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Report to Congressional Requesters

May 2004

DOD OPERATIONAL RANGES

More Reliable Cleanup Cost Estimates and a Proactive Approach to Identifying Contamination Are Needed

GAO-04-601

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GAO Highlights

Highlights of GAO-04-601, a report to congressional requesters

Why GAO Did This Study

For decades, the Department of Defense (DOD) has tested and fired munitions on more than 24 million acres of operational ranges. Munition constituents such as lead, trinitrotoluene (TNT), and perchlorate may cause various health effects, including cancer. Concerned about the potential cost to clean up munitions, Congress required DOD to estimate the cost to clean up its operational ranges.

You asked GAO to determine (1) how DOD identified the location and last use of operational ranges and the basis for DOD's cost estimates for cleaning up those ranges; and (2) DOD's policy to address contaminants linked to the use of munitions on operational ranges and, where contaminants such as perchlorate have been detected, what corrective actions the military services have taken.

What GAO Recommends

GAO recommends that DOD (1) revise its cost estimates for the cleanup of operational ranges using its most complete range inventory and a consistent estimating methodology, and (2) provide specific funding for sampling at sites where perchlorate contamination is likely, in accordance with DOD's policy requiring sampling.

In commenting on this report, DOD disagreed with GAO's findings and recommendations. GAO believes its findings are sound and its recommendations are appropriate.

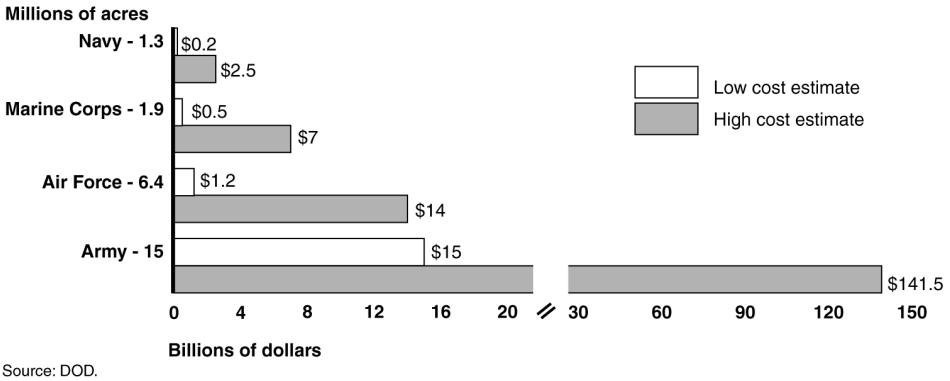
www.gao.gov/cgi-bin/getrpt?GAO-04-601.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Anu MIttal at (202) 512-3841 or MittalA@gao.gov.

What GAO Found

DOD identified the location and status of its operational ranges based on inventory data developed by the individual military services. However, the reliability of DOD's inventory is questionable because the services did not use a common framework to collect and analyze data on the number of existing operational ranges. Because DOD's cost estimates to clean up its operational ranges were based on individual service calculations that combined inventory data with unvalidated DOD cost assumptions, various service assumptions, and computer-generated cost rates, these cost estimates are also questionable. Specifically, GAO found that each service compiled inventory data using various methodologies over different time periods and developed cost estimates using a mix of differing assumptions and estimates, along with actual data. As a result, the services' estimates to clean up an acre of highly contaminated land vary from about $800 for the Air Force to about $7,600 for the Army. The figure below shows high and low cost estimates and range acreage used to estimate costs, by service.

High and Low Cleanup Cost Estimates and Total Range Acreage by Service



Source: DOD.

DOD does not have a comprehensive policy requiring sampling or cleanup on operational ranges for the more than 200 chemicals associated with military munitions. However, when required by the Safe Drinking Water Act or other environmental laws, DOD has sampled and cleaned up munitions and munitions constituents. With regard to perchlorate, DOD has issued sampling policies but cannot assure funding is provided for such sampling. In some cases, DOD has sampled for perchlorate when required under the Safe Drinking Water Act's Unregulated Contaminant Monitoring Regulation and for other contaminants when directed by state environmental agencies. However, DOD generally has not independently taken actions specifically directed at cleaning up munitions contaminants, such as perchlorate, on operational ranges when they have been detected.

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Abbreviations

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOD	Department of Defense
EPA	Environmental Protection Agency
NPDES	National Pollution Discharge Elimination System
RCRA	Resource Conservation and Recovery Act
TNT	Trinitrotoluene

GAO
Accountability * Integrity * Reliability

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

May 28, 2004

The Honorable John D. Dingell
Ranking Minority Member
Committee on Energy and Commerce
House of Representatives

The Honorable Hilda L. Solis
Ranking Minority Member
Subcommittee on Environment and Hazardous Materials
Committee on Energy and Commerce
House of Representatives

For decades, the Department of Defense (DOD) has tested and fired munitions on millions of acres of operational ranges. These munitions contain various constituents such as lead, trinitrotoluene (TNT), and ammonium perchlorate salt (perchlorate) that are, in some instances, known or suspected of causing health effects such as damage to the central and peripheral nervous systems, cancer, and interfering with thyroid function. Concerns about the potential cost to clean up munitions prompted Congress to require that DOD develop an estimate for what it would cost to clean up its operational ranges. The National Defense Authorization Act for Fiscal Year 2002 required DOD to provide (1) a comprehensive assessment of unexploded ordnance, discarded military munitions, and munitions constituents at current and former DOD facilities; and (2) an estimate of the aggregate projected cost of remediation (cleanup) at operational ranges,[1] stated as a range of costs, including a low and high estimate. As of April 2003, DOD identified 10,444 operational ranges located in the United States and its territories, with Army operational ranges accounting for 94 percent of the total. DOD estimated it would cost between $16 billion and $165 billion to clean up unexploded ordnance, discarded military munitions, and munitions constituents on these operational ranges.

There is a growing concern about the potential health effects associated with the environmental contamination caused by constituents used in the munitions and specifically the possible contamination of drinking water with perchlorate—the primary ingredient of solid rocket propellant that is also used in varying quantities in many types of munitions, explosives, and

[1]DOD was also required to provide a separate estimate for all other defense sites.

incendiary devices, such as mortars, grenades, and flares. The Environmental Protection Agency (EPA) estimates that about 90 percent of the perchlorate manufactured in the United States is for solid rocket fuel used for military purposes and by the National Aeronautics and Space Administration. According to EPA, studies have shown that perchlorate can interfere with thyroid function and negatively affect fetal and infant brain development and growth. Since 1990, the state of California has detected perchlorate in wells and other drinking water sources near sites that once supported munitions manufacturing, storage, and testing. EPA reports that perchlorate has been detected in 34 states and attributes a significant portion of the contamination to defense manufacturing and test sites.

In monitoring and cleaning up munitions and munitions constituents on operational ranges, DOD must comply with applicable provisions of various federal environmental laws, including the Safe Drinking Water Act, as amended; the Resource Conservation and Recovery Act of 1976, as amended (RCRA); and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA). EPA does not have specific regulatory standards under the Safe Drinking Water Act for the roughly 200 chemicals associated with military munitions use,[2] but requires sampling for some of these contaminants, including perchlorate. According to DOD, at least 20 of these constituents, including perchlorate, are of great concern due to their widespread use and potential environmental impact. For example, EPA and some states are considering whether to establish a specific drinking water standard for perchlorate levels and have, in some cases, established advisory levels. Appendix I contains a listing of munitions constituents of greatest concern and their potential health effects.

You asked us to determine (1) how DOD identified the location and last active use of all operational ranges and the basis for DOD's cost estimates for cleaning up those ranges; and (2) DOD's policy to address contaminants linked to the use of munitions on operational ranges and, where munitions-related contaminants have been detected, what corrective actions the services have taken. Specifically, you asked us to focus on DOD's actions with regard to perchlorate.

[2]DOD's *Fiscal Year 2002 Defense Environmental Restoration Program Annual Report to Congress.*

To determine how DOD identified the location and last active use of all operational ranges, we reviewed the services' inventory data and interviewed DOD and service officials to obtain information on how the inventories were conducted and the reliability of the data collected. We assessed the reliability of the services' data (1) by reviewing existing information about the data and processes that produced them and (2) by interviewing DOD officials knowledgeable about the data. We determined that data on the number of operational ranges and acreage were sufficiently reliable to include in our report. Although we found the reliability of data on operational range characteristics to be questionable, we present the data in the report for informational purposes. To determine the basis for DOD's cost estimates for cleaning up the operational ranges, we reviewed the services' estimated costs, supporting analyses, and calculations, and interviewed service and DOD officials on the scope and methodology used to develop cost estimates. To identify DOD's policy on sampling for constituents linked to the use of munitions on operational ranges, we reviewed DOD's and the services' policies related to sampling and cleanup of potential contaminants and specifically their policies on perchlorate. Finally, to report on what corrective actions the services have taken with regard to munitions constituents, particularly perchlorate, we visited seven DOD installations where perchlorate had been detected and discussed what efforts have taken place or were planned to respond generally to munitions-related contaminants and specifically to perchlorate.[3] Our observations about these installations are not generalizable to all military installations. We conducted our work between June 2003 and March 2004 in accordance with generally accepted government auditing standards. More detail on the scope and methodology of our review is presented in appendix II.

Results in Brief

DOD identified the location and status of its operational ranges based on inventory data developed by the individual services. However,

[3]The installations we visited were Holloman Air Force Base, in New Mexico; Edwards Air Force Base, in California; Army Redstone Arsenal, in Alabama; Army Aberdeen Proving Ground, in Maryland; Army White Sands Missile Range, in New Mexico; Naval Surface Warfare Center, Indian Head, in Maryland; and Naval Air Weapons Station, China Lake, in California. We selected installations based on available data, but were unable to determine the total number of installations reporting perchlorate contamination. DOD and EPA had only recently begun to collect data on perchlorate and data lists were not always current or complete, and were often redundant in that the same installations appeared on more than one list of installations reporting contamination.

inconsistencies in how DOD collected and analyzed data on operational ranges raise questions about the reliability of DOD's inventory. For example, the services used different methods to gather data, conducted inventories at different periods of time and for different reasons, and did not always validate their results. DOD's cost estimates to clean up operational ranges also are questionable because the estimates were based on this inventory data, as well as on a mix of cost assumptions that were not validated—where DOD did not establish a reasonable and defensible basis for the assumptions used—and computer-generated cost rates that varied across the services. For example, we found that in addition to DOD-provided assumptions, the services were allowed to use their own assumptions to estimate cleanup costs. Their differing approaches to estimating the percentage of acreage likely to be contaminated produced varying, and likely questionable, estimates of the costs to clean up operational ranges. In 2004, DOD completed another inventory of its operational ranges that was based on a more consistent data collection framework. However, because the 2004 inventory was conducted for a different purpose and scope, the 2003 and 2004 inventories are not comparable and there are differences between them. The differences between the two inventories make it difficult to determine if the range data used to estimate the cost of cleaning up operational ranges were accurate.

