

GAO

United States General Accounting Office

Report to the Chairman, Subcommittee  
on Superfund, Ocean and Water  
Protection, Committee on Environment  
and Public Works, U.S. Senate

May 1992

# SUPERFUND

## Problems With the Completeness and Consistency of Site Cleanup Plans



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**United States  
General Accounting Office  
Washington, D.C. 20548**

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**Resources, Community, and  
Economic Development Division**

B-247753

May 18, 1992

The Honorable Frank R. Lautenberg  
Chairman, Subcommittee on Superfund,  
Ocean and Water Protection  
Committee on Environment and Public  
Works  
United States Senate

Dear Mr. Chairman:

As requested, this report discusses the comparability of Environmental Protection Agency (EPA) and privately conducted Superfund cleanups, the completeness and consistency of cleanup plans for hazardous waste sites, and EPA's information systems for monitoring Superfund cleanups. The report contains several recommendations to the EPA Administrator for making improvements in each of these areas.

As agreed with your office, unless you publicly announce its contents earlier, we will make no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies to the appropriate congressional committees; the Administrator, EPA; and the Director, Office of Management and Budget. We will make copies available to others on request.

This work was performed under the direction of Richard L. Hembra, Director, Environmental Protection Issues, who can be reached on (202) 275-6111 if you or your staff have any questions. Other major contributors to this report are listed in appendix II.

Sincerely yours,

J. Dexter Peach  
Assistant Comptroller General

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# Executive Summary

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## Purpose

The nation faces the challenge of cleaning up thousands of hazardous waste sites that threaten the environment and public health and safety. Recent estimates for cleaning up the nation's worst sites range from about \$100 billion to \$300 billion, while federal funding for this cleanup is currently limited to \$15.2 billion. To maximize cleanup resources, the Congress gave the Environmental Protection Agency (EPA) enforcement authority to compel parties responsible for the waste to finance and manage the cleanup under the Superfund program. When responsible parties are not available, EPA conducts and finances the cleanup. However, this strategy has increased concerns about whether responsible-party cleanups are as stringent and permanent as EPA cleanups. The credibility of both EPA and the Superfund program in protecting human health and the environment rests in part on the consistency of responsible-party and EPA cleanups.

The Chairman, Subcommittee on Superfund, Ocean and Water Protection, Senate Committee on Environment and Public Works, requested that GAO determine whether cleanups at Superfund sites managed by EPA and responsible parties were consistent. Specifically, GAO was asked to (1) compare cleanup remedies used for similar EPA- and responsible-party-managed cleanups since 1987, (2) review the completeness and consistency of selected cleanup plans, and (3) evaluate the effectiveness of EPA's Superfund management information systems in monitoring and evaluating cleanups.

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## Background

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund) gave EPA authority and funding to clean up the nation's worst hazardous waste sites. CERCLA also gave EPA enforcement authority to compel the parties responsible for these sites, when available, to contribute toward their cleanup. In 1986 the Congress passed the Superfund Amendments and Reauthorization Act of 1986 (SARA), which established more rigorous cleanup requirements; stated a preference where practicable for waste treatments that permanently reduce the toxicity, mobility, or volume of hazardous waste; and provided additional funding.

Before cleaning up a site, EPA conducts—or negotiates a legal agreement with responsible parties to conduct—site studies to identify wastes and evaluate possible cleanup remedies. Following the site study, the appropriate EPA regional office issues a proposed cleanup plan that summarizes the proposed cleanup remedies and site risks. After soliciting

public comment on the plan, the regional office approves a specific remedy, and EPA or responsible parties under an agreement with EPA perform the cleanup.

Recent studies have reached different conclusions about the consistency of Superfund cleanups at EPA- and responsible-party-managed sites. Research reports by the Office of Technology Assessment and environmental advocacy groups voiced concerns about responsible-party studies and cleanups, alleging that responsible parties tend to contain rather than treat waste because doing so is less expensive. In contrast, an EPA analysis completed in June 1990 concluded that cleanups at EPA- and responsible-party-managed sites were consistent in selecting waste treatment or containment.

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## Results in Brief

GAO's analysis of cleanup plans for fiscal years 1987 through 1990 showed that responsible-party-managed cleanups tend to contain rather than treat waste more frequently than EPA-managed cleanups. For example, 43 percent of cleanup plans at responsible-party-managed sites selected solely waste containment, compared with 25 percent of cleanup plans at EPA-managed sites. By using containment more, responsible-party-managed cleanups permanently reduce waste toxicity, volume, or mobility less frequently than do EPA-managed cleanups.

Moreover, GAO's case studies of 34 cleanup plans detected problems that raise serious questions about the completeness and consistency of cleanup decisions at both EPA- and responsible-party-managed sites. For example, GAO reviewed sites where cleanup decisions had been made despite the fact that cleanup goals were not established for hazardous contaminants or were not set for all polluted media, such as soil or groundwater. Other cleanup plans had insufficient justification for selecting a particular cleanup remedy. Such plans do not meet EPA's program guidance and provide inadequate assurance that the selected cleanup remedy will provide sufficient long-term protection of human health and the environment.

EPA's efforts to manage the cleanup selection process are hampered by the lack of a centralized data base for Superfund remedies. Without such information, EPA cannot track and assess trends and summary information on approved cleanup plans, and its ability to manage the program and ensure consistency in remedy selection is limited.

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## Principal Findings

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### Cleanups Show Differences

GAO's analysis of 317 fiscal year 1987 to 1990 cleanup plans showed a difference in the extent to which containment was used at EPA and responsible-party sites. (Our analysis included all cleanup plans with final remedies for sources of contamination except those for federal facilities.) For example, 63 of 148 cleanup plans, or 43 percent, at responsible-party-managed sites used only waste containment, in contrast with 43 of 169 cleanup plans, or 25 percent, at EPA-managed sites. While containment is appropriate for certain types of wastes and site conditions, GAO also found that at sites with similar contaminants and characteristics, responsible parties tend to contain waste more frequently than EPA does. For example, 81 percent of responsible-party landfill cleanups (25 of 31), as opposed to only 54 percent of EPA landfill cleanups (14 of 26), used waste containment. At comparable sites where responsible parties are containing waste and EPA is treating it, the responsible-party cleanups may not provide the same level of long-term protection as the EPA cleanups.

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### Cleanup Plans Are Not Consistent

The inconsistency and incompleteness of cleanup plans makes the long-term effectiveness of some cleanups uncertain. For example, GAO found in its case studies of selected cleanup plans that EPA approved some cleanup plans without assurances that reasonable cleanup objectives and a remedy sufficiently protective of human health and the environment had been selected. Despite EPA regulations and guidance, 11 of the 18 cleanup plans selecting treatment that GAO reviewed established no cleanup goals for major contaminants or did not set cleanup goals for all contaminated media, leaving cleanup objectives unclear. Cleanup goals set for common hazardous waste components also varied considerably among sites, promoting the appearance of cleanup inconsistency. For example, soil cleanup goals for polycyclic aromatic hydrocarbons, a carcinogen frequently found at hazardous waste sites, varied widely—from 0.19 to 700 parts per million—across 14 sites.

In addition, cleanup plans did not always adequately explain why a particular remedy was chosen, did not specify a cleanup remedy, or were significantly changed without an opportunity for public comment. Without adequate analysis and justification to support the selected cleanup remedy, EPA cannot ensure that subsequent site work will protect human health and the environment.

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Recent EPA initiatives to review cleanup plans, standardize some remedies and soil cleanup levels, and evaluate risk assessment procedures, if effectively implemented, may help resolve some of these remedy selection problems. However, since EPA states that these efforts may take 3-6 years to implement, interim actions to improve the effectiveness of the remedy selection process may be necessary.

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### Management Information Is Inadequate

Weaknesses in EPA's cleanup remedy data bases prevent EPA from having adequate information to assess program performance and evaluate cleanup decisions. EPA has a number of information systems that contain Superfund cleanup data; however, the systems are not complete and integrated. A management information system containing sufficient and reliable technical cleanup information that is amenable to statistical analysis would enable EPA to manage the Superfund program better. Currently, EPA cannot easily identify the hazardous waste problems found in the past decade and the remedies chosen. Similarly, EPA cannot easily determine the remedies typically used at specific site types to support its effort to standardize cleanups and cleanup goals.

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### Recommendations

To improve the overall consistency of cleanup plans and provide EPA management with better information, GAO recommends that the EPA Administrator (1) direct regional administrators to approve only cleanup plans that adequately specify the cleanup goals and remedy, and provide justification for cleanup goals not set and (2) establish a cleanup remedy data base for EPA management to better manage and monitor remedy selection. Another recommendation on remedy documentation is included in chapter 3.

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### Agency Comments

GAO discussed this report with EPA Superfund program officials and incorporated their comments where appropriate. The officials generally agreed with the report's findings. However, as agreed, GAO did not obtain written EPA comments on a draft of this report.

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**Abbreviations**

ATR	<u>Annotated Technical Reference for Hazardous Waste Sites</u>
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
cPAH	carcinogenic polycyclic aromatic hydrocarbon
EPA	Environmental Protection Agency
NCP	National Contingency Plan
NPL	National Priorities List
OSWER	Office of Solid Waste and Emergency Response
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCP	pentachlorophenol
ppm	parts per million
PRP	potentially responsible party
ROD	Record of Decision
RODS	Record of Decision System
SARA	Superfund Amendments and Reauthorization Act



# Introduction

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The nation currently faces the challenge of cleaning up thousands of hazardous waste sites that threaten the environment and public health and safety. The Environmental Protection Agency's (EPA) National Priorities List (NPL) now contains over 1,200 seriously contaminated sites, and the list is projected to grow to about 2,100 sites by the year 2000. Recent estimates from a University of Tennessee study place the cost of cleaning up all the sites on the NPL at about \$100 billion to \$300 billion. At a time of fiscal constraints, obtaining the participation of potentially responsible parties (PRPs) in financing and managing cleanups is crucial to continuing work at these sites. However, environmental advocacy groups and the Office of Technology Assessment have expressed concern about the quality of responsible-party cleanups. They contend that responsible parties use less stringent cleanup goals for contaminants and more frequently select waste containment, which emphasizes preventing exposure to and migration of the waste over treatment that permanently alters waste or decreases its volume.

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## The Superfund Program

In 1980 the Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) to facilitate the cleanup of hazardous waste sites. The act gave EPA broad authority to respond to releases of hazardous contaminants. CERCLA established a \$1.6 billion trust fund (Superfund), financed primarily by taxes on crude oil and certain chemicals, for EPA to implement this new authority. The law also authorized EPA to compel parties responsible for hazardous waste sites, when available, to study and clean up the sites or reimburse EPA for cleanup costs. In 1986 the Superfund Amendments and Reauthorization Act (SARA) required EPA to emphasize cleanup remedies that treat—rather than simply contain—contaminated waste to the maximum extent practicable and to use innovative waste treatment technologies. SARA also set yearly numerical cleanup goals to encourage quicker cleanups and added \$8.5 billion to the Superfund. The Congress reauthorized CERCLA in 1990, making no substantive changes to the program but authorizing an additional \$5.1 billion.

With estimates of total cleanup costs at all hazardous waste sites running from about \$100 billion to \$300 billion, the costs will far exceed the \$15.2 billion Superfund trust fund. To maximize use of the trust fund, EPA uses its enforcement authority to compel PRPs—such as waste generators and haulers, and landowners—to conduct site studies and cleanups or reimburse EPA for these costs. When PRPs are available and financially viable, EPA negotiates legal settlements requiring PRPs to conduct and

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finance specific cleanup activities under EPA's oversight. EPA conducts the cleanup work when PRPs are not available.

