



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

November 19, 1993

OFFICE OF THE ADMINISTRATOR
SCIENCE ADVISORY BOARD

EPA-SAB-EEAC-LTR-94-001

Honorable Carol M. Browner
Administrator
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, DC 20460

Subject: Review of Economic Aspects of the proposed RIA for the RCRA
Corrective Action Rule by the Environmental Economics Advisory
Committee (also referred to as CV-2)

Dear Ms. Browner:

At the October, 1992 meeting of the SAB's Executive Committee (EC) the Board was asked by the Office of Solid Waste and Emergency Response (OSWER) to review the methodology for the draft Regulatory Impact Analysis (RIA). This cost/benefit analysis is required prior to promulgation of the Agency's final Resource Conservation and Recovery Act Corrective Action Rule. The EC, recognizing the importance, complexity, and novelty of OSWER's work and its multi-disciplinary character, established an *ad hoc* RCRA-RIA Steering Committee (RRSC) to assure that certain aspects of the RIA -- in both methodology and application -- received appropriate attention from the relevant SAB committees.

At a public meeting on January 29, 1993, the RRSC concluded, on the basis of presentations by and discussions with OSWER personnel, that four SAB individual committees should review the major segments of the RCRA-RIA. Specifically, the RRSC agreed to review: a) the contingent valuation (CV) methodology used in the RCRA RIA analysis (CV-1, by the Environmental Economics Advisory Committee (EEAC)); b) the application of CV in the RCRA-RIA (CV-2, by the EEAC); c) the principal fate and transport model (MMSOILS), used in the RCRA-RIA (by the Environmental Engineering Committee (EEC)); d) the ecological risk assessment portion of the RCRA-RIA (by the Ecological Processes and Effects Committee (EPEC)); and f) the human health risk assessment portion of the RCRA-RIA (by the Environmental Health Committee (EHC)).



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This letter comprises the report of the EEAC, which completed its review of the analytical methodology for the draft RIA at its meeting of September 23, 1993. The Committee evaluated four aspects of the proposed economic methodologies, including:

- a) the desirability of disaggregate information as part of the development and presentation of benefit-cost information in the RIA for a large, complex national rule
- b) the exploration and presentation of "human health benefits," including both the cancer and non-cancer health effects associated with the proposed rule
- c) the possibility of using the McClelland *et al.* (1992) CV analysis as the basis for estimating the non-use values for groundwater cleanup on a national scale
- d) the application of hedonic methods to evaluate the effects of contaminated sites on residential property values (Hedonic models recognize that many commodities within the same broad categories, like houses and automobiles, for example, have different features. The models imply that the prices of products within each category should be related to the mix of features that each type of commodity has. The models are sometimes used to estimate people's willingness to pay for dimensions of environmental quality that are location specific, such as air or water quality.)

Overall, EPA staff are to be commended for a number of innovations in the methodologies outlined for use in the full RIA and illustrated with the examples in the draft report. Especially notable from the perspective of the economic analysis were:

- a) the recognition, as part of the human health benefit analysis (and associated risk computations), that policies are not always effective
- b) careful descriptions of both baseline and "with-policy" effects in all aspects of the evaluation
- c) attempting to separate the effects of the sub-part S rule from those of other initiatives
- d) recognition of the importance of the extent of the market for benefits transfer



- e) full documentation of the econometric analysis associated with the hedonic property value models

With respect to the development and presentation of national benefit-cost estimates, the Committee recognizes that the RIA must, to the extent possible, represent the aggregate benefits estimated to be associated with the proposed regulatory alternative. Nonetheless, this goal does not preclude EPA staff from presenting disaggregate information for the benefits and costs associated with different components of the aggregate. For example, it should be possible to classify Solid Waste Management Units (SWMU) by size, location, and other characteristics and to develop the estimates according to these categories. This practice would facilitate evaluation of the methods used and improve the transferability of disaggregate results to the aggregate level.

Classification of SWMU would also permit evaluation of the likely distributional impacts of policy alternatives across different types of facilities and types of communities impacted. The Committee recognizes that the limits implied by confidentiality requires such disaggregation be conducted at levels that assure sites cannot be identified. However, this requirement does not preclude substantive effort to develop informative decompositions for the policy alternatives.

