THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION,
TECHNOLOGY
AND LOGISTICS

MAR 16 2007

The Honorable John P. Murtha
Chairman, Subcommittee on Defense
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515 -6018

Dear Mr. Chairman:

Pursuant to section 313 of the John Warner National Defense Authorization Act for FY 2007 (Public Law 109-364), the enclosed report details the DoD response plan for remediation of unexploded ordnance, discarded military munitions, and munitions constituents.

The first section of this report discusses the major areas of the Military Munitions Response Program Comprehensive Plan including performance goals, funding requirements, and munitions response technologies. Future updates to this plan will be provided in the FY 2007 through FY 2009 Defense Environmental Programs Annual Report to Congress. The second section of this report discusses the Department's efforts to develop reuse standards and principles for environmental responses to unexploded ordnance, discarded military munitions, and munitions constituents, known or suspected to be present on active and Base Realignment and Closure installations, and Formerly Used Defense Sites, throughout the United States and its territories.

Similar letters are being sent to the other congressional defense committees.

Sincerely,

Kenneth J. Krieg

Enclosure:
As stated

cc:
The Honorable C.W. Bill Young
Ranking Member

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION,
TECHNOLOGY
AND LOGISTICS

MAR 1 6 2007

The Honorable Daniel Inouye
Chairman, Subcommittee on Defense
Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Mr. Chairman:

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Kenneth J. Krieg

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As stated

cc:
The Honorable Ted Stevens
Ranking Member

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3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION,
TECHNOLOGY
AND LOGISTICS

MAR 16 2007

The Honorable Ike Skelton
Chairman, Committee on Armed Services
U.S. House of Representatives
Washington, DC 20515 -6035

Dear Mr. Chairman:

Pursuant to section 313 of the John Warner National Defense Authorization Act for FY 2007 (Public Law 109-364), the enclosed report details the DoD response plan for remediation of unexploded ordnance, discarded military munitions, and munitions constituents.

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Kenneth J. Krieg

Enclosure:
As stated

cc:
The Honorable Duncan Hunter
Ranking Member

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION,
TECHNOLOGY
AND LOGISTICS

MAR 16 2007

The Honorable Carl Levin
Chairman, Committee on Armed Services
United States Senate
Washington, DC 20510 -6050

Dear Mr. Chairman:

Pursuant to section 313 of the John Warner National Defense Authorization Act for FY 2007 (Public Law 109-364), the enclosed report details the DoD response plan for remediation of unexploded ordnance, discarded military munitions, and munitions constituents.

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Sincerely,

Kenneth J. Krieg

Enclosure:
As stated

cc:
The Honorable John McCain
Ranking Member

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION,
TECHNOLOGY
AND LOGISTICS

MAR 1 6 2007

The Honorable Robert C. Byrd
Chairman, Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Mr. Chairman:

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Sincerely,

Kenneth J. Krieg

Enclosure:
As stated

cc:
The Honorable Thad Cochran
Ranking Member

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION,
TECHNOLOGY
AND LOGISTICS

MAR 16 2007

The Honorable David Obey
Chairman, Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515-6015

Dear Mr. Chairman:

Pursuant to section 313 of the John Warner National Defense Authorization Act for FY 2007 (Public Law 109-364), the enclosed report details the DoD response plan for remediation of unexploded ordnance, discarded military munitions, and munitions constituents.

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Similar letters are being sent to the other congressional defense committees.

Sincerely,

Kenneth J. Krieg

Enclosure:
As stated

cc:
The Honorable Jerry Lewis
Ranking Member

Military Munitions Response Program
Fiscal Year 2007 NDAA

Section 313 Report

March 2007

Table of Contents

Introduction

Section 313 of the John Warner National Defense Authorization Act for Fiscal Year 2007 (2007 NDAA), Public Law 109-364, directs the Secretary of Defense to submit a report on the Department of Defense's (DoD's) response plan for remediation of unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC). This report, submitted in response to the 2007 NDAA Section 313 requirements, addresses DoD's:

- Performance goals,
- Response plans, and
- Reuse standards and principles

for the environmental responses to UXO, DMM, and MC known or suspected to be present on active and Base Realignment and Closure (BRAC) installations, and Formerly Used Defense Sites (FUDS) throughout the United States (U.S.).

DoD's primary mission is to protect and defend the United States. Sustaining the natural and built infrastructure required to support military readiness is integral to that mission. DoD's natural infrastructure includes nearly 30 million acres of land with accompanying air and water resources, while DoD's built infrastructure provides the military with the space and capability to organize, train, and equip our forces to protect our national interests.

To attain the level of readiness necessary to deter adversaries and defend our nation, DoD must develop, test, and deploy weapon systems and military munitions, and then train its personnel to use and maintain these systems. As a result, some properties DoD has used to meet its defense mission are known or suspected to contain UXO, DMM, and MC. DoD developed the Military Munitions Response Program (MMRP) in September 2001 to manage environmental responses to UXO, DMM, and MC.

In 10 United States Code (U.S.C.) §2710, Congress refers to certain properties known or suspected to contain UXO, DMM, or MC as "defense sites," which are defined as "locations that are or were owned by, leased to, or otherwise possessed or used by the Department of Defense. DoD refers to these sites as munitions response sites (MRSs). The term does not include any operational range, operating storage or manufacturing facility, or facility that is used for or was permitted for the treatment or disposal of military munitions."

The effect of this definition is to apply the MMRP to any location, other than the excluded locations, where UXO, DMM or MC are known or suspected to be present. UXO are defined as military munitions that (a) have been primed, fuzed, or armed, or otherwise prepared for action; (b) have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and (c) remain unexploded either by malfunction, design, or any other cause. DMM are military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal, but does not include UXO; military munitions that are being held for future use or planned disposal; or military munitions that have been properly disposed of, consistent with applicable environmental laws and regulations. MC refers to any materials originating from UXO, DMM, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions.

DoD developed the first section of this report, the Report on the Military Munitions Response Program Comprehensive Plan, to meet the Congressional requirements as outlined in Subsections (a) and (b) of Section 313 of the 2007 NDAA. The second section of this report, the Report on Reuse Standards and Principles, addresses Subsection (c) of Section 313 of the 2007 NDAA.

Report on the Military Munitions Response Program Comprehensive Plan

This section discusses the comprehensive plan as required in Subsections (a) and (b) of Section 313 of the 2007 NDAA. The following sections discuss major areas of the MMRP Comprehensive Plan including performance goals, funding requirements, and munitions response technologies. Future updates to this plan will be provided in the Fiscal Year (FY) 2007 through FY2009 Defense Environmental Programs Annual Report to Congress (DEP ARC).

Background

In the 1970s, DoD began to identify, characterize, and cleanup environmental contamination that occurred when hazardous substances and wastes were managed and disposed of using practices later found to pose a potential threat to human health or the environment. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) was enacted in 1980, establishing a requirement and framework for the identification, investigation, and cleanup of hazardous substances resulting from past practices. With the passage of the Superfund Amendments and Reauthorization Act in 1986, CERCLA was amended to create the Defense Environmental Restoration Program (DERP). This codified DoD's environmental restoration responsibilities and established procedures for environmental restoration activities in the U.S. Since the DERP's inception, the Office of the Secretary of Defense has overseen the program and its implementation by the Departments of the Army, Navy, and Air Force, the Defense Logistics Agency (DLA), and the Defense Threat Reduction Agency. This effort protects military personnel and communities from human health, environmental, and safety hazards, and preserves public lands, while ensuring that U.S. forces are able to continue to train to protect and defend the nation.