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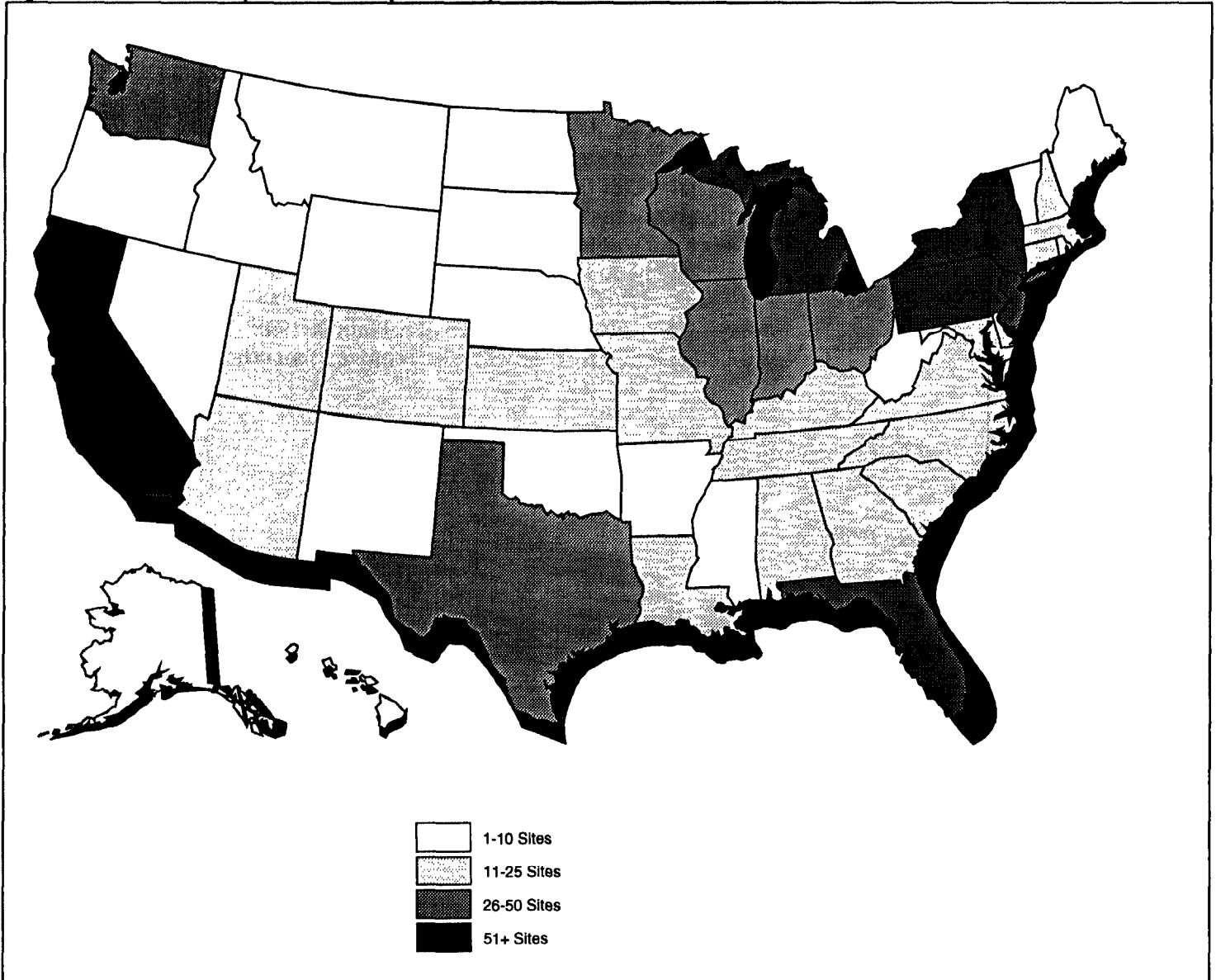
## **The Cleanup Process**

EPA learns of potentially hazardous sites from state and local officials and the general public. After investigating these sites, EPA ranks them according to the severity of their waste problems and places only the worst on its NPL for Superfund cleanup. If EPA determines that immediate site action is necessary, the agency conducts an emergency waste removal. Other sites are studied in-depth to design the appropriate long-term cleanup remedy. Action to clean up the site follows EPA development of a design. At the 1,207 sites on the NPL (see fig. 1.1), EPA or PRPs are currently conducting 559 site studies<sup>1</sup> and 312 cleanup actions. Thirty-eight sites have been sufficiently cleaned to be removed from the NPL.

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<sup>1</sup>This figure does not include 330 site studies at federally owned facilities on the NPL. EPA may require two or more site studies or cleanups at a single site.

Figure 1.1: Number of Superfund Sites by State, September 1990



Source: Based on EPA data.

EPA's Office of Solid Waste and Emergency Response (OSWER) sets policy and direction for the Superfund program and publishes guidance. Within

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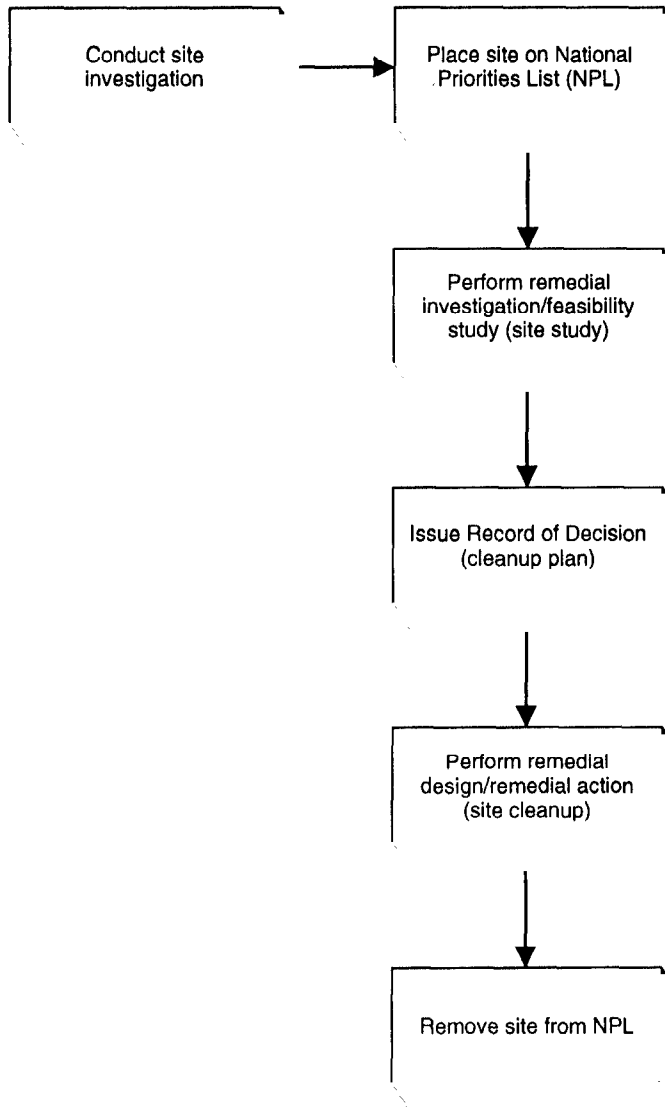
**OSWER, the Office of Emergency and Remedial Response administers EPA-managed cleanups, and the Office of Waste Programs Enforcement administers PRP-managed cleanups. EPA's 10 regional offices are responsible for managing and overseeing studies and cleanups and for selecting all cleanup remedies.**

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## **Selecting a Remedy**

**To determine how best to clean up a site, EPA requires an in-depth site study consisting of a remedial investigation and feasibility study. The remedial investigation assesses site contamination and estimates the risks posed to the surrounding community and environment. The feasibility study lists and evaluates alternatives for treating or containing the waste. On the basis of the site study, the proposed plan selects and recommends a particular cleanup remedy. Public comment on the plan is then solicited. EPA may conduct the study or negotiate with PRPs to perform it under EPA's oversight. In either case, EPA and PRPs generally hire private contractors to perform the actual study. (Fig. 1.2 depicts the Superfund remedy selection process.)**

Figure 1.2: Steps in the Superfund  
Remedy Selection Process



Source: Based on EPA information.

EPA documents cleanup decisions made through site studies and public comment in a Record of Decision (ROD). The ROD is supposed to (1)



provide a detailed presentation of all cleanup remedies considered as well as a description of the cleanup ultimately selected and (2) document decisions on whether the site's wastes will be treated or contained. It also

- describes the primary current or potential threats to human health and the environment from the site waste,
- identifies key assumptions made during the risk assessment, and
- documents target cleanup goals for contaminants in the site's various media, such as soil and groundwater.

EPA has delegated ROD approval to EPA's regional administrators. Key information influencing remedy selection includes the assessment of risk to human health and the environment, and contaminant cleanup goals. In addition, the National Contingency Plan (NCP), which governs Superfund, requires that cleanups be selected to meet the following nine criteria:

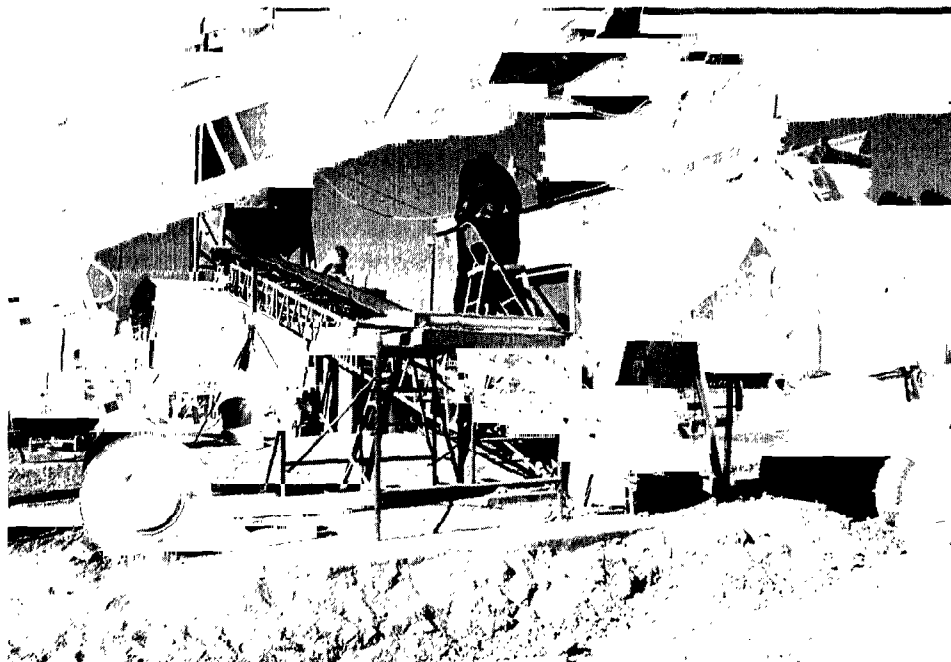
- overall protection of human health and the environment;
- compliance with other state and federal environmental laws;
- long-term effectiveness and permanence;
- reduction of waste toxicity, mobility, or volume;
- short-term effectiveness;
- implementability;
- cost;
- state acceptance; and
- community acceptance.

As a result of EPA's "enforcement first" initiative to increase PRP cleanup work, PRPs have managed more site studies. In these cases, PRPs also develop and analyze the proposed remedies. Regardless of whether EPA or PRPs manage the study and cleanup, EPA's regional offices maintain responsibility for providing oversight and ultimately selecting the remedies and approving all RODs.

Since SARA was passed in 1986, EPA policy has been to prefer Superfund cleanups that treat principal waste threats—permanently reducing the volume, toxicity, or mobility of hazardous waste—over remedies that merely contain waste. Examples of treatment remedies include incinerating the waste to destroy it, solidifying the waste to immobilize it, and applying a vacuum system to contaminated soil to remove the waste. Waste containment may be appropriate for high volumes of low-toxicity waste or for waste that cannot be treated. A common form of containment involves building a cap over a contaminated area to prevent exposure to

the waste and to prevent it from migrating. Containment remedies do not reduce waste volume or toxicity.

**Figure 1.3: Hazardous Waste Solidification at the Palmetto Superfund Site (Dixiana, S.C.)**



Source: EPA.

## Cleaning Up the Site

After approving the ROD, EPA begins, or negotiates with PRPs to manage, a cleanup consisting of a remedial design and remedial action. In the remedial design phase, EPA or PRPs determine technological specifications for the cleanup. During the remedial action phase, EPA or PRPs complete construction and perform the cleanup. If PRPs agree to perform the cleanup, the agreement is recorded in a legal document called a consent decree, and the cleanup work proceeds as described in the ROD, under EPA's oversight.

