

4.0 SWMU DESCRIPTIONS, PREVIOUS INVESTIGATIONS, AND PHASE II RFI DATA COLLECTION METHODOLOGIES

4.1 CHEMICAL AGENT MUNITIONS DISPOSAL SYSTEM, SWMU 13

4.1.1 SWMU Description and Waste Generation

CAMDS, located in the southwestern portion of TEAD-S, has been utilized for research and development of various methods of demilitarizing lethal chemical munitions and treating wastes from the demilitarization process since 1979. The facility was built as a pilot plant to demonstrate baseline technology for chemical munitions handling, waste incineration, waste treatment (i.e., scrap metal, brines, and ash), and pollution abatement.

The actual demilitarization facility is contained within a 10-acre fenced site (Figure 4-1). The site is served by rail and street access. Access to the facility is restricted to authorized personnel who have received the proper training and protective equipment for entering a potential chemical agent hazard area. Office trailers and a parking area are located just to the north of the CAMDS facility.

CAMDS demilitarizes both chemical munitions and bulk chemical agent (stored in canisters). Munitions include M55 GB Rockets, 105-MM Cartridges and Projectiles, 155-MM Projectiles, 8-inch projectiles, 4.2-inch mortars, 525- and 750-pound bombs, and M23 landmines containing chemical agent. Bulk items processed through the facility include spray tanks and tin containers. Agents demilitarized include the following:

- GB - Sarin or isopropoxymethylphosphoryl fluoride
- VX - Ethyl S-dimethylaminoethyl methylphosphonothiolate
- HD - Distilled mustard or bis(2-chloroethyl) sulfide
- HT - Mixture of bis(2-chloroethyl sulfide) and bis[2(2-chloroethylthio)ethyl] ether
- H - Levinstein mustard or bis(2-chloroethyl) sulfide
- GA - Tabun or ethyl N,N-dimethyl phosphoramidate-cyanidate
- L - Lewisite or dimethylphosphoramidocyanidic acid ether ester

Because of the variety of materials tested and demilitarized at CAMDS, the facility was designed to be flexible enough to handle different equipment and processes. The primary method of destroying the various munitions is incineration. This includes the incineration of the agents within the munitions, incineration of the contaminated metal parts and components, and incineration of the explosive compounds. When operating, the facility processes only one type of agent at a time. Table 4-1 gives the inventory of materials processed at CAMDS.

The facility is made up of a system of process buildings and equipment that include:

- Munitions holding area
- Unpack area(s)

