U.S. Army
Program Manager for
Chemical Demilitarization

Engineering Evaluation/Cost Analysis for the Treatment and Disposal of Chemical Agent Identification Sets at Ft. Richardson, Alaska

In accordance with 40 CFR 1500, this document is intended to comply with the National Environmental Policy Act of 1969.

February 2003

EXECUTIVE SUMMARY

Ft. Richardson is the headquarters for the U.S. Army Alaska (USARAK). The principal mission of USARAK is to maintain combat force readiness for rapid deployment in the Pacific theater or elsewhere as directed.

The Poleline Road Disposal Area (PRDA) site at Ft. Richardson was first investigated as a potential source of contamination in 1990, as part of the Army's Installation Restoration Program for Ft. Richardson. After an expanded site investigation report was issued in February 1991, several additional investigation activities took place at the PRDA site. Ft. Richardson was later proposed for inclusion on the U.S. Environmental Protection Agency's (USEPA) National Priorities List in June 1993. As a result of the investigations at the PRDA site, a removal action was started at the site in September 1993. The removal action, which later became known as Phase I, took place from September through December 1993, when it was interrupted because objects potentially contaminated with chemical warfare agent were found. Further work at the site was postponed until the impact of the potential presence of other chemical warfare materiel (CWM), in the form of chemical agent identification set (CAIS) items, could be evaluated.

Phase II of the removal action at the PRDA site took place between July and October 1994. Seven intact pigs, and other CAIS items, were found as a result of the Phase II removal action.

Ft. Richardson was officially listed on the National Priorities List in May 1994. Subsequently, in December 1994, the USEPA, the state of Alaska, and the Army signed a Federal Facilities Agreement (FFA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) to address the potential sources of contamination at the site. The CERCLA FFA addressed 46 source areas that were determined to pose either an actual or potential threat to human health or to the environment. The CERCLA FFA was signed shortly after the Phase II removal action for the PRDA site had been completed. The CERCLA FFA incorporated the ongoing removal action work at the PRDA site as part of the work to be conducted pursuant to the agreement.

In May 1995, the U.S. Army Corps of Engineers, Alaska District (USACENPD), published a draft Engineering Evaluation/Cost Analysis (EE/CA) for the treatment and disposal of two soil stockpiles that resulted from the Phase II removal activities. In April 1996, the state of Alaska and Ft. Richardson agreed to prepare an EE/CA for the treatment and disposal of the CAIS items.

An EE/CA must be completed for all non-time-critical removal actions as required by section 300.415(b)(4)(I) for the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This EE/CA, however, is being done to satisfy the requirements of a focused feasibility study for the implementation of an interim response action under the terms of the CERCLA FFA for Ft. Richardson. The goals of the EE/CA are to identify the objectives of the removal action and to analyze the various alternatives that may be used to satisfy these objectives for cost, effectiveness, and implementability. While an EE/CA is similar to the Remedial Investigation/Feasibility Study (RI/FS) conducted for remedial actions, it is less comprehensive.

Four alternatives have been identified in this EE/CA for the treatment and disposal of the CAIS items: (1) no action; (2) onsite treatment of the CWM CAIS items at the Army's Rapid Response System (RRS), which was specifically developed for the safe handling of CAIS items, with the subsequent shipment of treatment residues and other CAIS items to a commercial hazardous waste treatment, storage, and disposal facility (TSDF); (3) onsite repackaging using the RRS, with subsequent final treatment at a commercial TSDF; or (4) offsite shipment to an Army installation in the lower 48 states for treatment of the CWM CAIS items using the RRS, with subsequent shipment of treatment residues and other CAIS items for final treatment at an approved hazardous waste TSDF. Based on the evaluation presented in this report, the U.S. Army is recommending alternative 2 as the preferred removal action alternative.

This EE/CA was originally published in May 1997. It has been edited to include an additional pig, discovered in June 2000, during the demolition of the U.S. Air Force (USAF) Long-Range Radar Site in Tin City, Alaska. The USAF transported the pig to storage at Ft. Richardson with the CAIS recovered from the PRDA. The EE/CA has also been revised to reflect current PRDA status, RRS design, schedule for alternative 2, applicable regulations and costs.

Section 1 of the EE/CA describes the characterization of the site, including site description and background; previous removal actions; source, nature, and extent of contamination; analytical data; and a streamlined risk evaluation. Section 2 identifies the removal action objectives being evaluated in this EE/CA. Section 3 discusses in detail each of the alternatives with emphasis on effectiveness, implementability, and cost. Section 4 provides a comparative analysis of removal alternatives, while Section 5 provides the rationale for the recommended removal action alternative. Appendices provide backup information.

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SECTION 1
SITE CHARACTERIZATION

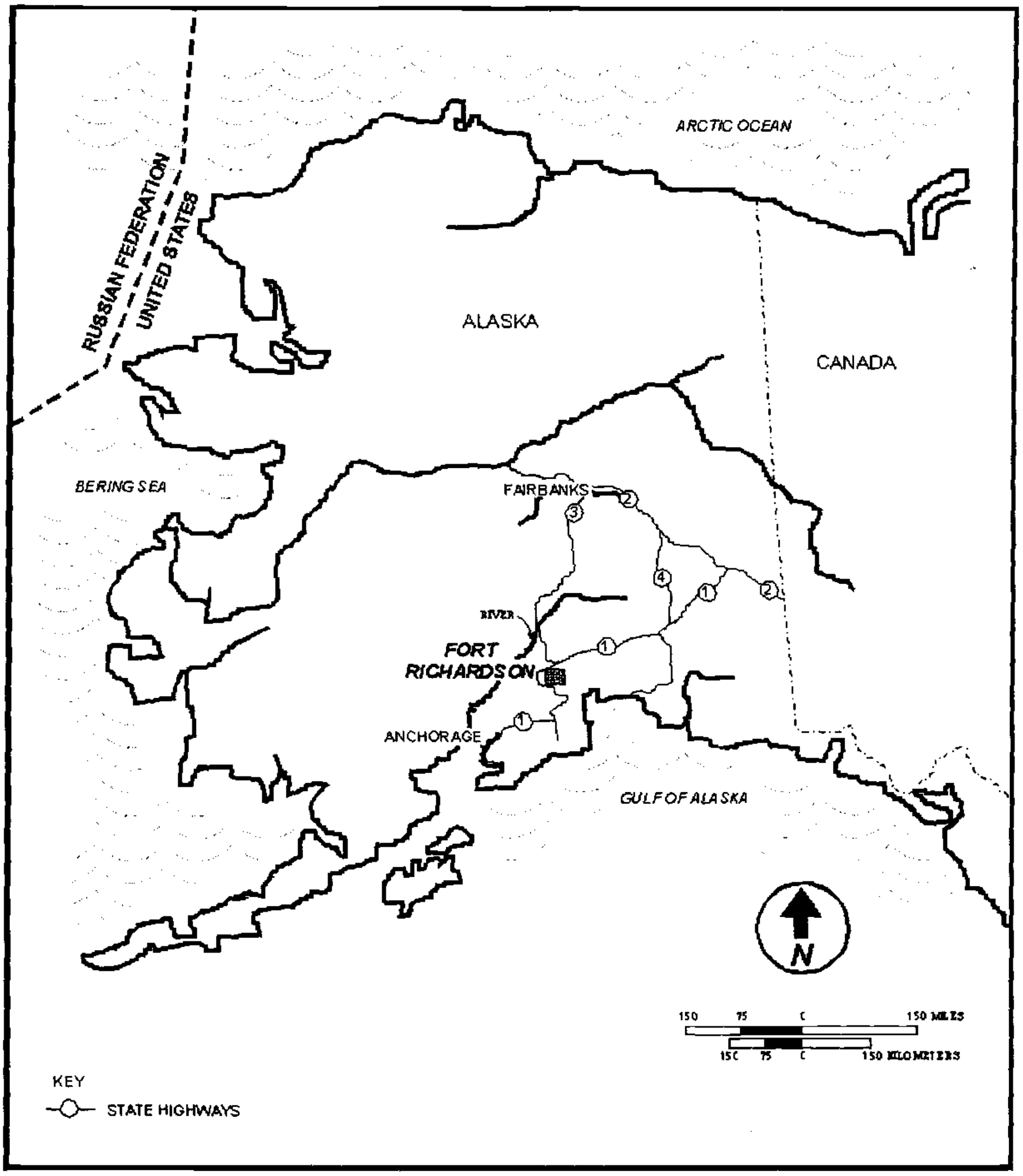
Section 1 provides information on site description and background of the Poleline Road Disposal Area (PRDA) and Ammunition Storage Area A, where the recovered chemical agent identification set (CAIS) items are located at Ft. Richardson, Alaska. Other information provided in this section describes previous removal actions at the PRDA site and the source, nature, and extent of contamination specific to the CAIS items that will be addressed under this Engineering Evaluation/Cost Analysis (EE/CA).

1.1 Site Description and Background

This section summarizes available data on the physical, demographic, and other characteristics of the site and surrounding areas to describe the nature of the site.

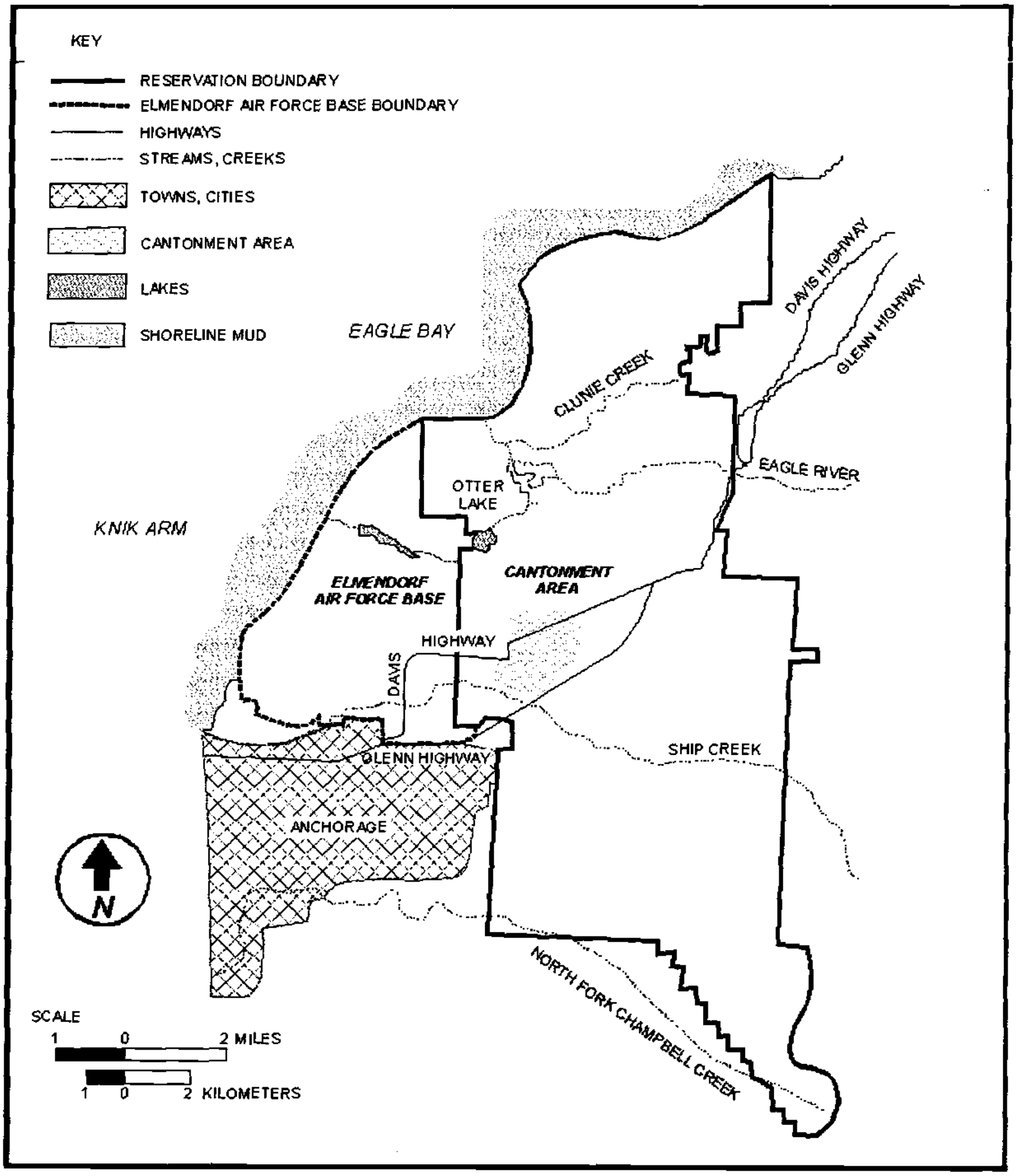
1.1.1 Site Location. Ft. Richardson is located within the municipality of Anchorage, in south-central Alaska (Figure 1-1), at approximately 61°15' latitude north and 149°40' longitude west. Alaska Highway 1 (Glenn Highway) and Davis Highway cross through the center of the installation (Figure 1-2). These two roads connect the city of Anchorage to the southwest of the installation with the suburban community of Eagle River to the northeast. The installation's main gate is located along Glenn Highway at the Ft. Richardson/Arctic Valley exit (Figure 1-3). Ft. Richardson's cantonment area (temporary quarters for troops) is located in the central part of the installation and is between and around Arctic Valley Road and Glenn and Davis highways.

The CAIS items recovered from the PRDA site are presently stored in Building 55228 (Bunker D-15), which is located on the northern portion of Ft. Richardson's Ammunition Storage Area A, approximately 1.5 miles northwest of the cantonment area (Figure 1-3). The PRDA site is located approximately 4.2 miles east-northeast of Building 55228 (Bunker D-15), and approximately 3 miles northeast from the cantonment area (Figure 1-4).



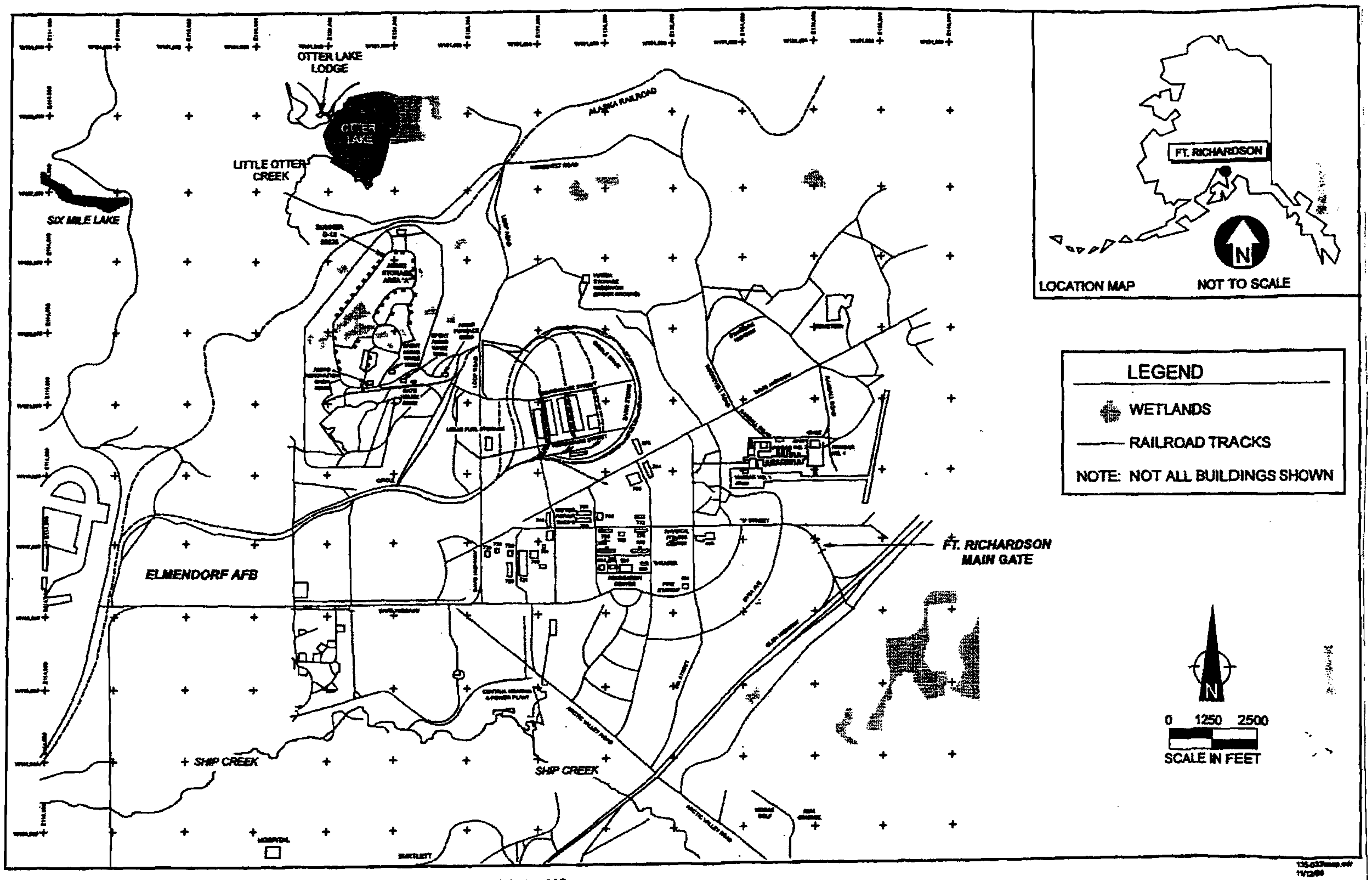
Source: USATHAMA, 1983

Figure 1-1. Location of Ft. Richardson



Source: USATHAMA, 1983

Figure 1-2. Ft. Richardson Map



Source: Corps of Engineers/FTR-MST/Inv. No. DACA85-00-B, Project 9000-036, July 8, 1995.

Figure 1-3. Ft. Richardson Cantonment Area and Vicinity

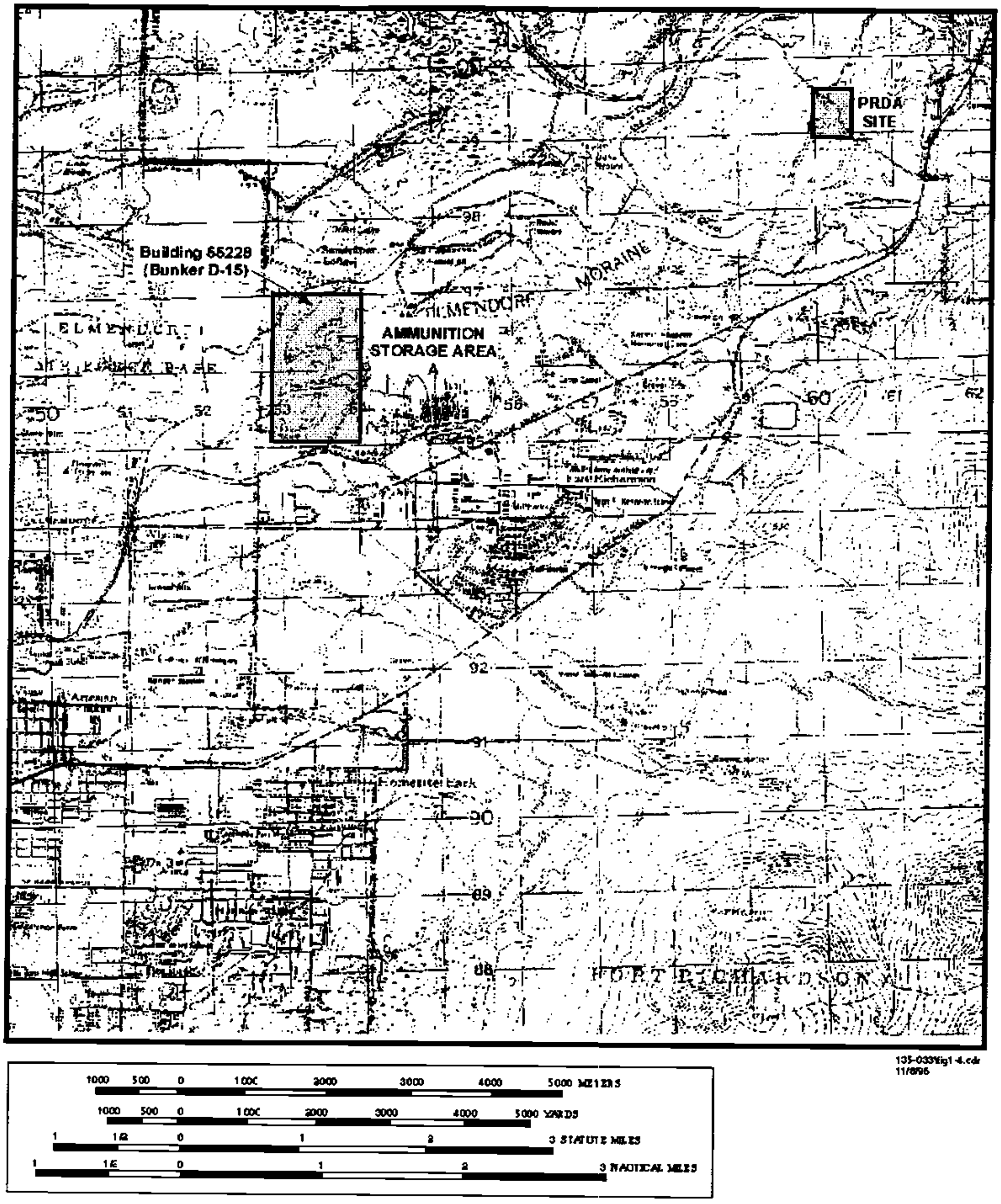


Figure 1-4. Location of Poleline Road Disposal Area Site Relative to Building 55228 (Bunker D-15)

1.1.2 Type of Facility and Operational Status

Ft. Richardson is the headquarters for the U.S. Army Alaska (USARAK). The principal mission of USARAK is "to command and control United States forces in Alaska and provide the services, facilities, and infrastructure to support power projection and training to rapidly deploy Army forces from Alaska in the conduct of contingency operations within the Pacific theater and elsewhere as directed" (Blake Publishing, 1995).

The largest military tenant at Ft. Richardson is the Alaska National Guard, which has facilities at Camp Carroll and Camp Denali within the installation. Other major nonmilitary tenant activities at Ft. Richardson include the Ft. Richardson National Cemetery, which belongs to the Veteran's Administration, and the Ft. Richardson Fish Hatchery, run by the state of Alaska (Blake Publishing, 1995).

Ft. Richardson was initially established as an Army Air Corps Post in 1940. In 1950, the installation was divided between the Army and the Air Force. The Army acquired additional lands and established a new cantonment area on the northern part of the old Army Air Corps Post. The new cantonment area was completed in 1955 and became the center of the installation now known as Ft. Richardson. The Air Force portion in the old Army Air Corps Post became Elmendorf Air Force Base.

More than 75 percent of the total land area in Ft. Richardson is dedicated to ranges, combat courses, drop zones, airfields, troop loading yards, training facilities, open storage areas, and ammunition storage areas. Other industrial-type activities that take place at Ft. Richardson occur mostly in the cantonment area and include the following: vehicle maintenance, general equipment and building maintenance, pest control and grounds keeping, photographic processing, printing, dry-cleaning, drinking water treatment, water quality and petroleum analysis, heat and electrical power generation, and dental and medical services. There are also several former construction and sanitary landfills scattered throughout the installation [U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), 1983]. [Note: These landfills are located in the same general area of Ft. Richardson and are collectively considered as one large landfill.

This landfill is currently undergoing closure pursuant to the Resource Conservation and Recovery Act of 1976 (RCRA) subtitle D and 18 Alaska Administrative Code (AAC) 60.]

As part of Ft. Richardson's Part B permit application under RCRA, a total of 120 solid waste management units (SWMUs) were identified [U.S. Environmental Hygiene Agency Army (USAEHA, 1991)]. On 29 March 1991, Ft. Richardson entered a RCRA Federal Facilities Compliance Agreement (FFCA) for the implementation of corrective actions to some of the SWMUs.

Ft. Richardson was proposed for inclusion on the National Priorities List (NPL) on 23 June 1993 [58 Federal Register (FR) 34018] and was officially listed on the NPL on 31 May 1994 (59 FR 27989). On 5 December 1994, the U.S. Environmental Protection Agency (USEPA), the state of Alaska, and the Army signed a Federal Facility Agreement (FFA) under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The CERCLA FFA addressed 46 contamination source areas that were determined to pose either an actual or potential threat to human health or to the environment. The purpose of the CERCLA FFA was to investigate the impact of past or present activities at the 46 source areas so that the appropriate response actions necessary to protect the human health, welfare, and the environment may be implemented (USEPA, 1994).

Of the 46 source areas addressed under the terms of the CERCLA FFA, underground storage tanks and other source areas where releases of petroleum, oil, and/or lubricants were suspected to have occurred were designated to be addressed under a separate, parallel-track program, subject to a two-party agreement between the U.S. Army and the state of Alaska. The remaining source areas were grouped into four categories of operable units, based on the amount of available information about the source area; the type of contamination; the geographic location and characteristics of the source area; and the affected media, potential for migration, exposure pathways, and target receptors. However, though some of the source areas would be addressed under a parallel-track program, upon completion of the investigations required under the U.S. Army and state of Alaska agreement, the response actions selected would be incorporated as part of one of the records of decision for implementing the response actions for the operable units, as appropriate (USEPA, 1994).

Some of the source areas addressed under the terms of the CERCLA FFA had been previously incorporated under the corrective action provisions of the 1991 RCRA FFCA. However, the USEPA, the state of Alaska, and the U.S. Army decided that those source areas should instead be addressed under the provisions of the CERCLA remedial response program, addressed in the CERCLA FFA (USEPA, 1994). The PRDA site was one of the source areas to be addressed under the terms of the CERCLA FFA. Under the agreement, the PRDA site was designated as Operable Unit B (USEPA, 1994).

The PRDA site was first investigated as a potential source of contamination in 1990, as part of the Army's Installation Restoration Program for Ft. Richardson. Based on information provided by a former soldier who served at Ft. Richardson during the 1950's and on a 1954 Corps of Engineers map that appeared to confirm the soldier's account, an area along Poleline Road in Ft. Richardson was identified as a site where waste disposal activities may have taken place. As a result of this information, the USATHAMA [now the U.S. Army Environmental Center (USAEC)] contracted with Environmental Science and Engineering, Inc. (ESE) to conduct an expanded site investigation (SI) to evaluate the site, to categorize the nature and/or potential threats to human health and to the environment, and to determine the type of response needed at the site. The expanded SI concluded that there had been releases of chemicals (primarily halogenated solvents) at the site, which posed a potential threat to public health and to the environment, but that the releases did not pose an immediate threat to persons living or working near the site that would warrant an immediate response, such as a removal or emergency action. The report recommended instead that a phased Remedial Investigation/Feasibility Study (RI/FS) [as defined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP)] be conducted at the site (USATHAMA, 1991).

After the expanded SI report was issued in February 1991, several additional investigation activities took place at the PRDA site. These investigations prompted the start of a removal action at the PRDA site in September 1993. OHM Remediation Services, Inc. (OHM) was contracted by the U.S. Army Corps of Engineers, Alaska District (USACENPD) to locate, remove, and dispose of any containers, debris, and contaminated soil present in two suspect burial trenches, identified from the investigations that followed the expanded SI for the PRDA site. The removal action, which later became known as Phase I, took place from September through December 1993, when it was interrupted because objects potentially contaminated with chemical warfare agents were found.

The Phase I removal action was interrupted when two sealed containers (known as pigs), used for packaging CAIS, were found in one of the trenches. At that point, the two pigs were overpacked and sent to Building 55228 (Bunker D-15) for storage, pending a decision on their final disposition. Other containers, contaminated soil, and debris removed from the trenches and the wastes generated during the removal action were shipped offsite for treatment and disposal. The trenches were then backfilled with clean soil, the site was secured, and the contractor was demobilized from the site.

Further work was postponed at the site until the impact of the potential presence of other chemical warfare materiel (CWM) could be evaluated (USACENPD, December 1994).

A new investigation to determine the location and extent of additional buried objects or trenches at the site was conducted by the U.S. Army Corps of Engineers' Cold Regions Research Environmental Laboratory (CRREL). At the same time, a new work plan was developed by OHM and USACENPD in order to continue the removal action at the site. As a result of CRREL's investigation, the site was divided into four general areas: Areas A-1, A-2, A-3, and A-4 (USACENPD, 1994b), shown in Figure 1-5.

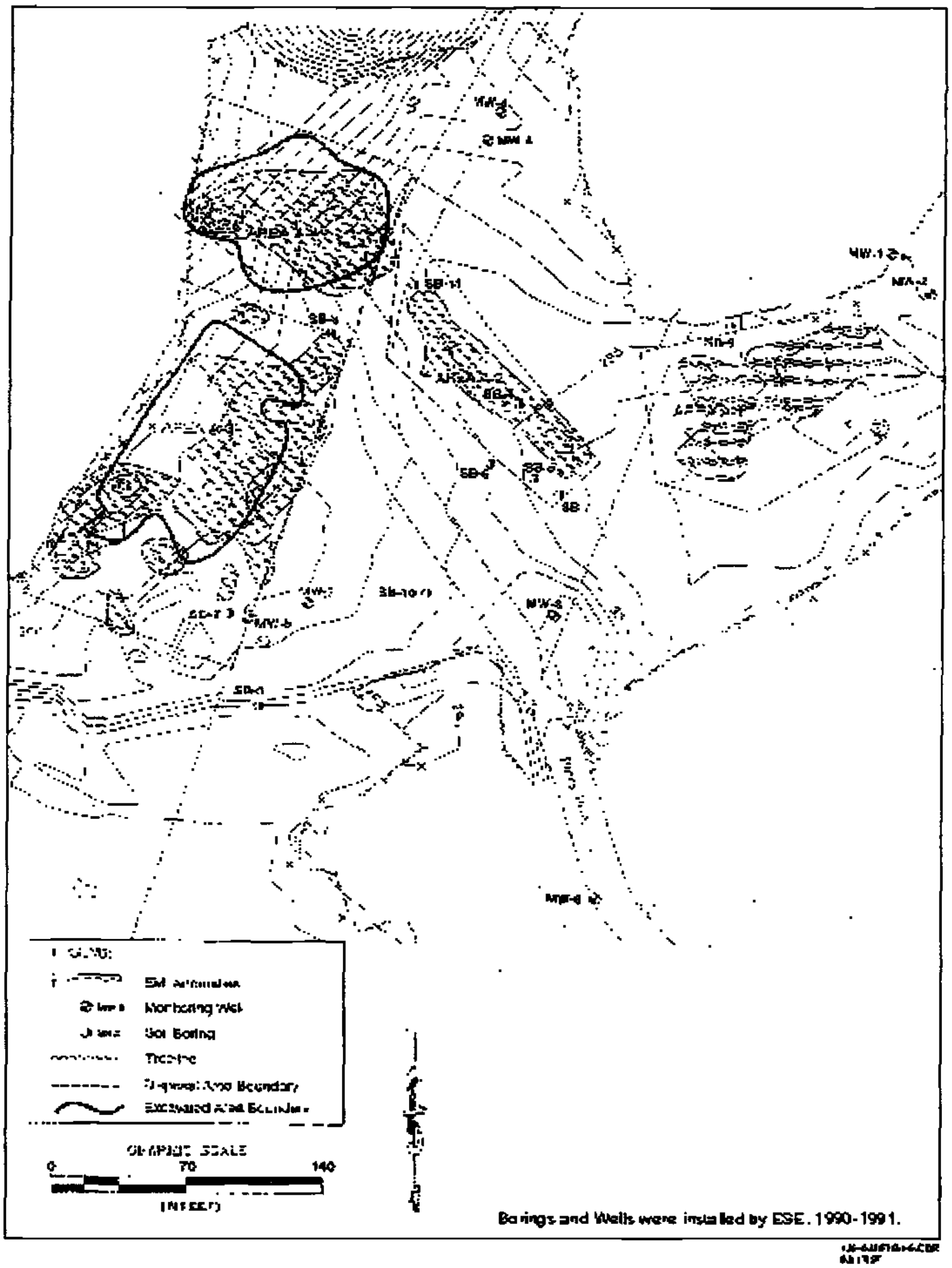


Figure 1-5. Results of 1994 CRREL Geophysical Survey and Outline of Excavated Areas During 1993 and 1994 Removal Actions at the PRDA Site

A combined environmental assessment (EA) and finding of no significant impact (FONSI) was issued for Phase II of the removal action at the PRDA site in June 1994. The Phase II removal action activities involved the following (USACENPD, 1994a):

A. The excavation, removal, and disposal of chemical waste, waste containers, and debris from Areas A-3 and A-4 of the PRDA site (The two trenches previously excavated are located within these two areas.)

B. The removal and temporary storage of contaminated soils excavated from Areas A-3 and A-4, pending a decision on their final disposition

C. The removal and temporary storage of any potential CWM item uncovered at the site, until it could be safely treated or destroyed

D. The collection and analysis of soil samples to define the extent of excavation and removal of contaminated soils and to define the disposal options

E. The collection of groundwater samples to further determine the presence and extent of groundwater contamination.

Phase II of the removal action at the PRDA site took place between July and October 1994. Seven intact pigs, and other CAIS-related items, were found as a result of the Phase II removal action. The CAIS items were overpacked and transported to Building 55228 (Bunker D-15) to be stored along with the previously recovered pigs, pending their final disposition. Other waste containers and contaminated debris removed from the trenches, and the waste generated during the removal action, were shipped offsite for treatment and/or disposal (USACENPD, 1994b).

The CERCLA FFA was signed shortly after the Phase II removal action for the PRDA site had been completed. The CERCLA FFA incorporated the ongoing removal action work at the PRDA site as part of the work to be conducted pursuant to the agreement. Additionally, the CERCLA FFA directed that an RI/FS be initiated at the site by March 1995 (USEPA, 1994).

In May 1995, USACENPD published a draft EE/CA for the treatment and disposal of two soil stockpiles that resulted from the Phase II removal activities. The alternatives evaluated by the EE/CA included the following: no action; shipping to an offsite facility for disposal in a Subtitle C hazardous waste landfill or for treatment by high-temperature incineration; and onsite treatment using either bioremediation, incineration, or low-temperature thermal desorption. The report recommended onsite treatment by low-temperature thermal desorption (USACENPD, 1995a).

On June 5, 1995, OHM and USACENPD remobilized to the PRDA site to conduct a Phase III removal action to decontaminate the rocks stored at the PRDA site stockpile storage area.

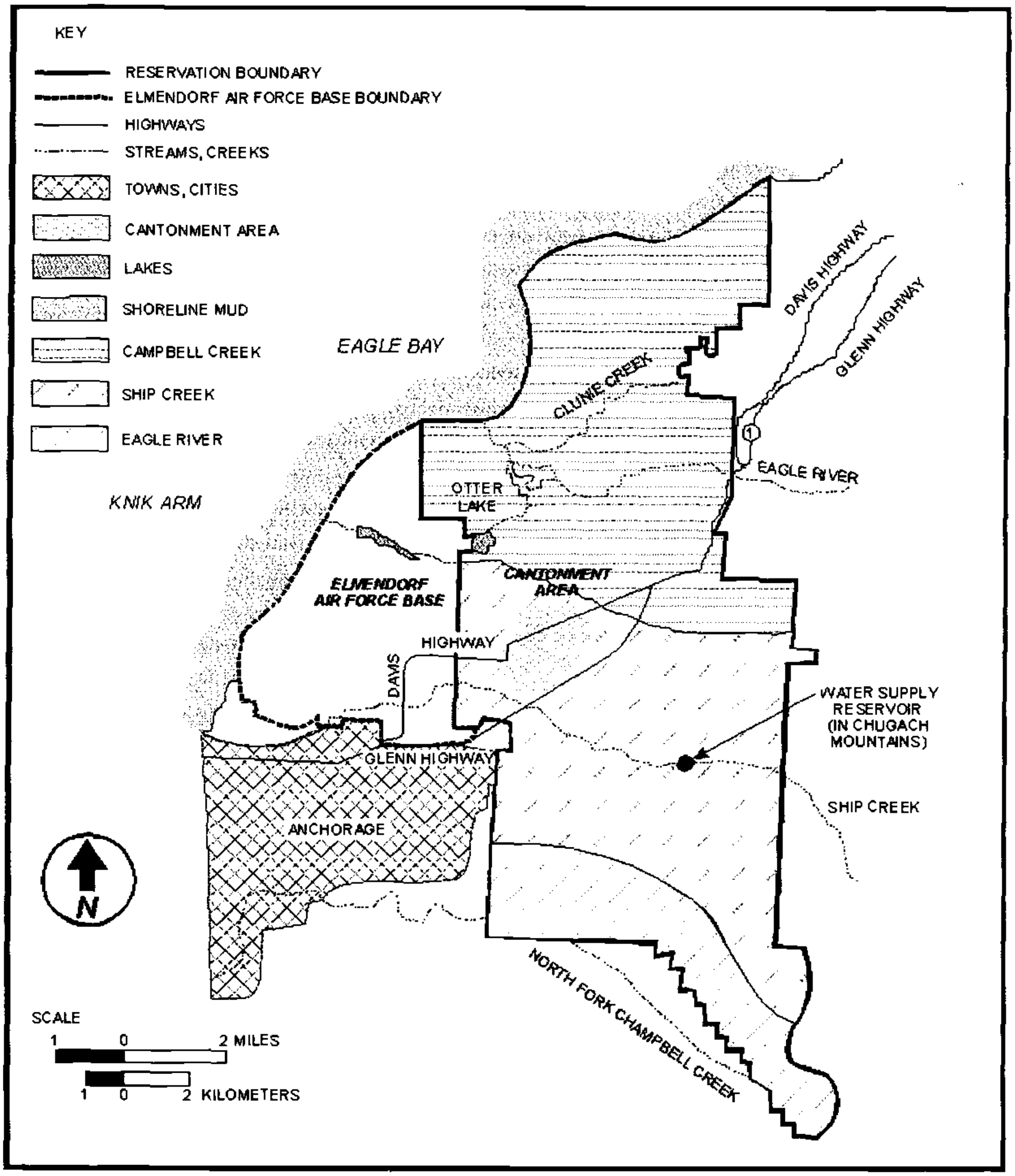
The Record of Decision (ROD) for the Poleline Road Disposal Area (Operable Unit B) was signed on September 14, 1997. The ROD primarily addressed the remediation of soil and groundwater contaminated with volatile organic compounds. The selected remedy for the site contamination in the ROD was High Vacuum Extraction (HVE) within the "hot spot" (area of highest solvent contamination). To date, a number of treatability studies have been implemented at PRDA, including soil vapor extraction and air sparging, six-phase heating for in-situ remediation of solvent contaminated soils and ground water, and the dual-phased HVE study. A total of nine long-term monitoring sampling events have been conducted of the PRDA groundwater to determine treatment effectiveness and the potential for migration of contaminants from the area. A soil stockpile generated from the removal action has been remediated (USACEAD, June 2002).

1.1.3 Structures/Topography. Ft. Richardson encompasses approximately 64,000 acres. The installation is bounded to the west by the city of Anchorage and Elmendorf Air Force Base, the Knik Arm waterway to the north, the community of Eagle River and the Chugach Mountains (Chugach State Park) to the east, and privately owned rural lands along North Fork Campbell Creek to the south (Figure 1-6).

With the exception of the areas located by the Chugach Mountains, most of Ft. Richardson lies within the Cook Inlet-Susitna of the Alaska Coastal Trough physiographic province, and the surface elevation generally does not exceed 492 feet above sea level (USATHAMA, 1983). The central and northern regions of the installation, which include Ammunition Storage Area A and the areas around the cantonment area, are flat to gently rolling, with a local relief of 49 to 246 ft above sea level (USATHAMA, 1983).

The general drainage flow at Ft. Richardson is primarily west to northwest toward Knik Arm and is dominated by the following three drainage basins: the Eagle River basin, the Ship Creek basin, and the North Fork Campbell Creek basin (Figure 1-7) (USATHAMA, 1983). The northern half of Ammunition Storage Area A, where Building 55228 (Bunker D-15) is located, drains into the Eagle River basin, while the southern half of Ammunition Storage Area A and most of the cantonment area drains into the Ship Creek basin.

Except for the developed areas, the area around the cantonment area is wooded and contains numerous streams, creeks, and ponds. Small inland freshwater marshes occur along sections of ponds and streams. Little Otter Creek and Otter Lake are located less than 0.5 mile to the north of Ammunition Storage Area A. Little Otter Creek drains into Otter Lake before continuing toward Eagle River through the Eagle River Flats, which is the largest and ecologically most important tidal marsh in the area. Ammunition Storage Area A, however, does not appear to be on a floodplain area (Gardner, 1996b). The cantonment area is the most developed area within Ft. Richardson. The area covers about 2,000 acres in the central portion of the installation, mostly between and around Arctic Valley Road and Glenn and Davis highways. This area includes administrative office buildings, barracks, an airport, recreational facilities, schools, family housing, warehouses, equipment maintenance facilities, heating and power generation facilities, medical and dental clinics, etc. The roads within this area are paved.



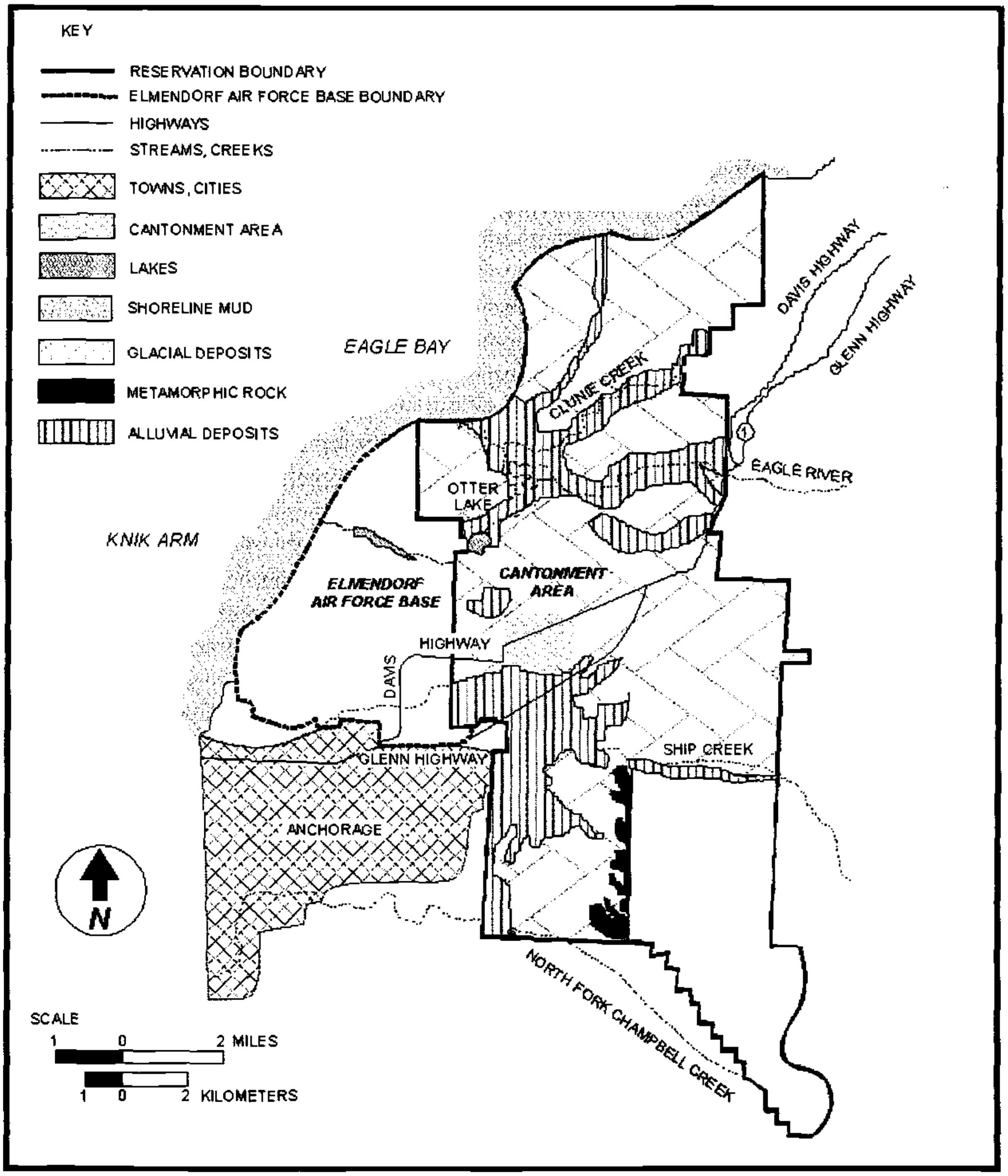
Source: USATHAMA, 1983

Figure 1-7. Ft. Richardson Drainage Basins

Ammunition Storage Area A, where the CAIS items are presently stored in Building 55228 (Bunker D-15), encompasses approximately 460 acres. The area consists of several bunkers for the storage of ammunition as well as other support facilities for maintaining and handling the munitions. The buildings are sited in accordance with Army guidelines for safe distance (i.e., the distance necessary to protect a building from the effects of a detonation in a nearby building, based on the maximum net explosive weight storage capacity for which the buildings are designed). The shortest separation distance between the bunkers in the ammunition storage area is about 200 feet. The perimeter of Ammunition Storage Area A is fenced, and access is controlled through the entrance gates 24 hours a day [U.S. Army Chemical Materiel Destruction Agency (USACMDA, 1994)]. The area is basically flat to gently rolling, wooded, and contains some small inland freshwater marshes. The roadways within the ammunition storage area, as well as those connecting it to the cantonment area, are gravel. Traffic within the ammunition storage area is limited.