## The Cleanup Debate

While site studies and cleanups continue to be managed by both EPA and PRPs, the Congress and representatives of environmental advocacy groups are concerned that EPA's emphasis on enforcement and desire to achieve

settlements with PRPs may result in cleanups that are less stringent and permanent. Environmental advocacy groups and the Office of Technology Assessment contend that cleanup remedies being developed in PRP-conducted studies generally favor less expensive containment remedies. Similarly, critics are concerned that PRPs' unwillingness to implement more expensive treatment cleanups is causing EPA to select and approve containment remedies. Representatives of the PRP community assert, however, that containment is often appropriate for reducing the risk to human health at hazardous waste sites. In their view, EPA often overestimates actual risks, resulting in overly stringent and expensive cleanups. Cleanup contractors said that containment is often appropriate for those PRP sites that are operating industrial facilities because treatment may disrupt operations and could subject workers to even greater exposure.

In response to these concerns and at the request of the Chairman, Subcommittee on Superfund, Ocean and Water Protection, Senate Committee on Environment and Public Works, EPA prepared an analysis comparing EPA- and PRP-managed cleanups. EPA's June 1990 study, A Comparative Analysis of Remedies Selected in the Superfund Program During FY 87, FY 88, and FY 89, concluded that "patterns of where treatment is chosen instead of containment for the sites requiring remedial action [cleanup] are generally the same for Fund-lead [EPA-managed] and Enforcement-lead [PRP-managed] sites." The study also found that any preferences for containment over treatment were appropriately based on site characteristics.

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## Objectives, Scope, and Methodology

In light of the continuing debate, the Chairman, Subcommittee on Superfund, Ocean and Water Protection, Senate Committee on Environment and Public Works, requested us to determine whether cleanup remedies selected for EPA- and PRP-managed cleanups were consistent. We subsequently agreed to (1) compare cleanup remedies used for similar EPA- and responsible-party-managed cleanups since 1987, (2) review the completeness and consistency of selected cleanup plans, and (3) evaluate the effectiveness of EPA's Superfund management information systems in monitoring and evaluating cleanup.

We performed our work at EPA headquarters in Washington, D.C., and at EPA Regions II (New York), IV (Atlanta), V (Chicago), and VI (Dallas). We selected these regions for geographic distribution and to assess the impact

that any regional variations in remedy-selection procedures may have on final cleanup decisions.

To compare cleanup remedies used by EPA and responsible parties, we interviewed EPA headquarters and regional officials regarding remedy selection policy. We also reviewed agency and regional guidance and quality assurance procedures for RODs. We met with representatives of chemical manufacturers and hazardous waste cleanup contractors to obtain their views on cleanup comparability for EPA- and PRP-managed cleanups. We synthesized available EPA ROD data from a number of sources to develop a data base of all 532 RODs approved in fiscal years 1987 through 1990. We consulted with appropriate EPA officials to identify authoritative and accurate ROD data sources for the data base. Using the data base, we tested the results of EPA's comparative analysis of EPA- and PRP-managed cleanups and added 1990 RODs to the analysis. Our data base identified site characteristics, major contaminants, cleanup remedy selected, and EPA or PRP management of the site studies and cleanups. We analyzed the data to determine whether EPA selected consistent remedies for EPA- and PRP-managed sites. We also determined whether the remedies selected for certain types of sites were consistent.

To review the completeness and consistency of EPA's cleanup plans, we conducted case studies of 34 former wood-preserving and industrial landfill RODs. We selected wood-preserving sites because they all used waste treatment in cleanup, regardless of whether EPA or PRPs performed the work. In contrast, we chose industrial landfills because they were cleaned up using a variety of treatment and containment remedies. For our case studies, we examined what cleanup goals were set for common contaminants, whether waste was treated or contained, and what treatment remedies were selected. We compared RODs based on EPA- and PRP-managed studies and RODs from different regions to document similarities and differences and discussed our concerns with relevant EPA staff.

To assess the effectiveness of EPA's information management systems, we interviewed staff who design and use the data bases to determine their content and accuracy and their adequacy for tracking and monitoring remedy selection.

We conducted our work between March 1991 and March 1992 in accordance with generally accepted government auditing standards. We discussed our findings with EPA Superfund program officials and

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incorporated their comments where appropriate. These officials generally agreed with the report's findings and said that the statistical analyses provide useful indicators of areas requiring continued management attention. As directed, we did not obtain written comments from EPA on the draft report.

# Responsible Parties Tend to Contain Rather Than Treat Hazardous Waste

Although the legislative preference of the Superfund program is to treat hazardous waste whenever practicable, responsible parties use significantly less treatment than EPA at comparable sites. Despite reports from environmental advocacy groups and the Office of Technology Assessment that some PRP cleanups appear to be less stringent and permanent than EPA-managed cleanups, EPA's analysis concluded that PRP cleanups were comparable and that any difference was attributable to other factors, such as site characteristics. However, our analysis of fiscal year 1987-90 RODs showed that PRP cleanups have a greater likelihood of containing waste without treating it than EPA-managed cleanups. Cleanups based on PRP site studies contain waste 43 percent of the time compared with 25 percent for EPA-managed cleanups. While this difference could be due to site characteristics, our analysis by site type or characteristic also showed marked differences, with EPA generally using more treatment than PRP cleanups for similar types of cleanup problems. By using containment more frequently, PRP-managed cleanups tend to permanently reduce the volume, toxicity, or mobility of hazardous waste less than EPA-managed cleanups.

## EPA's Analysis Found Comparable Treatment and Containment Levels

EPA's June 1990 comparative analysis of fiscal year 1987-89 RODs found that use of treatment rather than containment was generally the same for EPA- and PRP-managed cleanups. However, flaws in the study bring these results into question. The primary problem was that the report's conclusions did not highlight key statistics indicating differences in treatment and containment use in EPA- and PRP-managed cleanups. In addition, the analysis generally understated the amount of containment being used because it analyzed remedies by only two categories—treatment or containment—when in fact many of the remedies involved a combination of treatment and containment. Consequently, EPA's study results differ considerably from the results of our own analysis.

EPA included in its comparative analysis all 238 RODs approved in fiscal years 1987 through 1989 that described final remedies to control the source of the site contamination.<sup>1</sup> EPA classified these RODs as using either solely waste treatment or containment. EPA divided the RODs into 16 different hazardous waste site types on the basis of the site's former use or the presence of certain major contaminants. List 2.1 shows a breakdown of the 16 categories of sites EPA used in its analysis. EPA's analysis compared the use of a treatment or a containment remedy in RODs based

<sup>1</sup>These final-source-control RODs represent the final remedy chosen to control a source of contamination at a hazardous waste site. RODs describing interim waste control measures or addressing only groundwater contamination were not included in EPA's analysis.

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**Chapter 2**  
**Responsible Parties Tend to Contain Rather**  
**Than Treat Hazardous Waste**

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on PRP studies with RODs based on EPA studies. At the subsequent actual cleanup stage, the agency conducted a similar analysis of EPA- and PRP-managed cleanups.

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**List 2.1: EPA's 16 Site Types**

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**Contaminant-based Categories**

Asbestos

Dioxin

Metals

Metals/organic compounds

Organic compounds

Polychlorinated biphenyls (PCBs)

Pesticides

Radioactive/mixed waste

Solvents

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**Former Use Categories**

Battery recycling/lead

Metal-plating

Industrial landfill

Mining waste

Municipal landfill

Munitions

Wood-preserving

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Source: EPA.

EPA's analysis concluded that EPA and PRP studies and cleanups selected similar patterns of waste treatment and containment. According to the analysis, differences that did exist could be attributed to site characteristics, rather than EPA or PRP involvement in the study or cleanup. Within site types, the analysis also concluded that no significant difference existed in the remedies chosen at EPA and PRP sites. The study also found no evidence of inappropriate PRP influence in selecting cleanup remedies.

However, EPA's analysis contained a number of problems that raise serious concerns about the study's results. The primary problem with EPA's study is that it overlooked key statistics. While EPA reported that cleanups based on EPA and PRP studies used comparable levels of treatment, the study's underlying percentages do not support this assertion. According to the statistics supporting the comparative analysis, 61 percent of remedies

selected on the basis of PRP site studies treat at least some of the waste, as opposed to 71 percent of remedies selected on the basis of site studies that EPA managed.

Another weakness in EPA's comparative analysis was that EPA classified all RODS into either treatment or containment categories when in fact 20 percent of the RODS used a combination of treatment and containment. Thus, RODS selecting even a small amount of treatment were considered to be treatment RODS, which understates the amount of containment being used and conveys the impression that all wastes addressed in these RODS would be treated. For example, EPA classified the ROD for the Doepke Disposal Service site in Johnson County, Kansas, as a treatment ROD. Contamination at this private industrial landfill includes organic compounds, polychlorinated biphenyls (PCBs), pesticides, metals, and polycyclic aromatic hydrocarbons (PAHs).<sup>2</sup> Although the responsible party plans to treat the hazardous liquids in underground ponds in a portion of the site, the majority of the waste at the site will not be treated but rather contained with an impermeable cap.

We also found instances of RODS that EPA mistakenly included or excluded from the analysis. For example, EPA included six RODS that were not final-source-control RODS in the analysis and included one ROD twice. EPA did not include two other final-source-control RODS that should have been included.

Although EPA's comparative analysis concluded that PRP and EPA remedies were comparable and found no evidence of inappropriate PRP influence on remedy selection, the study recommended several actions to mitigate such influence in remedy selection. The study proposed that (1) PRPs no longer be allowed to perform the risk assessment portion of the site study, (2) new guidance be issued on overseeing PRP-managed site studies, and (3) all RODS selecting only waste containment be reviewed at EPA headquarters. These actions are discussed in chapter 3 of this report.

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## **PRPs Tend to Use Waste Treatment Less Often Than EPA**

Waste is treated less frequently when responsible parties plan the Superfund site cleanup than when EPA plans the cleanup at comparable sites. Our analysis of fiscal year 1987-90 RODS found that RODS based on EPA site studies recommended cleanups using at least some treatment of waste

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<sup>2</sup>Organic compounds include such products as paint, degreasers, and dry-cleaning fluid. PCBs are used in electric transformers and insulating and cooling products, while PAHs are used in wood-preserving operations. These compounds and metals can cause cancer and damage to the liver, kidneys, and other organs. Pesticides can cause a wide variety of health problems.



significantly more frequently (75 percent of the time) than RODs based on PRP studies (57 percent of the time). We also found this same trend when we analyzed the RODs by site type. For nearly all site types, PRPs used less treatment than EPA. As a result, EPA-managed cleanups tend to reduce the volume, toxicity, or mobility of the hazardous waste more than PRP-managed cleanups do.

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**Treatment Is Used Less**  
**Often When PRPs Manage**  
**the Site Study**

Because of concern over weaknesses in EPA's comparative analysis, we developed our own data base to perform a similar analysis. We expanded EPA's comparative analysis by including all RODs approved in fiscal years 1987-90, increasing the number of RODs analyzed from 238 to 317.<sup>3</sup> (See app. I.) We also added a "treatment and containment" category for those RODs that included a combination of cleanup remedies and analyzed RODs for the specific remedy they selected.<sup>4</sup>

Our analysis shows that RODs based on PRP site studies consistently include more waste containment than RODs based on EPA studies. We analyzed both interim and final RODs, by both the site study and subsequent cleanup stage and by fiscal years. In each case we found that PRPs used less waste treatment than EPA. For example, as figure 2.1 indicates, EPA selected waste containment as the sole remedy 25 percent of the time compared with 43 percent of the time for PRPs. In addition, EPA selected treatment as the sole remedy 50 percent of the time compared with only 36 percent of the time for RODs based on PRP studies.

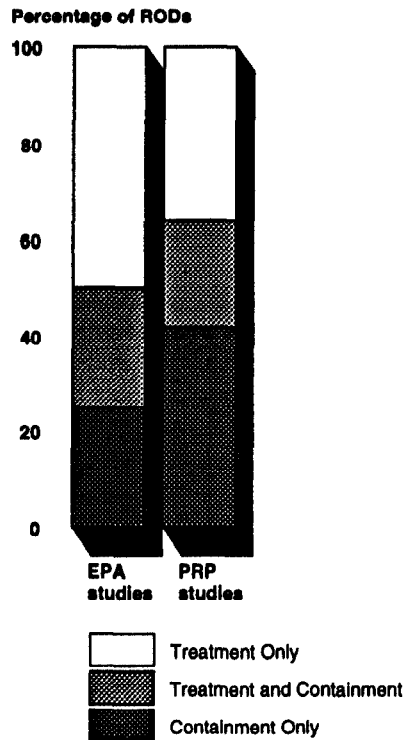
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<sup>3</sup>All of these are final-source-control RODs. We excluded RODs for federal facility sites.