DOD does not have a comprehensive policy requiring sampling or cleanup of the more than 200 chemical contaminants associated with military munitions on operational ranges. None of these munitions constituents are currently regulated with a drinking water standard under the Safe Drinking Water Act, although some of them, including perchlorate, are covered under the act's Unregulated Contaminant Monitoring Regulation.[4] Certain chemicals associated with military munitions may, however, be subject to other environmental laws, including RCRA and CERCLA. With a few exceptions, EPA generally has not used its authority under these laws to require DOD to conduct a cleanup of its operational ranges, although some states have required installations to monitor and sample for contaminants, including perchlorate. For example, EPA and several states have asked DOD to test for perchlorate in areas such as old dump sites because of concern about potential contamination of groundwater. In this context, DOD issued a policy in November 2002 allowing the services to test for perchlorate if there was a reasonable basis to suspect both the presence of

[4]DOD has other policies requiring the services to assess potential hazards from munitions constituents migrating from operational ranges to off-range areas.

perchlorate and the possibility for human exposure. In September 2003, DOD revised its policy to direct sampling for perchlorate contamination at previously unexamined sites, including operational ranges, where a perchlorate release is suspected and a pathway to human exposure is likely, but the policy did not identify specific funding for this sampling. None of the seven installations with reported perchlorate contamination that we visited were currently sampling operational ranges for perchlorate under DOD's guidance, although they had conducted some sampling when required by states. While six of the installations we visited had reported high levels of perchlorate, none of these were cleaning up perchlorate contamination because, installation officials said, DOD policy did not require that they do so. Further, at six of the locations we visited, we determined that research, manufacturing, testing, and disposal of perchlorate were the primary activities that had caused contamination, and not the use of ordnance during training exercises.

In order to assist Congress, EPA, and state regulators in assessing and planning for the cleanup of contamination from the use of munitions at operational ranges, we are recommending that DOD (1) use its most complete operational range inventory to revise its cost estimates for the cleanup of operational ranges and use a more consistent methodology for estimating costs, and (2) provide specific funding for sampling at sites where perchlorate contamination is likely, in accordance with DOD's policy requiring sampling.

In commenting on a draft of this report, DOD disagreed with our findings and recommendations. DOD disagreed with our conclusion that it did not have a comprehensive policy requiring sampling or cleanup of munitions constituents on operational ranges and cited specific policies requiring the services to respond to the release of munitions constituents. However, the policies cited by DOD pertain only to the migration of munitions constituents off-range, and environmental reporting, and do not address the sampling or cleanup of munitions constituents found on operational ranges that are the subject of this report. DOD disagreed with our recommendation that it needed to develop new cost estimates for cleaning up operational ranges, stating that it is developing a system for providing data and assessing its ranges for potential munitions constituent migration to off-range areas. However, the requirement in the National Defense Authorization Act for fiscal year 2002 was to report estimated costs to clean up operational ranges, not the costs to respond to or clean up constituent migration off-range. DOD also questioned whether decision makers would find useful an estimated cost to clean up operational ranges.

We disagree with DOD's view of the usefulness of the information to Congress, because on two occasions, including in DOD's authorization act, Congress has directed DOD to provide such information. DOD also disagreed with our recommendation to provide specific funding for perchlorate sampling. According to DOD, its current policy designates funding for perchlorate sampling as a high priority environmental project. However, we believe that due to limited funds and because perchlorate sampling must compete with other high priority environmental priorities, it may not be funded. Consequently, while DOD policy designates a funding mechanism for perchlorate, it cannot assure that perchlorate sampling will be funded. DOD also provided technical comments and clarifications that we incorporated into the report, as appropriate. DOD's comments appear in appendix V.

Background

DOD policy defined an operational range as an area used to conduct research, develop and test military munitions, or train military personnel. Operational ranges were considered active when regularly used for range activities, and inactive when not currently used but still under military control and available for use as a range.[5] Once a range is closed, DOD is required to identify, assess, and clean up or take other appropriate action in response to contamination by military munitions.[6] As such, DOD's current inventory of operational ranges represents a potential liability for future cleanup. Figures 1, 2, and 3 show examples of the types of ordnance and explosives that can be found on operational ranges.

[5]DOD no longer distinguishes between active and inactive ranges. The current statutory definition of an operational range is "a range that is under the jurisdiction, custody, or control of the Secretary of Defense and (A) that is used for range activities, or (B) although not currently being used for range activities, that is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities." Pub. L. No. 108-136, § 1042(e)(3) (Nov. 24, 2003).

[6]DOD distinguishes range cleanup from range clearance. Range clearance is routine, conducted for the continued use of active ranges, and performed primarily for safety reasons, whereas range cleanup involves interim removal, remedial activities, and a final remedy, but only for closed ranges.

Figure 1: Discarded Munitions on an Operational Range That Were Later Uncovered by Erosion

Source: U.S. Army.

Figure 2: Discarded Military Munitions Discovered on a Closed Range

Source: U.S. Army.

Figure 3: Munitions Debris, Including Ordnance, Collected during Range Clearance

Source: U.S. Army.

Section 313(a)(1) of the National Defense Authorization Act for Fiscal Year 2002[7] required DOD to provide Congress with a comprehensive assessment of unexploded ordnance, discarded military munitions, and munitions constituents at current and former DOD facilities.[8] The law required the assessment to include an estimate of the aggregate projected cost of

[7]Pub. L. No. 107-107 (Dec. 28, 2001).

[8]This report deals with operational ranges on active installations. In December 2003, we issued a report on closed installations or those in the process of closing. As of September 2002, DOD had closed 542 ranges on open installations and 74 ranges on installations closed under the Base Realignment and Closure process, and is required to clean up munitions contamination on these ranges, if present. See U.S. General Accounting Office, *Military Munitions: DOD Needs to Develop a Comprehensive Approach for Cleaning Up Contaminated Sites*, GAO-04-147 (Washington, D.C.: Dec. 19, 2003).

remediation (or cleanup) at operational ranges, to be presented as a range of costs including a low and high estimate, and delivered to Congress in 2003 in DOD's report on the Defense Environmental Restoration Program. In April 2003, DOD reported its estimate for the total cost to address the potential liability associated with unexploded ordnance, discarded military munitions, and munitions constituents at operational ranges to be between $16 billion and $165 billion.

Collecting Inventory Data and Estimating Cleanup Costs

To provide Congress with estimated costs to clean up operational ranges, DOD used inventory data available at the time of its April 2003 report, which counted 10,444 operational ranges located in the United States and its territories. At the direction of Congress, only operational ranges in the United States and its territories were to be considered for the purpose of estimating cleanup costs. According to DOD, these cost estimates were supported by individual service estimates, which in turn were supported by summary information on the number of operational ranges and acreage assumed to contain a high density of unexploded ordnance and munitions constituents—such as target areas, detonation sites, and demolition areas—and the percentage of acreage assumed to contain a low density of contamination from unexploded ordnance and munitions constituents, such as buffers, training areas, and maneuver areas.

The services continued to inventory operational ranges under section 366 of the National Defense Authorization Act for Fiscal Year 2003,[9] which required DOD to inventory operational ranges to address training range sustainment and encroachment concerns and submit the inventory to Congress as part of the President's fiscal year 2005 budget request early in calendar year 2004. The scope of this inventory effort addressed operational range training and testing capacities and capabilities, and specific constraints on the use of operational ranges, but did not specifically include data on the cleanup of unexploded ordnance, discarded military munitions, or munitions constituents.

[9]Pub. L. No. 107-314 (Dec. 2, 2002).

We previously reported that the two key data needed to develop operational range cleanup costs were (1) an accurate and complete operational range inventory and (2) a consistent methodology for estimating costs.[10] Reliable cost estimates can be critical information for DOD and Congress when considering the potential benefits of closing operational ranges or entire installations versus the potentially very high cost of cleaning up such sites. However, such estimates must be based on accurate data that, in the case of operational ranges, begins with a complete and accurate operational range inventory. The costs for cleaning up ranges can be extensive. For example, DOD estimates it will cost $22.6 million to clean up Fort McClellan in Alabama, recommended for closure under DOD's base realignment and closure program in 1995, and $247 million to clean up Fort Ord in California, closed in 1994. DOD officials explained that wide variations in cost can be attributed to a number of factors, such as future land use, technical complexities, and the high level of difficulty to locate, recover, and destroy ordnance located beneath the ground surface.

Environmental Laws and Regulations Affecting DOD Installations and Operational Ranges

DOD's operations at military installations and operational ranges in the United States are subject to laws and regulations governing a variety of environmental concerns, from water quality to the treatment and disposal of hazardous wastes. These laws include the Safe Drinking Water Act, the Clean Water Act, RCRA, the Federal Facility Compliance Act, and CERCLA. DOD is also generally required to comply with state and local environmental statutory and regulatory requirements on its installations and operational ranges. DOD has proposed that Congress specifically exempt it from requirements to clean up unexploded ordnance, munitions, and munitions constituents on operational ranges under RCRA and CERCLA.

The Safe Drinking Water Act authorizes EPA to issue national primary drinking water regulations setting maximum contaminant level standards for drinking water that must be met by public water systems.[11] EPA may authorize states to carry out primary enforcement authority for

[10]U.S. General Accounting Office, *Environmental Liabilities: DOD Training Range Cleanup Cost Estimates Are Likely Understated*, GAO-01-479 (Washington, D.C.: Apr. 11, 2001).

[11]A public water system is subject to the Safe Drinking Water Act if the system has at least 15 service connections or regularly serves at least 25 individuals.

implementing the Safe Drinking Water Act if, among other things, the state adopts drinking water regulations that are no less stringent than the national primary drinking water regulations. EPA has set standards for approximately 90 contaminants in drinking water, including microorganisms, organic chemicals, inorganic chemicals, disinfectants, disinfection byproducts, and radioactive substances.[12] None of the more than 200 chemical contaminants associated with munitions use are currently regulated under the Safe Drinking Water Act.

The 1996 amendments to the Safe Drinking Water Act required EPA to establish criteria for a monitoring program for unregulated contaminants (where a maximum contamination level has not been established) and to publish a list of contaminants—chosen from those not currently monitored by public water systems—to be monitored. EPA's regulation, referred to as the Unregulated Contaminant Monitoring Regulation, was issued in 1999 and supplemented in 2000 and 2001.[13] The purposes of the regulation are to determine whether a contaminant occurs at a frequency and in concentrations that warrant further analysis and research on its potential effects and to possibly establish future drinking water regulations. The first step in the current program required public water systems serving more than 10,000 customers (and a sample of 800 small public water systems serving fewer than 10,000) to monitor drinking water for perchlorate and 11 other unregulated contaminants over a consecutive 12-month period at any point between 2001 and 2003, and report the results to the EPA. Under this regulation, some DOD installations were required to monitor drinking water for perchlorate and other munitions-related contaminants and to report the results.