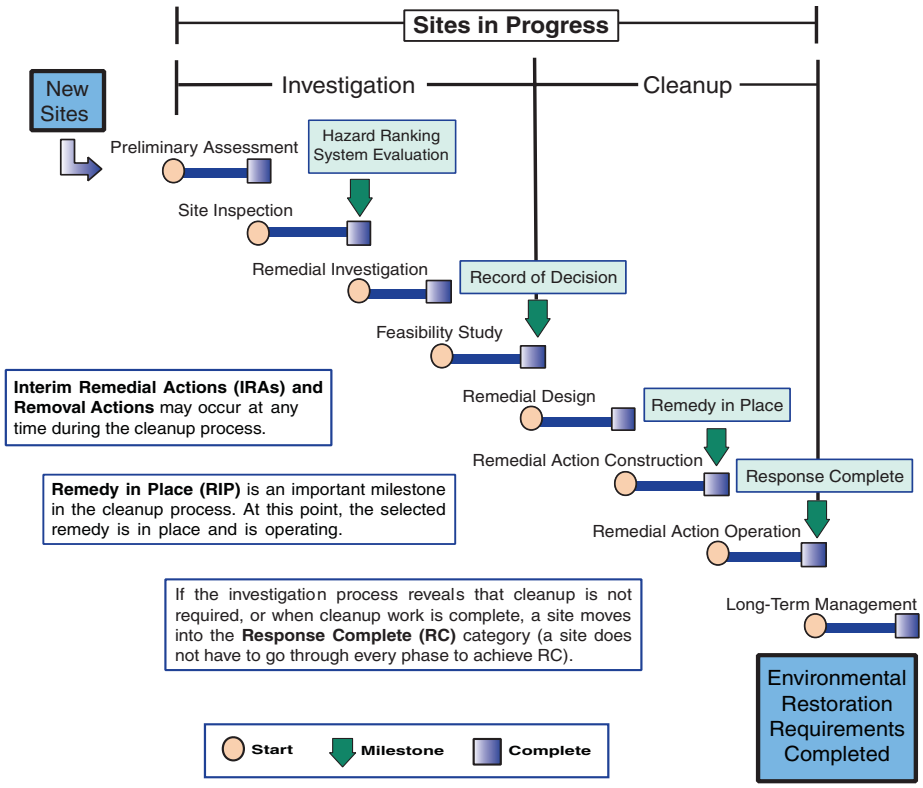
DoD built and maintains a successful environmental restoration program by focusing on reducing the health and safety risks posed by historical contamination. Within the DERP, the Installation Restoration Program (IRP) focuses on releases of hazardous substances, pollutants, or contaminants that pose environmental health and safety risks. For many years, DoD responded to properties that were known or suspected to contain UXO, DMM, or MC through the IRP; however, DoD established the MMRP as a new DERP program element in September 2001 to improve its overall approach for protecting human health and the environment and to attain a better understanding of response requirements for properties other than operational ranges known or suspected to contain UXO, DMM, or MC. As a separate program, the MMRP also increases the transparency of munitions response costs throughout the planning, programming, budgeting, and execution process.

The creation of the MMRP under the DERP builds on DoD's accomplishments with the IRP. DoD's objectives for MRSs under the MMRP are similar to those for IRP sites. These objectives include:

- Identifying where, what kind, and to what extent UXO, DMM, or MC are or may be present;
- Determining the associated hazards (i.e., explosive, chemical agent, human health) potentially posed to human health and the environment;
- Establishing goals and metrics to track and evaluate progress;
- Setting priorities for conducting munitions response actions;
- Planning, programming, and budgeting to effectively resource MMRP requirements;
- Conducting necessary munitions response actions;
- Developing and implementing effective munitions response-related technologies; and
- Providing for the timely transfer of excess land for safe alternative uses that are consistent with the completed munitions response.

To address environmental restoration in both IRP and MMRP program elements of the DERP, DoD applies the environmental restoration process set forth by CERCLA and its implementing regulation, the National Oil and Hazardous Substances Pollution Contingency Plan, and in some instances, the Resource Conservation and Recovery Act (RCRA). The CERCLA environmental restoration process consists of several phases that are illustrated in Figure 1. While some phases may overlap or occur concurrently,

Figure 1: CERCLA Restoration Progress



environmental response activities at DoD sites are generally conducted in the order shown.

Munitions Response Site Inventory

To assist the Department in addressing munitions issues, Congress enacted 10 U.S.C. §2710 in the 2002 NDAA, directing DoD to develop an inventory of all defense sites known or suspected to contain UXO, DMM, or MC. DoD published the first MRS inventory in FY2002 to accurately inform the scope of effort required for the MMRP. Since publication of the first inventory, DoD has collaborated with regulators, Indian tribes, and federal land managers to update, reconcile, and revise the MRS Inventory.

The inventory is updated annually and released in conjunction with the DEP ARC. Through FY2006, DoD had identified 3,316 MRSs as part of the MMRP inventory. The inventory continues to evolve as a result of improved site characterization, thorough historical records review, and the discovery of new MRSs. Since the initial reconciliation, changes in the inventory do not necessarily reflect newly discovered MRSs, but rather a division of large munitions response areas into multiple discreet MRSs. The current inventory is publicly available at http://deparc.egovservices.net/deparc/do/mmrp.

Munitions Response Site Prioritization Protocol

The Department employs a risk-based management strategy and cleanup approach for the DERP with three main elements: (1) implementing a systematic process for prioritizing sites for execution; (2) developing program goals and performance metrics to drive environmental restoration activities, secure funding, and track program progress; and (3) working with regulators and communities to address stakeholder concerns.

In addition to requiring DoD to complete an inventory of all munitions contaminated sites throughout the U.S., 10 U.S.C. §2710 tasked DoD to develop, with the states and Indian tribes, a protocol for assigning a relative priority to all MRS for response actions.. With over 3,300 sites in the MRS Inventory, DoD does not have the resources to address all of the munitions sites at once. Therefore, DoD developed the Munitions Response Site Prioritization Protocol (hereafter, Protocol) for assigning a relative priority to each MRS,

based on the potential hazards and site conditions. The Protocol replaces the Risk Assessment Code, which the U.S. Army Corps of Engineers has historically used to prioritize munitions responses at FUDS properties.

To develop the Protocol, the Deputy Under Secretary of Defense for Installations & Environment/ Environmental Management (DUSD(I&E)EM) worked with stakeholders within the Components, representatives of the states and Indian tribes, and other federal agencies, including the Department of Agriculture (USDA), the Department of the Interior (DOI), and the U.S. Environmental Protection Agency (EPA). After incorporating the lessons learned from the Protocol's testing and consultation with federal agencies, states, and Indian tribes, DoD promulgated the Protocol as a final rule in the *Federal Register* on October 5, 2005; the Protocol is codified at 32 CFR Part 179.

The risk posed by potential hazards present at an MRS is captured by the Protocol's central feature, the three hazard modules. Each module was created with a specific purpose in mind. The Explosive Hazard Evaluation (EHE) Module addresses the potential explosive hazards of UXO, DMM, and MC, when present in high enough concentration to present an explosive hazard, while the Chemical Hazard Evaluation (CHE) Module addresses the potential unique, acute physiological hazards of chemical warfare materiel (CWM). Chronic health and environmental hazards posed by MC and other related chemical constituents are addressed under the Health Hazard Evaluation (HHE) Module. DoD's approach is to assign each MRS a relative priority based on the greatest potential hazards posed by UXO, DMM, or MC using the three module ratings. The relative priority assigned to each MRS will serve as the primary factor for sequencing response actions. However, DoD recognizes that other factors, such as economic, programmatic, and stakeholder concerns, may impact sequencing decisions.

Components must submit the ratings of each hazard module evaluated along with the relative priority for each MRS in the inventory to DoD beginning in FY2007. DoD will publish the results of the Protocol's application annually in the DEP ARC.

To ensure consistency in the application of the Protocol, DoD conducted several training workshops throughout the country in FY2006, led by members of the workgroup that developed the Protocol. DoD offered these joint training sessions to Service personnel and stakeholders involved in the implementation of the Protocol. Based on feedback received during the training sessions, DoD revised and improved upon the workshop materials and, starting in FY2007, plans to provide training on the Protocol via the Internet for all interested parties.

