U.S. ARMY
PROGRAM MANAGER FOR
CHEMICAL DEMILITARIZATION

SURVEY AND ANALYSIS REPORT
SECOND EDITION

PROJECT MANAGER
FOR
NON-STOCKPILE CHEMICAL MATERIEL

DECEMBER 1996

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EXECUTIVE SUMMARY

In Section 176 of Public Law (PL) 102-484, of the 1993 Defense Authorization Act, Congress directed the U.S. Army to submit a report that identifies the locations, types, and quantities of non-stockpile chemical materiel (NSCM); explains the methods to be used for their destruction; provides the estimated cost and schedule for their destruction; and discusses transportation alternatives. The Survey and Analysis Report of November 1993 described all NSCM, regardless of whether it was covered by the Chemical Weapons Convention (CWC), and fulfilled, in part, the Congressional requirements. This survey and analysis report is a second edition to the original. All information contained within has been updated to reflect the most current information available.

This report divides NSCM into five categories: binary chemical weapons, recovered chemical warfare materiel (CWM), buried CWM, former chemical weapon production facilities, and miscellaneous CWM. Except for buried CWM, information concerning the locations and quantities of NSCM is well documented. Although documentation surveys, interviews, and site visits have been conducted, much information concerning buried CWM remains unknown. As additional data is gathered and disposal experience is gained, the information in this report will continue to be updated. However, as long as the CWM remains buried, it is not affected by the CWC.

This second edition of the Survey and Analysis (S&A) Report first discusses historical surveys conducted to gather information concerning the scope of the non-stockpile problem. The report then discusses the five categories of NSCM, each with an explanation of the amount and location of the specified items and possible methodologies for their destruction. Section 9 describes mission-specific equipment that is currently being developed for the sole purpose of destroying NSCM. Section 10 has been included to explain the cost and schedule estimates for destroying all NSCM, if so directed. These estimates are a continuing attempt to quantify the resources required to support the Non-Stockpile Chemical Materiel Program (NSCMP). The

Department of Defense (DoD) intends to continue gathering more information concerning the scope of the non-stockpile issue, identify destruction processes to be developed, and refine the cost and schedule estimates.

This report includes eight appendices: appendix A lists the potential buried CWM sites within the United States and its possessions; appendix B summarizes the miscellaneous CWM; appendix C lists binary chemical weapon components; appendix D lists potential overseas burial sites; appendix E provides a summary description of chemical agent identification set (CAIS); appendix F lists former chemical weapons production facilities by location; appendix G lists references; and appendix H lists acronyms and abbreviations. Appendix D is classified and is published under separate cover.

The Army conducted surveys, including comprehensive documentation surveys at Aberdeen Proving Ground in Maryland and the National Archives in Washington, DC to identify potential buried CWM sites. A database was developed with the information gathered during these surveys. Information from this database can be found in appendix A, where potential buried CWM sites within the United States are listed. For each state, narrative information concerning historical data, current status, and an assessment of the site is included for each potential burial location. Following the narrative is a state map displaying the potential burial location and relevant information on the sites from the database.

To date, a total of 96 locations in 38 states, the U.S. Virgin Islands and the District of Columbia have been identified. This is an increase of 14 locations and 5 states since the original Survey and Analysis Report (1993). The additional states are Iowa, Massachusetts, Michigan, Missouri, and Wyoming. Since the publication of the Survey and Analysis Report (1993), the Army has either removed the hazard or determined that no hazard exists at 33 locations in 18 states and the District of Columbia. This leaves 63 locations with potential buried CWM in 31 states and the Virgin Islands. Of the 63 locations with potential buried CWM, 40 are DoD installations and 23 are

formerly used defense sites (FUDS). Some of the locations have multiple buried CWM sites. The current estimate is 168 potential buried CWM sites and 56 sites that require no further action, for a total of 224 sites. This is a net increase of 9 sites since the Survey and Analysis Report (1993). These estimates for buried CWM are based on documentation research and cannot be confirmed until site characterization studies and, where appropriate, site excavations are accomplished. In the meantime, information will continue to be gathered, and potential buried CWM sites may be added or deleted from this database as appropriate.

Remediation of buried CWM sites poses a great challenge for the Department of Defense (DoD). As seen in appendix A, there are numerous sites with potential buried CWM within the United States, some on military installations and others at FUDS. Buried CWM sites have been divided into four buried CWM site types: CAIS only; small quantity, non-explosive; small quantity, explosive; and large quantity. The DoD will develop site characterization, excavation, removal, and treatment procedures for each burial type. Several destruction technologies, including thermal treatment systems, chemical neutralization, and other approaches, are being studied. Alternative courses of action include onsite treatment, leaving the CWM in the ground while controlling access to the site and containing potential contamination, and transporting the recovered CWM to a facility capable of storage and destruction.

Disposal and transportation options will be fully assessed in accordance with federal and state environmental regulations. Along with these environmental requirements, the recovered CWM will be subject to the provisions of the CWC. Guidelines for this determination are being developed by the CWC Preparatory Commission (PREPCOM). As long as the CWM remains buried, it is not affected by the CWC.

The location and quantities of binary chemical weapons are well documented and understood. Since the precursors of binary chemical agents are not lethal agents, the handling and destruction of these items should not pose major problems. The binary chemical weapons inventory is included in appendix C. The destruction of binary

chemical weapons will fully comply with the requirements of both environmental regulations and the CWC.

Recovered CWM includes items recovered during range clearing operations and from buried CWM sites. These weapons are stored at controlled locations and accounted for by careful documentation. Several technologies are currently being pursued by the Army for assessing and destroying recovered CWM. These technologies can be divided into the following groups: mobile characterization systems, temporary storage systems, and mobile remediation systems. Each respective technology will play a vital role in the assessment of the recovered CWM, its storage, and its final disposal. All systems are being developed to ensure environmental protection and the safety of both the workers and public. The destruction of the recovered CWM will fully comply with both the requirements of environmental regulations and the CWC.

The CWC requires that former chemical weapons production facilities be destroyed. This report identifies these facilities and discusses the characteristics and past use of each, and provides the three-phase disposal strategy adopted by the Project Manager for Non-Stockpile Chemical Materiel (PMNSCM).

The miscellaneous CWM is divided into four groups: Category 3 items as defined by the CWC; Research, Development, Test, and Evaluation (RDT&E) CWM; chemical samples; and ton containers (TCs) formerly used to store chemical agent. The Army plans to destroy all miscellaneous CWM by the most economic and efficient approved methods and processes. The destruction options include crushing CWC Category 3 non-explosively configured components, open burning/open detonation (OB/OD) of CWC Category 3 explosively configured components; incineration of CWC Category 3 explosively configured components; decontamination and smelting the TCs; and chemical treatment of the chemical samples. Options for demilitarization and destruction are being evaluated for compliance with both the applicable environmental regulations and the CWC requirements.

This report summarizes the rough order of magnitude (ROM) cost and schedule estimate for the NSCMP based on the 21 March 1996 Non-Stockpile Program Life Cycle Cost Estimate (LCCE). The NSCMP schedules and cost estimates are currently being revised to reflect changes in basic assumptions about the CWC and the results of the Army Auditing Agency (AAA). The revised LCCE will be completed in 1997.

The NSCMP is challenging and dynamic. Although progress has been made in defining the scope of the program and removing the potential hazards at some sites, much more needs to be done. The DoD recognizes the significance of the program and is prepared to take full responsibility for the safe destruction of all NSCM, if so directed. The DoD will continue to gather information on each type of NSCM, study the different destruction alternatives, develop destruction plans, and comply with all federal, state, and local regulations in selecting and executing the destruction processes. The DoD will also work closely with other federal agencies, local communities, and Congress to develop the destruction plans and identify resources for safe destruction operations.

The information included in this second edition of the Survey and Analysis Report will continue to be updated. A special request is being made to the readers of this document to provide information that will clarify or add to the information included in this report. Information may be mailed to:

Project Manager for Non-Stockpile Chemical Materiel
ATTN: SFAE-CD-N
Aberdeen Proving Ground, Maryland 21010-5401
or call 1-800-488-0648

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SECTION 1
INTRODUCTION

1.1 Purpose

This second edition of the Survey and Analysis (S&A) Report provides an updated assessment of the magnitude of effort required by the Department of Defense (DoD) to safely destroy all United States non-stockpile chemical materiel (NSCM) if so directed. The Survey and Analysis Report (1993) was provided to Congress on 23 November 1993, as a partial fulfillment of the requirement set forth in Section 176 of Public Law (PL) 102-484, of the fiscal year (FY) 1993 Defense Authorization Act.

1.2 Background

Historically, the destruction of NSCM has not been addressed with the same intensity as the disposal of the chemical weapons stockpile because most NSCM sites do not pose an immediate hazard to public health or the environment, and do not contain large quantities of agent. Therefore, DoD has placed higher priority on issues dealing with the safety, security, and destruction of the unitary chemical weapon stockpile. All necessary and reasonable precautions were taken concerning NSCM. The former chemical weapons production facilities were cleaned and placed in layaway status many years ago; the containers that held chemical agent have been decontaminated and stored awaiting final disposition; the binary chemical weapons systems' components were placed in storage; and recovered chemical weapons were placed in storage as they were removed from old test ranges or burial sites. Now, however, the priority for destroying NSCM has increased because of the Chemical Weapons Convention (CWC) and recent discoveries and subsequent recoveries of buried NSCM.

1.2.1 Historical Procedures. The U.S. Army Materiel Command (AMC) has been responsible for the emergency destruction and transportation of recovered chemical weapons. If chemical weapons were discovered at ranges, burial sites, or other locations, Explosive Ordnance Disposal (EOD) technicians were called on to identify and assess the condition of the weapons, and determine whether they were safe for transport. For weapons determined to be unsafe for transportation or storage, state and local officials were notified, all appropriate safety measures were taken, and the weapons were destroyed in place. The emergency destruction was reported to Congress, as required by Public Laws 91-121 and 91-441. For weapons determined to be safe for transportation, the U.S. Army Technical Escort Unit (TEU) was called on to transport the weapons to an appropriate chemical storage installation, where the weapons were then placed in secure storage while awaiting destruction.

1.2.2 United States Congressional Interest. In November 1985, the U.S. Congress passed Public Law 99-145 (Title 50 U.S. Code, § 1521) requiring the destruction of the United States stockpile of lethal chemical agents and munitions. Subsequently, House Appropriations Report 101-822, accompanying the FY91 Defense Appropriations Act, stated that,

> The Program Manager for Chemical Demilitarization (PMCD) currently has responsibility for demilitarizing only those items which were originally identified in 1986 as part of the Chemical Stockpile Disposal Program (CSDP). Not included are a host of lethal wastes from past disposal efforts, unserviceable munitions, chemically contaminated containers, chemical production facilities, subsequently located chemical munitions, sites known to contain significant concentrations of buried chemical weapons and waste, and binary weapons and components. The Committee therefore directs the Secretary of Defense to organize an overall program so that operational responsibility for all Defense Department chemical warfare activities rests within a single office which shall be fully accountable for total program execution.

Consequently, Congress directed DoD to organize an overall program so that operational responsibility for all DoD chemical warfare activities rested within a single

office that would be fully accountable for total program execution. On 13 March 1991, the Deputy Secretary of Defense directed that the Department of the Army (DA) be fully accountable for all DoD chemical warfare-related materiel destruction and designated the Secretary of the Army (SECARMY) as the Defense Executive Agent for this purpose. The U.S. Army Chemical Materiel Destruction Agency (USACMDA) was officially established by DA in 1992 with the expressed mission to execute chemical materiel destruction by providing centralized management of the demilitarization and disposal of the United States stockpile of lethal chemical warfare agents and munitions and NSCM. In October 1994, the official name for USACMDA was changed to the U.S. Army Chemical Demilitarization and Remediation Activity (USACDRA) and the organization was consolidated under the U.S. Army Chemical and Biological Defense Command (CBDCOM).

In December 1994, the Under Secretary of Defense, Acquisition and Technology [USD(A&T)], designated the chemical demilitarization program as an Acquisition Category (ACAT) I Defense Acquisition Board (DAB) program. A Memorandum of Understanding (MOU) between the Army Acquisition Executive and the Commander, AMC, dated 28 March 1995, stated “that the Chemical Demilitarization Program Manager (PM) shall be a direct reporting PM to the Army Acquisition Executive, effective this date. The Commander, U.S. Army Materiel Command shall provide matrix support to the PM as required.”

With the redesignation as an ACAT I program, the name changed again, from USACDRA to the Program Manager for Chemical Demilitarization (PMCD). The former Program Managers established by USACMDA were redesignated as the Project Manager for Chemical Stockpile Disposal (PMCSD) and the Project Manager for Non-Stockpile Chemical Materiel (PMNSCM).

PMCSD was given responsibility for the destruction of the chemical stockpile as was declared in 1985. The PMNSCM was given responsibility for the execution of the Non-Stockpile Chemical Materiel Program (NSCMP), which includes:

a. Binary Chemical Weapons
b. Recovered Chemical Warfare Materiel
c. Buried Chemical Warfare Materiel
d. Former Chemical Weapons Production Facilities
e. Miscellaneous Chemical Warfare Materiel.

1.3 Convention on the Prohibition of the Development, Production, Stockpiling, and Use of the Chemical Weapons and on Their Destruction, Commonly Referred to as the Chemical Weapons Convention

After years of negotiations, the United States and 159 other nations have signed the CWC. Under the provisions of the CWC, it will become effective 180 days after the 65th nation ratifies it.

Article I of the CWC states the general obligations of each signatory nation, which include the destruction of all chemical weapons and chemical weapons production facilities that meet the criteria set forth in the Convention. The CWC further differentiates the weapons and production facilities by the toxicity and commercial utility of the chemical agent contained or produced, establishes separate categories for the destruction of chemical weapons, and specifies time periods for the destruction of the various production facilities and weapons.

The grouping of chemicals by toxicity and commercial utility is done by segregation into separate Schedules. Briefly outlined, the Schedules are as follows:

Schedule 1: Lists chemicals developed, produced, stockpiled, or used as chemical weapons, or that have high potential for use in such activities, and for which there is little or no use for purposes not prohibited by the CWC. For the United States, the chemicals of most significance in the list are the nerve agents GB and VX, their precursors DF and QL, and the mustard and lewisite agents designated H, HD, HN1, HN2, HN3, HT, and L.

Schedule 2: Part A lists chemicals that pose a significant risk to the purposes of the CWC and are not produced in large commercial quantities for purposes not prohibited by the CWC. Part B includes, inter alia, chemicals used as precursors to other more toxic chemicals, and that are not produced in large commercial quantities for purposes not prohibited by the CWC. For the United States, the relevant chemical listed in Part A is the incapacitating agent BZ, and in Part B is thiodiglycol.

Schedule 3: Lists chemicals that have been produced, stockpiled, or used as chemical weapons, or that are important for the production of chemicals listed in Schedule 1 or 2, but that may be produced in large commercial quantities for uses not prohibited by the CWC. For the United States, the toxic chemicals include phosgene, cyanogen chloride, hydrogen cyanide, and chloropicrin.

The CWC mandates the immediate cessation of all activity at chemical weapon production facilities at entry into force (EIF) for a State Party except those actions required for closure. It explicitly covers all chemical weapon production facilities that produced chemical warfare agents after 1 January 1946. Those facilities that produced

Schedule 1 chemical agents must be destroyed within 10 years of EIF. All other chemical weapons production facilities must be destroyed within 5 years of EIF. For the United States, all the chemical weapons production facilities subject to the CWC produced either Schedule 1 or Schedule 2 chemicals.

The CWC divides chemical weapons into three categories based on the above Schedule of chemicals. As stated in the CWC, the three categories are:

Category 1: Chemical weapons on the basis of Schedule 1 chemicals and their parts and components.

Category 2: Chemical weapons on the basis of all other chemicals and their parts and components.

Category 3: Unfilled munitions and devices, and equipment specifically designed for use directly in connection with the employment of chemical weapons.

Category 1 chemical weapons are required to be destroyed within 10 years after EIF. The CWC specifies a destruction schedule based on a percentage of the declared national inventory of Category 1 chemical weapons. For the United States, PMCSD is responsible for the majority of Category 1 chemical weapons, with PMNSCM being responsible for the stockpile of binary weapons. PMNSCM is also responsible for recovered Category 1 weapons.

Category 2 chemical weapons are required to be destroyed within 5 years after EIF. The United States completed destruction of its stockpile of BZ chemical munitions in 1990, and has only limited items of Schedule 2 and Schedule 3 chemicals. Most of the Category 2 items are located in storage sites, and it is anticipated that some will be recovered from ranges.

Category 3 items are required to be destroyed within 5 years after EIF. By definition these items are generally not contaminated with chemical agents, and will not be difficult to destroy.

In some publications, Category 3 items are called “miscellaneous” CWM due to the wide variety of pieces, parts, and equipment included. While not an inaccurate description, this has caused some confusion with the PMNSCM mission area identified as “Miscellaneous CWM,” which includes not only the CWC Category 3 items, but also the lethal wastes and contaminated containers addressed in the House Appropriations Report 101-822, which accompanied the FY91 Defense Appropriations Act. This report uses the broader definition, and includes the CWC Category 3 items; Research, Development, Test, and Evaluation (RDT&E) CWM; chemical samples, including small quantities drained from recovered or leaking chemical weapons and those left from the chemical weapon quality assurance program; and empty ton containers (TCs) that were used to contain chemical agents. The TCs will be destroyed in accordance with Congressional direction.

The CWC also identifies and defines “old chemical weapons” as chemical weapons made before 1925, or chemical weapons made between 1925 and 1946 that have deteriorated to such extent that they can no longer be used as chemical weapons. After declaration and inspection, the pre-1925 chemical weapons may be destroyed as toxic waste. The deteriorated chemical weapons produced between 1925 and 1946 must be destroyed in accordance with the general provisions of the CWC.

Chemical weapons abandoned on the territory of another State Party are another special category in the CWC. The nation that abandoned the weapons is responsible for their removal and destruction. However, in instances where the abandoning party cannot be identified, the nation discovering the chemical munitions may request assistance from the Organization for the Prohibition of Chemical Weapons (OPCW) and other State Parties in their destruction.

The CWC imposes significant requirements on each nation to submit declarations, plans, and reports; to allow and host inspections, and the installation of monitoring equipment; to permit verification of destruction; and to cooperate with other State Parties that request information or assistance in the development of appropriate destruction methods. These plans are currently being developed by appropriate U.S. Government agencies, and involve coordination among the State Department, the Arms Control and Disarmament Agency (ACDA), DoD, the various states and facilities to be visited, and several commercial contractors.

Table 1-1 provides a synopsis of the categories and destruction requirements for production facilities and chemical weapons.

1.4 Lessons Learned

PMCSD has gained much experience in the planning, designing, construction, and operation of demilitarization facilities for the U.S. chemical weapons stockpile. PMNSCM is applying these lessons learned from the chemical stockpile disposal project to the NSCMP. Many lessons learned were incorporated into the updated rough order of magnitude (ROM) cost estimate included in this report. As a result of this experience, the ROM estimate reflects the best technical and cost information available. Nevertheless, many uncertainties remain. These uncertainties have been presented in a qualitative cost sensitivity analysis. The ROM estimate is provided as a range of costs dependent on these uncertainties. As the project matures and further information is developed, the range of costs will be narrowed to reflect the growing confidence in the estimate.

In addition to using lessons learned in planning, PMNSCM is working diligently to provide accurate information about its activities to affected parties. It is establishing a public outreach program to ensure the public has an opportunity to be heard, obtain information, and play an active role in the project. PMNSCM is coordinating its activities with state regulatory agencies to ensure the activities meet applicable

Table 1-1. CWC Categories and Destruction Schedules

Group	Description	Destruction Schedule
Production Facilities		
Category 1	Chemical weapons production facilities designed, constructed, or used since 1946 to produce or fill Schedule 1 chemical agent weapons.	Begin no later than 1 year after CWC EIF for a State Party. Complete no later than 10 years after EIF of the Treaty.
Category 2	Chemical weapons production facilities designed, constructed, or used since 1946 to produce or fill any other chemical weapons.	Begin no later than 1 year after CWC EIF for a State Party. Complete no later than 5 years after EIF of the Treaty.
Chemical Weapons		
Category 1	Chemical weapons on the basis of Schedule 1 chemicals and their parts and components. For the U.S., this includes munitions and containers filled with nerve agents (GB and VX), mustard (H, HT, and HN), and lewisite (L); and the chemical agent precursors DF and QL from the binary weapons.	Begin no later than 2 years after CWC EIF for a Sate Party. Complete no later than 10 years after EIF of the Treaty.
Category 2	Chemical weapons on the basis of all other chemicals and their parts and components. For the U.S., this includes recovered items filled with CG, CK, AC, or PS.	Begin no later than 1 year after CWC EIF for a State Party. Complete no later than 5 years after EIF of the Treaty.
Category 3	Unfilled munitions and devices and equipment specifically designed for use directly in connection with the employment of chemical weapons.	Begin no later than 1 year after CWC EIF for a State Party. Complete no later than 5 years after EIF of the Treaty.
RDT&E CWM		
	Declarations and limitations on the production, acquisition, and transfer of listed chemicals, depending on Schedules and specific requirements.	No destruction period specified, but limitations imposed on quantities of some chemicals allowed.

environmental regulations. It recognizes the need for full cooperation by all parties in successfully completing the disposal of non-stockpile materiel.

1.5 Report Format

This report first discusses historical surveys conducted to gather information concerning the scope of the non-stockpile problem. The report then discusses the five categories of NSCM, each with an explanation of the amount and location of the specified items and possible methodologies for their destruction. For buried CWM, miscellaneous CWM, and binary chemical weapons, the listings of the locations and quantities are included in separate appendices. Section 9 describes mission-specific equipment that is currently being developed for the sole purpose of destroying NSCM. Section 10 discusses the results of the cost and schedule estimates for destroying all NSCM, if so directed, and compares the 1996 ROM estimate to the 1993 ROM estimate. These estimates are a continuing attempt to quantify the resources needed to conduct the NSCMP.

SECTION 2
HISTORICAL SURVEYS

2.1 Background

To gather information concerning the scope of the potential buried chemical warfare materiel (CWM) disposal effort, the Army is continually conducting surveys of historical documentation, interviews of personnel who have knowledge of past chemical activities, and visits to some of the sites with the potential of containing non-stockpile chemical materiel (NSCM). For this report, the Army concentrated on information from six surveys: a documentation survey at Aberdeen Proving Ground (APG), Maryland; a documentation survey of the National Archives, Washington, DC; a detailed formerly used defense sites (FUDS) survey by the U.S. Army Corps of Engineers (USACE); the Arms Control and Disarmament Agency (ACDA) sea disposal survey; a survey of 35 continental United States (CONUS) sites for intensive study under the chemical weapons suspect burial site database; and surveys conducted during actual site visits. The Army has incorporated the results of these chemical surveys into a database included in Chemical Weapons Burial Historical Survey (appendix A), which will be the basis for defining the scope of the potential buried CWM disposal effort. The surveys were as thorough as possible for this study, but it is likely that additional buried CWM sites may be identified subsequent to the release of this report. Further research and onsite investigations are continuing to gather additional data on the identified sites and the potential buried chemical weapons within them. The database will be updated as additional data is received.

CWM that may be found at these potential buried CWM sites includes Chemical Agent Identification Sets (CAIS), 4.2-inch and Stokes mortar rounds, aerial bombs, rockets and projectiles, and storage containers of agent in cylinders, 55-gallon drums, and ton containers (TCs). Potential chemical agents in these munitions and containers include, but are not limited to, blistering agents [mustard (H) and lewisite (L)], nerve agents (GA,

GB, and VX), blood agents [hydrogen cyanide (AC) and cyanogen chloride (CK)] and choking agent [phosgene (CG)]. Buried CWM sites may also contain other hazardous wastes.

2.2 Aberdeen Proving Ground Survey

Aberdeen Proving Ground-Edgewood Area (APG-EA) is home to many of the agencies that developed, tested, produced, transported, and destroyed chemical agents and munitions. As such, APG-EA has the best concentration of historical files on past chemical activities, including transportation and destruction of chemical munitions. It was an ideal site for a documentation survey to determine where chemical weapons may have been buried.

2.2.1 Research Methodology. Files from six principal agencies were reviewed to compile a list of potential buried CWM sites, as well as of those sites where chemical weapons were developed, manufactured, tested, or stored. Special emphasis was placed on determining whether a site had direct or only potential evidence of containing buried chemical weapons. To the extent possible, attempts were made to discover the characteristics of a buried CWM site, its size, and its contents. However, records from past eras were often imprecise, and in many cases, only state that chemical materiel was buried, without including any definitive information on the type of materiel or the exact location of the burial.

The six agencies whose files were reviewed are as follows:

a. *Historical Office, U.S. Army Chemical and Biological Defense Command (CBDCOM).* This office contains a comprehensive holding of historical documents on the U.S. Army Chemical Corps and activities during World War I (WWI), World War II (WWII), and subsequent eras.

b. *U.S. Army Environmental Center.* This agency, formerly known as the U.S. Army Toxic and Hazardous Materials Agency, contains documentation related to the Army's efforts to clean up hazardous waste from Army installations.

c. *U.S. Army Center for Health Promotion and Preventive Medicine.* This agency, formerly known as the U.S. Army Environmental Hygiene Agency, contains documents describing solid waste management unit (SWMU) sites, including those containing contamination from chemical weapons.

d. *U.S. Army CBDCOM.* This office contains information on research and testing of chemical weapons.

e. *U.S. Army Technical Escort Unit (TEU).* This organization contains information on transportation of chemical weapons and recovery operations of chemical weapons found in past and recent years.

f. *U.S. Army Program Manager for Chemical Demilitarization (PMCD).* This organization was formerly known as U.S. Army Chemical Demilitarization and Remediation Activity (USACDRA). The Data and Document Control Center (DDCC) of this organization contains information on the destruction of chemical weapons.

2.2.2 Site Characteristics. The sites identified in this study include chemical weapon storage facilities, both current and historical; former chemical weapon production facilities; points of entry and debarkation, where ships and trains were used to transport chemical weapons; training areas, where CAIS were used; test centers and ranges, where chemical agents were fired and rounds that impacted on the surface may be buried; and disposal locations. As expendable training items, CAIS were not inventoried and documented as chemical weapons, and they may continue to be

discovered in many, and frequently unpredictable, locations. Historical records of these items are not extensive.

2.2.3 Survey Results. The APG-EA survey presents an initial effort to determine the numbers, types, and locations of buried chemical weapons through historical research. The results of this initial research have been incorporated in Chemical Weapons Burial Historical Survey (appendix A).

2.3 National Archives Survey

The National Archives and Records Administration (NARA) provides storage and reference services for active and semi-active federal records. The Washington National Records Center (WNRC), a part of NARA located in Suitland, Maryland, receives federal agency records approximately 4 years after their creation, maintains them for a minimum number of years (based on originator disposition instructions), destroys approximately 95 percent of them in accordance with disposition instructions, and forwards the remainder (approximately 5 percent) to the National Archives for permanent safekeeping. The WNRC and National Archives were the primary resources for this survey.

2.3.1 Research Methodology. A special research team was sent by the Army to the WNRC in Suitland, Maryland, and to the NARA in Washington, DC, to research files containing information on buried chemical weapons. Classified and unclassified records were reviewed at the WNRC, while only unclassified records were examined at the NARA. The classified records did not provide confirmed NSCM burial or disposal locations, but they did act as a source for identifying NSCM research areas.

2.3.2 Survey Results. This survey did not result in any potential disposal sites being added to the Chemical Weapons Burial Historical Survey (appendix A). It did, however, add valuable historical information concerning movement and testing of chemical

weapons, and lent support and added credence to the information on the burial sites identified during the APG-EA survey of historical records.

2.4 Formerly Used Defense Sites Survey

USACE has identified approximately 7,900 FUDS throughout the United States. FUDS are sites that, at one time, were under the jurisdiction of the Department of Defense (DoD) but are currently privately owned or under the jurisdiction of another government agency. Most of these sites are not suspected to contain CWM. However, a continuous screening of the list by USACE has resulted in over 700 sites that require further investigation to determine their CWM potential. These sites can be found in the Defense Environmental Restoration Program (DERP) Ordnance and Explosive Waste Chemical Warfare Materiel Archival Search, a database containing possible CWM burial sites established and maintained by USACE. Each location was chosen because data exist, or evidence suggests some degree of involvement with CWM. The data from this initial screening are now being checked by an extensive, 3-year, USACE survey. As information from this survey becomes available, the Chemical Weapons Burial Historical Survey (appendix A) will be updated. The USACE effort to date has provided valuable verification of some sites, and changes to the database for others.

2.4.1 Research Methodology. Research teams from USACE are reviewing the records of the Chemical Center and School archives, Fort McClellan, Alabama; the Command and General Staff College archives, Fort Leavenworth, Kansas; and the archives at Rock Island Arsenal (RIA), Illinois, to refine the CWM FUDS list. The teams are also comparing the burial site database from the APG-EA survey with the National Archives survey to confirm the accuracy of the lists. They also consulted with Project Manager for Non-Stockpile Chemical Materiel (PMNSCM) personnel to eliminate duplicate research. USACE is also conducting research at Dugway Proving Ground (DPG), Utah, and Tooele Army Depot (TEAD), Utah, and is reviewing record groups at WNRC, the General Accounting Office (GAO), U.S. Forest Service, and various Armed

Forces Centers for Military History. Team members are visiting potential CWM FUDS locations to confirm or correct the data.

2.4.2 Level of Effort. The archive search effort began in October 1992, and it is envisioned that this will be a long-term effort. After identifying the sites requiring further investigation, USACE will finalize the site list and authorize the initiation of site assessments.

2.4.3 Survey Results. In the initial stages of the archival research, USACE teams encountered some of the same types of difficulties experienced during the National Archives and APG surveys. One major problem experienced was the difficulty in accurately determining what actions had taken place in terms of CWM disposal. The USACE effort is continuing and much work is required to gather information on the numerous potential sites. As information is gathered and documented, additional sites may be incorporated into the Chemical Weapons Burial Historical Survey (appendix A).

2.5 Sea Disposal Survey

ACDA conducted a survey concerning chemical weapons that were disposed of by sea dumping. Coordination has been made with ACDA to receive the results of its survey. Besides the sea disposal programs carried out by the United States and other nations in the late 1960s, Allied Forces were responsible for the disposal of approximately 250,000 tons of German chemical munitions (total weight) by sea burial following WWII.

2.5.1 Research Methodology. At the WNRC, the ACDA teams conducted a thorough search of records and files involved with dumping of chemical weapons at sea. The information from the Army archival survey was provided to the ACDA research teams. In addition, information was obtained through interviews and consultation with historians and other subject-matter experts from APG, Maryland; Chemical Center and School at Fort McClellan, Alabama; Office of the PMCD; U.S. Army War College, Carlisle Barracks, Pennsylvania; Onsite Inspection Agency, Washington, DC;

Headquarters, Department of the Army (DA); National Archives; and the Library of Congress.

Other records and reports on sea dumping of chemicals were also analyzed and evaluated. They included government-to-government communications, newspaper articles, and scientific reports published in the United States and abroad. Numerous separate treaties, conventions, and international agreements were also examined.

The survey also included various literature reviews. These included locating and reviewing past literature reviews and initiating new reviews through the Defense Technical Information Center (DTIC) and Chemical Biological Information Analysis Center (CBIAC). Requests for information have also been submitted to the National Oceanographic Data Center, Naval Oceanographic Library, and Naval Research Laboratory Technical Library. Finally, a number of recognized chemical warfare experts were interviewed. These subject-matter experts were asked about the prospects for reclamation or alternative destruction of sea-dumped chemical munitions.

2.5.2 Level of Effort. The sea disposal survey started in mid-September 1992 and was completed in January 1993.

2.5.3 Survey Results. Copies of the survey report were distributed to affected agencies in February 1993. The information from the survey is maintained by PMNSCM.

2.6 Thirty-Five CONUS Sites for Intensive Study

Subsequent to the Survey and Analysis Report (1993), PMNSCM identified 35 additional CONUS sites for further research into the extent of CWM used there. A study was conducted to gain additional information on each of these sites. This information was the basis for determining which of these sites should be added to the Chemical Weapons Burial Historical Survey (appendix A).

2.6.1 Research Methodology. Record searches were conducted at several information centers that store records of past operations involving chemical warfare munitions and agents. These repositories included:

- U.S. Army DPG, Utah
- National Archives in Suitland, Maryland
- U.S. Army Chemical School, Fort McClellan, Alabama
- U.S. Army Center of Military History, Washington, DC
- U.S. Army Military History Institute, Carlisle Barracks, Pennsylvania
- U.S. Army CBDCOM, Historical Office, APG-EA, Maryland.

Records were reviewed for specific information on previously identified sites.

2.6.2 Survey Results. The information gathered during this survey, backed by information supplied by USACE, identified several new potential CWM burial sites. All of the information was reviewed in its entirety and the results incorporated into the Chemical Weapon Burial Historical Survey (appendix A).

2.7 Site Visits

The last type of historical survey involved visits to installations that have significant NSCM inventories or large chemical weapon burial sites. The installations visited include Rocky Mountain Arsenal (RMA), Commerce City, Colorado; TEAD, Tooele, Utah; Newport Chemical Activity (NECA), Newport, Indiana; Pine Bluff Arsenal (PBA), Pine Bluff, Arkansas; Navajo Depot Activity, Arizona; and DPG, Dugway, Utah. The purpose of these visits was to examine facilities, burial pits, and recovered weapons; interview personnel knowledgeable in past chemical activities on the respective installations; examine installation databases concerning historical activities; and review historical documentation.

2.8 Weapons Specification Package

The weapons specification package was a special survey conducted to ensure that PMNSCM had thorough descriptions of old United States and foreign chemical weapons. The effort was two-phased. The first phase was a focus on chemical weapon information on those weapons suspected to be associated with Former Raritan Arsenal, New Jersey, and Former Fort Segarra, U.S. Virgin Islands. The second phase was an expansive effort documenting WWI and WWII chemical weapons of the United States, Germany, France, Great Britain, and Japan.

The package consists of illustrations and specifications of each munition identified. Illustrations of each munition were included to provide general shape and dimensions. The specifications include critical identification measurements, markings, color codings, fillers, and hazards associated with each respective munition. Diagrams of each munition, when available, were included.

This effort included data-gathering trips to the U.S. Army Chemical Center and School, Ft. McClellan, Alabama; Explosive Ordnance Disposal (EOD) Technology Center, Indian Head, Maryland; and TEU and Edgewood Historical Office, APG, Maryland. The final weapons specification package is a useful tool in assisting EOD and TEU personnel responding to CWM sites, PMNSCM personnel identifying the type of weapons at burial sites, site safety personnel documenting and calculating hazards associated with operations, and Government representatives briefing the public.

The follow-on document to the weapons specification package includes additional technical information on old chemical weapons. The weapons specification package's name was changed to Old Chemical Weapons: Munitions Specification Report (1994) to better reflect its intended use. This compilation of information is intended to aid technically qualified personnel in the identification of older munitions, as well as to provide data for decision-makers who will make judgments on methods for munitions handling and disposition.

The information used to compile this report is based on historical documents that describe ammunition development and manufacture, technical manuals, munitions specifications, and other related sources. This document is based on the best information available at the time of its publication.

2.9 Historical Survey Results

The results of the surveys described above were the basis for the Chemical Weapons Burial Historical Survey (appendix A). PMNSCM has updated the Chemical Weapons Burial Historical Survey with information from additional historical surveys and from the completion of buried CWM site remediations. The precise total number of buried CWM sites cannot be confirmed until site characterization studies are concluded, but appendix A provides a summary of the efforts to date in quantifying the scope of the potential buried CWM disposal effort. As further information is received from the USACE survey and other sources, the number of potential buried CWM sites will be updated.

SECTION 3
BINARY CHEMICAL WEAPONS

3.1 Background

A binary chemical weapon is one that forms a lethal chemical agent from nonlethal constituents through a chemical reaction occurring during the time of flight to the target. Binary chemical weapons were manufactured, stored, and transported with only one nonlethal chemical component within the munition; the other nonlethal component was produced, stored, and transported separately. The Army's doctrine was to load the second binary component into the munition at the battlefield location, only after approval for use of the weapon had been given. The Department of Defense (DoD) tested three binary weapon systems: the Multiple Launch Rocket System (MLRS), bigeye bomb, and M687 GB 155mm binary projectile. The quantities of the binary weapons systems, along with illustrations of the weapons, are located in appendix C. The locations of the binary weapons are summarized in figure 3-1.

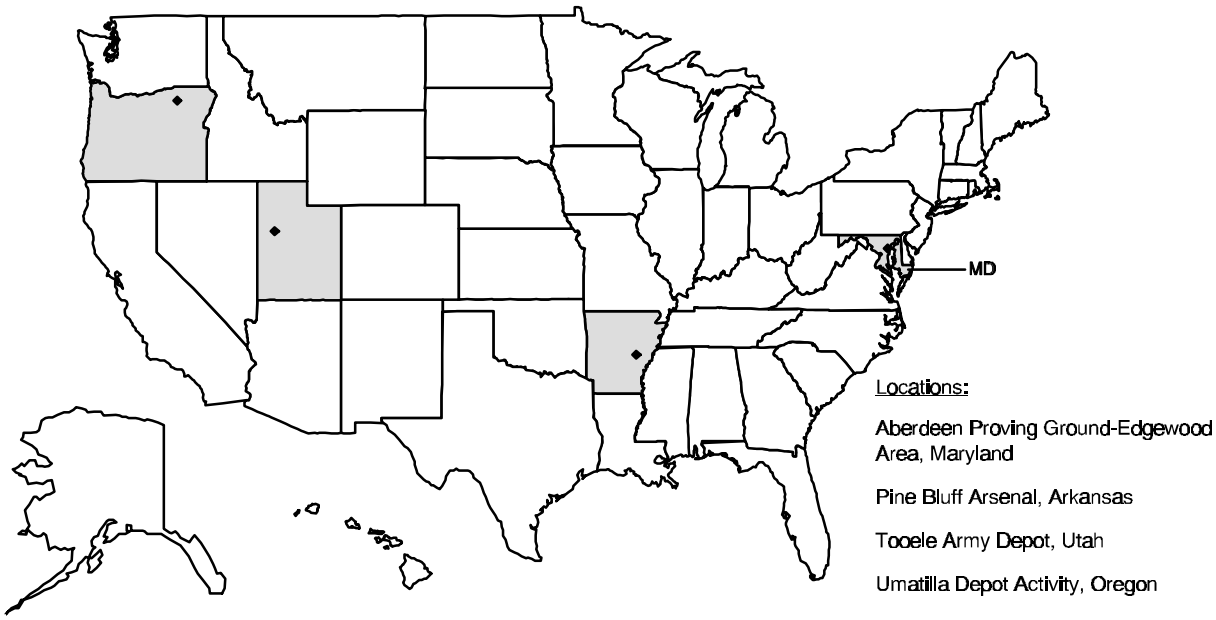

Figure 3-1. Location of Binary Chemical Weapons

3.2 Chemical Weapons Convention Issues

Binary chemical weapons are required to be destroyed within 10 years of entry into force (EIF) of the Chemical Weapons Convention (CWC), unless a request for extension is approved by the Conference of States Parties of the Organization for the Prohibition of Chemical Weapons (OPCW). Such an extension cannot exceed an additional 5 years.

3.3 Multiple Launch Rocket System

Full-scale development of the MLRS binary munition was never completed. Prototype development efforts ended in October 1990. Prototype facilities at Pine Bluff Arsenal (PBA), Arkansas, were never used for production and are currently in layaway status. Critical equipment and all completed components were sent to PBA for storage.

3.4 Bigeye Bomb

Developed by the Navy, the bigeye bomb is a binary bomb designed to be dropped from a jet aircraft. This system uses a liquid precursor (QL) and sulfur (powder) chemical reaction to form the nerve agent VX. When released from an aircraft, the bigeye bomb mixes the chemical components while in-flight to the target and sprays VX over the target area. Two hundred test weapons were delivered to the DoD. There are 200 empty bomb bodies and 160 empty ballonets remaining in storage. A ballonet is a container that held the sulfur separate from the QL until the bomb was released. The bigeye bomb never went into production.

3.5 Artillery Projectile

The M687 GB 155mm binary projectile uses a liquid precursor di-fluoro (DF) and isopropyl alcohol (OPA) to form nerve agent GB. The binary chemical reactants, DF and OPA, are contained in two separate, hermetically-sealed containers. The DF was

manufactured at PBA and sealed into the M20 (DF-filled canister). The M21 (an OPA-filled canister) was loaded into the projectile body during manufacture at the Louisiana Army Ammunition Plant, Shreveport, Louisiana. A fiberboard spacer occupies the space for the DF canister in the stored projectile body. Only on the battlefield at an ammunition supply point or artillery battery would the M20 (DF-filled canister) be inserted into the projectile. To activate the round, a fuze would also be installed at the artillery battery prior to firing. The canisters, loaded through the aft end of the projectile body, would ride one behind the other. Upon firing, inertial forces would rupture discs between the canisters and the spin of the round in-flight would mix the reactants to produce GB. The discs are designed to withstand rough handling, thus precluding rupture and mixing prior to firing. The M687 was the only binary weapon that reached the full-production stage.

3.6 Destruction Strategies

The MLRS never went into production and no chemicals remain. The production equipment and residual hardware can be disposed of in the same manner as the uncontaminated miscellaneous chemical warfare materiel (CWM) (section 7) in accordance with CWC requirements.

Only one bigeye bomb was filled with chemicals, and this bomb was later drained. The remaining bodies have never been exposed to either binary compound (QL or powdered sulfur). These noncontaminated components can be destroyed in a manner similar to the uncontaminated miscellaneous CWM (section 7) in accordance with CWC requirements. There is no sulfur remaining in the inventory. The QL can be incinerated and disposed of by a hazardous waste management contractor in accordance with Resource Conservation and Recovery Act (RCRA) and CWC requirements.

The M687 GB 155mm binary projectile can be disposed of by disassembly into its components. The OPA canister is first removed from the projectile body. The remaining projectile body contains the burster and will be disposed of in the same

manner as the uncontaminated miscellaneous CWM (section 7). The burster material will be removed and then disposed of in accordance with the requirements of the CWC. The remaining projectile bodies will then be destroyed to meet CWC requirements.

OPA is a commercial chemical and not listed in the Schedule of chemicals. It could be incinerated at an approved hazardous waste treatment facility. Several commercial facilities have current hazardous waste permits that could be used to incinerate the OPA in accordance with RCRA and CWC requirements.

The second chemical component of the M687, DF, is stored in canisters and drums. While this chemical is listed as a Schedule 1 chemical under the CWC, it can be handled as a toxic chemical rather than a lethal chemical agent. Several commercial facilities possess the environmental permits and equipment necessary to incinerate DF in accordance with RCRA and CWC requirements.

SECTION 4
RECOVERED CHEMICAL WARFARE MATERIEL

4.1 Background

Recovered chemical warfare materiel (CWM) includes items stored following recovery from range-clearing operations and buried CWM sites. Historically, upon discovery of such chemical warfare items, Explosive Ordnance Disposal (EOD) technicians were called on to assess the condition of the weapons and to determine whether they were chemically filled and safe for transportation or storage. Those weapons that could not be transported due to unacceptable risks were destroyed onsite, and the destruction was then reported to Congress as required by Public Laws (PL) 91-121 and 91-441. Those weapons determined to be safe for transport were overpacked and transported by U.S. Army Technical Escort Unit (TEU) personnel to an appropriate chemical storage installation. Currently, however, environmental regulations may preclude the transportation of some recovered weapons without permits, licenses, and special authorities. Therefore, renewed effort is underway to study alternative methods of their safe destruction onsite.

4.2 Chemical Weapons Convention Issues

Under the Chemical Weapons Convention (CWC), recovered CWM must be declared if it meets the definition of a chemical weapon. While the status of the recovered CWM is being determined, there is no requirement for its declaration. Once the CWM has been determined to be a chemical weapon, the weapon must be declared, and destroyed in accordance with the applicable CWC provisions. Chemical agent identification sets (CAIS) are training items and are not considered CWM under the CWC.

4.3 Locations and Quantities

Recovered chemical items are currently stored at Aberdeen Proving Ground-Edgewood Area (APG-EA), Maryland; Dugway Proving Ground (DPG), Utah; Johnston Island (JI), Pacific Ocean; Pine Bluff Arsenal (PBA), Arkansas; Rocky Mountain Arsenal (RMA), Colorado; and Tooele Army Depot (TEAD), Utah. In addition, a small quantity of chemical agent identification set (CAIS) items are located at Redstone Arsenal (RSA), Alabama; Camp Bullis, Texas; and Fort Richardson, Alaska. The locations of recovered CWM are summarized in figure 4-1. The quantity of these items by site is provided in table 4-1.

The quantity of recovered chemical munitions has changed since November 1993, when the Survey and Analysis Report (1993) was last published, due to: (1) the discovery of additional items during remediation activities, (2) removal of items listed in table 4-1 based on the Army's assessment program, and (3) the addition of a few items turned in by citizens under the Army's amnesty program.

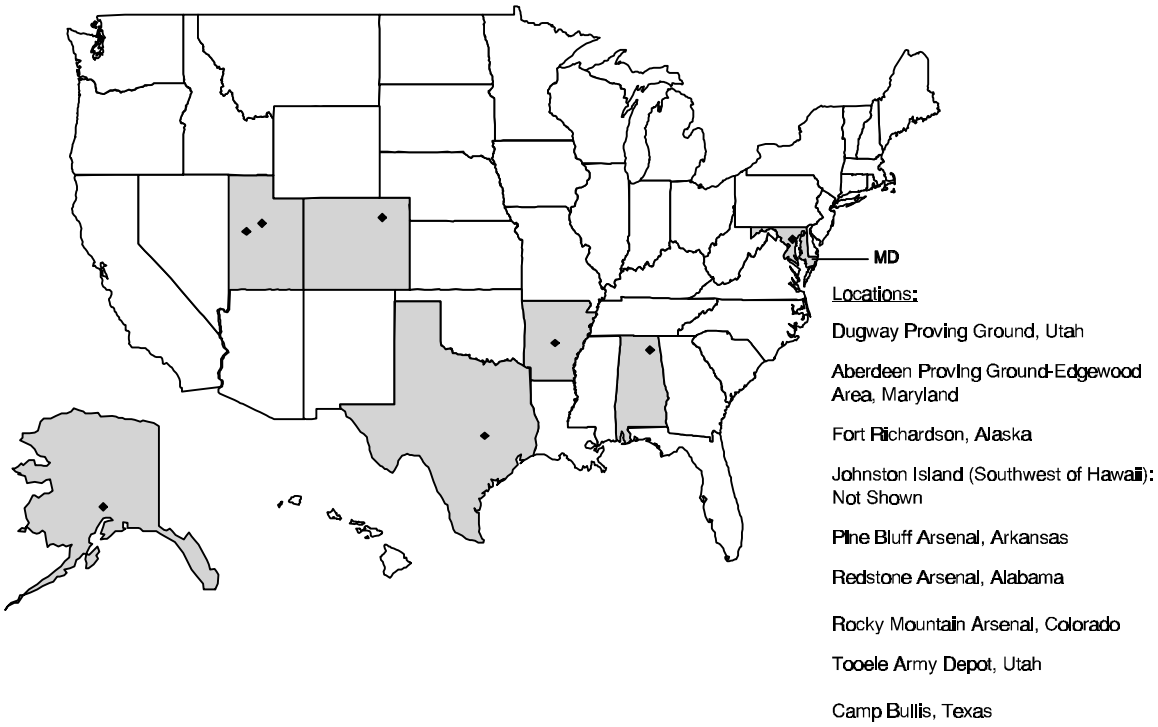

Figure 4-1. Locations of Recovered Chemical Warfare Materiel

Table 4-1. Recovered Chemical Warfare Materiel

Site	Quantity and Items	
Aberdeen Proving Ground-Edgewood Area, MD	205	Munitions [a]
Dugway Proving Ground, UT	42	Munitions [a]
Fort Richardson, AK	10	CAIS overpacks
Johnston Island (Southwest of Hawaii)	109	Chemical munitions
	20	Overpacked CAIS
	39	CAIS sets
	1	CAIS bottle
Pine Bluff Arsenal, AR	1,271	Chemical munitions
	5,299	CAIS and CAIS components
Redstone Arsenal, AL	1	CAIS bottle
	1	CAIS set
Rocky Mountain Arsenal, CO	1	GB 155mm
Tooele Army Depot, UT	64	Overpacked CAIS
Camp Bullis, TX	33	CAIS bottles

Note:

[a] These munitions have been recently portable isotopic neutron spectroscopy (PINS) tested and radiographed. A substantial number of the items (61 percent at APG-EA and 48 percent at DPG) were found not to have a chemical agent fill. Pending a U.S. Army Munition Assessment Review Board (MARB) decision, items found not to contain agent will be removed from the inventory of recovered chemical munitions.

The quantity of recovered munitions at APG-EA has increased to include items recovered during remediation activities at King's Creek and Lauderick Creek. The BZ munitions described in the Survey and Analysis Report (1993) were destroyed by a hazardous waste company. In addition, the quantity of recovered munitions, CAIS and CAIS components, at PBA has increased. These additional items were recovered primarily from the 52nd Court site located at American University, Washington D.C., the Mississippi State Fairgrounds located at Jackson, Mississippi, and at Raritan Arsenal located at Edison, New Jersey (recovered munitions were shipped to APG-EA). All items were transported to PBA for storage. In addition, 19 CAIS bottles were recently recovered at Ogden Depot, Utah. All CAIS recovered from Ogden Depot were shipped to TEAD and APG-EA. The MC-1 bomb shown at TEAD in the Survey and Analysis Report (1993) was found to not contain chemical warfare agent.

Since May 1992, the U.S. Army has assayed many of the items previously identified as recovered chemical munitions with the portable isotopic neutron spectroscopy (PINS) Chemical Assay System (section 9). During this assessment program, munitions are also radiographed to determine if they are explosively configured and to locate the agent fill line. In addition, a historical record search is conducted on the items. Liquid filled items that do not contain agent are typically drilled and drained onsite and the liquid waste is disposed of at a Resource Conservation and Recovery Act (RCRA)-permitted treatment facility.

To date, recovered munitions located at APG-EA, Maryland; Anniston Army Depot (ANAD), Alabama; DPG, Utah; and RMA, Colorado have been assessed in this manner. All of the recovered munitions located at ANAD were determined not to contain chemical agents and are no longer included in table 4-1. A substantial number of the munitions (61 percent at APG-EA and 48 percent at DPG) were found not to have a chemical agent fill and will be removed from the listing in table 4-1 pending a decision from the U.S. Army Munition Assessment Review Board (MARB). This same assessment program is planned to be conducted at JI and PBA. The quantity of

recovered munitions at these sites will be adjusted based on the results of the assessment.

4.4 Description

As discussed in paragraph 4.3, the quantity of recovered items is continually changing as additional items are discovered or as existing recovered items in storage are tested to determine if they have an agent fill. Currently, there are 1,628 recovered chemical munitions and submunitions, including mortar cartridges, artillery projectiles, bombs, Livens projectiles, and World War II (WWII) German traktor rockets. In addition, approximately 5,468 chemical agent containers (including CAIS, unidentified glass bottles, and a small quantity of bulk containers) have been recovered.

4.5 Destruction Options

As the majority of the recovered items in table 4-1 were not included in the list of stockpile chemical items existing in November 1985 when PL 99-145 was enacted, they were not scheduled for destruction under the Chemical Stockpile Disposal Program (CSDP). The Department of Defense (DoD) is studying several options for destroying these recovered items. Many of the recovered items are similar to items that are scheduled for destruction in the proposed CSDP plants. However, CSDP destruction methods may not be appropriate or feasible for some of these items. Non-stockpile munitions will most likely be destroyed using new, specialized equipment under development by the Project Manager for Non-Stockpile Chemical Materiel (PMNSCM) in accordance with CWC requirements. During planned testing of the Army's Rapid Response System (RRS), the recovered CAIS located at TEAD will be treated onsite and the detoxified residual material will be shipped offsite for disposal. Likewise, non-explosively configured recovered chemical munitions located at DPG will be detoxified onsite during testing of the Army's Munitions Management Device, Version 1 (MMD-1). When studying destruction options for the remaining items, the DoD will carefully consider CWC as well as technical and environmental regulatory

considerations. Among the latter are the condition of the weapons, whether the fill is known, and alternative destruction techniques available.

SECTION 5
BURIED CHEMICAL WARFARE MATERIEL

5.1 Background

Records indicate that chemical warfare materiel (CWM) was disposed of by land burial until the late 1950s. In most cases, the CWM was first treated (burned or chemically neutralized) prior to burial. Apparently, since burial was considered to be a final action, little detailed recordkeeping was performed for the burial activities. The records that are available indicate that some land burials may still contain chemical agent. In some cases, the potential buried CWM sites are located on formerly used defense sites (FUDS), which the Department of Defense (DoD) no longer controls. However, the majority of the potential buried CWM sites are still under military control. The potential buried CWM sites listed in appendix A illustrate the variables associated with CWM burials.

5.2 Chemical Weapons Convention Issues

Under the Chemical Weapons Convention (CWC), a member nation may choose to exclude CWM buried on its territory before 1 January 1977, or disposed of at sea before 1 January 1985, as long as the materiel remains buried. The CWC does not require this CWM to be declared or destroyed. However, if a member nation chooses to recover buried CWM, the materiel will be subject to the provisions of the CWC. After the recovered CWM is identified, it is then classified and declared according to the CWC criteria and subject to the applicable disposal requirements imposed by the CWC, the Environmental Protection Agency (EPA), and the state regulations. It should be noted that the CWC allows some negotiation of this disposal timetable for CWM declared after entry into force (EIF).

5.3 Organization

While the Project Manager for Non-Stockpile Chemical Materiel (PMNSCM) has been given the responsibility for the destruction of recovered buried CWM, there are significant contributions by many other organizations, both within and outside of the DoD. These include various activities from U.S. Army Corps of Engineers (USACE), U.S. Army Environmental Center (AEC), Army Surgeon General's Office, DoD Safety activities, EPA, Department of Health and Human Services (DHHS), Air Force Center for Environmental Excellence, Naval Facilities Engineering Command, Defense Logistics Agency (DLA), Occupational Safety and Health Administration (OSHA), and various state and local interests. The extent of involvement of each of these groups will depend on the particulars of a given buried CWM site.

5.3.1 Relationship Between the Project Manager for Non-Stockpile Chemical Materiel, U.S. Army Corps of Engineers, and U.S. Army Environmental Center.

The most significant relationships for remediation of buried CWM sites rest between PMNSCM, USACE, and AEC. USACE has the responsibility for environmental cleanup of all FUDS. It therefore manages the cleanup operations and funding at all FUDS locations. At active Army installations, the installation commander has overall responsibility for the site; and AEC has the program management responsibility for the environmental cleanup and administers Defense Environmental Restoration Account (DERA) funds for that purpose. Care must be given to distinguish the role of PMNSCM at these sites, which is to store, transport, and destroy the CWM that is recovered from these locations. The responsibilities of USACE and AEC are site characterization, excavation of materiel, and remediation of the site after removal of CWM.

It should be noted that there are active installations of the other armed services with potential buried CWM sites that do not fall under the administration of the USACE or the AEC for environmental cleanup. For example, the Naval Facilities Engineering Command (Navy/Marines), Air Force Center for Environmental Excellence, and DLA are responsible for environmental cleanup of their respective installations. PMNSCM

will need to coordinate with these organizations to destroy any CWM recovered from these installations in accordance with CWC, EPA, and state requirements.

5.3.2 Formerly Used Defense Site Buried Chemical Warfare Materiel Sites.

USACE has decentralized the responsibilities for remediation of Defense Environmental Restoration Program (DERP) sites to the division level. USACE has geographically divided the United States into engineering divisions, each with engineering districts. Each division has at least one hazardous, toxic, and radiological waste (HTRW) design district that administers remediation projects within its division boundary. To support the divisions, USACE has identified the Huntsville Engineering Support Center (HESC) as a Mandatory Center of Expertise (MCX) for ordnance and explosive waste (OEW). Since chemical weapons and materiel are considered by USACE to be OEW, the HESC is an important part of FUDS CWM projects. The HTRW design district also supports the geographical divisions in site cleanup after the CWM is removed from the site. Due to the unique nature of CWM, DoD established PMNSCM as the single organization responsible for CWM destruction.

The district engineer has overall responsibility for FUDS remediation within a USACE geographical area. The district is supported by the HESC for site inspection, planning, and removal of the CWM; PMNSCM for storage, transportation, and treatment of the CWM; and the geographical HTRW design district for supporting the hazardous waste cleanup. Figure 5-1 shows the responsibilities of the USACE organizations and PMNSCM at a FUDS location.

The site assessment and remedial phases for these potential FUDS locations will conform to the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), which requires state and public notification and participation. The Department of the Army (DA) fully intends to include state and local governments as team members in assessing the actions required for the potential sites.

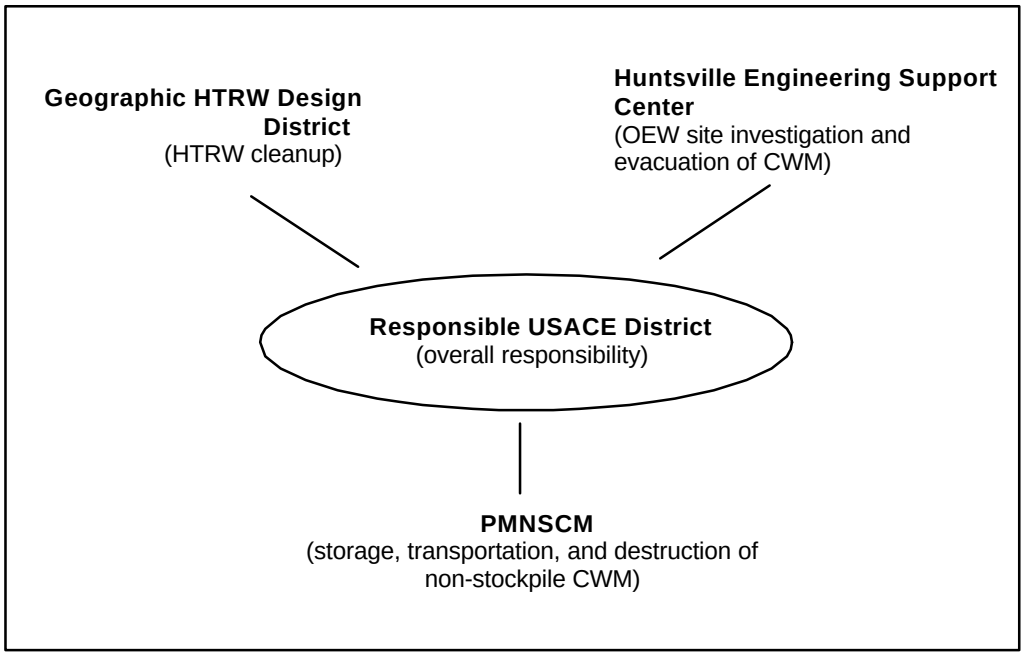

Figure 5-1. Organizational Responsibilities for the Remediation Activities for Potential Buried CWM Sites at FUDS

Specific tasks taken in the investigation and cleanup of a suspect buried CWM FUDS site would be to:

a. Verify that the site is eligible for the FUDS program and determine if further investigation is warranted. In the FUDS program, a preliminary assessment (PA) is conducted, and these findings are documented by completion of an inventory project report.

b. If further investigation is required, a site investigation (SI) is scheduled. This process includes site visits, in-depth archival research, interviews with personnel formerly affiliated with the site, and aerial photo interpretation to determine if CWM exists at the site. Documentation collected in archival searches for this report will provide much of the information necessary for an SI. Limited nonintrusive sampling may also be performed. It should be noted that, in most cases, the actual

existence of CWM cannot be determined until the site is excavated, which would occur at a much later phase of the project.

c. If the SI confirms the potential for CWM at the site, and upon receipt of authority, a remedial investigation/feasibility study (RI/FS) is initiated in accordance with the National Oil and Hazardous Substance Pollution Contingency Plan, 40 Code of Federal Regulations (CFR) part 300. This phase includes soil sampling, metal detection surveying and mapping, and installation of monitoring wells, as appropriate, to determine the nature and extent of contamination and development of remedial alternatives. After ensuring full public involvement, this phase ends with the selection of a remedial method.

d. Develop workplans to execute the chosen remedial alternative. The workplans include safety, medical support, emergency response, and environmental protection plans to ensure compliance with federal, state, and local requirements for remedial action, and ensure the safety of workers and the public.

e. Execute the remedial action plan (for example, excavation of the CWM and transportation offsite). The remedial action would be executed strictly in accordance with the workplan developed in the previous phase to ensure protection of human health and safety and to ensure compliance with applicable regulations. The site would be restored during this phase, including CWM-contaminated soil or groundwater treatment (if necessary). It should be noted that USACE is responsible for CWM until it is excavated. PMNSCM is responsible for handling, transporting, storing, and destroying the recovered CWM after it is excavated and placed in a sealed container.

f. At any time during this process, if an immediate threat to human health and safety is discovered, USACE and PMNSCM will immediately take all necessary action to remove the threat.

5.3.3 Army Installation Buried Chemical Warfare Materiel Sites. At Army installations, all activities concerning handling and destruction of CWM are coordinated with and authorized by PMNSCM. The installation commander has the overall responsibility for activities at potential burial sites. Support will be rendered by PMNSCM, USACE, and AEC. AEC and USACE districts support the installation commander in site investigation, excavation, and cleanup. PMNSCM is responsible for the storage, transportation, and destruction of the recovered CWM. Figure 5-2 shows the general responsibilities at an active Army installation.

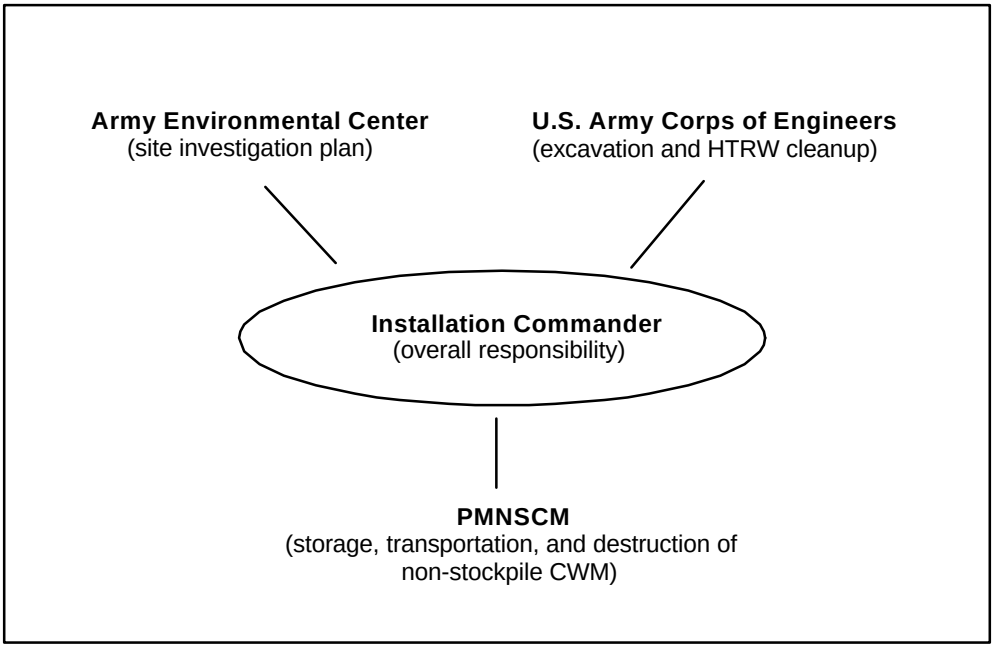

Figure 5-2. Organizational Responsibilities for the Remediation Activities for Potential Buried CWM Sites at Active Army Installations

5.3.4 Other Installations' Buried Chemical Warfare Materiel Sites. For Navy, Air Force, and DLA installations, restoration activities will be handled in a manner similar to Army installations. Instead of AEC or USACE, another organization will be responsible for site investigation, excavation, and cleanup. PMNSCM is still responsible for the storage, destruction, and transportation of recovered CWM.

5.4 Destruction Technologies

Regulations require the Army to determine the best course of action in remediating possible CWM burial sites in accordance with CWC requirements. If determined to be the best course of action, the CWM will be recovered and treated onsite. Although the destruction process will be selected on a case-by-case basis, the Army is committed to using the best treatment system in terms of health, safety, security, environmental protection, and cost. Recovered CWM treatment technologies to be considered include conventional and nonconventional thermal treatment, chemical neutralization, and alternative novel approaches.

The Army intends to develop and field systems capable of meeting the requirements of a buried CWM site. These systems are discussed in section 9. Other courses of action for consideration include leaving the CWM in the ground while controlling access to the site and controlling any subsurface or airborne migration. Another course of action is to excavate and transport the recovered CWM to a facility capable of storage and treatment. Transportation is discussed in greater detail in section 8.

5.5 Types of Buried Chemical Warfare Materiel Sites

One of the most difficult problems associated with buried CWM is the lack of available detailed information. Even at well-documented buried CWM sites, the condition of the buried materiel is usually unknown. Even when many sophisticated geophysical procedures are used to determine the location of buried materiel, until excavation and

positive identification can be made, the actual hazards associated with the materiel will not be completely identified.

Potential buried CWM sites can be divided into four general site types, as presented in table 5-1. Based on the characteristics of site types, the Army has begun development of mobile treatment systems: the Rapid Response System (RRS) for chemical agent identification sets (CAIS) sites, and the Munition Management Device, Version 1 (MMD-1) for small quantity non-explosive sites. The Army plans to develop the Munitions Management Device, Version 2 (MMD-2) for the treatment of small quantity explosive sites.

An approximate breakdown of the buried CWM site types listed in appendix A is provided in figure 5-3. This is only a rough estimated breakdown, because the majority of the sites are unconfirmed as to amount and type of agent or explosives present.

Table 5-1. Buried CWM Site Types

Site Type	Definition	Proposed Treatment System
CAIS	Records show potential for burial of only CAIS.	RRS
Small quantity, non-explosive	Records show potential for less than 1,000 CWM items and no potential for explosives or propellants.	MMD-1
Small quantity, explosive	Records show potential for less than 1,000 CWM items and for explosives or propellants.	MMD-2
Large quantity	Records show potential for more than 1,000 CWM items.	Not effectively treated with proposed mobile systems.

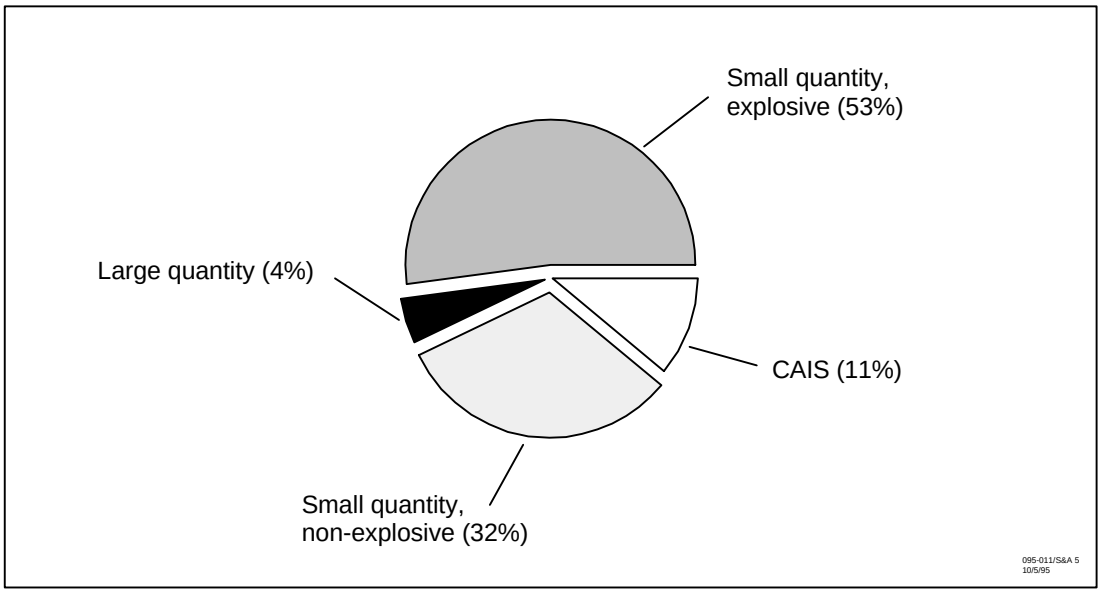

Figure 5-3. Estimated Percentage of Buried CWM Sites by Type [1]

[1] Percentages calculated excluding sites classified as no further action required.

5.5.1 Chemical Agent Identification Set Sites. CAIS were produced in large quantities (110,000) and various configurations to train soldiers and sailors in the identification of actual chemical warfare agents and in the proper actions upon identification. During their years of use (1928 to 1969), CAIS were widely distributed to military organizations. In the early 1980s, the Army made a concerted effort to destroy all of these sets. However, records confirm only a portion of the sets (21,458) were destroyed. Undoubtedly, many additional sets were consumed during the training for which they were originally intended. However, not all CAIS are accounted for, and they continue to show up periodically in burial sites and in storage. As expendable training items, CAIS were not inventoried and documented as chemical weapons, and expectations are that these sets will continue to be found.

The CAIS that were not used in training were sometimes buried. Originally, CAIS were packed in metal shipping containers as shown in figure 5-4 or wooden boxes. CAIS

Figure 5-4. Example of Chemical Agent Identification Set

that were buried in metal shipping containers can be readily detected by geophysical identification if approximate burial locations are known. In some cases, only the glass vials were buried. In these cases, locating CAIS prior to planned or accidental excavation is impossible. CAIS have also been found in their original packing in warehouses or remote storage locations. Additional information concerning CAIS is provided in appendix E.

In response to the need to destroy CAIS sets, the Army is developing the RRS, as described in section 9. The RRS may be deployed to the CAIS site, where it would be used to characterize the recovered CAIS components and detoxify the chemical agent. The most challenging action required during the remediation of buried CAIS sites will be locating the buried glass containers.

5.5.2 Small Quantity, Non-explosive Buried Chemical Warfare Materiel Sites.

Based on historical surveys to date, the small quantity, non-explosive sites are expected to be a frequently encountered type of potential buried CWM site. This is a logical conclusion based on the usual burial operations practiced in the past and the events leading up to them. Typically, CWM was stored or handled in the safest configuration allowable. As an example, bombs, if filled with chemical agent, were usually stored without bursters and fuzes, making them non-explosively configured. During disposal operations, if bursters were present, they were usually removed to preclude detonation and unwanted release.

Small quantities of buried suspect non-explosively configured CWM can be located using nonintrusive detection techniques. Magnetometers, ground-penetrating radar, and other techniques designed to detect anomalies below the surface are some of the nonintrusive detection techniques routinely used in site assessments. Unfortunately, exact identification of the buried munition is not possible with these techniques. Careful excavation to the anomalies and then uncovering the suspect CWM using archeological-type digging by hand is the current method of recovering buried CWM.

Even visual inspection of the unearthed suspect CWM cannot provide characterization of its fill. This is the reason for the development of the Mobile Munitions Assessment System (MMAS), which is described in section 9. The MMAS is a nonintrusive method for further defining the fill of recovered suspect CWM by determining whether the item contains a specific type of chemical agent.

Once the recovered suspect CWM is characterized, the item is placed inside a sealed container and moved to the Interim Storage Facility (ISF), as described in section 9, for temporary onsite storage. The sealed container will be stored until transportation or disposal plans can be executed.

5.5.3 Small Quantity, Explosive Buried Chemical Warfare Materiel Sites. The small quantity explosive CWM burial sites pose potential explosive and chemical agent hazards. Therefore, these sites are more difficult to remediate than non-explosive CWM burial sites. A site that has evidence of explosively configured CWM is placed in this category. An example of a potentially explosively configured chemical munition recovery is shown in figure 5-5.

Small quantities of buried suspect explosively configured CWM can be located using the same nonintrusive detection techniques as the non-explosively configured buried CWM sites. The visual inspection of suspect explosively configured CWM can sometimes determine whether it contains explosive components and is used to assess

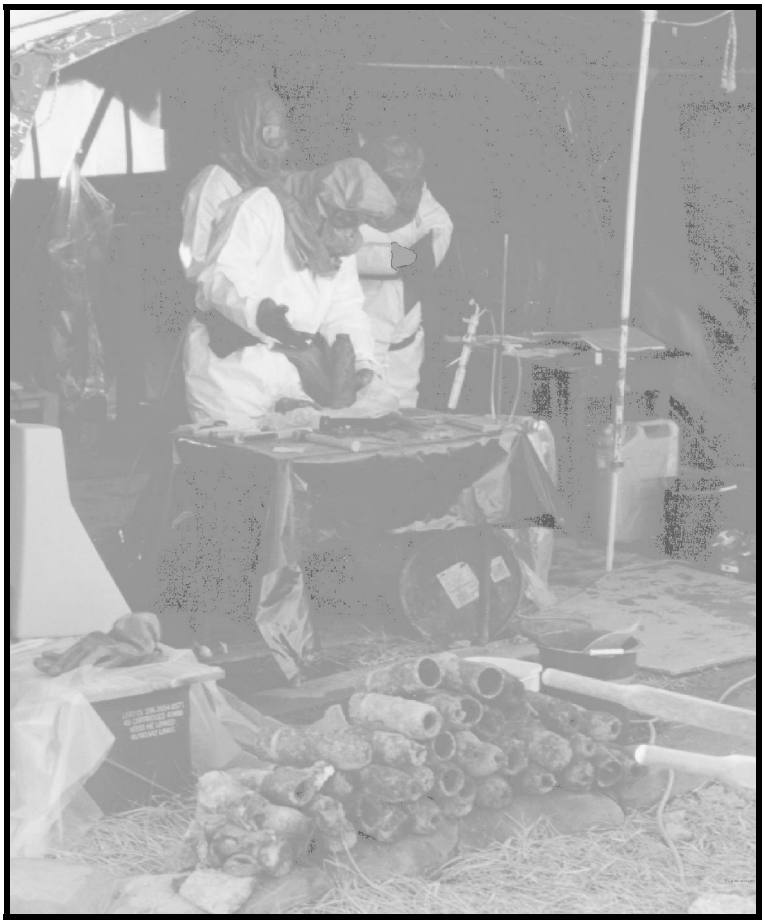

Figure 5-5. Explosively Configured Chemical Munition Recovery

whether the item can be safely handled. If the item can be safely handled, it will be analyzed using the MMAS. The results of this nonintrusive examination will identify whether the munition is explosively configured and characterize the agent fill type. The recovered CWM will then be sealed in a container and moved to a temporary storage site. The container will be stored until transportation or disposal plans can be executed.

5.5.4 Large Quantity, Chemical Warfare Materiel Burial Sites. Large quantity CWM burial sites have been identified as having the potential for greater than 1,000 CWM items. These sites can contain CWM of all types (to include explosively configured), sizes, and ages. The remediation of these sites will pose similar hazards to the small burial sites, but the magnitude of the effort will require a different remediation strategy. These sites represent substantial development and cleanup efforts. The excavation and treatment of CWM at these sites would be a significant undertaking. The Army will study many different options to remediate these sites. The nature of these facilities in terms of what technology would be used is not known at this time. The Army will rely heavily on the experience gained from the Chemical Stockpile Disposal Program (CSDP) and remediation of small burial sites in formulating plans for these sites. Aberdeen Proving Ground-Edgewood Area (APG-EA), Maryland; Tooele Army Depot (TEAD), Utah; Rocky Mountain Arsenal (RMA), Colorado; and Redstone Arsenal (RSA), Alabama, contain sites that are classified as large quantity CWM burial sites.

5.6 Locations

The Chemical Weapons Historical Survey (appendix A) identifies the potential locations for buried CWM and their corresponding sites. The buried CWM sites have been divided into categories that define the likelihood of the presence of buried CWM. The categories are: 1- Known Burial, 2- Likely Burial, 3- Suspect Burial, 4- Possible Burial, and 5- No Further Action. The category 5 sites have undergone efforts including further archival searches and recovery of buried CWM that have removed the known hazard of buried CWM. Each location may contain multiple sites and each site has been appropriately categorized.

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SECTION 6
FORMER CHEMICAL WEAPONS PRODUCTION FACILITIES

6.1 Background

Production of chemical weapons and chemical agents was conducted at various facilities prior to the signing of the Chemical Weapons Convention (CWC). These facilities produced chemical agent, precursors to chemical agents, or were used for loading and filling munitions. The Project Manager for Non-Stockpile Chemical Materiel (PMNSCM) mission includes disposition of these facilities in accordance with the CWC and in the interest of safeguarding the environment and public safety. The former chemical weapons production facilities that PMNSCM is currently programming for destruction are located at: Pine Bluff Arsenal (PBA), Arkansas; Newport Chemical Activity (NECA), Indiana; and Aberdeen Proving Ground-Edgewood Area (APG-EA), Maryland. A separate Program Manager has been established for the remediation of

Figure 6-1. Locations of Former Chemical Weapons Production Facilities

Rocky Mountain Arsenal, Colorado, and the Tennessee Valley Authority was responsible for the decontamination and destruction of the Phosphate Development Works at Muscle Shoals, Alabama. The Marquardt Company located in Van Nuys, California, and the Northrup Carolina Corporation located in Swannanoa, North Carolina, are commercial facilities that have not been programmed for destruction by PMNSCM pending Department of Defense (DoD) and Department of Army (DA) guidelines. The locations of these former production facilities are illustrated in figure 6-1. A complete listing of all former chemical weapon production facilities is in appendix F.

6.2 Chemical Weapons Convention Issues

Chemical weapons production facilities that were designed, constructed, or used anytime since 1 January 1946 are required to be declared and destroyed. All facilities must cease activities not related to closure immediately upon entry into force (EIF) of the CWC, and the facilities must be completely closed within 90 days of EIF. The CWC also requires that the facilities be available for an initial inspection, between 90 and 120 days after EIF, to ensure that the facility remains closed and is subsequently destroyed. The destruction of former facilities that produced Schedule 1 chemicals must commence within 1 year of treaty EIF, and must be completed no later than 10 years after treaty EIF. The CWC further stipulates that destruction of facilities that produced Schedule 2 or 3 chemicals must begin within 1 year of treaty EIF and be completed no later than 5 years after treaty EIF.

The CWC provides that, in exceptional cases of compelling need, a request to convert these facilities to nonprohibited purposes can be submitted to the Conference of State Parties. The history and status of the former production facility locations are summarized in the following paragraphs.

6.3 Pine Bluff Arsenal

Construction of PBA began in December 1941. It originally included facilities for manufacture, loading, storage, and assembly of incendiary and chemical munitions and other weapons. At one time or another, the following chemical agents, or their precursors, have been manufactured at PBA: mustard, lewisite, and di-fluoro [DF (a component of binary munitions)]. In addition, other chemicals have been manufactured, including chlorine and arsenic trichloride. Additionally, the filling of munitions has occurred using mustard, lewisite, an incapacitating agent (BZ), di-fluoro (DF), white phosphorus (WP), red phosphorus (RP), a riot control agent (CS), smoke, and pyrotechnics.

The BZ Munitions Fill Site and other sites located in the Integrated Binary Production Facility (IBPF) are facilities at PBA that must be declared under the CWC. The IBPF includes the following: Multiple Launch Rocket System (MLRS) Fill and Close Site; DF Production/M20 Fill Site; O-ethyl-O (QL) Production Site; and Bigeye BLU-80/B Fill and Close Site; and the di-chloro (DC) Production Facility.

a. *Former BZ Munitions Fill Site.* This site (figure 6-2) includes Buildings 32-530, 32-532, 32-534, 32-535, 32-536, and 32-538. Most of the equipment for BZ munition production has been removed, cutup, incinerated, and buried at the PBA landfill. All buildings meet the definition of chemical weapon production facilities and therefore must be declared and destroyed. Conversion for nonprohibited purposes could be permitted in exceptional cases of compelling need if requested by the United States and approved by the Organization for the Prevention of Chemical Weapons (OPCW).

b. *Integrated Binary Production Facility.* In 1978, a 150-acre section of PBA was selected to be the site for the IBPF. Within this facility, DF and M20 canisters, into which DF was placed, were produced. This operation

Figure 6-2. Former BZ Munitions Fill Site, Pine Bluff Arsenal, Arkansas

ended in January 1990. The MLRS facility, which was designed to fill DF in the munition, underwent systemization using a simulant and then put into a layaway status. In 1990, construction of the fill/close facility for the Bigeye bomb was completed at the IBPF. The fill process was systemized using a simulant; however, the facility never went into production. In 1988, construction of the DC facility began, and a limited proveout of this facility was completed in March 1991.

In 1988, a contract was awarded for the construction of a QL (precursor for agent VX) production facility. Installation of equipment began for this facility; however, construction was suspended when the facility was approximately 35 percent complete. There are presently no production operations at the IBPF, and facilities at the IBPF are being maintained in layaway status.

6.4 Newport Chemical Activity

NECA was used for the production of an explosive (RDX) from 1941 to 1946. In 1943, a heavy water plant was built and operated to the end of WWII. A refurbished heavy water plant, utilizing a Girdler-Spevack process, a distillation process, and a final electrolyte step was constructed in 1952 and operated until June 1957. The heavy water plant was subsequently reconfigured into a facility for producing the nerve agent VX in 1961. The VX plant operated until 1968. Currently, ton containers (TCs) of VX are stored at NECA as part of the chemical weapons stockpile. VX is the only chemical agent stored at NECA.

The VX plant, which includes a production site and a fill site, is the only facility at NECA required to be declared and destroyed under the CWC. The VX production process consisted of four steps, designated as steps 0, I, II, and III. Steps 0, I, and II converted raw materials to the chemical QL. Step III converted QL to VX. Steps I and II of the VX plant have already undergone an asbestos abatement program; however, additional hazardous materials are still believed to reside in the equipment. Step III equipment is housed in Building 143, a six-story metal building shown in figure 6-3. Asbestos covers much of its equipment. Building 143 is somewhat deteriorated, including corrosion of metal floors from bleach decontaminant that was once stored on the sixth floor.

Finished VX was stored in eight large product storage tanks. Six of the tanks have capacities of 50,000 gallons and two have capacities of 30,000 gallons. Six of the tanks are currently covered with asbestos. Building 144 is the chemical filling building. A portion of Building 144 was converted to a storage facility, subsequent to VX production and fill operations, to provide indoor storage of unitary stockpile VX TCs currently stored at NECA [the VX TCs are scheduled for demilitarization as a part of

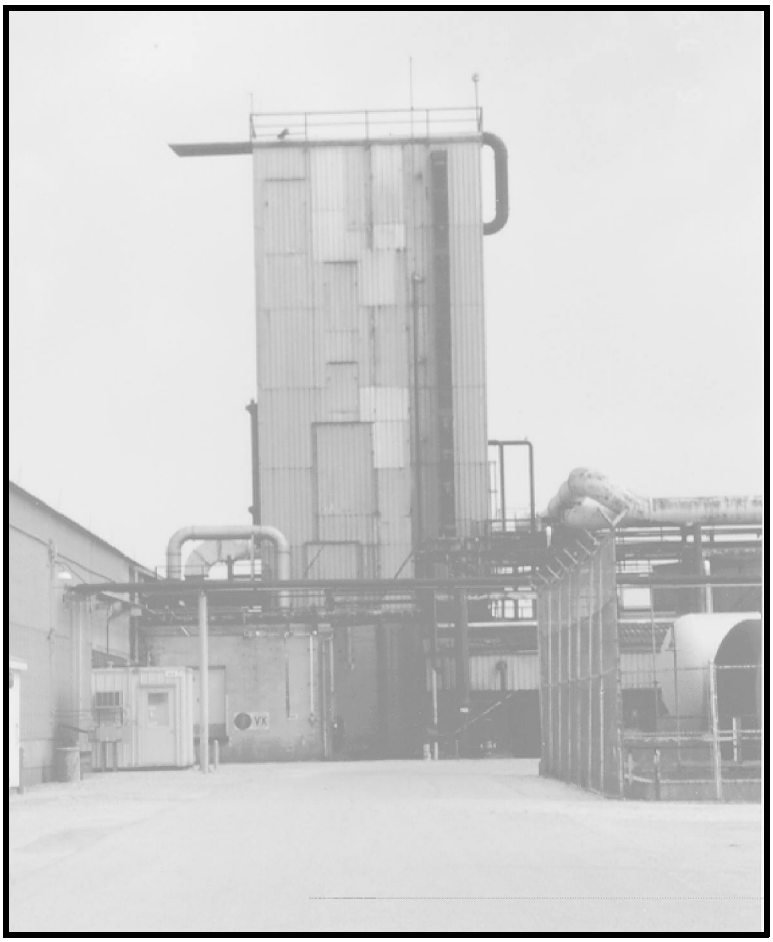

Figure 6-3. Step III VX Production Building,
Newport Chemical Activity, Indiana

the Chemical Stockpile Disposal Program (CSDP)]. Estimated quantities of contaminated materials and equipment to be treated are as follows:

a. Vessels, tanks, and piping - 6,100 cubic yards
b. Piping included above - 6.8 miles
c. Steel debris - 5,100 cubic yards
d. Concrete debris - 2,900 cubic yards
e. Asbestos - (not estimated).

6.5 Aberdeen Proving Ground-Edgewood Area

APG consists of two general areas separated by water, the Aberdeen Area and Edgewood Area. The latter was the primary chemical warfare research and development center for the United States. Its uses included pilot-scale manufacturing, production-scale manufacturing, and storage of chemical warfare materiel (CWM).

6.5.1 Production Facilities. The only facility at APG-EA that must be declared and destroyed under the CWC is the Pilot Plant Compound, which is shown in figure 6-4. The Pilot Plant Compound consists of nine buildings enclosed by a double-security fence. Building E-5625 was the main production building for the chemical weapon pilot plant at APG-EA. Construction of Building E-5625 was completed in 1941. Its use included pilot production of chemical agents, the filling of different types of munitions, and other related research and development activities. All of these activities ended

Figure 6-4. Pilot Plant Compound, APG-EA, Maryland

by 1970. However, limited activities, including filling munitions with simulants and production of methylphosphonic dichloride, continued until the building was closed in March 1986. Other hazardous materials contaminate the building structure and equipment, and polychlorinated biphenyls (PCBs) are located in electrical boxes. Asbestos was removed from the building in 1985; however, some asbestos may still exist in roofing materials and floor tiles contained within some of the buildings.

