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SUPERFUND CLEANUPS, ETHICS, AND ENVIRONMENTAL RISK ASSESSMENT

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I. INTRODUCTION

Nearly twenty years ago, former President Nixon signed the National Environmental Policy Act, this nation’s first major federal environmental law. Like the universe according to the “big-bang” theory, environmental law has been expanding in all directions since that time. Although the nation has now witnessed almost twenty years of continuing debate about environmental law, a relatively new element has recently entered the controversy, the use of risk assessment procedures to determine levels of acceptable risk from the threats of hazardous wastes.

Risk assessment procedures are the methods and techniques that are being used by government, and sometimes industry, to determine the magnitude and probability of the risks posed by hazardous chemicals or other environmental threats. In addition, these procedures include the processes for determining the acceptability of these risks. This Article will use the term risk assessment procedures to include the process that attempts to quantify the risk, generally referred to as risk assessment, and the procedures employed to protect against the threats posed by the risk, generally referred to as risk management procedures. Thus, environmental risk assessment procedures, when they are used in the management of superfund cleanups or in other environmental decision-making processes,
specify how environmental hazards will be characterized as to the nature and magnitude of the harm posed by these hazards and the degree of safety that can be expected from the cleanup remedy selected. Although the Superfund statute establishes criteria that must be taken into consideration in selecting the remedy at a superfund site, risk assessment procedures determine the methods for quantifying the risks and probabilities of harm that exist before and after the remedy is selected and implemented.¹

With increasing frequency, government agencies are using risk assessment procedures to set environmental standards and cleanup levels.² The need to determine acceptable levels of cleanup at superfund sites has had a particularly large impact on the growth of risk assessment as a decision-making tool. For example, the Superfund Amendments and Reauthorization Act of 1986 requires that a new agency of the federal government, the Agency for Toxic Substances and Disease Registry (ATSDR), prepare health assessments, including risk assessments for all existing and new superfund sites.³ The Superfund program has increasingly relied on such risk assessment procedures to make difficult decisions on the nature of remedial action at sites where soils and groundwater are often contaminated with high amounts of organic and other hazardous pollutants.⁴

Environmental professionals consider risk assessment procedures a useful new tool because: (1) modern technology has developed instrumentation that can measure pollutants to the parts per billion and sometimes parts per trillion levels, and government agencies find that they can identify pollutants at lower levels than those that can be cleaned up considering technical and sometimes economic

¹ Section 121(b) of Superfund specifies certain criteria that the President must consider in selecting a cleanup remedy at a Superfund site. 42 U.S.C. § 9621(b) (Supp. IV 1986). This section provides, inter alia, that the President shall select a remedy that must be “protective of human health and the environment . . . and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.” 42 U.S.C. § 9621(b)(1). Furthermore, section 121(d) of Superfund specifies certain minimum cleanup standards that must be applied in selecting the remedy. 42 U.S.C. § 9621(d). Indeed, the EPA uses risk assessment procedures in determining whether the remedy protects human health and the environment as required by section 121(b) of the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund).

² See Grad, The Tyranny of Numbers, 1 ENVTL. LAW & LITIGATION 1 (1986). Although risk assessment procedures have been used by governmental environmental agencies for the last decade, the use of these procedures has grown most recently because of the Superfund program.


limitations; and (2) in cleanup decisions, government must consider the toxicity of substances that can cause serious health and environmental problems at very low levels. This ability to measure pollutants at very low concentrations and the concern about the toxic effects of low levels of hazardous pollutants force government to ask, "How clean is clean?" Government must determine the acceptable level of residual pollutants left at a site after the cleanup is completed. Risk assessment helps answer these questions because it is a tool that attempts to identify the environmental or health risks posed by pollutants at various levels of cleanup.

As the state-of-the-art in risk assessment procedures develops under the pressure to make decisions in the superfund program, risk assessment procedures are used increasingly to make other regulatory decisions such as standard setting in air or water pollution programs. Government environmental agencies have clearly entered the age of the risk assessment.