<sup>4</sup>To assess the actual amount of planned treatment, we attempted to determine the volume of waste to be treated or contained under these RODs. However, many of the RODs did not contain sufficient information to make this determination because EPA's regions do not always estimate waste volume when preparing RODs.

**Chapter 2**  
**Responsible Parties Tend to Contain Rather**  
**Than Treat Hazardous Waste**

**Figure 2.1: Use of Treatment or Containment in Final-Source-Control RODs Based on EPA- and PRP-Managed Studies, Fiscal Years 1987-90**

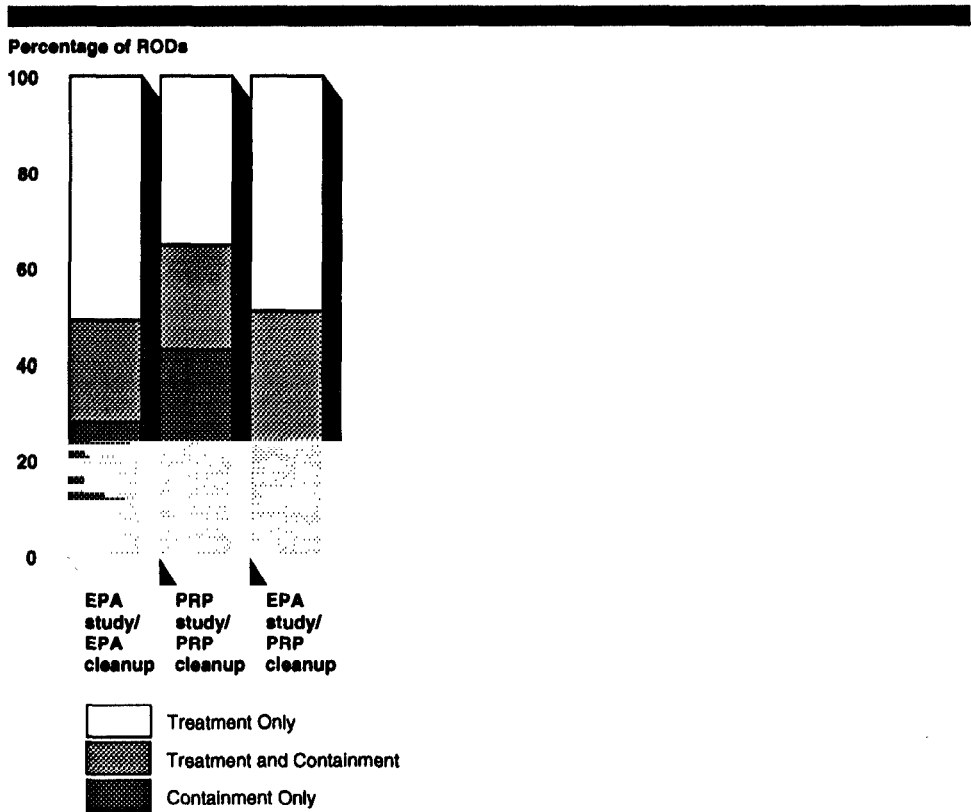


Note: Based on 169 EPA site studies and 148 PRP site studies.

Source: GAO's analysis of EPA data.

Cleanups based on EPA studies used the highest amount of treatment, regardless of who performed the cleanup, indicating that remedy differences stem primarily from who managed the site study. Frequently, EPA negotiates with PRPs to perform a cleanup after the agency manages the site study. Use of waste treatment for those cases in which PRPs took over the cleanup from EPA also significantly exceeded the treatment remedies selected at sites where PRPs managed both the study and cleanup. As figure 2.2 indicates, use of containment as the sole cleanup technology was highest, and use of treatment lowest, at sites where PRPs performed the study and cleanup.

**Figure 2.2: Percentage of Final-Source-Control RODs Including Treatment or Containment at Site-Study and Cleanup Stages, Fiscal Years 1987-90**

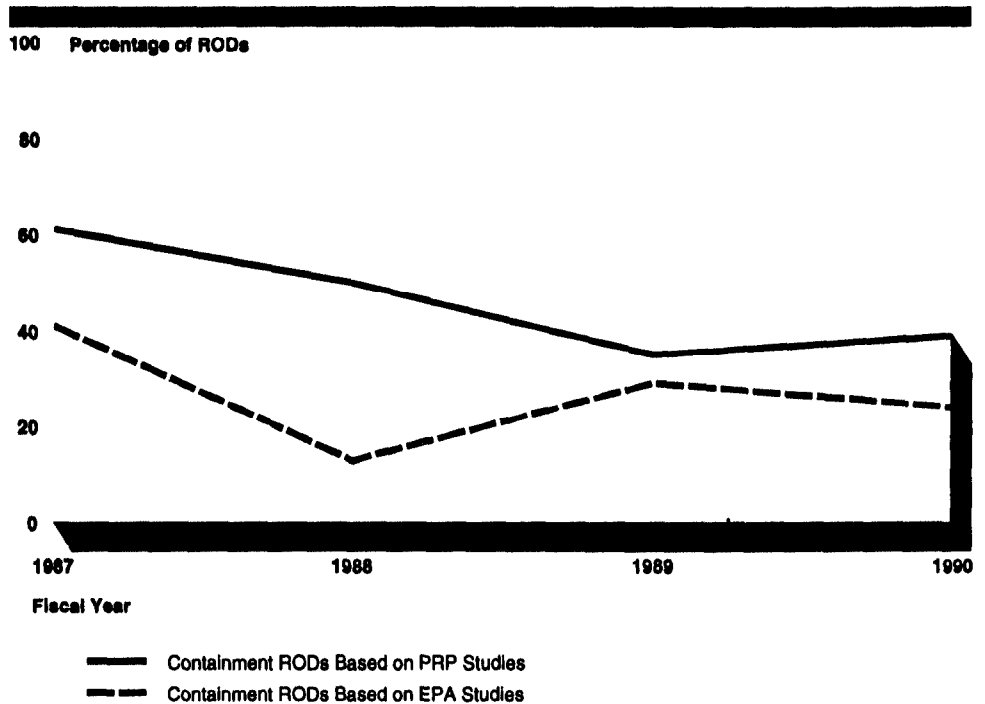


Notes: EPA study/EPA cleanup indicates that EPA managed the site study and cleanup; PRP study/PRP cleanup indicates that PRPs managed the site study and cleanup; and EPA study/PRP cleanup indicates that EPA managed the site study and PRPs managed the cleanup. The category PRP study/EPA cleanup comprises less than 5 percent of RODs, so was not included.

Source: GAO's analysis of EPA data.

Moreover, differences between RODs based on EPA- and PRP-managed studies have persisted over time. While the magnitude of the difference in use of treatment and containment between EPA and PRPs fluctuates each year, it does not increase or decrease in any readily apparent trend. Each year, EPA studies result in more frequent waste treatment than PRP studies, with differences ranging from 6 to 37 percent. (See fig. 2.3.)

**Figure 2.3: Percentage of Final-Source-Control RODs Including Containment, Fiscal Years 1987-90**



Notes: Number of RODs based on PRP studies: 13 in 1987, 36 in 1988, 48 in 1989, and 51 in 1990. Number of RODs based on EPA studies: 34 in 1987, 52 in 1988, 41 in 1989, and 42 in 1990.

Source: GAO's analysis of EPA data.

After we had completed our audit work for this report, EPA's Superfund staff performed an analysis of fiscal year 1991 RODs to determine whether differences between EPA and PRP cleanups persist. On the basis of this analysis, they believe that RODs based on EPA or PRP site studies selected treatment in roughly equal proportions last year. We did not review the 1991 RODs since they were not available at the time of our analysis. We also did not validate EPA's methodology or analysis results. Consequently, we are unable to comment on the validity of EPA's analysis.

**PRPs Treated Waste Less Often at Comparable Types of Sites**

Our analysis of cleanup remedies used at specific categories of hazardous waste site types showed that EPA treats waste more often than PRPs do. We specifically analyzed certain hazardous waste site types to determine if EPA and PRPs select similar remedies at comparable sites with similar site

contamination or site histories. The four site types with the largest number of final-source-control RODS were industrial landfills, metals/organic-compound sites, municipal landfills, and PCB sites.<sup>5</sup> The RODS in these site types represent over half of all source-control RODS during the period of our study, fiscal years 1987-90.

As figure 2.4 shows, PRPS contain waste more frequently at all four site categories. In fact, in three of the four categories—metals/organic-compound sites, municipal landfills, and industrial landfills—PRPS contain waste considerably more often than EPA does. For example, at municipal landfills, EPA contains waste 54 percent of the time while PRPS use containment 81 percent of the time. These differences indicate that cleanups based on PRP studies contain, rather than permanently reduce, hazardous waste toxicity or volume more frequently than cleanups based on EPA studies do. We analyzed site type distribution to ensure that PRPS were not disproportionately responsible for studying and cleaning up site types that tend to require containment.<sup>6</sup> We found that site types that favor containment were approximately equally distributed between EPA and PRPS at the study phase.

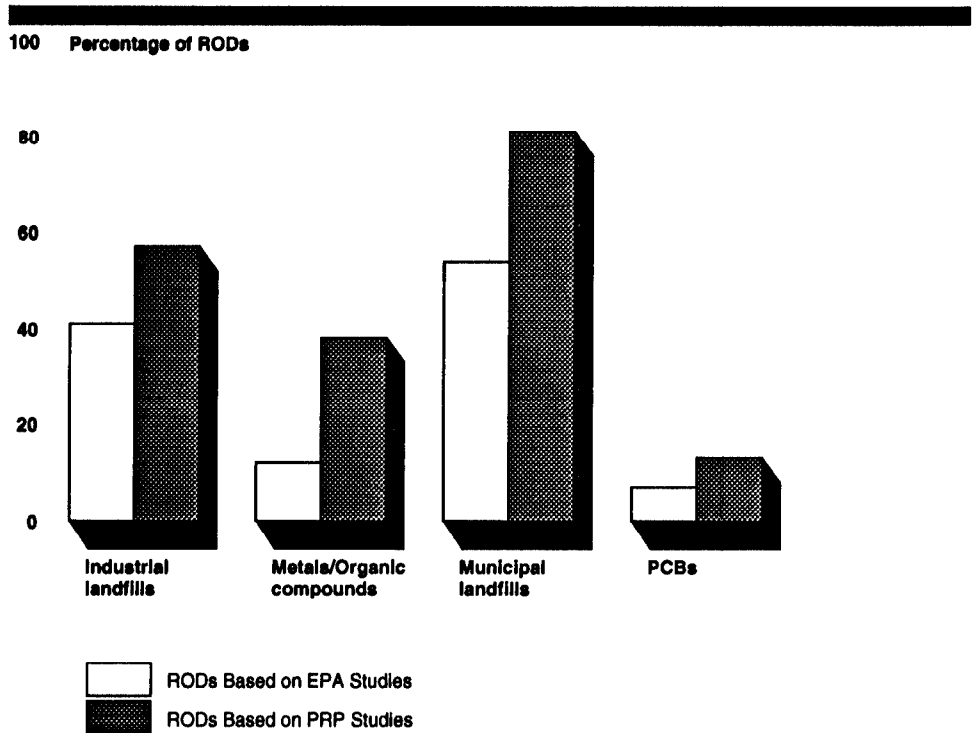
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<sup>5</sup>Industrial landfills are sites where soil has been excavated, and the cavity filled with predominately industrial wastes. Metals/organic-compound sites contain both organic and metallic compounds. Municipal landfills are sites where soil has been excavated and the cavity filled with mostly municipal and household wastes. PCB (polychlorinated biphenyl) sites contain mostly PCBs, a carcinogenic chemical, but may also contain both metals and organic compounds.

<sup>6</sup>Some types of contamination, such as asbestos or radioactive waste, are not amenable to treatment. Use of treatment at some site types, such as certain large landfills, is not practical given the large volume of waste.