MMRP Performance Goals

DoD is working to develop and implement program goals and performance metrics to measure MMRP progress. Similar to the IRP, DoD has developed goals for the MMRP to address MRSs with greatest risk first and to facilitate advancement through the CERCLA phases of the program. Risk-based goals are addressed based on the prioritization of sites under the Protocol. Program progress or performance goals, as shown in Figure 2, include:

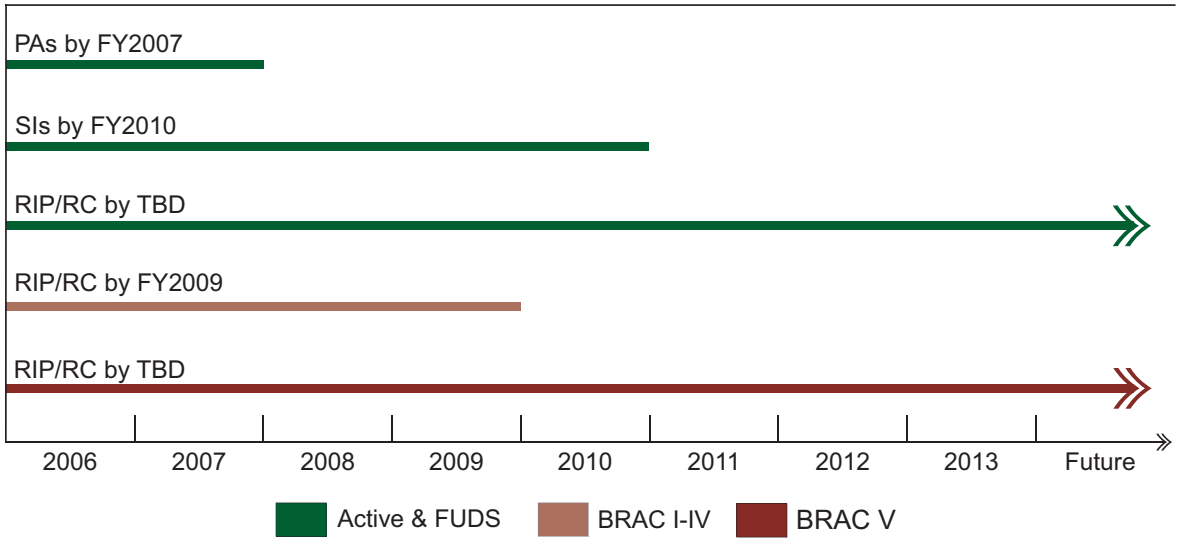
- Complete preliminary assessments (PAs) for all MRSs at active installations, excluding operational ranges, and FUDS properties by the end of FY2007.
- Complete site inspections (SIs) for all MRSs at active installations, excluding operational ranges, and FUDS properties by the end of FY2010.
- Achieve remedy in place/response complete (RIP/RC) at all MRSs identified in the first four rounds of the BRAC program by the end of FY2009.

DoD and the Components are progressing towards meeting these goals. For all Components, 98 percent of active installations and 100 percent of FUDS properties are projected to complete PAs for all the MRSs located at the installation or property by FY2007. Seventy-eight percent of active installations and 71 percent of FUDS properties are projected to complete SIs by FY2010. DUSD(I&E)EM will continue to monitor progress toward completing SIs and work with each Component to ensure the goals are met.

DoD continues to develop program goals and performance metrics as MRSs are prioritized and munitions response actions are sequenced. DoD established a workgroup to develop RIP/RC goals for all MRSs identified at active installations, FUDS properties, and installations closed or realigned by the 2005 BRAC round and plans to have these goals in place this fiscal year. DoD is currently

Figure 2

MMRP Short-Term Performance Goals



reviewing proposed final program completion dates for the MMRP which consider Component-specific and FUDS-specific completion dates due to the large variance in the number of MRSs under the responsibility of each Component.

The process of establishing MMRP goals and metrics mirrors the development and use of the management goals and metrics in the IRP. Once goals are agreed upon in the Department, they are incorporated in appropriate documents and DoD's President's Budget exhibits. DoD uses these program goals and performance metrics to accurately plan, program, and budget for stable funding to complete MMRP requirements. Continuing to develop and continuously evaluating the MMRP goals and metrics will help DoD build on the existing foundation to meet the future challenges.

Current Program Status

By the end of FY2006, DoD had identified 3,316 MRSs, an increase of seven MRSs from FY2005. Figure 3 shows the total number of MRSs by Component.

MRSs are categorized according to phase status in the response process. Since the MMRP is in the early stages of development, the majority of sites are still in the investigation stage. Figures 4, 5, and 6 show the status of MRS at active and BRAC installations, and FUDS properties.

Munitions response actions have been a part of the DERP for several years, primarily at BRAC installations and FUDS properties, providing DoD with solid experience in addressing the environmental and explosive hazards associated with the past use of military munitions. As a result, DoD has achieved response complete status at 457 MRSs at FUDS properties and 112 MRSs at BRAC installations. Overall, DoD has achieved RC at:

Figure 3

Component MRS Totals

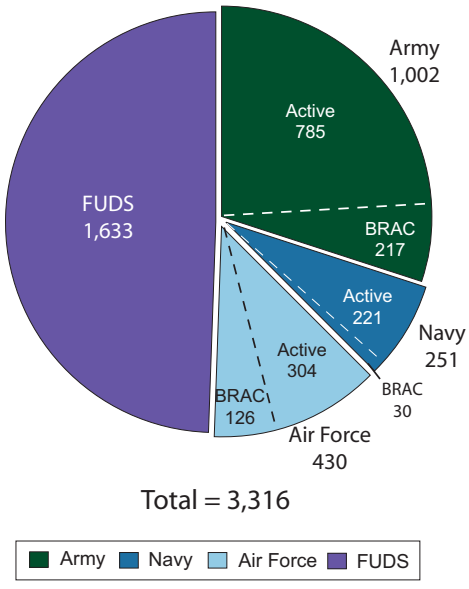
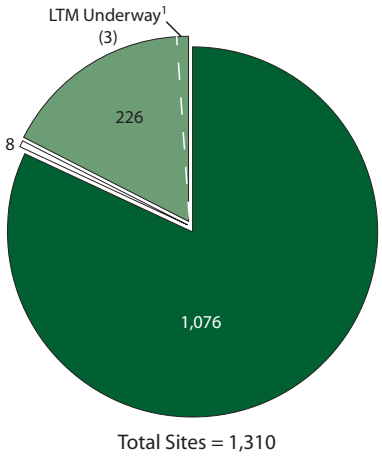


Figure 4

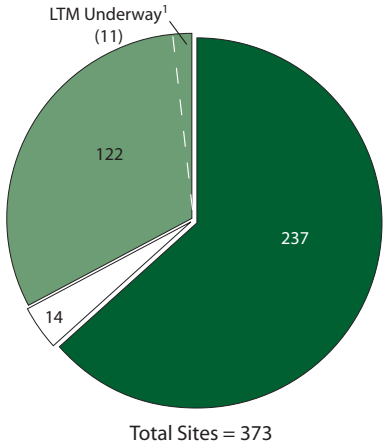
Active Installations
FY2006 MMRP Site Status



Total Sites = 1,310

Figure 5

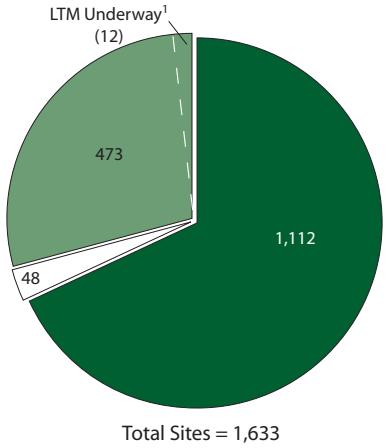
BRAC Installations
FY2006 MMRP Site Status



Total Sites = 373

Figure 6

FUDS Properties
FY2006 MMRP Site Status



Total Sites = 1,633

Response Complete | Investigation Planned or Underway | Cleanup Planned or Underway

[1] LTM is a subset of Response Complete.