1.1.4 Geology/Soil. The geology around Ft. Richardson is characterized by metamorphic bedrock formations and glacial features. Bedrock underlying Ft. Richardson consists of relatively soft, clastic sedimentary rocks of the Tertiary-period Kenai Formation (U.S. Army Garrison, Alaska, 1994). The bedrock formation outcrops in the south-central and southern parts of Ft. Richardson, at the Chugach Mountains (USACENPD, 1994a). This bedrock is covered by Wisconsin deposits of till, outwash, and silt, as well as pleistocene or recent alluvial fan deposits along Eagle River, Ship Creek, and their tributaries (Figure 1-8) (USATHAMA, 1983).

The alluvial fan complex starts at the Chugach Mountains and slopes downward, thickening as it extends to the west and northwest. The upper portion of the alluvial fan complex is comprised of thin, well-bedded and well-sorted gravel deposits, between 30- and 100-ft thick. The gravel grades into sand as the alluvial fan complex extends to the west. Underlying the surface gravel is a 60- to 200-ft thick layer of clay and silt interbedded with fine sand known as Bootlegger Cove Clay. Beneath this layer of clay



Source: USATHAMA, 1983

Figure 1-8. Geology Around Ft. Richardson

and silt is another layer of sand and gravel, 100- to 200-ft thick, which constitutes the main aquifer in the Anchorage area. The Bootlegger Cove Clay acts as a confining layer between the two gravel layers that, in combination with the downward slope of the alluvial fan complex, creates an artesian effect on the lower gravel aquifer. Groundwater flow in this confined aquifer is generally to the west and northwest (U.S. Army Garrison, Alaska, 1994).

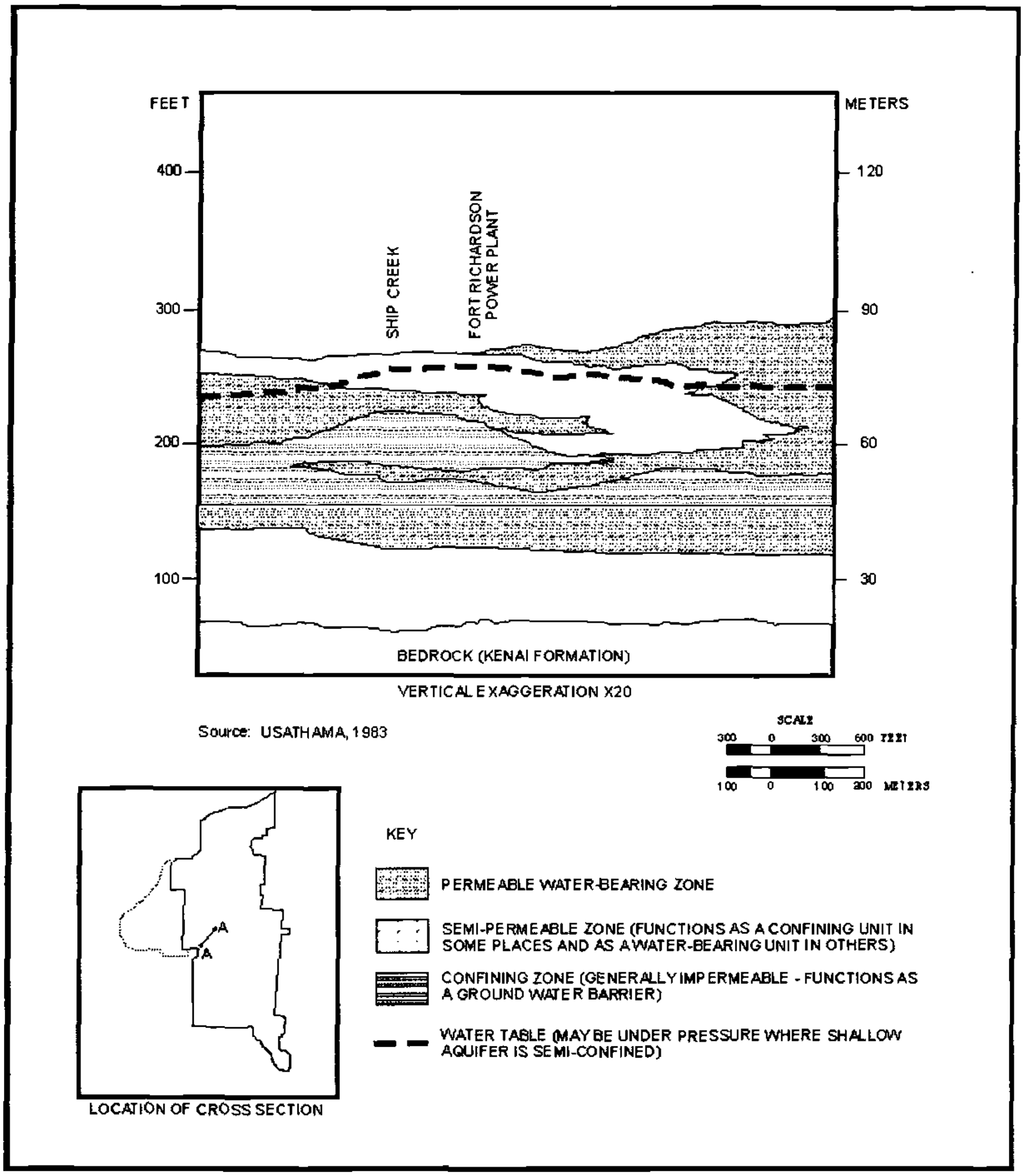
Underlying the lower gravel aquifer is a thick layer of poorly sorted glacial deposits that extend all the way down to bedrock (U.S. Army Garrison, Alaska, 1994).

Figure 1-9 shows a schematic hydrogeologic cross-section of the Ship Creek Valley near the Ft. Richardson power plant, which is 1.5 miles southeast from Ammunition Storage Area A.

Two principal aquifers have been defined in the Anchorage-Eagle River area: a shallow, unconfined aquifer, composed of glacio-fluvial deposits and a deeper, semi-confined fractured bedrock aquifer [Alaska Department of Natural Resources (ADNR), 1992 (as cited in USACENPD, 1995b)].

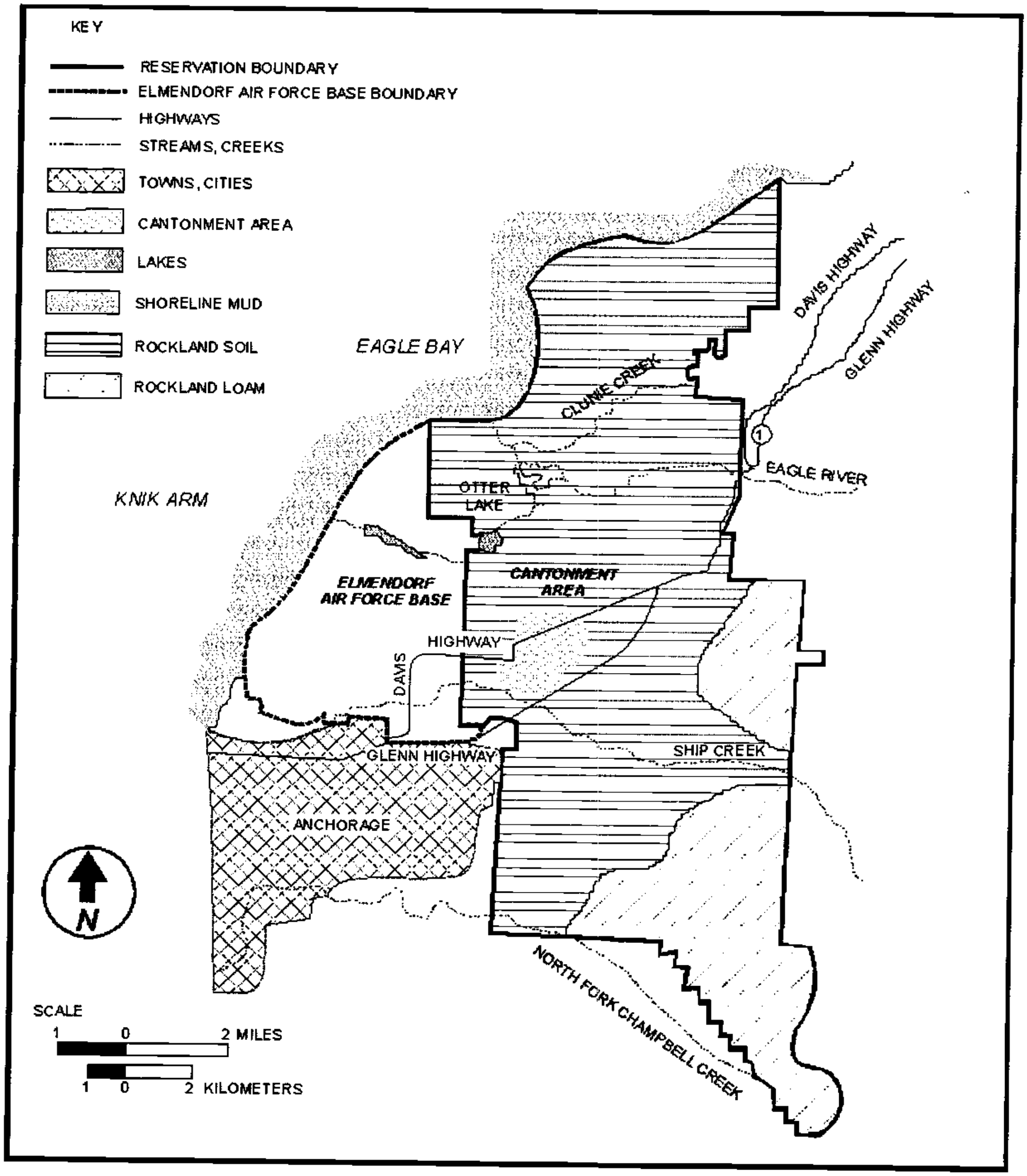
In some areas, these two aquifers are separated by fine-grained silts and clays that act as a confining layer, but the lateral extent of this layer is not known (USACENPD, 1995b).

Although Anchorage is in a seismic zone, no faults run through Ammunition Storage Area A (Gardner, 1996b). The soils at Ft. Richardson generally consist of two main types: Rockland soil and Rockland loam (Figure 1-10). The Rockland soil is comprised mostly of a rocky cobble material, but it may also include poorly to well-drained, very gravelly material. Rockland soil is found mainly in the southwestern portion of the installation in mountainous regions, ice fields, and non-vegetated areas. The most abundant soil type at Ft. Richardson, however, is Rockland loam, which fills the depressions and drainage basins in the lowlands. Rockland loam is comprised of well drained silt loam and peat layers, which overlay layers of gravelly or sandy loam (USATHAMA, 1983).



Source: USATHAMA, 1983

Figure 1-9. Schematic Hydrogeologic Cross-Section of the Ship Creek Valley



Source: USATHAMA, 1983

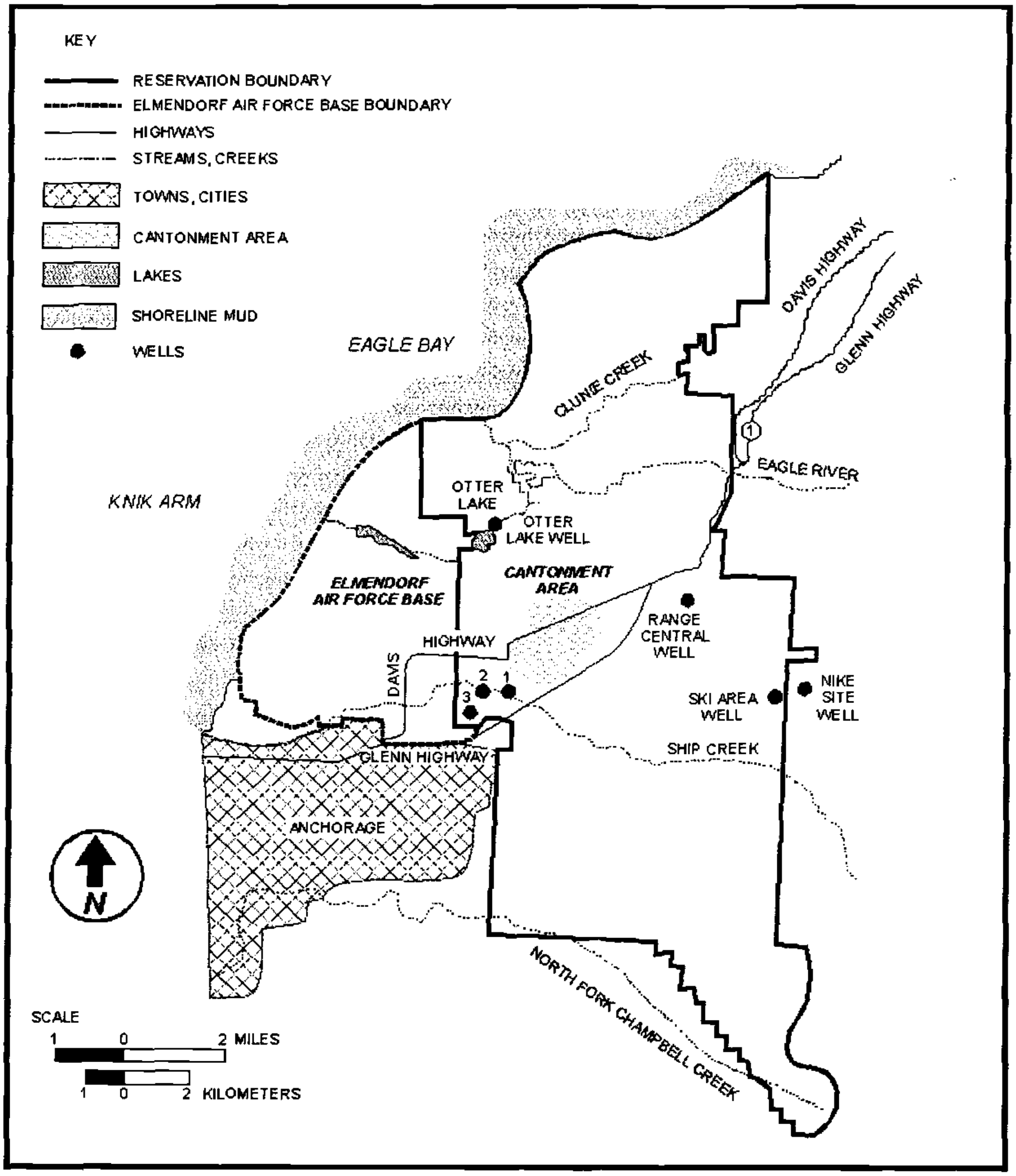
Figure 1-10. Soils at Ft. Richardson

1.1.5 Surrounding Land Use and Population. The areas around Ft. Richardson are mostly undeveloped woodlands. Elmendorf Air Force Base resides to the west of Ft. Richardson, across from Ammunition Storage Area A. Otter Lake, which is less than 0.5 mile away, is used for recreational purposes (USATHAMA, 1983). There is a lodge along the northern shore of Otter Lake [within one mile of Building 55228 (Bunker D-15)], and there are Boy Scout cabins on the south shore of the lake [within 0.5 mile of Building 55228 (Bunker D-15)].

The reservoir located on Ship Creek, shown in Figure 1-7, is the primary source of drinking water (USATHAMA, 1983). Figure 1-11 shows the location of drinking water wells on Ft. Richardson. There are at least four drinking water wells within a 3-mile radius of Ammunition Storage Area A, one by the Otter Lake Lodge, and three standby supply wells by Ship Creek (USATHAMA, 1983).

The population within the Anchorage Municipality is about 260,000 residents (USCB, 2000). The population of the community of Eagle River at the time of the 2000 census was about 12,000 residents. During daylight working hours, there are about 2,050 military personnel and about 4,250 civilian employees and military dependents at Ft. Richardson (USARAK Public Affairs). There are approximately six personnel, including the guard, who work near the Ammunition Storage Area A. They work mostly in the Ammunition Storage Building located near the entrance to Ammunition Storage Area A.

No archeological or historically significant sites have been identified at Ft. Richardson [Reynolds, 1984 (as cited in USACENPD, 1994a)].



Source: USATHAMA, 1983

Figure 1-11. Drinking Water Well Locations on Ft. Richardson

1.1.6 Sensitive Ecosystems. The type of wildlife found at Ft. Richardson is determined by the different habitats and the seasons (USATHAMA, 1983). The different types of habitats that may be found at Ft. Richardson include the following: alpine tundra, sub-alpine habitat, forest habitats, shrub thickets, bogs, and marshes [Gossweiler, 1984 (as cited in U.S. Army Garrison, Alaska, 1994)]. The most prominent and important wildlife species present at Ft. Richardson are large mammals and birds; they consist primarily of moose, bear, Dall sheep, swans, and waterfowl (USATHAMA, 1983).

The most prominent wetlands at Ft. Richardson are Eagle River Flats, Otter Lake Wildlife Area, and the McVeigh Marsh. Eagle River Flats, located along the lower portion of Eagle River, at Eagle Bay, is the largest and ecologically most important tidal marsh along the Knik Arm shoreline. The Otter Lake Wildlife Area, and the McVeigh Marsh are both inland fresh water marshes. All of these wetland areas support a highly diverse population of waterfowl species, serving both as breeding grounds and as migratory staging areas (USATHAMA, 1983).

The Otter Lake Wildlife Area is located within 0.5 mile north of Building 55228 (Bunker D-15), and the Eagle River Flats area is located about 1.5 miles northeast from the building. Little Otter Creek drains Otter Lake and joins the Eagle River near the southern end of the Eagle River Flats. No wetlands have been identified in the vicinity of Ammunition Storage Area A.

The two largest streams in the central portion of the installation, Eagle River and Ship Creek, support runs of chinook, pink, and chum salmon (USACENPD, 1994a). Ship Creek also supports sockeye and coho salmon, rainbow trout, and Dolly Varden (USACENPD, 1994a). Additionally, several other species of trout and nongame species of fish reside in lakes, ponds, and streams throughout the installation (USATHAMA, 1993). The state of Alaska operates a fishery within the boundaries of Ft. Richardson, near Ship Creek, about 2.5 miles south from Building 55228 (Bunker D-15).

No threatened or endangered species have been identified to be present at Ft. Richardson (USACENPD, 1995b).

1.1.7 Meteorology. Ft. Richardson is located in a transitional climate zone between the maritime climate of the coast and the continental climate of interior Alaska. Average temperatures in this area range from -2°C (28.4°F) to 7°C (44.6°F), with an annual mean of 3°C (37.4°F), and temperature extremes ranging from -18°C (-0.4°F) to 33°C (91.4°F). This area receives an annual average rainfall of between 13 to 20 in., with the heaviest period of rain being from July through September. The average rainfall for this 3-month period is close to 7 in. [Alaska Environmental Information and Data Center (AEIDC), 1989 (as cited in U.S. Army Garrison, Alaska, 1994)].

The prevailing winds in the Ft. Richardson area are from the south, although northerly winds may occur between September and April as a result of shallow cold air masses from the north that displace the less dense southerly flow. However, even during this period, the prevailing wind direction at the top of the nearby mountains is still from the south. Temperature inversions, which contribute to the buildup of air pollutants, occur in the Ft. Richardson area about 60 percent of the time and are accompanied by low wind velocities. Mean wind speeds in the area ranging from 2.6 to 3.7 meters per second are common (USATHAMA 1983).

1.2 Previous Removal Actions

OHM began a removal action in 1993, but work was halted when CAISs in metal pigs and other materials related to chemical warfare training activities were unearthed. The CRREL performed a geophysical survey in early 1994, and OHM completed the removal action in October 1994.

Geophysical surveys by ESE in 1990 and CRREL in 1994 were conducted to help locate disposal areas within the PRDA. The surveys identified significant anomalies consistent with trenches and buried waste in four areas at the PRDA. Two of these areas (Areas A-3 and A-4) showed the greatest evidence of buried waste and trenching, including possible stacked canisters or cylinders. These areas were selected for further investigation and removal actions, which were conducted in 1993 and 1994.

Figure 1-5 shows the results of the geophysical survey conducted by CRREL in 1994, including outlines of the areas that were excavated during the 1993 and 1994 removal actions at the PRDA site.

Soils excavated from Areas A-3 and A-4 were sampled. After buried debris was removed, soil sampling was performed on a grid pattern on the bottom and walls of the excavations to confirm that soils exceeding the removal action levels had been removed. Soils were excavated to a maximum depth of 14 feet, where water was encountered.

Soils that met the removal action levels (see the following first bullet) were mixed with borrow soil and returned to the excavations. No additional soil cover was added to Areas A-3 and A-4. Soils that exceeded the action levels were stockpiled in a fenced area southeast of the site on Barrs Boulevard in lined, plastic-covered piles surrounded by berms. These soils were later remediated under a separate contract. Rocks that were separated from the soil were also stored in the same fenced stockpile area. Stockpiled rocks were washed in early summer 1995 under an existing contract between OHM and the Rapid Response section of the Corps of Engineers, Omaha.

Following the removal action completed in October 1994, Trench Areas A-3 and A-4 were excavated and backfilled with a mixture of soil from a borrow pit on the post and excavated soil that meets the following action levels for three chlorinated solvents: 600 mg/kg trichloroethylene, 100 mg/kg perchloroethylene, and 30 mg/kg tetrachloroethane. Various types of buried waste were removed and either detonated, disposed, or stored in an Army bunker for later disposal. Areas A-1 and A-2 have been fenced and covered with a total of approximately three feet of soil. These areas have not been excavated. Soil boring samples revealed low levels of solvents.

A number of treatability studies have been implemented at PRDA, including soil vapor extraction and air sparging, six-phase heating for in-situ remediation of solvent contaminated soils and ground water, and the dual-phased HVE study. A total of nine long-term monitoring sampling events have been conducted of the PRDA groundwater to determine treatment effectiveness, and the potential for migration of contaminants from the area. Soil treatment at the PRDA was discontinued in October 1999 after meeting treatment goals (USACEAD, June 2002). The current condition of the site is as follows:

- Continued long-term groundwater monitoring at PRDA at the rate and frequency of 18 monitoring wells semi-annually for two more years, at which point an evaluation will be conducted to determine whether the frequency can be scaled back based on the sampling data.
- Soils will be monitored for natural attenuation until the groundwater contaminant concentrations meet state and federal requirements.
- The wetlands area has not been investigated, with the exception of a geophysical survey that revealed the presence of small metallic objects.

1.3 Source, Nature, and Extent of Contamination

This section summarizes the available information about the location, type, and attributes of the contaminants present or potentially present at the site, and it identifies the population that potentially could be affected.

1.3.1 Location of the Hazardous Substances, Pollutants, or Contaminants. The CAIS items recovered from the PRDA site are presently stored in Building 55228 (Bunker D-15), located in the northern portion of Ammunition Storage Area A. Building 55228 (Bunker D-15) consists of an Army standard earth-covered semicircular arch steel magazine. The building is constructed of corrugated steel plates bolted together and attached to a reinforced concrete foundation (Figure 1-12). The steel layer is covered by a 6-in. sand filter layer and by a minimum 2-ft thick earthen cover.

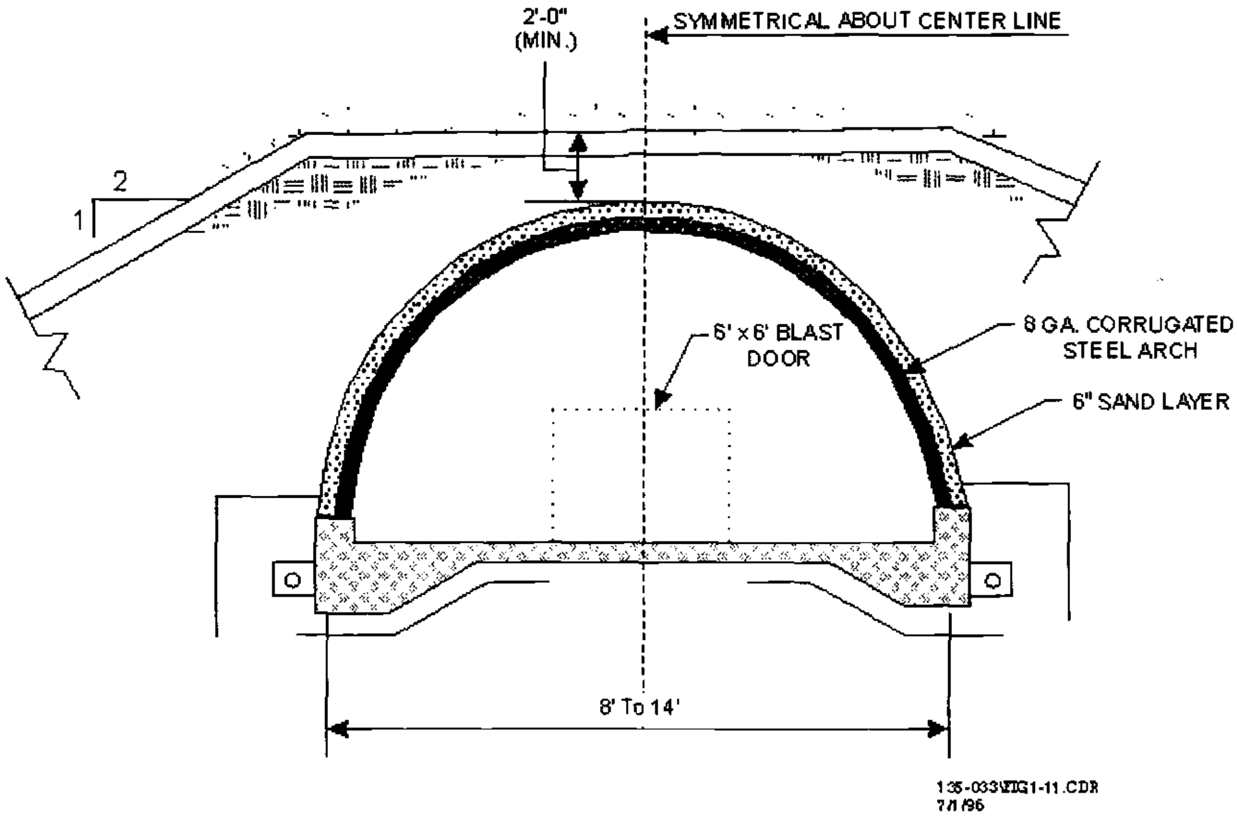


Figure 1-12. Standard Earth-Covered Semicircular Arch Magazine (Cross-Section)

The floor of the building is made of a smooth concrete slab that drains toward the sides and the front of the building. Two drainage gutters run the length of the building, one on each side. Each of these gutters is designed to discharge to the outside of the building. To reduce the possibility of discharges to the outside of the building, the gutters or outlets are filled with adsorbent material.

The interior dimensions of the building are approximately 26.5 ft wide by 60 ft long, and 13 ft high at the highest point. The building has approximately 1,060 square foot of available storage space. Presently, the building is used to store only the CAIS items removed from the PRDA site.

Access to Building 55228 (Bunker D-15) is by means of a double door, constructed with a steel plate and equipped with a high-security lock. The building is equipped with a passive ventilation system, consisting of vents located on the front, near the door, and a screened ventilation stack located at the rear end of the building. The building is also equipped with an intrusion detection system, which alarms in the event of unauthorized entry.

1.3.2 Hazardous Substances, Pollutants, or Contaminants Present at the Site.

During the Phase I Removal Action, several small empty amber jars (at least 20) were found during the excavation of Trench A. The jars had legible print on the outside which read, "HD - TOXIC GAS SET M1." Specification sheets for M1 pigs were also found. Two pigs containing CAIS were subsequently found in Trench B (USACENPD, December 1994). Analysis of samples collected from the soil excavated from Trenches A and B during the Phase I Removal Action confirmed the presence of Adamsite (DM) at the site (USACENPD, 1994b).

During the Phase II Removal Action, nine full or partially full glass bottles labeled "HD- TOXIC GAS SET M1"; one glass vial with a stopper (no comment as to whether it was empty or full); one amber bottle, 8-in. tall and 3-in. in diameter; one amber bottle, 24-ounce volume, with a small amount of clear liquid; five empty, unmarked, clear bottles, and various pigs (six empty and four full) were recovered from the PRDA site (USACENPD, 1994b).

Soil samples collected during the Phase II Removal Action were analyzed for distilled mustard (HD), 1,4-dithiane, 1,4-thioxane, and Lewisite. None of these compounds were detected (USACENPD, 1994b).

Based on a visual inventory performed in July 2002 of Building 55228 (Bunker D-15), where the CAIS items are presently stored, and previous reports, the following items from the PRDA activities are present:

A. Seven single round containers (SRCs), each holding one intact pig. One of the SRCs also contained an empty bottle marked "CN" (chlorocicetophenone a tearing agent,) but this bottle was subsequently removed from the SRC, decontaminated, and repackaged in one of three laboratory sample containers (LSCs) also in storage at the bunker. Moreover, one of the SRCs also contained a damp piece of cloth; this piece of cloth was removed, decontaminated, and repackaged in a 85-gal drum (described in Paragraph C).

B. Three LSCs, one containing three 3.5-ounce empty mustard bottles and one glass vial, one containing three empty 3.5-ounce mustard bottles, and one empty. The empty CN bottle removed from the SRC was repackaged in the LSC containing the glass vial. The LSCs are overpacked in wood crates.

C. An 85-gal drum containing fifteen empty mustard bottles, a piece of canvas, and the damp cloth that was removed from the SRC. The mustard bottles and the piece of canvas were decontaminated and tested for the presence of mustard.

D. Two metal buckets: one metal bucket previously stored the mustard bottles and one stored the piece of canvas.

An assessment of the seven SRCs was performed on August 5, 2000. Each SRC was x-rayed to determine its contents. Two of the SRCs appeared to be empty with only a small amount of unknown fill and no evidence of CWM. Four of the SRCs contained no evidence of CWM ampoules or bottles but may have K951/952 packing material. One SRC contains possible K941 mustard bottles; however, none of the CAIS items appeared to be in their original configuration.

The description of the contents of a K941 CAIS (Army designation M1) indicates that each set consists of 24 glass bottles, each 4.0 ounces in volume and typically filled with 3.5 ounces Levinstein mustard (H or HS) or HD. The bottles are round, have a screw top, and are marked with heat-resistant paint that reads "H-," "HS-," or "HD-," followed by the words "TOXIC GAS SET M1" [Program Manager for Chemical Demilitarization (PMCD), 1995].

The description provided by OHM and the x-ray assessment of the items recovered during the Phase I and II removal action suggests that the CAIS items recovered from the PRDA site are K941 sets. However, the presence of Adamsite (DM) in soil samples collected from the PRDA site, and the presence of a bottle of CN in the list of items inventoried at Building 55228 (Bunker D-15), seems to suggest that either K941 is not the CAIS recovered at the PRDA site, or there may have also been other configurations of CAIS present at the site.

Based on the presence of DM in soil samples collected during the Phase I Removal Action, and the presence of an empty bottle marked CN among the items inventoried in Building 55228 (Bunker D-15), another possibility is the K955 CAIS. According to the description of the K955 CAIS (PMCD, 1995), each K955 CAIS consists of seven 4.0-ounce glass bottles. Four of these glass bottles contain 90 cubic centimeters of activated charcoal, each, on which 25 milliliters of agent is adsorbed. Of these four glass bottles, two contain HD, one contains Lewisite (L or M-1), and one contains chloropicrin (PS). Of the three bottles remaining in the K955 CAIS, one contains six grams of triphosgene, a simulant of phosgene (CG); one contains 15 grams of CN; and one contains 15 grams of DM.

However, according to the draft EA/FONSI (USACENPD, 1994a), the CAIS items discovered at the PRDA site reportedly consisted of K951s. According to the description for the K951 CAIS (PMCD, 1995), this CAIS configuration consists of 48 Pyrex™, flame-sealed ampoules; 12 containing a 5 percent solution of mustard agent (H) in chloroform, 12 containing a 5 percent solution of L in chloroform, 12 containing a 50 percent solution of PS in chloroform, and 12 containing neat CG. Each ampoule contains approximately 40 milliliters of the corresponding solution.

The lack of a detailed inventory of the CAIS items recovered from the PRDA site, along with the apparent discrepancies in the available information, as previously discussed, make it reasonable to conclude that any or all of the three possible CAIS configurations could be in storage in Building 55228 (Bunker D-15) at Ft. Richardson. Table 1-1 provides a brief summary description of each of the three CAIS configurations thought to be in storage. Detailed descriptions of these CAIS can be found in Appendix B.

Table 1-1. CAIS Configurations Suspected to be at Ft. Richardson

Chemical	CAIS Set K941	CAIS Set K951/K952	CAIS Set K955
Mustard (H, HS or HD)	24 bottles, 3.5 oz each pure (neat) mustard	12 ampoules with 2 mL in 38 mL chloroform solution (5% concentration)	2 bottles, with 25 mL adsorbed in 90 cc of charcoal each
Lewisite (L)		12 ampoules with 2 mL in 38 mL chloroform (5% concentration)	1 bottle, with 25 mL adsorbed in 90 cc of charcoal
Chloropicrin (PS)		12 ampoules with 20 mL in 20 mL chloroform (50% concentration)	1 bottle, with 25 mL adsorbed in 90 cc of charcoal
Phosgene (CG)		12 ampoules with 40 mL [pure (neat) phosgene]	
Triphosgene			1 bottle, 6 grams
Chloroacetophenone (CN)			1 bottle, 15 grams
Adamsite (DM)			1 bottle, 15 grams

Notes:

CAIS = chemical agent identification set
mL = milliliters
oz = ounce

Source: Chemical Agent Identification Sets Information Package, PMCD, 1995.

1.3.3 Chemical and Physical Attributes of the Hazardous Substances, Pollutants, or Contaminants Estimated to Be Present at the Site. Table 1-2 provides the chemical and physical attributes of the hazardous substances, pollutants, or contaminants suspected to be in the CAIS present at the site. The CAIS are packed in pigs, cylindrical carbon steel containers with one sealed (welded) end and the other end with a flange where a carbon steel cap is bolted in place to seal the pig shut. Since these pigs had been buried for a number of years, their condition is not known. Therefore, the pigs are presently overpacked in SRCs. SRCs are carbon steel, single-trip containers specifically designed to store chemical munitions and to meet the minimum general packaging criteria for transportation required by the Department of Transportation (DOT). The SRCs come in various sizes. The pigs at Ft. Richardson are overpacked in SRCXXs that have a volumetric capacity of about 0.9 cubic meters (23 gal). Table 1-3 provides general toxicological data for the chemicals potentially present at the site.

1.3.4 Target Populations Potentially Affected by the Site. Because of the low volume of material in the ampoules, an exposure would be limited to a short, one-time occurrence. Since CAISs were used to train military personnel in the detection of CWM, it is assumed that exposure to the concentrations of CWM agents in CAIS would not result in acute or chronic effects. At most, exposures could result in irritation of the skin and eyes.

Most likely targets to be affected in the event of a release are fauna in the general area of the release and any humans (workers) close enough to the area to inhale vapors and gases resulting from a release. Given the small amount of material in storage, groundwater and surface water contamination would be expected to be below detection limits. Soil (or concrete) contamination would be limited to the immediate area of the release.

Table 1-2. Selected Chemical and Physical Properties of CAIS Contents

Agent	Vapor Density (Referenced to Air)	Freezing Point (°C)	Boiling Point (°C)	Hydrolysis Rate	Persistence	Odor	Solubility in Water
Sulfur Mustard (HD)	5.5	13 to 14	215 to 217	97% complete in 27 min. at ambient temperature	Long - 1.5 - several days to years	Garlic	1 g/L
Levinstein mustard (H)	5.4	10 to 15	217	Very rapid	Long	Garlic	Slightly soluble
Lewisite (L)	7.2	-44.7	169.8	Rapid	Short	Geraniums	0.05 g/L
Chloropicrin (PS)	5.7	-64	112	--	--	--	0.18 g/ 100g
Phosgene (CG)	1.38 g/mL	-118	7.6	Complete in <20 seconds. Hampered by low solubility.	Short	Rotting fruit or hay	0.3 g/L
Chloroacetophenone (CN)	5.3	56.5	247	Slow	Hours and days	Apple blossoms, irritating	Insoluble
Adamsite (DM)	Forms little vapor	195	410	Slow	Short	Odorless	Insoluble
Chloroform	4.13	-63.5	61	Rapid	Short	Ether-like	Insoluble

Notes:

CAIS = chemical agent identification set
g/L = grams per liter
g/mL = grams per milliliter

Source: Chemical Agent Identification Sets Information Package, PMCD 1995.

Table 1-3. Toxicological Data of the Chemicals Potentially Present at the Site

Chemical	Type of Agent	Primary Target Organs	Acute Effects	Chronic Effects
Chemical Warfare Materiel:				
Sulfur mustard	Blister agent (vesicant)	Acute: skin, eyes; Chronic: lungs, hematopoietic system	Skin LD_{50} - 100 mg/kg; oral LD_{50} - 0.7 mg/kg; Odor threshold - 0.0006 mg/m^3; effects include skin penetration, swelling, reddening; inflammation of conjunctiva and cornea; Systemic effects include bronchitis, diarrhea, apathy; near toxic levels cause damage to bone marrow	Lung impairment, cancer of the mouth, throat, skin, respiratory tract and leukemia; may cause birth defects
Lewisite	Blister agent (vesicant)	Acute: skin, eyes; Chronic: lungs	Inhalation LC_{50} - 1,200 to 1,500 mg min/m^3; severe damage to eyes; blistering, burning of skin	Chronic lung impairment; suspected human carcinogen
Hazardous Chemicals:				
Phosgene	Choking agent	Acute: lungs, mucous membrane, skin, eyes Chronic: same	Inhalation LC_{50} - 3,200 mg/m^3; Odor threshold - 0.5 ppm; 2 ppm is immediately dangerous, causing respiratory failure; skin contact results in burns; conjunctivitis	
Chloropicrin	Tear Agent (lacrimator)	Acute: eyes, respiratory system; Chronic: pulmonary system	Odor threshold - 0.0073 mg/L (1.1 ppm); 0.3 ppm for few seconds result in eye, skin irritation; 15 ppm intolerable due to irritation effects; 120 ppm for 30 min could result in death from pulmonary edema	Increased susceptibility to subsequent exposures

Table 1-3. Toxicological Data of the Chemicals Potentially Present at the Site (Concluded)

Chemical	Type of Agent	Primary Target Organs	Acute Effects	Chronic Effects
Hazardous Chemicals (Continued):				
Chloroacetophenone	Tear Agent (lacrimator)	Acute - eyes, skin, lung; Chronic - respiratory system	High concentrations result in conjunctivitis and corneal damage; low concentrations result in irritation of eyes and upper respiratory system	No reported effects
Adamsite	Vomiting Agent (sternutators)	Acute: respiratory system, eyes	Inhalation LC_{50} - 11,000 mg/m^3; causes sneezing and nasal pain, coughing, nausea at concentrations as low as 0.75 mg/m^3; vomiting	Dermatitis. Little indication of other cumulative toxic effects due to repeated exposures. Tolerance builds over time.
Chloroform	N/A	Acute: eyes, skin, lungs; Chronic: respiratory system	Headaches, dizziness and stupor, nausea and vomiting. Severe overexposure may cause muscular incoordination, unconsciousness and death. LD_{50} oral -908 mg/kg LC_{50} inhalation - 28 g/m^3	Headache, mental confusion, loss of balance, dermatitis.

Notes:

LC_{50} = Lethal Concentration 50%
LD_{50} = Lethal Dose 50%
OSHA = Occupational Safety and Health Administration
PEL = permissible exposure limits

Source: Chemical Agent Identification Sets Information Package, PMCD 1995.

1.4 Tin City, Alaska CAIS

In June 2000, a K-941 pig was discovered during the demolition of the U.S. Air Force (USAF) Long-Range Radar Site in Tin City, Alaska (Figure 1-13). The USAF arranged for transportation to and secure storage of the pig at Ft. Richardson. Building 55228 (Bunker D-15) in the Ammunition Storage Area at Ft. Richardson, which contained the similar pigs recovered from the PRDA, met all the applicable storage requirements.

In July 2000, the U.S. Army Technical Escort Unit (TEU) transported the pig from Tin City to Ft. Richardson and placed it in secure storage in Building 55228 (Bunker D-15). A x-ray of the pig shows that the CAIS items in the Tin City pig appear to be an intact K941 set. Table 1-1 describes the typical configuration of K941 CAIS. Table 1-4 is a detailed inventory of Building 55228 (Bunker D-15).

In September 2002, the Environmental Protection Agency (EPA) determined that the Tin City pig could be handled for treatment and disposal under CERCLA with the other CAIS items stored in building 55228 (Bunker D-15). A non-contiguous facility rule expands CERCLA to allow for inclusion of the Tin City pig. This approach is also in compliance with the Federal Facilities Agreement (FFA).

1.5 Analytical Data

Chemical analyses have not been performed to characterize the contents of the pigs presently stored in Building 55228 (Bunker D-15). Manufacturer's specifications and generator knowledge have been used to estimate the contents of the pigs. All of the pigs were x-rayed. The x-rays indicate the presence of K941 bottles in two of the pigs and debris in the balance of the pigs.

