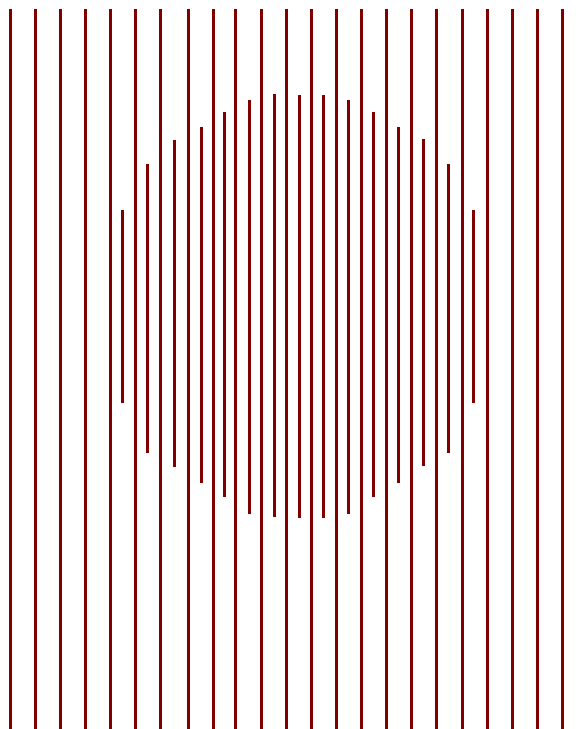


CBO PAPERS

**CLEANING UP
DEFENSE INSTALLATIONS:
ISSUES AND OPTIONS**

January 1995



CONGRESSIONAL BUDGET OFFICE

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**CONGRESSIONAL BUDGET OFFICE
SECOND AND D STREETS, S.W.
WASHINGTON, D.C. 20515**

NOTE

Unless otherwise noted, all dollar amounts are in 1995 dollars, and all years are fiscal years.

PREFACE

The Department of Defense (DoD) has devoted more than 10 years and \$11 billion to identifying, studying, and cleaning up contamination on thousands of military installations across the nation. During the past decade, the Congress has provided funding for DoD's environmental cleanup program that DoD considers sufficient to meet existing legislative and regulatory requirements. Given the rising costs of cleanup and budget increases in recent years, the department will probably need additional funds beyond those in the current budget plan to continue to meet the program's objectives. If the Congress chooses not to provide funding to meet existing requirements, legislative and regulatory relief may be required to enable the department to proceed with the cleanup program in accordance with cost-effective priorities that protect the health and safety of the population. Meanwhile, the department and the Congress could consider policy alternatives on which to base such priorities.

This Congressional Budget Office (CBO) paper describes the progress of DoD's cleanup program, examines its cost and budget history, and discusses current issues affecting the potential for successful implementation of future remediation efforts. It also discusses various steps that DoD and the Congress could take to control costs in the near and long term. The paper was requested by the Chairman and the Ranking Minority Member of the Senate Committee on Armed Services.

Wayne Glass prepared this paper under the direction of Neil M. Singer; Frances Lussier and Shaun Black provided important assistance. The author appreciates the thoughtful critiques and suggestions of Perry Beider, John Klotz, Bob Oswald, and Vic Weiszek. Many individuals at the Department of Defense, the Army Corps of Engineers, and the General Accounting Office provided helpful information, and their cooperation is gratefully acknowledged. The information, discussion, and analysis contained in the paper, however, remain the responsibility of the author and CBO.

Sherry Snyder edited the paper, and Chris Spoor provided editorial assistance. Cynthia Cleveland and Judith Cromwell prepared it for publication.

Robert D. Reischauer
Director

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SUMMARY

Environmental contamination of thousands of military facilities is a costly legacy of the Cold War for which the nation is paying increasing costs. The Department of Defense (DoD) has spent about \$11 billion on investigating, studying, and cleaning up contamination on military bases since 1984 and recently estimated that finishing the job could cost as much as \$30 billion. In 1995, the Congress authorized the department to spend about \$2.5 billion on environmental cleanup projects. According to current plans, the department expects to request another \$2.6 billion in 1996.

The current Administration has undertaken an ambitious, comprehensive plan to clean up defense installations in accordance with federal and state laws and regulations within the constraints of increasingly tight defense budgets. To date, the Congress has been able to authorize sufficient funding to meet DoD's requirements. Given the increasing costs of remediation, however, DoD may not be able to meet the requirements of its cleanup program on schedule and within budgetary projections. The Department of Defense and the Congress could consider alternative approaches to the cleanup program to ensure that the department's most important cleanup requirements are met within increasingly constrained budgetary allowances. This paper outlines the scope and nature of the cleanup tasks that DoD faces and assesses the department's progress and problems in implementing effective remediation actions. The study also discusses near- and long-term strategies for meeting cleanup goals, should the current plan prove unachievable.

SCOPE OF THE CLEANUP PROBLEM

The Department of Defense faces a massive environmental cleanup problem extending to some 27,700 potentially contaminated sites located on more than 9,700 military installations and former defense properties in all 50 states. Most of the contaminated sites are in states such as California, Texas, Alaska, Pennsylvania, and Virginia in which numerous defense facilities are located. The department has determined that many of those sites pose no hazard to public health and safety and require no further cleanup action. As a result, the number of active sites--those being studied and remediated--totaled about 13,200 as of March 1994. After years of study, DoD believes that it has identified virtually all potentially contaminated sites on its property. The

number of such sites, including the most seriously polluted--those that are on the National Priorities List (NPL)--continues to grow each year. DoD manages cleanup efforts at 107 bases that are on or proposed for inclusion on the NPL; those bases are located in 39 states.

The department's cleanup tasks are, for the most part, similar to those found in the civilian sector. With few exceptions such as buried ordnance and mixed waste containing radioactive materials, DoD requires no unique remediation technology to meet its needs. Common contaminants on military bases include petroleum, oil, and lubricants needed to operate and maintain equipment, as well as solvents, heavy metals, paint, acid, asbestos, and pesticides. The types of contaminated sites located on defense properties are also similar to those in the civilian sector. Storage areas, underground storage tanks, landfills, contaminated buildings, and polluted lagoons are characteristic problems for both military and civilian authorities. Consequently, investments by DoD in research and development of new technologies for locating, characterizing, and remediating contamination could have widespread dual-use applications.

The focus of DoD's environmental program during the past 20 years has been on locating and studying the characteristics of contaminated sites. Virtually all of the preliminary work is complete. As of the end of fiscal year 1993, DoD reported that it had finished about 96 percent of its initial assessments. About half of the active sites are now in the middle phase of the cleanup process--the remedial investigation/feasibility study phase--during which the sites are tested and sampled and initial plans for remediation are formulated. Only about 20 percent of DoD's active cleanup sites have completed that phase, however, making it unlikely that the department will achieve its goal of completing all studies by 1996.

Although the department has completed more than a thousand interim cleanup measures needed to protect human health and safety, almost all of the actual cleanup work for all sites, including NPL sites, has yet to be done. As of the end of fiscal year 1993, about 5 percent of all active sites and about 3 percent of the NPL sites had been cleaned up. Actual completion rates could be lower, however, since by the definition of the Environmental Protection Agency (EPA), a site has been "cleaned up" once contamination has been remediated or technology has been put in place and is operational, even though cleanup standards have not yet been achieved.

COST OF THE CLEANUP

Defense spending for environmental cleanup has increased dramatically during the past decade and could necessitate additional increases if current legal and regulatory requirements are to be met. In 1984, DoD spent about \$200 million for environmental cleanup; today's budget is about \$2.5 billion. On average, spending for cleanup has increased 23 percent each year during the past decade while budgets for research, development, and procurement of military weapons have decreased by about 7 percent each year. According to current plans, DoD projects significant reductions in spending for environmental cleanup during the next few years, when many projects will begin the transition from study and analysis to remediation. Until last year, most of the cleanup budget was allocated for studies; cleanup costs first exceeded 50 percent in 1994 when relatively few sites were actually in the final phase of cleanup. Competition for funding among various environmental programs is likely to become increasingly intense during the next several years, requiring trade-offs between meeting near-term cleanup requirements and long-term investments in more efficient cleanup methods.

Changes in DoD's cost estimates and budget plans continue to reveal the high degree of uncertainty that characterizes the cleanup program. In 1985 DoD estimated that completing the cleanup program would cost between \$6.9 billion and \$13.7 billion (1995 dollars). DoD recently estimated that the program could cost about \$30 billion. Annual budget requests have also risen. In 1989, the department estimated that it would need between \$900 million and \$1.2 billion to fund cleanup requirements in 1994; the Congress authorized about twice the higher estimate. Similar trends in cost growth have occurred at individual military bases. The Inspector General of DoD found that average cleanup costs for defense facilities scheduled to be closed were about 60 percent higher than initial estimates.

Although DoD now knows much more about the cleanup job it must do, much uncertainty remains about future costs. For example, each year the department identifies new contaminants on existing sites as well as additional polluted sites. Furthermore, most sites are still in the study phase, and plans to remediate them have yet to be decided, thereby adding to the uncertainty of cost estimates. The time needed to complete studies, analyses, and remediation also remains highly uncertain. Recent court rulings could also drive up costs by leading to stricter cleanup standards than those DoD planned to meet.

ALTERNATIVE STRATEGIES FOR MEETING DoD's CLEANUP GOALS

Given the dramatic growth in spending for environmental cleanup, the limited progress made to date, and the probability that if current cost trends continue, the department will be unable to afford to meet requirements within current budget plans, the Congress and DoD may want to consider various ways to meet the concurrent goals of efficiency and cleanup requirements. In doing so, both near-term and long-term strategies could be useful.

An important first step in meeting near-term needs could be to establish priorities for cleanup and then to rank all contaminated sites on defense installations and former defense properties. Future funding for cleanup could vary from year to year, but high-priority cleanup projects would be assured stable funding. Such guidance could maintain the present policy to remediate first the most seriously contaminated sites that are dangerous to human health and safety. Within that category, however, lower priority would be appropriate for those sites that, although located on NPL installations and technically considered as part of an NPL site, do not present immediate threats to health or the environment. In order to assist in establishing priorities among such sites and other sites that are not on the NPL, the Congress could consider requiring the department to improve its methods of determining the relative hazards posed at each site.