**Chapter 2  
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**Figure 2.4: Percentage of Final-Source-Control RODs Including Containment Alone for Selected Site Types, Fiscal Years 1987-90**



Notes: Number of RODs based on EPA site studies: 17 industrial landfills, 25 metals/organic-compounds sites, 26 municipal landfills, and 14 PCB sites. Number of RODs based on PRP site studies: 21 industrial landfills, 16 metals/organic-compounds sites, 31 municipal landfills, and 15 PCB sites.

Source: GAO's analysis of EPA data.

Researchers and groups involved in Superfund cleanups point to a variety of potential causes for the differences in RODs based on PRP- and EPA-managed site studies. For example, the Office of Technology Assessment concluded that EPA may tend to select containment when PRPs conduct the site study because these studies favor less costly containment remedies, or to encourage PRPs to perform the cleanup. However, representatives of the PRP community explained that differences between EPA and PRP cleanups may result from EPA's tendency to overstate the risks that sites pose. In contrast, they contend that PRP site studies more accurately portray site risks, resulting in cleanups that use more containment, but adequately protect human health. Representatives of cleanup contractors said that sites with PRP involvement often consist of

operating industrial facilities. They explained that treating rather than containing waste at these sites could disrupt facility operations. Excavation or other necessary treatment steps could also expose industrial workers to even higher levels of waste.

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## **Conclusions**

EPA's growing reliance on responsible parties to study and clean up hazardous waste sites requires that EPA ensure that these cleanups adequately comply with Superfund regulations and protect human health and the environment. Our analysis showed that at sites with similar contaminants or histories, EPA tends to treat hazardous waste more frequently than PRPs do, despite the statutory preference for waste treatment whenever practicable. Waste containment is acceptable for certain types of waste and site conditions but does not reduce the toxicity or volume of hazardous waste. At comparable sites where PRPs are containing wastes and EPA is treating waste, the PRP cleanups may not provide the same level of long-term protection of human health and the environment as the EPA cleanups. However, EPA was not aware of persistent differences between EPA and PRP cleanups, and EPA's own study did not identify them. Given that EPA will continue to rely on PRPs to finance and manage cleanups, it is important that the agency ensure that the cleanup remedies used at these sites will adequately protect the public from adverse health and environmental consequences in the future.

# Inconsistent ROD Quality Makes Long-Term Effectiveness of Some Cleanups Uncertain

Although the Records of Decision document EPA's cleanup decisions for hazardous waste sites, we found that they often lacked key information detailing the plan's cleanup objectives and selected cleanup remedy. Despite clear EPA requirements that cleanup goals and selected remedies be explained and justified, Superfund program managers are approving these RODs without this type of information. Our case studies of 34 of the 532 RODs approved in fiscal years 1987-90 indicated that RODs lacked the key information necessary to determine why a remedy had been selected and to what level the ROD proposed to clean up the site. These problems were present in RODs based on both EPA and PRP site studies. For example, at both EPA- and PRP-managed sites, cleanup goals<sup>1</sup> were not consistently set for each major contaminant, were sometimes not established at all, or varied widely. Some RODs did not specify a cleanup plan but rather described an array of cleanup remedies and postponed the decision until the design stage. Others simply did not explain why a particular cleanup strategy would be more appropriate than other remedies considered. Without such detailed information, EPA and the public cannot be assured that the cleanup plan has set reasonable objectives and selected a cleanup remedy that is protective of human health and the environment.

EPA's Superfund management officials recognize some of these problems with the RODs and are acting both at headquarters and in the regions to improve cleanup justification and documentation. For example, during EPA's annual analysis of approved RODs, the agency reinforces documentation standards by reviewing all RODs to determine if they adhere to current guidance. In addition, EPA's plans to standardize soil cleanup should help reduce variation in soil cleanup goals set. Finally, regional peer reviews have begun to help ensure that RODs undergo technical review and meet official agency requirements before approval. However, because accountability for preparing complete RODs is not clearly established in EPA, the agency continues to approve some RODs that lack key remedy information and that do not justify the remedy selected.

## EPA Does Not Always Specify Cleanup Goals

EPA's guidance and regulations require cleanup plans to establish clear cleanup goals for contaminated media to protect human health and the environment and to design cleanup remedies to meet these goals. However, our case studies revealed that RODs did not always include such goals, either for all major contaminants or for all affected media. Moreover, the goals that were established varied widely from site to site.

<sup>1</sup>A cleanup goal is the decreased level of contamination EPA plans to attain in a specific medium, such as soil or groundwater, to reduce the threat posed by a contaminant at a Superfund site.



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## **Soil Cleanup Goals Not Specified for Major Contaminants**

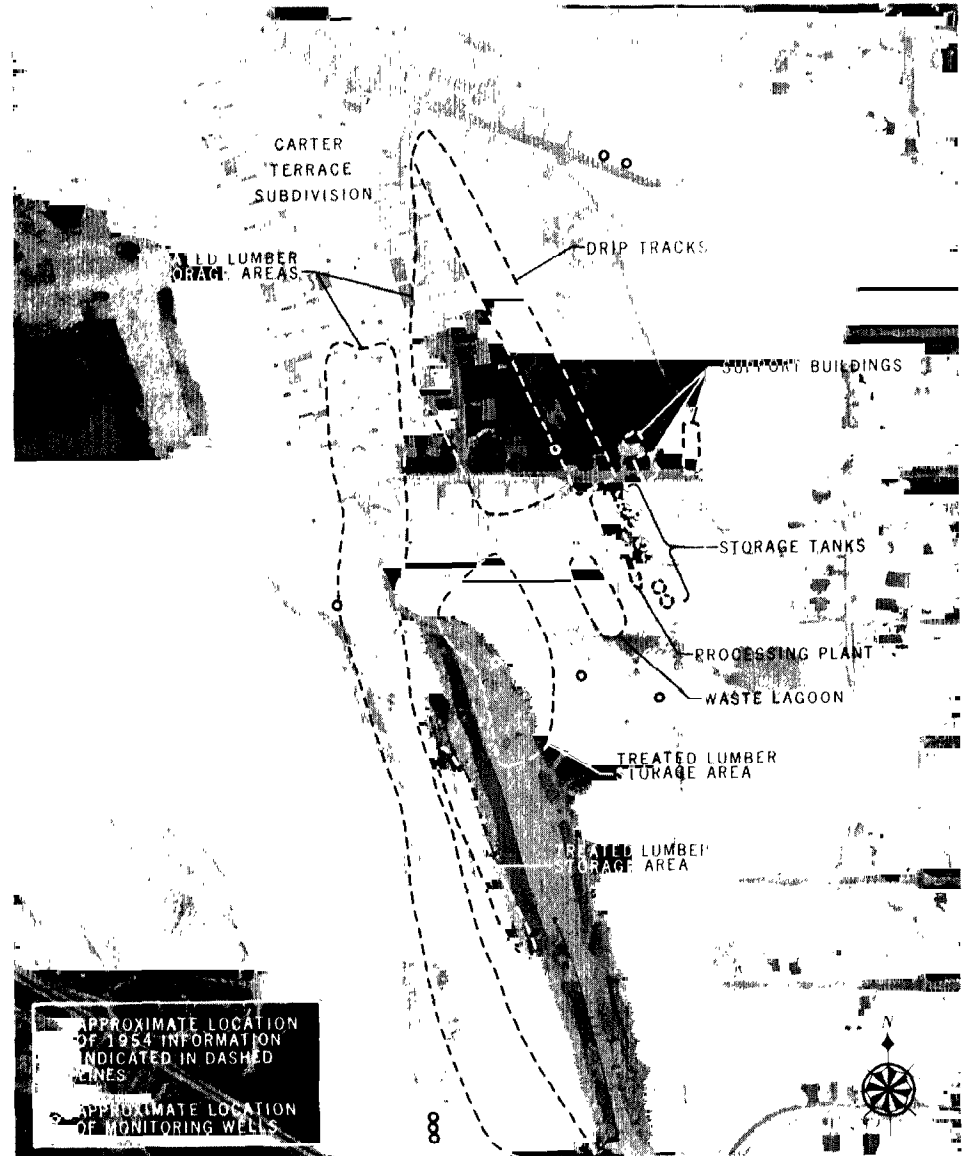
In several cases, EPA approved a ROD that required treatment of a site's waste but did not document a cleanup goal for each major contaminant detected. Cleanup goals must be set whenever treatment is proposed so that cleanup progresses to a level that EPA considers protective of human health and the environment and so an appropriate remedy can be selected to meet the goal. EPA has not set specific nationwide standards for soil cleanup for major contaminants, preferring to let site characteristics determine appropriate goals. As a result, regions must specify site-specific numerical goals in the ROD based on assumptions concerning the potential for human exposure and risk to human health at the site. This goal-setting is clearly required by EPA's ROD guidance and other decision documents. However, when we evaluated the 18 of 34 RODs we reviewed that selected treatment as part of the remedy, we found that 11 did not include soil cleanup goals.<sup>2</sup>

The ROD for the Koppers-Texarkana site in Texarkana, Texas (see fig. 3.1), did not specify cleanup goals for all contaminants. Creosote, pentachlorophenols, and metallic salts were used to preserve wood at this site from 1910 to 1961, leaving the site contaminated with PAHs, pentachlorophenols, and arsenic. Several years after wood-preserving operations ceased, a new owner built 79 single-family homes on the site. In September 1988 EPA approved the Koppers-Texarkana ROD, which proposed to treat the soil. The ROD set no goal for arsenic, which it considered a "primary contaminant of concern affecting the soil, groundwater, and sediments." However, EPA officials said the ROD does not state a goal for arsenic because it is a minor risk compared with the carcinogenic polycyclic aromatic hydrocarbons (cPAHs) that pose the major threat to human health at the site, and the treatment designed to remove them from the soil would also reduce the levels of other contaminants. The Koppers-Texarkana ROD was not consistent with the other documents referred to by EPA officials. By not explaining that EPA considered arsenic only a minor threat, the ROD appears not to ensure that its cleanup will proceed to a defined level that protects current and future site users.

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<sup>2</sup>Sixteen RODs that we evaluated did not include treatment of contaminated soil.

Figure 3.1: Aerial View of  
Koppers-Texarkana Site Showing  
Residences on Site (Texarkana, Tex.)



Source: EPA.

### Goals Not Specified for All Relevant Media

EPA did not establish a cleanup goal for each treated medium in which a major contaminant was detected in 13 of the 24 RODs that we evaluated that treated groundwater or soil. When EPA does not establish goals for affected media, it is difficult to determine when all cleanup objectives will

be met. Koppers-Texarkana, for example, contains high levels of PAH contamination in the soil, groundwater, surface water, and sediment, but the ROD set a cleanup goal only for the soil.<sup>3</sup> By setting cleanup goals only for soil, the Koppers-Texarkana ROD provided no assurance that protective levels will be attained in other contaminated media. Since no federal standards exist for the cleanup of PAHs in any medium, including groundwater, setting a numerical goal is crucial. EPA's 1989 ROD guidance emphasized this requirement and called for RODs to specify cleanup goals for each medium addressed. While EPA is aware that some RODs have not established cleanup goals, regions have not been held specifically accountable for approving RODs that comply with this guidance.

**Cleanup Goals Vary  
Considerably**

When RODs did establish numerical cleanup goals, these varied considerably. This range of goals has left EPA open to charges that it does not consistently protect human health and the environment at all sites. Several factors have contributed to the variation, including a lack of federal standards for soil cleanup, varying assumptions about future site use, and the use of different criteria to direct cleanup of the same contaminant. Superfund cleanups are also required to comply with state environmental laws, resulting in state-to-state variation. Noticeable variation occurred for cleanup of four of the seven major chemicals that we evaluated,<sup>4</sup> as shown in table 3.1.

**Table 3.1: Variation in Soil Cleanup Goals**

<b>Chemical</b>	<b>Cleanup goal range (ppm)<sup>a</sup></b>	<b>Number of cases</b>
cPAHs	0.19 - 700	14
Arsenic	3 - 200	6
Pentachlorophenol	17 - 300	6
Chromium	19.4 - 627	4

<sup>a</sup>Cleanup goals are expressed as a concentration in a particular medium. The concentration of a contaminant in the soil is generally expressed in parts per million (ppm). Source: GAO analysis of EPA data.

