrics can be used to evaluate their impact. For example, is trust being built between EPA and the communities? Have the various outreach efforts improved citizens' knowledge about current risks at a site, steps they can take to protect themselves, and the pros and cons of alternative remedies?

This section is plagued by many assertions about various benefits that could well be true, but are not backed up by any kind of independent research and analysis. For example, the discussion suggesting that community empowerment might reduce property value declines does not appear grounded in any research, but is a hypothesis yet to be tested. For example, the authors could have documented the number of NPL sites with active vs. inactive community groups, as well as examined some of the internal and external reports that have tried to evaluate the quality of EPA's community involvement efforts.

**Comment:** This seems consistent with your para#4

Similarly, there is a lengthy description of the role of ATSDR, that describes its activities, but just what the benefits are is not clearly defined nor measured in any fashion.

Deterrence: As noted in the response to charge question 1, the Committee feels that deterrence is a means to an end, namely, reduced contamination, which in turn leads to reduced negative environmental or health impacts. The report notes that the deterrence benefit is "indirect." However, the reduction in impacts that results from deterrence or avoidance of contamination in the first place is no less important potentially than the reduction that results from cleaning up existing contamination. Thus, there is no apparent justification or logic for including this as an indirect or "embedded" benefit. In revising Chapter 1 to develop a benefits assessment framework, the authors should consider including deterrence not as a separate "indirect" benefit category but rather as part of the health, amenities, ecological and materials benefits of Superfund. Of course, in doing so, it will be important to distinguish between impacts or benefits stemming from past contamination (where the opportunities for deterrence are limited to containment) and those that would result from future contamination (which can still be prevented or reduced).

The report's treatment of deterrence focuses almost exclusively on TRI, which is not really considered to be part of the Superfund program since it is funded through a separate appropriation [need to check this]. It does not address the primary deterrence effect created by CERCLA's liability provision, which is a key component of the legislation. The Committee recognizes the challenges associated with measuring the deterrence effects of Superfund, i.e., estimating the benefits resulting from *prevention or containment* of contamination. However, there is a growing body of empirical evidence, as well as a substantial theoretical literature,

regarding the impact of liability on firm behavior. (References for some of the empirical studies are given below.) While limited, this literature does suggest some conclusions regarding the impact of CERCLA liability. The Committee advises the Agency to draw on the work that has been done to date to examine the deterrence benefits of Superfund in an expanded discussion in the report.

Emergency Preparedness: This appears to be more of a description of the EPA removal and emergency response program and capabilities than an objective discussion of the benefits of these activities. The question is not what resources are put into this activity, but what are the accomplishments. If this section is supposed to describe benefits, then it should do so and discuss how ideally we would capture these benefits in economic terms, and what the current methodology and data limitations are for doing so. In addition, while participating in the response to the World Trade Center, the anthrax attacks and picking up the debris from the Columbia shuttle disaster are important, and worth mentioning, they are by no means the center of the emergency response program. And, in shifting resources to these new areas, some other activities most likely were reduced.

Information and Innovation: The Committee believes that one of the "shining stars" of the CERCLA program has been the innovative methods and technologies developed from the various programs funded by Superfund, and in particular the Office of Research and Development. The section of the SBA Report covers those topics well. A recent SAB Advisory on the Office of Research and Development's Contaminated Sites and RCRA Multi-Year Plans concluded that these programs have played, and will continue to play, a vital role in developing the science and technology for evaluating and cleaning-up the nation's hazardous waste sites.

The Committee recommends that the authors for the SBA Report obtain a copy of that advisory and incorporate some of those findings and conclusions herein.

International benefits: Many of the benefits from the Superfund program are applicable to international activities which are already considered by other benefit categories. However, it is worth expanding this section to include examples of international benefits, for example:

- Risk assessment approaches – monitoring, characterizing, RAs on sites
- Aid especially to Eastern European countries with heavy contamination and serious health problems as a result of environmental contamination. They have no money for research and development and look to the U.S. for ways to improve conditions.
- Databases for health effects and ecological impacts from exposures.
- Remediation technologies – development, U.S. companies working overseas with technologies developed at U.S. sites.
- Exposures often for worse in other countries – better to monitor for biomarkers to isolate specific effects/consequences from exposure.

#### **4.7 Charge Question 7:**

[?]

**4.8 Charge Question 8: Chapter 5 presents a proposed analysis for assessing the ground water effects of Superfund. Please comment on the proposed ground water effect-by-effect analysis with a consideration of the following questions.**

**8a. Will the approach described on pages 5-38 and 5-39 for quantifying the fraction of aquifers in the United States protected by Superfund provide useful information? Is the proposed approach to monetizing this benefit feasible? Is there a better approach to addressing the question of ground water protection?**

See Section 3.4.

**8b. The proposed methodology will probably not adequately capture the amount of ground water that will not become contaminated because of the Superfund program. Does the Panel have any suggestions about how to do so.**

We agree with the Agency's assessment of the difficulties in developing the counterfactual of ground water contamination without Superfund. But we have no suggestions about how to do this in a credible fashion.

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