ADAPTIVE MANAGEMENT IN SUPERFUND: THINKING LIKE A CONTAMINATED SITE

JONATHAN Z. CANNON[1]

[1] Professor, University of Virginia School of Law; former General Counsel, U.S. Environmental Protection Agency. Research for this Article was supported by a cooperative agreement between the U.S. Environmental Protection Agency and the University of Virginia establishing an interdisciplinary Center of Expertise for Superfund Site Recycling at the University. I am grateful for the able research assistance of Theresa Sirois, Stephanie Gitler, and Will Igoe.

INTRODUCTION

Over the last three decades adaptive management has emerged as one of the most promising innovations in natural resource management and environmental regulation. Yet the possible benefits of this approach for Superfund, which is among the Nation's most expensive and controversial environmental programs, have not been comprehensively explored. A 2003 study by the National Research Council (NRC) represented the first serious effort to apply adaptive management principles to cleanup of contaminated sites, with specific attention to contaminated Navy facilities under Superfund, the Resource Conservation and Recovery Act, and state regulatory statutes.[2] This Article examines adaptive management for Superfund as a whole, including the privately owned sites that predominate within the Superfund universe.[3] It elaborates the principles of adaptive management, explains how these principles might work within the legal and policy framework of Superfund, and explores their implications for managing individual Superfund sites as well as for administering the entire inventory of these sites. In the process, it sheds further light on the potential usefulness of adaptive management, which was developed for management of complex natural ecosystems, for a program dealing with local site contamination in largely urban settings.

The Article concludes that, in the complex and uncertain world within which it must operate, Superfund does have something to learn from adaptive management.[4] Superfund would work better, adaptive management principles suggest, with five changes in the framing and management emphasis of the Superfund program:

---

[2] NAT'L RESEARCH COUNCIL, ENVIRONMENTAL CLEAN UP AT NAVY FACILITIES: ADAPTIVE SITE MANAGEMENT (2003) [hereinafter ENVIRONMENTAL CLEAN UP AT NAVY FACILITIES]; *see also* NAT'L RESEARCH COUNCIL ET AL., LONG-TERM STEWARDSHIP OF DOE LEGACY WASTE SITES: A STATUS REPORT 31 (2003) [hereinafter LONG-TERM STEWARDSHIP OF DOE LEGACY WASTE SITES] (recommending that DOE use an adaptive approach to site stewardship).

[3] Fewer than 15 percent of the sites on Superfund's National Priorities List are owned by the Department of Energy, Department of Defense, or other federal agencies. *See infra* note 102.

[4] This Article will use the terms "Superfund," "Comprehensive Environmental Response, Compensation and Liability Act," and "CERCLA" interchangeably. CERCLA is codified as Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. §§ 9601–9675 (2000).

1. EPA should adopt a broad and flexible view of the public interest affected by Superfund sites. This expanded notion of the public good would encompass not only the values made explicit in the Superfund statute, such as environmental protectiveness, but also other values that emerge from consultation with those most affected by a site's disposition. It would give future use of sites a central importance in the Agency's decisions.
2. EPA should promote and monitor institutional innovations, including collaborative stakeholder processes, to clarify and order values in deliberations on alternate futures for the site.
3. In the lengthy process of site study, remediation and post-remedial review, EPA should improve monitoring and feedback mechanisms focused on crucial unknowns or uncertainties at the site and revisit and adjust prior decisions as warranted in light of new information. In particular, the Agency should improve its information gathering and review of anticipated future uses of the site in tandem with its planning, implementation, and review of clean up actions.
4. Acknowledging the ability of players in both the public and private sectors and at multiple levels of government to affect outcomes at the site, EPA should foster the integration of decisions across sectors and jurisdictional scales.
5. EPA should employ conscious policy learning in its management of the entire portfolio of sites. It should consider framing program policies on controversial issues or questions involving scientific or technical uncertainty as experiments and commit to systematic recording and analysis of program experience as a basis for review and change.

More generally, the Article recommends that the Agency embrace adaptive management principles in administering Superfund. Superfund as currently implemented, including recent agency initiatives in several of the areas mentioned above,[5]

[5] *See*, *e.g.*, Memorandum from Michael B. Cook, Director, Office of Superfund Remediation and Tech. Innovation, U.S. EPA, Superfund Site Progress Profiles—Status Report (Feb. 4, 2005) (on file with author) [hereinafter

provides some support for an adaptive approach. But "adaptive management has not yet been incorporated into the [cleanup] process as a whole,"[6] nor has Superfund adopted it as a management guide. Systematic application of adaptive management principles will be necessary to realize the full potential of this approach.

A Model of Superfund

The Article bases its analysis on a model of Superfund as a program for the management of contaminated sites by multiple parties, over extended time periods, and across a range of values or policy objectives. This model differs from what has been the prevailing concept of Superfund as time-limited intervention by federal officials focused predominantly on public health concerns. More specifically, the model challenges three major aspects of Superfund, as traditionally understood. The first of these is that contaminated sites can be dealt with effectively and decisively over a relatively limited time: the problem is defined, a remedy is ordered and implemented, and the problem is solved (i.e., the site is "cleaned up").[7] The statute states a preference for treatment remedies that "permanently" reduce the volume and toxicity of contaminants[8] and the early emphasis of both EPA and its congressional overseers was on rapid and complete clean ups. But, as it turned out, Superfund clean ups took much longer than initially anticipated, and, even more significantly for our purposes, most Superfund sites have contaminants remaining after the remedy is completed and will require long-term monitoring and

Superfund Site Progress Profiles] (initiative to collect and share data on experience at Superfund sites); U.S. EPA, STRATEGY TO ENSURE INSTITUTIONAL CONTROL IMPLEMENTATION AT SUPERFUND SITES (2004) [hereinafter STRATEGY TO ENSURE INSTITUTIONAL CONTROL IMPLEMENTATION], *available at* http://www.epa.gov/superfund/action/ic/icstrategy.pdf (strategy for tracking and evaluating success of administrative and legal controls at Superfund sites); Memorandum from Elaine F. Davies, Acting Director, Office of Emergency and Remedial Response, U.S. EPA, to Superfund National Policy Managers, Regions 1–10, (Oct. 12, 2001) [hereinafter Davies Memorandum], *available at* http://www.epa.gov/superfund/resources/early.pdf (urging early community involvement in site studies and future land use determination).

[6] ENVIRONMENTAL CLEANUP AT NAVY FACILITIES, *supra* note 2, at 4.

[7] *See id*. at 3 ("The predominant paradigm for site restoration in the United States until relatively recently involved a highly linear, unidirectional march from site investigation to remedial action and eventually to site closure.").

[8] 42 U.S.C. § 9621(b)(1) (2000).

review. At least for these sites with lingering contaminants, a more accurate program model is one in which site interventions by EPA are understood to occur in multiple phases over an extended period of time and under conditions of uncertainty and change. This is a model for which adaptive management, with its focus on experimental action and continuous learning through program monitoring and evaluation, is particularly suited.

Second, the Superfund model advanced here addresses the program's historical focus on protecting public health. This focus has been effective in forcing action to reduce health risks posed by site contamination, but has excluded or marginalized consideration of other value-significant dimensions of these sites, such as ecosystem function, economic development, and compatibility with community norms and aspirations. Superfund sites are resources (e.g., land and associated groundwater) whose restoration and future use may offer substantial economic benefits or advance important community values, including but not limited to the reduction of health risks. Although the Superfund statute makes "protectiveness" the central consideration in clean up decisions, there is considerable flexibility in what "protectiveness" requires. The statute also makes room for consideration of other objectives or values, and indeed these other values have made their way into the Superfund decision process, although often not directly or explicitly, as felt necessities of these sites.[9] This Article argues for an expansive deliberative scope for Superfund, one in which a range of potentially competing values are brought to bear in deliberations over alternative site futures. Adaptive management encourages institutional innovations, including collaborative stakeholder processes, by which such values can be identified, ordered and applied. This management model presumes that relevant preferences are, at least to some degree, endogenous to the deliberative process, and emerge as stakeholders absorb scientific and technical information in considering alternative scenarios for clean up and reuse.

The third program feature addressed by the model is the dominant federal role in decision making at Superfund sites. The Superfund statute places the authority for remedial decisions at National Priority List sites in the hands of federal officials, and

[9] One such "felt necessity" is often the political pressure to provide for economic development that is important to the community.

that authority, unlike site-specific decisional authority under many other federal environmental statutes, is not delegable to the states or local jurisdictions. States often have concurrent authority under their own laws for clean up of contaminated sites, and in some cases EPA defers to state clean up decisions under these laws. But more importantly for our purposes, the selection of a remedy is only one of the decisions that determine the future of a Superfund site. Subject to constraints imposed by a remedy selected by EPA, property owners and local authorities typically determine site use, and future use of a site can significantly impact remedy selection, implementation, and effectiveness over time. Thus, decision making at Superfund sites is best understood as a series of interactions among actors operating at multiple levels of government and across the public and private sectors. Adaptive management, with its emphasis on systems hierarchies, provides a framework for the integration of decision making across scales and seems particularly suited to the multi-scalar complexity of the Superfund program.

A Snapshot of the Superfund Program

Superfund sites represent a relatively small portion of the universe of contaminated sites in this country, but they include many if not most of the largest, environmentally most problematic, and politically most contentious sites, and thus have a policy importance disproportionate to their number.[10] Although much progress has been made on the current inventory of Superfund sites, much work remains to be done. As of October 2005, EPA had placed 1547 sites on Superfund's National Priorities List (NPL).[11] Of these, 308 had been deleted from the NPL, leaving 1239 on the current list.[12] Of the total 1547 sites, construction of

[10] *E.g.*, U.S. EPA, *Background on the Libby Asbestos Site*, http://www.epa.gov/region8/superfund/libby/background.html (last visited Apr. 2, 2005) (clean up of 1200 to 1400 residences and businesses contaminated with asbestos-contaminated vermiculite); U.S. EPA REGION 7, TIMES BEACH SITE, TIMES BEACH, MISSOURI, *at* http://www.epa.gov/region7/cleanup/npl_files/mod980685226.pdf (last visited Apr. 2, 2005) (clean up of a formerly incorporated city whose roads were sprayed with dioxin-contaminated oil, including relocation of all residences in a one square mile area).

[11] U.S. EPA, *NPL Site Totals by Status and Milestone*, http://www.epa.gov/superfund/sites/npl/index.htm (last visited Oct. 3, 2005).

[12] *Id.*

the remedy was complete at 966 (or about 60 percent).[13] The term "construction complete" means that all physical construction for remedies at these sites is complete, but does not mean that long-term clean up goals have been met.[14] Only 248 of the 1547 NPL sites, less than one-third of the "construction complete" sites, were in productive use.[15]

Estimates of the total universe of contaminated sites in this country have ranged between 70,000 and 500,000.[16] A study by Resources for the Future has projected that, each year over the next decade, between twenty and fifty of these sites will be added to the NPL and many more will become subject to action under state clean up programs.[17] Although this Article focuses on Superfund, the principles it develops are also applicable to state programs, including clean up and reuse of brownfield sites.

I. ADAPTIVE MANAGEMENT: LEARNING TO THINK LIKE A MOUNTAIN

In his canonical essay, "Thinking Like A Mountain," Aldo Leopold describes a process by which he came to understand the critical role of predators in ecosystems.[18] Rather than producing a "hunters' paradise," he discovered that eliminating wolves led to an overpopulation of deer, the depletion of foliage, and the degradation of the mountain ecosystem on which the deer depend. Leopold observed a similar effect from ranchers' clearing range land of wolves, which resulted in overgrazing. According to Leopold, the ranchers responsible for such clearing have not "learned to think like a mountain. Hence we have dustbowls, and

[13] *Id.*

[14] National Oil and Hazardous Substances Pollution Contingency Plan, 55 Fed. Reg. 8,666, 8,669 (Mar. 8, 1990) (to be codified at 40 C.F.R. pt. 300).

[15] U.S. EPA, *Superfund Redevelopment Program: At a Glance*, http://www.epa.gov/superfund/programs/recycle/index2.htm (last visited Oct. 3, 2005) (EPA includes in its count of sites "returned to productive use" both sites that have been redeveloped for a new use and sites that "are continuing to be used productively in [their] original use").

[16] KATHERINE N. PROBST ET AL., RES. FOR THE FUTURE, SUPERFUND'S FUTURE: WHAT WILL IT COST? 85 (2001).

[17] *Id.* at 105. Earlier estimates by EPA and the Congressional Budget Office had projected that "between 1500 and 7800 sites could be added to the NPL in the next 20 years." *Id.* at 82.

[18] ALDO LEOPOLD, A SAND COUNTY ALMANAC AND SKETCHES HERE AND THERE 129 (1949).

rivers washing to the sea."[19] "We all strive for safety, prosperity, comfort, long life, and dullness," Leopold observed, "but too much safety seems to yield only danger in the long run."[20]

At first glance, nothing could be more different from Leopold's mountain than a contaminated site. One represents a relatively undisturbed ecosystem, the other a highly disturbed environment, a place that is far from its "natural state;" over 80 percent of listed Superfund sites are in Metropolitan Statistical Areas.[21] Yet, although highly modified by human activity, Superfund sites do contain natural systems or are embedded within natural systems that provide important resources and services, such as supplying groundwater and surface water and providing habitat for humans and other life forms, from soil microbes to rare megafauna. These sites are also located within human socio-economic systems, which are closely linked to natural systems. Urban ecologists argue that biophysical and socio-economic systems in city landscapes should be considered together as parts of a single "urban ecosystem" and that the study of these systems should integrate consideration of biophysical and socio-economic drivers, including human values and institutions.[22]

Like the management of Leopold's wolf-deer-cow ecosystem, the management of Superfund sites and the human-natural systems within which they are situated has future implications for the welfare of humans and other living things. Thinking like a contaminated site means accepting stewardship obligations and employing new learning, just as Leopold does in coming to think like a mountain. Thinking like a contaminated site is the province of adaptive management.[23]

---

[19] *Id.* at 132.