- Seventeen percent of MRSs at active installations
- Thirty-three percent of MRSs at BRAC installations
- Twenty-nine percent of MRSs at FUDS properties.

Funding

Within the MMRP, funding is divided between Environmental Restoration (ER) and BRAC accounts. There are five ER accounts, one each for Army, Navy, Air Force, and FUDS, with cleanup for Defense Agencies like DLA being funded from the Defense Wide account. The ER accounts fund restoration activities at active installations and FUDS properties, while the BRAC account solely funds realigned and closed sites. Congress appropriates funds into the five ER accounts or the BRAC accounts for the purposes of funding the IRP, MMRP, and Building Demolition/Debris Removal program.

The MMRP requires predictable funding levels for accurate planning and program execution, as well as for estimation of future costs and activities. Without the required amount of funding, DoD cannot properly address or effectively mitigate risks associated with sites identified in the MRS Inventory. DoD engages in a budgeting process that is closely tied to program planning and execution to ensure proper funding levels are attained. The creation of the MMRP program element has helped DoD manage MMRP funding and allowed Congress to make more informed budgetary decisions in support of the program. DoD's cost-to-complete (CTC) estimates approximate the funding required to achieve MMRP goals Congress requested in Section 313 of the 2007 NDAA.

FY2006 Financial Status and Progress

In FY2006 DoD obligated $205.09 million on MRSs. Figure 7 shows the amount spent by each Component, distinguishing between ER and BRAC accounts. Funding amounts for FY2006 also reflect the transfer of funds from the ER account to provide funding for MRSs at installations closed in the BRAC 2005 round.

MMRP funding allocated by each Component is directly related to the number of MRSs. As the

Figure 7

FY2006 MMRP Site-level Obligation Amounts by Component (millions)

	Army	Navy	Air Force	FUDS	DLA	Total
ER	$12.40	$35.28	$10.80	$91.48	$0.00	$149.96
BRAC	$46.08	$6.75	$0.00	N/A	$0.00	$52.83
Total	**$58.48**	**$42.03**	**$10.80**	**$91.48**	**$0.00**	**$202.79**

majority of MRSs are found on FUDS properties, FUDS received much of the funding. As of the end of FY2006, only DLA had identified no MRSs at either its active or BRAC installations, which is reflected in the funding levels.

FY2006 Cost-to-Complete Estimates

The CTC estimates derived as a result of the budgeting process are based on DoD's available site-level data and provide the most accurate picture of anticipated cost trends for addressing MMRP requirements. Figures 8 and 9 show DoD's estimated funding requirements for munitions responses by budget year and Component. The FUDS program has the highest CTC estimates for MMRP activities due to the large number of MRSs present at FUDS properties. Spending levels for the MMRP are anticipated to increase across all Components in future years as DoD continues to increase its focus on addressing the risks associated with these sites. DoD's estimated CTC for munitions responses at BRAC installations is composed primarily of funding for addressing MMRP requirements at Army BRAC installations.

Figures 10 and 11 show DoD's estimated CTC for munitions responses by phase and Component. DoD demonstrates its commitment to addressing MMRP concerns by continuing to increase the resources available for reducing risks at these sites. As DoD prioritizes sites and continues to establish program goals and performance metrics, the Components will invest their MMRP funding accordingly to appropriately address the risks at these sites. More detailed site characterization and the addition of new sites to the program will provide a more accurate estimate of program CTC and future program requirements. As time progresses, the funding level for investigative activities should decrease as funding for cleanup increases.

The speed of cleanup is largely dependant on funding levels. DoD expects that as installations complete responses at IRP sites, more funding will shift towards completing response actions at MRSs. Once all IRP sites are complete, Components will divert all restoration funding to the MMRP.

Figure 8

Active Installation and FUDS Property
MMRP Estimated Costs by Component, FY2007-Complete (millions)

Component	FY2007	FY2008	FY2009	FY2010	FY2011	FY2012	FY2013	FY2014-Completion	Total
Army	$26.70	$37.01	$132.72	$210.96	$283.22	$326.36	$360.46	$1,654.65	$3,032.08
Navy	$43.28	$45.26	$43.41	$40.07	$54.66	$55.98	$57.02	$279.80	$619.48
Air Force	$17.82	$28.15	$57.80	$105.21	$108.59	$212.05	$242.19	$724.51	$1,496.32
DLA	$0	$0	$0	$0	$0	$0	$0	$0	$0
FUDS	$85.51	$80.21	$79.32	$77.63	$75.51	$81.73	$80.72	$12,078.89	$12,639.52
Total	**$173.31**	**$190.63**	**$313.25**	**$433.87**	**$521.98**	**$676.12**	**$740.39**	**$14,737.85**	**$17,787.40**

Figure 9

BRAC Installations from Rounds I-V
MMRP Estimated Costs by Component, FY2007-Complete (millions)[1, 2, 3]

Component	FY2007	FY2008	FY2009	FY2010	FY2011	FY2012	FY2013	FY2014-Completion	Total
Army	$10.67	$27.22	$29.82	$65.93	$47.53	$50.94	$41.76	$526.44	$800.31
Navy	$13.65	$20.66	$0.50	$0.44	$5.68	$4.86	$0.07	$56.04	$101.90
Total	**$24.32**	**$47.88**	**$30.32**	**$66.37**	**$53.20**	**$55.80**	**$41.83**	**$582.48**	**$902.21**

[1] Totals reflect installation project funding allocated to individual sites and do not include program management and support costs.
[2] Total BRAC environmental funding includes compliance, planning, program management, and restoration. This table only displays site-level BRAC costs
[3] Department of the Air Force's BRAC IRP budget includes MMRP costs. Future reporting will separate BRAC IRP and MMRP funds. DLA does not have BRAC MMRP costs.

Figure 10

Active Installation and FUDS Property
MMRP Site-Level Cost-to-Complete Estimates by Phase Category and Component, FY2007-Complete (millions)

Phase	Army	Navy	Air Force	FUDS	Total
Investigation	$863.06	$137.10	$352.73	$1,516.09	$2,868.98
Cleanup	$2,174.85	$447.89	$1,092.78	$10,676.48	$14,392.01
Long-Term Management	$138.11	$34.49	$50.81	$446.94	$670.34
Total	**$3,032.08**	**$619.48**	**$1,496.32**	**$12,639.52**	**$17,787.40**

Figure 11

BRAC Installations from Rounds I-V
MMRP Site-Level Cost-to-Complete Estimates by Phase Category and Component, FY2007-Complete (millions)

Phase	Army	Navy	Total
Investigation	$98.04	$4.72	$102.76
Cleanup	$652.40	$94.17	$746.56
Long-Term Management	$49.88	$3.01	$52.89
Total	**$800.31**	**$101.90**	**$902.21**

Technology

The potential risks to human health and the environment, and the costs for remediating MRSs known or suspected to contain UXO or DMM or to be contaminated by MC, are significant. DoD believes technology is an important aspect of its MMRP because the development and application of effective innovative environmental technologies can improve cleanup efficiency and reduce the associated costs. This section of the report summarizes the munitions response technologies that are currently available; assesses the impact of improved technologies on the cost of munitions responses; and outlines the objectives for the development and use of improved technologies. This information provides an accurate picture of how technology can benefit the MMRP and identifies the areas in which munitions response technology can be improved.

Since there are fundamental physical differences between munitions (i.e., UXO and DMM) and MC, this discussion of munitions response science and technology is divided into two categories: munitions technology, which includes those systems used to locate, detect, discriminate, recover, and destroy UXO and DMM; and MC science and technology, which includes the sampling and analysis of environmental media and the remediation of MC releases. In addition, the discussion of MC science and technology addresses the state of the current knowledge base related to the toxicological and environmental distribution, fate, and transport of MC.