As noted earlier, EPA has not set federal standards for soil cleanup. Currently, EPA suggests numerical soil cleanup goals only for lead and

<sup>3</sup>The Koppers-Texarkana ROD set a cleanup goal of "no detection" for "free phase creosote" in the groundwater. Although PAHs are found in creosote, the ROD did not set a clear and unambiguous goal specifically for the carcinogenic PAH contamination in that medium.

<sup>4</sup>The other three contaminants evaluated were benzene, trichloroethylene, and lead.

PCBs, resulting in each ROD either developing site-specific goals or following any established state standards. While EPA has acknowledged a need for soil standards, the wide array of soil types may make developing these standards a difficult task because soil types at different sites react with and retain hazardous wastes to different degrees. EPA plans to develop overall soil standards over the next 3-6 years and standards for some contaminants in surface soils with potential for direct human contact during 1992.

Cleanup goal variation also results from site study assumptions about potential future uses of hazardous waste sites.<sup>5</sup> Goals must be set based on the risk that a site's contamination may pose to human health and the environment. In order to estimate risk and set goals, EPA's regional staff must decide whether a site is more likely to be developed for residential, recreational, or industrial/commercial purposes on the basis of such factors as former site use, the nature of the surrounding area, and any restrictions on future use, such as zoning laws. Residential future use scenarios generally require more stringent cleanup goals because residents are assumed to come into contact with the soil more frequently than workers under a commercial/industrial scenario. Current risk assessment guidance, issued in December 1989, provides broad parameters for future use assumptions by indicating when industrial or residential use may be considered a reasonable possibility. Figure 3.2 discusses cleanup goals and future use assumptions at the Koppers-Texarkana site.

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<sup>5</sup>Future site use assumptions are made as part of an overall, site-specific risk assessment process that estimates the risk posed to human health by each detected contaminant. Depending upon the "use scenario" selected, a future population is assumed to risk exposure to remaining contamination with varying frequency.

**Figure 3.2: How Site Use Assumptions**  
**Affect Cleanup Goals**

The Koppers-Texarkana site, in part a residential development, shows how assumptions about future site use influence soil cleanup goals for cPAHs.

- **Initial Residential Use Scenario--100 ppm.** The September 1988 ROD set a soil cleanup goal of 100 ppm for cPAHs and assumed continued residential use at the site.
- **Revised Residential Use Scenario--0.33 ppm.** In 1990 EPA set a more stringent goal of 0.33 ppm, based on later risk assessment guidance that assumed residents would have more frequent contact with contaminated soils. The new goal was more comparable to the goals of 0.19-6 ppm in 8 of 11 other RODs that we reviewed for sites with residences.
- **Industrial Use Scenario--100 ppm.** In October 1991 federal legislation authorized the buyout of site homes. As a result, EPA prepared a March 1992 ROD amendment proposing that the cleanup goal revert to 100 ppm under an industrial use scenario after residents have been relocated from the site.

Source: GAO's analysis of EPA documents.

For example, at the North and South Cavalcade Street sites in Houston, Texas, cleanup goals varied by a factor of 700 as a result of future use assumptions. Environmental advocacy groups criticized EPA because PRPS are cleaning up the site with the less stringent goal while EPA is cleaning up the other site. Creosote and metallic salts were used to preserve wood at the 66-acre South Cavalcade Street site from 1910 to 1962, while creosote and PCPS were used for the same purpose at the 21-acre North Cavalcade site across the street from 1946 to 1961. Residential properties are located directly to the west of each site. At South Cavalcade Street, where PRPS conducted the cleanup study, EPA approved a cPAH soil cleanup goal of 700 ppm in September 1988. By contrast, the agency approved a far lower 1 ppm goal for the same contaminant at North Cavalcade Street where EPA performed the study less than 3 months earlier. According to regional officials, the North Cavalcade Street site cleanup goals are different because it may be developed as residential property in the future, while the South Cavalcade Street site is likely to remain industrial.

Finally, variation can result when EPA uses different cleanup criteria to direct cleanup of the same contaminant. For example, some RODs designed to address contaminated groundwater require that soil cleanup continue

until no contamination is detected leaching through the soil<sup>6</sup> to underlying groundwater aquifers. Other RODs set goals based on probable human exposure to contaminated soil. The South Cavalcade Street ROD, for instance, set two different soil cleanup criteria for cPAHS. It set a soil cleanup goal of 700 ppm, deemed protective of workers, but also stipulated that cleanup proceed to a cPAH level that would allow no contaminated water to leach through the soil, whichever is lower. Regional officials explained that the site's relatively high 700 ppm goal will ultimately be reduced because the "no leaching" stipulation will require a soil cPAH level of roughly 150 ppm. The South Cavalcade ROD does not discuss the leaching study that indicated the soil cleanup goal for cPAHS of about 150 ppm.

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## **Cleanup Remedy Decisions Are Not Adequately Justified**

EPA requires that RODs clearly detail cleanup decisions. Health risks and remedy goals should be presented clearly, and selected and alternative remedies must be discussed thoroughly. Alternative cleanup remedies are to be evaluated on the nine criteria outlined in chapter 1, including protection of human health and the environment, long-term effectiveness and permanence, cost, and ability to be implemented. The public relies on EPA to approve RODs that analyze and justify the cleanup, and EPA relies on the ROD to guide further cleanup design. However, some RODs that we evaluated did not adequately justify the cleanup remedy selected. Another offered no particular cleanup remedy at all, delaying selection until the post-ROD cleanup design stage because insufficient information was available to select a remedy. In still another case, EPA changed the cleanup remedy during the design stage without amending the ROD or informing the public of the change.

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## **Remedy Decisions Are Not Always Adequately Discussed and Justified**

One ROD we evaluated did not adequately explain and justify why EPA's regional office approved the particular cleanup remedy. For example, at the Pepe Field site in Boonton, New Jersey (see fig. 3.3), inorganic and organic soil contamination resulted from vegetable oils and cleaning products disposed of there. The site, surrounded on three sides by residences, is currently used as a public recreation area. In September 1989 EPA approved the Pepe Field ROD, which plans to prevent exposure to site contamination by maintaining a cap over contaminated soil, installing a landfill gas collection system, and upgrading an existing leachate collection system. According to the ROD, exposure to uncovered soils

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<sup>6</sup>"Leaching" refers to water flowing downward from the earth's surface to an underlying aquifer. This water may pick up particles of soil and contamination present in the soil. The resulting liquid is referred to as leachate.

could mean an excess cancer risk<sup>7</sup> due to nickel inhalation as high as 1 in 400,000. However, while a soil cap appears to be consistent with SARA, the ROD lacked key health risk data needed to support and justify this remedy. These key data were also missing in the site's risk assessment, the basis for remedy selection and cleanup goal decisions. Risk assessment flaws included

- failure to perform a formal analysis of potential human exposure, including gathering information on populations at risk and identifying potential ways people might come into contact with contamination, and
- elimination of a potential carcinogen (chromium) from evaluation although it was present in soil above the background concentration.<sup>8</sup>

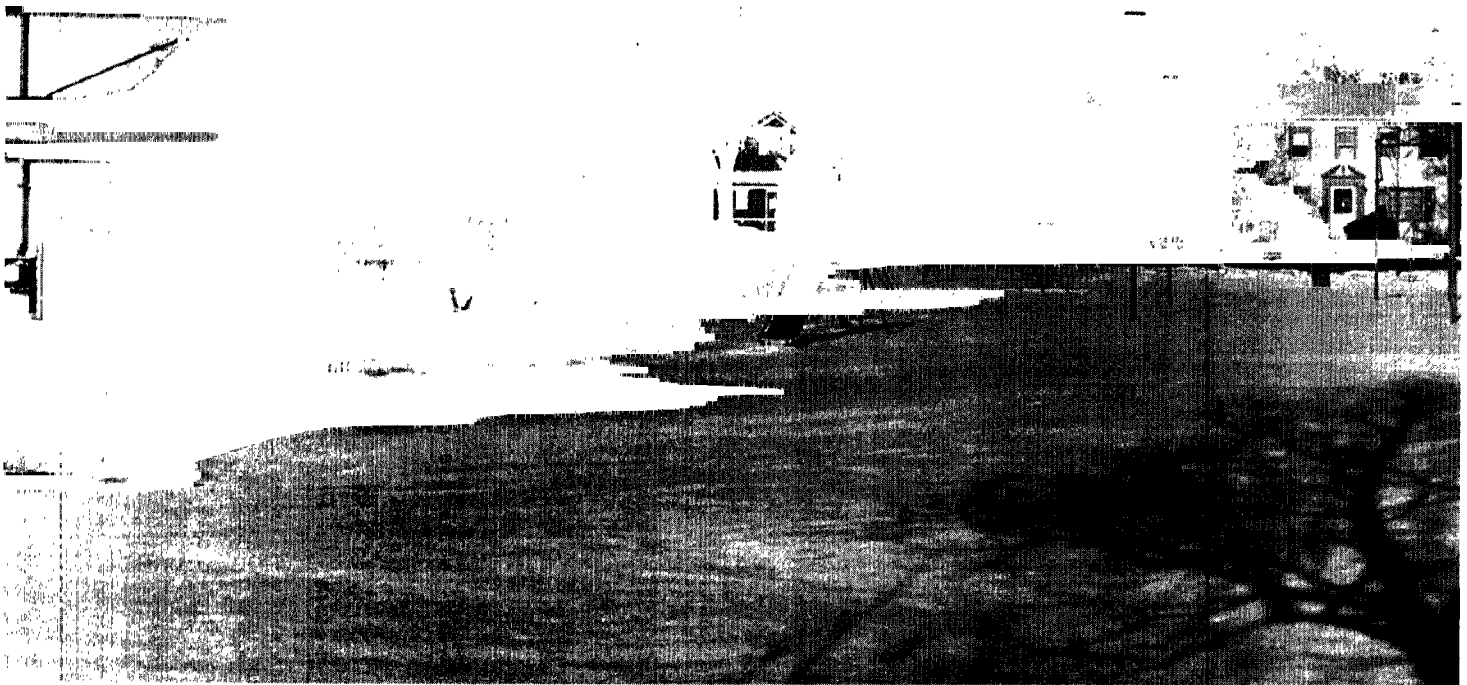
Regional officials agreed that the Pepe Field risk assessment was not well done and omitted important information but believe the remedy is still appropriate. As a result, the potential risks associated with exposure to site contaminants used to select the Pepe Field cleanup may have been underestimated.

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<sup>7</sup>EPA defines excess cancer risk as the potential risk that one additional person will develop cancer due to exposure to site-related contamination.

<sup>8</sup>Background concentration refers to the naturally occurring concentration of a contaminant in the immediate area.

**Figure 3.3: Baseball Field and Adjacent Residences, Pepe Field Site (Boonton, N.J.)**



Source: EPA.

### **RODs Do Not Always Specify the Remedies Selected**

In another case, EPA approved a ROD that did not specify a particular cleanup remedy, but rather proposed a range of remedies pending the results of studies to be conducted during cleanup design. Agency guidance clearly states that studies on potential treatments should be conducted during the cleanup study so that EPA can “better understand the expected advantages” of a treatment remedy and so that cleanup remedies can be selected with as much information as possible. Approving RODs without a cleanup plan does not fulfill the purpose of a ROD and prevents the public from commenting on the cleanup strategy.