The Committee also recommends that in developing the benefit-cost analysis, EPA staff should provide a more detailed description of the role of each type of analysis, as well as more complete perspectives on the judgements made in developing estimates of benefits and costs. For example, the Executive Summary of the draft RIA notes that benefits estimates would likely be larger if the health effects were monetized. In an apparent contradiction to the Summary, the Health Benefits chapter (Chapter 7) indicates that monetization was not undertaken because it was judged to overlap the monetary measures developed using the avoiding cost model; no discussion or explanation of these differing views are offered. Similarly, the hedonic estimates are provided without developing their role in the comprehensive benefit-cost analysis nor their implications for further RIA analyses.

These descriptions would permit a second type of evaluation associated with the aggregations that must accompany an RIA evaluation at a national level. Monetization of multiple components of benefits can lead to double counting if the concepts being measured and the rationale underlying each method are not well-understood and well-documented. Discussion of these concepts and rationale can provide a means of avoiding this. Together with the presentation of the estimates, such a discussion often allows plausibility checks, particularly if one approach produces



estimates that can be expected to provide an upper or lower bound on the estimates of an alternative approach.

The second major element of our review addressed the RIA's evaluation of the benefits from avoiding adverse human health effects (the Committee prefers the term "effects" to the term "benefits" as noted in the Technical Appendix). The RIA offers an innovative analysis of exceptionally difficult issues. The analysis is to be commended for recognizing and developing methods to reflect the fact that regulatory policies are not always completely effective. While there are also notable features in this component of the RIA, the Committee believes that there are also three important limitations. First, the Committee concludes that efforts to monetize the mortality risks reduction (e.g., reduction in statistical lives) should be included in the RIA. The Agency's *Guidelines for Preparing Regulatory Impact Analyses* discusses these procedures and recommends monetization, but the RIA does not do so. Monetizing of health effects is also an integral part of the benefit-cost analyses being undertaken for the Clean Air Act evaluation currently under way.

The argument that averting cost and monetized health effects would imply double counting is correct, but it ignores the role these estimates could serve as bounds on estimates of benefits. The inability to monetize all health effects should not preclude this effort. It may be possible to offer better resolution about how benefits might vary across different classes of facilities, regions, or other characteristics of the SWMU through quantification of the health effects than by using information on averting expenditures (because the exposed population and response estimates seem more firmly grounded in scientific evidence than the averting expenditure information),

Aggregation of non-cancer health effects based on exceedances of the chronic reference dose provides an index that is no more than informative. The Committee has been advised that there are a number of judgements used in developing the hazard indexes from hazard quotients (i.e., estimates of individual exposures to the chronic reference dose) for specific substances. The Committee recommends that efforts to aggregate across substances be avoided and disaggregated information for classes of substances be reported instead.

Finally, the cost effectiveness analysis and presentation of overall impacts aggregates effects over a 128 year time horizon. The Committee recommends that alternative strategies be investigated for dealing with the effects of this long time horizon, including: discounting the measures of physical effects before gauging cost effectiveness; calculating cost effectiveness based on a year-by-year cost effectiveness and these ratios then discounted to a base period or an annualization of all factors relevant to a comparison.



(The Committee also identified some further technical issues on the health benefits topic, as well as on the next two aspects of our review; a detailed summary is enclosed as a Technical Appendix to this letter.)

The EEAC devoted considerable effort to the issue of using the McClelland *et al.* CV estimates as a basis for making national estimates of non-use values for ground water cleanup. Because the focus of the McClelland *et al.* effort was to develop per-household estimates of these non-use values, a number of issues would need to be addressed to use the results for national estimates relevant to the RIA. The Committee's detailed findings on these issues are provided in the Technical Appendix.

Based on our earlier review of the McClelland *et al.* study itself, and two further issues raised by the methodology proposed for adopting the McClelland *et al.* results for use in the RIA, the Committee believes that the McClelland *et al.* estimates cannot be used for the intended purposes. The RIA's evaluation primarily deals with benefits from cleaning up over a long period of time (and in some cases partially) groundwater contaminated by industrial facilities. The McClelland *et al.* study focuses on municipal sources and describes a situation with instantaneous cleanup. Both issues are very important features of the problem and past literature suggests that they are likely to be important to people's willingness to pay for cleanup. Unfortunately, simple adjustments do not appear to be possible.

Last, a key element in the development of aggregate estimates is the determination of the number of households which would be willing to pay (a non-use value) for cleanup of the groundwater. This factor is the key determinant of the wide range of estimates of aggregate non-use values. No specific evidence has been developed on how to determine the number of these households. The original McClelland *et al.* study focused on per-household values. Subsequent work appears very preliminary based on the information made available to the Committee.