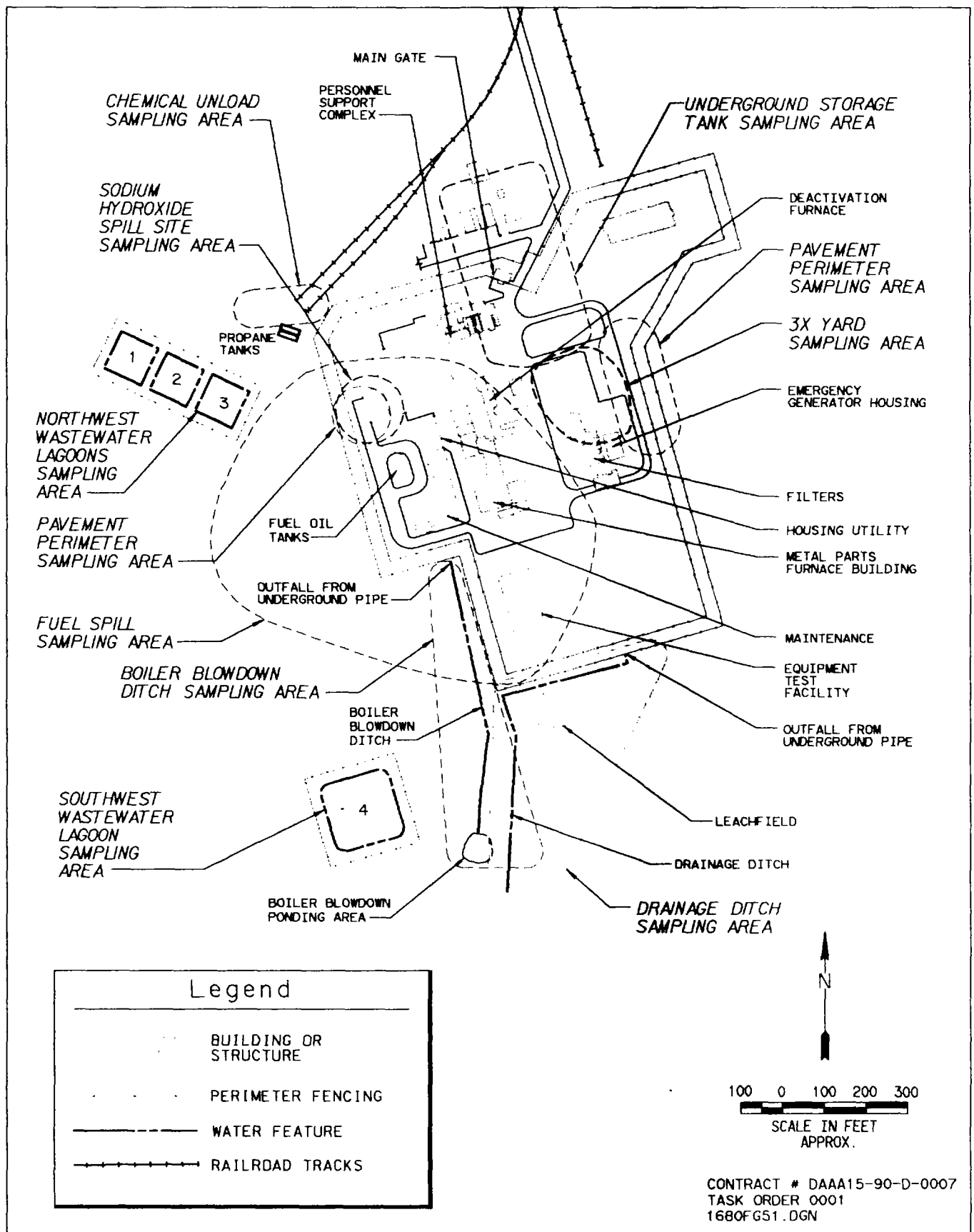


Figure 4-1. SWMU 13 Area Location Map

Table 4-1. SWMU 13 Summary of Materials Inventoried as of September 30, 1992

Munitions Destroyed	Amount
M55 GB Rockets	18,308
M55 GB Warheads	3
155mm GB Projectiles	11,860
105mm GB Projectiles	<u>7,771</u>
TOTAL	37,942
Munitions Downloaded^(a)	
M55 GB Rockets	1,007
M55 VX Rockets	11,994
155mm Mustard Projectiles	<u>2,999</u>
TOTAL	16,000
Agent Destroyed	
GB/Neutralization	181,950
VX/Incineration	48,114
VX/AQS ^(b) Testing	8
HD/Incineration (DFS ^(c))	(approx.) 432
GB/Incineration	
MPF ^(d)	28,774
DFS ^(e)	6,774
LIC ^(f)	<u>37,930</u>
TOTAL	303,982

^aThe downloading process involves the removal of explosive components in munitions.

^bAgent Quantification System.

^cDeactivation Furnace System.

^dMetal Parts Furnace.

^eDeactivation Furnace System.

^fLiquid Incinerator.

- Blast containment operating areas (cubicle numbers 1 and 2)
- Munitions disassembly/agent drain equipment
- Incinerators (deactivation furnace, metal parts furnace, toxic dunnage furnace, and liquid incinerator)
- Pollution abatement systems
- Ventilation system filters
- Brine drying equipment
- Toxic containment buildings
- Residual storage area
- Personnel support facilities
- Chemical laboratories
- Air monitoring network

The basic process flow begins with the delivery of munitions to the munitions holding area from storage sites outside of the CAMDS facility. The munitions are then inspected for leaks while in the holding area and are then transferred to the unpack area. Here, the munitions are placed on a conveyor that carries them to the explosive containment cubicle. At this point, the munitions are drained of agent and segmented. The agent is collected in a holding tank that may be incinerated in the liquid incinerator or deactivation furnace, or returned to storage. Dunnage is disposed of by incineration in the toxic dunnage incinerator. Explosive portions and any residual agent are incinerated in the deactivation furnace. The metal scrap is deposited in containers for disposal at an approved landfill or recovered for sale as scrap metal. Spent decontamination solutions (primarily sodium hydroxide) from the explosive containment cubicle are collected in the liquid waste collection and storage system, and are either dried in the brine drying area or incinerated. Incinerator effluent is treated in the deactivation furnace or metal parts furnace abatement systems. Scrubber liquids from the pollution abatement systems are dried on drum dryers, and the resulting salts are placed in 55-gallon fiber drum containers and, subsequently, removed by a contractor to an approved storage or disposal facility. Although a variety of potentially hazardous wastes are processed through the system, rigid controls and procedures are in place to prevent releases to the environment. An extensive air-monitoring network is also used to monitor any releases of chemical agent to the air pathway. Each monitoring device is connected to an alarm system that warns facility personnel to don their mask and prepare to evacuate if necessary.

In support of the demilitarization process, other potential sources of hazardous materials are present at CAMDS. These include laboratory wastes, hydraulic fluids, waste fuel oils, waste lubricants, solvents, above-ground fuel storage tanks, underground fuel storage tanks, discharge and drainage ditches, and wastewater lagoons.

Waste areas and product spills that have been noted at CAMDS are shown in Figure 4-1. The primary releases were reported to be at the boiler blowdown discharge ditch and surrounding area, the above-ground diesel (fuel oil) storage tanks, and the underground fuel oil product lines (Weston 1991).

According to information provided by the TEAD Environmental Management Office, numerous other reported spills have occurred at CAMDS. Between 1976 and 1981, an estimated 5,000 gallons of 3 to 18 percent sodium hydroxide solution spilled into the raw material storage bermed area. One spill reportedly filled a gravel-lined berm to within 3 inches of the top. Another reported spill occurred in the 3X Yard. A few square yards of soil were contaminated by a material containing 7 percent potassium dichromate. Evidence of the spill can be seen today in the form of surface soil staining (yellow).

TEAD-S has written procedures and plans developed to control and contain a release as well as counter measure designs to cleanup any residual material.

A spill is first categorized as emergency or non-emergency, depending on the type, quantity, and hazardous constituents of the material. An emergency spill must be handled by fire department emergency personnel only. Any spill of an unknown material should be considered an emergency until the type of material is determined. Any release of agent-related material is considered an emergency spill condition. Non-emergency spills are handled by local workers properly trained in the handling of the specific material.

The primary concern in any spill scenario is the protection of personnel from harm. The CAMDS facility spill practices include the initial response phase of control and containment followed by notification both verbally and in writing. Any spill that was sufficient in size to have exceeded the reportable quantity (RQ) requirements must be reported. Spill mitigation and cleanup are site-specific and spill-material specific; they are to be performed by hazardous waste management personnel for all non-emergency spills. Following the completion of cleanup procedures, all personnel, equipment, and materials are properly decontaminated. Table 4-2 provides a summary of previously reported spills or releases at CAMDS.

