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## Making Superfund Work

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*Under the amended law, cleanup of hazardous waste sites may be a real possibility.*

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The Superfund program, an attempt at a quick solution to a complex problem, has fallen far short of expectations. By mid-1984, four years into the program, the U.S. Environmental Protection Agency (EPA) could point to only six hazardous waste sites that had been permanently cleaned up—and even then, the adequacy of measures at three of these sites was subsequently challenged by the congressional Office of Technology Assessment (OTA). It is against this backdrop that, in 1984, Congress began discussing the reauthorization of the original Superfund law (the Comprehensive Environmental Response, Cleanup, and Liability Act of 1980) and measures to correct its shortcomings.

When it was enacted in 1980, the Superfund program was hailed as an aggressive effort to end the legacy of careless hazardous waste disposal. A five-year program with a \$1.6 billion trust fund, it would finance the investigation of dump sites and identify the parties responsible for the cleanups, and, if those parties could not be found, the program itself would finance whatever site remediation was needed.

Under the Superfund law, EPA was ordered to develop a list of more than 400 priority sites nationwide, at least one in each state. The agency soon recognized, however, that the scope of the problem was much larger, estimating that 2,000 sites would ultimately be included on the National Priorities List. Then in 1985, as the original legislation was about to expire, OTA issued its report—*Superfund Strategy*—which concluded that the magnitude of the hazardous waste problem was much larger than most lawmakers had envisioned. According to OTA, the number of dump sites could mushroom to more than 10,000, requiring cleanup efforts over a span of perhaps 50 years. The report estimated that costs borne by Superfund could reach \$100 billion and that overall costs to the nation could total several times that amount.

Initial efforts also brought other troublesome aspects of the problem into clearer focus. Basic knowledge was lacking on the environmental and public health threats posed by chemicals at hazardous waste sites; technological constraints proved formidable;

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and the number of professionals capable of designing and carrying out cleanup measures was inadequate.

Besides scientific, technical, and manpower problems, other troubles hampered the young program. Lawsuits brought by “potentially responsible parties,” citizen groups, and environmental organizations delayed cleanup efforts, and EPA’s management of the program not only drew widespread criticism but also was the subject of a criminal investigation.

In addition, residents of communities adjacent to hazardous waste sites were impatient with the first stage of the cleanup process—one- to two-year investigations to determine the nature and extent of the contamination, the environmental and public health risks posed, and the appropriate remedies. Alarmed citizens frequently demanded that the wastes be dug up and removed immediately, even if onsite remedies were available. This attitude, so pervasive that it has been given the acronym NIMBY (for “not in my backyard”), clearly influenced decisions by all governmental bodies involved in the cleanup process. Potential solutions were often evaluated on the basis of public acceptance rather than on their scientific and technological merits.

At the outset of the program, the generally accepted cleanup approach was either to contain contaminants at Superfund sites or to exhume the wastes and transfer them to state-of-the-art landfills. Although waste removal appeased residents who lived near a Superfund site, it was eventually deemed inadequate by the engineering and public health communities. In its report, OTA classified the landfill approach as an “impermanent” solution and warned that the transfer landfills might themselves someday become Superfund sites. The whole process was tantamount to a “toxic shell game,” in which environmental and health risks “are often transferred from one community to another, and to future generations.”

As for the other popular option at the time—the “cap and slurry wall” method that entailed paving over wastes or building clay walls around deposits—OTA was equally critical. The technique only contained the waste; it did not detoxify the hazardous materials or reduce their volume. Much less costly than transferring wastes to a landfill, the method was preferred by potentially responsible parties, but it, too, was dismissed as a stopgap measure.

In carrying out the program, EPA also had to reckon with the problem of certifying a dump site as permanently cleaned up. The agency’s demonstrated reluctance to make such decisions stemmed from uncertainties about the long-term adequacy of remedial measures and, consequently, from its desire not to release the potentially responsible parties from future liability. Congress offered no clear guidance on the issue.