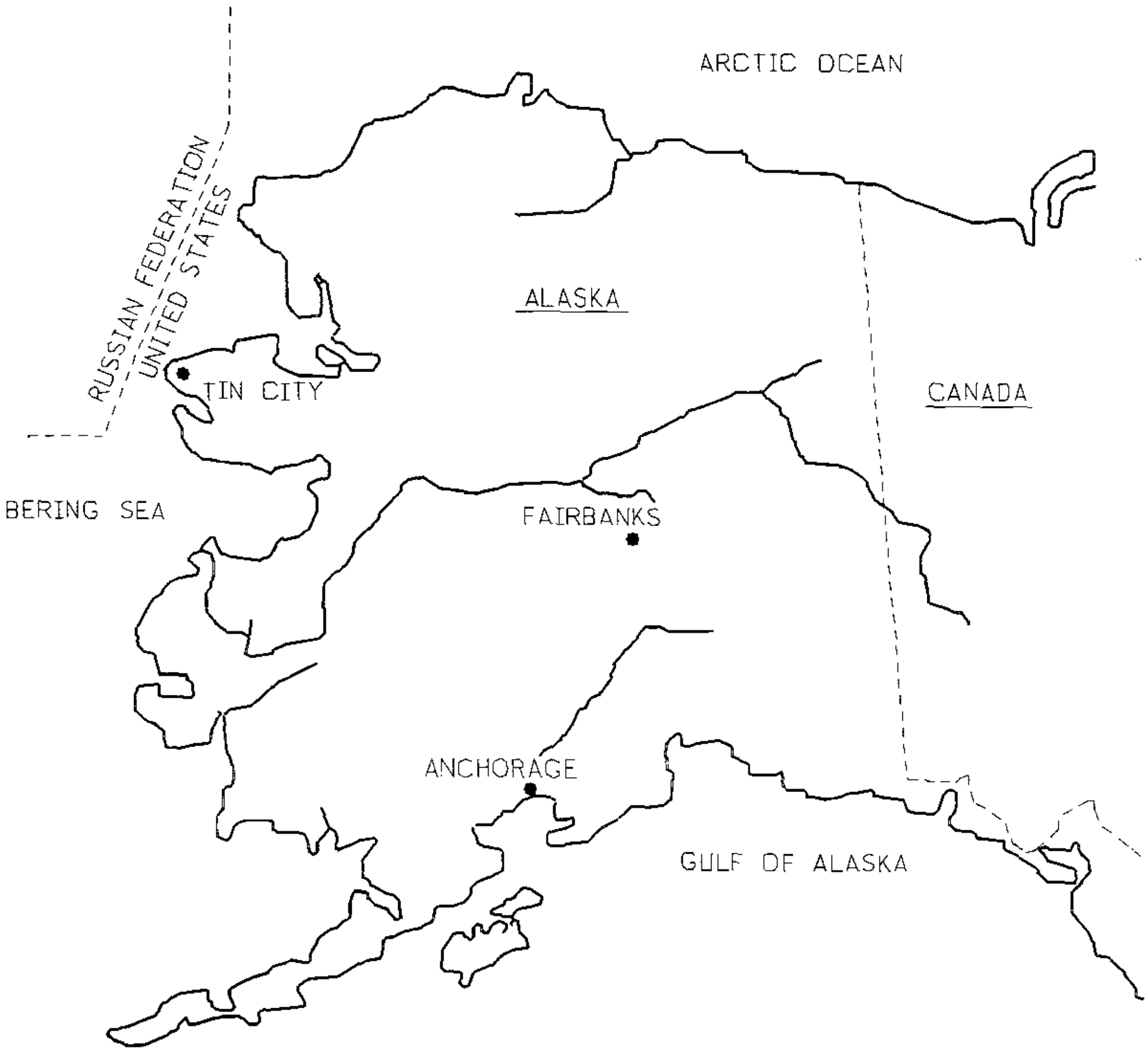


Figure 1-13. Location of Tin City

Table 1-4. Inventory of Bunker D-15

Item	Container No.	Contents[1]
SRC/MRC	01	Contents appear to be unknown cushioning material with no evidence of intact CAIS ampoules/bottles or CWM. Circular objects present in x-rays are possible caps from the cardboard container of the K951/952 packing material. It is suspected that the SRC is filled with dirt and CAIS packing residue.
SRC/MRC	02	Contents appear to be unknown cushioning material with no evidence of intact CAIS ampoules/bottles or CWM. Circular objects present in x-rays are possible caps from the cardboard container of the K951/952 packing material. It is suspected that the SRC is filled with dirt and CAIS packing residue.
SRC/MRC	03	Contents appear to be unknown cushioning material with no evidence of intact CAIS ampoules/bottles or CWM. Circular objects present in x-rays are possible caps from the cardboard container of the K951/952 packing material. Deformed cylinder objects are possible inner containers of the K951/952 CAIS filled with debris. It is suspected that the SRC is filled with dirt and CAIS packing residue.
SRC/MRC	04	Contents appear to be unknown cushioning material with possible 3½ ounce mustard bottles from the K941 CAIS. Some bottles appear to contain unknown material. It is suspected that the SRC is filled with K941 bottles and unknown cushioning material.
SRC/MRC	05	No evidence of intact CAIS ampoules/bottles or CWM is present. Small amount of unknown material appears to be in the bottom of the container. SRC-005 appears to be empty with the exception of a small quantity (approximately 5% fill) of unknown material in bottom of inner container.
SRC/MRC	06	Contents appear to be unknown cushioning material with no evidence of intact CAIS ampoules/bottles or CWM. Circular objects present in x-rays are possible caps from the cardboard container of the K951/952 packing material. It is suspected that the SRC is filled with dirt, unknown materials, and CAIS packing residue.
SRC/MRC	07	Contents appear to be unknown cushioning material with no evidence of intact CAIS ampoules/bottles or CWM. SRC-007 appears to be empty with the exception of a small quantity (approximately 25% fill) of unknown material in the bottom of the inner container.
LSC	08	Three empty 3.5-ounce mustard bottles, empty CN bottle, one glass vial
LSC	09	Three empty 3.5-ounce mustard bottles
LSC	10	Empty
85-gal drum		Fifteen empty mustard bottles, piece of canvas, damp cloth
Two metal buckets		Empty
SRC/MRC – Tin City		Contents appear to be an intact K941 set. The kit normally contains 24 glass bottles containing 3½ ounces of mustard each. Several of the bottles appear to be full.

[1] This is based on x-rays of the SRCs, past reports from PRDA activities, and a visual inventory of the bunker. No pigs have been opened.

1.6 Streamline Risk Evaluation

In general, long-term threats to the general public and ecological receptors would result from continuous releases of hazardous substances over time, resulting in downgradient or down-wind concentrations that are potentially hazardous. Because of the low volume of chemicals in the CAIS being stored at Ft. Richardson, a CAIS cannot act as a continuous source term for contaminant fluxes via air or groundwater to offsite public receptors. For this reason, dispersion modeling or other fate and transport modeling is not warranted.

Exposures to CAIS materials would be limited to short, one-time exposures to nearby receptors, presumably workers associated with activities at Ft. Richardson. In order to understand the potential toxic effects associated with a one-time exposure, it is necessary to know the concentration of the chemicals in the CAIS bottles and ampoules since the health effects associated with exposure to a chemical are related to the dose, or delivered concentration, of the chemical. However, since no analytical data are available to confirm this, it is necessary to make assumptions about the configuration and concentrations of the different chemicals in the ampoules based on available information. Table 1-1 summarizes potential configuration and concentration of the different chemicals in the ampoules.

Currently, the USEPA has not identified dose-response data and toxicity factors for *quantifying* the risk of subchronic or chronic toxic effects or carcinogenic effects for any of these materials. Dose-response data are available from which some regulatory levels and action levels have been established, such as Occupational Safety and Health Administration (OSHA), permissible exposure limits (PELs) and Department of Defense (DoD) airborne exposure limits.

Based on the information presented in Table 1-2, concentrations of the chemicals in the bottles and ampoules are in the range of 5 to 100 percent. Table 1-3 presents toxicity data for CAIS materials. Compared to an available dose-response data and available human median LD_{50} concentrations, the concentrations of the chemicals in the CAIS items are high enough to cause lethal effects if exposures were to occur. However, because the volume of the chemicals is so small, it is not certain that the CAIS, upon breakage, could act as a contaminant source long enough to result in a lethal dose to a receptor. More likely, the exposure would result in acute toxic effects, as listed in Table 1-3.

SECTION 2

SCOPE AND SCHEDULE OF REMOVAL ACTION

This section discusses the scope of the removal action alternatives to be evaluated in this report, within the context of CERCLA's statutory limitations for such actions.

2.1 STATUTORY LIMITS ON REMOVAL ACTIONS

Unless necessary to mitigate an emergency, or in cases where there is an immediate risk to human health or welfare or the environment, and response cannot otherwise be provided in a timely manner, CERCLA imposes a statutory limitation on superfund-financed removal actions of 12 months or $2 million [42 United States Code Annotated (USCA) 9604 (c)]. Although these limits do not appear to strictly apply to non-superfund-financed removal actions performed by other Federal agencies, the USEPA has determined that defacto compliance is still necessary since Congress intended the statutory time and dollar limits to signal the end point of the removal authority (53 FR 51396). Therefore, unless a statutory exemption can be invoked, the removal action activities must cease when the 12 months, $2 million statutory limits are reached, at which time any additional activities must meet the applicable remedial action requirements in the NCP (53 FR 51396).

The removal action for the treatment and disposal of the CAIS recovered from the PRDA site, however, would be carried out as an interim response action (IRA) pursuant to the CERCLA FFA for Ft. Richardson, as part of the remedial activities for the PRDA site. Therefore, pursuant to 40 Code of Federal Regulations (CFR) 300.415 (b)(5)(ii), the removal action would be exempted from the 12 month, $2 million statutory limits.

2.2 SCOPE OF REMOVAL ACTION

The scope of the action to be performed is to treat and dispose of the CAIS items in a safe manner that protects the environment and the health of the public. Specific removal action objectives include:

- Remove the containers of CAIS items presently in storage in Building 55228 (Bunker D-15)

- Treat any hazardous substances, pollutants, or contaminants in the CAIS items, as necessary, in order to reduce the likelihood of human, animal, or food chain exposure
- Appropriately treat and/or dispose of any residues resulting from such treatment.

2.3 SCHEDULE OF REMOVAL ACTION ACTIVITIES

The schedule for the removal of the CAIS-related waste from Ft. Richardson is as follows. The revised EE/CA is scheduled to be submitted in early 2003 and will be followed by a public meeting held for the express purpose of discussing its contents. A notice of availability of the EE/CA, the administrative record file, and a brief description of the EE/CA contents, will be published in a major local newspaper for public comment. Upon release of this notice, a 30-day public comment period will ensue. After all public comments have been reviewed, comments will be addressed according to their levels of significance. Public comments and their respective responses will be included in the administrative record. The necessary personnel and equipment for the chosen alternative will be deployed to the site in late spring 2003. Treatment and packaging activities will occur during the summer. All processing equipment will be decontaminated, sampled to confirm clean closure and certified by a professional engineer. All CAIS-related items, residual waste, and processing equipment will be removed from Ft. Richardson by the end of September 2003.

2.4 PLANNED REMEDIAL ACTIVITIES

The six-phase heating remedial system at the PRDA was turned off in October 1999 after meeting the ROD Remedial Action Objectives for soils. The soils will continue to be monitored for natural attenuation. Future planned additional actions include continued long-term monitoring at Operational Unit–B (OU-B) at the rate and frequency of 18 groundwater monitoring wells semi-annually for two more years, at which point an evaluation will be conducted to determine whether the frequency can be scaled back based on the sampling data (USACEAD, June 2002).

SECTION 3
IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section identifies four alternatives and provides descriptive narrative on each alternative. The four alternatives are: (1) no action, (2) onsite treatment of CWM with the Army's Rapid Response System (RRS) with subsequent offsite final treatment (incineration)/disposal (3) onsite repackaging using the RRS with subsequent final treatment (incineration) at an offsite facility, and (4) offsite shipment to a DoD facility for treatment of CWM with the RRS with subsequent shipment for final offsite treatment (incineration)/disposal. The Applicable or Relevant and Appropriate Requirements (ARARs) and other to-be-considered (TBC) requirements evaluated as part of this analysis of alternatives are presented in Appendix C. The four alternatives are described in detail in the following paragraphs.

3.1 Alternative 1: No Action.

Under this alternative, no action would be taken and the recovered CAIS items would remain in storage in Building 55228 (Bunker D-15). Implementation of this alternative may result in the need to apply for and obtain a final RCRA Part B Permit to allow for the long-term storage of the CAIS waste.

3.1.1 Effectiveness. *Overall protection of human health and the environment.* Building 55228 (Bunker D-15) provides adequate protection for the storage of the CAIS items. The CAIS items are properly overpacked in containers that are compatible with the hazardous substances, pollutants, or contaminants contained in them, and the containers ensure no detectable emissions when properly closed. The building provides for adequate containment of any liquid releases and provides effective protection against the elements. However, the building would not prevent, although it would mitigate, the escape to the atmosphere of gases and vapors resulting from a liquid spill. The current physical configuration of Building 55228 does not conform to all of the design criteria specified under 40 CFR 264 Subpart for the permitted storage of liquid RCRA wastes. Should the CAIS storage become subject to a RCRA Part B permit, Building 55228 would require several upgrades to ensure that the applicable design and operating standards will be met. Potential modifications may include air pollution controls and secondary containment system upgrades through either sealing existing drains or by installing a secondary containment system that meets the design criteria specified in the regulations and video monitoring. As an alternative to upgrading Building 55228, the CAIS items could be moved to another building on the facility that already meets the 40 CFR 264 Subpart I design standards. Building 55228 is not located within 200 ft of a fault, nor is it located within a 100-year floodplain.

Compliance with ARARs, and other criteria, advisories, and guidance. CAIS items have been in storage in Building 55228 (Bunker D-15) since October 1993. One pig containing CAIS items retrieved from the Tin City Radar Site has been stored Bunker D-15 since July 2000. All CAIS items currently storage in Bunker D-15 will remain in storage in this building until the final remedial action is implemented for the PRDA site OU-B. The storage of these CAIS items is in compliance with the substantive applicable requirements specified under 40 CFR Part 265 Subpart I, "Use And Management Of Containers." These standards are met through the packaging configuration of the waste and the structural design of Bunker D-15. As stated above, should this alternative be implemented and a Part B storage permit required, Building 55228 will require modification to ensure that all of the design standards specified in 40 CFR 264 Subpart I are met. The storage of the CAIS items is also in compliance with 40 CFR 266.205(d), "*Standards applicable to the storage of solid waste military munitions; Waste chemical munitions.*" As such, the storage of these waste items is not subject to the one-year storage prohibition of 40 CFR 268.50.

Compliance with the substantive container management requirements is specifically achieved through the following design and management practices. All of the waste is stored within steel pigs with secured lids. Any free liquids are contained within small vials as the primary waste container. The bottles containing free liquids are packaged inside metal containers. The metal containers are further overpacked into the pigs, which act as tertiary containment. All of the wastes within Bunker D-15 are staged on pallets in wooden crates. The waste types are compatible with the packaging and the absorbent material. Inspections of the containers are performed weekly, consistent with 40 CFR Section 265.174 to look for leaks or deterioration.

Waste contact with precipitation is minimized due to the packaging configuration, staging on pallets in wooden crates, and storage inside the bunker. The CAIS items in storage at Bunker D-15 are greater than 50 ft from the facility's property line, and no incompatible materials are known to be stored in the same inner packaging. The CAIS items in storage at Bunker D-15 are not characteristically hazardous for ignitability or reactivity, and no incompatible materials are known to be stored in the same inner packaging. None of the individual waste containers or pigs exceeds 26.4 gal in volume; therefore, the air emissions requirements for the storage of hazardous waste do not apply to the storage of the CAIS items in Bunker D-15 (40 CFR 264 Subpart CC).

To minimize the potential for worker exposure to chemical agents and in compliance with DoD requirements regarding facilities storing chemical agent, inspection of the inner primary waste containers is not performed. The multiple packaging configuration of this waste is expected to minimize the possibility of a release of the waste to the bunker; consequently, DoD will limit its inspection to the outer packaging of each container and air monitoring of the bunker on at least a monthly frequency.

Long-term effectiveness and permanence. Since storage of the CAIS items in Building 55228 (Bunker D-15) would only be an interim measure that would continue only until the final remedial action is implemented for the PRDA site (OU-B), it is not required to meet CERCLA's requirements for long-term effectiveness and permanence. However, the final remedial action alternative selected for the PRDA site would still have to address the criteria for long-term effectiveness and permanence with respect to the remediation/disposal of the CAIS items.

Reduction of toxicity, mobility, or volume through treatment. This alternative would not involve any treatment. It relies on containment and institutional controls as a way to reduce the mobility of the hazardous substances, pollutants, or contaminants of concern.

Short-term effectiveness. Building 55228 (Bunker D-15) and the institutional controls currently in place for the storage of the CAIS items would adequately protect the human health and the environment until the final remedial action for the PRDA site is implemented.

3.1.2 Implementability. This alternative would not change any of the current operations at Building 55228 (Bunker D-15).

3.1.3 Cost. The direct capital costs for continuing storage of the CAIS at Ft. Richardson amount to approximately $330 per day, which includes periodic inspections and use of the facility. Additionally, if a RCRA Part B permit is required, obtaining that permit would be an approximate cost of $250,000. Compliance with the permit would add costs for facility upgrades such as video monitoring and additional labor for required reporting. Given the open ended nature of this alternative, no present-worth cost estimate could be developed. However, this alternative provides only a temporary measure and would require that a permanent remedy, presumably different from the other remedial alternatives being evaluated in this EE/CA, be developed sometime in the future. At the present time, there is no basis to believe such an alternative could be developed in the near future that would provide such significant cost savings to justify delaying the implementation of any of the other alternatives being evaluated in this EE/CA. Therefore, it is estimated that implementing this "No Action" alternative would only increase the final costs for remediating the site, by delaying the inevitable implementation of any one of the other alternatives being evaluated in this EE/CA.

3.2 Alternative 2: Onsite Treatment of CWM Items and Offsite Treatment/Disposal of Associated Hazardous Substances.

This alternative would involve onsite treatment of CAIS items containing CWM to generate treatment residues with reduced toxicity for safer handling, transport, and ultimate disposal. It also would involve offsite commercial treatment/disposal of CWM treatment residues and offsite commercial treatment/disposal of other hazardous substances, pollutants, or contaminants.

This alternative would involve the use of the Army's RRS, which is a mobile platform (presently being fielded by the Army) for handling CAIS items under proper engineering controls. The RRS is comprised of two trailers: an operations trailer and a utility trailer. The CAIS items are handled in the RRS operations trailer (Figure 3-1).

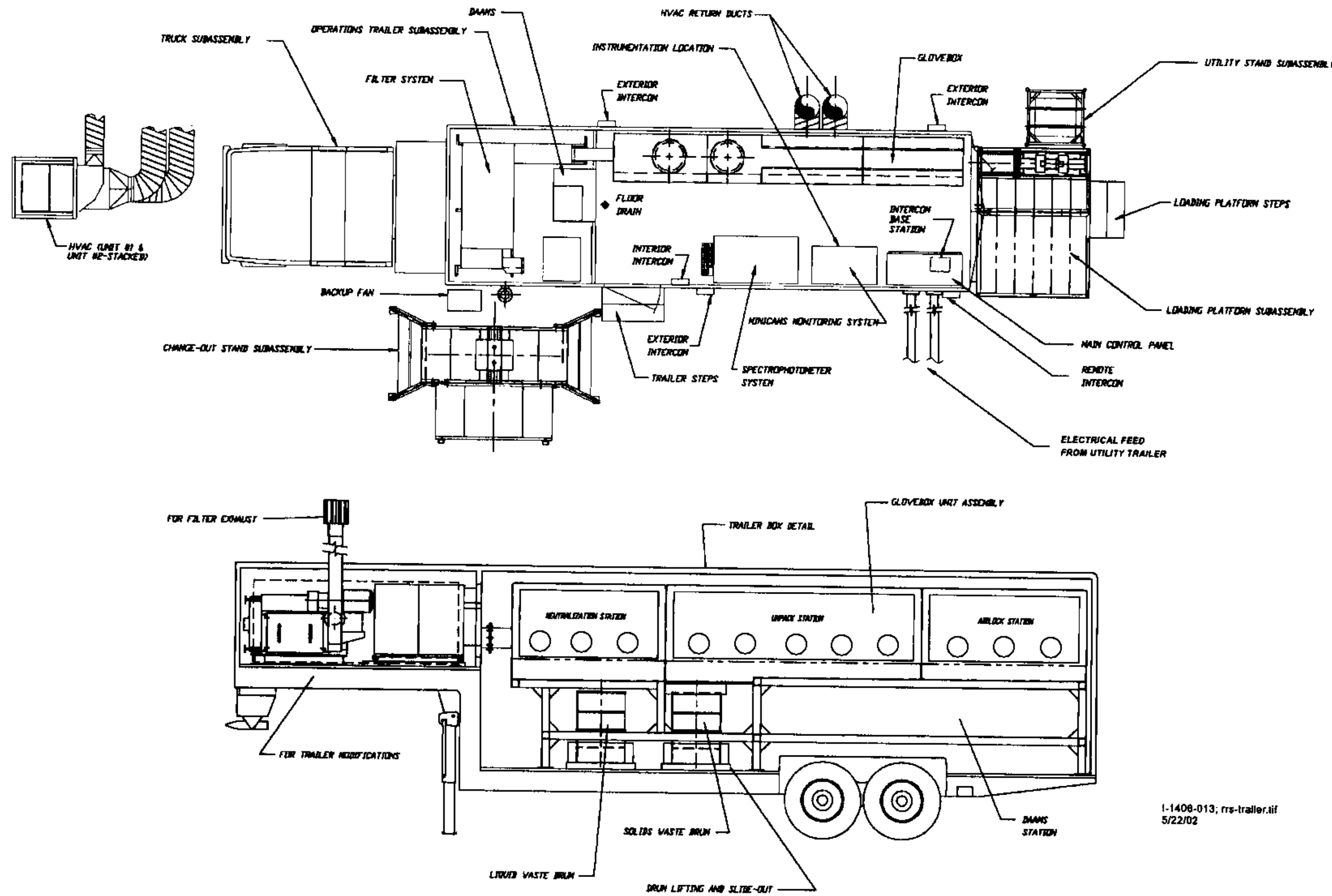


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Figure 3-1. RRS Operations Trailer

In the RRS trailer, engineering controls are provided by a negative pressure glovebox system that is ventilated to a carbon filter system to control toxic emissions. Within the glovebox, there is an unpack station that provides sufficient space to unpack and handle the CAIS items, a fiber optic probe for a Raman spectrophotometer, racks to facilitate the sorting of the CAIS items, a reactor to treat those CAIS items containing chemical warfare agent, and a waste containerization system that accommodates two drums to collect the waste generated during the operations. The RRS operations trailer is also equipped with a loading system to facilitate the loading of the CAIS item overpacks into the glovebox, air monitoring equipment to monitor the operations, and a Raman spectrophotometer to facilitate the segregation of the CAIS items based on their contents. A detailed description of the engineering features of the RRS glovebox and air monitoring system are provided in Appendix D.

The utility trailer contains two diesel powered generators (one primary and one backup) to supply the RRS with all necessary electrical power; however, the RRS can also operate from available commercial power. The utility trailer also houses an uninterruptible power supply to power critical systems until the backup generator starts in the event of a power failure.

The RRS is supported by a Mobile Analytical Support Platform (MASP), a separate mobile laboratory that supports the analysis of the air monitoring equipment within the RRS operations trailer. The MASP is equipped with a gas chromatograph (GC) for the analysis of air and waste samples. Depot Area Air Monitoring System (DAAMS) sorbent tubes are used within the RRS operations trailer to collect ambient air samples. These samples are then analyzed in the MASP if there is a need to confirm an alarm from a near real-time air monitoring device. The MASP also screens the treatment residues to ensure that adequate destruction of chemical agent was accomplished.

The RRS operations trailer, the utility trailer, and an administration trailer would be set up in front of Building 55228 (Bunker D-15) (Figure 3-2). Building 55228 is surrounded by a chain-link fence with a triple-strand barbed wire top. There is only one access gate, which is kept locked. The area outside the Building 55228 perimeter is forest.

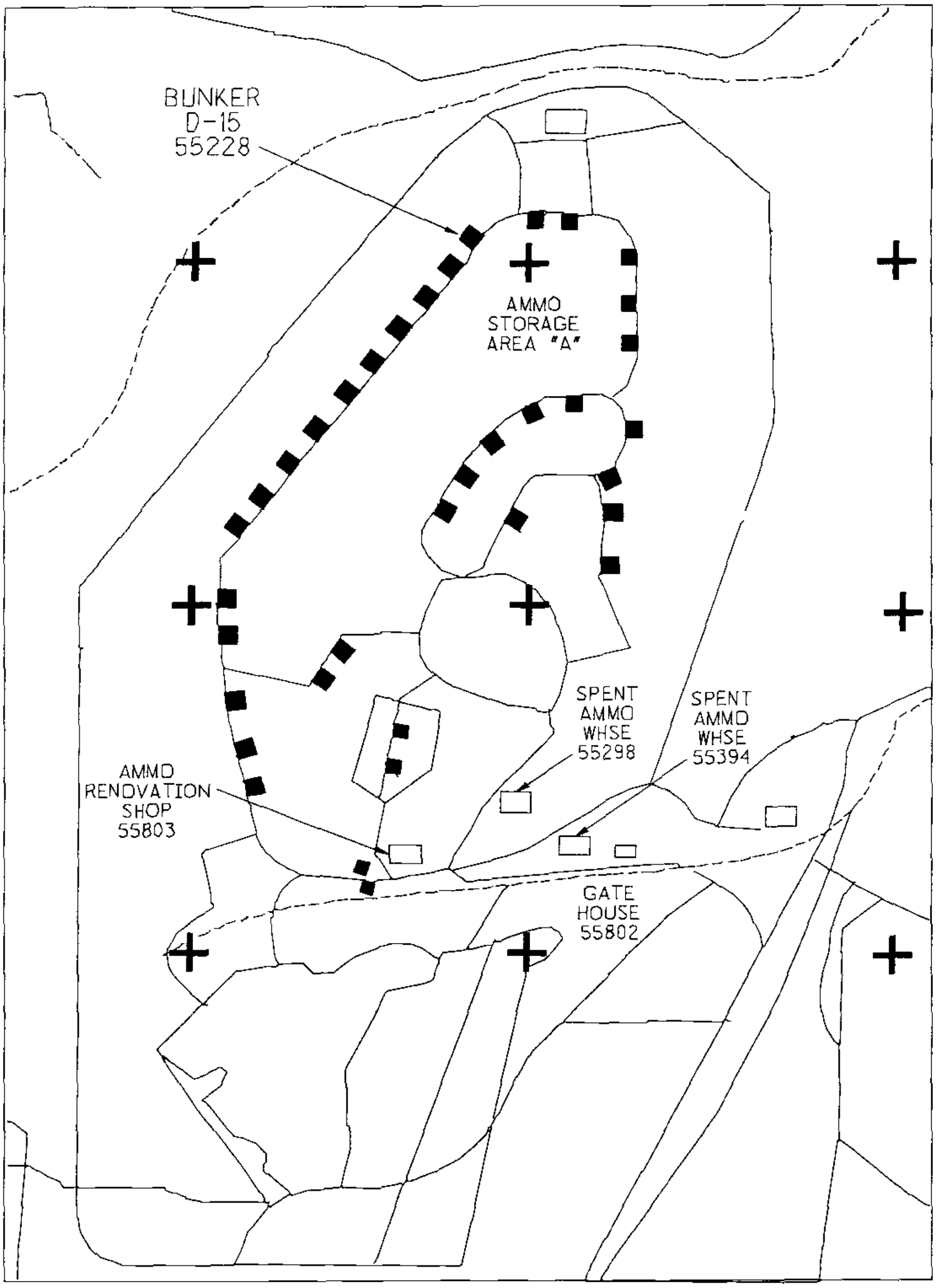

Figure 3-2. Location of Building 55228 (Bunker D-15)

No personnel work near Building 55228, where the RRS would be located.
Building 55228 is not located within 200 ft of a fault, nor is it located within a 100-year floodplain.

A waste staging area would be set up within Building 55228 to temporarily store the wastes generated during the RRS operations before they are shipped offsite for treatment/disposal. This staging area would have secondary containment for liquid drum storage.

To initiate processing the CAIS, the SRC would be monitored with Miniature Continuous Air Monitoring System (MINICAMS®) to verify that the pig is not contaminated; then the pig would be removed from the SRC. The pigs would be loaded by forklift onto a transport cart at the RRS operations trailer loading platform. The pig would then be moved into the RRS glovebox airlock, where it would then proceed to the unpack station. There, the pig would be opened using a pig cutter (an industrial cutter). The CAIS items would then be removed from the pig.

The CAIS items are expected to be loosely packed in absorbent material within the metal pigs. The pig parts and this packing material would be placed into the waste drum in the unpack station waste containment system compartment. If contaminated, the metal pigs would be decontaminated with five percent sodium hypochlorite or the chloroform/t-butyl alcohol/water/1,3-dichloro-5,5-dimethylhydantoin (DCDMH) decontamination solution before being placed in the waste drums. Furthermore, should there be any evidence of leaks or broken CWM CAIS items within the pig, the packaging material would be decontaminated before being placed into the waste drum. The dunnage would be decontaminated only in those cases where it is believed to be contaminated with chemical agent.

After the CAIS items have been removed from their packaging, they would be segregated, by contents, using either visual markings on the CAIS items themselves or by non-invasive characterization with the Raman spectrophotometer, if there are no distinguishable markings. Those CAIS items containing chemical agent would then be transferred to the neutralization station. At the neutralization station, they would be temporarily stored in the rack (sorted by contents) before being treated in the reactor. Those CAIS items that do not contain chemical agent would be kept in the holding rack at the unpack station until enough volume has been accumulated to properly repackage them into laboratory packs for shipment offsite to an approved hazardous waste treatment, storage, and disposal facility (TSDF) for final treatment and ultimate disposal.

A discussion of the various chemistries is provided in Appendix E. The reactions are considered complete when the concentration of chemical agent in the reaction products (treatment residues) is less than 50 milligrams per liter. This is the concentration at which the Army has determined that the toxicity of the chemical agent has been sufficiently reduced to allow for the treatment residues to be safely transported by commercial carrier to an approved hazardous waste TSDF for further treatment and ultimate disposal. The studies to validate the chemistry of the reaction processes, as well as the toxicological studies to support the established treatment performance goal, were completed in 1997.

To begin the reaction process, the CAIS bottle or ampoule containing chemical agent would be loaded into the reactor, the treatment reagents would then be added, and the lid sealed. The reactor keeper ring is designed to hold the crushing mechanism in place until the operator is ready to initiate the reaction. When ready, the operator releases the keeper ring lock and proceeds to exert pressure on the reactor, crushing mechanism to break the CAIS glass containers in the reactor. Once the glass containers are broken, the operator then would proceed to agitate the reactor mixture periodically for at least 15 min by turning the reactor crushing mechanism.

When at least 15 min have passed, the operator would open the reactor and transfer the contents of the reactor (including the pieces of glass) into the liquid waste drum, located underneath the neutralization station in the waste containerization system compartment.

Before the drum containing the liquid treatment residues is sealed and removed from the waste containerization system, a sample would be collected for analysis to confirm that the chemical agent concentration in the treatment residues is less than or equal to 50 milligrams per liter. When the sample is collected, the drum would be sealed and transferred to the temporary waste staging area. If the analytical results show that the chemical agent concentration in a drum of liquid waste is above 50 milligrams per liter, the drum would be loaded again into the neutralization station waste containerization system compartment. There it would be opened, and additional treatment reagent would be added. Another sample would then be collected to confirm that the treatment concentration goal has been achieved.

In the case of CWM decontaminated dunnage, the concentration of chemical agent in the extract of a representative dunnage sample must be less than or equal to 50 milligrams per liter before the Army would consider the dunnage to be safe for transport (by commercial carrier) to a commercial RCRA Subtitle C facility for final treatment/disposal. Therefore, to confirm the effectiveness of the dunnage chemical agent decontamination before the dunnage waste drum is sealed and transferred to the temporary waste staging area, a representative dunnage sample would be collected. This sample would be collected at the unpack station before the decontaminated dunnage is placed into the dunnage waste. If the analytical results show that the CWM concentration in the extract of the dunnage sample is above 50 milligrams per liter, the dunnage waste would be decontaminated with five percent sodium hypochlorite or the DCDMH cosolvent mixture. Another dunnage sample would then be collected to confirm that the treatment concentration goal has been achieved. A sample of any free standing liquid would also be collected and analyzed to confirm that the chemical agent concentration in the liquid does not exceed 50 milligrams per liter. This process would be repeated, as necessary, until the chemical agent concentration in the extract of the dunnage sample and in any free standing liquid is less than or equal to 50 milligrams per liter.

The CAIS items containing industrial chemicals would be repackaged into laboratory packs according to compatibility and hazard class, in accordance with the appropriate Department of Transportation (DOT) requirements. Single round containers (SRCs) would be used to repackage those CAIS items containing phosgene, if needed. Once the CAIS items that do not contain CWM have been repackaged, they would be transferred to the temporary waste staging area.

The RRS is expected to process two to three SRCs per week. During active treatment operations for CAIS containing chemical warfare agent, the carbon filters would be changed within 48 hours of a chloroform release in the glovebox or if a breakthrough is detected between carbon beds, whichever occurs first. When treatment operations for CAIS containing chemical warfare agent are not actively taking place, the filters would not be replaced unless a breakthrough is detected. At the end of the CAIS operation, all hazardous wastes would be removed from the glovebox and the equipment decontaminated. The amount and type of waste that would be expected to be generated by the RRS operations is provided in Table 3-1.

Table 3-1. Expected Wastes Generated During RRS Operations for Alternative 2

Waste Stream	Unit/ Container	Quantity	Weight	Waste Type
Dunnage/packaging materials (include pig parts)	30-gal drum	12	~ 150 lbs/ea	RCRA hazardous
Chemical warfare agent treatment residues (RED, BLUE, and CHARCOAL/ CHARCOAL L@processes)	5-gal drum	6	~ 60 lbs/ea	RCRA hazardous
Liquid phosgene	SRC	1	~ 20 lbs/ea	RCRA hazardous
Liquid chloropicrin	5-gal drum (lab pack)	1	~ 20 lbs/ea	RCRA hazardous
Poison solids (PS in charcoal, triphosgene, CN, DM)	20-gal drum (lab pack)	1	~ 30 lbs/ea	RCRA hazardous
Spent filters	95 gal drums	10	~ 200 lbs/ea	RCRA hazardous
Decontamination rinsate	55-gal drum	1	~400 lbs/ea	RCRA hazardous
PPE and Miscellaneous Waste	55-gal drum	8	~200 lbs/ea	RCRA hazardous

Notes:

PPE = personal protective equipment
RCRA = Resource Conservation and Recovery Act
RRS = Rapid Response System

All wastes generated during RRS operations would be considered hazardous and would be sent to an offsite RCRA Subtitle C facility in the contiguous 48 states for incineration and for ultimate disposal.

The wastes would be transported by a permitted hazardous waste transporter.

3.2.1 Effectiveness.

Overall protection of human health and the environment. Alternative 2 would remove the source of CWM and other hazardous substances, pollutants, or contaminants from Ft. Richardson, thus alleviating the potential for future exposures to human and ecological receptors. It is assumed that there would be no exposure to post-treatment residual materials and other hazardous materials at their final disposal destination. Alternative 2 would eliminate risks because it achieves overall protection by using existing treatment technologies, in addition to achieving destruction of the hazardous substances, pollutants, or contaminants.

Compliance with ARARs, and other criteria, advisories, and guidance. Alternative 2 would comply with the ARARs listed in Appendix C, as well as with Army criteria, advisories, and guidance specific to the management of CWM.

The current storage of the CAIS items in Bunker D-15 is in compliance with the substantive requirements of 40 CFR Part 265 Subpart I "Use and Management of Containers." The packaging configuration of the waste and the structural design of the bunker meet the necessary criteria to establish compliance with the container storage requirements. In addition, storage activities are compliant with 40 CFR 266.205(d) *"Standards applicable to the storage of solid waste military munitions; Waste chemical munitions."* As such, the storage of these waste items is not subject to the one-year storage prohibition of 40 CFR 268.50.

The CAIS items will be managed in the RRS glovebox. The design and operating standards of the RRS glovebox are sufficient to demonstrate compliance with the RCRA Subpart X "Miscellaneous Units" requirements. The RRS glovebox is constructed of materials that are compatible with the hazardous substances, pollutants, or contaminants in the CAIS items, thus precluding the potential for a constituent release due to degradation of system components. The glovebox would also provide adequate secondary containment in the event of a liquid spill or release that may occur during segregation and repackaging activities.

Prevention of airborne contaminant releases from the unit would be prevented, as the glovebox would also function as an enclosure vented through a closed vent system equipped with a carbon filter system, which would control any emissions. Moreover, the RRS operations would also comply with the RCRA facility siting requirements since Building 55228 (where the RRS would be located) is not within 200 ft of a fault, nor is it located within a 100-year floodplain.

Packaging of the CWM treatment residues, non-CWM CAIS items, and other wastes generated during the RRS operations would be consistent with the requirements of the Hazardous Materials Transportation Act (HMTA) (49 CFR 171-177). The applicable substantive 40 CFR 262 RCRA generator requirements for hazardous waste identification, newly generated waste management, labeling, and manifesting would also be implemented. The wastes generated from the RRS operations to be shipped offsite, would be sent only to a facility determined by the USEPA to be in compliance with the acceptability requirements of 40 CFR 300.440. Offsite activities must comply with all the substantive and administrative requirements of any laws that apply to the particular activities.

Long-term effectiveness and permanence. The only long-term risk associated with the CAIS material present at the site is the potential for an accidental one-time exposure to CWM and other hazardous materials. Alternative 2 would alleviate this risk by removing all the CAIS items from the site, by treating the CWM before offsite shipment, and by incinerating the CWM treatment residues as well as the other hazardous substances, pollutants, or contaminants in the CAIS items. This alternative would achieve long term effectiveness because all hazardous substances, pollutants, or contaminants are ultimately destroyed. Treatment residues from the detoxification/decontamination operation and the repackaged CAIS items would be classified as RCRA hazardous waste and would be further treated by incineration at a RCRA Subtitle C facility. Ash resulting from the final treatment (incineration at a TSDF) would be shipped to a RCRA Subtitle C landfill for final disposal. Nonhazardous debris generated during the RRS operations would be disposed of in a RCRA Subtitle D landfill.

Reduction of toxicity, mobility, or volume through treatment. This alternative would achieve a reduction in toxicity, mobility, and volume through treatment (i.e., detoxification of the CWM followed by incineration of the CWM treatment residues as well as of the other hazardous substances, pollutants, or contaminants in the CAIS items). An initial increase in the volume of the waste would occur as a result of the detoxification of the CWM. However, this comes as a tradeoff to a reduction in toxicity to make it safer for transport.

Short-term effectiveness. Three types of potential short-term risks have been identified in the evaluation of Alternative 2:

(1) Accidental exposures during handling and treatment at the RRS

(2) Accidental exposure to treated material and industrial materials during shipment offsite

(3) Transportation accidents.

Exposures to workers could occur during handling and treating of CAIS at the RRS. The following controls have been developed for the RRS to prevent short-term occupational exposures during treatment of CAIS items containing chemical agent:

- CAIS would be introduced into the RRS through an airlock.
- The three-station glovebox operates under negative pressure so that gases would not escape the glovebox.

- An air monitoring system would monitor air within crew working space and the air exiting the glovebox.
- Air exiting the glovebox would pass through a carbon filter system.
- RRS crew members would be certified to perform RRS tasks.

In the unlikely event these systems fail, exposure would be limited to small volumes of CAIS material, likely resulting in eye, skin, and respiratory irritation. Workers are not likely to be exposed to substances above OSHA-permissible exposure limits. There exists a potential for dermal exposure to liquid chloroform during RRS operations if chloroform spills penetrate the butyl gloves in the glovebox. This exposure would be mitigated by use of 4H glove liners.

Workers could be exposed to treatment residuals. A description of the chemical makeup of the residuals is provided in Appendix E. Only residual amounts of CWM and other hazardous constituents would be present in the treatment residuals. For example, less than 50 milligrams of sulfur mustard per liter of treatment.

A second type of short term exposure that would be associated with Alternative 2 is risk of accidents during transport of chemical warfare agent treatment residues and other hazardous materials to the offsite commercial TSDF. The potential exists for occupational and public receptors exposure to post-treatment residuals during transportation if material escapes packaging. However, this potential has not been quantified. Nevertheless, because of the low volume and low presumed concentration of chemical warfare agent in CAIS items, exposures would likely result only in minor irritation of the skin and eyes. To mitigate this exposure, the stringent packaging, shipping, and transportation requirements of the HMTA and of the Army would be enforced.

3.2.2 Implementability. The implementation of this alternative is technically feasible. The operation of the RRS glovebox system is based on basic engineering principles and proven technologies. The reactor treatment chemistry was validated in bench scale and operational testing. The RRS and the CWM treatment were field tested at the Deseret Chemical Depot (DCD) in Utah. Furthermore, except for the offsite landfill facilities that would receive nonhazardous debris, the offsite facility or facilities that would receive waste generated from the RRS operations would need to be authorized by the USEPA as acceptable to receive CERCLA wastes, pursuant to 40 CFR 300.440. Several RCRA Subtitle C facilities have already been approved to receive CERCLA wastes.

3.2.3 Cost. The cost estimate for Alternative 2 reflects a level of accuracy that should be within the range of -30 percent to +50 percent of the final design cost estimate. The detailed cost estimate is presented in Appendix F. The cost estimate is divided into three major cost categories: direct capital costs, indirect capital costs, and contingency. The direct capital costs include the costs for labor; equipment and materials; and travel, car rental, and per diem. The indirect capital costs include the costs for engineering and management (20 percent of the direct capital costs); and permits [not including RCRA or National Environmental Policy Act (NEPA) documentation], fees, and taxes (10 percent of the direct capital costs). A contingency (30 percent of the total capital costs) has been added to cover the costs associated with unforeseen circumstances, such as weather or administrative delays, and gaps in site characterization data. The summary of the costs for Alternative 2 is as follows:

Direct Capital Costs

A. Labor	$525,281	
B. Materials and Equipment	$706,984	
C. Travel/Car Rental/Per Diem	$274,752	
TOTAL DIRECT CAPITAL COSTS		$1,507,017

Indirect Capital Costs

D. Engineering and Management	$301,403		
E. Permits, Fees, and Taxes	$150,702		
TOTAL INDIRECT CAPITAL COSTS			$ 452,105
TOTAL CAPITAL COSTS			$1,959,122
CONTINGENCY			$ 587,737
TOTAL PROJECT COSTS		$2,546,859	

It should be noted that utilities, building, support personnel, and so forth, have already been identified and are available at Ft. Richardson.

3.3 Alternative 3: Offsite Treatment/Disposal.

This alternative is essentially the same as Alternative 2, except that the CAIS items containing chemical warfare agent are not treated before shipment to an offsite RCRA Subtitle C facility for incineration and subsequent disposal. Under this alternative, the CAIS items would be brought to the RRS operations trailer, where they would be segregated and repackaged according to compatibility and hazard class, in accordance with the appropriate DOT requirements. The CAIS items that do not contain chemical warfare agent would be shipped offsite for treatment/disposal in the same manner as Alternative 2. CAIS items containing chemical warfare agent, however, would be overpacked in SRCs and transported by military plane to the Army installation in the lower 48 states that is closest to the TSDF where the CAIS items containing chemical warfare agent would be incinerated. From the Army installation, the SRCs would be transported by truck under military escort to the TSDF. Table 3-2 provides a list of the wastes that would be generated during the RRS operations for Alternative 3.

Table 3-2. Expected Wastes Generated During RRS Operations for Alternative 3

Waste Stream	Unit/ Container	Quantity	Weight	Waste Type
Dunnage/packaging materials	30-gal drum	11	~ 200 lbs/ea	RCRA hazardous
CWM CAIS items	SRC	4	~ 25 lbs/ea	RCRA hazardous
Liquid phosgene	SRC	1	~ 20 lbs/ea	RCRA hazardous
Liquid chloropicrin	5-gal drum (lab pack)	1	~ max. 20 lbs/ea	RCRA hazardous
Poison solids (PS in charcoal, triphosgene, CN, DM)	20-gal drum (lab pack)	1	~ 20 lbs/ea	RCRA hazardous
Spent filters	95-gal drum	5	~ 120 lbs/ea	RCRA hazardous
Spent decontamination solution	30-gal drum	2	~ 200 lbs/ea	RCRA hazardous
Decontamination rinsate	55-gal drum	1	~460 lbs/ea	RCRA hazardous
Decontaminated PPE	55-gal drum	1	~ 100 lbs/ea	RCRA nonhazardous debris (to be disposed of as RCRA hazardous)

Notes:

PPE = personal protective equipment
RCRA = Resource Conservation and Recovery Act
RRS = Rapid Response System

3.3.1 Effectiveness.

Overall protection of human health and the environment. Alternative 3 would remove the source of CWM and other hazardous substances, pollutants, or contaminants from Ft. Richardson, thus alleviating the potential for future exposure to human and ecological receptors. It is assumed that there would be no significant exposures to post-treatment residual materials and other hazardous materials at their final disposal destination. This alternative would eliminate risk because it achieves overall protection by using existing treatment technologies in addition to achieving destruction of the hazardous substances, pollutants, or contaminants.