Some of the sites that are being investigated as part of this Phase II RFI became areas of concern as a result of the above-mentioned spills. In total, nine sites (Figure 4-1) within SWMU 13 are included in this report. Descriptions of these sites are presented in the following paragraphs. Section 7 includes site-specific previous investigation information along with the results from this Phase II RFI.

4.1.1.1 Fuel Spill Site

The three above-ground diesel (fuel oil) tanks, each with a capacity of 30,000 gallons, are located within the western perimeter of CAMDS (see Figure 4-1). Approximately 500 gallons of fuel were spilled on the ground surface in January 1978 and were reported to have been properly cleaned up by TEAD personnel. Reportedly, sand was applied to the site to adsorb the oil, which was taken to the TEAD-S Demolition Grounds and burned. Sometime between 1980 and 1985, an underground spill (line leak) of diesel fuel reportedly occurred in the vicinity of the three above-ground tanks. The line leak went undetected for a period of time, and an estimate of up to 38,000 gallons of fuel may have been lost. The line leak was

Table 4-2. SWMU 13 Reported Spills

Location	Description	Year	Quantity
Fuel Spills			
Main Tank Farm	Spilled on ground surface	1978	500 gallons
Main Tank Farm	Line leak underground	Between 1980 and 1985	38,000 gallons
Main Tank Farm	Spilled during unloading of truck	1983	2,000 gallons
Main Tank Farm	Unloading procedures	1983 to present	Undetermined
Day Tank (Underground)	Overfilled	Several times	Undetermined
Day Tank (Underground)	Hole(s) in tank	1988	Undetermined
Tank by Director's Trailer	Incorrect unloading	1988	Undetermined
Brine Drying Area Tank Farm	Leaking pipes, valves, etc., (small amounts continuously over the years)	Startup to present	Undetermined
Day Tank (Deactivation Furnace System)	Overfill	Several times	Undetermined
Toxic Dunnage Incinerator/ Pollution Abatement System	Broken pipe	1988	Undetermined
Petroleum, Oil, and Lubricants Shed	Used oil spill on ground	1987	50 gallons
Lab Building 541	Suspected leak in piping to collection tank	1988	Undetermined
Other Spills			
Segregator Area	Water left running in area. Water backed up and went over curb to outside of toxic area.	1988	100 gallons

Table 4-2. SWMU 13 Reported Spills (continued)

Location	Description	Year	Quantity
3X Yard	Leaking barrels of potassium	Startup-present	Undetermined
CAMDS	Broken sight glass on sodium Hydroxide tank	1991	4,1000

Source: Modified from Weston 1991.

subsequently repaired (EA 1988). In January 1983, a diesel fuel spill from one of the three tanks was reported. It is not known how much fuel was spilled.

Facility workers have reported fuel odors emanating from the basement of the Equipment Test Facility Building, which is south-southeast of the tanks (see Figure 4-1). It is probable that these odors are a result of the above-mentioned fuel spills.

4.1.1.2 *Underground Storage Tank Site*

The Underground Storage Tank Site consists of two underground fuel tanks. The first tank is located near the snack shop of CAMDS, north of the facility fence. A truck operator used an inadequate pipe (a protective pipe surrounding the correct fill pipe) to fill it, resulting in a direct discharge of an undetermined amount of petroleum fuel. The Underground Storage Tank Site also includes an underground diesel fuel tank located near the guard gate entrance to the facility. Fuel supply lines run from this tank to various process buildings. A concrete pit at the tank houses valves and controls for the supply lines. Both of these sites were identified as spill sites by Weston (1991).

4.1.1.3 *3X Yard*

This site encompasses approximately 6,025 square feet and is currently used as a staging area and thoroughfare for vehicle traffic. Very little is known about the site history of the 3X Yard, but it is known that barrels of 7 percent potassium dichromate leaked some of their contents onto the ground at the 3X Yard, but it is not known how much of the potassium dichromate leaked or when the leaking occurred. Evidence of the leaking is still observable as yellow staining of the surface soil at the 3X Yard.

4.1.1.4 *Boiler Blowdown Discharge Site*

The boiler blowdown discharge ditch and ponding area are used to collect boiler blowdown water, which consists of water used for cooling life-support compressors along with storm water that drains from the southwest portion of CAMDS facility within the CAMDS fence. These waters are discharged to the ground surface where they flow overland and pond outside

of the southern perimeter of the CAMDS facility. Discharge of water occurs on a continuous basis because of the operation of life-support compressors 24 hours a day (USATHAMA 1988). Ponding of water was observed during field work by Rust E&I in 1991 and 1993 and previously by other contractors (EA 1988, Weston 1991), indicating that a groundwater mound may exist. Sampling and analysis of the ponded water during previous investigations detected the explosive compound 2,6-dinitrotoluene (EA 1988, Weston 1991).

4.1.1.5 Drainage Ditch Site

Very little is known about the site history of the Drainage Ditch Site. This ditch receives storm water runoff from the eastern portion of the CAMDS facility within the CAMDS fence. Water flow in the ditch is intermittent and is primarily a function of storm events. It is common to see standing water at the point where the water discharges into the ditch, just outside the CAMDS fence. Much of the original drainage ditch was replaced by a corrugated buried pipe in 1990.

4.1.1.6 Chemical Unload Site

Railroad tracks serviced the CAMDS facility from approximately September 1979 through January 1984 (personal communication with TEAD-S personnel). The tracks terminate at the northwestern corner of the CAMDS facility at an unloading station. During this time, the station was used to transfer chemicals from the rail cars to the CAMDS facility via a network of piping. Although no spills have been reported, it is possible that some splashing or leaking may have occurred at the unloading station.

4.1.1.7 Pavement Perimeter Site

In order to determine whether any potentially hazardous materials were leaving the paved areas at CAMDS via storm water runoff, it was determined that the soils around the perimeter of the paved areas should be investigated.