[20] *Id.* at 133.

[21] E^2 Inc., Superfund Benefits Analysis 3–35 (Jan. 28, 2005) (partial review draft) [hereinafter Superfund Benefits Analysis], *available at* http://www.epa.gov/superfund/news/benefits.pdf. A Metropolitan Statistical Area is one "with at least one urbanized area that has a population of 50,000." Standards for Defining Metropolitan and Micropolitan Statistical Areas, 65 Fed. Reg. 82228, 82238 (Dec. 27, 2000).

[22] Charles P. Lord et al., *Natural Cities: Urban Ecology and the Restoration of Urban Ecosystems*, 21 VA. ENVTL. L. J. 317, 320, 324–26 (2003).

[23] *See* Bryan G. Norton & Anne Steinemann, *Environmental Values and Adaptive Management*, 10 ENVTL. VALUES 473, 487 (2001) ("[T]hink[ing] like a mountain' . . . requires thinking about the long-term as well as the short-term impacts of decisions, and thoughtful attempts to integrate these.").

Adaptive management has its origins in ecosystem management, where scientists and policymakers have encountered high degrees of uncertainty (and surprise) in the dynamics of natural systems and in the responses of those systems to human intervention.[24] It developed as a strategy of institutional "learning while doing." In adaptive management, policy decisions have a provisional, experimental quality; decision makers maintain flexibility and adjust as they go, based on monitoring the effects of their past decisions and on new information from other sources. A National Research Council study describes adaptive management as "involv[ing] a decision-making process based on trial, monitoring and feedback. . . and recogniz[ing] the imperfect knowledge of interdependencies existing within and among natural and social systems, which requires plans to be modified as technical knowledge improves."[25]

Proponents distinguish adaptive management from "old-fashioned 'trial and error,' a crude and familiar process in which the manager simply tries an approach thought most likely to succeed, and if it fails, moves on to the next most likely successful alternative."[26] Kai Lee advocates an "active" form of adaptive management, in which policies are explicitly selected and designed as experiments to ensure that "the most important uncertainties are tested rigorously and early."[27] Less rigorous forms of adaptive management, which avoid the explicit framing of policies as experiments, include providing mechanisms for regular collection and feedback of information, specifying points for policy review and re-evaluation, and maintaining openness and flexibility.[28]

---

[24] *See*, *e.g.*, C.S. HOLLING, ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT (1978); CARL WALTERS, ADAPTIVE MANAGEMENT OF RENEWABLE RESOURCES (Wayne M. Getz ed., 1986); KAI N. LEE, COMPASS AND GYROSCOPE: INTEGRATING SCIENCE AND POLITICS FOR THE ENVIRONMENT (1993).

[25] NAT'L RESEARCH COUNCIL, RESTORATION OF AQUATIC ECOSYSTEMS: SCIENCE, TECHNOLOGY AND PUBLIC Policy 357 (1992).

[26] Bradley C. Karkkainen, *Adaptive Ecosystem Management and Regulatory Penalty Defaults: Toward Bounded Pragmatism*, 87 MINN. L. REV. 943, 949 (2003) (*citing* WALTERS, *supra* note 24, at 64).

[27] Kai N. Lee, *Appraising Adaptive Management*, 3 CONSERVATION ECOLOGY 3 (1999), *available at* http://www.ecologyandsociety.org/vol3/iss2/art3/index.html.

[28] *See* WALTERS, *supra* note 24, at 232, 248–52; Elin Torrell, *Adaptation and Learning in Coastal Management: The Experience of Five East African Initiatives*, 28 COASTAL MGMT. 353, 354 (2000) (defining adaptive management

Even these more modest versions of adaptive management provide significantly greater capacity for learning than the traditional reactive management approaches.

These strategies for learning can extend not only to scientific but also to socio-economic and political uncertainties and can support the evolution of process as well as policy. Adaptive management envisions a dialectic between technical and scientific information and values affecting policy choices. Its earliest proponent, C.S. Holling, and co-author Stephen Light have stated that the focus of adaptive management should be on the "coupled dynamics of nature, society and resource institutions."[29] Kai Lee characterizes adaptive management as "[l]inking science and human purpose."[30] But often neither the science nor the human purpose is clear: there is "disagreement over both means and ends."[31] Lee proposes a collaborative process in which stakeholders frame the questions to be answered through policy experimentation, and also negotiate among themselves on the relative desirability of outcomes, selecting among alternative futures or development paths.[32] To advance the goals of adaptive management, these processes must be established at the outset of

as coping "with the uncertainty and complexity of ecosystems by creating spaces in which reflection and learning can occur and by allowing management processes to take action in light of new information"); GARY K. MEFFE ET AL., ECOSYSTEM MANAGEMENT: ADAPTIVE, COMMUNITY-BASED CONSERVATION 97, 103, 106 (2002) (identifying three types of adaptive management: active, passive and "documented trial and error"). *But see* W.H. Moir and W. M. Block, *Adaptive Management on Public Lands in the U.S.: Commitment or Rhetoric?*, 28 ENVTL. MGMT. 141, 141–42 (2001) (describing the information feedback system as the "weakest link" in adaptive management and expressing concerns about institutional willingness to modify a course of action when "there is a significant divergence from the trajectory toward stated goals").

[29] Lance H. Gunderson et al., *Barriers Broken and Bridges Built: A Synthesis*, *in* BARRIERS AND BRIDGES TO THE RENEWAL OF ECOSYSTEMS AND INSTITUTIONS 489, 508 (Lance H. Gunderson et al. eds., 1995). In this chapter, the co-authors, Gunderson, C.S. Hollings, and Stephen S. Light, state that it is possible that a model with such a focus "captures the ever-changing stages that are exhibited by complex adaptive systems, of which ecosystems and management institutions are two examples." *Id.*

[30] LEE, *supra* note 21, at 9.

[31] *Id.* at 105.

[32] *See id.* at 104–14. Other commentators also posit collaborative stakeholder processes for integrating science and values. *See, e.g.*, Norton & Steinemann, *supra* note 23, at 474, 478; Timothy L. McDaniels & Robin Gregory, *Learning as an Objective within a Structured Risk Management Decision Process*, 38 ENVTL. SCI. & TECH. 1921, 1922 (2004).

policy deliberations; must be ongoing or iterative; and must have learning as a central objective.[33]

Adaptive management proponents emphasize the hierarchical qualities of the human-natural systems they address. Systems are nested, operating at different spatial and temporal scales, and the linkages between these systems are a source of additional complexity and uncertainty.[34] This multi-scalar perspective applies not only to physical and biological processes with "distinct frequencies in space and time"[35] but also to institutional systems operating at different levels and sensitive to different interests and values.[36] Bryan Norton and Anne Steineman incorporate axioms of hierarchy theory into the understanding of adaptive management, as a "means to organize the spatial and temporal relationships that are so important in multi-scalar management."[37] In particular, the first axiom of hierarchy theory ("all observation and measurement must be oriented from some point within the system"[38]) "operationalizes both a scientific and political focus *from a specific locale, which represents a point within a complex, dynamic, and multi-scalar system*."[39] Accordingly, Norton and Steinemann argue for a place-based or community-based approach, in which "inputs" from local groups "serve as a starting point in the search for management goals."[40] A key challenge of adaptive management in the Superfund program is to distinguish appropriate roles for federal, state and local players and to design processes to integrate their distinct perspectives into a coherent, adaptive policy framework.

Superfund sites present the sorts of uncertainties and opportunities for learning over extended periods for which adaptive management is particularly suited. Decisions require information about (1) the nature, quantity and location of

[33] *See* McDaniels & Gregory, *supra* note 32, at 1921 (noting that adaptive management "has sometimes floundered because of inattention to concepts of good collective decision-making with stakeholders, while stakeholder processes have often neglected the importance of learning and adaptation").

[34] Norton & Steinemann, *supra* note 23, at 479.

[35] C.S. Holling, *Cross-Scale Morphology, Geometry, and Dynamics of Ecosystems*, 62 ECOLOGICAL MONOGRAPHS 447, 448 (1992).

[36] *See* Norton & Steinemann, *supra* note 23, at 478–79.

[37] *Id.* at 480.

[38] *Id.* at 481.

[39] *Id.* at 482 (emphasis in original).

[40] *Id.* at 480.

contaminants on site; (2) site characteristics, including ecosystem processes such as ground water flow and microbial activity; (3) costs and effectiveness of remedies; (4) political and economic conditions affecting clean up and reuse; and (5) values affecting the merits of alternative site futures. Studies and other information-gathering exercises are undertaken to obtain this information, but significant uncertainties often remain after the studies are complete, and new information is generated throughout the cleanup process. Some of this information may come by way of response to decisions made and implemented or sought to be implemented at the site. For example, an attempt to carry out a groundwater pump and treat remedy may reveal new information about cost or effectiveness that would cause decision makers to rethink the remedy. Adaptive management sees these sites and the human-natural systems in which they are situated as dynamic, unfolding at multiple scales of space and time.

Superfund also obviously lends itself to management that is oriented to a particular place or resource—the site—and that emphasizes deliberation among stakeholders identified particularly to that site. Compared to other environmental programs in which detailed regulatory standards drive decisions toward uniform results across diverse environmental and socio-economic settings, Superfund's decision criteria for clean ups, as articulated in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan (NCP), are relatively open and flexible.[41] Thus there is room to tailor decisions according to both the physical circumstances of the site (as well as the larger systems to which the site is connected) and the preferences or values of the community around it (as well as those of stakeholders at the state or national level).

Adaptive management in Superfund can be applied on site-by-site basis and also a site portfolio basis, as the Agency adjusts its management of its entire inventory of sites or distinct portions thereof in light of its program experience and other sources of new information. I explore the individual site

[41] For example, under the Clean Air Act, emissions limitations in permits issued to major sources are determined to a large extent by pre-existing technology-based or ambient-based requirements. *See* 42 U.S.C. § 7411 (2000). Similarly, the Clean Water Act prescribes discharge limitations in permits issued to dischargers based on technology-based effluent limitations guidelines and established water quality standards. *See* 33 U.S.C. §§ 1311, 1342 (2000).

applications first.

II. DELIBERATIVE SCOPE/DELIBERATIVE PROCESS: CLARIFYING HUMAN PURPOSE

The early implementation of Superfund heavily emphasized reducing the human health risks posed by contaminated sites to acceptable levels. Public debate focused on how quickly and effectively EPA was achieving that end, and for the most part it still does.[42] As the program has matured, however, it is evident that other concerns and values have important bearing on the disposition of these sites, including values expressed through the market (e.g., market efficiency), through local government processes (e.g., community welfare), and through other non-market institutions such as local environmental groups (e.g., ecological sustainability) or neighborhood associations (e.g., neighborhood identity or amenities).[43] Decisions by local stakeholders acting on these values can affect the long-term stability and effectiveness of federal remedy decisions and federal remedy decisions can affect the ability of these stakeholders to realize these values in the site's ultimate disposition.

This Article argues for the explicit recognition, in federal decision-making, of the multiplicity of values at play in determining actual outcomes at these sites, and in the section below analyzes the extent to which Superfund, as currently written, can accommodate such recognition. This deliberative breadth is a necessary implication of the linkage between "science and human purpose" that is at the heart of adaptive management.

---

[42] *See, e.g.*, Thomas Dunne, Acting Assistant Administrator, Office of Solid Waste and Emergency Response, Remarks by Thomas Dunne at the Superfund Seminar, Charlottesville, VA 3 (Dec. 2, 2004) (transcript *available at* http://www.epa.gov/swerrims/docs/2004_1202_dunne_sf_speech.pdf) (discussing cleanup of Love Canal, whose "human health problems uncovered . . . during the late 1970s galvanized public opinion in demanding a federal law to clean up contaminated land," as a paradigmatic "success story").

[43] The impact of these values is apparent in the dispositions of numerous sites. *See, e.g.*, *Green Light for Superfund Site*, BROWNFIELD NEWS, Dec. 2004, *at* http://www.brownfieldnews.com/archive/december/V8I5_western_utah.htm (discussing the evolution of a consolidated reuse plan for "large-scale, mixed use development" for site that occupies almost 20 percent of the City of Midvale, Utah, and is essential to the city's economic future); Front Royal-Warren County Economic Development Authority, *Avtex Redevelopment*, http://www.wceda.com/newpage12.htm (last visited Oct. 4, 2005) (describing a shift to a more conservation-oriented reuse plan, including 240-acre riverfront park, from intensive sports use initially planned).