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**Chapter 3**  
**Inconsistent ROD Quality Makes Long-Term**  
**Effectiveness of Some Cleanups Uncertain**

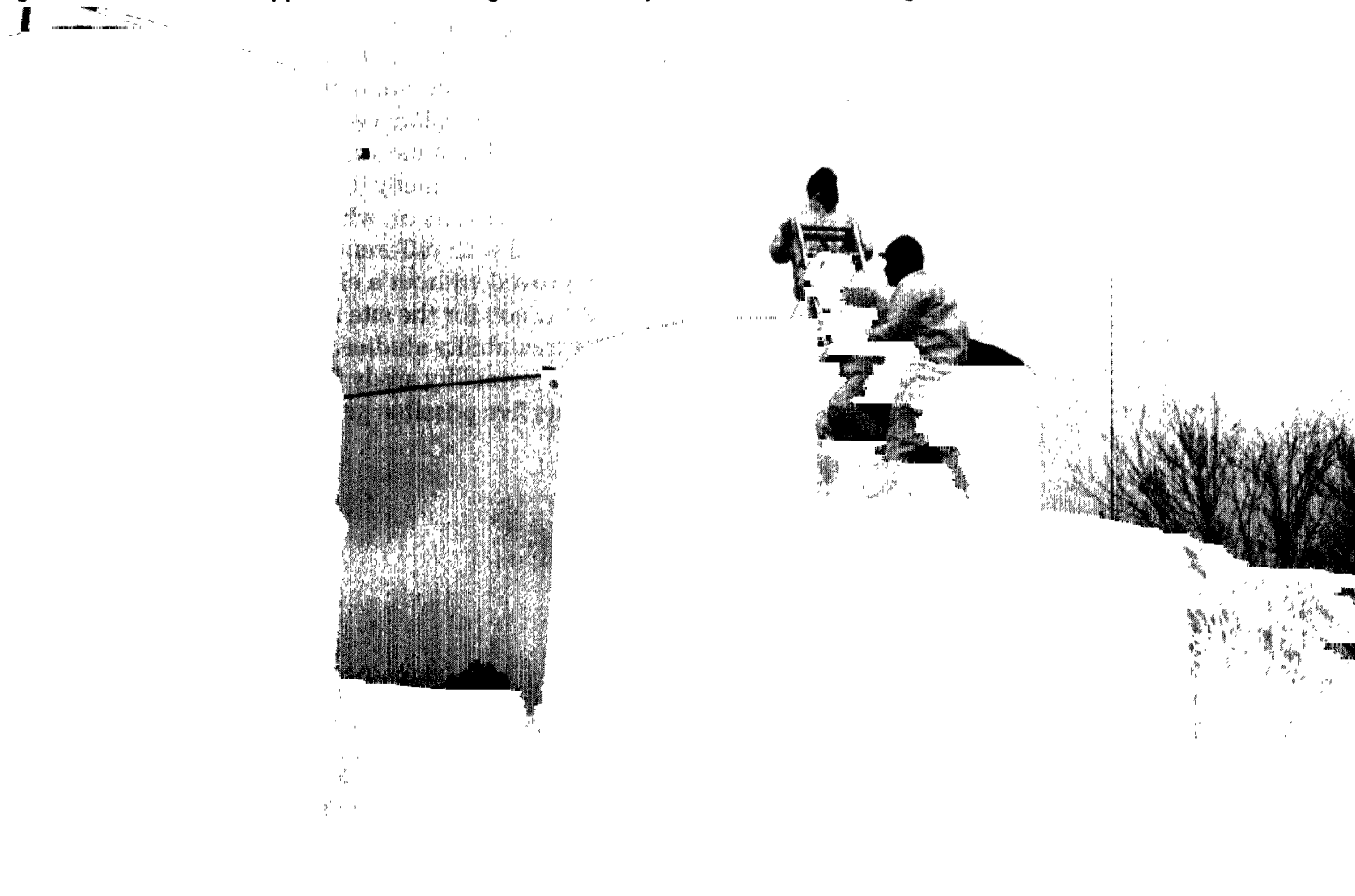
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The ROD for the Cape Fear site in Cumberland County, North Carolina (see fig. 3.4), did not specify a cleanup plan. The site soil and water are contaminated with a range of chemicals, including benzene, PAHs, arsenic, and chromium as a result of 30 years of wood preserving that ended in 1983. The site is adjacent to several residences, and another thousand people live within a quarter mile. The June 1989 ROD called for a soil flushing technique<sup>9</sup> as the preferred remedy for soil cleanup but delayed until the cleanup design stage decisions on whether organic and inorganic contamination should be treated with different remedies. A regional official said the ROD was approved without a cleanup plan because of program expectations that the ROD for the site be completed in 1989, leaving inadequate time for treatability studies. EPA also waited until cleanup design to conduct a treatability study for contaminated groundwater, and the ROD lists five possible groundwater cleanup remedies.

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<sup>9</sup>Soil flushing removes contaminants by forcing water and reactants through contaminated soil.

**Figure 3.4: Chromated Copper Arsenate Storage Tanks at Cape Fear Wood-Preserving Site (Cumberland County, N.C.)**



Source: EPA.

**EPA Does Not Always  
Properly Document  
Remedy Changes**

EPA's guidance on how and when to document post-ROD changes to a selected cleanup remedy is not followed consistently. When new information discovered during cleanup design necessitates a fundamental change in the remedy, EPA requires a ROD amendment. When a ROD is amended, regional officials must allow for public comment, as is done when planning the original cleanup. While current guidance does not specify time limits for developing a ROD amendment, timely preparation serves to inform and involve the public.

At the Palmetto wood-preserving site in Dixiana, South Carolina (see fig. 1.4), EPA's region changed and performed the cleanup without preparing a ROD amendment. Two companies conducted wood-preserving operations for 22 years at this 5-acre site, leaving high levels of arsenic and chromium in the site's soil and groundwater that pose a risk to drinking water sources. In September 1987 EPA approved the Palmetto ROD, which specified soil flushing to clean up the contaminated soil. During cleanup design, however, further sampling indicated that unstable hexavalent chromium (a carcinogen) was present and that soil flushing might not reduce contamination to soil cleanup goal levels. EPA responded by choosing a different form of soil flushing followed by soil solidification to further prevent leaching into the groundwater. EPA has not formally documented the changed remedy or offered an opportunity for public comment, although the cleanup has been implemented. Regional officials were unsure why a ROD amendment was not prepared.

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## **EPA Is Addressing ROD Consistency and Completeness**

In response to internal reviews and external criticism, EPA has taken steps at headquarters and in the regions to enhance cleanup quality and speed. Some of these actions may also improve ROD consistency and completeness. EPA's efforts include initiatives to improve the consistency of risk assessments and to standardize soil cleanup guidance, the development of new ROD guidance, and several pre- and post-approval ROD quality reviews. These initiatives, if effectively implemented, may help to resolve some of these remedy justification and documentation problems. For example, efforts to revise ROD guidance and standardize soil cleanup levels may lead to more comparable cleanup goals and remedies. However, since EPA estimates that these efforts may take 3-6 years to implement, interim actions may be necessary to improve the remedy selection and documentation process. Furthermore, EPA has issued extensive guidance on preparing RODs, yet continues to develop RODs that are not sufficiently documented, identifying a need to establish accountability within the program for approving complete and consistent RODs.

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## **EPA Has Begun Initiatives to Decrease Variation in Soil Cleanup Goals**

Several EPA policy initiatives could make risk management decisions more consistent, thereby lessening cleanup goal variation among similar sites. First, in June 1990 EPA prohibited PRPs from preparing risk assessments for future site studies, citing the need for greater consistency in risk

assumptions and conclusions.<sup>10</sup> Although it is too early to assess the impact of this change, having EPA conduct all risk assessments may result in more consistent risk definition, risk management, and soil cleanup goals.

Second, the EPA Administrator pledged in October 1991 to review how EPA evaluates and manages risk, including how it develops future land use assumptions. He stated that EPA's current policy permits "cleaning up to levels that allow for unrestricted residential use at some sites, but not at others." We believe this may discourage consistency in cleanup. The Administrator convened a special workgroup to evaluate the issue.

Finally, EPA has developed guidance on how to conduct and document cleanup studies at two site types (PCB sites and municipal landfills) that potentially demonstrate the feasibility of setting consistent cleanup goals for other types of sites. EPA has also proposed developing guidelines for cleaning up soil contaminants over the next 3-6 years, and plans to issue cleanup guidelines in 1992 for contaminants in surface soils with potential for direct human contact. EPA's efforts to standardize soil cleanup guidance should reduce the need for a full examination of risk and cleanup options at every Superfund site and result in more consistent numerical cleanup goals.

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### **EPA's Efforts May Result in Clearer Justification of Remedies**

EPA's regions and headquarters have developed a number of procedures for reviewing RODs before and after their approval. Although the regions we reviewed structured their ROD approval processes somewhat differently, each established formal or informal peer reviews beginning with 1989 or 1990 RODs. The project manager prepares the ROD, which then undergoes reviews for technical accuracy by specialized staff (e.g., hydrogeologists, toxicologists, and risk assessment specialists) and for completeness and quality by regional Superfund managers and the regional administrator. RODs calling for no cleanup action or for containment require headquarters consultation. Despite these layers of review, regions continue to approve RODs that lack important remedy selection information.

Beginning with fiscal year 1988 RODs, teams of EPA headquarters and regional staff annually evaluated whether RODs signed during the prior

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<sup>10</sup>PRPs challenged EPA's decision to bar them from conducting risk assessments. In December 1991 EPA signed a negotiated settlement with industry groups requiring the agency to review both the decision and its experience in implementing it. The settlement also requires EPA to solicit public comment on the decision.

fiscal year were complete, consistent, and adhered to statutory expectations and EPA guidance. Using a checklist of required ROD elements, the teams review each ROD approved in the previous fiscal year. This annual ROD analysis uses ROD forums to give individualized feedback on each region's RODs, but has not been used to establish accountability for preparing complete RODs that meet all relevant guidance. Regional officials generally praised the ROD checklist used in the ROD analysis as a useful tool to ensure that regional staff include all necessary information during ROD preparations. Although EPA officials believe that the ROD analysis and forums have improved ROD documentation, regional officials criticized the ROD analysis' stress on statistics about regional documentation. They suggested that focusing on the appropriateness of cleanup decisions and their comparability to cleanups in other regions would be more productive.

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## Conclusions

Despite guidance on how to select and document cleanups, EPA regions approved incomplete RODs that did not consistently document the extent of cleanup, justify the remedy chosen, or in some cases identify the eventual cleanup remedy. Without specific cleanup goals for all major contaminants or media and adequate explanation and justification of the cleanup plan, the long-term effectiveness of the cleanup and its ability to protect public health and the environment remain in question. Furthermore, by modifying cleanups without documenting the change, EPA excludes local communities from participating in cleanup selection. Headquarters consultation on some RODs and post-approval review have not resulted in consistent ROD documentation. Given the decentralized nature of the ROD approval process, EPA needs effective headquarters oversight to ensure that regions are accountable for approving complete and consistent RODs. Recent EPA initiatives have potential, if effectively implemented, for decreasing variations in cleanup goals and improving cleanup remedy justification and documentation.

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## Recommendations to the Administrator, EPA

To improve the consistency and completeness of RODs and ensure that ROD guidance is followed and that ROD changes are publicized and documented, we recommend that the EPA Administrator

- direct regional administrators to approve only cleanup plans that adequately specify the cleanup goals and remedy, and provide justification for cleanup goals not set and
- set deadlines for documenting changes to the cleanup selected in the ROD.

# Incomplete and Unreliable Data Hamper EPA's Management of Cleanup Selection

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Problems with EPA's information and data bases on cleanups hamper the agency's ability to monitor and evaluate selected remedies at the hundreds of sites on the NPL. Existing EPA information systems containing cleanup remedy data either do not lend themselves to computer access and analysis because they are not in an electronic data base format or are inaccurate and incomplete. This lack of an automated, centralized repository of information for cleanup remedies chosen and implemented at Superfund sites limits EPA's management of its remedy selection process and forces EPA to rely on small, specialized studies to address specific remedy selection issues rather than monitoring cleanups with an ongoing information system. With a readily accessible, reliable data base, EPA could better assess its selection of cleanup remedies at EPA and PRP sites, quickly identifying differences and trends needing management attention. Also, such a data base could assist EPA in standardizing the remedy planning and selection process.

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## A Cleanup Remedy Data Base Is Important to EPA Management

An automated cleanup remedy data base would enhance EPA's ability to manage the remedy selection process by allowing EPA management to monitor trends and quickly analyze important ROD components. By providing comprehensive information on approved RODs, the data base could be a critical component in EPA's current effort to standardize remedy selections.