4.1.1.8 Sodium Hydroxide Spill Site

On the morning of February 19, 1991, a 4,100-gallon sodium hydroxide spill occurred as a result of a broken sight glass on the holding tank. Spilled material consisted of approximately 21.5 percent sodium hydroxide or approximately 8,900 pounds of caustic. Lateral migration of the spill was contained within concrete retaining walls. Post-incident remedial measures conducted by TEAD-S personnel recovered approximately 4,700 gallons of free liquid, which was determined to contain approximately 5.3 percent caustic material mixed with rain water

and surface water from within the dike area. An estimated 2,100 pounds of caustic was recovered from this liquid mixture. The top 6 to 12 inches of contaminated soil was excavated and containerized in 55-gallon drums and placed in a permitted hazardous waste storage area.

4.1.1.9 Wastewater Lagoons

The Northwest Wastewater Lagoons consist of three separate lagoons that operate using a cascade system that flows from the upper lagoon to the lower. These lagoons were installed in 1991 according to the ASTM standard number ASTM D-698 and Utah state regulations (personal communication with TEAD-S personnel, 1993). The Northwest Wastewater Lagoons (Lagoons 1, 2, and 3) were not lined with any synthetic or clay layer; compacted native topsoil makes up the bottom of the lagoons with a rip rap layer overlying these soils. The northwest wastewater lagoons are approximately 9,470 square feet each in size and are approximately 5 feet deep. These lagoons receive sanitary sewer discharge from the CAMDS facility or, more specifically, from the Administrative Building and the Personnel Support Complex.

The Southwest Wastewater Lagoon was constructed by the Army Corps of Engineers in 1988. It encompasses approximately 28,320 square feet and is approximately 5 feet deep. Very little site history is available for this lagoon. However, TEAD-S personnel did inform Rust E&I that this lagoon receives sanitary sewer discharge from the Chemical Analysis Laboratory, the Maintenance Facility, and the Sample Analysis Facility.

4.1.2 Previous Investigations

The purpose of this section is to summarize the history of investigations conducted at TEAD-S. The objectives of each major study, the types of data collected, and general conclusions and recommendations are discussed below.

4.1.2.1 Installation Assessment of the Tooele Army Depot

The installation assessment (USATHAMA 1979) was conducted in response to a request by USATHAMA to identify and conduct an investigation at all potentially contaminated Army installations. The survey was facility wide, covering both TEAD-N and TEAD-S. The environmental quality of both areas of TEAD with respect to use, storage, treatment, and disposal of toxic and hazardous materials was the subject of the report. The study was also designed to identify any sites that might pose a threat to public health or to the environment.

This initial study, conducted in December of 1978, consisted of a review of available records and interviews of past and present employees. The findings and conclusions of this report were general in nature because of the lack of specific information concerning the nature and extent of potentially hazardous materials at each site. However, among the significant

conclusions and recommendations, the following were noted: (1) a potential contaminant migration route via groundwater flow exists; (2) a fuel oil spill of approximately 500 gallons was identified in the CAMDS area; and (3) several active landfills are located in TEAD-S and, while no hazardous materials have been reported, some contaminated wastes may have been buried. It was recommended that a surface-water and groundwater monitoring program be developed to ascertain the extent and character of any contaminant releases and subsequent migration of pollutants.

4.1.2.2 Installation Environmental Assessment

In 1982, Inland Pacific Engineering Co., under a contract with the U.S. Army Corps of Engineers, conducted an environmental assessment to define TEAD activities and to assess their potential environmental impact. As part of the investigation, an inventory of indigenous flora and fauna was prepared. The report provided a general summary of environmental, human, and economic impact in the event of facility closure and/or cleanup.

4.1.2.3 The Environmental Photographic Interpretation Center Report

In 1982, the Environmental Photographic Interpretation Center (EPIC) prepared an aerial photography interpretation report for the USEPA. The purpose of the study was to identify possible areas of past use, storage, treatment, and disposal of toxic and hazardous materials for both TEAD-N and TEAD-S. EPIC personnel acquired archival black and white photographs for approximately 5-year intervals between 1940 and 1981. Interpretative overlays were provided with the photographs, and suspected disposal areas were identified. These included landfill, trenches, pits, ditches, ponds, and disturbed areas.

4.1.2.4 Assessment of Environmental Contamination, Exploratory Stage Report

A two-phase Exploratory Stage Environmental Survey was conducted by Ertec, Inc., from October 1981 through October 1982. The purpose of the study was to ascertain the nature and extent of environmental contamination and the potential for contaminant migration onto off-site areas. The first phase consisted of a literature and data review, and a site reconnaissance to identify sites that had the greatest potential for contaminant migration. Phase II included the installation and sampling of 11 groundwater monitoring wells, as well as the sampling of soils and sediments for those sites identified in Phase I. Two of the eleven wells installed were located at the CAMDS Facility. Well S-1 was placed approximately 1,000 feet south of the boiler blowdown pond area of CAMDS, and Well S-3 was installed approximately 1,000 feet north of CAMDS.

Results indicated that TEAD-S was relatively free of contamination, with the exception of high arsenic levels—20 times the USEPA Water Quality Criteria Standards—in the southern and southeastern portion of the site. It was further surmised that arsenic found in the groundwater

was migrating off the depot property to the south. The source of **this arsenic** contamination was not known; it could not be determined if it was related to **either unrecorded facility activities** or to naturally occurring arsenic. ERTEC made a number of recommendations for further study and rated these recommendations according to **three priority categories**. However, most of the recommendations were for waste sites at TEAD-N.