Before this ascendancy of risk assessment as a decision-making tool, when a spill of a pollutant occurred, a government agency often simply told a responsible party to remove the pollutant. Inspections after cleanup often relied on visual observations to determine compliance with a cleanup order. Most environmental professionals consider risk assessment an improvement over what was done in the past because it provides a factual and scientific basis for the cleanup decision rather than an intuitive or emotional basis. Accordingly, many environmental professionals regard risk assessment procedures to be neutral policy tools that can be employed by the government to make sound technical judgments that assure efficient and appropriate cleanups.

Are important ethical or values questions hidden or distorted in the technical discourse that is necessarily the language in which regulators discuss the risks associated with our hazardous waste

See Grad, supra note 2, at 2. Although risk assessment procedures have been used in some environmental programs at the federal level for decades, use of these procedures has increased in the last few years at the state level and in some federal environmental programs.

For example, this author was a staff attorney with the New Jersey Department of Environmental Protection from 1973 through 1979. During that time, this author was aware of hundreds of spills per year that were reported to the New Jersey Department of Environmental Protection. Most of the spills reported during this time were petroleum products. This applicable water quality standard for oil was "no visible sheen." See 40 C.F.R. §§ 110.3 to 110.6 (1987). Compliance with the standard was therefore assumed when there was no visible evidence of oil. Only since the 1980s have state environmental agencies begun to think in a sophisticated way about appropriate cleanup levels of hazardous wastes from contaminated soils and groundwater.
problems? Is human communication somehow impoverished through the use of technology-laden language in conversations about environmental problems? This Article examines these questions and the ethical questions often embedded in risk assessment.

This Article first examines risk assessment methodology, and then explores the difference between scientific and ethical questions found in risk management procedures. Next, the Article compares risk assessment with risk management procedures, and then describes how ethical questions can be distorted in risk assessment procedures. Finally, the Article assesses the implications to sound public policy of these values distortions in risk assessment procedures.

II. RISK ASSESSMENT METHODOLOGY

Risk assessment methodology has four major components: (1) hazard identification, a determination of whether a substance will cause an adverse health effect; (2) dose-response assessment, an analysis of the relationship between an administered dose and the incidence of the adverse health effect; (3) exposure assessment, an analysis of the processes and pathways by which contact with a substance creates opportunity for exposure; and (4) risk characterization, the process of identifying the incidence of adverse health effects under various exposure pathways identified in the exposure assessment. 7 Each of these four major steps in developing a risk assessment relies on multiple analytical substeps. For example, in a report entitled “Risk Assessment in the Federal Government: Managing the Process,” the National Academy of Sciences identified fifty steps in risk assessment of chemical carcinogenicity. 8

III. SCIENCE AND ETHICS DISTINGUISHED

Before an analysis of the ethical questions that are embedded in risk assessment is possible, it is important to distinguish between

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7 The United States Environmental Protection Agency published five sets of guidelines on risk assessment methodology on September 24, 1986. These are: Guidelines for Carcinogen Risk Assessment; Guidelines for Estimating Exposures; Guidelines for Mutagenicity Risk Assessment; Guidelines for Health Assessment of Suspected Developmental Toxicants; and Guidelines for the Health Risk Assessment of Chemical Mixtures. 51 Fed. Reg. 33,992–34,040 (1986). These guidelines include a discussion of the major steps in risk assessment. Id. at 33,993.

8 NATIONAL ACADEMY OF SCIENCES, RISK ASSESSMENT IN THE FEDERAL GOVERNMENT (1983) [hereinafter RISK ASSESSMENT].
scientific and ethical questions. For purposes of definition, ethics means the domain of inquiry that attempts to answer the question, "What is good?" Ethical statements are propositions that such and such is good or bad, right or wrong, obligatory or nonobligatory. Ethics should be distinguished from the social sciences, such as sociology and psychology, which attempt to determine why individuals or groups make statements about what is right, good, or obligatory. Furthermore, ethics is concerned with "prescriptive" statements that attempt to transcend relative cultural and individual positions. In contrast, science is the discipline that attempts to make "descriptive" statements about the nature of reality through analysis of facts and experience. Science and its derivative technologies attempt to describe objectively, through an empirical methodology, facts and relationships between facts, and the laws of nature that govern the universe.

It is generally accepted that science cannot deduce prescriptive statements from facts. That is, one cannot deduce "ought" from "is" without supplying a new minor premise. Thus, one cannot introduce an evaluative term, such as "optimal solution," into the conclusion of an argument if the prior premises of the argument were entirely nonevaluative (for example, dose-response statistics). Although the description of certain facts may suggest an ethical position, one cannot deduce an ethical solution from a description of the facts alone.