A number of laboratories were constructed in Building E-5625. Each had a ventilation system and a drain system leading to one of four toxic sumps. Wastes were transferred to an effluent treatment system located south of Building E-5625. Neutralized wastes were passed into the sanitary sewer system after treatment. Removal, decontamination, and destruction of all processing equipment in the building has been completed by APG-EA personnel.

Building E-5625 itself is a four-story, steel frame structure with reinforced concrete floors, structural clay tile, and brick walls. It includes over 40,000 square feet of floor space, including the various additions and modifications that have been added over the years.

6.5.2 Other Facilities. Approximately 50 other APG-EA buildings have been identified as being potentially contaminated with various CWM. These buildings were involved in chemical weapons research and development, testing, storage, and other uses that may have resulted in chemical warfare agent contamination. These facilities are not required to be destroyed under the CWC, but should be destroyed by PMNSCM because of contamination. Of these approximately 50 buildings, 16 buildings were predominantly used in research and development activities. The following nine are most likely contaminated with chemical agent based on the records of their use:

E-3270	E-3640	E-5032	E-5165	E-5282
E-5440	E-5476	E-5481	E-5487	

The remaining seven buildings may be contaminated due to their proximity to the agent-contaminated buildings, their use in the activities of the agent-contaminated buildings or, in the case of storage facilities, the lack of documentation to prove that these facilities never contained chemical agent:

E-2370	E-3163	E-3641	E-5292
E-5294	E-5485	E-5489	

6.6 Northrup Carolina Corporation

The Northrup Carolina Corporation facility, also known as Swannanoa, is a commercial facility located in Swannanoa, North Carolina. Some of the facilities at the site were involved in BZ production under contract to the U.S. Army. The facility at Swannanoa is in a derelict condition, and is located on private property. Due to the condition of the facility, and other factors, the ultimate fate of this facility is undecided.

6.7 Marquardt Company

The Marquardt Company, located in Van Nuys, California, is a second commercial facility that includes several pre-existing buildings that were converted to make binary canisters, and a room that was modified to make prototype metal parts for the bigeye bomb program (section 3, Binary Chemical Weapons). No chemical agents were shipped to the Marquardt facility or loaded into munitions. However, the binary precursor isopropyl alcohol (OPA) was filled into canisters, thereby making it a chemical weapon production facility. The specialized, chemical-specific equipment used for these operations has since been removed and destroyed.

The Binary Fill Facility at Marquardt is currently being used as a movie studio by private industry. The ultimate fate of this facility is undecided.

6.8 Phosphate Development Works

The Phosphate Development Works (PDW) facility, located in Muscle Shoals, Alabama, was primarily used during the 1950s in the production of di-cloro (DC), an intermediate chemical used in the manufacturing of nerve agent GB. The decision to decommission and destroy the PDW facility and equipment was made in the early 1980s. Decontamination and destruction activities were done by the Tennessee Valley Authority (TVA), and no facilities declarable under the CWC remain.

6.9 Rocky Mountain Arsenal

RMA, located in Colorado, was used as a production facility for blister agent (mustard and lewisite) production during WWII and nerve agent GB production in the 1950s, and later used by Shell Oil Company in the production of insecticides and pesticides. All blister agent production was performed in the South Plants Area of RMA, while the GB production was performed in the North Plants Area. Additionally, munitions and bulk containers were filled at the plants with chemical agents. RMA's cleanup is being coordinated under a Federal Facility Agreement, in concert with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

The nerve agent (GB) production facility is shown in figure 6-5. Complete removal of the equipment from this facility was done in 1995, and PMRMA is in the process of destroying both the equipment and the facility. After the complete remediation of RMA, the installation will be turned over to the Department of the Interior and serve as a National Wildlife Refuge, with the Army retaining operation and maintenance responsibility of all remaining treatment systems and sites requiring long-term surveillance. RMA is already being managed as a wildlife refuge.

Figure 6-5. Main GB Production Building,
Rocky Mountain Arsenal, Colorado

6.10 Disposal Strategy

The disposal strategy developed as a general guide for destruction of former production facilities is a cautious approach that will meet the CWC requirements and Congressional mandates for ensuring the safety of people and the protection of the environment. There are three phases to the disposal strategy: Project Definition, Prerequisites, and Demolition and Disposal.

6.10.1 Phase I - Project Definition. A detailed facility-specific plan and schedule, defining complete mission activities, will be the final product of this phase (that is, the approved Demolition and Disposal Plan). Development of this plan and schedule will

include assessment and documentation of chemical agent contamination and general industrial configurations and hazards. Facility-specific requirements and constraints governing the accomplishment of complete facility demolition and disposal will be determined as part of this phase (for example, CWC requirements, safety regulations, environmental statutes, regulations and implementing guidance, bilateral and multilateral treaties, and participating and competing missions). This phase predominantly will be limited to records reviews, interviews, and other nonintrusive activities; however, configuration-changing predemolition and disposal activities may be executed, as warranted by site-specific requirements and CWC obligations.

6.10.2 Phase II - Prerequisites. This phase will include all activities subsequent to completion and acceptance of the Final Demolition and Disposal Plan (Phase I) and end with the demolition and disposal contract award. A Demolition and Disposal Request for Proposal (RFP) will be prepared, solicitation process completed, and contract awarded as a part of this phase. Other activities of this phase may include directed studies and limited tests to optimize the procedures adopted in the Final Demolition and Disposal Plan, to realign the chemical limited area to enhance access and control procedures, and other measures as necessary to meet CWC requirements and to prepare the site for the final phase.

6.10.3 Phase III - Demolition and Disposal. This phase will begin upon award of a facility Demolition and Disposal contract and end upon completion of all Demolition Disposal Plan requirements. All applicable environmental documentation will be finalized, submitted, and approved prior to actual demolition and disposal activities.

SECTION 7
MISCELLANEOUS CHEMICAL WARFARE MATERIEL

7.1 Background

The mission of the Project Manager for Non-Stockpile Chemical Materiel (PMNSCM) includes the disposal of unfilled munitions, submunitions, devices, and equipment specifically designed for use in connection with the employment of chemical weapons, and lethal wastes and contaminated containers addressed in the House Appropriations Report 101-822, which accompanied the fiscal year (FY) 91 Defense Appropriations Act. These items as a group have been classified as miscellaneous chemical warfare materiel (CWM).

7.2 Description

The miscellaneous CWM is divided into four groups: Category 3 items as defined by the Chemical Weapons Convention (CWC); research, development, test, and evaluation (RDT&E) CWM; chemical samples; and ton containers (TCs) formerly used to store chemical agent. The locations are summarized in figure 7-1. Changes in miscellaneous CWM are likely to occur as materiel is added or deleted as a result of the continuing verification process.

7.2.1 Chemical Weapons Convention Category 3 Items. The CWC divides chemical weapons into three categories based on the fill of the items. Category 3 items are unfilled munitions and devices, and equipment specifically designed for use directly in connection with the employment of chemical weapons. Category 3 items by definition are not contaminated with chemical agent. Examples of Category 3 items are complete, assembled rounds without chemical fill and with or without bursters and fuzes; simulant-filled munitions; inert munitions and dummy munitions; fuzes and

Figure 7-1. Locations of Miscellaneous Chemical Warfare Materiel

bursters specifically manufactured for chemical munitions; rocket warheads (empty) and motors; projectile cases; cartridge containers; and other metal and plastic components of chemical weapons. Appendix B, table B-1, provides a compilation of the identified Category 3 items, segregated by location, type, common military designator, size/caliber, number of units, nominal fill volume, and intended chemical fill. Also included in the list are other components not meeting the strict definition of chemical weapons under the CWC, but which will be included in the disposal effort. These items are located at Aberdeen Proving Ground-Edgewood Area (APG-EA), Maryland; Blue Grass Army Depot (BGAD), Kentucky; Pine Bluff Arsenal (PBA), Arkansas; Pueblo Depot Activity (PUDA), Colorado; Tooele Army Depot (TEAD), Utah; and Umatilla Depot Activity (UMDA), Oregon.

7.2.2 Research, Development, Test, and Evaluation Chemical Warfare Materiel. RDT&E CWM was used in the development of chemical weapons and processes. Currently there are no items listed as RDT&E materiel. However, it is anticipated that some of the materiel designated as chemical samples will be redesignated as RDT&E materiel and held for future research purposes as allowed by the CWC.

7.2.3 Chemical Samples. The Army transferred agent from leaking munitions, recovered munitions, and stockpiled munitions to glass ampules, metal gas cylinders (known as DOT bottles) and TCs. This was done to facilitate safe storage of agent, assess the quality of agent in the stockpile, or ascertain the causes and seriousness of leaking munitions. These chemical samples are located at Anniston Army Depot (ANAD), Alabama; APG-EA, Maryland; BGAD, Kentucky; Dugway Proving Ground (DPG), Utah; PBA, Arkansas; PUDA, Colorado; TEAD, Utah; and UMDA, Oregon. An inventory by location is provided in appendix B, table B-2. Many of the chemical samples will be destroyed by using the Munitions Management Devices.

7.2.4 Ton Containers. Bulk chemical agents were stored and shipped in large containers, known as TCs. Those TCs that were previously used to hold chemical agents are to be destroyed. The chemical agent has been removed from these TCs. An inventory by location of the TCs is provided in appendix B, table B-3. The locations of the TCs are ANAD, Alabama; APG-EA, Maryland; PBA, Arkansas; and TEAD, Utah. The majority of these TCs have been chemically decontaminated, but some have been found to contain a small amount of chemical agent residue. All of these TCs will be sampled and characterized to comply with applicable environmental regulations.

7.3 Chemical Weapons Convention Issues

The CWC specifies that Category 3, unfilled munitions and devices, and equipment specifically designed for use directly in connection with employment of chemical weapons, must be destroyed within 5 years of CWC entry into force (EIF). The quantity, nominal fill volume per item, and intended chemical fill are to be reported for

each type of unfilled chemical munition, submunition, device, or equipment. These items must be physically destroyed and the destruction verified and documented under the CWC.

The quantity of RDT&E CWM is limited by the CWC. The CWC allows member nations to produce and maintain limited quantities of Schedule 1 chemicals for research, medical, pharmaceutical, or protective purposes. The CWC limits the aggregate amount of Schedule 1 chemicals for such purposes to 1 metric ton, i.e., 1,000 kilograms.

The chemical samples are Schedule 1 chemicals as defined by the CWC. These items must be destroyed in accordance with the guidelines established for Category 1 chemical weapons.

The TCs are chemical storage containers used for many types of commercial chemicals, not just chemical agents. Because they are useful for other than the military application for chemical agents, the CWC does not govern these items.

7.4 Destruction Options

The Army plans to destroy all miscellaneous CWM by the most economical and efficient approved methods and processes. Options for demilitarization and destruction are being evaluated in light of both applicable environmental regulations and CWC requirements. The following destruction concepts are being evaluated.

7.4.1 Crushing. CWC Category 3 non-explosive components, metal and plastic parts, can be crushed using heavy equipment or presses to physically destroy the items. This is being considered to comply with the requirements of the CWC. Once these components are crushed, the debris can be scrapped. Crushing can be performed readily at the Army installations where the CWC Category 3 non-explosive components are stored.

7.4.2 Open Burn/Open Detonation. CWC Category 3 explosive components and chemical munition bursters and fuzes can be destroyed by open burning/open detonation (OB/OD) under existing Department of Defense (DoD) facilities' environmental permits. This is an environmentally accepted disposal method for noncontaminated explosive materiel. The bursters are placed in a pit, packed with explosives, and detonated. Following detonation, the metal remnants are recovered and scrapped. This method meets the criteria of physical destruction as defined in the CWC.

7.4.3 Incineration of Explosives. The chemical bursters can also be destroyed at environmentally permitted incinerators. This is an alternative to the OB/OD disposal at the storage site. The bursters would be transported to the incineration facility where they would be disposed of in accordance with environmental regulations. This method meets the criteria of physical destruction as defined in the CWC.

7.4.4 Smelting. The TCs have in the past been decontaminated and then smelted at the Government-owned, Government-operated (GOGO) furnaces at Rock Island Arsenal (RIA), Illinois. This is a viable approach that is being considered by the Army for the destruction of the TCs.

7.4.5 Chemical Treatment. The chemical samples can be destroyed by the mobile remediation systems described in section 9. The mobile remediation systems comply fully with applicable environmental regulations. These methods are consistent with the requirements of the CWC.

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SECTION 8
TRANSPORTATION CONSIDERATIONS FOR RECOVERED CHEMICAL WARFARE MATERIEL

8.1 Background

When determining actions to treat buried chemical warfare materiel (CWM) found at a formerly used defense site (FUDS) or a military installation, the Army must adhere to the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or the Resource Conservation and Recovery Act (RCRA). One of the requirements of CERCLA is the development of a Remedial Investigation/Feasibility Study (RI/FS) or an engineering evaluation/cost analysis (EE/CA) for removal actions, to assess the proposed action and provide a means for the public to comment on the proposed action. Alternatives to deal with the CWM, such as offsite transportation, must be assessed for this process. Whenever possible, the Army prefers that the CWM be treated onsite. However, it is envisioned that there may be occasions when it will not be feasible of practical to do so. Transportation to another location may be required.

When assessing transportation, some of the factors that must be considered are population proximity and density, chemical weapons type, hazard condition of the munition, and public policy considerations. Each CWM location will have a unique set of circumstances that must be evaluated prior to onsite treatment or transportation of CWM to another location. When considering transportation, RCRA issues associated with determining whether recovered CWM is a hazardous waste must be evaluated, especially as it applies to the receiving installation. RCRA permits, or modifications to existing RCRA permits, may be required to store and treat CWM.

8.2 Laws and Regulations Applicable to the Transportation of Recovered Chemical Warfare Materiel

Transportation of recovered CWM will take place as stipulated in Army Regulation (AR) 50-6. Several restrictions have been imposed by Federal Law on the transportation of chemical agents. Under 50 USC 1512a(b), chemical agent munitions recovered from a CWM burial site may be transported to the nearest chemical munitions stockpile storage facility that has the necessary permits for receiving and storing such items, if the Secretary of Defense determines it to be necessary, and if it can be accomplished while protecting public health and safety. Under 50 USC 1512, additional limitations are set forth regarding all transportation of chemical munitions. These restrictions include having the plans reviewed by the Department of Health and Human Services (DHHS) and sending a notification to Congress and the applicable states. However, in the event chemical agent munitions recovered from a CWM burial site constitute an emergency threat to public health or safety, the immediate transportation, offsite, of the recovered munitions may take place under the emergency provisions of 50 USC 1517 once a destination is identified. Recovered chemical agent munitions will be classified for environmental purposes as hazardous waste, and the offsite transportation will comply with the environmental and transportation regulations applicable to such waste.

Offsite transportation of chemical agent-contaminated soil and debris from a CWM burial site, if necessary, is not subject to the transportation restrictions under 50 USC 1512, and will take place only in accordance with the applicable environmental and transportation laws and regulations.

8.3 Transportation Studies

In the past, numerous studies were performed to assess the transportation of chemical weapons in the U.S. stockpile. While these studies were based on assumptions, quantities, and conditions that are not necessarily applicable to the potential buried

CWM sites, upon careful review, many of the basic considerations may prove to be of value to the Non-Stockpile Chemical Materiel Program (NSCMP).

8.4 Packaging Concepts

The most important role of a packaging system used to transport recovered CWM is its ability to contain agent during normal transport and to provide the impact protection necessary to minimize the risk to the public in the event of an accident during transport. In accordance with AR 50-6, the transportation of the recovered CWM must be in compliance with the applicable environmental and transportation laws and regulations. Therefore, the packaging of the recovered CWM must comply, at minimum, with the requirements of Title 49 of the Code of Federal Regulations (49 CFR). The Army has demonstrated that existing military containers meet the requirements of 49 CFR. These containers will be used, to the extent practicable, for packaging recovered CWM.

8.5 Risk Analysis

The risk analysis study performed to support the selection of alternatives for the Chemical Stockpile Disposal Program (CSDP) is of limited value to the NSCMP. Risk associated with transportation of the stockpile was based on factors that are not present or applicable to the NSCMP. CSDP transportation risk was associated with specific munition configurations traveling a specific number of miles to ensure that the large quantities present in the stockpile were demilitarized by a specific date. Similar factors may exist for the NSCMP, but their relationships and the quantification of the associated risk must be established separately from CSDP. Mitigation procedures will also differ in scope and effectiveness. As noted in the Stockpile Transportation Concept Plan, it is not possible to guarantee that chemical munition transportation can take place without risk.

8.6 Modes of Transportation

Programmatic considerations common to rail, water, air, and road transportation modes will be examined prior to any actual decision on options or the commencement of operations. This may require the preparation of site-specific documentation in accordance with provisions of the National Environmental Policy Act (NEPA), in addition to the preparation of a transportation operating plan, a safety plan, a risk analysis, a medical support plan, and an emergency response plan; the determination of personnel requirements; the development and implementation of personnel training programs; the establishment of command and control procedures; and the selection of transportation routes. All of these aspects will determine the site-specific mode or modes of transportation to be chosen. Each mode of transportation offers a unique set of safety, cost, and environmental factors that will need to be considered on programmatic and site-specific levels. As in previous studies, the packaging component will play a critical role in determining the mode of transportation. Accident scenarios, based on accidents that have occurred in previous hazardous materials transportation experience, will be defined for all the modes under consideration.

The Army has experience in transporting chemical munitions using all four modes of transportation, and will use these studies as reference material. However, RCRA requirements, some Department of Transportation (DOT) requirements, and various safety requirements were not applicable during the timeframes of previous chemical weapons movements. It is anticipated that each state where the recovered CWM originates, passes through, or ultimately terminates, will have at least limited jurisdiction over certain aspects of the transportation program.

8.7 State and Public Involvement

Except where immediate transportation is necessary to protect health and safety, lethal chemical agents may not be transported to or from a military installation in the United States or within the United States until: the Secretary of Defense has determined that

the move is in the interests of national security, plans have been reviewed by DHHS, and Congress and the applicable state have been notified (Public Laws 91-121 and 01-441). Movement of research and development quantities is exempted from this requirement. In addition, as part of the RI/FS, any proposed transportation alternative must be coordinated with the states that will be affected by the movement. The public in these states have a right to have public meetings that explain the proposed action and its potential consequences. The participation of the states, local governments, and the public will affect decisions concerning transportation.

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SECTION 9
MISSION-SPECIFIC EQUIPMENT

9.1 Background

Disposal of non-stockpile chemical materiel (NSCM), like many wastes, was historically believed to pose little risk, especially when accomplished on a military installation. Burial of chemical warfare materiel (CWM) had been practiced for many years and was considered to be acceptable until the late 1950s. In most cases, the CWM was first treated (burned or chemically neutralized) prior to burial. However, some burials may still contain chemical agent and pose a potential threat to human health and the environment. The potential threat is greater in cases where the burial sites are no longer under military control and are at risk of being excavated or otherwise disturbed. In some cases, even without disturbance, the burials may pose a threat to groundwater supplies and require some remedial action. To reduce the risks associated with buried CWM, it may be necessary to excavate the potential buried CWM site and permanently dispose of the recovered CWM in accordance with the current arms control, environmental, and safety regulatory requirements.

The excavation and destruction of buried CWM is a unique operation. The burning and neutralization of CWM in open pits, as used in the past, does not meet the strict arms control, environmental, and safety criteria established today. New disposal methods must be developed to meet current disposal criteria. The Army is pursuing technologies that ensure environmental protection, worker and public safety, and permanent disposition of the CWM in accordance with CWC provisions. This section provides information about current and future technologies that will be used to identify, store, and dispose of buried and recovered CWM.

9.2 Mobile Characterization Systems

9.2.1 Overview. Identification of unknown filled munitions, like those recovered at non-stockpile burial sites, is key to proper handling, storage, and final destruction. NSCM comes in many sizes and configurations, as described earlier. Usually, NSCM does not have any markings or records to indicate its contents. Some information can be derived by visual inspection, but the chemical fill identification is difficult to determine with any confidence. Even the contents of chemical agent identification set (CAIS) glass containers cannot be identified visually. The most accurate method of determining the CWM fill type is to sample and analyze the fill. Sampling the fill is an intrusive method that requires many safeguards for worker, public, and environmental safety. These safeguards are very restrictive and would be difficult to implement. For this reason, a nonintrusive method for identification of the CWM is preferred.

Since NSCM is stored and recovered in many locations in relatively small quantities, a portable system that can characterize the contents of suspect CWM is necessary. Proper identification at the site ensures safe storage, transportation, and destruction of the NSCM.

9.2.2 System Description. Knowing that NSCM will require proper characterization, the Army is developing the Mobile Munitions Assessment System (MMAS). The MMAS provides a nonintrusive evaluation of recovered munitions. The accurate characterization of the munitions will ensure that proper methods of storage, transportation, and disposition are selected. The concept of operations for the MMAS is that the equipment and technology will be deployed in mobile vans or trailers.

One of the noninstrusive characterization systems proposed for the MMAS is the portable isotopic neutron spectroscopy (PINS). Two years of field operations of the PINS have validated the performance capability of the MMAS concept. The PINS is a nonintrusive tool used to further define the contents of munitions and chemical storage containers. During the MMAS evaluation period, munitions were also radiographed to

evaluate whether they were explosively configured. In addition, a historical record search was conducted on the items. Results of this assessment program were provided to the U.S. Army Munitions Assessment Review Board (MARB) for a decision on the item's final disposition.

Munitions successfully analyzed during test trials include HD (mustard agent)-, GB-, and VX-(nerve agent) filled 155mm projectiles; HD- and L (lewisite)-filled ton containers (TCs); a VX-filled TMU-28 spray tank; and a GB-filled MC-1 bomb. This technology has been used successfully to categorize hundreds of suspect chemical munitions, ranging from small munitions to large bombs, at over a dozen present day and former military installations.

The MMAS will be developed in two phases. Phase I has two objectives: to meet the immediate need to augment response equipment currently used by the U.S. Army Technical Escort Unit (TEU), and to provide data and experience to be applied during development of the Phase II MMAS. Phase I will provide the Army with a better first-response capability to assess and characterize recovered CWM.

Phase II is the development of a complete system to categorize and assess discovered and recovered suspect CWM. Phase II includes further development and procurement of existing nonintrusive characterization technology. Phase II will provide the Army with advanced capability for the characterization of CWM for the collection and assessment of data required for safe demilitarization and management of NSCM.

9.3 Mobile Storage Systems

9.3.1 Overview. Suspect CWM recovery operations require onsite, temporary storage of containerized CWM. As suspect CWM is recovered, it will be characterized by the MMAS and placed in sealed containers. These containers will then be temporarily stored onsite until transportation or demilitarization plans can be implemented. These containers will be placed in a storage facility to ensure safety,

security, and compliance with applicable environmental regulations. Because of the numerous locations of suspect buried CWM sites, a reusable mobile storage facility is required.

9.3.2 System Description. The Army is developing an interim storage facility (ISF), as shown in figure 9-1, to meet the suspect CWM recovery operations requirements. The ISF will be used for the temporary storage of sealed containers of recovered, non-explosively configured CWM. The ISF is a fenced compound that contains interim holding facilities (IHFs). The number of IHFs contained in the ISF area is dependent on the anticipated number and types of suspect CWM at the burial site. The IHF is a mobile hazardous waste storage building that is in compliance with strict environmental regulations. Once the requirement for the ISF is fulfilled at a site, the IHF will be moved to the next active burial site.

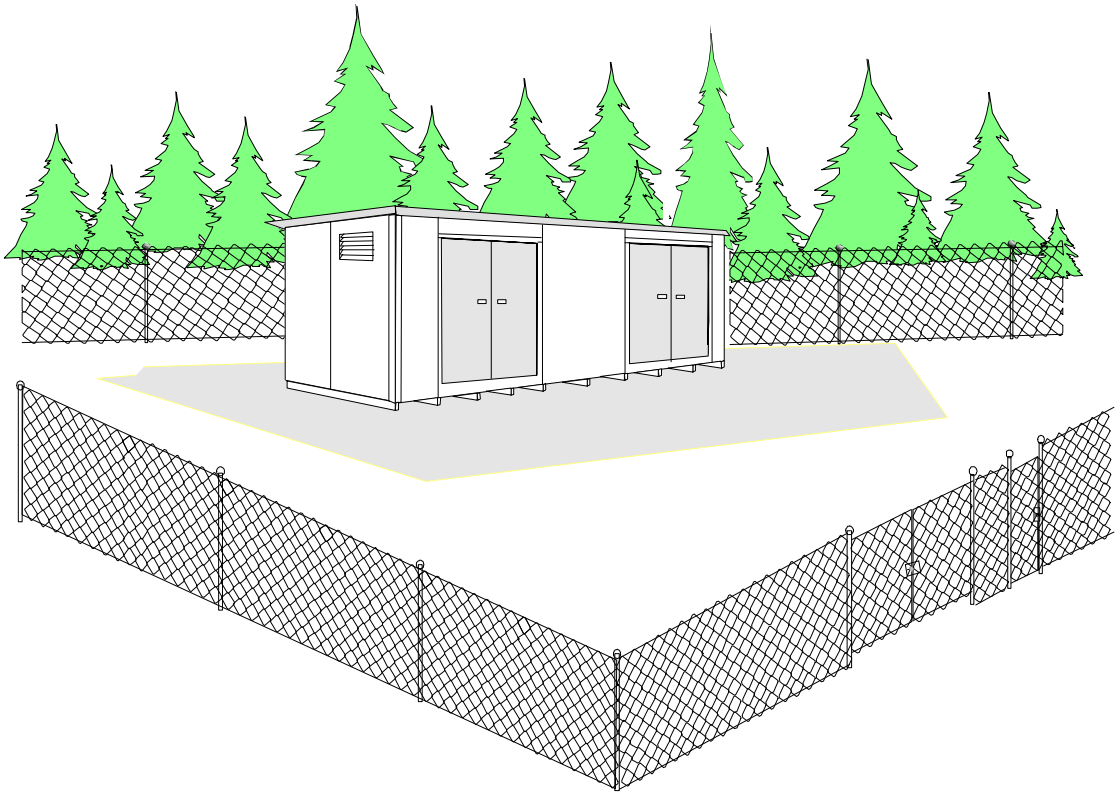

Figure 9-1. Conceptual Drawing of Interim Storage Facility

The IHF has many safety features. It is highly unlikely that any liquid agent would spill from the sealed container holding the recovered CWM, but to provide secondary containment, the bottom of the IHF is designed to contain any liquids that are spilled. Air monitoring ports have been installed to facilitate sampling of the air within the IHF. Through the use of these ports, air monitoring equipment can detect agent vapor at very low levels without opening the IHF. A carbon filtration system can be attached to the IHF if agent vapor is detected. The IHF is equipped with a refrigeration system to cool the CWM containers; liquid agent turns to vapor slower at reduced temperatures. The IHF is also equipped with a self-actuating fire suppression system.

For security purposes, the IHF is contained inside a lighted fenced compound. The ISF perimeter will be marked with a 6-foot high chain link fence to prevent unknowing and unauthorized entry. The fence will have signs warning of possible hazards.

9.3.3 Interim Holding Facility Plan. A site IHF plan provides a strategy for the interim storage of recovered CWM for a specific site. The plan identifies the type and location of the storage facility and defines the IHF operation. A strategy for monitoring during the placement into, storage, and removal of containers from the IHF is provided. Roles and responsibilities of the organizations involved are detailed along with their relationships to one another. These responsibilities include an emergency response strategy. The plan includes a risk assessment that provides an analysis of the hazards associated with the handling and storage of site-specific hazardous materials, including risk mitigation recommendations.

9.3.4 Transportation Plan. In the few instances that the Department of Defense (DoD) has transported materiel pending destruction, a detailed transportation plan was developed and coordinated with Federal and state regulatory agencies. The transportation plan provides a strategy for the movement of recovered CWM from the ISF of a specific site to a Resource Conversation and Recovery Act (RCRA)-approved storage facility. The plan identifies origin, mode of transportation, route to be taken, interim stops, and final destination. A strategy for monitoring during the handling and

transporting of the CWM is provided. Roles and responsibilities of the organizations involved are detailed along with their relationships to each other. These responsibilities include an emergency response strategy. The plan includes a risk assessment that provides an analysis of the hazards associated with the handling and transportation of site-specific hazardous materials, including risk mitigation recommendations.

9.4 Mobile Remediation Systems

9.4.1 Overview. As CWM continues to be recovered at remote burial sites, methods for the destruction of recovered CWM must be developed to minimize handling and transportation. Due to the nature and location of some of the possible buried CWM sites, a transportable and maneuverable system is required. Several different systems are currently being developed or proposed for the onsite destruction of recovered CWM. These mobile systems will have the ability to detoxify the chemical fills of a wide variety of munitions and CAIS.

The two mobile remediation systems currently under development are the Rapid Response System (RRS) and the Munitions Management Device, Version 1(MMD-1). Each system is specially designed to handle a specific type of recovered CWM. The RRS will allow for the identification of industrial chemicals and the identification and detoxification of blister agents contained in CAIS. The MMD-1 will process and decontaminate non-explosively configured CWM and its fill.

9.4.2 Rapid Response System Description. Due to the relative frequency of CAIS recovery, especially in the civilian environment, the Project Manager for Non-Stockpile Chemical Materiel (PMNSCM) has begun a program to develop equipment to provide a safe and environmentally sound method for disposing of these items. The RRS is being designed and built by the Ammunition Equipment Directorate (AED) of Tooele Army Depot (TEAD), with the assistance of the U.S. Army Edgewood Research, Development and Engineering Center (ERDEC).

The RRS is designed to treat recovered CAIS components and intact CAIS as close as practical to the recovery site. Onsite treatment will minimize transportation and handling of chemical agents prior to final disposal. The RRS will be able to treat recovered CAIS accumulated in hazardous waste interim storage, or taken directly from the recovery site.

The main components of RRS will be contained in two trailers: an operations trailer and a utility trailer (figure 9-2). The trailers, when attached to their prime movers, will permit land transportation of the RRS to a CAIS treatment location. Each trailer, along with its prime mover, can be transported by as small as a C-130 military aircraft for long-distance travel when required.

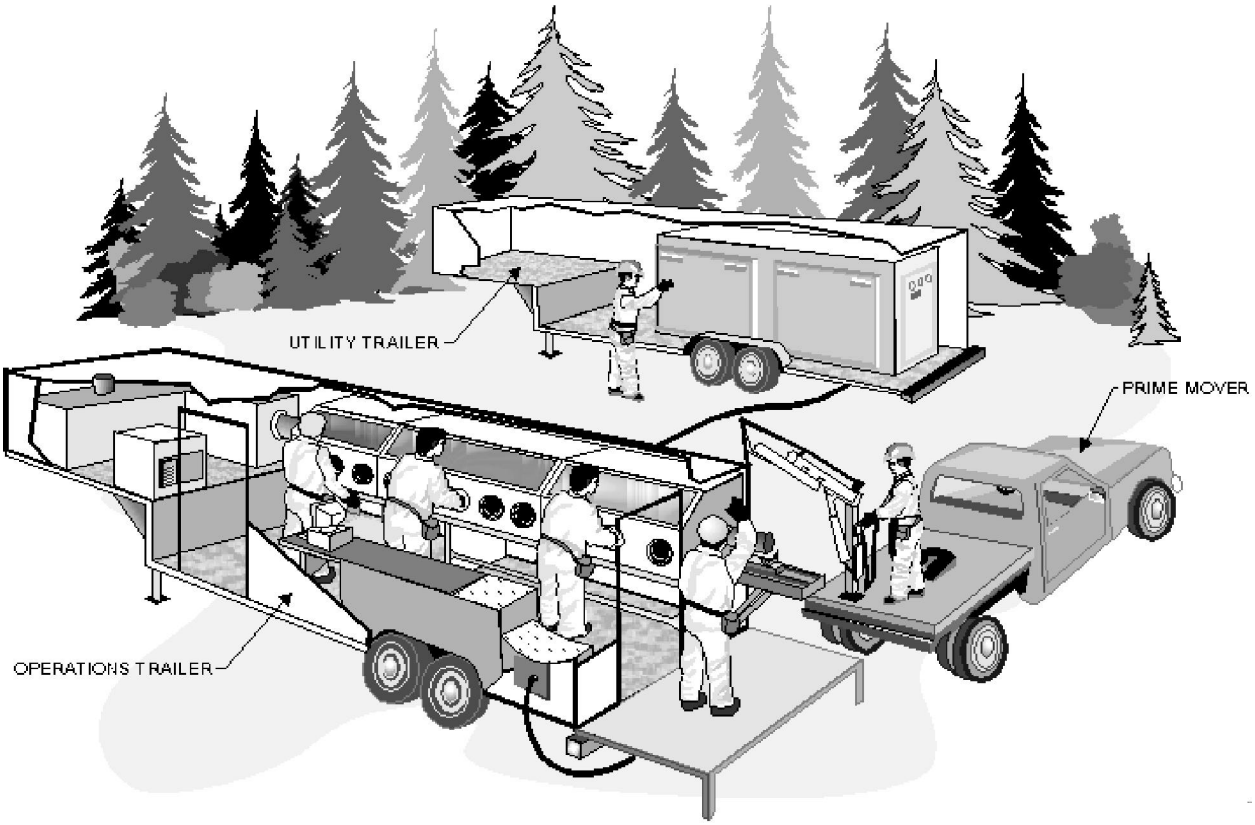

Figure 9-2. Conceptual Drawing of the Rapid Response System Site Layout

The operations trailer will contain all equipment required to safely access, identify, and either segregate containers of industrial chemicals or detoxify blister agents found in CAIS. The products of this detoxification process will be packaged according to Department of Transportation (DOT) standards for shipment to a permitted treatment, storage, and disposal facility (TSDF). The segregated industrial chemicals will be segregated and packaged to DOT standards for shipment to a permitted TSDF without further treatment by the RRS.

Support for the operations trailer will be provided by the utility trailer. The utility trailer will carry two diesel-powered generators that will provide the RRS with all necessary electrical power. This will enable the system to operate without commercial or host installation power when required.

9.4.3 Munitions Management Device, Version 1 System Description. The MMD-1 is a prototype system that was conceptualized by the U.S. Army TEAD AED, based on a patented commercial system. The MMD-1 is a program begun by PMNSCM to develop a safe and environmentally sound system to decontaminate non-explosively configured CWM recovered at burial sites.

The MMD-1 is a mobile unit contained in two trailers: a process trailer and a control trailer (figure 9-3). These trailers, along with the support equipment, can be transported by road to the suspect buried CWM sites. The process trailer will contain the equipment necessary to decontaminate a range of non-explosively configured chemical munitions and chemical agent fills.

One munition at a time will be opened, drained, and decontaminated by remotely controlled equipment. The chemical agent fill will be detoxified during the munition decontamination process. The munitions and the agent fill will be contained within engineering controls during the entire processing operation. The safeguards designed into the MMD-1 process will prevent the accidental release of agent during the

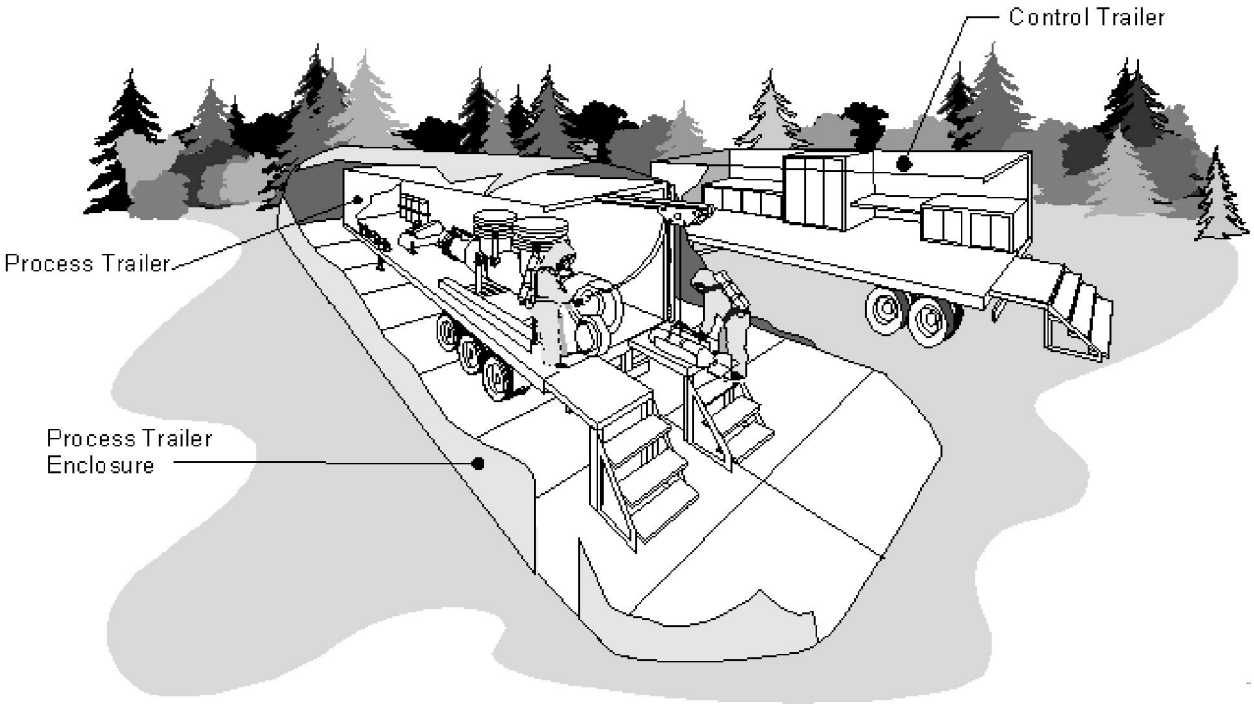

Figure 9-3. Conceptual Drawing of the Munitions Management Device, Version 1 Site Layout

processing operations. As a precautionary measure, the process trailer is designed to contain liquid or vapor accidentally released by the process equipment. The process trailer is also surrounded by a tent-like enclosure to provide an additional level of safety. An additional safety precaution taken is to monitor the process closely to detect any accidental release of agent vapor during operations.

After the processing operation is completed, the residual detoxification solutions will be analyzed for traces of residual chemical agent. The residual detoxification solution will be packaged in accordance with DOT regulations and shipped to a hazardous waste TSDF.

The control trailer will house the personnel who operate the remote controlled process equipment. These personnel will control and monitor all process activities conducted during the processing operations. The control trailer will also contain the laboratory equipment used to analyze the process feed and waste streams.

9.4.4 Future Munitions Management Device Versions. The MMD-1 is designed to treat non-explosively configured NSCM. MMD-2 will be developed to treat explosively configured NSCM, and MMD-3 will be developed to treat non-explosively configured bulk NSCM. Since disposal of explosively configured NSCM is more complex than that of other CWM, the development of the MMD-2 is expected to take longer than the MMD-1.

The proposed concept of the MMD-3 is based on a similar commercial system. The MMD-3 will drill a hole into the bulk item, implant a valve, and either drain the contents into an appropriate decontaminating reactor or transfer the contents into a DOT-approved container for subsequent shipment to another location for destruction.

9.5 Future Research and Development Efforts

Efforts continue to develop improved and safer technologies for application to the Non-Stockpile Chemical Materiel Program (NSCMP). Since the disposal effort requires the interactions of multiple organizations, PMNSCM will ensure the cooperative development of necessary equipment with the U.S. Army Corps of Engineers (USACE), TEU, ERDEC, the Environmental Protection Agency (EPA), and others. PMNSCM has envisioned six categories for evaluating or developing these new technologies: suppressive demolition, innovative accessing, innovative neutralization, innovative burial treatment, nonintrusive characterization of materiel, and multi-agent monitoring capability. Studies and tests completed under each of these six categories will contribute vital information to the continuing efforts to destroy recovered CWM in a safe and environmentally sound manner.

SECTION 10
COST AND SCHEDULE ESTIMATES

10.1 Disclaimer

The costs shown in this section are based on the 21 March 1996 Non-Stockpile Program Life Cycle Cost Estimate (LCCE). This cost estimate relied on several assumptions based on the Chemical Weapons Convention (CWC). The first assumption was CWC Entry Into Force (EIF) in the first quarter of 1997. The next assumption was the CWC destruction time limitations for each specifically defined chemical materiel. Since the March 1996 estimate, three major factors have influenced the LCCE. It has become apparent that EIF will not occur in the first quarter of 1997. Also, the present legal interpretation of the CWC language has revised the required amounts and chronology of the chemical materiel. In addition, the March 1996 LCCE was audited by the Army Auditing Agency (AAA) in January through July 1996. These items are all being addressed in a revised LCCE, which will be completed in 1997.

10.2 Background

As stated in section 1, Congress requested updated information on cost and schedule estimates for destroying all non-stockpile chemical materiel (NSCM). Since the Non-Stockpile Chemical Materiel Program (NSCMP) is in its initial phase, the procedures, destruction processes, regulatory requirements, and studies needed to implement the project have not been finalized. Because the implementation of the project has not been fully developed, the cost and schedule estimates are subject to uncertainties. The cost estimate reported here is the NSCMP Life Cycle Cost Estimate (1996), which updates the Survey and Analysis Report (1993) rough order of magnitude (ROM) cost and schedule estimate.

The following paragraphs summarize the cost and schedule approaches used for developing estimates for each of the NSCM categories discussed in sections 3 through 7. The current year life cycle cost estimate (which includes inflation) for destroying all NSCM within the United States and its territories, if so directed, is $15,231 million. The estimated schedule from program inception to completion is fiscal year (FY) 1992 to FY2033. Chemical Weapons Convention (CWC)-related chemical warfare materiel (CWM) within the United States and its territories will be destroyed within the time allowed by the CWC. The current cost estimate for destroying CWC NSCM is approximately $750 million.

Currently, no costs are associated with and no work has been identified under appendix D (Potential Overseas Burial Sites). This issue is described in detail in appendix D; however, should funding be required for CWC compliance or other reasons, a mechanism for providing supplemental funding should be considered.

10.3 Approach

The Project Manager for Non-Stockpile Chemical Materiel (PMNSCM) developed an updated ROM cost estimate based on the NSCMP Implementation Plan (1995), the Survey and Analysis Report (1993) ROM cost and schedule estimate, and the NSCMP Life Cycle Cost Estimate (1996). The NSCMP has been defined in more detail than available during the Survey and Analysis Report (1993) ROM cost estimate. In addition, the design of the Rapid Response System (RRS) and the Munitions Management Device, Version 1 (MMD-1) have progressed to the point where the costs associated with these systems can be estimated more accurately.

The updated ROM cost estimate provides a cost estimate to fully remediate all known NSCM, if so directed. It includes estimated costs for PMNSCM as well as the other affected agencies. For example, the excavation of suspect CWM is not a PMNSCM responsibility, but the estimated cost for excavation has been included in the updated ROM cost estimate. The appropriate program office in the Military Services would be

notified to allow the Service an opportunity to determine if the sites are Defense Environmental Restoration Account (DERA) eligible. The updated ROM cost estimate includes sufficient detail to substantiate the cost estimating methodologies.

10.3.1 Ground Rules and Assumptions. In developing a cost estimate, the initial phase is to establish ground rules and assumptions. These ground rules provide the basis for the cost analysis and the analytic judgment used to develop the cost estimate. The ground rules and assumptions used in the preparation of the cost estimate are as follows:

a. The NSCMP will be directed to destroy all NSCM within the United States [including Army, Navy, Air Force, and Defense Logistics Agency (DLA) requirements], not just that required under the CWC.

b. The CWC Preparatory Commission (PREPCOM) is still developing administrative regulations and technical procedures to support verification of compliance with the treaty. Therefore, the complete cost of treaty verification is not included in this cost estimate.

c. The cost estimate includes the DERA appropriation and military services budget accounts.

d. The potential buried CWM site cost estimate includes the cost for complete site remediation of CWM (including assessment, investigation, studies, recovery, storage, destruction, and site cleanup).

e. The CWC requirements for buried CWM begin when it is recovered.

f. All summary estimated costs are reported in current year dollars (present value).

g. The cost estimate includes total program costs from inception to completion (FY1992-FY2033).

h. Inflation rates are based on Office of the Secretary of Defense (OSD) inflation guidance, dated 21 February 1996.

i. Cost estimates are inclusive of general and administrative (G&A) costs and fee.

j. The cost estimate does not include remediation of ocean burials.

k. The cost estimate includes the destruction of CWM within the United States only.

l. The risk analysis does not include effects on the program from accidents, legal actions, significant changes to environmental regulations, and political changes.

m. No learning curve was applied for any of the destruction processes.

n. Only destruction efforts at Aberdeen Proving Ground, Newport Chemical Activity, and Pine Bluff Arsenal are costed in the cost estimate for former chemical weapons production facilities. Rocky Mountain Arsenal, Swannanoa, Marquardt, and Muscle Shoals are excluded for costing purposes.

10.3.2 Cost Structure. The cost estimate work breakdown structure (WBS) was governed by Military Standard (MIL-STD)-881-B, WBS for Defense Materiel Items, and Department of Defense (DoD) Instruction 5000.2, Defense Acquisition Management Policies and Procedures. The WBS divides the NSCMP into program and project (site)

levels. Each level contains ten basic elements of MIL-STD-881-B as follows: Mission/Demilitarization, System Engineering/Program Management, System Test and Evaluation, Training, Data, Peculiar Equipment/Services, Common Support Equipment, Operational/Site Activation, Industrial Facilities, and Spares. At the program level, the mission block is divided into the eight categories of NSCM as follows: Former Production Facilities; Binary CWM; Rapid Response System (RRS); Recovered CWM; Small Burial CWM; Research, Development, Test, and Evaluation (RDT&E) CWM which includes chemical samples; Miscellaneous CWM; and Large Burial CWM. Each category is then subdivided into project or site-specific cost. Figure 10-1 shows the program-level WBS.

10.3.3 Data Sources. Data, in the form of cost, technical, and programmatic information, serves as the basis for the analysis of the cost estimate or the technical baseline for each mission area and site type. Historical cost and technical data on analogous projects, processes, and procedures were used in the preparation of the cost estimate. The Army compiled available cost data and studies to develop the cost estimate. Project cost and technical information was collected from the Program Manager for Chemical Demilitarization (PMCD), U.S. Army Corps of Engineers (USACE), Army Environmental Center (AEC), Program Manager for Rocky Mountain Arsenal (RMA), Air Force, Navy, Environmental Protection Agency (EPA), and industry.

10.3.4 Generic Buried CWM Site Types. Potential buried CWM sites were categorized into generic types and cost estimates for each generic type were developed. The generic scheme was recommended because of the commonality of characteristics of the sites (size, quantity of CWM, and whether explosively configured). After many discussions between the PMNSCM, USACE, AEC, Navy Facilities

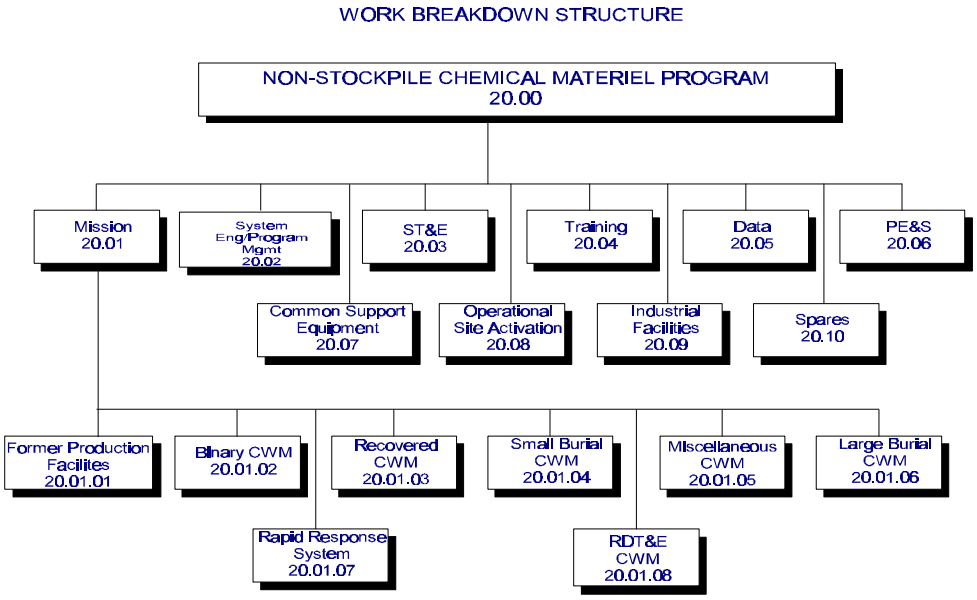

Figure 10-1. Program-Level Work Breakdown Structure

Engineering Command, Air Force Center for Environmental Excellence, and Army staff, the potential buried CWM sites database was categorized into eight generic types:

a. *Confirmed, Chemical Agent Identification Set Sites.* These are sites where documentation or investigations identify the specific location of potential burial sites for chemical agent identification sets (CAIS).

b. *Potential, Chemical Agent Identification Set Sites.* These are sites where documentation states that CAIS have been buried somewhere within the confines of a location (for example, somewhere on the installation). The specific CAIS burial sites are not known.

c. *Small Quantity, Explosive, Small Sites.* These are sites where documentation or investigations indicate that small quantities of chemical warfare munitions (less than 1,000) are potentially buried. CWM is either

known to be explosively configured, or explosives cannot be ruled out. The total geographical area where the CWM may be buried is 10 acres or less.

d. *Small Quantity, Non-explosive, Small Sites.* These are sites where documentation indicates that small quantities of non-explosively configured CWM are potentially buried. The geographical area of the site location is 10 acres or less.

e. *Small Quantity, Explosive, Large Sites.* These are sites where documentation indicates that small quantities of explosively configured CWM are potentially buried. The location of the potential burial site, however, is in a geographical area greater than 10 acres. In most cases, the specific location of the potential burial site is unknown.

f. *Small Quantity, Non-explosive, Large Sites.* These are the sites where documentation indicates that small quantities of non-explosively configured CWM are potentially buried. The location of the burial sites is in a geographical area over 10 acres.

g. *Range Sites.* These are sites where documentation indicates that small quantities of explosively configured CWM are potentially buried or are on the surface of former artillery, bombing, or other types of test ranges. These ranges can vary in size, from 1 acre to thousands of acres.

h. *Large Quantity Sites.* These are sites where historical documentation, studies, and personal knowledge indicate the burial of large quantities (over 1,000) of explosively and non-explosively configured CWM.

The remedial action for the buried CWM at each site will be based on comprehensive environmental studies. Since it is not allowable to predetermine the remedial action,

the cost estimate is based on an assumed disposal strategy. The cost of the remedial action selected as a result of the environmental studies is estimated to be similar to the assumed disposal strategy cost. The estimated cost for the remediation of potential buried CWM sites is based on the disposal methods listed in table 10-1. There was no intent to circumvent the environmental process to select the actions for use in the various projects.

10.3.5 Potential Buried CWM Site Classification. The database of potential buried CWM sites, which can be found in appendix A, was also classified by the likelihood of having buried CWM at the sites. The classifications are: 1 - Known Burial, 2 - Likely Burial, 3 - Suspect Burial, 4 - Possible Burial, and 5 - No Further Action. The classification of each site was determined by analyzing available information, which consisted of examining records, discussions with knowledgeable individuals, and in some cases, physical assessments of the sites. This classification of the potential buried CWM sites is important to the cost and schedule estimates because the lower the probability of having buried CWM at a site, the lower the probability should be for requiring full remediation at that site. A lower number of remediation activities reduces estimated costs and shortens estimated schedules.

The Army identified an estimated percentage of sites that will go through the complete site remediation process (table 10-2). The terms preliminary assessment/site investigation (PA/SI), remedial investigation/feasibility study (RI/FS), and remedial design/remedial action (RD/RA) are used for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site remediation actions. These terms are used as a basis for this estimate only and may be different depending on the specific site environmental requirements.

Table 10-2 indicates that 100 percent of the classification 1 - Known Burial sites are assumed to require a full remediation effort, which will be included in the cost and schedule estimate. The next line shows 100 percent of classification 2 - Likely Burial

Table 10-1. Disposal Methodology Used as a Basis for the Estimated Cost of Each Generic Site Type

Generic Buried CWM Site Type	Disposal System
Chemical agent identification set	RRS
Small quantity, non-explosive	MMD-1
Small quantity, explosive	MMD-2
Range	MMD-2
Large quantity	Cryofracture/Incineration Demonstration Plant (fixed facility) or Capping

Table 10-2. Estimated Percentage of Sites Requiring Remediation Activities

Potential Buried CWM Site Classification	PA/SI	RI/FS	RD/RA
1 - Known Burial	100%	100%	100%
2 - Likely Burial	100%	85%	70%
3 - Suspected Burial	100%	70%	50%
4 - Possible Burial	100%	50%	25%
5 - No Further Action	None	None	None

sites will require a PA/SI, 85 percent of the classification 2 sites will require an RI/FS, and 70 percent of the classification 2 sites will require an RD/RA. Classification 3 and 4 sites follow the same logic. Classification 5 - No Further Action sites were not included in the cost and schedule estimates based on the premise that no further action will be required at those sites.

10.3.6 Potential Buried CWM Sites Estimated Schedules. Discussions were carried out with all the affected organizations to develop generic schedules for each remediation action for each generic buried CWM site type. In considering the development of these schedules, the Army concluded that an estimated average schedule should be used for generic small quantity and range site types (table 10-3). The generic CAIS and large quantity sites were scheduled according to the estimated site-specific requirements.

Once the generic buried CWM site schedules were developed, the Army developed an overall remediation schedule based on the capabilities and management resources available. It was understood that this schedule would not necessarily reflect the final schedule once the NSCMP reaches the implementation phase. However, the development of an overall remediation schedule was necessary for calculating the current year (inflated) cost.

Table 10-3. Estimated Average Remedial Action Schedule for Generic Buried CWM Sites

Generic Buried CWM Site Type	PA/SI (years)	RI/FS (years)	RD/RA (years)	Total (years)
Small quantity	0.50	2.00	2.00	4.50
Range	1.00	2.00	2.50	5.50

The Army estimated that due to current capability and management resources, it could simultaneously support active remediation work at six potential buried CWM sites. PA/SIs (most of which have been completed) and RI/FSs will be initiated as soon as practical.

10.4 Potential Buried CWM Site Cost and Schedule Estimate

The WBS structure divides the potential buried CWM sites into three categories: Small Burial CWM, Rapid Response System (RRS), and Large Burial CWM. The total cost for the remediation of the potential buried CWM sites is $11,916 million. These figures are reported in current year (inflated) dollars and do not include programmatic support costs such as the development and procurement of the MMD-1. The remediation of all potential buried CWM sites is estimated to be completed in FY2033.

10.4.1 Small Burial CWM. This category includes the cost for remediation of all potential buried CWM sites that meet the criteria of the generic small quantity explosive, small quantity non-explosive, and range sites. The cost estimate is based on the disposal systems defined in table 10-1. The schedule is based on the estimated remedial action schedule defined in table 10-3. The estimated current year cost for remediation of the small burial CWM category is $5,370 million and is estimated to be completed in FY2033. This is a significant period of time, but the work required is very complex, costly, and time-consuming. Trying to compress the schedule will require substantial increases in yearly resources, which include personnel and funding.

10.4.2 Rapid Response System. This category includes the cost for the disposal of recovered CAIS currently in storage and the remediation of potential buried CWM sites that meet the criteria of generic CAIS sites. Site-specific schedules for recovered CAIS were developed using the projected operating duration of the RRS. Site-specific schedules for three potential buried CAIS sites were developed. Once these sites have been remediated, the cost estimate is based on the remediation of two sites per

year for the duration of the program. The estimated cost for the RRS category is $540 million and is estimated to be completed in FY2031.

10.4.3 Large Burial CWM. This category includes the cost for the remediation of large quantity buried CWM sites. It is estimated that another large quantity buried CWM site may be identified in addition to those listed in this report. Therefore, five large quantity buried CWM sites were included in this cost estimate. Three of the five large quantity buried CWM sites were assumed to require a fixed disposal facility, while two were assumed to require capping. Site-specific schedules have been developed. The cost of remediation of the large quantity buried CWM sites is $6,006 million and the estimated completion date is FY2031.

10.5 Binary CWM Cost and Schedule Estimate

The binary chemical weapons are described in section 3. For the cost and schedule estimate, M687 projectiles are assumed to be disposed in the following steps: (1) the M687 projectile is disassembled into the main projectile body, base plate and the isopropyl alcohol (OPA) canister; (2) the burster is melted out of the projectile body and incinerated; (3) the projectile body and base plate are sawed in two (to meet the CWC destruction requirements) and scrapped; and (4) the OPA is incinerated in a hazardous waste incinerator.

The di-fluoro (DF) canisters and bulk liquid binary CWM is assumed to be incinerated as a hazardous waste. The uncontaminated hardware is assumed to be physically destroyed and scrapped. These processes are identified for costing purposes only. Site-specific schedules were developed to aid in the cost estimate. The cost for the disposal of the binary CWM is $40 million and the estimated completion date is FY2006, which is consistent with the CWC destruction timeline.

10.6 Miscellaneous CWM Cost and Schedule Estimate

Miscellaneous CWM is described in section 7 and consists of CWC-defined Category 3 items (unfilled munitions, submunitions, devices, and equipment specially designed for chemical agent employment), empty ton containers (TCs), chemical samples, and RDT&E CWM. The WBS separates the cost of disposal of the RDT&E CWM and chemical samples from the CWC items and empty TCs.

10.6.1 CWC Category 3 Items and Empty Ton Containers. The location and quantities of CWC-defined items are listed in appendix B, table B-1. This list contains chemical munition bursters and unfilled munitions and devices. None of the items have been contaminated with chemical agent. For this cost estimate, the chemical munition bursters destruction method is assumed to be open burning/open detonation (OB/OD). The unfilled munitions and devices are assumed to be physically destroyed by crushing or cutting, and then scrapping. All of this materiel is to be destroyed within 5 years of the treaty's entry into force (EIF).

The location and quantities of empty TCs are listed in appendix B, table B-3. The empty TCs will be sampled and characterized for possible contamination. For this cost estimate, some of the empty TCs are assumed to be contaminated. The cost for disposal of these TCs is based on the following process: (1) the contaminated TCs are decontaminated using the Munitions Management Device, Version 3 (MMD-3); (2) the decontaminated TCs are cut, cleaned, and packaged for shipment to Rock Island Arsenal (RIA); and (3) at RIA, the TC pieces are thermally treated and smelted to recycle the steel.

The CWC does not require the empty TCs to be destroyed; therefore, there is not a scheduling constraint. A site-specific schedule was developed for each empty TC location.

The current year cost estimate for disposal of the Category 3 items and the empty TCs is $37 million; destruction of the TCs is estimated to be completed in FY2004.

10.6.2 RDT&E CWM and Chemical Samples. The locations and quantities of RDT&E CWM and chemical samples are described in section 7. It is stored in TCs, metal drums, metal gas cylinders [Department of Transportation (DOT) bottles], glass bottles, vials, or ampules. The cost estimate is based on the operation of the MMD-1 and MMD-3 disposal systems. A site-specific schedule was developed to aid in the cost estimate. The current year cost of disposal of the RDT&E CWM and chemical samples is $22 million and the estimated completion date is FY2000 in accordance with the CWC requirements.

10.7 Former Chemical Production Facilities Cost and Schedule Estimate

The cost estimate for the destruction of the former chemical production facilities at Aberdeen Proving Ground-Edgewood Area (APG-EA), Maryland; Newport Chemical Activity (NECA), Indiana; and Pine Bluff Arsenal (PBA), Arkansas is included in this report. Four other sites listed in section 6 - Rocky Mountain Arsenal (RMA), Swannanoa, Marquardt, and Muscle Shoals - are not included in this cost estimate. Destruction activities have already been completed at Muscle Shoals. The CWC requires the destruction of former production facilities within 10 years after EIF of the CWC.

The descriptions of the former production facilities are included in section 6. As stated, APG-EA contains many other facilities that are not required to be destroyed under the CWC; however, the Army intends to destroy these facilities. Therefore, the cost for these is included in the cost estimate. The three-phase demolition and destruction approach discussed in section 6 was used for the cost estimate. Similar to the other categories, the actual treatment selection will not be made until comprehensive environmental studies have been completed with the participation of affected states and the public.

The cost estimate for this category used the same WBS structure as the others. However, since the facilities are a known quantity, more of an engineering cost approach was used for this estimate. Using the former VX production facility at NECA, Indiana, as a basis, a cost model was used to develop the cost estimate. Detailed drawings and schematics of the plant were studied and several visits were made to the facility to gather data. The cost model used a representative sampling of the complete facility to develop the cost estimate. As an example, the cost for decontaminating a square foot of concrete was estimated. That cost was then applied to the total concrete area requiring decontamination. Similarly, all costs for equipment and plant decontamination and destruction were developed. Engineering drawings were reviewed and visits made to the former production facilities at the three other sites. The cost model was then used to develop the destruction cost estimates. Factors were applied for differences in labor and utility rates.

The current year cost estimate for destroying former chemical weapon production facilities and other structures (non-CWC) at Aberdeen, Newport, and Pine Bluff is $264 million and the estimated completion date is FY2016. The scheduled destruction of CWC specified former production facilities will be completed by FY2006. The FY2016 scheduled completion date includes efforts not within the scope of the CWC.

10.8 Recovered CWM Cost and Schedule Estimate

Recovered chemical weapons are currently located at four Army installations. Section 4 lists the types and locations of these items. For the purpose of this cost estimate, the destruction method of these items follows the assumptions used for the small generic burial sites. Non-explosive CWM is assumed to be disposed of by the MMD-1 system and the explosive CWM by the MMD-2 system. The actual method of treatment for these weapons cannot be made until technical and environmental studies are completed. Site-specific schedules were developed to aid in the cost estimations.

With appropriate funding, the destruction of recovered chemical weapons listed in section 4 can be completed by late FY2001, well within the 10-year CWC requirements. The estimated cost for destroying these items is $74 million.

10.9 Programmatic Cost Estimate

The project-level costs for each NSCM category do not include the programmatic-level costs. Programmatic costs use the MIL-STD-881-B WBS structure and include: Mission, System Engineering/Program Management, Systems Test and Evaluation, Training, Data, Peculiar Equipment/Services, Common Support Equipment, Operational/Site Activation, Industrial Facilities, and Spares. The mission block summarizes the costs from each of the NSCM categories (figure 10-1). Each of the other blocks captures the program-level costs. Program-level costs are associated with more than one project or category. For example, the training of personnel to operate disposal equipment used at more than one site is a programmatic training cost. Costs associated with training for a specific site are project-level costs. The equipment used to treat the CWM (such as transportable detoxification equipment, crushers, monitors, transportable laboratories, and vehicles) will be procured and tested at the programmatic level, but operation costs are incurred by the individual sites.

The programmatic costs are scheduled for the life of the NSCM program and are estimated to be $2,878 million.

10.10 Cost Estimate Uncertainties

The uncertainties of this cost estimate have been qualitatively defined by analyzing the estimate from the following three perspectives; engineering judgment was then used to quantify the uncertainty range of the cost estimate.

a. A study of 25 weapons programs in both the public and private sector was reviewed to determine the percent cost growth from the initial budget

estimates to final program cost at completion. The results were presented to PMCD on 5 May 1993, in a report entitled Assessment of CSDP Implementation Options (Chemical Stockpile Disposal Program).

b. Second, a review of numerous CERCLA feasibility studies (FS) cost estimates indicates that the FS technical baseline and cost estimating methodologies are consistent with those used for the updated ROM.

c. Third, a top-level risk analysis was performed at the generic site category level for the Survey and Analysis Report (1993) ROM that used a commercial software risk analysis package; that analysis still applies for the updated ROM.

Based on the above, the uncertainty range for this cost estimate is -25 percent to +75 percent for all NSCM categories with the exception of former production facilities. An uncertainty range of -10 percent to +25 percent was assumed for former production facilities because the technical baseline was more defined. It is important to note that parameters not considered in the risk assessment could easily cause the program cost to exceed the worst-case uncertainty assessments (for example, discovery of numerous additional sites or changes in environmental regulations).

Table 10-4 summarizes the cost estimate for the NSCMP including the associated uncertainty of each category. The total cost includes programmed requirements already identified for remediation projects under the Defense Environmental Restoration Program (DERP), and the CWC-related costs for NSCM within the United States and its territories.

Table 10-4. Uncertainty Range of the NSCMP Cost Estimate
(In millions of current year dollars)

Category	Lower Bound	Cost Estimate	Upper Bound
Small Burial	$4,027	$5,370	$9,398
Rapid Response	405	540	946
Large Burial	4,505	6,006	10,511
Binary CWM	30	40	70
Miscellaneous CWM	28	37	64
RDT&E	17	22	39
Former Production Facilities	237	264	330
Recovered CWM	55	74	128
Programmatic	2,159	2,878	5,037
Total	$11,463	$15,231	$26,523

Costs may not add due to rounding errors.

10.11 Non-Stockpile Chemical Materiel Program Schedule

The CWC establishes schedule requirements for the destruction of the United States chemical weapons, components and production facilities. Specifically, the CWC requires that unfilled munitions, submunitions, devices, and equipment specially designed for chemical agent employment and the former BZ production facility be destroyed within 5 years of the EIF. Schedule 1 recovered chemical weapons, binary weapons, and Former Production Facilities must be destroyed within 10 years of EIF.

The CWC does not require the United States to excavate CWM it buried on its territory before January 1, 1977. However, if the United States does recover buried CWM and they are found to meet the CWC definition of chemical weapons, the CWC requires their declaration, inspection by the Organization for the Prevention of Chemical

Weapons (OPCW), and destruction. Recovery can occur at any time, even after the 10-year period is over, but the recovered weapons still must be destroyed.

The schedule used for the cost estimate, as described above, is optimistic in that it assumes no significant delays due to technical, legal, or resource problems. A more specific schedule will be developed after the Army gains more experience in remediating some of these sites. Using the above assumptions, the PMNSCM can be completed with all mission areas in FY2033. A summary of the completion dates of each category is provided in table 10-5. This schedule meets the requirements established in the CWC.

10.12 Comparison to the 93 S&A ROM Cost and Schedule Estimate

A comparison between the S&A Report (1996) ROM cost and schedule estimate update (current year $15.2 billion) and the S&A Report (1993) (current year $17.7 billion) indicates virtually no increase in the current year cost of the NSCMP. A more appropriate comparison is done by using constant year dollars. After converting both ROM estimates to constant 1994 dollars, the 96 S&A ROM ($9.4 billion) shows a decrease of 18 percent from the 93 S&A ROM ($11.5 billion). This decrease is due to significant changes in the technical baseline and operational requirements. Even though the constant year cost estimate decreased, so did the current year cost estimate. The decrease of current year $2.5 billion was due to using inflation indicies to update the cost estimate. For consistency with the S&A Report (1993), the 1996 S&A ROM is also reported in current year dollars, but when direct comparisons are discussed, the percentage shown is computed from constant year 1994 dollars.

A summary of global differences between the 96 S&A ROM and the 93 S&A ROM cost estimates is defined below. Table 10-6 reflects a summary of 96 S&A ROM and the 93 S&A ROM cost estimates in current year dollars. Subsequent paragraphs provide more specific cost estimate differences with constant year percentage changes.

Table 10-5. NSCMP Estimated Schedule

Category	Start	Completion	
		CWC	Non-CWC
Small Burial	1998		FY2033
Rapid Response (CAIS)	1993		FY2031
Large Burial	1976		FY2031
Binary CWM	2002	FY2006	
Miscellaneous CWM	1993	FY1998	FY2004
RDT&E	1995	FY2000	
Former Production Facilities	1993	FY2006	FY2016
Recovered CWM	1994	FY2001	FY2031

Note:

All CWM covered by the CWC will be destroyed within the stipulated time periods.

Table 10-6. Summary of 96 S&A ROM Update and 93 S&A ROM Cost Estimates by Estimating Area (Cost Reported in Current FY$M)

Estimating Area	96 S&A ROM	93 S&A ROM
Potential Buried -	$11,916	$12,045
Small Burials CWM		
Rapid Response System		
Large Burial CWM		
Binary CWM	$40	$189
Miscellaneous -	$59	$208
Miscellaneous CWM		
RDT&E CWM		
Former Production Facilities	$264	$420
Recovered CWM	$74	$107
Programmatic	$2,878	$4,740
Total Cost Estimate	$15,231	$17,709

Cost may not add due to rounding errors.

- The 96 S&A ROM cost estimate is based on detailed site-level schedules that define design functions, permitting, pre-operations, and destruction functions for each of the estimating areas. The 93 S&A ROM cost estimate schedules were developed at the mission level and consist of one line for most estimating areas.

- The 96 S&A ROM cost estimate is based on updated schedules, fewer assumptions and a detailed technical baseline. The 93 S&A ROM cost estimate was based on a limited technical baseline and on numerous assumptions.

- The baseline destruction approach for many of the missions have changed to simpler, less costly methods. For example, the baseline CWM destruction method for the 96 S&A ROM cost estimate is onsite neutralization and transportation of the resultant waste to a permitted hazardous waste disposal facility. The corresponding destruction method for the 93 S&A ROM cost estimate was onsite mobile incineration.

10.12.1 Potential Buried CWM Site Cost. As with the WBS in paragraph 10.3, a cost estimate for the potential buried CWM was divided into three categories: Small Burial CWM, Rapid Response System (RRS) and Large Burial CWM. The net effect of all cost changes decrease the cost estimate 7 percent for these mission areas for the following reasons:

10.12.1.1 Small Burial Sites. The 96 S&A ROM cost estimate decreased due to changes in the technical baseline, i.e., from onsite incineration to onsite neutralization.

Further cost decreases were offset by the increase in generic site category excavation operations from the 93 S&A ROM cost estimate.

10.12.1.2 Rapid Response System Operations. The Rapid Response System 96 S&A ROM cost estimate increased due to an increase in the number of site remediations. The 93 S&A ROM costed one crew for remediation of nine site locations. The 96 S&A ROM estimate is based on two full crews remediating two sites per year for the duration of the buried CWM recovery effort. In addition, the 93 S&A ROM cost estimate was based on many analogies, engineering judgment, and estimating factors, while the 96 S&A ROM RRS remediation costs are based on a detailed labor and materials buildup.

10.12.1.3 Large Burial Sites. The 96 S&A ROM cost estimate increased for the large burial sites since 1993. A new site location, added as a future site, was included, thus increasing the total number of site locations to five. In addition, two capped sites were estimated in the 96 S&A ROM estimate versus only one for the 93 S&A ROM cost estimate.

10.12.2 Binary Chemical Warfare Materiel. The binary CWM destruction method was changed to a simpler process after the 93 S&A ROM estimate. In 1993, a process based on an analogy to the Drill and Transfer System (DATS) operations costs was used versus the current process of shipping to an offsite location that specializes in the destruction of similar munitions materiel. The net effect was a decrease in the cost estimate by 79 percent.

10.12.3 Miscellaneous Chemical Warfare Materiel. The baseline assumptions were changed for the miscellaneous CWM. The 96 S&A ROM cost estimate methodology uses OB/OD operations versus the 93 S&A ROM cost estimate methodology being onsite incineration with a mobile incinerator. Additionally, the quantities of energetics assumed in the 93 S&A ROM cost estimate decreased by over one order of magnitude in the 96 S&A ROM cost estimate. These changes caused an 83 percent decrease for the 96 S&A ROM cost estimate.

10.12.4 Research, Development, Test, and Evaluation. This estimating area is new and was not included in the 93 S&A ROM cost estimate.

10.12.5 Former Production Facilities. The Former Production Facilities cost estimate decreased by 40 percent from the 93 S&A ROM because the cost estimate for Rocky Mountain Arsenal (RMA) is not included in the 96 S&A ROM update. The RMA effort, which is separately funded by the Program Manager for RMA is nearing completion.

10.12.6 Recovered Chemical Warfare Materiel. The 96 S&A ROM cost estimate includes costs for only two site locations: APG and PBA. In the 93 S&A ROM, costs for five site locations were estimated: APG, PBA, DPG, ANAD, and TEAD. In addition, the costs for remediating the glass vials at PBA were moved to the RRS mission. Therefore, the 96 S&A ROM cost estimate was decreased by 32 percent from the 93 S&A ROM.

10.12.7 Programmatic. The Programmatic cost estimate between the 96 S&A ROM and the 93 S&A ROM cost estimate decreased 39 percent because of the following changes:

- The cost changes for engineering, management, testing, and evaluation efforts decreased as a result of using labor and materials buildup methodology for the 96 S&A ROM as compared to industry average factors used in the 93 S&A ROM cost estimate.

- Training cost increased significantly because the FY93 S&A estimate was based on equipment training only and did not take into account the extensive amount of process training that all site personnel must complete on an ongoing basis.

- The cost for special services and mission support tasks decreased because the 96 S&A ROM update was changed to consist primarily of

support equipment and labor (single round containers and personal protective equipment suits).

- Another major increase was the cost associated with the development, procurement, and testing of facilities and equipment required for destruction efforts. The 96 S&A ROM update increased to accommodate the design of the destruction equipment. In the 93 S&A ROM, it was assumed that all destruction equipment was commercially available. Later studies determined that commercial equipment was unavailable.

APPENDIX A

SURVEY AND ANALYSIS REPORT
SECOND EDITION

CHEMICAL WEAPONS BURIAL
HISTORICALSURVEY

APPENDIX A
CHEMICAL WEAPONS BURIAL HISTORICAL SURVEY
EXECUTIVE SUMMARY

This historical burial survey provides an estimate of the identity, number of locations, and the nature and scope of areas that may contain buried chemical weapons. A key component of the study is the development of a database showing potential locations, site sizes, identity, and estimated quantity of buried chemical warfare materiel (CWM). It should be noted that this is a compilation of information available from historical records. The database will be updated as additional information is received.

In most cases, these potential buried CWM sites served more than one purpose. Firing ranges were often used to dispose of leaking or defective munitions. Many historical references, primarily during and immediately after World War II, cite instances where chemical weapons were buried because of leaks discovered during transportation or storage. In some cases, munitions and other containers were drained into holes, covered with lime or open-pit burned, and finally covered with earth.

This historical burial survey should not be considered a definitive study to identify all sites that may contain buried chemical weapons or related materiel. Additional research centers and specific installation records need to be reviewed for other potential sites or confirmation of those already identified. A continuing effort of this nature, to provide further research, is being conducted by various organizations within the Department of Defense (DoD).

This report first includes a discussion of the background and approach used for the documentation survey. A summary of the results of the survey is included in tables listing the potential buried CWM locations at formerly used defense sites (FUDS) and active military installations. The database is then subdivided into listings by state. Within each state listing, there is a narrative summarizing the information for each

location, a state map showing the approximate location of each suspect burial location, and the burial database entry for each potential buried CWM site.

The database narratives present all available information and, where possible, the history, present conditions, previous investigation activities, activities completed to date, and a preliminary evaluation of risk posed by the sites. As information became available from the historical survey, the Army took steps to perform site visits to suspect FUDS locations to determine if an immediate threat to public health and safety exists.

The DoD is aggressively pursuing further investigation of potential buried CWM sites. Direction has been given and funds provided to accomplish archival searches for all FUDS locations. At any time during the investigation, if an immediate threat to human health and safety is discovered, the DoD will immediately take necessary action to remove the threat.

The information included in this database will continue to be revised as more information becomes available. A special request is made to the readers of this document to provide information that would clarify or add to the information included in this database. Information may be mailed to the following:

Project Manager for Non-Stockpile Chemical Materiel
ATTN: SFAE-CD-N
Aberdeen Proving Ground, Maryland, 21010-5401
or calling 1-800-488-0648.

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CHEMICAL WEAPONS BURIAL HISTORICAL SURVEY

BACKGROUND

The *Convention on the Prohibition of the Development, Production, Stockpiling, and Use of Chemicals Weapons and on Their Destruction*, once ratified, will require that all signatories destroy all chemical weapons, including chemical weapons recovered from burial sites. Under Section 176 of Public Law (PL) 102-484, the U.S. Congress mandated that the Department of the Army (DA) prepare a report that describes plans to destroy buried non-stockpile chemical weapons. Specifically required is a list of suspected locations, the type and nomenclature of munitions or materiel that may be contained at the site, and an estimate of the numbers of these weapons.

This report presents a continuing effort to define the numbers, types, and locations of buried chemical weapons through historical research. As a result of this continuing research, the buried chemical warfare materiel (CWM) site database, which includes each site and related information, has been developed. This compilation of historical data is a continuing effort to identify all possible sites where these munitions and agents may be found. Further research and onsite investigations are ongoing to determine more definitive information concerning many of these sites, the buried chemical weapons that may be within them, and whether the historical information is still valid today.

APPROACH

The approach used to compile and update the list of potential sites is based on historical research of locations that may contain buried chemical weapons, or those sites where chemical weapons were developed, manufactured, tested, or stored. These sites are listed based on the likelihood that chemical weapons may have been disposed of by burial or, as in the case of test ranges, penetrated below the ground

surface by impact. Each site in the database is assigned a classification, which indicates the likelihood that chemical munitions may be buried. The classifications are meant to reflect the current status of the sites and are defined as follows:

Classification 1: Known Burial A classification 1 site is a site at which confirmation of CWM has occurred, either by site assessment or actual recovery.

Classification 2: Likely Burial A classification 2 site is a site at which one of the following has been verified by historical records:

(1) The burial of chemical weapons has been reported.

(2) The firing of chemical weapons under range conditions (as opposed to static firing under test conditions) has been reported.

(3) The disposal of chemical weapons by dumping in shallow water has been reported.

Classification 3: Suspected Burial A classification 3 site is a site at which one of the following conditions apply:

(1) The normal duty activities performed on this site indicate a strong suspicion that buried chemical weapons may still exist even though they are indicated in the literature as destroyed. An example would be a burn pit where not all of the munitions may have been consumed even though the period literature indicated that they were.

(2) Chemical weapons were known to be disposed of on this site, but period literature indicates that the site was cleared; however, the technology for clearing such locations at that time may lead to the conclusion that not everything was removed.

(3) The site is a known chemical range, but the literature is unclear as to whether chemical agent was applied to the site by spraying (such that there would be no buried ordnance) or by range firing/bombing.

Classification 4: Possible Burial A classification 4 site is a site at which one of the following conditions apply:

(1) Although no literature exists indicating that burial was actually conducted, the activities and timeframe of the operations on the site indicate that burial of chemical weapons is a possibility.

(2) The normal duty activities performed on this site indicate some possibility that chemical weapons may have been buried, as no literature exists that documents their fate.

(3) There is enough literature to indicate that chemical agent identification sets (CAIS) or chemical weapons were used extensively at the site in such a way that (although the literature does not indicate it) some chemical materiel may be present.

Classification 5: No Further Action A classification 5 site is one for which the Department of Defense (DoD) has determined that no further remediation activity is warranted due to:

(1) Site assessment
(2) Completed remedial work
(3) The fact that suspect site is no longer accessible.

To the extent possible, attempts were made to discover the exact nature of the site, its size, and its contents. However, records during the timeframe researched are often imprecise. In many cases, the source states only that materiel was buried, without any

definitive information on the type of materiel or the exact location of the site. Within military installations, historical information is also open to question since many areas are no longer used for their original purposes. For example, a site described as the "Old Mustard Field" may not be shown on current installation maps because it is no longer used for that function.

A number of agencies, research centers, and documents were used and reviewed during the course of this effort. They are:

- *Historical Office, U.S. Army Chemical and Biological Defense Command (CBDCOM):* contains a comprehensive holding of historical documents on the U.S. Army Chemical Corps and activities during World War I (WWI), World War II (WWII), and subsequent eras.

- *U.S. Army Environmental Center (USAEC):* contains all documentation related to the Army's installation restoration program.

- *U.S. Army Center for Health Promotion and Preventive Medicine:* contains documents describing solid waste management unit (SWMU) sites, including those containing contamination from chemical weapons.

- *Technical Library, U.S. CBDCOM:* contains information on research and testing of chemical weapons.

- *U.S. Army Technical Escort Unit (TEU):* contains information on the transportation of chemical weapons and recovery operations of those found in past and recent years.

- *Technical Information Center (TIC), Program Manager for Chemical Demilitarization (PMCD):* contains information on demilitarization and

destruction technologies, environmental permits, munitions specifications, and toxicity data.

- *National Archives, Washington, DC and Suitland, Maryland:* contains historic information on the Chemical Warfare Service and various other records pertaining to chemical warfare.

- *Army War College, Carlisle, Pennsylvania*

- *Chemical Center and School, Ft. McClellan, Alabama*

- Washington National Records Center, Washington, DC.

- *Thirty-five CONUS* (continental United States) *Sites for Intensive Study Under the Chemical Weapons Suspect Burial Site Database* (dated February 18, 1994): a study in a series of continuing efforts to identify potential buried CWM sites.

- *Archival Search Reports:* reports used for several locations to identify site classifications.

- *U.S. Army Corps of Engineers* (USACE), *St. Louis District, Defense Environmental Restoration Program Ordnance and Explosive Waste Chemical Warfare Materials Archival Research:* Corps of Engineers database identifying potential buried CWM sites.

- Various Army military installation records.

SITE CHARACTERISTICS

The sites searched for evidence of CWM burials in this study include:

- Chemical weapons storage facilities, both current and historical
- Former chemical weapons production facilities
- Points of entry and debarkation where ships and rail yards were used to transport chemical weapons
- Training areas where CAIS were used
- Test centers and ranges where chemical agents were fired and rounds that impacted on the surface may be buried.

In addition, many sites encompass a broad range of missions, some of which are not associated primarily with the development, production, or testing of chemical weapons. For example, burials at these sites often hold CAIS. These sets, which contain ampules (vials) or bottles of agent, were used at military installations for training during and immediately after WWII. During these years, 110,000 CAIS were manufactured and distributed to military organizations. Between 1981 and 1982, 21,458 CAIS that had been recovered were destroyed at Rocky Mountain Arsenal (RMA). Although many were used up during the course of training in the field, CAIS have been recovered repeatedly from burial sites. These sites include active military installations of the Navy, Air Force, and Army/Air National Guard. These sites also include formerly used defense sites (FUDS) now on private land. In addition, CAIS have been removed from the private sector, from individuals who retained them as war souvenirs.

CAIS represent an unknown factor in chemical warfare burials. It must be understood that at the time of their use, they were considered an expendable training item. Consequently, there was no accountability for them and no recordkeeping requirements. This made them easily disposable or pilferable. Today, there is no way of accurately researching any (but a small portion) of the locations where CAIS may be found. Consequently, the Army is considering ways in which to react to these burial

areas or recovery sites as they are discovered. Programs to encourage the turn-in of these items or the divulging of burial information, such as an amnesty program where items may be turned in with no questions asked, have been used as a means of encouraging the recovery of CAIS or divulging further CAIS burial sites.

In the database narrative, a general assessment of the risk perception of each location is provided. Determinations made on the existence of threat to human health and safety (risk perception) are based on currently available information. In the case of the DoD active sites, the USAEC made the assessments. In the case of FUDS, local district engineers were responsible for threat determinations. Assessments may change during the investigative process.

Assessment criteria include the following:

- Current site usage
- Site accessibility/Government control of site
- Site susceptibility to intrusive activity
- Previous land usage and excavation
- Previous remediation efforts
- Type of chemical warfare materiel anticipated
- Population of area near the site.

SUMMARY OF RESULTS

A wide variety of CWM is suspected to be buried in a total of 224 sites, 56 of these sites require no further action. These 224 sites are located in 96 locations across 38 states, the District of Columbia, and the U.S. Virgin Islands. Of those 96 locations, 45 are FUDS and 51 are on DoD installations. Table 1 summarizes the list of potential buried CWM locations and sites that may require further remediation activities. Table 2 summarizes the potential buried CWM locations and sites that the DoD has determined no further action is required. Table 3 summarizes the sites classification by state.

The CWM that may be found at these potential buried CWM sites includes CAIS, mortar rounds, aerial bombs, rockets, projectiles, and storage containers of agent in cylinders, 55-gallon drums, and ton containers (TCs). Buried chemical agents include, but are not limited to, blister agents [mustard (H) and lewisite (L)], nerve agents (GA, GB, and VX), blood agents [hydrogen cyanide (AC) and cyanogen chloride (CK)], and choking agent [phosgene (CG)]. Burial sites contain other hazardous substances, such as white phosphorus (WP), which were also fielded by the U.S. Army Chemical Corps.

The Survey and Analysis Report (1993) provided this database to the public for the first time. Since its publication, additional information has been gathered that changes existing database entries and adds new database entries. The following sites were deleted from the database because supporting documentation did not meet the specific criteria of a potential buried CWM site:

Location	Site Deleted	Comments
Anniston Army Depot, Alabama	Z-1 Landfill	Rockets were disposed of by sea dump. No disposal activities at Z-1 landfill.
Pueblo Depot Activity, Colorado	Unknown - Lightning strike of munitions storage area.	No supporting documentation for presence of chemical munitions .
Pueblo Depot Activity, Colorado	Building 299	No supporting documentation for presence of chemical munitions.
Redstone Arsenal, Alabama	Large Quarry	No supporting documentation for presence of chemical munitions.
Redstone Arsenal, Alabama	Suspected World War II Staging Area	No supporting documentation for presence of chemical munitions.
Pine Bluff Arsenal, Arkansas	Site 12A	This is not a site but a clarification that Site 12A is included in Site 12.
Fort Gillem, Georgia	Unspecific	Duplicate of other Fort Gillem site.
Schofield Army Barracks, Hawaii	Ammunition Storage	Storage of ammunition does not meet the screening criteria.
Hawthorne Army Ammunition Plant, Nevada	HWAAP-A4 Babbitt Landfill	No supporting documentation for presence of chemical munitions.
Charleston Army Depot, South Carolina	Wet Basin moved to Charleston Naval Weapons Station, South Annex	Most of Charleston Army Depot is now part of the Charleston Naval Weapons Station, South Annex. Documentation indicates that the potential buried CWM site (Wet Basin) listed is located on the South Annex.
Water Island, U.S. Virgin Islands	Area 4	Duplicate site.