Compliance with ARARs, and other criteria, advisories, and guidance. Except for the chemical warfare agent transportation restrictions in 50 USCA 1512a(b), Alternative 3 would comply with the ARARs listed in Appendix C, as well as with Army criteria, advisories, and guidance specific to the management of CWM. The current storage of the CAIS items in Bunker D-15 is in compliance with the substantive requirements of 40 CFR Part 265 Subpart I "Use and Management of Containers." The packaging configuration of the waste and the structural design of the bunker meet the necessary criteria to establish compliance with the container storage requirements. In addition, storage activities are compliant with 40 CFR 266.205(d) *"Standards applicable to the storage of solid waste military munitions; Waste chemical munitions."* As such, the storage of these waste items is not subject to the one-year storage prohibition of 40 CFR 268.50.

The segregation and repackaging activities will occur within the RRS operations trailer glovebox. Since the purpose of the segregation and repackaging is to reconfigure the physical components of the waste stream to ensure safe transport to the off-site treatment facility, these activities can be considered treatment in accordance with the RCRA definition cited under 40 CFR 260.10. The design and operating standards of the RRS operations trailer are sufficient to demonstrate compliance with the RCRA Subpart X "Miscellaneous Units" requirements. The RRS glovebox is constructed of materials that are compatible with the hazardous substances, pollutants, or contaminants in the CAIS items items, thus precluding the potential for a constituent release due to degradation of system components. The glovebox would also provide adequate secondary containment in the event of any liquid spill or releases that may occur during segregation and repackaging activities.

Prevention of airborne contaminant releases from the unit would be prevented, as the glovebox would also function as an enclosure vented through a closed vent system equipped with a carbon filter system. Moreover, the RRS operations would also comply with the RCRA facility siting requirements since Building 55228 (where the RRS would be located) is not within 200 ft of a fault, nor is it located within a 100-year floodplain. Packaging of the CAIS items and other wastes generated during the RRS operations would be consistent with the requirements specified in 49 CFR 171-177. The applicable substantive 40 CFR 262 RCRA generator requirements for hazardous waste identification, management of newly generated wastes, labeling, and manifesting would also be implemented. The wastes generated from the RRS operations could only be sent to an offsite facility, which USEPA has determined meets the acceptability requirements in 40 CFR 300.440. All offsite activities would comply with all the substantive and administrative requirements of any laws that apply to the particular activities.

Long-term effectiveness and permanence. The only long-term risk associated with the CAIS material is the potential for an accidental one-time exposure to the CWM and other hazardous materials. Alternative 3 would alleviate this risk by removing the CAIS items from the site and incinerating them. Alternative 3 would achieve long-term effectiveness because all hazardous substances, pollutants, or contaminants in the CAIS items are ultimately destroyed through treatment (i.e., by incineration). Ash resulting from the treatment would be shipped to a RCRA Subtitle C landfill for final disposal. Nonhazardous debris generated during the RRS operations would be disposed of in a RCRA Subtitle D landfill.

Reduction of toxicity, mobility, or volume through treatment. This alternative would achieve reduction in toxicity, mobility, and volume through treatment (i.e., incineration of the hazardous substances, pollutants, or contaminants in the CAIS items).

Short-term effectiveness. Three types of potential short-term risks have been identified in the evaluation of Alternative 3:

(1) Accidental exposure during handling at the RRS

(2) Accidental exposure to CWM or other industrial materials during shipment offsite

(3) Transportation accidents.

Occupational exposures to workers could occur during handling of CAIS at the RRS. The following controls have been developed for the RRS to prevent short-term occupational exposures during repackaging of CWM:

- CAIS would be introduced into the RRS through an airlock.
- The three-station glovebox operates under negative pressure so that gases would not escape the glovebox.
- An air monitoring system will monitor air within crew working space and air exiting the glovebox.
- Air exiting the glovebox will pass through a carbon filter system.
- RRS crew members will be certified to perform RRS tasks.

Since CAIS items were used to train military personnel in the detection of CWM, it is assumed that exposure to the concentrations of CWM in CAIS would not result in a lethal, acute, or chronic dose to the receptor. Exposure could result in irritation of the skin and eyes. Workers are not likely to be exposed to any substances above OSHA permissible exposure limits. There exists a potential for dermal exposure to liquid chloroform during RRS operations if chloroform spills penetrate the butyl gloves in the glovebox. This exposure would be mitigated by use of 4H glove liners.

A second type of short term exposure that would be associated with Alternative 3 is risk of transportation accidents during transport of CWM and other hazardous materials to the offsite location. Appendix G summarizes the potential for accidents during transportation of the CWM. Regardless of the assumptions used to estimate the risk, it is estimated that no accidents would occur during such transport.

The potential exists for exposure to occupational and public receptors during transportation if material escapes packaging. This potential has not been quantified. However, because of the low volume and low presumed concentration of CWM, exposures would likely result only in irritation of the skin and eyes. To mitigate this exposure, the stringent packaging, shipping, and transportation requirements of the HMTA and the Army would be enforced.

3.3.2 Implementability. The implementation of Alternative 3 would be technically feasible. The operation of the RRS glovebox system and of commercial hazardous waste incinerators is based on basic engineering principles and proven technologies. However, to implement this alternative, the transportation restrictions in 50 United States Code (USC) 1512a(b) would require a waiver under Section 121(d)(4) of CERCLA [42 USC 9621(d)(4)]. The applicable waiver would be Section 121(d)(4)(D) of CERCLA: the remedial action selected will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, criteria, or limitation, through the use of another method or approach. In the case of Alternative 3, destruction of the CWM and the other hazardous substances, pollutants, or contaminants would be achieved by shipping the wastes directly to a commercial RCRA Subtitle C incineration facility. This would be achieved without first having to send it to a DoD chemical stockpile facility for pre-treatment of the CWM prior to ultimate treatment at a commercial RCRA Subtitle C incineration facility (Alternative 4).

The offsite facility or facilities that would receive waste generated from the RRS repacking effort would need to be authorized by the USEPA as acceptable to receive CERCLA wastes, pursuant to 40 CFR 300.440.

3.3.3 Cost. The cost estimate for Alternative 3 reflects a level of accuracy that should be within the range of -30 percent to +50 percent of the final design cost estimate. The detailed cost estimate is presented in Appendix F. The cost estimate is divided into three major cost categories: direct capital costs, indirect capital costs, and contingency. The direct capital costs include the costs for labor; equipment and materials; and travel, car rental, and per diem. The indirect capital costs include the costs for engineering and management (20 percent of the direct capital costs); and permits (not including RCRA or NEPA documentation), fees, and taxes (10 percent of the direct capital costs). A contingency (30 percent of the total capital costs) has been added to cover the costs associated with unforeseen circumstances, such as weather or administrative delays, and gaps in site characterization data. The summary of the costs for Alternative 3 is as follows:

Direct Capital Costs		
A. Labor	$397,123	
B. Materials and Equipment	$536,039	
C. Travel/Car Rental/Per Diem	$237,032	
TOTAL DIRECT CAPITAL COSTS		$ 1,170,194
Indirect Capital Costs		
D. Engineering and Management	$234,039	
E. Permits, Fees, and Taxes	$117,019	
TOTAL INDIRECT CAPITAL COSTS		$ 351,058
TOTAL CAPITAL COSTS		$1,521,252
CONTINGENCY		$ 456,376
TOTAL PROJECT COSTS	$1,977,627	

It should be noted that utilities, building, support personnel, and so forth, have already been identified and are available at Ft. Richardson. Actual facilities that would be willing to accept the CWM CAIS items for incineration have not yet been identified, which may have an impact on the cost and limit the feasibility of this alternative.

3.4 Alternative 4: Offsite Treatment of CWM at a DoD Facility with Further Offsite Treatment/Disposal.

Alternative 4 is essentially the same as Alternative 2, except that the RRS operations would take place offsite at a DoD chemical weapons stockpile facility in the lower

48 states. For this alternative, the SRCs currently in storage in Building 55228 (Bunker D-15) would be transported by military plane to the DoD chemical weapons stockpile facility where the RRS would be located. This would require at least two flights. Also, for conservative purposes, this alternative assumes that the decontaminated nonhazardous debris would be disposed in a RCRA Subtitle C hazardous waste landfill rather than in a RCRA Subtitle D landfill. Table 3-3 provides a list of the wastes generated during the RRS operations for Alternative 4.

3.4.1 Effectiveness.

Overall protection of human health and the environment. Alternative 4 would remove the source of CWM and other hazardous substances, pollutants, or contaminants from Ft. Richardson, thus alleviating the potential for future exposures to human and ecological receptors. It is assumed that there would be no exposure to post-treatment residual materials and other hazardous materials at their intermediate and final disposal destinations. This alternative would eliminate risks because it achieves overall protection by using existing treatment technologies in addition to achieving destruction of the hazardous substances, pollutants, or contaminants.

Compliance with ARARs, and other criteria, advisories, and guidance. This alternative would comply with ARARs listed in Appendix C as well as with Army criteria, advisories, and guidance specific to the management of CWM.

The current storage of the CAIS items in Bunker D-15 is in compliance with the substantive requirements of 40 CFR Part 265 Subpart I "Use and Management of Containers." The packaging configuration of the waste and the structural design of the bunker meet the necessary criteria to establish compliance with the container storage requirements. In addition, storage activities are compliant with 40 CFR 266.205(d) *"Standards applicable to the storage of solid waste military munitions; Waste chemical munitions."* As such, the storage of these waste items is not subject to the one-year storage prohibition of 40 CFR 268.50.

Table 3-3. Expected Wastes Generated During RRS Operations for Alternative 4

Waste Stream	Unit/ Container	Quantity	Weight	Waste Type
Dunnage/packaging materials (include pig parts)	30-gal drum	12	~ 150 lbs/ea	RCRA hazardous
Chemical warfare agent treatment residues (RED, BLUE, and CHARCOAL/ CHARCOAL L@processes)	5-gal drum	6	~ 60 lbs/ea	RCRA hazardous
Liquid phosgene	SRC	1	~ 20 lbs/ea	RCRA hazardous
Liquid chloropicrin	5-gal drum (lab pack)	1	~ 20 lbs/ea	RCRA hazardous
Poison solids (PS in charcoal, triphosgene, CN, DM)	20-gal drum (lab pack)	1	~ 30 lbs/ea	RCRA hazardous
Spent filters	95 gal drums	10	~ 200 lbs/ea	RCRA hazardous
Decontamination rinsate	55-gal drum	1	~400 lbs/ea	RCRA hazardous
PPE and Miscellaneous Waste	55-gal drum	8	~200 lbs/ea	RCRA hazardous

Notes:

PPE = personal protective equipment
RCRA = Resource Conservation and Recovery Act
RRS = Rapid Response System

Packaging and transportation of the CAIS items to the DoD facility where the RRS would be located would be in accordance with the DOT exemption for military shipment of CAIS, and it would also be in accordance with RCRA preshipment requirements for the transportation of hazardous wastes wastes identified in 40 CFR 262.

Before the CAIS items may be shipped offsite, the receiving DoD facility, and any facility that would be receiving hazardous wastes generated by the RRS operations, would need to be authorized by the USEPA as acceptable to receive CERCLA wastes, pursuant to 40 CFR 300.440. Furthermore, since the transportation, RRS operations, and subsequent incineration/disposal are all offsite activities, they must comply with all the substantive and administrative requirements of any applicable laws.

Long-term effectiveness and permanence. Alternative 4 addresses the primary long-term public risk associated with the storage of the CAIS at Building 55228 (Bunker D-15): accidental, one-time exposure to low levels and low volumes of chemical warfare agents. Alternative 4 would alleviate this risk by removing the CAIS items from the site, by treating the CWM CAIS items in the RRS so that military controls are no longer required, and by incinerating the CWM treatment residues as well as the other hazardous substances, pollutants, or contaminants from the CAIS items. Ash resulting from the final treatment (incineration at TSDF) would be shipped to a RCRA Subtitle C landfill for final disposal. Nonhazardous debris generated during the RRS operations would be disposed of at a RCRA Subtitle C hazardous waste landfill.

Reduction of toxicity, mobility, or volume through treatment. This alternative would achieve a reduction in toxicity, mobility, and volume through treatment (i.e., detoxification of the CWM followed by incineration of the CWM treatment residues as well as of the other hazardous substances, pollutants, or contaminants in the CAIS items). There would be an initial increase in the volume of the waste as a result of the detoxification of the CWM, but this comes as a tradeoff to a reduction in toxicity to make it safer for transport.

Short-term effectiveness. Four types of potential short-term risk would be associated with Alternative 4:

(1) Accidental exposure to CWM and other industrial materials during shipment offsite

(2) Accidental exposure during handling and treatment at the RRS

(3) Accidental exposure to treated material and industrial materials during shipment to the incineration facility

(4) Transportation accidents.

The potential for accidental breakage of CAIS bottles and ampoules is greatest during packaging activities. Potential exposure could occur to remediation workers. Exposure could be either through the dermal or inhalation route, or both. Although CWM and hazardous material concentrations are high, the low volume of material will limit the actual dose received and will therefore limit the severity of the effect of exposure. Exposures would be (at worst) acute-not lethal- and would result in eye and skin irritation and bronchial discomfort. If breakage of both bottles/ampoules and overpack packaging material occurs (an unlikely scenario) in a closed space (e.g., within the transportation vehicle), exposures could be more severe though mitigated by the packaging materials designed to prevent leaks.

Occupational exposures to workers could occur during handling and treating of CAIS at the RRS. The following controls have been developed for the RRS to prevent short-term occupational exposures during treatment of CAIS items containing chemical agent:

- The three-station glovebox operates under negative pressure.
- CAIS would be introduced into the RRS through an airlock.
- An air monitoring system will monitor air within crew working space and air exiting the glovebox.
- Air exiting the glovebox will pass through a carbon filter system.
- RRS crew members will be certified to perform RRS tasks.

Exposure could result in irritation of the skin and eyes. Workers likely will not be exposed to any substances above OSHA permissible exposure limits. There exists a potential for dermal exposure to liquid chloroform during RRS operations if chloroform spills penetrate the butyl gloves in the glovebox. This exposure will be mitigated by use of 4H glove liners.

Other types of short term exposure associated with Alternative 4 are from risk of transportation accidents during transport of pigs to the RRS and during transport of the CWM residues and other hazardous materials to the incineration facility. The transportation route for Alternative 4 would cover air shipment between Alaska and a DoD facility for treatment of the CWM CAIS items in the RRS and the subsequent transportation of CWM treatment residues and other materials to a RCRA Subtitle C facility for incineration and ultimate disposal. Appendix G summarizes the potential for accidents during transportation of the CAIS items. It is estimated that no accidents will occur. The potential exists for exposure to occupational and public receptors during transportation if material escapes packaging. However, this potential has not been quantified. Because of the small volume and low presumed concentration of CWM, exposures would likely only result in irritation of the skin and eyes. To mitigate this exposure, the stringent packaging, shipping, and transportation requirements of 49 CFR 171-177 and the Army would be enforced.

3.4.2 Implementability. The implementation of this alternative would be technically feasible. The operation of the RRS glovebox system is based on basic engineering principles and proven technologies. However, to implement this alternative, the transportation restrictions in 50 United States Code (USC) 1512a(b) would require a waiver under Section 121(d)(4) of CERCLA [42 USC 9621(d)(4)] as in Alternative 3. The reactor treatment chemistry was validated in bench scale and operational testing. The RRS would be required to be permitted as a RCRA miscellaneous treatment unit (40 CFR 264, Subpart X). Furthermore, the DoD facility where the RRS would be located, as well as the facility(ies) that would receive waste generated from the RRS operations would need to be authorized by the USEPA as acceptable to receive CERCLA wastes, pursuant to 40 CFR 300.440. Several RCRA Subtitle C facilities have already been approved to receive CERCLA waste.

3.4.3 Cost. The cost estimate for Alternative 4 assumes that the RRS would be located at Pine Bluff Arsenal (PBA) in Pine Bluff, Arkansas. The cost estimates for Alternative 4 reflects a level of accuracy that should be within the range of -30 percent to +50 percent of the final design cost estimate. The detailed cost estimate is presented in Appendix F. The cost estimate is divided into three major cost categories: direct capital costs, indirect capital costs, and contingency. The direct capital costs include the costs for labor; equipment and materials; and travel, car rental, and per diem. The indirect capital costs include the costs for engineering and management (20 percent of the direct capital costs); and permits, fees, and taxes (10 percent of the direct capital costs); plus the costs for a RCRA permit and the necessary NEPA documentation. A contingency (30 percent of the total capital costs) has been added to cover the costs associated with unforeseen circumstances, such as weather, administrative delays, and gaps in site characterization data. The summary of the costs for Alternative 4 is as follows:

Direct Capital Costs		
A. Labor	$491,226	
B. Materials and Equipment	$669,395	
C. Travel/Car Rental/Per Diem	$ 88,560	
TOTAL DIRECT CAPITAL COSTS		$1,249,181
Indirect Capital Costs		
D. Engineering and Management	$249,836	
E. Permits, Fees, and Taxes	$449,918	
TOTAL INDIRECT CAPITAL COSTS		$ 699,754
TOTAL CAPITAL COSTS		$1,948,936
CONTINGENCY		$ 584,681
TOTAL PROJECT COSTS	$2,533,616	

These costs were estimated assuming that all generated wastes would be disposed in a RCRA Subtitle C (hazardous waste) landfill. It should be noted that utilities, building, support personnel, and so forth, have already been identified and are available at both DCD and PBA.

SECTION 4
COMPARATIVE ANALYSIS OF ALTERNATIVES

An abbreviated comparative analysis of the interim remedial action alternatives is presented in Table 4-1. The purpose of this section is to identify the advantages and disadvantages of each alternative relative to one another so that key trade-offs that would affect the remedy selection can be identified. This analysis will follow the same format used in Section 3 for an independent presentation of each alternative.

4.1 Effectiveness.

Overall protection of human health and the environment. All four alternatives take into consideration factors that would ensure overall protection of human health and the environment. The RRS that is specified in Alternatives 2, 3, and 4 uses negative pressure and engineering controls to ensure worker safety. With the exception of Alternative 1, all alternatives would ensure that the recovered CWM and associated hazardous substances, pollutants, or contaminants ultimately would be destroyed at a commercial hazardous waste TSDF incinerator. For alternatives 2 and 3, the residues and ash from this process would be sent to a RCRA Subtitle C landfill. Nonhazardous debris and other nonhazardous waste generated from the process would be sent to a RCRA Subtitle D landfill. For Alternative 4, all residues and ash from the treatment process would be sent to a RCRA Subtitle C landfill.

Compliance with ARARs, and other criteria, advisories, and guidance. With the exception of the CWM transportation restriction in the case of Alternatives 3 and 4, all the alternatives comply with the ARARs identified in Appendix C. In the case of Alternatives 3 and 4, however, the CWM transportation restrictions could be waived pursuant to Section 121(d)(4)(D) of CERCLA.

Table 4-1. Comparative Analysis of Interim Removal Action Alternatives

Evaluation Criteria	Alternative 1 - No Action	Alternative 2 - Onsite Treatment of CWM; Offsite Treatment/Disposal of Residues and Other Hazardous Substances	Alternative 3 - Offsite Treatment/Disposal at a Commercial RCRA TSDF Facility	Alternative 4 - Offsite Treatment of CWM at a DoD Chemical Stockpile Facility
Effectiveness	Risks to trespassers or workers, potential releases to environment remain.	Risks to trespassers or workers reduced.	Risks to trespassers or workers moderate as more steps required for implementation.	Risks to trespassers or workers moderate as more steps required for implementation.
	Complies with ARARs except for container management design standards.	Complies with ARARs and other requirements.	Complies with ARARs except for transportation restrictions for CWM.	Complies with ARARs except for transportation restrictions for CWM.
	Long term effectiveness dependent on maintaining institutional controls. No technologies applied.	Long term effectiveness is achieved through treatment. Technology is pretreatment of CWM at the RRS, with offsite incineration/disposal of treatment residues and other hazardous substances, pollutants, or contaminants.	Long term effectiveness is achieved through treatment. Technology is repackaging using RRS with offsite incineration/disposal of all hazardous substances, pollutants, or contaminants, including CWM.	Long term effectiveness is achieved through treatment. Technology is transportation for offsite pretreatment of CWM at the RRS followed by subsequent shipment to a commercial hazardous waste facility of treatment residues and other hazardous substances, pollutants, or contaminants for incineration/disposal.
	Short term risk to environment is minimal.	Low short term risk since CWM is pretreated (detoxified) before being shipped offsite with other hazardous wastes.	Medium short term risk to environment since CWM would be shipped offsite.	High short term risk to environment based on numerous offsite transportation steps.
Implementability	High technical and administrative feasibility. No implementation of remedy actions is required.	High technical feasibility. Based on basic engineering principles and proven technologies.[b] High administrative feasibility. Several commercial hazardous waste TSDFs are authorized to receive CERCLA wastes. Implementable; however, no facilities have been identified to accept CAIS for incineration and should be undertaken in Summer or Fall when facility activity is minimal.	High technical feasibility. Moderate administrative feasibility which requires CERCLA waiver for CWM transportation restriction. Implementable; however, no facilities have been identified to accept CAIS for incineration and should be undertaken in Summer or Fall.	High technical feasibility. Based on basic engineering principles and proven technologies.[b] Low administrative feasibility because receiving DoD chemical stockpile facility will require USEPA approval for receiving CERCLA waste and the requirement exists for a RCRA permit. Implementable; however, should be undertaken in Summer or Fall.
Cost	Duration: indefinite NA[a]	Duration: 3-4 months Total Project: $2,546,859	Duration: 2-6months Total Project: $1,977,627	Duration: 2-6 months Total Project: $2,533,616

Notes:
[a] This alternative would be an interim measure; and it is estimated that its implementation would only increase the final costs for remediating the site.
[b] The RRS reactor treatment chemistry has been successfully tested and demonstrated.

ARAR = applicable or relevant and appropriate requirement
CAIS = chemical agent identification set
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CWM = chemical warfare materiel
DoD = Department of Defense
EE/CA = Engineering Estimate/Cost Analysis
PRDA = Poleline Road Disposal Area
RCRA = Resource Conservation and Recovery Act
RRS = Rapid Response System
TSDF = Treatment, storage, and disposal facility
USEPA = U.S. Environmental Protection Agency

Long-term effectiveness and permanence. Alternative 1 is considered to be only a temporary measure and therefore would provide no long-term effectiveness in meeting remedial action disposal requirements. Alternatives 2 through 4 would achieve long-term effectiveness because all hazardous substances, pollutants, or contaminants would ultimately be destroyed through incineration. The ash would reach final disposal in a RCRA Subtitle C landfill. Nonhazardous debris and other nonhazardous wastes generated from the process would be sent to a RCRA Subtitle D landfill for final disposal.

Reduction of toxicity, mobility, or volume through treatment. Alternative 1 does not involve any treatment and therefore does not meet CERCLA's statutory preference for alternatives that rely on treatment to permanently reduce the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants, as stated in 42 USC 9621. Alternatives 2 and 4 would reduce toxicity and mobility but would cause a temporary increase in volume as a result of the treatment in the RRS of CAIS items containing chemical warfare agent. However, the volume would ultimately be reduced through final treatment by incineration at a RCRA Subtitle C facility. Alternative 3 would reduce volume, mobility, and toxicity through treatment by incineration at an offsite commercial RCRA Subtitle C facility.

Short-term effectiveness. Alternative 1 will be effective in the short term through use of Building 55228 (Bunker D-15) and institutional controls currently in place (guards, etc.). Alternatives 2, 3, and 4 may cause some risk to workers in the RRS. However, as previously described, this risk would be mitigated through effective use of engineering and institutional controls.

4.2 Implementability.

Alternative 1 has no technical feasibility requirements associated with it. Alternatives 2, 3, and 4 are all technically feasible and adaptable to environmental conditions (i.e., the RRS can be transported to Alaska or can be used at one of the DoD chemical stockpile facilities in the lower 48 states). In addition, Alternatives 2, 3, and 4 would similarly contribute to remedial performance, which entails the destruction of the recovered CWM and associated hazardous materials.

Since no treatment is being considered for Alternative 1, availability is not a consideration. Alternatives 2, 3, and 4 have equipment available, including personnel, outside laboratory testing capacity (through the MASP or other means), and offsite treatment and disposal capacities as discussed in Section 3.

Administrative feasibility concerns for Alternatives 2, 3, and 4. All of these alternatives involve the offsite transfer of CERCLA wastes for treatment and/or disposal, which would require that the offsite receiving facility(ies) be approved for receiving CERCLA wastes pursuant to 40 CFR 300.440. While many commercial RCRA Subtitle C and Subtitle D facilities have already been approved by the USEPA for receiving CERCLA wastes, as appropriate, such is not the case for the DoD chemical weapons stockpile facilities (where the RRS would be located under Alternative 4). Other than, perhaps, transfers of recovered non-stockpile CWM from CERCLA emergency or time-critical actions at other sites, these facilities do not typically receive CERCLA wastes. Therefore, the facilities will most likely require USEPA approval pursuant to the provisions of 40 CFR 300.440 before any CAIS items from Ft. Richardson could be transferred for treatment and repackaging in the RRS as envisioned under Alternative 4.

For a facility to be approved to receive CERCLA wastes, not only must the receiving unit (the RRS in the case of Alternative 4) have no relevant violations and no existing releases, but other units at the facility must not have any releases posing a significant threat to public health or the environment, unless such releases are controlled by an enforceable agreement with the Federal or State Government. If the facility where the receiving unit would be located has a RCRA Subtitle C land disposal unit, then the entire facility is considered a RCRA Subtitle C land disposal facility. In that case, not only must the receiving unit have no violations or releases, but all the nonreceiving units at the facility must not have any releases as well, unless they are also controlled by an enforceable agreement with the Federal or State Government.

In addition to the administrative feasibility concerns associated with the offsite transfer of CERCLA wastes pursuant to 40 CFR 300.440, implementation of Alternatives 3 and 4 would require a waiver of the CWM transportation restrictions under 50 USCA 1512a(b). This waiver, however, could be granted pursuant to Section 121(d)(4)(D) [42 USC 9621(d)(4)(D)]: "the remedial action selected will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, criteria, or limitation, through the use of another method or approach."

4.3 Cost.

The costs for the remedial alternatives evaluated in this EE/CA range from $1,977,627 for Alternative 3, to similar costs of $2,533,616 for Alternative 4, and $2,546,859 for Alternative 2. Alternative 1 is believed only to increase the final costs of remediating the site, since it would only delay the implementation of any of the other alternatives being evaluated in this EE/CA. Therefore, it is considered to be the most expensive of the alternatives.

SECTION 5

RECOMMENDED REMOVAL ACTION ALTERNATIVE

Alternative 2 is the recommended removal action for the CWM stored at Ft. Richardson. Alternative 2 meets the preferred condition of onsite disposition by decreasing the potential risk to the public.

Alternatives 3 and 4 are less acceptable because they involve shipping the CAIS material containing CWM offsite without treatment, which increases the risk of an incident involving CWM CAIS items. They are also less acceptable because they require obtaining approval from the states where the RRS operations would take place, to bring in CAIS material.

Cost estimates for the three alternatives fall within the USEPA guidelines (-30 percent to +50 percent) for an estimate of this type.

5.1 Alternative 1

The "No Action" alternative delays treatment and increases programmatic costs.

5.2 Alternative 2

In Alternative 2, the CAIS items are brought to the RRS, where they are identified and segregated. CAIS items containing chemical agent are transferred to the neutralization station for treatment in the reactor. Those CAIS items that do not contain chemical agent would be repackaged in laboratory packs for shipment offsite to an approved hazardous waste TSDF for final treatment and ultimate disposal. Alternative 2 meets the guidance in Army Regulation (AR) 200-1 that states, "the preferred disposition alternative is onsite treatment."

Alternative 2 would remove the source of CWM and other hazardous substances from Ft. Richardson, thus alleviating the potential for future exposures to human and ecological receptors. Alternative 2 would eliminate risks because it achieves overall protection by using existing treatment technologies, in addition to achieving complete destruction of the hazardous substances, pollutants, or contaminants. Packaging the CWM treatment residues, non-CWM CAIS items, and other wastes generated during the RRS operations would be consistent with the requirements of the HMTA (49 CFR 171-177). The appropriate RCRA hazardous waste identification, labeling, and manifesting requirements would also be implemented. The wastes generated from the RRS operations to be shipped offsite, would be sent only to a facility determined by the USEPA to be in compliance with the acceptability requirements of 40 CFR 300.440.

Alternative 2 would achieve long-term effectiveness and permanence by removing all CAIS items from the site and treating the CWM before offsite shipment. Treatment residues from the detoxification/decontamination operation and the repackaged CAIS items would be classified as RCRA hazardous waste and would be further treated by incineration at a RCRA Subtitle C facility, resulting in its ultimate destruction. The implementation of this alternative is technically feasible. The operation of the RRS glove box system is based on basic engineering principles and proven technologies.

The estimated cost for implementing Alternative 2 is $2,546,859.

5.3 Alternative 3

For Alternative 3, the CAIS items would be brought to the RRS to unpack the CAIS items from their overpack containers, identify and segregate the CAIS items by their chemical contents, and repackage the CAIS items according to compatibility and hazard class (in accordance with the DOT requirements) for shipment offsite to a RCRA subtitle C incineration facility. Since treatment operations for CAIS containing chemical agent would not be taking place, these CAIS items would be overpacked in SRCs and transported by military plane to the Army installation in the lower 48 states closest to the TSDF where the CAIS items containing chemical warfare would be incinerated.

Alternative 3 would remove the source of CWM from Ft. Richardson, thus alleviating the potential for future exposure to human and ecological receptors. Except for the chemical agent transportation restrictions in 50 USCA 1512a(b), Alternative 3 would comply with the ARARs listed in Appendix C, as well as with Army criteria, advisories, and guidance specific to the management of CWM. Packaging the CAIS items and other wastes generated during the RRS operations would be consistent with the requirements specified in 49 CFR 171-177. The wastes generated from the RRS operations could only be sent to an offsite facility, which USEPA has determined that it meets the acceptability requirements in 40 CFR 300.440.

The implementation of Alternative 3 would be technically feasible. The operation of the RRS glovebox system and commercial hazardous waste incinerators is based on basic engineering principles and proven technologies. However, to implement this alternative, the transportation restrictions in 50 USC 1512a(b) would require a waiver under Section 121(d)(4) of CERCLA [42 USC 9621(d)(4)]. In the case of Alternative 3, complete destruction of the CWM and the other hazardous substances, pollutants, or contaminants would be achieved by shipping the wastes directly to a commercial RCRA Subtitle C incineration facility.

The estimated cost for implementing Alternative 3 is $1,977,627.

5.4 Alternative 4

Alternative 4 would require the transportation of the RRS and CAIS items to a DoD facility. In Alternative 4, it is assumed that the RRS would be transported to the PBA in Pine Bluff, Arkansas, and the CAIS items would be transported to it.

Alternative 4 would remove the source of CWM from Ft. Richardson, thus alleviating the potential for future exposure to human and ecological receptors. The implementation of this alternative would be technically feasible. The operation of the RRS glovebox system and commercial hazardous waste incinerators is based on basic engineering principles and proven technologies. However, implementing this alternative would require obtaining the approval of the states where the RRS operation would take place. Additionally, the transportation restrictions in 50 USC 1512a(b) would require a waiver under Section 121(d)(4) of CERCLA [42 USC 9621(d)(4)].

The estimated cost for implementing Alternative 4 is $2,533,616.

APPENDIX A.
ACRONYMS/ABBREVIATIONS

APPENDIX A.

ACRONYMS/ABBREVIATIONS

AA&E	Arms, Ammunition and Explosives
AAC	Alaska Administrative Code
ADNR	Alaska Department of Natural Resources
AEIDC	Alaska Environmental Information and Data Center
AFB	Air Force Base
AR	Army Regulation
ARAR	applicable or relevant and appropriate requirement
ASZM-TEDA	copper-silver-zinc-molybdenum-triethylenediamine
CAIS	chemical agent identification set
CDMH	chlorodimethylhydantoin
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CG	phosgene
CN	chloroacetophenone
CPRP	Chemical Personnel Reliability Program
CRREL	U.S. Army Corps of Engineers Cold Regions Research Laboratory
CVAOA	chlorovinylarsonic acid
CWC	Chemical Weapons Convention
CWM	chemical warfare materiel
DA	Department of Army
DAAMS	Depot Area Air Monitoring System
DCD	Deseret Chemical Depot
DCDMH	1,3-dichloro-5,5-dimethylhydantoin
DHHS	Department of Health and Human Services
DM	Adamsite
DMH	dimethylhydantoin

ACRONYMS/ABBREVIATIONS (Continued)

DoD	Department of Defense
DOT	Department of Transportation
EA	environmental assessment
EAFB	Elmendorf Air Force Base
EE/CA	Engineering Evaluation/Cost Analysis
EMI	electro magnetic inductance
EPA	Environmental Protection Agency
ESE	Environmental Science and Engineering, Inc.
FFA	Federal Facilities Agreement
FFCA	Federal Facilities Compliance Agreement
FM	Field Manual
FONSI	finding of no significant impact
FR	Federal Register
gal	gallon
g/l	grams per liter
g/mL	grams per milliliter
GC	gas chromatograph
GPL	General Population Limit
H	Levinstein mustard
HCl	hydrogen chloride
HD	distilled mustard
HEPA	high efficiency particulate air
HMTA	Hazardous Materials Transportation Act
HS	sulfur mustard
HT	thickened mustard
HVE	high vacuum extraction

ACRONYMS/ABBREVIATIONS (Continued)

ICA	Incapacitating concentration
IRA	Interim response action
L	Lewisite
LC_{50}	Lethal Concentration
LCA	Lethal Concentration
LD_{50}	lethal dose
LSC	laboratory sample container
MASP	Mobile Analytical Support Platform
mg/kg	milligrams per kilogram
mg/m^3	milligrams per cubic meter
MINICAMS®	Miniature Continuous Air Monitoring System
mL	milliliter
MOA	Municipality of anchorage
MRC	multiple round container
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NIOSH	National Institute of Occupational Safety and Health
NMR	nuclear magnetic resource
NPL	National Priorities List
OHM	OHM Remediation Services, Inc.
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OU-B	Operational Unit - B
oz	ounce
PAM	Pamphlet
PBA	Pine Bluff Arsenal

ACRONYMS/ABBREVIATIONS (Continued)

PEL	permissible exposure limits
PMCD	U.S. Army Program Manager for Chemical Demilitarization
PPE	Personal Protective Equipment
ppm	parts per million
ppmv	parts per million by volume
ppmw	parts per million by weight
PRDA	Poleline Road Disposal Area
PS	chloropicrin
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
RRS	Rapid Response System
SI	site investigation
SRC	single round container
STD	Standard
SWMU	solid waste management unit
TBC	to-be-considered
TCLP	Toxicity Characteristic Leaching Procedure
TEU	U.S. Army Technical Escort Unit
TSDF	treatment, storage, and disposal facility
TWA	Time-weighted average
UHC	underlying hazardous constituents
USACEAD	U.S. Army Corps of Engineers, Alaska District
USACENPD	U.S. Army Corps of Engineers
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USACMDA	U.S. Army Chemical Materiel Destruction Agency (now PMCD)
USAEC	U.S. Army Environmental Center
USAEHA	U.S. Army Environmental Hygiene Agency (now USACHPPM)

ACRONYMS/ABBREVIATIONS (Continued)

USAF	U.S. Air Force
USARAK	U.S. Army, Alaska
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency (now USAEC)
USC	United States Code
USCA	United States Code Annotated
USCB	United States Census Bureau
USEPA	U.S. Environmental Protection Agency
WWII	World War II

APPENDIX B.
CHEMICAL AGENT IDENTIFICATION SET (CAIS) DESCRIPTIONS

Adapted from:

U.S. Army Program Manager for Chemical Demilitarization (PMCD). Chemical Agent Identification Sets (CAIS) Information Package, November 1995.

APPENDIX B.

CHEMICAL AGENT IDENTIFICATION SET DESCRIPTIONS

SET K941

TOXIC GAS SET M1

OLD STOCK NUMBER: FSN 1365-219-8574

TIME FRAME OF USE: World War II - LATER 1950's

The K941 Chemical Agent Identification Set (CAIS) contains 24, 4-ounce glass bottles, each containing 3-1/2 ounces of mustard (H and HS) or distilled mustard (HD) for a total of 84 ounces (2.48 liters) per set.

Bottles are round and have a small screw top. Heat resistant paint on the bottles indicates "H," "HS," "HD," or "TOXIC GAS SET, M1." Four bottles are packed in a 1/2-in. layer of sawdust within a sealed metal can. The cans are pressure sealed, 6-1/2 in. high, and have a sardine-type key on the bottom. Six of these metal cans are fitted into a steel shipping cylinder that is 6-5/8 in. in diameter, approximately 38 in. long, and 0.145 in. thick. The open end of this container is closed by a flanged end cover, which is secured by eight bolts tightened over a 1/8-in. thick lead gasket.

In a former World War II (WWII) training area, K941 shipping containers (also called pigs) or loose K941 bottles are frequently found buried. Loose bottles should be handled carefully by field personnel during recovery using appropriate protective measures as the plastic/bakelite tops on these bottles are prone to leak.

SET K951/K952

WAR GAS IDENTIFICATION SET, INSTRUCTIONAL M1

SET GAS IDENTIFICATION, DETONATION M1

OLD STOCK NUMBER: FSN 1365-025-3272 (K951)
FSN 1365-025-3783 (K952)

TIME FRAME OF USE: EARLY 1930's TO LATE 1950's

The K951/K952 CAIS contained 48 Pyrex, flame sealed ampoules: 12 containing 1.4 ounces each of mustard solution (H, 5 percent in chloroform); 12 containing 1.4 ounces each of Lewisite solution (L, 5 percent in chloroform); 12 containing 1.4 ounces each of chloropicrin solution (PS, 50 percent in chloroform); and 12 containing 1.4 ounces each of neat phosgene (CG). The amount of agent and solvent in each ampoule is listed in Table B-1.

Each ampoule is 1 in. in diameter and 7-1/2 in. long. Each ampoule is packed in a cardboard screw cap container (mailing tube-type) with agent type indicated by letters on the cardboard container. Twelve cardboard containers each are packaged into 4 press fit metal cans which are 9-1/4 in. high. The cans are packed into a steel cylinder 6 5/8 in. in diameter, approximately 38 in. long, and 0.145 in. thick. The open end of the cylinder is closed by a flanged end cover, which is secured by eight bolts.

Table B-1. K951/K952 CAIS Glass Bottle Amount

Pyrex™ Ampoule	Agent	Chloroform
H	2 ml	38 ml
L	2 ml	38 ml
PS	20 ml	20 ml
CG	40 ml	0 ml

The only difference between the K951 and K952 is that the K951 was issued with blasting caps that were packed and shipped in a separate container.

The K951 ampoules (also called vials) are frequently found in burial sites at old WWII training areas. They are sometimes found loose, sometimes found in their original steel cylinders (also called pigs), and are sometimes found in drums, cans, or other disposal containers. When found loose, the agent type cannot be readily identified without sophisticated spectrographic equipment, and a worst case assumption of phosgene should be made by field personnel.

SET K955

SET, GAS IDENTIFICATION, INSTRUCTIONAL, M1 (NAVY SET)

OLD STOCK NUMBER: FSN 1365-386-6154

TIME FRAME OF USE: LATE 1930s TO WORLD WAR II

Each K955 CAIS contains seven 4-ounce glass bottles. Four of these glass bottles contain 3 ounces (90 cc) of activated charcoal each, on which 25 milliliters of agent is adsorbed. Of these four glass bottles, one contains Lewisite (L or M-1), one contains chloropicrin (PS), and two contain HD. Of the three bottles remaining in the K955 CAIS, one contains 6 grams of triphosgene (a simulant for CG), one contains 15 grams of chloroacetophenone (CN), and one contains 15 grams of adamsite (DM). The amount of agent and charcoal in each bottle is listed in Table B-2.

These sets are packed in a hinged, covered wood box that resembles a foot locker and measures 30-3/8 in. wide, 15-1/2 in. long, and 11-3/4 in. high. The inside of the box is divided into eight sections. Seven of the sections contain sealed metal cans in sawdust, and the eighth has instructions. The cans are 4 in. in diameter and 7 in. high and have a paint can-type lid. Inside each can is one round bottle with a large screw top or glass topper that is usually wax coated. The bottles are frequently filled with charcoal.

These bottles are frequently found loose in WWII disposal/burial sites. Their contents are easily identified by the letter and number code etched into the side of the glass bottle. Older sets use the code "M-1" for Lewisite, while newer sets use the familiar code "L."

Table B-2. K955 CAIS Glass Bottles Amounts

Bottle	Agent	Charcoal
HS	25 ml	90 cc
L/M-1	25 ml	90 cc
PS	25 ml	90 cc
CG-sim	6 g	0
CN	15 g	0
DM	15 g	0

APPENDIX C.
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO-BE-CONSIDERED GUIDANCE FOR CHEMICAL WARFARE MATERIEL (CWM) REMEDIATION AT FT. RICHARDSON, ALASKA

APPENDIX C.

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO-BE-CONSIDERED GUIDANCE FOR CHEMICAL WARFARE MATERIEL REMEDIATION AT FT. RICHARDSON, ALASKA

Onsite remedial actions must comply with applicable or relevant and appropriate requirements (ARARs) based on Section 121 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (42 USC 9621), unless a waiver is justified pursuant to 42 USC 9621(d)(4). Although compliance with ARARs generally applies as a matter of law only to remedial activities occurring onsite, the Environmental Protection Agency (EPA) has stated, as a matter of policy, that onsite removal action activities will attain ARARs "to the maximum extent practicable considering the exigencies of the situation" [53 Federal Register (FR) 51435, 40 Code of Federal Regulations (CFR) 300.415(j)]. Whether it is practicable for removal actions to comply with ARARs depends on the urgency of the situation, or whether the purpose of the removal action is to minimize and mitigate potential harm or to eliminate it (55 FR 8696). If the purpose of the removal action is only to minimize and mitigate harm, it cannot be expected to attain all ARARs. In the case of non-time-critical removal actions, however, given that at least six months of planning time is available for such actions, the EPA has indicated that it expects that it will generally be practicable for non-time-critical removal actions to attain ARARs [Office of Solid Waste and Emergency Response (OSWER) 9203.1-3]. As a result, ARARs for treatment/disposal of chemical agent identification set (CAIS) items have been identified and are provided in this appendix.

Several requirements found in 40 CFR have been evaluated as being "applicable" under the ARAR definition. "Applicable" requirements are defined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site" (40 CFR 300.5). To be applicable, a regulation must be legally enforceable at the site for the contaminant or action as if a private party were implementing the response action apart from any CERCLA authority. Therefore, for a requirement to be applicable, the jurisdictional prerequisites of the requirement must fully address the circumstances at the site or the circumstances of the proposed response activity (53 FR 51436).

"Relevant and appropriate requirements" are defined in the NCP as "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or state environmental or facility siting laws that, while not 'applicable' to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site" (40 CFR 300.5). However, "only those requirements that are determined to be both relevant and appropriate must be complied with" (53 FR 51436).