Failure to take account of a full range of values weakens the linkage, undermining the legitimacy of both the process and its outcomes among those most affected.[44] Because these values are not well-defined at the outset of the clean up process, Part II.A further urges EPA to increase its support for collaborative stakeholder processes that integrate the clarification of relevant values with the evaluation of alternative site futures.[45]

A. *Deliberative Scope: Superfund Decision Structure*

All Superfund remedies must meet applicable or relevant and appropriate requirements ("ARARs") under other federal and state environmental laws and must also achieve EPA's more general requirement of "overall protection of human health and the environment."[46] EPA has designated these two requirements as "threshold criteria,"[47] and this Article will sometimes refer to them together as "protectiveness." EPA's regulations identify seven other decision criteria for Superfund remedy selection. Five of these are "balancing criteria": long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost.[48] The two remaining factors—acceptability of the remedy to the state and to the local community—are "modifying criteria."[49] None of the balancing or modifying criteria may override the core requirement of protectiveness.[50]

The general protectiveness criterion addresses the environmental benefits of cleanup. Environmental benefits include gains that relate directly to human health and those that do not,

---

[44] *See* Janice Jiggins & Niels Röling, *Adaptive Management: Potential and Limitations for Ecological Governance of Forests in a Context of Normative Pluriformity*, *in* ADAPTIVE MANAGEMENT: FROM THEORY TO PRACTICE 93, 97 (James Oglethorpe ed., 2002) (urging recognition of normative pluralism in adaptive management).

[45] *See* LEE, *supra* note 21, at 105; Charles E. Lindblom, *The Science of "Muddling Through"*, 19 PUB. ADMIN. REV. 79, 81–83 (1959) (arguing that in complex situations, values are often unclear, in dispute, and uncertain in their application, and that they may be best accounted for in considering alternative proposals).

[46] 40 C.F.R. § 300.430(e)(9)(iii)(A)–(B), (f)(i)(A) (2005).

[47] *Id.* § 300.430(f)(i)(A)

[48] *Id*. § 300.430(f)(i)(B).

[49] *Id.* § 300.430(f)(i)(C).

[50] *See id.* § 300.430(f)(ii)(A) ("Each remedial action selected shall be protective of human health and the environment.").

such as restoration of ecosystem services and protection of biodiversity. A 1995 study of Superfund remedial decisions found an "almost exclusive" reliance on human health considerations, to the exclusion of ecological concerns,[51] but the Agency states that at present a number of its major clean up actions are driven by ecological protectiveness.[52] With the exception perhaps of cost and implementability as "balancing criteria," the statute and the regulations make no express provision for the consideration of the non-environmental values that might be implicated in competing remedial alternatives. There is considerable play, however, in what protectiveness requires. For example, for carcinogenic contaminants, EPA's regulations require clean up to an individual excess cancer risk of no more than 10^{-4} (one in 10,000) to 10^{-6} (one in 1,000,000).[53] Thus, the permissible residual cancer risk after clean up varies by two orders of magnitude. Moreover, the assessment of risk will vary widely depending on the assumptions made about such factors as actual and potential exposure to hazardous substances at the site, which—as we shall see—will vary with projections of future use and other conditions affecting the site. There is even broader discretion in determining the level of protectiveness required for ecological risks.[54] EPA also has discretion in the application of ARARs, including the authority to waive ARARs under certain circumstances.[55]

It is in this realm of discretion that a broader consideration of the public good may take place, including consideration of the non-environmental values associated with alternative remedial or

[51] K.D. Walker et al., *Confronting Superfund Mythology: The Case of Risk Assessment and Risk Management*, *in* ANALYZING SUPERFUND: ECONOMICS, SCIENCE AND LAW 29 (Richard L. Revesz & Richard Stewart eds., 1995). *See generally* GLENN W. SUTER II ET AL., ECOLOGICAL RISK ASSESSMENT FOR CONTAMINATED SITES (2000).

[52] Telephone Interview with Michael Cook, Director, Office of Emergency and Remedial Response, Washington, D.C. (Mar. 30, 2005).

[53] 40 C.F.R. § 300.430(e)(2)(i)(A)(2).

[54] *See* Memorandum from Stephen D. Luftig, Director, Office of Emergency and Remedial Response, U.S. EPA, to Superfund National Policy Mangers Regions 1–10, Issuance of Final Guidance: Ecological Risk Assessment and Risk Management Principles for Superfund Sites 2 (Oct. 7, 1999), *available at* http://www.epa.gov/oswer/riskassessment/pdf/final10-7.pdf.

[55] 42 U.S.C. § 9621(d)(2) (giving authority to the president to waive ARARs); *see also* United States v. Akzo Coatings of America, Inc., 949 F.2d 1409, 1446–50 (6th Cir. 1991) (upholding EPA's implicit waiver of state ARAR).

reuse scenarios. These values may enter the deliberations in at least two contexts. The first is the Agency's consideration of "reasonably anticipated future land use," under guidance issued for the preparation of the Remedial Investigation/Feasibility Study (RI/FS).[56] The second is the statutory requirement that EPA consider the views of the community on its proposed remedy. Both are discussed below.

1. *Reasonably Anticipated Future Land Use*

As part of the remedial investigation, EPA conducts a baseline risk assessment, which includes the determination of a "reasonable maximum exposure [to contaminants on site] expected to occur under both current and future land use conditions."[57] In May 1995 guidance, the Agency stated that the "[f]uture use of the land will affect the types of exposures and the frequency of exposures that may occur to any residual contamination remaining on site, which in turn affects the nature of the remedy chosen."[58] The guidance requires that clean up objectives reflect "reasonably anticipated future land use" and states further that "[l]and uses that will be available following completion of remedial action are determined as part of the remedy selection process."[59] Thus, the reasonably anticipated future land use becomes embedded in the remedial decision and may exclude certain future reuse options while facilitating others. EPA has recently acknowledged this effect of the future land use determination, stressing the importance of "[i]ntegrating realistic assumptions of future land use into Superfund response [as] an important step toward facilitating the reuse of sites following cleanup."[60]

---

[56] The RI/FS is discussed *infra* Section II.A.1.

[57] U.S. EPA, RISK ASSESSMENT GUIDANCE FOR SUPERFUND, HUMAN HEALTH EVALUATION MANUAL 6–4 (1989), *available at* http://www.epa.gov/oswer/riskassessment/ragsa/index.htm.

[58] Memorandum from Elliott P. Laws, Assistant Administrator, U.S. EPA, to Regional Directors, Land Use in the CERCLA Remedy Selection Process (May 25, 1995), *available at* http://www.epa.gov/swerosps/bf/pdf/land_use.pdf [hereinafter Land Use Directive]. For an excellent, detailed account of how land use is considered in the remedial process, see ROBERT HERSH ET AL., RES. FOR THE FUTURE, LINKING LAND USE AND SUPERFUND CLEAN UPS: UNCHARTERED TERRITORY 21–38 (1997), *available at* www.rff.org/Documents/RFF-RPT-landuse.pdf.

[59] Land Use Directive, *supra* note 58, at 2.

[60] Memorandum from Larry Reed, Acting Director, Office of Emergency and Remedial Response, U.S. EPA, to Superfund National Policy Managers Regions

The 1995 guidance concerning land use came in response to criticisms that the Agency's risk assessments and remedial decisions had reflexively assumed the future use would be residential. This assumption, critics argued, raised projected levels of exposure to contaminants left on site, leading to more aggressive clean up objectives and more expensive remedies.[61] Although the directive does not explain it this way, by considering "reasonably anticipated future land use," EPA can avoid remedies whose incremental costs would not be justified by the incremental benefits, such as an aggressive remedy that made a site "safe" for residential use when only industrial use was likely.

Consideration of future land uses allows, in some rough sense, a comparison of the benefits as well as the costs of various remedial/reuse options. Each potential land use will be associated with potential benefits (e.g., profits to the site owner, increases in neighboring property values, and contributions to community values not fully captured in property values) that are in addition to the human health and environmental benefits flowing from the clean up. Each land use scenario will also be associated with redevelopment costs, in addition to the expense of the clean up that would be required to support it.

Under the current guidance, EPA does not represent itself as selecting a "reasonably anticipated future land use" based on a determination of what would be in the overall public interest (a preference or value judgment); instead it sees itself as developing realistic assumptions about what land use will occur (a factual determination). However, the relative likelihood of a selection among various reuse options reflects a determination by someone or some institution (e.g., the owner, the real estate market, neighborhood groups, zoning officials, or some combination thereof) that, in the particular circumstances of a site, some uses are preferable to others. The process of developing these assumptions about future land use contains an implicit value judgment.

Moreover, EPA does not automatically accept a "reasonably anticipated land use" proffered by the community, but must

1–10, Reuse Assessment: A Tool to Implement The Superfund Land Use Directive 2 (June 4, 2001) [hereinafter Reuse Assessment], *available at* http://www.epa.gov/superfund/resources/reusefinal.pdf.

[61] Land Use Directive, *supra* note 58, at 3 (citing criticisms of EPA for "too often assuming that future use will be residential").

balance this preference for future land use with other technical and legal considerations provided in the Superfund law and its implementing regulations.[62] Specifically EPA balances the requirements to treat principal threats, to use engineering controls such as containment for low level threats, to use institutional controls to supplement engineering controls, and to consider the use of innovative technologies.[63] In addition, EPA must comply with other laws when they are "applicable or relevant and appropriate."[64] Thus, EPA adds its own review to the community preferences reflected in the "reasonably anticipated future land use."

In sum, consideration of land use can provide indications of how market efficiency and other values to the community may be affected by various site management options. When combined with other information within EPA's consideration, information about future land uses will aid selection of a remedial/reuse option that is in the overall public interest. In an era of limited federal cleanup dollars and possible reduced participation in cleanups by responsible parties, it may also help attract funding for cleanup from prospective developers.[65]

Ideally, the agency's remedial decision will facilitate a clean up/reuse package that enhances the site's value within the statutory constraints of protectiveness. It will be the agency's responsibility to manage sites in ways that encourage, or at least do not foreclose, beneficial long term strategies. This is not easy, for several reasons. First, determining "reasonably anticipated future land use" may be very difficult during the remedial decisionmaking process. In particular, "[a]t nearly 80% of sites on the NPL, there are adjacent residential areas."[66] Thus, "[p]redicting the 'future

[62] *See* Land Use Directive, *supra* note 58, at 7 (achieving land use preferred by a community may not be practicable); U.S. EPA, Reuse Assessment Guide, *in* Reuse Assessment, *supra* note 61, at 2 (suggesting need for "alternative future land us scenarios" where "it is impracticable to provide for a protective remedy that allows for the desired use") [hereinafter Reuse Assessment Guide].

[63] *See* Land Use Directive, *supra* note 59, at 7.

[64] U.S. EPA, REUSING SUPERFUND SITES: RECREATIONAL USE OF LAND ABOVE HAZARDOUS WASTE CONTAINMENT AREAS 14 (2001), *available at* http://www.epa.gov/superfund/programs/recycle/tools/recreuse.pdf.

[65] *See* Dunne, *supra* note 42, at 2, 5, 8 (asking whether Superfund should "raise our current emphasis on site reuse up another notch or two, and tap the economic winners for more of the cleanup costs").

[66] HERSH ET AL., *supra* note 58, at 70 (*citing* U.S. EPA, SUPERFUND ADMINISTRATIVE REFORM FACT SHEET (May 25, 1995)).

land use' of these sites could be difficult."[67] Second, even where "reasonably anticipated future land use" can be determined, that determination may only be possible in broad categories, such as industrial, commercial, recreational, or ecological. Indeed, EPA anticipates that the reuse assessment will be documented in these broad terms and that "[m]ore specific end uses (e.g., office complex, shopping center, or soccer facility) can be considered during the response process when detailed planning information is readily available."[68] A study published by Resources for the Future found that "anticipated use of a site often evolves in tandem with the site remedy."[69] It may take years for reuse plans to take on specific form, if they emerge at all. Third, the "reasonably anticipated land use" may change. Site ownership, market conditions, and political alignments within the local jurisdiction with land use control authority over the site can all change unpredictably, with direct implications for future land use.

Despite these difficulties, there are several steps that EPA could take to improve the accuracy and usefulness of reuse assessments over the long term, particularly where those assessments are likely have determinative effect on remedy selection, design, or implementation. The first step would be to reduce uncertainty by investing in more vigorous examination of future land use options in the Remedial Investigation/Feasibility Study (RI/FS) phase. Current land use guidance emphasizes that the reuse assessment should "rely on readily available information."[70] Given the role of future land use envisioned here (i.e., capturing important public values that might otherwise be missing from site deliberations and reflecting particularly the concerns and preferences of the community most immediately affected by EPA's decisions), going beyond "readily available information" will likely be warranted. Second, the Agency should take affirmative steps to enhance the likelihood that the "reasonably anticipated future land use" has institutional support within the local jurisdiction. In determining reasonable future land use, EPA is to consult with local land use planning authorities,

[67] *Id.*

[68] U.S. EPA, *Reuse Assessment Guide*, *in* Reuse Assessment, *supra* note 60, at 1 [hereinafter Reuse Assessment Guide].

[69] HERSH ET AL., *supra* note 58, at 6.

[70] Reuse Assessment Guide, *supra* note 68, at 1.

local officials, and the public[71] or solicit "community input."[72] But more than "consultation" may be appropriate. The individuals with whom EPA consults might be expected to have a diversity of views on what should be done with a site. Reconciling those views may warrant EPA sponsorship of focused deliberation on the future of the site, rather than the more passive inquiry contemplated by the guidance, and, if resolution is achieved, the memorialization of results in contractual commitments and/or planning and zoning measures may be advisable.[73] Finally, particularly where significant uncertainty about future land use remains, EPA should retain flexibility for adjustments in the remedy or its implementation in response to the emergence or refinement of promising reuse proposals.[74]

A recent pilot project funded by EPA and conducted by the Hagerstown Land Use Committee, E^2 Inc. and the University of Virginia's Institute for Environmental Negotiation offers an example of an intensive community-based process to elicit future land use preferences serving the decision needs addressed above.[75] At the Central Chemical site in Hagerstown, Maryland, a Land Use Committee, sponsored by Hagerstown's Planning Department, was convened, meeting a half dozen times among themselves and three times with the general public. The Committee's eighteen members included residents and property owners from around the site and from the city-at-large, local business interests and government officials, and the site owner and other potentially responsible parties.[76] Expertise was also provided by "resource members," including representatives of the Planning Department, Hagerstown's Fire Department, and Maryland's Department of the Environment.[77] Among the "guiding principles" or values

[71] Land Use Directive, *supra* note 58, at 4.