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## Managing Remedy Selection

To monitor, control, and promote consistent application and selection of cleanup remedies at Superfund sites, EPA needs the ability to quickly and accurately conduct comparative analyses of the important factors at each of its Superfund sites, including the process for selecting the remedies for cleaning up sites. In the past, EPA has relied on special studies rather than on a comprehensive system to analyze and monitor remedy selection. With an automated data base in a retrievable, quantitative format—rather than the current RODs data base of approved RODs, which uses a narrative, unretrievable format—EPA could quickly analyze, compare, and contrast such information from 944 approved RODs<sup>1</sup> on

- EPA-managed and PRP-managed site cleanup studies and cleanups at similar site types and under similar site conditions (e.g., similar contaminants or risks), to ensure consistent application and selection of remedies for protecting public health and the environment;

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<sup>1</sup>RODs approved through fiscal year 1991, according to an EPA official.

- remedy selection trends, to assess the impact of any EPA policy changes on cleanup remedies chosen at Superfund sites; and
- cleanup goals established for similar site types and conditions to ensure consistent levels of protection of the public and the environment from hazardous waste contamination.

## **Standardizing Remedies**

In June 1991 the EPA Administrator charged the Office of Solid Waste and Emergency (OSWER) with determining EPA's options for expediting Superfund cleanups. In response, OSWER's Superfund Task Force report recommended that EPA standardize remedy planning and selection as one way to accelerate its cleanups. Standardization was proposed in two areas: (1) the identification of standard remedies for common site categories and (2) the development of soil cleanup standards to speed remedy selection. EPA estimates such an effort could take 3 to 6 years to complete.

An automated cleanup remedy data base, similar to the one we developed (see app. D), would provide EPA with much of the data necessary to analyze RODs and the remedies selected at sites to produce a sound basis for establishing standards in its remedy planning and selection process. For example, the data base could draw on the hundreds of site studies and RODs that EPA has already approved to show the pattern of cleanup goals and remedies EPA has typically selected for particular contaminants and site types.

## **Data From Existing Systems Are Not Integrated and Readily Available**

EPA has a number of information systems containing some portion of data describing the cleanup of hazardous waste sites, but these systems cannot be integrated or analyzed by computer. Because EPA has never sought to monitor cleanups using a management information system, no one system contains information amenable to computer analysis of site cleanup remedies. For example, EPA's 1990 comparative analysis study gathered data manually from RODs and cannot be used to monitor ongoing remedy selection patterns because it has not been updated to include newer RODs. Consequently, to analyze whether differences existed in remedies between EPA- and PRP-managed studies and cleanups at Superfund sites, we developed our own cleanup remedy data base using data from a number of EPA's existing information sources. (See app. I for a description of the data base development.)

In order for EPA management to analyze and monitor cleanup information, a cleanup data base must contain sufficient, reliable, and well-defined

information on technical aspects of cleanups. The data base must also be organized into discrete data elements about each cleanup that can be manipulated using statistical analysis techniques.

None of the three EPA cleanup information sources we reviewed met these data base criteria, and all were missing data elements crucial to monitoring and analyzing cleanups. (See table 4.1.) In 1989 EPA established a Records of Decision System (RODS) data base containing the text and an abstract of the signed Superfund Records of Decision. According to EPA, the function of RODS is to serve as an information base on similar site conditions and to promote national consistency among Records of Decision. EPA also monitors work and events at hazardous waste sites using the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS). CERCLIS is a national inventory of information that serves as the central source of data on cleanup and enforcement action at hazardous waste sites. EPA's Annotated Technical Reference for Hazardous Waste Sites is a multivolume manual of printed summary data taken primarily from RODS written since the passage of SARA and classified according to 17 common site types. According to EPA, the reference was developed for remedial project managers to acquaint them with the basic technical background of each site type and with the decisions that have been made regarding similar sites.



**Table 4.1: EPA's Data Sources on Cleanup Remedies and Problems Associated With Using Them**

Data source	Data source description	Available in electronic format?	Data can be manipulated by computer?	Contains cleanup data?	Data fields with established definitions?	Data generally reliable?
RODS	RODS contains ROD texts and abstracts. It is meant to provide an information source for cleanups at similar sites. While RODS is available through a computer network, it is in narrative format and does not contain comparable discrete information for each ROD.	Yes	No	Yes	No	Yes
CERCLIS	CERCLIS monitors activities at each NPL site. Along with other data, it tracks the dates of specific cleanup actions and who performed them. The data base does not contain technical cleanup information.	Yes	Yes	No	Yes	? <sup>a</sup>
ATR <sup>b</sup>	The Annotated Technical Reference is a manual of ROD summary data. While it contains many relevant data elements, it is not computer accessible.	No	No	Yes	Yes	? <sup>a</sup>

<sup>a</sup>We did not specifically evaluate the reliability of CERCLIS or the Annotated Technical Reference. However, EPA's Office of Inspector General has identified accuracy weaknesses in the CERCLIS data base. We also identified errors in the Annotated Technical Reference.

<sup>b</sup>ATR=Annotated Technical Reference of Hazardous Waste Sites.

## Key ROD Information Is Not Available in Reliable or Standard Format

Important ROD information needed for a useful cleanup remedy data base for comparative analysis is often not reliable or available in a standardized format. During the development of our data base, we found that the estimates of remedy costs contained in the RODS often used inconsistent estimation methods, lacked supporting data, and were made under differing EPA policies. Also, estimates of the volume of site wastes were sometimes missing, and when included, were based on very general assumptions. Without such key ROD information, important ROD analyses cannot be performed, thereby limiting the information available to EPA for managing remedy selection.

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## Estimated Remedy Costs Are Not Consistent

Although EPA guidance for developing RODs includes estimated cleanup costs—in the form of capital, operations and maintenance, and present value costs<sup>2</sup>—as essential ROD components, such costs are not always calculated and presented in consistent, comparable formats in the RODs. For example, some cost estimates are presented only in terms of present value of total costs, while others are in terms of capital and operations and maintenance cost. Still others are not labeled as to the type of cost they represent. Also, the RODs and feasibility studies sometimes omit the supporting analyses necessary to validate the cost estimates. Furthermore, the cost of older RODs cannot be compared with that of newer RODs because in October 1988 EPA changed the discount rate<sup>3</sup> policy used in its present-value analysis for estimating the selected remedy's costs. When RODs lack consistent, comparable remedy cost estimates, important analyses like cleanup cost totals and comparisons, and evaluations of cost-effectiveness cannot be completed.

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## Reliable Data on Estimated Waste Volumes Is Lacking

EPA's Office of Emergency and Remedial Response conducted a study of 1988 and 1989 RODs to determine which hazardous waste site factors were most highly correlated with the selection of specific remedies. The study concluded that four key factors—type of contamination, volume of contaminated materials, concentration of inorganic and organic contamination, and the media affected—showed a high correlation with the type of remedy selected. However, RODs and their summary abstracts often do not contain estimates of the volume of hazardous waste materials located at the sites, despite EPA's ROD development guidance listing such estimates as an essential ROD component.

Estimating waste volumes is no easy task considering the potentially different types of wastes on site, the numerous types of containers, and the various media affected. For the Office of Emergency and Remedial Response study, EPA used the area of the site or remedy coverage times a depth of 10 feet (an estimated average depth of contamination EPA observed at sites). Although only used for estimating surface contamination, such a generalization may not be the best method for estimating a factor as important as waste volume in selecting cleanup remedies.

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<sup>2</sup>Capital costs refer to the estimated cost of constructing the cleanup. Operations and maintenance costs are those incurred to operate the ongoing cleanup technology. Present value refers to the estimated value in current dollars of all future costs.

<sup>3</sup>The discount rate is the interest rate that is used to determine the current value of money that will be earned or spent in the future.

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## **Conclusions**

Much of the information needed for analyzing site cleanup remedies is available in existing EPA information systems and in various formats throughout the agency. The data, however, are not readily accessible nor suitable for computer analysis and are not always accurate or complete. The effort and time to locate, gather, and prepare information for analysis from its current systems might require EPA to use contractors, special studies, or task forces as it did for the comparative analysis study discussed earlier in this report. Months and possibly years could pass before EPA could reap the benefits from the wealth of cleanup remedy information available in its current systems.

We believe that given the importance of remedy selection to the Superfund cleanup effort, EPA needs a cleanup remedy data base that will provide its managers with quick access to information needed for ensuring that cleanup remedies consistently protect human health and the environment in the most complete and economical manner, including the identification and analyses of any EPA and PRP remedy differences. Also, with a number of initiatives underway to speed Superfund cleanups, EPA needs the benefits of fast, accessible remedy data to quickly complete and implement its proposed projects, including the standardization of remedies and the remedial process.

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## **Recommendation to the Administrator, EPA**

Because of the importance cleanup remedy selection has to the Superfund program in protecting human health and the environment, we recommend that the Administrator, EPA, establish a cleanup remedy data base incorporating the key elements in the agency's Records of Decision to allow EPA management to quickly and thoroughly analyze EPA's remedy selection process and to assist the agency in its development and implementation of the standardization of remedies to speed cleanups.

# Development of GAO'S Remedies Data Base

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We created a data base to summarize the remedies used at Superfund sites in a computer-accessible and manipulable format. Existing EPA data bases do not have sufficient information to perform the types of analyses we performed for this review. (See ch. 4.) Other EPA data sources do not have cleanup information available in a computerized form.

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## Methodology

In order to determine trends and summary information on Superfund remedies, we included the following types of information in its remedies data base:

- site location,
- date of ROD signature,
- type of site,
- major contaminant, and
- specific technology selected to treat site waste.

We also included information on whether

- action to control waste was previously taken at the site,
- the ROD was final or interim,
- the ROD addressed controlling the contamination source and/or treating groundwater,
- the ROD elected to treat and/or contain site waste, and
- PRPS or EPA conducted the site study and cleanup.

In order to identify the best EPA source for each of these pieces of information, we interviewed EPA staff and reviewed agency documents. EPA's manual, Annotated Technical Reference of Hazardous Waste Sites, provided basic information about each ROD, such as its location, date of approval, whether it was interim or final, and major site contaminants. The ROD Abstracts are summaries that describe the actual remedy used to clean up site wastes and any previous site action. The Superfund Comprehensive Accomplishments Plan-2 report, drawn from the CERCLIS data base, documented whether EPA or PRPS conducted site studies and cleanup. We also used information from EPA's Technology Innovation Office to classify specific cleanup remedies, and other EPA guidance to classify specific contaminants into hazardous waste categories.

We coded information for our data base for each ROD approved during fiscal years 1987-90. We included all 532 RODs, including final- or

**Appendix I**  
**Development of GAO'S Remedies Data Base**

interim-source-control, groundwater, and "no action" RODs<sup>1</sup> in the remedies data base.<sup>2</sup> (See table I.1.)

**Table I.1: Number and Type of RODs in GAO's Remedies Data Base**

<b>ROD type</b>	<b>Number of RODs</b>
Source control	374
Groundwater	103
No action	40
Other <sup>a</sup>	15
<b>Total</b>	<b>532</b>

<sup>a</sup>These RODs do not address the contaminants but instead provide an alternate water supply to affected residents or impose land use controls.

Source: GAO's analysis of EPA data.

In order to ensure that information in the remedies data base correctly reflected the content of the RODs, we used several quality assurance procedures. We limited the number of staff entering data, trained staff in interpreting the data sources, and developed rules for entering specific ROD information. In addition, each of the 532 RODs was entered in the data base twice by different staff members. We identified discrepancies between the two sets of entries and corrected the information to resolve the coding differences and data entry errors as a quality control measure.

EPA expressed keen interest in our cleanup remedies data base and requested that it be made available for EPA's use in establishing a baseline for developing its own ongoing data base of remedies. After receiving permission from the Chairman, we will provide EPA with a copy of our data base.

<sup>1</sup>Final RODs represent the final action to clean up a site or a discrete portion of a site, whereas interim RODs record a temporary action, such as waste storage. Source-control RODs record remedial actions chosen to control a source of contamination, such as soil or barrels of waste. Groundwater RODs record EPA's chosen remedy for cleaning up groundwater contamination. "No action" RODs record EPA's decision that the site needs no additional cleanup.

<sup>2</sup>In some cases, EPA approved one ROD to clean up several adjacent sites and recorded these RODs as multiple RODs according to the number of sites they covered. We also entered these in the remedies data base as multiple RODs. Treating these multiple-site RODs as single RODs would reduce the number of remedies in the data base to 527.

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