In setting priorities, DoD could also consider which sites at closing military bases would warrant the most immediate attention. DoD could give priority to sites that could be sold and generate revenues to finance other defense cleanup activities and to sites that are likely to generate significant commercial activity to aid in local economic recovery. Indeed, the department could rank the sites based in part on some measure of the relative impact of cleanup activities on the local economy. Under that approach DoD could give priority to cleaning up bases in small communities whose economies have depended heavily on nearby military installations, or to larger communities affected by numerous base closings that, individually, might not be considered to have a significant local economic impact.

The department could also achieve near-term savings by delaying its most difficult and costly remediation projects that do not pose an immediate danger to public health and safety. Cleaning up buried ordnance and groundwater are among the most expensive and difficult remediation tasks. DoD could reduce near-term spending by billions of dollars by delaying remediation for sites contaminated with such materials. The department

would have to determine at which sites cleanup could safely be delayed before postponing cleanup activities.

A similar approach could apply to remediating groundwater sites. Potential near-term savings from delaying groundwater cleanup could total hundreds of millions of dollars. Such delays, however, could in some cases require renegotiating existing interagency agreements between DoD, the Environmental Protection Agency, and the states.

The department could achieve long-term savings by developing more efficient technologies while delaying the most difficult and expensive types of cleanups and perhaps other types of remediation. Data from laboratory and field tests indicate that emerging technologies could achieve significant savings in cleaning up a wide variety of contaminants. Although DoD has increased its spending on research and development (R&D) of new cleanup technologies, in 1994 it allocated about 6 percent of its environmental budget for that purpose. According to DoD's strategic plan for research and development, many R&D projects remain unfunded. Additional R&D funding could help to reduce long-term costs, but it should be examined for redundancy with other R&D projects funded either by the Department of Energy or EPA.

A new approach to setting cleanup standards could also contribute to achieving long-term savings. Current legislation and regulations favor the stricter cleanup standards when agencies disagree over appropriate cleanup goals. They also favor using permanent measures of remediation, which, when combined with stricter standards rather than the reasonably anticipated use of a property, could support unlimited future use. The Congress could consider legislation that approved using more flexible standards or, alternatively, that adopted less restrictive standards on a generic basis for various types of contaminants. The latter would create uniform cleanup standards for all federal EPA regions and could preempt disagreements that now occur as a result of differing standards required by the Resource Conservation and Recovery Act and the Comprehensive Environmental Response, Compensation, and Liability Act.

CHAPTER I

INTRODUCTION

The Cold War era focused U.S. defense efforts on building, training, equipping, and operating a military force to deter the Soviet Union and Warsaw Pact from initiating a military conflict. The history of the arms competition between East and West is well known, but awareness of the hidden costs of the Cold War has evolved only slowly. It is increasingly clear that the environmental contamination of the Department of Defense's (DoD's) military installations, which affected thousands of bases and communities throughout the nation, is a costly legacy of the Cold War era. Cleaning up that legacy has become a national priority.

The current Administration has committed itself to pursuing environmentally conscious defense programs and policies and has undertaken an ambitious, comprehensive plan to clean up the nation's military installations. However, it faces serious difficulties in achieving DoD's cleanup goals within existing schedule and budget constraints. DoD will probably not be able to meet the objectives of its cleanup program on schedule and within budgetary plans. The department and the Congress have therefore begun considering alternative approaches for overcoming various cost and schedule constraints.

DoD initiated a major environmental cleanup program in 1975 when it established the Installation Restoration Program to study and clean up contaminated sites located on defense installations. Later, DoD integrated that program into a more comprehensive one, the Defense Environmental Restoration Program (DERP).¹ The Congress authorized DERP in 1984 and at the same time established the Defense Environmental Restoration Account (DERA) to ensure visibility for the program and to encourage sufficient funding for environmental cleanup of defense facilities.

Funding for DERA has grown from about \$200 million in 1984 to over \$2 billion in 1995. Total funding for cleanup in 1995 is about \$2.5 billion, including DoD's request for funds to clean up bases affected by recommendations of the Defense Base Closure and Realignment Commission. Although the department's plans call for a reduction in funding over the next

1. The Defense Environmental Restoration Program includes the following programs: Hazardous Waste Disposal, Building Demolition/Debris Removal, Other Hazardous Waste, and the Installation Restoration Program. Funding for those programs is allocated to the Defense Environmental Restoration Account.

few years, budget requests could continue to grow if DoD is to meet the current cleanup plans and requirements.

Cleanup costs are likely to grow for several reasons. First, much remains unknown about the nature and scope of work to be done. Although DoD has made considerable progress in identifying and characterizing contaminated sites nationwide, it continues to discover new sites each year and to find out that some sites are more contaminated than originally thought. Even now, about 20 years after DoD established a cleanup program, the department is still primarily involved in locating and characterizing hazardous materials at its facilities. Actual cleanup activities are under way at very few sites; permanent remedial actions, for example, are under way at only 333 of some 10,400 of DoD's most hazardous sites.

Cleanup standards also have an effect on the ultimate cost of remediation; stricter standards than those preferred by DoD can increase costs considerably beyond original estimates and have done so in the case of cleaning up groundwater at Mather and George Air Force bases in California. National standards do not exist for the most common contaminants; therefore, DoD must negotiate cleanup standards for its most contaminated sites with the Environmental Protection Agency (EPA) and the affected state. Negotiated standards could be stricter--and more expensive--than those underlying DoD's initial cost estimates. Under current legislation, if standards set by the state exceed those of EPA or DoD, the state standards must be met. In fact, disagreements over standards have occurred, and the courts have ruled in favor of state-sponsored standards that could result in higher costs than anticipated for cleaning up defense facilities such as the Rocky Mountain Arsenal.²

Uncertainty in estimating costs has also contributed to unanticipated cost growth for cleanup and is likely to continue to do so. DoD's initial cost estimates for the cleanup program were not supported by extensive research or analysis and have proved overly optimistic. In 1985, for example, DoD estimated that cleaning up all hazardous waste sites would cost between \$7.0 billion and \$13.7 billion.³ Recently, DoD officials estimated that completing the program could cost about \$30 billion.⁴ Of course, the Defense

2. General Accounting Office, *Environmental Cleanup: Too Many High Priority Sites Impede DoD's Program*, GAO/NSIAD-94-133 (April 1994), pp. 23-24.

3. General Accounting Office, *Hazardous Waste: DoD Estimates for Cleaning Up Contaminated Sites Improved but Still Constrained*, GAO/NSLAD-92-37 (October 1991), p. 3.

4. General Accounting Office, *Environmental Cleanup*, p. 6.

Department knows considerably more about the nature and scope of the cleanup work to be done than it did 10 years ago, but significant uncertainty exists even for more recent estimates. The General Accounting Office observed that DoD estimates were prepared using a "top-down" approach based on historical costs for various phases of the cleanup process, not on the estimated cost for individual sites.⁵

Cleanup costs have also increased beyond initial estimates because early plans for cleanup did not fully consider the costs of remediating hundreds of bases that are to be closed. In its first round of recommendations in 1988, the Defense Base Closure and Realignment Commission did not require precise cost estimates for cleaning up bases, because the government was liable for cleanup costs under any circumstances and such costs would not have affected the long-term savings to be gained by closing a facility. DoD currently estimates that cleaning up the bases already directed to be closed will cost about \$4.3 billion through 1999. Next year, the department will decide to close additional bases, which could add significantly to the total cleanup cost.

Given the increasing costs of the cleanup program and the legislative and budgetary constraints that govern its future, the time is right to consider various approaches to ensuring the future affordability of cleaning up the nation's defense facilities. This paper seeks to assist the Congress by reviewing DoD's progress in cleaning up its facilities, highlighting the major issues that affect the efficiency and costliness of the cleanup program, and outlining various ways to reduce program costs.

5. General Accounting Office, *Federal Facilities: Agencies Slow to Define the Scope and Cost of Hazardous Waste Site Cleanups*, GAO/RCED-94-73 (April 1994), p. 23.

CHAPTER II

DoD's EXTENSIVE AND COMPLEX

CLEANUP TASKS

Environmental contamination is widespread among active and former military facilities and constitutes a formidable cleanup task for the Department of Defense. DoD estimates that it is responsible for about 27,700 contaminated sites that could require remediation. Those sites are dispersed among thousands of bases to be cleaned up through DoD's Installation Restoration Program and on formerly used defense sites (FUDS) located nationwide. As more research is done, the size of the potential cleanup task continues to increase significantly each year.

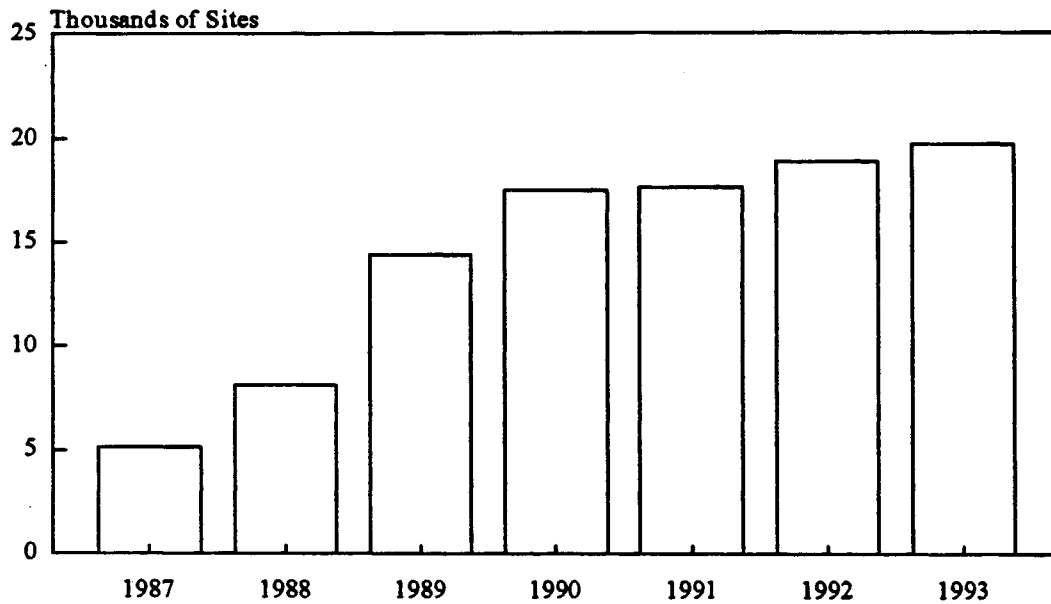
ESTIMATES OF POTENTIALLY CONTAMINATED SITES

The number of potentially contaminated sites identified by DoD on active military installations has increased dramatically--almost 25-fold--during the past decade. Most of the increase occurred during the late 1980s when DoD began a comprehensive program to locate and investigate potentially contaminated sites. For example, in 1985, DoD estimated that some 400 to 800 sites would require remediation.¹ Two years later, the department reported over 5,000 sites.² In the following year, it reported over 12,000 sites.³ In recent years, the rate of increase has begun to slow, however; according to DoD, the total number of sites included in the Installation Restoration Program had increased by only about 5 percent during fiscal years 1992 and 1993, from 18,795 sites to 19,694 (see Figure 1).