EPA is to be commended for recognizing the extent of the market question. Nonetheless, the McClelland *et al.* methodology does not offer an approach to deal with the problem.

Overall, the Committee recommends against using the specific approach proposed in the draft RIA for developing the aggregate estimates of non-use values. Unfortunately, there is no other information in the literature to be used to meet the needs of the RIA effort.



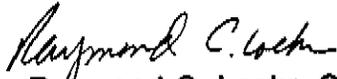
The Committee found the hedonic analysis to be a careful and systematic evaluation of the effect of proximity of a contaminated site on the prices of nearby residential properties. The Committee has some technical suggestions described in the Appendix, and recommends that if the results of the hedonic analysis are included in the RIA, two additions be made to the discussion. First, the relevant chapter should describe clearly the analysis as providing a record of studies undertaken and summarize in greater detail the reasons for not using the results in the benefit measurement.

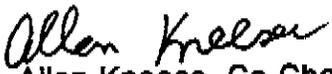
Lastly, a brief discussion of the potential (at a conceptual level) for using hedonic estimates to bound valuation estimates would be desirable.

In summary, from the perspective of its economic methodology, the draft RIA reflects considerable creativity by EPA staff. Although the Committee had a number of detailed suggestions, these can, with the exception of the estimates of aggregate non-use values, be addressed with revisions and extensions to existing methods.

We look forward to receiving your response to our comments.

Sincerely,


Dr. Raymond C. Loehr, Chair
Science Advisory Board


Dr. Allen Kneese, Co-Chair
Environmental Economics
Advisory Committee


Dr. V. Kerry Smith, Co-Chair
Environmental Economics
Advisory Committee

ENCLOSURES



TECHNICAL APPENDIX

The purpose of this Appendix is to summarize some detailed further suggestions elaborating on the Committee's comments regarding human health benefits estimates, the use of the McClelland *et al.* findings as a basis for national non-use value estimates, and the hedonic analyses.

a) Human Health "Benefits"

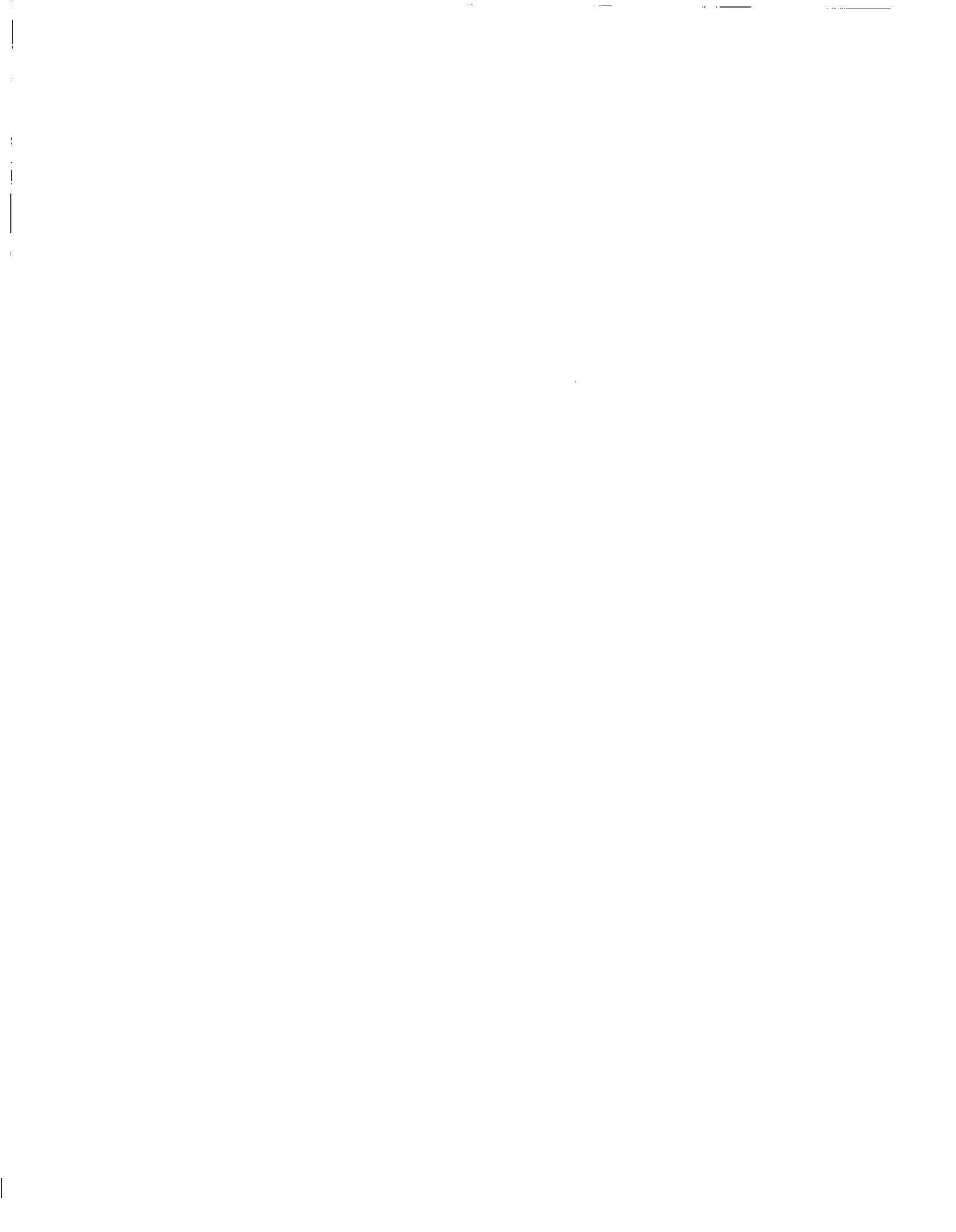
The Agency constructed two alternative baseline scenarios as descriptions of conditions in the absence of the Proposed Rule:

- 1) human exposures would NOT be capped through existing MCLs and taste/odor limits
- 2) exposures would be capped through existing MCLs and taste/odor limits.

The agency then estimated the reductions in the numbers of total cancer cases and non-cancer health effects associated with the Proposed Rule assuming that the rule would be less than 100 per cent effective in eliminating risks. The reductions in health effects are listed as the human health benefits.

A positive feature of this analysis is the recognition that policies are not always 100 per cent effective and that realistic estimates of benefits should be based on the expected level of effectiveness rather than the theoretical ideal. However, the reported numbers are not particularly informative for policy purposes for several reasons:

- 1) there is no economic valuation of the reductions in either cancer cases or non-cancer health effects. This is puzzling, since the Agency's *Guidelines for Performing Regulatory Impact Analysis* discusses approaches for estimating economic values for reductions in both morbidity and mortality and other Agency RIAs have utilized these approaches to monetize health effects.
- 2) the measure of non-cancer health effects involves a difficult-to-interpret aggregate index that consists of the sum of the numbers of individuals with daily intakes in excess of the chronic reference doses (RfD) for the substances analyzed plus numbers of individuals whose exposure to lead results in blood lead levels above the threshold. Two important pieces of information are obscured by this form of aggregations:
 - i) Different chemicals cause different types of health effects; and not all health effects are of the same severity. Thus mild and severe



adverse effects are lumped together and given the same weight in this analysis.

- ii) This form of aggregation treats a small exceedance of the RfD as equivalent to a large exceedance. Also, using the number of exceedances as an indicator of adverse health effects involves the implicit assumption that all exceedances cause an adverse effect. But in general, one would expect that as the average dose increases above the RfD, the percentage of the exposed population experiencing adverse health effects would rise, or the severity of the effects would increase, or both.
- 3) there is no systematic effort to describe and quantify the uncertainties in the analysis. In Chapter 13 a range of effects is reported. But this range reflects only the two alternative baseline exposure scenarios.

In addition to these limitations, the Committee also has reservations about several features of the analysis:

- 1) The uncapped scenario is not plausible as a matter of public policy. It assumes, in effect, that existing regulations affecting human exposures through a variety of pathways are ignored. This scenario undoubtedly seriously overstates the number of cases of cancer and non-cancer health effects in the absence of the rule and therefore overstates the health benefits of the rule.
- 2) The report estimates baseline risks for people who move onto sites after they are closed (p. 7-39 to 40). Apparently these risks were not used in the calculations for Table 7-23 (see the first line on p. 7-41). But this raises the question of why these calculations were done and reported in the first place. In any case, it seems unlikely that in the absence of the rule, sites would be used in this way, given the high calculated risks.
- 3) The report states that one big facility dominates the risk estimates. It would be useful to see the results with this facility omitted. It also suggests a policy design issue: should the regulations have two tiers with stricter regulations for facilities like the one big one included in the sample?
- 4) The report uses IRIS cancer slope factors which are mostly 95 percent UCLs, not maximum likelihood estimates. The report is also based on other standard "conservative" practices in risk assessment. Thus, the estimated health benefits cannot be considered to be expected values or most likely values. Given the level of effort devoted to other parts of the



analysis, and given the potential economic impact of the Proposed Rule, more effort should be devoted to both expected values and upper and lower bounds for the health benefits.

This decision to measure effects with count variables leads to the failure to take account of the temporal distribution of health effects. One hundred twenty-eight years of health effects are aggregated as if they were equally important and measured with equal precision. This is especially troublesome when it is recognized that these aggregates (over 128 years) provide the basis for the cost effectiveness analysis -- comparing discounted costs to undiscounted physical effects. At a minimum, the comparison should be made year by year and then discounted.

b) Feasibility of Using McClelland et al Estimates for National Estimates of Non-use Values for Groundwater Cleanup

Our earlier report (CV-1) raised a number of questions with the results of the McClelland *et. al* contingent valuation study. The focus of that review was on the **per household** estimates of nonuse values for complete cleanup of contaminated groundwater. The overall judgment of the Committee was that we had no confidence that the respondents to the McClelland *et. al* survey were clear about the commodity they were being asked to value. This basic failing called into question the usefulness of the willingness to pay (WTP) estimates as indications of a typical household value for complete cleanup of contaminated groundwater.

There are also a number of problems with adopting this perspective, including serious discrepancies between the context of the commodities to be evaluated as part of the effects of the planned RIA and what has been described to the respondents in the McClelland *et. al* survey. Equally important, there are significant unresolved issues in the benefit transfer procedures used. These problems are independent of our review of the McClelland *et. al* report and relate exclusively to the use of their estimate in the draft methodology document for the RIA. The most important of our concerns are:

1) Technical Questions

i) At the close of our review of the survey procedures, questionnaire and estimates, it was suggested that the Committee might consider the feasibility of using the estimates as an approximate upper bound on the **per household** WTP to meet the goal of an upper bound evaluation of this source of aggregate benefits generated by the Rule. There is no basis in the McClelland *et. al* study, related literature (see Boyle [1993]) or the analysis presented in the RIA to assume the estimates are upper bounds for per household WTP. The RIA does not use the full range of estimates developed by McClelland *et. al* but focuses instead on a comparison of two of the five scenarios, arguing **incorrect-**



ly, that such comparisons were judged to be the most reliable in the NOAA panel report on contingent valuation (see pp 10-14 to 10-15). Nonuse values were measured by the difference between the complete cleanup and the public treatment scenarios. No recommendation of this type was part of the NOAA panel's report.

- ii) The analysis did not rely on the primary data from the survey. The analysis uses predictions from the Box-Cox model for WTP as if they were primary data, performs a subsequent linear regression treating these predictions as dependent variables and income plus regional dummy variables as independent variables. Based on the McClelland *et. al* report, these variables were arguments of the original Box-Cox models. This exercise has no basis in statistical methods. Predictions from this model were adjusted by a single (for all estimates) adjustment factor of .503 to compute the WTP for public treatment. The difference was then the basis for the nonuse values. It is hard to understand why this strategy was adopted when primary data on the difference that is sought are available in version C of the McClelland *et. al* survey questionnaires.