While facts alone are insufficient, an ethical system such as utilitarianism may provide the minor premise needed for ethical reasoning. For instance, if one concluded that option "A" will create the

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10 See Brown, Ethics, Science, and Environmental Regulation, 9 EnvTL. Ethics 331 (1987).

11 See, e.g., Callicot, Hume's Is/Ought Dichotomy and the Relation of Ecology to Leopold's Land Ethic, 4 EnvTL. ETHICS 162 (1982). The relationship between facts and ethical positions is of considerable controversy within the philosophical community. Although certain linguistic philosophers have held that moral reasoning made by individuals does not rely on deductive models in which ethical conclusions follow from ethical principles, I believe that it is particularly important in developing public policy that those who are making ethical assertions be required to expose ethical premises that support ethical conclusions. See Marrietta, Knowledge and Obligation in Environmental Ethics: A Phenomenological Approach, 4 EnvTL. ETHICS 153 (1982).
greatest happiness by applying the utilitarian maxim that one should choose that option that creates the greatest happiness, one can conclude that option “A” is the optimal solution. From a proposition that a particular problem creates a particular risk, however, one cannot deduce what risk is acceptable without first deciding the criteria for acceptability. Therefore, on this largely traditional view of the logic of ethics, science cannot answer ethical questions all by itself.

That is not to say, however, that science is irrelevant to ethics. Ethics is concerned with the ends that should be chosen by people. Science plays an extremely important role in most environmental ethical discussions because, once a particular goal is chosen, science can evaluate various means available to achieve that goal. Science can also analyze which goals are feasible and sometimes what the consequences of various alternatives are. If a society determines that it is good to build a nuclear power plant, for instance, science can analyze what structures or what types of institutions will most effectively and safely achieve the type of power plant that is desired by the community. Science can also help analyze what environmental impacts can be expected from the power plant.

Science is thus obviously fundamental to the description of environmental problems discussed in this Article and can be particularly important in identifying the health risks that certain projects pose. Those who are interested in a full and clear discussion of values questions posed by environmental problems, therefore, are not anti-scientific. In fact, sound scientific analysis is essential in any attempt to define fully most ethical questions considered here.

Despite the importance of science to ethical discussions, however, science cannot fully determine whether the power plant should be built, precisely because no amount of descriptive analysis can logically compel a prescriptive course of action. If we agree that the question of whether society should build a nuclear power plant is essentially an ethical question, while admitting that science is extremely important in analyzing the facts, and thereby giving content to the ethical question, it must be admitted that there is no generally accepted consensus in the philosophical community about which ethical system or approach to apply to any given problem. For instance, several major ethical approaches attempt to define good, including utilitarianism, Kantian ethics, natural rights, and Rawlsian contract theory, just to name a few. Moreover, some philosophers believe that ethical assertions should be treated as nothing more than the emotive preferences of the person making the assertion on the
grounds that ethical assertions are entirely subjective and relative to the person making the values judgment.

In addition, it is sometimes difficult to determine which facts should be considered and what weight they should be given in any ethical calculus. Because most of the dominant Western philosophical systems make human interests the measure of value, human interests, some critics argue, are the only interests considered in Western ethical systems. As a result, such concerns as the rights of animals are not appropriately considered in traditional ethical debate. In response to the perceived inadequacy of traditional ethical approaches to environmental problems, and as concern about environmental problems has increased over the last ten years, environmental philosophers have attempted to create new ethical approaches to these complex ethical problems. Because the number of approaches has multiplied, establishing that there are ethical questions that have not been adequately considered in public policy formulation is far easier than finding ethical solutions. This Article identifies how risk assessment procedures may distort ethical discourse about environmental problems.