The following sites have had the classification updated to reflect current status of the sites:

Location	Site	Classification Change	Comments
Fort McClellan, Alabama	Range I	4 to 5	Site investigation report completed.
Fort McClellan, Alabama	Building 3183	3 to 5	Site investigation report completed.
Fort McClellan, Alabama	DEI	4 to 5	Site investigation report completed.
Fort McClellan, Alabama	T-31	4 to 5	Site investigation report completed.
Fort McClellan, Alabama	T-24A	4 to 3	Further information found.
Redstone Arsenal, Alabama	Former Mustard Gas Demil Site BB	3 to 2	Strong evidence of chemical munitions disposal efforts in support documentation.
Chichagof Harbor, Alaska	Gas Yard	2 to 4	No land disposal activities referenced in support documentation.
Fort Wainwright, Alaska	Unknown	1 to 5	Completed site investigation. No further CWM was found.
Pueblo Depot Activity, Colorado	SWMU 2	3 to 5	Further investigation indicates past references were erroneous.
American University, District of Columbia	52nd Court	1 to 5	Completed site investigation.
American University, District of Columbia	Camp American University	2 to 5	Comprehensive investigation of this site by USACE revealed no CWM.
Bushnell Army Airfield, Florida	Withlacoochee Forest	4 to 5	Completed archival search.
Fort Pierce, Florida	Unknown	2 to 5	Completed archival search.
Targhee National Forest, Idaho	Pond's Lodge	4 to 5	Archival search report recommends no further action.
Camp Atterbury, Indiana	H-1	3 to 4	Further information indicates past references were erroneous.
Naval Surface Warfare	Southeast Quarter	4 to 3	Further information found

Location	Site	Classification Change	Comments
Center, Crane Division, Indiana			indicates that more chemical materiel may exist.
Barksdale Air Force Base, Louisiana	Unknown	4 to 5	Completed review.
Concord Spur, Louisiana	Sea	4 to 5	Support documentation indicates that the CWM was removed from Concord Spur.
Mississippi River, Louisiana	River	2 to 5	Support documentation indicates no further action is to be taken.
Aberdeen Proving Ground-Edgewood Area, Maryland	Other Edgewood Study Areas (Maxwell Field in 1993 S&A)	2 to 1	CWM recovered.
Camp Shelby, Mississippi	Unknown	2 to 5	Completed review.
Nebraska Ordnance Plant, Nebraska	Landfill	2 to 5	USACE recommends no further action based on groundwater analysis.
Delaware Ordnance Works, New Jersey	Unknown	4 to 5	Bombs were decontaminated according to support documentation.
Raritan Arsenal, New Jersey	Area 5	1 to 5	Completed site investigation.
Defense Distribution Region East, Pennsylvania	Unknown	4 to 5	Remedial investigation/feasibility study was conducted and no evidence of chemical agents was found.
Black Hills Ordnance Depot, South Dakota	Chemical Warfare Area	2 to 4	Further information found.
Black Hills Ordnance Depot, South Dakota	Burning Ground #2	4 to 2	Further information found.
Fort Hood, Texas	Unknown	4 to 5	Site investigation conducted.
Defense Depot Ogden, Utah	Site 3	1 to 5	Completed site investigation.
Defense Depot Ogden, Utah	K-941 Area	1 to 5	Completed site investigation.

The following potential buried CWM locations and sites have been added to the database, since the 1993 report, because of new information gathered:

State	Component	Location	Site
Alaska	Army	Fort Richardson	Poleline Road Disposal Area
Arizona	Army	Yuma Proving Ground	The Western Environmental Test Area
Arkansas	Army	Pine Bluff Arsenal	Bombing Mat Vicinity
Arkansas	FUDS	Southwestern Proving Ground	Unknown
Florida	FUDS	Lakeland Army Air Field	Area #2
Illinois	Army	Fort Sheridan	Impact Area
Iowa	FUDS	Camp Dodge & Polk County National Guard Range	Unknown
Kentucky	Army	Fort Knox	Chemical Warfare Training Field
Maryland	Army	Aberdeen Proving Ground-Edgewood Area	Canal Creek Study Area
Massachusetts	FUDS	Fort Devens	South Post
Michigan	FUDS	Chemical Warfare Development Division	Dow Chemical Company Centralized Disposal Pits
Mississippi	FUDS	Camp Van Dorn	Detonation Pits
Mississippi	FUDS	Jackson	Mississippi State Fairgrounds
Missouri	FUDS	Camp Crowder	Unknown
New York	FUDS	Camp Hero	Unknown
South Carolina	Navy	Charleston Naval Weapons Station, South Annex	Unknown
Ohio	FUDS	Cleveland Plant	Mustard Burial Site
Texas	Army	Camp Bullis	Landfill Site #8
Texas	FUDS	Camp Barkeley	Area Marked with Four Gas Danger Signs
Wyoming	Air Force	F.E. Warren Air Force Base	Unknown

APPENDIX FORMAT

The remainder of this appendix consists of three major components, listed by state: (1) narrative descriptions of the locations and preliminary evaluation of risk, (2) a map depicting the location of the sites, and (3) the database listing of each site and its characteristics.

Table 1. List of Potential Buried CWM Locations and Sites
That May Require Remediation (Continued)

Table 1. List of Potential Buried CWM Locations and Sites
That May Require Remediation

State	Component	Location	Site
Alabama	Army	Fort McClellan	Area T-24A
			Area T-38
			Area T-5
			Area T-6
			Range J
			Range K
			Range L
			Water Hole
		Redstone Arsenal	Area of Former Mustard Gas Demil Operations
			Chemical Training Facility EE
			Former Chemical Disposal Site M
			Former Chemical Storage Area AA
			Former Chemical Storage Area X
			Former Disposal Site O (RSA-62)
			Former Disposal Site P (RSA-61)
			Former Mustard Gas Demil Site BB
			Former Mustard Gas Storage Area Y
			Inactive Chemical Disposal Site H

Table 1. List of Potential Buried CWM Locations and Sites
That May Require Remediation (Continued)

State	Component	Location	Site
			Inactive Disposal Site N (RSA-52)
Alabama (Continued)	Army (Continued)	Redstone Arsenal (Continued)	Mustard Gas Demil Site and Disposal Trenches
			Old Bone Yard Site
			Toxic Area Z
			Toxic Chemical Area Y1
			WWII Lewisite Manufacturing Facility Site
	FUDS	Camp Sibert	Area 2
			Unknown
	Army	Gerstle River Test Site	Operation Cleanup Disposal Pits
			Blueberry Lake
			Unspecific
Alaska	FUDS	Cape Yakak Radio Station	Storage
		Gerstle River Expansion Area	Expansion Area
		Chichagof Harbor	Gas Yard
		Unalaska Island	Water
			Not Specific
			Storage
		Yuma Proving Ground	The Western Environmental Test Area[c]
Arizona	Army	Camp Navajo	AREE-3 (Chemical Canyon)
Arkansas	Army	Fort Chaffee	Dug Well

Table 1. List of Potential Buried CWM Locations and Sites That May Require Remediation (Continued)

State	Component	Location	Site
		Pine Bluff Arsenal	Bombing Mat Vicinity[c]
	FUDS	Southwestern Proving Ground[b]	Unknown[c]
California	Army	Fort Ord	Unknown
	FUDS	Santa Rosa Army Air Field	Unknown
	Air Force	Edwards Air Force Base	Ranges
Colorado	Army	Pueblo Depot Activity	SWMU 13
			SWMU 12
			AREEs 17, 18, 19, and 20
		Rocky Mountain Arsenal	GB Pits
			Section 30 Disposal Area
			Section 31
			Basin A
			Section 30 Range
			Withlacoochee Area 2-4
		Withlacoochee	Zephyrhills Gunnery Range
Florida	FUDS	Brooksville Army Air Field	Unspecific
	Air Force	MacDill Air Force Base	Old Strategic Air Command
Georgia	Army	Fort Benning	Harmony Church
		Fort Gillem	Unknown
Hawaii	Army	Schofield Army Barracks	Unknown
			Unknown

Table 1. List of Potential Buried CWM Locations and Sites That May Require Remediation (Continued)

State	Component	Location	Site
		Kipapa Ammunition Storage	Kipapa Gulch
Illinois	Army	Savanna Army Depot Activity	Area 14
			Area 8
			Area 9
			Fire Pits
		Fort Sheridan[b]	Impact Area[c]
Indiana	Army	Camp Atterbury	H-1
	Navy	Naval Surface Warfare Center, Crane Division	Southeast Quarter
	Army	Newport Chemical Activity	Chemical Plant
Iowa[a]	FUDS	Camp Dodge & Polk County National Guard Target Range[b]	Unknown[c]
Kentucky	Army	Blue Grass Army Depot	Demilitarization Grounds
			Trench
		Fort Knox[b]	Chemical Warfare Training Field[c]
Louisiana	Air Force	England Air Force Base	SWMU #53
	FUDS	Camp Claiborne	Unknown
	Army	Fort Polk	Range 23-A
Maryland	Army	Aberdeen Proving Ground-Edgewood Area	Carroll's Island
			Graces Quarters Study Area
			King's Creek
			Lauderick Creek Study Area - School Fields

Table 1. List of Potential Buried CWM Locations and Sites That May Require Remediation (Continued)

State	Component	Location	Site
			Other Edgewood Study Areas
			New O Field
			Old O Field
			Carroll Island Study Area
			Graces Quarters Study Area
			J Field Study Area
			Canal Creek Study Area[c]
			Westwood Study Area
		Fort Meade	Unknown
Massachusetts[a]	FUDS	Fort Devens[b]	South Post[c]
Michigan[a]	FUDS	Chemical Warfare Development Division[b]	Dow Chemical Company Centralized Disposal Pits[c]
Mississippi	Air Force	Columbus Army Airfield	Unknown
	FUDS	Camp Van Dorn[b]	Detonation Pits[c]
Missouri[a]	FUDS	Camp Crowder[b]	Unknown[c]
Nevada	Army	Hawthorne Army Depot	HWAD-5
			HWAD-A11
			HWAD-A6e
New Jersey	FUDS	Fort Hancock	Beach
	Navy	Naval Air Warfare Center, Aircraft Division, Lakehurst	Proving Ground
			Airstrip
New Mexico	Army	Fort Wingate Depot Activity	Storage
New York	FUDS	Camp Hero[b]	Unknown[c]

Table 1. List of Potential Buried CWM Locations and Sites
That May Require Remediation (Continued)

State	Component	Location	Site
North Carolina	FUDS	Laurinburg-Maxton Army Air Base	Landfill
	Navy	Marine Corps Base, Camp Lejeune	Rifle Range Chemical Dump
Ohio	Army	Ravenna Army Ammunition Plant	Site 28
	FUDS	Cleveland Plant[b]	Mustard Burial Site[c]
Oregon	Army	Umatilla Depot Activity	Northwest Corner
	Navy	Charleston Naval Weapons Station, South Annex	Unknown
South Carolina	FUDS		Wet Boat Basin
South Dakota	FUDS	Black Hills Ordnance Depot	Burning Ground 1
			Burning Ground 2
			Chemical Warfare Area
			Unknown
Tennessee	DLA	Defense Depot Memphis	Dunn Ave.
			Dunn Field
Texas	Army		Area 3, 6 and 7
		Camp Bullis	Landfill Site #8[c]
		Camp Stanley Storage Activity	Unknown
Utah	Army	Dugway Proving Ground	Area 19
			Base Pond
			Disposal Area
			Drainfield
			East Carr Old Range
			East Carr
			Landfill

Table 1. List of Potential Buried CWM Locations and Sites
That May Require Remediation (Continued)

State	Component	Location	Site
Utah (Continued)	Army (Continued)	Dugway Proving Ground (Continued)	North Camel Back Ridge
			Rocket Pit
			South Tower Grid
			Target Q
			Test Area Test Site
			Unknown
			Unknown
			Unknown V-Grid
			Waste Pit
			Area 15
			Area 16
			Area 17
			Area 18
			Area 5
			Area 6
			Area 8
			Area 9
			Impact Area
			Old Range
			Range 1
			Range 2
			Range 3
			Range 4
			Target Q
			Test Area

Table 1. List of Potential Buried CWM Locations and Sites
That May Require Remediation (Continued)

State	Component	Location	Site
	FUDS	Dugway Proving Ground (areas known as the Southern Triangle and Skull Valley)	Test Area 1
			Unknown
Utah (Continued)			Yellow Jacket Area
			Skull Valley
			Area 2
	Army	Tooele Army Depot	Disposal
			Drain Pond
			Gravel Pit
			Mortar Pit
			Pit
	FUDS	Wendover Bombing and Gunnery Range	Western Utah
Virgin Islands	FUDS	Water Island	Flamingo
			Water Island, Adj to Test Area 8
			Area 4
			Area 5
			Area 6
			Area 8

Notes:

[a] New states added to the second edition of the Survey and Analysis Report.
[b] New locations added to the second edition of the Survey and Analysis Report.
[c] New sites added to the second edition of the Survey and Analysis Report.

Table 2. List of Buried CWM Locations and Sites that the DoD has Determined No Further Activity is Warranted

State	Component	Location	Site
Alabama	Army	Fort McClellan	Building 3183
			DEI
			Range I
			T-31
	FUDS	Theodore Naval Ammunition Magazine	Railroad Section
			Dock Area
Alaska	Army	Fort Richardson[2]	Poleline Road Disposal Area[3]
	Army	Fort Wainwright	Unknown
Arkansas	Army	Pine Bluff Arsenal	SWMUs 18, 23, 24, 29, and 75
			Site 12, SWMU 10
			Site 7b, SWMU 19
			Site 7c, SWMU 21
			Site 7d, SWMU 20
			Triplett Creek
			All Areas
			Mortar Range
			Unknown
California	FUDS	Mount Shasta	Unknown
Colorado	Army	Pueblo Depot Activity	SWMU 2
District of Columbia	FUDS	American University	52nd Court
			Camp American University

State	Component	Location	Site
Florida	FUDS	Bushnell Army Air Field	Withlacoochee Forest
		Chassahowitzka Swamp	Auxiliary Area
		Drew Field	Restricted
		Dry Tortugas Keys	Unknown
		Fort Pierce	Unknown
		Lakeland Army Air Field[b]	Area #2[c]
Georgia	FUDS	Manchester	Railroad Section
Hawaii	FUDS	Waiakea Forest Reserve	Forest
Idaho	FUDS	Targhee National Forest	Pond's Lodge
Kansas	FUDS	Marysville	At Current Mile Post 151
Louisiana	FUDS	Mississippi River	River
		Concord Spur	Sea
	Air Force	Barksdale Air Force Base	Unknown
Mississippi	Army	Camp Shelby	Unknown
	FUDS	Horn Island	Area 27
			Unknown
			Danger Area
		Jackson[b]	Mississippi State Fairgrounds[c]
Nebraska	FUDS	Nebraska Ordnance Plant	Landfill
New Jersey	Army	Raritan Arsenal	Area 5
		Delaware Ordnance Works	Unknown

State	Component	Location	Site
New York	FUDS	Mitchell Field	Unknown
Pennsylvania	DLA	Defense Distribution Region East	Unknown
Texas	FUDS	San Janinto Ordnance Depot	Unknown
	Army	Fort Hood	Unknown
	FUDS	Camp Barkeley[b]	Area marked with four "GAS-DANGER" signs[c]
Utah	DLA	Defense Depot Ogden	Magazine
			Site 3
			K-941 Area
Virginia	Army	Fort Belvoir	Unknown
Washington	Navy	Submarine Base Bangor	Unknown
Wyoming[a]	Air Force	F.E. Warren Air Force Base[b]	Unknown[c]
U.S. Virgin Islands	FUDS	Water Island	Water Island
			Area 7

Notes:

[a] New states added to the second edition of the Survey and Analysis Report.
[b] New locations added to the second edition of the Survey and Analysis Report.
[c] New sites added to the second edition of the Survey and Analysis Report.

Table 3. Number of Potential Buried CWM Sites by State and Classification

State	Class 1	Class 2	Class 3	Class 4	Class 5	Total
AL	1	6	14	5	6	32
AK	1	2	2	2	3	10
AZ	1	2	1	None	None	4
AR	None	None	1	2	9	12
CA	2	None	None	1	1	4
CO	2	4	1	1	1	9
DC	None	None	None	None	2	2
FL	None	4	None	None	6	10
GA	None	2	None	None	1	3
HI	None	1	None	2	1	4
ID	None	None	None	None	1	1
IL	None	1	4	None	None	5
IN	None	None	2	1	None	3
IA	None	None	1	None	None	1
KS	None	None	None	None	1	1
KY	None	None	2	1	None	3
LA	None	1	2	None	3	6
MA	1	None	None	None	None	1
MD	8	3	2	None	None	13
MI	None	1	None	None	None	1
MS	None	1	None	1	5	7
MO	None	None	None	1	None	1
NE	None	None	None	None	1	1
NV	None	1	2	None	None	3
NJ	None	3	None	None	2	5
NM	None	None	None	1	None	1
NY	None	None	None	1	1	2
NC	None	1	1	None	None	2
OH	None	1	1	None	None	2
OR	None	None	None	1	None	1
PA	None	None	None	None	1	1

State	Class 1	Class 2	Class 3	Class 4	Class 5	Total
SC	None	None	None	2	None	2
SD	None	3	None	1	None	4
TN	None	None	None	2	None	2
TX	2	1	None	None	3	6
UT	4	27	9	5	3	48
VA	None	None	None	None	1	1
WA	None	None	None	None	1	1
WY	None	None	None	None	1	1
VI	None	1	3	2	2	8
Totals:	22	66	48	32	56	224

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ALABAMA

NAME OF LOCATION: Fort McClellan

Port McClellan (FTMC) consists of three main bodies of Government-owned and leased land in the foothills of the Appalachian Mountains in northeastern Alabama. They are the Main Post, Pelham Range, and the Choccolocco Corridor. The combined total land area is 45,715 acres located 84 miles west of Atlanta and 99 miles north of Montgomery. Anniston, Alabama, a major municipality, adjoins the main installation on the south and west.

The area known today as FTMC first attracted interest among military circles when the Fourth Alabama Artillery discovered, at the time of the Spanish-American War in 1898, that the Choccolocco Mountains formed an excellent background for firing artillery projectiles. From 1912 to 1916, Federal officials from Washington were sent to Anniston to study the possibility of locating an Army camp in this area.

In 1917, the Federal Government purchased 18,952 acres near Anniston for use as an artillery range. With the outbreak of World War I, it was decided to use the property as a training camp, and it was subsequently named Camp McClellan in honor of Major General George B. McClellan.

In 1917, Camp McClellan was used to train troops for World War I and served in that capacity until the armistice. It was then designated as a demobilization center. Between 1919 and 1929, it served as a training area for active Army units and other civilian elements. In July 1929, Camp McClellan was redesignated as FTMC and continues to serve as a training area to the present day.

In October 1940, the Government acquired another 22,168 acres due west of FTMC. This tract of land was named Pelham Range in honor of Major John Pelham. In 1941, 4,160 acres were leased to the Federal Government by the Alabama State Legislature to provide an access corridor from the main post to Talladega National Park. This provided another 100,000 acres of woodland accessible for training.

From August 1945 until August 1946, FTMC served as a separation point. After a 3-month closing period, it was reactivated as a Recruit Training Center until May 1947. It ceased operations and was placed on inactive status until 1951.

On January 4, 1951, the Army reactivated FTMC on an unlimited basis for operation of the Chemical Corps School and as a replacement center for the Chemical Corps. The Chemical Corps School offered advanced training in all phases of chemical, biological, and radiological warfare to students from all branches of the military service until it was deactivated in 1973.

In 1966, the mission of the installation was changed and the fort was renamed US. Army School/Training Center and Fort McClellan. In July 1975, the U.S. Army Military Police School was moved from Fort Gordon, Georgia, to FTMC.

Two major areas at FTMC involved the use of agents: (1) the Chemical Corps School and Replacement Center for the Chemical Corps, which was active from 1951 through 1973; and (2) the U.S. Army Combat Developments Command Chemical, Biological, Radiological Agency, which was active from 1962 through 1973.

No significant industrial or manufacturing operations occurred at FTMC. Potential chemical materiel that may exist is due primarily to training exercises conducted by the U.S. Army Chemical Center and School during the period of 1951 to 1973. The implementation of chemical education and training programs led to the establishment of a number of training ranges both on the Main Post and on Pelham Range to supplement classroom training facilities. Individual ranges were used at different times for varying periods during the residence of the Chemical School.

LOCALITY/STATE: Northeastern Alabama, in Calhoun County

SCOPE OF RESTORATION EFFORT: Field work for a remedial investigation/feasibility study (RI/FS) with support from the installation and other organizations began in April 1994. The RI/FS is studying 12 sites, 9 of which have potential chemical agent contamination. Most studies have combined investigations for chemical warfare agents, agent breakdown products, radiation, and organic and inorganic contaminants. No chemical warfare agents (CWAs), nor their breakdown products, have been detected to date. Four sites, the "Old Water Hole," 24A, Range K, and Range L ("Lima Pond"), have potential for buried chemical ordnance based upon sampling, geophysics, and historical records search. Some active and inactive artillery ranges are littered with unexploded ordnance (UXO). Potential for these UXOs to contain chemical agents is low, but this will be investigated before they are cleared from the areas.

EFFORT TO DATE: In a 1977 assessment of FTMC, a few fenced burial grounds and training areas were suspected of containing both radiological and chemical contamination despite field decontamination, therefore warranting further investigation. The report also concluded that no contamination had migrated offpost. A May 1983 US. Army Environmental Hygiene Agency report on groundwater quality at FTMC concluded groundwater and soil contamination could still be present at FTMC. A January 1984 reassessment of the original records identified several areas as potentially contaminated with CWAs. Most of these training areas were considered clean and available for surface activities. An enhanced preliminary assessment in December 1990 identified 67 potential sites, 17 of which had the possibility for CWAs and/or agent breakdown product contamination. The 1992/1993 site investigation (SI) studied 17 sites. Eleven of these were screened for CWAs and then analyzed for agent breakdown products; none were found. Nine sites with possible chemical agent contamination, along with three old landfills, were identified for further study during the current RI/FS. Field work was completed in July 1995.

REMEDIATION SCHEDULE: If required, remediation will be accomplished during the remedial action (RA) in the work plan.

RISK PERCEPTION: Sites potentially contaminated with chemical agents are being systematically investigated and are not believed to pose a threat to public health.

NAME OF LOCATION: **Redstone Arsenal (including the former Huntsville Arsenal and Gulf Chemical Warfare Depot)**

Redstone Arsenal (RSA) is located in southwestern Madison County, Alabama, approximately 100 miles from the cities of Birmingham, Alabama, Chattanooga and Nashville, Tennessee. The Tennessee River serves as the southern boundary of the installation. The installation is bound on the east/northeast by the city of Huntsville. It encompasses an area of 38,300 acres that is roughly a rectangle 6 miles wide and 10 miles long. This area includes areas formerly known as Huntsville Arsenal and the Gulf Chemical Depot.

On July 2, 1941, the preliminary plan was presented for the acquisition of 32,244 acres for the construction of Huntsville Arsenal. A southern portion of this land was used to build the Gulf Chemical Depot. The depot's original mission included receipt, storage, and shipment of Chemical Warfare Service (CWS) munitions, bulk chemicals, decontaminating apparatuses, and protective material. By the end of World War II, the depot became a focal point for the return of munitions from overseas.

In 1945-46, the depot was also responsible for the segregation and classification of all ammunition and decontamination and disposal of foreign "war gases." On January 15, 1947, the functions of Gulf Chemical Depot were transferred to Huntsville Arsenal. Redstone Ordnance Plant (now known as Redstone Arsenal) was built on 4,000 acres of land on the southeastern project area. This plant was responsible for the assembly of chemical munitions and loading and assembling all bursters for chemical projectiles and bombs. The Huntsville Arsenal mission included the production of chemical agents, smoke, and incendiary materiel, which were used to fill projectiles, grenades, smoke pots, and bombs.

After World War II, the activities of both arsenals were decreased and each arsenal was put on stand-by status in February 1947. In 1947, Huntsville Arsenal was declared surplus and placed under caretaker status under RSA. RSA was reactivated on June 1, 1949, for research and development of rocket systems, a mission which it retains to the present day.

Mustard, lewisite, Phosgene, and chlorine were manufactured at RSA and stored at the Gulf Chemical Depot. Tons of munitions containing chemical agents were shipped, stored, demilitarized, and processed through RSA. The Installation Assessment conducted in 1977 states that contamination in the plant areas was a result of these operations.

The assessment cites an unknown historical document as follows:

> "Filling of M47A2 bombs began in October 1942, but assembly lines were not adequately designed for bomb filling, consequently serious contamination resulted."

Also, during filling operations of the Navy MK42 bomb in January 1943, the bombs tilted on the assembly line pallets and the bomb screw closures leaked.

Demilitarization programs were started in the late 1940s. Historical records indicate that over one million rounds were disposed of within a 6-month period. Clean-up operations were conducted by the U.S. Army Technical Service Unit (TSU) [predecessor to today's Technical Escort Unit (TEU)] from May 1947 to August 1947 and from January 1948 to March 1949.

Historical records indicate that the areas used to dispose of these munitions include Area 2 and burning pits in three areas and the training area. Other areas, namely the HD (distilled mustard) Burial Site, the Lewisite Waste Lagoon, and Toxic Area 4, were mentioned but not in great detail.

LOCALITY/STATE: Huntsville (Madison County), Alabama

CHEMICAL MATERIEL ACTIVITIES AT THIS LOCATION: Historical records give a good account of the activities conducted on the site. This includes the identification of areas where chemical warfare materiel (CWM) was disposed. RSA has identified approximately 25 sites where CWM was manufactured, stored, demilitarized, or destroyed.

EFFORT TO DATE: The U.S. Army Corps of Engineers (USACE), on behalf of U.S. Army Missile Command, is conducting extensive hazardous, toxic, and radiological waste (HTRW) studies at RSA. Huntsville Division, the Corps' Center of Expertise for CWM, and the Savannah District, USACE, is supporting the HTRW mission. Interim remedial actions, designed to prevent contamination migration from waste disposal lagoons used in the manufacturing of lewisite, are currently underway at two sites. Investigations of 4 manufacturing, 6 storage, and 11 suspected demilitarization/disposal areas of CWM are ongoing in FY96.

REMEDIATION SCHEDULE: As part of the HTRW investigation program, all known or suspected sites will be investigated. Further investigation and the initiation of feasibility studies at some of these 21 sites will be done in FY96. All work is being done in accordance with the installation action plan for RSA. Further CWM remediation will be conducted when appropriate.

RISK PERCEPTION: RSA is a controlled access facility. Unless disturbed by excavation, no threat to human health and safety is anticipated. All known CWM sites that are considered to be a threat to personnel have been identified with fences and signs. The installation has also identified these sites as "No Build" areas.

NAME OF LOCATION: **Camp Sibert**

Camp Sibert, established in Alabama's Etowah and St. Clair counties in 1942, was a replacement training center for the CWS. Training included such tasks as smoke screening, chemical decontamination, chemical depot maintenance, and chemical impregnation work. During exercises, fuming sulfuric acid (FS) (a solution of sulfur trioxide dissolved in chlorosulfonic acid) was dropped on troops from airplanes to simulate aerial mustard attacks.

Camp Sibert was equipped with a Field Filling Area (spray tanks with FS), a Toxic Gas Handling Area, a Toxic Gas Yard, and decontamination operations areas that supported decontamination training in which chemical agents were used. Training at Camp Sibert ended and the camp was closed in April 1945.

In July 1947, the Technical Escort Detachment conducted a survey of Camp Sibert. Toxic gas areas were located and subsequently decontaminated in accordance with the standards of the time.

LOCALITY/STATE: Etowah and St. Clair counties of Alabama

FUDS ACTIVITIES AT THIS LOCATION: There is one major area where chemical warfare materiel (CWM) was buried when Camp Sibert closed. This site, designated as Area 2, was used to bury and decontaminate discarded chemical agents and chemical ordnance. In 1948, the Army decontaminated chemical agents in pits and removed buried ordnance for offsite disposal. Chemical agents were decontaminated in situ (in-place) and resultant materials were reburied. Recently, U.S. Army Corps of Engineers (USACE) found the suspected location of the burial pits. The possibility exists that some ordnance may still be buried at the site.

PREVIOUS CORPS ACTIVITIES: USACE completed a preliminary assessment of this site in July 1986. In 1989, USACE performed a records review and site visit to identify potentially contaminated sites. A confirmation study of potential contamination and an inventory project report are currently being finalized.

Soil samples were collected at the mustard gas burial pit. The samples did not indicate the presence of mustard gas, lewisite, or their breakdown byproducts, though they did contain low levels of chlorinated solvents. Samples from a residential well located near the burial pits and at the personnel decontamination and chemical agent "gas filling" yard were analyzed and did not indicate the presence of mustard gas, lewisite, or their breakdown products.

USACE completed an Archive Search Report (ASR) for CWM in July 1993. The report recommended further investigation of 10 areas with potential CWM. Two site surveys of the former Camp Sibert were accomplished by USACE in May and July 1993. Remains of a 4.2-inch mortar round were found during the July site survey.

ACTIONS COMPLETED/PLANNED FOR THE FUTURE: Huntsville Division, USACE's Mandatory Center of Expertise for Ordnance and Explosive Waste (OEW), has completed Phases 1 and 2 of an Engineering Evaluation/Cost Analysis (EE/CA). These included geophysical mapping of anomalies in areas designated "suspected of being contaminated" through the ASR. Additionally, areas suspected of being contaminated with conventional OEW were only sampled to identify some of the anomalies. Evidence of conventional OEW was confirmed in the sample areas. The Report of Investigation of the results of these samplings and of the geophysical mapping are being prepared by the contractor.

The next step is to do soil and groundwater sampling near the anomalies identified as potential chemical contamination to ensure that no contaminate plume is migrating offsite. The area of Former Camp Sibert is rural but is continually being used for the construction of new homes.

RISK PERCEPTION: Based on studies, several of the areas of former Camp Sibert present a potential for the existence of CWM. Additional work is planned to determine if risks do indeed exist and, if so, to remove those risks.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: The areas which may contain CWM do not present an immediate danger to public health and safety as long as no intrusive activities (drilling and excavation) take place. Normal use does not present an immediate danger.

NAME OF LOCATION: **Theodore Naval Ammunition Magazine**

Theodore Naval Ammunition Magazine is located in Theodore, Alabama, 5 miles south of Mobile. Here the Navy unloaded the "SS Francis L. Lee," which transported German toxic-filled munitions after World War II (WWII). By the time it reached Theodore, the cargo had severely deteriorated. Dunnage was shattered and munitions were leaking. Because of these circumstances, the Guard and Security Unit [now known as the Technical Escort Unit (TEU)] from Edgewood, Maryland, unloaded and stored the shipment, pending rail transport to the Gulf Chemical Warfare Depot at Huntsville, Alabama, the Eastern Depot at Edgewood, Maryland, and the Midwest Depot at Pine Bluff Arsenal (PBA), Arkansas.

LOCALITY/STATE: Theodore, Alabama

FUDS ACTIVITIES AT THIS LOCATION: Theodore Naval Ammunition Magazine (Theodore Ammunition Terminal) was first occupied by the Army in 1942. During WWII and the Korean Conflict, the Army and Navy used the facility for receiving, storing, and shipping ammunition. The site was deactivated in 1964.

An incident occurred during a rail shipment from Theodore Naval Ammunition Magazine to PBA. A leaking bomb was discovered during a routine inspection of a rail car at Ponola, Alabama. The bomb was unloaded and the rail car returned to Theodore, Alabama. Although the disposition of the bomb is unknown, there is no evidence of a burial site within the boundary of the Theodore Naval Ammunition Magazine.

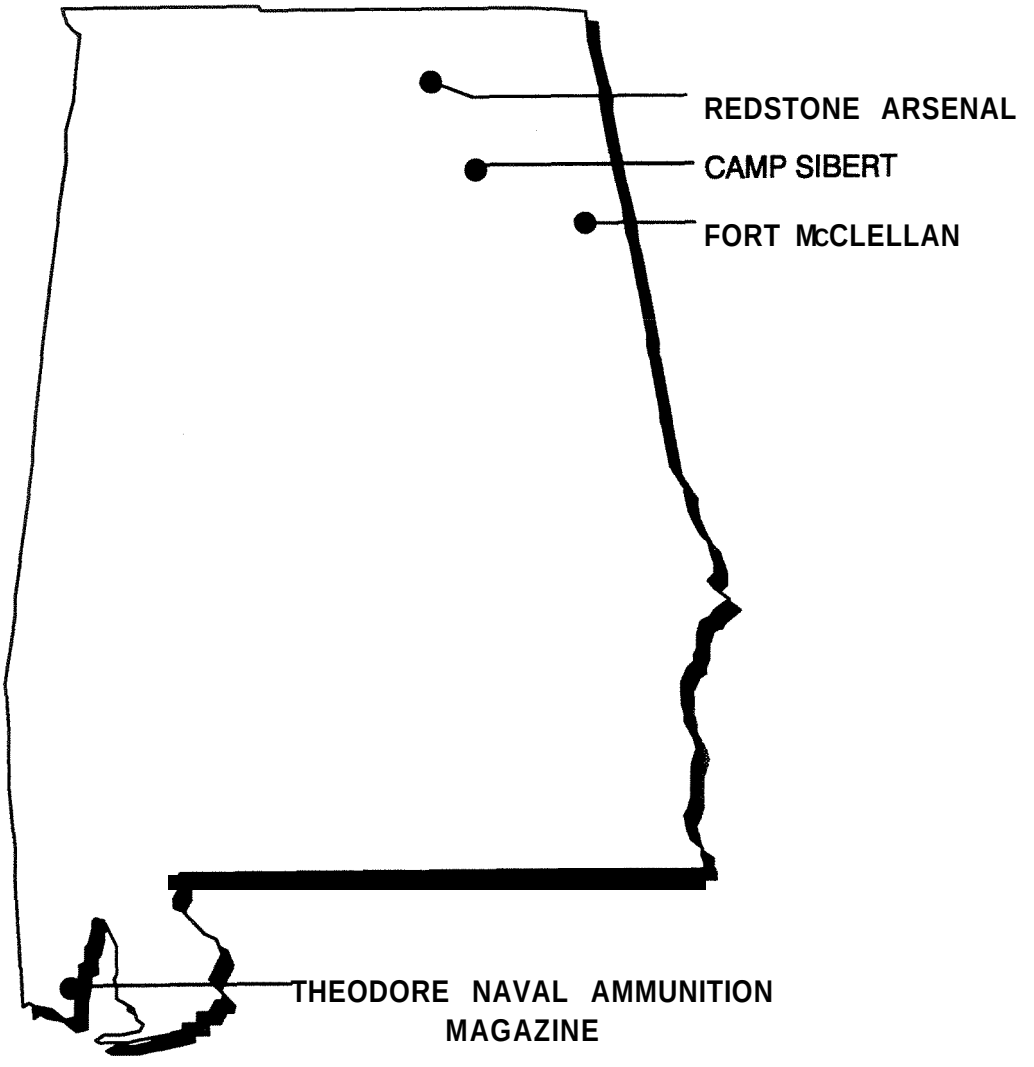
PREVIOUS CORPS ACTIVITIES: USACE personnel completed a preliminary assessment of this site in January 1988 and concluded there was no evidence of any ordnance remaining onsite. At the time, however, the investigators were unaware of the information recently found from the historical survey. In August 1993, during preparation of the Archive Search Report, a site survey of the Theodore Naval Ammunition Magazine was made. No evidence of CWM was found.

ACTIONS PLANNED FOR THE FUTURE: An archive search for this site has been finished and recommends no further action.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: The site is now part of a large commercial, industrial, and transportation complex known as Theodore Industrial Park. Though significant intrusive activities have occurred since the site was surplused by the General Services Administration (GSA) in 1964, no ordnance problems have been reported. It is anticipated that intrusive activities will continue in the future.

RISK PERCEPTION: This area is not believed to present any threat to human health and safety.

ALABAMA


REDSTONE ARSENAL
CAMP SIBERT
FORT McCLELLAN
THEODORE NAVAL AMMUNITION MAGAZINE

LOCATION	Fort McClellan
LOCALITY	Anniston
STATE	AL
SITE	Area T-24A
DESCRIPTION	Explosive Ordnance Disposal area. Chemical munitions training area. Two burning pits used to decontaminate chemical weapons were filled. The site is fenced. Agents used: choking agent (CG), incapacitating agent (BZ), nerve agent (GB), and mustard. Timeframe: ?-1973.
SIZE	1.5 acres
CONTENTS	Unknown
COMMENTS	Also characterized as Area FTMC-33. April and July 1973 soil analyses for agents in question were negative. No subsurface analyses done. During 1992 site investigation fieldwork, soil samples were taken from two high probability locations and screened for chemical warfare agents by the U.S. Army Technical Escort Unit using MINICAMS®. The samples were then analyzed for chemical warfare agent breakdown products. Nothing was detected. Fieldwork conducted during 1994 included trenching that found fuel-contaminated soil, mainly containing lead and semi-volatile organic compounds. Potential groundwater contamination at site. Scrap munitions were also found, but were probably filled with water, based on a portable isotopic neutron spectroscopy evaluation conducted by the Program Manager for Chemical Demilitarization in June 1994. Site will be extensively assessed using several geophysical methods during current remedial investigation/feasibility study.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Fort McClellan
LOCALITY	Anniston
STATE	AL
SITE	Area T-38
DESCRIPTION	U.S. Army Technical Escort Unit reaction area used for chemical agent training. Used to store chemical agents and munitions containing nerve agents (GB, VX) and mustard. Timeframe: 1961-1972.
SIZE	6 acres
CONTENTS	Unknown
COMMENTS	Also characterized as area FTMC-32. In January 1973, surface contamination found. In March 1973, no surface contamination. During 1992 site investigation fieldwork, soil samples were taken from four high probability locations and screened for chemical warfare agents by the U.S. Army Technical Escort Unit using MINICAMS®. The samples were then analyzed for chemical warfare agent breakdown products. Nothing was detected. Fieldwork included installation of four monitoring wells, geophysics, and soil borings, and was completed in July 1995.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Fort McClellan
LOCALITY	Anniston
STATE	AL
SITE	Area T-5
DESCRIPTION	Located between Sunset Hill and Howitzer Hill on southern perimeter of main post. Used during 1961-73 for training detection and decontamination of mustard and nerve agent (VX). Site of 110-gallon mustard spill.
SIZE	11.4 acres
CONTENTS	Unknown. Surface samples in December 1972, and April and July 1973 showed no contamination.
COMMENTS	Also characterized as Area FTMC-29. Mustard spill was decontaminated and soil was disposed of on Range J. During 1992 site investigation fieldwork, soil samples were taken from five high probability locations and screened for chemical warfare agents by the U.S. Army Technical Escort Unit using MINICAMS®. The samples were then analyzed for chemical warfare agent breakdown products. Nothing was detected. Observed training ordnance will have to be cleared prior to site clearance.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Fort McClellan
LOCALITY	Anniston
STATE	AL
SITE	Area T-6
DESCRIPTION	Agent decontamination area (Naylor Field). Lies near the base of the east slope of Howitzer Hill. Active:? - 1973. Training quantities of mustard were used.
SIZE	7.5 acres
CONTENTS	Unknown
COMMENTS	Also characterized as Area FTMC-30. Analyses of random soil samples in 1973 showed no contamination. Fieldwork conducted in 1992 included screening samples for chemical warfare agents by the U.S. Army Technical Escort Unit using MINICAMS®, then analysis for chemical warfare agent breakdown products. Nothing was detected. It was recommended in the 1993 site investigation report that no further action was warranted for this site at the present time. Observed debris and training ordnance will have to be cleared prior to site release.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Fort McClellan
LOCALITY	Anniston
STATE	AL
SITE	Building 3183
DESCRIPTION	Old toxic training area. Area behind Building 3183, main post. Used for training in the detection and identification of mustard and possibly other agents. Timeframe: Early 1950s to ?
SIZE	1000 square feet
CONTENTS	Unknown
COMMENTS	Also characterized as Area FTMC-34. No spills at site. Limited quantities of agents used. During 1992 site investigation fieldwork, soil samples were taken from two high probability locations and screened for chemical warfare agents by the U.S. Army Technical Escort Unit using MINICAMS®. The samples were then analyzed for chemical warfare agent breakdown products. Nothing was detected. It was recommended in the 1993 site investigation report that no further investigation was warranted for this site.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

LOCATION	Fort McClellan
LOCALITY	Anniston
STATE	AL
SITE	DEI
DESCRIPTION	Detection and identification area. Used for nerve (GB), blood (CK, AC), and choking (CG, CX) agents training. Navy may have used mustard in late 1950s. Date closed: 1972.
SIZE	1.1 acres
CONTENTS	All training aids and the building from area T-4.
COMMENTS	Also characterized as Area FTMC-25. Training aids and building debris were burned twice and buried in pit. During 1992 site investigation fieldwork, soil samples were taken from two high probability locations and screened by the U.S. Army Technical Escort Unit using MINICAMS®. The samples were then analyzed for chemical warfare agent breakdown products. Nothing was detected. The 1993 site investigation report recommended that no further investigation was warranted for this site at the present time.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

LOCATION	Fort McClellan
LOCALITY	Anniston
STATE	AL
SITE	Range I
DESCRIPTION	Toxic agent shell tapping area 1963-1964. West Central portion of Pelham Range.
SIZE	0.5 acres
CONTENTS	May contain mustard.
COMMENTS	Also characterized as Area FTMC-26. During 1992 site investigation fieldwork, soil samples were taken from two high probability locations and screened for chemical warfare agents by the U.S. Army Technical Escort Unit using MINICAMS®. The samples were then analyzed for breakdown products. Nothing was detected. The 1993 site investigation report recommended that the site be removed from further investigation.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

LOCATION	Fort McClellan
LOCALITY	Anniston
STATE	AL
SITE	Range J
DESCRIPTION	Used for agent training and disposal of decontaminated mustard spill residue. Timeframe: ? - 1963.
SIZE	1 acre
CONTENTS	Unknown
COMMENTS	Also characterized as Area FTMC-36. Limited monitoring indicated no surface contamination. During 1992 site investigation fieldwork, soil samples were taken from four high probability locationsand screened for chemical warfare agents by U.S. Army Technical Escort Unit using MINICAMS®. The samples were than analyzed for chemical warfare agent breakdown products. Nothing was detected. Fieldwork for 1994/1 995 remedial investigation/feasibility study included geophysical work, screening soil samples for chemical warfare agents and analyzing for chemical warfare agent breakdown products, installing and sampling three monitoring wells. Fieldwork was completed in July 1995.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Fort McClellan
LOCALITY	Anniston
STATE	AL
SITE	Range K
DESCRIPTION	Chemical training area on Pelham Range. Unknown agents used and time of use are unknown. When site was bulldozed, rusted toxic agent signs found.
SIZE	2 acres
CONTENTS	Unknown
COMMENTS	Also characterized as Area FTMC-35. 1967, site was cleared. 1980, surface was monitored. No contamination found. During 1992 site investigation fieldwork, soil samples were taken from one high probability location and screened for chemical warfare agents by the U.S. Army Technical Escort Unit using MINICAMS®. The samples were then analyzed for chemical warfare agent breakdown products. Nothing was detected. Fieldwork for 1994 remedial investigation/feasibility study included geophysical evaluations, screening soil samples for chemical warfare agents using MINICAMS®, and analyzing for chemical warfare agent breakdown products. Fieldwork was completed in July 1995.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Fort McClellan
LOCALITY	Anniston
STATE	AL
SITE	Range L
DESCRIPTION	Lima Pond. Chemical munitions disposal site on Pelham Range. Surrounded by chain-link fence. Disposal site is a man-made bermed area.
SIZE	0.5 acres
CONTENTS	Captured World War II mustard munitions and chemical munitions in drums.
COMMENTS	Also characterized as Area FTMC-27. During 1992 site investigation fieldwork, no soil samples were collected, but qualitative geophysics conducted by the U.S. Army Technical Escort Unit detected buried metal. Remedial investigation/feasibility study fieldwork for 1995 included extensive geophysical characterization and soil, sediment, surface water, and groundwater sampling and analysis. Conduct intrusive confirmation of geophysical results in pond area; site regrading to fill pond; short term groundwater monitoring with subsequent well abandonment. Fieldwork was completed in July 1995.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Fort McClellan
LOCALITY	Anniston
STATE	AL
SITE	T-31
DESCRIPTION	U.S. Army Technical Escort Unit reaction area. Training with 20 ml and 40 ml quantities of nerve agent (GB) and mustard (HD) and storage of other unknown chemical agents. Timeframe: 1957-l 969. Used prior to area T-38.
SIZE	3.4 acres
CONTENTS	Unknown
COMMENTS	Also characterized as Area FTMC-31. Several spills from stored materials. Standard operating procedures required decontamination of spills. During 1992 site investigation fieldwork, soil samples were taken from five high probability locations and screened for chemical warfare agents by the U.S. Army Technical Escort Unit using MINICAMS®. The samples were then analyzed for chemical warfare agent breakdown products. Nothing was detected. The 1993 site investigation report recommended that no further investigation was warranted for this site.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

LOCATION	Fort McClellan
LOCALITY	Anniston
STATE	AL
SITE	Water Hole
DESCRIPTION	Old water hole on Pelham Range. Location, size, and time of suspect disposal operations are unknown. Site was not located during a contamination survey in 1986.
SIZE	Unknown
CONTENTS	Source cites this as a possible chemical munitions disposal area, but this is not confirmed.
COMMENTS	Also characterized as Area FTMC-37. The site was identified during 1992 fieldwork, when the U.S. Army Technical Escort Unit conducted qualitative magnetometer survey which indicated substantial quantities of buried materials. The fieldwork planned for remedial investigation/feasibility study was completed in 1995 which included extensive geophysics, installation and sampling of five monitoring wells; screening soil samples for chemical warfare agents, and analyzing for chemical warfare agent breakdown products. Conduct intrusive confirmation of geophysical results in pond area; site regrading to fill shallow depression; short term ground water monitoring with subsequent well abandonment.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Redstone Arsenal
LOCALITY	Huntsville
STATE	AL
SITE	Area of Former Mustard Gas Demil Operations
DESCRIPTION	This area is a suspected former mustard gas demilitarization site.
SIZE	2 to 5 acres
CONTENTS	Unknown
COMMENTS	None
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Redstone Arsenal
LOCALITY	Huntsville
STATE	AL
SITE	Chemical Training Facility EE
DESCRIPTION	This area was used for training troops using live agents, including mustard and nerve agents.
SIZE	One acre
CONTENTS	Residues from mustard and nerve agents (VX and GB).
COMMENTS	The training area consisted of two concrete pads, approximately 3 feet by 4 feet by 1 foot. This area is surrounded by a 450-meter-radius safety circle for containment and cleanup.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	4 - Possible burial

LOCATION	Redstone Arsenal
LOCALITY	Huntsville
STATE	AL
SITE	Former Chemical Disposal Site M
DESCRIPTION	This area was used for disposal of materials contaminated with mustard gas and lewisite. In the early 1950s, several 800-pound coffins filled with mustard gas shells were buried here in two to three trenches.
SIZE	7.5 acres
CONTENTS	Mustard gas shells in cement coffins.
COMMENTS	Groundwater sampling was conducted and concentrations of thiodiglycol were lower than the detection limit.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Redstone Arsenal
LOCALITY	Huntsville
STATE	AL
SITE	Former Chemical Storage Area AA
DESCRIPTION	Mustard gas was stored above ground in open drums at this site.
SIZE	30 acres
CONTENTS	Possible mustard gas in drums.
COMMENTS	It is not known if the drums were shipped offsite for disposal or demilitarized onsite.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Redstone Arsenal
LOCALITY	Huntsville
STATE	AL
SITE	Former Chemical Storage Area X
DESCRIPTION	Chemical warfare agents, including lewisite and mustard gas, were stored in drums at this facility. Troop training operations were conducted at this site.
SIZE	350 acres
CONTENTS	Mustard gas and lewisite.
COMMENTS	It is not known if the drums were shipped offsite for disposal or demilitarized onsite.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Redstone Arsenal
LOCALITY	Huntsville
STATE	AL
SITE	Former Disposal Site 0 (RSA-62)
DESCRIPTION	This area was used as a disposal/demilitarization site for white phosphorus and mustard.
SIZE	14.5 acres
CONTENTS	Possible mustard and white phosphorus or residue.
COMMENTS	The materials were incinerated in disposal trenches and marked with vertical railroad ties. Groundwater sampling was conducted and thiodiglycol, a breakdown product of mustard, was not detected.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Large quantity
CLASSIFICATION	2 - Likely burial

LOCATION	Redstone Arsenal
LOCALITY	Huntsville
STATE	AL
SITE	Former Disposal Site P (RSA-61)
DESCRIPTION	This area was used as a disposal/demilitarization site for white phosphorus and mustard. The materials were incinerated in disposal trenches and marked with vertical railroad ties.
SIZE	14 acres
CONTENTS	Mustard and white phosphorus.
COMMENTS	Trenches are still visible. Groundwater sampling was conducted and thiodoiglycol was not detected.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Large quantity
CLASSIFICATION	2 - Likely burial

LOCATION	Redstone Arsenal
LOCALITY	Huntsville
STATE	AL
SITE	Former Mustard Gas Demil Site BB
DESCRIPTION	300 to 350 mustard gas shells were reported to have been demilitarized at this site.
SIZE	Less than 1 acre
CONTENTS	Mustard gas and residue.
COMMENTS	This site is fenced, posted, and restricted. Mustard agent was detected in the soil during an Army investigation in 1985.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Redstone Arsenal
LOCALITY	Huntsville
STATE	AL
SITE	Former Mustard Gas Storage Area Y
DESCRIPTION	This area was used for the storage of mustard gas canisters on bare ground.
SIZE	130 acres
CONTENTS	Mustard gas canisters.
COMMENTS	The mustard gas was removed and shipped offsite or demilitarized onsite.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Redstone Arsenal
LOCALITY	Huntsville
STATE	AL
SITE	Inactive Chemical Disposal Site H
DESCRIPTION	This area was used for the demilitarization/disposal of high explosives, white phosphorus, and mustard gas. Troop training operations at this site.
SIZE	11 acres
CONTENTS	Unknown
COMMENTS	Groundwater samples were taken and no organics or explosives were detected.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Redstone Arsenal
LOCALITY	Huntsville
STATE	AL
SITE	Inactive Disposal Site N (RSA-52)
DESCRIPTION	This area was used as a disposal site for chemical munitions, including mustard and lewisite agents. Disposal operations were conducted in the trenches and on the land surface.
SIZE	36 acres
CONTENTS	Possible chemical agents (mustard and lewisite) or breakdown products.
COMMENTS	This site is fenced and marked with "Keep Out" signs on the northeast portion with Marshall Space Flight Center boundary. Groundwater sampling has been conducted and arsenic, lead, chromium, trichloroethene, tetrachloroethene, and trichloromethane were detected.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Large quantity
CLASSIFICATION	2 - Likely burial

LOCATION	Redstone Arsenal
LOCALITY	Huntsville
STATE	AL
SITE	Mustard Gas Demil Site and Disposal Trenches
DESCRIPTION	These trenches were used to dispose of unused mustard gas shells after World War II.
SIZE	Several trenches
CONTENTS	There are an estimated 18 trenches. Each trench appears to be 400 to 600 feet long, 5 to 10 feet wide, and 5 to 6 feet deep. Photos show men in gas masks laying shells into the trenches.
COMMENTS	None
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Large quantity
CLASSIFICATION	1 - Known burial

LOCATION	Redstone Arsenal
LOCALITY	Huntsville
STATE	AL
SITE	Old Bone Yard Site
DESCRIPTION	This area was used for disposal of chemical munitions, toxic materials, and chemical wastes. Open burning of reject phosphorous-filled munitions may have taken place.
SIZE	Several acres
CONTENTS	Unknown
COMMENTS	There is evidence that the wastes have been removed.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Redstone Arsenal
LOCALITY	Huntsville
STATE	AL
SITE	Toxic Area Z
DESCRIPTION	This site was used as a disposal area for toxic chemicals. A large variety of items and wastes, including Phosgene, were demilitarized, treated, and disposed of at this site.
SIZE	5 acres
CONTENTS	Numerous toxic chemicals, including Phosgene.
COMMENTS	This area is currently under investigation as part of a Resource Conservation and Recovery Act facility investigation.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	3 - Suspect burial

LOCATION	Redstone Arsenal
LOCALITY	Huntsvilie
STATE	AL
SITE	Toxic Chemical Area Y 1
DESCRIPTION	This site consists of an abandoned chemical (mustard) storage/disposal area.
SIZE	2 to 5 acres
CONTENTS	Unknown, possible mustard agent.
COMMENTS	This site is fenced and signs posted "Keep Out, Land Contaminated, Toxic Chemicals."
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Redstone Arsenal
LOCALITY	Huntsville
STATE	AL
SITE	World War II Lewisite Manufacturing Facility Site
DESCRIPTION	Site of a lewisite manufacturing facility. The "parking lot" on this site proved to be a potential dumping ground.
SIZE	6 to 8 acres
CONTENTS	Unknown
COMMENTS	During operation, wastewater containing arsenic was discharged into the Arsenic Ponds South, Area U.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Camp Sibert
LOCALITY	Atalla
STATE	AL
SITE	Area 2
DESCRIPTION	Two closely adjoining gravel-covered plots used to detonate mustard-filled land mines. Used as a chemical dump. Empty or filled drums were burned with chloride of lime.
SIZE	40 square yards each
CONTENTS	Unknown
COMMENTS	Samples taken at 5 feet with no contamination. Excavation and clearance of site, June and July 1947. Some breakdown products likely.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Camp Sibert
LOCALITY	Atalla
STATE	AL
SITE	Unknown
DESCRIPTION	Barrels that once contained agent were recovered in burial pits in three training areas.
SIZE	Unknown
CONTENTS	Barrels once containing unspecified chemical agents.
COMMENTS	None
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Theodore Naval Ammunition Magazine
LOCALITY	Theodore
STATE	AL
SITE	Dock Area
DESCRIPTION	Francis L. Lee, ship filled with leaking mustard-filled German bombs, unloaded. Ship moved to Edgewood, Maryland. Extensive decontamination conducted. In 1946, ship turned over to Merchant Marines, Baltimore.
SIZE	Unknown
CONTENTS	Leaking German mustard bombs. Some contamination from breakdown products
COMMENTS	No direct evidence of burials. Bombs were transported to Pine Bluff Arsenal and Aberdeen Proving Ground-Edgewood Area, Maryland. Final disposition of leakers unknown,
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

LOCATION	Theodore Naval Ammunition Magazine
LOCALITY	Theodore
STATE	AL
SITE	Railroad Section
DESCRIPTION	Railcar destined for Pine Bluff Arsenal left Theodore; leaker found in Panola, Alabama. Train without leaker returned to Theodore.
SIZE	Unknown
CONTENTS	Leaking German mustard-filled bombs were stored in this area.
COMMENTS	Disposal site of leaking bomb bodies unknown. Some contamination from agent breakdown products may be present.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

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ALASKA

NAME OF LOCATION: **Gerstle River Test Site**

The Gerstle River Test Site (GRTS), approximately 19,000 acres, has been a part of Army operations since it was acquired under Public Land Order 910 on August 7, 1953. The installation is located approximately 10 miles east of the Fort Greely boundary.

Testing activities were performed at GRTS since the mid-l 950s. Complete records describing test activities between 1954 and 1962 are not available; however, limited information indicates that the Army performed some surveillance, chemical agent munitions and high-explosive munitions testing during this period. During later testing in the mid 1960s, the Army could not account for the detonation of one high explosive round.

As a result of the test activity on these areas, numerous cleanup operations have occurred from 1968 to 1971. These operations were conducted to clear the areas of chemical and explosive contamination.

Blueberry Lake, a man-made lake in an area of the Test Site, was used while frozen over to store materiel pending disposal. An incident occurred in the spring of 1967 (date varies in sources reviewed). Munitions containing the nerve agent GB (total unknown), a cylinder of the nerve agent GA, a cylinder of GB and vials from agent test kits containing GB, VX (a nerve agent), HD (distilled mustard) and lewisite were stored on the ice-covered lake pending disposal. In the spring when the ice melted, these items sank to the bottom of the lake. The lake was drained and the items were recovered during a subsequent clearance operation. The recovered materiel was decontaminated, detonated, and buried in pits located at the lake.

A second cleanup operation occurred as a result of reports of 55-gallon drums of HD that were buried near a command post on the Test Site land. During the investigation two additional burial pits were located. The first pit contained HD residue from testing and three empty, burned, ton containers of mustard. The second contained no contaminated materiel. This materiel was transported to the burial pits at Blueberry Lake.

Later, all debris from test grids and leased land was removed and transported to disposal pits at the Test Site. Debris clearance from the two main burial pits at Blueberry Lake was completed.

LOCALITY/STATE: Near Fort Greely, Alaska

SCOPE OF RESTORATION EFFECT: Several past burial sites have been identified and cleaned up. An ongoing site screening inspection is underway to gather information to be used by the U.S. Environmental Protection Agency (EPA) in scoring the site for possible inclusion on the National Priorities List.

EFFORT TO DATE: A 1987 site investigation included multi-media environmental sampling for selected parameters, including explosive-type compounds and the breakdown/degradation products expected from chemical agents.

REMEDIATION SCHEDULE: The Corps of Engineers, Huntsville, is preparing to geophysically map potential buried chemical warfare materiel (CWM) sites. They will use the Huntsville unexploded ordnance knowledge base to sort anomalies and locate potential missing rounds. At the same time, a site safety submission will be prepared.

RISK PERCEPTION: Troops training near suspect areas will be alerted to the remote potential hazard and a visual area sweep will be conducted, as appropriate. The potential for high explosive ordnance being present at GRTS does exist.

NAME OF LOCATION: Gerstle River Expansion Area

LOCALITY/STATE: Near Fort Greely, Alaska

FUDS ACTIVITIES AT THIS LOCATION: In the 1960s, 78,458 acres of land adjacent to the GRTS, Gerstle River Expansion Area (GREA), was leased for use by the Arctic Test Board at Fort Greely. Prior to being leased to the Department of Defense (DoD), by the State of Alaska, and the Bureau of Land Management (BLM) in 1964, the land was an undeveloped wilderness area. During DoD ownership, three test grids, with support areas and command posts, were established at the expansion area. GREA was used as a test site for ordnance and chemical operations, field trials, and engineering analyses on agents and munitions. From July 1965 to July 1967, GREA was used to statistically and dynamically test GB and VX filled 155mm munitions, VX filled 8-inch munitions, GB filled M55 rockets, and GB filled bomblets. Tests were also conducted to determine the types of weapons and munitions under different climatic conditions. These tests were carefully controlled and well documented. However, four GB filled 155mm rounds were not accounted for during the various test programs in the expansion area.

In April 1970, the land lease permit for 13,719 acres of BLM property expired and the land was returned to BLM.

In June 1972, the lease for the remaining 64,829 acres was terminated and the land was returned to the State of Alaska. Prior to the lapse of this lease, a number of environmental cleanups were performed at the entire GRTS, with "Operation Cleanup Alaska" being the last one in 1971.

ACTIONS COMPLETED/PLANNED FOR THE FUTURE: An Archives Search Report (ASR) was prepared in June 1994 by the USACE, St. Louis District. The ASR documented the current conditions and information available from the records of the post's active period. No soil or groundwater sampling was conducted during this effort.

A site characterization of the GREA was performed by the Huntsville Division, Corps of Engineers, in September 1994. The site characterization involved nonintrusive, visual and magnetometer investigations of seven sites in the GREA. The site investigation recommended further investigation for three areas.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: The area is currently used for hunting and trapping by local residents. The state of Alaska has also developed the area into a bison range and is planting supplemental forage.

RISK PERCEPTION: The potential for chemical ordnance being present at the GREA does exist. The area is forested and remote.

NAME OF LOCATION: **Fort Wainwright**

Fort Wainwright is located on the eastern edge of the city of Fairbanks in the Tanana River Basin of interior Alaska. The history of this site begins with Ladd Army Airfield (LAAF), established in 1939. In September 1942, LAAF had an important role in the implementation of the wartime lend-lease program as a crew-transfer point for conveying various types of military aircraft to Russia. On September 18, 1947, LAAF was redesignated Ladd Air Force Base. Its early missions were to serve as a resupply and maintenance base for the remote distant early warning sites and an experimental station in the Arctic Ocean.

Fort Wainwright was established on 1 January 1961, where it served as a base for helicopter activities. The Fort currently comprises 917,000 acres. Records indicate that no lethal chemical agents have been used at Fort Wainwright; however, several chemical agent identification sets (CAIS) were stored there until the late 1970s. Recent documentation indicates that 30 CAIS were buried at Ft. Wainwright. Six CAIS were removed as a result of excavation activities sometime during the 1960s. Another source indicates that four CAIS were stored at Ft. Wainwright prior to shipment to Rocky Mountain Arsenal for disposal.

LOCALITY/STATE: Fairbanks, Alaska

SCOPE OF RESTORATION PROGRAM: Fort Wainwright's current mission is to train soldiers and test equipment in arctic conditions. There is no evidence of chemical agent manufacture or testing at Fort Wainwright; however, CAIS have been found and removed. Recently, an investigation was conducted using improved ground-penetrating radar (GPR) techniques of a site in the Birch Hill area of the post, where there were unverified reports of up to thirty 17.5-liter cylinders of mustard having been buried shortly after World War II. Several cylinders of unknown contents were reportedly removed and destroyed in 1965. Anomalous signals obtained indicated the presence of subsurface features contrasting with the general background, but they could not confirm the presence of buried cylinders.

EFFORT TO DATE: Fort Wainwright is a National Priorities List installation with an extensive installation restoration program (IRP), primarily addressing conventional hazardous waste and contamination. The FY93 Army Work Plan has identified approximately $8 million in funded IRP projects. The suspect Birch Hill site has been fenced and marked with warning signs. Excavation and remediation of the Birch Hill site was completed in August of 1995, and no further chemical warfare agent was found.

REMEDIATION SCHEDULE: A scope of work is in preparation for soil and groundwater sampling to follow up on the GPR work. If chemical agent burial sites are identified, an investigation will be conducted under the existing IRP.

RISK PERCEPTION: No imminent threat to human health and safety from chemical warfare agents has been identified at Fort Wainwright. The ongoing environmental remediation program provides further safeguard and response capability.

NAME OF LOCATION: **Cape Yakak Radio Station**

LOCALITY/STATE: Adak Island/Aleutians, 52N,177W, Alaska

FUDS ACTIVITIES AT THIS LOCATION: During World War II (WWII), certain islands in the Aleutians were used as storage sites for chemical warfare munitions. Chemical warfare activities were initiated in March 1942. At that time, seven large posts and several small posts were activated. The locations of all of these installations were not available from research files, but research did indicate that toxic gas yards were constructed for all posts. The largest gas yard was located at Adak Island. These same sources cited a toxic gas yard on Attu Island.

From May to August 1947, the US. Army Technical Escort Detachment was dispatched to move 948 ton containers of 'toxic agents" from Attu to Chichagof Harbor. The ton containers were subsequently dumped 12 miles out at sea.

In a report describing further use of chemical materiel, a list includes tests with 4.2-inch chemical mortars using unnamed types of agents.

The Navy relinquished all but the northern part of the island to the U.S. Fish and Wildlife Service about 1959.

ACTIONS PLANNED FOR THE FUTURE: A site survey of Adak was accomplished by the Corps of Engineers in June 1993 during preparation of the Archives Search Report. No evidence of chemical warfare materiel (CWM) was found outside of the active Naval installation. An ASR was completed in October 1993.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: The U.S. Navy has closed the active Adak Island Naval Station except to those on military orders. Safety and security operations of the U.S. Navy limit susceptibility of the active site to intrusive activity. The formerly used defense site (FUDS) on the southern portion of the island is uninhabited.

RISK PERCEPTION: The island is remote and the FUDS portion uninhabited. Unless the site is disturbed by excavation, no threat to human health and safety is anticipated. Visits to the FUDS portion of the site by the general public is generally limited and extensive use is not anticipated. Potential CWM contamination sites are on the Naval Station.

NAME OF LOCATION: Chichagof Harbor

LOCALITY/STATE: Attu Island/Aleutians, Alaska

FUDS ACTIVITIES AT THIS LOCATION: Attu Island on the western end of the Aleutian Islands was sparsely inhabited at the start of World War II. Attu and Kiska were captured by the Japanese on 7 June 1942 following the June 3 to 4 bombing of Dutch Harbor by carrier-based planes. The Aleuts were imprisoned in Japan while Attu was developed as a garrison.

The Japanese garrisons on Attu and Kiska were subsequently subjected to heavy American aerial and naval bombardment. The U.S. Army 7th Infantry Division assaulted Attu on 11 May 1943, capturing the island by May 30. Unexploded ordnance was removed. The soft tundra covered considerable quantities of Japanese and American ordnance, which, since World War II, has been collected and moved to two different sites on the Island.

Chemical warfare artillery and bombs were stored at Attu from July 1944 to July 1947. This included mustard (M47A2 bombs) and lewisite (M33 bombs).

The chemical materiel [948 one-ton containers (61 mustard and 887 lewisite), each containing about 150 gallons of agent] remaining on Attu in 1947 were dumped at sea or burned on Attu, and 20 one-ton containers (10 mustard, 10 lewisite) were transferred to Adak. Documentation on their ultimate disposition has not been found. The sea dump site was 12 miles northeast of Attu with a depth of 11,850 feet (173 degrees 32 feet E longitude and 53 degrees 3 feet N latitude).

ACTIONS COMPLETED/PLANNED FOR THE FUTURE: The USACE conducted an archives search and a site survey of the area was accomplished in June 1993. A delivery order for phase one of an engineering evaluation/cost analysis was awarded on 30 June 1994. The Scope of Work required the review of records, a visit to the site, and the preparation of a report prioritizing the areas to be fully investigated in a subsequent delivery order. The site visit was conducted from 15 to 30 September 1994, and the draft prioritization report has been received by the Huntsville Division, Corps of Engineers.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: Currently, the human population is a 20-person U.S. Coast Guard Long Range Aid to Navigation station. The island is part of the Alaska Maritime Wildlife Refuge.

RISK PERCEPTION: Except for a 20-person Coast Guard Station, the island is uninhabited. Unless the site is visited, no threat to human health and safety is anticipated. The ordnance dumps suspected within the Coast Guard installation are off limits to the Coast Guard personnel. There are few other visitors to this remote island, which is extremely difficult to visit since it is the last island in the Aleutians. The chance for visitation by members of the public is very low.

NAME OF LOCATION: **Unalaska Island**

LOCALITY/STATE: Dutch Harbor, Alaska

FUDS ACTIVITIES AT THIS LOCATION: Local divers working on the former Captains Bay ammunition dock in January 1987 discovered four metal containers washed up on the shore, each about 5 inches in diameter and 30 inches long, containing a total of 44 glass vials. The containers were turned over to the Unalaska Police Department, which notified the 176th Explosive Ordnance Detachment (EOD), Fort Richardson, Alaska. Ordnance specialists identified the vials as elements of the Ml War Gas Identification Set. This was a World War II training kit used to teach soldiers how to identify chemical warfare agents by odor and immediate effects.

EOD repacked the 44 vials and transported them to the disposal facility at Johnston Atoll.

The Technical Escort Unit conducted an additional underwater search and shoreline survey at the ammunition lock dock in February 1987. More containers with vials were found in the water and on the shore. A total of 469 additional vials were found, repacked, and transported to Johnston Atoll.

ACTIONS COMPLETED/PLANNED FOR THE FUTURE: An ASR was completed in October 1993, and a Phase 1 engineering evaluation/cost analysis (EE/CA) was awarded in June 1994. The Phase 1 prioritization report was received in October 1994. Field activities in support of the EE/CA has been completed and the report is being finalized.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: Unalaska Island (Dutch Harbor) is one of the fastest-growing communities in Alaska. There has been significant recent development in support of the fishing industry. Construction has included apartments, fish processing plants, dock and port facilities, airport facilities, and service-related stores. This development has taken place primarily at Amoknok Island and adjacent to the city of Unalaska, on the site of the former Dutch Harbor Naval Operating Base and Fort Mears. Because of the population growth, increasingly remote and undeveloped areas of Alaska are being used for recreation and development.

RISK PERCEPTION: There have been no further reported incidents since 1987; previous discoveries indicate possible risk. However, as a precaution, the USACE is finalizing an archival search for further historical information.

NAME OF LOCATION: **Fort Richardson**

Fort Richardson was established in 1940 under the command of the Alaskan Defense Force (ADF) to protect Alaska against foreign attack. In 1941, ADF was redesignated the Alaskan Defense Command and was a staging area during World War II. The troop population varied from 7,800 to 15,500. In 1950, Fort Richardson was divided between the Army and Air Force. Currently, the US. Army, Alaska is headquartered at Fort Richardson, and consists primarily of the 1st Brigade, 6th Infantry Division (Light) and supporting units assigned to the U.S. Army Garrison, Alaska. Its mission includes command and control of combat ready Army forces in Alaska capable of worldwide deployment in support of the United States'national interests and objectives. In 1991, the Army entered into the Resource Conservation and Recovery Act (RCRA) Federal Facilities compliance agreement. In 1993, Fort Richardson was proposed for inclusion on the National Priorities List, which was approved in 1994. Fort Richardson remains on the NPL as of February 1995.

LOCALITY/STATE: Anchorage, Alaska

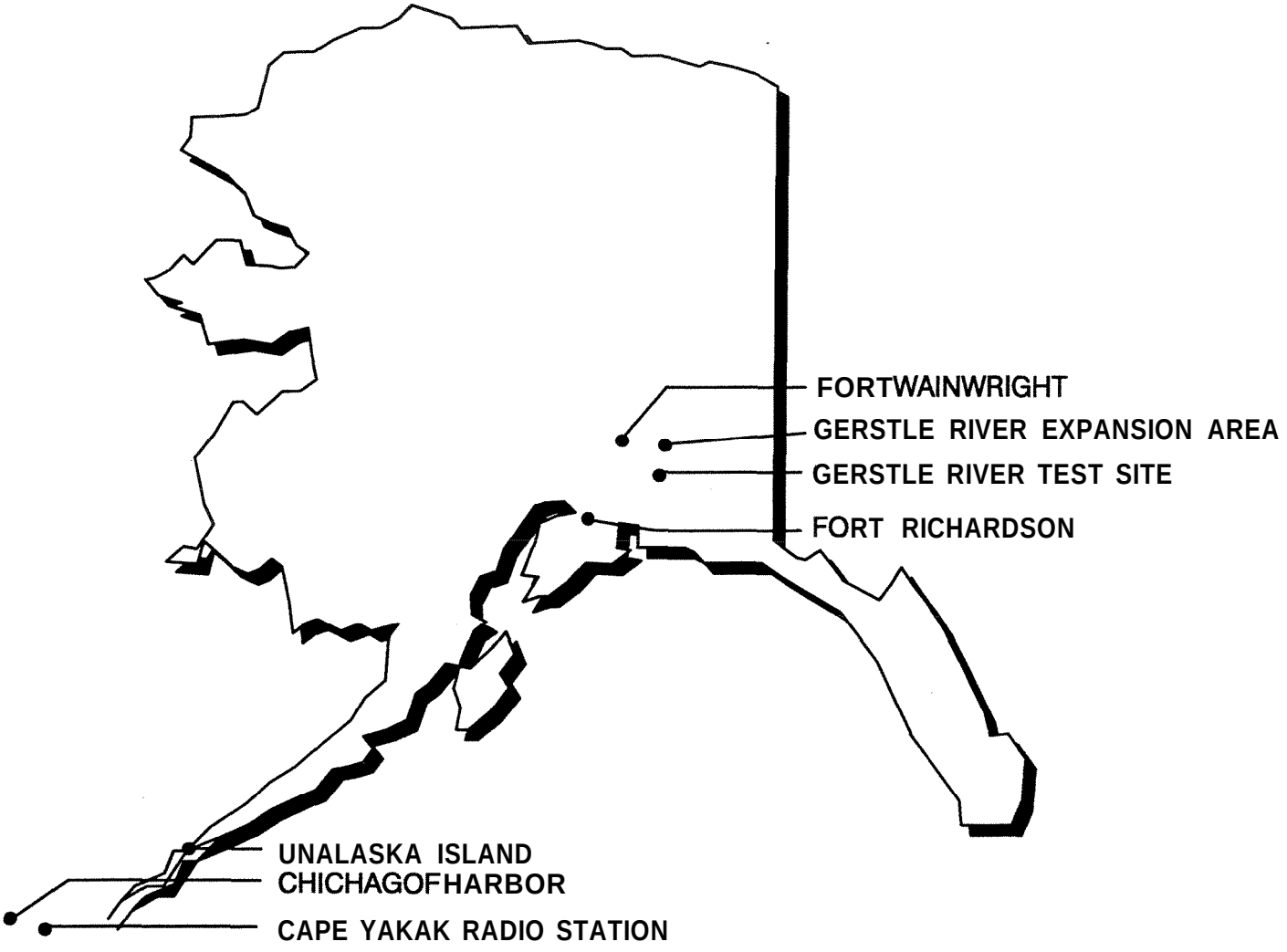
SCOPE OF RESTORATION EFFORT: Two trenches, now known as the Poleline Road Disposal Area, were being investigated because they were thought to be the source of the Volatile Organic Compounds found in the soil and shallow groundwater. Excavation of the trenches began on 29 September 1993. On 1 October 1993, two "pigs" containing chemical agent identification sets (CAIS) were uncovered. The site was secured and evacuated. Excavation of the Poleline Road Disposal Area was completed 24 October 1994. The one-acre site uncovered 12 items; two six-gallon cans that contained mustard-contaminated clothing; and 10 large pipe-shaped, steel overpack containers called "pigs." X-rays of the pigs show that seven contain glass bottles believed to be CAIS and the other three were filled with glass bottles and other unknown items. The recovered materiel was over-packed and put in an ammunition bunker for temporary storage.

EFFORT TO DATE: All known chemical warfare materiel (CWM) has been excavated and placed in temporary storage.

REMEDIATION SCHEDULE: Excavation of CWM was completed October 1994.

RISK PERCEPTION: All CWM has been excavated from this site and placed in temporary storage. There is no perceived threat to human health and safety due to buried CWM.

ALASKA


FORTWAINWRIGHT
GERSTLE RIVER EXPANSION AREA
GERSTLE RIVER TEST SITE
FORT RICHARDSON
UNALASKA ISLAND
CHICHAGOFHARBOR
CAPE YAKAK RADIO STATION

LOCATION	Gerstle River Test Site
LOCALITY	Fort Greely
STATE	AK
SITE	Operation Cleanup Disposal Pits
DESCRIPTION	During a cleanup in 1970, all disposal areas on the leased land were excavated and material placed in four disposal pits.
SIZE	Unknown
CONTENTS	Munitions casings, agent test kits, construction debris, cable, and other materials.
COMMENTS	One of the pits contains the vehicle remains from one of the tests conducted in this area.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Gerstle River Test Site
LOCALITY	Fort Greely
STATE	AK
SITE	Blueberry Lake
DESCRIPTION	In the winter of 1965, munitions and other materials stored on a frozen lake (Blueberry Lake) fell through when ice melted. The lake was drained and the material was recovered, decontaminated, and buried in two pits adjacent to the lake.
SIZE	1,000 feet in diameter and approximately 8 feet deep
CONTENTS	Potential for nerve agent GB munitions, chemical agent identification sets with nerve agents GA, GB, and VX, and mustard and lewisite.
COMMENTS	None
TYPE	Disposal
INSTALLATION	**Army**
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Gerstle River Test Site
LOCALITY	Fort Greely
STATE	AK
SITE	Unspecific
DESCRIPTION	Static detonation of nerve agent (VX and GB) munitions and dynamic firing of projectiles. Tests conducted from December 6, 1962 through September 14, 1967. Source states tests from 1953 to late 1960s. During later testing in the mid 1960s, the Army could not account for the detonation of one high explosive round.
SIZE	19,000 acres
CONTENTS	Potential for GB, VX munitions and one high explosive munition.
COMMENTS	Numerous attempts were made to clear the range, but all were incomplete.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	1 - Known burial

LOCATION	Gerstle River Expansion Area
LOCALITY	Fort Greely
STATE	AK
SITE	Expansion Area
DESCRIPTION	Area next to Gerstle River Test Site was also used as a test site. Cleanup effort in 1968 of two test locations produced sensors and other contaminated hardware (buried on Center land).
SIZE	78,458 acres
CONTENTS	Dump site used to dispose of materials contaminated with chemical agents. Potential fo GB, VX munitions.
COMMENTS	Cleanup operations took place September 1968.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Fort Wainwright
LOCALITY	Fort Wainwright
STATE	AK
SITE	Unknown
DESCRIPTION	Specific report of 23 chemical agent identification sets buried. Total of 30 buried. Seven removed in 1960s before excavation halted.
SIZE	66 by 164 feet
CONTENTS	23 chemical agent identification sets.
COMMENTS	Pit located and confirmed by ground-penetrating radar. Site was excavated and no chemical warfare agents were found.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	5 - No further action

LOCATION	Fort Wainwright
LOCALITY	Fort Wainwright
STATE	AK
SITE	Unknown
DESCRIPTION	Approximately 4 chemical agent identification sets (CAIS) stored here pending shipment to Rocky Mountain Arsenal in late 1970s. Shipment was completed in January 1978.
SIZE	Unknown
CONTENTS	Unknown; however, potential exists for unreported CAIS.
COMMENTS	None
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	5 - No further action

LOCATION	Cape Yakak Radio Station
LOCALITY	Adak Island on Aleutians
STATE	AK
SITE	Storage
DESCRIPTION	20 one-ton containers transferred from Attu in 1947 for long-term storage. Adak was also the location of a large toxic gas yard.
SIZE	Unknown
CONTENTS	Possibly 10 one-ton containers of mustard and 10 one-ton containers of lewisite. Held in storage in 1947.
COMMENTS	Containers were cleaned, rust-painted, and prepared for long-term storage. Final disposition of material unknown.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Chichagof Harbor
LOCALITY	Attu Island on Aleutians
STATE	AK
SITE	Gas Yard
DESCRIPTION	In 1947, 948 ton containers were loaded onto barges and dumped at sea. Ton containers were loaded with mustard and lewisite.
SIZE	Unknown
CONTENTS	61 mustard ton containers: 887 ton containers of lewisite.
COMMENTS	Potential for burial at this site due to storage during World War II. Final disposition of material unknown.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Unalaska Island
LOCALITY	Dutch Harbor
STATE	AK
SITE	Water
DESCRIPTION	Site investigated in June and July 1987. Found to have chemical agent identification sets dumped in shallow water. All visible items removed.
SIZE	Unknown
CONTENTS	Chemical agent identification sets vials loosely strewn on sea floor.
COMMENTS	All visible items removed and sent to Johnston Atoll for disposal.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	3 - Suspect burial

LOCATION	Fort Richardson
LOCALITY	Anchorage
STATE	AK
SITE	Poleline Road Disposal Area
DESCRIPTION	Two trenches, now known as the Poleline Road Disposal Area, were being investigated because they were thought to be the source of the Volatile Organic Compounds (VOCs) found in the soil and shallow groundwater. Excavation of the trenches began on September 29th, 1993. On October 1, 1993 two "pigs," containing chemical agent identification sets, were uncovered. The site was secured and evacuated. Excavation of the Poleline Road Disposal Area was completed October 24, 1994. The one-acre site uncovered 12 items; two 6-gallon cans which contained mustard-contaminated clothing; and ten large pipe-shaped, steel overpack containers called "pigs." X-rays of the pigs show that seven contain glass bottles believed to be chemical agent identification sets and the other three were filled with glass bottles and other unknown items. The recovered materiel was overpacked and put in an ammunition bunker for temporary storage.
SIZE	One acre
CONTENTS	Ten pigs which are believed to contain chemical agent identification sets.
COMMENTS	Removal action at Poleline Road Disposal Area completed FY95 per the installation action plan for Fort Richardson, Alaska. The recovered chemical warfare materiel has been placed in temporary storage awaiting final disposition.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	5 - No further action

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ARIZONA

NAME OF LOCATION: **Yuma Proving Ground**

Yuma Proving Ground (YPG) is located in the southwest comer of the State of Arizona, north of the Gila River and east of the Colorado River in Yuma County. Almost all of the installation activities are located in its southern part. The seven principal areas of the Material Test Directorate are Kofa Firing Range, Castle Dome Heliport, Castle Dome Annex, Mobility Test Headquarters, Laguna Airfield, and the Main Cantonment Area.

The following is a list of historical events at YPG:

1942: Military use began as it served as part of the area used by General George S. Patton's "Desert Training Command" troops preparing for the invasion of North Africa.

1943: The organization that was to become YPG officially began operation under the designation of Yuma Test Branch. Its mission was to test bridges and river-crossing equipment, boats, vehicles, and well-drilling equipment.

1950: Deactivated because of a military austerity program.

1951: In April, under the recommendation of the U.S. Army Research Office, the location was reactivated for use in desert environmental testing.

1962: Yuma Test Station was assigned to the U.S. Army Materiel Command.

1963: On July 1, Yuma Test Station was redesignated YPG.

The burial site at YPG was used from the early 1950s to 1969 for the disposal of decontaminated waste. A total of 10 pits, eight of which were opened during the initial investigation in 1979, are located here. The agents disposed of at the burial site are mustard (HD), lewisite (L), nerve agents GB and VX, blood agents cyanogen chloride (CK) and hydrogen cyanide (AC), choking agent phosgene (CG), and riot control agent CS.

LOCALITY/STATE: Yuma County, southwestern Arizona

SCOPE OF RESTORATION EFFORT: In October 1979, an investigation team from Dugway Proving Ground conducted an onsite investigation of seven of the pits. The team concluded that all items recovered were totally void of chemical agents. The team did not excavate the remaining three pits but noted that they contained the same types of materiel which were destroyed using the same decontamination/neutralization procedures as the materiel in the other pits. The team concluded that no hazard was

present at the pits or in the vicinity.[1] The open pits were subsequently covered after markings were obliterated.

EFFORT TO DATE: In October 1994, three bottles of HD from a K941 chemical agent identification set were discovered in the West Environmental Test Area. This area had been inactive for years. Retired personnel provided information that lead to the discovery of the bottles.

REMEDIATION SCHEDULE: The West Environmental Test Area will be reaccessed for the potential for additional discoveries.

RISK PERCEPTION: There is essentially no threat to public health from chemical agent at YPG.

[1] An inconsistency in the number of pits occurs in the documentation for this site. In the original installation assessment, dated 1980, nine piits were identified in this burial site. In the update to the assessment, dated 1988, ten pits were discussed during the survey described in this paragraph.

NAME OF LOCATION: Camp Navajo

Camp Navajo covers 28,000 acres of range land; 2,624 acres of this land came from private owners, 9,080 from the state of Arizona, and the remainder from government sources. It gets it name from its location in the land of the Navajo. The camp draws a large number of its work force from Native Americans residing in the nearby Navajo Reservation.

The camp is situated on a rolling wooded plateau surrounded by a mountain range. The terrain is rugged due to its volcanic origin and the presence of high areas such as San Francisco peak (elevation: 12,670 feet). The installation is serviced by U.S. highways 66 and 89; the Atchison, Topeka & Santa Fe Railway; and the Flagstaff Municipal Airport.

The following is a list of historical events at Camp Navajo:

1942: Navajo Ordnance Depot was established on February 5 by War Department General Order No. 9.

1943: Construction completed in January.

1945-end of WWII: Served as a prisoner of war camp for Austrian soldiers.

1945: The initial shipment of chemical warfare service ammunition arrived in January, consisting of phosgene (CG), cyanogen chloride (CK), and mustard (H)-filled bombs.

1958: The Depot's entire stockpile of mustard munitions was removed in a 24-car shipment and disposed of at sea.

1967: The Depot was assigned a Defense Supply Agency depot mission and the mission of storing Air Force firebombs and related material.

1971: On March 1, Navajo Army Depot was placed in reserve status and redesignated as Navajo Depot Activity under the command of Pueblo Army Depot Activity.

1975: In February, the State of Arizona was granted use of the land and buildings for National Guard training and support activities.

1975: In September, the command was transferred to Tooele Army Depot (TEAD).

1982: On June 1, 1982, accountability and responsibility for the real property at NADA was transferred to United States Property and Fiscal Officer (USPFO), State of Arizona, Arizona National Guard (AZNG). At the same time, a license was granted to the State of Arizona Acting by and

through the Adjutant General to use and occupy NADA on behalf of the Department of the Army, subject to and in accordance with an Interservice Support Agreement (ISA) between USPFO for Arizona and the Commander, TEAD.

1988: On December 29, the Defense Secretary's Commission on Base Realignment and Closure transmitted their report that recommended Navajo for closure and anticipated its eventual transfer to the AZNG.

1992: On November 16, the first Minuteman II rocket motor was placed into storage in a newly refurbished igloo.

1993: In May the $1.7 million rocket motor transfer facility handled its first Minuteman II rocket motor.

1993: In October the first troops were billeted in the new, $6 million training site facility.

1993: On 30 September 1993, the ISA with TEAD was terminated. This action, along with relocating the ammunition-mission stocks to Hawthorne Army Ammunition Plan, completed the transition of the installation to the AZNG and implemented BRAC I. NADA was renamed Camp Navajo.

1994: On 15 September 1994, the last of the unserviceable ammunition-mission stocks was open-detonated. The Demolition Area is now entering RCRA-Closure.

The mission of Camp Navajo is as follows:

1. To operate a Major Training Area providing those facilities and installation support services that will enhance the mobilization readiness of the AZNG and other DoD personnel and units training at the installation..

2. To provide facilities and installation support services for a State-operated Mobilization Site, Regional Training Site, the Arizona Military Academy and tenant activities.

3. To operate a supply function for the receipt, storage, issue, maintenance and disposal of assigned commodities.

Camp Navajo was used to store bombs containing chemical agents from 1945 until the 1960s. In 1958, mustard-filled M-70 bombs were removed from storage in the D-200 series igloos and transported to California for disposal at sea. Two of the bombs, marked as M-78 bombs (which may have been an experimental mustard configuration), were found to be leaking and they were taken to "Chemical Canyon" and the contents were burned. No other operation with these bombs was identified.