The number of the most seriously contaminated areas identified by DoD--those listed on the National Priorities List (NPL)--has also increased dramatically. (NPL sites are those that score above 28.5 according to the Hazard Ranking System, an evaluation system used by the Environmental Protection Agency to measure the toxicity of contaminants; their mobility through air, water, and soil; and the potential danger they pose to the health

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1. General Accounting Office, *Hazardous Waste: DoD Estimates for Cleaning Up Contaminated Sites Improved but Still Constrained*, GAO/NSIAD-92-37 (October 1991), p. 3.
 2. Department of Defense, Defense Environmental Restoration Program, *Annual Report to Congress for Fiscal Year 1987* (March 1988), p. 6.
 3. General Accounting Office, *Hazardous Waste*, p. 3.

FIGURE 1. NUMBER OF POTENTIALLY CONTAMINATED SITES IN DoD's INSTALLATION RESTORATION PROGRAM, 1987-1993



SOURCE: Congressional Budget Office using data from the Department of Defense, Defense Environmental Restoration Program, *Annual Report to Congress*, Fiscal Years 1987-1994.

of the local population.) Between 1987 and 1992, that number rose from 44 to 101, an increase of almost 130 percent. That rate has since slowed--to about 6 percent during the 1992-1993 period, at the end of which DoD had 107 listings on the NPL (see Figure 2).⁴

DoD has also identified an increasing number of potentially contaminated sites on former military properties that the department remains responsible for remediating. The increase in the number of formerly used defense sites, however, has been less dramatic than that of other categories of sites. At the end of 1993, DoD reported about 8,000 contaminated FUDS, up from about 7,200 in 1987--an increase of about 11 percent.

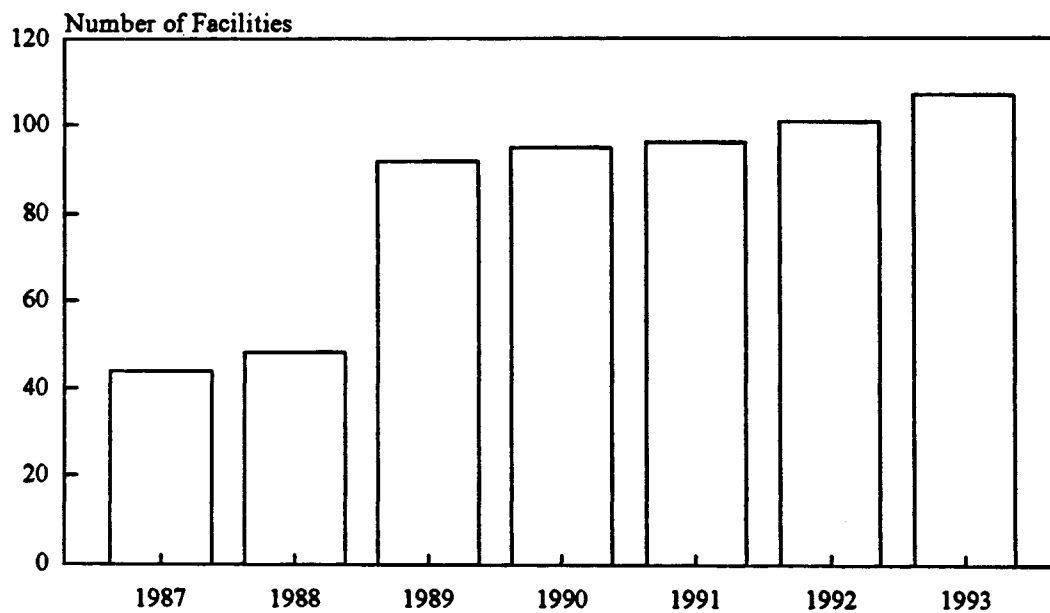
DoD's cleanup task, though massive by any standard, might prove to be less formidable than the preceding numbers suggest. Of the 19,694 potentially contaminated sites that DoD has identified on active military facilities, the department has completed cleanup actions at 570 sites and determined that no further action is necessary at more than 8,600 sites. That means that 10,439 sites, or slightly more than 50 percent of the total number of potentially contaminated sites on operational military installations, will require further work. DoD also estimates that 2,815 active FUDS at which cleanup actions have been ongoing require further remediation. As a result, a total of approximately 13,250 sites--by DoD's count--will require additional cleanup work.

The number of sites actually requiring remediation could be higher than DoD's estimate, however, since the department's finding that no further cleanup action at a site is necessary may be challenged by the Environmental Protection Agency, the states' regulatory authorities, or both. If those organizations disagree with DoD's determination, the department could be required to proceed with remediation activities that it had previously concluded were unnecessary.

Contaminated sites are located at 1,722 installations in all 50 states. Not surprisingly, the states most affected are those in which defense plays a significant role. California has more than 2,500 contaminated sites on some 150 installations and leads the nation with 19 NPL sites. Texas has almost 1,100 sites and Alaska nearly 900 sites. More than 700 sites each are located in Pennsylvania, Virginia, New York, and Florida (see Table 1).

4. A listing on the NPL generally corresponds with an installation. Many individual contaminated sites, however, may exist on an installation that is listed. According to DoD, about 5,500 contaminated sites are located on installations listed on the NPL.

FIGURE 2. DEPARTMENT OF DEFENSE FACILITIES ON THE NATIONAL PRIORITIES LIST, 1987-1993



SOURCE: Congressional Budget Office using data from the Department of Defense, Defense Environmental Restoration Program, *Annual Report to Congress*, Fiscal Years 1987-1994.

TYPES OF CONTAMINANTS AND SITES REQUIRING CLEANUP

With the exception of ordnance and explosive chemicals, the contaminants at DoD facilities are similar to those found on civilian property. The most common contaminants--the petroleum, oil, and lubricants used to operate and maintain military equipment--have been identified at more than 5,300 DoD sites. Solvents, heavy metals, and paint have been found at thousands of sites. Other common hazardous materials such as acid, asbestos, and pesticides are also found on military bases. The 10 most common types of contaminants found at DoD sites are listed in Table 2.

The types of contaminated sites found on defense facilities are also similar to those found in the civilian sector. DoD reports more than 3,000 contaminated storage areas, about 2,700 underground storage tanks, and more than 2,000 landfills (see Table 3). Thousands of spill areas, surface and subsurface disposal areas, and contaminated buildings must also be cleaned up. Hundreds of polluted lagoons, waste treatment plants, and burn areas dot DoD's landscape. Training areas for fire fighting and aircraft accidents, which require extensive remediation efforts, are also common to military facilities. Most of the contaminants at those sites can be cleaned up using the same technologies that are used in the civilian sector.

TABLE 1. STATES WITH THE LARGEST NUMBER OF CONTAMINATED DEFENSE SITES

State	Sites Under the Installation Restoration Program	Formerly Used Defense Sites	Total
California	2,491	60	2,551
Texas	1,010	61	1,071
Alaska	700	196	896
Pennsylvania	817	39	856
Virginia	777	11	788
New York	686	43	729
Florida	681	28	709
Alabama	645	21	666
Illinois	583	50	633
Maryland	567	19	586

SOURCE: Congressional Budget Office using data from the Department of Defense, Defense Environmental Cleanup Program, *Annual Report to Congress for Fiscal Year 1993* (March 31, 1994).

Contaminated sites of types rarely found in the civilian sector are less numerous but still constitute a major challenge for the DoD cleanup program and may require the development of new technologies for their remediation. DoD reports that unexploded ordnance and munitions, for example, exist on some 220 sites; explosive and ordnance disposal areas have been located at another 268 sites.

SPECIAL PROBLEMS POSED BY UNEXPLODED ORDNANCE AND CONTAMINATED GROUNDWATER

Cleaning up unexploded ordnance and chemical warfare materials is among the most difficult, dangerous, time-consuming, and expensive tasks DoD faces. The U.S. Army Corps of Engineers has identified almost 1,700 sites on which these hazardous materials have been reported.

Current technology to remediate buried ordnance is time consuming and costly. Most ordnance sites are surveyed by operators on foot using hand-held metal-detecting equipment. Bulldozers and specially protected heavy equipment are used to dig up buried ordnance and transport it to facilities where it will be de-armed or exploded. Some ordnance sites, such as the

**TABLE 2. MOST COMMON TYPES OF CONTAMINANTS
ON DEFENSE FACILITIES**

Type of Contaminant	Number of Sites
Petroleum, Oil, Lubricants	5,324
Solvents	1,857
Heavy Metals	1,344
Paint	1,017
Ordnance Components	620
Polychlorinated Biphenyls	606
Acid	555
Refuse Without Hazardous Waste	429
Explosive Chemicals	405
Pesticides	402

SOURCE: Congressional Budget Office using data from the Department of Defense.

former naval artillery practice range at Kahoolawe, Hawaii, are located in remote areas with extremely difficult terrain. Other sites are wooded and difficult to survey.

Experts have testified that buried ordnance sometimes migrates toward the surface over time, so that remediation may be effective only temporarily before an area must be cleaned again. Ordnance sites that have been remediated to a specified depth thus may require periodic monitoring to ensure that undetected ordnance, or ordnance buried below the level that was cleaned up, does not migrate to the surface and become a hazard.