The determination of whether a requirement is relevant and appropriate is based on professional judgment and takes into consideration the specific environmental and technical factors at the site. First, it is necessary to evaluate if the requirement is relevant by determining whether the requirement addresses, in a broad sense, the same chemicals, actions, or location covered by the requirement and related conditions at the site. Then, once the requirement is found to be relevant, a determination is made about whether it is well suited to the particular circumstances at the site. Once a requirement has been determined to be relevant and appropriate, such a requirement must be complied with to the same extent as if it were applicable (53 FR 51436-51437). With respect to state ARARs, the NCP specifies that "only those state standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable or relevant and appropriate" (40 CFR 300.5). Furthermore, to be considered as an ARAR, the state standards must be more stringent than any Federal standard and must also be promulgated by state law or regulation, and such law or regulation must be of general applicability and legally enforceable

(53 FR 51437). The state is responsible for identifying state ARARs related to the cleanup action.

Table C-1 lists the ARARs identified for the onsite activities that would be conducted as part of the alternatives evaluated for the disposal of CAIS items recovered from the Poleline Road Disposal Area (PRDA) site at Ft. Richardson. Offsite activities are not subject to the concept of ARARs but must comply with both the substantive and administrative requirements of all applicable Federal and State laws and regulations.

Because ARARs do not exist for every chemical or circumstance likely to be found at a CERCLA site or because the existing ARARs may not be sufficiently protective of human health and the environment, other advisories, criteria, or guidance developed by EPA, other Federal agencies, or states may be identified as requirements to-be-considered (TBC) for developing the response action. TBC requirements are not mandatory as cleanup standards under CERCLA since, by definition, they are generally neither promulgated nor enforceable and therefore do not have the same status as ARARs. Nevertheless, EPA believes that the use of TBC requirements applies to both removal and remedial actions, and that it is consistent with CERCLA's statutory requirement to protect human health and the environment and to comply with ARARs. However, the application of the TBC requirements to a response action is still subject to the statutory requirements of CERCLA, including the requirement that the response be cost effective (55 FR 8745).

TBC requirements generally fall within three categories: health effects information with a high degree of credibility, technical information on how to perform or evaluate site investigations or response actions, and policy (53 FR 51436). Table C-2 lists the TBC requirements identified for the onsite activities that would be conducted as part of the alternatives evaluated for the disposal of CAIS items recovered from the PRDA site.

Requirements of non-environmental laws and regulations apply on their own force and are not incorporated as part of the ARARs process established by CERCLA Section 121(d) (55 FR 8679). This includes requirements that are promulgated as part of the NCP (i.e., the CERCLA Offsite Rule, Occupational Safety and Health

Administration), which may not be evaluated for attainment or waiver as part of the ARARs process. Furthermore, pursuant to CERCLA Section 120(a)(2), no Federal agency may adopt or utilize guidelines, rules, regulations, or criteria that are inconsistent with the guidelines, rules, regulations, and criteria established by the EPA.

Table C-1. Applicable or Relevant and Appropriate Requirements for the Disposal of CAIS Items Recovered from the PRDA Site at Ft. Richardson, Alaska

Requirement	Rationale for ARAR
A. Chemical Specific Requirements **50 USC 1512(2)**	
Gives the U.S. Department of Health and Human Services (DHHS) responsibility with respect to any hazards to public health and safety related to the transportation, testing, or disposal of any chemical warfare agents in the U.S. stockpile, and authorizes the Secretary of the DHHS to recommend what precautionary measures are necessary to protect the human health and safety with respect to such chemical warfare agent transportation, testing, or disposal. Pursuant to 50 USC 1512(2), DHHS endorsed (see 53 FR 8504 - 8507) the safety and health standards developed by the Department of Defense (DoD) for handling the chemical warfare agents. These standards include: MUSTARD (H, HD, HT) • 72-hour time weighted average (TWA) airborne general population limit (GPL) - 0.0001 mg/m^3 • 8-hour TWA worker airborne exposure limit - 0.003 mg/m^3. LEWISITE (L) • 72-hour TWA airborne GPL - 0.0001 mg/m^3 • 8-hour TWA worker airborne exposure limit - 0.003 mg/m^3. DHHS also endorsed chemical warfare agent control limits for stack emissions proposed by DoD, but with the condition that they be evaluated by air dispersion modeling of worst-case credible events for compliance with the general population and worker exposure limits. These stack emission control limits known as allowable stack concentrations are as follows: MUSTARD (H, HD, HT) - 0.03 mg/m^3 LEWISITE (L) - 0.03 mg/m^3.	Although these requirements specifically apply to the chemical warfare agents in the U.S. stockpile, they are considered relevant and appropriate because they address the same chemical warfare agents present in some of the CAIS items recovered from the PRDA site, and because they address the same type of actions (transportation and disposal) being evaluated for the disposal of CAIS. Furthermore, since no other applicable requirements exist for evaluating the chemical warfare agent emissions resulting from the storage of such agents, they are also considered relevant and appropriate for such emissions.

Requirement	Rationale for ARAR
B. Action Specific Requirements	
Use and Management of Containers	
40 CFR 264.171- 177	
Containers used to manage hazardous waste:	These requirements are considered to be applicable since:
• Must be in good condition • Must be made of or lined with materials that are compatible with the hazardous waste • Must be closed during storage (except to add or remove waste)	• Due to the concentration levels of specific chemical constituents in the CAIS items, the waste is considered characteristically hazardous pursuant to 40 CFR Part 261
• Must be managed in a manner that would prevent leaks • Must be inspected weekly for signs of leaking or deteriorating containers, or for signs of deterioration of the secondary containment system	• The CAIS items are packaged in containers, and the RRS reactor meets the definition of a container in 40 CFR 261.10.
• Must be placed on an impervious, crack-free base, capable of containing 10 percent of the volume of containers of free liquids (or the volume of the largest container of free liquid) • Must comply with the requirements for *incompatible* wastes.	• Even though the RRS glovebox would be considered a miscellaneous unit used for the treatment and storage of hazardous wastes (as defined in 40 CFR 261.10), the RCRA standards for use and management of containers would still apply per 40 CFR 264.601.

Requirement	Rationale for ARAR
Land Disposal Restriction – Prohibitions on Storage **40 CFR 268.50** When storage of hazardous wastes restricted from land disposal pursuant to 40 CFR 268, Subpart C extends beyond one year, the owner/operator of the facility bears the burden of proving that such storage is solely for the purpose of accumulating sufficient quantities to allow for proper recovery, treatment, or disposal.	These requirements are considered to be applicable since: • Hazardous wastes (as defined in 40 CFR Part 261) that do not meet the definition of chemical munitions in accordance with 40 CFR 266.205(d), could be generated during the removal action. • These hazardous wastes would be subject to the land disposal restrictions in 40 CFR Part 268.
Land Disposal Restriction Treatment Standards 40 CFR 268.40 A prohibited waste identified in the table "Treatment Standards for Hazardous Wastes" may be land disposed only if it meets the requirements found in the table.	The concentrations of specific constituents in the CAIS waste result in the CAIS items meeting the LDR definition of a prohibited waste, and therefore those constituents must be treated to meet the treatment standards specified in table under 40 CFR 268.40. These requirements apply since the waste is being shipped to an off-site facility for treatment and ultimate disposal.

Requirement	Rationale for ARAR
Land Disposal Restrictions - Universal Treatment Standards	
40 CFR 268.40(e) & 268.48	
Characteristic hazardous wastes (D001 – D043) subject to the table "Treatment Standards for Hazardous Wastes," that are not managed in a Clean Water Act wastewater treatment system, must meet the Universal Treatment Standards table under 268.48 for all underlying hazardous constituents (UHC) [defined under 268.2(i)] reasonably expected to be present in the waste	The CAIS items are considered characteristically hazardous and carry several D-codes including reactivity. Therefore, the chemical composition of the materials must be further evaluated to identify potential UHCs that may be present in the waste. These requirements apply since the waste is being shipped to an off-site facility for treatment and ultimate disposal.
Hazardous Waste Determination	
40 CFR 262.11	
A person who generates a solid waste must determine if the waste is a hazardous waste using either process knowledge or by sampling and analysis.	Newly generated wastes and treatment residuals will be generated during RRS operations that meet the definition of a solid waste. And therefore are subject to a hazardous waste determination.
Waste Analysis	
40 CFR 264.13(a)(1) – (3)	
Before an owner or operator treats, stores, or disposes of any hazardous waste, he must obtain a detailed chemical and physical analysis of a representative sample of the waste. At a minimum, the analysis must contain all of the information which must be known to treat, store, or dispose of the waste in accordance with 40 CFR Part 264 and/or Part 268. The characterization can be based on sampling data or via process knowledge.	The CAIS related items will undergo treatment in the RRS, and any residuals and newly generated wastes will be stored on site pending transter to a commercial off-site treatment, storage, and disposal facility (TSDF). Waste analysis requirements are applicable to on-site management of the waste and necessary for acceptance at the off-site TSDF.

Requirement	Rationale for ARAR
Standards Applicable to the Storage of Solid Waste Military Munitions – Waste Chemical Munitions	
40 CFR 266.205(d)	
Waste military munitions that are chemical agents or chemical munitions that meet the definition of hazardous waste are subject to the applicable regulatory requirements of Resource Conservation and Recovery Act (RCRA) Subtitle C; except the storage prohibition codified under 40 CFR 268.50 shall not be applicable.	is requirement is considered to be applicable since distilled mustard (HD) and L CAIS items are considered to be chemical munitions per 50 USCA 1512a(b).
Miscellaneous Units	
40 CFR 264 Subpart X	
A miscellaneous unit must be located, designed, constructed, operated, maintained, and closed in a manner that will ensure protection of human health and the environment. Applicable requirements defined under 40 CFR 264, Subpart I, Use and Management of Containers, must be implemented as appropriate. Protection of human health and the environment includes but is not limited to implementation of design and operating requirements, detection and monitoring, and requirements for response to releases of hazardous waste or hazardous constitutents to ensure chemical agent oxidation treatment effectiveness[a] and to: • Prevent releases that may have adverse effects on human health and the environment due to migration of waste constituents in the ground water or subsurface environment • Prevent releases that may have adverse effects on human health and the environment due to migration of waste constituents in surface water, or wetlands, or on soil surface • Prevent releases that may have adverse effects on human health and the environment due to migration of waste constituents in the air.	The RRS unit meets the definition of a RCRA miscellaneous unit; therefore the protective standards that are defined under Subpart X are applicable to the operation of the unit. In addition, the substantive portions of the container management requirements defined under Subpart I will apply to the treatment conducted in the RRS, since the reactor vessel meets the definition of a container.

Requirement	Rationale for ARAR
General Facility Standards	
40 CFR 264.11	
Every facility owner or operator must apply to EPA for an EPA identification number in accordance with the EPA notification procedures.	This requirement is considered to be applicable since the wastes generated during RRS operations at Fort Richardson will be sent to an off-site TSDF for treatment and ultimate disposition.
40 CFR 264.14 (a) – (c)	
The owner or operator must prevent the unknowing entry, and minimize the possibility for the unauthorized entry, of persons or livestock onto the active portion of his facility by providing either a 24-hour surveillance system (e.g., television monitoring or surveillance by guards or facility personnel) which continuously monitors and controls entry onto the active portion of the facility; or an artificial or natural barrier (e.g., a fence in good repair or a fence combined with a cliff), which completely surrounds the active portion of the facility; and a means to control entry, at all times, through the gates or other entrances to the active portion of the facility (e.g., an attendant, television monitors, locked entrance, or controlled roadway access to the facility). A sign with the legend, "Danger -- Unauthorized Personnel Keep Out", must be posted at each entrance to the active portion of a facility, and at other locations, in sufficient numbers to be seen from any approach to this active portion. The legend must be written in English, and must be legible from a distance of at least 25 feet. Existing signs with a legend other than "Danger -- Unauthorized Personnel Keep Out" may be used if the legend on the sign indicates that only authorized personnel are allowed to enter the active portion, and that entry onto the active portion can be dangerous.	These requirements are considered applicable since the CAIS items being treated in the RRS are considered to be characteristically hazardous (as defined under 40 CFR Part 261), and contact with the waste may result in injury to unknowing or unauthorized personnel.
40 CFR 264.15	
The facility must be inspected for malfunctions and deterioration, operator errors, and discharges which may be causing -- or may lead to -- (1) release of hazardous waste constituents to the environment or (2) a threat to human health. The owner or operator must conduct these inspections often enough to identify problems in time to correct them before they harm human health or the environment. The frequency of these inspections must be based on the rate of deterioration of the equipment and the probability of an environmental or human health incident if the deterioration, malfunction, or any operator error goes undetected between inspections. Areas subject to spills, such as loading and unloading areas, must be inspected daily when in use, and container storage areas inspected weekly.	These requirements are considered applicable since the CAIS items being treated in the RRS are considered to be characteristically hazardous (as defined under 40 CFR Part 261), and therefore, the unit must be inspected to ensure safe and compliant operation.
40 CFR 264.16	
Personnel must be receive training that teaches them to perform their duties in a way that ensures the facility's compliance and ensure that they are able to respond effectively to emergencies by familiarizing them with emergency procedures, emergency equipment, and emergency systems.	Since hazardous wastes are being managed in the RRS, facility personnel must be trained to be aware of the specific regulatory and emergency criteria applicable to the work scope.

Requirement	Rationale for ARAR
40 CFR 264.17 (a) & (b) The owner or operator must take precautions to prevent accidental ignition or reaction of ignitable or reactive waste. This waste must be separated and protected from sources of ignition or reaction including but not limited to: open flames, smoking, cutting and welding, hot surfaces, frictional heat, sparks (static, electrical, or mechanical), spontaneous ignition (e.g., from heat-producing chemical reactions), and radiant heat. While ignitable or reactive waste is being handled, the owner or operator must confine smoking and open flame to specially designated locations. "No Smoking" signs must be conspicuously placed wherever there is a hazard from ignitable or reactive waste. (b) Where specifically required by other sections of this part, the owner or operator of a facility that treats, stores or disposes ignitable or reactive waste, or mixes incompatible waste or incompatible wastes and other materials, must take precautions to prevent reactions which: (1) Generate extreme heat or pressure, fire or explosions, or violent reactions; (2) Produce uncontrolled toxic mists, fumes, dusts, or gases in sufficient quantities to threaten human health or the environment; (3) Produce uncontrolled flammable fumes or gases in sufficient quantities to pose a risk of fire or explosions; (4) Damage the structural integrity of the device or facility; (5) Through other like means threaten human health or the environment	These requirements are considered applicable since a variety of wastes will be generated and handled during RRS operations. There is the potential that some wastes may exhibit the characteristic of ignitability or reactivity. In addition, due to the variety of waste types to be generated, compatibility must be evaluated to ensure safe management of wastes and other materials used in the immediate vicinity.
Preparedness and Prevention	
40 CFR 264.31 Facilities must be designed, constructed, maintained, and operated to minimize the possibility of a fire, explosion, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface water which could threaten human health or the environment.	This requirement is considered applicable since the RRS is a facility (as defined in 40 CFR 261.10) that will be used to treat hazardous waste while deployed at the Fort Richardson facility.
40 CFR 264.32 The RRS must be equipped with alarm, communication, and emergency equipment to notify personnel in the area of immediate hazards, summon emergency assistance, and to respond to releases of hazardous waste or constituents.	These requirements are considered applicable due to the hazardous properties of the wastes being treated and generated in the RRS unit.
40 CFR 264.33 All facility communications or alarm systems, fire protection equipment, spill control equipment, and decontamination equipment, where required, must be tested and maintained as necessary to assure its proper operation in time of emergency.	This requirement is considered applicable since the RRS will be equipped with suitable emergency communication and spill response equipment due to the waste types being managed in the unit.

Requirement	Rationale for ARAR
40 CFR 264.34 Whenever hazardous waste is being poured, mixed, spread, or otherwise handled, all personnel involved in the operation must have immediate access to an internal alarm or emergency communication device, either directly or through visual or voice contact with another employee, *unless* the Regional Administrator has ruled that such a device is not required under §264.32.	This requirement is considered applicable since waste containers will be opened and the waste materials handled during processing in the RRS unit.
Generator Requirements for Onsite Management of Hazardous Wastes Before Offsite Shipment	
40 CFR 262.34 Containers used to accumulate hazardous waste prior to offsite shipment must: • Be in good condition • Be made of or lined with materials that are compatible with the hazardous waste • Be Kept closed during storage (except to add or remove waste) • Be managed in a manner that would prevent leaks • Be inspected weekly for signs of leaking or deteriorating containers • Comply with ignitable and reactive requirements • Comply with incompatible waste requirements. • Comply with air emissions standards.	These requirements are considered to be applicable since, during the removal action, hazardous wastes (as defined in 40 CFR Part 261) could be generated (as defined in 40 CFR 261.10), and since such wastes would be accumulated (per 40 CFR 262.34) in containers (as defined in 40 CFR 261.10) before offsite shipment for treatment/disposal.
Pre-Transport Container Packaging Labeling, and Marking	
40 CFR 262.30-32 Before transporting hazardous waste, or offering hazardous waste for transportation off-site, a generator must: • Package the waste in accordance with the applicable DOT regulations on packaging under 49 CFR Parts 173, 178, and 179; • Label each package in accordance with the applicable DOT regulations for hazardous materials under 49 CFR 172; • Mark each package of hazardous waste in accordance with the applicable DOT regulations for hazardous materials under 49 CFR 172.	Following completion of the treatment activities in the RRS, treatment residuals and newly generated wastes meeting the definition of RCRA hazardous waste will be transported to an off-site TSDF.

Requirement	Rationale for ARAR
Air Emissions Standards/Control of Volatile Organic Emissions from Containers Used to Accumulate Hazardous Waste Before Offsite Shipment	
40 CFR 264.179, 40 CFR 264/265 Subpart CC	
Except when the container must remain uncovered for waste stabilization or certain other treatment processes, and if any of the following three conditions applies: (1) the hazardous waste entering the container is not the result of an organic destruction or removal process, (2) The hazardous waste does not meet the numerical concentration limits for the organic hazardous constituents specified for the hazardous waste under the Land Disposal Restrictions (40 CFR Part 268), or (3) the hazardous waste has not been treated by the treatment technology specified under the Land Disposal Restrictions for the hazardous waste; a container with a design capacity greater than 0.1 m^3 (26.4 gal), but less than 0.46 m^3 (121.5 gal), that remains at the facility for less than 1 year, and for which all hazardous waste entering the container has an average volatile organic concentration greater or equal to 500 ppmw must meet the following requirements:	Although 40 CFR 265.1080 (b) (6) explicitly exempts waste management units that are used solely for onsite treatment or storage of hazardous waste generated from remedial activities conducted under CERCLA authority from the requirements of 40 CFR 265.1087 to control volatile organic emissions from containers, these requirements are considered to be relevant and appropriate because:
• Air pollutant emissions from the container must be controlled by either: 1) Using a container that meets the applicable U.S. Department of Transportation (DOT) regulations under 49 CFR 107, 172, 173, 178 or 179, and 180. [Note: no exceptions to the 49 CFR 178 or 179 regulations are allowed except for a lab pack, where the exceptions for combination packaging in 49 CFR 173.12(b) may be appiled.] 2) Using a container equipped with a cover and closure devices such that, when closed, there are no visible holes, gaps, or other open spaces into the interior of the container. 3) Using an open-top container in which an organic vapor-suppressing barrier (e.g., organic vapor suppressing foam) is placed on or over the hazardous waste such that no hazardous waste is exposed to the atmosphere.	• Containers larger than 26.4 gal may be used to accumulate hazardous wastes with a volatile organic concentration greater than 500 ppmw.
• The container must be composed of suitable materials to minimize exposure of hazardous waste to the atmosphere and to maintain the equipment integrity for as long as the equipment is in service.	• These hazardous wastes would not be the result of an organic destruction or removal process, would not meet the numerical concentration limits for organic hazardous constituents specified under the Land Disposal Restrictions, nor would they have been treated by the corresponding treatment technology specified under the Land Disposal Restrictions for the hazardous wastes.
• The container covers and closure devices must be in place, as applicable, and secured and maintained in the closed position, except for the purpose of adding hazardous waste or other material to the container.	
• If the container is opened for the purpose of filling it to its full capacity, the closure devices and the covers must be installed and closed, as applicable, upon conclusion of the filling operation.	

Requirement	Rationale for ARAR
• If the container is opened for the purpose of intermittently adding discrete quantities or batches of material over a period of time, the closure devices and the covers must be installed and closed, as applicable, upon any of the following conditions: (1) the conclusion of the filling operation, (2) the completion of a batch loading operation after which no additional material will be added to the container within 15 minutes, (3) if the person performing the loading operation leaves the immediate vicinity of the container, or (4) upon shutdown of the process generating the material being added to the container, whichever condition occurs first. • The container closure devices or covers may be opened for the purpose of removing hazardous waste from the container. • If the container is empty, as defined in 40 CFR 261.7(b), the container may be open to the atmosphere at any time. • If discrete quantities or batches of waste are removed from the container but the container does not meet the condition of an empty container as defined in 40 CFR 261.7(b), the closure devices and the covers must be installed and closed, as applicable, upon the conclusion of a batch removal after which no additional material will be removed from the container within 15 minutes, or if the person performing the unloading operation leaves the immediate vicinity of the container, whichever condition occurs first. • The container closure devices or covers may be opened when access inside the container is needed to perform routine activities other than transfer of hazardous waste (e.g., measuring depth, collecting a sample, or accessing equipment inside), but the closure devices and the covers must be promptly installed and closed, as applicable, following the completion of the activity.	

Requirement	Rationale for ARAR
• If the container is equipped with a spring-loaded, pressure relief valve, conservation vent, or similar type of pressure relief device that vents to the atmosphere, such device may be opened during normal operations for the purpose of maintaining the container internal pressure in accordance with the design specifications for the container. However, such device must be designed to operate with no detectable emissions when closed, and the settings at which the device opens must keep the device closed whenever the container's internal pressure is within the designed operating specifications. • If the container is equipped with a closure device such as a pressure relief valve, frangible disc, fusible plug, or any other type of device that functions exclusively to prevent physical damage or permanent deformation to the container by venting gases or vapors directly to the atmosphere during unsafe conditions resulting from an unplanned, accidental, or emergency event, such device may be opened at any time conditions require doing so to avoid an unsafe condition. A container with a design capacity greater than 0.1 m^3 (26.4 gal) that must remain uncovered for waste stabilization or certain other treatment processes, for which all hazardous waste entering the container has an average volatile organic concentration greater or equal to 500 ppmw, and for which (1) the hazardous waste is not the result of an organic destruction or removal process, (2) the hazardous waste does not meet the numerical concentration limits for organic hazardous constituents specified under the Land Disposal Restrictions (40 CFR Part 268) for the hazardous waste, or (3) the hazardous waste has not been treated by the treatment technology specified under the Land Disposal Restrictions for the hazardous waste, must meet the following: • Air pollutant emissions from the container must be controlled by either: 1) Venting the container directly through a closed-vent system to a control device. 2) Venting the container inside an enclosure that is exhausted through a closed-vent system to a control device. • If an enclosure is used to control air pollutant emissions from the container, the container enclosure must be designed and operated in accordance with the criteria for a permanent total enclosure as specified in "Procedure T - Criteria for and Verification of a Permanent or Temporary Total Enclosure" under 40 CFR 52.741, Appendix B. The enclosure may have permanent or temporary openings to allow worker access, passage of containers through the enclosure by conveyor or other mechanical means, entry of permanent mechanical or electrical equipment, or direct airflow into the enclosure. The verification procedure for the enclosure specified in Section 5.0 to Procedure T in 40 CFR 52.741, Appendix B, must be performed initially when the enclosure is first installed and, thereafter, annually.	

Requirement	Rationale for ARAR
• The closed-vent system and control device used to control the air pollutant emissions from the container must be designed and operated in accordance with the requirements in 40 CFR 265.1088.	
• Safety devices such as a pressure relief valve, frangible disc, fusible plug, or any other type of device that functions exclusively to prevent physical damage or permanent deformation to a unit or its air emission control equipment by venting gases or vapors directly to the atmosphere during unsafe conditions resulting from an unplanned, accidental, or emergency event, may be installed on the container or on the enclosure, closed-vent system, or control-device used to control the air pollutant emissions from the container.	
• The closed-vent system, or control-device used to control the air pollutant emissions from the container must be inspected and monitored as specified in 40 CFR 265.1088.	
40 CFR 265.1088 A closed-vent system used to control air pollutant emissions from containers subject to the requirements of 40 CFR 265.1087, that is designed to operate at a pressure below atmospheric, and that does not include any bypass devices that could be used to divert the gas or vapor stream before entering the control device must meet the following:	These requirements are considered to be relevant and appropriate since:
• The closed-vent system must route the gases, vapors, and fumes emitted from the hazardous waste management unit to a control device.	• The requirements of 40 CFR 265.1087 to control volatile organic emissions from containers are considered to be relevant and appropriate.
• The close-vent system must be equipped with at least one pressure gauge or other pressure measurement device that can read from a readily accessible location to verify that negative pressure is being maintained in the closed-vent system when the control device is operating.	• The RRS glovebox and carbon filter system would be used to control air pollutant emissions from containers. • The RRS glovebox and carbon filter system function as an enclosure connected through a closed-vent system to a control device.
• The closed-vent system must be visually inspected to check for defects such as visual cracks, holes, or gaps in ductwork connections before it is put into service, and at least once every year thereafter. • In the event a defect in the closed-vent system is found, it must be repaired as soon as practicable, but not later than 15 calendar days after it is found. A first attempt to repair the defect must be made no later than 5 calendar days after the defect is found. Delay of repair of the closed-vent system is allowed if the repair is technically infeasible without process unit	• The RRS glovebox and carbon filter system are both designed to operate at a pressure below atmospheric and are not equipped with bypass devices that could be used to divert the volatile organic emissions before they enter the carbon filter system.

Requirement	Rationale for ARAR

shutdown, or if the emissions resulting from immediate repair would be greater than the fugitive emissions likely to result from delay of repair. In either case, repair of the unit must be completed by the end of the next process unit shutdown.

A carbon adsorption system using carbon canisters that do not regenerate the carbon directly onsite in the control device, and that is used as the device to control the air pollution emissions from containers subject to the requirements of 40 CFR 265.1087, must meet the following:

- The carbon adsorption system must be designed and operated to reduce the total organic content of the inlet vapor stream vented to it by at least 95 percent by weight.
- The carbon adsorption system must be operated such that gases, vapors, and/or fumes are not vented to it during periods of planned maintenance or carbon adsorption system malfunction (i.e., periods when the carbon adsorption system is not operating or is not operating normally), except in cases when it is necessary to vent the gases, vapors, or fumes either to avoid an unsafe condition, or to implement malfunction corrective actions or planned maintenance actions.
- During periods of planned maintenance or malfunction of the carbon adsorption system, the carbon adsorption system is not required to reduce the total organic content of the inlet vapor stream vented to it by at least 95 percent by weight.
- The periods of planned routine maintenance of the carbon adsorption system (during which it is not required to reduce the total organic content of the inlet vapor stream vented to it by at least 95 percent by weight) must not exceed 240 hours per year.
- Malfunctions of the carbon adsorption system must be corrected as soon as practicable after their occurrence, in order to minimize excess emissions of air pollutants.
- Following the initial startup of the carbon adsorption system, all activated carbon must be replaced with fresh carbon on a regular basis by using one of the following procedures:

  1) Monitoring the concentration level of the organic compounds in the exhaust vent of the carbon system on a regular schedule and replacing the carbon immediately when breakthrough is indicated. [Note: The monitoring frequency must be daily or at an interval no greater than 20 percent of the time required to consume the total carbon working capacity established per the carbon adsorption system design analysis required per 40 CFR 265.1035(b)(4)(iii)(G), whichever is longer].

  2) The carbon may be replaced on a regular, predetermined time interval that is less than

Requirement	Rationale for ARAR
the design carbon replacement interval established per the carbon adsorption system design analysis required per 40 CFR 265.1035(b)(4)(iii)(G).	
• The carbon removed from the filter system must be either regenerated in a RCRA-permitted thermal treatment unit, or disposed of by incineration in a RCRA-permitted incinerator, boiler, or industrial furnace.	
• The performance of the carbon adsorption system must be demonstrated by either conducting a performance test following the procedures specified in 40 CFR 265.1034(c)(1) through (c)(4), or by means of a design analysis prepared in accordance with the requirements specified in 40 CFR 265.1035(b)(4)(iii). (*Note:* The carbon adsorption system performance must be based on the total quantity of organics vented to the atmosphere from all carbon adsorption system equipment.)	
Decontamination of Containers 40 CFR 261.7	
A container that held any hazardous waste, except for a compressed gas or an acutely hazardous waste, is considered empty (that is, decontaminated) if all the wastes have been removed by commonly employed practices (such as, pouring, pumping, and aspirating), and no more than 2.5 cm (1 in.) of residue remain on the bottom of the container or inner liner; no more than 3 percent by weight of the total capacity of the container remains in the container or inner liner, if the container is less than or equal to 110 gal in size; or no more than 0.3 percent by weight of the total capacity of the container remains in the container or inner liner, if the container is greater than 110 gallons in size.	This requirement is considered to be applicable since the CAIS items are not defined as acutely hazardous waste and the single round containers (SRCs) containing the CAIS items are containers (as defined in 40 CFR 261.10), and could be managed as non-hazardous waste or could be set aside for reuse after the CAIS items are removed.
Decontamination of Hazardous Debris 40 CFR 268.45	
Washing with water sprays or water baths of sufficient temperature, pressure, residence time agitation, surfactants, bases, and detergents to remove hazardous contaminants; and chemical oxidation using hypochlorite (bleach) or other oxidizing reagents of equivalent destruction efficiency are two of the best demonstrated available technologies specified for the decontamination of metal and plastic surfaces contaminated with hazardous waste.	This requirement is considered to be applicable since some of the hazardous waste treated during the RRS operations would consist of hazardous debris (as defined in 40 CFR 268.2).

Requirement	Rationale for ARAR
Offsite Shipping of Wastes 50 USCA 1512a. (b)	
Chemical munitions that are discovered or otherwise come within the control of the DoD and that do not constitute part of the chemical weapons stockpile may only be transported to the nearest chemical munitions stockpile storage facility that has the necessary permits for receiving and storing such items if the transportation of such munitions to that facility is considered by the Secretary of Defense to be necessary, and if it can be accomplished while protecting public health and safety.	This requirement is considered to be applicable since, for the purpose of the statute, HD and L CAIS items are considered to be chemical munitions.
Closure 40 CFR 264.111 and 114	
Closure activities must be conducted in a manner that minimizes the need for further maintenance; and controls, minimizes, or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the environment. All contaminated equipment, structures, and soils must be properly disposed of or decontaminated.	These requirements are considered to be applicable since Specific chemicals are present in the CAIS items that result in the items being considered characteristically hazardous wastes (as defined in 40 CFR Part 261), and since Building 55228 (Bunker D-15) and the RRS constitute facilities (as defined in 40 CFR 261.10).
40 CFR 264.115	
Within 60 days of completion of closure of each hazardous waste surface impoundment, waste pile, land treatment, and landfill unit, and within 60 days of the completion of final closure, the owner or operator must submit to the Regional Administrator, by registered mail, a certification that the hazardous waste management unit or facility, as applicable, in accordance with the closure performance standards specified in 40 CFR Parts 264.111 and 264.114. The certification must be signed by the owner or operator and by an independent registered professional engineer.	This requirement is considered to be applicable since specific are chemicals present in the CAIS That result in the items being considered characteristically hazardous wastes (as defined in 40 CFR Part 261), and since Building 55228 (Bunker D-15) and the RRS constitute facilities as defined in 40 CFR 261.10).

Requirement	Rationale for ARAR
40 CFR 268.45	
Washing with water sprays or water baths of sufficient temperature, pressure, residence time agitation, surfactants, bases, and detergents to remove hazardous contaminants; and chemical oxidation using hypochlorite (bleach) or other oxidizing reagents of equivalent destruction efficiency are two of the best demonstrated available technologies specified for the decontamination of metal and plastic surfaces contaminated with hazardous waste.	This requirement is considered to be applicable to the closure decontamination activities since the U.S. Environmental Protection Agency (USEPA) indicated that it believes that the treatment methods in 40 CFR 268.45 would always satisfy the decontamination standard for structures and equipment in the closure provisions (57 FR 37243).
40 CFR 264.178	
All hazardous waste and hazardous waste residues must be removed from the containment system. Remaining containers, liners, bases, and soil containing or contaminated with hazardous waste or hazardous waste residues must be decontaminated or removed.	These requirements are considered to be applicable since: • Specific chemicals in the CAIS items are present in concentrations that result in the CAIS items being considered characteristically hazardous wastes pursuant to 40 CFR Part 261. • The CAIS items are packaged in containers and the RRS reactor meets the definition of a container in 40 CFR 261.10. • Building 55228 (Bunker D-15) and the RRS meet the definition of a facility (as defined in 40 CFR 261.10) used for the storage of hazardous waste containers.

Requirement	Rationale for ARAR
C. Location Specific Requirements	
40 CFR 264.18(a) and (b)	
The facility used to handle and or treat CAIS items must not be located within 61 m (200 ft) of a fault which has had displacement in Holocene time. The facility used to store, handle, and or treat CAIS items must not be located within a 100-year floodplain unless it is designed, constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-year flood; or procedures are in place for safely removing the waste to higher ground before flood waters can reach the facility.	These requirements are considered to be applicable since the chemicals in the CAIS items are considered hazardous wastes (as defined in 40 CFR part 261), and since Building 55228 (Bunker D-15) and the RRS constitute facilities (as defined in 40 CFR 261.10).

Notes:

CAIS = Chemical Agent Identification Set
CFR = Code of Federal Regulations
DHHS = U.S. Department of Health and Human Services
DOT = Department of Transportation
FR = Federal Register
gal = gallon
GPL = general population limit
m = meter
m^3 = cubic meters
mg/m^3 = milligrams per cubic meter
ppmv = parts per million by volume
ppmw = parts per million by weight
PRDA = Poleline Road Disposal Area
RCRA = Resource Conservation and Recovery Act
RRS = Rapid Response System
TWA = time-weighted average
USC = United States Code

[a] Treatment will be considered effective and successful when chemical agent analytical results confirm chemical agent oxidation to the treatment goal of less than 50 ppm and excess oxidant must be present in the nautralent.

Table C-2. To-Be-Considered (TBC) Requirements for the Disposal of CAIS Items Recovered from the PRDA Site at Ft. Richardson

Citation	Requirement		
29 CFR 1910.1000	Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits:		
	Phosgene (CG)		0.4 mg/m^3
	Chloropicrin (PS)		0.7 mg/m^3
	Chloroacetophenone (CN)		0.3 mg/m^3
National Institute of Occupational Safety and Health (NIOSH)	Ceiling Value:		
	Chloroform		9.7 mg/m^3
Potential Military Chemical/Biological Agents and Compounds (FM-9, December 1990) and Material Safety Data Sheets	Lethal/Incapacitating Dose/Concentration Data:		
	Mustard (H, HS, HD)	LD_{50} (skin)	100 mg/kg
		LD_{50} (oral)	0.7 mg/kg
		LCt_{50} (lungs)	1,500 mg-min./m^3
		LCt_{50} (skin)	10,000 mg-min./m^3
		ICt_{50} (skin)	2,000 mg-min./m^3
	Lewisite (L)	LD_{50}	30 mg/kg
		LCt_{50} (lungs)	1,400 mg-min./m^3
		LCt_{50} (skin)	100,000 mg-min./m^3
		ICt_{50} (skin)	1,500 mg-min./m^3
	Phosgene (CG)	LCt_{50}	3,200 mg-min/m^3
		ICt_{50}	1,600 mg-min./m^3

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Table C-2. To-Be-Considered (TBC) Requirements for the Disposal of CAIS Items Recovered from the PRDA Site at Ft. Richardson (Continued)

Citation	Requirement		
Potential Military Chemical/Biological Agents and Compounds (FM-9, December 1990) and Material Safety Data Sheets (Continued)	Chloropicrin (PS)	LCt_{50}	2,000 mg-min/m^3
	Chloroacetophenone (CN)	LCt_{50} ICt_{50}	7,000 mg-min./m^3 80 mg-min./m^3
	Adamsite (DM)	LCt_{50} ICt_{50}	11,000 mg-min./m^3 22 - 150 mg-min./m3
U.S. Department of Defense (DoD) Standard 6055.9 STD, Chapter 11	This chapter sets forth standards for chemical warfare agent operations. Pertinent standards include: • Operations involving punching, drilling, or sawing non-explosively configured chemical munitions for removal of the chemical warfare agents require vapor containment. The effectiveness of the vapor containment system must be measured (e.g., static pressure) at the start of each operation and at least every 3 months. • Mustard or Lewisite contaminated items that have been decontaminated by approved procedures, bagged or contained in a chemical warfare agent-tight barrier (of sufficient volume to allow for the collection of an air sample without being diluted by incoming air), and for which subsequent monitoring tests verify an off-gas concentration below 0.003 mg/m^3 is considered to be decontaminated to the 3X level. (Completely decontaminated and disassembled parts that are simply shaped and are made of essentially impervious materials do not require monitoring.) • Mustard or Lewisite contaminated items that have been decontaminated using procedures known to completely degrade the respective chemical warfare agent molecule or for which analyses demonstrate that the total quantity of chemical warfare agent is below the minimal effects dosage determined by the Surgeon General of the Army are considered to be decontaminated to the 5X level and may be released for general use or sold to the general public. • Monitoring of facilities to determine the appropriate level of decontamination must be seated for at least 4 hours, at 70 °F or higher, before sample collection.		

Table C-2. To-Be-Considered (TBC) Requirements for the Disposal of CAIS Items Recovered from the PRDA Site at Ft. Richardson (Continued)

Citation	Requirement
U.S. Department of Defense (DoD) Standard 6055.9 STD, Chapter 11 (Continued)	• Monitoring of protective clothing and equipment to determine the level of decontamination must include containerization at 70 °F or higher for at least 4 hours before sample collection. • Reuse of mustard contaminated protective clothing is not permitted. • Air ventilation systems used to provide chemical warfare agent vapor containment must be designed and periodically tested to ensure that exhaust emissions do not exceed the applicable control limits; must use redundant filters when high concentration of chemical warfare agents may be expected; must be equipped with a backup blowers to engage if the main blower fails; and must be fitted with means to measure the pressure drop across the filters. • Gloveboxes must be provided with catch basins, traps, or spill trays of suitable size to control spills. • Working surfaces which could be contaminated with chemical warfare agents must be constructed of chemical warfare agent resistant materials. • The electrical system for facilities that handle chemical warfare agents must be equipped with a backup power source designed to start automatically and capable of supporting critical functions in the event of power outage. • Chemical warfare agent liquid waste systems must be provided and must be designed with sufficient capacity to collect and contain any potential chemical warfare contaminated effluent. Vents or other openings in the system must be fitted with approved filters. • Chemical warfare agent operations must be provided with decontamination facilities of sufficient capacity to catch and contain liquid effluents. Adequate decontamination solution must be available for immediate use, if necessary.
Department of the Army (DA) Pamphlet (PAM) 385-6, Chapter 5	This Chapter sets forth general U.S. Army policy with respect decontamination and disposal of personnel, equipment, and clothing contaminated with chemical warfare agents. Pertinent requirements under this U.S. Army policy that would supplement the DoD Standard 6055.9 STD include: • Material, equipment, and clothing that has been decontaminated to at least the 3X level may be disposed by burial only in a landfill that has been approved by the U.S. Environmental Protection Agency (USEPA) or under an authorized state Resource Conservation and Recovery Act (RCRA) program for hazardous waste disposal. • For facilities contaminated with mustard agent, monitoring to determine the appropriate level of decontamination must be conducted at ambient temperature with the area closed, for at least three 8-hour periods.

Table C-2. To-Be-Considered (TBC) Requirements for the Disposal of CAIS Items Recovered from the PRDA Site at Ft. Richardson (Concluded)

Citation	Requirement
DA PAM 385-61, Chapter 6, Paragraph 6-5.s.	This paragraph sets forth safety design criteria for gloveboxes used to provide containment of chemical warfare agent vapors. Pertinent requirements under this U.S. Army policy that would supplement the DoD Standard 6055.9 STD include: • The glovebox must be at a minimum negative pressure of 0.25-inches of water. • The air makeup intake to the glovebox must be provided with filters, backup dampers, or other means to prevent backup. • Temporary openings into the glovebox must maintain an inward flow of at least 90 linear feet per minute (fpm) while chemical warfare agents are contained in the glovebox.

Notes:

CFR = Code of Federal Regulations
FM = field manual
ICA = incapacitating concentration
LCA = lethal concentration
LD = lethal dose
mg/kg = milligrams per kilogram
mg-min/m^3 = milligrams per cubic meter
NIOSH = U.S. National Institute of Occupational Safety and Health
OSHA = U.S. Occupational Safety and Health Administration
STD = standard
USEPA = U.S. Environmental Protection Agency

APPENDIX D.
ENGINEERING FEATURES OF THE RAPID RESPONSE SYSTEM (RRS) GLOVEBOX AND AIR MONITORING SYSTEM

APPENDIX D. ENGINEERING FEATURES OF THE RAPID RESPONSE SYSTEM GLOVEBOX AND AIR MONITORING SYSTEM

The Rapid Response System (RRS) glovebox consists of a single-wall enclosed structure within the RRS operations trailer (Figure D-1). It is constructed of 11-gauge walls and top and 0.187-in. thick bottom 316L stainless steel sheets over a carbon steel square tubing frame, and 3/8-in. Lexan® polyacrylate windows furnished with 8-in. diameter gloveports with butyl rubber gloves. The carbon steel tubing frame is painted with a chemical-resistant epoxy paint. The full glovebox dimensions are 231 in. long, 32 in. wide, and 75-1/2 in. high, and it sits 36-1/4 in. off the floor of the RRS operations trailer.

The glovebox is divided by two 316L stainless steel inner walls into the following three separate compartments or stations: the airlock station, the unpack station, and the neutralization station. The airlock station is approximately 64 in. long, the unpack station is 100 in. long, and the neutralization station is 60 in. long. Each of the walls separating the station compartments is furnished with a 316L stainless steel door, 18 in. wide and 22 in. high, that allows access from one compartment to the other, and the walls have air dampers to regulate the airflow within the glovebox. Access to the glovebox from the exterior of the RRS operations trailer is via two sets of doors: one located on the RRS operations trailer measuring 19-1/2 in. wide by 24-1/4 in. high and made of 316L stainless steel, and the other located on the rear end of the glovebox at the airlock station measuring 20 in. wide by 23 in. high and made out of a 1/4-in. aluminum plate coated with Epoloid paint. Two 18-in. diameter, round openings, one on the floor of the unpack station and the other on the floor of the neutralization station, connect the glovebox with the waste containerization system located underneath. Each opening is fitted with a flange and a lid. Each flange forms a 1-in. protruding lip on the floor of the corresponding glovebox station to prevent any spilled liquid from uncontrollably running into the waste containerization system.