LOCALITY/STATE: Camp Navajo is located approximately 12 miles west of Flagstaff, Arizona. Although some private and commercial land is found along the northern boundary, the majority of the land surrounding Camp Navajo is national forest or state-owned.

SCOPE OF RESTORATION EFFORT: The installation restoration program (IRP) has been ongoing since the initial installation assessment was prepared in December 1979. Since then, several reports have been written summarizing various aspects of the camp environment. Three general-type assessments addressing the overall environmental status of the camp have been completed. In addition, various studies have been completed that investigated possible contamination that may have been the result of past waste management practices. In 1991, a project to prepare a Master Environmental Plan was initiated. This plan summarized all previously conducted investigations, recommended further investigatory needs at each site, and prioritized the sites for investigation and remediation.

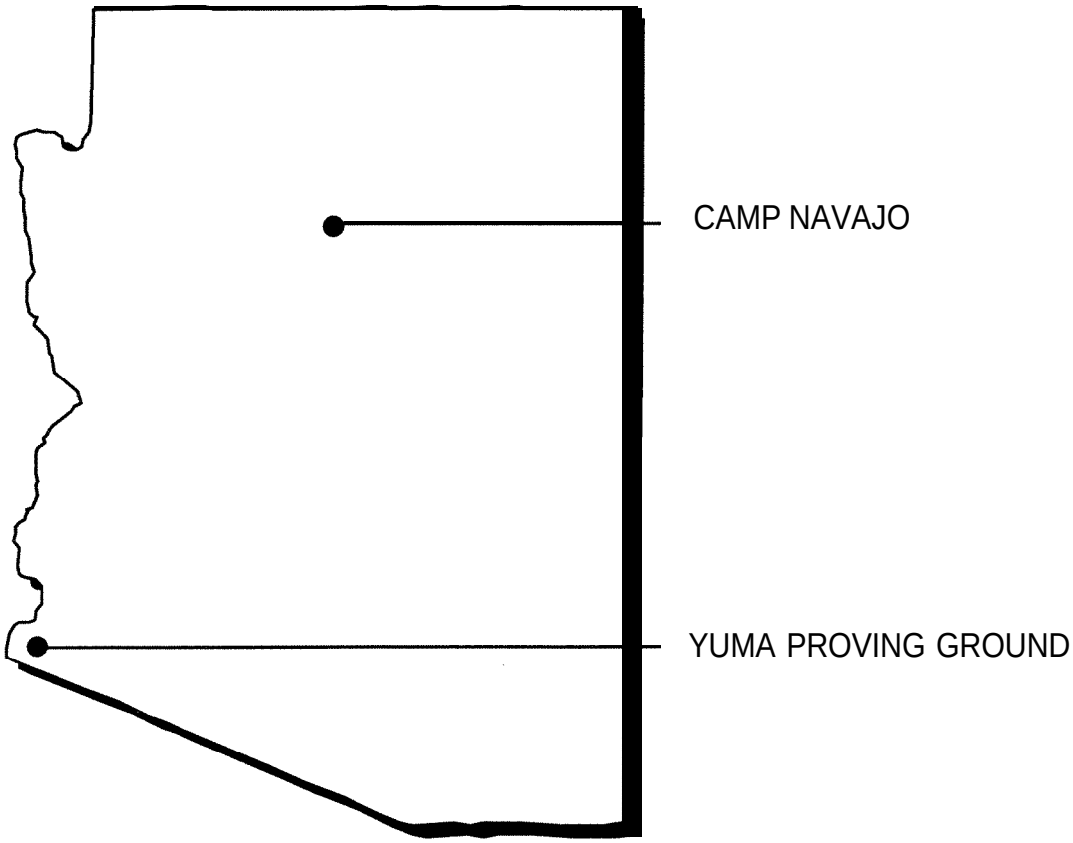
EFFORT TO DATE: As part of the effort to prepare the Master Environmental Plan, site tours, interviews with employees, and a records review were conducted in 1991. One of the sub-sites located in the Open Burning/Open Detonation Area was previously used for destruction of ammunition and bombs from 1945 to the mid-l 970s. This area, AREE-3, is referred to as the "Dam" or the "Chemical Canyon." White phosphorous munitions were detonated and burned in this area. One or two mustard-filled, 250-pound bombs were detonated and burned in this area in the mid-1950s. These bombs were suspected "leakers" and were brought directly to this area from their storage bunker. Previously conducted soil sampling showed the presence of TNT, nitrate, and total phosphorus. A second sub-site in this same area is called the "Former Cyanogen Chloride/Phosgene Demilitarization Area." In the early 1950s, this area was used for the destruction of an unknown quantity of CG- and CK-filled, 500- and 1 ,OOO-pound aerial bombs. No further investigations have been conducted at this site.

Recently, two M70 or M78 (thought to be mustard-filled) bombs were found in the "Chemical Canyon" and destroyed on base. In addition, two potential mustard bomb burial pits were identified.

REMEDIATION SCHEDULE: Removal actions and remedial design/remedial action work will be integrated as appropriate into the Army's IRP.

RISK PERCEPTION: Camp Navajo is not considered to be an immediate threat to either human health or the environment.

ARIZONA



LOCATION	Yuma Proving Ground
LOCALITY	Yuma
STATE	AZ
SITE	Not specific
DESCRIPTION	Chemical Agent Disposal Area. Three operations of burning munitions: 1966, 1968, and 1969. Site contains eight open pits and one closed pit. Used since 1950s to dispose of residue from Toxic Laboratory.
SIZE	4.7 acres
CONTENTS	Potential for mustard, and nerve agent (GB), ton containers and cylinders; 155-millimeter GB/VX projectile, and M23 mine.
COMMENTS	Munitions were tapped, decontaminated, and burned. Certified decontaminated by Dugway Proving Ground in 1979.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Yuma Proving Ground
LOCALITY	Yuma
STATE	AZ
SITE	Storage
DESCRIPTION	Chemical test and storage area used to test-fire chemical munitions including grenades, smoke, thermite, simulant-filled mines, unknown agent-filled projectiles, and rockets. Munitions were statically and dynamically fired.
SIZE	Unknown
CONTENTS	Unknown. Potential for buried munitions and/or residue.
COMMENTS	None
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Yuma Proving Ground
LOCALITY	Yuma
STATE	AZ
SITE	The West Environmental Test Area
DESCRIPTION	Four small bottles of distilled mustard (HD) from a chemical agent identification set were located at a remote site on Yuma Proving Ground's Cibola Firing Range.
SIZE	Approximately 20 acres
CONTENTS	Chemical agent identification set.
COMMENTS	Currently, the area where the items were found has been rendered inaccessible until Yuma Proving Ground can be assured that no other problems exist.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	1 - Known burial

LOCATION	Camp Navajo
LOCALITY	Bellemont
STATE	AZ
SITE	AREE-3 (Chemical Canyon)
DESCRIPTION	Area known as Chemical Canyon used to burn two leaking mustard-filled bombs in 1958. Area also used to burn white phosphorus (WP) and plasticized white phosphorus (PWP).
SIZE	Unknown
CONTENTS	Two M-78 250-pound mustard bombs.
COMMENTS	Mustard-filled M-78 bombs stored in D-200 series igloos. M-78 bomb may be an error or may be an experimental series.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

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ARKANSAS

NAME OF LOCATION: Fort Chaffee

Fort Chaffee is located approximately 6 miles from downtown Fort Smith, Arkansas. The installation consists of approximately 69,802 acres. The current mission of Fort Chaffee is to provide facilities and support training operations for the National Guard, U.S. Army Reserve Units, Navy and Marine Reservists, Air National Guard, and the Reserve Officer Training Corps.

Fort Chaffee, named for the late Major General Adna R. Chaffee, the first Chief of Armored Forces, was initially established as Camp Chaffee under direction of the War Department in 1941. The first mission assignment was to train armored divisions. Camp Chaffee was used as a prisoner-of-war camp between November 1942 and May 1946. After World War II, Camp Chaffee was deactivated and reactivated twice. During the Korean Conflict in May 1950, Camp Chaffee reopened to provide basic and advanced field artillery training. On March 21, 1956, the Secretary of the Army, by General Order, redesignated Camp Chaffee as Fort Chaffee.

The "Gassed Area" of Fort Chaffee was identified as being a site for chemical agent training and decontamination exercises after World War II, where chemical agent identification sets (CAIS) were used.

LOCALITY/STATE: Fort Smith, Arkansas

SCOPE OF RESTORATION EFFORT: Corrective action requirements are being identified under the Installation Restoration Program. Only one site is potentially contaminated with chemical agents. A hand-dug, brick-walled well was located in the vicinity of a former disposal area for residues from CAIS. No contamination was found with sampling. The well was backfilled and the area was revegetated.

EFFORT TO DATE: Thirty-one sites, including the one chemical agent site, have been identified as not requiring additional remedial action.

REMEDIATION SCHEDULE: The present restoration effort at Fort Chaffee is directed at conventional industrial contamination. No further chemical agent investigations are planned.

RISK PERCEPTION: it is extremely unlikely that any threat to public health or safety from chemical agents remains at Fort Chaffee.

NAME OF LOCATION: **Pine Bluff Arsenal**

Pine Bluff Arsenal (PBA) is located in Jefferson County, Arkansas, approximately 8 miles northwest of Pine Bluff, Arkansas and 30 miles southeast of Little Rock, Arkansas. The Arkansas River borders PBA on the northeast side. PBA was established in 1941 for the manufacture of mustard and lewisite agents, and for the loading and assembling of incendiary and chemical munitions, including signal smokes and obscurant materials.

At the close of World War II, captured German chemical warfare materiel was sent to PBA for evaluation. In 1947, during disposal of German Traktor rockets, several rockets were propelled from the burning pits. The disposal operation in 1947 was to drain and decontaminate the agent, point the nose of the drained rockets into the ground, cover with thermite and ignite, and let the motor and thermite burn. Unknown to the Americans at that time, the Germans had used pull instead of push motors on the rockets, so that when the rocket fuel ignited, the rockets were pulled out of the disposal pit.

The pits have been tested and all contaminants and contaminated soil have been removed and placed in environmentally acceptable disposal units. All known rockets were recovered and placed in proper storage or disposed of. Biological operations were initiated in the 1950s and closed in the 1970s. Chemical warfare agent BZ was received and placed into pyrotechnic munitions in the 1960s. All BZ munitions and remaining bulk BZ stock were disposed of by Resource Conservation and Recovery Act (RCRA)-permitted incineration from 1988 to 1990. The old BZ filling facility was decontaminated, and all subsequent tests for agent and contaminants were negative. Since the early 1970s, only incendiary, riot control, screening smoke, and signaling smoke munitions have been produced, along with defensive equipment and operations (such as gas mask rebuild). The installation also serves as a conventional and chemical storage depot. In addition, a number of waste storage, treatment, and disposal facilities are operated onsite in support of the various industrial operations.

LOCALITY/STATE: Pine Bluff, Arkansas

SCOPE OF RESTORATION EFFORT: Because PBA has completed remediation work on all known sites requiring action, the current installation restoration program (IRP) primarily involves long-term monitoring. PBA is also summarizing all remediation data in two reports to meet RCRA permit requirements to remove these sites from the solid waste management units list.

EFFORT TO DATE: A total of 72 sites were investigated during the IRP, with 11 sites having the potential of containing chemical agent contamination. The investigations were initiated in 1972 and all required remediation completed in 1989. There were 20 sites that required remediation, which was accomplished through the Military Construction Army (MCA) program at a cost of approximately $40 million. The sites

were remediated by one of two methods: in-situ closure using slurry wall and synthetic liner technology, or clean closure, which removed all contaminated material and soils to other appropriate disposal sites.

REMEDIATION SCHEDULE: As a result of PBA's proactive actions in remediation of past activities, the future action will consist of assessment/investigation and remediation in case of an unlikely discovery of additional disposal sites.

RISK PERCEPTION: Since the burial and test sites have been remediated, it is extremely unlikely that any threat to public health, safety, or the environment exists from past operations. As an active storage facility for stockpile chemical agents and weapons, PBA has an active and thorough monitoring and detection program in place, as well as a trained and ready emergency response force. The threat to human health, safety, and environment is very low because of the surety program and government-controlled access to all storage areas.

NAME OF LOCATION: Southwestern Proving Ground

LOCALITY/STATE: Hope, Hempstead County, Arkansas

FUDS ACTIVITIES AT THIS LOCATION: Southwestern Proving Ground (SWPG) was located on 44,568 acres in Hope, Arkansas, Hempstead county.

In the early 1940s, munitions filled with mustard gas were tested at SWPG. These included the 105mm projectile, 155mm projectile, and 30 lb bomb. Several additional chemical shells may have been used or stored at SWPG. The Chief of Ordnance wrote a letter to the Proof Department at SWPG regarding changes in the Safety Phase Test as part of the ballistic acceptance tests that were conducted there. The changes include specifications for the Safety Phase Test of the following munitions:

- Rounds, Complete, Shell, Chemical, M60, with M57 P.D., Fuze, for Howitzer, 105mm, M2
- Rounds, Complete, Shell, Chemical, for Howitzer, 75mm, Ml.
- Rounds, Complete, Shell, Chemical, for Gun, 75mm, M1897, Ml916 and M1917.
- Rounds, without fuze, Shell, Chemical, Mk. II, for Gun 75mm, M1897, M1916, and M1917.

The M60, 105mm rounds were filled with White Phosphorus (WP), Mustard Gas (H), or Distilled Mustard (HD). The 75mm chemical shell for the howitzer was filled with WP. The filling in the chemical shell for the 75mm gun was an unspecified gas.

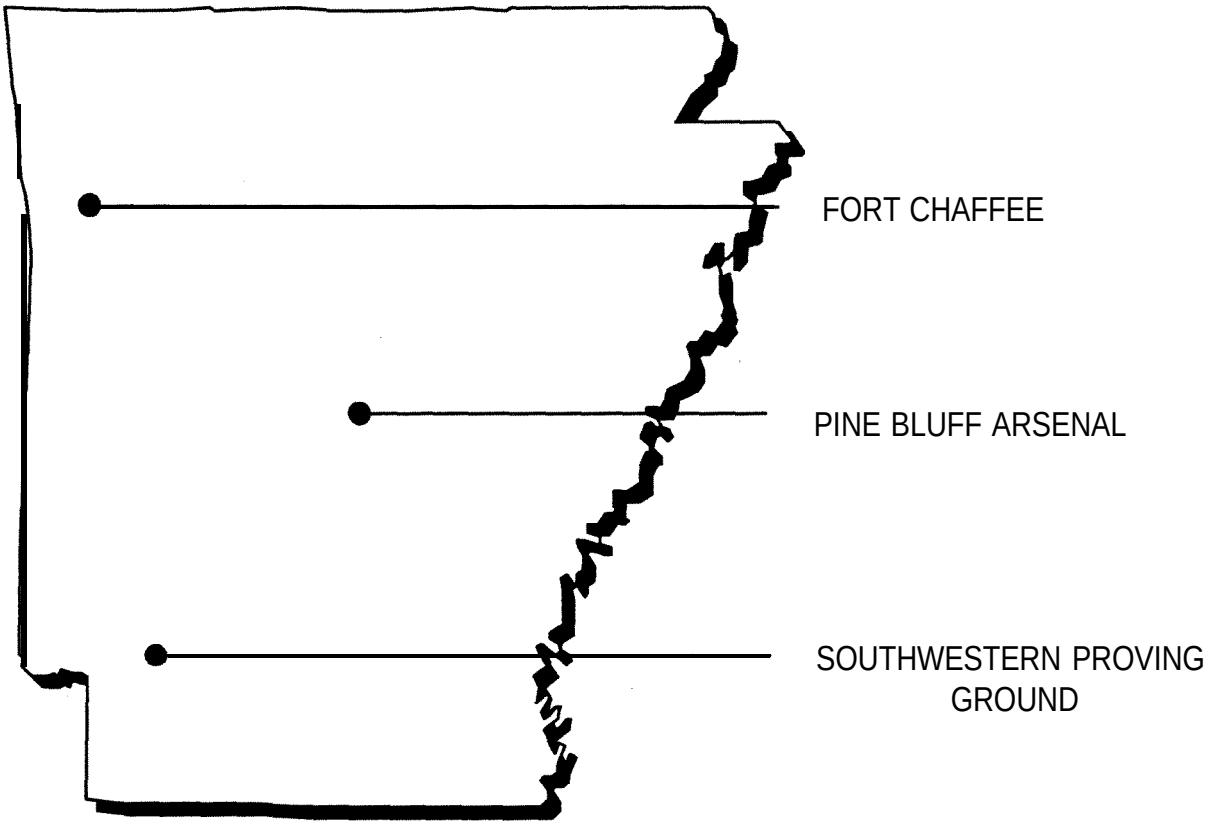
A completion report provided to the St. Louis District by the Armament, Munitions, and Chemical Command at the Pine Bluff Arsenal. The report provides details on the disposition of 138,642 M70, 115 lb. chemical bombs. Between 30 and 50 of these bombs were shipped to SWPG during the period from June 1943 to December 1943. It is unclear whether these bombs were tested or stored.

PREVIOUS CORPS ACTIVITIES: US. Army Corps of Engineers (USACE), St. Louis District prepared an Archival Search Report.

ACTIONS PLANNED FOR THE FUTURE: No further actions are planned for this location at this time.

RISK PERCEPTION: No threat to human health and safety is currently known to exist.

ARKANSAS


FORT CHAFFEE
PINE BLUFF ARSENAL
SOUTHWESTERN PROVING GROUND

LOCATION	Fort Chaffee
LOCALITY	Fort Chaffee
STATE	AR
SITE	Dug Well
DESCRIPTION	Used in the mid-1940s to train troops in chemical warfare operations. Area known as gassed area. Old well reportedly used to dispose of chemical agent identification sets. Area is a hand-dug well.
SIZE	30 square feet
CONTENTS	Chemical agent identification set residue potential.
COMMENTS	Groundwater and sediment samples collected with negative results.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	3 - Suspect burial

LOCATION	Pine Bluff Arsenal
LOCALITY	Pine Bluff
STATE	AR
SITE	SWMUs 18, 23, 24, 29, and 75
DESCRIPTION	Old chemical manufacturing area. Between 1942 and 1943, mustard and lewisite were manufactured. Portions were later leased to private industry for production of DDT and its intermediates; DDT was manufactured between 1948 and 1957. Malathion, parathion, and chlorobenzenes were brought to Pine Bluff Arsenal to be blended into pesticide products, but they were not manufactured on the site. In 1969, another private company manufactured and stored chlorine in the main industrial area. The buildings and surrounding areas became contaminated with DDT and heavy metals. The contaminants were conveyed to sediments in the receiving streams by rainfall runoff.
SIZE	95 acres
CONTENTS	Isolated pockets of DDT and heavy metals contamination were dispersed throughout this area; however, no mustard or lewisite agent was detected.
COMMENTS	Remediation was completed in 1986. Initial remediation efforts within this area were begun in 1975, with the containment and encapsulation of DDT wastes. As the cleanup continued, surface features were modified in 1984 by an FY83 Military Construction, Army project for runoff control. The final phase of the extensive remediation effort was completed in 1986, when the numerous buildings, underlying foundations and soil, and industrial sewer lines were removed from the area and disposed of at an onsite, Resource Conservation and Recovery Act-permitted hazardous waste landfill.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

LOCATION	Pine Bluff Arsenal
LOCALITY	Pine Bluff
STATE	AR
SITE	Site 12, SWMU 10
DESCRIPTION	Site was primarily used as a burn and disposal area for mustard munitions for a period of approximately 6 years. Last known use of this area was in 1948. Scattered across the site were mounds and trenches, which were the result of disposal operations. Four parallel trenches on the southern end of the site contained rusted munitions and 55-gallon drums. A larger pile of debris existed west of the four trenches, where shell casings were stacked and burned with thermite. A smaller pile was present south of the four trenches. A large burning area located in the central portion of the site covered approximately one acre. Pits on the northern end of the site contained the remains of tubes that held igniter mix for the munitions. A smaller burn area in the northern portion of the site covered about 10,000 square feet.
SIZE	25 acres
CONTENTS	Approximately four acres of Site 12 were covered with fill material or contaminated soil. The majority of the fill was burned residue from various types of disposal operations. Mustard byproducts and high concentrations of sulfur were detected in the fill. Arsenic, barium, and lead were the major contaminants in the fill, with concentrations as high as 24 mg/kg arsenic, 10,000 mg/kg barium, and 4300 mg/kg lead. Cadmium and chromium were also found, with levels of 42 mg/kg cadmium and 280 mg/kg chromium. Various munition types and munition-related hardware were present on the site and in the trenches.
COMMENTS	Site has been remediated in accordance with a state-approved closure plan. Efforts were completed in October 1988. The selected closure plan consisted of relocating the contaminated materials from the site to another closure cell. This type of offsite closure was environmentally feasible because the waste material was not a hazardous waste. Prior to excavation of the soil and fill material, the suspect munitons were recovered from the site by Arsenal forces and placed into storage. These items are currently being stored at Pine Bluff Arsenal as a hazardous waste awaiting final treatment and disposal as part of the Non-Stockpile Chemical Materiel Program.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

LOCATION	Pine Bluff Arsenal
LOCALITY	Pine Bluff
STATE	AR
SITE	Site 7b, SWMU 19
DESCRIPTION	Area was used as a lewisite disposal site and consisted of an unlined, 4-acre breached lagoon that drained into a small tributary of Phillips Creek. Vegetation was nonexistent or severely distressed in the drained lagoon area and in the stream bed to the confluence with the drainage that ran south of the lagoon area. The "abandoned" lagoon contained a white limey sludge that measured as deep as 7 feet in some areas. The white limey sludge was demilitarized lewisite. Mercury, a catalyst used in the lewisite production, was also disposed of in the lagoon. The site was characterized by a pH greater than 12 and very high levels of arsenic and mercury.
SIZE	5 acres
CONTENTS	The sludge was a white to light-gray, soft, sticky material that contained approximately 65-percent calcium and had a pH of about 12.6. The sludge contained up to 39,000 mg/kg arsenic and 4400 mg/kg mercury. There were also low concentrations of silver, cadmium, and lead in the sludge. The primary contaminants in the underlying soil were also arsenic and mercury. The greatest amount of contamination existed in the top foot of soil underneath the sludge, where arsenic and mercury comprised about 3 percent of the soil by weight. Contaminant levels decreased sharply below this highly contaminated layer, with contamination extending an average of 8 feet below the sludge.
COMMENTS	Site has been remediated in accordance with a state-approved closure plan. Efforts were completed in October 1989. The waste quantities mandated onsite closure. The selected plan used the same slurry wall and membrane-lined cover strategy as was employed at Site 7c. Again, the vast majority of the material was encapsulated in place with minor amounts being moved as necessary to consolidate the material in the most reasonable compact arrangement.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

LOCATION	Pine Bluff Arsenal
LOCALITY	Pine Bluff
STATE	AR
SITE	Site 7c, SWMU 21
DESCRIPTION	Area was contaminated by several activities and is located south of a ditch that drained into the stream leaving the lewisite area (Site 7d). The site had several pockets of low-level inactive mustard agent and a strong chemical odor, and did not support vegetation. The drainage ditch was approximately 6 feet deep and drained to the west toward Site 7d. It contained residue from the burn area and runoff from the Depot Storage Yard and bulk container renovation facility. The effluent generated by the renovation facility was contaminated with arsenic and mercury from blister agent containers and was characterized by nonexistent or severely distressed vegetation.
SIZE	6 acres
CONTENTS	Residue from mustard burning and decontamination was a soft, yellow-brown, spongy material with a black crust and a strong chemical odor. It had a pH of 0.5 to 1 .5, which may have resulted from treatment with DANC, a decontaminating agent. The burn pile contained a black, gooey material 2 to 3 feet in depth. This material contained up to 280 mg/kg mustard agent. The mustard was not volatizing at room temperature and was considered to be in an inactive state. Within the site, concentrations of arsenic and mercury were as high as 700 mg/kg and 800 mg/kg, respectively.
COMMENTS	Site has been remediated in accordance with a state-approved closure plan. Efforts were completed in September 1989. Selected closure plan used a 36-inch wide slurry wall as a perimeter closure cell wall to minimize groundwater contamination by diverting groundwater around or underneath the contaminated material. A membrane-lined cover over the area enclosed by the cell walls and surface runoff diversion ditches was used to prevent downward migration of the contamination by eliminating surface water from infiltrating the closure cell. The plan consisted of in-situ closure of the bulk of the materials at the site, with movement of minor amounts of material in the most reasonable compaction arrangement.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

LOCATION	Pine Bluff Arsenal
LOCALITY	Pine Bluff
STATE	AR
SITE	Site 7d, SWMU 20
DESCRIPTION	Two water-filled pits about 75 feet wide and 600 feet long located south of the Depot Storage Yard between Sites 7b and 7c. These were borrow pit areas used to provide material for the constuction of the Depot Storage Yard. Just east of the borrow pits, mustard and lewisite munitions were buried after World War II (Site 7c). These munitions were exhumed and demilitarized (burned) in 1955. Both borrow pits were contaminated with arsenic and mercury and contained demilitarized lewisite in their western portions. The northern pit had a strong chemical odor and discolored soil on its northern slope. Several rusted mortar casings protruded from the sediment.
SIZE	11 acres
CONTENTS	The material used to backfill the trenches that previously held mustard and lewisite munitions was saturated silty clay; it was colored gray, black, red, and greenish-gray and had a strong chemical odor. The backfill contained up to 10,000 mg/kg arsenic and 5,400 mg/kg mercury. Arsenic concentrations in the borrow pit sediment were as high as 3,300 mg/kg. About 5,000 cubic yards of the sediment was present in the two pits. The primary contaminants in the soil, as they were in the fill, were arsenic and mercury. Contamination extended a maximum of 3 feet into natural soil below the trench backfill and 4 feet below the borrow pit sediments. Concentrations of metals in the soil were approximately one order of magnitude less than in the fill.
COMMENTS	Site has been remediated in accordance with state-approved closure plan. Efforts were completed in October 1989. As with Site 7b, the quantity of waste mandated onsite closure using the same slurry wall and membrane-lined cover technique. Again, most material was encapsulated in place with some quantities from the associated creek and drainage ditch being excavated and then consolidated within the containment area.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

LOCATION	Pine Bluff Arsenal
LOCALITY	Pine Bluff
STATE	AR
SITE	Triplett Creek
DESCRIPTION	Triplett Creek, more commonly known as Phillips Creek, receives runoff from the drainage basin containing Sites 7b, c, and d, and the old chemical manufacturing area.
SIZE	N/A
CONTENTS	Contaminants were present in stream sediment in the immediate vicinity of the specific areas.
COMMENTS	Remediation was completed in 1984. Chemical and biological evaluations after the completion of remediation efforts within the basin showed no contamination of the creek.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

LOCATION	Pine Bluff Arsenal
LOCALITY	Pine Bluff
STATE	AR
SITE	All areas
DESCRIPTION	On July 8, 1947, German 150-millimeter rocket projectiles (Traktor) filled with nitrogen mustard (HN) were improperly burned. A number of these projectiles flew out of the disposal pit. At least seven have been recovered at various spots on the Arsenal and one has been recovered outside the Arsenal boundary.
SIZE	Unknown
CONTENTS	Unknown; however, over 100 rockets left the pit.
COMMENTS	Numerous German Tracktor rockets were recovered during the remediation of Site 12 and at various locations on Pine Bluff Arsenal. There are currently no unknown rockets or contamination that has not been removed; therefore, no further investigations are planned or deemed necessary at this time.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

LOCATION	Pine Bluff Arsenal
LOCALITY	Pine Bluff
STATE	AR
SITE	Mortar Range
DESCRIPTION	4.2-inch chemical mortar range. High explosive, white phosphorus, mustard gas, and fuming sulfuric acid-filled mortar shells were fired and impacted here.
SIZE	Unknown
CONTENTS	Potential mortar shells and residue from testing.
COMMENTS	There is no defined mortar range at Pine Bluff Arsenal. All known areas of impact have been investigated and any suspect rounds recovered. No further investigations are planned or deemed necessary.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

LOCATION	Pine Bluff Arsenal
LOCALITY	Pine Bluff
S T A T E	AR
SITE	Unknown
DESCRIPTION	10 rounds (mustard-filled) fired approximately 500 yards along the Arkansas River.
SIZE	Unknown
CONTENTS	10 rounds mustard-filled (exploded/unexploded?)
COMMENTS	Numerous suspect mustard rounds were recovered during the remediation of Site 12 and the soil borrow area south of Site 12. No further investigations are planned or deemed necessary.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

LOCATION	Pine Bluff Arsenal
LOCALITY	Pine Bluff
STATE	AR
SITE	Bombing Mat Vicinity
DESCRIPTION	Surface debris consisting of concrete, scrap metal, and various types of munition items were found sparsely scattered around the area.
SIZE	Unknown
CONTENTS	Unknown
COMMENTS	None
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Southwestern Proving Ground
LOCALITY	Hope
STATE	AR
SITE	Unknown
DESCRIPTION	Three references to ammunition filled with mustard gas ready for test at Southwestern Proving Ground were found: 1. Shell, Gas, H.S., Ml 05, unfuzed, w/burster, M6. 155-mm How., Ml 7, 18" ready for test. 2. Bomb, Gas, H.S., 30lb., M46 from Redstone Ordnance Plant was ready to test. 3. Shell, Gas, H.S., Ml 10, unfuzed, 155-mm How., M17, 18" ready for test. It is unknown if any of these items were actually tested.
SIZE	Unknown
CONTENTS	Unknown
COMMENTS	None
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	4 - Possible burial

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CALIFORNIA

NAME OF LOCATION: Fort Ord

Fort Ord is located near the cities of Marina Del Ray Oaks, Seaside, Sand City, and is 9 miles north of Monterey, California. The land for this installation was purchased in 1917 and was called the Fort Ord Complex and was comprised of several camps. The installation was used as a maneuver area and field artillery range for the 1 Ith Cavalry and the 76th Field Artillery. In 1933, the post was renamed Fort Ord.

Fort Ord was an Infantry Training Center. During World War II, troops assigned to Edgewood Arsenal, Maryland, trained and conducted experiments at Fort Ord and Fort Ord's sub-installation Camp McQuaid.

Chemical agent identification sets (CAIS) were used at Fort Ord prior to 1974 for field training of troops at a site past the landfill area off lmjin Road. In 1974, four CAIS in the inventory were removed from the installation and sent to Edgewood, Maryland. They were subsequently sent to Rocky Mountain Arsenal for destruction.

LOCALITY/STATE: Fort Ord, California (Monterey County)

SCOPE OF RESTORATION EFFORTS: As at many other training installations, CAIS were found at Fort Ord and removed. At many installations around the country, CAIS were buried and later encountered during construction-related activities; however, no records of such practice or of subsequent CAIS discovery have been found at Fort Ord. Contamination at the firing ranges is most likely limited to unexploded ordnance, explosive residues, and heavy metals.

EFFORTS TO DATE: Remedial investigations are underway at 41 sites on the installation for conventional toxic wastes. Four Records of Decision have been completed at Fort Ord. These will allow the remedial design/remedial action for all but seven sites, unexploded ordnance/ordnance and explosive wastes, and Monterey Bay.

REMEDIATION SCHEDULE: There is no known need for chemical agent remediation at Fort Ord.

RISK PERCEPTION: This installation is not believed to present any immediate threat to human health or safety due to chemical agents.

NAME OF LOCATION: **Santa Rosa Army Air Field (also known as Sonoma Municipal Airport)**

LOCALITY/STATE: Sonoma County, California, between Santa Rosa and Healdburg

FUDS ACTIVITIES AT THIS LOCATION: The former airfield consisted of 1590 acres leased from Sonoma County government, purchased in fee from private owners or obtained by aviation easement. During World War II, it was used to conduct fighter training. Some training involved using of chemical agent identification sets (CAIS). This took place in an area later occupied by the Sonoma County Water Agency Maintenance Yard.

Between October and November 1982, while installing a sewage line, workers were overcome by a white cloud of smoke that appeared in the trench. Several weeks later, construction halted when an ampule of 5-percent lewisite solution from a CAIS was found. In August and September 1983, the Technical Escort Unit began excavation of the site and discovered 24 CAIS components. None were hazardous. During the operation, excavations covered an area of 90 feet by 35 feet by 6 feet and over 20,000 cubic feet of earth was removed and sifted. Though further components were found, areas near the excavation are still suspected of containing CAIS components. In 1985, an additional five ampules of gas were discovered and the location was cleaned up under the supervision of the Corps of Engineers with technical assistance from the U.S. Army Toxic and Hazardous Materials Agency.

PREVIOUS CORPS ACTIVITIES: U.S. Army Corps of Engineers (USACE) personnel conducted a preliminary assessment of the site in 1992. The assessment, concluding that the potential for buried CAIS exists, recommended that Huntsville Division further evaluate the site. In August 1992, representatives from the USACE, the U.S. Army Chemical Materiel Destruction Agency, and Sonoma County met to discuss the site and potential danger. This site has been visited many times between 1983 and October 1992.

ACTIONS COMPLETED/PLANNED FOR THE FUTURE: The USACE has completed an Archives Search Report of the Santa Rosa Army Air Field. Since the technology to detect buried glass vials has not yet been developed, the current plan, which is in draft form and is being coordinated, is to assist the Sonoma County Government in their planned construction by preparing a Site Safety Submission that will cover all aspects if more glass vials of chemical warfare materiel are recovered. This plan is being coordinated with all required government agencies and will be approved by the Department of Defense Explosive Safety Board. The intent is for the Army to do required excavations prior to the county doing construction work. An engineering evaluation/cost analysis is currently being reviewed by California Department of Toxics and the community.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: Residential, county, state, and commercial property borders the site. The site is used by the county as a detention facility and is not accessible to the public. The county has several utility and building construction projects that will require excavation.

RISK PERCEPTION: Unless the site is disturbed by excavation, no threat to human health and safety is anticipated. The USACE has advised the county to avoid excavating in this area.

NAME OF LOCATION: Mount Shasta

LOCALITY/STATE: Mount Shasta, Siskiyou, California

FUDS ACTIVITIES AT THIS LOCATION: In December 1943, the Chemical Warfare Service began design of a highly mobile laboratory unit for proposed laboratory teams accompanying task forces in the combat zone. This portable unit for gas intelligence missions weighed 3,293 pounds and was packed in seven plywood boxes and nine smaller cases that could be stowed in a single 2-1/2 ton truck. It was assembled and standardized in October 1944 as the M3 mobile laboratory.

As the battle lines shifted from North Africa across the Mediterranean, the National Defense Research Committee (NDRC) sent a mobile unit group from the University of California to Mount Shasta, where the climate and terrain were similar to those in sections of Italy. The investigation of this group was chiefly concerned with clouds of nonpersistent gas released from 100-pound M47A2 bombs. An NDRC report was prepared on the chemical warfare tests carried out on the slopes of Mount Shasta. The report indicates that the bombs were filled with butane and statically fired to observe dispersion patterns through the forest.

PREVIOUS CORPS ACTIVITIES: An Archive Search Report was completed in 1993, with a recommendation of no further action. The tests were with nonchemical warfare materiel.

ACTIONS PLANNED FOR THE FUTURE: None.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: None.

RISK PERCEPTION: There is no risk to public health and safety.

NAME OF LOCATION: Edwards Air Force Base

LOCALITY/STATE: Kern Country, California

WORK PLAN STATUS: National Priorities List Installation

SCOPE OF RESTORATION EFFORT: Edwards Air Force Base (AFB) has potential chemical munitions sites within its Installation Restoration Program.

EFFORT TO DATE: Current reports and historical documentation indicate Edwards AFB was used to test air-dropped chemical munitions with mustard, nerve, Phosgene, cyanogen chloride, and hydrogen cyanide fills. During 1992, two AN-MI25 bomblets and one M-78 bomb were uncovered with fuzes still intact. The munitions were incinerated onsite and 30 days of monitoring took place following the disposal.

During May 1950, the Technical Service Unit conducted a clearance operation that produced items that were chemical-filled. All explosives were detonated. All chemical munitions were punctured, and the contents were destroyed by burning (area not identified), Further decontamination was done using bleach powder and DANC (a decontaminant). The installation was granted a Certification of Clearance after this operation on June 9, 1950.

REMEDIATION SCHEDULE: Removal actions and remedial design/remedial action work will be integrated as appropriate into the installation restoration program.

RISK PERCEPTION: Because the impact ranges are in a controlled area, the threat to public health due to chemical agents is low to nonexistent.

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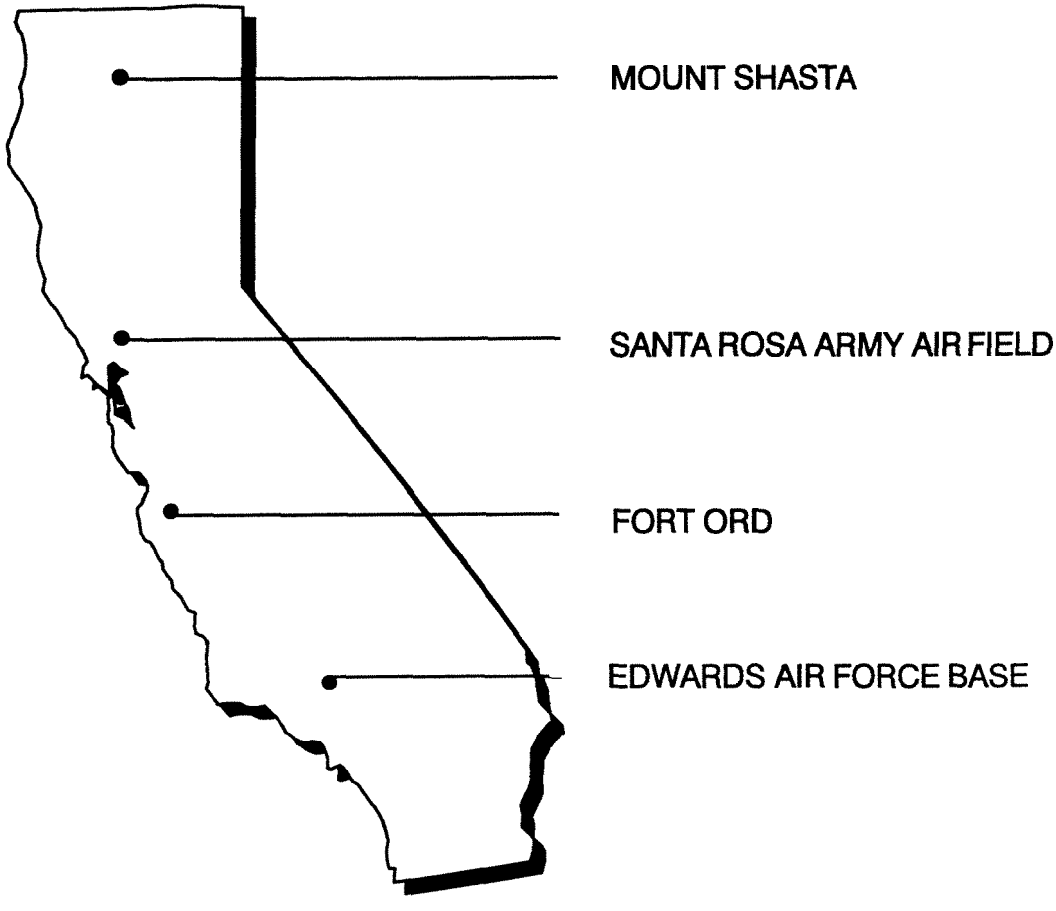
CALIFORNIA


MOUNT SHASTA
SANTA ROSA ARMY AIR FIELD
FORT ORD
EDWARDS AIR FORCE BASE

LOCATION	Fort Ord
LOCALITY	Monterey
STATE	CA
SITE	Unknown
DESCRIPTION	Near Imjin Road Landfill. Used as a chemical warfare training area.
SIZE	Unknown
CONTENTS	Mustard chemical agent identification sets suspected.
COMMENTS	Some chemical agent identification sets transferred to Aberdeen Proving Ground-Edgewood Area in 1974. Later sent to Rocky Mountain Arsenal and destroyed in 7981.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	4 - Possible burial

LOCATION	Santa Rosa Army Air Field
LOCALITY	Santa Rosa
STATE	CA
SITE	Unknown
DESCRIPTION	Burial site of a chemical agent identification set. North of Sonoma County Water Agency Maintenance Yard.
SIZE	4 by 4 by 1-1/2 feet deep
CONTENTS	Potential for other chemical agent identification set burials.
COMMENTS	None
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	1- Known burial

LOCATION	Mount Shasta
LOCALITY	Siskiyou
STATE	CA
SITE	Unknown
DESCRIPTION	Testing of chemical warfare agents.
SIZE	Unknown
CONTENTS	100-pound M47A2 bombs filled with butane.
COMMENTS	An Archives Search Report (ASR) was completed in September 1993. The conclusion of the ASR is that no toxic chemical agents were used in the experiment.
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

LOCATION	Edwards Air Force Base
LOCALITY	Rosemont
STATE	CA
SITE	Ranges
DESCRIPTION	Bombardment ranges. In 1992, two Ml25 bomblets and one M78 bomb were discovered in a fuzed and unsafe condition. These items, with full state and Environmental Protection Agency cooperation, were detonated. Historical installation maps indicate several bombing areas were used to test air-dropped chemical munitions.
SIZE	Unknown
CONTENTS	World War II and Korean era air bombs to include mustard, nerve agent (GB), Phosgene, cyanogen chloride, and hydrogen cyanide.
COMMENTS	None
TYPE	Range
INSTALLATION	Air Force
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	1 - Known burial

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COLORADO

NAME OF LOCATION: **Pueblo Depot Activity**

Located in southeastern Colorado, Pueblo Depot Activity (PUDA) lies 14 miles east of Pueblo, Colorado, and north of the Arkansas River in Pueblo County. PUDA covers 22,654 acres of rolling prairie lands and has a mixture of buildings and other structures, with open and undeveloped areas as well.

In 1941, the location of PUDA was selected in response to the acceleration of national defense efforts prior to United States intervention in World War II.

The following is a list of historical events at PUDA:

1942: U.S. Army Corps of Engineers began construction on former cattle grazing land.

1942: In April, the Ordnance Corps assumed responsibility for the depot.

1948: Ammunition workshop buildings were constructed for the renovation and demilitarization of ammunition.

1962: Pueblo Ordnance Depot became the Pueblo Army Depot under the newly created Supply and Maintenance Command, with consolidation of the Army Technical Services.

1970: Navajo Army Depot, Flagstaff, Arizona; Fort Wingate Army Depot, Gallup, New Mexico; and Tooele Army Depot, Tooele, Utah, were made satellites to Pueblo Army Depot under direction of the Army Materiel Command.

1976: Department of the Army Readiness Command (DARCOM) General orders No. 104, dated June 16, 1976, reassigned Pueblo to Tooele Army Depot as Pueblo Depot Activity.

1984: DARCOM became the Army Materiel Command.

PUDA currently serves as a storage site for chemical weapons stockpile materiel.

The former Mustard Disposal Area is located south of North Burn Area 2, between gates 23 and 24. It is a fenced area approximately 6 acres where 105mm, 155mm, and 4.2-inch mustard rounds were destroyed from 1965 to 1968. The total quantities of munitions destroyed are currently unknown. Since 1968, leaking munitions have been decontaminated with bleach, dried, sealed in pressure-tested containers, and stored in a designated igloo. In 1988, tests conducted at the site reported that thiodiglycol (a mustard agent decomposition product) was not detected in the soil.

The Chemical Weapons Munitions Burial Ground, located in the northeast portion of the installation, served as a burial site from 1942 to 1946. It was used to destroy approximately 100 to 125 M-70 mustard-filled bombs. The bombs were thermally and chemically decontaminated in a pit lined with bleach, dunnage, and fuel. The pits were then backfilled and warning signs posted on perimeter fencing.

The North Burn Areas 1 and 2 are located in the northwest corner, west of gate 23 and southwest of the North Demolition Area. Clothing worn by workers handling "leaking" mustard agent munitions may have been burned here.

LOCALITY/STATE: PUDA is located 14 miles east of the city of Pueblo, Colorado, just north of the Arkansas River.

SCOPE OF RESTORATION EFFORTS: A Resource Conservation and Recovery Act facilities investigation (RFI), a corrective measure study (CMS), and a corrective action order (CAO) are underway. The CAO, issued in December 1991, requires action be taken at the landfill, TNT washout facility, and an industrial disposal ditch. This requires development of an RFI work plan and interim remediation of groundwater contamination. The State is considering adding eight additional sites to the CAO. Other areas under investigation, including the burning areas, disposal areas, and lagoons, have contributed metals and explosive residues to soil. Volatile solvents have been detected in groundwater downgradient of the landfill, both on- and off-post. The 1990 Enhanced Preliminary Assessment recommended sampling for mustard agent and degradation products at three areas associated with chemical munitions handling and the Chemical Munitions Storage Area, once the stockpile has been demilitarized.

EFFORTS TO DATE: The RFI workplan for SWMUs 12 and 13 was submitted to Colorado Department of Public Health and Environment (COPHE) in December. A geophysical study and surface clearance has been completed on these sites. A CMS will be accomplished following field work for the workplan. The Chemical Demilitarization Program is scheduled to operate past the base closure date of 1995. The U.S. Army Corps of Engineers, Omaha District, is evaluating procedures for remediating sites potentially contaminated with chemical agent.

REMEDIATION SCHEDULE: Remediation schedules will be better addressed once the RFI and CMS are completed. Destruction of stockpiled chemical agent munitions will be addressed under the Chemical Stockpile Disposal Program.

RISK PERCEPTION: Onsite residents live in the administrative area with little or no exposure to areas of contamination. All explosive detonation and chemical warfare materiel areas are located within secure areas, with access only granted on an as needed basis. The chemical munitions storage igloos are monitored quarterly to ensure there are no leaks. Quarterly monitoring also includes visual inspection to identify containers that may pose a future risk. The annually updated Installation Disaster Control Plan identifies contingencies for dealing with all possible chemical-related accidents.

NAME OF LOCATION: **South Plants Area, Rocky Mountain Arsenal**

Rocky Mountain Arsenal (RMA), Colorado is 27 square miles in area. The South Plants Area production facilities, particularly those surrounding the Old Mustard Disposal Plant, are cited as potential chemical warfare materiel burial grounds. Liquid-filled 155mm projectiles were excavated during parking lot construction in the early 1970s.

LOCALITY/STATE: RMA, Commerce City, Colorado

LOCATION HISTORY: From the construction of RMA in 1942 to 1946, the Army was the sole user of the South Plants manufacturing complex. At various times during this period, the Army manufactured and filled munitions with the chemical agents Levinstein mustard and lewisite. Acetylene, chlorine/caustic, sulfur monochloride, sulfur dichloride, arsenic trichloride, and thionyl chloride were produced as feedstock for the manufacture of these agents. Phosgene, although not manufactured at RMA, was filled into 500- and 1 ,OOO-pound bombs. Five types of incendiary bombs were either filled or produced at RMA during this period.

After World War II (WWII), most buildings in the South Plants were placed on standby status for military activities while portions of the manufacturing complex were leased to private industry for the production of commercial products. Records have been located for nine companies that conducted manufacturing or processing operations in the South Plants from 1946 to 1982, when manufacturing activities in the South Plants ceased. The two major lessees of facilities in the South Plants were Julius Hyman and Company (1947 to 1952) and Shell Oil Company (1952 to the present). Hyman manufactured chlorinated pesticides including aldrin, dieldrin, and chlordane. Hyman also manufactured, or brought onto, RMA the feedstock chemicalsused in manufacturing its commercial products. From 1952 to 1982, Shell produced chlorinated hydrocarbon insecticides, organophosphate insecticides, carbamate insecticides, herbicides, and soil fumigants. After WWII, the Army did not manufacture chemical agents in the South Plants.

At various times between 1946 and 1966, the Army used buildings that it had not leased to others in the South Plants Area to demilitarize munitions containing mustard and cyanogen chloride and to recondition one-ton containers that had stored mustard, Phosgene, and lewisite. The Army filled munitions with distilled mustard from 1953 to 1955 and intermittently renovated mustard filled bombs from 1952 to 1954. From 1971 to 1974, the Army demilitarized bulk mustard stocks at RMA in its South Plants facilities. In 1976 the Army transferred phosgene from existing storage containers to modified containers that could meet Department of Transportation criteria for transport. From 1961 to 1982, the Army operated, in conjunction with the Air Force, a hydrazine blending and storage facility in the eastern portion of the South Plants.

PLANNED ACTIONS: No response actions are planned prior to the final Record of Decision (ROD).

RISK PERCEPTION: The entire RMA is a Comprehensive Environmental Response, Compensation, and Liability Act site, with interim cleanup underway. The remedial investigation/environmental assessment/feasibility study process is being followed to develop a comprehensive ROD. The potential exposure of on-post workers and off-post residents has been evaluated as part of this process. Appropriate measures will be used to ensure protection of human health and the environment during and after cleanup.

NAME OF LOCATION: North Plant Area, Rocky Mountain Arsenal

LOCALITY/STATE: RMA, Commerce City, Colorado

LOCATION HISTORY: During the Korean War (June 1951 to January 1953), the North Plant Area (NPA) of the arsenal was constructed. The NPA was used to manufacture Sarin, a new type of nerve agent. Sarin, or GB, was manufactured at the GB Production Site, located within NPA, from February 1953 until August 1957. Intermittently between 1953 and 1969, numerous GB munition filling programs were conducted by the Army at the GB Fill Site located within the NPA. In addition, the Army redistilled low purity GB that had been stored onsite in ton containers, on an intermittent basis between May 1964 and March 1970 at the GB Production Site. The majority of the NPA is comprised of the GB Production Site and the GB Fill Site.

PLANNED ACTIVITIES: Remediation of the NPA is pending a final Record of Decision (ROD) to implement a coordinated agreement among the principal parties. Response activities will begin as soon as the ROD is approved.

RISK PERCEPTION: The entire RMA is a Comprehensive Environmental Response, Compensation, and Liability Act site, with interim cleanup underway. The remedial investigation/environmental assessment/feasibility study process is being followed to develop a comprehensive ROD. The potential exposure of onpost workers and off-post residents has been evaluated as part of this process. Appropriate measures will be used to ensure protection of human health and the environment during and after cleanup.

NAME OF LOCATION: **Toxic Storage Yard, Rocky Mountain Arsenal**

LOCALITY/STATE: RMA, Commerce City, Colorado

LOCATION HISTORY: The toxic storage yard, in the northeast corner of Section 31, was constructed before April 1953 to store materiel including GB-filled ton containers and munitions. The yard was used for storage until the late 1970s or early 1980s. Chemical agents stored include mustard, lewisite, Phosgene, GB, and VX. A series of dirt-floored storage sheds were constructed in the new toxic storage yard as part of an expansion of the storage facilities. By 1980, storage sheds on 12 dirt plots were used to store empty munitions, ton containers, salt drums from GB demilitarization activity, chemical agent identification sets and laboratory samples. Between 1981 and 1982, the chemical agent identification sets and laboratory samples were incinerated in the North Plants facilities.

Constructed in 1956 and 1958, the western rows of storage plots were used when storage operations were moved from the old toxic storage yard to the new toxic storage yard in 1969. Several spills occurred when mustard, distilled mustard, and phosgene ton containers were moved. Storage of GB-filled munitions occurred from 1973 to 1976. Mustard, cyanogen chloride, 30-gallon drums of lewisite and 55-gallon drums of heptachlor were also included in the inventory of items stored in these sheds during the late 1970s.

PLANNED ACTIONS: All except one storage shed was dismantled in the 1980s. No response actions are planned prior to the final ROD.

RISK PERCEPTION: The entire RMA is a Comprehensive Environmental Response, Compensation, and Liability Act site (CERCLA), with interim cleanup underway. The remedial investigation/environmental assessment/feasibility study process is being followed to develop a comprehensive ROD. The potential exposure of on-post workers and off-post residents has been evaluated as part of this process. Appropriate measures will be used to ensure protection of human health and the environment during and after cleanup.

NAME OF LOCATION: **Old Toxic Storage Yard, Rocky Mountain Arsenal**

LOCALITY/STATE: RMA, Commerce City, Colorado

LOCATION HISTORY: The old toxic storage yard in Section 6 was used to store one-ton containers and 55-gallon drums of Levinstein and distilled mustard beginning in the early 1940s. Incendiary bombs were stored on this site in October 1946. Chemical agents such as mustard, distilled mustard, and phosgene were stored in this yard until 1969. Several documented spills occurred over approximately 25 years of storage yard use. A 7969 presidential directive ordered an increase in security for the storage of chemical agents at all U.S. government storage sites. In compliance with this directive, chemical agents stored at the yard at Section 6 were moved to the newer and more secure toxic storage yard in Section 31. Spills of phosgene were documented in the Section 6 yard, although Phosgene, being of a gaseous nature, is thought to have volatilized into the air rather than contaminated the soil.

Other mustard leaks were documented at the site, although their exact locations are unknown. The toxic storage yard in Section 5 was an overflow storage area for the Section 6 yard and was used to store leaking drums of Levinstein and distilled mustard during World War II. In the late 1940s, this yard was used to store approximately 1,000 mustard-filled 55-gallon drums and ton containers.

PLANNED ACTIONS: No response actions are planned prior to the final Record of Decision.

RISK PERCEPTION: The entire RMA is a CERCLA site, with interim cleanup underway. The remedial investigation/environmental assessment/feasibility study process is being followed to develop a comprehensive ROD. The potential exposure of on-post workers and off-post residents has been evaluated as part of this process. Appropriate measures will be used to ensure protection of human health and the environment during cleanup.

NAME OF LOCATION: **Basin A, Rocky Mountain Arsenal**

LOCALITY/STATE: RMA, Commerce City, Colorado

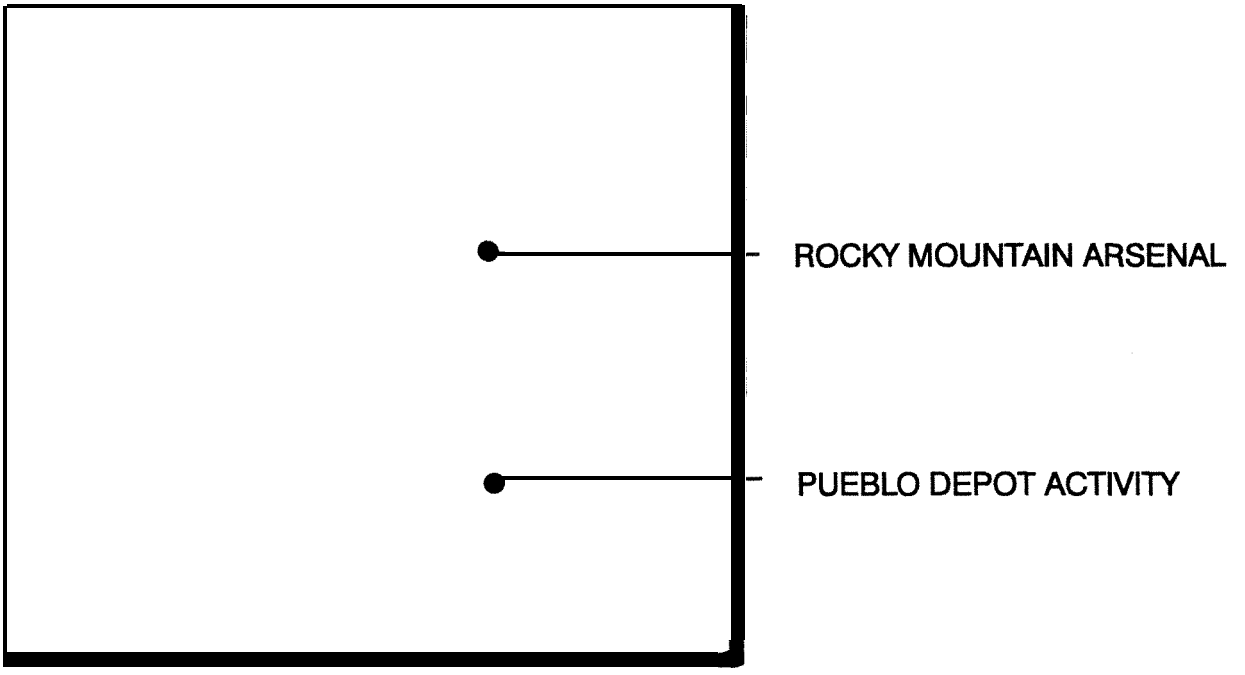
LOCATION HISTORY: Basin A was an unlined liquid waste disposal basin approximately 123 acres in size with a capacity of about 350 million gallons. It was constructed in 1942-43 to receive liquid waste from the Army's mustard and lewisite production operations at RMA. Beginning in the late 1940s, liquid waste from lessee pesticide production operations was disposed in Basin A. Also, starting in 1953, liquid waste from the Army's GB production was disposed in Basin A. In 1956-57, liquid wastes from Basin A were transferred to a newly constructed asphalt lined disposal basin referred to as Basin F. By September 1957, all liquid waste from Basin A had been transferred to Basin F and Basin A was no longer used for liquid waste disposal.

Other types of wastes disposed in Basin A include equipment contaminated with mustard, ton containers of mustard, and miscellaneous trash and solid waste. On the eastern side of Basin A, the Army and Shell Oil Company operated a series of complex disposal trenches where the following items were known to have been disposed: aldrin, dieldrin, endrin, isodrin, dicyclopentadiene, chlorobenzene, hexachlorocyclopentadiene (HCCPD, Hex), HCCPD impurities, heavy hydrocarbons from Shell, and other Army waste from installation or demilitarization operations from mustard, lewisite, nerve gas (GB and VX), adamsite, cyanogen chloride, chlorinated paraffin, white phosphorus, Phosgene, dichlor, and unexploded ordnance.

PLANNED ACTIONS: No response actions are planned prior to the final ROD.

RISK PERCEPTION: The entire RMA is a CERCLA site, with interim cleanup underway. The remedial investigation/environmental assessment/feasibility study process is being followed to develop a comprehensive ROD. The potential exposure of on-post workers and off-post residents has been evaluated as part of this process. Appropriate measures will be used to ensure protection of human health and the environment during cleanup.

COLORADO



LOCATION	Pueblo Depot Activity
LOCALITY	Pueblo
STATE	**CO**
SITE	SWMU 13
DESCRIPTION	Area known as gas or mustard disposal area. Located on east side of installation in the surveillance and test range. Agent burned with dunnage between 1965 and 1968. Area fenced with warning signs.
SIZE	Approximately 6 acres
CONTENTS	Leaking mustard rounds (105-millimeter and 155millimeter) and 4.2-inch rounds destroyed by burning.
COMMENTS	Source cites no contamination from thiodiglycol. Size of area differs in sources. Eyewitness interview indicates this site may be classified as a large burial site. The Army will conduct further investigations to determine whether this site should be re-classified as a large burial site.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Pueblo Depot Activity
LOCALITY	Pueblo
STATE	CO
SITE	SWMU 12
DESCRIPTION	Area cited as chemical warfare burial. Located on west side of installation. Area is fenced and marked. Disposal took place between September 1942 and February 1946. Mustard decontaminated and burned.
SIZE	1/4 acre
CONTENTS	100 to 125 M-70 mustard bombs disposed of by burning.
COMMENTS	Pit lined with dunnage and fuel. Size of area differs in sources.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Pueblo Depot Activity
LOCALITY	Pueblo
STATE	CO
SITE	SWMU 2
DESCRIPTION	Used as demolition area for conventional and suspected mustard munitions from 1946 to 1953.
SIZE	25 acres
CONTENTS	Potential for mustard munitions or residue.
COMMENTS	Confirmation of chemical warfare materiel demilitarization was not obtained at this location during the Archives Search Report, Pueblo Depot Activity May 1994. It is believed that past references to chemical warfare materiel potential at this location are erroneous.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

LOCATION	Pueblo Depot Activity
LOCALITY	Pueblo
STATE	c o
SITE	AREEs 17, 18, 19, and 20
DESCRIPTION	2,000 feet southwest of Gate 23. Three pits that may have been used for mustard disposal not confirmed. Source cites evidence of light- and dark-colored material in one pit from historical photograph.
SIZE	Unknown
CONTENTS	Unknown, possibly mustard.
COMMENTS	Historical use of this area is unknown.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Rocky Mountain Arsenal
LOCALITY	Commerce City
STATE	c o
SITE	GB Pits
DESCRIPTION	Located northeast of Basin A. With the completion of Basin F, this area became the depository for residue from demilitarized, off-specification nerve (GB) munitions. Timeframe: approximately 1951.
SIZE	Unknown
CONTENTS	Potential for nerve agent (GB) and residue.
COMMENTS	None
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Rocky Mountain Arsenal
LOCALITY	Commerce City
STATE	CO
SITE	Section 30 Disposal Area
DESCRIPTION	Around 1957, used for disposal of mustard munitions; 1945 to 1955, pit in south central area used to dispose of liquid from M34 cluster bombs; in 1950s, disposal of 4.2-inch chemical mortars.
SIZE	1 square mile
CONTENTS	Liquid from M34 clusters, mustard munitions.
COMMENTS	Excavated mustard rounds in 1970. Tested soil for mustard contamination with negative results.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	1 - Known burial

LOCATION	Rocky Mountain Arsenal
LOCALITY	Commerce City
STATE	CO
SITE	Section 31
DESCRIPTION	Site of toxic storage yard. Storage area for l-ton containers of nerve (GB), mustard, and choking (CG) agents. Nerve agent (VX) drained from M-55 rocket into ground during demilitarization operation.
SIZE	Unknown
CONTENTS	Unknown
COMMENTS	Large spills occurred during transfer operation. Dates of operation are unknown.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Rocky Mountain Arsenal
LOCALITY	Commerce City
STATE	CO
SITE	Basin A
DESCRIPTION	Used as a disposal area, 1942 to 1952. Numerous pits for disposal of mustard ton containers, M-125 nerve (GB) bomblets, and other chemical warfare materiel. This is a major chemical warfare burial site.
SIZE	123 acres
CONTENTS	Projectiles, sample bottles, inert bombs, and rounds with bursters.
COMMENTS	Characterized as Section 36 in remediation planning. U.S. Army Technicat Escort Unit's old disposal area.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Large quantity
CLASSIFICATION	1 - Known burial

LOCATION	Rocky Mountain Arsenal
LOCALITY	Commerce City
STATE	c o
SITE	Section 30 Range
DESCRIPTION	Large section used as an impact range for 4.2-inch mortars from 1946 to 1950. Also used as a disposal area.
SIZE	1 square mile
CONTENTS	4.2-inch mortar rounds and high explosive incendiaries, smokes, and slugs.
COMMENTS	Probability of unexploded ordnance.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

DISTRICT OF COLUMBIA

NAME OF LOCATION: American University

LOCALITY/STATE: Spring Valley, Washington, D.C.

FUDS ACTIVITIES AT THIS LOCATION: The American University Experiment Station, located in northwest Washington, D.C., was established by the Bureau of Mines in April 1917. It became the Research Division of the Chemical Warfare Service on July 1, 1918. Its mission was to prepare and test chemical warfare compounds for possible use in gas warfare, to develop methods for making these compounds, and to develop masks, canisters, protective clothing, incendiaries, smokes, and signals.

In early 1918, 500 acres of land adjacent to the University were leased and used as a trench mortar proving ground. Eighteen wooden buildings were constructed to support an Organic Research Unit, which experimented with a number of "toxics," including adamsite. Stokes mortars and Livens projectiles were fired at what was then known as Camp American University during the 1917-1918 timeframe. Also during this period, chemical munitions filled with "solid toxics" were exploded in "bomb pits" to determine the concentration of materials in air. Three bomb pits were dug: one in 1917 and two in 1918.

A site known as the "Old Mustard Field," is shown on an aerial map of the Station dated July 1918. It is approximately 500 feet in diameter, and it is located approximately 1,500 feet southwest of Massachusetts Avenue and 2,900 feet northwest of Nebraska Avenue.

In January 1993, construction workers uncovered a pit in a housing development at 52nd Court near the site of American University. The pit contained a variety of World War I era munitions, some of which were liquid-filled. This pit was excavated and the munitions were safely removed from the area during Phase I remediation activities. As a result of this incident, additional information has been found that indicates this area was used as a proving ground for the Chemical Warfare Service.

ACTIONS PLANNED FOR THE FUTURE: The U.S. Army Corps of Engineers has now completed Phase II, which is a comprehensive investigation and cleanup of this site. The Corps aggressively searched for further buried munitions. No chemical warfare materiel (CWM) was found. The record of decision (ROD) for no further action was signed and approved June 2, 1995.

RISK PERCEPTION: All CWM discovered has been removed from the site.

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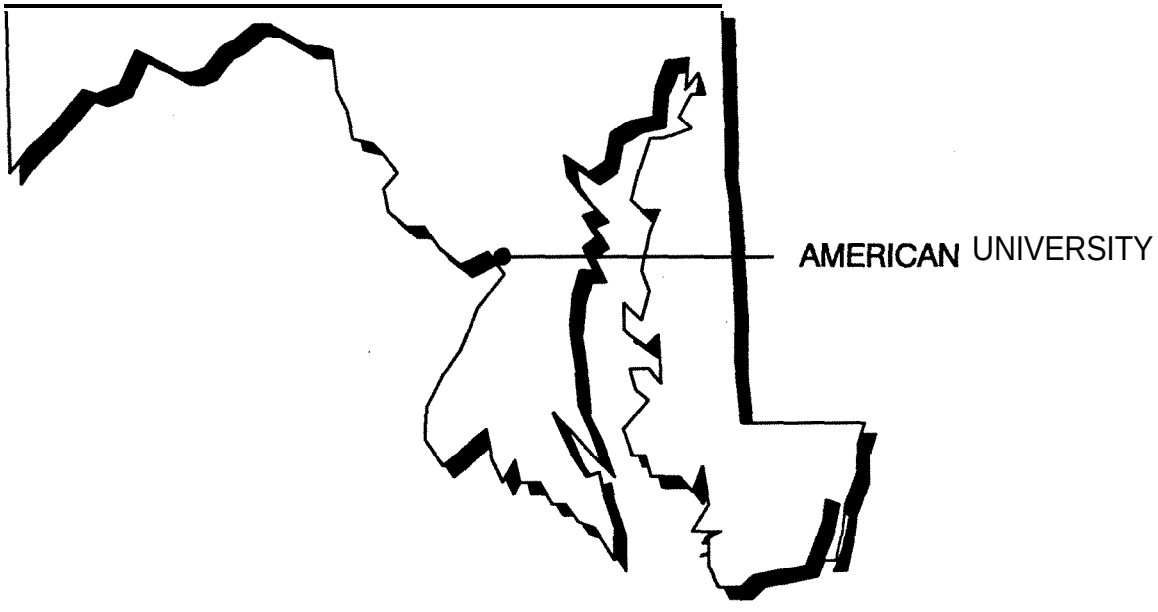
DISTRICT OF COLUMBIA (WASHINGTON D.C.)



LOCATION	American University
LOCALITY	Washington
STATE	DC
SITE	52nd Court
DESCRIPTION	A circular trench system approximately 500 feet in diameter, located approximately 1500 feet southwest of Massachusetts Avenue. and approximately 2900 feet northwest of Nebraska Avenue. This area was carried as a suspect site whose location was unknown until January 1993, when a contractor accidently uncovered site. Site has been completely remediated as an emergency response.
SIZE	500 feet in diameter
CONTENTS	World War l-era munitions including stokes mortars and Livens projectiles.
COMMENTS	Also tested and produced components for protective equipment, smoke, and incendiaries.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM **SITE**	Small quantity, explosive
CLASSIFICATION	5 - No further action

LOCATION	American University
LOCALITY	Washington
STATE	DC
SITE	Camp American University
DESCRIPTION	Formerly known as American University Experimental Station and Camp American University. Used as CWS proving ground, training camp, and laboratory from 1917 to 1920. Early in 1918, 150 acres of adjacent land (leased) to be used as a trench mortar proving ground. Completed remedial investigation in January 1995.
SIZE	600 acres (+)
CONTENTS	WW I-era munitions, including Stokes mortars and Livens projectiles.
COMMENTS	None
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

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FLORIDA

NAME OF LOCATION: **Bushnell Army Air Field (Sub-Post to Orlando Air Base)**

The Chemical Warfare Service (CWS) Mobile Unit, a satellite unit of Dugway Proving Ground (DPG), Utah, conducted operations at Bushnell Army Air Field, Bushnell, Florida, from November 1943 to October 1945. The site of the tests was the Withlacoochee Forest, located approximately 23 miles southeast of Bushnell, Florida. Although Bushnell Army Air Field required storage and handling facilities to support the test operations, no definitive information on these facilities or direct evidence of burial sites were found. Further, there is no documentation found on any range clearance operations or evidence of a need for a Certification of Clearance for Bushnell Army Air Field.

LOCALITY/STATE: Bushnell, Sumpter, Florida

FUDS ACTIVITIES AT THIS LOCATION: To learn the behavior of agents under Pacific island conditions, DPG sent a mobile unit of CWS personnel to Bushnell. The unit continued to function after the war. The initial test project determined the offensive value of bombs filled with nonpersistent agents used on semitropical terrain. Between 1943 and the end of the war, investigators evaluated a large variety of chemical munitions (bombs, shells, thermal generators, land mines, rocket heads, and spray tanks) for their efficiency in dispersing toxic agents. On Florida beaches, they determined the hazard of mustard-contaminated sand to assault troops. At the end of the war, Bushnell closed its agent and munitions program and turned to testing insecticides, fungicides, and miticides.

ACTIONS COMPLETED: The Corps of Engineers has completed an Archives Search of the Bushnell AAF and, as anticipated, evidence suggests no further action. Documentation to provide a no action alternative is currently being prepared for this site by the U.S. Army Corps of Engineers (USACE), Huntsville Division.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: The area is mainly agricultural with a few residential developments. The risk from intrusive activity is low.

RISK PERCEPTION: In February 1993, the site was observed by automobile and on foot. A helicopter overflight of the site was performed on March 20, 1993. Two additional site surveys were accomplished in May and August 1993, as part of the ongoing Archives Search Report. No intrusive activities or hazards were observed. The area is not believed to present any immediate threat to human health and safety.

NAME OF LOCATION: **Withlacoochee, also known as Zephyrhills Gunnery Range**

The site of the tests for the CWS Mobile Unit was the Withlacoochee Forest, located approximately 23 miles southeast of Bushnell, Florida. From November 1943 to October 1945, operations were conducted in Withlacoochee Forest and based at either Bushnell, Florida, or Brooksville Army Air Field. These operations included:

1. A sizeable quantity of mustard-filled bombs was dropped from aircraft at altitudes ranging from 500 to 10,000 feet.

2. Experiments were conducted using mustard-filled 4.2-inch chemical mortar rounds and 7.2-inch rockets. The rounds were fired on four square targets under various weather conditions, and vapor samples were taken. Mustard gas was also spread using aircraft spray tanks. Human observers were used to check the effectiveness of the dispersal methods.

The Zephyrhills Air to Ground Gunnery Range is located in Richloam, Florida.

During May 1950, the U.S. Army Technical Service Unit (TSU) conducted a clearance operation that produced items that were chemical-filled. The following is a list of items found:

- 197 M74 bombs, mustard-filled[1]
- Nine M70 bombs, containing mustard
- 16 M69 bombs, containing mustard
- One 4.2-inch chemical mortar projectile, with fuse, armed, mustard-filled
- Five M47A3 bombs, mustard-filled
- Fifteen containers for smoke mixtures, for the M89, M90, or M98
- Target identification bombs filled with mustard.

All explosives were detonated. All chemical munitions were punctured and the contents were destroyed by burning. Further decontamination was done using bleach powder and DANC (a decontaminant). The installation was granted a Certification of Clearance after this operation on June 9, 1950. This clearance, however, did not account for all munitions lost during operations.

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[1] The M74 was not normally filled with mustard. This was an experimental item consisting of the M74 cluster filled with 10 pounds of mustard and used in the E71 cluster bomb.

LOCALITY/STATE: Approximately 17,000 acres located in Sumpter and Hernando Counties, Florida.

FUDS ACTIVITIES AT THIS LOCATION: The original range was called the Lacoochee Bombing and Gunnery Range and contained 10,562 acres acquired by use permit from the Florida State Department of Agriculture in 1943. An additional 7,680 acres of land were later permitted from the same owner. The lands were all contiguous except for two separate tracts of land located approximately 3 miles to the west. A map showing the entire larger area was titled "Air to Ground Gunnery Range Zephyrhills Army Airfield." Additional lands were also reserved for the CWS, but their actual use has not been verified. The CWS performed aerial and staticordnance tests on this range. Bushnell Army Air Field, Brooksville Army Air Field, Zephyrhills Army Airfield, and possibly other air fields in the area apparently used this range for bombing and gunnery operations with live munitions. The permit for the Army use of the site was relinquished in 1946.

PREVIOUS CORPS ACTIVITIES: An overflight of the entire area was accomplished by the USACE on March 20, 1993. No construction was ongoing at any of the parcels of land identified and no intrusive activities were observed. A site visit to various areas used by the CWS was conducted by the USACE in April 1993. An Archive Search Report (ASR) was completed in July 1993 and recommended additional investigations to determine if chemical warfare materiel (CWM) is still present.

ACTIONS COMPLETED AND PLANNED FOR THE FUTURE: A Phase 1 engineering evaluation/cost analysis was completed in the summer of 1994, consisting of geo-physical mapping and surface sweeps. Awaiting Site Investigation Report. Further investigation is not feasible at this time due to terrain and planned land use.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: The former range is located within the Withlacoochee State Forest-Richloam Wildlife Management Area and remains undeveloped. Two separate parcels in Hemando County have recently been sold to a quarry company which currently is not using the site.

RISK PERCEPTION: At present, the majority of the site remains undeveloped. This area is believed to present a potential for the existence of CWM. However, unless intrusive activities are undertaken, the risk is considered minimal. The ASR developed information that up to 126 chemical bombs may still be present at the site. The owners of the site will be notified. The owners of the two privately held parcels (640 acres each) have been provided with the information available concerning the sites.

NAME OF LOCATION: **Brooksville Army Air Field**

LOCALITY/STATE: Brooksville, Hernando County, Florida

FUDS ACTIVITIES AT THIS LOCATION: The Brooksville Army Air Field (AAF) was located 5 miles south of Brooksville, Florida, on the west side of U.S. Route 41. In 1945, the CWS Mobile Unit at Bushnell AAF was moved to Brooksville. Operations of the unit while at Brooksville were not defined in historical documents reviewed to date.

In 1946, the Army inventoried various Engineer, CWS, and Quartermaster materials at Brooksville. During the inventory, drums of distilled mustard (HD), FS smoke, lewisite, and mustard (H) were transferred to MacDill Army Air Base, Tampa, Florida. On May 7, 1946, in an unknown area, five old drums (contents unknown) were burned and dumped, a leaking EK3[1] experimental mustard-filled munition was removed from a box car (disposition unknown), and one 55-gallon drum of VV (thickened mustard developed for field use) was disposed of by an undefined dumping method. No documentation has been found on either range clearance operations or certification of clearance.

PREVIOUS CORPS ACTIVITIES: The USACE completed a preliminary assessment of this-site in 1986 and concluded that no further action was necessary. At the time of the assessment, the investigators were unaware of the chemical warfare materiel (CWM) information recently provided by the U.S. Army Chemical Demilitarization and Remediation Activity.

Representatives of the USACE revisited the site on December 11, 1992. They observed no visible hazards. On May 21, 1993, the airport manager found in an old Authorities Minutes Book that on March 18, 1963, the authority met and discussed information concerning glass vials that had escaped the burning and were found some 18 years later by airport employees. One employee was injured when a vial broke. A team from MacDill Air Force Base responded to this incident. An overflight of the area was made on March 20, 1993, with no intrusive activities observed.

An ASR has been completed, recommending further investigation of three areas, noting evidence that the Army had disposed of at least 127 mustard bombs and other CWM onsite. On May 26, 1993, an investigation revealed that the Hernando County Airport Authority was initiating intrusive activities (drilling subsurface explorations) to investigate hazardous waste contamination of drinking wells. The Corps of Engineers verbally notified the Airport Authority and the State of Florida, Department of Environmental Protection, of the potential danger and recommended extreme caution in any subsurface explorations.

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[1] The EK3 and EK4 were experimental, thin-walled, mustard-filled canisters that fit inside the 500-pound E23R2 or M4 cluster bombs. The canister contained 3 pounds, 5 ounces of mustard.

ACTIONS COMPLETED/PLANNED FOR THE FUTURE: The site characterization by geophysical mapping was completed in June 1995.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: The site has been developed into an airport industrial park, prison, land rentals, and tree farming.

RISK PERCEPTION: The ASR revealed the possibility of 127 mustard bombs being buried, but the risk to the public is lessened because of current land use, county ownership, the county's awareness of potential hazards, and the fact that possible buried CWM is not accessible as long as no excavation or drilling takes place.

NAME OF LOCATION: Chassahowitzka Swamp

LOCALITY/STATE: Chassahowitzka Wildlife Management Area, Florida (50 miles north of Tampa)

FUDS ACTIVITIES AT THIS LOCATION: The DPG Mobile Unit of the CWS requested in November 1944 an auxiliary bombing range for large area tests. The center of this area is approximately 28 degrees 37 minutes North, 82 degrees 35 minutes West. The CWS intended to use the area for testing of air-dropped chemical bombs. Apparently, the CWS did use 3.5 sections of land to the west of the proposed bombing area for vegetation defoliant testing. Based on recent area photos, no remaining effects of the defoliation appear in the area.

PREVIOUS CORPS ACTIVITIES: A site survey was completed in August of 1993 and no evidence of chemical warfare materiel (CWM) or the use of the area for bombing was found. An ASR was also completed in September 1993 and recommended no further action.

ACTIONS PLANNED FOR THE FUTURE: None.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: The area is remote and in state forest lands, which have been harvested at least once since 1945. It is believed that the area was never used for bombing.

DISTRICT RISK PERCEPTION: Because no evidence of actual CWM use exists, there is no perceived threat to public health and safety.

NAME OF LOCATION: Drew Field

LOCALITY/STATE: Tampa, Hillsbourgh, Florida

FUDS ACTIVITIES AT THIS LOCATION: Drew Field is located in Tampa, Florida in the area known as Tampa International Airport, During World War II (WWII), Drew Field was a reservation of the U.S. Army Air Corps. The Army conducted chemical warfare training at the installation, requiring the storage and use of significant amounts of toxic, incendiary, and smoke agents and munitions, as well as explosives. This materiel included mustard agent in 55-gallon drums and M50, M50x (an experimental item), and M69 incendiary bombs.

In August 1948, the reservation was transferred to the Hillsbourgh County Port Authority. In May 1950, the U.S. Army Technical Service Unit conducted a subsurface inspection and disposal operation. During this inspection, 42, 55-gallon drums (two of which were mustard-contaminated) were unearthed and disposed. The installation was granted a Certification of Clearance with the exception of an area known as the 'Restricted Area."

On April 27, 1965, the restricted area was investigated to determine the extent of possible contamination and to dispose of any munitions found. During the operation, numerous vials from chemical agent identification sets (CAIS) and numerous M50 and M69 incendiary bombs were found. The bombs were taken to a burning pit to be disposed of at a later date. This project was completed on June 11, 1965. The fate of the CAIS was undetermined. On April 26, 1966, a Certificate of Clearance was issued by the U.S. Army Technical Escort Unit, stating that the area was found negative of chemical contamination.

PREVIOUS CORPS ACTIVITIES: The USACE completed a preliminary assessment of this site in 1992 and concluded that no further action was necessary regarding ordnance and explosive waste. At the time, the investigators were unaware of the information recently provided by the U.S. Army Chemical Demilitarization and Remediation Activity documentation survey. An overflight of the area was accomplished by the representatives of the USACE on March 20, 1993. Construction activities were observed, but no intrusive activities were observed. An Archive Search Report, which included a detailed site survey by Corps of Engineers'personnel, was completed in June 1993. It recommended no further action be undertaken at Drew Field for chemical warfare materiel.

ACTIONS COMPLETED: The Corps of Engineers has completed an ASR of Drew Field and evidence suggests no further action. This will be documented via an engineering evaluation/cost analysis.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: The area is heavily developed. In a February 3, 1993 telephone conversation, the Deputy Director of Facilities for the

Hillsbourgh County Aviation Authority stated that the area is being constantly developed and that no casings and/or canisters of any kind have been found.

RISK PERCEPTION: The Technical Escort Unit tested the former chemical test area in 1966 with negative results. This area is not believed to present any immediate threat to human health and safety.

NAME OF LOCATION: Dry Tortugas Keys

LOCALITY/STATE: Approximately 70 miles west of Key West, Florida, in Monroe County

FUDS ACTIVITIES AT THIS LOCATION: These Keys were used by the Chemical Warfare Service (CWS) as a test range during 1944 to determine the decontamination requirements for tropical beach terrain. Tests were conducted using 5-gallon land mines and other methods to spread mustard agent on the beaches of several islets. Various hazard assessments and decontamination methods were tried. The site was used for 3 months, On June 6, 1950, the TSU conducted an inspection of the Keys to locate and dispose of any possible contaminated items. They detected no contamination. A Certificate of Clearance was granted in 1950.

PREVIOUS CORPS ACTIVITIES: USACE personnel completed a preliminary assessment of this site in 1986 and concluded that no further action is necessary. The islands are small, well-surveyed, and remote. The Archives Search Report was completed in July of 1993 with a recommendation of no further action. The area where the mustard agent was tested has eroded and been replaced several times due to storms and currents in the Gulf of Mexico. No hazard exists from chemical warfare materiel and no further action is required.

ACTIONS PLANNED FOR THE FUTURE: No further action is recommended.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: The remote site is currently owned by the National Park Service (NPS). In a telephone conversation on January 29, 1993, with the Corps of Engineers, the Chief of Maintenance stated that he plans no intrusive activities.

RISK PERCEPTION: No immediate threat to human health and safety is believed to exist at this site. The NPS has been contacted and informed about past use of the site.

NAME OF LOCATION: **MacDill Air Force Base**

In a documented incident between March 1952 and November 1953, a U.S. Army Chemical Corps detachment, located at MacDill Air Force Base, was ordered to cease operations and turn over some of their ordnance to Air Force Explosive Ordnance Disposal (EOD) for disposal. One of these items was a 500-pound mustard bomb with a live explosive burster. The burster was removed and the bomb was buried near the water's edge, approximately 4 feet underground, across Southshore Road from the Strategic Air Command alert facility. U.S. Army Technical Escort records, which date back to the time of this incident, show the delivery date of the bomb to MacDill, but no departure date.

LOCALITY/STATE: Tampa, Florida

SCOPE OF RESTORATION EFFORT: The Air Force is investigating the site as part of the installation's Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI). The scope of the investigation includes electromagnetic survey, groundwater, soil, and sediment sampling.

EFFORT TO DATE: In May 1991, a search for the bomb was conducted by base EOD personnel using electromagnetic equipment. The survey failed to locate the bomb. In August 1991, Environmental Protection Agency (EPA) Region IV identified the site as a solid waste management unit and requested that the base conduct an RFI. In June 1993, base EOD personnel conducted another search with electromagnetic equipment, enlarging the area of search based on an interview with a former military member stationed at MacDill. Several anomalies were detected but nothing conclusive. RFI field work began in August 1994 and was concluded in December 1994.

REMEDIATION SCHEDULE: A Final RFI Report was submitted to the EPA in March 1995. No additional work has been scoped for the site at this time.

RISK PERCEPTION: No threat to public health due to chemical agents is currently known or suspected to exist.

NAME OF LOCATION: Fort Pierce

LOCALITY/STATE: Fort Pierce, Saint Lucie County, Florida

FUDS ACTIVITIES AT THIS LOCATION: The suspect chemical warfare training site is located on Hutchinson Island, St. Lucie and Martin counties. The exact boundaries have yet to be determined but the north boundary is near the county line between the Indian River and St. Lucie county. The south boundary is the Frank A. Wacha Bridge in Martin County. Available records do not specifically identify the areas used by the Army Chemical Corps. During the WWII time frame, at an unknown site, testing was conducted to determine the best method of coping with the enemy's use of gas in defending a beachhead. Sources indicate testing of liquid agents but no direct evidence of burial exists. The area where this occurred is now under sea water.

PREVIOUS CORPS ACTIVITIES: The USACE completed a preliminary assessment of this site in 1991 and concluded no further action for ordnance and explosive waste (OEW) was necessary. However, at the time of the assessment, the investigators were unaware of the chemical warfare materiel (CWM) information recently provided by the U.S. Army Chemical Demilitarization and Remediation Activity documentation survey. An overflight of the 21-mile-long area was made on March 20, 1993. Intrusive activities involving residential construction were observed. A site survey of the area was made in May 1993 as part of the ongoing Archives Search Report. An OEW item was discovered next to a residential construction site in Indian River County, approximately 7 to 10 miles north of Hutchinson Island. The local Explosive Ordnance Detachment was called and the piece was safely destroyed.

ACTIONS COMPLETED: The Corps of Engineers has completed an ASR of Fort Pierce and evidence suggests no further action. Records found during the Archives Search suggest that no further risk exists at the site from chemical warfare materiel.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: The site is located in a rapidly developing coastal community. There is construction taking place in the area.

RISK PERCEPTION: An inventory project report was completed in 1991 and no chemical hazards of any kind were found or reported at this site. However, a risk exists at this site due to the extensive use for both conventional ordnance and CWM by the U.S. Army and the U.S. Navy.

NAME OF LOCATION: **Lakeland Armv Air Field**

LOCALITY/STATE: Lakeland, Polk County, Florida

FUDS ACTIVITIES AT THIS LOCATION: The former Lakeland Army Air Field is located approximately 35 miles west of Tampa, Florida, and 6 miles southwest of the city of Lakeland. On April 23, 1942, the city of Lakeland deeded the Municipal Airport to the War Department, establishing Lakeland AAF.