Before one can analyze the ethical questions embedded in risk assessment, one must first be capable of identifying those aspects of risk assessment procedures that raise ethical and/or scientific questions. Most of the current debate about risk assessment appears to be scientific rather than ethical. The number of scientific questions raised in risk assessment are numerous because of the considerable uncertainty that exists about most of the steps in a risk assessment. Scientific uncertainty exists in risk assessment because: (1) epidemiological data relating to dose rates to human disease does not exist for most problems; (2) extrapolating dose-response results from animals to humans requires the selection of untested assumptions; (3) effects of exposure may take years or generations to materialize for chronic diseases; (4) human experimentation is excluded on ethical grounds; (5) experiments must assume some dose rates, thereby giving no information about other dose rates; and (6) exposure assessments must rely upon complex models that attempt to describe how pollutants may be transported through air, water, and soil and

13 At the annual conference for the Society of Risk Analysis held in Washington, D.C., on October 30 to November 2, 1988, approximately 155 papers were given on various aspects of risk assessment. Most of the papers dealt with technical issues associated with risk assessment.
14 See, e.g., Lepse, Quantitative Risk Assessment in Regulation of Carcinogens, 4 HARV. ENVTL. L. REV. 86 (1980).
thereby create exposure opportunities to humans and animals. Scientific uncertainty is often found in many of these component steps of a risk assessment because, in many of these areas, either a scientifically sound theoretical basis has not yet been developed, or empirical data is inconclusive. Because theory is weak or data is incomplete, risk analysis must rely upon making many assumptions for which there is no a priori scientific basis that compels the choice of that assumption.

Furthermore, risk assessment must rely upon a large number of distinct scientific disciplines. Risk assessment quantification must be based on biostatistics, carcinogenesis, toxicology, pathology, epidemiology, genetics, medicine, nutrition, biochemistry, and teratology. Biostatistics is the most frequently used discipline because many of the component steps in risk assessment require giving relative weights to findings from different studies or tests. In addition, a risk assessment performed for a superfund cleanup must often rely on geology, hydrogeology, hydrology, civil engineering, and mathematical modeling. Consequently, it is very difficult for any government agency to have at its disposal, at any one time, all the expertise necessary to develop or review a risk assessment.

If risk assessment is to be used as the basis of regulatory action, choices must be made among options. Because there is often no a priori scientific basis for making such choices, these choices must be understood as unproven assumptions. While acknowledging that unproven assumptions must be made in risk assessment, environmental professionals often act as if they can look exclusively to scientific theory for guidance in selecting among available assumptions. For example, if no toxicological data exists for a particular chemical, prudent scientific theory suggests that the risk assessor use the toxicological data associated with a chemical of similar structural or chemical properties for the needed toxicological numbers. In this way, the risk assessor can bracket his or her ethical or political views by looking to scientific theory to resolve the many uncertainties. Following such procedures allows the scientific facts about the nature of the risk to be determined in such a way that the risk assessment

16 Id. at 89. Biostatistics must be called upon in thirteen of the thirty-six component steps of risk assessment identified by McCray.
is not distorted by biases, prejudices, or personal values of the
individual assessor.

And so risk assessment is understood among environmental
professionals as a scientific exercise that must rely upon a scientific
process that is not fully developed but that, in principle, given
enough time, can be expected to obtain the same confidence that
other predictive sciences have enjoyed. Because the problems with
risk assessment are viewed as primarily scientific problems, envi­
ronmental professionals focus almost exclusively on issues of scien­
tific uncertainty when discussing aspects of the development of a
risk analysis. Environmental professionals view risk assessment
problems primarily as technical problems. Because these risk as­
essment problems are viewed in this way, if ethical questions arise
in the development of a risk assessment, they are often hidden in
the technical language of the scientist.

IV. RISK MANAGEMENT COMPARED TO RISK ASSESSMENT

Once a quantitative risk assessment is completed, the use of the
assessment in the regulatory process requires a "risk management"
decision. Risk management is the process in which various regu­
latory options for dealing with a risk are analyzed and decisions are
made on how to handle the danger threatened by the risk. If, for
instance, a risk assessment determines that a particular chemical
spill poses a risk of one in ten thousand of causing cancer, a risk
management analysis may evaluate alternative ways of dealing with
that risk, such as removing the spilled material or placing the site
of the spill behind a protective fence and, in this way, protecting
people from exposure to this risk.