Munitions Technology Currently Available

The type and complexity of the technologies used at different points in conducting a munitions response to UXO or DMM reflect the different activities that occur throughout the response process. Figure 12 provides a brief summary of the current status of munitions technology based on the stages of the munitions response process.

Munitions Constituent Science and Technology

In addition to the concerns about UXO and DMM at MRSs, there is concern about the potential for releases of MC from UXO and other military munitions. There are over 200 chemicals associated with military munitions and their degradation and combustion products. Of these chemicals, 20 are of greatest concern

Figure 12

Current Status of Munitions Technology

Stage	Technology	Description	Assessment
Area Identification and Characterization	**Traditional Approach**	• Derived from the characterization of a fraction of the site using visual surface sweeps and detection technologies.	• Involves the use of professional judgment and research.
	Wide area assessment	• Uses statistical tools, high-resolution airborne LIDAR and orthophotography, and helicopter borne magnetometry.	• Demonstrated successfully at multiple MRSs. • Currently being used at a limited number of MRSs.
Detection	**Simple Analog Systems**	• Known as "mag-and-flag". • Involves personnel scanning an area of land with a simple analog system, such as a hand-held magnetometer that senses disturbances in the local magnetic field caused by the presence of ferrous metal and translates this disturbance into an audio signal that is interpreted by the operator. When the signal indicating an electromagnetic field disturbance is heard, the operator marks the location with a small pin flag.	Many limitations, including: • No sensor data recorded for subsequent analysis; • Highly dependent on operator performance - decision to mark a location is based on operator's instantaneous and subjective analysis of signal; • Does not distinguish between military munitions (i.e., UXO, DMM) and innocuous pieces of metal; • Unable to detect deeply buried military munitions; • Relatively inefficient, capable of scanning only small areas of land at a given time. Some advantages exist, especially in cases when vegetation or difficult terrain makes the use of more advanced systems difficult
	Digitally Recorded, Geo-referenced Systems	• More advanced than simple analog systems - considered the current sensor technology baseline. • Combinations of different sensor technologies and the use of more complex EMI sensor systems are emerging as the next step in the evolution of detection technology. • Can digitally record information from sensor signals and reference that data to the position of the detected anomaly on the site.	• Currently available with a wide range of properties and performance characteristics that can be matched with site-specific conditions. • Cover a larger amount of surface area than simple analog systems. • Systems currently used in the field are primarily restricted to total field magnetometers and single axis, time-gate EMI systems. • Next generations of systems that are undergoing demonstrations today use multi-axis, wide bandwidth detectors and offer significant advantages for discrimination.
	Underwater Detectors	• A new generation of underwater digital geophysical systems has emerged in the last few years. They have provided the first high quality detection of military munitions that are underwater and covered with sediment.	• Far less mature than land based systems. • A number of technical challenges remain, including navigation, station keeping, and sensor deployment in water. • Few systems employed to date include towed side-scan sonar, magnetometer systems, and simple EMI systems.

Stage	Technology	Description	Assessment
Discrimination		• Currently, discrimination based on simple features such as size allows for a discrimination of military munitions from innocuous items.	• No single system has emerged as having a distinct performance advantage - each of the systems available has a unique set of properties and performance characteristics that must be matched to site-specific conditions and often a mix of technologies is used. • Key to reducing the cost and improving the effectiveness of munitions responses lies in improved discrimination.
Recovery		• One of the most common methods of addressing military munitions is to recover the item intact for destruction or neutralization - an inherently hazardous process. • Primary objective is to conduct the recovery in a manner that minimizes potential hazards to the public, response personnel, and to any nearby property, while at the same time attempting to minimize any environmental impacts. • In most cases, response personnel manually excavate and recover individual military munition in order to minimize the potential for accidental disturbance and unintended detonation.	• The ability to use larger, more powerful devices is emerging and offers a significant benefit for these areas. • Access problems caused by property owner-imposed restrictions, geographical features, or by environmental impact concerns can also restrict the ability to use such devices to retrieve or remove military munitions. • Currently, no cost effective specialized systems for the recovery of buried military munitions in water.
Destruction		• Current technology baseline for military munition destruction is destruction in place by open detonation. • An explosive charge or perforator is used to destroy the military munition either through the direct action of donor explosive or by causing sympathetic detonation of the explosive charge in the military munition. Often sandbags or water-filled blivets are used to mitigate blast effects.	• When moving military munitions poses an unacceptable risk, then destruction in place by open detonation is the safest option for disposal. • In cases where the risk to move discovered munitions is acceptable, specialized technologies, such as destruction chambers, may be used in the detonation of recovered munitions.

due to their widespread use and potential environmental impact. The Department's understanding of the causes, distribution, and potential impacts of releases of MC has emerged in the last few years. In addition, the current technology for characterizing, treating, and monitoring releases of MC, especially over extremely large areas, is also evolving. Figure 13 provides an overview of the stages of MC science and associated technology.

Munitions Response Research, Development, Testing, and Evaluation

DoD has two principle objectives in striving to advance the state of the technologies used to conduct munitions responses. First, these efforts seek to enhance the overall effectiveness of munitions responses, improve safety for response personnel, and increase overall protection of human health and the environment. Second, these efforts seek to reduce the costs associated with the MMRP and increase program efficiency.

To provide focus for the technology development programs, DoD has established six objectives specific to munitions technology development and five objectives

specific to MC technologies; these objectives are listed in Figure 14. These objectives do not represent single endpoints in the technology development process, but rather describe classes of technologies required to meet specific operational needs. Information on the specific work being conducted by DoD to meet these objectives can be found at the Strategic Environmental Research and Development Program (SERDP) and the Environmental Security Technology Certification Program (ESTCP) Web sites (http://www.serdp.org and http://www.estcp.org).

Munitions Technology Development Objectives

Current technology and funding constraints limit DoD's ability to achieve total risk elimination (i.e., detecting and removing all explosive hazards). Brief summaries of each of the six munitions technology development objectives and DoD's efforts to pursue technological solutions are described below.

Wide-Area Assessment

Wide-area assessment technology can rapidly identify the areas within sites that require detailed characterization. Future developmental activities are focused on extending the use of these systems to a wide

Figure 13

Stages of MC Technology

Technology	Stage
Sources Fate and Transport of Munitions Constituents	Knowledge concerning sources of MC has significantly improved over the last several years but no systematic investigations had been conducted to gain a clear understanding of how MC releases occur and migrate into the environment on ranges.
	Several well-established models for general chemical fate and transport through soil and groundwater have been developed but none that specifically address MC. These general models require specific information about each chemical to model its movement and determine its effect on the environment. The gaps that remain in certain chemical, biological, and toxicological properties of MC make these general models difficult to use.
Human and Ecological Impacts	Assessment requires an understanding of the potential effects of MC related chemicals on humans and how an MC release can impact ecological receptors.
	Conservative benchmark values have been adopted for many MC due to the limited scientific data available but significant progress in assessing these issues has been made in the last several years.
Site Characterization and Monitoring	Baseline technologies for characterizing and monitoring MC in soil and groundwater consist of the devices used in standard laboratory methodologies and sampling techniques. Costs for sampling and analysis can range from $200 to $1,000 per sample.
	On-site characterization methods are emerging that provide a rapid and cost-effective alternative to laboratory analysis, but are available only for the more common MC.
	A standardized sampling strategy for characterizing MC contamination at former ranges has been developed by DoD and accepted by the EPA.
Treatment and Containment	Baseline technology for treating MC in groundwater has been pump-and-treat systems. For most MC filtration through activated carbon or ion exchange resins is the standard ex-situ treatment, but a number of alternative in-situ treatment and ex-situ approaches are emerging and being implemented due to DoD investments. These investments are reducing the costs of cleanup as compared to ex-situ pump-and-treat methods.
	Baseline for treating MC in soils was excavation followed by incineration. DoD has developed a number of alternative ex-situ treatments, such as composting and soil washing, which are much more cost effective. At present, there is no standard approach for in-situ treatment or containment of MC in soil.