On August 10, 1943, the Base Chemical Section was activated to train all personnel in defensive measures against poison gas. A plot of ground, 100 yards from the east gate, was procured and converted into a chemical warfare demonstration area that included various facilities for outdoor classes. A classroom was fitted out in the chemical warfare section building for Unit Gas schools and other indoor classes. In 1944, a chemical magazine was setup in the area of the Ordnance Dump. Various frameworks were erected to enable the use of 100 percent live mustard in training.

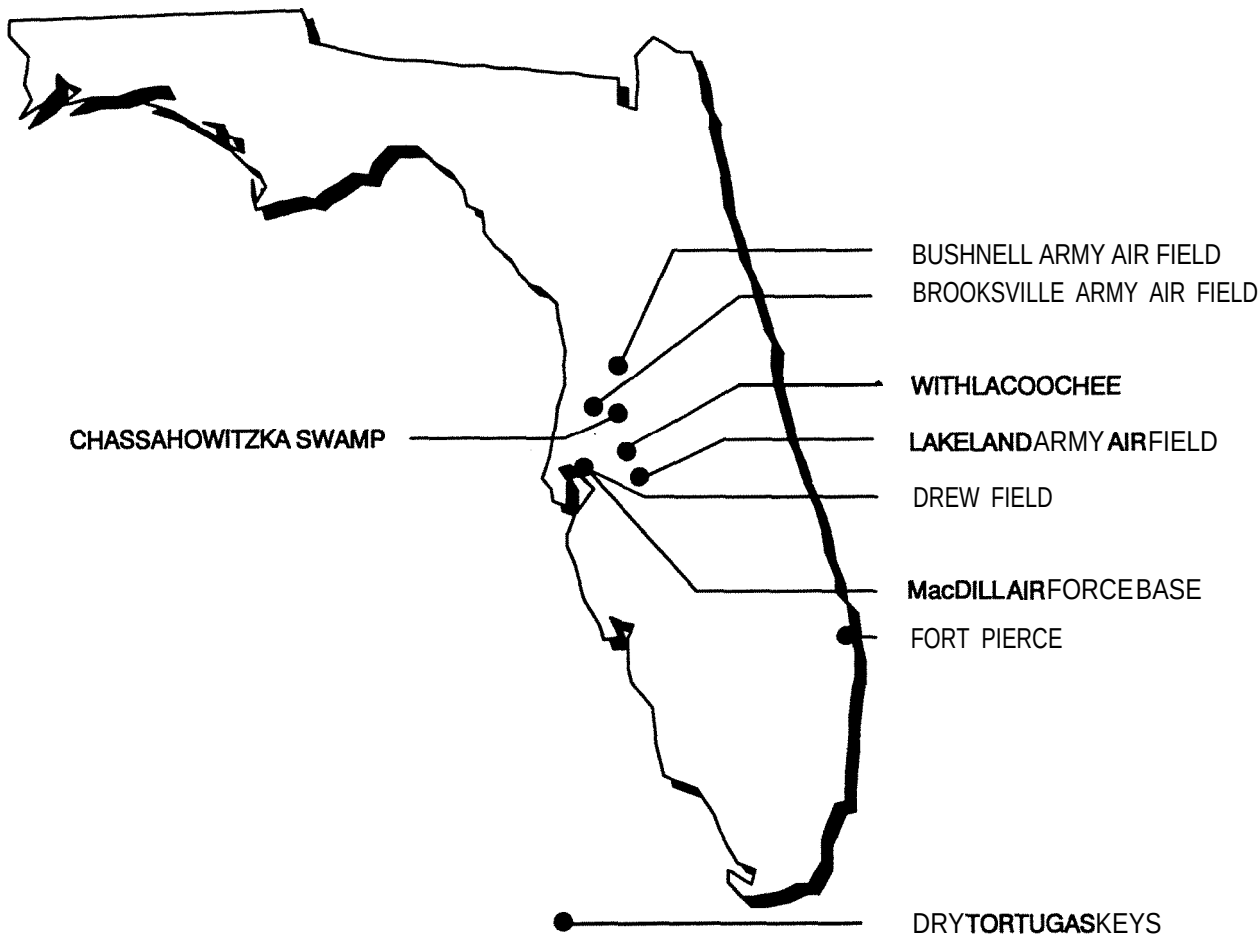
There is no evidence indicating that CWMs were spilled or accidentally dispensed.

PREVIOUS CORPS ACTIVITIES: The USACE, Jacksonville District, prepared an Inventory Project Report to establish this site as a Formerly Used Defense Site under the Defense Environmental Restoration Program. An ASR for this site was prepared by the USACE, St. Louis District, in September 1993 with a recommendation of no further action.

ACTIONS PLANNED FOR THE FUTURE: No further actions are planned.

RISK PERCEPTION: The site is primarily being used as a general aviation airport and an industrial area. Portions of the former air field are still open land and others have been developed with residential subdivisions. Based upon historical documents, air photo interpretation, interviews with people familiar, with the site, and a personal inspection, there does not appear to be any chemical warfare materiel or other munitions remaining at the former Lakeland Army Air Field. No threat to human health and safety is currently known to exist.

FLORIDA


BUSHNELL ARMY AIR FIELD
BROOKSVILLE ARMY AIR FIELD
WITHLACOOCHEE
CHASSAHOWITZKA SWAMP
LAKELAND ARMY AIR FIELD
DREW FIELD
MacDILL AIR FORCE BASE
FORT PIERCE
DRY TORTUGAS KEYS

LOCATION	Bushnell Army Air Field
LOCALITY	Bushnell
STATE	FL
SITE	Withlacoochee Forest
DESCRIPTION	Bushnell Army Air Field was the base of operations for the Bushnell Mobile Unit, which conducted the series of tests in the Withlacoochee Forest from November 1943 to October 1945. Bushnell Mobile Unit was a satellite operation of the U.S. Army Dugway Proving Ground.
SIZE	Unknown
CONTENTS	No direct evidence of burials cited.
COMMENTS	The U.S. Army Corps of Engineers has completed an Archives Search Report (ASR) of the Bushnell Army Air Field. Evidence found during the ASR suggests no further action. This will be documented via an engineering evaluation/cost analysis (EE/CA).
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

LOCATION	Withlacoochee
LOCALITY	Bushnell
STATE	FL
SITE	Withlacoochee Area 2-4
DESCRIPTION	Field tests of mustard-filled bombs air-dropped on target area 100 feet above ground at 185 miles per hour. Also field-tested 4.2-inch mustard-filled mortars.
SIZE	Unknown
CONTENTS	Potential for an unknown number of Levinstein mustard bombs.
COMMENTS	Decontamination uncertain. Location uncertain.
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Withlacoochee
LOCALITY	Richloam
STATE	FL
SITE	Zephyr Hills Gunnery Range
DESCRIPTION	Chemical rounds found on this range were punctured and agent burned. Explosives were detonated by using C-3. Munitions included: M-74, M-70, M-69, mustard bombs, 4.2-inch mortars, M47A2 bombs, and mustard containers.
SIZE	16,000 square feet
CONTENTS	Potential for buried bombs, mortars, and mustard containers.
COMMENTS	Site granted Certificate of Clearance, June 1950. M-74 bomb is a cluster in the E-71 cluster bomb, a Chemical Corps item.
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Brooksville Army Air Field
LOCALITY	Brooksville
STATE	FL
SITE	Unspecific
DESCRIPTION	Disposal of unknown numbers of cluster bombs by burning/burial. Disposal of five drums (unknown contents), two test jars, mustard, one drum of VV (thickened mustard developed for field use).
SIZE	Hole 6 feet deep
CONTENTS	Clusters with 1.5 quarts of mustard each, drums with mustard and unknown contents.
COMMENTS	In a third action, U.S. Army Technical Escort Unit also removed a leaking bomb from a railcar at this location. No specific burial of this item was indicated.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Chassahowitzka Swamp
LOCALITY	50 miles north of Tampa
STATE	FL
SITE	Auxiliary Area
DESCRIPTION	An auxiliary area about 1 square mile has been established for special large area tests. It was planned to drop a sizable amount of mustard-filled chemical bombs from both below and above 500 feet.
SIZE	1 square mile
CONTENTS	Possible surface/subsurface unexploded ordnance.
COMMENTS	A site survey was completed in August 1993 and no evidence of chemical warfare materiel or the use of the area for bombing was found.
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

LOCATION	Drew Field
LOCALITY	Tampa
STATE	FL
SITE	Restricted
DESCRIPTION	Exploration of restricted area by U.S. Army Technical Escort Unit. Drilling project found CAIS vials. Source cites burning of two mustard-contaminated drums at this site.
SIZE	Unknown
CONTENTS	Unknown. Potential for CAIS or residue from burning.
COMMENTS	Area now known as Tampa International Airport. Given Certificate of Clearance June 9, 1950 (does not include restricted area). The U.S. Army Corps of Engineers conducted an Archives Search Report which concluded that no further action was necessary.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, nonexplosive
CLASSIFICATION	5 - No further action

LOCATION	Dry Tortugas Keys
LOCALITY	Florida Keys
STATE	FL
SITE	Unknown
DESCRIPTION	Test were conducted using 5-gallon land mines and other methods to spread mustard on the beaches. Various decontamination methods were tested.
SIZE	Unknown
CONTENTS	Unknown
COMMENTS	Clearance operation conducted. Was granted Certificate of Clearance in 1950. The U.S. Army Corps of Engineers conducted an Archives Search Report and concluded that no further action was required.
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

LOCATION	MacDill Air Force Base
LOCALITY	Tampa
STATE	FL
SITE	Old Strategic Air Command
DESCRIPTION	Strategic Air Command alert facility. 500-pound mustard gas bomb found near building 1105. High explosive removed and buried near waters edge. Timeframe: March 1952 to December 1953.
SIZE	Unknown
CONTENTS	500-pound mustard bomb. Attempts to locate bomb in 7991 were unsuccessful.
COMMENTS	Information obtained from interview with former base personnel.
TYPE	Disposal
INSTALLATION	Air Force
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Fort Pierce
LOCALITY	Fort Pierce
STATE	FL
SITE	Unknown
DESCRIPTION	Test on best method of coping with the enemy's use of gas in defending a beachhead. Date unknown.
SIZE	Unknown
CONTENTS	Unknown
COMMENTS	Timeframe: World War II. The U.S. Army Corps of Engineers has completed an Archives Search. Evidence suggests no further action required. This will be documented via an engineering evaluation/cost analysis (EE/CA).
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

LOCATION	Lakeland Army Air Field
LOCALITY	Lakeland
STATE	FL
SITE	Area #2
DESCRIPTION	Area #2 was the ordnance storage area for the air field. A mustard chemical magazine was set up in the area of the Ordnance Dump and various frameworks were erected to enable the use of 100 percent live mustard in training.
SIZE	Unknown
CONTENTS	Unknown
COMMENTS	Lakeland Army Airfield was rated a no further action in both the Inventory Project Report and the Archives Search Report by the U.S. Army Corps of Engineers, Huntsville Division.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

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GEORGIA

NAME OF LOCATION: Fort Benning

Fort Benning is located in the western central portion of Georgia and is contiguous to the city of Columbus, Georgia. It occupies areas of the counties of Muscogee and Chattahoochee, Georgia, and Russell, Alabama. Fort Benning was established in September 1918 to train infantry troops of the U.S. Army.

LOCALITY/STATE: Columbus, Georgia

SCOPE OF RESTORATION EFFORT: The Fort Benning Installation Restoration Program is designed to investigate contamination problems at two sites, one of which has the potential for chemical agent contamination. At some time in 1945, suspected toxic chemical agents (GA, GB, or GD) were buried in a wooded section of Harmony Church area. This agent site was identified as having potential contamination problems after a 1945 water distribution map was found indicating an area marked "Toxic Agents Buried" and the symbol "G." The investigation will determine whether any agent existed at the site. Chemical agent identification sets (CAIS) have also been used at Fort Benning. These CAIS could account for some soil contamination noted in old documents.

EFFORT TO DATE: In 1992 a remedial investigation and feasibility study was initiated at the site. During excavation, several broken vials of CAIS were discovered, resulting in the temporary hospitalization of three workers. The contents of the vials were tentatively identified by the U.S. Army Technical Escort (TEU) as dilute solutions of mustard, lewisite, Phosgene, chloropicrin, adamsite, and CN. The investigation was suspended indefinitely and all uncovered vials were removed by TEU and shipped to Pine Bluff, Arkansas for disposal. Analytical tests completed prior to the discovery of the vials indicated that no groundwater contamination exists. However, groundwater monitoring was incomplete and additional subsurface investigation will still be necessary. In the interim, a fence has been erected at the site to restrict access and prevent accidental contact by military and civilian personnel.

REMEDIATION SCHEDULE: Further investigation and remediation of the site will occur when funding becomes available.

RISK PERCEPTION: Access to the agent site is restricted; therefore, the location investigated does not pose a known hazard to public health and safety.

NAME OF LOCATION: Fort Gillem

Fort Gillem is located in extreme northern Clayton County, Georgia, approximately 10 miles south of Atlanta. Construction of this installation, which covers 1,452 acres, began in 1940. During World War II, the mission of Fort Gillem was to support the Army's needs for weapons and equipment, research and development, procurement, production, storage, distribution, inventory management, maintenance, and disposal. This installation is a subpost of Fort McPherson and supports the U.S. Army Forces Command readiness mission.

LOCALITY/STATE: Atlanta, Georgia

SCOPE OF RESTORATION PROGRAM: On June 30, 1946, a leaking, 500-kilogram, mustard-filled bomb was detected on a freight car located at the Georgia Railroad Freight Yard Delta Crossing, Dekalb and Delta Avenues, Atlanta, Georgia. The leaking bomb was removed from the freight car by U.S. Army TEU personnel and transported to the Atlanta Ordnance Depot (now Fort Gillem). The bomb was buried by TEU personnel on July 2, 1946 in an excavation 3 meters deep. It is probable that decontaminant was added. There has been an oral report that the bomb was removed. Documentation on the removal has not been located.

EFFORT TO DATE: Fort Gillem is currently conducting a site investigation of the suspected location of the chemical munition. The contractor is using geophysical techniques to determine possible locations of the suspected chemical munition. After the geophysical investigation is complete, TEU will conduct mustard gas sampling at the suspected locations. Following a characterization of the suspected locations by TEU, the contractor will conduct surface and subsurface analysis for priority pollutants. This will. include installing monitoring wells and conducting soil sampling.

REMEDIATION SCHEDULE: The contractor delivered a draft site investigation report in August 1995.

RISK PERCEPTION: No known threat to public health due to chemical agent exists at Fort Gillem.

NAME OF LOCATION: **Manchester**

LOCALITY/STATE: Manchester, Meriwether, Georgia

FUDS ACTIVITIES AT THIS LOCATION: In June 1946, the Army was transporting chemical warfare munitions by rail to Huntsville Arsenal. The cargo consisted of 1 ,000-pound, mustard-filled German bombs. Near Manchester, Georgia, a leaking bomb was discovered in one of the cars. Approximately 22 bombs were removed to find the leaker. The leaking munition had a cracked seam, measuring 1 inch wide along the length of the bomb. Almost all of the mustard had emptied onto the floor of the car.

The remaining contents of the bomb were neutralized and buried at depth of 6 to 7 feet. Signs were posted to indicate the site. The bomb casing and rail car were decontaminated with DANC (a decontaminant) and the train proceeded to Huntsville Arsenal, Alabama.

The burial site at Manchester, Georgia, was redug to a depth of 10 feet on September 30, 1946. Although an odor of mustard was present in a small quantity of dirt removed, tests using the M9 detector kit revealed no traceable amounts. The suspected dirt was decontaminated using 200-pounds of bleach and the hole refilled. A report stated that the area was now entirely free of mustard and no danger existed.

PREVIOUS CORPS ACTIVITIES: A site inspection was made of this area on February 24, 1993, and there were no visual signs of hazardous conditions. A local resident and former railroad company official was interviewed onsite. He had worked in the rail yard and witnessed the decontamination of the mustard gas in the rail yard, and he stated that he was not aware of any hazardous effects to humans, animals, or vegetation. There was no one found who was aware of any hazardous effects resulting from the buried mustard agent. The site was determined to be completely decontaminated in 1946. The small amount of chemical originally buried and the length of time since disposal would make hazardous conditions at this site unlikely.

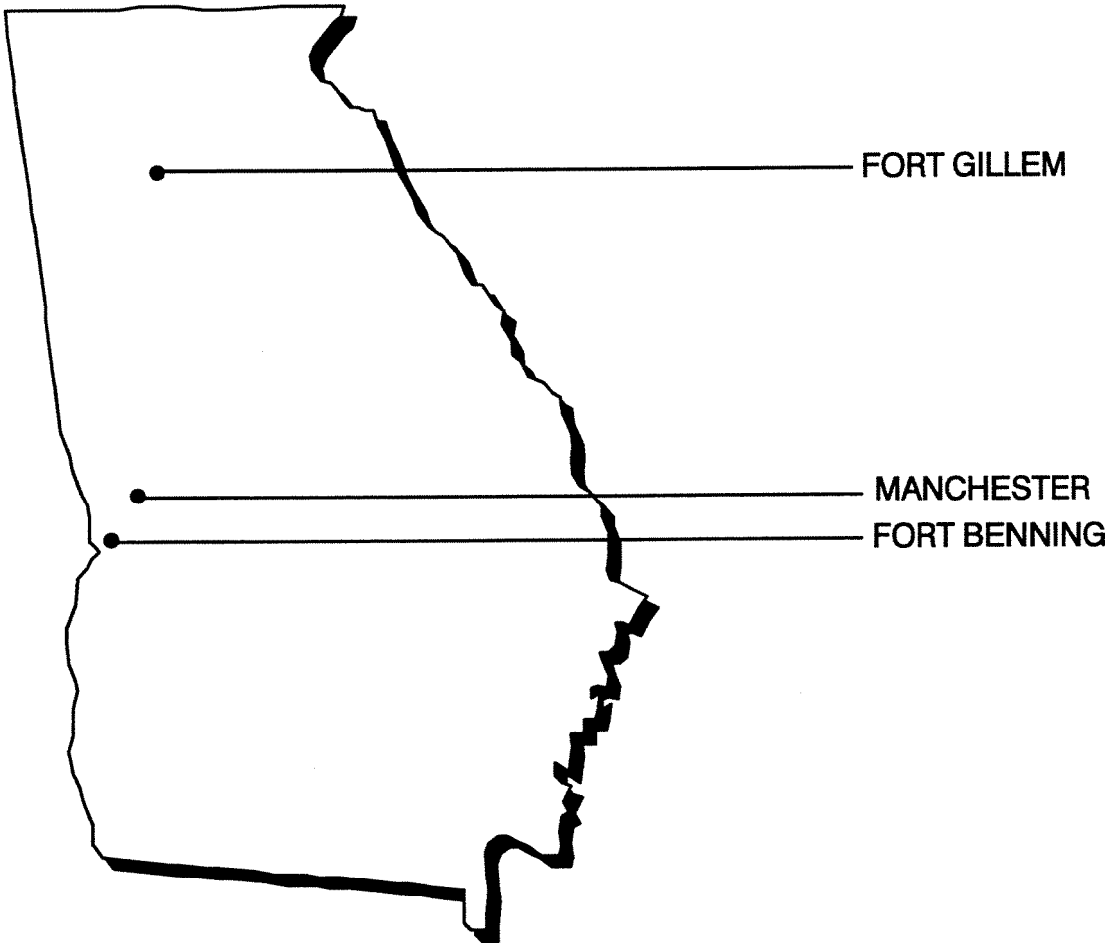
A site survey was conducted in May 1993 as part of this report. The site has been regraded by the railroad. The burial pit area, on railroad property, was narrowed down to a 1 00-foot diameter circle as a result of the site survey. An Archives Search Report was finalized in September 1993 and concluded that remaining residue (if present) no longer presents a CWM hazard.

ACTIONS PLANNED FOR THE FUTURE: No further action required.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: Since the burial site is located on a railroad right-of-way, inside a track wye, intrusive activities are not expected.

RISK PERCEPTION: The chemical agent, which was neutralized, has probably long ago decomposed. The remains of the chemical agent is buried 6 to 7 feet beneath the surface on the railroad right-of-way. There is virtually no threat to human health and safety.

GEORGIA



LOCATION	Fort Benning
LOCALITY	Columbus
STATE	GA
SITE	Harmony Church
DESCRIPTION	Suspected toxic agent burial site located in wooded section. A 1945 map cites Toxic Agents Buried and G markings. Area known as Harmony Church.
SIZE	Unknown
CONTENTS	G markings may indicate nerve agent burial.
COMMENTS	Source cites contaminated soil with possible chemical agent identification set burial in an unspecified location. Source states no chemical agent used at this site.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Fort Gillem
LOCALITY	Atlanta
STATE	GA
SITE	Unknown
DESCRIPTION	On July 2, 1946, leaking mustard-filled bomb discovered during rail transport to Huntsville, Alabama. Bomb was decontaminated and buried. Railcar and area were decontaminated. Bomb buried within 50 feet of boundary fence and within 20 feet of unimproved road.
SIZE	10 feet deep
CONTENTS	One 500-kilogram, mustard-filled aerial bomb (German).
COMMENTS	Area located at Delta Crossing, Georgia Freight Yard. Formerly known as Atlanta General Depot. The bomb was recovered on 1 October 1946 and burned in hole, and the area was decontaminated. A geophysical survey of the area was performed in February 1995. The data collected during this survey located one potential location of the burial site. In April 1995, the U.S. Army Technical Escort Unit conducted a sampling event within the suspected area. Preliminary field screening of soil samples did not indicate the presence of mustard agent. Soil samples from these borings were collected and delivered to a surety lab for analysis.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Manchester
LOCALITY	Manchester
STATE	GA
SITE	Railroad Section
DESCRIPTION	In June 1946, leakers encountered during rail shipment. Bomb had crack in seam. Most of liquid leaked onto floor of car and soaked through to door. Bomb emptied into pit with chloride of lime.
SIZE	6 feet to 7 feet deep and marked
CONTENTS	Contents of a 1 OOO-pound, mustard-filled German aerial bomb.
COMMENTS	Casing flushed with DANC and delivered as scrap to Huntsville Arsenal. The U.S. Army Corps of Engineers has concluded that the remaining residue (if any) of the 1946 destruction and neutralization of the remaining residue no longer presents an ordnance and explosive waste or chemical warfare materiel hazard.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

HAWAII

NAME OF LOCATION: Schofield Army Barracks

Schofield Barracks is located approximately 22 miles northwest of Honolulu in the north-central plateau of Oahu. The largest Army post in Hawaii, its mission is to provide administration, training, and housing facilities for the 25th Infantry Division and 45th Support Group.

Named in honor of Major General John M. Schofield, Civil War Veteran, Secretary of War, and Commanding General of the U.S. Army's Pacific Division (1888-1895), it was established in 1908 to provide a base for the Army's mobile defense of Pearl Harbor and the island of Oahu. Until the 1920s, Schofield Barracks had been garrisoned by infantry, cavalry, and artillery regiments.

In the 1920s, these regiments were joined by units from a signal battalion, ordnance company, ammunition team, tank company, medical regiment, maintenance squadron, and a chemical gas unit. These types of units, excluding the chemical warfare function, characterize the activities of Schofield Barracks to the present day.

Following the Japanese attack of Pearl Harbor, Hawaii became a critical supply base and command center during the war in the Pacific. Training camps, including the Jungle Training Center, were established to teach close-in fighting, map reading, and jungle-warfare techniques. Following World War II, Schofield Barracks'soldiers were employed in the disposal of surplus war goods.

Records indicate the storage of chemical munitions on the post includes mustard (H), lewisite (L), cyanogen chloride (CK), and hydrocyanic acid (AC). All remaining stocks were removed and disposed of by deep-sea burial in 1945.

Chemical agent identification sets were stored and used for training purposes. Records were not located to indicate if any chemical agents were used during warfare maneuvers.

LOCALITY/STATE: Oahu, Hawaii

SCOPE OF RESTORATION PROGRAM: Schofield Barracks is a National Priorities List installation. The objective of the Schofield Barracks Installation Restoration Program is to investigate and recommend solutions for conventional hazardous contamination problems at four operable units as established under the Federal Facility Agreement.

EFFORT TO DATE: A 1984 installation assessment (IA) and the preliminary assessment/site inspection efforts conducted in FY91 -92 found no records indicating past disposal of chemical warfare materiel (CWM) on Schofield Barracks. The IA reported a major disposal operation that removed all chemical agent munitions from

Schofield Barracks storage areas for deep-sea burial in 1945. An account of liquid-filled Stokes mortar rounds being found and exploded in-place in the central range area has not been confirmed during the IA.

REMEDIATION SCHEDULE: The account of liquid-filled Stokes mortar rounds being discovered occurred on an active range, which will not be investigated further until the range is closed.

RISK PERCEPTION: There is no evidence of any immediate threat to human health and safety from CWM, since there is controlled access to the active range.

NAME OF LOCATION: Kipapa Ammunition Storage

LOCALITY/STATE: Oahu, Hawaii

SCOPE OF RESTORATION PROGRAM: The Kipapa Ammunition Storage Site is one of the sub-installations on the Hawaiian Islands supporting Schofield Barracks. It is located approximately 5 miles south of Schofield Barracks and comprises two noncontiguous areas containing a total of 77 tunnels, formerly used by the Army for ammunition storage. All of these tunnels have been sealed, except for one, which is currently used by the U.S. Department of Commerce. The installation is also used as a ground training area by the 25th Infantry Division.

Kipapa reportedly was acquired in 1944 for the purpose of storing ammunition. According to testimony from a legal claim involving dredging of blistering (mustard) agents 3 miles at sea off Pearl Harbor, chemical agents were also stored at Kipapa Gulch during World War II.

EFFORT TO DATE: Because the bunkers were reportedly abandoned and the bunker doors were welded shut, environmental concerns at Kipapa in past years have been limited (documentation and dates for abandonment have not been located). Recently, some consideration has been given to the bunkers, such as updating the Restoration Management Information System, and discussion has occurred regarding whether requirements for environmental investigations are appropriate. Requirements have not been identified under the Installation Restoration Program (IRP) to date.

REMEDIATION SCHEDULE: Because no requirements have been identified under the IRP, there is no remediation schedule concerning Kipapa.

RISK PERCEPTION: Public access to Kipapa Ammunition Storage area is restricted. Currently, the area is used by the Army's 25th Infantry Division for training. There has been no documented or suspected release of chemical agent or associated public health threat from the area.

NAME OF LOCATION: **Waiakea Forest Reserve**

LOCALITY/STATE: Hilo, Hawaii Island, Hawaii

FUDS ACTIVITIES AT THIS LOCATION: Between 1966 and 1967, four chemical warfare agent tests took place in the Waiakea Forest Reserve on the Island of Hawaii. Three of the tests involved the nonpersistent nerve agent GB and were conducted during April to June 1966, March to April 1967, and April to May 1967. The fourth test involved the incapacitating agent BZ. The test area is located approximately 18 miles southwest of Hilo and 1 mile south of Stainback Road. All the tests observed prevailing meteorological conditions that ensured toxic clouds did not travel beyond 1 square mile of the 1.5-square mile test area.

Between September 21 and October 8, 1970, a complete removal operation was conducted in the test area. All the decontaminated materiel found was removed and transferred to the Kilauea Military Camp.

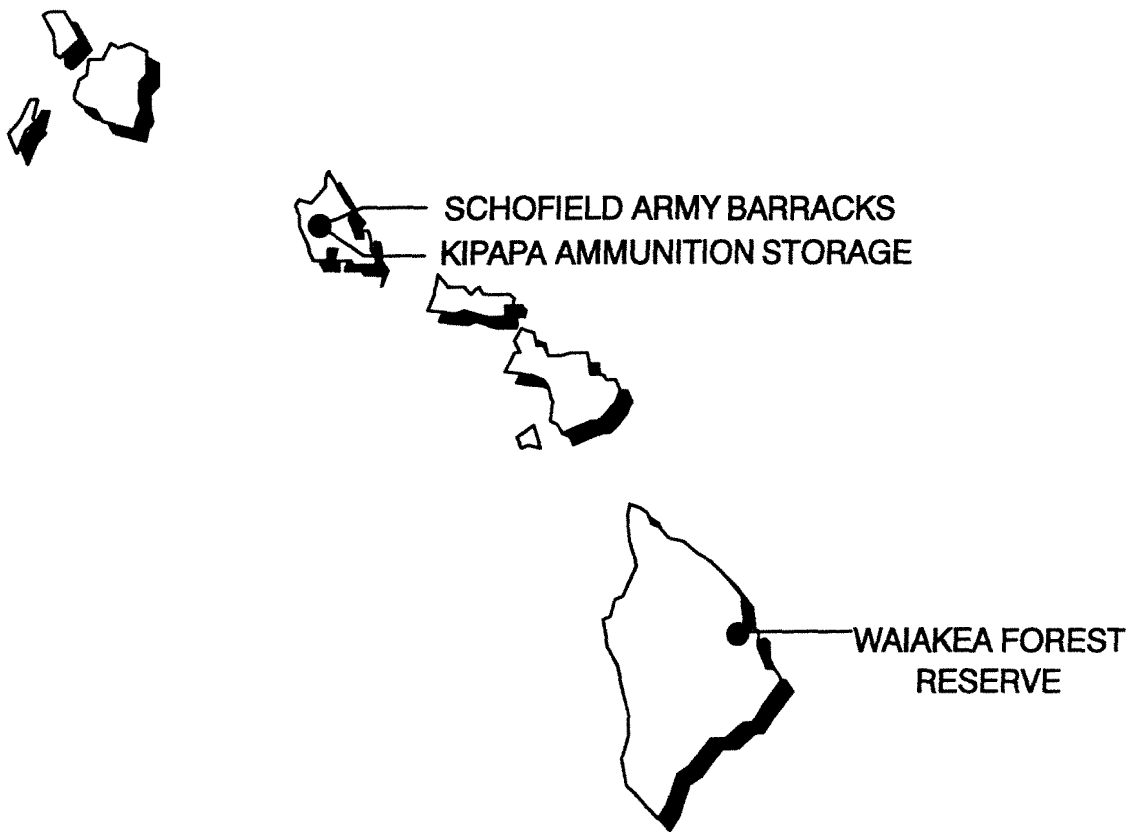
An Archives Search Report completed in July 1993 recommended no further action.

ACTIONS PLANNED FOR THE FUTURE: No further action is planned on this site.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: The site has been visited by U.S. Army Corps of Engineers personnel. It is not susceptible to intrusive activity and is not easily accessible by the general public. Signs are posted in the forest that forbid trespassing. The nearest main public road is several miles away. There is no nearby community and no development is planned. The terrain is extremely rough.

RISK PERCEPTION: The threat to human health and safety is minimal because the site is remote, there is little or no human activity, a great deal of time has elapsed since testing, and because the site was cleared in 1970.

HAWAII


SCHOFIELD ARMY BARRACKS
KIPAPA AMMUNITION STORAGE
WAIAKEA FOREST
RESERVE

LOCATION	Schofield Army Barracks
LOCALITY	Oahu
STATE	Hl
SITE	Unknown
DESCRIPTION	Disposal area reportedly contains Stokes mortar rounds. Defined to be in same area as the central range disposal pits, consists of small dug pits (6 meters by 10 meters) and open disposal areas in bottom of ravines.
SIZE	Unknown
CONTENTS	Potential for Stokes mortar rounds (contents not identified).
COMMENTS	Disposal area could not be located.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Schofield Army Barracks
LOCALITY	Oahu
STATE	HI
SITE	Unknown
DESCRIPTION	Chemical agent identification sets and toxic gas training kits were stored and used for training purposes, Chemical war maneuvers involving 1,295 troops were conducted at Schofield Barracks in December 1942.
SIZE	Unknown
CONTENTS	Chemical agent identification sets.
COMMENTS	Disposition of contents not defined.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	4 - Possible burial

LOCATION	Kipapa Ammunition Storage
LOCALITY	Oahu
STATE	HI
SITE	Kipapa Gulch
DESCRIPTION	Ammunition tunnels used during World War II for the storage of blister agents (from the dredging of Pearl Harbor). All but one of the ammunition tunnels abandoned with doors welded shut. Dates unknown.
SIZE	Unknown
CONTENTS	Unknown
COMMENTS	Blister agents-container types not indicated.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Waiakea Forest Reserve
LOCALITY	Hilo
STATE	HI
SITE	Forest
DESCRIPTION	Tests using chemical agents were conducted during 1966 and 1967. Three tests used the nerve agent GB; a fourth test used the incapacitating agent BZ. Test site decontaminated 9 October 1970.
SIZE	Test area: 2.4 square miles
CONTENTS	Unknown. No specific burial cited. May contain residual contamination
COMMENTS	Test site located 18 miles southwest of Hilo and 1 mile south of Stainback Road. Certificate of Clearance issued by U.S. Army Corps of Engineers, October 9, 1970. An Archives Search Report was completed in July 1993 and recommended no further action.
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

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IDAHO

NAME OF LOCATION: Targhee National Forest

In 1943, the Dugway Proving Ground Mobile Unit conducted tests in the Targhee National Forest to determine the behavior of nonpersistent chemical agents when released from bombs adjacent to a forest. The types of munitions used in the tests were aerial bombs, notably the M47A1. Also, 500- and 1 OOO-pound T2 bombs were used. Each munition was filled with phosgene (CG) and nitrous oxide (NO,).[1]

The tests were conducted in the vicinity of Pond's Lodge, Island Park, Idaho. Four target areas were selected and tests were conducted as follows:

- Tom Creek Meadow: Six tests with M47A1 bombs, explosively loaded and filled with CG and NO,.
- Big Springs Forest: Four tests with M47A1 and T2 bombs, explosively loaded and filled with CG and NO,; one test with a 1000-pound T2 bomb, explosively loaded and filled with CG and NO,.
- Black Canvon: Nine tests with M47A1 and T2 bombs, explosively loaded with NO, and filled with NO, and CG.
- Moose Creek Plateau: Five tests with M47A2 bombs, filled with NO, and CG.

The bombs used in these tests were functioned statically with the bomb body buried 5 to 6 inches in the ground. Operations reports indicate that the Chemical Warfare Service carefully inventoried and accounted for materials used in the tests.

LOCALITY/STATE: Targhee National Forest, Island Park, Fremont County, Idaho

FUDS ACTIVITIES AT THIS LOCATION: Targhee National Forest is located approximately 25 miles west of Yellowstone National Park on the Idaho, Wyoming, and Montana borders. In December 1943, the Chemical Warfare Service conducted tests of a mobile laboratory designed to accompany Army task forces in combat zones at five locations in the Targhee National Forest. This area was used to simulate the climate and terrain found in Italy. The tests involved static detonations of 25 partially buried aerial bombs of various sizes (up to 1000 pounds), filled with nonpersistent gas (CG or NO_2).

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[1] NO, is not a chemical agent but was used alone and mixed with CG in order to produce a visible cloud to facilitate visual and photographic evaluation.

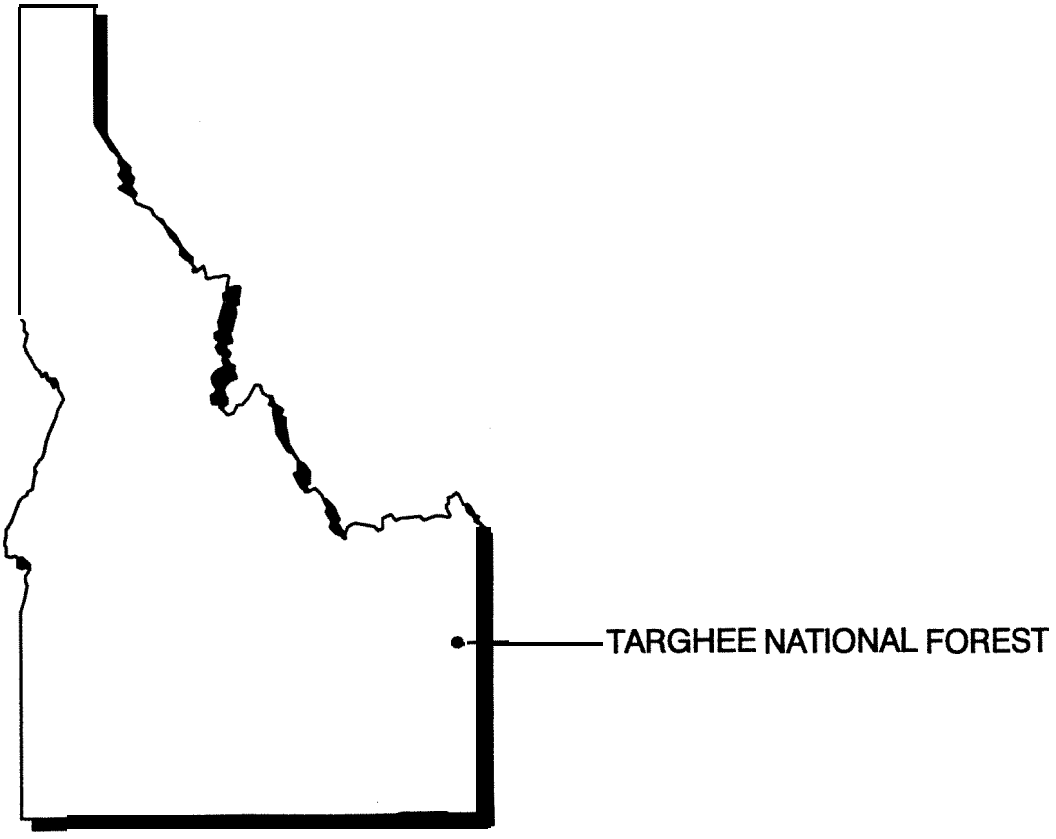
PREVIOUS CORPS ACTIVITIES: A preliminary site visit was conducted by the Corps of Engineers, Walla Walla District, Environmental Engineering Branch (CENPW-EN-EE), during March 1993. A follow-up site visit was conducted by CENPW-EN-EE and the Corps of Engineers, St. Louis District (CELMS-PM-M), during September 1993, to complete the Archives Search Report and Preliminary Assessment. No evidence of non-stockpile chemical materiel was found. No explosive or ordnance waste hazards were discovered during both site visits. The St. Louis District designated a Risk Assessment Code (RAC) of 5 for this location in its archives search report of September 1993, meaning no further action was deemed necessary. The Walla Walla District prepared an inventory project report (INPR) on 28 June 1994, to establish this location as formerly used by the Army and recommended no further action (NOFA). The NOFA was approved on 15 July 1994, by the Corps of Engineers, North Pacific Division, the geographic division.

ACTIONS PLANNED FOR THE FUTURE: No further action is required at this site.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: The four sites used for testing chemical agent are located within the Targhee National Forest. Some intrusive activity can be expected due to use by the U.S. Forest Service and general public with access to national forest lands. However, Corps of Engineers site inspections identified specific locations for 23 of the 25 bomb test sites. The remaining 2 test sites were narrowed to general locations and inspected. No military or chemical warfare service materiel were found at any of the sites.

RISK PERCEPTION: Considering the type of testing, the care in inventory control, and very limited number of ordnance tested, this area is not believed to present any immediate threat to human health and safety. Coordination with U.S. Forest Service rangers and onsite inspections by the Walla Walla and St. Louis Districts revealed no knowledge or evidence of test craters, explosive wastes (shrapnel) or chemical agent residues in any of the test sites.

IDAHO



LOCATION	Targhee National Forest
LOCALITY	Island Park
STATE	ID
SITE	Ponds Lodge
DESCRIPTION	In 1943, area used to test effectiveness of aerial bombs M47A1 and T2, filled with phosgene and nitrous oxide. Bombs were functioned statically upwind of sampling array Four target areas used: Tom Creek Meadow, Big Springs Forest, Black Canyon, and Moose Creek Plateau.
SIZE	Approximately 200,00-250,000 acres
CONTENTS	Potential for remains of aerial bombs. An Archives Search Report completed in September 1993 concluded that there does not appear to be any chemical warfare materiel remaining at this location.
COMMENTS	Part of Dugway Mobile Unit activities.
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

ILLINOIS

NAME OF LOCATION: **Savanna Army Depot Activity**

Savanna Proving Ground was first commissioned in December 1918. The facility was used for proofing and testing of field artillery and ammunition. Approximately 13,165 acres were purchased along the eastern bank of the Mississippi River in Illinois. In March 1921, the name was changed to Savanna Ordnance Depot. The decision to make the Depot one of the largest single facilities in the country for the storage of ammunition was the beginning of an intensive construction program from 1939 to 1941. Through a number of name changes beginning in 1950, the U.S. Army Materiel Development and Readiness Command Ammunition School was established in 1977. The depot was reduced to Activity status in June 1976.

Chemical agent munitions have never been manufactured or tested at the depot; however, mustard rounds have been stored and demilitarized. During the 1947 to 1950 and 1966 time frames, pits in areas 9 and 14 were used to burn 105-millimeter and 155-millimeter mustard (H)-filled rounds. Area 8 was used to burn leaking 75-millimeter H-filled rounds from 1947 to 1950. The "fire pits" were used to dispose of 36 seriously leaking H-filled 75-millimeter rounds. The rounds were first detonated, then burned in the pits. Records further indicate that 319 mustard-filled 155-millimeter rounds were shipped to Rocky Mountain Arsenal, Colorado, in the 1960s.

LOCALITY/STATE: Savanna, Illinois

SCOPE OF RESTORATION EFFORT: The Savanna Army Depot Activity (SVADA), a National Priorities List installation because of explosives and conventional hazardous wastes, was a storage and transfer point for mustard-filled artillery projectiles. In 1992, the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) completed a historical review involving record searches and personnel interviews to document past mustard storage and disposal operations at SVADA. The majority of disposal operations were conducted at the Burning Ground (site 14), and in the vicinity of the TNT Washout Facility (sites 8 and 9, including areas adjacent to sites 1 and 7).

EFFORT TO DATE: In 1979, USATHAMA completed the Installation Assessment to assess environmental quality. In 1982, an installation-wide environmental investigation was completed. During 1992, an initial surface magnetometer sweep and clearance of sites 8, 9, and 14 was performed by an unexploded ordnance (UXO)-qualified contractor and no chemical munitions were encountered. During future soil-intrusive field investigation and remediation activities, UXO clearance will be conducted, in addition to onsite agent screening at suspected disposal pits.

REMEDIATION SCHEDULE: The remedial investigation/feasibility study (RI/FS) is complete. The incineration of TNT-contaminated lagoon sediment was completed in December 1993.

During the RI/FS field work at site 14, mustard residuals or residuals from breakdown products were not encountered.

RISK PERCEPTION: Since the mode for mustard destruction was burning, and given the sandy soil conditions and the seasonal flooding of sites 8, 9, and 14 within the Mississippi River floodplain, the potential for encountering residual mustard is remote.

NAME OF LOCATION: **Fort Sheridan**

LOCALITY/STATE: Fort Sheridan, Illinois

Fort Sheridan is located approximately 25 miles north of Chicago, Illinois, on approximately 695 acres. The installation was established in 1888. Originally called Camp Highwood, it was named for General Philip Sheridan, Civil War cavalry hero and Indian fighter who became Commander-in-Chief of the Army in 1888. Prior to its closure, Fort Sheridan was the operations base for Headquarters, Fourth Army, and the U.S. Army Recruiting Command. Fort Sheridan's missions included command and control of reserve units in seven midwestern states, recruiting functions for the Army, and support for the Army reserve units recruiting operations in the seven state area.

A 1943 record indicates Fort Sheridan conducted chemical warfare training every 6 months or more often as required.

The U.S. Army Technical Escort Unit removed a bomblet from an impact area in 1979.

SCOPE OF RESTORATION PROGRAM: Fort Sheridan is currently conducting the cleanup of unwanted, abandoned ammunition and explosives located on the Department of Defense owned real property, consisting of approximately 38 acres located near the golf course on Fort Sheridan, Illinois, prior to the release from Department of Defense custody. No chemical warfare materiel is suspected at this site.

EFFORT TO DATE: Archival searches have been conducted by the U.S. Army Corps of Engineers, St. Louis; Fort Sheridan; and the Program Manager for Chemical Demilitarization.

RISK PERCEPTION: At this time, no threat to public health and safety due to chemical agents is currently known to exist.

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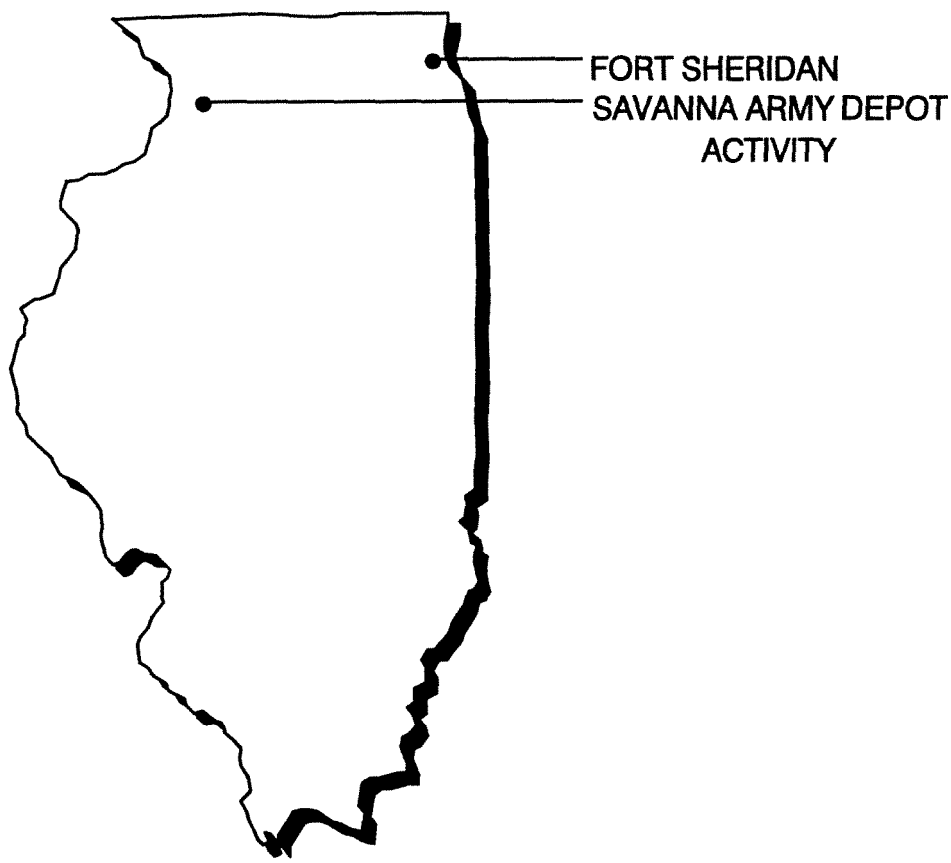
ILLINOIS



LOCATION	Savanna Army Depot Activity
LOCALITY	Savanna
STATE	IL
SITE	Area 14
DESCRIPTION	Original 155-millimeter mustard-filled projectile burn site. U.S. Army Technical Escort Unit cites plan for burning 288 shells in November 1947. Approximately twelve rounds were burned (three at a time) on four different occasions during 1942 to 1945.
SIZE	Unknown
CONTENTS	Potential for residue from approximately twelve 155-millimeter rounds burned.
COMMENTS	Open storage (Area 39) of 155-millimeter mustard-filled rounds, shipped to Rocky Mountain Arsenal during 1960s. Also named Savanna Proving Ground, 1918 to 1921; Savanna Ordnance Depot, 1921 to 1962.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Savanna Army Depot Activity
LOCALITY	Savanna
STATE	IL
SITE	Area 8
DESCRIPTION	Used to burn leaking 75-millimeter mustard rounds (1947 to 1950). This area may also have been known as the fire pits. (See Fire Pits.)
SIZE	Unknown
CONTENTS	Potential for residue from 75-millimeter mustard rounds.
COMMENTS	None.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Savanna Army Depot Activity
LOCALITY	Savanna
STATE	IL
SITE	Area 9
DESCRIPTION	Ten pits used from 1947 to 1950 to burn mustard rounds.
SIZE	10 to 15 feet deep
CONTENTS	Potential for residue from more than 100 total 105-millimeter and 155-millimeter mustard-filled rounds.
COMMENTS	None.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Savanna Army Depot Activity
LOCALITY	Savanna
STATE	IL
SITE	Fire Pits
DESCRIPTION	From April 25 to June 3 1949, 1.558 leakers were discovered while unpacking rounds for demilitarization. Thirty-six leakers were destroyed by detonating and burning in large pit, and burial.
SIZE	Unknown
CONTENTS	Thirty-six seriously leaking rounds [MK2, 75-millimeter gun shell (mustard-filled)] or residue.
COMMENTS	Rounds were detonated and burned in the pits. Fire pits probably also known as area 8.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Fort Sheridan
LOCALITY	Chicago
STATE	IL
SITE	Impact Area
DESCRIPTION	The U.S. Army Technical Escort Unit conducted an emergency response action due to the presence of chemical surety material (M-139 bomblet) on an impact area in June 1979.
SIZE	Unknown
CONTENTS	Unknown.
COMMENTS	A 1943 record indicates Fort Sheridan conducted chemical warfare training every six months, or more often as required.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	3 - Suspect burial

INDIANA

NAME OF LOCATION: Camp Atterbury

Camp Atterbury is located in Edinburgh, Indiana, approximately 35 miles south of Indianapolis. This installation was built as a temporary camp during World War II and named in March 1942. It has changed status from active to inactive a number of times, and finally became inactive in June 1954.

Between 1968 and 1970, approximately 25 to 30 gallons of a bulk liquid with a molasses type consistency (possibly mustard) was reportedly disposed of by pouring it onto the ground, mixing it with gasoline, and burning it in a known area of the installation. Also, between 1979 and 1980, an ampule of an unknown solution, which may have been part of a chemical agent identification set (CAIS), was found.

LOCALITY/STATE: Edinburgh, Indiana

SCOPE OF RESTORATION EFFORT: Camp Atterbury is a federally owned National Guard installation, 33,500 acres in size. Limited funding was requested in FY93 for sampling/investigation of an approximately l-acre area where mustard agent residue or destruction byproducts may have been buried or deposited on the ground over 20 years ago. However, the site is believed to be of such extremely low risk to public health and the environment that this site restoration effort may wait until higher priority sites are restored. CAIS are also likely to have been used during training.

EFFORT TO DATE: Preliminary planning and coordination between the installation and the U.S. Army Technical Escort Unit (who may conduct whatever sampling operation is decided upon) has occurred.

REMEDIATION SCHEDULE: Uncertain at this time. There is an extremely small probability that sampling will show anything of significance that will result in further work.

RISK PERCEPTION: There has been no evidence of any threat to public health from the chemical agent at Camp Atterbury. Any contamination that may exist is expected to be strictly localized and is under Government control. Areas of concern are posted off-limits for sub-surface activities.

NAME OF LOCATION: **Naval Surface Warfare Center, Crane Division**

The Naval Surface Warfare Center, Crane Division, is located in southwestern Indiana, 70 miles southwest of Indianapolis, Indiana. It was first commissioned in December 1941 and consists of 62,404 acres. The original mission of this installation was loading, preparing, renovating, receiving, storing, and issuing all types of ammunition to the fleet. This mission was later expanded to include applied science, weapons engineering, quality pyrotechnics, ammunition generation, industrial production equipment, support services, and quality assurance. The center also stored strategic materiel, such as brass, iodine; tantalite, mica, talc, antimony, bismuth, columbite, and lead.

A chemical agent burial ground is located in the southeast quarter of the installation. The burial ground was established during World War II to support the installation's mission of unloading, storing, and maintaining chemical warfare munitions. In January 1945, the installation became a major storage facility for U.S. Navy chemical warfare munitions. The burial ground was also used to dispose of pyrotechnic mixtures and radioactive thorium.

According to records and interviews with past and present employees, chemical munitions weretaken to Building 600 (Transfer Depot) for loading and shipment to Ogden, Utah. Leaking rounds were taken to the burial grounds where they were drained and buried in holes 12 feet deep and covered with a heavy lime slurry. The munition casings were also buried in the same holes.

In addition, 2,808 chemical agent identification sets (CAIS) were stored at this site, but were moved to Rocky Mountain Arsenal for demilitarization. These were incinerated between 1979 and 1982.

LOCALITY/STATE: Crane, Indiana

WORK PLAN STATUS: Currently undergoing a Resource Conservation and Recovery Act (RCRA) Facilities Investigation Phase II Release Assessment sampling program at the mustard munition burial site to ascertain the nature and presence of contamination. Geophysical surveys (electromagnetic induction, magnetometer, and ground penetrating radar), soil sampling, and groundwater sampling are being used.

SCOPE OF RESTORATION EFFORT: The former Naval Weapons Support Center, Crane, Indiana, was a major storage facility for U.S. Navy chemical warfare munitions during World War II with a documented chemical burial site. The burial site is currently a solid waste management unit and in the RCRA Corrective Action Program.

EFFORT TO DATE: In 1973, the Defense Explosive Safety Board directed the excavation of any chemical materiel from the suspect chemical burial ground, The project was initiated in 1974, which yielded a quantity of radioactive thorium nitrate and 10 mustard aerial bombs containing a small quantity of agent. The project was halted

at that time because the level of effort available was thought to be insufficient considering the materiel exhumed.

In February 1980, the Naval Weapons Support Center (Crane Division) developed an operations plan to exhume all materiel associated with the chemical burial ground. Execution direction was given to the Naval Sea Systems Command in June 1980. Explosive Ordnance Disposal personnel initiated the operation on 9 September 1980. The effort involved intensive work in the field until 24 September 1980, when the exhumation phase was considered complete. The yield was: six empty M70A1 mustard bombs, one gas identification set with six ounces of mustard agent, unidentified radioactive waste, and radioactive thorium nitrate containers. All chemical materiel were safely decontaminated/detoxified.

REMEDIATION SCHEDULE: The site will most likely end up in a Phase III Release Characterization program, which will further determine the extent of contamination and rate of migration. The final Record of Decision for the site is due in May 1997.

RISK PERCEPTION: The potential threat to human health and safety from all operations at Crane, Indiana, is low. The threat from the site where the chemical agents were buried is small, since the materiel has been removed, the area is fenced within the secured boundaries of the center, and the extent and movement of the plume of groundwater contamination is known. No drinking water wells are currently threatened.

NAME OF LOCATION: **Newport Chemical Activity**

The Newport Chemical Activity (NECA) is located 3 miles south of Newport, Indiana, along Indiana State Highway 63. It encompasses 7,104 acres and was established in February 1942. Its mission was to produce the explosive materiel RDX for munitions during World War II, along with heavy water. In 1959, the Department of the Army selected this installation as the site for the production plant for persistent nerve agent VX. The plant started producing VX in 1961.

An area known on installation maps as the Decontaminated Waste Burial Ground (DWBG) is located south of the chemical plant in the southeast portion of the installation. Records indicate that the site was active in 1963, 1968, and 1974. Four specific burial sites have been identified at the DWBG, and three additional areas -- bum cages, pit A, and a 300-gallon buried sewer tank. The latter three areas are not thought to have involved chemical agents. A U.S. Army Toxic and Hazardous Materials Agency (now called Army Environmental Center) document, dated December 1991, entitled "Site Investigation Report for the Night Soils Pit, the TNT Manufacturing Area, Chemical Plant, Decontaminated Waste Burial Ground, and Little Raccoon Creek," discusses the four suspect burial sites in the DWBG:

Burial Area 1: Burial area 1 is located in the southern portion of the DWBG and comprises six known trenches. The five northernmost trenches were reported used in 1968 for burial of decontaminated wastes associated with the production of agent VX, and include drums, gas masks, gloves, pipes, sample bottles, valves, etc. These trenches could also contain rocket, mine, and projectile components. The southernmost trench was used for disposal of drums (now removed) containing polymerized urea from decomposed VX stabilizer dicyclohexyl carbodimide.

Burial Area 2: Burial area 2 is located east of the bum cages and consists of two separate burial trenches oriented east to west. Signs mark the trenches as containing wastes with asbestos from lines 1 and 2 of the TNT plant. Nitrobody-contaminated gaskets and insulation materials from the TNT plant were also reportedly buried.

Burial Area 3: Burial area 3 is located east of burial area 2 and consists of one trench oriented north to south. Wastes were reported to be placed in the trench in 1974. However, the data does not define the volume or the type of waste placed in the trench. It is referred to as the "sulfur waste" area.

Burial Area 4: Burial area 4 is located in the northeastern corner of the DWBG and consists of one large trench. The waste reportedly placed in this area contained residues of a 1966 to 1967 binary program (including VX production) that was terminated by fire and

deflagration. The residue was chemically decontaminated even though chemical agent was not believed to have been present at the time of the accident. Asbestos insulation from the chemical process towers used during the production of heavy water was also reported to be placed into this trench in 1963. The volume of wastes in the trench is unknown.

LOCALITY/STATE: NECA is 3 miles south of Newport, Indiana, in Vermillion County. The nearest major municipalities are Terre Haute, 32 miles to the south, and Danville, 32 miles to the north.

SCOPE OF RESTORATION EFFORT: The Installation Restoration Program (IRP) at NECA addresses a variety of potential contaminants at numerous sites. Only two areas, however, are of concern to the Non-Stockpile Chemical Materiel Program; the DWBG and former VX production facility. The four burial areas of the DWBG were previously explained. The VX plant is discussed in paragraph 6.3 of the basic document.

Concerning the DWBG, the NECA has been issued Resource Conservation and Recovery Act (RCRA), Part B permits by the Indiana Department of Environmental Management and the U.S. Environmental Protection Agency (EPA) Region 5. The permits contain a compliance schedule for requirements on 30 out of 66 solid waste management units (SWMUs) presently identified at NAAP. A RCRA Facility Investigation (RFI) Release Characterization Sampling Work Plan was developed and submitted in November 1994 for the DWBG and the other SWMUs.

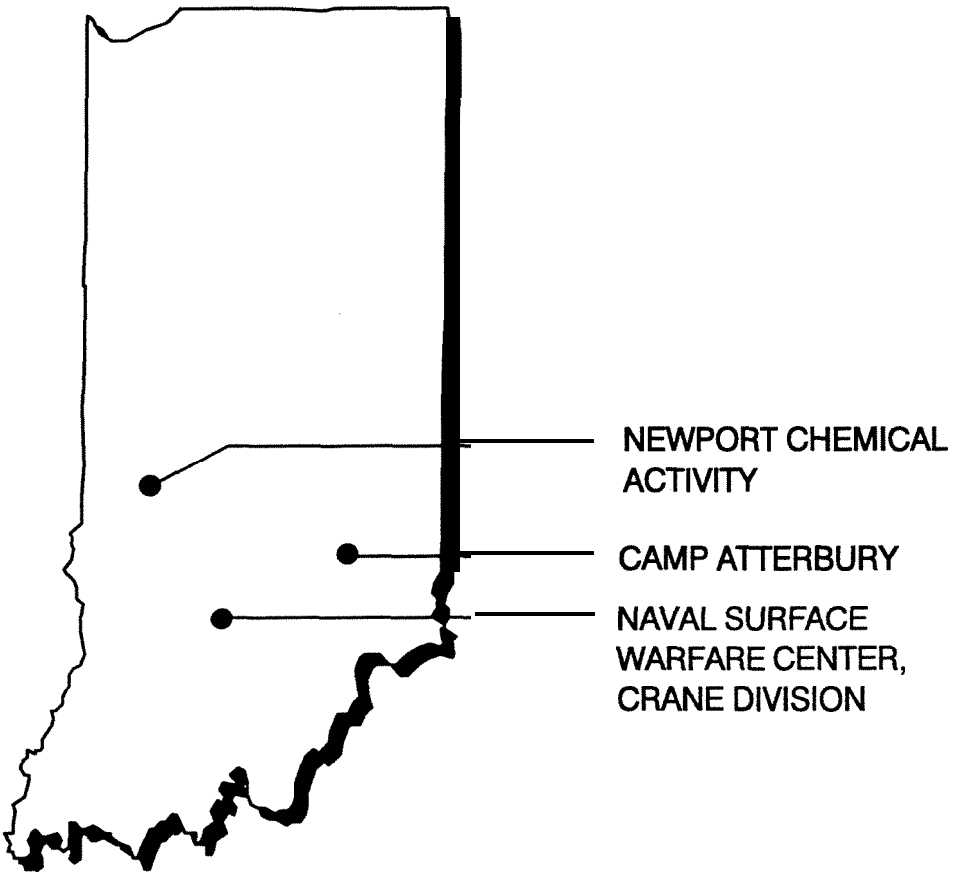
The Chemical Weapons Convention requires the destruction or conversion of all chemical production facilities within 10 years of the treaty's entry into force (January 1995). The former VX plant at NECA is one of the facilities that is planned for destruction. The Army has started its initial planning for the facility's destruction and is currently developing a project schedule. At this time, it is believed that the project will require 7 to 8 years to complete. State officials and the public will be fully coordinated with during the planning and implementation phases.

EFFORT TO DATE: The IRP at NECA is extensive and active. Much coordination has occurred with the State of Indiana and EPA Region 5. RCRA Part B permits have been issued for the SWMUs. The RFI workplan is now being developed. Planning for the destruction of the former VX plant is ongoing.

REMEDIATION SCHEDULE: The scope of remediation has not yet been established at any of the sites that are potentially contaminated with chemical warfare materiel (CWM). The scope of remediation, if any, will be determined by the administrator of EPA Region 5 after the submission of the required studies in the permit compliance schedule.

RISK PERCEPTION: Buried CWM is not expected to migrate or be disturbed if the current land use as a military installation continues. Thus, the threat to human health and safety appears to be very low. As a chemical agent stockpile storage facility, NECA has an active and thorough monitoring and detection program in place and a trained and ready emergency response force.

INDIANA


NEWPORT CHEMICAL ACTIVITY
CAMP ATTERBURY
NAVAL SURFACE WARFARE CENTER, CRANE DIVISION

LOCATION	Camp Atterbury
LOCALITY	Edinburgh
STATE	IN
SITE	H-I
DESCRIPTION	Twenty-five to thirty gallons of a bulk liquid with a molasses type consistency (possibly mustard) was poured from dark olive-drab containers onto the ground and ignited. Time frame 1968 to 1970. Also suspected burial of chemical agent identification sets discovered in 1979 and 1980.
SIZE	Unknown
CONTENTS	Bulk liquid (possibly mustard) and chemical agent identification sets.
COMMENTS	None.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Naval Surface Warfare Center. Crane Division
LOCALITY	Crane
STATE	IN
SITE	Southeast Quarter
DESCRIPTION	Chemical Burial Ground (mustard bombs) used during World War II. Total pits, unknown. 2,808 chemical agent identification sets stored in magazines (later moved to Rocky Mountain Arsenal for demilitarization).
SIZE	Unknown
CONTENTS	Chemical agent identification sets, mustard bombs.
COMMENTS	Ten mustard-filled bombs excavated in May 1974. In 1980, under a chemical burial ground exhumation project, explosive ordnance disposal personnel excavated six empty M70A1 mustard bombs, one gas identification set with six ounces of mustard, unidentified radioactive waste, and radioactive thorium nitrate containers. The materials were safely destroyed. Water samples will be taken periodically, and assuming no adverse readings, the site will be certified as free from chemical contamination.
TYPE	Disposal
INSTALLATION	Navy
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	3 - Suspect burial

LOCATION	Newport Chemical Activity
LOCALITY	Newport
STATE	IN
SITE	Chemical Plant
DESCRIPTION	Holding basins and burial ground (pits). All nerve agent (VX) decontaminated prior to release to holding basins. Defective VX munitions decontaminated and agent buried in pits. Casings either incinerated and sold as scrap or shipped to Aberdeen Proving Ground-Edgewood Arsenal, Maryland for disposal.
SIZE	Unknown
CONTENTS	Possible residue from nerve agent (VX) burning.
COMMENTS	Materiel may be buried in Burial Area 1 of the Decontaminated Waste Burial Ground.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

IOWA

NAME OF LOCATION: **Camp Dodge and Polk County National Guard Target Range**

LOCALITY/STATE: Polk County, Iowa

FUDS ACTIVITIES AT THIS LOCATION: The area now known as Camp Dodge was originally founded in 1907 as a 78 acre summer training site for the Iowa National Guard. By 1917 the site, located northwest of the city of Des Moines, had grown to 570 acres. During World War I (WWI), Camp Dodge was selected as one of 16 sites designated as regional training centers for the war effort. The War Department purchased 2,595 acres and leased an additional 2,900 acres to the north of the site, which was to be used for the artillery range. After the war, the size of Camp Dodge was reduced to 3,165 acres and was used for the training of Iowa National Guard troops. In 1955 the title of the land was conveyed to the State of Iowa by Quitclaim Deed and Correction Deed. In 1965, 872 acres of land that had formed the small arms practice range were returned to the Federal Government for the formation of Saylorville Reservoir. The WWI Camp Dodge area is now occupied by the Camp Dodge Military Reservation, the major training area for the Iowa National Guard; portions of Saylorville Lake; and various farming and residential communities.

During the WWI combat training tasks, the use of gas masks were included. The soldiers trained at a building which simulated gas attacks. The building was located on the southwestern portion of the WWI Camp Dodge cantonment area. Inspection of the site has revealed no reports of contamination.

According to the records of the 7th Corps Area of the Chemical Warfare Service, chemical warfare training was conducted on post during the 1920s and 1930s. Standard training sessions included lectures on dual and collective protection, the tactical use of chemical warfare ammunition, and simulated gas attacks upon mobs combining the use of smoke and tear gas.

Chemical Warfare Materiel listed as being shipped to Camp Dodge included:

- HC smoke candles
- CN smoke candles
- CN grenades, hand and rifle
- WP grenades, hand and rifle
- Gas Identification Sets.

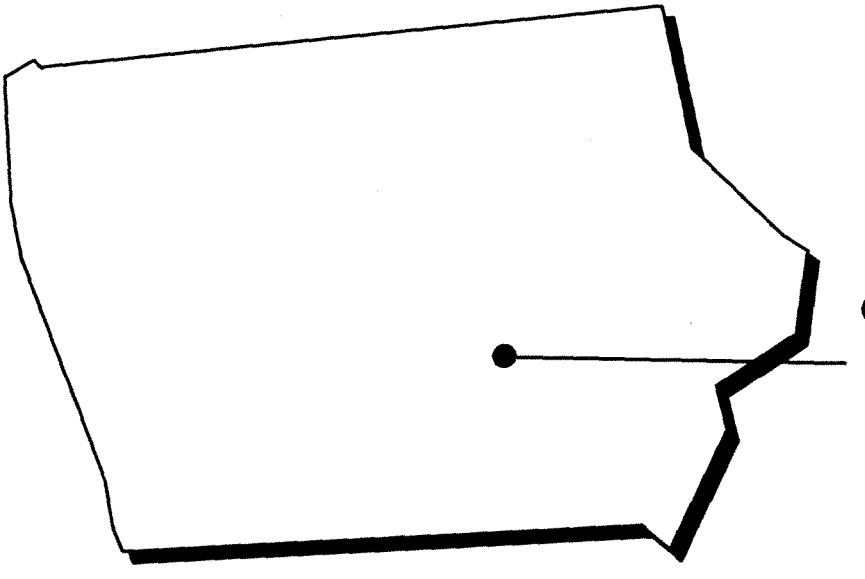
One gas identification set was recovered by the Technical Escort Unit in 1989. This container is reported to have originated off site and was unrelated to possible past training practices at Camp Dodge.

PREVIOUS CORPS ACTIVITIES: A report entitled "Cultural Resource Reconnaissance Study at Camp Dodge National Guard Training Installation, Polk County, Iowa" was prepared by the U.S. Army Corps of Engineers, Omaha District. The purpose of this study was to prepare an inventory of all cultural resources and to present recommendations for their management to the Iowa National Guard. An Archives Search Report for this site was prepared by the U.S. Army Corps of Engineers, St. Louis District, in September 1993.

ACTIONS PLANNED FOR THE FUTURE: No site remediation plans for this location at this time.

RISK PERCEPTION: Investigations, including conversations and interviews with individuals familiar with the site; actual site inspection for surface evidence of contamination; and aerial photographic and mapping interpretation have failed to uncover any surface evidence of CWM contamination. No threat to human health and safety is currently known to exist.

IOWA



LOCATION	Camp Dodge and Polk County National Guard Target Range
LOCALITY	Des Moines
STATE	IA
SITE	Unknown
DESCRIPTION	According to Technical Escort Unit records. World War II chemical agent identification sets were buried on this site. The U.S. Army Technical Escort Unit responded and picked up one pig from Camp Dodge in 1989.
SIZE	Unknown
CONTENTS	Chemical agent identification sets.
COMMENTS	None
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	3 - Suspect burial

KANSAS

NAME OF LOCATION: Marysville

LOCALITY/STATE: Marysville, Kansas

FUDS ACTIVITIES AT THIS LOCATION: Marysville is located in north central Kansas in Marshall County. In September 1944, during a rail shipment of mustard (H) from Deseret Chemical Warfare Depot, Tooele, Utah, three 55-gallon drums were discovered leaking. The mustard drums were removed from the train, the contents decontaminated, and the residue buried near Mile Post 151 at a depth of 6.5 feet. Information sources did not indicate if the site had been excavated at a later date.

PREVIOUS CORPS ACTIVITIES: An Archive Search Report (ASR) was completed in August 1993. A site visit was conducted by the US. Army Corps of Engineers in July 1992, with a second visit in June 1993. Corps personnel have met with a representative of Union Pacific Railroad (owner of the site) and the former mayor of Marysville. Although the exact location of the burial could not be verified due to the removal of the marking signs, it was narrowed to about a 500-foot strip along the northeast side of the track. There was one spot within this strip with stressed vegetation. The ASR concluded any remaining residue no longer presents a CWM hazard.

ACTIONS PLANNED FOR THE FUTURE: No further action.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: Since the burial site is located on Union Pacific Railroad right of way, no intrusive activities are expected.

RISK PERCEPTION: No threat to human health and safety is anticipated.

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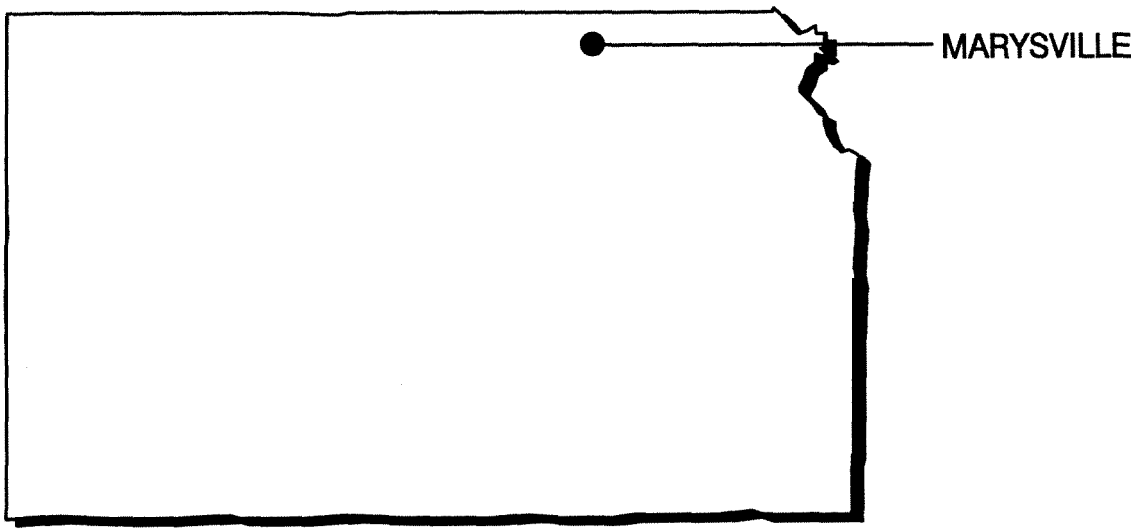
KANSAS



LOCATION	Marysville
LOCALITY	Marysville
STATE	KS
SITE	At current Mile Post 151
DESCRIPTION	During rail shipment, contents of three 55-gallon drums leaking mustard decontaminated and buried near Mile Post 151. Sign posted reading Poison Gas and dated. Occurred in September 1944.
SIZE	4 by 8 by 6-1/2 feet deep
CONTENTS	Mustard decontaminated in pit with chloride of lime slurry.
COMMENTS	Drums shipped to Rocky Mountain Arsenal. Actual location is near current Mile Post 151. The U.S. Army Corps of Engineers completed an Archives Search Report in August 1993 and concluded any remaining residue no longer presents a chemical warfare hazard.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

KENTUCKY

NAME OF LOCATION: **Blue Grass Army Depot**

The Lexington-Blue Grass Depot Activity (now known as the Blue Grass Army Depot) was assigned the mission for receipt, issue, storage, maintenance, and disposal of ammunition, The Depot is situated in Madison County, Kentucky, 30 miles southeast of the city of Lexington, and 6 miles south of Richmond. Construction of the ammunition storage area, a general supply storage area, and a utilities and administrative area began on the 14,494-acre tract of land in April 1942.

The first completed portion of this installation was turned over to the Ordnance Department by Army Engineers on 4 September 1942, and actual operations of the installation began on 2 October 1942, when seven carloads of ammunition were received for storage. The installation was operated by the Federal Government until 25 October 1943, at which time the operation of the installation was assumed by a private corporation under the name of Blue Grass Ordnance Depot, Inc. The corporation operated the installation until 25 October 1945, when the Federal Government resumed operations.

Chemical agents have been stored at the installation from 1942 to the present. During 1949 through 1951, most of the chemical munitions were shipped to Rocky Mountain Arsenal. Demolition and burning operations were also conducted here. During 1949 to 1955, the Demolition and Burning Ground was used to bum leaking mustard-filled projectiles. The projectiles were broken apart by shaped-charge explosives and burned in trenches using scrap wood and fuel oil. Approximately 900 rounds were burned in this area.

In 1951, 105-millimeter mustard-filled projectiles were demilitarized. However, during operation, burster assemblies of 243 rounds could not be removed. These 243 rounds were destroyed at the Demolition and Burning Ground. The projectiles were drilled and mustard agent drained prior to disposal of the bursters. The mustard was then burned.

LOCALITY/STATE: Richmond, Kentucky

SCOPE OF RESTORATION PROGRAM: The mission of Blue Grass Army Depot includes the receipt, storage, and issuance of ammunition; repair of general supplies; calibration of electronics equipment: and demilitarization of munitions. Chemical agents that are stored at Blue Grass Army Depot are nerve agents GB and VX, and the blister agent mustard (H), which is contained in a variety of munitions and configurations. All of these agents are stored in liquid form. After applying for a Resource Conservation and Recovery Act (RCRA) Part B Permit, a RCRA Facility Assessment was completed in 1990, and identified 39 solid waste management units (SWMUs) and four areas of concern.

EFFORT TO DATE: In 1987, investigations were initiated at 13 SWMUs, including the Demolition and Burning Ground (also known as the Mustard Burial Trenches), which involves chemical munitions. Further investigation at this site is planned. In addition to the Demolition and Burning Ground, another site involving chemical agents is the Temporary H Storage Site; it has been identified as a requirement in the 1993 Installation Restoration Program Work Plan.

Site investigation work has been performed at the temporary H storage area with the result of "no further action required." A decision is to be prepared by the installation.

REMEDIATION SCHEDULE: This effort will be integratedinto the remedial program.

RISK PERCEPTION: No significant public health threat exists at the installation because of past disposal of chemical agent. No evidence of any continuing release of contamination exists. As a chemical agent stockpile storage facility, the Blue Grass Army Depot has an active monitoring and detection program and a trained emergency response force.

NAME OF LOCATION: Fort Knox

LOCALITY/STATE: Fort Knox, Meade County, Kentucky

Fort Knox is located on the Indiana-Kentucky border, approximately 25 miles south of Louisville, on U.S. Route 31 W. In January 1918, 10,000 acres of what is now Fort Knox were leased by the War Department. In July of that year 40,000 acres were purchased for marching and maneuver areas at Camp Taylor on the outskirts of Louisville. The new area was named Camp Henry Knox in honor of the major general who was the first Secretary of War and Washington's successor as commandant of the Colonial Army. Today, Fort Knox is 14 miles from north to south and 18 miles from east to west, containing approximately 110,351 acres. Approximately 58 firing ranges exist to accommodate weapons ranging in size from a pistol to the 120mm gun.

With the arrival of World War I, construction began to make Camp Knox an artillery center. When the Armistice was signed, the post was only partially completed and had never been occupied by troops. The 10th Artillery Brigade was the first unit in the new barracks in December 1918. In 1922 Camp Knox became a permanent post for training troops. After artillery activities moved to Fort Sill, Oklahoma, in 1926, the post was designated a National Forest. Civilian caretakers maintained the post from 1926 through 1928.

In 1932 Colonel Daniel Van Voorhis selected Camp Knox for mechanized cavalry training. In January 1932, it was again made a permanent post and the name was changed from Camp Knox to Fort Knox.

In June 1943, vapor detector kits were tested at Fort Knox. Seven mustard-filled mines were detonated on an area of farmland covered with weeds. The size of the area was 30 yards by 35 yards. The mines contained one gallon of mustard each and were filled on site manually from a 55-gallon drum of mustard. It is not known what became of the unused mustard.

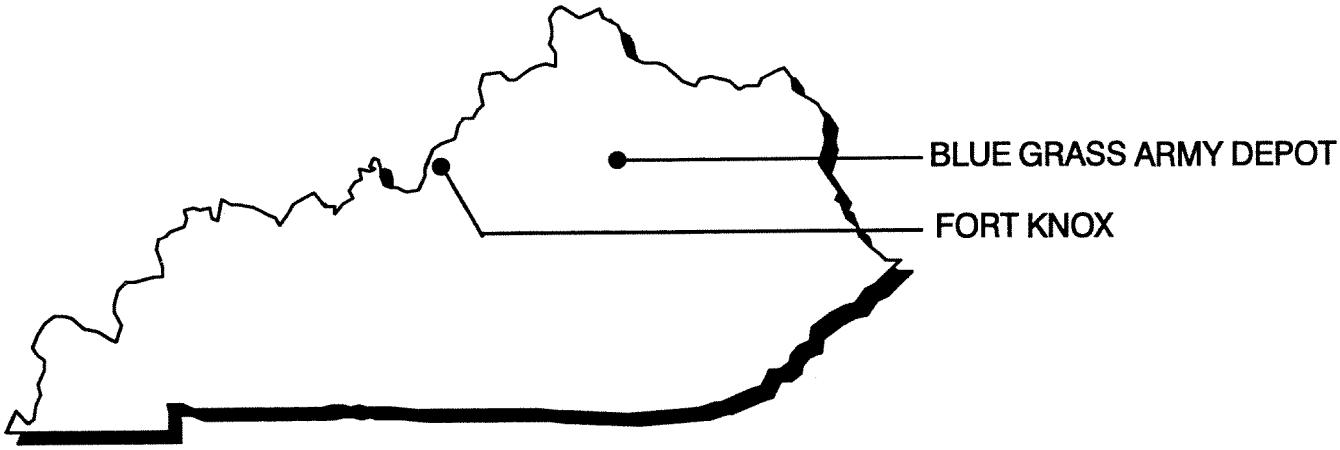
In February 1957 a letter from the Army Medical Research Laboratory was written thanking Army Chemical Center for their delivery of phosgene and a Chemical Corps Materiel Command Safety Manual containing information concerning applicable storage and handling of Phosgene. It is unclear what the phosgene was used for and how it was disposed.

SCOPE OF RESTORATION PROGRAM: Fort Knox is currently conducting cleanup activities in accordance with the Resource Conservation and Recovery Act. None of these sites has been identified as containing buried chemical warfare materiel (CWM).

EFFORT TO DATE: Archival searches have been conducted by the U.S. Army Corps of Engineers (USACE), St. Louis; Fort Knox; and the U.S. Army Chemical Demilitarization and Remediation Activity.

RISK PERCEPTION: No threat to public health due to chemical agents is currently known or suspected to exist at Fort Knox,

KENTUCKY



LOCATION	Blue Grass Army Depot
LOCALITY	Richmond
STATE	KY
SITE	Demilitarization Grounds
DESCRIPTION	Active from 1949 to 1955. In 1951, mustard projectiles broken apart by explosives and agent drained and burned. Casings were stored and later shipped to Rocky Mountain Arsenal.
SIZE	Unknown
CONTENTS	Potential for residue from 243 105-millimeter mustard-filled munitions. Nine hundred projectiles burned.
COMMENTS	Source states 9 leaking 155-millimeter shells and 10 leaking 105-millimeter shells destroyed June through August 1950. Total of 43,343 155-millimeter and 3,194 105-millimeter shells destroyed 1950 to 1951.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Blue Grass Army Depot
LOCALITY	Richmond
STATE	KY
SITE	Trench
DESCRIPTION	Area described as mustard trench. Discovered in southwest part of installation in 1988. Method of disposal unknown. This area may be the same as the demilitarization and disposal grounds.
SIZE	60 by 30 feet
CONTENTS	Potential for mustard or residue.
COMMENTS	No mustard or mustard breakdown products found in soil samples. Samples taken circa 1989.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Fort Knox
LOCALITY	Louisville
STATE	KY
SITE	Chemical Warfare Training Field
DESCRIPTION	On a chemical warfare training field at Fort Knox (unspecified location), numerous demonstrations on the actual use of mustard gas (HS) were held. During these exercises, 55-gallon drums were opened and chemical land mines were filled and then later detonated. Participants donned various levels of protection and were instructed to do various movements within the contaminated area. The final disposition of the drums and remnants of the mines was not mentioned. No further information was found in reference to chemical warfare materiel.
SIZE	Unknown
CONTENTS	Possible mustard residue.
COMMENTS	None
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	4 - Possible burial

LOUISIANA

NAME OF LOCATION: Mississippi River

LOCALITY/STATE: New Orleans, Jefferson, Louisiana

FUDS ACTIVITIES AT THIS LOCATION: New Orleans was a port of embarkation/debarkation for military supplies during World War II. Leaking chemical warfare bombs were discovered during the loading and unloading of a ship at the Port of New Orleans. Two bombs of unknown size and fill were removed from the shipment and sunk in quicksand in the ship canal, three to four miles below Braithwaite. (Braithwaite is located in Plaquemines Parish, on the east descending bank of the Mississippi River, approximately nine miles below the city of New Orleans,) There are indications that this was a common practice and the potential number of items disposed of in this fashion is significantly higher than two bombs. Information is not sufficient to locate the dump location. Efforts to locate the exact disposal site were unsuccessful.

ACTIONS PLANNED FOR THE FUTURE: The U.S. Army Corps of Engineers has determined the potential buried chemical warfare materiel is not accessible for recovery due to the imprecise location data, the depths of the quicksand, and numerous channel shifts over time. No further actions are planned at this time.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: It is unlikely that intrusive actions will take place.

RISK PERCEPTION: Little risk is posed to the public by the buried munitions. Further investigation and evaluation is required to assess whether other munitions are buried and where they may have been deposited.

NAME OF LOCATION: **England Air Force Base**

LOCALITY/STATE: Alexandria, Louisiana

SCOPE OF RESTORATION EFFORT: England Air Force Base was used during World War II as an Army Air Field and was closed in December 1992. In 1969, workers excavating the site, which was characterized by the Army as a solid waste management unit (SWMU #53) and known as the HAZ Chemical Burial Mountain and the Old Rifle Range Backstop, were overcome by an unknown gas. Glass vials uncovered at the site probably contained Phosgene. The glass vials were believed to have been buried in 1945 to 1946. The vials are probably from a chemical agent identification set (CAIS) (K95 11952 or K953/954).

EFFORT TO DATE: The site is in the Installation Restoration Program as Landfill No. 11, and may contain chemical agent identification sets (CAIS). The Army is developing an onsite neutralization capability for CAIS that will be used for remediation at this site. Neutralization onsite at England AFB by the Army is an action that needs to be completed, and action that needs to be completed before proposing base property as suitable for transfer in the base disposal process (base closure in 1992). In the meantime, the site is closed off and not accessible to the public.

REMEDIATION SCHEDULE: As previously described.

RISK PERCEPTION: No threat to public health due to chemical agents is currently known or suspected to exist. Public access to Landfill No. i 1 is restricted. The only threat posed would be due to unsupervised excavation at the site.

NAME OF LOCATION: **Barksdale Air Force Base**

LOCALITY/STATE: Bossier City, Bossier, Louisiana

WORK PLAN STATUS: Barksdale is not a National Priorities Listed Installation and not under a Federal Facilities Agreement.

ACTIVITIES AT THIS LOCATION: Barksdale is a U.S. Air Force installation under Air Combat Command with B-52 bombers, KC135 and KC10 aircraft refueling tankers, and a Reserve squadron of A-10 close air support aircraft. Tankers are due to move under the base realignment and closure program. The base has a land area of approximately 22,000 acres, with 5,500 acres developed for industrial/residential, and the remainder is improved woodlands, including abandoned World War II bombing ranges. The woodlands are heavily forested with a timber harvesting program that generates revenues for the installation. Approximately 6,000 acres are managed wetlands.

SCOPE OF RESTORATION EFFORT: There are no chemical restoration efforts ongoing under the Barksdale Installation Restoration Program (IRP). During an IRP Records Search in 1986, the use and possible disposal of chemical weapons were investigated. No field testing or geophysical surveys were conducted for chemical weapon disposal. Old newspaper and photo accounts indicate chemical training being conducted in the early 1940s, but no indication of actual use or disposal.

ACTIONS COMPLETED: No local records exist to indicate that any chemical munitions are buried on base or that chemical-filled bombs are in the abandoned and closed bomb range. Information provided by the U.S. Army Chemical Materiel Destruction Agency, Aberdeen Proving Ground, in September 1993, includes a training trip report dated February 1945, indicating chemical munitions and test kits were in use at Barksdale Field in 1945. This information has been reviewed and no further investigation is warranted at this time.

RISK PERCEPTION: Barksdale is a controlled military installation with limited access and the threat to public health due to chemical agents is considered low to nonexistent.

NAME OF LOCATION: Camp Claiborne

LOCALITY/STATE: Alexandria, Rapides, Louisiana

FUDS ACTIVITIES AT THIS LOCATION: Camp Claibome was a chemical warfare training area in World War II. A memorandum found in the National Archives refers to 7,992 smoke bottles remaining at the camp, and outlines a request to ship the bottles to five other military posts, Further in the memorandum, it requests that the remaining balance of 1,992 bottles of HS be retained in storage at the camp. HS is mustard gas. Since this correspondence was between Engineer Corps Officers, it is felt that the reference to HS was a misprint and the smoke bottles probably contained HC. If the smoke bottles truly contained mustard gas, then it should have been Chemical Warfare Officers deciding on the disposition of the bottles.