[72] Reuse Assessment Guide, *supra* note 68, at 7.

[73] The Agency has suggested adoption of such an approach as part of community involvement. *See* Davies Memorandum, *supra* note 5, at 3 (encouraging EPA staff to "work with the community to develop a process for exploring future use").

[74] These process suggestions are developed further in the remainder of this Section and *infra* Section III.

[75] HAGERSTOWN LAND USE COMM. ET AL., CENTRAL CHEMICAL SUPERFUND REDEVELOPMENT INITIATIVE PILOT PROJECT: PROJECT REPORT (2003), *available at* www.virginia.edu/ien/HagerstownLUCFinalReport.pdf.

[76] *Id.* at 34.

[77] *Id*. Resource members were individuals that served in an advisory

expressly incorporated into the committee's deliberations were to "[p]rotect the long-term health and safety of community residents;" "[e]nsure that site reuses are compatible with surrounding neighborhoods;" "provide community-wide benefits," including the creation of tax benefits and new jobs; "integrate the natural environment into the site's reuse;" and "[u]nderstand the site within its local surroundings and as part of the larger community."[78]

The committee reached consensus, recommending that the site be reused for either mixed light industrial development (with a natural buffer area), commercial office park development (with natural buffer uses for the site) or some combination of the two scenarios.[79] Its recommendations included actual site sketches showing the location and size of the natural buffers and areas designated for commercial and light industrial use.[80] Although these uses were consistent with the existing zoning for the site and required no amendments to municipal ordinances to accommodate them, the committee's recommendations were adopted by the Hagerstown's City Council for inclusion in the city's Comprehensive Plan.[81] The committee recognized that additional information about the site could affect "types of appropriate land uses allowed at the site in the future" and urged EPA to "continue to work closely with the City of Hagerstown and community residents in the future to address community concerns and work with the community to clean up the Central Chemical site and return the site to successful reuse."[82]

2. *Community Views*

Another related portal through which market considerations and other values important to the community may enter site

capacity, but were not directly involved in determining the eventual Committee recommendations, and had no direct stake in the project's outcome. *See id.*

[78] *Id.* at 6.

[79] *Id.* at 2. "The Committee indicated an equal interest in either land use, or a combination of both land uses, as reuse opportunities at the Central Chemical site." *Id.* at 2 n.1.

[80] *See id.* at 3–5.

[81] *See id.* at 18; E-mail from Franklin E. Dukes, Director, Institute for Environmental Negotiation, Charlottesville, VA (Oct. 19, 2005); MAYOR & CITY COUNCIL, HAGERSTON, MD, 60TH SESS., REGULAR SESSION MINUTES 8 (May 25, 2004), *available at* http://www.hagerstownmd.org/CityGov/councilminutes.asp.

[82] *Id.* at 39.

deliberations along with environmental protection is the requirement that EPA solicit community views[83] and consider the acceptability of the Agency's preferred remedy to the state and the community in selecting a remedy.[84] The state and the local community typically have strong concerns about the environmental risks at a given site, but they also may have concerns about other issues. The state may be concerned about operation and maintenance costs that it will have to shoulder. The community may be concerned about the effects of the remedy and future uses of the site on jobs, property values, tax revenues, quality of life, the identity of the neighborhood, as well the environmental justice implications of such decisions. Under EPA regulations, acceptability of a remedy to the state and community is a consideration that comes relatively late in the process. As "modifying criteria," the acceptability of the remedy assumes, at least nominally, a less central role in EPA's deliberations than the "threshold" protectiveness criteria or even the "primary balancing criteria" such as effectiveness and implementability.[85] Nevertheless, like consideration of land use, consultation with the state and local community on remedy selection provides a vehicle for a broader range of concerns to enter the process. In most cases, the local community is the primary if not the sole bearer of the environmental risks posted by the site, and its views will therefore bear importantly on the relative environmental value of various clean up scenarios. The local community also stands to reap a substantial portion of the non-environmental benefits of clean up, including the benefits that flow from reuse of the site, and may also be in the best position to assess those benefits. The next Section explores collaborative processes designed to develop and order community preferences relevant to site management decisions in both the public and private sectors.

B. *Deliberative Process*

The Superfund statute contemplates a decision process for remedy selection that is deliberative rather than technocratic. A classic bureaucratic or technocratic decision model might be appropriate if the statute provided rules of decision that could be

[83] 40 C.F.R. § 300.430(c).
[84] 40 C.F.R. § 300.430(e)(9)(iii)(H)–(I).
[85] 40 C.F.R. § 300.430(f)(i)(A)–(C).

applied mechanically. But, as we have seen, the statute and EPA regulations identify general factors to be balanced, provide some soft signals about how they are to be weighed, and create avenues for still other values to influence the process.[86] An EPA decision maker strikes the final balance, but she does so with limited guidance from the statute as to which outcome should be favored.

To help guide EPA's deliberations, the Superfund statute and EPA regulations and guidance provide for "community involvement," which is EPA's term for its process of informing the affected community about the site and considering its advice.[87] The statute and regulations require the Agency to consult with the community during the RI/FS process; hold a public meeting on its proposed remedial plan for the site; provide an opportunity for public comment before the remedy is selected; and consider the acceptability of the plan to the state and the community.[88] In response to public reaction to the proposed plan, EPA is required to reassess "its initial determination that the preferred alternative provides the best balance of trade-offs, now factoring in any new information or points of view expressed."[89] EPA community involvement guidance encourages EPA site teams to go beyond the "letter of the law" by engaging the community early and seeking and considering its input throughout the process—from initial site assessment to post-clean up monitoring and deletion from the National Priority List.[90] At sites with high levels of interest, EPA also encourages establishment of Community Advisory Groups (CAGs), representing diverse community interests, to consult with EPA and state and local governments.[91]

Despite the commitment reflected in its guidance, commentators have been critical of the Agency's engagement of

---

[86] *See supra* notes 46–56 and accompanying text.

[87] U.S. EPA, SUPERFUND COMMUNITY INVOLVEMENT HANDBOOK (2002), *available at* www.epa.gov/superfund/tools/cag/ci_handbook.pdf [hereinafter SUPERFUND COMMUNITY INVOLVEMENT HANDBOOK].

[88] 40 C.F.R. § 300.430(c).

[89] 40 C.F.R. § 300.430(f)(4).

[90] Davies Memorandum, *supra* note 5; SUPERFUND COMMUNITY INVOLVEMENT HANDBOOK, *supra* note 87, at 3, 23–38.

[91] U.S. EPA, GUIDANCE FOR COMMUNITY ADVISORY GROUPS AT SUPERFUND SITES 2–4 (1995), *available at* www.epa.gov/superfund/tools/cag/resource/guidance/caguide.pdf [hereinafter GUIDANCE FOR COMMUNITY ADVISORY GROUPS AT SUPERFUND SITES]; SUPERFUND COMMUNITY INVOLVEMENT HANDBOOK, *supra* note 87, at 33–34.

stakeholders.

> [C]urrent practice treats stakeholder participation as a constraint—i.e., potentially controversial alternatives are eliminated early. Little effort is devoted to maximizing stakeholder satisfaction; instead the final decision is something that no one objects too strenuously to. Ultimately, this process does little to serve the needs or interests of the people who must live with the consequences of an environmental decision."[92]

1. *Collaborative Stakeholder Processes*

As a response to such criticisms, adaptive management supports a more widespread use and monitoring of collaborative stakeholder processes throughout the Superfund program. Three features of such processes are of particular importance within an adaptive management framework for Superfund. First, collaborative stakeholder processes are value-driven; they are dedicated not merely to reducing conflict over EPA decisions, an often cited purpose of the Agency's community outreach efforts, but more fundamentally to enhancing value to those primarily affected by such decisions. EPA remains the primary steward of certain values, for example, by assuring minimal protectiveness and husbanding the fiscal resources of the Superfund program, but acknowledges the community as the source of other values crucial to its decisions.

Second, these processes provide a forum for clarifying and ordering values that are typically not well-defined or prioritized in terms of preferred site outcomes or objectives. At Superfund sites, stakeholder preferences are likely initially to be unclear or misinformed, because of the unfamiliarity of the issues, including the technicalities of risk analysis and remedial selection and design, and uncertainties surrounding the sites.[93] Thus,

---

[92] I. Linkov et al., *Multi-Criteria Decision Analysis: A Framework for Structuring Remedial Decisions at Contaminated Sites*, *in* COMPARATIVE RISK ASSESSMENT AND ENVIRONMENTAL DECISION MAKING 15, 41 (Igor Linkov & Abou Bakr Ramadan eds., 2004), *available at* www.environmentalfutures.org/Images/ArmyPaper_Oct31.pdf.

[93] *See* Gary H. McClelland et al., *The Effect of Risk Beliefs on Property Values: A Case Study of a Hazardous Waste Site*, 10 RISK ANALYSIS 485, 495 (1990) (concluding that "a sizeable portion" of residents living in the vicinity of a Superfund site held "inaccurate beliefs about the actual risks" posed by living near the site); Ted Gayer et al., *Private Values of Risk Tradeoffs at Superfund Sites: Housing Evidence on Learning about Risk*, 82 REV. OF ECON. AND STAT.

stakeholder preferences are amenable to shaping by a process of consideration (i.e., they are at least to some degree endogenous rather than exogenous to the decision process).[94] In the sustained deliberative process contemplated by adaptive management, the public interest emerges through a focused interaction, in which consideration of technical and scientific information about the site and alternative scenarios combines with evaluation.

Third, these processes involve policy learning, which is the development and refinement of community preferences over time as uncertainties are resolved and more is understood about the site and its possible futures.[95] Policy learning requires that collaborative efforts commence at the earliest stages of a Superfund site inquiry and continue as long as decisions remain to be made. It also requires that stakeholders help frame working hypotheses about site conditions and alternatives and identify questions to be answered by activities at the site. Rather than soliciting one-time public reactions to data, policy learning contemplates an ongoing dialectic between technical and scientific information and values affecting policy choices.

Collaborative stakeholder processes embodying these features may be most effectively carried out through relatively small, continuous, representative groups, like the eighteen-member Land Use Committee that considered the future of the Central Chemical site in Hagerstown.[96] The group should be large enough to provide balanced representation of diverse interests, including those of immediate neighbors of the site, facility owners, and other responsible parties; the local business and real estate communities; environmental and other community public interest groups; and local government.[97] At the same time, keeping the group as small as possible within this constraint reduces transaction costs, enhances the development of norms of reciprocity and trust, and

439, 446 (2000) (finding a significant change in disamenities associated with NPL sites upon release of RI/FS).

[94] *See* Jody Freeman, *Collaborative Governance in the Administrative State*, 45 U.C.L.A. L. REV. 1, 53 (1997).

[95] *See generally* Paul A. Sabatier, *An Advocacy Coalition Framework of Policy Change and the Role of Policy-Oriented Learning Therein*, 21 POL'Y SCI. 129 (1988) (describing a conceptual framework for understanding the role of policy learning, and its impact on governmental programs).

[96] *See supra* text accompanying notes 75–82.

[97] *See* GUIDANCE FOR COMMUNITY ADVISORY GROUPS AT SUPERFUND SITES, *supra* note 91, at 7–8.

increases the possibility that community members with different interests and values will find agreement.[98] The continuity of these groups, particularly with regard to stability in their leadership, is also important to their success as instruments of policy learning.[99]

2. *Community Advisory Groups (CAGs)*

As described in a 1995 guidance document, EPA supports the use of Community Advisory Groups (CAGs) at sites where there is a high level of interest and concern about the site or where there are environmental justice concerns.[100] Agency studies have found that such groups are more effective in clarifying concerns and resolving issues than public meetings; the same studies also show that a CAG can give the community more influence in site decisions.[101] Despite the Agency's endorsement of CAGs, they have been used at very few Superfund sites; the Agency has only used CAGs at approximately 6 percent of eligible NPL sites.[102] There may be several reasons for this. First, because of limitations on federal advisory committees imposed under the Federal Advisory Committee Act[103] (FACA), EPA has concluded that it may not act directly to establish a CAG, although it may encourage a CAG's formation.[104] Instead, the community—i.e., one or more

[98] *C.f.* MANCUR OLSON, THE LOGIC OF COLLECTIVE ACTION 51–65 (1965); *see also* Jon Z. Cannon, *Choices and Institutions in Watershed Management*, 25 WM. & MARY L. & POL'Y REV. 379, 408 (2000) (suggesting ways to reduce deliberative group sizes in instances where constituencies are large).

[99] *See* U.S. EPA, COMMUNITY ADVISORY GROUPS: PARTNERS IN DECISIONS AT HAZARDOUS WASTE SITES CASE STUDIES 5 (1996) [hereinafter COMMUNITY ADVISORY GROUPS: PARTNERS IN DECISIONS].

[100] GUIDANCE FOR COMMUNITY ADVISORY GROUPS AT SUPERFUND SITES, *supra* note 91, at 3; SUPERFUND COMMUNITY INVOLVEMENT HANDBOOK, *supra* note 90, at 33–34.