Cleaning up buried ordnance is also among the more expensive remediation tasks the department must perform. DoD recently estimated that, using current technology, it costs about \$65,000 per acre to survey and remediate a site with unexploded buried ordnance. The Army Corps of Engineers estimates that tens of thousands of acres will require remediation. Cleanup costs for buried ordnance and chemical warfare materials could total several billion dollars.

TABLE 3. MOST COMMON TYPES OF CONTAMINATED SITES ON DEFENSE FACILITIES

Type of Site	Number of Sites	Number of Active Sites ^a
Storage Areas	3,479	994
Underground Storage Tanks	2,689	1,485
Landfill	2,016	1,402
Spill Areas	1,904	1,273
Surface Disposal Areas	1,475	874
Disposal Pit/Dry Well	849	640
Contaminated Building	709	309
Oil/Water Separator	573	149
Surface Impoundment/Lagoon	557	430
Fire/Crash Training Area	532	401

SOURCE: Congressional Budget Office using data from Department of Defense, Defense Environmental Cleanup Program, *Annual Report to Congress for Fiscal Year 1993* (March 31, 1994), p. 40.

- a. Sites at which study, design, or cleanup actions are under way or those awaiting a decision that cleanup work is complete.
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Remediation of groundwater remains one of the department's most vexing problems. Groundwater at many DoD facilities is contaminated by trichloroethene, a hazardous material found in solvents used for cleaning equipment. Although the time and money required to remediate groundwater vary greatly according to the cleanup standard that is set, current cleanup technology is slow and costly. Determining the location and extent of contamination requires expensive wells for sampling and monitoring the pollutants. Current systems that pump water from the ground and treat it with scrubbing devices can take years, even decades, to achieve cleanup standards. Scientists believe that some groundwater cannot be permanently or entirely cleaned no matter how long it is treated.⁵

The potential total cost of remediating groundwater on defense facilities is unknown. Although DoD currently plans to remediate 113 sites, it is unable to estimate the total amount of groundwater that must be treated. But characterizing and cleaning groundwater are expensive tasks that could cost billions of dollars by the time the department has studied the sites, put remediation technology in place, and cleaned up groundwater to standards.⁶

DoD has also identified about 130 sites that could be expensive and difficult to remediate because they contain low-level radioactive waste or mixed waste. Since such wastes can be hazardous to human health and safety, they require special handling and treatment. The Department of Energy estimates that the cost of cleaning up radioactive waste buried in trenches using current technology ranges from \$14,000 to \$26,000 per cubic meter.⁷

HOW MUCH REMAINS TO BE DONE?

Although DoD has made considerable progress in identifying its environmental problems since the cleanup program began almost 20 years ago, much work remains to be done in both characterizing and cleaning up contaminated defense facilities. DoD has devoted most of its efforts during the past two decades to locating and studying the characteristics of contaminated sites. Having essentially completed the initial investigatory

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5. "Some Water Cleanups Not Feasible, Study Says," *Washington Post*, June 24, 1994, p. A3.
 6. In 1991, the Department of Defense estimated that, on average, it cost \$6.2 million to remediate a site with contaminated groundwater and about \$0.9 million to operate and maintain the cleanup operation each year. If DoD completed cleanup of a site in 20 years, the average cost of such remediation could approach \$25 million.
 7. Congressional Budget Office, *Cleaning Up the Department of Energy's Nuclear Weapons Complex* (May 1994), p. 74.

phase at all its sites, it is devoting most of its current efforts to characterizing contaminated sites and developing technical plans and schedules for cleaning them up. Although DoD has completed more than a thousand interim cleanup measures to minimize environmental threats to health and safety, it has completed relatively few permanent cleanup actions. More and more sites are approaching the cleanup phase, however, and if goals and schedules are met, the cost of remediation will continue to rise.

Phases of the Cleanup Process

Cleanup activities are divided into three major phases: the preliminary assessment/site inspection (PA/SI) phase in which a site is located and initial sampling and analysis are done; the remedial investigation/feasibility study (RI/FS) phase in which further characterization analysis is completed and alternative methods of cleanup are examined; and the remedial design/remedial action (RD/RA) phase in which detailed cleanup plans are chosen and implemented.⁸

Preliminary Assessment/Site Inspection. During the preliminary assessment, defense employees review records and study installations to determine whether contamination exists that may pose a hazard to public health or the environment. Researchers collect information on the source, nature, and magnitude of hazardous substances believed to be released on the facility. As part of the assessment, personnel inspect the property, take samples, and analyze materials to determine whether a site is contaminated. If it is not, the department declares that no further cleanup action is required.

Remedial Investigation/Feasibility Study. This second phase of the cleanup process includes further sampling and analysis to determine the type, quantity, and location of contaminants. Researchers also measure and evaluate the health and safety risks that the contaminants could pose to residents of the facility and to the nearby population. Findings from sampling and analysis suggest possible methods of remediation that DoD considers as it completes a feasibility study.

Remedial Design/Remedial Action. Once the appropriate oversight authorities--including the Environmental Protection Agency, state regulators, and DoD--agree on how to clean up a contaminated site, DoD prepares detailed plans for implementing a remedial action. All cleanup actions that are taken, including in some cases installing equipment used for long-term

8. General Accounting Office, *Hazardous Waste*, p. 9.

cleanup operations, occur during the remedial action phase. Monitoring, maintenance, treatment, and operation of equipment may follow that phase for long-term remediation projects.

Modest Progress Made on Cleaning Up Active Installations and Bases That Are Closing

Overall, DoD has completed most of the work required for the first phase of the cleanup process for sites located on active military facilities and on bases that are being closed. As of the end of fiscal year 1993, DoD had completed about 96 percent of the preliminary assessments required for some 19,694 potentially contaminated sites. As a result of investigations during each phase and of completed cleanups, the department concluded that no further action would be necessary for 9,255 sites--almost 47 percent of the total.

In March 1994, the department reported that it had begun the second phase of the cleanup process at approximately 5,000 sites. However, only about 20 percent of DoD's active sites have completed the intermediate RI/FS phase. The department will probably not be able to achieve the goal it set in 1991 to finish all RI/FS activities by 1996.

The department has cleaned up only a small fraction--about 5 percent--of the contaminated sites needing remediation. Indeed, some of the 571 sites the department has "cleaned up" may not have yet met final cleanup standards. DoD considers a cleanup action complete when it has successfully remediated a hazardous waste problem or when cleanup technology and equipment are put into place and operating. A completed action could include instances, for example, in which technology is in place to remediate groundwater even though cleanup standards have not yet been met.

Evidence indicates, however, that completion rates may be accelerating. Between 1991 and 1992, DoD completed cleanup actions on 44 sites. In 1993, it completed cleanups at 155 sites--three and a half times as many as in the year before.

Progress on Cleaning Up NPL Sites and Formerly Used Defense Sites

DoD is still in the early stages of cleaning up its most highly contaminated sites--many of those located on the 107 military facilities listed on the National Priorities List. Of the 5,500 sites on NPL facilities, about 70 percent are in the PA/SI phase, and about 30 percent have completed that phase.

Relatively few sites have entered or completed the RI/FS phase. As of the end of fiscal year 1993, only 402 contaminated sites on bases on the NPL--about 7 percent of the total--had either started or completed the design phase. Slightly more than 300 sites--about 6 percent of the total--had entered the final (RD/RA) phase of the remediation process. DoD has completed cleanup of 157 sites on NPL facilities, only about 3 percent of the total.

Similarly, DoD has made only limited progress in cleaning up contamination at formerly used defense sites. Most of those sites are still being studied: remedial designs are complete for only about 10 percent, and cleanup work is complete at only about 6 percent. Those figures may not capture the full extent of the work to be done, however, since DoD has not yet determined whether cleanup of many FUDS is necessary and whether the department is liable for implementing cleanup actions. Last year, for example, DoD identified 660 new FUDS that the department could be responsible for remediating.

CHAPTER III

THE MOUNTING COSTS OF CLEANUP

Since 1984, the Department of Defense has spent about \$11 billion on the Defense Environmental Restoration Program and on cleaning up bases scheduled to be closed. Spending on the cleanup program has risen dramatically during the past decade. In 1984, DoD spent only \$200 million; by 1991, annual spending had increased to about \$1.5 billion. This year, the Congress authorized DoD to spend about \$2.5 billion for environmental restoration including funding for cleaning up bases scheduled to be closed.

Funding for environmental cleanup is one of the few areas in which defense spending has increased in recent years. On average, spending for environmental cleanup has risen about 23 percent a year since 1984. In comparison, defense spending on procurement and on research and development during the same period has decreased by an average of about 7 percent each year.

Most environmental spending to date has been allocated for identifying and studying potentially contaminated sites rather than for permanent cleanup. According to the General Accounting Office, DoD allocated about \$2.7 billion (1991 dollars) to the Defense Environmental Restoration Account between 1984 and 1990; almost \$2.3 billion of that amount was spent on environmental cleanup activities. Only about 20 percent (\$465 million) was spent for cleaning up contaminated sites; the remainder, presumably, was spent for studies.¹ Moreover, most of the spending for cleanup actions has probably financed interim remedial measures rather than permanent cleanup, since so few permanent cleanup actions have occurred.

As more studies are completed and remedial actions are undertaken, spending for environmental cleanup will shift from financing studies to conducting cleanup. Fiscal year 1994 marked the first time that DoD spent more for cleanup than for studies; over 52 percent of spending for DERA was allocated to cleanup activities. Based on DoD's budget request for 1995, the portion of spending for cleanup will increase to about 63 percent.² Figure 3

1. General Accounting Office, *Hazardous Waste: DoD Estimates for Cleaning Up Contaminated Sites Improved but Still Constrained*, GAO/NSIAD-92-37 (October 1991), p. 17.

2. Statement of Sherri W. Goodman, Deputy Under Secretary of Defense for Environmental Security, before the Subcommittee on Military Readiness and Defense Infrastructure of the Senate Committee on Armed Services, May 4, 1994.

highlights DoD's changing priorities for its cleanup budget for 1992 through 1995.