Figure 14

Technology Development Objectives

Munitions Technology Development Objectives	MC Technology Development Objectives
Wide-Area Assessment	Sources of Contamination
Production Ground Surveys	Fate and Transport
Cued Identification	Human and Ecological Toxicity
Standards and Protocols	Site Characterization and Monitoring
Recovery and Destruction	Treatment and Containment
Decision Tools	

variety of terrain and improving their ability to detect smaller munitions.

Production Ground Surveys

Production ground surveys currently involve the use of sensors to detect and locate subsurface military munitions. New sensor concepts with advanced detection and discrimination capabilities are in development. When coupled with similar efforts to improve the post-collection processing systems, these systems should lead to even greater improvement in detecting munitions more efficiently and effectively.

Cued Identification

This objective focuses on the development of enhanced discrimination technology. Cued identification is a key element in discriminating between subsurface military munitions and innocuous materials with similar sensor signatures, and is a critical feature of efforts to reduce the inefficiencies caused by poor discrimination.

Standards and Protocols

This objective is focused on developing standardized methods for the collection, management, and evaluation of geophysical data. It includes the establishment of standardized test facilities and protocols that enable the evaluation of detection systems under reproducible conditions.

Recovery and Destruction

This objective is focused on developing systems that will improve the safety and efficiency of recovery and destruction activities. Developing tools for the treatment of residues, mass clearance of highly contaminated areas, and safe removal and destruction of UXO and DMM in all site environments are of primary interests.

Decision Tools

This objective is focused on developing methods to guide and evaluate actions throughout the munitions response process. Developing statistical assessment tools, quality control tools, and hazard assessment tools are of primary interest.

Munitions Constituent Technology Development Objectives

DoD is continually seeking a better understanding of MC and potential solutions to prevent, halt, or remediate releases of MC. The development of technology and management options to monitor, contain, and remediate MC requires a better understanding of sources of contamination, MC behavior over time, transport mechanisms, and human and ecological toxicology. A description of the MC technology development objectives follows.

Sources of Contamination

This objective focuses on developing a greater understanding of MC releases, including the range activities associated with MC releases; the size, form, frequency and distribution of those releases; and how MC initially migrate into the environment. An assessment of potential sources of MC and a characterization of the associated releases are being conducted using laboratory simulations, computer modeling, and controlled firings on ranges and test chambers.

Fate and Transport

This objective focuses on developing predictive tools for the movement and life of MC in soil, sediment, groundwater, surface water, and the marine environment. Much of the physical, chemical, and

biological data have been developed over the last few years and gaps are currently being filled.

Human and Ecological Toxicity

This objective focuses on developing standardized and accepted toxicity benchmarks for all munitions constituents.

Site Characterization and Monitoring

This objective addresses the need for sampling protocols and technology designed to characterize and monitor MC on ranges. Sampling protocols designed to characterize ranges are under development, but must be tested in coordination with the regulatory community to ensure acceptance. Also under development are technologies designed to decrease the cost of groundwater and soil monitoring and innovative approaches specifically designed to characterize the large areas typical of ranges. Advances in sensor design, electronics miniaturization, and wireless communications are being used to develop the next generation of tools.

Treatment and Containment

The focus of this objective is to develop in-situ treatment and containment techniques for soil and groundwater. Cost-effective treatment and containment of munitions constituents in groundwater and soil are being developed.

Impact of Investments on Munitions Response Technology

A comprehensive evaluation of the impact of technology investment requires detailed information on the characteristics of MRSs (e.g., topography, vegetation, soil type, expected future land use), data on the specific technologies under consideration, as well as an extensive data set on the costs associated with ongoing or recently completed response actions. Because this level of detail is not available, the information presented here shows the nature of the impact that can result from investing in new technologies without attempting to quantify expected impacts and cost savings.

The impacts of advancing the state of current technology vary from direct predictable cost reductions to improved efficiency, and are expected to include:

- Increases in the efficiency of remediation systems leading directly to improved cleanup and decreasing unit costs;
- Improvements in the overall effectiveness of a system that impact subsequent tasks or that causes a change in the total life cycle costs and long-term management requirements;
- Changes in the munitions response process due to the introduction of new technologies; and
- Overall improvements in program performance, efficiency, and confidence that impact cost, schedule, and management.

Unit costs and expected performance depend on the complexity and size of the site as well as the future land use and cleanup goal. Independent of these variables, though, reviews of the costs associated with munitions responses identified three variables as consistently having the greatest overall impact on cost. These variables are:

- The acreage requiring detailed surface and subsurface investigation;
- The number of anomalies requiring intrusive investigation per acre; and
- The total duration of a response.

Technology targeted to specifically address these site variables can significantly impact the overall cost of munitions responses. Technology is expected to have a significant impact on the quality of cleanup that can be achieved, which will reduce risks and free up land for alternative uses. Improved technology can also impact long-term costs by minimizing long-term management requirements at a site and reducing the need to return to sites where the response has been completed.

Communicating with Stakeholders

DoD actively engages the community and other stakeholders while restoring current and former defense properties impacted by historical activities by developing partnerships with communities, state and federal agencies, and Indian tribal governments. Building strong and effective partnerships helps DoD facilitate communication to fulfill environmental restoration requirements and ensure the future success of cleanup plans.

Through application of the Protocol, which requires stakeholder participation, DoD will increase other stakeholders' understanding of the challenges associated with military munitions response activities and further their effective management.

By formally and informally consulting with organizations from the local to the federal level, the Department enhances cooperation, increases communication, improves decision making, and maximizes the effectiveness of each participant's resources by pooling assets, eliminating redundancies, and sharing best practices. DoD is encouraging participation of other stakeholders by working with the U.S. Environmental Protection Agency (EPA), state environmental regulators, Indian tribal governments, and other federal agencies through the Munitions Response Committee (MRC) to address issues related to munitions responses in an attempt to develop consensus-based approaches to guide munitions responses.

DoD established Restoration Advisory Boards (RABs) to extend the idea of community participation to all interested parties. RABs provide communities affected by DERP activities at active and BRAC installations and FUDS with the ability to discuss, evaluate, and exchange information in an open forum. DoD focuses on including people of diverse backgrounds, interests, and occupations within the locally affected community in the cleanup process. RABs complement other community involvement initiatives, such as community relations plans, public notices, and information repositories.

At BRAC installations, DoD engages stakeholders in both the environmental restoration and land transfer processes. The Department works with community groups, such as RABs and Local Redevelopment Authorities (LRAs), throughout the environmental restoration process to expedite cleanup and reuse of BRAC property.

DoD also works with states through the Defense-State Memorandum of Agreement (DSMOA) Program to sustain environmental restoration activities. The Department provides financial reimbursements for technical services conducted by state agencies at DoD installations to expedite environmental restoration at current and former defense properties through the coordination of efforts. Partnerships established through the DSMOA Program provide opportunities for DoD to openly coordinate and communicate with state regulators to achieve program objectives and respond to concerns through the implementation of program policies and guidelines.

Managing Programmatic Information

To track the additional data required for the MMRP, DoD modified its Knowledge-Based Corporate Reporting System (KBCRS), updating the data structure to include MMRP data elements required by statute, as well as those called for in DoD guidance. In addition to the data discussed above, these data elements include:

- A unique identifier for each MRS
- A record of the location, boundaries, and extent of each MRS
- Current land owners, and
- Land use controls or restrictions.

In turn, each Component modified its data collection procedures to record and provide these data in support of the MMRP inventory requirements. DoD continues to update KBCRS as new information becomes available.