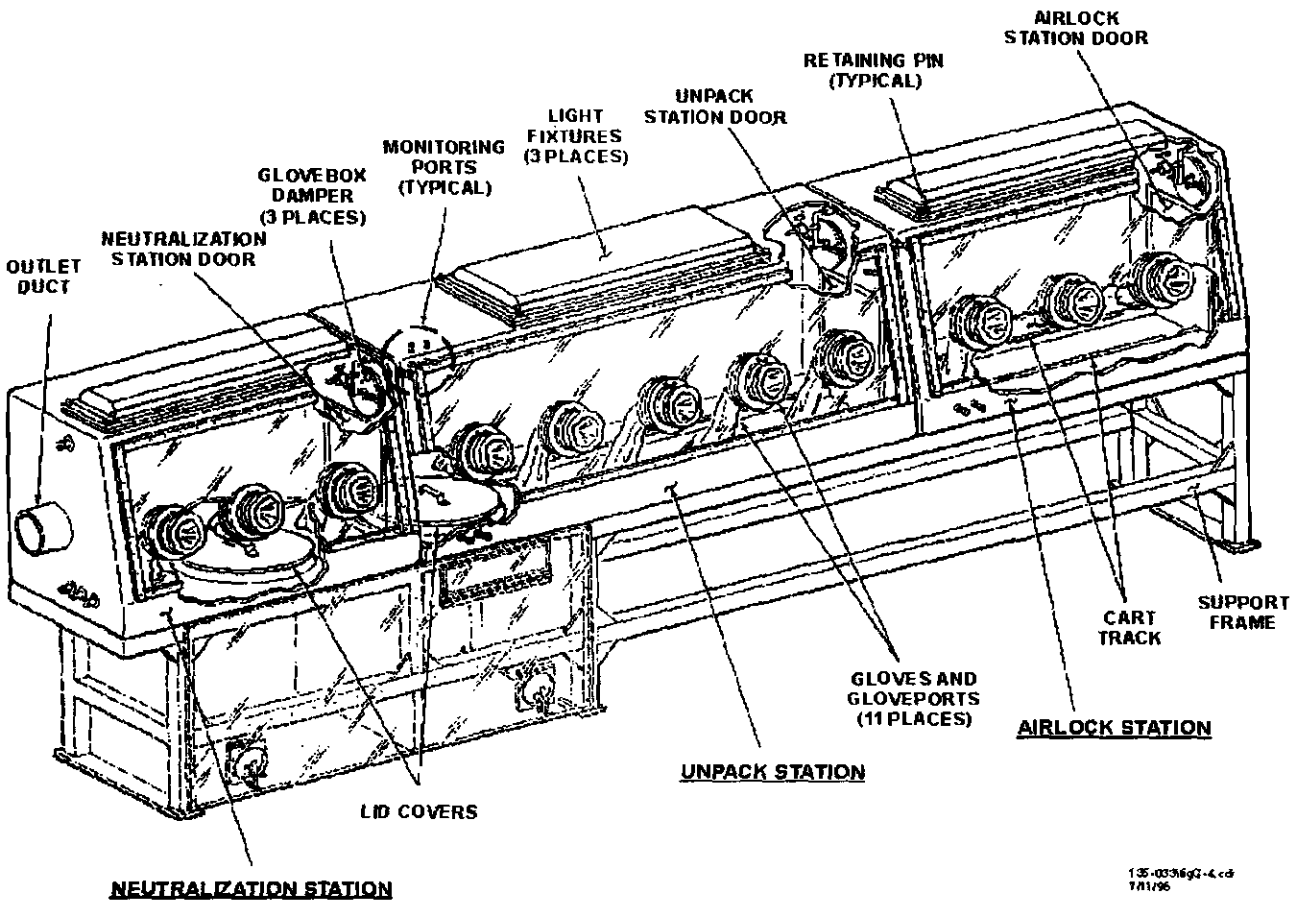

Figure D-1. Glovebox System

The glovebox waste containerization system is comprised of two independent, enclosed compartments: one underneath the glovebox unpack station and the other under the neutralization station (Figure D-2). Each compartment is approximately 40 in. wide by 34 in. high by 33 in. deep. The compartment under the unpack station accommodates a 30-gallon open-head waste drum to collect the waste generated during the process of unpacking the CAIS items from their overpacks. The compartment under the neutralization station holds a 5-gallon close-head liquid waste container inside a 30-gallon open head drum, which is used at the glovebox neutralization station to collect the liquid waste stream (neutralents) generated from the treatment of chemical agent found in CAIS items.

The top side of each waste containment system compartment is the bottom of the RRS glovebox, and the left and right side compartments are constructed of 11 gauge 316L stainless steel sheets. The front side of each compartment consists of a large 3/8-in. Lexan® polyacrylate window. The window in front of the compartment under the unpack station is furnished with a smaller window that opens to provide limited operator access to fit the lid of the open-head drum. The back of the two compartments is an extension of the RRS operations trailer wall. It consists of two doors constructed of a plywood fiberglass composite with a 36-ounce woven fiberglass smooth finish covered with a white gel coat that provide access to the waste containment system from outside the RRS operations trailer. The doors have butyl rubber gaskets around the edges to provide a seal when the doors are closed. The floors of the compartments are made of a 1/8-in. 316L diamond tread stainless steel plank that is an extension of the RRS operations trailer floor.

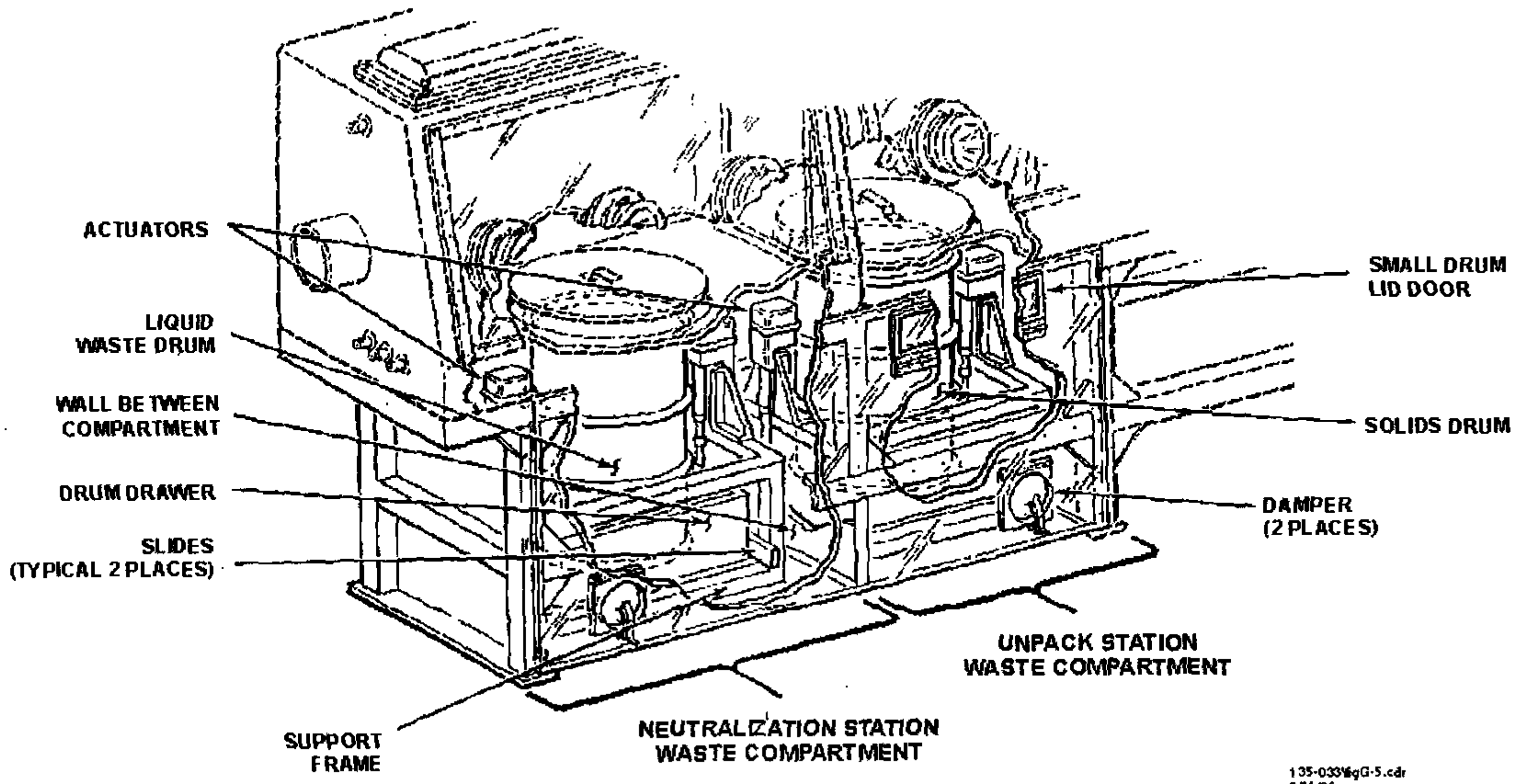

Figure D-2. RRS Waste Containerization System

Each waste compartment functions independently from the other. The waste drums sit on two drawers (one in each compartment) that slide in and out of the waste containerization system, through the back access doors to facilitate the loading and unloading of the drums (Figure D-3). The drawers are made of welded 1/8-in. thick 316L stainless steel plates. Once the drums are loaded, lifting actuators in each of the waste containerization system compartments raise the drawers to hold the drums in a sealed secure position against the flanges surrounding the two openings on the bottom of the glovebox. These two drum opening flanges are fitted with viton gaskets that form a seal between the glovebox and the waste drums when they are securely in place.

All seals and seams are designed to be liquid tight, and the assembled glovebox has a maximum design air leak rate of 0.5-in. of water in 2 hours, based on an initial pressure difference of 2-in. water column. A variable speed induced draft fan in the glovebox carbon filter system maintains the glovebox at a minimum of 0.25-in. water column negative pressure (measured at the unpack station). The carbon filter system consists of the fan, a prefilter, two high efficiency particulate air (HEPA) filters, and a series of redundant carbon filters consisting of two coconut shell carbon filters and two molybdenum-triethylenediamine (ASZM-TEDA) carbon filters (Figure D-4). The prefilter and first HEPA filter are designed to catch any dust and other particles generated during the glovebox operations. The coconut shell carbon filters are designed to preferentially capture chloroform but will also capture other CAIS materials. The ASZM-TEDA carbon filters are designed to capture those high vapor pressure compounds such as phosgene and cyanogen chloride not captured by the coconut shell carbon filters. The last HEPA filter in the carbon filter system is designed to capture any loose carbon particles.

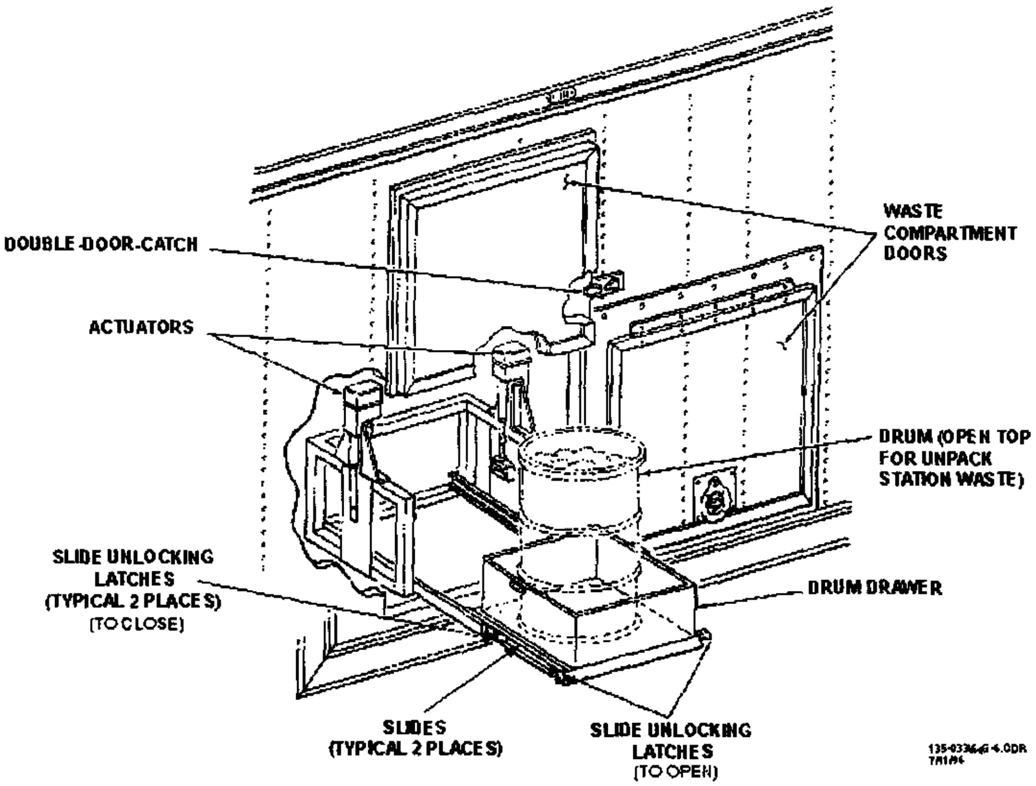

Figure D-3. Glovebox Waste Compartment Drum Drawer, Slides, and Actuators

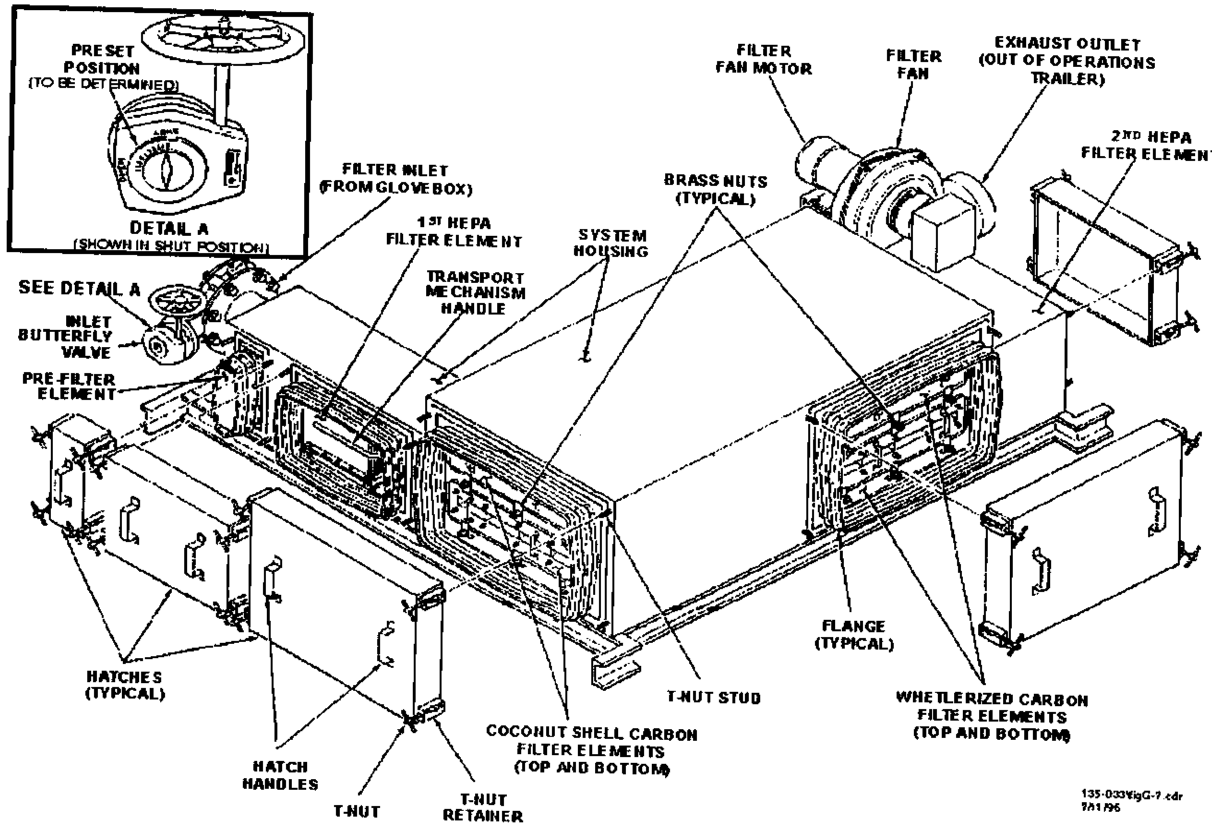

Figure D-4. Glovebox Carbon Filter System

The reactor in the glovebox neutralization station is constructed of 316L stainless steel and has a nominal capacity of 1 gallon (Figure D-5). The reactor consists of a container vessel, a lid, a manual crushing mechanism to break the chemical warfare materiel (CWM) CAIS items and to provide mixing, a keeper ring, a rupture disk, and a pressure release valve. A separate 316L stainless steel funnel is used to transfer the contents of the reactor to the liquid waste drum once the reaction is complete.

A cart transfer mechanism is used to transfer the CAIS item overpacks from the RRS operations trailer loading platform (located outside the RRS operations trailer) through the glovebox airlock station to the unpack station. Different carts are used to transfer different configurations of CAIS item overpacks. The carts and the tracks that form this overpack transfer mechanism will be constructed of 316L stainless steel.

The materials of construction used for the RRS glovebox system were specifically selected to be compatible with the CAIS materials and reagents that may be handled in it. Furthermore, since some of the materials to be handled in the RRS glovebox system may be corrosive, the waste drums used in the waste containerization system are specifically selected to be compatible with the waste material they will contain.

The glovebox structure provides secondary containment for the neutralization station reactor as well as for those CAIS items that are stored in the holding racks located in the unpack and neutralization stations. The glovebox unpack station has a secondary containment capacity of approximately 12 gallons while the neutralization station has a secondary containment capacity of about 7 gallons. These secondary containment capacities far exceed the maximum amount of liquid that would be stored or managed at either station at any given time. Nevertheless, to limit the spread of any leaked or spilled materials throughout the glovebox, catch trays made of 316L stainless steel would be located under the neutralization station reactor and would be used within different working areas of the unpack station. Secondary containment for the waste drums in the containerization system is provided by the drawers, which have a containment capacity of 32-gallons each.

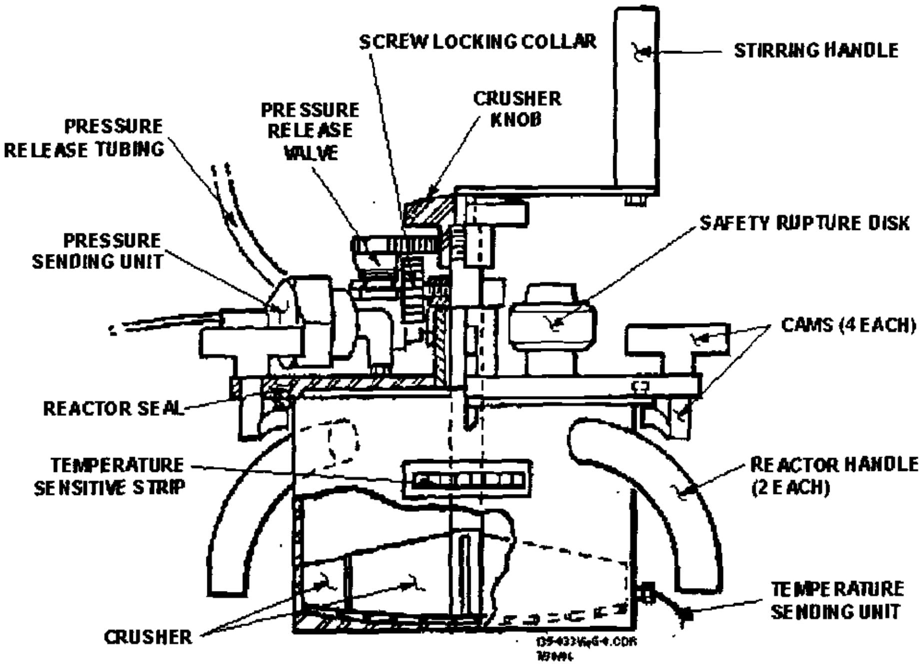

Figure D-5. Reactor Assembly

The RRS operations trailer is equipped with an air monitoring system to monitor for worker exposure or release of material to the environment, to determine the need for carbon filter changeout, and to determine the effectiveness of equipment decontamination procedures. The air monitoring system primarily consists of Miniature Continuous Air Monitoring System (MINICAMS®) automated gas chromatographs (GC) systems with alarm capabilities that collect and analyze air samples and provide the results in near real time (3 to 10 minutes for each sampling and analysis cycle). A stream selector system is used to rotate the MINICAMS® through various monitoring ports located within the RRS operations trailer work space, the glovebox, and the carbon filter system. To confirm MINICAMS® alarms, Depot Area Air Monitoring System (DAAMS) sorbent tubes and colorimetric tubes are used to collect air samples through sampling ports located at the same locations as the MINICAMS® sampling ports.

In addition to the air monitoring system, there is a differential pressure transmitter in the glovebox unpack station, which continuously monitors the pressure inside the glovebox and provides feedback to the carbon filter fan controller. The controller continuously regulates the fan speed to maintain the negative pressure within the glovebox at a minimum of 0.25-in. water column. This differential pressure transmitter is also designed to activate an alarm in the event of loss of negative pressure within the glovebox. Additionally, a differential pressure gauge at the unpack station provides the glovebox operators with a visual indication of the negative pressure within the glovebox.

APPENDIX E.

TREATMENT REACTIONS

APPENDIX E.

TREATMENT REACTIONS

This appendix describes the chemistry to be used during Rapid Response System (RRS) treatment of Chemical Agent Identification Set (CAIS) items.

RED Process. The reactions of the sulfur mustard occur with 1,3-dichloro-5,5-dimethylhydantoin (DCDMH) in the presence of water and a chloroform/t-butyl alcohol solvent. The reactions are shown in Figure E-1. In this process, DCDMH reacts with the distilled mustard (HD) to form several products. Primarily, these products result from a simple chlorination and (with the participation of the water in the solvent) from an oxidation of the organic sulfides to chlorinated sulfoxides and sulfones. A loss of hydrogen chloride (HCl) from the initial products leads to the formation of chlorovinyl chloroethyl sulfoxides and a small amount of 2-chlorovinyl 2-chloroethyl sulfide. At the same time, the reagent also causes some of the carbon sulfur bonds of the HD to be cleaved to form a mixture of 2-chloroethylsulfonyl chloride and tri- and tetrachlorinated ethanes. The DCDMH is consumed by dechlorination first to form chlorodimethylhydantoin (CDMH) and then to form dimethylhydantoin (DMH). The mole percent values shown in Figure E-1 represent the conversions of HD to products that have been observed in laboratory studies. The products from this reaction are all soluble in the solvent mixture.

Lewisite (L) is chemically converted to a primary product by DCDMH, chlorovinylarsonic acid (CVAOA), as shown in Figure E-2. The reaction requires the water in the solvent to both hydrolyze the chlorines on the arsenic to hydroxyl groups and to participate in the oxidation of the arsenic. The CVAOA is soluble in the solvent mix.

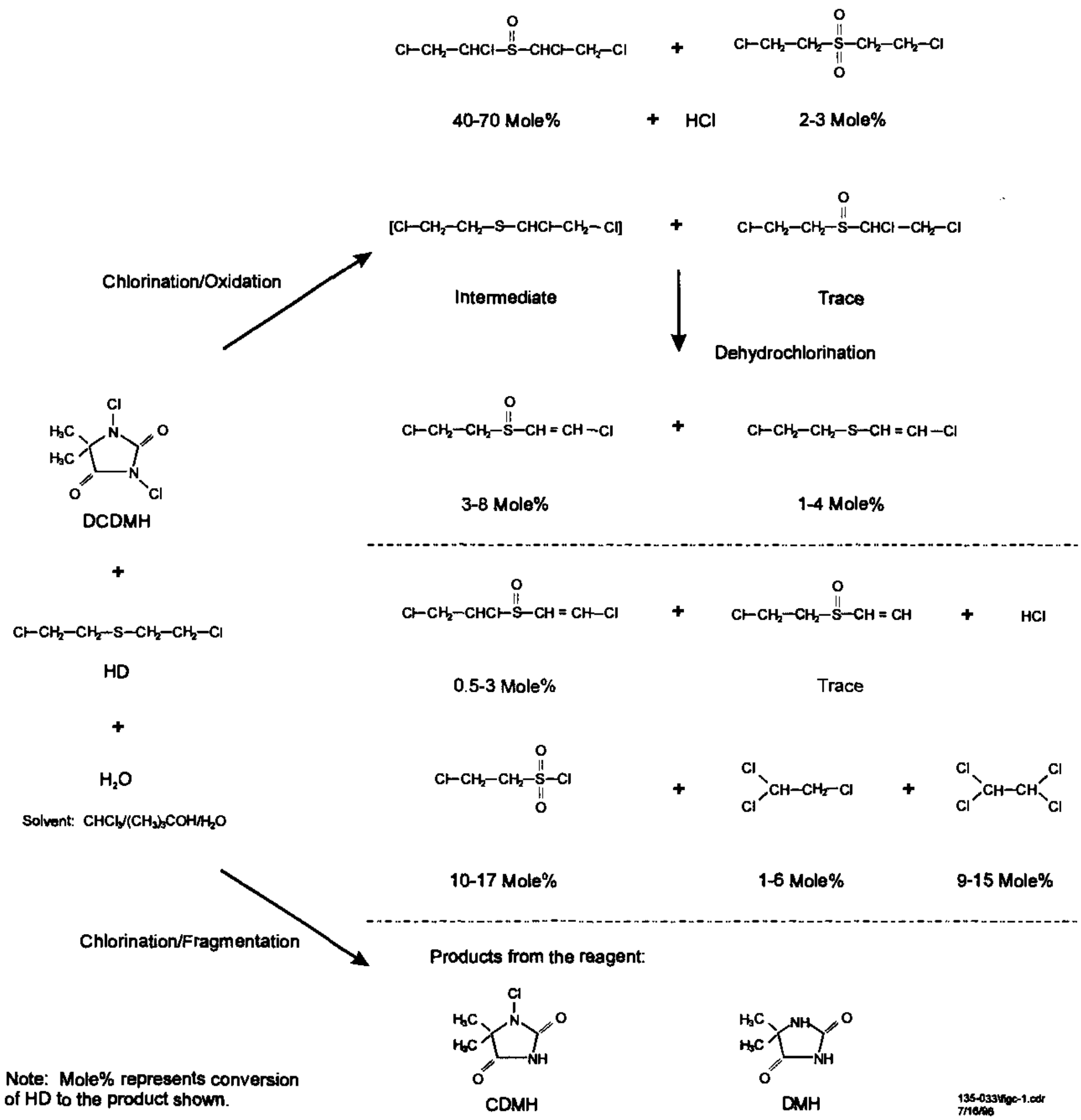

Figure E-1. RED Process

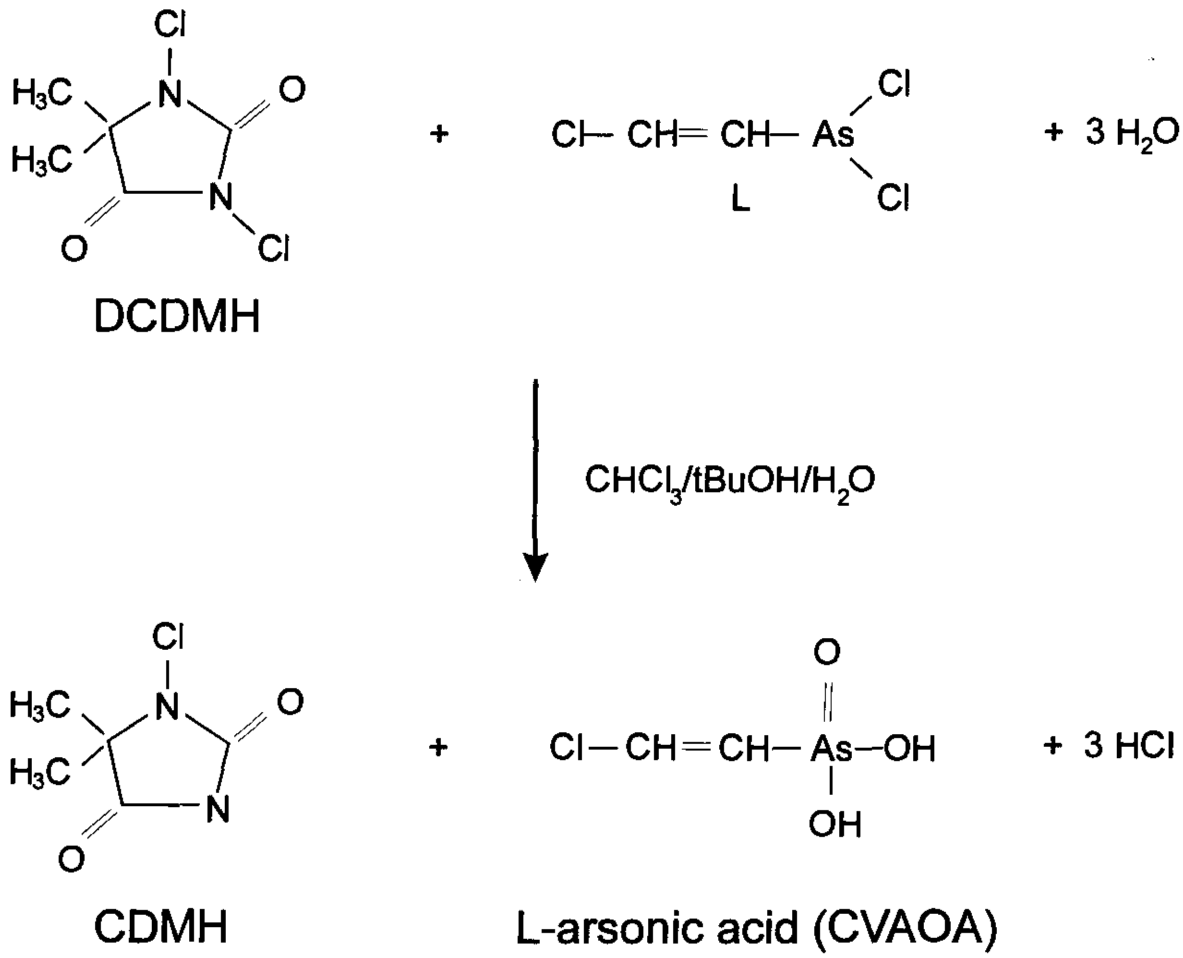

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Figure E-2. Red Process, L Reactions

The rate of reaction between DCDMH and HD, and L CAIS is fast: $t_{1/2} < 30$ sec at room temperature. Because of the relatively low concentrations, the heat generated by the reactions causes the mixture to increase in temperature by only a few degrees. When the process is run in a closed reactor, a maximum of 5 psig pressure has been observed. To ensure that all of the reagent and solutions from the broken ampoules are completely mixed, the detoxification process mixtures are agitated for 15 min. Analysis of the waste indicates that the concentration of residual chemical agent is below 50 mg/L following the 15-min contact time (contact time or agitation period refers to the amount of time DCDMH is in contact with the chemical agent in the reactor). Any trace amounts of the agents that remain after the reaction in the reactor will continue to be in contact with the DCDMH or CDMH in the waste drum.

Other reactions occur that produce essentially non-toxic products; these merit identification because they may appear as major products following each reaction. The HCl formed can be expected to react with the t-butyl alcohol to form t-butyl chloride as shown in reaction (a) in Figure E-3. This well known process is expected in this solution. Trichloro- and tetrachlorobutanes have also been found in the treatment residues, which indicate that further chlorination of the t-butyl chloride may have consumed all of this intermediate. Excess DCDMH and/or CDMH is present in the treatment residues after completion of the 15-min period of agitation. This has been confirmed by iodometric titration for available chlorine or by nuclear magnetic resource (NMR) analysis for CDMH and/or DCDMH. With time, the excess available chlorine will chlorinate the reaction products, including the chemical warfare agent products, t-butyl alcohol, and dimethylhydantoin, until it is exhausted. However, these chlorinations are very slow. The t-butyl alcohol cosolvent will react with excess available chlorine from the DCDMH or CDMH to produce a series of chlorinated butanes and butenes and chlorinated t-butyl alcohol, including trichlorobutanes, tetrachlorobutanes, tetrachlorobutenes, and dichloro- and trichloro-t-butyl alcohols, as shown in reaction (b) in Figure E-3.

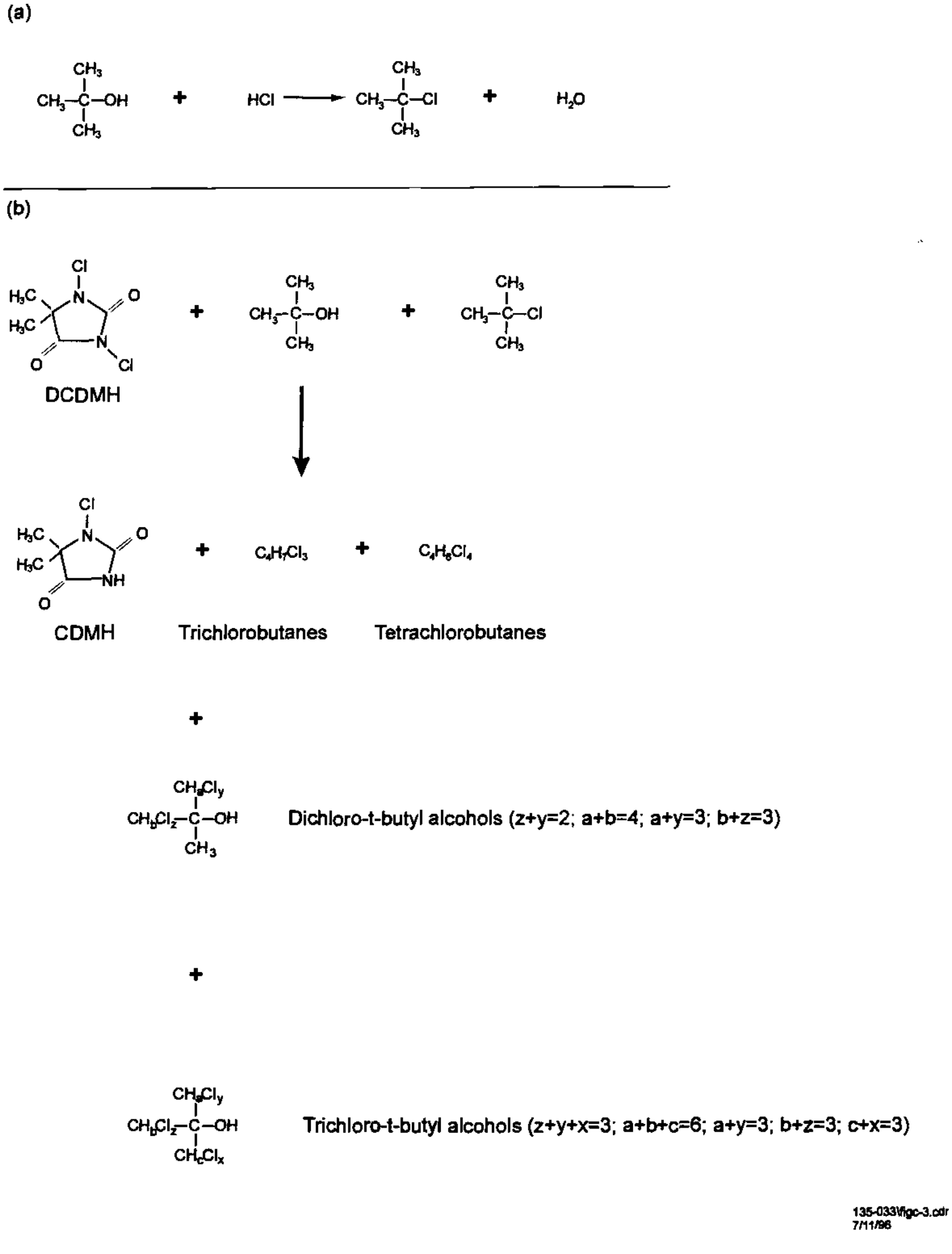


Figure E-3. Chlorobutanes Formation

BLUE Process. The BLUE Process reaction is similar to the RED process reaction for HD (Figure E-1), but the relative amounts of compounds formed are different. The major portion of the products, 2-chloroethyl dichloroethyl sulfoxides and bis-(dichloroethyl) sulfoxides, are formed in the chlorination/oxidation step, along with small amounts of the HD-sulfone [bis-(2-chloroethyl) sulfone]. Various quantities of chlorinated ethyl vinyl sulfoxides, 2-chloroethyl 2-chlorovinyl sulfide, and a small amount of 2-chloroethyl 2-chlorovinyl sulfone have been observed in the laboratory tests of this HD treatment method. Trace amounts of trichloroethane and tetrachloroethane have also been found. See Figure E-4 for the range of products that are expected in this treatment process. Although the DCDMH reagent is also used in the RED Process, the product mixture for the BLUE Process is somewhat different from that in the RED Process, because HD is present in higher concentration and no other agent is present.

The rate of reaction is very rapid ($t_{1/2} < 30$ sec at room temperature), and a negligible amount of pressure is generated. Heat is evolved in the process, but the solution temperature has been observed to rise by less than 40°C. Excess DCDMH or CDMH is present after completion of the treatment reaction. The presence of excess reagent in treatment residues has been confirmed by an iodometric titration for available chlorine and by an NMR analysis for residual DCDMH or CDMH. With time, the excess available chlorine will chlorinate the HD reaction products, t-butyl alcohol, and the methyl groups of the dimethylhydantoin, until it is exhausted. Chlorobutanes are slowly formed from the t-butyl alcohol as in the RED Process reaction (Figure E-3); however, no chlorinated t-butyl alcohol has been found in the BLUE Process treatment residues. The concentration of residual sulfur mustard following a contact time of 30 min is below 50 mg/L.

CHARCOAL/CHARCOAL "L" Process. The sulfur mustards (HD or HS) adsorbed in charcoal are reacted with a mixture of DCDMH and chloroform. The L adsorbed in charcoal is reacted with the same mixture of DCDMH, water, and a chloroform/5-butyl alcohol solvent used for the RED Process. The chemical agents on the charcoal are distributed in the porous structure of the charcoal. This preparation immobilized the liquid chemical agents to allow their use for training troops to recognize the odors of the

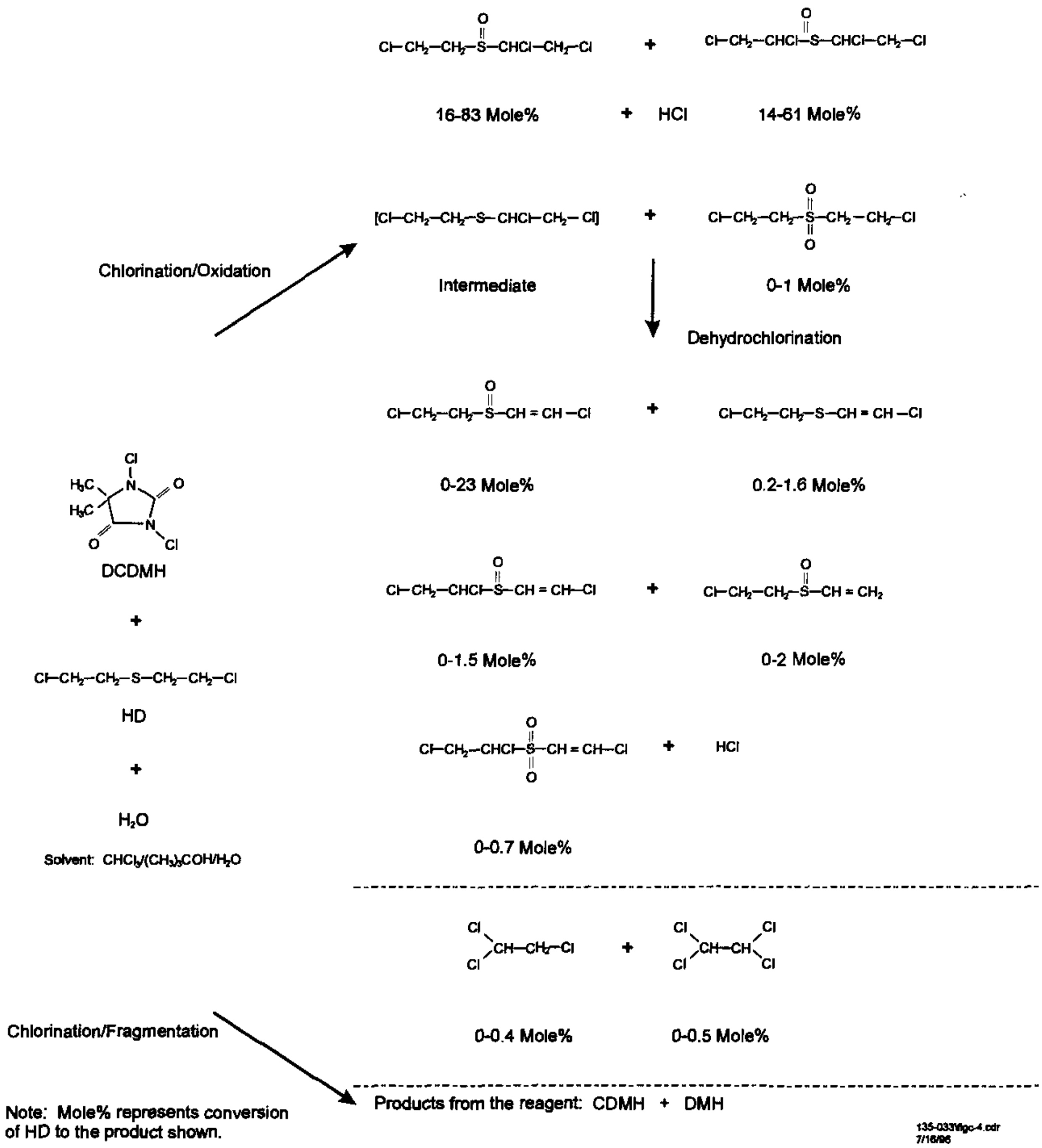
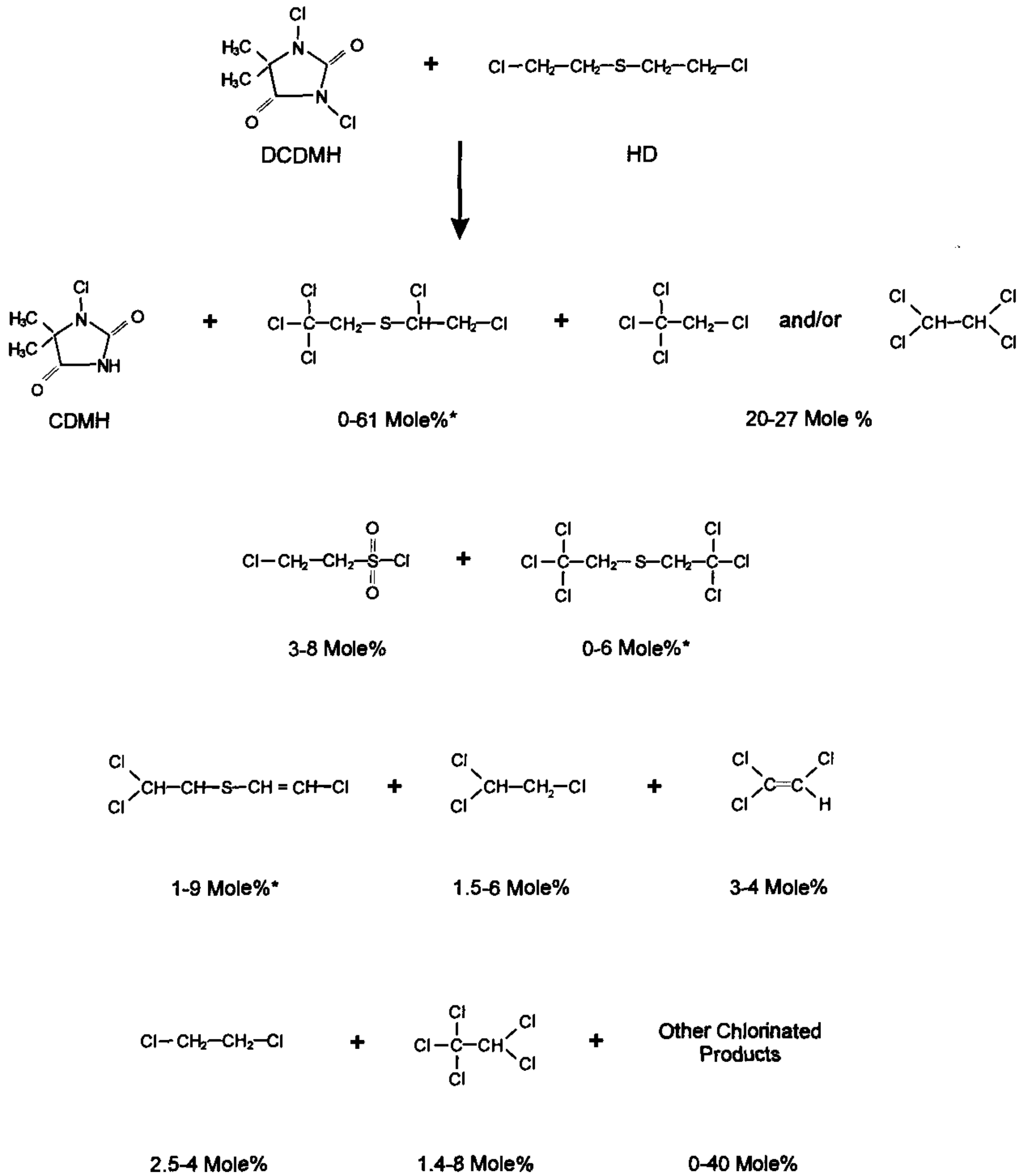


Figure E-4. BLUE Process

agents. The charcoal contains pores of various sizes, which are defined as micropores (<20A), mesopores (20-500A), and macropores (>500A). As much as 10 percent of the chemical agent is adsorbed in the micropores. Before a chemical treatment reaction can occur, reagent and the chemical agent must make contact. Therefore, either the chemical agent must diffuse out of the small pores, or the DCDMH must penetrate into the smallest pores. Chloroform rapidly penetrates the macro-, meso-, and micropores to assist the dissolution and diffusion of the reactants, in and out of the pores. The DCDMH reacts with the chemical agents either by migrating into the pores, along with the solvent, or by reacting with the chemical agent as it fluxes from the pores. The DCDMH in solution has been found to penetrate the smallest of charcoal pores and selectively react with the chemical agent while leaving the charcoal unreacted.