4.1.2.5 Aerial Photography Interpretation Addendum

Through an interagency agreement between the USEPA and the U.S. Army, the EPIC provided additional aerial photography imagery analysis for the TEAD facility. Black and white aerial photographs taken in 1974, as well as some low-altitude color infrared photographs taken in 1981, were compared. The photographs documented the location of trenches in the mustard holding area, disturbances indicating potential disposal, and explosion craters within the demilitarization disposal areas. The report provides a discussion of the photographic enlargements, as well as a brief discussion of all potential disposal and contaminated sites.

4.1.2.6 SWMU Evaluation

In 1986, the U.S. Army Environmental Hygiene Agency (AEHA 1986) reviewed the data submitted for SWMUs located within TEAD-S for adequacy as part of the pending RCRA Part B Permit Application for the CAMDS Facility. The report recommended that additional environmental investigations be conducted at the demilitarization area/disposal pits and the drainage pond, which are located in areas outside of SWMU 13.

4.1.2.7 Final Interim Facility Assessment

The Draft Interim RFA was conducted by NUS (NUS 1987) Corporation for USEPA Region VIII in order to comply with the Hazardous and Solid Waste Amendments (HSWA) of 1984. This study evaluated releases of hazardous wastes or hazardous constituents and identified appropriate corrective actions. The RFA provides information on SWMUs at the RCRA facilities, evaluates the potential for releases to the environment, and determines the need for further investigations.

4.1.2.8 Preliminary Assessment/Site Investigation Report

EA conducted a PA/SI for TEAD-S in 1988. The study included a review of all available data and an on-site visit by EA personnel to identify potential sources of environmental contamination. Of the sites identified, five were determined to present a significant potential threat to human health or the environment. Two of the five sites were located at the CAMDS facility: (1) the Fuel Spill Site and (2) the Boiler Blowdown Discharge Site. Three

groundwater-monitoring wells (S-CAM-1, S-CAM-2, and S-CAM-3) were installed at the Fuel Spill Site at the CAMDS facility. Groundwater in the vicinity of the above-ground diesel fuel storage tanks, or tank farm area, was found to be heavily contaminated with diesel fuel. Liquid collected from the Boiler Blowdown Discharge Site ditch south of CAMDS was found to contain the explosives 2,4,6-TNT and tetryl. On the basis of their findings, EA recommended that soil borings and additional monitoring wells be placed in the Fuel Spill Site to better define the extent of fuel contamination, and that additional liquid and sediment samples be collected from the Boiler Blowdown Discharge Site ditch to evaluate the potential source and pathway for contamination.

4.1.2.9 Remedial Investigation Report

An RI was conducted at TEAD-S by Weston (Weston 1991). The primary objectives of the RI were to characterize potential contamination in four areas within the installation. Samples from several media, including soil, groundwater, surface water, and sediments, were collected and analyzed for a variety of potential contaminants of concern.

At CAMDS, six boreholes were drilled in and around the facility to investigate the site geology. In addition, Weston sampled four existing monitoring wells and installed and sampled six new wells (S-25-88 through S-30-88). Surface-water samples were collected from the Boiler Blowdown Discharge Site and from an open pit previously used for sewage effluent. Sediment samples were also collected from the Boiler Blowdown Discharge Site and from a drainage ditch downgradient of the CAMDS facility. The subsurface-soil, surface-water, sediment, and groundwater samples were analyzed for metals (except subsurface soils), explosives, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), anions, and petroleum hydrocarbons. In the case of groundwater, the samples were also analyzed for radionuclides and agent breakdown products.

The RI report recommended that groundwater monitoring continue around the CAMDS facility in order to follow the migration of contaminants and that additional monitoring wells be installed west and northwest of the CAMDS facility to better define the groundwater flow at CAMDS. Quarterly sampling of wells was recommended. Aquifer testing was also recommended to provide data needed to evaluate groundwater extraction as a potential remedial option if necessary. Further sampling of surface water and sediments related to the Boiler Blowdown Discharge Site was also recommended.

4.1.3 Phase II RFI Field Investigation Program

Based on the findings and recommendations presented in Section 4.1.2, it was determined that a Phase II RFI was necessary. The objectives of the Phase II RFI investigation at SWMU 13 are to (1) verify contaminants previously identified, (2) define the horizontal and vertical extent of known releases at the CAMDS facility, (3) assess the extent to which the underlying aquifer had been contaminated, (4) compare contamination values to regulatory standards, (5)

assess potential risks to human health and the environment, and (6) make recommendations for any future action at this SWMU.

In order to develop data that would allow characterization of each of the known releases, the SWMU was divided into nine sites of known or suspected contaminant releases for various field studies. Each site was selected on the basis of results of previous investigations or reports of previous spills or releases. The nine study areas at SWMU 13 are as follows:

- Fuel Spill Site
- Underground Storage Tank Site
- 3X Yard
- Boiler Blowdown Discharge Site
- Drainage Ditch Site
- Chemical Unload Site
- Pavement Perimeter Site
- Sodium Hydroxide Spill Site
- Wastewater Lagoons

Phase II RFI Work Plans were completed by Ebasco in 1991. They provided the details of the proposed field investigation program to be conducted at SWMU 13 for the first seven sites listed above and provided the basis for the Rust E&I field program. However, as a result of further evaluation of existing data, results of field-screening activities (i.e., soil gas survey), and actual field conditions encountered, Rust E&I made numerous modifications to the original proposed field investigation program during the 1991 field effort. The actual work conducted versus the work proposed is summarized in Appendix B. Further descriptions of these changes and rationale (where appropriate) are provided in the discussion of each work task in the following subsections. Analytical results from the first field effort indicated that data gaps existed and additional sampling was necessary. So, in August 1993, Rust E&I returned to CAMDS for an additional field effort. Table 4-3 presents a summary of the additional sampling that was conducted in 1993.