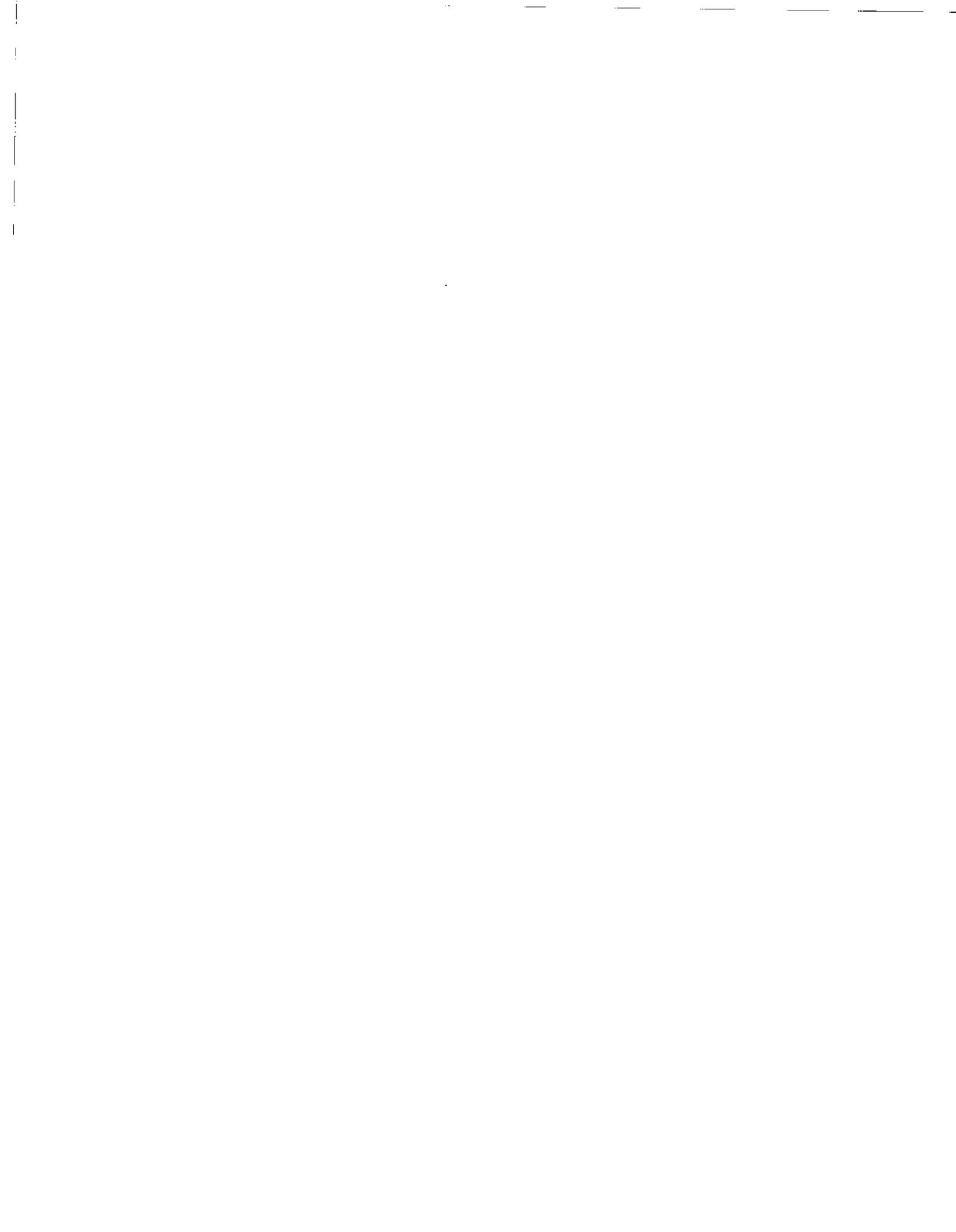
These are **not** the only technical problems associated with the economic methodology used in the benefit transfer. They are examples and reinforce the need for appropriate peer review of methods **prior** to the presentation of materials to committees of the SAB.

2) Benefit Transfer

i) The most fundamental problem arises with the source of the contamination. All of the McClelland *et. al* questionnaire variations identify the source of contamination as a **public landfill**. The majority of the sites affected by the RCRA rule would not fit this description. The pretest and design work from the McClelland *et. al* study suggest this distinction is **very** important. Virtually all of the literature on people's responses to contamination of groundwater finds similar results. The source matters to people's evaluation of the problem and to the character of the response.

ii) The extent and timing of cleanup activities presented in the McClelland *et. al* survey are **completely** different from all of the potential RCRA actions and there is no basis for gauging the temporal properties of the nonuse estimates in response to changes identified as critical in the McClelland *et. al* pretest as well as in the earlier Mitchell-Carson focus group analyses.

iii) The most fundamental issue giving rise to the range in estimates of the aggregate nonuse values is the extent of the market. Estimates range from \$170 million to \$18 billion for aggregate nonuse values depending on the assumption about extent of the market. This variation does **not** relate to the



variability in contingent valuation estimates or to the Committee's concerns about the commodity understood by survey respondents. It results exclusively from **assumptions** about which households are actually concerned about each site.