PREVIOUS CORPS ACTIVITIES: An Inventory Project Report was completed in July of 1993. This report established that the current owner is the U.S. Department of Agriculture, that there was a potential for Ordnance and Explosive Waste (OEW), that the potential for chemical warfare materiel was unknown, and that the "impact area" be further investigated for OEW.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: A site survey was made. Intrusive activity was not observed.

RISK PERCEPTION: The Archives Search Report will address the question of whether or not the smoke bottles contained "HS" (mustard). If mustard was used in training/maneuver areas, then disposal or burial pits would have been commonly used for duds and leakers. Until the report is complete, the risk perception is unknown.

NAME OF LOCATION: Concord Spur

LOCALITY/STATE: Belle Chasse, Plaquemines Parish, Louisiana

FUDS ACTIVITIES AT THIS LOCATION: Concord Spur was a railroad ammunition pier located south of Belle Chasse, on the west bank of the Mississippi River. The site was used during World War II to load ammunition onto ships. Sometime after World War II, the railroad spur and pier were removed.

Two leaking mustard-filled bombs were found on a railcar arriving from Edgewood Arsenal, Maryland. The bombs were removed from the shipment, placed on a barge, and buried in the Mississippi River.

An Archive Search Report indicated the bombs were moved to the site listed as River, Mississippi River, New Orleans, for disposal.

ACTIONS PLANNED FOR THE FUTURE: No further action required.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: Not applicable.

RISK PERCEPTION: This site is not believed to present any threat to human health and safety due to buried CWM.

NAME OF LOCATION: Fort Polk

LOCALITY/STATE: Leesville, Louisiana

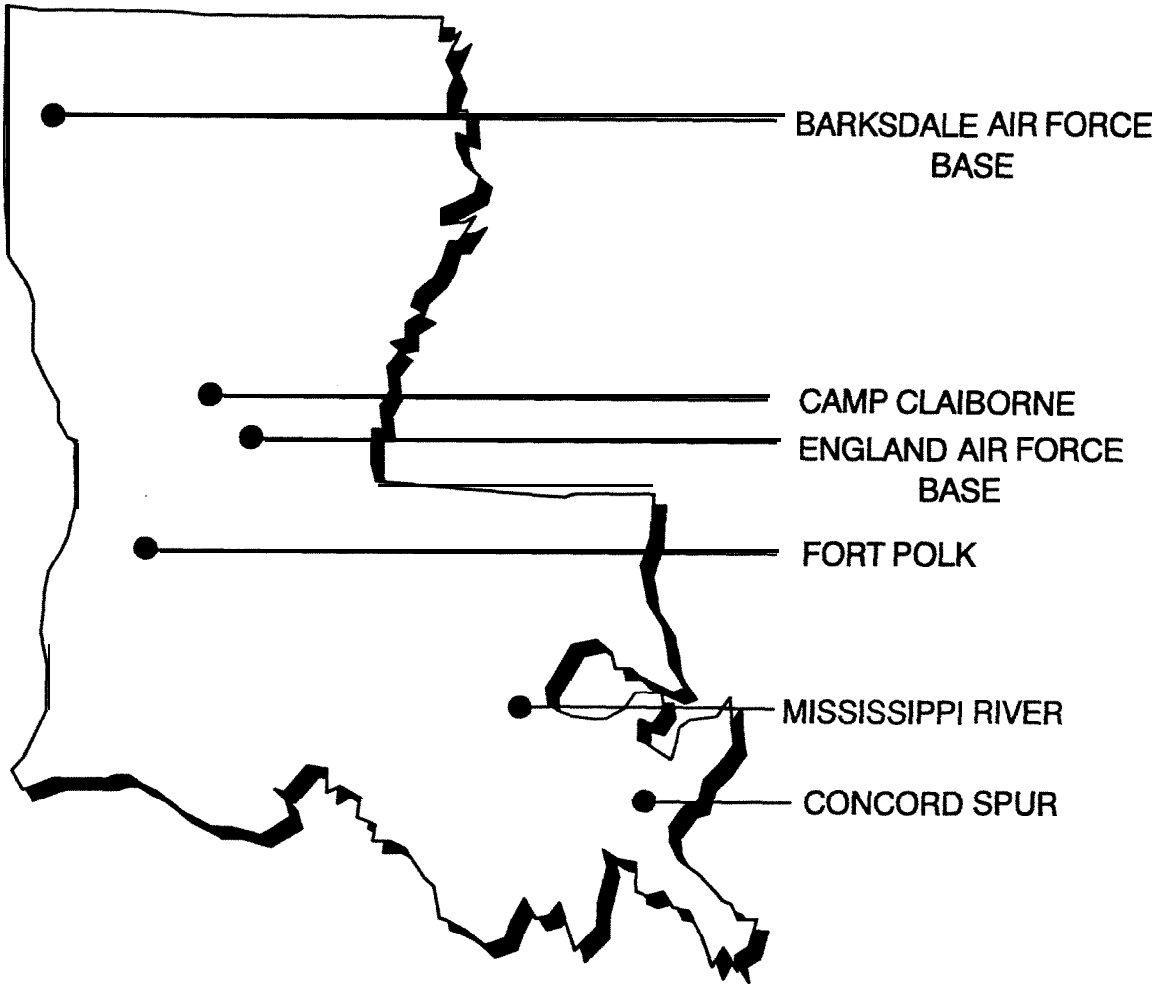
SCOPE OF RESTORATION PROGRAM: Fort Polk is the home of the Joint Readiness Training Center. Its mission is to provide advanced-level joint training for Army and Air Force contingency forces under conditions that simulate those of real low- and mid-intensity conflicts throughout the world. Several projects have been identified for environmental restoration, including open burning/open detonation grounds and wastewater lagoons. Prior to 1987, no record existed indicating manufacture, storage, use, or disposal of chemical agents or munitions at Fort Polk. In June 1987, the chemical agent burial site at Range 23-A was excavated. Chemical agent identification sets (CAIS) containing mustard, lewisite, and choking and blood agents (CG and CK, respectively) were exhumed. Tests of soils for leakage did not reveal any of these agents. However, arsenic (a decomposition product of lewisite) was detected. The Environmental Protection Agency was informed and a U.S. Army Technical Escort team from Pine Bluff Arsenal handled the removal and disposal.

EFFORT TO DATE: Because the U.S. Army Technical Escort Unit removed the small quantity of CAIS, no further remedial response is necessary.

REMEDIATION SCHEDULE: None required.

RISK PERCEPTION: There is no evidence that chemical warfare materiel presents any threat to human health and safety at Fort Polk.

LOUISIANA


BARKSDALE AIR FORCE BASE
CAMP CLAIBORNE
ENGLAND AIR FORCE BASE
FORT POLK
MISSISSIPPI RIVER
CONCORD SPUR

LOCATION	Mississippi River
LOCALITY	New Orleans
STATE	LA
SITE	River
DESCRIPTION	Bombs sunk in quicksand in ship canal, 3 to 4 miles below Braithwaite, Louisiana, in 1944. Bomb fill unknown.
SIZE	95 feet deep
CONTENTS	At least twenty 100-pound bombs, and two T3 100-pound mustard bombs.
COMMENTS	The two bombs associated with the Concord Spur entry are also buried at this location. The U.S. Army Corps of Engineers has determined the potential chemical warfare materiel is not accessible for recovery due to the imprecise location data, the depth of the quicksand, and numerous channel shifts over time. No further actions are planned at this time.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

LOCATION	England Air Force Base
LOCALITY	Alexandria
STATE	LA
SITE	SWMU #53
DESCRIPTION	Thought to be small containers of agents buried in 1945 and 1946, believed to be chemical agent identification sets (K951/952 or K953/954). In 1969, workers excavating site were overcome by an unknown gas.
SIZE	Unknown
CONTENTS	Glass tube uncovered, possibly containing Phosgene.
COMMENTS	Area known as Hazardous Chemical Burial Mountain. Also known as Old Rifle Range Backstop.
TYPE	Disposal
INSTALLATION	Air Force
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	2 - Likely burial

LOCATION	Barksdale Air Force Base
LOCALITY	Bossier City
STATE	LA
SITE	Unknown
DESCRIPTION	Test kits were being used and it was found that the ampules were mismarked. The ampules marked "Ml" (lewisite) were really "HS" (mustard). Unit gas officers and non-commissioned officer school conducted training with field identification of agents.
SIZE	Unknown
CONTENTS	Unknown
COMMENTS	Information discovered in 1993 has been reviewed and no further action is deemed necessary.
TYPE	Disposal
INSTALLATION	Air Force
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	5 - No further action

LOCATION	Camp Claiborne
LOCALITY	Alexandria
STATE	LA
SITE	Unknown
DESCRIPTION	Storage of 1,992 bottles of "HS" to be used as third army training reserve.
SIZE	Unknown
CONTENTS	Potential chemical agent identification sets.
COMMENTS	None
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	3 - Suspect burial

LOCATION	Concord Spur
LOCALITY	Belle Chasse
STATE	LA
SITE	Sea
DESCRIPTION	In February 1946, two leakers were found on a railcar of 100 T3 126-pound bombs enroute from Edgewood Arsenal to Concord Spur, Louisiana. Leakers were placed on a barge and disposed of by New Orleans Chemical Section, in the Mississippi River.
SIZE	N/A
CONTENTS	**N/A**
COMMENTS	Bombs were turned over to San Jose project personnel at Corazal Railroad yards on March 20, 1946. Documentation indicates the bombs were transported to the site listed as River, Mississippi River, New Orleans, for disposal. Since the disposition of the bombs is documented, no further action is required at this site.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

LOCATION	Fort Polk
LOCALITY	Leesville
STATE ,	LA
SITE	Range 23-A
DESCRIPTION	Chemical agent burial site. Unknown dates of burial. Source cites disposal of chemical agent identification sets and related equipment.
SIZE	12 by 15 by 5 feet
CONTENTS	Chemical agent identification sets, mainly mustard and lewisite potential.
COMMENTS	Chemical agent identification sets containing HD, L, and CG were exhumed in June 1987. Soil samples collected in 1987 showed no evidence of mustard; however, arsenic was detected.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	3 - Suspect burial

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MARYLAND

NAME OF LOCATION: Aberdeen Proving Ground-Edgewood Area

The Edgewood Area (formally Edgewood Arsenal) of Aberdeen Proving Ground (APG), Maryland, is situated adjacent to the towns of Edgewood and Joppatowne in the southwestern part of Hat-ford County, approximately 21 miles northeast of Baltimore. It is situated on a peninsula of the Chesapeake Bay known as the Gunpowder Neck, which extends 9 miles south into the Chesapeake Bay between the Bush River and Gunpowder River. The Edgewood Area also includes Carroll Island and Graces Quarters and is approximately 12 miles from the Aberdeen Area of APG.

The installation was initially known as the Gunpowder Reservation and was used by the Ordnance Department for the manufacture and filling of gas shells. On May 4, 1918, the installation was officially designated Edgewood Arsenal. Edgewood Arsenal remained an Ordnance installation until July 1, 1918, when it was transferred to the newly created Chemical Warfare Service.

Fort Hoyle Military Reservation, which was located adjacent to and was serviced with utilities from Edgewood Arsenal, later became part of Edgewood Arsenal. During World War I, the Arsenal manufactured great quantities of chemical agent. Following the war, plants were placed on standby and the major function during ensuing years was the manufacturing of gas masks.

During the 1920s, the Chemical Warfare School was established along with the research and development activities of the Chemical Warfare Service. In May 1942, the installation was designated the Chemical Warfare Center. On August 2, 1945, the designation was changed to the Army Chemical Center.

Reorganization of the Army on August 1, 1962, resulted in redesignation of the Army Chemical Center back to the historic Edgewood Arsenal. On July 1, 1971, Edgewood Arsenal became a part of APG. The Edgewood Area is currently responsible for the research and development, test and evaluation, procurement, production, and mobilization planning of chemical materiel and related equipment.

The principal areas in which chemical weapons were tested or disposed of include: Westwood, O-Field, Old O-Field, J-Field, Kings Creek, G-Field, M-Field, D-Field, Maxwell Point, Carroll Island, the Landerick Creek Area (school fields), and Graces Quarters. The Westwood Area was used for a variety of miscellaneous training and testing activities, such as mustard decontamination testing and demilitarization testing. The Westwood Area was also used as an impact area for incendiary bomb testing and static testing of bombs and grenades, as well as for repacking of radioactive material.

O-Field was used for burial and disposal of chemical munitions, high-explosive (HE) filled rounds, and detoxified waste. Disposal took place during World War II and the Korean Conflict and Vietnam war timeframes. Old O-Field contains a 4.5-acre landfill, which was used as a burial ground for allied and enemy chemical-filled and conventional munitions, contaminated equipment, and miscellaneous hazardous waste

during and after World War II. The amounts and specific types of contamination are unknown but are considered to be significant.

J-Field was used extensively for chemical agent testing and disposal operations conducted since World War II. Chemical agent analysis in sediment, air, groundwater, and surface water have not detected chemical agent, only degradation products. Fields F, G, M, and D, and Maxwell Point, were used as impact areas for testing chemical-filled military ordnance containing various chemical agents.

A 1923 terrain map of the King's Creek area of Edgewood Arsenal shows the location of a firing range extending from the north side of King's Creek to the Chesapeake Bay. The firing range was known as the Artillery Component Testing Range. In November 1992, a World War I Stokes mortar round and a Livens projectile were discovered during an environmental cleanup operation. Although no other documentation could be found, this area is believed to contain small numbers of individual chemical weapons as well as some small pits. Navy EOD divers also found numerous liquid-filled projectiles in King's Creek. In 1994, the Navy divers returned and removed 51 rounds. Additional rounds remain in the creek.

Carroll Island was used from 1949 to 1969 to test chemical agents VX, GB, and mustard; incapacitating agents; and experimental lethal agents. Carroll Island has upwards of 12 disposal pits with unknown contents. Cleanup of one pit in February 1993 recovered a liquid-filled, 120-millimeter rocket and a liquid-filled landmine. Thiodiglycol was found in surface water at Carroll Island. Graces Quarters has several disposal pits, the contents of which are unknown. Four pits were excavated in 1993 and were found to contain 400 smoke and 4 HE rounds. Other pits/disposal sites remain.

LOCALITY/STATE: Edgewood, Maryland

SCOPE OF RESTORATION EFFORT: An Interagency Agreement has been signed that is the effective "driver" of the restoration program at APG, and the installation is in compliance with all established deadlines. The Edgewood Area (EA) of APG, as the longtime center of much of the Army's research, development, and testing in the chemical warfare area, presents unique remediation problems associated with chemical warfare agents. The entire APG-EA is a National Priorities List site. The most serious spot is known as Old O-Field, an area where large amounts of chemical ordnance were buried during and after World War II. Agent byproducts, as well as many other contaminants, have been found in the groundwater downgradient of the area; a water treatment system is being installed and remediation efforts for the field are planned. Other areas presenting potential chemical agent hazards include Carroll Island and Graces Quarters, offshore from the post. Finally, there are various other areas over the post where chemical munitions are occasionally uncovered, and all excavation at EA is carefully monitored. All potential types of chemical agent, ordnance, and agent/ordnance combinations could be found at EA.

EFFORT TO DATE: Several remedial investigations and feasibility studies are underway and interim removal actions, where appropriate, have been completed. Two Records of Decision have already been signed for the O-Field Area. A preliminary Focused Feasibility Study (FFS) of extraction and cleanup options was performed in 1987 for the 4.5-acre site at Old O-Field. The report concluded that there was no proven technology that could safely remove the CWM. Another FFS was performed in 1993/94 for the Old O-Field landfill. The Record of Decision for the Old O-Field landfill was signed in October 1994. It requires the installation of a protective cover system, called a permeable infiltration unit (PIU), to reduce risks from unexploded ordnance. The permeable cover will allow water to infiltrate through the landfill, thus allowing natural degradation of the waste to continue. Contaminants that reach the groundwater will be extracted through a down-gradient extraction well system and treated through a groundwater treatment facility. The Record of Decision also calls for the Army to conduct treatability studies after the cover system is installed to evaluate whether or not the wastes in the landfill can be effectively treated in place.

REMEDIATION SCHEDULE: Remediation at APG-EA will occur as identified throughout the restoration process. The design for the Old O-Field PIU is underway.

RISK PERCEPTION: As a chemical agent stockpile storage site, APG-EA has an active and thorough chemical agent monitoring and detection program, as well as a trained and ready emergency response capability. Along with area restrictions and safety precautions built into the installation restoration program, this essentially minimizes any threat to public health and safety from chemical agent.

NAME OF LOCATION: Fort Meade

Fort George G. Meade (FGGM) is located approximately equidistant between Washington, D.C. and Baltimore, Maryland. The installation formerly contained approximately 13,000 acres; however, recent land transfers have reduced the size of the base to approximately 5,000 acres. FGGM has been a permanent U.S. Army installation since 1917. The installation currently serves as home for Headquarters, First U.S. Army. FGGM became a Military District of Washington Installation on 1 October 1993.

The installation currently contains administration, recreational, and housing facilities. The base formerly contained limited training areas and firing/combat ranges; these areas were included within the recent land transfers.

In 1988, the U.S. Army Base Realignment and Closure Act (BRAC) recommended that 9,000 acres of FGGM be closed or excessed. These 9,000 acres encompass the southernmost two-thirds of the formerly 13,000 acre facility. The U.S. Army has since transferred approximately 8,100 acres to the Department of Interior (DOI) for use as a wildlife refuge currently being administered by the Patuxent Wildlife Research Center. The remaining portion of the BRAC parcel, which includes the Tipton Army Airfield, is scheduled to be transferred to Anne Arundel County on 1 October 1995.

Numerous environmental investigations have been conducted at FGGM since BRAC. In 1989, the U.S. Army Toxic and Hazardous Materials Agency [now U.S. Army Environmental Center (USAEC)] conducted an enhanced Preliminary Assessment of the 9,000 acre BRAC parcel. This report identified a concern of unexploded ordnance contamination to exist anywhere on the BRAC parcel. Specific records from the archives at FGGM were not adequate to verify the extent, character, and location of the unexploded ordnance contamination.

In support of the BRAC environmental restoration program, USAEC has undertaken an unexploded ordnance survey to locate and identify areas on the BRAC parcel. Incidental to these surveys, USAEC has located a number of unexploded ordnance, thought to most probably be smoke projectiles, which have physical characteristics similar to chemical-filled ordnance. Photoionization neutron spectroscopy testing has been completed on 25 unexploded rounds suspected of containing chemical agent. All tests showed that no rounds contained chemical agent. There have been reports of chemical agent identification kits once having been stored at FGGM, as well as mustard agent. World War I-era training possibly involving mustard has been reported also. The reports could not be verified in their entirely, and extensive searches have not indicated any agent presence.

LOCALITY/STATE: Fort George G. Meade, Maryland, and Patuxent Wildlife Research Center - North Tract, Laurel, Maryland (Anne Arundel County)

SCOPE OF RESTORATION EFFORTS: The USAEC is conducting unexploded ordnance surveys to locate impact areas on the 9,000-acre BRAC parcel. These surveys consist of a magnetometry-assisted surface survey with excavations and removals to a depth of 6 inches from the surface.

EFFORTS TO DATE: USAEC unexploded ordnance surveys were completed in June 1994. Risk assessments are ongoing.

REMEDIATION SCHEDULE: There is no planned chemical agent remediation for FGGM at this time. Additional study and analysis of the recently revealed data are required to determine future activities.

RISK PERCEPTION: This installation is not believed to present any immediate threat to human health or safety due to chemical agents. Public access is controlled by the Department of the Interior (DOI), U.S. Fish and Wildlife Service - Patuxent Wildlife Research Center. It is believed that DOI intends the property to be fully utilized for public access programs.

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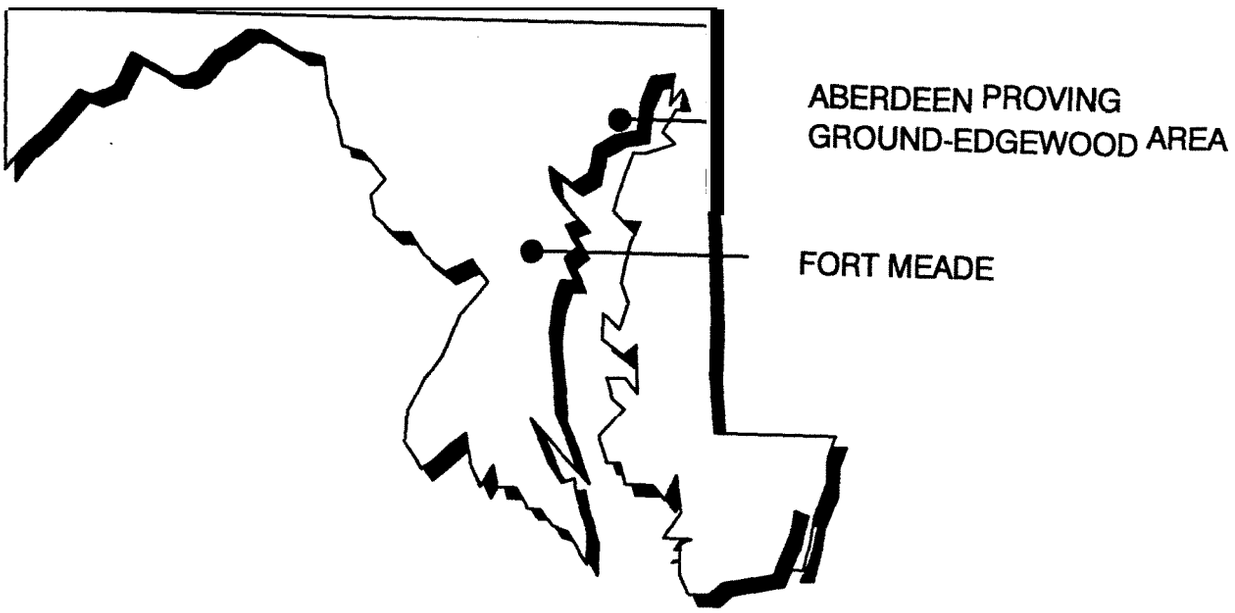
MARYLAND



LOCATION	Aberdeen Proving Ground-Edgewood Area
LOCALITY	Edgewood
STATE	MD
SITE	Carroll's Island
DESCRIPTION	Disposed of remains of munitions test items and GB-, VX-, mustard-, and BZ-contaminated lab equipment.
SIZE	Ten pits in 4-acre site; 2 pits in unknown area.
CONTENTS	Remains of test items; contaminated lab equipment.
COMMENTS	No agent disposal noted.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Aberdeen Proving Ground-Edgewood Area
LOCALITY	Edgewood
STATE	MD
SITE	Graces Quarters Study Area
DESCRIPTION	Used as agent disposal area during World War II and from 1950 to t969.
SIZE	800 acres
CONTENTS	Unknown items; soil contaminated with BZ, nerve agent (VX), and mustard. Disposal of lab equipment and test items.
COMMENTS	None
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	1 - Known burial

LOCATION	Aberdeen Proving Ground-Edgewood Area
LOCALITY	Edgewood
STATE	MD
SITE	Kings Creek
DESCRIPTION	Stokes mortar rounds found onpost at Kings Creek in November 1992. Site appears to be a World War I disposal area.
SIZE	Unknown
CONTENTS	Stokes mortar, unknown fill.
COMMENTS	Little information is known at this time. Verbal information received from U.S. Army Technical Escort Unit, Aberdeen Proving Ground-Edgewood Area.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	1 - Known burial

LOCATION	Aberdeen Proving Ground-Edgewood Area
LOCALITY	Edgewood
STATE	MD
SITE	Lauderick Creek Study Area - School Fields
DESCRIPTION	Chemical warfare training and testing sites. Firing of chemical ordnance; agent training.
SIZE	1,100 acres
CONTENTS	Unexploded ordnance, possible chemical weapons.
COMMENTS	Liquid-filled projectiles and mortar rounds found in 1984. From 1920 to 1951, the U.S. Army Chemical School used portions of the Lauderick Creek Area for chemical warfare training. The chemical ordnance used in the training was mostly smoke and tear gas. There was also some use of high-explosive and lethal filled munitions, mostly phosgene (a choking gas) and mustard (a blister agent). The Nike Missile Battery was constructed on some of the former Chemical School fields.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	1 - Known burial

LOCATION	Aberdeen Proving Ground-Edgewood Area
LOCALITY	Edgewood
STATE	MD
SITE	Other Edgewood Study Areas
DESCRIPTION	Chemical warfare research, development, and related activities occurred in the Edgewood Area of Aberdeen Proving Ground. Small pit and trench fills, former burning grounds, spill areas, and disposal pits that are outside of the other Study Areas (known as sites in this database) are being investigated. Examples are Fields G, M, and D, and Maxwell Point, Douglas Road Munitions Disposal Site, and H Field Chemical Munitions Impact Area. These areas are contaminated with military chemical ordnance as a result of extensive testing and disposal operations since World War I.
SIZE	Unknown
CONTENTS	Ordnance included chemical munitions, high-explosive projectiles and bombs, mines, and grenades.
COMMENTS	None
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	1 - Known burial

LOCATION	Aberdeen Proving Ground-Edgewood Area
LOCALITY	Edgewood
STATE	MD
SITE	New 0 Field
DESCRIPTION	From the mid-1950s to the early 1980% New O-Field was used primarily for open-pit burning and disposal of chemical warfare munitions; some burials are likely.
SIZE	About 15 acres
CONTENTS	Unknown types and quantities; includes BZ.
COMMENTS	Active site after World War II.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Aberdeen Proving Ground-Edgewood Area
LOCALITY	Edgewood
STATE	MD
SITE	Old 0 Field
DESCRIPTION	Unknown detonation in disposal pits followed by spontaneous denotations in June 1949. Used as burial ground for allied and enemy munitions during and after World War II. From 1941-l 953, the Army used Old O-Field for disposing of chemical warfare agents, munitions, equipment, and other waste materiel.
SIZE	5 acres
CONTENTS	High-explosive and chemical-filled munitions; actual types unknown but represent a spectrum of United States, foreign, and experimental chemical warfare materiel.
COMMENTS	Some pits 100 yards long, 10 feet wide, and 10 feet deep. May also contain contaminated equipment, smoke, and incendiaries.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Large quantity
CLASSIFICATION	1 - Known burial

LOCATION	Aberdeen Proving Ground-Edgewood Area
LOCALITY	Edgewood
STATE	MD
SITE	Carroll Island Study Area
DESCRIPTION	Carroll Island test activity. Used from 1949 to 1971. Potential for residue from testing with nerve agent (VX, GB), and incapacitating and experimental agents/munitions.
SIZE	855 acres
CONTENTS	Agent dispersion and burning conducted.
COMMENTS	No disposal operations known. TNT used to explode munitions in place.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	1 - Known burial

LOCATION	Aberdeen Proving Ground-Edgewood Area
LOCALITY	Edgewood
STATE	MD
SITE	Graces Quarters Study Area
DESCRIPTION	Graces Quarters test site. Contains disposal pits with unknown agents and munitions. Used as test area during World War II and from 1950 to 1969.
SIZE	Unknown
CONTENTS	Agent dispersion and burning conducted.
COMMENTS	None
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Aberdeen Proving Ground-Edgewood Area
LOCALITY	Edgewood
STATE	MD
SITE	J Field Study Area
DESCRIPTION	Extensive chemical agent testing and disposal conducted on this site in World War II. U.S. Army Technical Escort Unit records also indicate adamsite (DM) disposal. Between 1940 and the 1970s, the Army disposed of chemical agents, high explosives, and chemical wastes at J Field.
SIZE	Unknown
CONTENTS	Contaminated with nerve agents, munitions, white phosphorus, and riot control agents.
COMMENTS	Used for open-pit disposals. Many tons of nerve (GA) and mustard-filled containers burned in pits.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	1 - Known burial

LOCATION	Aberdeen Proving Ground-Edgewood Area
LOCALITY	Edgewood
STATE	MD
SITE	Westwood Study Area
DESCRIPTION	The Westwood area may be contaminated with some mustard and pyrotechnic rounds including unexploded ordnance. The Army used this Study Area for testing, training, materiel storage, and ammunition loading. The range is no longer used for testing of munitions.
SIZE	523 acres
CONTENTS	Some ordnance and related material. Fragments possible on surface.
COMMENTS	None
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Aberdeen Proving Ground-Edgewood Area
LOCALITY	Edgewood
STATE	MD
SITE	Canal Creek Study Area
DESCRIPTION	The Army used Canal Creek Area to load and test chemical warfare agents. Examples are Canal Creek Marsh/Landfill (used as a disposal site for chemical munitions), G Street Salvage Yard, and Building 103 Dump.
SIZE	Unknown
CONTENTS	Unknown
COMMENTS	Ten bomblets removed from G Street Salvage Yard by The U.S. Army Technical Escort Unit to J Field for detonation on 23 April 1990. These have been identified as GB-filled.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	1 - Known burial

LOCATION	Fort Meade
LOCALITY	Fort Meade
STATE	MD
SITE	Unknown
DESCRIPTION	In the 1950s, an unknown number of chemical agent identification sets were stored here. It was reported that mustard agent was stored in three concrete structures in the 1920s. It was also reported that in the mid-1950s, some canisters containing mustard were unearthed by heavy equipment and then the area was backfilled without removing the canisters.
SIZE	Unknown
CONTENTS	Chemical agent identification sets and possible mustard.
COMMENTS	None
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

MASSACHUSETTS

NAME OF LOCATION: **Fort Devens**

LOCALITY/STATE: Ayer, Massachusetts

FUDS ACTIVITIES AT THIS LOCATION: Ft. Devens was established in 1917, in response to America's entry into World War I, and consists of more than 11,000 acres. During the years the installation was on active status, all types of ordnance and chemical warfare materiel training were conducted. Soldiers received their gas defense training in two gas chambers. One used tear gas, the other used "various kinds of poisonous gases." Thirty-two Ml Gas ID Sets were received by Ft. Devens. Chemical Agent Identification Sets (CAIS) were used at Ft. Devens to train the soldiers in the identification of sight, color, smoke in detonation, and odor of chemical agents. Training was also conducted using 4.2-inch chemical mortars. Edgewood Arsenal planned to ship to Ft. Devens liquid mustard, chemical land mines, field ID sets, detonators, incendiary bombs, and tear gas capsules and pots. It is unknown if these items arrived at Fort Devens or not.

Four Stokes mortars, two filled with H or HD and two filled with Fuming Sulfuric Acid (FS), have been found on or off the installation (one round suspected to be filled with H was found offpost).

Currently, the training areas and ranges are located on what is known as the South Post. Up until the 1960s, there were ranges and training areas located on the North and Main Posts. Portions of the North and Main Posts are being returned to civilian use in the near future. The South Post will remain in Department of Defense (DoD) hands and will be used by the National Guard for training purposes.

PREVIOUS CORPS ACTIVITIES: The U.S. Army Corps of Engineers completed an Archive Search Report of the site in 1995 and concluded that the potential for unexploded ordnance and chemical warfare materiel on portions of the installation does exist.

ACTIONS PLANNED FOR THE FUTURE: The Corps of Engineers recommended further actions be taken at numerous areas on Fort Devens to include statically sweeping, soil sampling, and water sampling.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: Public access is not anticipated due to the South Post remaining under DoD control.

RISK PERCEPTION: Due to the conventional ordnance and chemical ordnance found by the Corps of Engineers during their 1995 site inspection, there is a probability that more will be found.

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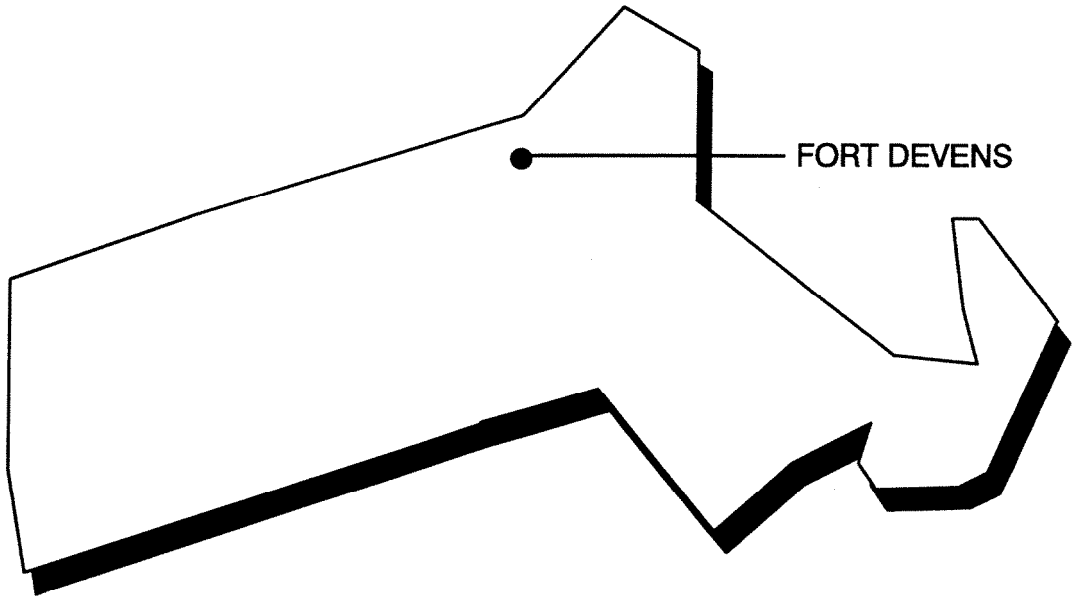
MASSACHUSETTS



LOCATION	Fort Devens
LOCALITY	Ayer
STATE	MA
SITE	South Post
DESCRIPTION	This area was used for training with chemical agent identification sets (CAIS) and 4.2-inch chemical mortars. Four Stokes mortars, two filled with H or HD and two filled with FS, have been found on or off the installation (one round suspected to be filled with H was found off post).
SIZE	Unknown
CONTENTS	The possibility exists for CAIS and chemical mortars.
COMMENTS	The U.S. Army Corps of Engineers completed an Archives Search Report in May 1995 and recommended further actions be taken at numerous areas on Fort Devens to include statically sweeping, soil sampling, and water sampling.
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	1 - Known burial

MICHIGAN

NAME OF LOCATION: **Chemical Warfare Development Division**

LOCALITY/STATE: Midland County, Michigan

FUDS ACTIVITIES AT THIS LOCATION: The Chemical Warfare Development Division operated in Midland, Michigan, in the first World War. The site was located one mile south of Bay City Road, on the current property of the Dow Chemical Plant. During its operation, the plant was surrounded by Dow Chemical property.

The Chemical Warfare Development Division facilities included a manufacturing building for the development of mustard gas which was located near the entrance of the present Gate No. 2. The mustard gas was produced in building 20A and stored in Building 30 until it was shipped from the plant.

The Chemical Warfare Development Division mustard gas plant, Building 20A, was one of the first manufacturing buildings on the site and was built around the turn of the century. The plant manufactured chloroform prior to the U.S. Army contracting Dow to make mustard gas during World War I. This Dow facility was the first in the United States to make synthetic chloroform. Since chloroform uses a chlorhydrinate process in its manufacture, the equipment was readily converted to the production of mustard gas, which requires the same process.

The purpose of the Chemical Warfare Development Division at Midland, Michigan, was to develop a process for the large scale production of mustard gas. Experimental production of a thousand tons of mustard gas was completed prior to the shutdown of the plant at the end of the war. Following the war, the plant was converted and used for the production of aspirin.

Mustard agent and contaminated equipment from the Chemical Warfare Development Division was disposed of on Dow Chemical property by burial.

PREVIOUS CORPS ACTIVITIES: An Archives Search Report for this site was prepared by the U.S. Army Corps of Engineers, St. Louis District, in September 1993.

ACTIONS PLANNED FOR THE FUTURE: No remediation actions are planned at this time.

RISK PERCEPTION: The property is currently owned by Dow Chemical Company as part of the Dow Chemical Co. Plant. The plant grounds are fenced and protected by security guards. Access to the plant grounds is made through Dow Chemical officials. Therefore, the general public will not have access to the suspected burial sites. Currently, there are no plans to develop the land that contains the suspected burial site. The only threat to human health and safety posed would be due to unsupervised excavation of the site.'

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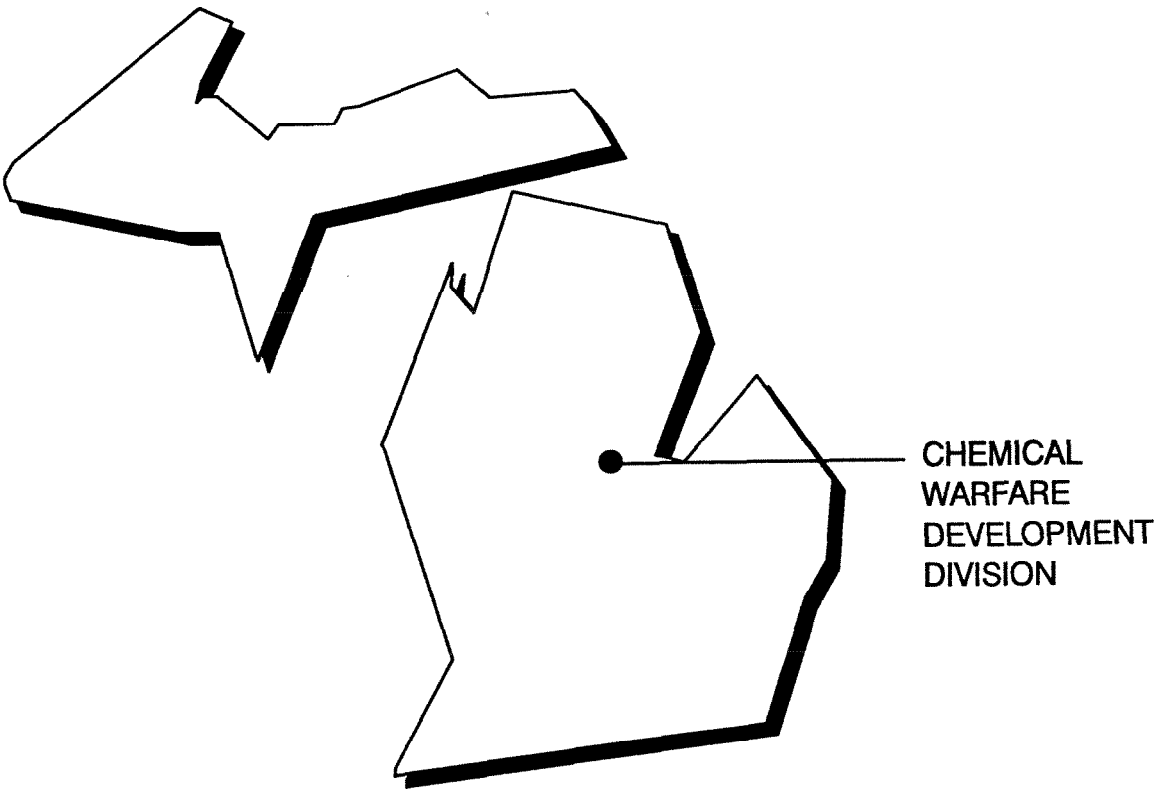
MICHIGAN



LOCATION	Chemical Warfare Development Division
LOCALITY	Midland
STATE	MI
SITE	Dow Chemical Company, centralized disposal pits
DESCRIPTION	Mustard agent and contaminated equipment from the Chemical Warfare Development Division was disposed of on the property of Dow Chemical Company, Midland, Michigan, in 1924. It can not be determined whether the suspected original disposal site was completely decontaminated by Dow personnel at a later date. If Dow personnel did remove the mustard agent and contaminated equipment, it could not be determined where the agent and equipment were moved to. It can be stated with some certainty that the relocated agent and equipment probably stayed within the Dow Chemical property boundary.
SIZE	Unknown
CONTENTS	Possible mustard agent, residue, and contaminated equipment.
COMMENTS	None
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	2 - Likely burial

MISSISSIPPI

NAME OF LOCATION: Camp Shelby

Camp Shelby is on 132,397 acres in the southeastern portion of Mississippi, 10 miles south of Hattiesburg. Established in July 1917, Camp Shelby was a training camp for the 38th Division. Abandoned in 1919, but reactivated for World War II (WWII), Camp Shelby's mission was to train infantry divisions during WWII.

In June 1950, the U.S. Army Technical Services Unit (TSU) excavated a drum of suspected agent. TSU did not detect any chemical agent. The operation continued until officials determined that no additional materiel was present.

LOCALITY/STATE: Hattiesburg, Mississippi

SCOPE OF RESTORATION EFFORTS: Camp Shelby is a State and Federally owned National Guard training site. The Mississippi Military Department published a Record of Decision for the Camp Shelby Environmental Impact Statement in the Federal Register on December 9, 1994. The special use permit is for continuation of training on U.S. Forestry Service lands.

EFFORT TO DATE: In June 1950, the TSU excavated a drum of suspected agent about 4 miles from the present cantonment area. A sign marked the area as "Impact Area and Mustard Gas." Evidence of chemical agent was not found. The impact area today is about 14,500 acres in size. Additional investigation of this site indicates no evidence that Camp Shelby has buried mustard-filled bombs or was a site where decontamination took place after WWII.

REMEDIATION SCHEDULE: The Mississippi Army National Guard and the U.S. Army Environmental Hygiene Agency conducted a Preliminary Assessment and found no additional evidence of non-stockpile chemical materiel (NSCM). No NSCM remediation is planned.

RISK PERCEPTION: Due to the absence of evidence supporting the existence of NSCM at the site, threat to public health and safety is believed to be non-existent. Any contamination would be strictly localized and under government control, so the hazard to public health and safety would not exist.

NAME OF LOCATION: **Columbus Army Airfield (now known as Columbus Air Force Base)**

LOCALITY/STATE: Columbus, Mississippi

SCOPE OF RESTORATION EFFORT: None. Columbus Air Force Base has no known chemical munitions sites identified in their Installation Restoration Program.

In July 1946, a shipment of German mustard-filled bombs was in route from Theodore, Alabama, to Pine Bluff Arsenal, Arkansas. When the train was passing through Amory, Mississippi, leaks were detected in the shipment on one of the railcars. After an investigation, one 500-kilogram bomb was found leaking.

The bomb was removed from the car and the car and tracks were decontaminated (method undefined). The bomb was transported to Columbus Army Airfield where it was buried with dry mix in a hole 15 feet deep. The bomb was later recovered on October 3, 1946 and burned within the hole.

EFFORT TO DATE: In April 1994, an Explosive Ordnance Disposal (EOD) team from Tyndall AFB, Florida, searched for remains of the mustard gas bomb in an area that was formerly a small arms range and an ammunition bum pit near the western boundary of the base. The EOD team used MK-26 Ferrous Ordnance Locators, which are designed to locate ferrous ordnance to a depth of 6 meters. The search did not turn up any ordnance.

On June 9, 1994, a team from the St. Louis District office of the U.S. Army Corps of Engineers visited Columbus AFB to perform an archives search in association with the Defense Environmental Restoration Program for Formerly Used Defense Sites where chemical warfare materials were suspected. The team conducted interviews with the base environmental office and several men who were employed at Columbus AFB during and after World War II. The veterans did not have any knowledge of the burial of the mustard gas bomb incident. The team searched the area where the bomb was reportedly buried. No evidence of a burial site or burial activities was found.

REMEDIATION SCHEDULE: None planned.

RISK PERCEPTION: No threat to public health due to chemical agents is currently known or suspected to exist.

NAME OF LOCATION: **Horn Island Chemical Warfare Service (CWS) Quarantine Station (Jackson Project)**

Horn Island is located ten miles south-southwest of Pascagoula, Mississippi. This island was under the jurisdiction of the Department of Interior, and in 1947 an Officer from the U.S. Army Technical Services Unit requested a clearance permitting work on Horn Island. From July 21 to August 1, 1947, approximately 40 250-kilogram and 90 500-kilogram German mustard-filled, leaking bombs were destroyed by burning.

The bombs were placed in a shallow trench with dry wood, pine cones, oil-soaked rags, and fuel oil. The bombs were ruptured with rifle fire and ignited. Upon completion of the burning, the area was inspected to determine if all the bombs had ruptured and burned and to test for agent contamination. The empty bomb casings were loaded onto a barge and dumped at sea. The equipment and area used on Horn Island also were decontaminated.

LOCALITY/STATE: Approximately 10 miles south-southwest of Pascagoula, Mississippi (Jackson County) in Mississippi Sound area of the Gulf of Mexico

FUDS ACTIVITIES AT THIS LOCATION: This island was used by the U.S. Chemical Warfare Service (CWS) as an experiment station beginning in 1943. The island was also used in 1946 to destroy approximately 130 captured German mustard gas bombs from World War II. The Army relinquished all control of the island by December 1948.

The island is presently under the jurisdiction of the Department of Interior (DOI) and is a designated wilderness area of the Gulf Islands National Seashore. Although DOI owns most of the island, four private individuals and one partnership own small tracts.

PREVIOUS CORPS ACTIVITIES: U.S. Army Corps of Engineers personnel completed a preliminary assessment of this site in 1990 and recommended that further investigation was necessary to determine if chemical warfare materiel (CWM) was present. An Archives Search Report was completed in April 1993. The areas where the mustard bombs were destroyed in 1946 have been eroded into the Gulf of Mexico due to normal movement of the island. Also, an eyewitness to the destruction verified cleanup of the site by the CWS.

ACTIONS PLANNED FOR THE FUTURE: No further action is anticipated in regards to CWM at this site.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: The ranger station and a tower (for release of eagles) of the Department of Interior are the only structures on the island. It is not under an immediate threat to be altered by construction activity.

RISK PERCEPTION: Because CWM were decontaminated and removed and because the original site has washed away, there is no perceived threat to public health and safety from a CWM aspect.

NAME OF LOCATION: Camp Van Dorn

LOCALITY/STATE: Centerville, Wilkinson county, Mississippi

FUDS ACTIVITIES AT THIS LOCATION: Camp Van Dorn is located in Centerville, Mississippi, Wilkinson county. The camp consists of 41,544 acres just outside of Centerville. First known as Centerville Cantonment, it was established on September 20, 1942. It was soon designated Camp Van Dorn in honor of Confederate General Earl Van Dorn.

Camp Van Dorn was an Infantry Divisional Training Camp during World War II. It contained a Chemical Decontamination Company that conducted training from April 4, 1944 through May 30, 1944.

The site was declared surplus in 1946 and was sold to numerous buyers over a period of years from 1947 to 1953.

Sniff bottles and CAIS (detonating, Ml) were used at Camp Van Dorn for training purposes. CAIS were detonated and remains were then raked up and buried.

PREVIOUS CORPS ACTIVITIES: USACE, St. Louis District, has conducted an Archival Search.

ACTIONS PLANNED FOR THE FUTURE: USACE is re-evaluating the site for the presence of CWM.

RISK PERCEPTION: At this time, no threat to human health and safety is currently known to exist.

NAME OF LOCATION: **Jackson**

LOCALITY/STATE: Jackson, Mississippi

FUDS ACTIVITIES AT THIS LOCATION: During the excavation for a sewer line near the Mississippi State Fairgrounds, behind an old guard armory, construction workers accidentally unearthed World War I chemical training kits in April 1995. Members of the U.S. Army Technical Escort Unit (TEU) were immediately sent to the site to assess the situation. The TEU recovered 268 vials and 17 bottles. The unmarked four ounce vials and eight ounce bottles are believed to contain Phosgene, lewisite and mustard. All of the recovered materiel was transported to Pine Bluff Arsenal, Arkansas. The site was cleared in May 1995. Mississippi state officials declared the site clean and completed construction of the utility trench without incident. The Department of Archives and History has researched the past activities to possibly obtain more information on the site, and other potential chemical activity in the area. The research has not found any information on the site or any other chemical activities in the area.

PREVIOUS CORPS ACTIVITIES: None.

ACTIONS PLANNED FOR THE FUTURE: No further action required.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: None.

RISK PERCEPTION: All recovered chemical warfare materiel (CWM) has been removed from this site. There is no perceived threat to human health and safety due to buried CWM.

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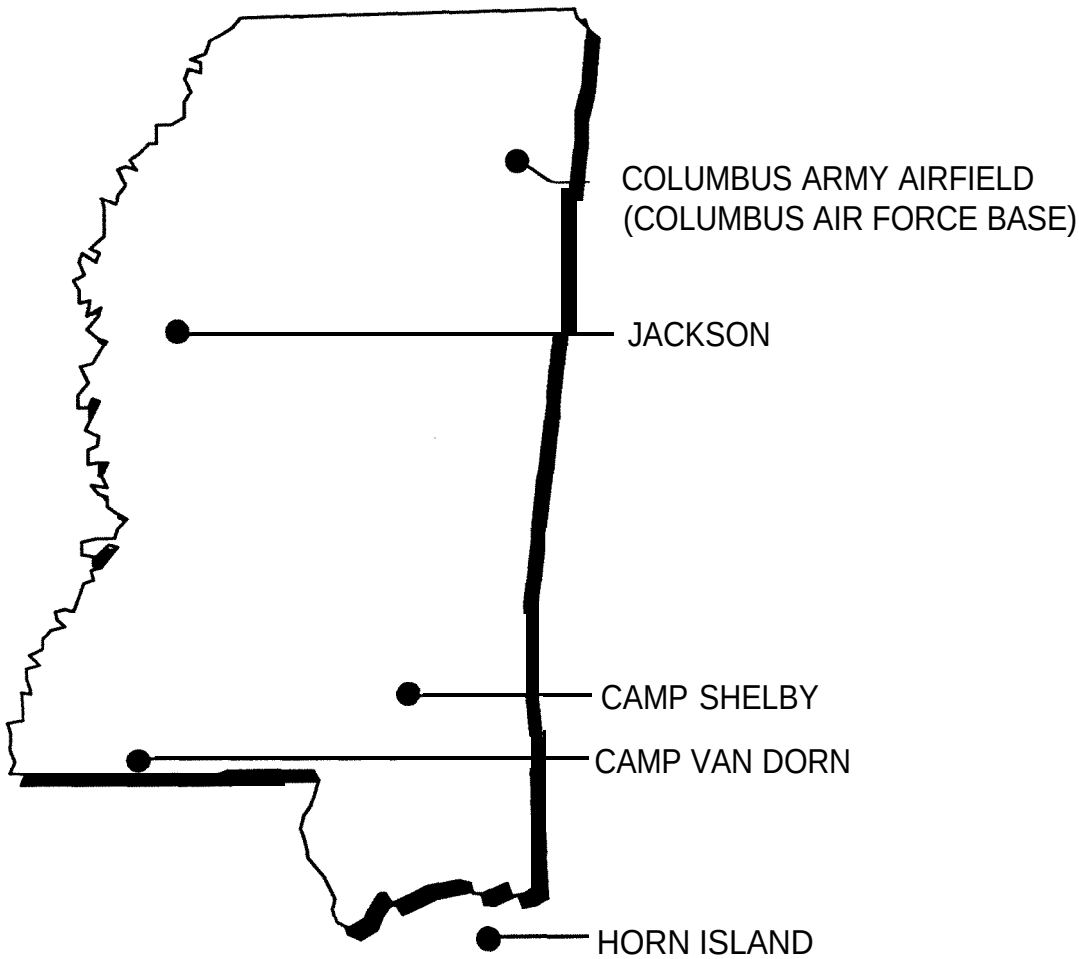
MISSISSIPPI



LOCATION	Camp Shelby
LOCALITY	Hattiesburg
STATE	MS
SITE	Unknown
DESCRIPTION	In June 1950, U.S. Army Technical Escort Unit discovered area marked Impact Area and Mustard Gas. A drum was found at a depth of 14 feet, recovered, punctured, and no evidence of toxic agents could be detected.
SIZE	30 by 30 feet
CONTENTS	One 55-gallon drum, contents not specified
COMMENTS	Additional investigation of this site indicates no evidence that Camp Shelby has buried mustard-filled bombs or was a site where decontamination took place after World War II.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

LOCATION	Columbus Army Airfield
LOCALITY	Columbus
STATE	MS
SITE	Unknown
DESCRIPTION	On July 14, 1946. leaking munition found during rail shipment between Theodore and Pine Bluff Arsenal. Leak discovered at the Bigbee Siding, Frisco railroad. All areas decontaminated.
SIZE	15-foot hole
CONTENTS	One 500-kilogram mustard-filled German bomb. Bomb buried with dry mix, sign posted.
COMMENTS	Bomb recovered on October 3, 1946, burned in hole and area checked. Some sources cited a 1 ,000-pound bomb. In April 1993, an individual who was involved in the bomb's destruction and burial identified the general area but could not locate the specific burial site.
TYPE	Disposal
INSTALLATION	Air Force
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Horn Island
LOCALITY	Horn Island
STATE	MS
SITE	Area 27
DESCRIPTION	On July 27 through 31, 1946, forty 250-kilogram and ninety 500-kilogram bombs from Theodore Naval Ammunition Magazine were burned in shallow trenches and in stacks. 500-kilogram bombs marked by two red bands. Empty bomb casings dumped at sea.
SIZE	1 by 1 1/2 by 4 feet
CONTENTS	Forty German 250-kilogram and ninety 500-kilogram bombs were burned. May contain residue.
COMMENTS	First burn on Horn Island in 1946. Air tested during burn for mustard vapor and arsenic had negative results. An Archives Search Report was completed in 1993. The areas where the mustard bombs were destroyed in 1946 has been eroded into the Gulf of Mexico.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

LOCATION	Horn Island
LOCALITY	Horn Island
STATE	MS
SITE	Unknown
DESCRIPTION	Used as a disposal area for toxic gas. Horn Island is 10 miles south-southeast of Pascagoula, Mississippi.
SIZE	Unknown
CONTENTS	German toxic bombs.
COMMENTS	Source states that this area is no longer contaminated. The Archives Search Report concludes the area has been eroded away and no further action is required.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

LOCATION	Horn Island
LOCALITY	Horn Island
STATE	MS
SITE	Danger Area
DESCRIPTION	Established a danger area for testing new secret warfare agent.
SIZE	3 square miles
CONTENTS	Unknown
COMMENTS	Established new range area at western end of the island.
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

LOCATION	Camp Van Dorn
LOCALITY	Centerville
STATE	MS
SITE	Detonation Pits
DESCRIPTION	An Army Services Training Center was located here during the 1940s. The Unit Officer's Gas Course taught there covered all common agents used in chemical warfare including war gases, screening smokes, and incendiaries. Sniff bottles and chemical agent identification sets (detonation, MI) were used to smell actual agents.
SIZE	Holes 10 to 20 yards apart
CONTENTS	Holes were dug 10 to 20 yards apart and used for the detonation of the gas identification sets. Wires and broken glass were raked up and buried.
COMMENTS	The Inventory Project Report only addresses ordnance and explosive wastes. The U.S. Army Corps of Engineers is re-evaluating this site for the presence of chemical warfare materiel.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	4 - Possible burial

LOCATION	Jackson
LOCALITY	Jackson
STATE	MS
SITE	Mississippi State Fairgrounds
DESCRIPTION	During the excavation for a sewer line near the Mississippi State Fairgrounds, behind an old guard armory, construction workers accidentally unearthed World War I chemical training kits in April 1995. Members of the U.S. Army Technical Escort Unit (TEU) were immediately sent to the site to assess the situation. The TEU recovered 268 vials and 17 bottles. The unmarked four-ounce vials and eight-ounce bottles are believed to contain Phosgene, lewisite, and mustard. All of the recovered materiel was transported to Pine Bluff Arsenal, Arkansas. The site was cleared in May 1995. Mississippi state officials declared the site clean and completed construction of the utility trench without incident. The Department of Archives and History **has** researched the past activities to possibly obtain more information on the site, and other potential chemical activity in the area. The research has not found **any** information **on** the site or any other chemical activities in the area.
SIZE	Four feet wide by 60 feet long by 5 feet deep
CONTENTS	Phosgene, lewisite, and mustard-filled vials and bottles.
COMMENTS	The site was cleared in May 1995. Mississippi state officials declared the site clean and completed construction of the utility trench without incident.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	5 - No further action

MISSOURI

NAME OF LOCATION: Camp Crowder

LOCALITY/STATE: Newton and McDonald Counties, Missouri

FUDS ACTIVITIES AT THIS LOCATION: Camp Crowder was established during World War II on 42,803 acres, approximately 3 miles southeast of Neosho, in Newton and McDonald counties, Missouri. Newton and McDonald counties are the most southwestern counties in Missouri.

Camp Crowder operated as a Signal Corps Replacement Training Center from 1942 to 1946. The camp was deactivated from 1946 to 1951, It was reactivated as an Army Reception Center for the Korean conflict. In 1953, Camp Crowder was redesignated as a U.S. Branch Disciplinary Barracks. The camp operated in this capacity until 1958. About 3,700 acres of the old camp was used as U.S. Air Force Plant 65 from 1958 to 1967.

Three sites where the possibility of chemical warfare materiel (CWM) may exist on former Camp Crowder lands have been located. The first site is located in the vicinity of the Gas Chamber #110. An incident occurred on this property in 1986 in which a bulldozer operator was affected by an unknown chemical agent. The area was thoroughly investigated at the time and remains of chemical test kits, as well as conventional munitions, were located. These test kits contained mustard, lewisite, chloropicrin, and Phosgene.

The second site was the magazine area in the northern section of the former camp. At this site an incident occurred in July 1981 where three National Guardsmen were injured by an unknown gas. The investigation into this incident was not as thorough as the one conducted after the 1986 incident. It is possible that similar debris such as that retrieved during the 1986 incident, described in the previous paragraph, still exists in this location.

The third site was a patrol/infiltration area located at the northern section of the camp between Elm Spring and the incinerator. This area was used by troops to sharpen their bivouacking and patrolling skills during their last week at the camp before shipping out. Simulated attacks occurred in this area and smoke was used. It is not known if chemical agents or simulants were used in these simulated attacks.

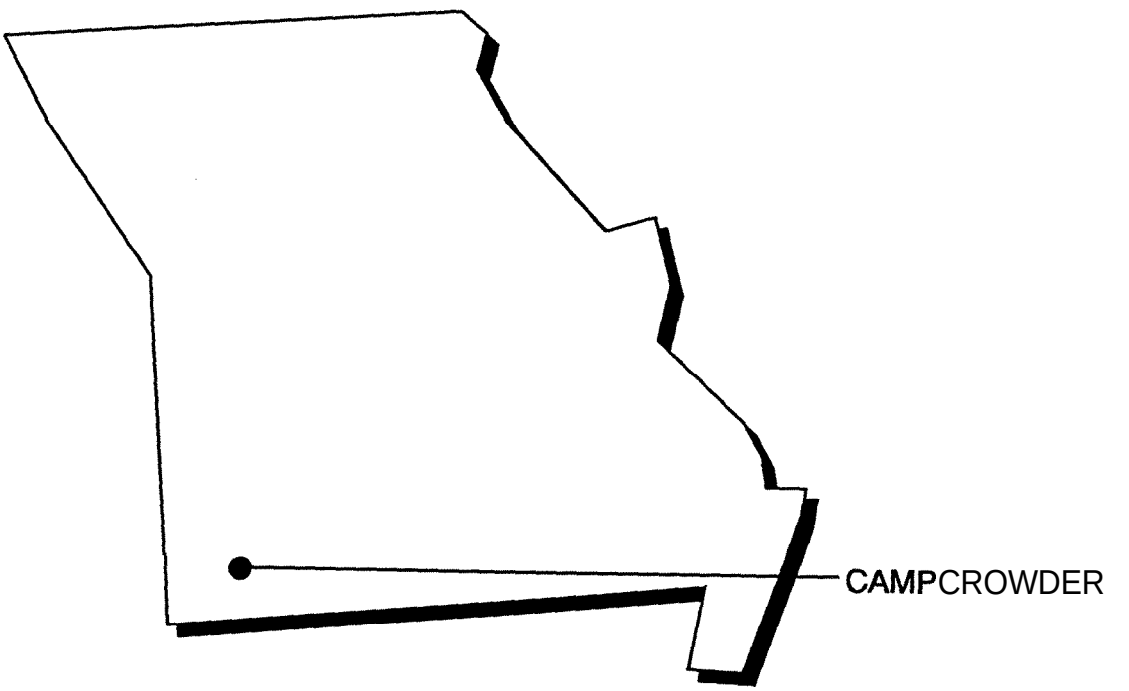
The CWM used at this location was predominantly training materials. There is no indication as to the exact amount of CWM used. During World War II, three gas chambers were used in order to train troops for the purposes of identifying various war gases. Several first-hand reports indicate tear gas as the primary gas used in the chambers; however, chemical test kits were also used. These instructional kits contained various gases, some full strength and others diluted, which were used to familiarize troops with the attributes of various toxic debilitating gases. The gases were contained in vials during this training. The Technical Escort Unit recovered 14 vials (CAIS) from Camp Crowder in 1986.

PREVIOUS CORPS ACTIVITIES: A report entitled "Preliminary Assessment of Ordnance Contamination at the Former Camp Crowder, Neosho, Missouri" was prepared for the U.S. Army Corps of Engineers, St. Louis District dated, October 1992. A Site Survey and Project Summary Sheet for this site was prepared on 30 July 1991. An Archives Search Report for this site was prepared by the U.S. Army Corps of Engineers, St. Louis District, in April 1993.

ACTIONS PLANNED FOR THE FUTURE: No remediation actions are planned at this time.

RISK PERCEPTION: The area surrounding the former magazine storage igloos has a high probability of CWM still present below the surface. This area is fairly secluded and is primarily visited by National Guardsmen during maneuvers. The civilian populace is not authorized access to this area. The only threat to human health and safety posed would be due to unsupervised excavation of the site.

MISSOURI



LOCATION	Camp Crowder
LOCALITY	Neosho
STATE	MO
SITE	Unknown
DESCRIPTION	The U.S. Army Technical Escort Unit recovered 14 vials (chemical agent identification set) from Camp Crowder in 1986.
SIZE	Unknown
CONTENTS	Chemical agent identification sets have been recovered from this site and the possibility for additional chemical warfare materiel exists.
COMMENTS	None
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	4 - Possible burial

NEBRASKA

NAME OF LOCATION: Nebraska Ordnance Plant

LOCALITY/STATE: Mead, County of Saunders, Nebraska

FUDS ACTIVITIES AT THIS LOCATION: Sometime during the 1950s, munitions were en route to Offutt Air Force Base by air transport when six leaking chemical rounds were discovered. The leaking rounds were removed at the Nebraska Ordnance Plant in Mead, taken to the property office, and subsequently buried.

Since that time the land was acquired by the University of Nebraska, which converted the area in which the munitions were buried to a four-acre landfill. In 1991, workers digging a trench in or around the landfill noted a "green-colored gas" coming out of the ground. The Army's Technical Escort Unit recommended that no further action be taken at that time. The work was discontinued and the area was backfilled, and later capped in 1993.

PREVIOUS CORPS ACTIVITIES: The U.S. Army Corps of Engineers has made numerous visits to the site investigating the landfill reportedly containing the chemical warfare materiel (CWM). An Archives Search Report for CWM was completed in December 1993. The Corps of Engineers installed fencing around the area in 1994. Groundwater monitoring wells have been installed around the perimeter of the landfill. Results from well sampling suggest that the landfill is not contributing contaminants to the groundwater. The Corps of Engineers currently is completing a remedial investigation/feasibility study for the entire former Nebraska Ordnance Works, including the landfill reportedly containing the CWM.

ACTIONS PLANNED FOR THE FUTURE: Because groundwater analysis results indicate no contamination, the Corps of Engineers recommends no further action.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: Since the CWM is in a completed portion of a landfill, no intrusive activities are expected.

RISK PERCEPTION: A meeting between the Army, Environmental Protection Agency Region VII, and the Nebraska Department of Environmental Quality was held at the site to determine options for dealing with the CWM potentially located in the landfill. It was decided that intrusive work in the area would likely not be required if there was no evidence to suggest contaminants from the landfill were threatening groundwater. No excavation is planned for the landfill. This area is not believed to present any immediate threat to human health and safety.

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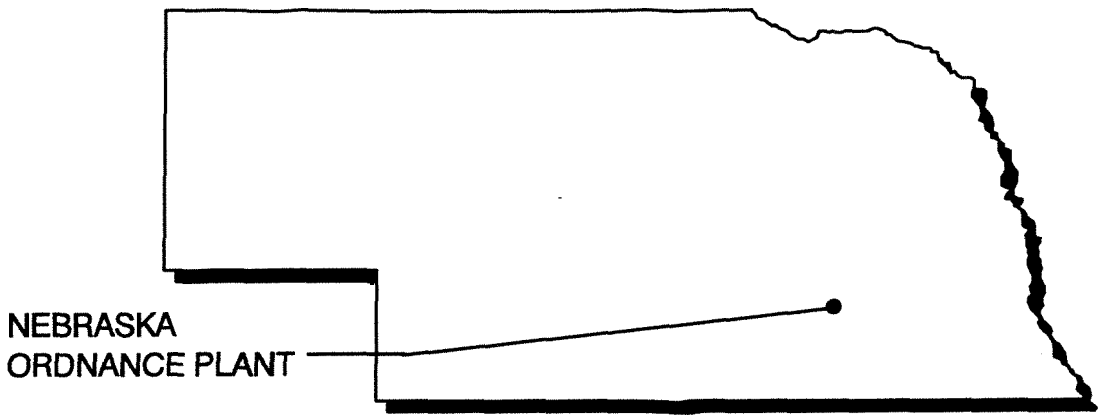
NEBRASKA



LOCATION	Nebraska Ordnance Plant
LOCALITY	Mead
STATE	NE
SITE	Landfill
DESCRIPTION	In 1991, workers digging a trench discovered a green-colored gas coming out of the ground. Land on the former Nebraska Ordnance Plant site. During the 1950s, six leaking chemical rounds were buried. Since the 1950s, the land was acquired by the University of Nebraska which converted the area to a landfill. The colored gas may be indicative of chlorine.
SIZE	4 acres (landfill)
CONTENTS	Potential for six leaking chemical rounds.
COMMENTS	Area has been backfilled, capped, and fencing and monitoring wells have been installed. Because groundwater analysis results indicate no contamination, the U.S. Army Corps of Engineers recommends no further action.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

NEVADA

NAME OF LOCATION: Hawthorne Army Depot

Hawthorne Army Depot (HWAD) is located in the west-central portion of Nevada in Mineral County, approximately 135 miles southeast of Reno. The Depot as of 1977 consists of 148,517 acres; however, at one time it included an area of approximately 200,000 acres. Since 1958, over 50,000 acres have been declared excess and turned over to the Bureau of Land Management, U.S. Department of Interior, or Mineral County.

The depot complex has a total of 2,617 structures, of which 2,229 are explosive magazines with a maximum storage capacity of 600,000 tons. The depot also has a 700-acre bomb disposal range 25 miles northeast of Hawthorne off State Highway 31.

The mission of the plant as of 1994 is to be responsible for receiving, renovating, maintaining, storing, and issuing of ammunition, explosives, expendable ordnance items, and weapons and technical ordnance materiel. HWAD also tests weapons and performs demilitarization of munitions through the western area demilitarization facility. The installation has several sites which may contain buried munitions or chemical agent:

- Mustard Gas Disposal Area (HWAD-5)
- Old Bomb Disposal Area No. 5 (HWAD-A6e)
- Magazine 18 AT5 Disposal Pit (HWAD-Al 1).

The Mustard Gas Disposal Area may contain mustard agent; the Old Bomb Disposal Area No. 5 has unknown chemicals; and Magazine 18 AT5 Disposal Pit may contain mustard and phosgene (CG). These areas have been used at various times since the installation was commissioned and some are still in use.

LOCALITY/STATE: Hawthorne, Nevada

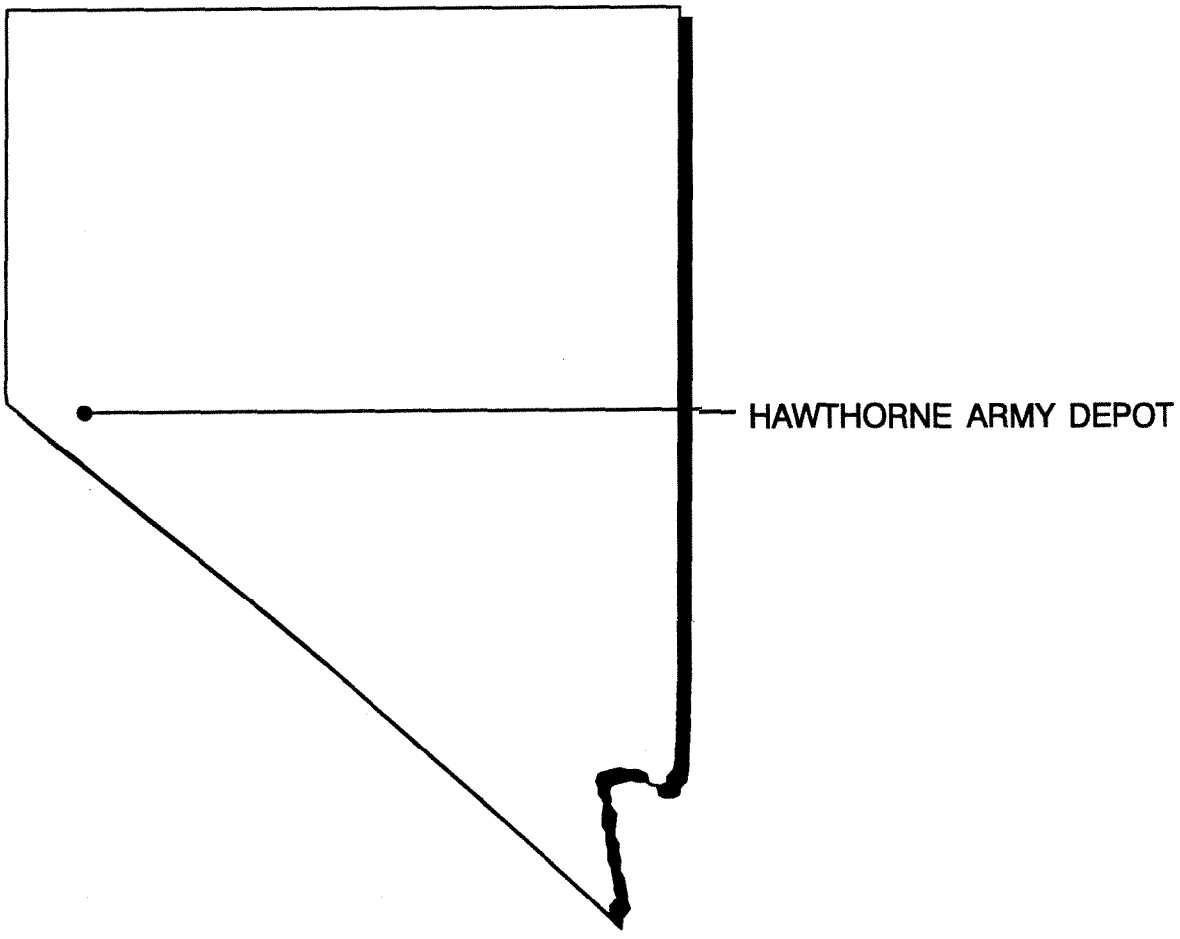
SCOPE OF RESTORATION PROGRAM: Currently, investigations are being conducted at HWAD under the Installation Restoration Program (IRP) at a number of solid waste management units (SWMUs). The identified SWMUs are concerned with suspected chemical agent disposal: the Mustard Gas Disposal Area, the nearby Magazine 18AT5 Disposal Pit, and the Old Bomb Disposal Area No. 5. Prior to 1977, the Depot was a Naval Ammunition Depot. During that time, mustard and phosgene chemical munitions were disposed of onsite. The Mustard Gas Disposal Area was first used during World War II and last used in 1946 to decontaminate and bury an unspecified quantity of mustard munitions. The area was deluged with super-tropical bleach in 1946 in an effort to decontaminate any residual agent. In 1971, an attempt was made to locate the munitions and determine if any mustard agent remained either in the soil or in the munitions. Several pits were located and excavated. Field chemical detectors gave positive readings for mustard within some empty munitions containers; however, laboratory analysis of samples taken from the containers were negative. All the disposal pits were not located until 1971. The area covers approximately 400 acres

and currently is well marked and secured with barbed-wire fencing. Due to disposal of unknown chemicals, the Magazine 18AT5 Disposal Pit, and the Old Bomb Disposal Area No. 5 are suspected areas of chemical agent disposal. Only the Mustard Gas Disposal Area has confirmed information concerning chemical agent disposal.

EFFORT TO DATE: In 1988, the U.S. Army Technical Escort Unit conducted a soil survey at the mustard site. As a result of the soil survey, requirements under the IRP for further investigation were identified. Currently, IRP requirements for all areas of concern, including all suspected chemical agent sites, have been identified.

RISK PERCEPTION: The public health threat posed by chemical agent at HWAD is minimal because the suspected areas are under Government control.

NEVADA



LOCATION	Hawthorne Army Depot
LOCALITY	Hawthorne
STATE	NV
SITE	HWAD-5
DESCRIPTION	Mustard Gas Disposal Area. U.S. Navy buried numerous types of munitions here in the 1940s. After 1 946, mustard munitions decontaminated with super-tropical bleach and buried.
SIZE	Cited as 40 to 400 acres
CONTENTS	Potential for mustard, Phosgene, and chloride munitions. Quantity unknown. Chemical agent identification sets destroyed in 1977.
COMMENTS	One of eight burial or open burning/open detonation sites. Some open and uncovered pits present. Metal fragments and debris on surface.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Hawthorne Army Depot
LOCALITY	Hawthorne
STATE	NV
SITE	HWAD-A 11
DESCRIPTION	Area known as MAG 18 AT5 Disposal Pit. Open unlined pit next to mustard disposal area.
SIZE	300 by 100 by 15 feet
CONTENTS	Potential for mustard and phosgene ammunition boxes and open burning residue.
COMMENTS	Disposal by open burning and waste piling. Some United States Navy munitions.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Hawthorne Army Depot
LOCALITY	Hawthorne
STATE	NV
SITE	HWAD-A6e
DESCRIPTION	Known as Old Bomb Disposal Area No. 5. Has 3 trenches 150 by 30 by 20 feet located end-to-end that occupy center.
SIZE	850 by 100 feet
CONTENTS	Drums of unknown chemicals, small arms projectiles, and burn residue.
COMMENTS	Warning signs posted along boundary.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	3 - Suspect burial

NEW JERSEY

NAME OF LOCATION: Raritan Arsenal

LOCALITY/STATE: Edison, Middiesex, New Jersey

FUDS ACTIVITIES AT THIS LOCATION: The former Raritan Arsenal is located in Edison, New Jersey, on the Raritan River. It was established during World War I to provide a storage point for trans-shipments from the Atlantic seaboard. After the war, shipments of materiel from overseas were received at the Arsenal and distributed to other points for permanent storage.

Raritan Arsenal was used as a shipping port for vessels transporting chemical warfare munitions, Chemical munitions and/or containers that developed leaks during transportation or storage were disposed of at Raritan. All containers were 55-gallon drums and all munitions were 1 00-pound bombs.

A small detachment of Chemical Corps personnel assisted by civilians disposed of leaking munitions and containers in an area referred to as the Chemical Burial Grounds, or Area 5. The disposal procedure consisted of digging a 5 by 5 by 5-foot pit, pouring the liquid mustard into a decontaminating solution in the pit, and then placing empty containers or bomb casings into the pit. The pit was then covered with earth and signs were posted over it indicating the date of the burial, the type of agent buried, and a warning against digging in the area. The signs have long disappeared and no accurate estimate of the number of pits dug in the area has been obtained.

A Site Safety Submission was approved in March 1995.

ACTIONS PLANNED FOR THE FUTURE: No further actions are planned at this time. Any future remediation of Area 5, if required, will be included in a decision document.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: The lo-acre Area 5, located within an industrial park, is fenced to prevent unauthorized access. The owner is well aware of the site's history and is awaiting the U.S. Army Corps of Engineers'remediation of the site before proceeding with development.

RISK PERCEPTION: Because of the measures taken to prevent public access and the owner's willingness to defer excavation for development pending remediation of the site, no threat to human health and safety is anticipated.

The excavation and remediation of Area 5 was completed in FY96. The recovered items found were 428 chemical agent identification set (CAIS) items and 5 M70 bombs (suspect Lewisite). The CAIS were transported to Pine Bluff Arsenal for future disposal, and the M70 bombs were transported to Aberdeen Proving Ground, Edgewood Area for treatability studies.

NAME OF LOCATION: Fort Hancock

LOCALITY/STATE: Sandy Hook, Monmouth, New Jersey

FUDS ACTIVITIES AT THIS LOCATION: Fort Hancock is located on the Sandy Hook Peninsula of New Jersey. During 1857, construction began on Sandy Hook as Fort Hudson (sometimes called Fort Lincoln). This peninsula became a proving ground for heavy weapons after 1874. The Fort was named Fort Hancock in 1895, in honor of General Winfield Scott Hancock, a Civil War Union general, and it is where smokeless powder was introduced in 1891.

In 1918, the proving ground mission was moved to Aberdeen Proving Ground, Maryland. The Fort became an anti-aircraft site to help protect the New York metropolitan area and served in this capacity through World War II. Fort Hancock was deactivated in 1950, but was soon reactivated due to the Korean conflict. Deactivation occurred again in 1953, but the Fort was reopened in 1956.

Records indicate the recovery of four Livens projectiles found at the Gateway National Recreation Area of Sandy Hook. The area may be a potential site for chemical warfare materiel (CWM). In their report, the recovery team emphasized that the area looked capable of hiding additional unrecovered munitions.

PREVIOUS CORPS ACTIVITIES: The U.S. Army Corps of Engineers conducted a preliminary assessment of the site in 1991. The assessment concluded that the potential for buried ordnance exists and recommended to the Huntsville Division program a project to further evaluate the site. A site visit was conducted on 26 January 1993 to update site demographics. An Archive Search Report was prepared in August 1993. It documented the discovery of the four Livens projectiles and numerous discoveries of unexploded ordnance.

ACTIONS COMPLETED/PLANNED FOR THE FUTURE: The Corps of Engineers has completed an Archives Search of Fort Hancock, New Jersey, and evidence suggests no further action in the construction area. This will be documented via an engineering evaluation/cost analysis. Further actions involving other portions of Fort Hancock are planned.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: The CWM was discovered in an area of sand dunes. The area is heavily overgrown with shrubs and vines and is not easily accessible. No buildings or other facilities are located near the CWM site, and the owner (National Park Service) has no plans for excavation or development of the area.

RISK PERCEPTION: The areas of unexploded ordnance are in the immediate vicinity of heavily used public facilities associated with the beaches on Sandy Hook. The unexploded ordnance discoveries have generally been on the surface or within a foot or two of the surface. Though the CWM was discovered in a less-heavily used area of Sandy Hook, it was found on the surface. Because the risk to human health and safety from both unexploded ordnance and CWM is considered significant, the Corps is recommending to the National Park Service that access to the site be prevented.

NAME OF LOCATION: **Naval Air Warfare Center, Aircraft Division, Lakehurst**

On March 26, 1918, Lakehurst Proving Grounds, Gunpowder Reservation, was established. The Lakehurst Proving Grounds, located on 2,600 acres, was established during World War I (WWI) for testing purposes. Prior to this establishment, these grounds were under the jurisdiction of the Eddystone Ammunition Company of Philadelphia, Pennsylvania. The Eddystone Ammunition Company tested shrapnel and artillery shells on a large range of about four square miles from 1915 to 1917.

The initial lot of gas shells reached this Post from the United States Filling Plant, Edgewood Arsenal, Maryland, on April 17, 1918. These shells were fired on April 25, 1918. Sources state that these shells were the first gas-filled projectiles experimentally fired in the United States. In connection with these experimental firings, gases were being developed in the plant's chemical laboratory. Documentation on one test indicates that adamsite (DM) candles were penetrated at various distances, presumably to determine the level of protection afforded by filters against the resulting cloud.

On May 12, 1921, instructions were issued to abandon Lakehurst Proving Grounds. Activities and equipment were then transferred to Edgewood Arsenal, Maryland. The American Armament Corporation tested tank and anti-aircraft guns within the Proving Ground for about two years, starting in 1940 or 1941. Inert aerial bombs were tested at the site in 1943. This was the final known ordnance testing activity at the site.

LOCALITY/STATE: Lakehurst, New Jersey

WORK PLAN STATUS: National Priorities List Installation

SCOPE OF RESTORATION EFFORT: Lakehurst Proving Grounds, established prior to and during WWI, tested chemical agents. The Proving Grounds contained three test ranges, one 3,200 yards in length, a second 4,200 yards in length, and the third 5,775 yards in length. The ranges included two sets of trenches, two observation towers, and four impact grounds.

EFFORT TO DATE: Unexploded ordnance has been uncovered during construction-related excavation in 1945, 1952, 1958, and 1982. Isolated ordnance items, usually inert, are uncovered several times per year. In addition, several railroad box cars of phosgene projectiles were allegedly disposed of in the northwest section of the station. In 1993, a geophysical survey conducted in the suspect area did not indicate the presence of buried ordnance.

REMEDIATION SCHEDULE: Investigations of the Proving Ground chemical site are part of on-going studies under the activity installation restoration program.

RISK PERCEPTION: The potential threat to human health and safety from all operations at Lakehurst is being evaluated. The threat from the sites where phosgene shells may have been buried is currently under evaluation.

NAME OF LOCATION: **Delaware Ordnance Works at Pedricktown Army Reserve Support Facility**

LOCALITY/STATE: Pedricktown, southwest New Jersey, along the Delaware River

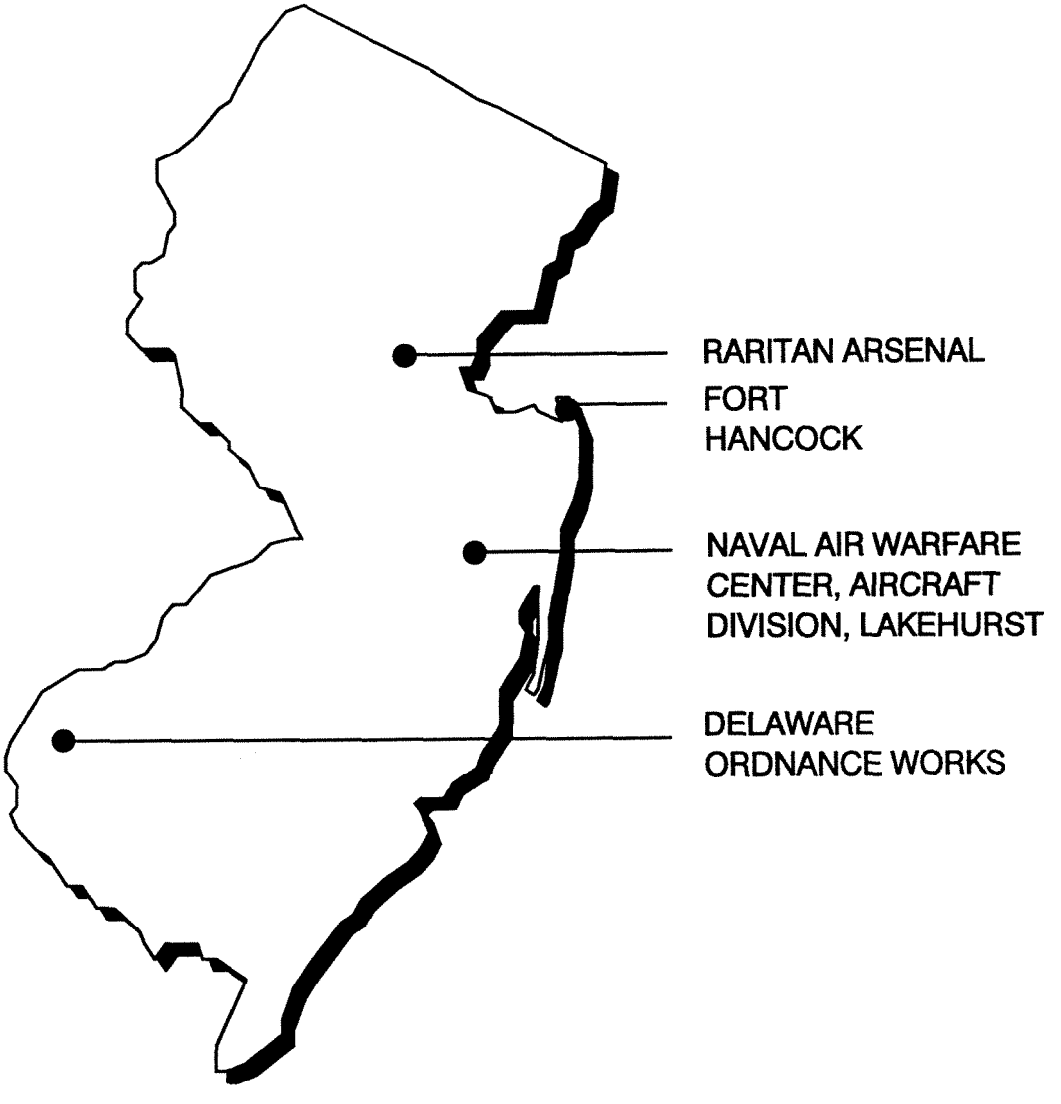
SCOPE OF RESTORATION EFFORT: The Delaware Ordnance Works was established on the site of the Pedrickstown Army Reserve Support Facility (PARSF) in 1918. It remained in operation until 1958 as the final assembly and storage point for munitions prior to offsite shipment. The 78th Division of the Army Reserve is currently stationed at the PARSF. Records indicate that at an unspecified time, two phosgene bombs were demilitarized and decontaminated with caustic and water at a remote corner in the upper burning grounds. The bombs were tested for agent and the results were negative. The casings were turned in for salvage.

EFFORT TO DATE: Because the location where the two phosgene bombs were demilitarized is unknown and the bombs tested negative for chemical agent, further investigation is unnecessary at this time.

REMEDIATION SCHEDULE: No remediation schedule at this time.

RISK PERCEPTION: There is no documented or suspected public health threat from chemical agents at the PARSF.