4.1.3.1 Mobilization

Prior to the start of both field efforts, Rust E&I established a mobile field office at TEAD-S near the Chemical Surety office to serve as a base for the field investigation program. The office was equipped with water, power, a refrigerator, freezer, ice, and sample coolers. A telephone was also installed, and a mobile cellular phone was used to maintain constant communications with field crews and TEAD-N personnel.

Before any field activities were allowed to begin, field personnel were required to attend chemical surety safety training and gas-mask training. Baseline cholinesterase blood tests were also obtained for all field personnel. In addition, safety briefings concerning unexploded ordnance (UXO) were provided by the UXO subcontractor.

Table 4-3. SWMU 13 Summary of Additional Sampling, Phase II RFI

Sample Site	Number of Samples	Media Type	Analyte Suite											
			TPHC	VOC ^(a)	SVOC ^(b)	EXP ^(c)	ABP ^(d)	Metals ^(e)	Anions ^(f)	Rad ^(g)	ALK	pH	TOC	
Monitoring Wells (New)	5	Water	x	x	x	x	x	x	x	x	x			
Monitoring Wells (Existing)	30	Water	x	x	x	x	x	x	x	x	x			
Background	12	Soil							x	x		x	x	
Fuel Spill Site	8	Soil	x											
3X Yard	13	Soil							x ^(h)					
Boiler Blowdown Discharge Site	1	Water	x			x								
Drainage Ditch Site	6 1 ⁽ⁱ⁾	Soil Water							x x					
Chemical Unload Site	6	Soil		x	x		x	x	x	x				
Pavement Perimeter Site	8	Soil					x ^(j)							
Sodium Hydroxide Spill Site	12	Soil										x	x	
Wastewater Lagoons	4 4	Water Sludge	x x	x x	x x	x x	x x	x x	x x	x x	x x		x x	x x
Underground Storage Tank Site^(k)														

^aVolatile organic analyte suite consists of the analytes included in the EPA Target Compound List for VOCs.

^bSemi-volatile organic analyte suite consists of the analytes included in the EPA Target Compound List for SVOCs.

^cExplosives analyte suite consists of NB; 2,4-DNT; 2,6-DNT; 1,3-DNB; 1,3,5-TNB; 2,4,6-TNT; tetryl; RDX; HMX.

^dAgent breakdown product analyte suite consists of thiodiglycol, isopropyl methylphosphonic acid, fluoroacetic acid.

^eMetals analyte suite consists of As, Hg, Pb, Sb, Ni, Ag, Be, Cd, Cr, Cu, Se, Tl, Zn.

^fAnions analyte suite consists of Br, F, Cl, SO₄, NO₂, NO₃.

^gRadionuclide analyte suite consists of gross alpha, gross beta, total uranium.

^hChromium only.

ⁱThree water samples were proposed. However, only one sample was collected as there was not enough water in the ditch to sample at two of the sampling locations.

^jFluoroacetic acid only.

^kNo additional sampling necessary.

All permits for monitoring well drilling, installation, utility/digging, and other site access and use were obtained prior to the start of fieldwork. USAEC approval was received for Well No. 1 at TEAD-S as the source of water used for equipment decontamination. Two decontamination pads were constructed at CAMDS, one being located within the fenced portion of the facility and the other located outside of the fenced area.

The first field effort began in May 1991 and was completed July 1991. The second effort was conducted from August 1993 through October 1993.

4.1.3.2 *Soil-Gas Sampling*

The work plans for the 1991 effort called for the collection of 121 soil-gas samples to be analyzed for BTX and 29 samples to be analyzed for trichloroethylene, carbon tetrachloride, and methylene chloride. These samples were to be collected in areas where solvents and fuels with a volatile organic component were likely to occur at CAMDS. To accomplish the soil-gas survey, three portable gas chromatographs were set up in the mobile field office. Soil-gas samples were extracted from rods driven to a depth of 7 feet, and the samples were taken to the field office for analysis. The total number of samples collected were 112 soil-gas samples for BTX (instead of the proposed 121) and 112 samples for trichloroethylene, carbon tetrachloride, and methylene chloride (instead of 29) (see Appendix B). On the basis of the first survey completed, a second round of sampling was proposed, approved, and conducted to better define the extent of VOC-related contamination. Results of the soil-gas survey along with the rationale for the additional sampling are presented in Section 7.2.1. The results of the soil-gas survey were utilized for the selection of soil borings for verification of the soil-gas results via subsurface-soil sampling and analysis.

4.1.3.3 *Surface-Water and Sediment Sampling*

During the 1991 field effort, surface-water samples were to be collected from the boiler blowdown ditch (one sample) and the southeast drainage ditch (one sample) and analyzed for VOCs, SVOCs, agent breakdown products (ABPs), explosives, TPH, metals, anions, and pH. The surface-water sample from the boiler blowdown ditch was collected as proposed. The proposed surface-water sample from the southeast drainage ditch, however, could not be collected since the drainage ditch was dry. Sediment samples were collected in the southeast drainage ditch and analyzed for VOCs, SVOCs, ABPs, explosives, TPH, metals, anions, and pH.

Based on the 1991 sample results, additional surface-water and sediment samples were collected during the 1993 field investigation. Section 7.0 presents this sampling information.