Cleanup standards varied unpredictably from site to site, reflecting the absence of a clearly defined policy objective and of a systematic approach to the characterization of risk. Within the loose framework that evolved, a site could be designated as cleaned up if the residual cancer risk was in the range of 1 in 10,000 to 1 in 100 million, with the target dictated by the costs involved and the efficacy of available technology. Almost by default, EPA’s regional administrators determined the extent of cleanup measures, basing decisions primarily on their perceptions of affordability rather than on public health considerations.

### **Hazard reduction at the source**

After two funding extensions of the 1980 Superfund law and prolonged debate in conference committee, the Superfund Amendments and Reauthorization Act of 1986 (SARA) was approved by Congress. Influenced by OTA’s *Superfund Strategy*, the new law contains provisions that are intended to correct the weaknesses of the original Superfund legislation and to accelerate the cleanup of hazardous waste sites. It allocated \$9 billion for a five-year cleanup effort, including \$98 million specified for studies on detecting and evaluating waste hazards and \$ 100 million earmarked for research, demonstration, and training programs on new cleanup technologies.

Beyond trying to fill voids in scientific and technical understanding, SARA has introduced a fundamentally different approach to cleaning up hazardous waste sites. In an about-face, Congress designated the cap-and-slurry-wall method, along with the excavation of wastes and their transfer to landfills, as remedies of last resort. Instead, onsite methods that “permanently and significantly reduce the volume, toxicity, or mobility of hazardous substances” became the preferred remedial actions.

SARA also contains a “technology-forcing” component that is designed to broaden the range of onsite

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### **An Unreasonable Cleanup Standard?**

*In order to assess the adequacy of cleanup measures at Superfund sites, SARA established the groundwater quality goals of the Safe Drinking Water Act: to achieve water quality levels at which “no known or anticipated adverse effects on the health of persons occur.” By imposing these goals as standards, Congress intended to quell criticisms of the first five years of the Superfund program: that the EPA arbitrarily set cleanup targets and, in so doing, made public health considerations subordinate to cost concerns.*

*In the case of the Safe Drinking Water Act, Congress intended these lofty goals to serve only as a guide to development of realistic, enforceable standards that are based on considerations of human health, cost, and technological feasibility. In SARA, the lawmakers removed cost and technological feasibility from consideration to ensure that protection of human health is the Superfund program’s top priority. But the law’s rigid standards will often lead to absurd requirements.*

*Potentially responsible parties are likely to seek variances, which the EPA is empowered to grant. Local citizens will counter by demanding that cleanups should achieve the standards established by the law. Yet, at many Superfund sites, prohibitive costs or the limitations of treatment technology will place the drinking water standards beyond reach. Thus, SARA may have created unrealistic expectations and generated lawsuits, erecting barriers to hazardous waste cleanup rather than providing reasonable guidelines to expedite the process.*

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treatment options and encourage innovation. The law empowers the president to “select an alternative remedial action...whether or not such action has been achieved in practice at any other facility or site that has similar characteristics.”

Consistent with the new emphasis, EPA is now stressing the importance of evaluating onsite treatment-based alternatives in “remedial investigations and feasibility studies,” which constitute the initial step in the cleanup process. But onsite remedies first require a thorough understanding of the physical, chemical, and hydrogeological properties of dump sites, which can be obtained only through detailed study. Moreover, assessments of alternative treatments will require laboratory and pilot-scale studies.

More often than not, gathering the necessary information will take a considerable amount of time, perhaps more than Congress intended. Disappointed with the slow rate of progress during the first five years of the Superfund program, Congress set an ambitious schedule: SARA instructs EPA to begin work at 375 sites by 1991, or nearly four times the number of sites where investigations or cleanup measures were initiated during the first five years of the program. The EPA has echoed this desire; in congressional testimony, J. Winston Porter, head of the Superfund program, said that he aimed to reduce the average cleanup time at waste sites by two years. But it is not yet clear whether the laudable goals of expediting cleanups and achieving effective onsite remedies will be compatible at many Superfund sites.