[12]None of the approximately 90 contaminants regulated by EPA under the Safe Drinking Water Act are associated with the use of military munitions. Some regulated contaminants, such as arsenic, may result from the use of military munitions, but EPA does not regulate arsenic resulting from such use. It does, however, regulate arsenic found in drinking water resulting from the erosion of natural deposits, runoff from agriculture sites, and certain production wastes.

[13]40 C.F.R. § 141.40.

The Clean Water Act authorizes EPA to regulate the discharge of pollutants into waters in the United States. EPA may authorize states to carry out a state program in lieu of the federal program if the state program is at least equivalent to the federal program and provides for adequate enforcement. Under the Clean Water Act's National Pollution Discharge Elimination System (NPDES) program, facilities discharging pollutants into waters of the United States are required to obtain an NPDES permit from EPA or authorized states. NPDES permits include specific limits on the quantity of pollutants that may be discharged and require monitoring of those discharges to ensure compliance. EPA's list of the toxic pollutants subject to regulation under the Clean Water Act includes nitrobenzene, a chemical that is on DOD's list of 20 constituents of greatest concern.[14]

RCRA requires owners and operators of facilities that treat, store, and dispose of hazardous waste, including federal agencies, to obtain a permit specifying how their facilities will safely manage the waste. Under RCRA's corrective action provisions, facilities seeking or holding RCRA permits can be required to clean up their hazardous waste contamination. The corrective actions can be specified in the facility's operating permit, in a separate corrective action permit, or through an enforcement order. EPA also has authority under RCRA to order a cleanup of hazardous waste when there is an imminent and substantial endangerment to public health or the environment. EPA may authorize states to administer their own programs in lieu of the federal program, as long as these programs are equivalent to and consistent with the federal program and provide for adequate enforcement. EPA's regulations define hazardous wastes to include those that are specifically listed in the regulations as well as those that are "characteristic wastes." Characteristic hazardous wastes are defined as wastes that are ignitable, corrosive, reactive, or toxic. A federal district court in California recently ruled, in part, that perchlorate is a hazardous waste under RCRA because it is ignitable.[15]

[14]40 C.F.R. § 401.15.

[15]*Castaic Lake Water Agency v. Whittaker Corp*, 272 F. Supp. 2d 1053 (C.D. Cal. 2003). The conclusion that perchlorate is a hazardous waste was the first step in the court's analysis of whether perchlorate is a hazardous substance under CERCLA. (The definition of hazardous substances under CERCLA includes hazardous waste under RCRA.)

Under section 107 of the Federal Facility Compliance Act of 1992,[16] EPA was required, in consultation with DOD and the states, to issue a rule identifying when military munitions become hazardous waste under RCRA, and to provide for protective storage and transportation of that waste. Under the rule issued by EPA, military munitions are subject to RCRA when, among other things, (1) unexploded munitions or their constituents are buried or otherwise disposed of, or (2) when used or fired munitions are taken off-range.[17]

CERCLA governs the cleanup of releases or threatened releases of hazardous substances, pollutants, or contaminants. CERCLA's definition of a hazardous substance includes substances regulated under various other environmental laws, including RCRA, the Clean Air Act, the Clean Water Act, and the Toxic Substances Control Act. Under section 120 of CERCLA, the federal government is subject to and must comply with CERCLA's requirements to the same extent as any nongovernmental entity. DOD's cleanup under CERCLA section 120 is interrelated with its environmental restoration program under section 211 of the Superfund Amendments and Reauthorization Act of 1986.[18]

Contaminants Associated with Military Munitions

According to DOD, there are more than 200 chemicals associated with military munitions, and of these, 20 are of great concern due to their widespread use and potential environmental impact. TNT, Propanetriol trinitrate (nitroglycerin), Royal Demolition Explosive, and perchlorate are among the 20. Perchlorate is the primary oxidizer in propellants, present in varying amounts in explosives, and is highly soluble. According to EPA, an estimated 90 percent of the perchlorate produced in the United States is manufactured for use by the military and the National Aeronautics and Space Administration. Typical production quantities average several million pounds per year. Nonmilitary uses for perchlorate include fireworks, flares, fertilizer, and automobile airbags. As of 2004, EPA reported that 34 states confirmed perchlorate contamination in ground and

[16]Section 107 of the Federal Facility Compliance Act amended RCRA by adding a new section 3004(y), codified at 42 U.S.C. § 6924(y).

[17]40 C.F.R § 266.202.

[18]Under the Defense Environmental Restoration Program established under section 211, DOD is required to identify, investigate, and clean up environmental contamination and other hazards at active and closing installations, as well as at formerly used defense sites.

surface water, and in states where EPA determined the source of the contamination, it attributed a significant portion to defense manufacturing and test sites.

EPA has not established a federal drinking water standard for perchlorate. However, in 1999, EPA established a provisional reference dose for perchlorate in drinking water of between 4 and 18 parts per billion. A reference dose is an estimate of the daily exposure to a human that would not pose a significant risk of harmful effects. In October 2003, the National Academy of Sciences (Academy) began a study of the best scientific model to use for determining a drinking water standard or reference dose for perchlorate, if any. According to EPA, the Academy's study will take about one year to complete. Based on recommendations from the Academy, EPA will decide whether to regulate the contaminant and will have up to 2 years after making an affirmative determination to propose a national primary drinking water regulation for perchlorate.[19] An EPA official told us that updating drinking water standards can take 2 to 3 years and predicted that a perchlorate standard will likely not be available until 2006 or 2008.

In the meantime, some states that detected perchlorate in various media, such as groundwater, have established state guidance or advisory levels for the contaminant. As of February 2004, seven states have established interim perchlorate advisory levels. Of those states, Maryland and Massachusetts have the lowest perchlorate advisory level of 1 part per billion. On March 12, 2004, California revised its advisory action level for perchlorate from 4 parts per billion to 6 parts per billion.

DOD's Inventory and Cost Estimates for Operational Range Cleanup May Not Provide Congress with a Reliable Picture of Potential Liabilities

DOD's estimate that it would cost between $16 billion and $165 billion to clean up unexploded ordnance, discarded military munitions, and munitions constituents on operational ranges is questionable. To determine the costs of operational range clean up, DOD had to first inventory its operational ranges and obtain data such as the type of range and munitions used. However, the military services used inventory data that were collected for different purposes over different periods of time and verified with varying degrees of analytical rigor. Next, the costs of operational range cleanup were calculated using a mix of unvalidated assumptions provided by DOD and assumptions provided by the individual services, as

[19] 42 U.S.C. § 300g-1(b)(1)(E).

well as actual service data, where available. Consequently, DOD's overall cost estimates were based on assumptions, estimates, and actual data that differed across the services and that raise questions about the reliability of DOD's estimated costs to clean up operational ranges.

Operational Range Inventory Process Lacked a Common Framework and Analytical Rigor

Each service inventoried its operational ranges and collected data on range acreage and munitions used, using various methodologies over different periods of time. (See table 1 for the starting and ending dates of the service's inventories.) Services also conducted inventories for different reasons, such as to respond to pending legislation on ranges, public concern about military use of ranges, or simply to gather data to calculate cleanup cost estimates. The rigor of the analysis and the degree of the validity of the inventory results varied by service. The inconsistencies in how DOD collected and analyzed data on operational ranges raise questions about the reliability of DOD's inventory.

Table 1: Dates Service Inventories Were Conducted

Military Service	Inventory started	Inventory ended
Air Force	August 2001	December 2002
Army	July 2000	December 2002
Marine Corps	October 2001	November 2002
Navy	December 1999	January 2000

Source: GAO analysis of military service data.

The Air Force inventory of operational ranges in the United States and its territories was based on a survey sent to field command levels to estimate costs to clean up operational ranges. Service officials said survey data was validated during on-site field inspections or, in some cases, brief desk reviews to assure surveys were complete and free of obvious errors. As of December 2002, the Air Force counted 222 active ranges, 23 inactive ranges, and 23 ranges that were not categorized as either active or inactive. Together, Air Force operational ranges covered 6,423,161 acres.

The Army's inventory of operational ranges was conducted concurrently with an inventory of nonoperational ranges and was based on field surveys. According to Army officials, the Army initiated an inventory of its ranges primarily in response to anticipated legislation on the use of ranges,[20] which required a comprehensive inventory of DOD ranges as well as a collection of descriptive data about each range, such as the acreage and types of munitions used on the range. The Army's inventory was also conducted in response to DOD directives issued in August 1999 that required the services to establish and maintain an inventory of operational ranges and data on munitions and ordnance.[21] To inventory ranges, the Army used contract support staff who requested data from field commands and installations, and then sought to validate the data through on-site visits. Army officials said the Army's inventory of operational ranges was completed in December 2002, and encompassed 9,427 active ranges, 377 inactive ranges, and 4 ranges not designated active or inactive. In total, Army operational ranges covered 14,991,072 acres in the United States and its territories.

Similar to the Army, the Marine Corps conducted an inventory of its operational ranges primarily in response to anticipated legislation on the use of ranges and DOD directives that required the services to establish and maintain an inventory of operational ranges and data on munitions and ordnance. The Marine Corps developed its inventory from an archive data search and surveys sent to installations. Headquarters' officials reviewed the surveys to assure that submitted data agreed with data in the archive search. As of December 2002, the Marine Corps counted 216 operational ranges totaling 1,980,119 acres in the United States and its territories. According to headquarters' officials, the Marine Corps did not distinguish between active and inactive ranges but designated all ranges as operational.

[20]On September 26, 1997, DOD published a proposed range rule on closed, transferred, and transferring ranges containing military munitions. The proposed rule identified a process for evaluating response action on closed, transferred, and transferring ranges and required a comprehensive inventory of DOD ranges, including a collection of descriptive data for each range. However, the proposed rule applied to nonoperational ranges only. On November 13, 2000, DOD withdrew the proposed range rule from the rule-making process because DOD, EPA, and federal land managers could not reach consensus on several key issues, including how explosive safety would be handled under the rule, concurrence on remedial actions, and who would decide the remedy.

[21]DOD Directives 4715.11 and 4715.12.