4.1.3.4 Soil Boring Drilling, Logging, and Sampling

The soil borings at SWMU 13 were drilled using a truck-mounted hollow-stem auger rig (750 CME drilling rig) according to requirements set forth in the USATHAMA Geotechnical Requirements (USATHAMA 1987). A 7-5/8-inch outside diameter (O.D.) by 4-1/4-inch inside diameter (I.D.) auger was used for drilling. For soil sampling, a 3-inch O.D. by 24-inch-long stainless-steel split-spoon sampler was used for soil-sample collection. At each boring location, a survey for UXO and utilities was performed prior to drilling. For each boring, a geologist prepared a borehole drilling log that documented the lithology and samples collected. The soils were characterized and described using the Unified Soil Classification System (equivalent to ASTM D 2487-69 standards) and a Munsell Color Chart. Samples were obtained at prescribed intervals using the stainless-steel split-spoon sampler. The samples were screened immediately with a photoionization detector (PID) for the presence of VOCs prior to sample collection and bottling. The soils were also monitored for agent breakdown products as drilling progressed for safety reasons. The samples were then bottled, properly labeled, and packaged for shipment.

Because of the changes to the 1991 sampling, Appendix B includes information that shows the proposed 1991 soil boring program versus the actual soil borings completed and presents the number of proposed samples and associated analyses versus the actual number of samples collected and analyzed. Based on the 1991 sample results, additional samples were collected during the 1993 field investigation. Section 7 presents this sampling information.

Soil samples were collected from SWMU 13 representing the geographic and geologic variation within the soils. ASTM Standard Testing Procedures (ASTM D4318-84) were used to perform Atterberg limit tests, and the grain size distribution was determined by sieve analysis for these samples. These data allowed classification of the soils based on the Unified Soil Classification System (Table 4-4), including the assignment of a soil group and symbol to the samples. Data from these tests are included in Appendix C.

The work plans called for electric (gamma-ray, neutron, and guard resistivity) logging to be performed on three of the deep (40- to 50-foot) boreholes at SWMU 13. Rust E&I received USAEC approval to replace the proposed logging with continuous split-barrel coring to better define the subsurface lithology of the CAMDS area. The core was logged by the field geologist to obtain a complete stratigraphic log of the boreholes.

Following drilling and sample collection, the remaining drill cuttings and sampling material wastes were drummed in Department of Transportation (DOT)-approved 55-gallon containers, and the borings were grouted to the surface with USAEC-approved neat cement grout. Where necessary, the boring area was restored to its natural surface following grouting.

Table 4-4. Unified Soil Classification System - ASTM-D 2487-69

Field Identification Procedures (Excluding particles larger than 75 mm and basing fractions on estimated weights)				Group Symbols ¹	Typical Names				
<p>Fine Grained Soils More than half of material is smaller than No. 200 (75 µm) sieve size (The No. 200 (75 µm) sieve size is about the smallest particle visible to the naked eye.)</p>	<p>Sands with Fines (Appreciable amount of fines)</p>	<p>Sands More than half of coarse fraction is smaller than No. 4 (4.75 mm) sieve size (For visual classifications, 5 mm may be used as equivalent to the No. 4 (4.75 mm) sieve size.)</p>	Wide range in grain size and substantial amounts of all intermediate particle sizes.	GW	Well graded gravels, gravel-sand mixtures; little or no fines.				
			Predominantly one size or a range of sizes with some intermediate sizes missing.	GP	Poorly graded gravels, gravel-sand mixtures; little or no fines.				
			Non-plastic fines (for identification procedures see ML below).	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.				
			Plastic fines (for identification procedures see CL below).	GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.				
	<p>Gravels with Fines (Appreciable amount of fines)</p>	<p>Gravels More than half of coarse fraction is larger than No. 4 (4.75) sieve size</p>	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.	SW	Well graded sands, gravelly sands; little or no fines.				
			Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	Poorly graded sands, gravelly sands; little or no fines.				
			Non-plastic fines (for identification procedures see ML below).	SM	Silty sands, poorly graded sand-silt mixtures.				
			Plastic fines (for identification procedures see CL below).	SC	Clayey sands, poorly graded sand-clay mixtures.				
	<p>Identification procedures on fraction smaller than No. 40 (425 µm) sieve size</p>			<p>Sils and Clays Liquid limit greater than 50</p>	<p>Dry Strength (Crushing Characteristics)</p>	<p>Dilatancy (Reaction to Shaking)</p>	<p>Toughness (Consistency Near Plastic Limit)</p>	<p>ES</p>	Overlaying surface rubble and road base materials.
	None to low	Quick to slow	None						ML
Medium to high	None to very slow	Medium	CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.				
<p>Sils and Clays Liquid limit less than 50</p>	Low to medium	Slow	Low		OL	Organic silts and organic silt-clays of low plasticity.			
	Low to medium	Slow to none	Low to medium		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.			
	High to very high	None	High		CH	Inorganic clays of high plasticity, fat clays.			
	Medium to high	None to very slow	Low to medium		OH	Organic clays of medium to high plasticity.			
<p>Highly Organic Soils</p>			<p>Readily identified by color, odor, spongy feel and frequently by fibrous texture.</p>		PT	Peat and other highly organic soils.			
<p>Coarse Grained Soils More than half of material is larger than No. 200 (75 µm) sieve size² (The smallest particle visible to the naked eye.)</p>									

4.1.3.5 Soil Fluorescence Testing

Fluorescence testing was conducted on soil samples 13FS-01 through 13FS-26 to determine whether it could be used to identify soils containing petroleum hydrocarbons from the former diesel fuel spill at SWMU 13. The technique involved observation of soil fluorescence of the original unaltered samples. These data were collected and the samples were altered by adding a solvent to the soil, removing the extract obtained, and placing the extract under an ultraviolet light. The field geologist recorded the observed fluorescence of the altered samples. The fluorescence of the soil under the ultraviolet light yielded shades of yellow and purple. The higher the concentration of total petroleum hydrocarbons (TPHCs) within the soils, the brighter the purple fluorescence. Such a screening technique is typically used at recent gasoline spills to help define the extent of fuel contamination in soils. This helps reduce the number of samples required for petroleum hydrocarbon analysis. The test results for SWMU 13 indicated the presence of TPHCs. However, when compared with corresponding laboratory analysis results (Appendix D), there were no TPHCs detected in many of the samples with positive test results and therefore did not show a good correlation. Since the results were inconclusive, the value of the test appears questionable for further use at SWMU 13. The type of fuel (diesel), the age of the spill, and low concentrations may be responsible for the poor test results. The results of the fluorescence testing are presented in Appendix C.