[101] COMMUNITY ADVISORY GROUPS: PARTNERS IN DECISIONS, *supra* note 99, at vii.

[102] E-mail from Leslie Leahy, Superfund Cmty. Involvement and Outreach Branch, U.S. EPA, Washington, D.C., EPA Community Advisory Group List as of 10/05/04 (Oct. 27, 2004) (on file with author) (data showing that CAGs have been initiated at seventy-three NPL sites). This calculation excludes the 178 federal facilities NPL sites (*i.e.*, sites owned or operated by the Department of Energy, Department of Defense, or other federal agency for which CAGs are not appropriate but for which other advisory groups may be provided). Telephone Interview with Leslie Leahy, Superfund Cmty. Involvement and Outreach branch, U.S. EPA, Washington, D.C. (Nov. 26, 2004).

[103] 5 U.S.C. app. §§ 1–14 (2000).

[104] GUIDANCE FOR COMMUNITY ADVISORY GROUPS AT SUPERFUND SITES, *supra* note 91, at 8; SUPERFUND COMMUNITY INVOLVEMENT HANDBOOK, *supra*

local stakeholders—must establish the CAG. This requirement makes the formation of a CAG contingent to a significant degree on the community's self-organizing capabilities. Under FACA, EPA may not select a CAG's members, but EPA guidance requires that it certify the group's representativeness,[105] and thus the Agency retains some leverage to ensure diversity and balance. Second, CAGs absorb EPA resources, including significant time of the EPA Community Involvement Coordinator (CIC); these are resources that may, in the judgment of EPA officials, be better employed elsewhere. Finally, because CAGs typically increase the influence of the community in the decision process, some EPA officials may be concerned that they will have correspondingly less control. This concern about control may be joined with concerns that if the CAG does not function well, it will impair rather than enhance the decision process.

Although formal collaborative structures will certainly not be warranted at every site, evidence that CAGs have the potential to work as adaptive management vehicles supports arguments for a greater effort to expand and perfect their use. Congress should consider amending the Superfund statue, FACA or both to encourage the use of CAGs and to empower EPA to take a more direct role in establishing and supporting them. Even in the absence of statutory changes, EPA should ratchet up its commitment to CAGs, including not only technical and administrative support but also strategic use of its site decision-making authority to reduce the risks of failure inherent in collaborative undertakings.

3. *Avoiding Failure*

Two common modes of failure—capture and stalemate—are of special concern for CAGs and other collaborative processes at Superfund sites. Even if they include a representative range of stakeholder interests and values, collaborative groups like CAGs run the risk of capture: domination by sophisticated, well-organized interests that may unduly skew the deliberations in their favor. Capture is a risk in almost all policymaking settings, but some commentators have argued that it is more likely to occur in local, collaborative forums than in the context of centralized

note 90, at 33

[105] GUIDANCE FOR COMMUNITY ADVISORY GROUPS AT SUPERFUND SITES, *supra* note 91, at 8.

rule making[106] and thus poses a particular challenge for increased EPA reliance on CAGS. EPA can reduce this risk through its technical assistance grants (TAGs), which fund community groups (CAGs may qualify) to hire independent technical advisors to interpret information, or through the Agency's technical outreach services for communities (TOSC) program, which provides independent technical advice through EPA research centers.[107] This expert assistance can counter the disadvantage that lay citizens may experience vis-à-vis more sophisticated or well-resourced players.[108] Although EPA encourages community groups to apply for these resources,[109] only about half of the CAGS at NPL sites have had technical assistance through TAGS or TOSC.[110]

The Agency can also ensure, as it must by law, that its final remedy decision is consistent with CERCLA's criteria, including protectiveness,[111] in order to provide a base level of protection against overreaching by interests that may be better organized, better informed, or otherwise advantaged in the process. More particularly, EPA can signal to the stakeholders that, in considering acceptability to the community among the statutory criteria, the Agency will not defer to CAG recommendations that do not reflect a reasonable accommodation of the range of local stakeholder interests and values.

Collaboration may also be undermined by strategic behavior among stakeholders, such as "stonewalling, strategic bargaining, dilatory tactics, and other forms of unilaterally imposed transaction costs, tending inevitably toward stalemate or least-common-denominator outcomes."[112] Although these behaviors may occur

[106] Karkkainen, *supra* note 26, at 961. *But see* Richard L. Revesz, *Federalism and Environmental Regulation: A Public Choice Analysis*, 115 HARV. L. REV. 553 (2001).

[107] *See* U.S. EPA, COMMUNITY ADVISORY GROUP TOOLKIT 21–25 (1998) [hereinafter TOOLKIT].

[108] SUPERFUND COMMUNITY INVOLVEMENT HANDBOOK, *supra* note 87, at 31. COMMUNITY ADVISORY GROUPS: PARTNERS IN DECISIONS, *supra* note 99, at 4–5 (noting unanimous agreement among CAG members at Brio Refining, Inc., site that TAG was a key element to success).

[109] *See generally* TOOLKIT, *supra* note 107 at 21–25.

[110] U.S. EPA Superfund, Community Advisory Groups as of 9/25/03 (on file with author) (showing sixty-seven CAGS at NPL sites, with thirty-four having TAG or TOSC assistance).

[111] *See* 42 U.S.C. § 9621(c)(2000).

[112] Karkkainen, *supra* note 26, at 964.

in any negotiation, they may be particularly likely in situations where the consequences of failure to agree are unclear, and thus the parties have little incentive to cooperate, [113] as may be the case under the relatively open-ended statutory criteria for remedy selection under Superfund. EPA can create incentives to bargain by giving notice to the parties of the remedy that it is considering adopting in the absence of a recommendation, and thus giving the stakeholders a distinct point to bargain around.[114] This signaling will occur formally with the Agency's issuance of its "proposed remedy" but could also occur earlier in the process as EPA discusses remedial options informally with interested parties.

Working through CAGs requires EPA to balance several roles: enabler of the collaborative process, setter of boundaries and provider of incentives to ensure that the process is effective and fair, and final arbiter of the remedy.[115] These roles are in tension, and managing them effectively may be among the greatest challenges of a more decentralized model for Superfund. As with technical and scientific issues, the design and implementation of collaborative mechanisms at each site are subject to contingencies, and thus are properly the subject of "learning by doing" within an adaptive management frame.[116]

One might question whether EPA can be trusted to carry out these roles as an honest broker. For example, one might be concerned that the Agency would be reluctant to truly empower local stakeholders or give appropriate deference to their

---

[113] *See id*. at 966.

[114] *See id*. at 965–970 (proposing a "regulatory default rule" to incentivize and provide boundaries for cooperative policy resolutions). EPA reports that at a New England site, there was little community interest until the Agency issued a proposed remedy that triggered opposition from both the PRPs and the community, leading to the formation of a "coordinating committee." This collaborative effort ultimately led to "a far less costly and less intrusive alternative that won support from all stakeholder groups in the community." SUPERFUND COMMUNITY INVOLVEMENT HANDBOOK, *supra* note 87, at 31.

[115] *See* DeWitt John, *Good Cops, Bad Cops*, BOSTON REV. Oct.–Nov. 1999, at 19 (describing the task of central authorities in local collaborative ventures as "simultaneously [to] command and devolve").

[116] Contingencies include continuity (uncertainty about whether key members will remain); representativeness (uncertainty about whether all key interests are identified and represented), and optimal size and deliberative process (uncertainty about whether and how the group will develop a successful dynamic). The testing, monitoring, and refinement of collaborative approaches are also crucial to the institutional evolution of the program as a whole, as discussed *infra* in Section V.

recommendations out of an institutional reluctance to limit its own policy prerogatives by sharing "turf." In enacting Superfund, Congress deemed it in the national interest that the Agency be solely entrusted with making the final remedy decision, but this arrangement carries with it the risk of self-serving central bureaucratic behavior that could discourage or distort local stakeholder processes at some cost to the broader public interest. Limiting this risk are the institutional benefits that EPA stands to gain from producing value-enhancing results at the community level. The Agency's popular brownfields program, which began as an agency initiative to facilitate the reuse of contaminated sites not dealt with under Superfund,[117] evidences the Agency's recognition of this, as does the Agency's recently increased emphasis on community involvement and site reuse under Superfund.[118] Finding out what affected communities want and helping to give it to them, in appropriate measure, can generate political capital for the Agency in the White House and Congress and among the general public—capital that the Agency can use to preserve its authorities and protect its budget. Thus the Agency's most fundamental institutional interests, properly understood and implemented, are likely to be congruent with well-supported, empowered, and balanced stakeholder collaborations.

4. *Quantitative and Qualitative Techniques*

Although they do not provide a substitute for a deliberative process, quantitative techniques such as cost-benefit analysis and multi-criteria decision analysis (MCDA) may be useful as deliberative aides. One limitation of these approaches is the assumption that values or preferences are fixed and pre-existing and thus can simply be aggregated (cost-benefit analysis) or

[117] For an account of the history and mission of EPA's Brownfields Program, see U.S. EPA, *About Brownfields*, http://www.epa.gov/brownfields/about.htm (last visited May 4, 2005). Congress has defined "brownfield site" to exclude sites that are listed or proposed for listing on the NPL or the subject of a removal action. *See* 42 U.S.C. § 9601(39).

[118] *See* Davies Memorandum, *supra* note 5 (encouraging community involvement in all phases of the cleanup process); Memorandum from Michael B. Cook, Director, Offfice of Emergency and Remedial Response, U.S. EPA, to Superfund National Program mangers Regions 1–10 & OERR Center Directors and Process Managers, Reuse Considerations During CERCLA Response Actions 1 (Oct. 10, 2002) (on file with author) [hereinafter Cook Memorandum] (emphasizing "early and continuing consideration of anticipated land use" during cleanup).

otherwise systematically sorted, ranked, and applied (MCDA) to indicate the desired or optimal result.[119] Some forms of MCDA, however, retain the flexibility to "allow stakeholders to 'change their minds'" by adjusting the relative weightings given to selection criteria or "by introducing new criteria or alternatives at any time during the analysis."[120] MCDA has a further advantage over traditional cost-benefit analysis in its ability to account systematically for preferences or values that are not related to any economic use or value.[121] And it has been applied with some success in collaborative settings "as a framework that permits stakeholders to structure their thoughts about pros and cons of different remedial and environmental management options."[122] The disciplined thinking involved in these analytical techniques may help stakeholders counter the effects of "cognitive problems" that have been identified as affecting environmental decision making.[123] For example, stakeholders may have difficulty accurately assessing the range and probability of possible outcomes in a context of uncertainty.[124] Systematic analysis and quantification of contingencies, even though subject to uncertainties themselves, can sharpen the judgment of stakeholders about how to factor uncertainty into their deliberations. These methodologies may also improve the deliberative process by limiting the ability of interest groups to exploit distorted perceptions of risks and probabilities to their advantage.

Qualitative techniques may also assist the deliberative process involved in Superfund cleanups. Examples include historical reviews of the site and its environs, local cultural studies, and architectural designs that visualize alternative uses as physical continuations of the site.[125] These tools can open up

[119] Lowell Prichard, Jr et al., *Valuation of Ecosystem Services in an Institutional Context*, 3 ECOSYSTEMS 36, 38–39 (2000); Norton & Steinemann, *supra* note 23, at 478–49.

[120] Linkov et al., *supra* note 92, at 10.

[121] *Id.* at 1.

[122] *Id.* at 25; ENVIRONMENTAL CLEANUP AT NAVY FACILITIES, *supra* note 2, at 106–07.

[123] CASS R. SUNSTEIN, THE COST-BENEFIT STATE: THE FUTURE OF REGULATORY PROTECTION 9, 26–27 (2002) (discussing "cognitive problems" affecting environmental decisionmaking, such as the "availability heuristic," effects of emotions or "hysteria" on estimates of probability, and fragmentary thinking).

[124] *See id.*

[125] Each of these techniques was previewed at a conference at the University

value-enhancing possibilities that site owners and developers, as well as local, state, and federal governments, each thinking separately in their traditional ways, might not explore;[126] stakeholders can then jointly assess these possibilities. A scenario that emerges successfully from the process may not only coalesce support for a particular remedial option but also coordinate successive actions among governmental entities and across the public and private sectors.

III. FLEXIBILITY, UNCERTAINTY, AND CHANGE: DOING AND LEARNING

The Superfund process is extended in time and made up of myriad information-gathering activities and decisions. These activities and decisions include the initial identification and scoring of the site; listing on the National Priority List (NPL); the Remedial Investigation/Feasibility Study (RI/FS) (including the reasonably anticipated future land use determination); remedy selection, implementation, and evaluation; possible remedy revision; deletion from NPL; and post-remedial five-year review for the roughly 60 percent of "construction complete" sites where some residual waste remains on site. This process is lengthy. EPA has estimated the average time from proposal for listing on the NPL to completion of the remedial action at approximately eight years, but a recent study by Resources for the Future calculates the average instead at over eleven years.[127] Actually achieving final cleanup goals may take much longer in some cases; at sites with long term remedial actions such as bioremediation and soil vapor extraction final clean up can take twenty years or more.[128] For the roughly 60 percent of sites where waste remains on site after completion of the remedy, monitoring and review are mandated for as long as contamination remains above a level that allows "unlimited use and unrestricted exposure."[129] For some

of Virginia in April 2004, Revitalizing Land and Restoring Communities, in presentations by Daniel Bluestone (local culture), Julie Bargmann (site design), and Niall G. Kirkwood (history). *See* Center of Expertise for Superfund Site Recycling, *Conference Info*, http://www.virginia.edu/superfund/conference.html (last visited Oct. 6, 2005).