The Navy's inventory of operational ranges in the United States and its territories was conducted at the request of the Navy's Environmental Readiness Division. The Navy's inventory was prepared in response to the anticipated inventory requirements of DOD's proposed range rule and because of increased public and regulatory scrutiny of military ranges, Navy officials said. The inventory was conducted through surveys sent to the installations. As of December 2002, Navy operational ranges totaled 121 active ranges and 31 inactive ranges on 1,284,374 acres.

As of April 2003, when DOD reported its estimated cost to clean up operational ranges, DOD's inventory included 10,444 operational ranges totaling 24.6 million acres in the United States and its territories. (See table 2 for a breakout of operational ranges by service and status and total acres.)

Table 2: Active and Inactive Operational Ranges and Acreage as Reported by DOD in April 2003

	Operational Ranges				
	Active	Inactive	Not categorized	Total	Total acreage (in millions)
Air Force	222	23	23	268	6.4
Army[a]	9,427	377	4	9,808	15.0
Marine Corps	0	0	216	216	1.9
Navy	121	31	0	152	1.3
DOD total	**9,770**	**431**	**243**	**10,444**	**24.6**

Source: GAO analysis of military service data.

[a]According to Army officials, the Army's inventory of operational ranges was finalized in the summer of 2003 and revised to 9,427 active and 377 inactive ranges totaling about 15 million acres in the United States and its territories.

DOD continued to inventory its operational ranges. The National Defense Authorization Act for Fiscal Year 2003 required DOD to develop a plan to address training range issues, such as range sustainment and encroachment and, as part of this plan, to develop a range inventory system that included all available operational training ranges. In January 2003, DOD provided the services with an inventory framework and data definitions to ensure reporting consistency and required the services to complete detailed inventories of all of their operational ranges. DOD

revised its existing inventory of operational ranges to meet this new requirement. Because the revised inventory was conducted for different purposes, using a scope and set of assumptions that were different from the inventory data used to estimate cleanup costs, it identified a different number of operational ranges. For example, the inventory for developing the cost estimates used actual operational range acreage, whereas the revised inventory used actual and potential operational range acreage. Further, the revised inventory is divided into range complexes and individual ranges, and includes operational ranges outside the United States and its territories not included in the inventory DOD used to estimate cleanup costs.

In February 2004, DOD released the results of its training range plan and revised inventory. The revised inventory listed 353 range complexes and 172 individual ranges on 26 million acres worldwide. These numbers differ from the inventory data DOD used to estimate cleanup costs, which counted 10,444 operational ranges on 24.6 million acres in the United States and its territories primarily because of the aggregation of individual ranges into complexes and the inclusion of ranges outside the United States and its territories. For example, under the prior inventory, Fallon Naval Air Station, in Nevada, reported it had 150,365 acres of rangeland, but under the new inventory, Fallon reported it had just 103,300 acres of actual and potential rangeland. Also under the prior inventory, the Marine Corps reported that Camp Lejeune, in North Carolina, had 95,872 acres of rangeland, while under the new inventory, Camp Lejeune reported it had 152,000 acres of actual and potential rangeland (even though the entire installation encompasses just 153,000 acres). The Marine Corps also reported that Camp Pendleton, in California, had 39,084 acres of rangeland under the old inventory, but under the new inventory, Camp Pendleton reported it had 114,000 acres of actual and potential rangeland, almost a threefold increase.

While the 2003 and 2004 inventories are not readily comparable because of the varying scope and definitions used to develop the revised inventory, the difference between the two highlights the difficulty in understanding the basis for, and the results of, DOD's cost estimates. Finally, we believe the differences in the two inventories may further complicate efforts of Congress to identify the potential liabilities that may exist if operational ranges or installations are closed and require cleanup.

Cost Estimates Were Calculated Using a Mix of Differing Assumptions, Estimates, and Actual Data

In 2002, DOD provided guidance to the services on how to estimate costs for cleaning up operational ranges. This guidance specified the scope for estimating costs but allowed for variation across the services. According to DOD officials, because the requirement to estimate cleanup costs was a one-time congressional requirement, DOD directed the services to limit their data gathering efforts by using certain costing assumptions and a computer-costing model in combination with already existing data. Examples of the scope and some of the assumptions DOD used to estimate costs include the following:

- The scope of the inventory was limited to operational ranges within the United States and its territories because DOD believed that was what Congress intended.

- The scope excluded certain operational ranges, such as water ranges, because DOD did not have a model for estimating costs associated with such ranges and did not have any significant historical experience on which to base an estimate. DOD also did not develop cost estimates for several types of airspace, such as warning areas and restricted areas.

- DOD directed the services to use both a computer-costing model that automatically assigned certain values for the cleanup costs of unexploded ordnance and discarded military munitions and an electronic worksheet to estimate costs to clean up munitions constituents.

- DOD provided cost assumptions to the services based on operational range acreage and other variables. For example, the services were directed to divide range acreage into areas assumed to have a high density of contamination and a low density of contamination and, on that basis, calculate individual cleanup costs.

- DOD also provided specific assumptions to calculate costs for various cleanup activities. For example, to estimate the cost to remove unexploded ordnance from a highly contaminated range area, the services were told to assume they would need to remove ordnance from 50 percent of that area to calculate the high cost estimate and 5 percent of that area to calculate the low cost estimate.

DOD said its assumptions were based on discussions with the services and developed through consensus. DOD could not provide any documentation that the assumptions they asked the services to use were validated—a

confirmation of the reasonableness and justification for assumptions used—and a senior DOD official told us that, in fact, the assumptions were not validated.

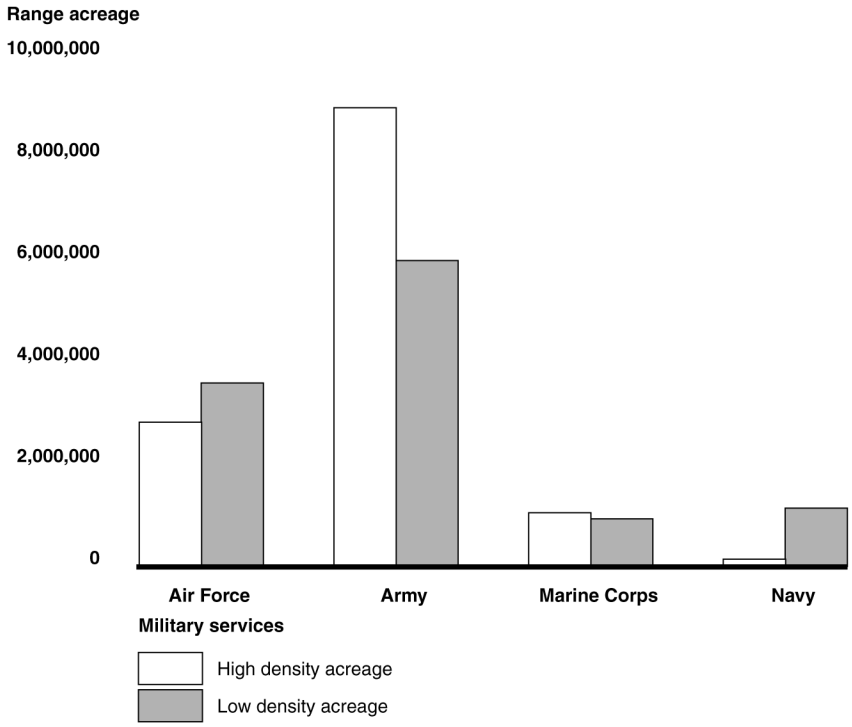
Furthermore, DOD instructions to the services allowed them to use additional assumptions or site-specific data so that cost estimates were calculated based on a mix of actual data and assumptions. Based on our review of DOD's 2003 report to Congress, and discussions with service officials on their methodologies to estimate costs, we found DOD did not fully explain the mix of assumptions and data used and how this mix affected the cost estimates, so that the usefulness of DOD's overall cleanup cost estimates to Congress is questionable.

The inconsistencies in how the services developed their cost estimates are evident in areas such as how the services calculated high-density acreage (that is, the area of a range containing a high density of ordnance) and the costs for cleaning up these acres. For example, although DOD guidance directed the services to estimate what proportion or percentage of operational range acreage contained a high density of unexploded ordnance and munitions constituents, and specified how various types of ranges were to be treated for cost estimating purposes, each service performed this calculation differently. If site-specific data was unavailable, the Marine Corps used varying percentages based on the characteristics of similar ranges to determine those that were highly contaminated. Our analysis showed that for about two-thirds of its operational ranges, the Marine Corps assumed 10 percent of its nonsmall arms or multipurpose range acreage was highly contaminated. However, based on a review of the Marine Corps' total cleanup cost estimates for operational ranges, GAO determined that the Marine Corps calculated its costs assuming that an average 53 percent of range acreage has highly contaminated. In contrast, the Air Force and the Army used estimated data to determine that 44 percent and 60 percent of their acreage was highly contaminated, respectively.[22] Further, the Air Force did not designate a percentage of each operational range with a high density of contamination and a low density of contamination, but rather defined each operational range as either 100 percent high density or 100 percent low density. The Navy used actual data to determine that 11 percent of its operational range acreage was highly

[22]Army officials told us the Army assumed 60 percent of operational range acreage was highly contaminated, but our analysis of Army data (see table 4) shows the Army actually assumed that 58 percent of acreage was highly contaminated.

contaminated. (Figure 4 shows the high and low density acreage by service used to estimate cleanup costs.)

Figure 4: High and Low Density Operational Range Acreage Used to Estimate Cleanup Costs, by Service



Source: GAO analysis of military service data.

Based on the data provided by the services, the model calculated four totals for each operational range: a low and high estimated cost to clean up the portion of the range assumed to have a low level of contamination, and a low and high estimated cost to clean up the portion of the range assumed to be highly contaminated. Low estimates for low and high contamination areas were combined to calculate a total low estimate, and high estimates for low and high contamination areas were combined to calculate a total high estimate. (See table 3 for low and high estimates by service.)

Table 3: Low and High Cost Estimates to Clean Up Unexploded Ordnance, Discarded Military Munitions, and Munitions Constituents

Billions of dollars

	Low estimate	High estimate
Air Force	1.2	14.0
Army	14.5	141.5
Navy	0.2	2.5
Marine Corps	0.5	6.7
DOD[a]	16.0	165.0

Sources: The Fiscal Year 2002 Defense Environmental Restoration Program report and military service data.

[a]Estimates do not add due to rounding.

In general, using the model and standardized assumptions should have produced estimates with some variation across the services because of differing missions, operational practices, and types of munitions used. However, as reflected in table 4, a tenfold difference in the average cost to clean up an acre of highly contaminated rangeland calls into question the mix of different assumptions and data used by the services to estimate costs. For example, the Air Force's average cost to clean up an acre with a high density of contamination was $755, whereas the Army's estimate was $7,577. As a result, the services cost estimates are not comparable. (Table 4 shows the total and average cost per acre estimates by service.)