Reporting on Program Progress

As the site-level MRS inventory is updated, MRSs are prioritized, funding is budgeted, and work is executed, DoD will report its progress and initiatives accordingly through the DEP ARC.

Managing the Program

DoD has demonstrated success in the IRP, and will continue this progress in the MMRP. By building the MMRP through forward thinking policies and guidance, establishing an inventory, applying a risk-based approach to addressing sites, and creating goals and performance metrics, promoting innovative technology—the same steps taken to create the IRP—DoD has assembled the framework for the MMRP on a proven foundation. Through effective program management, including increased stakeholder participation and outreach, inclusive data collection and site tracking, and consistent and thorough reporting, DoD will continue to build the MMRP on the success of the IRP.

Report on Reuse Standards and Principles

This section discusses the reuse standards and principles for munitions remediation as required in Subsection (c) of Section 313 of the 2007 NDAA. The Department has engaged in several efforts, both within DoD and in collaboration with other federal and state agencies, related to reuse standards and munitions response. This report discusses two efforts: DoD's finalized Base Redevelopment and Realignment Manual (BRRM), which provides DoD personnel guidance for working with stakeholders regarding property reuse options at BRAC installations; and the MRC.

Base Redevelopment and Realignment Manual

The opportunity to merge all or parts of former military installations into the community and to reuse or redevelop the facilities can provide communities with a unique opportunity to shape their physical, economic, and social future. DUSD(I&E), in cooperation with the Components, developed the BRRM in FY2006 to provide a common set of flexible guidelines for base reuse and redevelopment implementation for installations closed under BRAC 2005 and the remaining incomplete actions from prior BRAC rounds. The BRRM identifies common-sense approaches and general practices to follow during base closure and redevelopment implementation. For example, the BRRM stresses that the Components should utilize all appropriate means (e.g., public benefit conveyances and negotiated sales) to transfer property for safe use, collaborate effectively, rely on and leverage market forces, and work with the community to address growth.

DoD's policy is to act expeditiously when feasible, whether closing or realigning an installation, to facilitate the transfer of real property for community reuse. Cooperation and consultation with LRAs and other federal agencies is a key to successful redevelopment and reuse at BRAC installations. The Department works with the LRA, as well as federal and state agencies, to develop an agreed upon redevelopment plan that provides for the reuse or redevelopment of the property.

Before transferring any BRAC property, the Component must analyze the environmental effects and potential hazards associated with the property. When UXO, DMM, and MC that may pose a threat to human health and the environment are known or suspected to be present on property, Components must take appropriate measures to address potential hazards before transfer. In preparing that analysis, the Components develop the proposed federal action, which will include the LRA's redevelopment plan, and then consider a range of reasonable disposal alternatives and assess their environmental effects in the context of the reasonably foreseeable reuse of the property. The Components, in consultation with environmental regulators and the LRA, make parcel-by-parcel decisions on the responsibilities for any remaining remediation. Remedial actions may be completed by the LRA, by DoD, or by both, either before or after transfer.

Munitions Response Committee

Since 2001, DoD has worked with regulatory agencies to achieve agreement on appropriate munitions reuse principles through the MRC. DoD established the MRC in July 2001 to develop consensus on munitions response strategies among stakeholders.

The MRC operates by identifying and discussing munitions response issues that require resolution. A consensus position is developed through collaboration on specific "white papers." The consensus positions identified in the white papers serve as benchmarks for all parties to generate their implementing guidance, policies, and procedures.

Long-term Protectiveness

In FY2004, the MRC began drafting the *Long-Term Protectiveness Principles* white paper to establish principles for determining when, after completion of an initial munitions response, conduct of additional munitions response at an MRS may be warranted, and the potential impact of the selected munitions response on the potential reuse of the MRS. The need for developing principles arose because of the level of uncertainty associated with any munitions response and the potential future need for revisiting a site with a previously completed munitions response. There are three central issues that have not yet been resolved. Those issues, which are discussed further, concern:

- the appropriateness of deciding the long-term protectiveness issue within the MRC;
- the potential impacts of new technology;
- the timing of when a response is warranted based on an unanticipated change in land use on an MRS.

While DoD is not opposed to conducting additional munitions responses, the Department believes that existing laws, regulations, and policies already address long-term protectiveness and reuse of the property. DoD believes that each MRS should be assessed on a case-by-case basis, using site-specific information, to determine if additional response actions are necessary.

For example, the Department has had a policy in place since 1997 for conducting additional cleanup at IRP sites. Under this policy, DoD would return to conduct appropriate cleanup if the remedy was no longer protective of human health and the environment because: the remedy failed to perform as expected; an institutional control proved to be ineffective; additional contamination attributable to DoD activities was discovered; or new scientific or health data caused revisions of regulatory requirements for protectiveness. Although not all encompassing, the Department considers this policy to include, or could be amended slightly to include, additional munitions response efforts at an MRS.

Appropriateness of the Issue

DoD considers the issue of long-term protectiveness to have significant implications beyond the MMRP. As such, the Department does not believe that the MRC is the best venue to address this issue, as membership does not include representation from other impacted parties.

Potential Impacts of New Technology

DoD's position is not to fund a new munitions response action while the current remedy remains effective, solely because new technology allows additional cleanup. The Department will evaluate the efficiency and cost-benefit of new technology to determine whether its application would reduce lifecycle management costs sufficiently to justify the cost of an additional response.

Changes in Land Use

The Department's policy is to not fund additional munitions response actions in order to accommodate a change in land use that was not reasonably anticipated at the time of remedy selection as long as the current remedy remains protective. DoD considers that, once it has satisfied its agreed upon obligations under the Record of Decision (ROD) with the state or the transferee under the deed, it should not be expected to underwrite future cleanup activities based on new and unanticipated land use or future transfers.

Conclusion

DoD manages hundreds of installations and facilities essential to military operations and training. It manages the MMRP as one part of the process to restore current and former defense properties that were environmentally impacted by past defense activities. DoD's efforts at BRAC locations ensure that transferred property is safe for reuse and allows DoD to realign its forces and infrastructure to effectively transform the military to meet emerging mission needs. Cleaning up UXO, DMM, and environmental contamination (e.g., MC) from past activities protects both military personnel and the public from environmental health and safety hazards and supports the ability of U.S. forces to train effectively.

DoD has an obligation to protect these assets for future generations. To meet this responsibility, DoD is continually transforming environmental management programs and strategies to become more capability-based and performance-oriented. These transformations will allow DoD to protect the environment and human health, while sustaining DoD's capability to maintain military readiness and ensure America's security.

Base Realignment and Closure (BRAC). The process that DoD uses to reorganize its installation infrastructure to more efficiently and effectively support its forces, increase operational readiness, and facilitate new ways of doing business. A variety of actions culminated in binding recommendations issued in 1988, 1991, 1993, 1995, and 2005 to close or realign military installations in the United States. These actions include the processes of selecting bases for closure or realignment and carrying out the associated closure or realignment activities such as relocating military units and disposing of excess property. The *National Defense Authorization Act for FY 1989*, Public Law 100-526, governed the 1988 BRAC process. The *Defense Base Closure and Realignment Act of 1990*, Public Law 101-510, as amended, governed the 1991, 1993, 1995, and 2005 BRAC processes.