NEW JERSEY


RARITAN ARSENAL
FORT HANCOCK
NAVAL AIR WARFARE CENTER, AIRCRAFT DIVISION, LAKEHURST
DELAWARE ORDNANCE WORKS

LOCATION	Raritan Arsenal
LOCALITY	Edison
STATE	NJ
SITE	Area 5
DESCRIPTION	Used as a disposal area for bulk mustard and 100-pound chemical-filled bombs. Area known as Chemical Burial Grounds. Excavation and remediation of Area 5 was completed in FY96. The recovered items found were 428 Chemical Agent Identification Set items and 5 M70 100-pound bombs. Recovered items were sent to Pine Bluff Arsenal and Aberdeen Proving Ground-Edgewood Area.
SIZE	4.3 acres
CONTENTS	Chemical Agent Identification Sets and M-70 100-pound bombs.
COMMENTS	Tested positive for mustard at 4 1/2 feet below surface in June 1961. The excavation and remediation of Area 5 was completed in FY96. Any further actions, if required, will be included in a decision document.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

LOCATION	Fort Hancock
LOCALITY	Sandy Hook
STATE	NJ
SITE	Beach
DESCRIPTION	Live rounds found and shipped to Aberdeen Proving Ground-Edgewood Area, Maryland in May 1981. All contarned gas storage cylinders.
SIZE	Unknown
CONTENTS	Four Livens projectiles, liquid-filled; partially intact Stokes mortar.
COMMENTS	Livens projectiles found at Gateway National Recreation Area. Area appears to have potential for further items.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Naval Air Warfare Center, Aircraft Division, Lakehurst
LOCALITY	Lakehurst
STATE	NJ
SITE	Proving Ground
DESCRIPTION	Used for testing gas shells of various caliber circa 1918. Testing conducted in conjunction with experiments at American University Site. Contains three ranges of 3,220 yards, 4,200 yards, and 5,500 yards in length. One source cites test of 500 DM candles that were penetrated at various distances.
SIZE	Approximately 2,600 acres
CONTENTS	Chemical and non-chemical munitions.
COMMENTS	Activities conducted during 1918-l 921 and 1940-l 943.
TYPE	Range
INSTALLATION	Navy
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Naval Air Warfare Center, Aircraft Division, Lakehurst
LOCALITY	Lakehurst
STATE	NJ
SITE	Airstrip
DESCRIPTION	In 1952, U.S. Army Technical Escort Unit uncovered a number of toxic agent shells while constructing the airstrip.
SIZE	Unknown
CONTENTS	Potential for toxic agent shells (specific fill unknown).
COMMENTS	In 1993, a geophysical survey of the suspect area did not indicate the presence of buried CWM ordnance.
TYPE	Disposal
INSTALLATION	Navy
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Delaware Ordnance Works
LOCALITY	Pedricktown
STATE	NJ
SITE	Unknown
DESCRIPTION	Demilitarization of two phosgene bombs in remote corner of upper burning grounds. Agents decontaminated in bomb with water and caustic (NaOH) and emptied.
SIZE	Unknown
CONTENTS	Residue from one 500-pound and one 1,000-pound phosgene bomb.
COMMENTS	Bombs tested for agent had negative results. Assumed agent hydrolyzed. Bomb casings turned in for salvage.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

NEW MEXICO

NAME OF LOCATION: **Fort Wingate Depot Activity**

Fort Wingate was established in 1850 as a military outpost. In 1862, the fort received the name Fort Wingate and was later garrisoned by units of the New Mexico volunteers, the 37th U.S. infantry, and the 3rd Cavalry.

At the beginning of World War I, the installation was designated as the Fort Wingate General Ordnance Depot, with the mission to store TNT. The depot was the largest storage depot of high explosives in the world.

The present Fort Wingate dates back to 25 February 1941, when construction was started on a new depot several kilometers west of the original Fort Wingate. In 1941, as the United States entered World War II, the installation became highly active with incoming and outbound shipments of high explosives. Storage of ammunition other than TNT began in 1942.

In 1962, plans were initiated to use Fort Wingate as a site for test firing the PERSHING and SERGEANT Missile systems. Several successful firings were conducted. Fort Wingate officially closed in January 1993.

Records of chemical-filled munitions storage at Fort Wingate were not found during the installation assessment that was conducted in 1980 or by the U.S. Army Environmental Hygiene Agency's Ground Water Contamination Survey conducted in 1988. However, status reports of chemical-filled ordnance dated 1 May 1942, stated that 28,932 75mm shells, (mustard-filled) and 46,669 155mm shells (mustard-filled) were in storage at Fort Wingate. The US. Army Technical Escort. Unit records also state that 45 carloads of mustard-filled munitions were shipped from Fort Wingate, New Mexico, to the Black Hills Ordnance Depot, South Dakota, on 6 March 1944.

LOCALITY/STATE: Fort Wingate Depot Activity is located 8 miles east of Gallup, New Mexico and about 130 miles west of Albuquerque on Interstate 40. It is bordered on the west by the Bureau of Indian Affairs (Navajo Tribal Trust Land), Navajo Tribe (Freelands), on the south, on the east by the Cibola National Forest, and on the north by the Red Rock State Park. The depot occupies approximately 22,120 acres (34 square miles) of land in McKinley County, New Mexico.

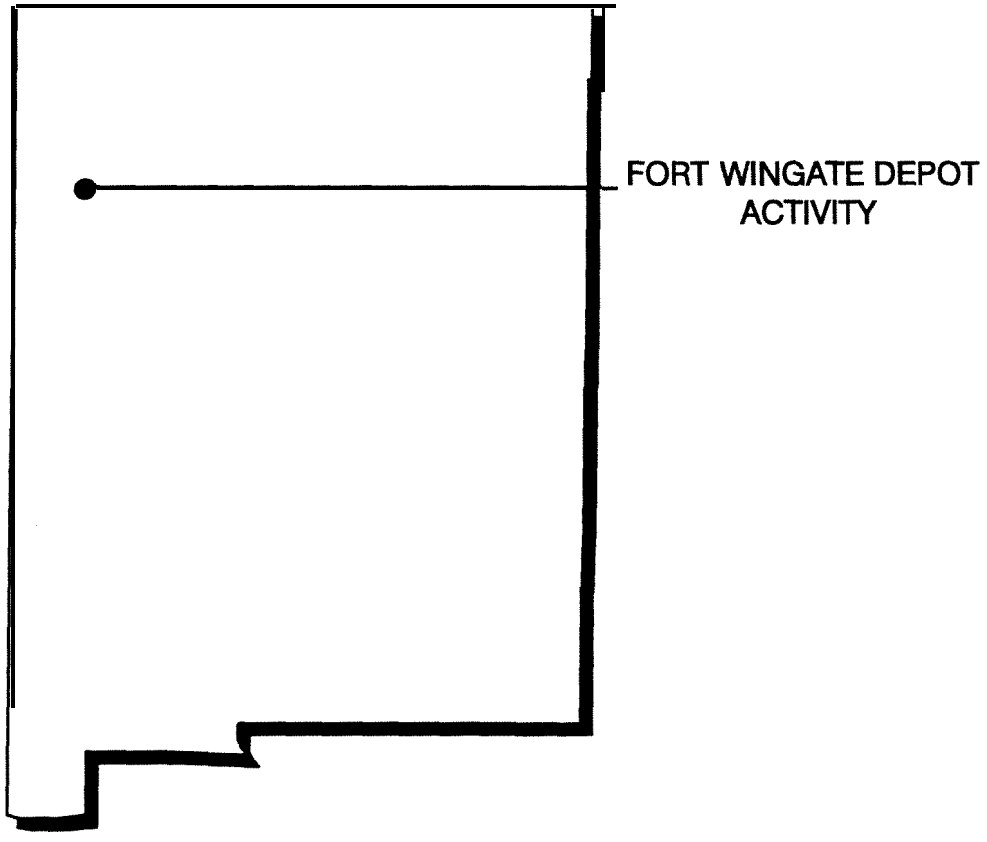
SCOPE OF RESTORATION EFFORT: Reports mention that chemical agent was stored at Fort Wingate Depot Activity at one time but has since been removed. The installation assessment conducted by the U.S. Army Toxic and Hazardous Materials Agency in 1980 stated that no chemical or biological agents or radiological materials are stored on the installation. Personnel interviews conducted in 1992 during the preparation of the base closure environmental investigation work plans confirmed this fact, and as a result, the base closure remedial investigation/feasibility study (RI/FS) has not included investigations for chemical agents or related materiel.

EFFORT TO DATE: Restoration efforts associated with chemical agent are not currently applicable for the Fort Wingate Depot Activity.

REMEDIATION SCHEDULE: RI/FS was completed in July 1995. If new information develops, it will be followed up immediately.

RISK PERCEPTION: None due to chemical agent.

NEW MEXICO



LOCATION	Fort Wingate Depot Activity
LOCALITY	Gallup
STATE	NM
SITE	Storage
DESCRIPTION	Also known as Fort Wingate; used as a storage site. Source cites storage of 75-millimeter, 105-millimeter, and 155-millimeter mustard shells, and 30-pound mustard bomb.
SIZE	Unknown
CONTENTS	Unknown. Potential for 75-millimeter and 155-millmeter mustard shells due to storage site use.
COMMENTS	In March 1944, source sites all munitions moved to the Black Hills Ordnance Depot (45 railcar loads). Complete inventory not specified.
TYPE	Disposal
INSTALLATION	**Army**
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	4 - Possible burial

NEW YORK

NAME OF LOCATION: Mitchell Field

LOCALITY/STATE: Garden City, Nassau, New York

FUDS ACTIVITIES AT THIS LOCATION: Mitchell Field was known as Camp Winfield during the Civil War and as Camp Black during the Spanish American War. Mitchell Field had a long aviation history that spanned both World War I (WWI) and World War II (WWII).

Chemical warfare materiel (CWM) was shipped to Mitchell Field during WWII and the Chemical Warfare Service conducted schools there. The courses consisted of a review of agents, field identification, sniff set, first aid for gas casualties, use and care of mask, gas chamber exercise, protective clothing, and operation and maintenance of decontaminating apparatus (hand- and power-driven). References from letters about one of these courses states that the testing identification kits used were sending particles of the agent and broken glass at the troops.

PREVIOUS CORPS ACTIVITIES: An Inventory Project Report established multiple ownership that included Federal, county, and private ownership. The report was completed on January 3, 1992, and stated that the potentials for ordnance and explosive waste (OEW) and CWM were unknown. A site survey as part of the archives search report was accomplished on August 26, 1993. No evidence of OEW or CWM was found. However, records from the Nassau County Police Department revealed four incidents of ordnance (types unknown) removal prior to 1983.

ACTIONS COMPLETED/PLANNED FOR THE FUTURE: The Corps of Engineers has completed an Archives Search of Mitchell Field and evidence suggests no further action for CWM. Action is planned to further investigate the possibility of conventional ordnance contamination.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: Multiple ownership of the site includes Nassau County commercial activities, the U.S. Navy, Hofstra University, and Nassau Community College. A large portion of the site is extensively developed. Extensive landscaped and paved areas could be developed; however, no development is scheduled.

DISTRICT RISK PERCEPTION: The risk to public health and safety from CWM is considered low since the area is already extensively developed and no evidence of CWM contamination has been found or reported.

NAME OF LOCATION: Camp Hero

LOCALITY/STATE: Montauk, Suffolk County, New York

FUDS ACTIVITIES AT THIS LOCATION: Camp Hero was located on the eastern tip of Long Island. This 470-acre property was acquired through purchase and condemnation proceedings by DoD between August 1941 and May 1944. Camp Hero was used as a harbor defense installation for Long Island Sound.

Between April 1951 and December 1972, 308 acres were transferred to the Air Force for air defense. Between July 1974 and April 1983, New York State acquired all property by quitclaim deed with no clauses, but with a restrictive clause limiting the use to public park purposes.

Gas identification exercises were held at Camp Hero. Men were sent through clouds of Phosgene, mustard, and lewisite.

ACTIONS PLANNED FOR THE FUTURE: No remediation actions are planned at this time.

RISK PERCEPTION: Based on available documentation, the risk is perceived to be minimal.

NEW YORK

LOCATION	Mitchell Field
LOCALITY	Nassau
STATE	NY
SITE	Unknown
DESCRIPTION	Chemical agent identification sets were being used here. During chemical agent identification set testing, particles of the agents and broken glass were flying back at the troops.
SIZE	Unknown
CONTENTS	Possible chemical agent identification sets
COMMENTS	The U.S. Army Corps of Engineers has completed an Archives Search Report and suggests no further action for chemical warfare materiel.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	5 - No further action

LOCATION	Camp Hero
LOCALITY	Long island
STATE	**NY**
SITE	Unknown
DESCRIPTION	Although no history of activities or functions of this installation were found, records indicate that on 22 February 1945, Battery "A" Coast Artillery Battalion (Mustard - HD) held a "Gas Identification Detonation Exercise." During this exercise, men were sent into clouds of mustard, Phosgene, and lewisite. On this day the weather conditions were less favorable (inversion) and the clouds hung close to the ground; thus, a high number of men experienced irritations on their faces and arms. Because the inversion conditions were the cause of the men's irritations, it was stated that the exercises would only be held on favorable weather days.
SIZE	Unknown
CONTENTS	Unknown
COMMENTS	None
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	4 - Possible burial

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NORTH CAROLINA

NAME OF LOCATION: Laurinburg-Maxton Army Air Base

LOCALITY/STATE: Cities of Laurinburg and Maxton, Scotland County, North Carolina

FUDS ACTIVITIES AT THIS LOCATION: Activated in 1942 for use as a glider training site, by 1947 the site was considered excess property and most of the land transferred to the city of Laurinburg and town of Maxton. The site is currently used as a local airport and an industrial park. Reports indicate that an old landfill off the southwest end of Runway 5-23 was used in 1944 to 1945 as a burial site for eight to ten 55-gallon drums of mustard agent. One eyewitness indicated that the drums were placed in a hole and perforated with machine gun fire to drain the drums.

PREVIOUS CORPS ACTIVITIES: U.S. Army Corps of Engineers personnel conducted a preliminary assessment of the site in 1990 and concluded the potential for chemical warfare materiel (CWM) exists at the landfill. The site was revisited on 5 February 1993, to complete the site reconnaissance. An additional site visit was made in June 1993, as part of the Archives Search Report completed in July 1993. There are two areas where ordnance contamination may exist and three possible dump sites where mustard agent may have been disposed.

ACTIONS COMPLETED/PLANNED FOR THE FUTURE: Phase 1 of an engineering evaluation/cost analysis has been completed and the Final Report is due from the contractor. Phase 1 consisted of additional data search and geophysical mapping. Results will be provided in the Final Report. Future actions are anticipated to be sampling and actual anomaly investigation.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: It is not anticipated that any construction will take place in the vicinity of the CWM site because it is located in the clear approach zone of the airport runway.

RISK PERCEPTION: As long as no intrusive activity takes place, this area will not present an immediate threat to human health and safety. The Corps of Engineers notified the owner of potential CWM by letter dated 30 April 1991. In addition, an eyewitness accompanied the site survey team to the areas and is the primary source of information.

NAME OF LOCATION: **Marine Corps Base, Camp Lejeune**

LOCALITY/STATE: The Marine Corps Base, Camp Lejeune, is located in Onslow County, North Carolina, near the city of Jacksonville. The reservation borders the Atlantic Ocean.

WORK PLAN STATUS: National Priorities List Installation

SCOPE OF RESTORATION EFFORT: Marine Corps Base, Camp Lejeune, provides housing, training facilities, logistical support, and administrative support for Fleet Marine Force units and conducts specialized schools and other directed training. Marine Corps Base, Camp Lejeune, has 39 installation restoration (IR) sites currently under investigation to assess long-term impacts. Five of these sites, Sites 41 (Camp Geiger Dump near former trailer park), 69 (Rifle Range Chemical Dump), 74 (Mess Hall Grease Pit), 75 (MCAS Basketball Court Site), and 76 (MCAS Curtis Road Site), have potential for contamination from chemical agents. At Site 69, chemical agent test kits are known to exist, as well as possible hazardous materiel including glass vials, white powder, polychlorinated biphenyls, fire retardants, pentachlorophenol, DDT, TCE, malathion, diazinon, lindane, calcium hypochlorite, gas cylinders, and HTH. During a disposal incident at Site 69, 50 blue and blue-green unmarked drums of what was believed to be training agent (chloroacetophenone gas) were buried in trenches by personnel wearing adsorption canisters and other protective clothing.

In 1970, another burial incident occurred where 5-gallon cans and 55-gallon drums were placed together in a pit approximately 6 to 20 feet deep. When covering the pit with soil, an explosion and fire occurred. Site 74 also has the potential for chemical agent contamination. Reportedly, several drums left over from a Site 69 burial incident may be buried at Sites 41 and 74. In addition, drums of chloroacetophenone and other training agents were reported buried at Sites 75 and 76.

EFFORT TO DATE: To date, no residual chemical agent contamination has been found in the investigations. A fence was constructed around Site 69 in 1990 for precautionary measures. A full remedial investigation has been completed in and around Site 74 in 1995 for Sites 69 and 74. According to the remedial investigation report, chemical surety degradation compounds were detected in soils and sediments at Site 69, while only existing in sediments at Site 74.

At Site 41, the remedial investigation report showed no chemical agent contamination was encountered during drilling operations conducted during the field investigation, plus soil analytical results showed no chemical surety degradation compounds. However, this site is still considered to be a suspected burial location for this material and is planned to be subject to long term monitoring.

At Sites 75 and 76, only limited investigations have been conducted to date, and thus far, no evidence of this material has been found in samples.

REMEDIATION SCHEDULE: The majority of these sites are scheduled for remediation through Camp Lejeune's IR program to eliminate any human health and ecological risks. Under the proposed record of decision, Sites 41 and 74 are not scheduled for remediation. Institutional controls are planned for these sites as no suspected source materiel or evidence of a risk to human health or the environment has been found. Although the investigation is not complete at Site 69, remediation will be required at the site for contaminants other than chemical agents.

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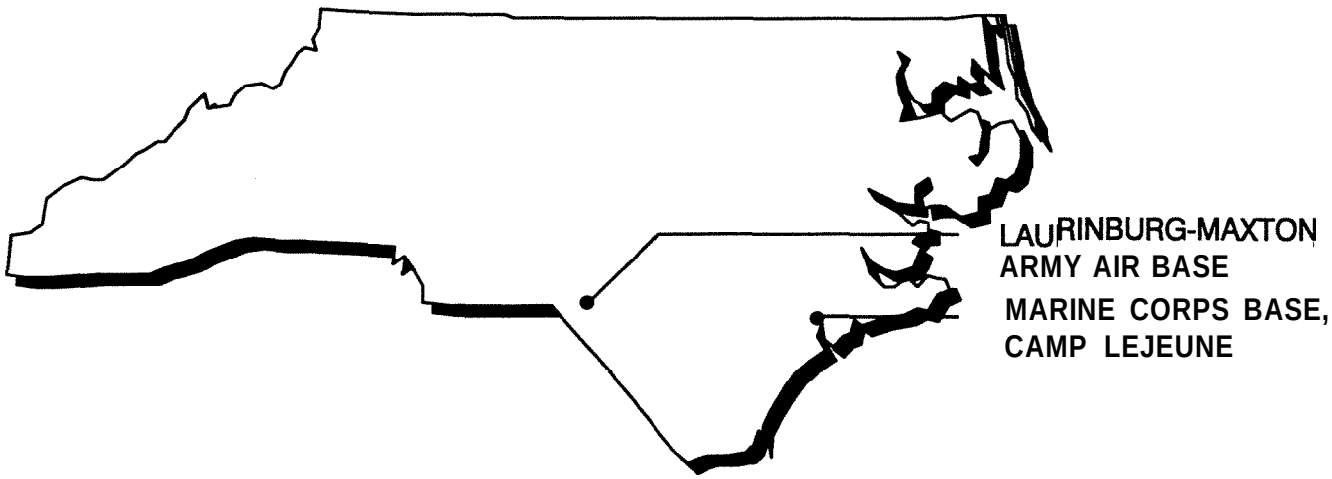
NORTH CAROLINA



LOCATION	Laurinburg-Maxton Army Air Base
LOCALITY	Laurinburg-Maxton
STATE	NC
SITE	Landfill
DESCRIPTION	The old landfill off the southwest end of runway 5-23 was used as a burning site for disposal of eight to ten drums of mustard during 1944 to 1945. Information based on an eyewitness account.
SIZE	Unknown
CONTENTS	Potential contamination from mustard disposal operation.
COMMENTS	Eyewitness states that drums were punctured with machine guns prior to burning.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Marine Corps Base, Camp Lejeune
LOCALITY	Jacksonville
STATE	NC
SITE	Rifle Range Chemical Dump
DESCRIPTION	Site known as Rifle Range Chemical Dump. Located 9,000 feet east of Range and Snead Ferry Road intersectron. Used as a disposal site for chemical waste from 1950 through 1976.
SIZE	Unknown
CONTENTS	Containers for chemical agent identification sets, and possibly training agent CN (tear gas).
COMMENTS	Also characterized as Site 69. Site may contain other chemical waste and calcium hypochlorite (decontaminant).
TYPE	Disposal
INSTALLATION	Navy
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

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OHIO

NAME OF LOCATION: **Ravenna Army Ammunition Plant**

Ravenna Army Ammunition Plant covers a total area of 21,419 acres in a space 3.5 miles wide and 11 miles long. The installation is located in northeastern Ohio in Trumbell and Portage Counties. It is situated approximately 25 miles east of Akron and 10 miles east of Ravenna. The eastern and southern portions of the installation are characterized by a moderately flat terrain, while the western and northern portions display low hills.

Ground was broken for the installation's facilities in 1940. Operations at the installation commenced in December 1941. The installation's principal missions were ammunition loading and depot storage. The installation produced ammunition during World War II, the Korean Conflict, and the Vietnam Conflict. At the present time, the installation is in modified caretaker status. The installation's principal current missions are the care, maintenance, and surveillance of industrial stocks (bulk explosives and inert materiel) and the modified caretaker maintenance of installation facilities.

LOCALITY/STATE: Ravenna, Ohio

SCOPE OF RESTORATION EFFORT: The installation had previously submitted a Resource Conservation and Recovery Act Part B permit application for its Open Burning and Open Detonation (OB/OD) Grounds. As part of that process, an effort was initiated to identify corrective action requirements. The installation has subsequently withdrawn its permit application and has begun the closure process with respect to the OB/OD Grounds, Potentially contaminated sites continue to be investigated, however, under the auspices of the Installation Restoration Program (IRP). To date, only one site is potentially contaminated with chemical agent. A mustard burial site is believed to be located in a wooded area approximately 500 feet south of Hinkly Creek, along an abandoned power line, southwest of Demolition Area 1. The mustard burial site was most likely used prior to 1950 and is less than an acre in size. In 1969, an Army agency excavated a suspected burial site and recovered one 50-gallon drum and seven small rusty cans that were not contaminated with mustard agent. Later, an unidentified and undocumented source reported that there was a second burial site. This second site is situated in the location described above and is enclosed within a cyclone fence. No visible evidence of contamination has been identified in connection with this second site.

EFFORT TO DATE: As stated above, attempts have been made to locate all suspected burial sites. To date, no physical evidence has been found identifying mustard agent or contamination.

REMEDIATION SCHEDULE: Further environmental investigations under the auspices of the IRP, to include the suspected mustard burial site, were initiated in 1995.

RISK PERCEPTION: There is no evidence of agent release or associated threat to public health from chemical agent at the installation. Access to suspect areas is restricted.

NAME OF LOCATION: Cleveland Plant

LOCALITY/STATE: Cleveland, Ohio

FUDS ACTIVITIES AT THIS LOCATION: The War Department established its Cleveland Plant on 11 March 1918. With the formation of the Chemical Warfare Service, it became the Offense Section of the Development Division. Located on the corner of East 131st Street and Taft Ave., the plant was an outgrowth of the Development Division's facility in nearby Nela Park. The Cleveland Plant produced mustard gas between March and November 1918.

On April 2, 1918, the first run was made on an ethylene generator. On April 26 of the same year, Lieutenant Marshall, along with a crew of workers, started using the generated ethylene to make mustard.

The plant was strictly a research facility and no attempts were made to produce quantities beyond that required for experimental purposes. However, there remained a necessity to dispose of these limited quantities. The method of disposal was on-site burial, and burial on adjacent land. A historical photograph, captioned "Burying Mustard," was found. The photo shows personnel in protective clothing and masks pouring barrels of a viscous substance into the ground.

PREVIOUS CORPS ACTIVITIES: An Archives Search Report for this site was prepared by the U.S. Army Corps of Engineers, St. Louis District, in December 1993.

ACTIONS PLANNED FOR THE FUTURE: No remediation actions are planned at this time.

RISK PERCEPTION: Based on photographic interpretations and the characteristics of the contaminant, the potential is high that the site remains contaminated with mustard. The suspected burial site has in effect been capped by a concrete floor of a warehouse addition, which was constructed in the mid-to-late 1940s. This structure would serve to lessen the climatic/weather effects on the mustard and thereby slowing, if not preventing, the chemical decomposition of the contaminant.

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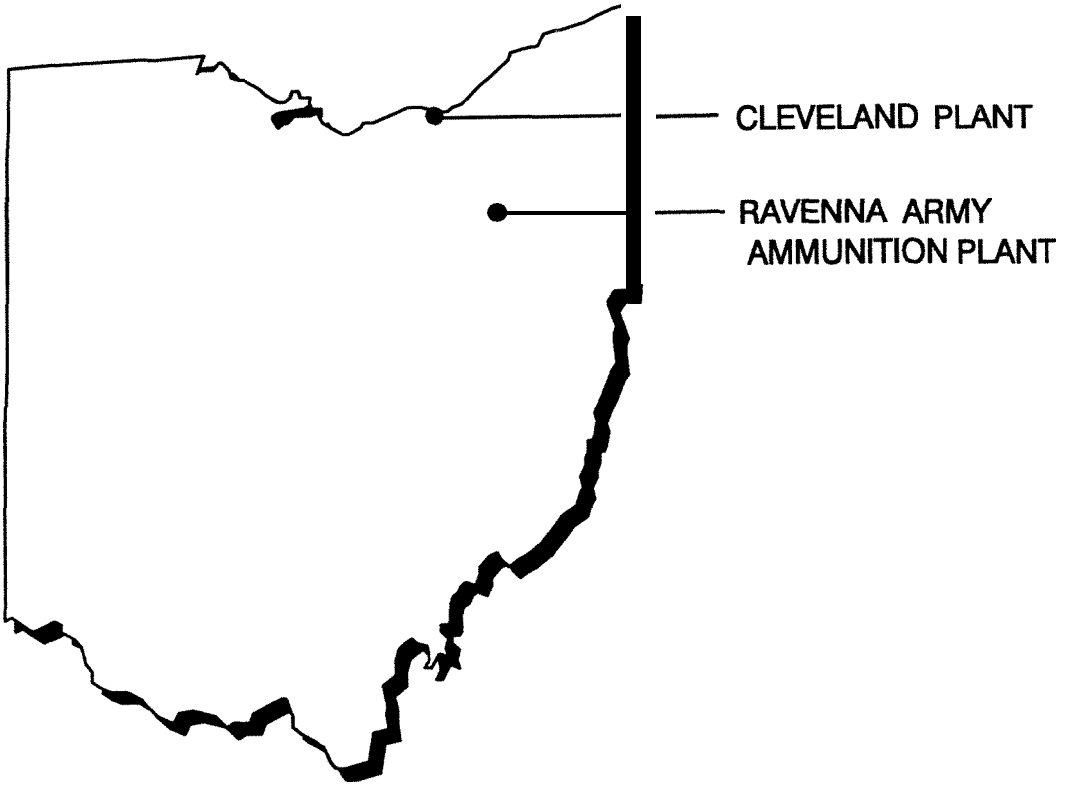
OHIO



LOCATION	Ravenna Army Ammunition Plant
LOCALITY	Ravenna
STATE	OH
SITE	Site **28**
DESCRIPTION	Possible mustard agent burial site, pre-1950.
SIZE	15 by 18 by 18feet
CONTENTS	One 50-gallon drum and seven small rusty cans excavated in 1969.
COMMENTS	Excavated site may not be the right location. Right location may be adjacent to this site.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Cleveland Plant
LOCALITY	Cleveland
STATE	OH
SITE	Mustard Burial Site
DESCRIPTION	The Cleveland Plant was established as the development center for mustard. The plant was strictly a research facility; however, there remained a necessity to dispose of the mustard. A historic photograph, captioned "Burying Mustard," was found. The photo shows personnel in protective clothing and masks pouring a viscous substance from barrels into the ground. The barrels appear to be the size of a 55-gallon drum.
SIZE	Small Area
CONTENTS	Mustard in liquid form, not in drums or bombs.
COMMENTS	None
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	2 - Likely burial

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OREGON

NAME OF LOCATION: Umatilla Depot Activity

Umatilla Depot Activity (UMDA) is located in northeastern Oregon, in Umatilla and Morrow counties. This depot covers 19,700 acres in area and was purchased in 1940.

UMDA began storing ammunition in 1941; its functions were extended to ammunition demolition in 1945, and maintenance and storage of conventional munitions in 1955. Storage of chemical weapons began in 1962.

UMDA is still an active installation. There are burial sites that reportedly have possible mixed contamination of chemical agents from decontamination of various chemical weapons. There are also 20 burning pits, bomb disassembly sites, demolition pads, maintenance for mustard ton containers, trash burning pits, and underground storage. However, no direct evidence of chemical munitions burial is present.

LOCALITY/STATE: UMDA is approximately 170 miles east of Portland, Oregon, 2 miles south of the Columbia River, and 4 miles west of Hermiston, Oregon.

SCOPE OF RESTORATION EFFORT: Two work plans addressing remediation sites have been finalized. The remedial investigation/feasibility study (RI/FS) work plan addressing 58 sites included in the Federal Facilities Agreement was finalized October 1990. The supplemental RI/FS workplan addressing 13 additional sites was finalized February 1991. Of the 71 sites, eight were considered to have a small possibility of having chemical agents. No evidence of chemical munitions burial or chemical agents were found during sampling of the following sites:

1. Site 10: Former Agent H Storage Area
2. Site 49: Drill and Transfer Site
3. Site 41: GB/VX Decontamination Solution Burial Areas
4. Site 59: GB/VX Decontamination Solution Burial Areas
5. Site 33: Gravel Pit Disposal Area
6. Site 9: Remote Munitions Disassembly Area
7. Site 64: Leaking Railcar Shipment Inspection Area
8. Site 29: Septic Tanks.

Soil sampling was planned for all of these sites, with analyses planned to be performed for metals, pesticides, organics, and explosives, as necessary, and also agent breakdown products. Because the sites could have had actual chemical agents, it was required to screen the samples for agents before allowing the samples to leave the depot.

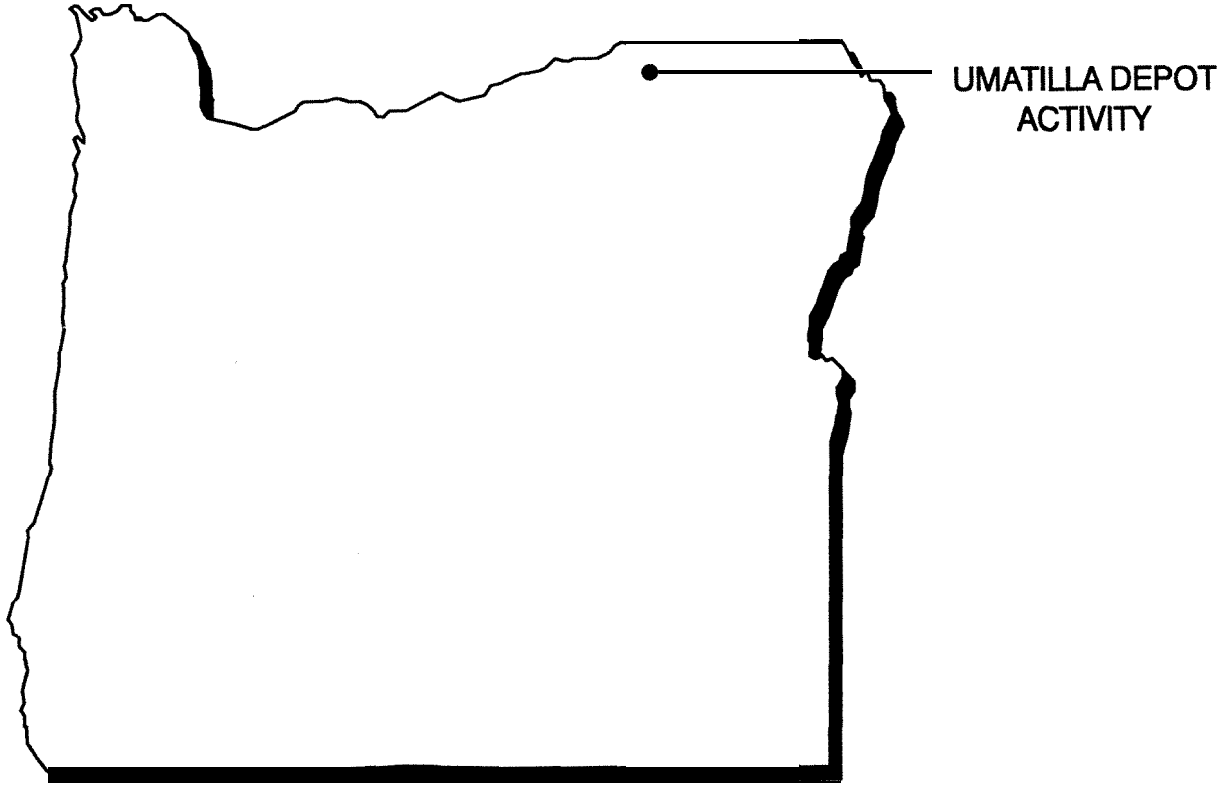
EFFORT TO DATE: A contract laboratory was set up onsite to verify the absence of chemical agents before sending the samples offsite for full analysis. Sampling has been conducted at all of these sites with analyses for metals, pesticides, organics, explosives (as necessary), and agent breakdown products. No chemical agents (GB, VX, or H) were found in any samples. A sample taken from septic tanks, at Site 29,

contained trace amounts of thiodiglycol, a breakdown product of agent H. The level was barely above detectable limits. Because the amount of thiodiglycol found was at such a low level, it was not considered harmful to people or the environment. Therefore, no action was required.

REMEDIATION SCHEDULE: All sites were considered for possible remedial action in a feasibility study. Since no contamination levels at these sites exceeded cleanup criteria, no remedial action was necessary. No action decisions for all of the previously listed sites were documented in a September 1994 miscellaneous sites record of decision and a September 1994 supplementary decision document (Site 64).

RISK PERCEPTION: There is no threat to public health or safety from chemical agents at any of the 8 sites. As a chemical stockpile storage facility, the Depot has an active and thorough monitoring and detection program in place, and has a trained emergency response force at the ready.

OREGON



LOCATION	Umatilla Depot Activity
LOCALITY	Hermiston
STATE	OR
SITE	Northwest Corner
DESCRIPTION	Contains 20 burning pits (each pit measures 8 to 10 feet in depth and 20 feet in diameter), demolition pads, and underground storage.
SIZE	1,750 acres
CONTENTS	Residue from mustard maintenance operation.
COMMENTS	Source cites mixed contamination.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	4 - Possible burial

PENNSYLVANIA

NAME OF LOCATION: **Defense Distribution Region East (formerly the New Cumberland Army Depot)**

This site, formerly known as the New Cumberland Army Depot, is an 832-acre general supply depot located in south-central Pennsylvania, York County, five miles south of Harrisburg. The primary functions of the site are related to supply and maintenance. It is responsible for the receipt, storage, care and preservation, and shipment of Department of Defense, Agency for International Development, and installation operating supplies.

Marsh Run Storage Depot (the original name for New Cumberland Army Depot) was constructed in 1917. The Depot was redesignated an Army Reserve Depot with the mission to provide reserve storage for Quartermaster, Signal, Ordnance, Medical, Engineer, and Chemical Warfare items. In 1918, following the end of World War I, the Depot served as a receiving point for supplies returned from overseas.

Little activity occurred at the Depot from the end of the war until World War II. During World War II, the Depot's primary mission was to serve as filler depot to several ports of embarkation for overseas shipment. The Depot also served as a reception center for newly inducted soldiers. In 1941, a clothing impregnation plant was added to the laundry.

During the later part of World War II, a prisoner of war (POW) camp for German prisoners was established. Following deactivation of the POW camp and the reception center, a branch of the U.S. Disciplinary Barracks was activated until March 1959.

The Depot was the site for receiving and disposing of excess supplies and equipment by the Quartermaster Supply Section for 13 states from the end of the war until June 1947. Beginning in September 1946, a War Reserves Branch was established to store supplies and equipment; the branch became especially active during the Korean Conflict.

The Depot became a separate installation under the Quartermaster General on January 1, 1948. During the Korean Conflict, activity increased as Maintenance Divisions were formed and storage space enlarged. Between 1957 and 1959, the Quartermaster Supply Section increased activities in subsistence, clothing textiles, and some Civil Defense stocks. The Quartermaster Inspector General Field Office was moved to the Depot from 1959 to 1962, when it was deactivated. In 1962, the Depot was officially named New Cumberland Army Depot and became a field installation of the U.S. Army Supply and Maintenance Command.

The New Cumberland Army Depot was used as a chemical supply depot during World War II and the Korean Conflict. Records show that the only commodities issued during these timeframes were those pertaining to chemical warfare, such as flame throwers, smoke generators, detector devices, DANC (a decontaminant), Decontaminating Solution No. 2 (DS-2), bleach, impregnated clothing, and protective masks. No toxic

chemical agents were stored or issued other than the chemical agent identification sets (CAIS), which were stored in various warehouses. The storage of these CAIS indicates a possibility of their presence on the Depot.

LOCALITY/STATE: New Cumberland, Pennsylvania

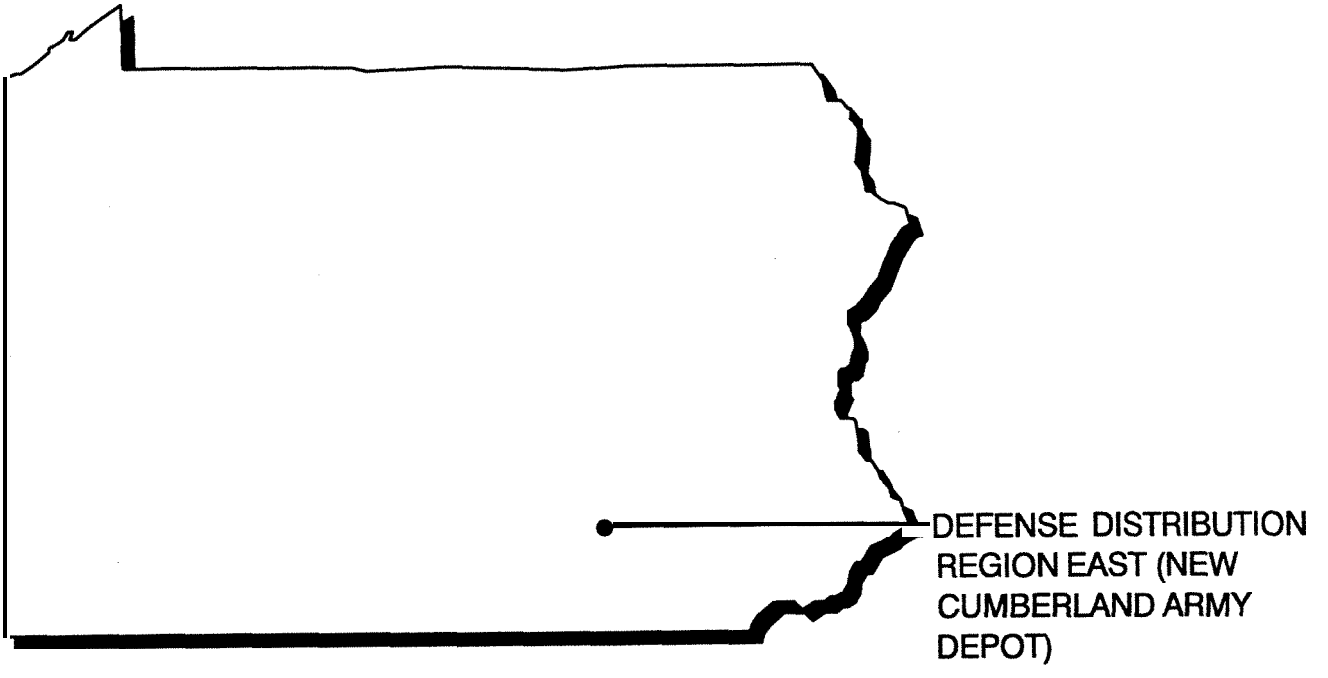
SCOPE OF RESTORATION EFFORT: According to a report titled "New Cumberland Army Depot and Toxic Chemical Munitions" prepared for the US. Army Engineer District Omaha, by Dr. Martin K. Gordan from the Office of History, Headquarters, U.S. Army Corps of Engineers, on September 28, 1989, the New Cumberland Army Depot did not store toxic chemical munitions and the available inventories show that chemical munitions were in fact never stored there. U.S. Army Toxic and Hazardous Materials Agency (now the Army Environmental Center) contractors conducted a field study of 20 solid waste management unit sites. Based on this investigation, it has been determined that no chemical munitions or chemically contaminated groundwater were present at the installation.

EFFORT TO DATE: During the 1940s and 1950s, it was common practice to bury CAIS when they were no longer needed; however, no evidence has been found to indicate that any were buried at this site. Thus, there is no requirement to conduct an extensive search at this time. A remedial investigation/feasibility study has been conducted and no evidence of chemical agents was found.

REMEDIATION SCHEDULE: Presently, no remediation studies or investigations are required.

RISK PERCEPTION: The threat to human health and safety is felt to be very low.

PENNSYLVANIA



LOCATION	Defense Distribution Region East
LOCALITY	New Cumberland
STATE	PA
SITE	Unknown
DESCRIPTION	Storage of chemical agent identification sets. Formerly known as the New Cumberland Army Depot.
SIZE	Unknown
CONTENTS	Possibly chemical agent identification sets.
COMMENTS	No indication of fate of chemical agent identification sets. Remedial Investigation/Feasibility Study has been conducted and no chemical agents have been detected.
TYPE	Disposal
INSTALLATION	Defense Logistics Agency
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	5 - No further action

SOUTH CAROLINA

NAME OF LOCATION: **Charleston Naval Weapons Station**

Charleston Ordnance Depot was constructed in 1918 as part of the Charleston Port Terminal, and it became active on 19 November 1918. After World War I, these facilities were used by the Ordnance group to store a variety of ammunition. The Depot was used by the Animal Embarkation Activity as a remount station to process horses and mules prior to shipment abroad.

The Ordnance section functioned as the Charleston Reserve Depot until December 1921, when it became known as the Charleston Ordnance Reserve Depot. In 1927, it was renamed the Charleston Ordnance Depot, and it continued ammunition operations until 1942.

Upon termination of ammunition activities in 1942, the Depot was temporarily designated the Charleston Port of Embarkation to reflect its Transportation Corps activities (1943 to 1945) during World War II. During the later part of 1945, Charleston Ordnance Depot was reactivated with a mission of storage and renovation of ammunition. Simultaneously, a small boat wet-storage area was activated near the entrance to Goose Creek for the storage of Army vessels received from closing installations.

In 1952, ammunition operations were again phased out due to the encroachment of community and industrial activities into the immediate area surrounding the Depot. During the following 10 years, it served as a transportation depot and underwent the following name changes: the Charleston Transportation Corps Marine Depot (1952); the Charleston Transportation Corps Depot (1952); and the Charleston Transportation Depot (1952 to 1962). On 1 August 1962, the Depot became a subordinate command of the newly created U.S. Army Supply and Materiel Command; at that time it was officially redesignated as the Charleston Army Depot. Upon merger of the two major commands on 1 July 1966, Charleston Army Depot came under the direct command of the U.S. Army Materiel Command.

In 1946, disposal operations were conducted involving more than 100 leaking German bombs containing mustard. The bombs were 500-pound and 1000-pound thin-case bombs that leaked at the seams. The bombs, still loaded in original boxes and crates, were loaded onto a steel lighter (barge) for disposal at sea, 165 miles from the mainland. Because of concern that the wooden crates might prevent the bombs from sinking, primacord detonating fuse was wrapped around each crate to blow away the wood.

The Charleston Army Depot site is now located on the Charleston Naval Weapons Station and on private land. Some land adjacent to the Naval Weapons Station that was a portion of the former Charleston Army Depot has been returned to private, county, and state interests. All documentation indicates that the suspected burial sites are completely contained in the boundaries of the Naval Weapons Station.

The section on Charleston Army Depot in the 1993 S&A report has been deleted from this update since it is now located on Charleston Naval Weapons Station land.

LOCALITY/STATE: Charleston, South Carolina

WORK PLAN STATUS: Defense Environmental Restoration Program

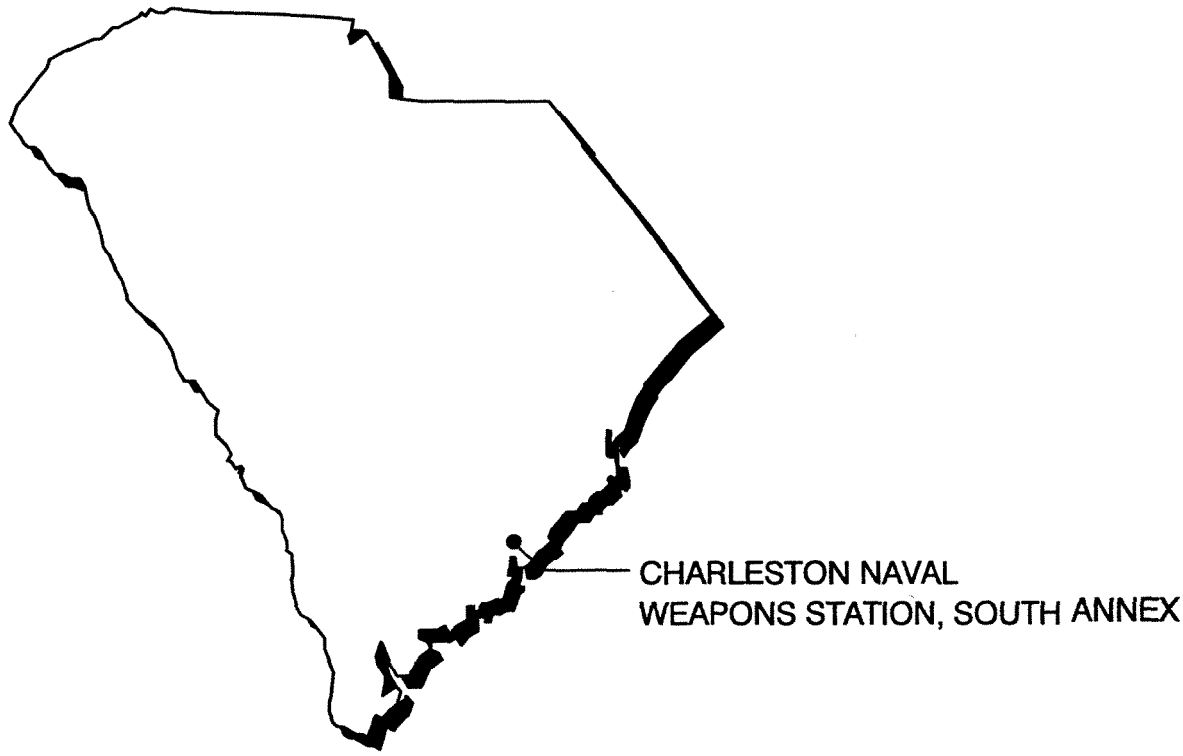
SCOPE OF RESTORATION EFFORT: The former Charleston Army Depot was involved with handling mustard munitions after World War II. Mustard munitions passed through the dock facilities of the installation, but the munitions were never stored in magazines or warehouses on the Depot. During normal operations, mustard munitions arrived at the Depot and were transferred to barges at the Depot docks. The barges were then towed out to sea and the cargos dumped into the ocean. The barges were fitted with special cradles to hold the mustard containers and facilitate their dumping at sea. After disposal operations were completed, the barges were decontaminated, moved up a creek that enters into Goose Creek, and then burned. Currently, Charleston Naval Weapons Station is involved in storage and renovation of ammunition.

EFFORT TO DATE: No chemical agent contamination has been found. An Archival Search Report was completed in July 1994.

REMEDIATION SCHEDULE: A remedial investigation schedule is being developed for the potential mustard contamination area as part of the on-going Installation Restoration Program.

RISK PERCEPTION: This area is not believed to present any immediate threat to human health and safety. The sites where barges were decontaminated and burned do not appear to create any threat.

SOUTH CAROLINA



LOCATION	Charleston Naval Weapons Station, South Annex
LOCALITY	Charleston
STATE	SC
SITE	Unknown
DESCRIPTION	Formerly part of Charleston Army Depot that disposed of leaking German mustard bombs at sea.
SIZE	Unknown
CONTENTS	German 500-pound and 1 ,000-pound mustard bombs.
COMMENTS	None
TYPE	Disposal
INSTALLATION	Navy
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Charleston Naval Weapons Station, South Annex
LOCALITY	Charleston
STATE	**SC**
SITE	Wet Boat Basin
DESCRIPTION	This facility has been located on property presently owned by the U.S. Naval Weapons Station. All information concerning the movement of chemical ordnance through the Charleston depot mentioned the Wet Boat Basin. Though no information was discovered concerning the disposal of any such weapons at the site the undocumented disposal of some munitions is always a possibility. Particularly, since a known conventional munition disposal site is just north of the boat basin. Leaking German mustard bombs were disposed of at sea, 165 miles from mainland.
SIZE	Unknown
CONTENTS	More than 100 German mustard-filled bombs, 500-pound and 1 ,000-pound, were disposed of at sea.
COMMENTS	No difficulties cited during operation.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, nonexplosive
CLASSIFICATION	4 - Possible burial

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SOUTH DAKOTA

NAME OF LOCATION: **Black Hills Ordnance Depot**

LOCALITY/STATE: Edgemont, Fall River County, South Dakota

FUDS ACTIVITIES AT THIS LOCATION: This installation was used by the U.S. Army for storage, renovation, and disposal of ammunition from 1942 to 1968. Stored at various locations on post were high explosives, white phosphorus, mustard, cyanogen chloride, and phosgene in 105mm, M-70, M-78, and M-79 munitions. In the early 1960s, M55 nerve agent-filled rockets (GB and VX) were also stored.

Because of pressure problems, the M-78 and M-79 bombs (Phosgene and cyanogen chloride filled) were subjected to periodic pressure tests. A small number of the bombs were deteriorated and were disposed of. The disposal method was unspecified.

In 1949, due to a large quantity of leaking munitions in certain lot numbers of M-70 mustard-filled bombs, 500 bombs (10 from each lot number) were sent to Rocky Mountain Arsenal for evaluation. In 1950, approximately 310,000 M-70 mustard-filled bombs were stored, many of which were leaking.

Disposal operations at Black Hills Ordnance Depot (BHOD) were conducted at three disposal sites. Burning Ground 1 was used to destroy mustard-filled munitions. Although the date when Burning Ground 1 was first used is unknown, activities at this site did not take place after 1946. Burning Ground 2 was constructed in 1946, where mustard-filled munitions are known to have been destroyed. Due to the increase in munitions to be destroyed in 1950, three new burning pits were recommended for construction at Burning Ground 2. It is not known whether these pits were constructed.

In November 1951, a new burning site was proposed to increase the capacity to destroy leaking mustard munitions. The proposed site was 2,400 feet from the Depot boundary fence and 2,400 feet from the northern boundary fence. Records do not indicate whether this site was constructed. However, a new burning site was located in the northwest corner of the installation. The date of construction is unknown. Records indicate that only phosgene and mustard bombs were destroyed there.

In 1965, the former BHOD was declared surplus for military needs and was sold. Part of the depot was purchased by the city of Edgemont and later resold to private enterprise for cattle grazing. A portion of the depot was retained by the U.S. Forest Service. Five years after the property was sold, concerns referring to the disposal of munitions at Burning Ground 2 and the presence of mustard were voiced by individuals who occupied that ground. Tests were conducted and the surface was found to be free of contamination. As part of the ongoing archives search for chemical warfare materiel, a site survey was conducted by TCT, St. Louis, a contractor of the US. Army Corps of Engineers. During the site survey three unfilled chemical rounds were discovered. An Army Explosives Ordnance Detachment disposed of the rounds.

ACTIONS COMPLETED/PLANNED FOR THE FUTURE: The original Archives Search Report (ASR) was completed in October 1993. The ASR raises data which indicates that BHOD had a large-scale chemical weapons disposal program.

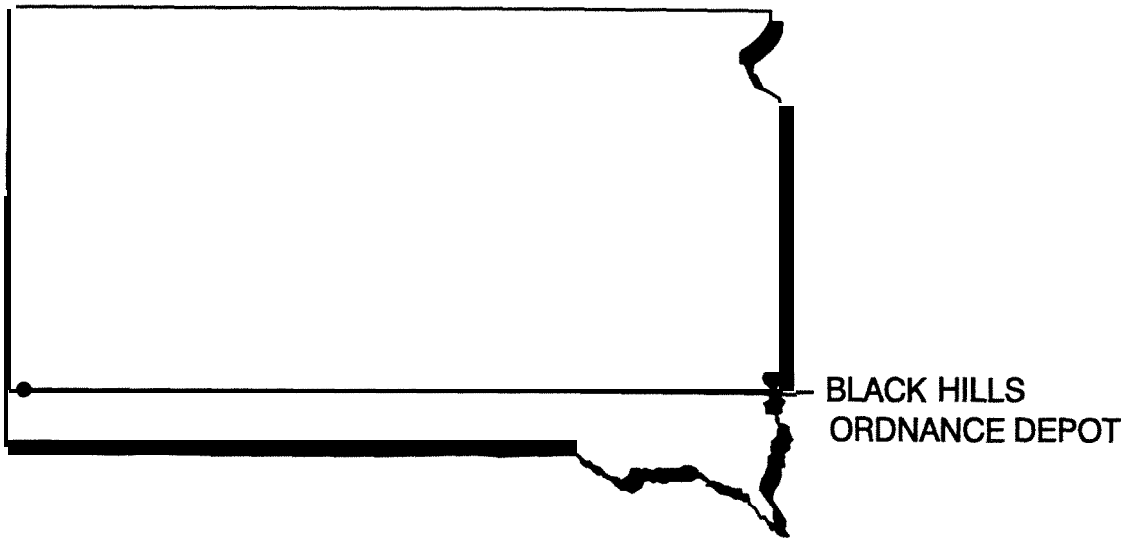
In addition, a Preliminary Site Investigation was completed in November of 1993. Two Delivery Orders were issued to an A and E contractor to do additional geophysical mapping, aerial photography, and an engineering evaluation/cost analysis. Work is ongoing and scheduled for completion in FY96. Two other Delivery Orders were issued to a Services Contractor. The first was for clearance for the proposed Ash Landfill. This work is temporarily on hold awaiting resolution of disputed ownership. The second was for the preparation of the work plans and other plans associated with the Site Safety Submission. This work is ongoing. Also in this Delivery Order was the initial surface clearance of Burning Grounds 1 and 2. This work includes soil and water sampling for chemical warfare materiel and by products.

Existing documents indicate as many as 38,800 chemical munitions were destroyed by open burning at BHOD between 1945 and 1957. It is known from past experience that open burning disposal operations did not always destroy 100 percent of the chemical munitions. The efficiency of the open burning operation is dependent on the types of chemical munitions and the procedures used. There is no definitive method for determining the efficiency of the open burning operations used at BHOD, but there may be enough buried intact chemical munitions remaining from these disposal operations to classify it as a large burial site. At this time, the Army does not know the magnitude of the buried chemical munitions at BHOD. It is conducting further investigations to determine the extent of the buried intact chemical munitions and will classify the sites accordingly. At this time, the sites at BHOD are classified as small quantity buried CWM site.

SUSCEPTIBILIN TO INTRUSIVE ACTIVIN: The South Dakota Department of Environment and Natural Resources requested that the U.S. Army Corps of Engineers (USACE) determine whether or not the location of, a proposed incinerator ash landfill fell within the scope of this investigation. Huntsville Division of USACE replied that it did not fall within a known contaminated area. However, the available records were not all inclusive and, therefore, all potential contamination may not be known. Huntsville Division strongly recommended that no intrusive work be done at the former depot at this time. As a result of this recommendation, the State of South Dakota put on hold a permit application submitted by Fall River Properties for an ash incinerator landfill. Other planned activities are also on hold.

RISK PERCEPTION: A site visit during 1992 revealed that, unless disturbed by intrusive activities, no threat to human health and safety is anticipated. Because the site is remote, sparsely populated, and is used mostly for grazing, threat to human health and safety is minimal. This is a site where USACE is recommending to owners that no intrusive activities take place prior to Army evaluation. All USACE activities are coordinated with the public.

SOUTH DAKOTA



LOCATION	Black Hills Ordnance Depot
LOCALITY	Edgemont
STATE	SD
SITE	Burning Ground 1
DESCRIPTION	Initial demolition and burning area. Mustard-filled AN-M47 100-pound munitions were destroyed by burning here. Site not used after 1946.
SIZE	Unknown
CONTENTS	Potential mustard-filled munitions residue.
COMMENTS	Date of first use of this site unknown.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Black Hills Ordnance Depot
LOCALITY	Edgemont
STATE	SD
SITE	Burning Ground 2
DESCRIPTION	Constructed in 1946. Indication that this area was greatly expanded during the years following 1948. This was a large scale disposal area including chemical and conventional munitions. Destruction of mustard-filled munitions by the burning pit method continued through the 1950s.
SIZE	Unknown
CONTENTS	Disposal activities included CG, CK, mustard bombs, mustard projectiles, and conventional ammunition.
COMMENTS	Reference provides good detail on disposal methods. The Army will conduct further investigations to determine whether this site should be reclassified as a large burial site.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Black Hills Ordnance Depot
LOCALITY	Edgemont
STATE	SD
SITE	Chemical Warfare Area
DESCRIPTION	On May 10, 1957 mustard was transferred from M70 containers at an unspecified location in the Chemical Area. The transfer resulted in a 64 percent recovery rate of agent. Once deconned, the bomb casings were placed in open pits and burned. The pits were located in the Chemical Area.
SIZE	Unknown
CONTENTS	Unknown
COMMENTS	Reference described various ways of demilitarizing and detonating the rounds.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Black Hills Ordnance Depot
LOCALITY	Edgemont
STATE	SD
SITE	Unknown
DESCRIPTION	Experimental demilitarization work (mustard-filled munitions). Reference describes various procedures for demilitarizing 3,500 155-mm mustard-filled projectiles that were not able to be handled by routine methods.
SIZE	Unknown
CONTENTS	Unknown.
COMMENTS	Timeframe: 1949.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

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TENNESSEE

NAME OF LOCATION: Defense Depot Memphis

Defense Depot Memphis is located in the southern portion of the city of Memphis, approximately 6 miles north of the Tennessee-Mississippi line and 8 miles east of the Mississippi River.

Its mission has been related to the Army Engineer, Chemical, and Quartermaster Services, and it provided supply, stock control, storage, and maintenance for all three organizations. This installation was originally named Memphis General Depot, but was also known as Memphis Quartermaster Depot, Memphis Army Service Forces Depot, and Memphis Army Depot.

In July 1946, an incident occurred when German mustard-filled bombs in a railroad shipment from Theodore, Alabama, to Pine Bluff Arsenal were found leaking. Eight cars were routed to Defense Depot Memphis for disposal, and of these, three cars were found to contain leaking bombs The leaking bombs were taken to an area north of Dunn Road, known as Dunn Field, where they were placed over a pit containing a bleach slurry. Holes were shot into the bombs to drain the mustard into the pit. Following this operation, the bomb bursters were exploded with dynamite. The bomb casings were probably also buried here. As many as 29 bombs may have been destroyed in this manner.

Chemical agent identification sets were also stored at the depot. Six of the ampules from these sets were found leaking and were disposed of by burial on Dunn Field. Water and soil samples taken from the burial site were analyzed and no agent or agent by-products were detected.

LOCALITY/STATE: Memphis, Tennessee

WORK PLAN STATUS: National Priorities List Installation

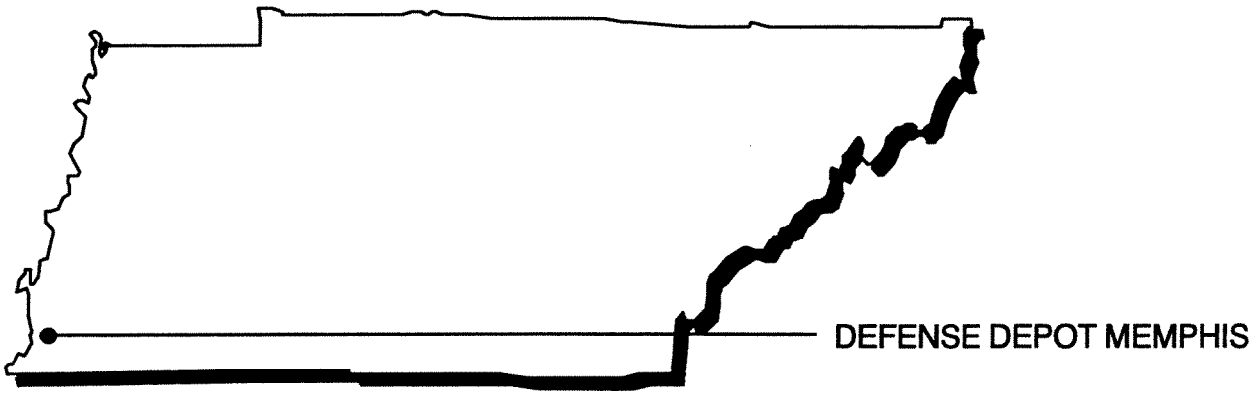
SCOPE OF RESTORATION EFFORT: Defense Depot Memphis is a 642-acre site owned by the Army and operated by the Defense Logistics Agency (DLA). Prior to the Depot opening in January 1942, the site was utilized for producing cotton. The initial mission and function of Defense Depot Memphis was to provide stock control, storage, and maintenance services for the Army Engineer, Chemical, and Quartermaster Corps. During World War II, the Depot served as an internment center for 800 prisoners of war and performed supply missions for the Signal and Ordnance Corps. Since 1963, the Depot has been a principal distribution center for DLA in shipping and receiving hazardous materials, textile products, food products, electronic equipment, construction materials, and industrial, medical, and general supplies.

All required workplans have been submitted to the U.S. Environmental Protection Agency (EPA) and the Tennessee Department of Environment and Conservation (TDEC) for approval.

REMEDIATION SCHEDULE: Defense Depot Memphis is considering early action at several sites by employing an engineering method known as the observational approach. Sites that can be remediated or mitigated prior to Remedial Investigation will be evaluated and selected. Examples are: 1) well-documented and defined shallow soil contamination, and 2) known buried containers that can be removed before they release (in some cases release additional) contaminants.

RISK PERCEPTION: There appears to be no threat to human health and safety from past activities concerning chemical agents, The potential threat to human health and safety from all past activities is still being evaluated. The Depot is monitored by EPA and TDEC on all current activities through the Comprehensive Environmental Response, Compensation, and Liability Act and the Resource Conservation and Recovery Act process. An environmental staff and emergency spill response team maintain compliance for all hazardous waste and hazardous material management activities.

TENNESSEE



LOCATION	Defense Depot Memphis
LOCALITY	Memphis
STATE	TN
SITE	Dunn Ave.
DESCRIPTION	On July 14 through 30, 1946, mustard was decontaminated from three contaminated railcars. Decontamination was in open pits. Railtracks from Amory to Memphis were also decontaminated.
SIZE	Unknown
CONTENTS	Leaking 500- and 1 ,000-pound German aerial bombs.
COMMENTS	Holes shot in noses of munitions. As many as twenty-nine, 500-pound bombs decontaminated and buried. Mustard drained in bleach slurry pit, then burned.
TYPE	Disposal
INSTALLATION	Defense Logistics Agency
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Defense Depot Memphis
LOCALITY	Memphis
STATE	TN
SITE	Dunn Field
DESCRIPTION	Disposal of chemical agent identification set; six ampules.
S I Z E	Unknown
CONTENTS	Chemical agent identification sets
COMMENTS	Soil and water sampling detect no agent or agent byproducts.
TYPE	Disposal
INSTALLATION	Defense Logistics Agency
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	4 - Possible burial

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TEXAS

NAME OF LOCATION: **San Jacinto Ordnance Depot**

LOCALITY/STATE: Houston, County of Harris, Texas

FUDS ACTIVITIES AT THIS LOCATION: San Jacinto Ordnance Depot, located on the Houston Ship Channel in the Port of Houston, consisted of 4,918 acres. The installation was used as a primary transshipment depot to handle ammunition shipments en route to other ports.

Records indicate that two 500-pound Phosgene-filled bombs (one empty and one partially empty) and one 500-pound mustard-filled bomb were buried in separate holes along the eastern banks of the Houston Ship Canal (approximately 1/2 mile from the docks of the depot). Additionally, one Phosgene-filled bomb was sunk in the Houston Ship Canal approximately 1 mile below the depot docks.

PREVIOUS CORPS ACTIVITIES: The U.S. Army Corps of Engineers completed an archives search at this site in July 1991. An additional archives search from June to July 1993 did not uncover any new information on the San Jacinto Ordnance Depot.

ACTIONS PLANNED FOR THE FUTURE: According to the recommendations and conclusions of the July 1991 archives search report, the disposal of the chemical bombs in the east bank of the Houston ship canal was conducted in a manner to expedite decomposition of the bombs' agent fill. According to the report, the bombs are not likely to be intact. The report recommends no further action for conventional or chemical munitions.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: Current land use is almost fully industrialized, with little undisturbed land remaining. According to the archives search report, 68 different companies were operating on the former depot property. Numerous improvements, such as the addition of roads, ships, barge docks, factories, refineries, and buildings, can be observed.

RISK PERCEPTION: Chemical warfare materiel (the buried bombs) should have decomposed long ago. The sunken bomb should remain undisturbed. For these reasons, there is little threat to human health and safety.

NAME OF LOCATION: Fort Hood

Fort Hood is located in central Texas in Bell and Coryell counties. It is situated between Austin and Waco. The largest incorporated civilian community in the area is the adjacent Killeen.

The site for the present day Fort Hood was selected in December 1941 as the training camp for newly created World War II (WWII) tank destroyer units. On 14 January 1942, the War Department announced the relocation of the Tank Destroyer Center from Fort Meade, Maryland, to the newly created 160,063-acre Camp Hood. In April 1950, Camp Hood was declared a permanent station and redesignated as Fort Hood.

In 1947, Killeen Base, a Defense Atomic Support Agency facility, was constructed in an area now identified as West Fort Hood, on 1665 acres of land held for use by a permit from the Department of the Army.

In 1953, an additional 49,647 acres of land was acquired to permit training with longer-range weapons. On 31 May 1963, Gray Air Force Base was transferred to the Army and is presently known as Robert Gray Airfield. In 1969, Killeen Base was deactivated and the real property transferred to Fort Hood.

Chemical warfare training areas on this installation have existed since 1943. The first of these was located on the southwest edge of the range area and was designated as the Mustard Gas Area. By 1945, a second chemical warfare training area was established on the south border, at which time both sites were designated as chemical warfare areas.

LOCALITY/STATE: Killeen, Texas

SCOPE OF RESTORATION EFFORT: As a major training installation during WWII, it would not have been unusual for limited use of chemical warfare agents to have occurred on post. There is no evidence that any residues remain today or of any agent/munitions having been buried. A June 1982 U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) report, "Installation Assessment of Fort Hood, Report Number 188," stated that no evidence of actual chemical agents use could be found.

EFFORT TO DATE: USATHAMA returned to Fort Hood in April 1987 and updated the 1982 report, now entitled "Update of the Initial Installation Assessment of Fort Hood, Report Number 188U." There were no recommendations to do any further investigations at the two sites. However, after the release of the Interim Survey and Analysis Report on 20 April 1993, the Texas Water Commission sent a request of information on the two sites.

In February 1994, a survey was conducted in the two Fort Hood, Texas, former WWII-era chemical warfare training areas by representatives of Pine Bluff Arsenal (PBA) to determine the likelihood of chemical agent contamination. Soil, water, and

vegetation samples tested at the PBA Quality Assurance Laboratory, in accordance with established Environmental Protection Agency protocols, and historical research failed to substantiate the presence or likelihood of contamination at the two training sites. A copy of the survey report was sent to the Texas Natural Resource Conservation Commission and no requirement for further corrective action is anticipated.

REMEDIATION SCHEDULE: It is believed that no threat to human health or safety exists from possible past chemical activities at Fort Hood, Texas, and no further corrective action is necessary.

RISK PERCEPTION: Fort Hood has been home to an Army corps and division(s), and has been used extensively for the training of soldiers for a considerable time without any chemical agent incident. There appears to be no threat to human health or safety from possible past chemical activities.

NAME OF LOCATION: Camp Bullis

Camp Bullis was established in September 1917 as a target range and maneuver ground for Fort Sam Houston and Camp Travis. Camp Bullis originally consisted of about 4,922 acres of leased land located adjacent to the Leon Springs Military Reservation. Acquisition of Camp Bullis extended the Leon Springs Military Reservation approximately 5 miles in a southerly direction, bringing the reservation to within 10.5 miles of Fort Sam Houston. Target ranges were completed and used throughout World War I. The land remained under lease until it was purchased in 1919.

Camp Bullis was used during World War I as an Officers Training Camp. Units of the Reserve Officers Training Corps, Civilian Military Training Corps, and Civilian Conservation Corps used the camp during the summers. Additional land was acquired in 1920, 1923, and 1933. The last purchase was made in 1941.

During World War II, units stationed at Fort Sam Houston conducted target practice and field training at Camp Bullis. The reservation was used by Regular Army, Reserve, National Guard, and civilian groups for training. The current installation includes most of the land formerly designated as the Leon Springs Military Reservation.

On 24 February 1995, an assessment team arrived at Camp Bullis to investigate and identify reports of possible chemical agent identification sets (CAIS). These sets, along with filter-type canisters, were unearthed during an intrusive investigation of a former landfill. The area investigated is heavily weeded and rock-covered, and will require extensive bush/tree removal as future intrusive investigations/remediations are performed.

LOCALITY/STATE: San Antonio, Texas

SCOPE OF RESTORATION EFFORT: Camp Bullis could well have been the site of training or testing involving the use of limited quantities of chemical agents or munitions. There is evidence of limited quantities of pre-World War II chemical ordnance having been recovered on post. Any such items remaining today would not include nerve agents, but mustard or phosgene are possibilities.

EFFORT TO DATE: The installation will initiate a requirements document for assessing the site.

REMEDIATION SCHEDULE: This effort will be integrated into the remedial program at the appropriate time.

RISK PERCEPTION: There has never been any documented release of chemical agent that posed a threat to public health. Any significant excavation on the installation, however, should be accompanied by appropriate precautions.

NAME OF LOCATION: Camp Stanley Storage Activity

LOCALITY/STATE: San Antonio, Texas

SCOPE OF RESTORATION EFFORT: Camp Funston was redesignated Camp Stanley in 1917. Camp Stanley was used for troop training and the first officers training camp. Large stocks of ammunition were first stored at Camp Stanley in 1920 under the jurisdiction of the Eighth Corp Area. Jurisdiction of Camp Stanley was transferred to the Chief of Ordnance in 1933 and became a part of the San Antonio Arsenal. During World War II, Camp Stanley was involved in the storage and issue of ammunition and storage of general supplies. Camp Stanley was transferred to Red River Arsenal in 1949 with a mission of reconditioning, renovation, and demilitarization of ammunition, ammunition components, and explosives. Camp Stanley was redesignated Camp Stanley Storage Activity in 1954 with a primary mission of small arms ammunition storage, which continues to the present day. Records indicate that mustard-filled munitions were buried on the installation in July 1942. Three 155mm mustard rounds were recovered, decontaminated, and destroyed in May 1958. Supporting documentation is on file at Camp Stanley.

EFFORT TO DATE: Environmental assessment of the installation is presently under way to provide a baseline for present and future environmental actions addressing conventional hazardous wastes. Present environmental projects include removal of 18 underground storage tanks, assessment of a contaminated water well, and the closure of a hazardous waste storage area. Current environmental efforts are being funded with Defense Business Operating Funds.

REMEDIATION SCHEDULE: No further chemical agent remediation work is currently planned.

RISK PERCEPTION: There have been no documented or suspected releases of chemical agent or associated public health threats from Camp Stanley.

NAME OF LOCATION: Camp Barkeley

LOCALITY/STATE: Abilene, Taylor County, Texas

FUDS ACTIVITIES AT THIS LOCATION: Camp Barkeley is located in west central Texas, Taylor County, 12 miles southwest of Abilene. Camp Barkeley, one of the largest installations in Texas, was activated in 1941 and consisted of approximately 77,000 acres, It was used as a training and infantry base during World War II.

As an Army training camp and division training center, Camp Barkeley had a very active artillery range. Artillery used consisted of rockets, grenades, and mortars. The impact area was located in a triangular tract of land east of Highway 158. This area also had a moving target for personnel to practice. Additionally, personnel were constantly being trained at the camp in the use of small arms and grenades. Pit areas were built at the camp for grenade training and igloos were built for munitions storage.

The presence of chemical warfare materiel (CWM) for training purposes was mentioned in numerous documents found at regional and national archives. Chemical items used included limited quantities of mustard, smoke grenades, smoke pots, Chloroacetophenone (CN) grenades, CN candles, and chemical shells. Training manuals show that chemical training was given in classrooms and field locations. This training included the use of tear gas and gas chambers. Decontamination procedures were also conducted at the camp.

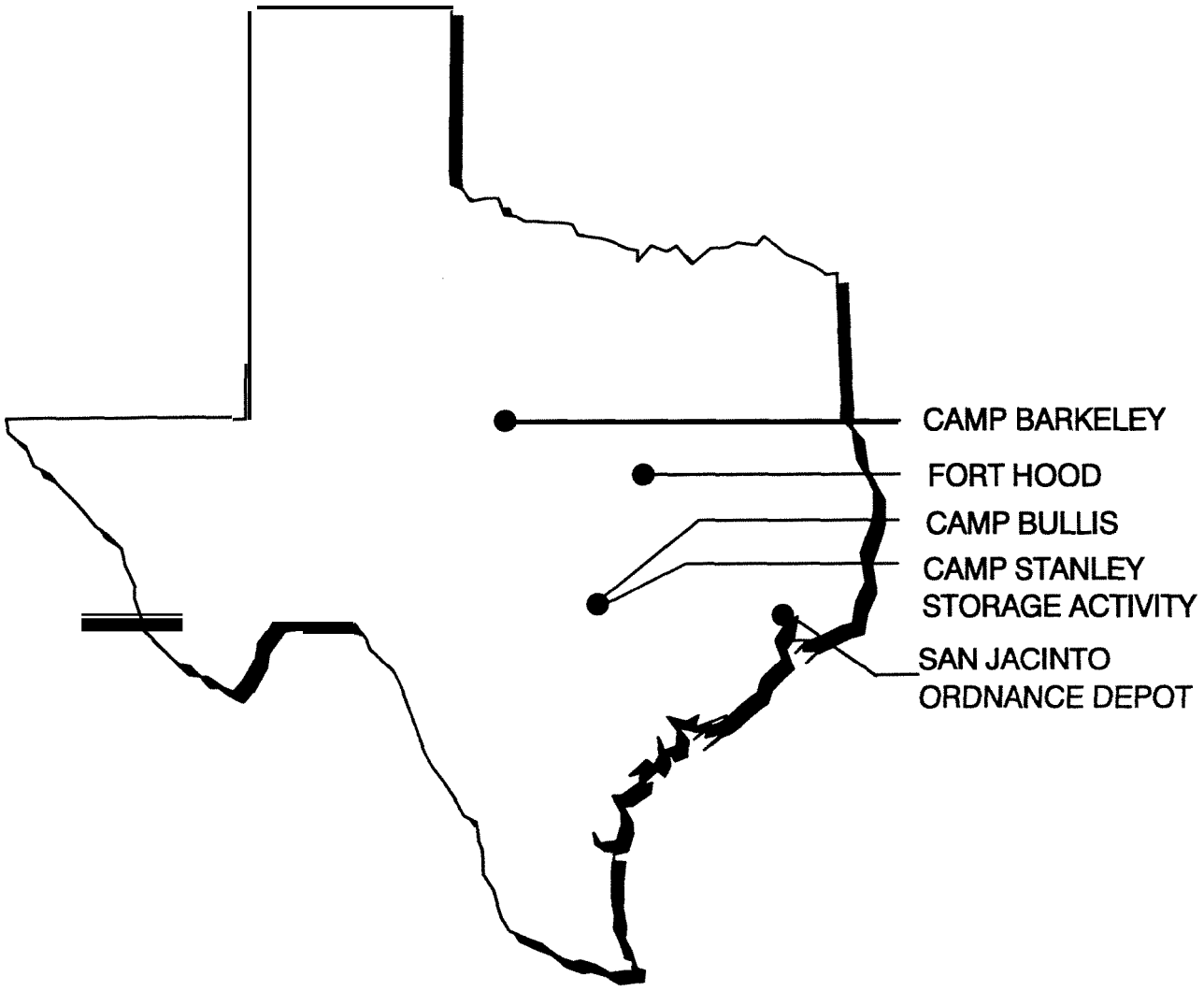
At the end of World War II, the land was sold. Several different sweeps were made of the area and the camp was certified as decontaminated. The decontamination reports specifically mention the clearing of munitions from the grenade area, the inspection of the storage igloos, and the number and kinds of duds found.

PREVIOUS CORPS ACTIVITIES: The Ft. Worth District Corps of Engineers performed a Defense Environmental Restoration Program Site Survey Report from November 1984 to January 1985. An Archives Search Report for this site was prepared by the U.S. Army Corps of Engineers, St. Louis District, in September 1993.

ACTIONS PLANNED FOR THE FUTURE: No further actions required.

RISK PERCEPTION: The site is currently used for grazing cattle and agriculture purposes. A portion of the former installation is used as a Texas National Guard training site. No indication of chemical contamination was found or observed during the site inspection. Based on documents and interviews, it is known that limited quantities of CWM containing mustard were used in training exercises. Specific areas in which this training took place were not located. Likewise, no maps or drawings were found to pinpoint the location of the gas chamber and/or CWM storage facility which is assumed to have been present on the site. No threat to human health and safety is currently known to exist.

TEXAS


CAMP BARKELEY
FORT HOOD
CAMP BULLIS
CAMP STANLEY
STORAGE ACTIVITY
SAN JACINTO
ORDNANCE DEPOT

LOCATION	San Jacinto Ordnance Depot
LOCALITY	Houston
STATE	TX
SITE	Unknown
DESCRIPTION	From July 6 through 24, 1946, three leaking bombs buried along eastern banks of Houston Ship Canal, 1/2 mile from depot docks. Additional phosgene bomb sunk in canal 1 mile below depot docks.
SIZE	Unspecified
CONTENTS	Residue from burial of two 500-pound phosgene bombs; one 500-pound mustard bomb. Area marked with signs.
COMMENTS	Some bombs recovered and detonated. Shattered bomb casings reburied at depth of 7 feet. According to the recommendations and conclusions of the July 1991 Archives Search Report, the disposal of chemical bombs in the east bank of the Houston ship canal was conducted in a manner to expedite decomposition of the bombs'agent fill. The report recommends no further action be taken at this site.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

LOCATION	Fort Hood
LOCALITY	Killeen
STATE	TX
SITE	Unknown
DESCRIPTION	Chemical warfare training area established in 1943 was located in southwest edge of the range (known as the mustard gas area). Second area established on the installation's southern border 1945.
SIZE	Unknown
CONTENTS	No direct evidence of burials cited. Use of riot control (CN) cited.
COMMENTS	No information on training method. Source cites training on decontamination procedures. Also states no chemical agents manufactured. In February 1944, a survey was conducted in the two Fort Hood former World War II-era chemical warfare training areas by representatives of Pine Bluff Arsenal to determine the likelihood of chemical agent contamination. Soil, water, and vegetation samples tested at Pine Bluff Arsenal Quality Assurance Laboratory, in accordance with established Environmental Protection Agency protocols, and historical research failed to substantiate the presence or likelihood of contamination at the two training sites.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

LOCATION	Camp Bulk
LOCALITY	San Antonio
STATE	TX
SITE	Area 3, 6. and 7
DESCRIPTION	United States Air Force Explosive Ordnance Disposal team recovered United States and foreign (French and United Kingdom) chemical rounds during sweeps from September to November 1976. Recovered 4.2-inch M-2 mortar rounds containing CN, WP, and CG, and 75-millimeter rounds containing WP, chloropicrin, and possibly mustard gas.
SIZE	Unknown
CONTENTS	4.2-inch and Stokes mortars; empty containers of mustard, CS, and CN.
COMMENTS	Reportedly used for chemical weapons training until approximately 1964. Based on unexploded ordnance sweeps, potential for Phosgene, mustard, PS, CS, and CN rounds.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	1 - Known burial

LOCATION	Camp Bullis
LOCALITY	San Antonio
STATE	TX
SITE	Landfill Site #8
DESCRIPTION	Chemical agent identification sets have been unearthed at several locations within the landfill. Along with the chemical agent identification sets, 13 empty pigs and filter type canisters were discovered. The recovered bottles were marked CN, HS, CG, DM, and PS.
SIZE	9.2 acres (estimated)
CONTENTS	Chemical agent identification sets, pigs, and filter type canisters.
COMMENTS	The landfill has been closed for many years and now is used as a training site for medical services personnel.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	1 - Known burial

LOCATION	Camp Stanley Storage Activity
LOCALITY	San Antonio
STATE	TX
SITE	Unknown
DESCRIPTION	Records indicate that mustard-filled munitions were buried on the installation. Three 155-millimeter H-filled shells were recovered, decontaminated, and destroyed.
SIZE	Unknown
CONTENTS	Mustard filled munitions.
COMMENTS	Potential for other burials exists.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Camp Barkeley
LOCALITY	Abilene
STATE	TX
SITE	Area marked with four "GAS-DANGER" signs
DESCRIPTION	Sniff sets (containing mustard, lewisite, chloropicrin, and tear gas) and chemical agent identification sets were used in field exercises. Facilities included a detonation area for field identification of chemical agents and a decontamination area. Cans, smoke pots, etc., were put into a round open trash pit.
SIZE	Unknown
CONTENTS	Chemical agent identification sets
COMMENTS	None
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	5 - No further action

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UTAH

NAME OF LOCATION: Dugway Proving Ground

Dugway Proving Ground (DPG) is located near Dugway, Utah, and covers an area of 802,387 acres. The terrain includes mountains and valleys and a large, flat, sparsely-vegetated area that reaches westward into the southern portions of the barren salt flats of the Great Salt Lake Desert.

After the bombing of Pearl Harbor in 1941, the CWS saw a need to expand its testing facilities. President Franklin D. Roosevelt signed an executive order on 6 February 1942 that withdrew 126,765 acres of secluded land with scarce wildlife population from public domain. This land was located north of the Dugway mountains and on 12 February 1942 was officially established as the present DPG site. The U.S. Army Corps of Engineers initiated construction immediately and DPG was officially activated on 1 March 1942. DPG was allocated an additional 141,729 acres in April 1942 and commenced testing of military weapons that summer under the Technical Division of the Chemical Corps.

The following sequence of events portrays the development of DPG as a major Test and Evaluation Command (TECOM) component:

1946: DPG and Desert Chemical Warfare were placed under one command (General Order No. 10) and redesignated Dugway Desert Command.

1947: DPG was placed on inactive status.

1950: DPG was reactivated as an Industrial Installation under the Chief of Chemical Corps.

1962: General Order No. 46 placed DPG under TECOM.

Nineteen ranges have been identified at DPG. These range areas have been the focus of many chemical test operations. Thousands of munitions containing mustard were tested during the period of 1942 through 1945 and from 1952 through 1956. Twelve thousand field tests employing 47,900 munitions or dissemination devices with nerve agents GA, GB, and VX were conducted from 1945 to 1968.

One special project conducted at DPG was Project Sphinx. Project Sphinx was a program designed to determine the best chemical warfare materiel (either available or under development) for penetrating Japanese caves and underground fortifications, as well as the best and most effective means of deployment. A large number of tests were conducted with persistent and non-persistent agents. These tests were conducted at DPG; Bushnell, Florida; San Jose Island, Panama; and certain United Kingdom experimental stations.

To support these tests, Project Sphinx was carried out at DPG, employing toxic agents (CG, CK, AC, and mustard) in addition to a variety of smoke and incendiary materials.

Targets selected for the conduct of tests were:

- Camel's Back Cave No. 2, located on Camel's Back Ridge on the Dugway Reservation.
- River Bed Target, located in the Rising Sun Grid at Dugway.
- Great Western and Old Ironsides mines, a horizontal tunnel approximately 175 feet long located outside the military reservation in the Dugway Mountains.
- Yellow Jacket Mine Area, consisting of ten mine shafts and tunnels located outside the military reservation in the Dugway Mountain Range.

Large amounts of chemical weapons were used in these tests, including bombs, mortar and artillery shells, rockets, and air-dropable light case tanks.

LOCALITY/STATE: DPG is situated 56 miles due west of Provo at the southern tip of Skull Valley.

SCOPE OF RESTORATION EFFORTS: DPG is a Government owned and operated installation that has been in operation since 1942 as a chemical, biological, and conventional weapons test facility. Biological weapons testing ceased at DPG in 1969 and the biological research program has since allowed only defensive testing. An initial installation assessment completed in April 1979 concluded that there was not a potential for offpost migration of hazardous chemicals at DPG, although there is still a potential for discovery of chemical munition items.

Restoration efforts at DPG are being conducted to fulfill the requirements of a Consent Order issued by the State of Utah on 13 September 1990, and corrective action provisions associated with the draft Part B RCRA Permit application submitted in December 1992.

The 13 September 1990 Consent Order requires the investigation and development of closure plans for 45 SWMUs, four of which have since been deleted.