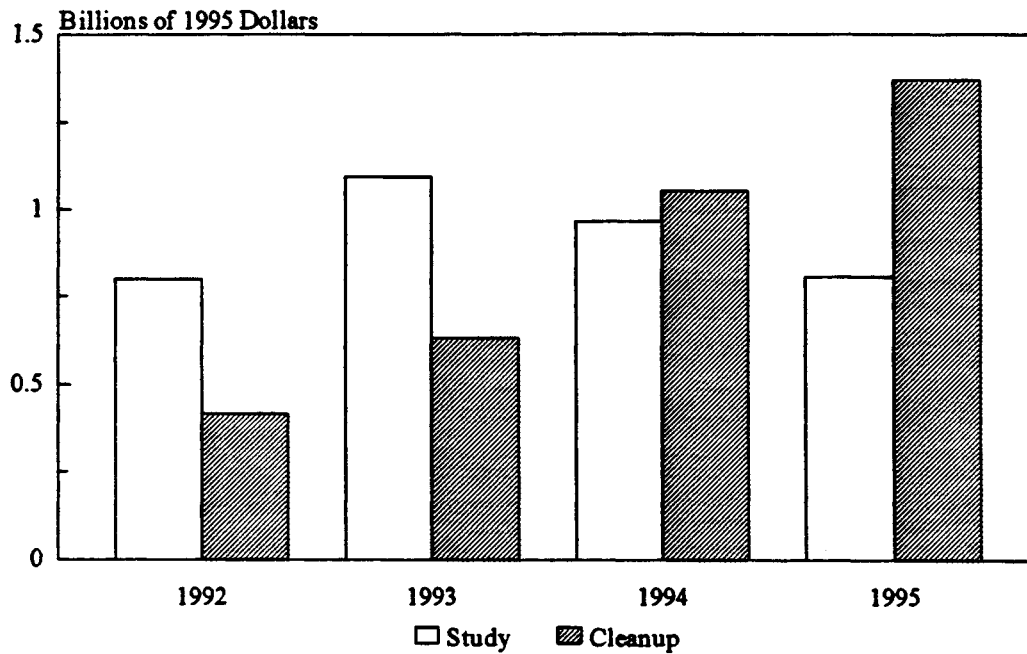
Since precise knowledge of the size and scope of remaining cleanup tasks is far from complete, estimating the total cost of cleaning up DoD's thousands of hazardous waste sites is difficult and subject to considerable uncertainty. The trend in DoD's cost estimates for the cleanup program, however, is quite clear: they have been rising steadily during the past decade. In 1985, the department estimated that it would cost between \$6.9 billion and \$13.7 billion to clean up the 400 to 800 sites that DoD had identified as requiring remediation. Several years later, the range of estimates for completing the cleanup program--then including some 12,342 potentially contaminated sites--had increased to between \$11 billion and \$16 billion. In November 1989, the Deputy Assistant Secretary of Defense for the Environment estimated that completing the cleanup of some 15,257 sites, including the Rocky Mountain Arsenal, would cost between \$14.3 billion and \$19.5 billion. In 1991, DoD's estimate increased to \$27.3 billion to study and remediate, as necessary, some 24,500 potentially contaminated sites.³ In May 1994, the Deputy Under Secretary of Defense for Environmental Security indicated that the department was preparing a new, comprehensive program estimate and suggested that the program could cost \$30 billion (see Figure 4).

Current estimates for annual cleanup costs are also dramatically higher than DoD estimated they would be just a few years ago. In 1989, for example, the department estimated that in 1994 it would need between \$900 million and \$1.2 billion to fund requirements under DERP; last year the Congress appropriated more than twice the higher estimate. DoD's current budget estimates for the 1990-1999 period, on average, are about twice what the department had projected it would need in 1989. If the current program experiences the same degree of budgetary growth over the next five years, cleanup costs could exceed \$20 billion during that period.

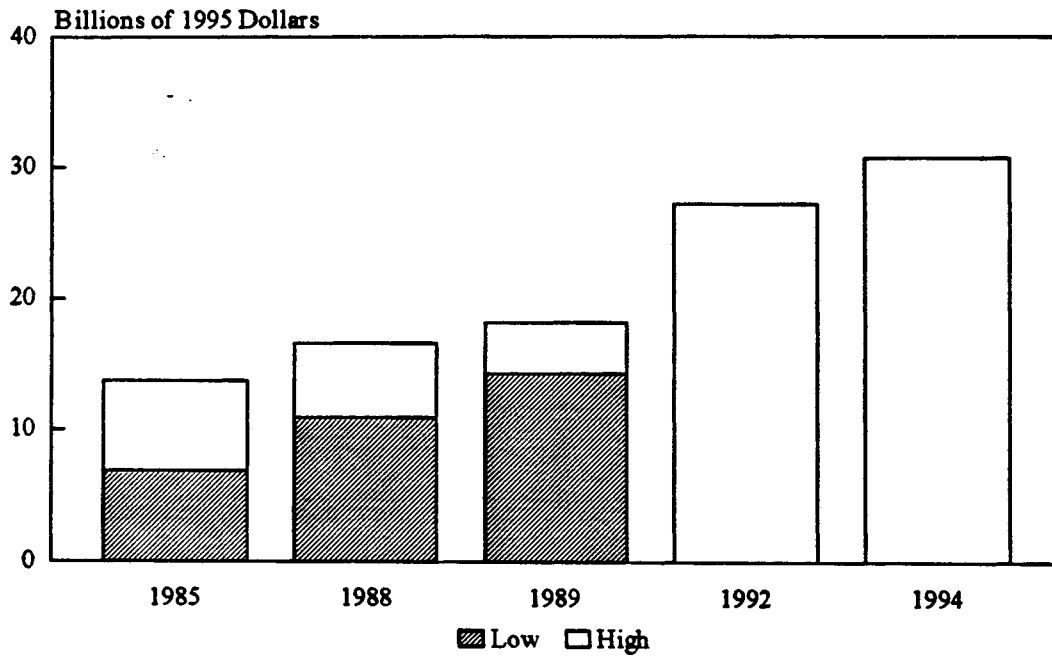
Current estimates, however, are likely to be moderately more reliable than those made during the initial stages of the Defense Environmental Restoration Program or even as recently as 1989. DoD's initial estimates were based on very limited information about the size and scope of the cleanup problem. The department has now completed nearly all of its preliminary assessments for the sites it has identified (though it continues to identify new sites each year) and has made considerable progress in the

3. General Accounting Office, *Hazardous Waste*, pp. 14-16.

FIGURE 3. DoD's SPENDING FOR STUDIES AND CLEANUP, 1992-1995



SOURCE: Congressional Budget Office based on the testimony of Sherri Goodman, Deputy Under Secretary of Defense for Environmental Security, before the Subcommittee on Military Readiness and Defense Infrastructure of the Senate Committee on Armed Services, May 4, 1994.

FIGURE 4. DoD's ESTIMATES OF TOTAL COSTS FOR THE INSTALLATION RESTORATION PROGRAM

SOURCE: Congressional Budget Office estimates using data from General Accounting Office, *Hazardous Waste: DoD Estimates for Cleaning Up Contaminated Sites Improved but Still Constrained*, GAO/NSIAD-92-37 (October 1991), p. 14.

remedial investigation/feasibility study phase of the cleanup process. In addition, DoD has completed more than 500 cleanup actions that provide useful empirical data on which to base estimates of future costs.

Further complicating the task of estimating costs is the uncertainty surrounding the time needed to complete the various stages of the cleanup process. Past estimates have been optimistic. In 1991, DoD believed that it would complete the preliminary assessment phase for all sites in the Installation Restoration Program by 1992, the remedial investigation/feasibility study phase by 1996, and the cleanup phase by about 2010. Current estimates for cleaning up sites on NPL facilities suggest that the initial phase is taking longer than DoD expected--about 18 months for simple soil contamination, 36 months for complex soil contamination, and six years for contamination of groundwater.

In contrast, the remedial investigation/feasibility study phase seems to be taking less time than DoD expected years ago. According to recent estimates for cleaning up sites on NPL facilities, RI/FS takes, on average, from six months to one year to complete--well within the four years DoD envisioned in 1991. Recent estimates for completing the cleanup phase, however, seem consistent with earlier estimates of 14 years. DoD currently estimates that the final phase may vary from six months for cleaning up simple soil contamination sites to 15 years for remediating contaminated groundwater.⁴

Some recent data from the Environmental Protection Agency also suggest that cleaning up the most contaminated nondefense sites--those on the National Priorities List--takes a long time and, in many cases, longer than expected.⁵ In total, the average time to complete cleanup of nondefense NPL sites measured from the proposed listing on the NPL could be between 13 years and 15 years. Moreover, data for individual projects, called operable units, that are located on NPL sites indicate that the typical time to complete cleanup has increased significantly. During the first half of 1993, the Environmental Protection Agency estimated that the remedial investiga-

4. Data from the Department of Defense's response to questions for the record of hearings before the Subcommittee on Defense of the House Committee on Appropriations on fiscal year 1995 DoD appropriations, March 23, 1994.

5. Congressional Budget Office, "Analyzing the Duration of Cleanup at Sites on Superfund's National Priorities List," CBO Memorandum (March 1994), pp. 2 and 9. Nondefense NPL sites may not differ significantly from those located on defense installations. Both types of sites are designated on the NPL because they had received high scores on a uniform scale--the Hazard Ranking System--that provides an overall measure of contamination.

tion/feasibility study and cleanup phases for an operable unit increased from about 9.4 years to almost 10.3 years.

Many of the bases that DoD is closing have also experienced unanticipated cost increases as a result of longer cleanup time, stricter cleanup standards, and poor initial estimates. The DoD Inspector General recently found that cost estimates for cleanup had exceeded baseline estimates at 34 of 49 bases being closed.⁶ The median cost of cleanup was about 50 percent higher for current estimates than for baseline estimates, and the average cost was about 60 percent higher. According to personnel assigned to those bases, the unanticipated increase in costs results primarily from the discovery of additional contaminated sites and hazardous wastes, cleanup standards that are stricter than initially planned, and higher construction costs.