Chemical Warfare Materiel (CWM). Items generally configured as a munition containing a chemical compound that is intended to kill, seriously injure, or incapacitate a person through its physiological effects. CWM includes V- and G-series nerve agents or H-series (mustard) and L-series (lewisite) blister agents in other than munition configurations; and certain industrial chemicals (e.g., hydrogen cyanide [AC], cyanogen chloride [CK], or carbonyl dichloride [called phosgene or CG]) configured as a military munition. Due to their hazards, prevalence, and military-unique application, chemical agent identification sets (CAIS) are also considered CWM. CWM does not include riot control devices; chemical defoliants and herbicides; industrial chemicals (e.g., AC, CK, or CG) not configured as a munition; smoke and other obscuration-producing items; flame and incendiary-producing items; or soil, water, debris, or other media contaminated with low concentrations of chemical agents where no CA hazards exist. (32 CFR 179.3)

Components. The Office of the Secretary of Defense, the Military Departments, the Defense Agencies, the Department Field Activities, and any other Department organizational entity or instrumentality established to perform a government function. (32 CFR 179.3)

Defense Environmental Restoration Program (DERP). Program that addresses hazardous substances, pollutants, contaminants, and, in some cases, military munitions remaining from past operations at military installations and formerly used defense sites. The DERP can be found at Chapter 160 of title 10, U.S.C.

Defense Site. Locations that are or were owned by, leased to, or otherwise possessed or used by the Department. The term does not include any operational range, operating storage or manufacturing facility, or facility that is used for or was permitted for the treatment or disposal of military munitions. (10 USC 2710(e)(1))

Discarded Military Munitions (DMM). Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include UXO, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental law and regulations. (10 USC 2710(e)(2))

Feasibility Study (FS). A study undertaken by the lead agency to develop and evaluate options for remedial action. The FS emphasizes data analysis and is generally performed concurrently and in an interactive fashion with the RI, using data gathered during the RI. The RI data are used to define the objectives of the response action, to develop remedial action alternatives, and to undertake an initial screening and detailed analysis of the alternatives. The term also refers to a report that describes the results of the study. (40 CFR 300.5)

Formerly Used Defense Sites (FUDS). A facility or site (property) that was under the jurisdiction of the Secretary of Defense and owned by, leased to, or otherwise possessed by the United States at the time of actions leading to contamination by hazardous substances. By the DERP policy, the FUDS program is limited to those real properties that were transferred from DoD control prior to October 17, 1986. FUDS properties can be located within the 50 States, District of Columbia, Territories, Commonwealths, and possessions of the United States. (US Army Engineer Regulation 200-3-1 FUDS Program Policy)

Installation Restoration Program (IRP). Program designed to focus on releases of hazardous substances, pollutants, or contaminants that pose environmental health and safety risks at military installations and formerly used defense sites. This program is within DERP. (10 USC 2701)

Long-Term Management (LTM). Term used for environmental monitoring, review of site conditions, and/or maintenance of a remedial action to ensure continued protection as designed once a site achieves Response Complete. Examples of LTM include landfill cap maintenance, leachate disposal, fence monitoring and repair, five-year review execution, and land use control enforcement actions. This term should be used until no further environmental restoration response actions are appropriate or anticipated. LTM is reserved for monitoring once a site achieves Response Complete, and should not be used to refer to monitoring after Remedy in Place, (this includes sites for which the selected remedy is natural attenuation). (Management Guidance for the DERP, September 2001)

Military Munitions. All ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the DoD, the Coast Guard, the DOE, and the National Guard. The term includes confined gaseous, liquid, and solid propellants; explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives and chemical warfare agents; chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, and demolition charges; and devices and components of any item thereof. The term does not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components, other than nonnuclear components of nuclear devices that are managed under the nuclear weapons program of the DOE after all required sanitization operations under the Atomic Energy Act of 1954 (42 USC 2011 et seq.) have been completed. (10 USC 101(e)(4))

Military Munitions Response Program (MMRP). Formerly known as the OE Cleanup Program, which is part of the DERP, the MMRP is the program under which DoD carries out environmental restoration activities. The MMRP is a category under the DERP that requires Components to identify munitions response sites requiring action. (10 USC 2710)

Munitions Constituents (MC). Any materials originating from UXO, DMM, or other military munitions, including explosive and nonexplosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. (10 USC 2710(e)(3))

Munitions Response. Response actions, including investigation, removal actions, and remedial actions, to address the explosive safety, human health, or environmental risks presented by UXO, DMM, or MC, or to support a determination that no removal or remedial action is required. (32 CFR 179.3)

Munitions Response Area (MRA). Any area on a defense site that is known or suspected to contain UXO, DMM, or MC. Example MRAs include former ranges and munitions burial areas. An MRA is comprised of one or more munitions response sites. (32 CFR 179.3)

Munitions Response Site (MRS). A discrete location within an MRA that is known to require a munitions response. (32 CFR 179.3)

Munitions Response Site Prioritization Protocol (MRSPP). A tool adopted by DoD to assign a relative priority for munitions responses to each location in the Department's inventory of defense sites known or suspected of containing UXO, DMM, or MC. (32 CFR 179)

Operational Range. A range that is under the jurisdiction, custody, or control of the Secretary of a military department and that is used for range activities; or 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. (10 USC 101(e)(3))

Preliminary Assessment (PA). A review of existing information and an off-site reconnaissance, if appropriate, to determine if a release may require additional investigation or action. A PA may include an on-site reconnaissance, if appropriate. (Definition based on 40 CFR 300.5)

Remedial Investigation (RI). A process undertaken by the lead agency to determine the nature and extent of the problem presented by the release. The RI emphasizes data collection and site characterization, and is generally performed concurrently and in an interactive fashion with the feasibility study. The RI includes sampling and monitoring, as necessary, and includes the gathering of sufficient information to determine the necessity for remedial action and to support the evaluation of remedial alternatives. (40 CFR 300.5)

Remedy in Place (RIP). Designation that a final remedial action has been constructed and implemented and is operating as planned in the remedial design. Because operation of the remedy is ongoing, the site cannot be considered Response Complete. (Definition based on *Management Guidance for the DERP*, September 2001)

Response Complete (RC). Milestone reached when the selected remedy has achieved cleanup goals specified in the ROD or decision document. (*Department of the Navy Environmental Restoration Program Manual*, August 2006)

Restoration Advisory Board (RAB). An advisory group for the environmental restoration process that includes members of the public, the installation, and regulatory agencies. The purpose of a RAB is to gain effective input for stakeholders on cleanup activities and to increase installation responsiveness to community environmental restoration concerns. (10 USC 2705)

Site Inspection (SI). An on-site investigation to determine whether there is a release or potential release and the nature of the associated threats. The purpose is to augment the data collected in the preliminary assessment and to generate, if necessary, sampling and other field data to determine if further action or investigation is appropriate. (40 CFR 300.5)

Unexploded Ordnance (UXO). Military munitions that (1) have been primed, fused, armed, or otherwise prepared for action; (2) have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and (3) remain unexploded, whether by malfunction, design, or any other cause. (10 USC 101(e)(5))

United States. In a geographic sense, the States, the District of Columbia, Commonwealths, territories, and possessions and associated navigable waters, contiguous zones, and ocean waters of which the natural resources are under the exclusive management authority of the United States. (10 USC 2710(e)(10))

ARC	Annual Report to Congress
BRAC	Base Realignment and Closure
CA	Chemical Agent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CWM	Chemical Warfare Materiel
DERP	Defense Environmental Restoration Program
DLA	Defense Logistics Agency
DMM	Discarded Military Munitions
DoD	Department of Defense
DOE	Department of Energy
DOI	Department of the Interior
EE/CA	Engineering Evaluation/Cost Analysis
EPA	Environmental Protection Agency
FR	Federal Register
FS	Feasibility Study
FUDS	Formerly Used Defense Sites
FY	Fiscal Year
IRP	Installation Restoration Program
LTM	Long-Term Management
MC	Munitions Constituents
MMRP	Military Munitions Response Program
MRA	Munitions Response Area
MRS	Munitions Response Site
NDAA	National Defense Authorization Act
ODUSD(I&E)	Office of the Deputy Under Secretary of Defense (Installations & Environment)
PA	Preliminary Assessment
RAB	Restoration Advisory Board
RC	Response Complete
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RIP	Remedy In Place
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SI	Site Inspection
USACE	United States Army Corps of Engineers
USC	United States Code
UXO	Unexploded Ordnance