In risk management decisions, public policy or ethical choices must
be made. In making these risk management decisions, choices must
be made about levels of protection, the level of toxic pollutant that
will remain at the site, whether humans or animals will be protected,
and the extent to which economics should be considered. In contrast,
risk assessment is assumed to be a value-free, scientific, analytical

17 See Brown, supra note 10, at 347.
18 For a discussion of the risk assessment and risk management interface, see Diesler, The
19 Id. Much of the literature on risk management decisions does not classify management
decisions as ethical questions. The literature simply provides that management or policy
options must be chosen. Any ethical dimension of such a choice is not apparent from most of
the risk management literature.
process that postpones values questions to the risk management decision process. As a scientific procedure, it is assumed that the personal values of the assessor can be virtually eliminated from the risk assessment quantification process.

A. Risk Assessment Is Not Completely Value-free

Are risk assessments really “value-free” scientific procedures? Are the values of the assessor necessarily part of the risk assessment? Analysis of the choices that must be made in risk analysis makes the answer clear. Because risk assessment depends on choices for which there is no a priori scientific method of deciding from among available assumptions, risk assessment ultimately depends largely, if not predominantly, on values positions rather than on science.20 Each of the four components of risk assessment methodology requires the application of some judgment that must ultimately rely on something less than scientifically proven principles. Many of the choices that must be made in completing a risk assessment must be viewed as pure values judgments.21 For example, in the hazard identification portion of an assessment, the decision on picking a confidence level to determine statistically whether there has been a positive determination of whether a substance is a hazard is a pure values judgment.22 Most of the component steps in risk assessment are classified mid-way between pure science and pure values.23 In summary, values judgments, understood as decisions about the appropriate degree of conservatism about risk assessment assumptions, pervade risk assessment methodology.

If values judgments, rather than analytical science, are necessarily part of the risk assessment process, to what extent are the political or world views of the analyst responsible for the analysis? Frances M. Lynn addressed this question in a study entitled “The Interplay of Science and Values in Assessing and Regulating Environmental Risks.”24 According to this report,

20 McCray, supra note 15, at 92. Of the thirty-six components of risk assessment identified by McCray, none are purely scientific. All these components therefore require the application of some value judgment according to McCray. That is, none of the components are merely the mathematical application of data to scientifically settled rules.
21 See id.
22 See id. at 90–93.
23 Id.
24 Lynn, The Interplay of Science and Values in Assessing and Regulating Environmental Risks, 2 SCI. TECH. & HUM. VALUES 40 (Spring 1986).
[even] after controlling for the influence of such standard demographic variables as age, sex, region, religion, and family background, scientists employed by industry tended to be politically and socially more conservative than government and university scientists. They chose scientific assumptions that decreased the likelihood that a substance would be deemed a risk to human health and increased the likelihood that a higher level of exposure would be accepted as safe. Government scientists were the most liberal politically and most protective in choosing among scientific assumptions. University scientists fell in between their governmental and industrial colleagues.25

Similarly, a study prepared by the National Academy of Sciences reported that, where a scientist or risk assessor must make choices among several scientifically plausible options, policy considerations inevitably affected some of the choices.26 These conclusions suggest that extra-scientific factors such as the cost of cleanup may influence the quantification of risk.27

Because the mere selection of the dose-response curve from several available options can change the level of the risk by orders of magnitude, the potential prejudice of non-scientific influences is great in risk assessment. For instance,

[one model predicts the lifetime health risks from consuming drinking water containing fifty micrograms per liter of trichloroethylene (TCE) to be approximately one percent while another predicts the risk to be less than 0.00000001%. As the authors of the article reporting these estimates note: "[t]hese estimates provide a range of uncertainty equivalent to not knowing whether one has enough money to buy a cup of coffee or pay off the national debt."28

The many values assumptions embedded within risk assessment methodology thus make the apparent precision that is implied by quantification highly questionable.

It is often difficult, however, to determine from risk assessments that values considerations have affected quantification. Some scientists are very reluctant to identify the role that values have played in quantitative risk assessment because scientific processes are ideally value-free exercises. Some scientists tend to hide controversial

25 Id. at 41.
26 Risk ASSESSMENT, supra note 8, at 33.
27 Lynn, supra note 24, at 45.
values decisions behind the guise of scientific objectivity because scientists are not accustomed to admitting that values considerations have affected their objective pursuits. In addition, scientific discourse does not easily accommodate values discussions.