Will cleanup costs continue to grow? The budget and cost data cited above suggest that unless steps are taken either to delay elements of the cleanup program or to introduce cheaper methods of remediation, funding requests will continue to increase if DoD is to meet the requirements. In addition, empirical data on characterization and cleanup work is limited, so confidence in current cost estimates remains low. For example, much of the RI/FS work (about 80 percent) and almost all of the permanent cleanup work (about 95 percent) remains to be done.

DoD must also continually expand its cost estimates to include newly discovered contamination problems. The department routinely discovers more extensive contamination than initial research indicated, additional types of contaminants on sites already located, as well as hundreds of new hazardous waste sites each year. A recent court ruling could contribute to higher costs by affirming legal requirements favoring stricter standards of cleanup when jurisdictions disagree. If such rulings affect numerous cleanup projects, total cleanup costs could increase significantly.

Finally, since DoD and the Congress have not decided which bases to close during next year's round of base closures, the department has made no estimate of any additional near-term budget needs for cleaning up those bases. If history is a guide, however, such cleanups will require funds beyond those currently in the Defense Environmental Restoration Account.

6. Department of Defense, Office of the Inspector General, *Environmental Problems Emerging During Base Realignment and Closure* (July 1993), p. 5.

CHAPTER IV

KEY ISSUES AFFECTING FUTURE CLEANUP

Although the size, scope, and cost of the cleanup program have grown beyond expectations, a variety of other factors will also affect whether the Department of Defense will be able to meet its cleanup objectives. Are its cleanup goals realistic? Will cleanup standards be flexible enough to permit cost savings? How should the department approach cleaning up bases that are scheduled to be closed? What funding priorities should apply among environmental programs that are competing for resources, if cutbacks occur?

OPTIMISTIC PROGRAM GOALS

The department's modest progress with its cleanup program has not met the goals set in 1991, which suggests that current goals may also be too optimistic. In September 1991, DoD planned to have completed all the preliminary assessments and site inspections by the end of 1992. According to the Defense Environmental Cleanup Program's *Annual Report to Congress for Fiscal Year 1993*, the department has completed about 96 percent of the required preliminary assessments and, according to Congressional Budget Office estimates, about 83 percent of the site investigations. The 1991 plan called for all remedial investigations and feasibility studies to be under way by 1993 and completed by 1996. But as of April 1994, only about 50 percent of the active sites were in the RI/FS phase, and only 20 percent had completed that stage. Finally, the 1991 plan projected that the program would be completed--that is, either all sites cleaned up or remediation technology in place--by about 2010. The department has not revised that estimate, although it is reexamining program objectives.

CURRENT LEGISLATION AND ITS STRINGENT CLEANUP STANDARDS

Cleanup standards are also likely to have a significant impact on DoD's ability to meet its objectives for the cost and schedule of cleanup. Although various federal laws such as the Toxic Substances Control Act, the Clean Water Act, the Clean Air Act, and the Solid Waste Disposal Act contain certain cleanup standards that must be met, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) provides that in cases in which federal and local standards differ and states' standards are more stringent, the

latter standards and requirements take precedence.¹ Guided by existing legislation and local standards and requirements, federal and local representatives normally negotiate cleanup standards for individual cleanup projects. When they are unable to agree, however, questions arise about which standards to apply.

Disagreement about what may be an appropriate standard may reflect a conflict over whether CERCLA or the Resource Conservation and Recovery Act of 1976 (RCRA) should govern the cleanup.² Both laws govern the cleanup of hazardous wastes but are implemented through different authorities, which could prefer different standards for cleanup. CERCLA directs the Department of Defense to remediate a hazardous waste site in consultation with the Environmental Protection Agency and state authorities. RCRA delegates authority to direct the cleanup of contaminated sites to EPA, which in turn delegates implementing authority to the states.

More stringent cleanup standards are costly to meet and usually take more time. Information that describes how widespread the problem of differing standards may be is not currently available; individual cases, however, such as the Rocky Mountain Arsenal in Colorado and George and Mather Air Force bases in California, suggest that the impact can be substantial. In April 1993, the U.S. Court of Appeals for the Tenth Circuit ruled that the state of Colorado could exercise authority under RCRA to direct cleanup actions taken at the Rocky Mountain Arsenal. The Army, EPA, and Colorado have not yet agreed on final cleanup standards for the arsenal, but the Army believes that stricter standards, if ordered by the state, would add significantly to the estimated \$2.3 billion needed to remediate the property according to the Army's plan. Similarly, the Air Force estimated that California's more stringent standards for cleaning up groundwater at George and Mather Air Force bases would add one-time costs of about \$500,000 for remediation equipment and almost \$200,000 annually for operation and maintenance.

1. 42 U.S.C. 9621d.

2. The Comprehensive Environmental Response, Compensation, and Liability Act as amended by the Superfund Amendments and Reauthorization Act of 1986 establishes policies and procedures governing the identification, investigation, and cleanup of past releases—or impending releases—of hazardous wastes, including those on defense property. The Resource Conservation and Recovery Act of 1976 as amended by the Hazardous and Solid Waste Amendments (HSWA) of 1984 establishes a program, governed by states authorized by EPA, to manage the handling of hazardous wastes, including those on defense property. HSWA, like CERCLA, also governs the investigation and cleanup of existing waste sites but includes some requirements that differ from those in CERCLA. For DoD installations that need a RCRA permit to manage hazardous wastes, EPA or authorized states may require corrective cleanup actions for hazardous wastes released from solid waste management units on the installation. The standards that those corrective actions must meet may differ from the standards that might be required under CERCLA.

Appropriate standards of cleanup, however, may not necessarily be the most stringent standards. Many analysts believe that cleanup standards should reflect the likely use of contaminated property rather than require cleanup actions that would ensure unrestricted use in the future. Military airfields that are being closed, for example, may be more likely to be reused as commercial airfields than, say, as residential property. The cleanup standards appropriate for remediating hazardous waste at an operational airfield are likely to be less demanding than those for residential areas unless the contamination poses a threat to human health and safety. Some Members of Congress have supported changes to legislation permitting cleanup standards to reflect "reasonably anticipated future land uses," and those changes could result in considerable savings in cleanup costs.³ Unless the Congress adopts such a provision, however, current legislation requiring more stringent cleanup standards will remain in effect.

REDUCED CLEANUP TIME TO ACCELERATE THE REUSE OF DEFENSE PROPERTY

Reducing the time it takes to clean up hazardous waste on defense facilities that are scheduled to be closed is particularly important in order to accelerate the reuse of the property to help offset local economic losses. The timing of cleanup can be an important factor in aiding recovery. The Defense Base Closure and Realignment Act of 1990, as amended, requires that DoD complete all base closures and realignments approved by the Congress within six years of receiving the President's recommendations.⁴ In addition, CERCLA requires DoD to certify that "all remedial action necessary to protect human health and the environment" has been taken before any property may be sold or transferred. In effect, those laws require DoD to complete environmental cleanup work within six years on former defense properties that are expected to be sold or transferred to nonfederal jurisdictions or to the private sector.

Since the communities affected by the closing of military bases are anxious to offset lost revenues, they have a strong incentive to ensure that DoD complies with the requirements of CERCLA and the procedures of the Base Closure and Realignment Commission (BRAC), or that the department uses other means to accelerate the reuse of former defense property at least on an interim basis. In October 1992, the Congress enacted legislation to

3. Superfund Reform Act of 1994, S. 1834, 103rd Cong., 2nd Sess., p. 104.

4. Defense Base Closure and Realignment Commission, *1993 Report to the President* (July 1, 1993), p. A-7.

assist communities in achieving their goals. The Community Environmental Response Facilitation Act directed DoD and other federal agencies to identify uncontaminated parcels of land, including property located on installations on the National Priorities List, that could be sold or transferred without requiring any cleanup. As of August 1994, DoD had identified more than 150,000 acres of uncontaminated property on closing defense facilities that could be sold or transferred without delay.

Leasing property to private concerns or transferring property to other federal agencies is also an effective way to accelerate reuse of former military bases.⁵ Although DoD remains liable for cleaning up contaminated property that it has leased or transferred, it is not required to complete its work before the date of such transactions. Cleanup of contaminated sites located on those parcels, though not constrained by schedules for closing bases, is governed by schedules and standards agreed on by DoD, EPA, and state regulatory authorities. To date, DoD has completed or is negotiating some 75 leases for property located on defense facilities scheduled to be closed. DoD has transferred ownership of approximately 40 parcels to new owners, some of which are other federal agencies.

New remediation technology can also reduce the time it takes to clean up hazardous wastes. But DoD, EPA, and state regulators have been reluctant to endorse the use of new technologies that have not been fully demonstrated. They have been more likely to adopt more traditional remediation techniques whose costs and effectiveness are better known. Efforts are under way, however, to promote the validation and certification of new, time-saving remediation technologies. As part of its "Fast Track Cleanup Program," DoD has established teams for cleaning up bases and charged them with identifying and encouraging the use of new, more efficient remediation technologies. DoD, in partnership with the Western Governors Association, is also promoting the use of new technologies through the Develop On Site Innovative Technology Program, an interagency cooperative effort to develop guidelines for general acceptance of remediation technologies.⁶

Under current practices, remediation technology is selected on a case-by-case basis and incorporated into records of decision that set out remediation plans. Although various programs such as those cited above are under

5. For a discussion of ways to accelerate reuse of property on bases scheduled to be closed, see *The Report of the Defense Environmental Response Task Force* (August 1991).

6. Statement of Sherri W. Goodman, Deputy Under Secretary of Defense for Environmental Security, before the Subcommittee on Installations and Facilities of the House Committee on Armed Services, April 20, 1994.

way to encourage the use of new technologies, no standards or procedures that govern their validation and certification exist. The lack of such standards and procedures contributes to the unwillingness of various interested parties to take risks in applying new, more efficient technologies.

The Congress has, on the one hand, sought to encourage acceptance and broad application of new remediation technologies. Title IV of the National Environmental Technology Act of 1994 outlines a program to establish standards and procedures for testing and validating remediation technologies that would permit their widespread application. On the other hand, the Congress has not fully supported DoD's requests for funding. In 1994 and 1995, the Congress denied DoD's request for funds for the Defense Environmental Restoration Account earmarked to gain regulators' acceptance of new cleanup technologies for wider application. The Congress, however, provided a small amount in 1995--about \$10 million--to support acceptance of new technologies through DoD's Innovative Environmental Security Technology Program.