To determine the efficiency for each of the reactions between DCDMH and the chemical agents, adsorbed on the charcoal, both the liquid layer (solvent) and solid layer (charcoal) were analyzed after the treatment was complete. Figure E-5 illustrates the reaction between DCDMH and HD adsorbed on charcoal as developed from gas chromatograph/mass spectrometer (GC/MS) analyses of the solution and the Soxhlet extract from the charcoal. The analyses of the solution indicates that HD is reduced to less than 50 mg/L within 15 min, but the conversion of all of the HD adsorbed in the charcoal requires longer time. The analyses indicate that the HD in the Soxhlet extract from the charcoal does not decrease below the quantitation limit of 50 mg/L until the process is continued for 30 min. Since a large excess of DCDMH is used in this reaction, a variety of chlorinated products are produced. Chlorinated sulfides, polychlorinated ethanes, and polychlorinated ethylenes appear as major products. Since no water is added, no significant amounts of oxygen-containing products are formed, which explains how the CHARCOAL reaction differs from the RED Process. The mono-substituted



*Isomeric mixtures, only one isomer is shown.

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Figure E-5. CHARCOAL Process, HD Reactions

chlorodimethyl-hydantoin and the dimethylhydantoin appear as major products from the treatment reagent. The distribution of these products varies greatly depending on the amount of initial chemical warfare agent. Hexachloroethane, trichloroethylene, and sulfur dioxide have been identified as minor products; several minor products have been detected chromatographically but have not been identified. The small quantity of 2-chloroethylsulfonyl chloride formed in some experiments probably resulted from the presence of a trace amount of water in the reactor.

The reaction of DCDMH, in the mixed solvent, with L adsorbed on charcoal produces the primary product, CVAOA. This process is nearly identical to the reaction that occurs in the RED process, as shown in Figure E-2. In the presence of the charcoal, a small amount of tetrachloroethane is also formed. The reaction is fast.

The rate of reaction between HD and L with DCDMH in the liquid layer is too fast to measure by removing samples and analyzing them periodically. The rate of the reaction in the charcoal pores also has not been measured. The concentrations of chemical warfare agents (HD and L) in the liquid layer have been found to be below 50 mg/L, the quantitation limit, following a 15-min contact time. The concentrations of chemical agent in the charcoal Soxhlet extracts have been found to be below 50 mg/L after a 30-min contact time. Therefore, these results show that after 15 min, the agent remaining in the charcoal is still reacting with the DCDMH. A slightly increasing reaction temperature beyond the 15-min period also indicates that the reaction is not complete; however, the reaction will continue in the waste drum. The pressure and temperature observed in the laboratory for these reactions has not exceeded 2.5 psig and 35°C, respectively. Excess concentrations of DCDMH and CDMH have been found to be present up to 36 hours in the mixture. This ensures that the chemical agent treatment will be complete in the waste drum.

The treatment residue from any of the HD and L on charcoal bottles will be combined in the waste drum. If no L is treated in the test, the products of the charcoal process will be as described in Figure E-5, but if L is treated, further reactions will occur in the waste drum as shown in Figure E-6. These reactions occur because water is introduced into the mixture, and water allows the oxidation of the sulfur mustard products to sulfoxides and sulfones and oxidation of the nitrogen mustards to chloral hydrate and bis-(2-chloroethyl)amine. Because t-butyl alcohol is also introduced, various chlorobutanes are also formed, as observed in the RED process (see Figure E-1).

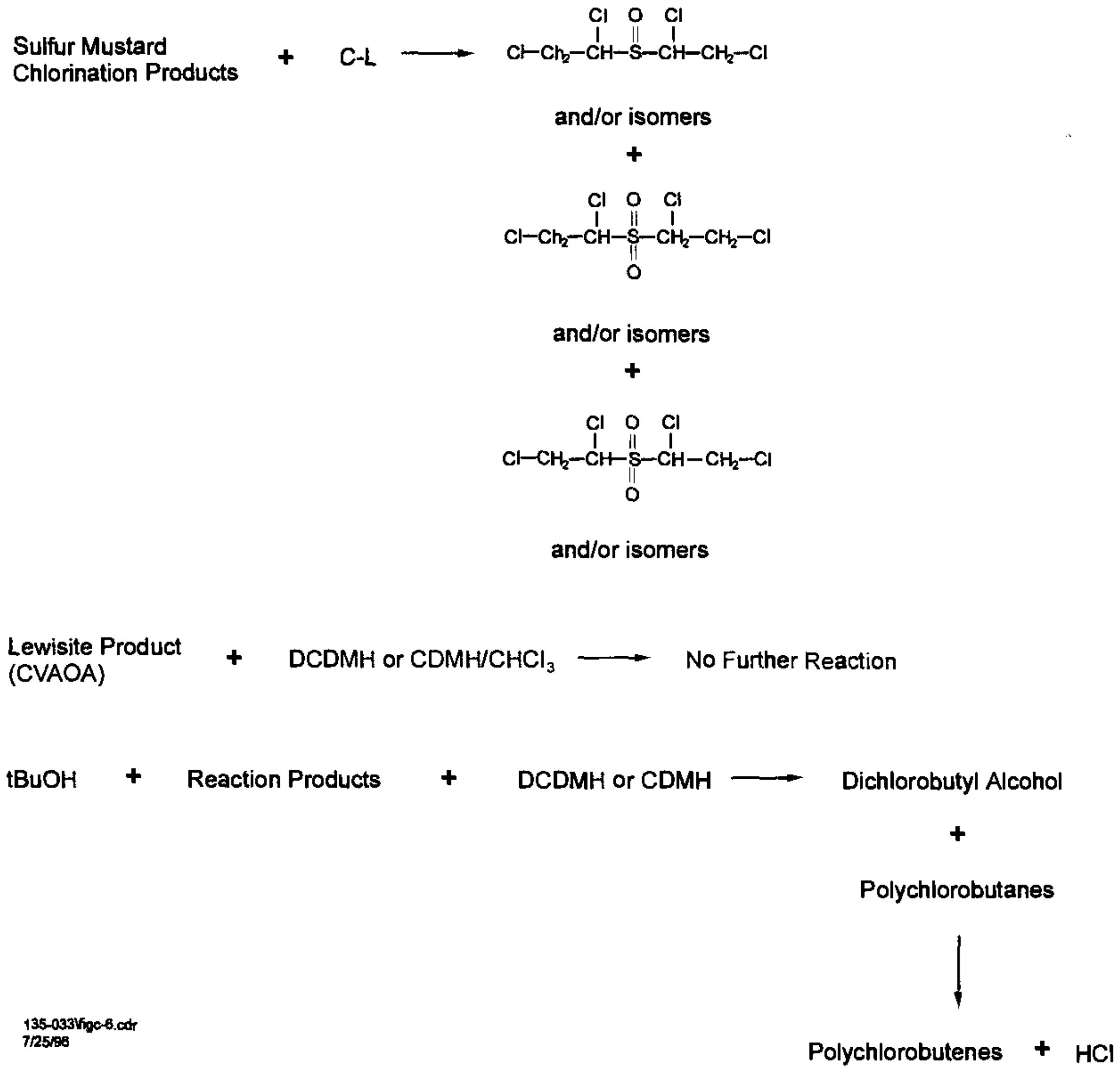

Figure E-6. Reactions in the Combined Waste from the CHARCOAL Processes

APPENDIX F.

COST EVALUATION SUPPLEMENTAL INFORMATION

APPENDIX F.
COST EVALUATION SUPPLEMENTAL INFORMATION

This appendix presents the bases for estimating the costs for the removal action alternatives evaluated as part of this Engineering Evaluation/Cost Analysis (EE/CA) for the treatment and disposal of the Chemical Agent Identification Set (CAIS) recovered from the Poleline Road Disposal Area (PRDA) site at Ft. Richardson, Alaska and Tin City, Alaska.

Except for Alternative 1: No Action, all of the removal action alternatives being evaluated in this EE/CA rely on the use of the U.S. Army Rapid Response System (RRS), a mobile platform specifically designed for handling CAIS under proper engineering controls.

The following sections describe the methodology and the general and alternative-specific assumptions used to develop the cost estimates.

F-1 METHODOLOGY

Generally, engineering judgment has been used to estimate the costs for the removal alternatives being evaluated in this EE/CA. The costs for the removal alternatives have been classified as direct capital costs, indirect capital costs, and contingency. Direct capital costs are those costs directly related to the construction and implementation of the removal alternative. These include the costs associated with obtaining and preparing the site where the removal alternative takes place; the costs for labor, materials, equipment, utilities, and purchased services necessary to install and carry out the removal alternative; and the costs of transporting and disposing of waste materials generated during the implementation of the removal alternative. Indirect capital costs include those for engineering and administrative expenses, as well as those costs associated with permits, fees, and taxes. The contingency is intended to cover the costs resulting from unforeseen circumstances.

Except for Alternative 1: No Action, for which a detailed cost estimate was not developed, spreadsheets were developed to present the respective costs associated with the implementation of the different alternatives. These spreadsheets are included in Attachment F-1 at the end of this appendix.

F-2 GENERAL ASSUMPTIONS

Under Alternative 1: No Action, the CAIS items would remain in storage at Ft. Richardson for an indefinite period of time. It is estimated that the direct capital costs for continuing storage of the CAIS at Ft. Richardson amount to approximately $330 per day plus the potential cost for a RCRA Part B permit, estimated at $250,000 and the cost of any facility modifications and requirements necessary to comply with the permit. However, given the open-ended nature of the No Action alternative, it is not possible to develop a present worth cost estimate with which to evaluate this alternative on an equal basis with the others. Nevertheless, at the present time there is no basis to believe that a different alternative could be developed in the near future that would provide significant cost savings over those other alternatives being evaluated in this EE/CA. Therefore, it would be very difficult to justify the selection of the No Action alternative, on the basis of "potential cost savings." In the end, it is estimated that implementing the No Action alternative would only increase the final costs for treating and disposing of the CAIS recovered from the PRDA site since it would only delay the inevitable implementation of one of the other alternatives being evaluated in this EE/CA. The other alternatives being evaluated in this EE/CA rely on the use of the RRS.

The RRS is comprised of two trailers: an operations trailer and a utility trailer. The RRS operations trailer houses a glovebox where the CAIS are actually handled. This glovebox is connected to a carbon filter system to control any toxic emissions that might be generated during the handling of the CAIS. The RRS operations trailer also houses a RAMAN spectrophotometer to help identify the contents of the individual CAIS items; a 1-gal reactor where CAIS items may be treated; and a waste containerization system (an integral part of the glovebox) to collect waste generated while handling CAIS items in the glovebox. The RRS utility trailer contains two diesel-powered generators (one primary and one backup) to supply the RRS with all necessary emergency electrical power. The RRS can also operate on commercial power. Additionally, the RRS includes equipment to set up a temporary storage facility to store the wastes generated during operations.

The RRS is supported by a Mobile Analytical Support Platform (MASP), a separate mobile laboratory that facilitates the operation of the necessary monitoring equipment within the RRS Operations trailer and provides gas chromatography capabilities to perform chemical analyses.

Both the RRS and the MASP are Government furnished equipment.

The home base for the RRS and the MASP is at Teledyne Brown Engineering (TBE), Inc., in Huntsville, Alabama. The home base for the RRS and MASP operating crew is assumed to be Huntsville, Alabama.

The following paragraphs discuss the general assumptions that have been made to develop the cost estimates for those alternatives where the RRS is used.

F-2.1 RRS Operations

The RRS operations have been organized into five different activities: mobilization/site preparation, setup, operations, closure, and demobilization/site clearing. Only one crew will be required to operate the RRS and MASP.

Mobilization/site preparation activities encompass the transportation of the RRS and MASP equipment, materials, and operating personnel to the site where the RRS operations are set to take place and also the preparation of the site where the RRS operations are set to take place. The time and modes of transportation required for mobilizing the RRS and MASP equipment and materials to the site are dependent on the location of the site where the RRS operations are set to take place and are discussed in detail under the alternative-specific assumptions. The mobilization of the RRS and MASP operating crew is assumed to require 1 day of travel by plane. It is also assumed that the mobilization of the RRS and MASP crew will be scheduled such that the RRS and MASP crew is present at the RRS operations site when the RRS and MASP equipment arrive.

As for site preparation, all of the alternatives that rely on the use of the RRS would occur at U.S. Army installations. Therefore, it is assumed that the RRS would be set within existing buildings at such Army installations and that the extent of site preparation will only involve the clearing of the building or leveling of the site and setting up utility connections for the RRS, MASP, and support equipment, and it will also involve the setting up existing office space for personnel support. This is assumed to require only 2 working days.

Setup activities encompass integration, assembly, test, and checkout of the RRS and MASP equipment, the completion of a baseline air monitoring program to establish background air monitoring conditions, and the completion of a pre-operation test. Setup is assumed to require a total of 33 working days, with each set of activities occurring sequentially.

RRS operation activities encompass the moving of the CAIS from storage to where the RRS operations are to take place and the processing of the CAIS in the RRS. The CAIS overpacks and CAIS related materials would be processed during operations. However, the duration of the operations activities and the amount of materials and equipment required to process the CAIS in the RRS depends on whether the removal alternative involves the treatment of the CAIS items that contain chemical warfare materiel (CWM) or whether the remedial alternative involves only the identifying, sorting, and repackaging of the CAIS items for shipment offsite for disposal. These are discussed in detail in the alternative-specific assumptions.

Closure activities encompass the decontamination of the RRS operations trailer equipment that is used to process the CAIS, the shipment of all of the waste generated from the processing of the CAIS and from the equipment decontamination activities, and the preparation of the RRS and MASP for their shipment back to their home base. Closure activities are expected to require 10 working days: 5 working days for decontamination and 5 working days for packing the RRS and MASP equipment. Shipment of the waste is assumed to occur concurrently with these two activities.

Demobilization/site clearing activities encompass the transportation of the RRS and MASP equipment, materials, and operating personnel back to their corresponding home base as well as the return of the site where the RRS operations took place back to its original condition. This is essentially the reverse of the Mobilization/Site Preparation Activities and as is the case for the Mobilization/Site Preparation activities, the time and modes of transportation required for mobilizing the RRS and MASP equipment and materials to the site depend on the location of the site where the RRS operations take place. They are discussed in detail under the alternative-specific assumptions. The mobilization of the RRS and MASP operating crew is assumed to be by plane and is assumed to require 1 day. It is also assumed that the mobilization of the RRS and MASP crew will be scheduled to occur on the day after the RRS and MASP equipment and materials leave the site so that they may help with the site clearing activities.

F-2.2 Labor

The RRS crew is assumed to include a total of ten people: one manager/supervisor, one quality assurance and health and safety manager, four glovebox operators, two RAMAN operators/monitoring specialists, one person for maintenance support, and one site administrator. The MASP crew is assumed to include a total of three people: one senior chemist and two laboratory technicians.

During operations, the RRS crew is assumed to be organized in teams: an administration and support team consisting of the site manager, the quality assurance and health and safety manager, the maintenance support technician, and the site administrator; and two glovebox operations teams, each consisting of two glovebox operators and one RAMAN/monitoring specialist. Due to the ergonomic constraints in operating the glovebox, the work of the glovebox operations team is limited to only 2 hours at a time. Therefore, it is assumed that the two glovebox operations teams will rotate every 2 hours so that while one team is operating the glovebox, the other team outside the RRS operations trailer is standing by the emergency decontamination station and performing other support activities.

It is assumed that the U.S. Army installation (where the RRS activities will take place) will provide direct support to the RRS operations for environmental engineering, safety, maintenance, CAIS storage and onsite transportation, and other miscellaneous support activities. The extent of installation support is assumed to be equivalent to two full-time engineers, two full-time technicians, and one half-time forklift operator. The level of effort for Installation support is assumed to be for the duration of onsite operations (i.e., from site preparation to site clearing).

Although different labor categories have been used to develop the cost estimates, an average, loaded, hourly rate of $69.50 has been applied to all labor categories. It has also been assumed that personnel will work a standard work week schedule (i.e., 8 hours per day, 5 days per week, Monday through Friday). Further details are discussed under the alternative-specific assumptions.

F-2.3 Materials and Equipment

The Materials and Equipment necessary to carry out the RRS operations have been organized into the following categories:

- *Medical Surveillance*. It is assumed that the RRS and MASP crew (a total of 13 people) will be required to enroll in a medical surveillance program. The cost of this medical surveillance program has been estimated at $1,100 per person and has been charged to Mobilization.

- *Transport of the RRS and MASP to the site*. Transportation of the RRS and the MASP to the site is generally expected to be done over land and water and involves four trailers: the RRS operations trailer, the RRS utilities trailer, the MASP, and a trailer for support equipment and supplies. It is assumed that two drivers will be used per trailer and that the drivers will be based at Huntsville, Alabama, which is also the home base of the RRS and MASP. The costs for transporting the RRS and MASP equipment over land and water are estimated at $1.78 per mile for each trailer. These costs include salaries and per diem for the drivers. Travel by air for the drivers is listed separately.

- *RRS Usage Fees.* Although the RRS is Government furnished equipment, a standard usage fee has been developed for the RRS to capture the costs associated with it. The RRS usage fees are based on the equipment design and fabrication costs, maintenance and replacement costs, spares, specialized operator training requirements, and expected usage over its life expectancy (estimated at 7 years). This usage fee is estimated at $5,500 per calendar day.

- *MASP Usage Fees.* Although the MASP is Government furnished equipment, a standard usage fee has been developed for the RRS to capture the costs associated with this equipment. This usage fee is estimated at $2,325 per calendar day, based on the usage fees for comparable commercial mobile laboratories.

- *Forklift.* It is assumed (i.e., from site preparation to site clearing) to be used to support the RRS operations. The lease costs for this forklift are estimated at $40 per calendar day.

- *Lab Supplies.* The amount of lab supplies has been estimated at $1,400 per calendar day, starting with the 3-day baseline monitoring and ending with the completion of the equipment decontamination activities during closure.

- *Replacement of Carbon and High Efficiency Particulate Air (HEPA) Filters.* The replacement rate for the carbon and HEPA filters used in the RRS ventilation filter system depends on whether the remedial alternative involves the treatment of the CAIS items that contain CWM or whether the remedial alternative involves only identifying, sorting, and repackaging of the CAIS items for shipment offsite for disposal. Therefore, the number of carbon and HEPA filter replacements needed for each Alternative is discussed in the alternative-specific assumptions. The costs for replacing the carbon and HEPA filters, however, have been estimated at $4,325 per set.

- *Decontamination Supplies.* Decontamination supplies include brushes, decontamination solution, and other miscellaneous items required for decontaminating the RRS operations trailer. The costs for decontamination supplies are estimated at $1,100.

- *Treatment Reagents.* The costs to prepare and supply the reagents required to treat the CAIS items containing CWM have been estimated at $21,500.

- *Utilities.* Utilities are estimated at $450 per day for each calendar day starting on the day the RRS and MASP equipment arrives at the site until the day they leave.

- *Miscellaneous Supplies.* Miscellaneous supplies are estimated at $100 per day for each working day starting with site preparation through site cleaning.

- *Disposable Personal Protective Equipment (PPE).* The costs for disposable Tyvek™ suits are estimated at $4.00 per suit. It is estimated that each person will use two suits per working day while onsite.

- *Waste Containers.* The quantity and type of waste containers and waste disposal and analysis costs depends on whether the removal alternative involves the treatment of the CAIS items that contain CWM or whether the removal alternative involves only identifying, sorting, and repackaging of the CAIS items for shipment offsite for disposal. The costs for purchasing standard 5 gal drums, 20 gal drums, 30 gal drums, 55 gal drums and 95 gal drums, are estimated at $10, $40, $50, $90 and $105 each, respectively. A specialty stainless steel 5-gal drum must be used for the neutralized chemical agent waste. These drums cost $1,000 each. The costs of SRCs are estimated at $1,325 each.

- *Waste Disposal/Analysis*. The costs for disposal of 30 gal drums and 55 gal drums of hazardous waste at a RCRA subtitle C (hazardous waste) incinerator are estimated at $430 and $550 per drum, respectively. The costs for disposal of 95-gal drums of hazardous waste at a RCRA subtitle C (hazardous waste) incinerator are estimated at $550 per box. It is assumed that all containers of hazardous waste will be sampled and analyzed for Toxicity Characteristic Leaching Procedure (TCLP) metals ($150 per sample), TCLP organics ($240 per sample), free liquids test ($32 per sample), heat of combustion ($85 per sample), ash contents ($27 per sample), and chemical warfare agent ($650 per sample).

- *Air Transport of CAIS*. Transportation of CAIS by air is expected to be by C-12 military aircraft. The costs of a C-12 military aircraft are estimated at $5.40 per mile. The costs for loading and unloading the CAIS onto and out of the plane are estimated at $270 per load.

F-2.4 Travel/Car Rental/Per Diem

The costs for travel, car rental, and per diem are dependent on the location of the site where the RRS operations are set to take place and on whether the remedial alternative involves the treatment of the CAIS items that contain CWM or whether the remedial alternative involves only identifying, sorting, and repackaging of the CAIS items for shipment offsite for disposal. Standard U.S. Government per diem rates for the appropriate locality have been used to estimate the per diem related costs.

Round-trip airfare rates have been estimated as follows:

- Baltimore, Maryland, to Anchorage, Alaska $2,000
- Huntsville, Alabama, to Anchorage, Alaska $2,250
- Baltimore, Maryland, to Houston, Texas $2,000

- Baltimore, Maryland, to Pine Bluff, Arkansas $ 1,350
- Huntsville, Alabama, to Pine Bluff, Arkansas $ 1,000

It is assumed that four minivans will be rented for the RRS and MASP crew at an estimated cost of $60 per day. Car rental costs are estimated at $50 per day.

F-2.5 Engineering and Management Costs

Engineering and management costs include the costs of administration, design, construction supervision, and drafting necessary to implement the remedial alternative. These costs are estimated to be 20 percent of the direct capital costs. Specifically, they include the costs for developing the remedial alternative's operations plan, health and safety plan, and contingency plan at 15 percent of the direct capital costs, and administrative costs, including U.S. Army oversight, at 5 percent of the direct capital costs.

F-2.6 Permit, Fees, and Taxes

These costs encompass the administrative and technical costs necessary to obtain licenses and permits for the installation and operation of the remedial alternative. These costs are estimated at 10 percent of the direct capital costs, not including the cost for environmental permits that [under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)], are not required for the remedial alternatives taking place at Ft. Richardson. For those remedial alternatives where the RRS operations take place outside Ft. Richardson, the costs for a RCRA permit are estimated at $250,000, and the costs for documentation to comply with the National Environmental Policy Act (NEPA) are estimated at $75,000. (It is assumed that an environmental assessment will be required.)

F-2.7 Contingency

A contingency allowance of 30 percent has been added to the total capital cost to compute the total project cost. This contingency is intended to cover the costs associated with unforeseen circumstances, such as weather or administrative delays and gaps in site characterization data.

F-3 ALTERNATIVE-SPECIFIC ASSUMPTIONS

The remedial alternatives that rely on the use of the RRS are:

- Alternative 2: Onsite Treatment of CWM Items and Offsite Treatment/Disposal of Associated Hazardous Substances
- Alternative 3: Offsite Treatment/Disposal
- Alternative 4: Offsite Treatment of CWM at a Department of Defense (DoD) Facility with Further Offsite Treatment/Disposal.

A detailed description of these alternatives is provided in Section 3 of the EE/CA.

This section presents the specific assumptions that have been made to estimate the costs for these alternatives.

F-3.1 Alternative 2

F-3.1.1 Mobilization/Site Preparation. It is assumed that, for this alternative, the RRS and the MASP are transported from Huntsville, Alabama, over land and by barge, a distance of approximately 4,000 miles. It is assumed that the RRS and MASP will be trucked to Seattle, Washington, barged to Anchorage, Alaska, and returned to Huntsville, Alabama in reverse manner. The mobilization of the RRS and MASP equipment over land and by sea is assumed to require 4 weeks.

The RRS and MASP operating crew are assumed to travel to Anchorage, Alaska, from Huntsville, Alabama, the day before the RRS and MASP equipment is scheduled to arrive in Anchorage. It assumed that travel for the RRS and MASP crew to Anchorage will require 1 full day. It is, therefore, assumed that the RRS and MASP crew will help with the site preparation activities. Actual mobilization/site preparation time by the crew will be approximately 5 days.

It is assumed that Ft. Richardson personnel will commence site preparation activities prior to the RRS and MASP equipment scheduled arrival at Ft. Richardson.

F-3.1.2 Setup. The setup of the RRS and MASP equipment is assumed to commence after the site preparation activities have been completed. It is assumed that the RRS and MASP crew, supported by installation personnel, will set up the RRS and MASP equipment, as discussed in the general assumptions.

The quantity and type of waste containers to be used are based on the amount of wastes expected to be generated during the implementation of the Alternative, as shown on Table 3-1 of the EE/CA. The waste containers are assumed to be purchased and delivered to the site as part of the setup activities.

F-3.1.3 Operations. RRS operation activities are assumed to commence immediately after the conclusion of the setup pre-operations testing activities. For this Alternative, the RRS operations involve unpacking the CAIS items from their overpack containers, identifying and segregating the CAIS items by their chemical contents, treating CAIS items containing chemical warfare agents in the RRS operations trailer reactor, and repackaging CAIS items that do not contain chemical warfare agents (that contain industrial chemicals).

The RRS is designed to process CAIS overpacks at a rate equivalent to one per working day, when treating CWM CAIS items. This would require 12 working days to process the twelve CAIS overpacks and related items at Ft. Richardson. However, assuming only an 85 percent availability, the RRS operations are assumed to last 14 working days. It is assumed that the carbon and HEPA filters will need to be changed four times during operations.

F-3.1.4 Closure. All closure activities are expected to require 10 working days. Decontamination of the RRS operations trailer equipment is assumed to take 5 working days, during which all of the RRS monitoring equipment will continue to operate and lab supplies are assumed to be required. It is also assumed that the wastes generated during the RRS operation and decontamination activities will be shipped offsite for disposal after the decontamination activities are completed. Once the decontamination activities are completed, the RRS and MASP equipment will be disassembled and prepared for shipment back to Huntsville, Alabama. This is assumed to require 5 working days. It is also assumed that the carbon and HEPA filters will be changed once at the end of the decontamination activities.

The number and types of hazardous waste containers generated during Alternative 2 are listed in Table 3-1 of the EE/CA. All hazardous wastes generated during the implementation of this Alternative are assumed to be disposed at a RCRA Subtitle C (hazardous waste) incinerator.

F-3.1.5 Demobilization/Site Clearing. It is assumed that, after preparing the RRS and MASP for shipment, the RRS and MASP crew will assist with the site clearing activities.

It is assumed that the RRS and MASP equipment will be barged to Seattle, Washington and commercially trucked to Huntsville, Alabama. The demobilization of the RRS and MASP equipment is assumed to require 3 weeks and will cover a distance of approximately 4,000 miles.

It is assumed that the RRS and MASP operating crew will travel back to their home base the day after the RRS and MASP equipment leaves for Huntsville, Alabama. It assumed that travel for the RRS and MASP crew back to their home base will require 1 full day.

It is assumed that Ft. Richardson personnel will commence site clearing activities as soon as the RRS and MASP equipment leaves the site. It is assumed that the entire site clearing activities will take 2 working days.

F-3.2 Alternative 3

F-3.2.1 Mobilization/Site Preparation. It is assumed that, for this alternative, the RRS and the MASP are transported from Huntsville, Alabama, to Anchorage, Alaska, over land and by barge, a distance of approximately 4,000 miles. It is assumed that the RRS and MASP equipment will be trucked to Seattle, Washington, barged to Anchorage, Alaska, and returned to Huntsville in reverse manner. The mobilization of the RRS and MASP equipment over land and by sea is assumed to require 4 weeks.

The RRS and MASP operating crew are assumed to travel to Anchorage, Alaska, from their home base, the day before the RRS and MASP equipment is scheduled to arrive in Anchorage. It assumed that travel for the RRS and MASP crew to Anchorage will require 1 full day. It is therefore assumed that the RRS and MASP crew will help with the site preparation activities.

It is assumed that Ft. Richardson personnel will commence site preparation activities on the day before the RRS and MASP equipment is scheduled to arrive at Ft. Richardson and that such site preparation activities will be completed the following working day.

F-3.2.2 Setup. The setup of the RRS and MASP equipment is assumed to commence after the site preparation activities have been completed. It is assumed that the RRS and MASP crew, supported by installation personnel, will set up the RRS and MASP equipment, as previously discussed under the general assumptions.

The quantity and type of waste containers to be used are based on the amount of wastes expected to be generated during the implementation of the Alternative, as shown on Table 3-2 of the EE/CA. The waste containers are assumed to be purchased and delivered to the site as part of the setup activities.

F-3.2.3 Operations. RRS operation activities are assumed to commence immediately after the conclusion of the setup pre-operations testing activities. For this Alternative, the RRS operations involve unpacking the CAIS items from their overpack containers; identifying and segregating the CAIS items by their chemical contents; and repackaging the CAIS items according to compatibility and hazard class, in accordance with the DOT requirements, for shipment offsite to a RCRA Subtitle C incineration facility.

The RRS is designed to process CAIS overpacks and related items at a rate equivalent to one per working day when treating CWM CAIS items. This would require 12 working days to process the twelve CAIS overpacks and related items at Ft. Richardson. However, assuming only an 85 percent availability, the RRS operations are assumed to last 14 working days. Also, since no treatment would be taking place within the RRS glovebox, that would generate a lot of vapor emissions, it is assumed that the carbon and HEPA filters will need to be changed only once during Operations. There would be no costs for treatment reagents.

F-3.2.4 **Closure.** All closure activities are expected to require 10 working days. Decontamination of the RRS operations trailer equipment is assumed to take 5 working days, during which all of the RRS monitoring equipment will continue to operate and lab supplies are assumed to be required. It is also assumed that the wastes generated during the RRS operation and decontamination activities will be shipped offsite for disposal after the decontamination activities are completed. Once the decontamination activities are completed, the RRS and MASP equipment will be disassembled and prepared for shipment back to Huntsville, Alabama. This is assumed to require 5 working days. It is also assumed that the carbon and HEPA filters will be changed once at the end of the decontamination activities.

The number and types of hazardous waste containers generated during Alternative 3 are listed in Table 3-2 of the EE/CA. All hazardous wastes generated during the implementation of this Alternative are assumed to be disposed at a Resource Conservation and Recovery Act (RCRA) Subtitle C (hazardous waste) incinerator.

The repackaged CAIS items containing CWM are assumed to be loaded onto a C-12 military aircraft for shipment to the RCRA subtitle C (hazardous waste) incineration facility. For the purpose of estimating the costs for disposal of the CAIS items containing CWM, it is assumed that the incineration facility will be located near

Houston, Texas. Therefore, the total travel distance for the C-12 military aircraft is 3,480 miles.

It is assumed that local personnel from Ft. Richardson, Alaska, will transport the CAIS from Ft. Richardson to Elmendorf Air Force Base (EAFB) and load the CAIS onto the C-12 plane. The costs for materials and equipment to transport the CAIS and load them onto the plane are estimated at $270. The level of effort required for loading the CAIS onto the C-12 planes is assumed to require one Ft. Richardson engineer for 4 hours and three Ft. Richardson technicians for 4 hours (including transportation convoys).

The mobilization of the CAIS by C-12 aircraft is assumed to require 2 days.

It is assumed that personnel from the U.S. Army Technical Escort Unit (TEU) will be used to unload the CAIS and transport them to the RCRA subtitle C (hazardous waste) incineration facility where the CAIS items will be incinerated. It is assumed that unloading and transporting the CAIS items will require six TEU personnel, two escort cars, and one truck. The costs for materials and equipment to unload the CAIS and transport them to the incineration facility are estimated at $270, in addition to $55 for truck rental.

The TEU personnel are assumed to travel to Houston, Texas, from their home base in Edgewood, Maryland, the afternoon before the CAIS are scheduled to arrive in Houston, Texas. It assumed that travel for the TEU personnel will require one-half day. It is assumed that once the C-12 aircraft carrying the CAIS items containing CWM arrive in Houston, the TEU personnel will unload and transport them to the incineration facility, where they will witness the incineration of the CAIS items that same day. It is assumed that the TEU personnel will return to their home base the following morning.

F-3.2.5 Demobilization/Site Clearing. It is assumed that, after preparing the RRS and MASP for shipment, the RRS and MASP crew will assist with the site clearing activities.

The four trailers will travel a distance of approximately 4,000 miles, and it is assumed to require 3 weeks.

It is assumed that the RRS and MASP operating crew will travel back to their home base the day after the RRS and MASP equipment leaves for Huntsville, Alabama. It assumed that return travel for the RRS and MASP crew to their home base will require 1 full day.

It is assumed that Ft. Richardson personnel will commence site clearing activities as soon as the RRS and MASP equipment leave the site. It is assumed that the entire site clearing activities will take 2 working days.

F-3.3 Alternative 4

F-3.3.1 Mobilization/Site Preparation. It is assumed that, for this alternative, the twelve CAIS overpacks and related items at Ft. Richardson are transported to Grider Field in Pine Bluff, Arkansas, by two C-12 military aircraft, a distance of approximately 3,415 air miles. From Grider Field, a UH-60 helicopter would then be used to transfer the CAIS overpacks and related items to PBA (two 12-mile trips).

It is assumed that local personnel from Ft. Richardson, Alaska, will transport the CAIS overpacks and related items from Ft. Richardson to EAFB and load the CAIS overpacks onto the C-12 planes. This is assumed to require two loads. The costs for materials and equipment to transport the CAIS overpacks and related items and load them onto the plane are estimated at $270 per load.

It is assumed that local personnel from PBA will be used to transfer the CAIS overpacks and related items from the C-12 aircraft to the UH-60 helicopter and to unload the CAIS overpacks and related items from the UH-60 and transport them to temporary storage at PBA. It is assumed this will consist of two loads. The costs for materials and equipment to unload the CAIS and transport them to temporary storage are estimated at $270 per load.

The level of effort required for the loading of the CAIS onto the C-12 planes is assumed to require two Ft. Richardson engineers for 4 hours, and six Ft. Richardson technicians for 4 hours (including transportation convoys). The unloading of the CAIS overpacks and related items at Pine Bluff Arsenal (PBA), is assumed to take place as part of the installation support. The mobilization of the CAIS overpacks and related items by C-12 aircraft and UH-60 helicopter is assumed to require 2 days.

It is assumed that, for this alternative, the RRS and the MASP are transported from Huntsville, Alabama, to PBA in Pine Bluff, Arkansas, over land, a distance of approximately 400 miles. Transporting the RRS and MASP equipment to PBA is assumed to require 3 working days. The RRS and MASP operating crew are assumed to travel to Pine Bluff, Arkansas, from their home base, on the day before the RRS and MASP equipment and the CAIS overpacks and related items are scheduled to arrive at PBA. It assumed that travel for the RRS and MASP crew to Anchorage will require 1 full day. It is therefore assumed that the RRS and MASP crew will help with the unloading of the CAIS overpacks and related items and with site preparation activities at PBA. It is assumed that PBA personnel will commence site preparation activities prior to the arrival of the RRS and MASP equipment at PBA.

F-3.3.2 Setup. The setup of the RRS and MASP equipment is assumed to commence after the site preparation activities have been completed. It is assumed that the RRS and MASP crew, supported by installation personnel, will set up the RRS and MASP equipment, as previously discussed under the general assumptions.

The quantity and type of waste containers to be used are based on the amount of wastes expected to be generated during the implementation of the Alternative, as shown on Table 3-3 of the EE/CA. The waste containers are assumed to be purchased and delivered to the site as part of the setup activities.

F-3.3.3 Operations. RRS operation activities are assumed to commence immediately after the conclusion of the setup pre-operations testing activities. For this Alternative, the RRS operations involve unpacking the CAIS items from their containers, identifying and segregating the CAIS items by their chemical contents, treating CAIS items that contain chemical warfare agents in the RRS operations trailer reactor, and repackaging those CAIS items that do not contain chemical warfare agents (i.e., those that contain industrial chemicals).

The RRS is designed to process CAIS overpacks at a rate equivalent to one per working day, when treating CWM CAIS items. This would require 12 working days to process the twelve CAIS overpacks and related items from Ft. Richardson. However, assuming only an 85 percent availability, the RRS operations are assumed to last 14 working days. Also, it is assumed that the carbon and HEPA filters will need to be changed four times during operations.

F-3.3.4 Closure. The entire closure activities are expected to require 10 working days. Decontamination of the RRS operations trailer equipment is assumed to require 5 working days, during which all of the RRS monitoring equipment will continue to operate and lab supplies are assumed to be required. It is also assumed that the wastes generated during the RRS operation and decontamination activities will be shipped offsite for disposal after the decontamination activities are completed. Once the decontamination activities are completed, the RRS and MASP equipment will be disassembled and prepared for transportation back to Huntsville, Alabama. This is assumed to require 5 working days. It is also assumed that the carbon and HEPA filters will need to be changed once at the end of the decontamination activities.

The number and types of hazardous waste containers generated during Alternative 4 are listed in Table 3-3 of the EE/CA. All hazardous wastes generated during the implementation of this Alternative are assumed to be disposed at a RCRA Subtitle C (hazardous waste) incinerator.

F-3.3.5 Demobilization/Site Clearing. It is assumed that, after preparing the RRS and MASP for transportation back to Huntsville, the RRS and MASP crew will assist with the site clearing activities.

It is assumed that a commercial carrier will transport the RRS and MASP equipment back to Huntsville, Alabama, over land, a distance of approximately 400 miles. This will require 1 day. It is assumed that the RRS and MASP operating crew will travel back to their home base the day after the RRS and MASP equipment leaves PBA. It assumed that travel for the RRS and MASP crew back to their home base will require 1 full day. It is assumed that PBA personnel will perform the site clearing activities and that the entire site clearing activities will require 2 working days. It is assumed that the two office trailers will be returned on the next working day after the RRS and MASP equipment depart PBA.