To the extent that currently available environmental and human-health standards allow, SARA also provides guidelines for certifying the adequacy of cleanup measures at Superfund sites. At a minimum, waste treatments must achieve the groundwater quality goals established under the Safe Drinking Water Act. Critics have argued that these standards are too rigid and that, in many cases, they will prove unattainable, (See sidebar: “An Unreasonable Cleanup Standard?”) For the great majority of chemicals that are not covered under the Safe Drinking Water Act (standards have been written for 22 chemicals) and for which no other federal or state human-health standards exist, EPA and state regulatory agencies will continue to struggle with the complex and controversial issue of acceptable risk.

Improving the quality of public participation in the decisionmaking process at Superfund sites was another objective embodied in SARA. The act includes a provision for technical assistance grants, awarded by EPA to citizen groups. These grants enable local groups to retain technical consultants, who serve as advisors during remedial investigations and feasibility studies and who may be included in working meetings between the EPA, state agencies, and the potentially

responsible parties. As a result, citizens may have a better basis for evaluating the scientific and technical merits of recommended cleanup measures, and have input into the decisionmaking process much earlier than at the formal public hearing stage.

### **An example of SARA's impact**

To begin appreciating the impact that SARA can have on the nation's approach to cleaning up hazardous waste sites, consider the current assessment of the Superfund site at the Ciba-Geigy plant in Toms River, New Jersey. Since 1952, the plant has manufactured dyes, epoxy resins, and various specialty chemicals. Manufacturing wastes have been treated and disposed of at the site in a variety of ways—including a drum landfill, unlined waste treatment lagoons, and sludge disposal areas. Migration of chemicals from these facilities has contaminated groundwater over about 350 acres.

The plant has become one of the most controversial Superfund sites in a state that has more such sites than any other. Not surprisingly, local residents were not receptive to the EPA's insistence on a thorough site investigation and careful review of alternative treatment remedies. In their view, the correct approach was to exhume the wastes and transport them off site.

From an apparent stalemate evolved a serious discussion of site remediation. Following the enactment of SARA but before EPA had promulgated its guidelines for the awarding of technical assistance grants, Ciba-Geigy decided to help break the deadlock. Instead of waiting for EPA, the company gave the Ocean County Citizens for Clean Water what in essence was a technical assistance grant, a \$50,000 award that enabled the citizens' group to retain consultants with the expertise necessary to participate in

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### **New Cleanup Technologies**

*The Superfund program now stresses onsite containment and treatment of hazardous wastes rather than the exhuming of contaminants and their transfer to federally approved landfills, as had been the norm during the first five years of the program. This shift in emphasis has prompted EPA and the "potentially responsible parties" at Superfund sites to evaluate a host of promising but, as yet, unproven treatment technologies. Examples of these technologies are the four cited by the scientific advisory committee convened by the Ciba-Geigy Corporation to evaluate treatment alternatives at the Toms River Superfund site in New Jersey.*

**Bioremediation** exploits methods to stimulate and enhance natural biological processes that break down hazardous organic chemicals into nontoxic substances. The oil industry and several other industries have successfully demonstrated this approach, primarily for industrial sludges. In addition, limited success has been realized with a wide range of chemical species, especially chlorinated hydrocarbons. The technique entails adding nutrients, hydrogen peroxide, or other innocuous substances to contaminated wells in order to accelerate degradation and solubilization of hazardous materials.

**In situ chemical extraction** which is already used for industrial applications such as paper processing, metal ore beneficiation, and synthetic resin reactivation, holds promise for the cleanup of industrial sludge and contaminated soils. At hazardous waste sites, acidic or alkaline solutions (depending on the target contaminants) could be injected into the soil, where they would react with waste materials and form new compounds containing the target metals or organic chemicals. The substances would then be flushed from the subsurface and collected at recovery wells.