[126] Lee, *supra* note 27.

[127] PROBST ET AL., *supra* note 16, at 47–52; *accord* Superfund Benefits Analysis, *supra* note 21, at 3–37 to 3–38.

[128] PROBST ET AL., *supra* note 16, at 49.

[129] OFFICE OF EMERGENCY AND REMEDIAL RESPONSE, U.S. EPA,

Department of Energy sites involving radioactive contaminants, the projected period of agency involvement extends for thousands of years.[130]

Adaptive management leads us to think of this process as a series of interventions over time, with the aim of ensuring that each intervention is informed by current information, including information about what occurred in response to previous interventions. Adaptive management anticipates that decisions will leave maximum flexibility for later adjustments and that they will be revisited and revised, if appropriate, in light of new information. It also anticipates effective coordination of site decisions made by the public and private sectors and by multiple levels of government. Achieving these management characteristics in Superfund will depend on having institutions that (1) provide for adequate monitoring and feedback mechanisms (information flow); (2) do not foreclose options unnecessarily while proceeding with the tasks of decision and implementation (flexibility); (3) enable revisiting and adjusting prior decisions as warranted (self-criticality); and (4) integrate across sectors and jurisdictional scales (hierarchical linkages). The discussion that follows explores how such institutions might work.

The Superfund process as currently defined demonstrates some ability to accommodate an adaptive approach, including required monitoring and modification of remedies to ensure protectiveness over time. Recent initiatives further demonstrate EPA's willingness to review and adjust prior remedial decisions and reuse determinations in light of new information or changed circumstances.[131] However, Superfund's learning process remains

COMPREHENSIVE FIVE-YEAR REVIEW GUIDANCE 1–4 (2001), *available at* http://www.epa.gov/superfund/resources/5year/guidance.pdf [hereinafter COMPREHENSIVE FIVE-YEAR REVIEW GUIDANCE].

[130] *See* LONG-TERM STEWARDSHIP OF DOE LEGACY WASTE SITES, *supra* note 2, at 8–10 (2003).

[131] *See, e.g.*, U.S. EPA, SUPERFUND: BUILDING ON THE PAST, LOOKING TO THE FUTURE 58 (2004), *available at* http://www.epa.gov/superfund/action/120day/pdfs/study/120daystudy.pdf [hereinafter 120 DAY STUDY] (recommending that the program set up a review team "to make sure that the selected remedies at sites incorporate new technology and the most cost-efficient cleanup approach based on experience since the remedies' selection"); U.S. EPA, *Return to Use: An Initiative to Remove Barriers to Reuse at Superfund Sites* http://www.epa.gov/superfund/programs/recycle/rtu/index.htm (last visited Oct. 6, 2005) (describing an initiative to "remove barriers to reuse that are not necessary for the protection of human health, the environment, or the remedy at

largely reactive and without systematic articulation or justification. These shortcomings are particularly evident in the technically and institutionally complex co-evolution of the remedy and reuse plans for the site—a dance that, as we have observed, is essential to a value-enhancing disposition of the site.

A. *Adaptive Management in Superfund Site Remediation*

1. *From Site Study to Remedy Completion*

As mentioned above, it takes more than eleven years on average for a Superfund site to move from proposed listing on the NPL to completion of the remedy.[132] This average is likely to grow even longer in the future. To meet the Agency's "construction complete" goals, EPA regional managers have focused on sites for which remedy construction could be completed quickly; as a result, many of the sites remaining "require more complex, lengthy, and expensive cleanups."[133] A significant portion of the work remaining is concentrated at "mega sites" [134]—sites whose clean up costs exceed fifty million dollars[135] and whose high cost and technical, scientific, and institutional complexity can greatly extend the time to remedy completion. Current and anticipated funding constraints will almost certainly extend the average time for clean up even further.[136] The process defined by EPA regulations and related guidance provides multiple decision opportunities during this extended period.[137] This process therefore allows adjustments to be made in response to new or evolving information and thus for the application of adaptive management principles.

During this first phase, EPA conducts the remedial

those sites where remedies are already in place").

[132] *See supra* note 127 and accompanying text.

[133] KATHERINE N. PROBST & DIANE SHERMAN, RES. FOR THE FUTURE, SUCCESS FOR SUPERFUND: A NEW APPROACH FOR KEEPING SCORE 3, *available at* http://www.rff.org/documents/RFF-RPT-SuperfundSuccess.pdf (2004).

[134] *See generally* SUPERFUND SUBCOMM., NATI'L ADVISORY COUNCIL FOR ENVTL POLICY AND TECH., FINAL REPORT 69–71, http://www.epa.gov/oswer/docs/naceptdocs/NACEPTsuperfund-Final-Report.pdf (Apr. 2004) [hereinafter NACEPT REPORT] (analyzing how best to address mega Superfund sites).

[135] *Id.* at 1

[136] Dunne, *supra* note 42, at 7.

[137] *See infra* notes 139–43 and accompanying text.

investigation/feasibility study (RI/FS) and selects, designs and implements a remedy. The remedial investigation (RI) characterizes the site, conducting field studies and a baseline risk assessment, and sets protectiveness goals that are used to develop remedial alternatives and to measure the efficacy of those alternatives.[138] EPA regulations recognize that "estimates of actual or potential exposures and associated impacts on human and environmental receptors may be refined throughout the phases of the RI as new information is obtained" and therefore that these goals may change during the remedial investigation.[139] In the baseline risk assessment, discussed above, the reasonably anticipated future land use is determined and used to set clean up objectives.[140] By implication, assumptions about future land use, along with other elements of EPA's risk assessment, will be reviewed and refined in light of "new information" prior to the selection of a remedy.

The feasibility study (FS), which is developed in coordination with the RI, defines and assesses (practicable and cost-effective) remedial alternatives to meet clean up objectives for the site. EPA regulations require that EPA's assessment of alternatives take into account uncertainties affecting the success and long-term effectiveness of the remedy.[141] Information gleaned during the RI/FS may help reduce them or manage them effectively over time.

In the remedial decision, EPA selects the remedy that will be undertaken at the site and issues a record-of-decision (ROD). Issuance of the ROD is followed by remedial design and implementation (RD/RA). During this post-ROD phase, conditions at the site may change and new information will certainly emerge during the construction and evaluation of the remedy, including sampling and analysis to determine whether clean up levels have been achieved by the remedy.[142] Negotiations

[138] *See* 40 C.F.R. § 300.430(d).

[139] *Id.*

[140] *See supra* note 57 and accompanying text.

[141] 40 C.F.R. §§ 300.430(e)(9)(iii)(C) (assessment of alternatives by the degree of certainty that they will prove successful), 300.430(e)(9)(iii)(C)(2) (consideration of the adequacy and reliability of containment systems and institutional controls), 300.430(e)(9)(iii)(F)(1) (evaluation of technical feasibility, including "unknowns" associated with the construction and operation of the remedy).

[142] 40 C.F.R. § 300.435(b).

with responsible parties to carry out the clean up with private funds rather than with public funds may occur during the RD/RA phase. The outcome of these negotiations may affect clean up plans. In provisions that recognize that there may be changes in the ROD between its issuance and final implementation, the NCP provides a mechanism by which new information and developments bearing on the remedy can be considered and acted upon during the RD/RA.[143] ROD amendments provide an important adaptive management tool, both during and after the RD/RA, and pursuant to a program reform begun in 1996 to update remedy decisions, there is some evidence that this tool is being used effectively in response to new information generated during the remedial design process.[144]

EPA regulations do not expressly address how EPA is to manage uncertainty or new information affecting the reasonably anticipated future land use during the RI/FS. EPA guidance states that "where the future land use is relatively certain, the remedial action objective generally should reflect this land use."[145] If uncertainty surrounds the reasonably anticipated future land use, "a range of the reasonably likely future land uses should be considered."[146] Each reasonably possible land use may be consistent with some remedial alternatives, including engineering measures and institutional controls, but not with others.[147] Thus, the guidance directs that "[t]hese likely future land uses can be

[143] 40 C.F.R. § 300.435(c)(2) (providing for public explanation of significant [but not fundamentally altering] changes in the ROD and for public notice and comment on amendments to the ROD for fundamental alteration of basic features of the remedy).

[144] Memorandum from Stephen D. Luftig, Director, Office of Emergency and Remedial Response & Barry N. Breen, Director Office of Site Remediation Enforcement, Superfund Reforms: Updating Remedy Decisions (Sept. 27, 1996) [hereinafter Superfund Reforms: Updating Remedy Decisions], *available at* http://www.epa.gov/superfund/resources/gwdocs/updating.pdf; U.S. EPA, UPDATING REMEDY DECISIONS AT SELECT SUPERFUND SITES: BIANNUAL SUMMARY REPORT FY 2000 AND FY 2001, at 6–7 (2003), *available at* http://www.epa.gov/superfund/programs/reforms/docs/rem_report.pdf [hereinafter UPDATING REMEDY DECISIONS] (showing 111 remedy updates for these two fiscal years, 63 at the initiation of outside parties and 48 at the initiation either of EPA or of multiple parties).

[145] Land Use Directive, *supra* note 58, at 8.

[146] *Id.*

[147] Margaret Calder Ferguson, Evaluation of Remediation Technologies for Various Contaminants Found on Superfund Sites 17, 21–24 (Apr. 2002) (unpublished manuscript on file with author).

reflected by developing a range of remedial alternatives that will achieve different land use potentials."[148] By developing this range, the Agency retains flexibility to respond to new information on future land use at least through remedy selection.

Similarly, EPA regulations make no specific mention of future land use in the RD/RA phase. EPA guidance states that the remedy selection process includes determination of "[l]and uses that will be available following completion of the remedial action" and planning of site activities that are "consistent with the reasonably anticipated future land use."[149] Where reuse plans are well-developed at the time of remedy selection, the remedy can be tailored in its design and implementation to ensure both protectiveness and the realization of the reuse plans. In some cases, where site preparation requirements for future development may exceed what is necessary to achieve a protective remedy, arrangements can be worked out to accommodate those requirements prior to implementing the remedy. For example, at the Raymark site in Stratford, Connecticut, the remedy chosen was an engineered containment system.[150] The prospective developer paid for dynamic compaction and the installation of pilings during the construction of the containment system in order to support future building on the site.[151] Thus, by reducing the total costs of remedy implementation and site preparation, the net value of the clean up and redevelopment of the site can be increased.

Reuse plans are often not well-developed at the time of remedy selection, in which case the Agency may make protective remedy decisions that anticipate the most likely category or categories of redevelopment and preserve maximum flexibility for future adjustments. Under its general remedy revision authority, discussed above, the Agency may modify its remedy to accommodate proposals that emerge during the RD/RA phase. For example, the remedy for the Rentokil, Inc. site, a former wood treating plant in Henrico County, Virginia, provided for removing wood treating equipment and some contaminated sediments and for building control structures to reduce further migration of

[148] Land Use Directive, *supra* note 58, at 8.

[149] *Id.* at 2.

[150] U.S. EPA, REUSING SUPERFUND SITES: COMMERCIAL USE WHERE WASTE IS LEFT ON SITE 7–8 (2002), *available at* www.epa.gov/superfund/programs/recycle/c_reuse.pdf [hereinafter REUSING SUPERFUND SITES: COMMERCIAL].

[151] *Id.* at 8.

contaminants into a creek.[152] During implementation, the remedy was revised to provide for redevelopment, allowing building foundations to be incorporated into the cover and other structures necessary for construction and consistent with long-term maintenance of the remedy.[153] The Rentokil site illustrates the importance, as part of an adaptive management approach, of retaining flexibility to respond to new information on land use preferences as well as other value dimensions of the site even after the remedy has been selected and is being implemented.

Because future land use is so heavily dependent on decision makers other than EPA—the site owner, potential developers, local land use authorities, and state officials—and because future land use and the evaluation and implementation of remedial measures are so closely related, focused stakeholder processes of the sort discussed in Section II provide a critical adaptive management tool. These processes can provide information on evolving stakeholder preferences relating to site planning and management over the course of the RI/FS and the DR/RA and even beyond.[154] Moreover, collaborative stakeholder processes can help integrate perspectives across multiple scales within the decisional hierarchy.

2. *Site Reviews*

The period after completion of the remedy presents perhaps an even broader field for adaptive management, and yet the potential for adaptive management in this field is not well-developed in the EPA regulations and guidance, particularly regarding land use. For sites on which hazardous substances remain, EPA conducts post-remedial inspections and reviews. For remedies adopted after the Superfund amendments of 1986, the statute requires that the Agency conduct an in-depth review of the effectiveness of the remedy at such sites every five years after initiation of the remedial action.[155] This review produces (1) an

[152] *Id.* at 41.

[153] *See id.*

[154] *See supra* text accompanying notes 93–99.