INCREASED COMPETITION FOR FUNDING

Although funding for DoD's environmental programs has grown dramatically during the past 10 years, further growth is unlikely in view of the cutbacks planned for defense spending over the next few years. Competition for funding is likely to become increasingly intense as the department reduces its spending. Still, spending on environmental programs constitutes a very small portion of DoD's overall budget and could grow even in a constrained budget environment if DoD and the Congress chose to increase spending needed to meet the environmental cleanup standards required by law.

The rapid growth in the rate of environmental spending during the past decade stems partly from DoD's having spent so little of its budget on the environment 10 years ago. In 1984, spending on environmental programs totaled less than one-tenth of one percent of DoD's budget; it is now slightly more than 2 percent (see Table 4). As of January 1994, the department had no plans to increase environmental spending beyond 1995, however, and in fact projects major cutbacks during the next several years.

Competition for funding will increase not only among the appropriation accounts within the defense budget such as procurement, research and development, and operation and maintenance (which contains funding for environmental programs) but also among environmental programs. In 1984, DoD restructured its environmental budget to consolidate funding for

environmental programs into a single line item. As a result, all elements of the defense environmental program except the BRAC cleanup--Compliance and Pollution Prevention, the Defense Environmental Restoration Program, Environmental Research and Development, and Conservation--have greater visibility, and relative priorities and trends are easier to identify. DoD examines alternative approaches to spending for environmental programs as a part of its program budget review.

Shares of spending for various elements of the environmental program were relatively constant between 1990 and 1993 and, according to current plans, will remain so during the next five years. Priorities in spending shifted, however, beginning in 1994. Between 1990 and 1993, the department allocated more funds to handling and storing hazardous wastes than to cleanup. During the 1990-1993 period, DoD spent about \$6.1 billion on compliance--about 49 percent of funding for all environmental programs. Spending on cleanup during that period amounted to \$5.8 billion, or approximately 46 percent of the total. Since then, however, DoD has allocated slightly more funding to cleanup than to compliance. In 1994, for

TABLE 4. DoD's SPENDING FOR ENVIRONMENTAL PROGRAMS, 1984-1994
(In millions of 1995 dollars of budget authority)

	Environmental Spending	Total Defense Spending	Environmental as a Percent- age of Total Defense Spending
1984	213	366,421	0.1
1985	431	390,479	0.1
1986	481	373,215	0.1
1987	490	359,185	0.1
1988	510	351,733	0.1
1989	608	346,705	0.2
1990	1,617	339,091	0.5
1991	2,835	304,495	0.9
1992	3,949	304,536	1.3
1993	4,209	279,563	1.5
1994	5,546	254,445	2.2

SOURCE: Congressional Budget Office using data from the Department of Defense.

example, it spent almost 48 percent of environmental funding on cleanup and about 43 percent on compliance. During the next five years, the department plans to spend about 48 percent of its total environmental budget on cleanup (about \$11.7 billion) and about 47 percent (\$11.4 billion) for compliance (see Table 5).

If the cost of remediation increases significantly beyond current expectations and necessitates budgetary increases for cleanup to meet legal requirements, DoD might have to make offsetting reductions to spending for compliance and pollution prevention. Funding for research and development and for conservation in 1995 totals about 6 percent of environmental funding, and financing the overruns in the cost of remediation by cutting R&D and conservation would devastate those programs. Moreover, reduced funding for research and development would jeopardize the potential for developing more efficient remediation technologies that would help to control future costs.

TABLE 5. DoD's SPENDING FOR MAJOR ENVIRONMENTAL PROGRAMS AS A PERCENTAGE OF TOTAL ENVIRONMENTAL SPENDING, 1990-1999

	Compliance	Cleanup		Environmental R&D
		DERA	Environmental Restoration of Closing Bases	
Actual				
1990	57	43	0	0
1991	44	42	12	3
1992	53	31	14	2
1993	45	29	13	9
1994	43	36	11	6
Projection				
1995	46	38	10	4
1996	46	39	10	3
1997	48	38	8	4
1998	46	40	8	4
1999	48	40	8	2

SOURCE: Congressional Budget Office using data from the Department of Defense.

NOTE: DERA = Defense Environmental Restoration Account; R&D = research and development.

CHAPTER V
STRATEGIES FOR CONTROLLING
FUTURE CLEANUP COSTS

Given the dramatic growth in spending devoted to environmental programs, the limited progress made to date in cleaning up defense facilities, and the probability that current spending plans might not allow the Department of Defense to meet existing requirements, the Congress may want to consider various ways to meet the twin goals of efficiently remediating the most pressing contamination problems and returning as many sites as possible to usable condition. Potential solutions could incorporate both near-term and long-term approaches. The following sections analyze the relative merits and difficulties of such approaches.

STEPS DoD COULD TAKE
TO CONTROL COSTS IN THE NEAR TERM

Since the outset of DoD's environmental cleanup program, the department has been able to provide sufficient funds to meet existing legislative and regulatory requirements. Consequently, it has not needed to establish priorities to govern funding for environmental programs and individual cleanup projects. However, if the costs of environmental programs increase beyond DoD's ability to meet legislative and regulatory requirements, the department will need to set priorities among competing demands for funding.

Applying a zero-based budgeting approach that ranks environmental programs and projects according to priority could ensure that the cleanup program met its most pressing requirements while remaining within budgetary constraints. Once DoD completed its ranking of programs and projects, the department would fund the most important cleanup tasks first, ensuring progress for those sites in accordance with negotiated cleanup standards and schedules. As the availability of funds shifted from year to year, cleanup activities with a lower priority could be delayed if necessary without affecting progress on those having a higher priority. Both DoD and the Department of Energy have developed models based on setting priorities that could assist in supporting zero-based budgeting.

What sorts of priorities might be appropriate to guide future funding if choices must be made? Some, such as funding cleanup of the most seriously contaminated projects--contaminated sites posing the greatest threat to health and safety--would maintain the government's current policy. The most

seriously contaminated defense sites are located on installations included on the National Priorities List, and cleaning up sites that pose the most serious risks to health and human safety on those bases clearly deserves the highest priority.

A "worst-first" policy, however, could be modified to ensure that the department assigned priority to remediating only the most threatening contaminated sites located on NPL defense installations. According to current practices, DoD installations that are heavily contaminated qualify for the NPL on the basis of an aggregate Hazard Ranking System score for the entire facility. Dozens of individual sites may be located on such a facility, however--some more contaminated than others--and they all contribute to the aggregate score.¹ According to DoD's figures, the 107 defense installations included on the NPL include some 5,500 individual contaminated sites.

Although the Hazard Ranking System is useful in identifying contaminated sites that pose the greatest risk to public health and safety, applying it is a time-consuming and expensive process. The department therefore applies it only to areas for which preliminary investigations reveal a likelihood of serious contamination. The department needs a timely, less costly method of assessing contamination to assist in determining the relative threat that individual sites pose to health and the environment.

Some Members of Congress have recognized that need and favor improved methods of assessing the risk to health and safety of local populations as a means of determining cleanup priorities. A bipartisan group introduced a bill during the 103rd Congress to establish guidelines for systematically characterizing the potential adverse health or ecological effects of exposure to environmental hazards. The Risk Assessment Improvement Act would establish a pilot project enabling scientists to rank dissimilar hazardous materials according to their risk to the population.² Improved risk-assessment methods such as the legislation proposes could assist in establishing cleanup priorities among all contaminated sites, including those listed on the NPL.

When setting priorities, policymakers should also consider alternative approaches to cleaning up property on military bases that are scheduled to be closed. Although leasing contaminated property on those bases or transferring it to other federal agencies may be preferable in some cases, completing

1. See General Accounting Office, *Environmental Cleanup: Too Many High Priority Sites Impede DoD's Program*, GAO/NSIAD-94-133 (April 1994), p. 9.

2. Risk Assessment Improvement Act of 1994, H.R. 4306, 103rd Cong., 2nd Sess., pp. 14-15.

environmental cleanup actions quickly to aid in local economic recovery may be more useful in others. The Comprehensive Environmental Response, Compensation, and Liability Act requires that DoD clean up its property before it can sell or transfer the title to private purchasers or buyers other than federal agencies. Property that has been cleaned up is attractive to investors who wish to avoid the risks of dealing with hazardous wastes, and revenues generated by the sale or transfer of "clean" property can be used to support other environmental cleanup activities at bases that are scheduled to be closed. Clean property that is ready for immediate reuse can also benefit the local economy. DoD could assign priority to those contaminated parcels that, if they are remediated, are likely to generate significant revenues or commercial activity to aid in local economic recovery.

The priorities DoD sets for cleaning up defense facilities scheduled to be closed could also reflect the relative economic impact on them. DoD and the Congress could assign higher priority to remediating commercially viable defense properties in locales that have been particularly hard hit by the closing of military facilities. That approach would favor cleaning up bases in small communities heavily dependent on their military installation, or cleaning up facilities in large communities affected by numerous base closings that, taken individually, might not be viewed as having a significant impact on the local economy.

DoD and the Congress could also control near-term spending by choosing to delay costly remediation projects, such as cleaning up unexploded ordnance and contaminated groundwater, that do not pose an immediate threat to human health and safety. Delaying remediation of these types of contaminants at sites where public health and safety would not be endangered by doing so could save billions of dollars in the short term. Delays, however, could require renegotiating existing agreements between DoD, EPA, and state regulatory authorities.

According to recent figures, the Army has identified about 1,700 sites covering tens of thousands of acres contaminated by ordnance and chemical warfare materials. Assuming an average cost of \$65,000 per acre to remediate such property, delaying cleanup could enable DoD to reduce spending substantially in the near term, perhaps by billions of dollars. Of course, DoD must clean up such properties at some point in the future, but significant net savings in the long term could be possible if, in the interim, the department developed less costly methods of remediation.