Table 4: High Cost Estimates to Clean Up an Acre with a High Density of Contamination, by Service

Service	Acreage	High cost estimate (dollars)	Average high cost per acre (dollars)
Air Force	2,835,579	2,140,072,819	755
Army	8,691,311	65,855,410,348	7,577
Marine Corps	1,023,623	3,719,488,388	3,634
Navy	134,459	920,669,000	6,847

Source: GAO analysis of military service data.

DOD Does Not Have a Comprehensive Policy on Contaminants Associated with Military Munitions and Has Not Specifically Cleaned Up Known Perchlorate Contamination

DOD does not have a comprehensive policy requiring sampling or cleanup of the more than 200 chemical contaminants associated with military munitions on operational ranges. However, DOD installations have sampled for and cleaned up munitions-based constituents when directed by state regulatory authorities. With regard to perchlorate, DOD has issued sampling policies but does not provide specific funding for such sampling. Nevertheless, we found some installations have sampled and monitored for perchlorate to meet the requirements of environmental laws and regulations, such as RCRA and the Unregulated Contaminant Monitoring Regulation. During visits to six installations that reported high levels of perchlorate, we found that none were cleaning up perchlorate contamination. At six of the seven installations we visited, perchlorate contamination was largely the result of researching, manufacturing, testing, and disposing of munitions, and not the use of munitions during training.

Previous DOD Policy Did Not Require Cleanup or Sampling for Contaminants Associated with Military Munitions

According to EPA, of the more than 200 chemicals associated with military munitions, which include 20 that DOD considers to be of greatest concern due to their widespread use and potential environmental impact, none are specifically regulated under the Safe Drinking Water Act. Further, except in some specific instances, EPA does not generally use its authority under other environmental laws, such as RCRA and CERCLA, to require DOD to conduct cleanups on operational ranges.[23] An EPA official told us that although EPA is concerned with constituents associated with military munitions such as perchlorate and Royal Demolition Explosive, and the migration of plumes (pollutants that drain or flow through soil and water) from military ranges to groundwater, the agency generally does not interfere with DOD's operation of its operational ranges. Recently, DOD proposed that Congress specifically exempt it from requirements to clean up unexploded ordnance, munitions, and munitions constituents that remain on operational ranges under RCRA and CERCLA.

[23]In some instances, EPA has used its authority under these acts to require cleanup of munitions constituents on operational ranges. For example, at Fort Richardson, Alaska, EPA required the Army to clean up contamination caused by munitions containing white phosphorus.

DOD policy does not generally require the services to clean up or sample for munitions contaminants because, according to DOD officials, these contaminants are deposited on operational ranges in the course of the normal and intended use of these munitions. Yet, DOD may be required by EPA or states to sample and clean up its munitions contaminants under various environmental laws and regulations on operational ranges. For example, under the Clean Water Act, facilities that discharge pollutants into surface water are required to obtain a NPDES permit from EPA or an authorized state agency. Several states have required some DOD installations to monitor for various contaminants associated with military munitions as part of the NPDES permit process. For example, the Regional Water Quality Control Board in San Diego and the Hampton Roads Sanitation District in Hampton Roads, Virginia, required Navy facilities to monitor their water discharges for various constituents that are on EPA's list of toxic pollutants under the Clean Water Act.[24] Under the Unregulated Contaminant Monitoring Regulation, EPA required some installations to sample for and report on 12 unregulated contaminants in drinking water during any 12-month period between 2001 and 2003. The list of contaminants included four munitions-related contaminants—perchlorate, 2,4 and 2,6 dinitrotoluene, and nitrobenzene. In April 2004, DOD reported that 36 installations had sampled for the presence of unregulated contaminants in drinking water, including perchlorate, under this regulation. Of these, 33 installations reported no perchlorate was detected or detection results were below the reporting limit of 4 parts per billion. Only three Air Force installations detected perchlorate above the reporting limit, ranging from just over 4 parts per billion to 46 parts per billion.

Revised DOD Policy Directs Sampling for Perchlorate under Certain Conditions but Little Sampling Has Been Done

In November 2002, DOD issued its first policy on perchlorate assessment that stated the services may sample and assess for perchlorate if there was a reasonable basis to suspect both a potential presence of perchlorate and a likely pathway that could lead to human exposure. The policy stated that the services could fund assessments using the operations and maintenance environmental compliance account, but specified that sampling should be considered a lower priority (Class II) environmental project and, as we

[24]See 40 C.F.R. § 401.15. The three constituents—2,4 and 2,6 dinitrotoluene (used to produce explosives and ammunition and known to cause cancer) and nitrobenzene (may be used in defense manufacturing and linked to blood disorders)—are on DOD's list of munitions constituents of greatest concern.

found in a prior effort, was unlikely to be funded.[25] Finally, the policy directed those installations that sampled for and found perchlorate to report to DOD on the location and amount of perchlorate found. On September 29, 2003, DOD issued a revised policy on perchlorate sampling that directed the services to (1) consolidate data on perchlorate detections, including data developed in response to environmental laws such as the Clean Water Act and Safe Drinking Water Act, and (2) sample any previously unexamined sites, including ranges, where a perchlorate release is suspected because of prior DOD activities and where human exposure is likely. The policy stated that the services should fund sampling using the same environmental compliance account specified in the previous policy, but elevated sampling to a higher (Class I) funding priority and thus made it more likely to be funded. However, when DOD issued its policy, funding had already been allocated to Class I requirements for fiscal year 2004. In future years, unless specific or additional funding is added, perchlorate sampling will have to compete with other high priority environmental requirements and may not be funded.

In implementing the revised policy, the services added a third criterion requiring that installations coordinate with, or obtain written approval from, headquarters and the chain of command before sampling for perchlorate. However, if sampling is specifically required by an environmental law or state agency, the service policies do not require installations to request approval or notify headquarters before sampling. During visits we made to selected installations with reported perchlorate contamination between October 2003 and January 2004, we found installations were not sampling under the revised policy to determine the presence of perchlorate on operational ranges. More broadly, as of

[25]To assure compliance with the requirements of environmental laws, DOD has an environmental quality program that is largely funded by DOD's appropriation for operation and maintenance activities. This account also funds a wide range of installation activities such as military training, base operations, and property management. As such, DOD's environmental quality program must compete with these other activities for funding. As GAO reported in June 2003, DOD's environmental quality program has a ranking system for funding environmental activities where activities ranked Class 0 or I must be funded in the current program year because of a law or regulation, whereas funding for activities ranked Class II or III may be deferred because there is no legislative requirement in the current budget year. We found DOD did not always have sufficient funds to pay for environmental priorities and sometimes did not follow the program's ranking system and instead funded lower priority activities while not funding some higher priorities. See U.S. General Accounting Office, *Environmental Compliance: Better DOD Guidance Needed to Ensure That the Most Important Activities Are Funded*, GAO-03-639 (Washington, D.C.: June 17, 2003).

February 2004, Marine Corps and Navy officials said that no installations had requested permission to sample under this policy. According to the Air Force, three installations asked for permission to sample for perchlorate because EPA had asked that they sample. Air Force headquarters approved two of the requests but denied the third because, according to Air Force headquarters, there was not a reason to suspect the presence of perchlorate. Four Army installations have asked for approval to sample for perchlorate, and Army headquarters approved all four as of March 2004, an Army headquarters official said. Overall, this suggests that little sampling is being done under DOD's revised perchlorate policy.

Although none of the installations had begun sampling under DOD's revised policy, during our visits we found a few installations had sampled and monitored for perchlorate to meet the requirements of certain environmental laws and regulations. Table 5 summarizes the perchlorate sampling that has been conducted at installations we visited as reported by DOD as of April 2004.

Table 5: Summary of Perchlorate Sampling Conducted at Installations Visited by GAO

Installation	Number of samples collected	Number of positive detections	Range of concentrations detected (in parts per billion)	Source of perchlorate contamination
Edwards Air Force Base	413	309	Up to 2,100,000 in soil and up to 30,700 in groundwater	Propulsion research and rocket test stand; maintenance; landfill
Holloman Air Force Base	2	1	7,600	Research, development, testing and evaluation
Aberdeen Proving Ground	1,193	540	Less than 1 and up to 12,000	Training with pyrotechnics and smoke; use of propellants, ordnance, smoke and chemical agents
Redstone Arsenal	Not reported	Not reported	Up to 37,000	Rocket testing
White Sands Missile Range[a]	Not reported	Not reported	Not reported	Not reported
Naval Air Weapons Station, China Lake	12	12	Up to 720	Research, development and testing; disposal; possible natural occurrence
Naval Surface Warfare Center, Indian Head	708	278	Up to 480,000	Disposal, open burning, unknown source

Source: DOD perchlorate sampling data as of April 2004.

[a]Although it was not reported by DOD as of April 2004, we found during our visit to White Sands Missile Range that officials sampled for perchlorate as part of an RCRA application.

During our visits, we found the following installations had sampled for and monitored perchlorate to meet the requirements of RCRA or the Safe Drinking Water Act:

- In 1999, as part of an application under RCRA to close an open burning and detonation facility used to destroy excess and obsolete ammunition, the state of New Mexico required White Sands Missile Range, in New Mexico, to sample for contaminants, including perchlorate. The former open burning and detonation facility is located on an operational range. Groundwater sampling detected high levels of perchlorate—up to 25,000 parts per billion.[26] The Army installed 56 monitoring wells on the range to map the plume. Each well is sampled quarterly. After four years of quarterly sampling and monitoring, Army officials said the plume is stable and contained, which means it is isolated underground and not expected to move. Further, officials said there is no indication that perchlorate has migrated outside the identified plume. Under its RCRA closure permit with the state of New Mexico, the Army must continue monitoring the groundwater for up to 20 years.

- Three of the seven installations we visited tested for perchlorate under the Safe Drinking Water Act's Unregulated Contaminant Monitoring Regulation program. Edwards Air Force Base, in California, sampled twice in 2002 and reported that none of the 12 chemicals listed on the EPA list of unregulated contaminants, including perchlorate, were detected in any of the groundwater samples collected from drinking water wells. (Under the regulation, EPA required surface water systems to be sampled quarterly and groundwater systems to be sampled semiannually for one consecutive 12-month period.) Redstone Arsenal, in Alabama, sampled quarterly for a 12-month period beginning June 2001. Two water intake sites were sampled (a drinking water source and a drinking water and industrial water source), both along the Tennessee River. Redstone Arsenal reported that perchlorate was not detected above the EPA sampling level of 4 parts per billion. Nearby Huntsville, Alabama, also sampled for perchlorate and detected no contamination, a Redstone Arsenal official said. Finally, although the requirements of the Unregulated Contaminant Monitoring Regulation did not apply to

[26]Initially, Army officials said they believed the perchlorate contamination resulted from the burning of rocket motors in pits at the open burning and detonation facility. More recently, however, Army officials speculated that the plume in the hazardous test area is from another unknown source because it is uphill from the open burning and detonation facility.

the Naval Air Weapons Station, China Lake, in California, because its water supply system was too small, installation officials volunteered to sample for perchlorate and other unregulated contaminants. Accordingly, in October 2003, officials at China Lake sampled 10 drinking water wells for perchlorate and other contaminants, but perchlorate was not detected.