[155] 42 U.S.C. § 9621(c) (2000). As a policy matter the Agency also requires five-year reviews for (1) remedial actions taking more than five years to complete; (2) pre-1986 remedies where hazardous substances are left on site above levels that allow for unlimited use and exposure; and (3) removal-only sites (i.e., sites that have been addressed solely under EPA's emergency removal authority) where hazardous substances are left on site above levels that allow for unlimited use and exposure. *See* COMPREHENSIVE FIVE-YEAR REVIEW

assessment of whether the remedy is protecting human health and the environment and (2) recommendations for actions that need to be taken to ensure continued effectiveness (if the remedy has performed adequately to date) or to restore protectiveness (if it has not). The Agency's review includes community notification, a site inspection and interviews, a review of data from site monitoring, and "any other information [that has] come to light that could call into question the protectiveness of the remedy."[156] The Agency may require additional sampling and collection of other data as necessary to decide whether the remedy is functioning adequately.[157] Five-year reviews may be discontinued only when the Agency determines that contaminant levels on site are below levels that allow for unlimited use and unrestricted exposure.[158]

The five-year review plays a central role in the long-term stewardship of NPL sites, but EPA could significantly improve its usefulness as an adaptive management tool. The five-year review gives the agency both the occasion and the information on which to act, if the protectiveness of the remedy is in question.[159] The review is crafted particularly to ensure the continued effectiveness of engineering measures designed to contain remaining on-site contamination (such as caps) and institutional controls designed to limit human exposure (such as land use restrictions). Recently EPA took steps to enhance its "ability to gather, manage and evaluate" information on institutional controls through the five-year review.[160]

However, EPA's five-year review guidance does not direct the Agency to inquire into dimensions of the remedy/reuse other than protectiveness or to take action if it is apparent that the remedy is not functioning well along these dimensions. For example, the guidance does not require investigation of whether the remedy remains cost-effective, that is, whether changed conditions at the site or new technological information indicate

GUIDANCE *supra* note 129, at 1-3 to 1-4.

[156] COMPREHENSIVE FIVE-YEAR REVIEW GUIDANCE *supra* note 129, at 3-7.

[157] *Id.* at 4-12 to 4-13.

[158] *Id.* at 1-4.

[159] *But see* ENVIRONMENTAL CLEANUP AT NAVY FACILITIES, *supra* note 2, at 303 (discussing the importance of continuing on site monitoring after remedy implementation).

[160] STRATEGY TO ENSURE INSTITUTIONAL CONTROL IMPLEMENTATION, *supra* note 5, at 4.

that a modified remedy could be operated or maintained at lower cost.[161] Although EPA's reform initiative to update remedies extends by its terms to all RODs, whether construction of the remedy is complete or not,[162] most of the remedy updates have occurred in the design phase.[163] Requiring focused examination of this issue during the five-year review could provide additional information for post-completion sites.

The available guidance also affords only limited consideration of site reuse. It does direct EPA to consider "changes in land use" as part of its review, but such changes are only relevant to the issue of whether unanticipated exposures have undermined the protectiveness of the remedy.[164] There is no consideration of whether the reuse option anticipated by the remedy has been carried out, whether the current use represents a productive use of the site or otherwise accords with the wishes of the community, or whether alternative uses have materialized that promise a more locally acceptable use of the site without compromising the remedy's protectiveness. Recently the Agency has expressed interest in facilitating reuse at post-completion sites. Late in 2004, EPA announced a "Return to Use" initiative, "designed to remove barriers to reuse that are not necessary for the protection of human health, the environment, or the remedy at those sites where remedies are already in place."[165] The eleven demonstration projects selected for that initiative are a beginning, but broader program guidance will be necessary to secure review of all post-completion sites, including the more than four hundred such sites that are not in productive use.[166] The Agency has stated its intent to issue guidance to integrate "consideration of reuse throughout the response cycle," including "long-term

[161] COMPREHENSIVE FIVE-YEAR REVIEW GUIDANCE, *supra* note 129, at 4-4 (requiring the reviewer to "identify any opportunities to improve the performance and/or reduce the costs of sampling and monitoring" only if "readily apparent" during the course of review).

[162] *See* Superfund Reforms: Updating Remedy Decisions, *supra* note 144, at 3.

[163] UPDATING REMEDY DECISIONS, *supra* note 144, at 1.

[164] COMPREHENSIVE FIVE-YEAR REVIEW GUIDANCE, *supra* note 129, at 4-5.

[165] U.S. EPA, *Return to Use: An Initiative to Remove Barriers to Reuse at Superfund Sites*, http://www.epa.gov/superfund/programs/recycle/rtu/index.htm#back (last visited Apr. 21, 2005).

[166] U.S. EPA, *Return to Use Demonstration Projects*, http://www.epa.gov/superfund/programs/recycle/rtu/demos.htm (last visited Apr. 5, 2005).

stewardship."[167] In framing that guidance, the Agency could make good use of the five-year review.

In sum, the five-year review is ideally suited to carry out adaptive management of sites after remedy completion but, as it is currently structured, adaptive management principles and processes are applied only to some of the factors that are relevant to enhancing site value. Dimensions related to non-environmental values that may be important to the community are not integrated, and the review therefore wastes an opportunity for EPA, in consultation with the state, local officials, community groups, and business interests, to further the public interest as it is broadly understood.

It remains open at any time for an interested party to seek modification of a remedy to accommodate a different, more beneficial use.[168] A town may propose remedy enhancements that would allow use of a site as a park, or a developer may propose changes that would allow more intensive (i.e., higher exposure) uses of the site. If the proponent will fund the enhancements and can persuade the Agency that the amended remedy will be protective and consistent with the other statutory criteria, EPA may approve it. That less than one-third of construction complete sites have been returned to productive use suggests that there is significant unrealized potential at these sites.[169] Because of the stigma attached to hazardous waste sites, however, underutilized Superfund sites may not receive the attention either from private development interests or public entities that other properties might.[170] The five-year review offers a strategic opportunity for EPA to re-engage the community on the issue of site utilization as well as on the issue of protectiveness, and to facilitate alternative uses of the site where it is determined that the land is being

[167] Cook Memorandum, *supra* note 118, at 2.

[168] 40 C.F.R. § 300.435(c)(2); U.S. EPA, UPDATING REMEDY DECISIONS AT SELECT SUPERFUND SITES: SUMMARY REPORT FY 2002 AND FY 2003, at i (2004), *available at* http://www.epa.gov/superfund/programs/reforms/ docs/urd02-03.pdf (describing remedy changes based on additional technical information; changes in relevant regulatory requirements or land use; and "State input or community preference").

[169] *See supra* text accompanying note 15.

[170] There is evidence that previously contaminated sites remain depressed in value even after clean up. *See, e.g.*, Jill J. McCluskey & Gordon C. Rausser, *Stigmatized Asset Value: Is It Temporary or Long-Term?*, 85 REV. ECON. & STAT. 276 (2003); Bill Mundy, *Stigma and Value*, 60 APPRAISAL J. 7 (1992).

underutilized. The characteristics of Superfund sites, as among a relatively small group of the most contaminated sites in the nation, are not within the range of information or expertise typically possessed by local real estate markets or local governments. Niche entrepreneurs specializing in developing contaminated sites may help to supply that information and expertise to the affected community, but EPA remains an important and arguably more transparent additional source. Certainly where the Agency is required to maintain prolonged contact with the site, as under the five-year review provisions, it seems appropriate that its ongoing consultations with local private and public interests provide a forum for ensuring that the site is well-used as well as safe.

IV. HIERARCHICAL LINKAGES: INTEGRATING ACROSS SCALES

Adaptive management attends to hierarchical linkages, in both natural and human systems. It calls on EPA and others who make decisions affecting Superfund sites to locate their understanding of the site's physical and biological resources in the larger physical and biological systems to which they belong. It also calls on decision makers to understand their place within the institutional hierarchy that affects the site. Because Superfund sites—as distinct from other categories of land generally managed by private markets and local regulation—experience a substantial federal presence, the hierarchical considerations affecting these sites are both unusual and complex.

To understand how the hierarchical aspects of Superfund sites might best be addressed within an adaptive management framework, it is helpful to understand the possible theoretical rationales for federal involvement in these sites. Economists offer the subsidiarity or matching principle to determine the level of government at which regulatory decisions should be made: the decisions should be made at the smallest unit of government whose geographic scope includes all the significant costs and benefits of the regulation.[171] The matching principle supports federal regulation where a localized activity, such as site contamination, would have significant environmental or economic effects in other

[171] *See* WALLACE OATES, FISCAL FEDERALISM 31–38 (1972); Henry N. Butler & Jonathan Macey, *Externalities and the Matching Principle: The Case for Reallocating Environmental Regulatory Authority*, 14 YALE L. & POL'Y REV. 23, 25 (1996).

states. Physical interstate spillovers of the sort generally acknowledged to warrant federal intervention are not apparent at most Superfund sites, as the effects of soil and groundwater contamination tend to be geographically confined. The Eleventh Circuit, however, in *United States v. Olin Corp.*, 107 F.3d 1506 (11th Cir. 1997), held that Superfund fell within the federal Commerce Power, noting comments in the legislative history that the "improper disposal of hazardous waste threatened natural resource-dependent, interstate industries, such as commercial fishing."[172] The court also cited Congressional findings that "accidents associated with purely intrastate, on-site disposal activities" adversely affected interstate commerce, and it concluded that "the regulation of intrastate, on-site waste disposal constitutes an appropriate element of Congress' broader scheme to protect interstate commerce and industries thereof from pollution."[173] Nevertheless, the interstate externalities argument for Superfund does not seem particularly strong compared to similar arguments for other federal environmental statutes, such as the Clean Air Act and Clean Water Act, in which interstate pollution problems figure much more prominently.

There are at least two other possible theoretical justifications for the federalization of programs for cleaning up seriously contaminated sites. First, the contamination of many of these sites is traceable to the business activities of large national or multinational corporations. Given the size of these corporations, their substantial economic leverage within the individual states, and the hefty costs of clean up, one might argue that a federal liability system is necessary in order to prevent a race to the bottom in clean up programs among states, resulting in too little clean up. This possible destructive interstate competition provides an independent justification for a federal scheme, and indeed the race to the bottom was cited by legislators and courts to justify the centralized decision structure of Superfund.[174] However, Richard Revesz and others have criticized the race-to-the-bottom rationale in environmental regulation as an insufficient theoretical basis for

[172] 107 F.3d at 1511 n.10.

[173] *Id.* at 1511 n.11.

[174] The first federal court decision interpreting Superfund liability as requiring a nationally uniform rule was *United States v. Chem-Dyne Corp.*, 572 F. Supp. 802, 809 (S.D. Ohio 1983) (quoting remarks of Congressman Florio in floor debates on the passage of Superfund).

the federalization of environmental programs.[175] There may be competition for economic development, Revesz argues, in which states are forced to balance their desire for jobs with their preference for a clean environment, but that competition is not necessarily a race to the bottom; indeed it may be welfare-enhancing.[176]

Second, it might be argued that the states lack the capability (the scientific, technical, or legal sophistication) to effectively deal with the largest and riskiest contaminated sites. Only the federal government, with its advantages of scale, can marshal the requisite expertise to manage these sites effectively and thus the federal regime is justified.[177] This argument may be partially offset by the geographic heterogeneity of contaminated sites, where "on-the-ground knowledge is of central importance, and the diversity of circumstances is salient."[178] Moreover, even granting superior technical, scientific and legal capabilities to federal officials, this rationale does not necessarily support placing sole decision-making authority at NPL sites in the hands of federal officials, as Superfund does:[179] the federal government might simply make its expertise available to state or local decision makers.

The federal presence at NPL sites and other contaminated sites warranting emergency response serves important functions, but the possible theoretical justifications for that presence do not

[175] *See* Richard L. Revesz, *Rehabilitating Interstate Competition: Rethinking the "Race-to-the-Bottom" Rationale for Federal Environmental Regulation*, 67 N.Y.U. L. REV. 1210, 1233–44 (1992); Wallace E. Oates, *On Environmental Federalism*, 83 VA. L. REV. 1321, 1325–27 (1997). *But see* Daniel C. Esty, *Revitalizing Environmental Federalism*, 95 MICH. L. REV. 570, 627–38 (1996) (responding to Revesz).

[176] Revesz, *supra* note 175, at 1242.

[177] See Joshua D. Sarnoff, *The Continuing Imperative (But Only From a National Perspective) for Federal Environmental Protection*, 7 DUKE ENVTL. L. & POL'Y F. 225, 251–57 (1997) (identifying potential "economies of scale . . . by centralizing research, standard setting, control-measure selection, implementation, or enforcement").

[178] Esty, *supra* note 175, at 617.

[179] Unlike most other federal environmental programs, Superfund does not provide for formal delegation of decision-making authority to the states. However, under strong devolutionary pressures federal program managers have developed various mechanisms by which power is effectively shared with state governments; these mechanisms include allowing sites that would qualify for the NPL to be dealt with under state programs without ever being listed. *See* Superfund Benefits Analysis, *supra* note 21, at 2–7.

provide overwhelming support for federal hegemony. The interests and capabilities of states, localities, and private parties in the management of Superfund sites justify a substantial and ongoing role for them in site-related decision making. Typically the benefits of cleaning up and redeveloping a Superfund site are realized predominantly within the state and indeed within the local jurisdiction in which the site is located. A significant portion of the costs of clean up and reuse are also likely to be felt within the state and the locality. Even if federal funds are used for clean up, spreading most of the remedial costs nationally, the state remains obligated for a share of those costs and for long-term operation and maintenance costs as well. Moreover, the land use aspects of Superfund sites fall within the traditional purview of state and local regulation. Accordingly, adaptive management in Superfund site management suggests that EPA invest heavily in processes to elicit the preferences of state and local stakeholders throughout its involvement at the site—with particular emphasis on the community where the impacts of site activities will be concentrated—and to facilitate integration of the results into federal, state, and local decisions affecting the site.