Failure to address and identify values considerations in risk assessment particularly affects environmental risk assessment. For instance, given that the cost of a cleanup is a factor that continually exerts pressure on a scientist to reexamine his or her assessment of the risk, the failure to identify such trans-scientific considerations as cost in the quantification of the risk may hide the fact that the conclusions of a risk assessment may have affected the choice of assumptions. Equally disturbing is the propensity of some scientists, in the face of uncertainty, to focus all discussion on the quantitative issues while ignoring or denying political considerations such as the amount of money that is available in the superfund for cleanup. Such an approach prevents those who are interested in creating rational public policy from achieving their objective.

B. Risk Management Decisions Require Consideration of Issues That Transcend Typical Management Problems

Similar to the fact that risk assessment cannot escape the need to take values questions into consideration, risk management decisions in superfund cleanup cases require consideration of issues that transcend typical management problems. This section explores some of the ethical questions that arise in the risk management phase of risk assessment procedures.

Although many environmental professionals understand that it is in the risk management component of the risk assessment procedures that some public policy choices must be made, some risk managers are not trained to identify some of the ethical questions that may arise at this stage. The kinds of decisions that must be made in the risk management stage of hazardous waste or superfund cleanup raise many difficult ethical questions that are rarely recognized as ethical questions. Such decisions include determining the

29 Brown, supra note 10, 346–47.
30 Id.
31 For a discussion of how conclusions of risk assessment may affect a person's choice of assumptions, see generally Rushefsky, Assuming the Conclusions: Risk Assessment in the Development of Cancer Policy, 4 Pol. & Life Sci. 31 (1985).
32 Brown, supra note 10, at 946–47.
33 Id.
level of protection that the cleanup is attempting to achieve and whether water supplies are going to contain chemicals that pose a risk of causing cancer of one in one thousand or one in a million. A risk manager must decide whether cleanups should protect humans or animals, and, if animals are to be protected, what species should be protected. A risk manager may also have to decide whether to protect groundwater for current users or to protect all future potential users of the water by insisting that all the groundwater beneath a site meet the appropriate standards. Or a manager may have to choose between protecting people from contaminated soil by leaving some contaminated soil behind a fence or requiring that all the contaminated soil be completely removed to another location. Additionally, a manager may have to determine the cost to be expended in cleanup when the risk to health is quantifiable but small. These kinds of questions cannot be answered by science alone because they are essentially ethical or political. They are prescriptive, not descriptive, in nature. As a result, a scientific management technique cannot logically prescribe which choices should be selected if that management technique refrains from taking a position on these ethical questions.

Economists and others have attempted to develop a variety of analytical techniques, including cost-benefit analysis, that some professionals assert transform these ethical questions into value-free, neutral, technical questions. But most philosophers believe such an approach is equivalent to squaring a circle because each analytical technique takes an unarticulated ethical position that excludes other viable ethical approaches. For example, cost-benefit analysis assumes something similar to utilitarianism as its ethical position. Thus, employing a cost-benefit analysis when making a risk management decision is tantamount to taking a position on an ethical question.

Many philosophers view cost-benefit analysis approaches to public policy decision-making to be inappropriate because utilitarianism rests on the dubious ethical position that moral rights can be balanced with expected utilities. Many philosophers believe that utilitarian approaches must be tempered by rights theories or other principles of justice. Nevertheless, the fact that an ethical approach

34 For a discussion of why cost-benefit analysis and other economic analytical techniques cannot transform environmental problems into technical problems that avoid ethical questions, see M. Sagoff, The Economy of the Earth (1988).
35 Id. at 104–11.
has been implicitly taken is usually not understood by the analyst, or is hidden in the jargon of the analysis, when cost-benefit analysis becomes the basis for a risk management decision.

Other ethical problems may also be hidden in risk management decisions.\(^{36}\) Most importantly, risk assessment involves so much scientific uncertainty that comparisons of risks may be no better than untutored speculation. Because of this uncertainty, risk assessment cannot be relied upon to make the fine distinctions that it is sometimes required to do as part of a public policy decision.

Ethical questions also arise if a particular hazard is not equally distributed among subgroups in a population. For instance, migrant farmers may be exposed to pesticides picking oranges in concentrations thousands of times higher than the concentrations to which city dwellers are exposed. Considerations of due process or other rights theories may require that the migrant worker be protected from the pesticide to the same degree that the average consumer of oranges is protected.