DOD Has Not Directed the Services to Clean Up Known Perchlorate Contamination

According to information provided by DOD and officials at the installations we visited, the services were generally not cleaning up known perchlorate contamination. DOD officials explained that perchlorate is not a regulated contaminant and, therefore, there is no requirement to clean up perchlorate contamination.[27] (Current DOD policy is that DOD will clean up perchlorate if there is imminent and substantial endangerment to the public.) The exceptions we found were two installations that had cleaned up perchlorate under demonstration projects designed to demonstrate perchlorate cleanup technologies. At the installations we visited, perchlorate contamination was generally the result of research, manufacturing, testing, and disposal of munitions (such as rocket motors) that contained high levels of perchlorate. In one case, the perchlorate resulted from training with smoke munitions containing perchlorate.

Although six of the seven sites we visited reported high levels of perchlorate contamination, none of these installations were conducting cleanup actions specifically directed at perchlorate. However, at two installations we visited—Edwards Air Force Base and the Naval Surface Warfare Center, Indian Head—officials said they conducted demonstration projects to develop perchlorate treatment and cleanup technologies in anticipation of future cleanup requirements. (See app. III for details on these demonstration projects.)

At six of the seven installations we visited that had operational ranges and detectable levels of perchlorate, we found the perchlorate contamination was generally not due to training on operational ranges. Rather, we found that prior and ongoing research, manufacturing, testing, and disposal of

[27]Although there is not a standard for perchlorate under the Safe Drinking Water Act, in at least one instance EPA required the Army to clean up munitions constituents in groundwater, such as perchlorate. EPA required the Massachusetts Military Reservation to clean up munitions constituents under its Safe Drinking Water Act authority, which allows it to take action when there is an imminent and substantial endangerment to the health of persons. 42 U.S.C. § 300i(a).

rocket motors were primarily responsible for perchlorate contamination. (See app. IV for details of perchlorate contamination caused by such factors.) Only Aberdeen Proving Ground, in Maryland, reported that some perchlorate contamination was due to the use of perchlorate during training exercises on operational ranges. Further, Aberdeen was the only installation we visited where perchlorate had contaminated a neighboring municipal water supply. At Aberdeen, perchlorate concentrations of up to 5 parts per billion have been detected in drinking water supply wells and 24 parts per billion have been detected in groundwater.

Between June and August 2002, Aberdeen Proving Ground sampled drinking water wells owned by the city of Aberdeen located in and along the northern border between the city and the installation, and detected perchlorate contamination in four wells ranging from 1.2 to 5 parts per billion. According to Aberdeen officials, the installation sampled for perchlorate because it was required to do so by the state of Maryland. Groundwater samples taken near the well field showed a large perchlorate plume with contamination levels up to 24 parts per billion. Aberdeen Proving Ground officials attributed the perchlorate contamination to intensive testing and training with smoke grenades and other obscurants. Until about mid-2002, during training exercises in the vicinity of the city of Aberdeen drinking water wells, Aberdeen Proving Ground trained troops using smoke grenades that contained perchlorate. After perchlorate was found in city drinking water, Aberdeen Proving Ground stopped all training with smoke grenades containing perchlorate. However, officials at Aberdeen Proving Ground are not cleaning up the perchlorate detected in city wells. Instead, both the city of Aberdeen and the installation sample finished water and production wells on an alternating monthly schedule: Finished water is sampled weekly, four production wells are sampled twice a month, and the remaining eight production wells are sampled monthly. Recent sampling has detected contamination below the EPA interim assessment guidance of 4 parts per billion, but in some cases, well samples have been above the Maryland Department of the Environment public health advisory for perchlorate, which is 1 part per billion for drinking water. In the event a sample is found to be above the Maryland state advisory limit, the city of Aberdeen blends well water without perchlorate with well water containing perchlorate to lower the concentration level to below 1 part per billion. The Army stated that it would not clean up the perchlorate contamination at Aberdeen until an EPA maximum contaminant level for perchlorate in drinking water is established.

Conclusions

Because of DOD's approach to how it inventoried its operational ranges for munitions and how it estimated the costs to clean up those ranges, both the inventory and the cost estimates are questionable. Further, DOD did not fully disclose to Congress the basis and limitations of its estimates, including identifying estimates based on direct observations and those based on assumptions, and the affect of assumptions on DOD's cost estimates. Instead, DOD provided only general information to Congress on the assumptions and cost model used without specific details on how costs were developed or the effect of assumptions used on the resulting cost estimates. Consequently, we believe it is difficult for Congress to evaluate the cost estimates DOD provided and that it may be unwise to rely on them for assessing the potential liability associated with contamination on operational ranges. Reliable cost estimates can be a critical piece of information for DOD and Congress when considering the potential costs versus benefits of closing operational ranges or entire installations. However, such estimates must be based on accurate data that, in terms of ranges, begins with a complete and accurate operational range inventory.

DOD installations have conducted little or no sampling for perchlorate under DOD's perchlorate policy, and DOD has not provided specific funding to the services to conduct the sampling that is required by its policy. Available information indicates that testing for perchlorate on installations has been limited and is specifically needed at facilities that are or were involved in research, manufacturing, testing, and disposal of munitions. DOD's decision not to provide specific funding to the services for sampling hampers the ability of DOD, as well as EPA and the states, to collect better data on the extent and nature of possible perchlorate contamination on military installations. Such information could be important to regulators when determining if there is a potential public health risk from perchlorate and deciding what, if any, actions might be warranted. Further, the lack of such information impedes DOD and congressional efforts for planning and budgeting future cleanup that may be required if federal or state standards regulating perchlorate are adopted.

Recommendations for Executive Action

In order to the assist Congress, EPA, and state regulators in assessing and planning for the cleanup of contamination associated with military munitions at operational ranges, we are making the following two recommendations:

- To improve congressional oversight of DOD and its operational ranges, including providing Congress with more realistic estimates of the potential liability associated with cleaning up contamination related to the use of military munitions, we recommend that DOD, using a more consistent estimating methodology, use its most complete operational range inventory to revise its cost estimates for the cleanup of operational ranges. The revised estimates should include an explanation of the basis and scope on which the inventory was conducted, and how the cost estimates were calculated. The estimates should be accompanied by a detailed description of how costs were developed, such as where estimates and assumptions were used, the basis of and rationale for any assumptions used, and an explanation as to how such assumptions affected cost figures.

- To develop information needed by Congress, EPA, and the states, such as the location and amount of perchlorate contamination, when deciding what, if any, actions are warranted to address such contamination, we recommend that DOD, acting under its revised perchlorate sampling policy, provide specific funding for comprehensive sampling at sites where no prior sampling has been conducted, yet perchlorate contamination is likely and human exposure is possible based on the sites' prior or current use. To help identify possible sites of perchlorate contamination, we recommend DOD consolidate and review sampling data previously collected by installations under environmental laws governing the release or disposal of various hazardous substances.

Agency Comments and Our Evaluation

In its May 6, 2004, letter, DOD disagreed with our findings and recommendations. DOD also provided technical comments and clarifications that we incorporated in the report, as appropriate.

DOD disagreed with our conclusion that it did not have a comprehensive policy requiring sampling or cleanup of munitions constituents on operational ranges, and that it generally has not taken actions to clean up contaminants. In its letter, DOD cited specific policies in place requiring the services to address the release of munitions constituents. However, the guidance DOD cited pertains only to the migration of munitions constituents off-range and the reporting of environmental liabilities, but does not address the sampling or cleanup of munitions constituents found on operational ranges that are the subject of this report. Further, DOD's letter states that it is responding to munitions constituents at 23 installations and ranges. We acknowledge that DOD is sampling for, and in some cases, cleaning up munitions constituents when directed to do so by EPA or a state environmental agency under various environmental laws. In reviewing the data provided by DOD, however, we found that only 2 of the installations they cited had operational ranges and both of those were being cleaned up because of EPA direction or a court order. At the 12 other installations with active ranges, half of them had sampled or were sampling for munitions constituents as a result of EPA or state environmental agency requests, RCRA requirements, or cleanup associated with Superfund hazardous waste sites. None of these installations, however, were cleaning up the munitions constituents found as a result of sampling.

DOD disagreed with our assessment that its inventory data and cost estimates were questionable and said it was not necessary to revise its cost estimates because inventory data used to develop the estimates were "accurate within reason." In its comments, DOD stated that it was not required to use validated costing assumptions, or a consistent estimating methodology, because the fiscal year 2002 National Defense Authorization Act provided that the standard for the report of liabilities did not apply to DOD's cost estimates. Although the act allowed DOD to develop cost estimates that did not meet the same standards as required for the report of liabilities in DOD's annual financial statement, we believe that DOD had a responsibility to provide Congress with useful information by making a reasonable attempt to prepare accurate and complete estimates, including assuring that its assumptions were valid. However, as our report sets out, the inconsistencies in how DOD collected and analyzed data on operational ranges raise questions about the reliability of DOD's inventory. Specifically, DOD did not provide Congress with a detailed description of how the costs were prepared and an explanation of where site-specific data were used in place of assumptions, why specific and different assumptions were used by the services, and how assumptions affected the overall cost estimates. Without DOD's supporting data and analysis, it is difficult for Congress to

evaluate the accuracy or validity of the cost estimates DOD provided and it may be unwise to rely on them for assessing the potential liability associated with contamination on operational ranges.

DOD disagreed with our recommendation that it needed to develop new cost estimates for cleaning up operational ranges, stating that it is developing a system for providing auditable data that meets the standards for the report of liabilities and is actively assessing its ranges for potential munitions constituent migration to off-range areas. However, the requirement in the National Defense Authorization Act for fiscal year 2002 was to report estimated costs to clean up operational ranges, not the costs to respond to or clean up constituent migration off-range. In its letter to GAO, DOD also questioned whether decision makers would find useful an estimated cost to clean up operational ranges and asserted that it is not required to develop cleanup estimates for operational ranges until such costs become probable and estimable by accounting standards. We disagree with DOD's view of the information and its usefulness to Congress. Congress on two occasions asked DOD to provide just such information. Specifically, the 2002 Defense Authorization Act required that DOD report this information. In addition, the Senate Committee on Armed Services, in its report accompanying the National Defense Authorization Act for fiscal year 2000 (S. Rep. No. 106-50), directed DOD to provide to the congressional defense committees a report with a complete estimate of current and projected costs to clean up munitions constituents. In our opinion, the authorization act's requirement and the committee's direction provide ample evidence that congressional decision makers would find such information useful.