ALTERNATIVE 2		
COST SUMMARY		
I. Direct Capital Costs		
A. Labor	$525,281	
B. Materials and Equipment	$706,984	
C. Travel/Car Rental/Per Diem	$274,752	
Total Direct Capital Costs		$1,507,017
II. Indirect Capital Costs		
D. Engineering and Management (20% of Direct Capital Costs)	$301,403	
E. Permits, Fees, and Taxes (10% of Direct Capital Costs)	$150,702	
Total Indirect Capital Costs		$452,105
TOTAL CAPITAL COSTS		$1,959,122
III. Contingency (30% of Capital Costs)		$587,737
TOTAL PROJECT COSTS		$2,546,859

I. DIRECT CAPITAL COSTS													
A. LABOR													
Description	Rate	Mobilization/		Setup		Operations		Closure		Demobilization/		TOTAL	
		Site Preparation								Site Clearing			
		5	wk-days	10	wk-days	14	wk-days	10	wk-days	5	wk-days	44	wk-days
		5	cal-days	14	cal-days	19	cal-days	12	cal-days	5	cal-days	55	cal-days
	($/hour)	(man-hours)	($)	(man-hours)	($)	(man-hours)	($)	(man-hours)	($)	(man-hours)	($)	(man-hours)	($)
1. RRS Manager/Supervisor	$69.50	16	$1,112	80	$5,560	112	$7,784	80	$5,560	16	$1,112	304	$21,128
2. RRS QA and H&S Manager	$69.50	16	$1,112	80	$5,560	112	$7,784	80	$5,560	16	$1,112	304	$21,128
3. RRS Glovebox Operator	$69.50	64	$4,448	320	$22,240	448	$31,136	320	$22,240	64	$4,448	1216	$84,512
4. RRS RAMAN Operator	$69.50	32	$2,224	160	$11,120	224	$15,568	160	$11,120	32	$2,224	608	$42,256
5. RRS Maintenance Support	$69.50	16	$1,112	80	$5,560	112	$7,784	80	$5,560	16	$1,112	304	$21,128
6. RRS Site Administrator	$69.50	16	$1,112	80	$5,560	112	$7,784	80	$5,560	16	$1,112	304	$21,128
7. MASP Sr. Chemist	$69.50	16	$1,112	80	$5,560	112	$7,784	80	$5,560	16	$1,112	304	$21,128
8. MASP Lab Technician	$69.50	32	$2,224	166	$11,537	242	$16,819	166	$11,537	32	$2,224	638	$44,341
9. Security Guard	$69.50	32	$2,224	672	$46,704	912	$63,384	576	$40,032	16	$1,112	2208	$153,456
10. Ft. Richardson Engineer	$69.50	32	$2,224	160	$11,120	224	$15,568	160	$11,120	32	$2,224	608	$42,256
11. Ft. Richardson Technician	$69.50	32	$2,224	160	$11,120	224	$15,568	160	$11,120	32	$2,224	608	$42,256
12. Ft. Richardson Forklift Operator	$69.50	8	$556	40	$2,780	56	$3,892	40	$2,780	8	$556	152	$10,564
TOTAL LABOR		312	$21,684	2078	$144,421	2890	$200,855	1982	$137,749	296	$20,572	7558	$525,281
B. MATERIALS AND EQUIPMENT													
1. Medical Surveillance RRS/MASP Crews			$14,300										$14,300
2. Transportation of RRS and MASP			$28,527								$28,527		$57,055
3. RRS Usage Fees			$27,500		$77,000		$104,500		$66,000		$27,500		$302,500
4. MASP Usage Fees			$11,625		$32,550		$44,175		$27,900		$11,625		$127,875
5. Office Trailer			$0		$0		$0		$0		$0		$0
6. Forklift			$86		$605		$821		$519		$86		$2,118
7. Transport of CAIS from Bunker to RRS							$0						$0
8. Lab Supplies					$11,200		$26,600		$8,400				$46,200
9. PPE (OSHA Level A) decontamination					$0		$0		$0				$0
10. *Carbon/HEPA Filters*							$43,250		$4,325				$47,575
11. Treatment Reagents							$21,500						$21,500
12. Decontamination Supplies									$1,100				$1,100
13. Utilities (Electric/Diesel and Water)			$450		$6,300		$8,550		$5,400		$450		$21,150
14. Miscellaneous Supplies			$200		$1,000		$1,400		$1,000		$200		$3,800
15. PPE (2 *suits/person/day*)			$104		$1,040		$1,456		$1,040		$104		$3,744
16. Waste Containers					$9,835								$9,835
17. Waste Disposal/Analysis									$48,232				$48,232
TOTAL MATERIALS AND EQUIPMENT			$82,793		$139,530		$252,252		$163,916		$68,493		$706,984
C. TRAVEL/CAR RENTAL/PER DIEM			$32,346		$65,352		$88,692		$56,016		$32,346		$274,752
TOTAL DIRECT CAPITAL COSTS			$136,823		$349,303		$541,799		$357,681		$121,411		$1,507,017

B. MATERIALS AND EQUIPMENT							
Description	Quantity		Units		Cost		TOTAL
1. Medical Surveillance RRS/MASP Crews	1	crew	13	persons/crew	$1,100.00	/person	$14,300
2. Transportation of RRS and MASP (4 trailers, mobilization and demobilization)	8	trailer-trips	4,000	miles/trailer-trip	$1.78	/mile	$57,055
3. RRS Usage Fees	1	RRS	55	cal-days	$5,500	/RRS-cal-day	$302,500
4. MASP Usage Fees	1	MASP	55	cal-days	$2,325	/MASP-cal-day	$127,875
5. Office Trailer		trailers	49	cal-days	$55.00	/cal-day	$0
6. Forklift	1	forklift	49	cal-days	$43	/cal-day	$2,118
7. Transport of CAIS from Bunker to RRS	10	overpacks		trip/overpack	$325.00	/trip	$0
8. Lab Supplies		fixed	33	cal-days	$1,400	/cal-day	$46,200
9. PPE (OSHA Level A) decontamination	21	wk-days		suits/wk-day	$325.00	/suit	$0
10. Carbon/HEPA Filters	5	changes	1	set/change	$4,325	/set	$21,625
11. Treatment Reagents		fixed		lump sum	$21,500		$21,500
12. Decontamination Supplies		fixed		lump sum	$1,100		$1,100
13. Utilities (Electric/Diesel and Water)		fixed	47	cal-days	$450	/cal-day	$21,150
14. Miscellaneous Supplies		fixed	38	wk-days	$100	/wk-day	$3,800
15. PPE (2 suits/person/day)	36	wk-days	26	suits/wk-day	$4.00	/suit	$3,744
16. Waste Containers							
- 5-Gallon Drums (standard)	1	drum		lump sum	$10	/drum	$10
- 5-Gallon Drums (stainless)	6	drum		lump sum	$1,000	/drum	$6,000
- 20-Gallon Drums	1	drum		lump sum	$40	/drum	$40
- 30-Gallon Drums	12	drums		lump sum	$50	/drum	$600
- 55-Gallon Drums	9	drums		lump sum	$90	/drum	$810
- SRC	1	SRC		lump sum	$1,325	/SRC	$1,325
- 95-Gallon Drums	10	drums		lump sum	$105	/drum	$1,050
TOTAL WASTE CONTAINERS							$9,835
17. Waste Disposal/Analysis							
- Decontaminated Pigs (or Pig Parts) (solid, nonhazardous waste, disposal in RCRA Subtitle D landfill)		30-gal. drums	405	lb/drum	$215	/drum	$0
- Dunnage/Packaging Materials including pig parts (solid, hazardous waste, disposal in RCRA Subtitle C incinerator)	12	30-gal. drums	150	lb/drum	$430	/drum	$5,160
metals analysis (TCLP)			1	sample/drum	$150	/sample	$1,800
organics analysis (TCLP)			1	sample/drum	$240	/sample	$2,880
free liquids test			1	sample/drum	$32	/sample	$389
heat of combustion			1	sample/drum	$85	/sample	$1,020
ash contents			1	sample/drum	$27	/sample	$324
chemical warfare agent (GC/MS)			1	sample/drum	$650	/sample	$7,800
- Chemical Warfare Agents Treatment Residues (liquid, hazardous waste, disposal in RCRA Subtitle C incinerator)	8	5-gal. drums	60	lb/drum	$430	/drum	$2,580
metals analysis (TCLP)			1	sample/drum	$150	/sample	$900
organics analysis (TCLP)			1	sample/drum	$240	/sample	$1,440
heat of combustion			1	sample/drum	$85	/sample	$510
ash contents			1	sample/drum	$27	/sample	$162
chemical warfare agent (GC/MS)			1	sample/drum	$650	/sample	$3,900
- Liquid Phosgene (hazardous waste, disposal in RCRA Subtitle C incinerator)	1	SRC	20	lb/SRC	$215	/lab pack	$215
- Liquid Chloropicrin (hazardous waste, disposal in RCRA Subtitle C incinerator)	1	5-gal. drum (lab pack)	20	lb/drum	$215	/lab pack	$215
- Poison Solids (hazardous waste, disposal in RCRA Subtitle C incinerator)	1	20-gal. drum (lab pack)	30	lb/drum	$215	/lab pack	$215
- Spent Filters (solid, hazardous waste, disposal in RCRA Subtitle C incinerator)	10	95-gal. Drum	200	lb/drum	$550	/drum	$5,500
metals analysis (TCLP)			1	sample/drum	$150	/sample	$1,500
organics analysis (TCLP)			1	sample/drum	$240	/sample	$2,400
heat of combustion			1	sample/drum	$85	/sample	$850
ash contents			1	sample/drum	$27	/sample	$270
chemical warfare agent (GC/MS)			1	sample/drum	$650	/sample	$6,500
- Spent Decontamination Solution (liquid, hazardous waste, disposal in RCRA Subtitle C incinerator)	0	55-gal. drums	460	lb/drum	$550	/drum	$0
metals analysis (TCLP)			1	sample/drum	$150	/sample	$0
organics analysis (TCLP)			1	sample/drum	$240	/sample	$0
heat of combustion			1	sample/drum	$85	/sample	$0
ash contents			1	sample/drum	$27	/sample	$0
chemical warfare agent (GC/MS)			1	sample/drum	$650	/sample	$0
- Decontamination Rinsate and micellaneous waste (liquid, hazardous waste, disposal in RCRA Subtitle C incinerator)	1	55-gal. drums	400	lb/drum	$550	/drum	$550
metals analysis (TCLP)			1	sample/box	$150	/sample	$150
organics analysis (TCLP)			1	sample/box	$240	/sample	$240
heat of combustion			1	sample/box	$85	/sample	$85
ash contents			1	sample/box	$27	/sample	$27
chemical warfare agent (GC/MS)			1	sample/box	$650	/sample	$650
- Decontaminated PPE and miscellaneous waste (solid, nonhazardous waste, disposal in RCRA Subtitle D landfill)	8	55-gal. drums	200	lb/drum	$215	/drum	$1,720
TOTAL WASTE DISPOSAL/ANALYSIS							$48,232
TOTAL MATERIALS AND EQUIPMENT							$681,034

C. TRAVEL/CAR RENTAL/PERDIEM							
Description	Quantity		Units		Cost		TOTAL
Rountrip Airfare Anchorage, AK, to Salt Lake City, UT		persons	1	trip	$2,162	/person-trip	$0
Perdiem (hotel & meals)	18	persons	49	days	$246	/person-day	$216,972
Roundtrip Airfare Baltimore, MD, to Anchorage, AK	3	persons	1	trip	$2,000	/person-trip	$6,000
Roundtrip Airfare Huntsville, AL, to Anchorage, AK	18	persons	1	trip	$2,250	/person-trip	$40,500
Car Rental	4	minivans	47	days	$60	/minivan-day	$11,280
TOTAL TRAVEL/CAR RENTAL/PERDIEM							$274,752

ALTERNATIVE 3		
COST SUMMARY		
I. Direct Capital Costs		
A. Labor	$397,123	
B. Materials and Equipment	$536,039	
C. Travel/Car Rental/Per Diem	$237,032	
Total Direct Capital Costs		$1,170,194
II. Indirect Capital Costs		
D. Engineering and Management (20% of Direct Capital Costs)	$234,039	
E. Permits, Fees, and Taxes (10% of Direct Capital Costs)	$117,019	
Total Indirect Capital Costs		$351,058
TOTAL CAPITAL COSTS		$1,521,252
III. Contingency (30% of Capital Costs)		$456,376
TOTAL PROJECT COSTS		$1,977,627

I. DIRECT CAPITAL COSTS													
A. LABOR													
Description	Rate	Mobilization/ Site Preparation		Setup		Operations		Closure		Demobilization/ Site Clearing		TOTAL	
		5	wk-days	10	wk-days	6	wk-days	8	wk-days	5	wk-days	34	wk-days
		5	cal-days	14	cal-days	10	cal-days	10	cal-days	5	cal-days	44	cal-days
	($/hour)	(man-hours)	($)	(man-hours)	($)	(man-hours)	($)	(man-hours)	($)	(man-hours)	($)	(man-hours)	($)
1. RRS Manager/Supervisor	$69.50	16	$1,112	80	$5,560	48	$3,336	64	$4,448	16	$1,112	224	$15,568
2. RRS QA and H&S Manager	$69.50	16	$1,112	80	$5,560	48	$3,336	64	$4,448	16	$1,112	224	$15,568
3. RRS Glovebox Operator	$69.50	64	$4,448	320	$22,240	192	$13,344	256	$17,792	64	$4,448	896	$62,272
4. RRS RAMAN Operator	$69.50	32	$2,224	160	$11,120	96	$6,672	128	$8,896	32	$2,224	448	$31,136
5. RRS Maintenance Support	$69.50	16	$1,112	80	$5,560	48	$3,336	64	$4,448	16	$1,112	224	$15,568
6. RRS Site Administrator	$89.50	16	$1,112	80	$5,560	48	$3,336	64	$4,448	16	$1,112	224	$15,568
7. MASP Sr. Chemist	$69.50	16	$1,112	80	$5,560	48	$3,336	64	$4,448	16	$1,112	224	$15,568
8. MASP Lab Technician	$69.50	32	$2,224	166	$11,537	108	$7,506	128	$8,896	32	$2,224	466	$32,387
9. Security Guard	$69.50	32	$2,224	672	$46,704	480	$33,360	480	$33,360	16	$1,112	1680	$116,760
10. Ft. Richardson Engineer	$89.50	32	$2,224	160	$11,120	96	$6,672	128	$8,896	32	$2,224	448	$31,136
11. Ft. Richardson Technician	$69.50	32	$2,224	160	$11,120	96	$6,672	128	$8,896	32	$2,224	448	$31,136
12. Ft. Richardson Forklift Operator	$69.50	8	$556	40	$2,780	24	$1,668	32	$2,224	8	$556	112	$7,784
13. TEU Specialist	$69.50		$0		$0		$0	96	$6,672		$0	96	$6,672
TOTAL LABOR		312	$21,684	2078	$144,421	1332	$92,574	1696	$117,872	296	$20,572	5714	$397,123
B. MATERIALS AND EQUIPMENT													
1. Medical Surveillance RRS/MASP Crews			$14,300										$14,300
2. Transportation of RRS and MASP			$28,527								$28,527		$57,055
3. RRS Usage Fees			$27,500		$77,000		$55,000		$55,000		$27,500		$242,000
4. MASP Usage Fees			$11,625		$32,550		$23,250		$23,250		$11,625		$102,300
5. Office Trailer			$0		$0		$0		$0		$0		$0
6. Forklift			$86		$602		$430		$430		$172		$1,720
7. Transport of CAIS from Bunker to RRS							$0						$0
8. Lab Supplies					$11,200		$14,000		$5,600				$30,800
9. PPE (OSHA Level A) decontamination					$0		$0		$0				$0
10. Carbon/HEPA Filters							$4,325		$4,325				$8,650
11. Decontamination Supplies									$1,100				$1,100
12. Utilities (Electric/Diesel and Water)			$450		$6,300		$4,500		$4,500		$450		$16,200
13. Miscellaneous Supplies			$200		$1,000		$600		$800		$200		$2,800
14. PPE (2 suits/person/day)			$104		$1,040		$624		$832		$104		$2,704
15. Waste Containers					$5,185								$5,185
16. C-12 Cargo Plane Loading/Unloading									$540				$540
17. C-12 Cargo Plane Flights									$16,802				$18,802
18. Truck Rental (CWM CAIS disposal)									$55				$55
19. Waste Disposal/Analysis									$31,828				$31,828
TOTAL MATERIALS AND EQUIPMENT			$82,792		$134,877		$102,729		$147,062		$68,578		$536,039
C. TRAVEL/CAR RENTAL/PER DIEM			$32,346		$65,352		$46,680		$60,308		$32,346		$237,032
TOTAL DIRECT CAPITAL COSTS			$136,822		$344,650		$241,983		$325,242		$121,496		$1,170,194

B. MATERIALS AND EQUIPMENT							
Description	Quantity		Units		Cost		TOTAL
1. Medical Surveillance RRS/MASP Crews	1	crew	13	persons/crew	$1,100.00	/person	$14,300
2. Transportation of RRS and MASP (4 trailers, mobilization and demobilization)	8	trailer-trips	4,000	miles/trailer-trip	$1.78	/mile	$57,055
3. RRS Usage Fees	1	RRS	44	cal-days	$5,500.00	/RRS-cal-day	$242,000
4. MASPP Usage Fees	1	MASP	44	cal-days	$2,325.00	/MASP-cal-day	$102,300
5. Office Trailer		trailers	40	cal-days	$55.00	/cal-day	$0
6. Forklift	1	forklift	40	cal-days	$43.00	/cal-day	$1,720
7. Transport of CAIS from Bunker to RRS	10	overpacks		trip/overpack	$325.00	/trip	$0
8. Lab Supplies		fixed	22	cal-days	$1,400.00	/cal-day	$30,800
9. PPE (OSHA Level A) decontamination	13	wk-days		suits/wk-day	$325.00	/suit	$0
10. Carbon/HEPA Filters	2	changes	1	set/change	$4,325.00	/set	$8,650
11. Decontamination Supplies		fixed		lump sum	$1,100.00		$1,100
12. Utilities (Electric/Diesel and Water)		fixed	36	cal-days	$450.00	/cal-day	$16,200
13. Miscellaneous Supplies		fixed	28	wk-days	$100.00	/wk-day	$2,800
14. PPE (2 suits/person/day)	26	wk-days	26	suits/wk-day	$4.00	/suit	$2,704
15. Waste Containers							
- 5-Gallon Drums	1	drum		lump sum	$10.00	/drum	$10
- 20-Gallon Drums	1	drum		lump sum	$40.00	/drum	$40
- 30-Gallon Drums	4	drums		lump sum	$50.00	/drum	$200
- 55-Gallon Drums	6	drums		lump sum	$90.00	/drum	$540
- SRC	3	SRC		lump sum	$1,325.00	/SRC	$3,975
- 95-Gallon Drums	4	drums		lump sum	$105.00	/drum	$420
TOTAL WASTE CONTAINERS							$5,185
16. C-12 Cargo Plane Loading/Unloading	1	trip	2	loads/trip	$270.00	/load	$540
17. C-12 Cargo Plane Flights (one way trips, 1 flight per trip)	1	flight	3,480	miles/flight	$5.40	/mile	$18,802
18. Truck Rental (CWM CAIS disposal)	1	truck	1	day	$55.00	/truck-day	$55
19. Waste Disposal/Analysis							
- Decontaminated Pigs (or Pig Parts) (solid, nonhazardous waste, disposal in RCRA Subtitle D landfill)		30-gal. drums	405	lb/drum	$215.00	/drum	$0
- Dunnage/Packaging Materials (solid, hazardous waste, disposal in RCRA Subtitle C incinerator)	11	30-gal. drums	200	lb/drum	$430.00	/drum	$4,730
metals analysis (TCLP)			1	sample/drum	$150.00	/sample	$1,650
organics analysis (TCLP)			1	sample/drum	$240.00	/sample	$2,640
free liquids test			1	sample/drum	$32.00	/sample	$352
heat of combustion			1	sample/drum	$85.00	/sample	$935
ash contents			1	sample/drum	$27.00	/sample	$297
chemical warfare agent (GC/MS)			1	sample/drum	$650.00	/sample	$7,150
'- Chemical Warfare Agents (liquid, hazardous waste, disposal in RCRA Subtitle C incinerator)	4	SRC	25	lb/SRC	$325.00	/SRC	$1,300
- Liquid Phosgene (hazardous waste, disposal in RCRA Subtitle C incinerator)	1	SRC	20	lb/SRC	$215.00	/lab pack	$215
- Liquid Chloropicrin (hazardous waste, disposal in RCRA Subtitle C incinerator)	1	5-gal. drum (lab pack)	20	lb/drum	$215.00	/lab pack	$215
- Poison Solids (hazardous waste, disposal in RCRA Subtitle C incinerator)	1	20-gal. drum (lab pack)	20	lb/drum	$215.00	/lab pack	$215
- Spent Filters (solid, hazardous waste, disposal in RCRA Subtitle C incinerator)	4	95-gal. Drum	120	lb/drum	$550.00	/drum	$2,200
metals analysis (TCLP)			1	sample/drum	$150.00	/sample	$600
organics analysis (TCLP)			1	sample/drum	$240.00	/sample	$960
heat of combustion			1	sample/drum	$85.00	/sample	$340
ash contents			1	sample/drum	$27.00	/sample	$108
chemical warfare agent (GC/MS)			1	sample/drum	$650.00	/sample	$2,600
- Spent Decontamination Solution (liquid, hazardous waste, disposal in RCRA Subtitle C incinerator)	2	30-gal. drums	200	lb/drum	$550.00	/drum	$1,100
metals analysis (TCLP)			1	sample/drum	$150.00	/sample	$300
organics analysis (TCLP)			1	sample/drum	$240.00	/sample	$480
heat of combustion			1	sample/drum	$85.00	/sample	$170
ash contents			1	sample/drum	$27.00	/sample	$54
chemical warfare agent (GC/MS)			1	sample/drum	$650.00	/sample	$1,300
- Decontamination Rinsate (liquid, hazardous waste, disposal in RCRA Subtitle C incinerator)	1	55-gal. drums	460	lb/drum	$550.00	/drum	$550
metals analysis (TCLP)			1	sample/drum	$150.00	/sample	$150
organics analysis (TCLP)			1	sample/drum	$240.00	/sample	$240
heat of combustion			1	sample/drum	$85.00	/sample	$85
ash contents			1	sample/drum	$27.00	/sample	$27
chemical warfare agent (GC/MS)			1	sample/drum	$650.00	/sample	$650
- Decontaminated PPE (solid, nonhazardous waste, disposal in RCRA Subtitle D landfill)	1	55-gal. drums	100	lb/drum	$215.00	/drum	$215
TOTAL WASTE DISPOSAL/ANALYSIS							$31,828
TOTAL MATERIALS AND EQUIPMENT							$536,039

C. TRAVEL/CAR RENTAL/PERDIEM							
Description	Quantity		Units		Cost		TOTAL
Rountrip Airfare Anchorage, AK, to Salt Lake City, UT		persons	1	trip	$2,162	/person-trip	$0
Perdiem (hotel & meals)	18	persons	38	days	$246	/person-day	$168,264
Roundtrip Airfare Baltimore, MD, to Anchorage, AK	3	persons	1	trip	$2,000	/person-trip	$6,000
Roundtrip Airfare Huntsville, AL, to Anchorage, AK	18	persons	1	trip	$2,250	/person-trip	$40,500
Car Rental RRS/MASP Crew	4	minivans	36	days	$60	/minivan-day	$8,640
Perdiem TEU Crew (hotel & meals)	6	persons	2	days	$119	/person-day	$1,428
Roundtrip Airfare Baltimore, MD, to Houston, TX	6	persons	1	trip	$2,000	/person-trip	$12,000
Car Rental TEU Crew	2	cars	2	days	$50	/car-day	$200
TOTAL TRAVEL/CAR RENTAL/PERDIEM							$237,032

ALTERNATIVE 4		
COST SUMMARY		
I. Direct Capital Costs		
A. Labor	$491,226	
B. Materials and Equipment	$669,395	
C. Travel/Car Rental/Per Diem	$88,560	
Total Direct Capital Costs		$1,249,181
II. Indirect Capital Costs		
D. Engineering and Management (20% of Direct Capital Costs)	$249,836	
E. Permits, Fees, and Taxes (10% of Direct Capital Costs + $250,000 for RCRA Permit + $75,000 for Environmental Assessment)	$449,918	
Total Indirect Capital Costs		$699,754
TOTAL CAPITAL COSTS		$1,948,936
III. Contingency (30% of Capital Costs)		$584,681
TOTAL PROJECT COSTS		$2,533,616

I. DIRECT CAPITAL COSTS													
A. LABOR													
Description	Rate	Mobilization/ Site Preparation		Setup		Operations		Closure		Demobilization/ Site Clearing		TOTAL	
		3	wk-days	10	wk-days	13	wk-days	8	wk-days	4	wk-days	38	wk-days
		3	cal-days	14	cal-days	19	cal-days	10	cal-days	4	cal-days	50	cal-days
	($/hour)	(man-hours)	($)	(man-hours)	($)	(man-hours)	($)	(man-hours)	($)	(man-hours)	($)	(man-hours)	($)
1. Fort Richardson Engineer	$69.50	8	$556		$0		$0		$0		$0	8	$556
2. Fort Richardson Technician	$69.50	24	$1,668		$0		$0		$0		$0	24	$1,668
3. RRS Manager/Supervisor	$69.50	16	$1,112	80	$5,560	104	$7,228	64	$4,448	16	$1,112	280	$19,460
4. RRS QA and H&S Manager	$69.50	16	$1,112	80	$5,560	104	$7,228	64	$4,448	16	$1,112	280	$19,460
5. RRS Glovebox Operator	$69.50	64	$4,448	320	$22,240	416	$28,912	256	$17,792	64	$4,448	1120	$77,840
6. RRS RAMAN Operator	$69.50	32	$2,224	160	$11,120	208	$14,456	128	$8,896	32	$2,224	560	$38,920
7. RRS Maintenance Support	$69.50	16	$1,112	80	$5,560	104	$7,228	64	$4,448	16	$1,112	280	$19,460
8. RRS Site Administrator	$69.50	16	$1,112	80	$5,560	104	$7,228	64	$4,448	16	$1,112	280	$19,460
9. MASP Sr. Chemist	$69.50	16	$1,112	80	$5,560	104	$7,228	64	$4,448	16	$1,112	280	$19,460
10. MASP Lab Technician	$69.50	32	$2,224	166	$11,537	226	$15,707	128	$8,896	32	$2,224	584	$40,588
11. Security Guard	$69.50	32	$2,224	672	$46,704	912	$63,384	480	$33,360	16	$1,112	2112	$146,784
12. PBA Engineer	$69.50	32	$2,224	160	$11,120	208	$14,456	128	$8,896	32	$2,224	560	$38,920
13. PBA Technician	$69.50	32	$2,224	160	$11,120	208	$14,456	128	$8,896	32	$2,224	560	$38,920
14. PBA Forklift Operator	$69.50	8	$556	40	$2,780	52	$3,614	32	$2,224	8	$556	140	$9,730
TOTAL LABOR		344	$23,908	2078	$144,421	2750	$191,125	1600	$111,200	296	$20,572	7068	$491,226
B. MATERIALS AND EQUIPMENT													
1. Medical Surveillance RRS/MASP Crews			$14,300										$14,300
2. C-12 Cargo Plane Loading/Unloading			$1,081										$1,081
3. C-12 Cargo Plane Flights			$36,902										$36,902
4. UH-60 Helicopter			$1,100										$1,100
5. Temporary Storage of CAIS at RRS Site			$330		$4,620		$6,270						$11,220
6. Transportation of RRS and MASP			$2,853								$2,853		$5,705
7. RRS Usage Fees			$16,500		$77,000		$104,500		$55,000		$16,500		$269,500
8. MASP Usage Fees			$6,975		$32,550		$44,175		$23,250		$6,975		$113,925
9. Office Trailer			$0		$0		$0		$0		$0		$0
10. Forklift			$86		$605		$821		$432		$173		$2,118
11. Transport of CAIS from Bunker to RRS							$0						$0
12. Lab Supplies					$11,200		$26,600		$5,600				$43,400
13. PPE (OSHA Level A) decontamination					$1,950		$8,450		$2,600				$13,000
14. Carbon/HEPA Filters							$43,250		$4,325				$47,575
15. Treatment Reagents							$21,500						$21,500
16. Decontamination Supplies									$1,100				$1,100
17. Utilities (Electric/Diesel and Water)			$450		$6,300		$8,550		$4,500		$450		$20,250
18. Miscellaneous Supplies			$200		$1,000		$1,300		$800		$200		$3,500
19. PPE (2 suits/person/day)			$104		$1,040		$1,352		$832		$104		$3,432
20. Waste Containers					$9,835								$9,835
21. Waste Disposal/Analysis									$49,952				$49,952
TOTAL MATERIALS AND EQUIPMENT			$80,881		$146,100		$266,768		$148,392		$27,255		$669,395
C. TRAVEL/CAR RENTAL/PER DIEM			$6,225		$24,780		$33,630		$17,700		$6,225		$88,560
TOTAL DIRECT CAPITAL COSTS			$111,014		$315,301		$491,523		$277,292		$54,052		$1,249,181

Attachment F-1-10

B. MATERIALS AND EQUIPMENT							
Description	Quantity		Units		Cost		TOTAL
1. Medical Surveillance RRS/MASP Crews	1	crew	13	persons/crew	1,100.00	/person	$14,300
2. C-12 Cargo Plane Loading/Unloading (one way trips during mobilization)	2	trips	2	loads/trip	$270	/load	$1,081
3. C-12 Cargo Plane Flights (one way trip, 1 flight/trip)	2	flights	3,415	miles/flight	$5.40	/mile	$36,902
4. UH-60 Helicopter (during mobilization)	1	UH-60	1	hour	$1,100	/UH-60hour	$1,100
5. Temporary Storage of CAIS at RRS Site	1	Bunker	34	days	$330	/cal-day	$11,220
6. Transportation of RRS and MASP (4 trailers, mobilization and demobilization)	8	trailer-trips	400	miles/trailer-trip	$1.78	/mile	$5,705
7. RRS Usage Fees	1	RRS	49	cal-days	$5,500	/RRS-cal-day	$269,500
8. MASP Usage Fees	1	MASP	49	cal-days	$2,325	/MASP-cal-day	$113,925
9. Office Trailer		trailers	49	cal-days	$55	/cal-day	$0
10. Forklift	1	forklift	49	cal-days	$43	/cal-day	$2,118
11. Transport of CAIS from Bunker to RRS		overpacks	1	trip/overpack	$325	/trip	$0
12. Lab Supplies		fixed	31	cal-days	$1,400	/cal-day	$43,400
13. PPE (OSHA Level A) decontamination		wk-days	2	suits/wk-day	$325.00	/suit	$0
14. Carbon/HEPA Filters	4	changes	5	set/change	$4,325	/set	$86,500
15. Treatment Reagents		fixed		lump sum	$21,500		$21,500
16. Decontamination Supplies		fixed		lump sum	$1,100		$1,100
17. Utilities (Electric/Diesel and Water)		fixed	45	cal-days	$450	/cal-day	$20,250
18. Miscellaneous Supplies		fixed	35	wk-days	$100	/wk-day	$3,500
19. PPE (2 suits/person/day)	33	wk-days	26	suits/wk-day	$4.00	/suit	$3,432
20. Waste Containers							
- 5-Gallon Drums (standard)	1	drum		lump sum	$10	/drum	$10
- 5-Gallon Drums (stainless)	6	drum		lump sum	$1,000	/drum	$6,000
- 20-Gallon Drums	1	drum		lump sum	$40	/drum	$40
- 30-Gallon Drums	12	drums		lump sum	$50	/drum	$600
- 55-Gallon Drums	9	drums		lump sum	$90	/drum	$810
- SRC	1	SRC		lump sum	$1,325	/SRC	$1,325
- 95-Gallon Drums	10	drums		lump sum	$105	/drum	$1,050
TOTAL WASTE CONTAINERS							$9,835
21. Waste Disposal/Analysis							
- Decontaminated Pigs (or Pig Parts) (solid, hazardous waste, disposal in RCRA Subtitle C landfill)		30-gal. drums	405	lb/drum	$432	/drum	$0
- Dunnage/Packaging Materials (solid, hazardous waste, disposal in RCRA Subtitle C incinerator)	12	30-gal. drums	150	lb/drum	$430	/drum	$5,160
metals analysis (TCLP)			1	sample/drum	$150	/sample	$1,800
organics analysis (TCLP)			1	sample/drum	$240	/sample	$2,880
free liquids test			1	sample/drum	$32	/sample	$389
heat of combustion			1	sample/drum	$85	/sample	$1,020
ash contents			1	sample/drum	$27	/sample	$324
chemical warfare agent (GC/MS)			1	sample/drum	$650	/sample	$7,800
- Chemical Warfare Agents Treatment Residues (liquid, hazardous waste, disposal in RCRA Subtitle C incinerator)	6	30-gal. drums	60	lb/drum	$430	/drum	$2,580
metals analysis (TCLP)			1	sample/drum	$150	/sample	$900
organics analysis (TCLP)			1	sample/drum	$240	/sample	$1,440
heat of combustion			1	sample/drum	$85	/sample	$510
ash contents			1	sample/drum	$27	/sample	$162
chemical warfare agent (GC/MS)			1	sample/drum	$650	/sample	$3,900
- Liquid Phosgene (hazardous waste, disposal in RCRA Subtitle C incinerator)	1	SRC	20	lb/SRC	$215	/lab pack	$215
- Liquid Chloropicrin (hazardous waste, disposal in RCRA Subtitle C incinerator)	1	5-gal. drum (lab pack)	20	lb/drum	$215	/lab pack	$215
- Poison Solids (hazardous waste, disposal in RCRA Subtitle C incinerator)	1	20-gal. drum (lab pack)	30	lb/drum	$215	/lab pack	$215
- Spent Filters (solid, hazardous waste, disposal in RCRA Subtitle C incinerator)	10	95-gallon drums	200	lb/drum	$550	/drum	$5,500
metals analysis (TCLP)			1	sample/box	$150	/sample	$1,500
organics analysis (TCLP)			1	sample/box	$240	/sample	$2,400
heat of combustion			1	sample/box	$85	/sample	$850
ash contents			1	sample/box	$27	/sample	$270
chemical warfare agent (GC/MS)			1	sample/box	$650	/sample	$6,500
- Spent Decontamination Solution (liquid, hazardous waste, disposal in RCRA Subtitle C incinerator)		55-gal. drums	460	lb/drum	$550	/drum	$0
metals analysis (TCLP)			1	sample/box	$150	/sample	$0
organics analysis (TCLP)			1	sample/box	$240	/sample	$0
heat of combustion			1	sample/box	$85	/sample	$0
ash contents			1	sample/box	$27	/sample	$0
chemical warfare agent (GC/MS)			1	sample/box	$650	/sample	$0
- Decontamination Rinsate (liquid, hazardous waste, disposal in RCRA Subtitle C incinerator)	1	55-gal. drums	400	lb/drum	$550	/drum	$550
metals analysis (TCLP)			1	sample/box	$150	/sample	$150
organics analysis (TCLP)			1	sample/box	$240	/sample	$240
heat of combustion			1	sample/box	$85	/sample	$85
ash contents			1	sample/box	$27	/sample	$27
chemical warfare agent (GC/MS)			1	sample/box	$650	/sample	$650
- Decontaminated PPE and miscellaneous waste (solid, nonhazardous waste, disposal in RCRA Subtitle D landfill)	8	55-gal. drums	200	lb/drum	$215	/drum	$1,720
TOTAL WASTE DISPOSAL/ANALYSIS							$49,952
TOTAL MATERIALS AND EQUIPMENT							$695,320

C. TRAVEL/CAR RENTAL/PERDIEM							
Description	Quantity		Units		Cost		TOTAL
Rountrip Airfare Pine Bluff, AR, to Salt Lake City, UT		persons	1	trip	$1,606	/person-trip	$0
Perdiem (hotel & meals)	18	persons	47	days	$85	/person-day	$71,910
Roundtrip Airfare Baltimore, MD, to Pine Bluff, AR	3	persons	1	trip	$1,350	/person-trip	$4,050
Roundtrip Airfare Huntsville, AL, to Pine Bluff, AR	18	persons	1	trip	$100	/person-trip	$1,800
Car Rental	4	minivans	45	days	$60	/minivan-day	$10,800
TOTAL TRAVEL/CAR RENTAL/PERDIEM							$88,560

APPENDIX G.

ASSESSMENT OF TRANSPORTATION HAZARDS

APPENDIX G.
ASSESSMENT OF TRANSPORTATION HAZARDS

This appendix provides an assessment of transportation hazards for Alternatives 3 and 4 of this Engineering Evaluation/Cost Analysis (EE/CA).

Alternative 3 involves the transportation of single round containers (SRCs) and other containers containing CAIS items. These SRCs would be transported from Ft. Richardson, Alaska, to a Resource Conservation and Recovery Act (RCRA) Subtitle C incineration facility in the lower 48 states. For the purpose of this assessment, it has been assumed that the RCRA Subtitle C incineration facility would be located in Houston, Texas.

Alternative 4 would involve transportation of the SRCs and other containers containing CAIS items that are presently in storage at Ft. Richardson to a Department of Defense (DoD) site. The Rapid Response System (RRS) would be used to segregate the CAIS items based on their contents, to treat those CAIS items containing chemical warfare materiel (CWM), and to repackage the remaining CAIS items and CWM treatment residues for shipment to a commercial RCRA Subtitle C incineration facility for disposal. For the purpose of this assessment, it has been assumed that the DoD site would be the U.S. Army's Pine Bluff Arsenal (PBA) in Arkansas.

General Ground Transportation Requirements

For Alternative 3, the SRCs and other containers containing CAIS items would be transported by truck from Ammunition Supply Point Bunker D-15 in Ft. Richardson to Elmendorf Air Force Base (AFB) in Alaska. From there, the SRCs and other containers would be airlifted by a C-12 plane to Hobby Airfield in Houston, Texas, and refueled at Ketchikan, Alaska; Fairchild AFB, Washington; and Pueblo, Colorado. From Hobby Airfield, the CWM CAIS items would be loaded onto a truck and transported to the RCRA Subtitle C incineration facility.

For Alternative 4, transportation to PBA, the SRCs and other containers would be moved by truck from Bunker D-15 at Ft. Richardson to Elmendorf AFB. A C-12 fixed-wing aircraft would transport the CAIS items from Elmendorf to Michaels Army Airfield in Utah. The plane would refuel at Ketchikan, Alaska; Fairchild AFB, Washington; Buckley Air National Guard Base, Colorado; and then to Grider Field, Pine Bluff, Arkansas. The CAIS would then be loaded onto a UH-60 helicopter for transport to PBA and then by truck to the final destination.

Because recovered CWM is classified as hazardous waste, the trucks used to transport the recovered CWM must pass an inspection by U.S. Army Technical Escort Unit (TEU) personnel before use. Each inspection would be documented on DD Form 626. Each truck would have a licensed driver and an assistant at all times. TEU personnel must either be accepted in the Chemical Personnel Reliability Program (CPRP), as required by AR 50-6, or be accepted under the Arms, Ammunitions, and Explosive (AA&E) required by AR 190-11. These personnel must pass a medical examination before participating in any escort mission. During ground transport operation, the TEU would use radio or cellular telephones for communication.

Ground Transportation from Ft. Richardson Building 55228 (Bunker D-15) to Elmendorf AFB

Ground transportation of CWM from Ft. Richardson Ammunition Supply Point Bunker D-15 to Elmendorf AFB would be accomplished using a truck operated by the TEU. The ground transportation route starts at Ft. Richardson Building 55228 (Bunker D-15) and continues 0.8 mile to the entrance of the Ammunition Supply Point. The truck would then turn right onto an unnamed road and travel 2.3 miles. The truck would then turn left onto Davis Road and travel 0.8 mile north, 1.5 miles southwest on Burns Road, and enter the airfield at Elmendorf AFB. The accident probability for this route is calculated, using a base accident rate of 2.19×10^{-8} accidents per mile. This accident rate is modified by a factor of 2 for the segment of the route from Building 55228 (Bunker D-15) to Davis Road to account for the condition of the dirt and gravel roads. This yields a modified accident rate of 4.38×10^{-8} accidents per mile, which, multiplied by the distance of 3.1 miles, yields an accident probability of 1.36×10^{-7} for this segment. The base accident rate of 2.19×10^{-8} accidents per mile is applied to the 2.3 mile segment of the route along Burns Road and Davis Road, yielding an accident probability of 5.04×10^{-8} for this segment. The accident probability for one trip along the entire route is 1.86×10^{-7}. The accident probability for two trips along the entire route is 3.72×10^{-7}.

Air Transportation from Elmendorf AFB to Houston, Texas

A C-12 fixed-wing aircraft would be used to transport the CWM from Elmendorf AFB to Hobby Airfield in Houston, Texas. Refueling stops would be made at Ketchikan, Alaska; Fairchild AFB, Washington; and Pueblo, Colorado. The accident rate for the C-12 aircraft is 5.88×10^{-9} accidents per mile, based on information provided by the U.S. Army Safety Center. Applying the accident rate to the 815 mile segment from Elmendorf AFB to Ketchikan, Alaska, yields an accident probability of 4.8×10^{-6}. Applying the accident rate to the 850 mile segment from Ketchikan to Fairchild AFB yields an accident probability of 5.0×10^{-6}. Applying the accident rate to the 991 mile segment from Fairchild AFB to Pueblo yields an accident probability of 5.8×10^{-6}. Finally, the segment from Pueblo to Hobby Airfield in Houston is 825 miles. The accident probability for this segment is 4.9×10^{-6}. The air transportation accident probability for one trip from Elmendorf AFB in Alaska to Hobby Airfield in Houston, Texas, is 2.1×10^{-5}. These results are summarized in Table G-1.

Table G-1. Aircraft Accident Probability

Alternative 3 - Elmendorf AFB, Alaska, to Hobby Airfield, Houston, Texas

Aircraft	Flight Portion	Flight Length or Time of Flight	(x) Accident Rate	(=) Probability per Flight Segment	(x) No. of Flights	(=) Accident Probability
C-12	Aggregate rate	815 miles	5.88×10^{-9}/mile	4.8×10^{-6}	1	
		Elmendorf AFB to Ketchikan, AK			Subtotal	4.8×10^{-6}
C-12	Aggregate rate	850 miles	5.88×10^{-9}/mile	5.0×10^{-6}	1	
		Ketchikan, AK, to Fairchild AFB, WA			Subtotal	5×10^{-6}
C-12	Aggregate rate	991 miles	5.88×10^{-9}/mile	5.8×10^{-6}	1	
		Fairchild AFB, WA to Pueblo, CO			Subtotal	5.8×10^{-6}
C-12	Aggregate rate	824 miles	5.88×10^{-9}/mile	4.9×10^{-6}	1	
		Pueblo, CO, to Hobby Airfield, Houston, TX			Subtotal	4.9×10^{-6}
Alternate Route - Elmendorf, AK, to Houston, TX - Total Air Accident Probability						2.1×10^{-5}

Air Transportation from Elmendorf AFB, Alaska, to Pine Bluff Arsenal, Arkansas

A C-12 fixed-wing aircraft would be used to transport the CWM from Elmendorf AFB to Grider Field, Pine Bluff, Arkansas, AD-1A. Refueling stops would be made at Ketchikan, Alaska; Fairchild AFB, Washington, and Buckley ANGB, Colorado. The accident rate for the C-12 aircraft is 5.88×10^{-9} accidents per mile, based on information provided by the U.S. Army Safety Center. Applying the accident rate to the 815 mile segment from Ft. Richardson to Ketchikan yields an accident probability of 9.6×10^{-6} for two trips. Applying the accident rate to the 850 mile segment from Ketchikan to Fairchild AFB yields an accident probability for two trips of 1.0×10^{-5}. Applying the accident rate to the 906 mile segment from Fairchild AFB to Buckley ANGB yields an accident probability of 1.1×10^{-5}. Applying the accident rate to the 844 mile segment from Buckley ANGB to Grider Field yields an accident probability of 1.0×10^{-5}.

At Grider Field, the CWM would be transferred to a UH-60 helicopter for a 12 mile flight to PBA. The UH-60 helicopter has an average speed of 150 miles per hour; therefore, the flight should take 0.08 hour. The takeoff accident rate for the UH-60 is 2.7×10^{-5} per flight. The inflight accident rate of 3.5×10^{-6} accidents per hour multiplied by the flight time of 0.08 hour yields an inflight accident probability of 2.8×10^{-7}. The landing accident rate for the UH-60 is 7.2×10^{-5} per flight. The accident probability for one complete UH-60 helicopter flight from Grider Field to PBA is 1.0×10^{-4}. The accident probability for two UH-60 helicopter flights from Grider Field to PBA is 2.0×10^{-4}. Table G-2 summarizes these results. The total air transportation accident probability from Ft. Richardson to PBA is 2.4×10^{-4}.

Table G-2. Aircraft Accident Probability

Alternative 4 - Elmendorf AFB, Alaska, to Pine Bluff Arsenal, Arkansas

Aircraft	Flight Portion	Flight Length or Time of Flight	(x) Accident Rate	(=) Probability per Flight Segment	(x) No. of Flights	(=) Accident Probability
C-12	Aggregate rate	815 miles	5.88×10^{-9}/mile	4.8×10^{-6}	2	
		Anchorage, AK, to Ketchikan, AK			Subtotal	9.6×10^{-6}
C-12	Aggregate rate	850 miles	5.88×10^{-9}/mile	5.0×10^{-6}	2	
		Ketchikan, AK, to Fairchild AFB, WA			Subtotal	1.0×10^{-5}
C-12	Aggregate rate	906 miles	5.88×10^{-9}/mile	5.3×10^{-6}	2	
		Fairchild AFB, WA, to Buckley ANGB, CO			Subtotal	1.1×10^{-5}
C-12	Aggregate rate	844 miles	5.88×10^{-9}/mile	5.0×10^{-6}	2	
		Buckley ANGB, CO, to Pine Bluff, AR			Subtotal	1.0×10^{-5}
UH-60	Takeoff	-----	2.7×10^{-5}/flight	2.7×10^{-5}	2	5.4×10^{-5}
	Inflight	12 mi÷ 150 mi/hr = 0.08 hr	3.5×10^{-5}/hr	2.8×10^{-7}	2	5.6×10^{-7}
	Landing	-----	7.2×10^{-5}/flight	7.2×10^{-5}	2	1.4×10^{-4}
		Pine Bluff, AR, to Pine Bluff Arsenal, AR			Subtotal	2.0×10^{-4}
Alternate Route 2 - Anchorage, AK, to Pine Bluff Arsenal, AR - Total Air Accident Probability						2.4×10^{-4}

Ground Transportation from Hobby Airfield to the RCRA Subtitle C Incineration Facility

At Hobby Airfield, the CWM would be transferred from the C-12 aircraft to a truck for transport to the RCRA facility. For the purpose of estimating the accident probability for ground transportation, the RCRA Subtitle C incineration facility has been assumed to be Rhone Poulene in Houston, Texas. This facility is located 10 miles from Hobby Airfield. The rate of road conditions to the treatment, storage, and disposal facility is 2.19×10^{-8} accidents per mile. This produces an accident probability of 2.2×10^{-7} for one trip.

Ground Transportation at Pine Bluff Arsenal

The ground transportation route at PBA is from the landing zone, north on Doolittle Road, west on Webster Road, along Avenue 55 to 504 Street, northwest on 504 Street to Avenue 6242, and southwest on Avenue 6242 to Gate 4 of the Bond Road Exclusion Area. The Webster Road, Avenue 55, and 504 Street segment of the route is 3.0 miles long. The accident rate of 2.19×10^{-8} accidents per mile is applied to this 3.0 mile segment of the transportation route, resulting in an accident probability of 6.57×10^{-8} for this segment. The Doolittle Road and Avenue 6242 segments of the route total 2.0 miles in length and are on two-lane, unimproved, gravel roads. A factor of 2 increase in the accident rate is applied to these segments, resulting in an accident rate of 4.38×10^{-5} per mile. This accident rate applied to the 2.0 mile segment yields an accident probability of 8.76×10^{-8}. The accident probability for one complete trip from PBA to the Exclusion Area is thus 1.53×10^{-7}. The accident probability for two trips is 3.07×10^{-7}.

Total Transportation Accident Probability for Each Transportation Scenario

The total transportation accident probability for each transportation scenario consists of the sum of the transportation accident probability for each mode of transportation used for each of the scenarios. For Alternative 3, transportation from Ft. Richardson, Alaska, to Houston, Texas, is 2.1×10^{-5}. For Alternative 4, transportation from Ft. Richardson, Alaska, to PBA, Arkansas, is 2.4×10^{-4}.

APPENDIX H.
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APPENDIX H.
REFERENCES

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