Ethical problems may also be hidden if the risk management decision-making process fails to consider the type of harm that will be created by the risk. Risks that are grave and dangerous differ from risks that involve less dire consequences. Risks that create harms that are reversible may be less objectionable than those risks that create irreversible harm. If certain activities create a risk of death, even though that risk may be small, that risk may be more objectionable on certain ethical grounds than a risk associated with sickness that has a higher numerical probability of occurring.

Ethical problems may also be hidden in risk management decision-making processes that fail to distinguish risks created by new technologies or activities from those risks that people are exposed to daily but cannot control. That is, questions of risk sometimes confuse the ethical with normal uncontrollable risks. For instance, we often hear comparisons of risks with natural background conditions such as lightning or earthquakes. Although we have no choice but to accept the natural risks, new risks may be objectionable on ethical grounds. If one person in 100,000 dies because of background radiation from the atmosphere, it does not necessarily follow that it is ethically appropriate to choose to expose people to new levels of radiation that are likely to produce the same rate of death. Risk management decisions that allow exposure to pollutants because

\(^{36}\) See Brown, supra note 10, at 338.
they compare favorably with risks that are natural, therefore, hide ethical considerations.

Similarly, risk management decisions that simply declare that cleanup procedures at a superfund site will leave pollutants at a level that pose an acceptable risk may hide important ethical questions. The term “acceptable risk” includes a normative dimension that is usually not defended in the public policy debate. Thus, a government sometimes declares that a cleanup standard will adequately protect public health without exposing the ethical criteria on which this adequacy rests. For example, small risks to a small proportion of the human population are often asserted to be “acceptable.”

When a large number of humans are involved, however, there can be a large number of statistical casualties. These casualties are tolerated because the quantitative risk seems small. If the government is willing to accept a risk that one in 100,000 will get cancer from exposure to a substance that all people in the United States may be exposed to, the government is willing to tolerate 2,500 cancers. Despite the low risk statistically, the number of actual cancers caused may make such a risk unacceptable according to a variety of ethical theories. Ethical considerations may thus require that the risk be avoided or minimized.

Risk management decisions may mask certain considerations when a risk manager, under the pressure of scientific uncertainty, bases a risk management decision on liberal assumptions because he or she could not prove that more conservative assumptions represent the actual risk. Who has the burden of proof to show that a new technology or substance is safe or that the risk is acceptable is an important ethical consideration. This consideration is important because ethics distinguishes between risks that one chooses to accept from those that one is exposed to without permission.

Because risk assessment often attempts to predict consequences in situations of fundamental uncertainty, where harm may be created because of the introduction of a new substance or technology, the proponent of the new substance or technology may shoulder the burden of proof of showing that the risk assessment is reliable according to certain ethical theories. Therefore, where uncertainty is great as to the nature of the harm, ethical considerations may demand that the proponent of a new chemical be prohibited from manufacturing that chemical until the proponent demonstrates that it is safe. The mere statement of a quantified but uncertain risk associated with that chemical may otherwise distort these ethical considerations where the uncertainty has been resolved in favor of
the person who is responsible for exposure to the pollutant because the government assumed a burden of proof it could never satisfy.

V. CONSEQUENCES OF FAILURE TO IDENTIFY ETHICAL QUESTIONS IN RISK ASSESSMENT

Although it is admittedly important to continue to enhance our analytical ability to make mathematical estimates of risk, it is also critically important to develop the ability and procedures to identify the many values questions that are often central to making a risk management decision but that are sometimes hidden in the risk assessment jargon. Failure to identify the ethical positions that are necessarily embedded in most risk assessment procedures leads to the following problems:

(1) Failure of democratic institutions. If risk assessment decisions about toxic waste often rely primarily on ethical choices rather than scientific calculation, the failure to disclose these ethical choices constitutes a failure of our democratic institutions. In a democracy, such judgments are supposed to be made by the people or their elected representatives, not by experts who hide ethical choices in technical jargon. If risk assessment quantifications ultimately rely upon the choices of individuals, the dominant ideology of those “expert” individuals may determine the level of protection that citizens receive.