The Part B RCRA Application process requires the state to conduct a RCRA Facility Assessment (RFA). Findings from the RFA indicated that 128 SWMUs and 21 areas of concern exist. Records indicate that there are several chemical munition burial sites in some of the 21 areas and also perhaps in some of the SWMUs. All the sites identified require that a RFI be conducted.

EFFORT TO DATE: A RI/FS is currently underway for the Consent Order SWMUs. The studies being conducted are Nature and Extent Investigations (NEIs). Thirty sites have been investigated. CWM and agent breakdown products have been identified.

All other onpost sites not included in the Consent Order are being investigated under the RFI. The RFI will only investigate the Rising Sun Grid (River Bed Target). The Yellow Jacket, Old Ironsides, Great Western Mines, and Southern Triangle are located off DPG property and are considered FUDS. The RFI Phase I confirmatory sampling began on 10 November 1992 and is scheduled to conclude in approximately one year. The NEIs will begin upon conclusion of the confirmatory sampling portion of the RFI and are estimated to last 18 months. DPG has removed one liquid-filled IOOO-pound bomb and two explosive bursters from the Yellow Jacket area in recent years.

REMEDIATION SCHEDULE: The investigation is on-going and any required remediation work involving chemical agent or munitions will be integrated into the IRP.

RISK PERCEPTION: The Yellow Jacket area, Old Ironsides, Great Western, and Southern Triangle have never been cleared. The area adjacent to Yellow Jacket was used as a high-explosive test range during the World War II time period. The potential risk from these sites is unknown until they are characterized and cleared. On the installation, access to potential residual contamination sites is restricted.

NAME OF LOCATION: **Dugway Proving Ground (Sheep Burial Site)**

LOCALITY/STATE: Dugway, Tooele, Utah

FUDS ACTIVITIES AT THIS LOCATION: In 1968, a large number of sheep were killed in Utah, allegedly by ingesting nerve agent VX. The sheep were buried in a landfill approximately 200 feet long located near White Rock Mountain in Tooele County, Utah. The landfill is approximately 0.5 mile off the Northeast boundary of DPG. The site consists of two parallel trenches, with an additional five trenches on the Skull Valley Indian reservation and one pit in Skull Valley (Hatch ranch) that also contain sheep from the same incident.

PREVIOUS CORPS ACTIVITY: None

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: There are no known excavations on or near the site at this time.

RISK PERCEPTION: There is no scientific reason to suggest that any VX remains at the site or with the sheep remains, if it was present in the first place. This area is not believed to present an immediate threat to human health and safety.

NAME OF LOCATION: **Dugway Proving Ground (South Triangle and Yellow Jacket Ranges)**

LOCALITY/STATE: Dugway, Tooele, Utah

FUDS ACTIVITIES AT THIS LOCATION: The Southern Triangle consists of 16,000 acres used as an artillery range from the 1940s through 1960s for chemical and conventional munitions. Yellow Jacket Grid (different from Yellow Jacket Mine Area) consists of 11,000 acres used for testing chemical agent, mortars, rockets, and bombs during the 1940s and 1950s. Both ranges border the DPG.

These are open ranges, portions of which are currently managed by the BLM or owned by the State of Utah and a private property owner. Available records indicate that the state and private property may be contaminated.

PREVIOUS CORPS ACTIVITY: A planned site visit was deemed not feasible until further archival investigation is conducted to discover the locations of the impact areas within both ranges.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: There are known excavations from ongoing mining activities on the Yellow Jacket site. There have been reports of motorcycles and 4-wheel drive vehicles using the ranges.

RISK PERCEPTION: There is risk associated with both of these sites; however, due to the remoteness of the area, it is not believed to present any immediate threat to human health and safety.

NAME OF LOCATION: **Tooele Army Depot-South Area**

Tooele Army Depot-South Area (TEAD-S) was originally established as a CWS depot under the control of the Office of the Chief of Chemical Warfare Service. The site for the depot was located near St. John, Utah, and was acquired in February 1942. Initial construction was completed in 1943. The initial name of the depot was St. John Chemical Warfare Ammunition Storage Depot, Utah. The name was later changed to Desert Chemical Warfare Depot. In May 1955, the depot was redesignated the Desert Depot Activity and placed under the command of TEAD. It then became known as the South Area. The South Area occupies 19,634 acres in Rush Valley, Tooele County.

TEAD's current mission is to operate a supply depot for the receipt, storage, issue, maintenance, and disposal of stored materiel. The TEAD-S serves as the chemical weapons storage area for the depot. These weapons are part of the Chemical Weapons Stockpile.

LOCALITY/STATE: TEAD-S is located approximately 52 miles southwest of Salt Lake City, Utah in Tooele County. The area surrounding the installation is primarily used for cattle and sheep grazing.

SCOPE OF RESTORATION EFFORT: The TEAD-S Installation Restoration Program is designed to investigate 29 SWMUs in a phased approach under a Corrective Action Permit issued by the State of Utah. Several RFIs are underway. These studies were initiated in 1978 and have been ongoing since.

EFFORT TO DATE: Seven of the 27 suspected release SWMUs were likely used for either the storage or disposal of non-stockpile chemical materiel. All of these sites have been tested for agents and agent breakdown products. SWMU 1 is a known chemical agent materiel disposal location containing many burial pits, and SWMU 25 is also suspected to contain many pits. Groundwater at SWMUs 1 and 25 contain very low levels of heavy metals, semi-volatile organics, explosives, and agent breakdown products. Generally, soil is contaminated with the same types of chemicals at SWMUs 1, 2, 3, 4, 5, 9, and 25. Several CAIS test tubes containing mustard have been recovered from SWMU 1 near a trench that was presumably used to train installation employees. No off-post migration of chemical agents has been found.

REMEDIATION SCHEDULE: All field work associated with the Phase II RFIs (known release SWMUs and the groups of suspected release SWMUs) was completed by 1994.

RISK PERCEPTION: A comprehensive and systematic restoration program has been underway for some time. Access to suspect areas is restricted and there is no credible threat to public health from chemical agent contamination releases. As a chemical

agent stockpile storage site, TEAD-S has an active and thorough monitoring and detection program in place, as well as a trained emergency response force.

NAME OF LOCATION: **Defense Depot Ogden**

The Utah General Depot, officially activated on 15 September 1941 and later renamed Defense Depot Ogden, is located on the original right-of-way of the Central Pacific Railroad. The site is located on 1,139 acres of land in an irregular elongated area, 4,000 yards long in the north-south direction and 2,178 yards wide in the east-west direction.

The installation site was purchased in September 1940. It was renamed Defense Depot Ogden on 1 January 1965 and became part of the Defense Supply Agency.

LOCALITY/STATE: Ogden, Utah

WORK PLAN STATUS: NPL Installation.

SCOPE OF RESTORATION EFFORT: During 1942 to 1946, over one million pounds of mustard agent in one-ton containers were stored at the depot. These agent-filled containers were moved to DPG, Utah, in late 1946. CAIS were also stored at the depot.

Mustard and phosgene were buried in Burial Site 3 along with components of CAIS. The CAIS vials of agent were broken and placed in several pits, treated with chlorinated lime, and buried. The pits are described as being about 6-1/2 feet deep.

In 1985, a survey of aerial photographs was used to delineate waste disposal areas, and a geophysical investigation using magnetic imaging was conducted to confirm the presence of buried objects.

In 1988, US. Army TEU excavated 24 test pits to investigate the areas considered suspect. All chemical warfare agents and chemical surety materiel recovered were removed and shipped to Tooele Army Depot (TEAD) for disposal.

In November 1989, another geophysical survey was conducted using magnetic, ground-penetrating radar, and electromagnetic induction, which delineated several possible burial trenches around and inside the Burial Site 3 area. Additional site characterization activities were conducted during 1990.

EFFORT TO DATE: One hundred and ten intact vials of chemical warfare agents and chemical surety materiel were recovered and removed in 1988. M9A2 chemical agent detection kits, components of M-l Gas Identification Instructional Sets (K955), M-l Toxic Gas Sets (K941), and M-l Gas Identification Detonation Set (9511952) were identified.

Soil contamination results follow.

Soil Contamination	High Level	Cleanup Level
Arsenic	559 mg/kg	35 mg/kg
Mercury	9.8 mg/kg	2 mg/kg
Adamsite	134 mg/kg	
Chloroacetophenone	2.9 mg/kg	
Mustard	5000 mg/kg	
Thiodiglycol	120 mg/kg	

During the fall of 1993, excavation of the Water Purification Tablet Area of Operable Unit #3 was performed. The excavation consisted of the disposal of 591 tons of soil and debris, In April 1994, a magnetometer survey was completed and three additional anomalies were located. These anomalies will be included in the remediation of Operable Unit #3. In September 1994, TEU mobilized onsite and began final cleanup at Operable Unit #3.

TEU excavated and sifted approximately 1,300 cubic yards of soil and debris. Seventeen vials of chemical warfare agent and chemical surety materiel were recovered and removed in 1995. All items were transported to TEAD.

REMEDIATION SCHEDULE: A RI/FS of operable unit #3 was completed 6 December 1991. The proposed remediation plan was submitted 4 March 1992 and the ROD was signed 28 September 1992. Remedial actions began at Operable Unit #3, as described above, in the fall of 1994. Early winter weather conditions caused the cleanup at Operable Unit #3 to be halted in mid-November. Cleanup resumed in the spring of 1995 and was successfully remediated in accordance with the Remedial Design Documents in July 1995. Each burial area has subsequently been backfilled with clean fill.

RISK PERCEPTION: All contaminated groundwater above health standards remains on depot property. The soil contamination (arsenic) could pose chronic health risk in the future. Intact vials of chemical agents could cause an acutely toxic dermal or inhalation risk if encountered. Because the contaminated sites are under Government control, the threat to human health an safety is considered minimal. Any ground-intrusive actions in the area will be done under strict safety guidelines.

NAME OF LOCATION: Wendover Bombing and Gunnery Range

LOCALITY/STATE: Wendover, Tooele, Utah

FUDS ACTIVITIES AT THIS LOCATION: An article in the Philadelphia Inquirer, 9 November 1969, referred to the usage of Western Utah, Wendover Bombing and Gunnery Range (over 1 million acres of Federal Reserve), and Bonneville Salt Flats for work on new chemical munitions and samplers on grids checking the effectiveness of aerial tests of nerve gas or stimulants by Dugway Proving Ground. Most of the Wendover Bombing and Gunnery Range is presently on the active Utah Training and Testing Range.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: The area is remote and there is a lack of information at this time concerning the presence of chemical warfare materiel (CWM). A site visit was completed as part of the archives search.

RISK PERCEPTION: Considering the remoteness of the site and the lack of information concerning the presence of CWM, this area is not believed to present an immediate threat to human health and safety. Further investigation is required for confirmation.

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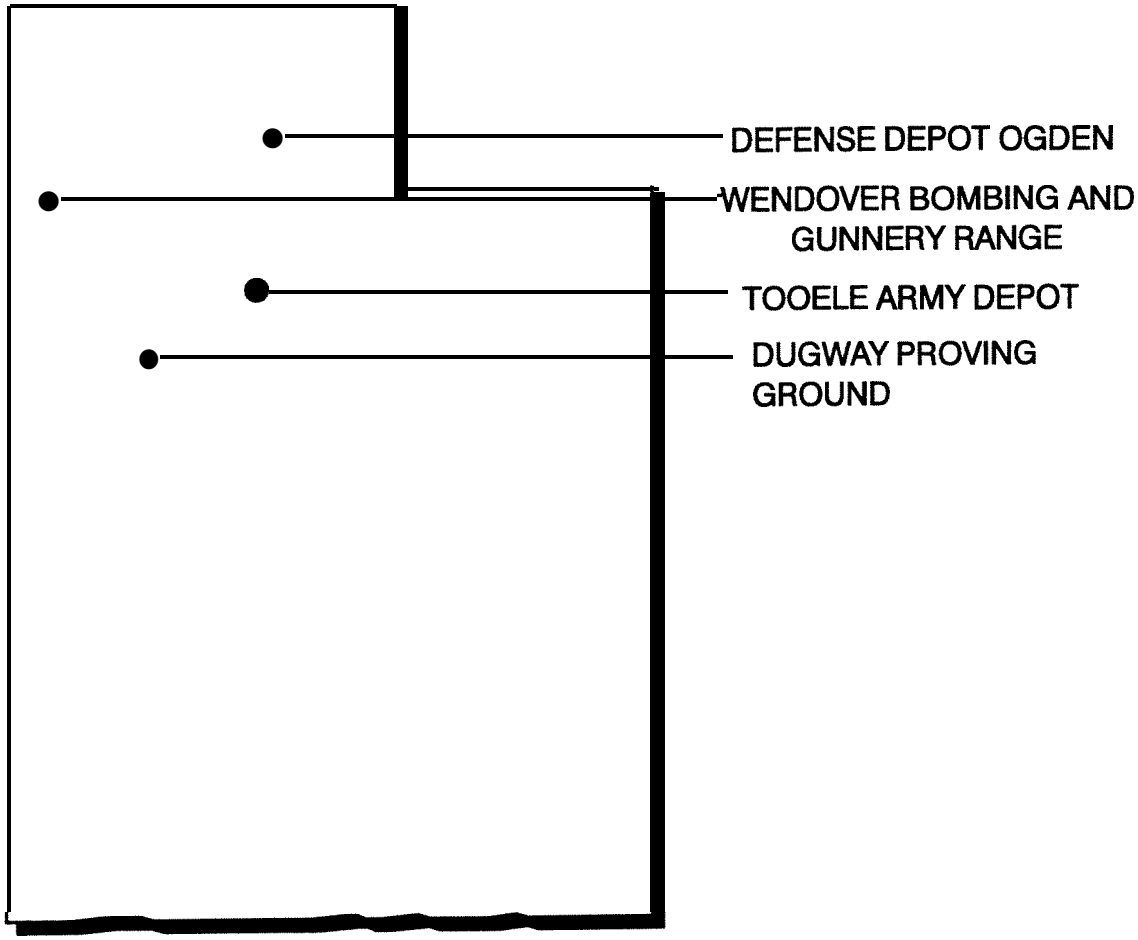
DEFENSE DEPOT OGDEN
WENDOVER BOMBING AND GUNNERY RANGE
TOOELE ARMY DEPOT
DUGWAY PROVING GROUND

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Area 19
DESCRIPTION	Destroyed chemical munitions by explosive caustic immersion methods. During 1960s, disposed of 500 items such as artillery projectiles and bomblets containing chemical agents.
SIZE	Unknown
CONTENTS	Unknown. May be residual contamination.
COMMENTS	Chemical and high-explosive munitions suspected.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Base Pond
DESCRIPTION	Disposal site located at Base Pond and Highway 101. Classified items were disposed of at this site. This site is in the Downwind and Dense Array Grid area.
SIZE	Unknown
CONTENTS	Classified items. It is not known if the items were contaminated with agents.
COMMENTS	Disposal occurred in the 1950s. Also characterized as SWMU-DPG-23.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Disposal Area
DESCRIPTION	Southeast boundary. This disposal area is located south of Little Davis Mountain. Items disposed of at this site date back to 1940s and include drums of various agents from the Deseret Laboratones.
SIZE	Unknown
CONTENTS	Drums of mustard nerve agents (GB) and foreign chemical munitions (live).
COMMENTS	Area has been covered. Suspected unexploded ordnance. Characterized as SWMU-DPG-57. Radioactive wastes removed from site in approximately 1986.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Drainfield
DESCRIPTION	Wastewater drainfield. Drainfield is destroyed. Agents were possibly discharged into drain. Used in 1940 to 1950. Uncovered in 1986.
SIZE	Unknown
CONTENTS	Agents not specified.
COMMENTS	Also characterized as SWMU-DPG-97.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	East Carr Old Range
DESCRIPTION	Area contains an unknown number of sites. Items disposed of from the Old Range include fused bombs, shells, and rounds containing nerve agents (GB, GD, VX) and scrap metal from range cleanup.
SIZE	Unknown
CONTENTS	Agent decontaminant residues, nerve agents (GB, GD, VX), and scrap metal.
COMMENTS	Burial site containing bombs, shells, and rounds. Partial backfill. Dates back to 1960s and 1970s. Also characterized as SWMU-DPG-54.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	East Carr
DESCRIPTION	Located near Building 3150 on east side of Carr facility. Wastes burned at this site include nerve agents (GA, GB, GD, VX) in drums, bombs, chemical-filled rounds, and laboratory vials.
SIZE	Unknown
CONTENTS	Nerve agents (GA, GB, GD, VX) disposed of in drums, fuzed bombs, and lab vials.
COMMENTS	Burial site. Dates back to 1940s and 1950s. Later back-filled. Site characterized as SWMU-DPG-52.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Landfill
DESCRIPTION	Abandoned landfill southwest of Carr facility. Possible agent residues from testing programs. Abandoned early 1960s.
SIZE	Unknown
CONTENTS	Possible residue from burning of chemical items.
COMMENTS	Burial site. Possible agent residues. Also characterized as SWMU-DPG-105.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	North Camel Back Ridge
DESCRIPTION	North Camel Back Ridge. Disposal of contaminated munitions and wastes. Dates back to the 1940s. Backfilled in 1978.
SIZE	2 acres
CONTENTS	Contaminated munitions; agent types unknown. Some CS contamination noted
COMMENTS	Hazardous material buried in 1940s. Also characterized as SWMU-DPG-21. Unexploded ordnance likely.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Rocket Pit
DESCRIPTION	Area within West Granite Peak. Six of the 61 disposal pits closed in 1975 and were certified agent-free. Decontamination exercise in 1977 of 20 nerve agent (GB) evaporated tanks in an area 1.5 miles from pits.
SIZE	Unknown
CONTENTS	Unknown. Some residual contamination suspected.
COMMENTS	Area also known as the M-55 Nerve (GB) Rocket Pit.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	South Tower Grid
DESCRIPTION	South Tower Grid. From 1950 to 1977, nerve agents (GA, GB) and mustard items were disposed of on surface and by burial. Caustic immersion was used to decontaminate these items before burial.
SIZE	Unknown
CONTENTS	Nerve agent (GA, GB) and mustard were disposed of in this area.
COMMENTS	Site also characterized as SWMU-DPG-17. Site presently used for open burning-open detonation. Possible residues or degradation exists.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Target Q
DESCRIPTION	Disposal area was used to dispose of German World War II agents. West of Granite Peak near Mica Road.
SIZE	Unknown
CONTENTS	The German chemical agents are not defined. Source cites nerve agent (GA) bombs.
COMMENTS	The exact location of this site is unknown. Also characterized as SWMU-DPG-I 0.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Test Area
DESCRIPTION	Ballistic Grid. This disposal site is located in the test area at the intersection of Downwind Westroad and Juliet Road. Disposal area trench for miscellaneous cleanup debris including M-55 rocket casings.
SIZE	30 by 75 by 10 feet
CONTENTS	Possible nerve agent contamination.
COMMENTS	Hazardous potential is unknown. Cleanup operations were conducted in 1960s and 1970s.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Test Site
DESCRIPTION	Abandoned test site. Contains contaminated test debris and underground storage tanks Contains possible chemical agents and other contaminants. Active in 1950s. Characterized as SWMU-DPG-I 14.
SIZE	Unknown
CONTENTS	Possible agent residues may be present. Specific types unknown.
COMMENTS	None
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Dugway Proving Ground
LOCALSTY	Dugway
STATE	UT
SITE	Unknown
DESCRIPTION	Storage near Carr Facility. Source cites contaminated soil, mustard agent located during excavation for a new facility in July 1986.
SIZE	800 by 800 feet
CONTENTS	Mustard-contaminated soil.
COMMENTS	Burial was pre-1980. Discovered in this area in July 1986. Also characterized as SWMU-DPG-61.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Unknown
DESCRIPTION	Disposal area near north Cedar Mountain. Area is reportedly used for the disposal of carcasses contaminated with nerve agent used in 1960s.
SIZE	Unknown
CONTENTS	Contaminated with nerve agent VX.
COMMENTS	Site may be outside the installation boundry. Also characterized as SWMU-DPG-67.
T Y P E	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Unknown
DESCRIPTION	Disposal area west of the Ditto area. Nerve agents (GA, GB, VX) and mustard were decontaminated. Activated in 1943; backfilled and abandoned in 1985.
SIZE	5 acres
CONTENTS	Nerve (GA, GB, VX) and mustard agents.
COMMENTS	Area was backfilled in 1985. Also characterized as SWMU-DPG-37.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	V-Grid
DESCRIPTION	This disposal area contains buried waste from nerve (VX) agent Test Grid Area. This disposal site is within the V-Grid test range. Timeframe: 1940 to 1960.
SIZE	Unknown
CONTENTS	VX-contaminated trucks and test material.
COMMENTS	Potential hazardous material may still be present at this location. Characterized as SWMU-DPG-5.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Waste Pit
DESCRIPTION	Radioactive waste pit. Primarily tritium and carbon-14 and possibly other waste residue Used for testing chemical and biological agents. Dates from 1950 through 1977.
SIZE	Unknown
CONTENTS	Tritium and carbon- 14 radioactive waste residue. Chemical and biological agents.
COMMENTS	Waste burial site. No mention of decontamination. Characterized as SWMU-DPG-12.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Area 15
DESCRIPTION	Also known as Tower Grid Area. Used to determine munition efficiency and area coverage of artillery shells, bomblets, land mines, and test devices that disseminated chemical agents and simulants.
SIZE	494 acres
CONTENTS	Nerve (GB) and mustard agent contamination suspected.
COMMENTS	Unknown quantities of nerve (GB) and mustard agent were tested here.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Area 16
DESCRIPTION	Used in 1950s for testing munitions and subsequent effectiveness against hilltop fortification complex.
SIZE	Unknown
CONTENTS	Mustard
COMMENTS	Surface unexploded ordnance cleared. Subsurface unexploded ordnance suspected.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Area 17
DESCRIPTION	Used in World War II for testing chemical mustard and incendiary munitions. Approximately 5,000 rounds fired.
SIZE	Unknown
CONTENTS	Mustard-filled rounds.
COMMENTS	Surface unexploded ordnance cleared. Subsurface unexploded ordnance suspected.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Area 18
DESCRIPTION	Used as high-explosive and illuminating impact area. Used in 1940s as a chemical munition impact area. Mortar projectiles fired during late 1950s and 1960s.
SIZE	Unknown
CONTENTS	Suspected mustard.
COMMENTS	Many mortar bodies exist on ground surface.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	1 - Known burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Area 5
DESCRIPTION	Chemical, biological, and radiological target area. Used in firing demonstrations including 155-millimeter rounds and M-55 rockets. Sixty-five hundred rounds were fired as part of chemical weapons orientation course conducted from 1959 to 1969.
SIZE	Unknown
CONTENTS	155-millimeter nerve agent (GB) filled munitions.
COMMENTS	Cleared surface unexploded ordnance. Possible subsurface unexploded ordnance
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Area 6
DESCRIPTION	Chemical Corps Board Area. Used to test effectiveness of chemical munitions against protection afforded by bunkers and foxholes in 1950s to 1960s. Approximately 200 chemical-filled mines and projectiles tested.
SIZE	Unknown
CONTENTS	Nerve agent (GB) and mustard-filled land mines and projectiles.
COMMENTS	Cleared surface unexploded ordnance. Possible subsurface unexploded ordnance.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Area 8
DESCRIPTION	V-Grid. Tests with artillery projectiles, landmines, vehicle spray systems, drone rockets and other dissemination devices conducted during 1950s and 1960s. Approximately 1,000 field tests.
SIZE	Unknown
CONTENTS	Artillery projectiles, land mines, drones, and rockets with nerve agent VX.
COMMENTS	None
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Area 9
DESCRIPTION	Also known as Target X area. 8-inch mustard-filled projectiles were tested from 1954 to 1955.
SIZE	Unknown
CONTENTS	Mustard-filled projectiles.
COMMENTS	Five hundred projectiles, rockets, and explosive devices have been removed. Subsurface unexploded ordnance suspected.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	1 - Known burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Impact Area
DESCRIPTION	South of Wig Mountain. Abandoned and disgarded oil tanks. Located in the vicinity of the former chemical test area and in Wig Mountain.
SIZE	Unknown
CONTENTS	Miscellaneous fuel oil tanks present. May contain munitions from impact area.
COMMENTS	Used from 1968 to present. Also characterized as SWMU-DPG-30.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Old Range
DESCRIPTION	Partially buried landfill in Old Range 1 mile east of Carr. Dates back to early 1960s. Possible chemical munitions disposal site.
SIZE	Unknown
CONTENTS	Unknown. Area detonated in August 1966 to remove surface explosives.
COMMENTS	Test burial site. Items or chemical agents unknown. Also characterized as SWMU-DPG-I 06.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Range 1
DESCRIPTION	Ballistic Grid Romeo and Juliet German Village 1951 to 1968 dissemination ballistic firings, ballistic drops, and engineering and development testing of chemical-filled 4.2-inch mortar. 105-millimeter, 155-millimeter, 8-inch projectiles, and 115-millimeter rocket.
SIZE	Unknown
CONTENTS	Chemical-filled rounds: 4.2-inch mortar, 105-millimeter, 155-millimeter, 8-inch projectiles, and 115-millimeter rockets.
COMMENTS	Surface cleared of unexploded ordnance; subsurface unexploded ordnance suspected.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity. explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	**Range 2**
DESCRIPTION	Rising Sun Grid, Area 2. Used in World War II and from 1950 to 1967. Tunnel complex constructed and rockets, artillery, projectiles, bombs, and bulk containers of nerve (GB) and mustard were used.
SIZE	Unknown
CONTENTS	Nerve (GB) and mustard agent residues.
COMMENTS	Surface unexploded ordnance removed. Range referred to as Southern Triangle, which contains private and Utah Bureau of Land Management land.
TYPE	**Range**
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Range 3
DESCRIPTION	Also known as Granite Peak Impact Area. Extensive firings of artillery projectiles, mortars, and rockets were conducted circa late-l 950s to early-l 960s.
SIZE	Unknown
CONTENTS	Nerve (GB) and mustard agent residue
COMMENTS	Ten thousand rounds fired during reliability tests. Surface unexploded ordnance removed. Subsurface unexploded ordnance suspected.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Range 4
DESCRIPTION	Also known as All Purpose Grid Facility. Used in 1940s to test chemical-filled explosives and loaded munitions including 1 ,000-pound cluster bombs. Five hundred test operations conducted in this area.
SIZE	984 square feet
CONTENTS	Nerve (GB) agent residue.
COMMENTS	Clear of surface unexploded ordnance. Subsurface unexploded ordnance suspected.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Target Q
DESCRIPTION	Waste burial site located southwest of Granite Peak. Contains test residue from World War II and German chemical agent bombs. Used during the 1940s and 1950s. Area has been backfilled.
SIZE	Unknown
CONTENTS	Possible nerve agent (GB) and mustard contamination.
COMMENTS	Exact method of burial unknown. Also characterized as SWMU-DPG-10.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Test Area
DESCRIPTION	This area used mustard and nerve agent (GB) to defeat various types of fortifications. Used from 1940s and during World War II and in 1950-l 967.
SIZE	10 acres
CONTENTS	Mustard and nerve agent (GB) in a wide variation of tests.
COMMENTS	Not a disposal area. Hazardous materials were used and may be present, particularly in collapsed bunkers. Also characterized as SWMU-DPG-l 5.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Test Area 1
DESCRIPTION	Site is located on November Road in the Downwind Target Area. Used to test chemical-filled rockets and artillery shells. Dates back to 1960s. Backfill in 1965
SIZE	Unknown
CONTENTS	Chemical agents from rocket and artillery shells being tested.
COMMENTS	No records on disposal. Potential contamination due to the nature of tests from 1951 to 1968. Also characterized as SWMU-DPG-24.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Unknown
DESCRIPTION	Test and disposal unknown. Area used as an impact and disposal site from 1942 to 1949.
SIZE	Unknown
CONTENTS	Chemical munitions, spray tanks, and ton containers.
COMMENTS	No official record search of area in November and December 1976 and 1977 revealed chemical weapons.
TYPE	Range
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Yellow Jacket Area
DESCRIPTION	Yellow Jacket Area is west of Southern Triangle. Used in 1940s and 1950s to test munitions containing chemical agents, incendiaries, and high explosives.
SIZE	Unknown
CONTENTS	Unknown
COMMENTS	Complete documentation is lacking. Not within current installation boundaries.
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	1 - Known burial

LOCATION	Dugway Proving Ground
LOCALITY	Dugway
STATE	UT
SITE	Skull Valley
DESCRIPTION	During a test mission near Dugway, 320 gallons of VX were sprayed from an aircraft. At the end of the test run, however, two high-pressure dispensers failed to snap firmly shut. As a result, the VX continued to pour out outside of the target area and wind gusts carried it as far as 45 miles away.
SIZE	Unknown
CONTENTS	Possible VX breakdown products.
COMMENTS	None
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Tooele Army Depot
LOCALITY	Tooele
STATE	UT
SITE	Area 2
DESCRIPTION	Mustard holding area spill. Spill occurred in mid- to late-l 950s. Located in southwest part of storage area 2 (south area), SWMU #9.
SIZE	500 by 500 feet
CONTENTS	Mustard leaking from bombs.
COMMENTS	Spill was decontaminated, treated with bleach. and plowed into ground.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Tooele Army Depot
LOCALITY	Tooele
STATE	UT
SITE	Disposal
DESCRIPTION	Located in demilitarization area (south area), SWMUs #1 and #25. Twenty-six pits for disposal of chemical munitions in 1940s and 1950s. Although listed as a single site. area consists of over 20 large pits and is a major site.
SIZE	1.478 acres
CONTENTS	M-70 mustard bombs, incendiaries, smoke, M-74 bombs, and one German GA bomb.
COMMENTS	Disposed of by open burn. Buried mustard without burning. Total 373 acres in eastern area; 1105 acres in western.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Large quantity
CLASSIFICATION	1 - Known burial

LOCATION	Tooele Army Depot
LOCALITY	Tooele
STATE	UT
SITE	Drain Pond
DESCRIPTION	Unlined drainage pond located in south area east of building 600, SWMU #5. Used in late 1940s to 1950s. One source cites mustard contamination.
SIZE	20 by 70 by 10 feet
CONTENTS	Wastewater from high-explosive cluster bombs, incendiaries, smoke pots, and mustard projectiles.
COMMENTS	Presently surrounded by wire fence with overflow drain.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Tooele Army Depot
LOCALITY	Tooele
STATE	UT
SITE	Gravel Pit
DESCRIPTION	Located in south area, SWMU #2. Contains items that were not demilitarized prior to burial. May contain smoke pots bombs, incendiaries, and mustard. Timeframe of use unknown.
SIZE	5.8 acres
CONTENTS	Mustard, M2 ignition cartridges, and squibs.
COMMENTS	Site located within Igloo Toxic Storage Yard (Area 10).
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Tooele Army Depot
LOCALITY	Tooele
STATE	UT
SITE	Mortar Pit
DESCRIPTION	Located in the south area. SWMU #4. Prior to 1954, 19,000 projectiles that were open burned in 15 pits were buried here. Also used in 1971.
SIZE	Unknown
CONTENTS	4.2-inch mortar rounds (mustard-filled).
COMMENTS	Original pits where items were burned were decontaminated. Contained in and investigated with SWMU #1
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Tooele Army Depot
LOCALITY	Tooele
STATE	UT
SITE	Pit
DESCRIPTION	Covered disposal pit south of storage area 2, SWMU #3. Reportedly contains drums marked decontaminating agent non-corrosive.
SIZE	Unknown
CONTENTS	Possible agent contamination, No description beyond waste could be found.
COMMENTS	Exact location unknown. May contain contamination from agent breakdown products.
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Defense Depot Ogden
LOCALITY	Ogden
STATE	UT
SITE	Magazine
DESCRIPTION	Mustard storage area. From 1942 to 1946, over one million pounds of mustard received from Aberdeen Proving Ground-Edgewood Arsenal, Maryland, and stored in magazine area. Chemical agent identification sets were also stored in this area until disposal in the late 1940's.
SIZE	Unknown
CONTENTS	In late 1946, source cites all materiel was shipped to Dugway Proving Ground.
COMMENTS	During the RI/FS conducted under CERCLA, 14 soil borings in the magazine site and other geo-technical techniques concluded that mustard or its degredation products were not present; thus, no further action is required.
TYPE	Disposal
INSTALLATION	Defense Logistics Agency
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	5 - No further action

LOCATION	Defense Depot Ogden
LOCALITY	Ogden
STATE	UT
SITE	Site 3
DESCRIPTION	Burial Site 3. Used from World War II to late 1940s to bury mustard and Phosgene. Also may contain smoke bombs. Stored 500 to 1,000 chemical agent identification sets in pigs in igloos. Also known as Prestone Well area. During 1994, non-hazardous sea-dye markers (reddish brown powder) was unearthed at Site 3. The powder, when mixed with water, produces a fluorescent green color (similar to anti-freeze). The dye is likely the source of the Prestone well. During the summer of 1995, excavation of soil at Site #3 was completed. The area has been backfilled and regraded. Additional chemical agents unearthed at this site included: one 4-oz bottle of charcoal impregnited with Lewisite, believed to be part of the K-955 Training kit and 3 bottles of chemical gas simulant. The chemical gas simulant was analyyzed and found to contain water, hydrochloric acid and carbon dioxide. This indicates the triphosgene had completely been used up. Workers also recovered one intact tube of mustard from the K-951 kit.
SIZE	6.5 feet deep
CONTENTS	Five- to ten-gallon containers of mustard dumped in pit with chlorinated lime and soil. Also contained chemical agent identification set vials that were broken and decontaminated with chlorinated lime.
COMMENTS	Incident in 1960 resulted in unearthing liquid and fumes. During an Installation Restoration Program investigation in 1988, the U.S. Army Technical Escort Unit removed 100 vials of mustard from this site. This site was successfully remediated in accordance with the remedial design documents in 1995.
TYPE	Disposal
INSTALLATION	Defense Logistics Agency
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

LOCATION	Defense Depot Ogden
LOCALITY	Ogden
STATE	UT
SITE	K-941 Area
DESCRIPTION	Chemical agent identification sets stored and disposed of in 1946. Recent (1992) accidental excavation of chemical agent identification set material. During May 1995, U.S. Army Technical Escort Unit recovered 15 bottles of "HS" mustard similar to those found in K-941 kit. The mustard and Lewisite was shipped to Tooele Army Depot for proper disposal.
SIZE	Unknown
CONTENTS	Chemical agent identification sets (K941, Toxic Gas Set, MI).
COMMENTS	This site was successfully remediated in accordance with the remedial design documents in 1995.
TYPE	Disposal
INSTALLATION	Defense Logistics Agency
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

LOCATION	Wendover Bombing and Gunnery Range
LOCALITY	Tooele
STATE	UT
SITE	Western Utah
DESCRIPTION	Used for work on new chemical munitions and samplers on the grids checking the effectiveness of aerial tests of nerve gas or simulants by Dugway Proving Ground.
SIZE	Unknown
CONTENTS	Possible nerve agent.
COMMENTS	None
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	2 - Likely burial

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VIRGINIA

NAME OF LOCATION: **Fort Belvoir**

Fort Belvoir is located approximately 9 miles south of Alexandria, Virginia. The Main Post is bounded on the east and southeast by Dogue Creek and the Potomac River, on the south and southwest by Accotink Bay, Pohick Bay, and Gunston Cove, and on the northwest by State Highway 611. A detached area known as the North Area lies northwest of the Main Post in the vicinity of Interstate Highway I-95.

In 1912, the War Department purchased 1,482 acres of an estate lying along the Potomac River for use as a summer camp and rifle range by Engineer troops stationed at Fort McNair. At the conclusion of World War I, it became an Engineer School and was named Fort Humphrey. In 1935, the reservation was renamed Fort Belvoir. The Engineering Center and Fort Belvoir came into being 1 January 1956 and were subsequently designated as the U.S. Army Engineer Center and Fort Belvoir. The Fort is the former home of the U.S. Army Engineer School.

Records indicate that CAIS were stored in the magazine area until late 1960s. The sets were packed in shipping containers by personnel from the former Edgewood Arsenal (presently Edgewood Area), Aberdeen Proving Ground, Maryland, and shipped to an unknown location. Reportedly, chemical agents were not manufactured or tested at this installation.

LOCALITY/STATE: Fairfax County, Virginia

SCOPE OF RESTORATION EFFORT: The RD/RA effort for FY93 at Fort Belvoir is for the Engineer Proving Ground in nearby Newington, and is part of the overall remediation effort necessary prior to turning the area over for private development. Documentation shows that at one time CAIS were stored at Fort Belvoir, but were later removed.

EFFORT TO DATE: No evidence has been found of residual chemical agent contamination.

REMEDIATION SCHEDULE: Project on-going.

RISK PERCEPTION: There is no evidence of any threat to public health due to chemical agent contamination.

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VIRGINIA

LOCATION	Fort Belvoir
LOCALITY	Fairfax County
STATE	VA
SITE	Unknown
DESCRIPTION	Location known as magazine area used to store chemical agent identification sets.
SIZE	Unknown
CONTENTS	Possibly chemical agent identification sets.
COMMENTS	Shipped to unknown location in late 1960s. Subsequent document search produced no evidence of any chemical agent identification set burial on Ft. Belvoir
TYPE	Disposal
INSTALLATION	Army
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	5 - No further action

WASHINGTON

NAME OF LOCATION: **U.S. Naval Magazine Bangor, currently Submarine Base Bangor**

LOCALITY/STATE: Silverdale, Washington

WORK PLAN STATUS: NPL Installation

SCOPE OF RESTORATION EFFORT: During the unloading of the USS Treanor on 29 July 1947, one leaking 4.2-inch Phosgene-filled mortar round was found and disposed of in a disposal area. In addition, the base was involved in receiving, renovating, maintaining, storing, and issuing ammunition, explosives, and expendable ordnance items.

EFFORT TO DATE: No chemical agent contamination has been found.

REMEDIATION SCHEDULE: A remedial investigation is not planned for this site.

RISK PERCEPTION: The threat from the site where one leaking phosgene mortar round was disposed of is negligible because of the small quantity of phosgene involved and the likelihood that the materiel decomposed because the shell casing was not sealed properly.

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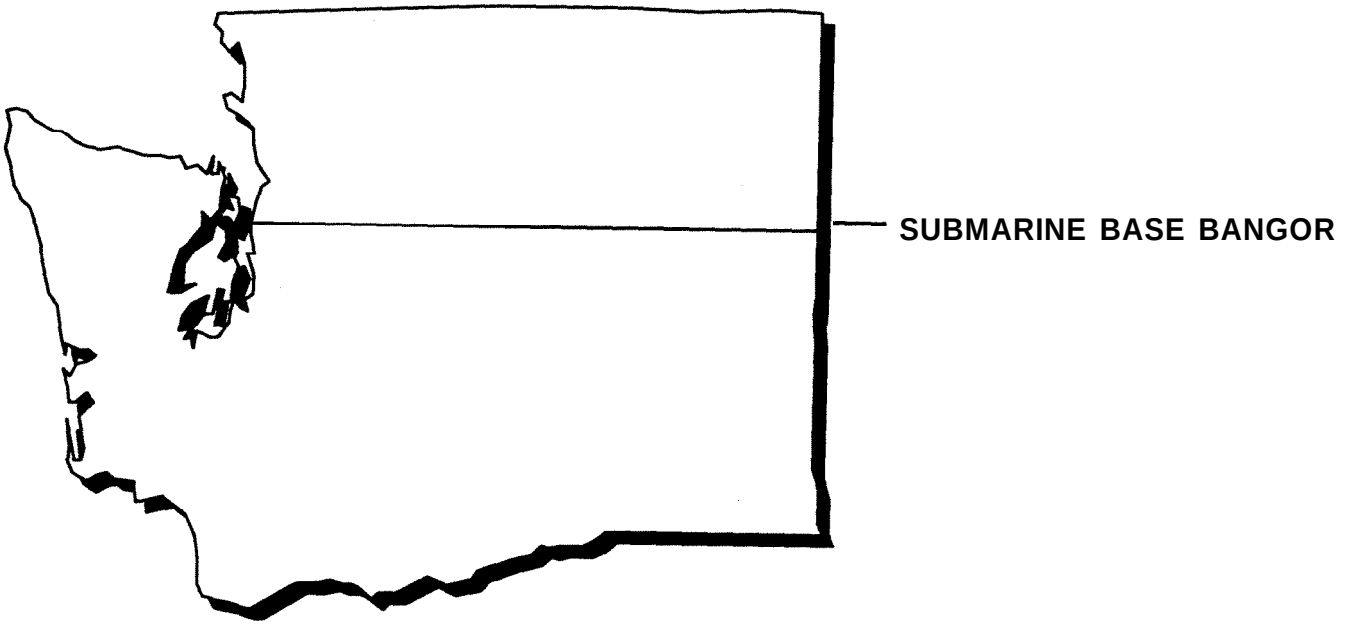
WASHINGTON



LOCATION	Submarine Base Bangor
LOCALITY	Silverdale
STATE	WA
SITE	Unknown
DESCRIPTION	On July 29, 1947, leaking 4.2-inch Phosgene-filled round found aboard ship USS Tom Treanor during off-loading operation. Disposed of in disposal area. Disposal method unknown.
SIZE	Unknown
CONTENTS	4.2-inch phosgene filled munition.
COMMENTS	Remainder of the ship's cargo, 16 cars of 1 ,000-pound bombs, was transported to Rocky Mountain Arsenal. No incidents were reported. The threat from the site where one leaking phosgene mortar round was disposed of is negligible because of the small quantity of phosgene involved and the likelihood that the materiel decomposed because the shell casing was not properly sealed.
TYPE	Disposal
INSTALLATION	Navy
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	**5 - No further** action

WYOMING

NAME OF LOCATION: **F. E. Warren Air Force Base**

LOCALITY/STATE: Cheyenne, Wyoming

F. E. Warren Air Force Base is located in the northwestern quadrant of the city of Cheyenne, 50 miles north of Fort Collins, Colorado, and 100 miles north of Denver, Colorado. In 1867, troops of the United States Cavalry established Fort D. A. Russell on this site. In 1930, the name of the post was changed to Fort Francis E. Warren, in honor of the first state governor of Wyoming. Then in 1947, the post was ceded to the United States Air Force, becoming Francis E. Warren Air Force Base.

Fort Warren was an Army Services Forces Training Center during WWII. The post chemical officer conducted a 36-hour chemical warfare school for unit gas officers and noncommissioned officers. From 6 November 1943 to 26 January 1945, 17 courses were conducted with 897 students.

A recent interview with a former March AFB employee provided an account of unearthing a chemical agent identification set (CAIS) during excavation. Further investigation on the details of this account is ongoing.

SCOPE OF RESTORATION PROGRAM: F.E. Warren Air Force Base is currently conducting remediation of 20 hazardous waste sites. None of these sites have been identified as containing buried chemical warfare materiel (CWM).

EFFORT TO DATE: Archival searches have been conducted by the US. Army Corps of Engineers (USACE), St. Louis; F.E. Warren Air Force Base; and the Program Manager for Chemical Demilitarization.

RISK PERCEPTION: No threat to public health due to chemical agents is currently known or suspected to exist at F.E. Warren Air Force Base.

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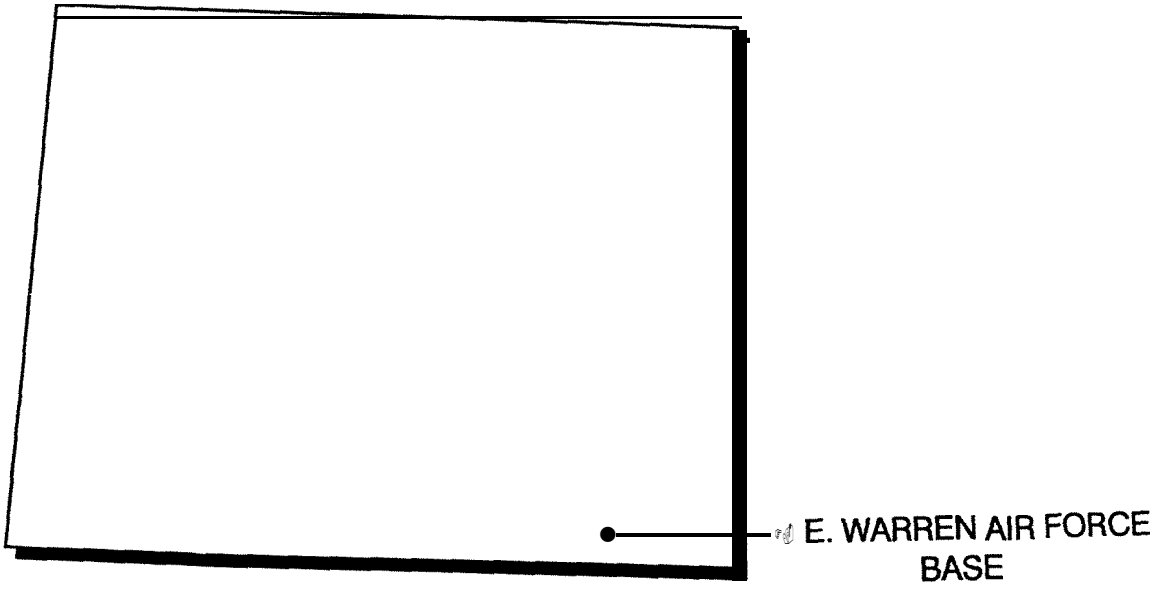
WYOMING



LOCATION	F.E. Warren Air Force Base
LOCALITY	Cheyenne
STATE	WY
SITE	Unknown
DESCRIPTION	F. E. Warren was an Army Services Forces Training Center during World War II. The post chemical officer conducted a 36-hour chemical warfare school for unit gas officers and noncommissioned officers. From 6 November 1943 to 26 January 1945, 17 courses were conducted with 897 students.
SIZE	Unknown
CONTENTS	Chemical agent identification sets.
COMMENTS	There is an eyewitness account describing the discovery of buried chemical agent identification sets. Further investigation on the details of the account are ongoing.
TYPE	Disposal
INSTALLATION	Air Force
BURIED CWM SITE	Chemical agent identification set
CLASSIFICATION	5 - No further action

U.S. VIRGIN ISLANDS

NAME OF LOCATION: **Water Island (former Fort Segarra)**

The San Jose Project, established in 1944 to test chemical agents, came to a halt in 1947 when the Army was notified that San Jose Island (in the Panama Canal Zone) would have to be evacuated because the Army's lease was not renewed.

The San Jose Project moved from the Panama Canal Zone to the former U.S. Navy Submarine Base just west of Charlotte Amalie on St. Thomas, U.S. Virgin Islands. Test sites were located in the western tip of St. Thomas and on all of Water Island, a small island just across the channel from the main post of the submarine base. Water Island contained eight test areas, a toxic gas yard, and a change house. This project gathered technical data on performance of chemical munitions and protective materiel in order to ascertain their effectiveness and suitability under jungle conditions.

At the beginning of test operations at St. Thomas, 57 tests were scheduled. Records indicate that only nine of these tests (three of which were surveillance tests) were actually conducted. Records and personal interviews indicate that all testing was conducted at the south end of Water Island, with the exception of one phosgene test that was conducted on the west end of St. Thomas. This test involved emitting phosgene from ton containers to determine the effectiveness of gas-proof shelters. Chemical agents and munitions involved in the tests and stored on Water Island are listed in Table 1.

The San Jose Project terminated on 12 May 7950. Disposition of toxic materiel remaining at St. Thomas at the end of the project was scheduled for burial at sea or transport back to the continental United States Records and personal interviews indicate that the majority of the chemical warfare materiel stored on Water Island was removed at the end of the San Jose project. However, records do not indicate the disposition of all the items involved in the tests. These items include four M78 CK-filled, 500-pound bombs involved in the surveillance tests, remnants from the M70 bomb tests, and smoke pots.

LOCALITY/STATE: Charlotte Amalie, St. Thomas, U.S. Virgin Islands

FUDS ACTIVITIES AT THIS LOCATION: The former Ft. Segarra is located on Water Island in St. Thomas Bay, between the East and West Gregerie Channels, south of the city of Charlotte Amalie, St. Thomas, U.S. Virgin Islands. The fort comprised approximately 500 acres acquired in June 1944. A number of chemical warfare-related tests were conducted during the San Jose Project on St. Thomas and Water Island. Records indicate the south end of Water Island was the primary location for testing, with one test being conducted on the west end of St. Thomas. Agents involved in the tests included H, HD, HQ, GA, CK, and CG. The reports indicate that only non-persistent agents were tested on St. Thomas.

TABLE 1

Agent	Contaminant	
	Item	Tested or Stored
HD	M70 Bomb	Static firing test
CK	M78 500-pound Bomb	Surveillance test
CK	ANM79 1 OOO-pound Bomb	Surveillance test
CK	M70	Surveillance test
H/HD	T-3 125-pound Bomb	Surveillance test
GA, HD, HQ	E-23 Smoke Pot	Static firing test
CG	Ton Containers	Gas-proof shelter test
GA, HD, HQ, HT, HE	M2/M2A1 4.2-inch Mortar	Stored only
GA	E-46 125-pound Bomb	Stored only
GA	E-52 125-pound Bomb	Stored only
GA	German 250 KG Bomb	Stored only
CG, H, HD, GA	Bulk Container	Stored only
CG	M79 Bomb	Stored only

Since the Army vacated Water Island in 1950, there has been one incident where CWM was recovered. This occurred in 1966 during an excavation operation in the Flamingo Bay area. The Naval Ordnance Disposal Detachment at Roosevelt Roads was contacted and the items were removed from the site. The Detachment identified the items as M70 and M78 chemical bombs. No further excavation was conducted in the area.

PREVIOUS CORPS ACTIVITIES: U.S. Army Corps of Engineers personnel completed a preliminary assessment of the site in 1990 and concluded that further investigation was necessary to determine if CWM was present. An archive search was completed in July 1991. Topographic mapping and isolation of the incident area by fencing was accomplished in October 1991. A Draft Work Plan for emergency removal was prepared in March 1992. A Work Plan for RI/FS characterization was submitted in January 1993, and lastly, a Work Plan for non-intrusive investigation submitted in December 1993 received approval 11 March 1994. The execution of this work between 14 March and 10 June 1994 resulted in the identification of three areas

south of Flamingo Bay warranting further investigation. The initial Site Safety Submission was completed 30 June 1994.

ACTIONS PLANNED FOR THE FUTURE: Obtain approval of the work plan for intrusive investigation and proceed with implementation. The engineering evaluation/cost analysis has been initiated and will be completed.

SUSCEPTIBILITY TO INTRUSIVE ACTIVITY: A site visit was conducted on 17 December 1992, but no intrusive activities were observed. No intrusive activities are known to be planned by the present owners. Construction on Water Island is limited due to controversy concerning ownership and lease requirements.

RISK PERCEPTION: Unless potential chemical burial areas are disturbed by excavation, no threat to human health and safety is anticipated.

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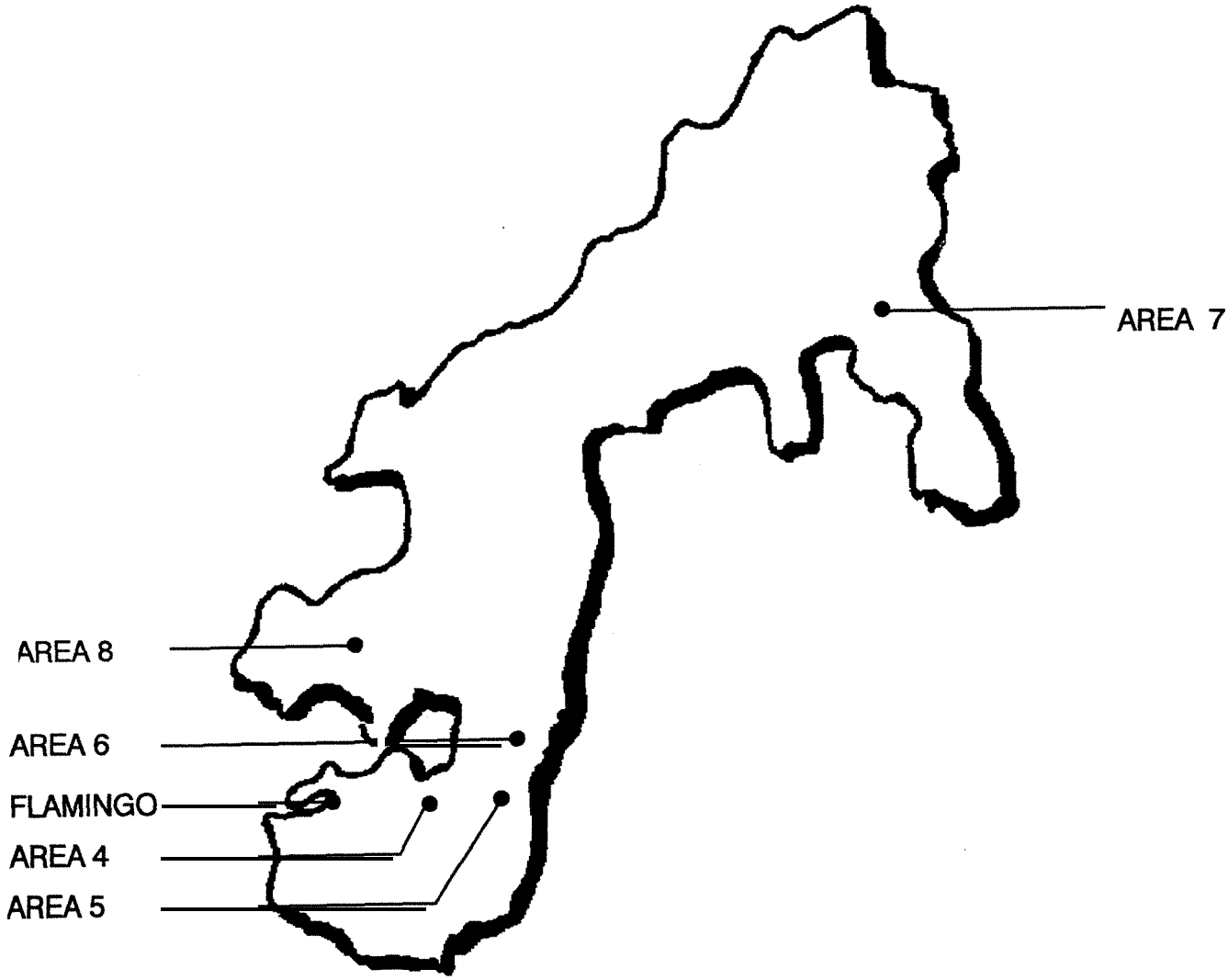
WATER ISLAND
VIRGIN ISLANDS



LOCATION	Water Island
LOCALITY	St. Thomas
STATE	VI
SITE	Flamingo
DESCRIPTION	South shore of Flamingo Bay. Several M-70 and M-78 bombs were uncovered during excavation operations.
SIZE	Unknown
CONTENTS	Contents of bombs not mentioned, but probably CG or CK.
COMMENTS	Evacuation of area revealing M-78 bombs occurred in 1966. These items were vented and subsequently sea dumped.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	2 - Likely burial

LOCATION	Water island
LOCALITY	St. Thomas
STATE	VI
SITE	Water Island
DESCRIPTION	During 1950s, used as a toxic gas yard for the San Jose Project. Storage of various chemical-filled munitions. Seventy 4.2-inch mustard-filled mortars (some HT-filled); 225 115-pound T-3 mustard bombs.
SIZE	Unknown
CONTENTS	Unknown; potentially 250-kilogram German GA bombs and containers [mustard and nerve agent (GA)].
COMMENTS	Bombs to be sea dumped. Sea dump operation was carried out. T-3 bombs may have been shipped to Aberdeen Proving Ground-Edgewood Arsenal.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	5 - No further action

LOCATION	Water Island
LOCALITY	St. Thomas
STATE	VI
SITE	Water island, Adjacent to Test Area 8
DESCRIPTION	Storage of various chemical munitions. Toxic Gas Yard for the San Jose Project to include 115-pound M-70 bombs; 500-pound M-78 bombs; 1000-pound M-79 bombs; 118 Phosgene-filled ton containers; 4.2-inch mortars, and T-3 bombs.
SIZE	Unknown
CONTENTS	Unknown, but potential exists for buried chemical munitions.
COMMENTS	Bombs to be sea dumped. Sea dump operation was carried out. Some items returned to United States.
TYPE	Disposal
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, non-explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Water island
LOCALITY	St. Thomas
STATE	VI
SITE	Area 4
DESCRIPTION	Static test of the M-70 mustard bomb with 0.50 percent yellow Dupont oil (Phase 1 and 2 Test). In addition, static tests of smoke pots filled with mustard and GA occurred in this area. Decontamination and disposal area for test hardware and test area undefined.
SIZE	**1.3** acres
CONTENTS	Unknown, but potential for buried mustard bombs, mustard filled and GA filled smoke pots exists.
COMMENTS	M-70 HD-filled bombs were statically fired in a vertical position nose-down November through December 1948. Mustard-filled smoke pots tested in August 1949. Clean-up and decontamination of operations are unknown.
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Water Island
LOCALITY	St. Thomas
STATE	VI
SITE	Area 5
DESCRIPTION	Static test of the M-70 mustard-filled bomb (Phases 3 and 4 test). Decontamination and disposal area for test hardware and test area are undefined. Mustard mixed with 0.50 percent yellow Dupont oil.
SIZE	3.3 acres
CONTENTS	Unknown, but potential for buried mustard bombs exists.
COMMENTS	Timeframe: December 9, 1948.
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	3 - Suspect burial

LOCATION	Water Island
LOCALITY	St. Thomas
STATE	VI
SITE	Area 6
DESCRIPTION	Static test of the M-70 mustard-filled bomb (Phases 7 and 8 test). Decontamination and disposal area for test hardware and test area are undefined. Mustard mixed with 0.25 percent red Dupont oil.
SIZE	Unknown
CONTENTS	Unknown, but potential exists for buried mustard bombs.
COMMENTS	Timeframe: February 10, 1949.
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	4 - Possible burial

LOCATION	Water Island
LOCALITY	St. Thomas
STATE	VI
SITE	Area 7
DESCRIPTION	Static test of the M-70 mustard-filled bomb (Phase 8 test). Decontamination and disposal area for test hardware and test area are undefined. Mustard mixed with 0.25 percent red Dupont oil.
SIZE	Unknown
CONTENTS	Unknown, but potential exists for buried mustard bombs.
COMMENTS	The test plan for the M70 bomb test identified areas 1 and 7 as test areas. The test report which presented the final results of the test showed contamination contours for each area and indicated that the tests had actually been conducted in test areas 4, 5, 6, and 8.
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	5 - No further action

LOCATION	Water Island
LOCALITY	St. Thomas
STATE	VI
SITE	Area 8
DESCRIPTION	Static test of the M-70 mustard-filled bomb (Phases 5 and 6 test). Decontamination and disposal area for test hardware and test area are undefined. Mustard mixed with 0.50 percent yellow Dupont oil.
SIZE	Unknown
CONTENTS	Unknown, but potential exists for buried mustard bombs.
COMMENTS	Timeframe: January 13 (Phase 5); January 8 to 25, 1949.
TYPE	Range
INSTALLATION	Formerly used defense site
BURIED CWM SITE	Small quantity, explosive
CLASSIFICATION	4 - Possible burial

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APPENDIX B

SURVEY AND ANALYSIS REPORT
SECOND EDITION

MISCELLANEOUS CHEMICAL WARFARE MATERIEL

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APPENDIX C

SURVEY AND ANALYSIS REPORT
SECOND EDITION

BINARY WEAPON COMPONENTS

APPENDIX C
BINARY WEAPON COMPONENTS

Table 1. Agent Location and Amount

Facility	Agent Fill Type	Amount (ton)
APG	DF	0.57
	QL	0.73
PBA	DF	126.51
	QL	48.21
TEAD	QPA	33.58
UMDA	OPA	470.59

Table 2. Miscellaneous Hardware

Facility/Item	Agent Fill Type	Number of Munitions or Canisters	Weight of Fill (tons)
APG			
Bulk (drum)	DF	2	0.57
Bulk (drum)	QL	3	0.50
Cylinder	QL	6	0.23
PBA			
M20-DF Canister	DF	56,820	125.00
Bulk (drum)	DF	7	1.51
Bulk (drum)	QL	296	48.21
TEAD			
M687 155mm projectile assembly with M21 (OPA canister) loaded	OPA	17,220	33.58
UMDA			
M687 155mm projectile assembly with M21 (OPA canister) loaded	OPA	241,328	470.59

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APPENDIX D

SURVEY AND ANALYSIS REPORT
SECOND EDITION

POTENTIAL OVERSEAS BURIAL SITES
(CLASSIFIED)

LIMITED DISTRIBUTION

APPENDIX E

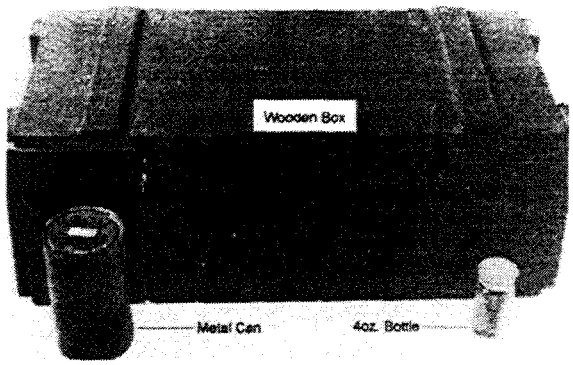
SURVEY AND ANALYSIS REPORT
SECOND EDITION

CHEMICAL AGENT IDENTIFICATION SETS
HAZARDS AND PRECAUTIONS

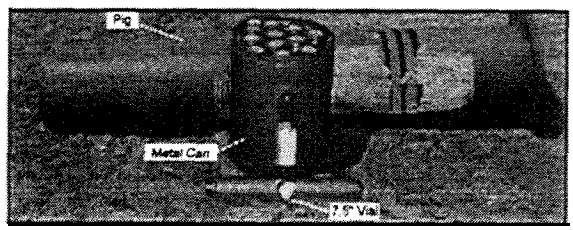
CHEMICAL AGENT IDENTIFICATION SETS
HAZARDS AND PRECAUTIONS

Chemical agent identificationsets (CAIS) were developed to aid in the training of soldiers, airmen and sailors. Training consisted of teaching the proper procedures for identifying chemical agents and taking proper actions in the event of a chemical attack. The CAIS contain small amounts of chemical agents and industrial chemicals that simulate chemical agents. Three major varieties including seventeen different types of CAIS were produced over the years.

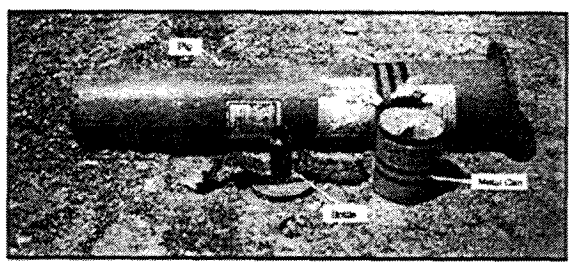
One major variety of CAIS was an instructional "sniff set" that contained agent impregnated charcoal. It was intended for use indoors to instruct military personnel in recognizing the odors of chemical agent. This type of set contained only small amounts of chemical agent. The agent impregnated charcoal was contained in round 4 ounce heavy-walled, wide mouth bottles. These bottles were stored and shipped in wooden boxes



A second major variety, designed for use outdoors, consisted of agent (pure or in solution) in sealed Pyrex ampules. The glass ampules would be detonated, creating an agent cloud. Soldiers would then try to identify the agent based on its odor and other characteristics. These typically contained more agent than the instructional "sniff sets" and could produce a much greater hazard. The glass ampules were packaged in mailing tubes which were placed in metal cans. These metal cans were stored and shipped in steel shipping containers, known as "PIGS."



A third major variety of CAIS were those containing bulk mustard. These CAIS were used in decontamination training by purposely contaminating the terrain or equipment with mustard, and then teaching the soldiers how to don the correct protective clothing and decontaminate the area or equipment. These CAIS contained relatively large quantities of pure mustard. The mustard was contained in bottles packaged in metal cans. These metal cans were stored and shipped in steel drums or pigs as depicted.

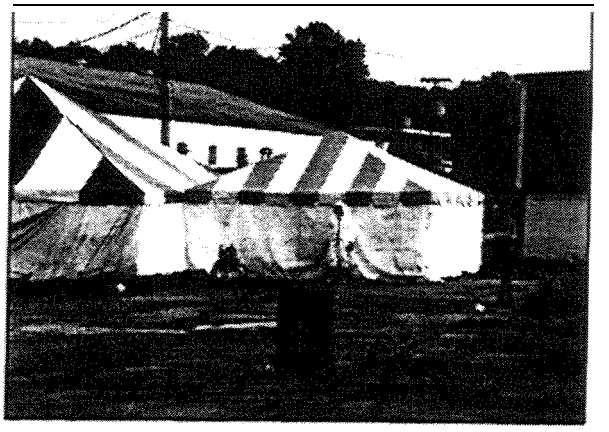


Approximately 110,000 CAIS were produced between 1928 and 1969. During their years of use, they were widely distributed to military organizations conducting chemical warfare training. In the early 1980s, the Army recalled the remaining CAIS for destruction. Approximately 21,458 CAIS were recovered and destroyed as a result of this effort. In addition, many of the CAIS would have been destroyed during the training for which they were originally intended. However, not all CAIS have been accounted for. To date, they continue to be unexpectedly found. CAIS have also been known to be kept as war trophies and souvenirs.

CAIS material not used during training was sometimes buried in remote areas as a means of disposal. But because of increasing privatization and development of formerly used defense sites (FUDS), once remote areas are now accessible to the public. This explains why CAIS are sometimes found during excavation operations.

For example, in 1995, a sewer line was being laid at the state fairgrounds in Jackson, Mississippi. This area was the site of an old Armory. The sewer excavation unearthed unusual glass vials. Excavation operations were containers and the state environmental office and the U.S. Army were notified.

The Army sent the U.S. Army Technical Escort Unit (TEU) to aid in the recovery and contingency transportation of the glass vials. The TEU is responsible for the safe transport of chemical warfare materiel. The glass containers were positively identified as part of a number of CAIS components that were buried many years earlier. The CAIS vial burial



CAIS Site at Jackson, MS (under tent)

site had unknowingly been covered with asphalt and turned into a parking lot for the state fairgrounds. The buried glass vials remained undisturbed until the excavation for the sewer line.

CAIS Excavation at Jackson, MS

The recovery effort at the state fairgrounds safely cleared the area and removed a total of 268 vials and 17 bottles. The sewer line was successfully installed after the glass vials were removed. This example illustrates the importance of recognizing CAIS components to reduce the hazards to workers who unknowingly uncover them.

CAIS were extensively used by all military services. Because they were disposable training aids, detailed records about their disposition were not kept. A list of locations that have been associated with CAIS is included to illustrate the widespread use of CAIS. This list provides the reader with examples of the types of locations that may contain CAIS components.

CAIS components were sometimes buried, as in Jackson, MS, but they may also be found in warehouses or stored as old war memorabilia. The early warning signs of CAIS are visual identification and odor. The photos of CAIS provide the general shapes of the CAIS components that could be encountered. CAIS were disposed of in their original shipping containers or as individual components.

As in the example of Jackson, MS, sometimes the glass bottles and vials are broken during excavation and a white cloud is frequently formed during such incidents. The CAIS components emit distinct odors produced by the chemical agents. These odors are as follows:

Mustard has an odor similar to garlic or horseradish.
Nitrogen Mustard has an odor that is fishy or musty.
Lewisite has an odor similar to geraniums.
Chloropicrin has an odor that is pungent and stinging.
Phusgene has an odor similar to newly mown hay, grass or green corn.
Chloroacetophenone has an odor similar to apple blossoms.
Cyanogen Chloride has a pungent odor.
Adamsite, a solid, has no pronounced odor.

Exposure to these chemical agents can cause coughing, nausea, vomiting, irritation, burning sensation, swelling of the eyes, itching, redness and blisters on the skin, and acute pain and tightness in the chest.

If items that are suspected to be CAIS components are encountered, back away (move into the wind), evacuate the site, seek medical attention if necessary, prevent others from entering the area, and notify Army and state officials.

Report the discovery of suspected CAIS components to the Army Operations Center at (703) 679-0218 and to Headquarters, Department of the Army at (703) 679-5690.

Information concerning the location of suspect CAIS components can be reported to the Project Manager for Non-Stockpile Chemical Materiel at l-800-488-0648 or to the Army Operations Center.

For additional information on CAIS components or the Non-Stockpile Chemical Materiel Project, please contact:

Public Affairs Office, PMNSCM
Aberdeen Proving Ground
Aberdeen, MD 2101O-5401

or call l-800-488-0648
(410) 671-141 1/3445

Examples of Locations Where Chemical Agent Identification Sets Were Recovered

City	Location
Alabama	
Anniston	Fort McClellan
Attalla	Camp Sibert
Birmingham	Birmingham Army Air Base
Courland	Courtland Army Air Field
Huntsville	Redstone Arsenal
Montgomery	Montgomery Army Air Field
Montgomery	Maxwell Field
Tuskegee	Tuskegee Army Air Field
Alaska	
	Alaskan Division. Air Transport Command, 1456th Army Air Field
Anchorage	Fort Richardson
Dutch Harbor	Unalaska Island
Fort Wainwright	Fort Wainwright
Kodiak	Havsta Kodiak
Nome	Marks Air Force Base
Whitter	Port Whitter
Arizona	
Phoenix	Luke Air Force Base
Tucson	Davis Monthan Field, 233rd Army Air Field Base Unit
Yuma	Yuma Proving Ground
Arkansas	
Fort Chaffee	Fort Chaffee
P i Bluff	Pine Bluff Arsenal
California	
	Weapons Station Seat Beach
Barstow	Marine Corps Base. Barstow
Bodega Bay	Santa Rosa Army Air Field
Chii	Chico Army Air Field, 4th Air Force, 317th Wing 433rd Army Air Field
Concord	Concord
Daggett	Oaggett Municipal Airport, 4th Air Force, 316th Wing
El Toro	Marine Corps Air Station. El Toro
Fairfield	Fairfield-Suison Army Airbase, 1504th Army Air field
Fresno	Hammer Field, 4th Air Force, 456th AAF
Lemore	Lemore Army Air Field, 4th AF. 321st Wing. 461st AAF
Long Beach	556th Army Air Field. Base Unit 6th Ferrying Group
Merced	Merced
Monterey	Fort Ord
Muroc	Nair
Palm Springs	566th Army Air Air Field, Base Unit, 21st Ferrying Group
Riverside	March Air Force Base
Sacramento	Mather Field. 1505th Army Air Field Base Unit
Sacramento	McClellan Field
Santa Ana	Santa Ana Any Air Base, AAF Redistribution Station
Santa Maria	Santa Maria Army Air Field
Santa Rosa	Santa Rosa Army Air Field
Stockton	Stockton Military Air Field
Van Nuys	Metropolitan Airport. 441 st AAF Base Unit
Colorado	
Denver	Lowry Air Force Base
Denver	Rocky Mountain Arsenal
Pueblo	2nd Air Force, 46th Bombing Training Wing
Delaware	
Dover	Dover Army Air Field, Army Airbase
Wilmington	New Castle AAB, Air Transport Comm. Ferrying Division
Florida	
	Warner Robins Air Technical Services
Boca Raton	Boca Raton Air Field. Training Command
Gotha	Gotha Ordnance Depot
Jacksonville	NAS Jacksonville
Marianna	Marianna Army Air Field
Panama City	Tyndall Field
Tampa	Drew Field
Tampa	MacDill Field
Venice	Venice Army Air Field
Georgia	
Albany	Turner Army Air Field
Columbus	Fort Benning
Macon	Cochran Field

cii	Location
Georgia continued	
Richmond	Daniel Field
Savanna	Hunter Field
Warner-Robbins	Robbins Field
Willie	Fort Stewart
Hawaii	
	Upper Kipapa Military Reservation
Lualualei	Oahu
Oahu	Schofield Army Barracks
Idaho	
Boise	Gowen Field
Mountain Home	Mt. Home Air Force Base
Illinois	
Lawerrceville	George Field, 805th Army Air Field, Base Unit
Rockford	Camp Grant
Indiana	
Crane	Naval Surface Warfare Center, Crane Division
Iowa	
Des Moines	Fort Des Moines & Fort Des Moines Target Range
Des Moines	Camp Dodge & Pdk County Guard Range
Kansas	
Coffeyville	Coffeyville Army Air Field
Dodge City	Dodge City Army Air Field Pilot School
Hennngton	Herington Army Air Field
Independence	Indendence Army Air Field
Kansas City	Fairfax Field, 569th AAF Base Unit, 33rd Ferrying
Milford	Fort Riley
Pratt	Pratt Army Air Field
Salina	Smoky Hill Army Air Field
Topeka	Topeka Air Force Station
Victoria	Walker Army Air Field
Kentucky	
Fort Thomas	Fort Thomas
Lexington	Lexington-Bluegrass Army Depot
Louisville	Bowman Field
Louisville	Fort Knox
Louisiana	
Alexandria	camp Claiborne
Alexandria	England Air Force Base
Alexandria	Esler Field
Bossier City	Barkdale Air Force Base
Cameron	Lake Charles
Leesville	Fort Pdk
Maryland	
Baltimore	Baltimore Armory
Edgewood	Edgewood Arsenal
Sturgis	Fort Meade
Michigan	
Gwinn	KI Sawyer Air Force Base
Mt. Clemens	Selfridge Air Force Base
Minnesota	
Minneapolis	Fort Snelling
Mississippi	
	Keeler Field, 340th Army Air Field Base Unit
Centerville	Cam Van Dom
Greenville	Greenville Army Air Field
Jackson	Jackson
Missouri	
Neosho	Camp Cmwder
St. Joseph	Rosecrans Army Air Field & Rosecrans Rifle Range
St. Robert	Fort Leonard Wood
Montana	
Great Falls	557th Army Air Field, Ease Unit, 7th Ferrying Group
Nebraska	
	Fort Crook
Geneva	Fairmont Army Air Field, 17th BOTW General Supply
Keamey	Keamey Army Air Field. 2nd Air Force. 21st Bomb Wing
Lincoln	Lincoln Army Air Field

Examples of Locations Where Chemical Agent Identification Sets Were Recovered

City	Location
Nebraska continued	
Manchester	Grenier Field
Omaha	Fort Omaha
Nevada	
Hawthorne	NAD. Hawthorne
Las Vegas	Las Vegas Army Air Field
Reno	Reno Army Air Base
New Jersey	
Earle	Earle Naval Ammunition Depot
Edison	Raritan Arsenal
Lakehurst	Lakehurst NAS
Newark	Atlantic Overseas ATSC, Port Of Newark
New Mexico	
	Fort Sumner Any Air Field
	Kirkland Air Force Base
Alamogordo	Alamogordo Army Air Base
New York	
	NRC Brooklyn
	NRC Staten Island
	NRC Huntinston
	NRC Freeport
	Seneca AD
Bayside	Fort Totten
Long Island	Camp Hero
Nassau	Mitchell Field
Plattsburgh	Ptattsbuqh Barracks
Rome	Rome Army Air Field,4104th Army Airfield Base Unit
Troy	Troy
North Carolina	
Charlotte	Morris Field & Spencer Mountain Rifle Range
Fayetteville	Fort Bragg
Jacksonville	Camp Lejeune
North Dakota	
	Finley AFS
Ohio	
Columbus	Columbus
Columbus	Lockbourne Army Air Base
Newark	Newark
Oklahoma	
Altus	Altus Army Air Field
Ardmore	Ardmore Army Air Field
McAlester	Naval Ammunition Depot, McAlester
Oregon	
Chambursburg	New Cumberland Any Depot
Hermiston	Umatilla AD
Pennsylvania	
	Tinicum Township
New Cumberland	Defense Distribution East
South Carolina	
Charleston	Charleston Naval Weapons Station
Port Royal	Marine Corps Depot, Parris Island
South Pacific	
	Johnston Island
Tennessee	
Dyersburg	Dyersburg Army Air Field
Memphis	Defense Depot Mempfiis
Texas	
	Randolph Field
Abilene	Abilene Army Air Field
Abilene	Camp Barkeley
Amarillo	Amarillo Army Air Field. Small Firing Range
Biggs	Biggs Fiefd, 235th Army Air Field, Base Unit
Brownwood	Camp Bowie
Bryan	Bryan Army Air Field IS. IP
Dalhart	Dalhart Army Air Field
Dallas	555th Army Airfield. Base Unit, 5th Ferrying Group
Eagle Pass	Eagle Pass Army Air Fiefd Base Unit, Pilot School, Basic
Ellington	Ellington Field
Foster	Foster Fiefd
Texas continued	
Goodfellow	Goodfellow Field
Hattingen	Harfingen Army Air Field
Hondo	Hondo Army Air Field
Laughlin	Laughlin Army Air Field, Pilot School
Pyote	Pyote Army Air Field
San Angelo	San Angelo Army Air Field
San Antonio	78th Flying Training Wing & San Ant. Av. Cadet Ctr
San Antonio	Camp Bullis
San Marcos	San Marcos Army Air Field, AAFNS
Sherman	Perrin Fiefd
Victoria	Aloe Army Air Field
Utah	
Kearns	Ord Army Air Field
Ogden	Hill Field
Ogden	Defense Depot Ogden
Tooele	Tooele Army Depot
Wendover	Wendover Bombing and Gunnery Range
Virginia	
Fairfax County	Fort Belvoir
Quantico	Marine corps Base, Quantico
Yorktown	Yorktown NWS
Washington	
	McChord Field, 4th Air Force, 317th West
	Keyport MS
Wisconsin	
Angelo	Fort McCoy
Wyoming	
Casper	Casper Army Air Field
Cheyenne	F. E. Warren Air Field

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APPENDIX F

SURVEY AND ANALYSIS REPORT
SECOND EDITION

FORMER CHEMICAL WEAPONS PRODUCTION FACILITIES BY LOCATION

APPENDIX F

SURVEY AND ANALYSIS REPORT
SECOND EDITION

FORMER CHEMICAL WEAPONS PRODUCTION FACILITIES BY LOCATION

LOCATION	FACILITY
Rocky Mountain Arsenal, Colorado	North Plants Area GB Fill Site
	North Plants Area GB Production Site
	South Plants Area HD Fill Site
	South Plants Area HD Distillation Site
Pine Bluff Arsenal, Arkansas	MLRS Fill/Close Site
	DC Production Area
	DF Production/M2O Fill/Close Site
	QL Production Site
	Bigeye BLU-80/B Fill/Close Site
	BZ Munitions Fill Site
Aberdeen Proving Ground, Edgewood Area, Maryland	Pilot Plant
Newport Chemical Activity, Indiana	Production Site
	Fill Site
Northrup Carolina Corporation, Swannanoa, North Carolina	Chemtronics, Inc.
Marquardt Company, Van Nuys, California	The Marquardt Company
Muscle Shoals, Alabama	Phosphate Development Works

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APPENDIX G

SURVEY AND ANALYSIS REPORT
SECOND EDITION

REFERENCES

APPENDIX G

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SECOND EDITION

REFERENCES

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APPENDIX H

SURVEY AND ANALYSIS REPORT
SECOND EDITION

ACRONYMS/ABBREVIATIONS

APPENDIX H

SURVEY AND ANALYSIS REPORT
SECOND EDITION

ACRONYMS/ABBREVIATIONS

AC	hydrogen cyanide (blood agent)
ACAT	Acquisition Category
ACDA	Arms Control and Disarmament Agency
ADF	Alaskan Defense Force
AEC	U.S. Army Environmental Center
AED	Ammunition Equipment Directorate
AFB	Air Force Base
AMC	U.S. Army Materiel Command
ANAD	Anniston Army Depot
APG	Aberdeen Proving Ground
APG-EA	Aberdeen Proving Ground - Edgewood Area
AR	Army Regulation
ASA/IL&E	Assistant Secretary of the Army/Installation, Logistics and Environment
ASR	Archive Search Report
AZNG	Arizona National Guard
BGAD	Blue Grass Army Depot
BHD	Black Hills Ordnance Depot
BLM	Bureau of Land Management
BRAC	Base Realignment and Closure Act
BZ	3-quinuclidinyl benzilate (incapacitating agent)
CAIS	Chemical Agent Identification Set
CAMDS	Chemical Agent Munitions Destruction System
CAO	corrective action order

CBDCOM	U.S. Army Chemical and Biological Defense Command
CBIAC	Chemical Biological Information Analysis Center
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CG	phosgene (choking agent)
CK	cyanogen chloride (blood agent)
CMS	corrective measure study
CN	chloracetophenone
CONUS	continental United States
CS	O-chlorobenzylmalononitrile (riot control agent)
CSDP	Chemical Stockpile Disposal Program
CWA	chemical warfare agent
CWC	Chemical Weapons Convention
CWM	chemical warfare materiel
CWS	Chemical Warfare Service
DA	Department of the Army
DAB	Defense Acquisition Board
DARCOM	Department of the Army Material Development and Readiness Command
DC	di-chloro
DDCC	Data and Document Control Center
DERA	Defense Environmental Restoration Account
DERP	Defense Environmental Restoration Program
DF	di-fluoro (binary precursor)
DHHS	Department of Health and Human Services
DLA	Defense Logistics Agency
DMWR	Depot Maintenance Work Requirement
DoD	Department of Defense
DOI	Department of the Interior

DOT	Department of Transportation
DPG	Dugway Proving Ground
DTIC	Defense Technical Information Center
DWBG	Decontaminated Waste Burial Ground
EA	environmental assessment
EE/CA	engineering evaluation/cost analysis
EIF	entry into force
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
ERDEC	Edgewood Research, Development, and Engineering Center
FFS	focused feasibility study
FGGM	Fort George G. Meade
FS	feasibility study
FS	sulfuric acid
FTMC	Fort McClellan
FUDS	formerly used defense site
FY	fiscal year
GA	tabun (nerve agent)
G&A	General and Administrative
GAO	General Accounting Office
GB	sarin (nerve agent)
GOGO	government-owned, government-operated
GPR	ground-penetrating radar
GREA	Gerstle River Expansion Area
GRTS	Gerstle River Test Site
H	mustard agent (blister agent)
HD	distilled mustard agent (blister agent)

HE	high explosive
HESC	Huntsville Engineering Support Center
HN	nitrogen mustard (blister agent)
HT	mustard-agent T mixture (blister agent)
HTRW	hazardous, toxic, and radiological waste
HWAD	Hawthorne Army Depot
IA	installation assessment
IBPF	integrated binary production facility
IHF	interim holding facility
IR	installation restoration
IRP	installation restoration program
ISF	interim storage facility
JI	Johnston Island
L	lewisite (blister agent)
LAAF	Ladd Army Air Field
MARB	U.S. Army Munitions Assessment Review Board
MCX	Mandatory Center of Expertise
MIL-STD	Military Standard
MLRS	Multiple Launch Rocket System
MMAS	Mobile Munitions Assessment System
MMD	Munitions Management Device
MOU	Memorandum of Understanding
NADA	Navajo Army Depot Activity
NARA	National Archives and Records Administration
NCP	National Contingency Plan
NDRC	National Defense Research Committee

NEI	nature and extent investigation
NECA	Newport Chemical Activity
NEPA	National Environmental Policy Act
NOFA	no further action
NPA	North Point Area
NPL	National Priorities List
NPS	National Park Service
NSCM	non-stockpile chemical materiel
NSCMP	Non-Stockpile Chemical Materiel Program
OB/OD	open burning/open detonation
OEW	ordnance and explosive waste
OPA	isopropyl alcohol (binary precursor)
OPCW	Organization for the Prohibition of Chemical Weapons
OSD	Office of the Secretary of Defense
OSHA	Occupational Safety and Health Administration
PA/SI	preliminary assessment/site investigation
PARSF	Pedrickstown Army Reserve Support Facility
PBA	Pine Bluff Arsenal
PCBs	polychlorinated biphenyls
PDW	Phosphate Development Works
PINS	portable isotopic neutron spectroscopy
PL	Public Law
PM	Program Manager
PMCD	Program Manager for Chemical Demilitarization
PMCSD	Project Manager for Chemical Stockpile Disposal
PMNSCM	Project Manager for Non-Stockpile Chemical Materiel
POW	prisoner of war

PREPCOM	Preparatory Commission
PS	chloropicrin (tear agent)
PUDA	Pueblo Depot Activity
QL	O-ethyl-O'(2-diisopropylaminoethyl) methylphosphonite (binary precursor)
RA	remedial action
RCRA	Resource Conservation and Recovery Act
RD/RA	remedial design/remedial action
RDT&E	Research, Development, Test, and Evaluation
RDX	cyclotrimethylenetrinitramine
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RFP	Request for Proposal
RIA	Rock Island Arsenal
RI/FS	remedial investigation/feasibility study
RMA	Rocky Mountain Arsenal
ROD	Record of Decision
ROM	rough order of magnitude
RRS	Rapid Response System
RSA	Redstone Arsenal
S&A	survey and analysis
SECARMY	Secretary of the Army
SI	site investigation
SVADA	Savanna Army Depot Activity
SWMU	solid waste management unit
SWPG	Southwestern Proving Ground

TC	ton container
TDEC	Tennessee Department of Environmental Control
TEAD	Tooele Army Depot
TECOM	U.S. Army Test and Evaluation Command
TEU	U.S. Army Technical Escort Unit
TSDF	treatment, storage, and disposal facility
TSU	Technical Service Unit
TVA	Tennessee Valley Authority
UMDA	Umatilla Depot Activity
USACDRA	U.S. Army Chemical Demilitarization and Remediation Activity
USACE	U.S. Army Corps of Engineers
USACMDA	U.S. Army Chemical Materiel Destruction Agency
USAEC	U.S. Army Environmental Center
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
USD (A&T)	Under Secretary of Defense, Acquisition and Technology
USPFO	U.S. Property and Fiscal Officer
UXO	unexploded ordnance
VX	O-ethyl-S-(2-diisopropylaminoethyl)methyl phosphonothiolate (nerve agent)
WBS	Work Breakdown Structure
WNRC	Washington National Records Center
WP	white phosphorus
WWI	World War I
WWII	World War II
YPG	Yuma Proving Ground

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