The RIA presents alternative estimates, identifies the fact that McClelland *et. al* use the phrase "in your community" to describe how households were intended to infer responsibility. Subsequent research is sketched in four pages of a later McClelland *et. al* [1993] report where it is suggested that the concept of community was examined in March 1993 post-testing of the survey. The authors describe a question added to the survey to elicit information about how respondents would evaluate their community. No information was provided in that report about how the results used to propose a definition for the community (as a proxy measure for the extent of the market) were derived -- sample size, implementation, and correspondence of other variables for the new survey with the original survey were not discussed.

These comments are intended to illustrate the substantive questions in the development of the nonuse benefit estimates. Taken together with the questions about interpreting the per household estimates of nonuse values, we are forced to conclude that there is no basis for accepting any of the EPA estimates of nonuse values.

c) Hedonic Analyses

The hedonic chapter and "sanitized" companion report provide an analysis of residential property values using a hedonic framework where housing prices are related to the home and site characteristics including the distance from hazardous waste treatment, storage and disposal facilities (TSDF) at three distinct sites.

In each case study, a notable "event" took place at the TSDF during the observation period. For two of the studies, distance from the TSDF became a significant explanatory variable in the hedonic price equation only after the publicizing of the "event." In the third case study, distance from the site was strongly significant throughout the entire period. The results from this study are qualitatively reasonable and promising. They are based on large samples of housing prices. But, the authors and the Committee caution against adoption of the quantitative estimates of benefits of remediation based on these studies at this time. We reiterate that list adding additional reasons to those reported and introducing some new concerns:

- 1) **Functional form.** The report relies primarily on a linear hedonic model, although it employs a semi-log and a piece-wise (in distance from site) linear form. The "benefit" estimates (see point 5 below) obtained seem quite sensitive to functional form and the authors admit the need to



investigate. Additionally, the implication of linear in characteristics models, i.e. constant marginal prices of characteristics, has not been found especially satisfactory in other studies. The fact that housing prices are being underestimated in some house size ranges and overestimated in others suggests to them and to us the need to experiment with more flexible functional forms with respect to housing characteristics as well.

- 2) **Explanatory power.** Little of the variation in housing prices is explained by the model probably because data are not available on important housing characteristics (especially neighborhood characteristics). Both the report and the Committee agree on this point. This is a particularly difficult problem in one case study where the effects of one TSDF are being estimated, when in fact several such facilities exist in the surrounding area.

While it should be possible to incorporate some additional neighborhood characteristics, others may pose more complicated problems than the authors anticipate. Some neighborhood characteristics might themselves be endogenous -- brought about by the location of the facility. The report suggests using socio-demographic characteristics of the neighborhood to explain price differences but these, too, may pose an endogeneity problem.

- 3) **Outliers.** The report suggests that outliers (i.e. houses that sell for less than \$50,000 and over \$500,000) are quite influential in their estimates. Clearly the model is not explaining these very well. If, in addressing problems 1 and 2 above, this outlier problem is not resolved, the Committee suggests the authors adopt some of the numerous available statistical techniques for dealing with outliers rather than relying on *ad hoc* procedures.
- 4) **Distance as a proxy variable.** The authors use distance from a TSDF as a proxy for the relative damage due to the site. But, all effects from a site are not radially symmetric. Prevailing winds and topographical features can increase/decrease the impact of noxious fumes and other aesthetic effects. The significance of these will be case specific.
- 5) **Benefit measurement.** Without any discussion, the report takes the change in the hedonic price function (as if each affected house were moved farther from the site) as a measure of benefits. Welfare measurement in hedonic models is extremely complicated and depends on such factors as the extent of the market, whether the market could be considered closed or open, the heterogeneity of participants, etc. Even if one



considers only a short run, when individuals (and therefore the hedonic price functions) do not adjust, the hedonic price function is a locus of equilibrium points and not a demand function.