V. ADAPTIVE MANAGEMENT OF THE SUPERFUND SITE INVENTORY

Adaptive management principles are also applicable to EPA's management of the Superfund site portfolio as a whole. Program level issues that might benefit from continuous learning include what remedies work best in particular types of sites or with particular types of contaminants; what remedies work best with specific types of land use; what community involvement techniques are most effective in eliciting useful and reliable information about community preferences; how best to integrate decisions across private and public sectors and across federal, state, and local jurisdictions; and what the relevant contingencies are and how best to address them.

Institutional learning has been going on since the program began, but much of it has been episodic and reactive. Since 1989, EPA has conducted at least three comprehensive agency-level studies of its management of the program.[180] In addition, EPA's Inspector General, the General Accounting Office,[181] and

[180] 120 DAY STUDY, *supra* note 131, at 17–18.

[181] The General Accounting Office is now known as the Government

non-governmental groups have reviewed the program with sporadic zeal.[182] These studies typically begin with a set of problems, concerns, or allegations, then assemble data relevant to the issues, and finally conclude with a set of findings and recommendations for addressing the problems, concerns, or allegations. They represent a rough form of trial-and-error learning, which tends to be driven by perceived program failures or impending crises rather than conscious policy experimentation or, more modestly, continuous monitoring of key program indicators and corresponding program adjustments.

EPA could improve Superfund policy learning program-wide by acknowledging and addressing complexity and uncertainty in program implementation; framing policies to test hypotheses about how the program might work better and carefully monitoring their implementation; and, even more fundamentally, systematically monitoring and recording experience at sites as a basis for ongoing review and adjustment of national policies. The last of these—generating and recording site information—is crucial for continuous learning, and it is an area of particular difficulty for Superfund. Despite the existence of various Superfund databases, Katherine Probst and Diane Sherman found that "it is difficult to obtain reliable information on key attributes for [NPL] sites" without talking to regional staff directly involved with the site.[183] Well-developed case studies of Superfund site decision making are scarce. Agency documents, such as the RI/FS and the ROD, are prepared as part of the administrative record at each site, but do not record all the steps leading to the decision reached—for example, the nature and success of collaborative efforts, the scientific and technical uncertainties addressed, or the lessons learned. There are also few well-developed accounts of the post-ROD process, including remedy review and reuse decisions. The absence of such accounts makes it very difficult to determine, among other things, frequently occurring contingencies and the most effective responses or moderating measures for those contingencies for the Superfund universe as a whole.

Probst and Sherman recommend that the Agency develop a

Accountability Office. *See* GAO, *GAO's Name Change and Other Provisions of the GAO Human Capital Reform Act of 2004*, http://www.gao.gov/about/namechange.html (last visited Oct. 9, 2005).

[182] *See* 120 DAY STUDY, *supra* note 131, at 18–19.

[183] PROBST & SHERMAN, *supra* note 133, at 7.

core set of data for each site that includes "important measures of progress as well as key site attributes" and "that meets the needs of the full panoply of stakeholders."[184] They see a consistent, well-maintained site monitoring and reporting system not only as a means of improving management of particular sites but also as a source of aggregated data for improving overall program efficiency and effectiveness.[185] Similarly, the recent report of the Superfund Subcommittee of EPA's National Advisory Council for Environmental Policy and Technology (NACEPT) recommended that EPA "develop and implement a system to ensure clear, transparent dissemination of a core set of data for all NP sites and Superfund program activities."[186] Properly detailed, this data could provide the basis for more effective integration of diverse stakeholder perspectives within Superfund's complex hierarchical setting.

These criticisms notwithstanding, Superfund has established practices that facilitate learning program-wide. These practices include using pilot projects to test new policies or strategies before widespread implementation;[187] facilitating the testing of new cleanup technologies and collecting and disseminating information about those technologies;[188] and tracking the success of program reforms and initiatives.[189] Recently Superfund has even re-energized its effort to collect and disseminate timely and

---

[184] *Id.* at 8.

[185] *Id.* at 9.

[186] NACEPT REPORT, *supra* note 134, at 5–88.

[187] *See, e.g.*, U.S. EPA, *Data Sharing Pilots*, http://www.epa.gov/superfund/action/ic/datashar/index.htm (last visited Apr. 27. 2005) (describing pilot to test data-sharing strategy for institutional controls among EPA, state, and local land use authorities).

[188] *See, e.g.*, U.S. EPA, *Superfund Innovative Technology Evaluation*, http://www.epa.gov/ORD/SITE (last visited Apr. 27, 2005) (encouraging development and implementation of innovative technologies for treatment and for monitoring and measurement); U.S. EPA, *About CLU-IN*, http://www.clu-in.org/about (last visited Apr. 27, 2005) (providing "information about innovative treatment and site characterization technologies to the hazardous waste remediation community"); U.S. EPA, CLEANING UP THE NATION'S WASTE SITES: MARKETS AND TECHNOLOGY TRENDS, at v (2004 ed.), *available at* http://www.clu-in.org/download/market/2004market.pdf (disseminating information on "nature and extent of future cleanup market" for use by federal, state and local governments and private industry involved in cleanups).

[189] *See, e.g.*, U.S. EPA, *Reforms by* Round, http://www.epa.gov/superfund/programs/reforms/byround.htm (last visited Apr. 27, 2005) (describing implementation of "Superfund reforms").

complete information on experience at individual sites.[190] These practices provide a basis for further application of adaptive management principles to the program as a whole.

VI. ISSUES AND CONCERNS

A. *Environmentalist Concerns*

Environmentalists might be troubled by the application of adaptive management advanced here, particularly the assumption that most sites will require long-term attention. Long-term management is only necessary, they might argue, where clean ups are less than complete. Doing clean ups "right" the first time—that is, choosing and implementing remedies that reflect the statutory preference for permanence and avoid the need for engineering and institutional controls—minimizes the need for long-term care and the uncertainties associated with such care. Markets and/or local government officials then have maximum flexibility to determine reuse without need of further involvement by EPA. Thus, rather than accommodating the current practice of leaving waste on site, reforms should focus on doing clean ups right.

It is certainly the case that long-term stewardship entails environmental risks and other costs that would not be incurred if every site were left in pristine condition at the conclusion of the remedy. But these stewardship costs may be justified as providing a more beneficial balance between protection and other values over time, including controlling the costs of initial cleanup; indeed, under current conditions of limited availability of funds, controlling remedial costs at individual sites can assure that more sites receive protection.[191] Moreover, at sites where treatment or removal of all contaminants is simply not achievable, extended management must be provided in any event to assure continued protectiveness of the remedy. Because of the challenges presented to local decision makers by the special characteristics of Superfund

[190] Much of this material is now available online through the CERCLIS database. *See* U.S. EPA, *Superfund Information Systems: Cerclis Database*, *available at* http://cfpub.epa.gov/supercpad/cursites/srchsites.cfm (last visited Oct. 9, 2005).

[191] *See* ENVIRONMENTAL CLEANUP AT NAVY FACILITIES, *supra* note 2, at 38–42 (discussing rising costs of clean up and limitations of clean up technology as fostering greater reliance).

sites, expanding the federal management process to include ongoing consideration of land use potential and community wishes may be well worth the costs. Among other things, facilitating the productive use of sites may help secure management consistent with long-term public health protection.

B. *Agency Concerns*

One might expect the EPA to have policy and legal concerns about the expansion of its long-term responsibilities at sites. Particularly with Superfund under serious resource constraints,[192] the Agency may see itself as having limited capacity for conducting more intensive, community-based inquiries into remedy/reuse options or for expanding its long-term stewardship obligations, such as by broadening consideration of land use in its five-year reviews.

The answer to this concern is similar to the answer to environmentalists. If one of the Agency's goals is to use public funds to maximize public benefit, then the program adjustments suggested here should be considered against alternative uses of agency resources. With limited funds, the Agency must triage among sites and among activities relating to a specific site. The argument is, at least with respect to specific sites, that greater public good is achievable through relatively inexpensive process changes, such as greater use of CAGs and expanding the five-year review process. The Agency must decide whether that argument is persuasive, and it must further decide whether the benefits of expending additional resources in site management justifies the potential impact on cleanup at other sites in the queue.

The Agency might also be concerned about perceptions that the adaptive management model suggested here, with its emphasis on the disposition of the site as a whole, including its future use, would convert Superfund into a federal land use program. By conditioning the uses to which land can be put and the terms on which those uses can be carried out, however, Superfund unavoidably intrudes on the process of land management normally carried out between private markets and local officials. Given the fact of that intrusion, it would seem incumbent upon the Agency to facilitate, to the extent it is able, a disposition of sites that reflects

[192] *See* Robert Hennelly, *Superfund Heading for a Super Crisis*, N.J. REP., Jan.–Feb. 2003, at 20, 30.

not only the market realities but also the citizen preferences of the affected locality.

Finally, the Agency (and others) might be concerned that EPA lacks the legal authority to implement the Article's recommended changes, particularly the suggestion of continuing involvement with land use issues at Superfund sites. This Article has suggested that this involvement is warranted, where contaminants remain on site, by provisions of CERCLA for selecting and maintaining remedies at NPL sites.[193] But this involvement may be approaching the limits of the Agency's statutory authority and will have to be tailored to be consistent with that authority or additional legislative authorization obtained.

C. *Responsible Party Concerns*

Responsible parties may have reservations about the management approach suggested here to the extent that, to accommodate new learning, it would encourage ongoing attention to the uses of sites and to potential remedy changes. In particular, responsible parties that are also present site owners may resent the sustained intrusion of these considerations, threatening to turn a federal cleanup program into a federal land use program. It is not clear, however, that this approach would place additional constraints on the prerogatives of Superfund site owners. In its five-year review, EPA will determine either that a remedy continues to be protective or that it does not. The remedy may not be protective for any one of a number of reasons: the contamination may be more extensive than originally understood, the remedy may not be operating as effectively as projected, or the land use on which the remedy was predicated may have changed, leading to higher exposure than was contemplated by the remedy. In any of these circumstances the responsible parties, including any that are also site owners, may be liable for additional remedial actions necessary to assure protectiveness. This has always been the case under EPA's interpretation of the statute.

Under the approach suggested here, EPA, in consultation with the site owner and the community, would also use the five-year review to assess the current land use. Assuming the remedy is protective under the current use, however, EPA would have no authority based on its review to order a different land use; this

[193] *See supra* Section II.A.

remains a decision left to the owner and local land use authorities. An owner might seek to upgrade a remedy to accommodate a new use, but under EPA's legal interpretation, such an upgrade could not be compelled by the statute and would not be chargeable to the responsible parties unless undertaken by them voluntarily.[194] Thus, there would seem to be little or no additional clean up liability risks for responsible parties in the extended attention to land use suggested here.

Imposing the costs of upgrading an otherwise protective remedy on the party or parties benefiting from the upgrade, rather than on the originally responsible party, tests the efficiency of a use that requires more intensive clean up. A site owner will proceed with a new use only if the increase in the value of the property resulting from the new use outweighs the cost of upgrading the remedy and any other costs of development. If the owner is a public entity, presumably it will proceed with the new use only if the public benefits flowing from the new use outweigh the upgrade costs.

An important concern for many Superfund site owners is limiting liability that may be triggered by future actions on site. Owners of a number of large Superfund sites refuse to consider selling them or otherwise making them available for use by others, such as by lease, due to liability concerns.[195] Their concerns include the fear not only that the actions or omissions of third parties on the site might occasion the need for additional remedial work (e.g., due to failure to maintain a cap or adhere to site use restrictions), but also and perhaps even more significantly, that third party access could expose the company to toxic tort litigation. These concerns are compounded by questions about the ability of institutional controls such as covenants or local land use regulations to ensure compliance over the long term.[196] EPA has recently acted to improve monitoring and enforcement of institutional controls,[197] but adoption of a uniform environmental

[194] *See* REUSING SUPERFUND SITES: COMMERCIAL, *supra* note 150 at 5.

[195] Telephone Interview with John Quarles, Senior Counsel, Morgan Lewis, Washington, D.C., Nov. 10, 2003.

[196] *See* Kurt A. Strasser & William Breetz, *Benefits of a Uniform State Law for Institutional Controls*, *in* IMPLEMENTING INSTITUTIONAL CONTROLS AT BROWNFIELDS AND OTHER CONTAMINATED SITES 31, 33–35 (Amy L. Edwards ed., 2003) (discussing enforceability problems).

[197] *See* STRATEGY TO ENSURE INSTITUTIONAL CONTROL IMPLEMENTATION, *supra* note 5.

covenants act among the states could also help address this problem by binding subsequent owners to maintain the remedy and to take other precautions to minimize risks at the site.[198] Such legislation may prove attractive to disparate interests—property owners concerned about future liability, environmentalists concerned about the long-term integrity of the remedy, and developers desiring an increase the number of properties available for development.

CONCLUSION

The broad transition that this Article encourages would itself represent an adaptive response at the program level, as Superfund continues to mature from its early crisis response mode to long-term site management and as it responds to signals from the political system favoring attention to the values associated with reuse as well as reduction of environmental risk. The Agency can facilitate this transition by acknowledging its broader policy horizon, using policy as a tool for experimentation, strengthening program monitoring and reporting, and maintaining flexibility and openness to regular policy review and adjustment. Expanding Superfund's capacity for learning by doing will be critical as the Agency deals with new challenges such as limited funding, megasites, and terrorist threats and as it seeks more generally to define the continued relevance of Superfund to evolving societal needs and concerns.

[198] UNIF. ENVIRONMENTAL COVENANTS ACT (2003), *available at* http://www.law.upenn.edu/bll/ulc/ueca/2003final.pdf (describing the enforcement benefits of a uniform law).