DOD also disagreed with our recommendation that DOD provide specific funding for sampling for perchlorate. As our report points out, DOD's current policy on perchlorate sampling designates funding for sampling as a Class I high priority environmental project. This means that perchlorate sampling is a priority for funding, along with all other high priority environmental projects. As a result, perchlorate sampling must compete with other high priority environmental priorities for funding and, due to limited funds, may not be funded. The result is that while DOD policy has designated a funding mechanism for perchlorate, DOD's policy cannot assure that perchlorate sampling will be funded. Simply stated, if DOD wants to assure that installations conduct perchlorate sampling where appropriate, then it will need to provide specific funding for this sampling.

As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies of this report to the appropriate congressional committees, the Secretary of Defense, and other interested parties. We will also make copies available to others upon request. In addition, the report will be available at no charge on the GAO Web site at http://www.gao.gov.

If you or your staffs have any questions, please call me at (202) 512-3841, or Edward Zadjura at (202) 512-3841. Key contributors to this report are listed in appendix V.

Anu K. Mittal
Director, Natural Resources
and Environment

Safety, Environmental, and Human Health Risks

Military munitions can pose risks to public safety, human health, and the environment. Unexploded ordnance poses a risk of physical injury to those who encounter it. Military munitions may also pose a health and environmental risk especially on ranges located in ecologically sensitive wetlands and floodplains because their use and disposal may release constituents that may contaminate soil, groundwater, and surface water. More than 200 chemical munitions constituents are associated with ordnance and its use. When exposed to some of these constituents, humans potentially face long-term health problems, such as cancer and damage to the heart, liver, and kidneys.

Munitions Constituents of Greatest Concern

Of the more than 200 chemical munitions constituents associated with ordnance and its use, DOD considers 20 to be of greatest concern because of their widespread use and potential environmental impact. The 20 munitions constituents, taken from DOD's *Fiscal Year 2002 Defense Environmental Restoration Program Annual Report to Congress*, are

- Trinitrotoluene (TNT),
- 1,3-Dintrobenzene,
- Nitrobenzene,
- 2,4-Dinitrotoluene,
- 2-Amino-4,6-Dinitrotoluene,
- 2-Nitrotoluene,
- 2,6-Dinitrotoluene,
- 4-Amino-2,6-Dinitrotoluene,
- 3-Nitrotoluene,
- Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX),
- 2,4-Diamino-6-nitrotoluene,
- 4-Nitrotoluene,

- Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX),
- 2,6-Diamino-4-nitrotoluene,
- Methylnitrite,
- Perchlorate,
- 1,2,3-Propanetriol trinitrate (Nitroglycerine),
- Pentaerythritoltetranitrate (PETN),
- 1,3,5-Trinitrobenzene, and
- N,2,4,6-Tetranitro-N-methylaniline (Tetryl) (White Phosphorus).

While many of these compounds have been an environmental concern to DOD for more than 20 years, the current understanding of the causes, distribution, and potential effect of constituent releases into the environment remains limited. The nature of the potential effect, and whether it poses an unacceptable risk to human health and the environment, depends upon the dose, duration, and pathway of exposure, as well as the sensitivity of the exposed populations. The link between constituents and their potential health effects is not always clear and continues to be studied. Table 6 describes some of the potential health effects of five of the munitions constituents of greatest concern.

Table 6: Potential Effects of the Munitions Constituents Closely Associated with Military Munitions

Contaminant	Potential toxicity/effects
Trinitrotoluene (TNT)	Possible human carcinogen. Targets liver, skin, irritations, cataracts.
Royal Demolition Explosive (RDX)	Possible human carcinogen, prostate problems, nervous system problems, nausea, and vomiting. Laboratory exposure to animals indicates potential organ damage.
High Melting Explosive (HMX)	Animal studies suggest potential liver and central nervous system damage.
Perchlorate	Exposure causes itching, tearing, and pain; ingestion may cause gastroenteritis with abdominal pain, nausea, vomiting, and diarrhea; systemic effects may follow and may include ringing of ears, dizziness, elevated blood pressure, blurred vision, and tremors. Chronic effects may include metabolic disorders of the thyroid.
White Phosphorus	Reproductive effects. Skin burns, irritation of throat and lungs, vomiting, stomach cramps, drowsiness. Liver, heart, or kidney damage. Death.

Source: Environmental Protection Agency.

Scope and Methodology

You asked us to determine (1) how DOD identified the location and last active use of all operational ranges and the basis for DOD's cost estimates for cleaning up those ranges; and (2) DOD's policy on sampling for contaminants linked to the use of ordnance on operational ranges and, where munitions-related contaminants have been detected, what corrective actions the services have taken. Specifically, you asked us to focus on DOD's actions with regard to perchlorate.

To determine how DOD identified the location and last active use of all operational ranges, we reviewed the services' inventory data and interviewed service headquarters officials to determine how the inventories were conducted and the reliability of the data collected. We assessed the reliability of the services' data (1) by reviewing existing information about the data and the processes that produced them and (2) by interviewing DOD officials knowledgeable about the data. We determined that data on the number of operational ranges and acreage were sufficiently reliable to include in our report; however, we determined that data on range characteristics were unreliable. Although we found the data on range characteristics to be unreliable, we present the data for informational purposes. To determine the basis for DOD's cost estimates for cleaning up operational ranges, we reviewed the services' estimated costs, supporting analyses, and calculations, and interviewed service and DOD officials on the scope and methodology used to develop cost estimates.

To identify DOD's policy on sampling for constituents linked to the use of ordnance on operational ranges, we reviewed DOD's and the service's policies related to the sampling and cleanup of potential contaminants and specifically their policies on perchlorate. We also interviewed officials at both headquarters and several installations on the implementation of DOD and service policies. To report on what actions the services have taken with regard to munitions constituents and perchlorate, we visited seven DOD installations where perchlorate had been detected and discussed what efforts have taken place, or were planned, to respond generally to munitions-related contaminants and specifically for perchlorate. We selected installations based on available data but were unable to determine the total number of installations reporting perchlorate contamination. We selected installations where generally high levels of perchlorate had been detected or, in one case, where perchlorate had contaminated a local municipal water supply. We also based our selection on the desire to include at least two installations from each military department and installations from different states or geographic locations in order to

provide a mix of services and state agencies. (See table 7 for a listing of the installations we visited.)

During our visits, where possible, we observed the areas of contamination as well as any cleanup demonstration projects under way. To identify what levels of contamination had been detected at DOD installations, we first obtained various summary schedules and lists of active and closed DOD and non-DOD sites with suspected or detected perchlorate contamination from both EPA and DOD. Because DOD has only recently begun to collect data on perchlorate, none of the listings we obtained included all installations. Further, most lists did not generally contain current data and were incomplete. Additionally, much of the data was redundant, with the same installations appearing on more than one list. Prior to selecting an installation to visit, therefore, we contacted service officials to verify that perchlorate contamination had, in fact, been detected. Our observations about perchlorate contamination and response actions at these installations are not generalizable to all military installations.

Table 7: Installations Visited during Our Review

Installation	Military department	State	Perchlorate contamination levels initially detected or reported
Edwards Air Force Base	Air Force	California	Up to 160,000 parts per billion in groundwater (detected in 1997)
Holloman Air Force Base	Air Force	New Mexico	About 16,000 parts per billion in surface water (detected in 1999)
Aberdeen Proving Ground	Army	Maryland	5 parts per billion in drinking water and 24 parts per billion in groundwater (reported in 1998)
Redstone Arsenal	Army	Alabama	About 19,000 parts per billion in groundwater (as of 2000)
White Sands Missile Range	Army	New Mexico	21,000 parts per billion in groundwater (reported in 1998)
Naval Air Weapons Station, China Lake	Navy	California	560 parts per billion in groundwater (detected in 2001)
Naval Surface Warfare Center, Indian Head	Navy	Maryland	More than 1,000 parts per billion in surface water (reported in 1998)

Source: GAO.

Installations That Were Cleaning Up Perchlorate as a Result of Demonstration Projects

Although we found no installations were cleaning up perchlorate, two installations we visited were conducting or had conducted demonstration projects of new technologies to clean up perchlorate, in anticipation of future cleanup requirements.

Edwards Air Force Base

In May 2003, Edwards Air Force Base, in California, began a demonstration project to remove perchlorate from groundwater. Edwards officials said the installation funded the project because the Air Force is DOD's lead agency for perchlorate-related efforts and expected to help develop perchlorate treatment technologies. Edwards first detected perchlorate on the installation in 1997, while testing for other contaminants, and has detected perchlorate at 10 sites on the installation. Perchlorate contamination of 160,000 parts per billion was detected at one site where the source of the contamination is attributed to the use of perchlorate by various research facilities beginning about 1945. On this site the Air Force constructed a well field and project treatment facility. The demonstration project uses resin beads, which act like a magnet to pull perchlorate out of the water. Four wells extract groundwater that is discharged into a storage tank and then pumped through treatment equipment containing the resin. Treated groundwater is returned to the aquifer through five injection wells. Plans are to operate the project through July 2005. Currently, Edwards officials report that perchlorate continues to be removed to nondetectable levels, or less than 1 part per billion.

Naval Surface Warfare Center, Indian Head

In 2002, the Naval Surface Warfare Center, Indian Head, in Maryland, funded a field demonstration project using naturally occurring microorganisms, or bacteria, that break down or consume perchlorate. Navy officials first became concerned about perchlorate in 1998 when they learned of widespread perchlorate contamination at DOD sites in California. At that time, the installation regularly drained perchlorate-contaminated water into ditches and two bordering rivers. In 2001, Navy officials sampled and detected a shallow and well-defined plume of perchlorate contamination located in an area where the Navy once cleaned small rocket motors using a high-pressure wash. Perchlorate levels detected in the area ranged from 8,000 to 430,000 parts per billion. On this site in early 2002, the Navy installed two extraction wells, two injection wells, and nine groundwater monitoring wells. Groundwater was removed from the site, mixed with a lactate and a carbonate/bicarbonate liquid mixture, and then reinjected into the aquifer. After 20 weeks, perchlorate

levels were reduced by more than 95 percent in eight of the nine monitoring wells. According to Navy officials, the mixture acted as an oxidizer to stimulate microorganisms that consumed the perchlorate. Officials said they plan to reuse the equipment to field test the technology at another site in an attempt to clean soil contaminated with perchlorate.