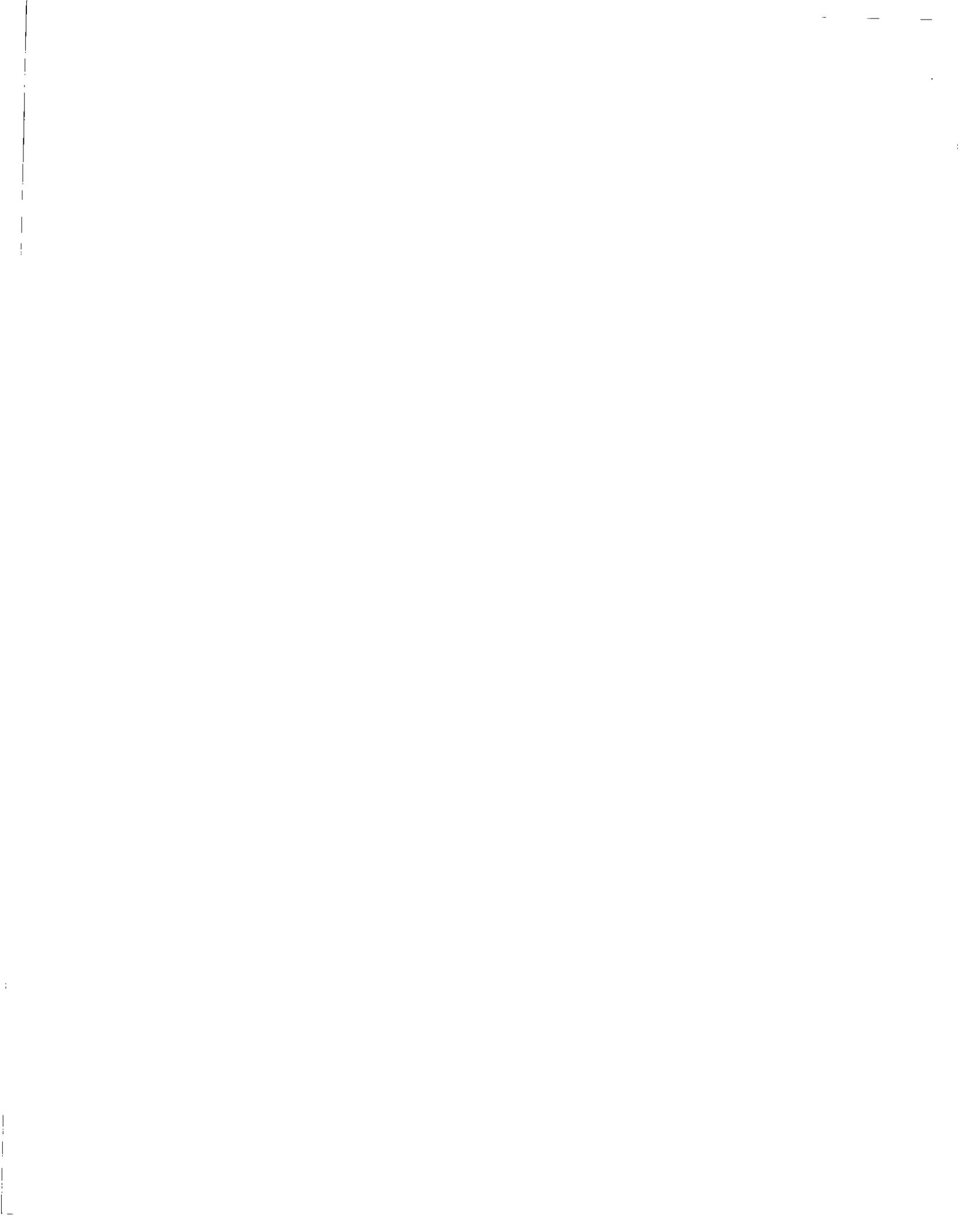
Under certain circumstances, McConnell (in Kopp and Smith, Valuing Natural Assets [1993]) has suggested that the change in the hedonic price as predicted by the change in policy could serve as an approximate welfare measure. However, the report shows no appreciation for this complex problem and needs to consider the factors that would make this a good or bad approximation, or an upper or lower bound. From our understanding of the problem, this predicted change is likely to be an upper bound on the welfare measure sought, but this needs to be examined. Other literature of interest on the subject includes Palmquist (in Braden and Kolstad, eds., Measuring Demand for Environmental Commodities, [1991]; Kanemoto *Econometrica* [1988]; Cropper, Deck and McConnell *REStat* [1988]; Bartik and Smith in Mills, eds., Handbook of Urban Economics, [1987].

- 6) **Repeat sales/time series.** In addition to the hedonic study described above, the report analyzed some time series data in a "repeat sales" analysis for a small sample of houses that were sold more than once during the time period. Little came of that analysis and, for a number of reasons, we do not recommend that they pursue this part of the study.



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