Similarly, in certain cases, DoD could achieve significant savings in the long term by delaying remediation of contaminated groundwater until less

costly methods were developed. Delays would be appropriate, however, only at sites where doing so would not endanger public health and safety. Based on 1991 cost estimates, DoD could reduce near-term spending by hundreds of millions of dollars by delaying the cleanup of such sites.³ If new technologies currently in development prove effective, costs of characterization and remediation could be reduced by 50 percent or more.

In some cases, delaying the cleanup of groundwater could raise costs if cheaper methods of remediation were not perfected and a hiatus permitted contamination to increase or spread. The department remains liable for cleaning up contaminated groundwater in any event and would have to characterize, sample, and monitor the site before resuming remediation. The department might also have to supply fresh water to tenants of base property or to property owners in the locale who would be affected. The funding needed to support this approach could exceed savings gained in the near term as a result of delaying remediation. Cost analyses could assist in determining the advisability of such delays.

APPROACHES FOR CONTROLLING LONG-TERM COSTS

Since virtually all of DoD's cleanup work has yet to be done, the prospects for savings in the long term lie in developing less expensive methods of remediation. Many research projects now in the laboratories or being tested in the field are providing results that foreshadow lower costs. According to current DoD estimates, for example, new technologies for cleaning up metals in contaminated groundwater could reduce costs from as high as \$40 to as low as 10 cents per thousand gallons; and for metals in contaminated soils, from as high as \$250 to as low as \$20 per ton. DoD estimates that it might be able to cut the cost of remediating buried ordnance by 33 percent using technology now being developed.

New technologies for studying contaminated sites could also achieve significant savings. For example, new penetrometer technologies could reduce the cost of surveying property containing buried ordnance from \$5,000 to as low as \$600 per acre. New well-drilling techniques could reduce sampling costs from \$280 to as low as \$10 per well-foot. Of course, those estimates are preliminary and require additional testing and application to confirm their validity. However, they are based on laboratory and field tests that suggest potential savings of those magnitudes. Table 6 summarizes potential savings

3. Department of Defense, *Installation Restoration Program Cost Estimate* (September 1991), pp. 24-27. The estimate cited is based on costs for remediating 63 sites that have contaminated groundwater.

for future technologies for remediating, characterizing, or detecting various types of contaminants.

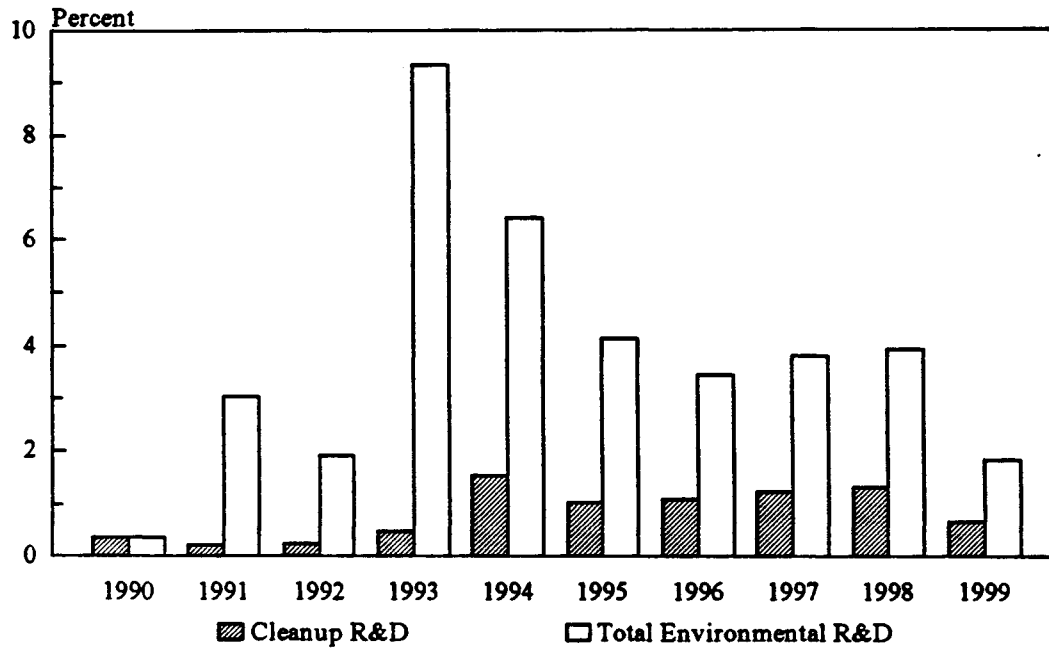
Can DoD afford to make additional investment in long-term solutions? Given the estimates of future budgets and the magnitude of potential savings, perhaps it cannot afford not to. Moreover, funding for environmental research and development has been quite modest. In 1991, the Congress authorized \$86 million for environmental R&D, only about 3 percent of DoD's total funding for environmental programs. Although environmental R&D funding has increased since then in absolute terms, since 1993 it has decreased as a portion of overall spending on environmental programs (see Figure 5). The department spent about \$357 million on environmental R&D in 1994--slightly more than 6 percent of all environmental spending.

TABLE 6. ESTIMATED COSTS OF CURRENT AND EMERGING ENVIRONMENTAL TECHNOLOGY

Contaminant	Current Technology	Emerging Technology
Explosives/Organics		
In soil (Per ton)	\$350 to \$1,500	\$30 to \$400
In groundwater (Per 1,000 gallons)	\$1 to \$5	\$0.02 to \$2
Heavy Metals		
In soil (Per ton)	\$75 to \$250	\$20 to \$200
In groundwater (Per 1,000 gallons)	\$0.10 to \$40	\$0.10 to \$2
Characterization/Detection of Unexploded Ordnance (Per acre)	\$5,000	\$600 to \$1,600
Unexploded Ordnance (Per acre)	\$60,000	\$40,000 to \$50,000
Characterization/Detection of Contamination in Soil and Groundwater (Per well-foot)	\$100 to \$280	\$10 to \$40

SOURCE: Congressional Budget Office using data from the Department of Defense.

FIGURE 5. DoD's SPENDING ON CLEANUP R&D AND TOTAL ENVIRONMENTAL R&D AS A PERCENTAGE OF DoD'S TOTAL ENVIRONMENTAL BUDGET, 1990-1999



SOURCE: Congressional Budget Office using data from the Department of Defense.

NOTES: Data for 1995 through 1999 are CBO projections.
R&D = research and development.

The department allocates only about one-quarter of its spending on environmental research and development to investigating new cleanup technologies. DoD spent about \$84 million (or 23 percent) in 1994 on studying new cleanup techniques. The department plans to spend even less in 1995--about \$57 million--though cleanup R&D's share of all R&D spending will remain about the same. The rest of environmental R&D spending is allocated to the Strategic Environmental Research and Development Program and for defense research on compliance, pollution prevention, conservation, and other programs.

Last year, the Congress supported a major increase in spending for DoD's environmental research and development efforts. DoD requested \$100 million for the Strategic Environmental Research and Development Program; the Congress authorized \$153 million. This year, the Congress authorized DoD's request for \$112 million, but appropriated only \$62 million because that program's account had large unobligated balances in 1993 and 1994.

Whatever the cause of delays in obligating funds, ample opportunities exist for investment in research and development. According to DoD's Tri-Service Environmental Quality R&D Strategic Plan, many R&D projects remain unfunded. In 1994, for example, DoD estimated that R&D projects could have used an additional \$277 million. If the Congress had authorized those additional funds, spending for R&D would have increased to about 11 percent of total spending on environmental programs. Funding for additional R&D projects could help reduce long-term costs, but should be reviewed and coordinated with related projects funded by either the Department of Energy or the Environmental Protection Agency.

Since virtually all of DoD's remediation work has yet to be done, now could be an opportune time to reconsider the government's approach toward setting cleanup standards. Current policy, as set forth in CERCLA, states that federal agencies should select strict cleanup standards that favor permanent solutions to contamination problems.⁴ Some people believe that "permanent solutions" are those that ensure unlimited use of property in the future. Unlimited use requires that the strictest cleanup standards be applied, even if they are not needed to permit reuse of a contaminated site. Unlimited use, for example, could require meeting strict cleanup standards appropriate for a residential development or a day care center, as opposed to standards for industrial use or an operational airport.

4. 42 U.S.C. 9621.

Since meeting stricter cleanup standards is considerably more expensive than fulfilling less demanding ones, a new approach that sets standards on the basis of anticipated future land uses could result in significant savings in cleanup costs. Indeed, some Members of Congress favor an approach that would permit the government to set standards reflecting the reasonably anticipated future use of a property. The government could set such standards when a more stringent standard has not been set through legislation or regulation or is not appropriate because of special circumstances of the cleanup site.

Under this approach, the federal government could adopt generic cleanup standards for specific hazardous substances or contaminants that would meet national cleanup goals intended to protect human health and the environment.⁵ Doing so would create uniform cleanup standards applicable to all regions and thus would preempt disagreement--sometimes generated by differences between the Resource Conservation and Recovery Act and CERCLA--among federal agencies and state regulators over appropriate standards. Establishing generic standards could be quite difficult, however, since scientific opinions would probably vary regarding optimal generic standards covering different regions and different circumstances.

How much could be saved by revising the government's approach to setting cleanup standards? At this stage of the cleanup program, when relatively few sites have entered the final stages of the process, no reliable comprehensive estimates are possible. Certain cases, however, suggest that the magnitude of potential savings for seriously contaminated sites could be quite significant. The cost of cleaning up Fort Meade, Maryland, for example, was reduced considerably when federal and state authorities agreed that standards for unlimited use were inappropriate and that part of a former artillery practice range could be used as a wildlife preserve. DoD originally estimated that remediating the base, including a large tract of land contaminated with unexploded ordnance and related metals, would cost almost \$55 million. By agreeing to use the property as a game preserve and setting cleanup standards appropriate to that use, DoD expects to save about \$30 million--more than half--in cleanup costs.

Similar savings might be possible at other facilities featuring munitions testing and storage, such as Jefferson Proving Ground, Indiana. Based on current costs of remediation, cleaning up more than 55,000 acres of contaminated property on the base could cost billions. However, DoD's current plan,

5. Superfund Reform Act of 1994, S. 1834, 103rd Cong., 2nd Sess., p. 104.

which sets aside large parcels of property for use as a preserve, estimates that costs will amount to only about \$70 million.