Installations That Identified Perchlorate as a Result of Munitions Research, Manufacturing, Testing, and Disposal Activities

We visited installations that had operational ranges and detectable levels of perchlorate but found the perchlorate contamination was generally not due to training, but rather due to prior and ongoing research, testing, manufacturing, and disposal of rocket motors and propellant waste on operational ranges and other parts of the installations.

Edwards Air Force Base

Perchlorate contamination was detected at 10 sites on Edwards Air Force Base beginning in 1997. Officials attributed all detected perchlorate contamination to rocket propellant manufacturing, research, development, and testing, and not to the use of munitions during training. The maximum perchlorate contamination level detected was 160,000 parts per billion in groundwater at one site. Officials said no live bombs had been exploded on Edwards Air Force Base ranges since 1952, and some ranges where bombs were exploded have been closed. Perchlorate is not used as part of current range activities, and Edwards Air Force Base does not test for contaminants on operational ranges, installation officials said.

Holloman Air Force Base

In March 1999, after a rainstorm, the U.S. Geological Survey sampled for perchlorate in a normally dry riverbed at Holloman Air Force Base, in New Mexico, and detected contamination of 16,000 parts per billion. During periods of rain, the river flows from the installation to the neighboring White Sands National Monument. The contamination was found on the installation near a former munitions operations site and rocket sled. Air Force officials said it was unlikely that the contamination was due to training. They attributed the perchlorate contamination to munitions research and testing in the 1960s and 1970s. Officials at White Sands National Monument attributed the perchlorate contamination to spent rocket motors stacked near the river and a high-speed rocket sled used to test the effects of acceleration. DOD and New Mexico's state environmental agency sampled the riverbed and surrounding area again in 1999 and 2000 but did not find the high concentration of perchlorate previously detected. Air Force officials said they believed the 16,000 parts per billion detected in 1999 was an anomaly.

Naval Surface Warfare Center, Indian Head

At the time of our visit, officials at the Naval Surface Warfare Center, Indian Head, in Maryland, reported they detected perchlorate contamination at five sites on the installation, of which three were landfills, one was a metal parts disposal site, and one was a metal parts degreasing tank site. Indian

Head detected maximum perchlorate concentrations between 88 and 450,000 parts per billion in the soil at two of the three landfills. At the third landfill, a perchlorate concentration of 2,000 parts per billion was detected in the groundwater. However, none of the contamination detected was attributed to the use of perchlorate during training exercises on operational ranges.

Redstone Arsenal

As of March 2004, Redstone Arsenal, in Alabama, detected perchlorate contamination in the groundwater at 2 sites and in surface water and soil at 11 other sites. Redstone Arsenal officials attributed contamination to various past production, maintenance, and disposal activities at a number of sites, including at open burning areas used to incinerate waste rocket motor propellant, burning trenches used to incinerate solid material contaminated with rocket propellant, a rocket engine plant, motor degreasing and trimming areas, and a propellant waste storage area. Perchlorate contamination of about 20 parts per billion was also detected in ground and surface water outside the installation. The highest concentration levels detected in groundwater on Redstone installations have ranged from 106,000 to 160,000 parts per billion and the highest concentration levels detected in surface water have ranged from 377 to 1,700 parts per billion. Although Redstone Arsenal has conducted training on the installation, none of the contamination detected has been attributed to the use of perchlorate during training exercises.

White Sands Missile Range

White Sands Missile Range, in New Mexico, detected perchlorate contamination at two sites beginning in 1999. At one site, sampling detected perchlorate concentrations up to 25,000 parts per billion. Officials said they were unsure of the precise cause of the contamination but said they initially believed it was due to an open burning and detonation facility used in the 1950s to incinerate rocket motors. However, officials also said that the contamination plume was uphill from where the open burning and detonation site is believed to have been, so that the contamination may be generally due to previous testing of hazardous materials in the area. Perchlorate was also found at the former site of a high-energy laser system test facility. Perchlorate contamination detected has been as high as 118 and 295 parts per billion in some wells. Officials said the contamination might be due to open ground burning of expended test items, or residue from actual tests, conducted prior to 1995. Officials said they planned to conduct more sampling to precisely identify the source of the perchlorate

but did not attribute any of the perchlorate detected to training exercises on operational ranges.

Naval Air Weapons Station, China Lake

At the time of our visit in October 2003, the Naval Air Weapons Station, China Lake, in California, had detected perchlorate at five sites on the installation. Perchlorate contamination was predominantly found in drainage and waste disposal areas, most likely the result of research on propellants and explosives, and residue from the manufacture of propellants. Installation officials said that since the 1960s, thousands of pounds of perchlorate-based propellant have been stored and tested on China Lake. In July 2003, installation officials sampled and detected perchlorate concentrations of 778 and 921 parts per billion at two wells and at a drainage site. However, none of the contamination detected is attributed to the use of munitions during training exercises on operational ranges.

Comments from the Department of Defense

OFFICE OF THE UNDER SECRETARY OF DEFENSE
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ACQUISITION,
TECHNOLOGY
AND LOGISTICS

MAY - 6 2004

Ms. Anu Mittal
Director, Natural Resources and Environment
U.S. General Accounting Office
441 G Street N.W.
Washington, DC 20548

Dear Ms. Mittal:

This letter is the Department of Defense (DoD) response to the GAO report, "DOD OPERATIONAL RANGES: More Reliable Cost Estimates and a Proactive Approach to Identifying Contamination Are Needed," May 2004 (GAO-04-601).

The Department nonconcurs with GAO recommendations that the Department (1) revise its cost estimates for the cleanup of operational ranges and (2) provide specific funding for sampling at sites where perchlorate contamination is likely. Enclosed are specific comments on each of these recommendations.

The Department also nonconcurs with the GAO findings that (1) the reliability of DoD's inventory is questionable, (2) DoD's cost estimates are questionable, (3) DoD does not have a comprehensive policy requiring sampling, (4) neither DoD nor the Services provide specific funding to installations to sample for or cleanup contaminants linked to munitions use, and (5) no corrective actions have been taken by DoD specifically directed at cleaning up contaminants, such as perchlorate. Enclosed are specific comments on each of these findings.

Although some of GAO's points merit discussion, the Report presents an invalid characterization of the Department's environmental efforts at operational ranges. The Department believes that government decision makers deserve a more accurate and objective analysis of the Department's Sustainable Range policies and actions.

The Report incorrectly asserts that DoD does not have a comprehensive policy requiring sampling or cleanup of munitions constituents. A careful examination of the Department's policies and actions demonstrate that it has comprehensive policies in place to address munitions constituents associated with operational ranges. The Report mentions none of the key policies. For example:

- Since 1999, DoDI 4715.11 has required the Services to conduct an appropriate response using existing statutory authorities (e.g., DERP, CERCLA) to any release of munitions constituents that are migrating from an operational range to off-range areas. An update to be published soon will further require assessments of the hydrology and hydrogeology of operational ranges and how the ranges are being or have been used.

- The Defense Planning Guidance (DPG) for Fiscal Years 2004-2009 established a requirement for the Services to "... assess potential hazards from off-range migration of munitions constituents and begin remediation by FY2008." The Services have begun implementing programs to conduct operational range assessments, and are expecting to begin any necessary responses by the FY08 date.
- DoD Directive 3200.15 "Sustainment of Ranges and Operating Areas (OPAREAs)" requires reporting of environmental liabilities for operational ranges where the Department of Defense is obligated to conduct environmental remediation, in accordance with DoD 7000.14-R (the DoD Financial Management Regulations).

The Report states that, "DoD policy does not require the Services to clean up or sample for munitions contaminants." In fact, the Department has had policy in place on response actions for some time. In addition to the failure to discuss current policies, GAO does not address new or expanding policies that the Department presently has under development.

The Report also asserts that, "To date, no corrective actions have been taken specifically directed at cleaning up contaminants when they have been detected." Again, this observation is not factual. DoD is responding to munitions constituents at twenty-three installations and ranges, as is illustrated in the enclosures. The Report fails to recognize DoD's efforts at these sites.

Finally, the Report asserts that DoD's operational range inventory and its estimates of cleanup costs are "questionable." However, the Report provides no supporting analysis for this conclusion and is misleading in that it does not factually address:

- The adequacy of inventory data to support cost estimating.
- The specific Congressional direction to DoD about development of the aggregate high-low cost estimates.
- The reasonableness of the assumptions in the detailed estimating guidance the Department developed.
- Differences in the way the Services use and manage operational ranges and the impact of these differences in cost estimates among the Services.

In addition, the Report incorrectly assumes that decision makers would find a cost to clean up an operational range useful. The decision to close an operational range will not be determined by cleanup cost. It will be determined by whether the range is needed for operational requirements. An estimate of the cost to clean up a range will be developed after the range is no longer operational. There is no requirement for DoD to produce cleanup estimates for operational ranges.

The report also misrepresents the current state of affairs because it fails to report the facts surrounding EPA's treatment of perchlorate regulation. The report insinuates that DoD has some affirmative responsibility to sample for perchlorate under the Safe Drinking Water Act beyond Unregulated Contaminate Monitoring Rule requirements, which is not the case.

This response and the enclosed materials are provided to help GAO better understand and recognize DoD's policies and actions. Enclosure 1 provides the Department's specific responses to GAO's Report Findings and Recommendations. Enclosure 2 offers the Department's detailed, line-by-line analysis of the elements of GAO's report. Enclosures 3 and 4 provide examples of the Services' operational range assessment programs that assess potential hazards from off-range migration of munitions constituents. Enclosures 5, 6, and 7, which the U.S. Environmental Protection Agency provided to Congressman Dingell in response to an inquiry, provide some details on munitions constituents. Specifically:

- Enclosure 5 provides information on DoD installations where sampling for perchlorate and other munitions constituents is ongoing
- Enclosure 6 provides information on occurrences of perchlorate or other constituents of military munitions in public or private drinking water wells where a DoD facility is a possible or likely source of the occurrence.
- Enclosure 7 provides information on DoD installations where EPA has reason to believe that a constituent of military munitions, including perchlorate, TNT, RDX, HMX, or White Phosphorus has been detected or discovered, and the status of the response action.

Taken together, the analytical and logical deficiencies in this Report render the findings and recommendations invalid. The Department recommends that the Report be withdrawn and a new analysis be undertaken.

Sincerely,

Alex A. Beehler
Assistant Deputy Under Secretary of Defense
(Environment, Safety, and Occupational Health)

Enclosures:
As stated.

GAO Contacts and Staff Acknowledgments

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Staff Acknowledgments

In addition to those named above, Christine Frye, Roderick Moore, David Noguera, and Doreen Feldman made key contributions to this report. John Delicath and Amy Webbink also contributed to this report.

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