This failure to identify ethical positions allows any person who wants to impose his or her ideology on government environmental protection activities to do so by controlling the way in which “technical” decisions are made. Furthermore, in superfund cases risk assessments are often prepared by technical experts hired by the party responsible for cleanup, and government does not have at its disposal at any one time all of the different expert disciplines that are necessary to critique such a risk assessment and thereby expose the values premises embedded therein. As a result, the values assumptions of the person responsible for causing the environmental hazard often determine how the risk associated with the environmental problem is quantified.

(2) Inability to analyze risk management decisions. If important policy questions are hidden in what appears to be rational, but neutral, technical calculations, communication about hazardous waste is distorted. If the ethical choices that have been made in the risk assessment and risk management decisions have not been disclosed, those who are interested in adequate public protection from
environmental hazards, as well as those who are concerned about the level of costs that they must assume to implement a cleanup, cannot critique the risk assessment. For example, people who live near a hazardous waste site will be misled by statements that a cleanup is "adequate" if cleanup "adequacy" actually rests on a quantitative process that is structured by pervasive uncertainty or dubious ethical thinking.

(3) The propensity of cost to influence risk assessment and risk management procedures. Because the costs of a cleanup can be calculated with more precision than the environmental risk, some environmental professionals tend to change assumptions that have been made in a risk assessment to accommodate these cost considerations. If cost is taken into account in risk assessment procedures, that fact should be disclosed. When a risk management decision allows a responsible party to clean up a site by allowing some pollutants to remain in the soil because cost considerations would not allow complete cleanup, that fact should be disclosed. Thus, if PCBs of fifty parts per million (ppm) will be left in soil at a superfund site because the cost of removing to one ppm is considered prohibitive, professionals should disclose that the resulting cancer risk quantification estimates the cancer risk of fifty ppm PCB to be $1.0 \times 10^{-3}$ and one ppm PCB to be $1.0 \times 10^{-6}$.

Such disclosure is ethically preferable to changing the assumptions in the risk assessment so that fifty ppm PCB risk quantification becomes $1.0 \times 10^{-6}$. Because of the softness of scientific certainty, there is a propensity in risk assessment to make the risk quantification "work out" to be consistent with the level of costs considered acceptable. The failure to acknowledge that the risk management process has taken cost into account constitutes systematically distorted communication about values.

(4) The propensity to clean up to "acceptable" levels only. Because scientific procedures are considered capable of defining levels of acceptable risk, there is a growing propensity to clean up only to those levels generated through the risk assessment despite the fact that, in some circumstances, complete removal of the hazardous chemicals may be feasible. Because risk-based levels may be considerably higher than the naturally occurring background levels of those chemicals in groundwater or soils, the cleanup to "acceptable" health levels may tolerate considerable degradation of groundwater or soils compared to the levels found before the contamination. Thus, a risk-based approach to cleanup may encourage toleration of degradation of the environment in situations where it is economically and tech-
nologically feasible to restore contaminated areas or waters to natural background conditions. Because it is likely that views of the toxicity of hazardous wastes may change in the future, such an approach may be folly.

VI. CONCLUSION

In conclusion, environmental decisions must be viewed primarily as ethical choices rather than as technically dictated conclusions. It is important in an age of increasing scientific complexity that interested parties attempt to understand the values positions and ethical issues that underlie scientifically derived policy choices. Experts and concerned citizens must realize that crucial policy choices concerning environmental pollution and toxic chemicals are values judgments, matters of morality, and social and political judgments.

As long as the values component of environmental decision-making is relegated to technical experts, persons who are not necessarily experts in ethics or values studies, communication about risk assessment procedures may be flawed by values distortions. Given that technicians sometimes are reluctant by training and disposition to deal with values questions, risk assessment procedures must be amended to assure that ethical issues are identified to avoid systematic distortion of values questions. Government must bring greater clarity to the debate about environmental cleanup through identification of the embedded values positions and issues in risk assessment procedures. To accomplish this goal, risk assessment methodology must require that those performing risk assessment identify with clarity and precision: (1) the nature and magnitude of all uncertainty, (2) any assumptions embedded in risk assessment procedures that have been relied upon, (3) identification of any ethical issues considered in the analysis and the ethical approaches taken on these issues, and (4) the extent to which costs or other trans-scientific considerations have affected the analysis.