**Vapor stripping** involves the forced movement of air through soils contaminated with volatile organic compounds. The resulting vapors rise through the soil and are collected on the surface. The technique has been used successfully at several Superfund sites.

**Multiphase remediation** is a generic term that refers to the general process of introducing contaminant-removing chemicals into subsurface pools. Although used by the petroleum industry to recover oil from subsurface reservoirs, multiphase remediation has yet to be used to remove pollutants from contaminated aquifers.

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the site review process. These consultants could not only represent residents, but could translate for them the often complex findings and recommendations generated by the review. Their direct involvement helped allay citizens' suspicions that EPA was following a predetermined course of action.

Similarly, Ciba-Geigy redirected its attention after the passage of SARA from off site disposal to onsite remedies. The company convened an advisory committee of internationally recognized experts to evaluate treatment technologies for the mix of contaminants at the site. The committee concluded that several emerging technologies—bioremediation, in situ chemical extraction, vapor stripping, and multiphase remediation—warranted consideration (see sidebar, “New Cleanup Technologies”), and that a comprehensive program of laboratory, field, and pilot testing would be needed to determine their local effectiveness. Such a program will delay the cleanup process, but its longer-term effect will be consistent with the site remediation goals advanced by SARA.

Recent events at the Toms River Superfund site mark an almost complete turnabout from the old days. Although differences remain, combative interactions between EPA, Ciba-Geigy, and local residents have evolved into a constructive dialogue. The alternative of offsite disposal—a likely remedy before SARA—appears to have been relegated to the option of last resort, as Congress intended. Now that citizens have equal access to technical information they have come to realize that the excavation-and-removal approach they once favored does not necessarily solve the toxic waste dilemma, but only transfers it to another site and another generation.

Some observers might conclude, however, that the most tangible result of SARA is additional studies and further delay; no site remediation measures have yet been implemented. But if research and testing yield truly permanent solutions at the Superfund site, that will certainly be preferable to the implementation of quick measures that prove ineffective in the long run. Moreover, given the hydrogeological characteristics of the Toms River site, the contaminated ground water poses no immediate threat to public health or the surrounding environment. Therefore, there is adequate time to design, develop, and implement a permanent onsite solution that meets the goals embodied in SARA.

### **What lies ahead?**

Experiences at Toms River and elsewhere suggest that the public is becoming sensitized to the importance of onsite remedies, even if this approach will slow the implementation of cleanup measures. But public acceptance—a factor that should weigh as heavily in the decisionmaking process as do technical considerations—is by no means ensured.

For example, there is likely to be considerable public pressure to clean contaminated aquifers to drinking water quality. This may not be feasible for all contaminants and all sites. Furthermore, treatment techniques can significantly reduce the amount of hazardous waste at Superfund sites, but residual toxic chemicals are likely to remain. Incineration of wastes, for example, leaves ashes that contain hazardous materials. The residuals must be contained on site and monitored indefinitely. These materials can be contained safely, but nearby residents who want all wastes eliminated may not be satisfied.

Reasonable progress toward satisfactory long-term solutions can result only from a rational, realistic approach to identifying risks and alternatives. Such an approach requires that all groups with a stake in cleaning up Superfund sites—the potentially responsible parties, governmental agencies, and especially the public—participate as equals in the decisionmaking process. If given equal access to technical resources and allowed to participate in the planning process, the public is likely to develop a greater appreciation of the complexity of hazardous waste problems and to be more accepting of onsite remedies.

### *Recommended reading*

J.W.Porter, “EPA Interim Guidance to Agency Regional Offices Discussing Issues Related to Selecting Superfund Site Remedies,” *Environment Reporter* (January 16, 1987): 1603–1608.

“The Superfund Amendments and Reauthorization Act of 1986; A Detailed Analysis,” *The Hazardous Waste Consultant* (January/February 1987): 4–1 to 4–30.

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