4.1.3.6 Monitoring Well Drilling and Installation

The monitoring well borings were drilled and sampled utilizing the procedure previously described for soil borings (see Section 4.1.3.4) with the exception of the auger diameter. These borings were drilled with 9-5/8-inch-O.D. augers to facilitate installation of the well casing, screen, and well annulus construction materials (Table 3-2). Well construction activities were documented and recorded on the appropriate drilling, borehole, and well construction logs (see Appendix C). Well construction specifications were established by the field geologist and approved by the on-site USAEC representative prior to installation. Groundwater monitoring wells were constructed using hollow-stem augers, which were slowly removed from the hole as specified in the USAEC geotechnical requirements (USATHAMA 1987).

The following procedure was followed when completing a monitoring well:

1. Within 12 hours of completing the boring to the desired depth and establishing the well-construction specifications, the auger center bit and rods were removed from the hollow-stem augers.
2. The well casing, screen, and associated parts (i.e., bottom cap) were steam cleaned prior to use and were then assembled as they were lowered into the boring through the hollow-stem augers. The materials used consisted of 4-inch threaded schedule 40 PVC. The casing and screen were constructed using a combination of 5-foot and 10-foot sections as required. A screen slot size of 0.010 inch was selected for all wells installed.

3. With the assembled well casing and screen placed at the required depth, the filter pack, consisting of graded 16-40 size Colorado Silica Sand, was slowly placed in the annulus between the casing and the boring. This was accomplished by pouring the sand into the annulus between the hollow-stem auger and the PVC casing as the hollow-stem augers were being removed, ensuring that sand was maintained within the augers to prevent potential filter-pack voids or borehole collapse. A weighted tape was used to measure the depth to the top of the sand to ensure that bridging had not occurred and that the top of the sand was at the proper depth above the top of the screen (2 feet).
4. Once the filter pack was in place, a 5-foot-thick bentonite seal was constructed by pouring 1/4-inch bentonite pellets between the hollow-stem auger and casing as the augers were slowly removed with water added to the pellets to allow them to hydrate prior to adding grout to the remaining portion of the borehole.
5. Following emplacement of the bentonite seal, a slurry of USAEC-approved cement was used to fill the remainder of the hole annulus. The top of the casing was cut off at 2.5 feet above ground surface, and a 6-5/8-inch-O.D. steel protective casing with a locking cap was lowered into the grout slurry to be secured in place as the grout hardened.
6. Once the grout was hardened (after 24 hours), a 6-inch-thick coarse gravel (3/4- to 3-inch washed and sized gravel clasts) pad was constructed in a 4-foot radius around each well. A cement mortar mix was then placed at 6 inches above surface level in annulus between the PVC casing and the protective steel casing. Just above this surface, a 1/4-inch hole was drilled through the protective casing to allow moisture to escape from within the protective casing. Using a welder, permanent well identification (ID) numbers were placed directly on the protective casing. The protective casing was then painted with high visibility orange paint and the well ID painted with white paint. Locks were then placed on each well, the keys of which were supplied to TEAD.
7. Protective posts were then installed around each well and painted with high visibility orange paint.
8. After 48 hours but less than 7 days, the wells were developed by removing a minimum of 5 bore volumes of water using a bailer. Results of the well development process are provided in Appendix A.

4.1.3.7 Monitoring Well Ground Survey

Ground survey measurements were taken on all monitoring wells installed during this field effort to provide (X-Y) location information and (Z) elevation values. Traverses were completed according to USATHAMA requirements, and data are presented in Appendix I.

4.1.3.8 Groundwater-Level Measurements

Water-level measurements were made at each new and existing well at SWMU 13 prior to purging and sample collection. These measurements were made using an electronic interface probe to also allow the measurement of floating product where present along with determination of the top of the water table. Measurements were made and recorded with an accuracy of +/- 0.01 foot as specified by USAEC. This required that multiple measurements be made until the variance between measurements was within the required accuracy. Results of the water-level measurements are presented in Appendix A.

4.1.3.9 Groundwater Sampling

Both new and existing wells were sampled at SWMU 13 during the 1991 and 1993 efforts as part of this Phase II RFI. Prior to sample collection, the casing volume for each well was calculated and the amount of purging was determined to obtain a minimum of five bore volumes of water. Purging was accomplished using the dedicated bailer installed at each well. Measurements of pH, conductivity, temperature, and dissolved oxygen were conducted after each bore volume was removed during purging. The results of these measurements are presented in Appendix A.

A total of 30 monitoring wells were purged and sampled at SWMU 13 during the 1991 effort, and 35 monitoring wells were sampled during the 1993 investigation. The samples were collected using the dedicated bailer at each well. After purging and prior to sampling, the bailer was rinsed with USAEC-approved water and distilled water. Samples collected for dissolved metals were filtered in the field using a 0.45-micron filter. The samples were collected in the appropriate containers as specified in the approved work plans. The samples were collected for analysis of VOCs, SVOCs, agent breakdown products, explosives, total petroleum hydrocarbons, metals, anions, and radionuclides. Dissolved oxygen and pH were included in the analyte suite for the 1991 effort. Analytical results are presented in Appendix D:

4.1.3.10 Aquifer Testing

For monitoring wells installed during the Phase II RFI, rising and falling head slug tests were performed. The test was performed using a slug on a polyethylene rope. A digital recorder connected to a transducer was used to record changes in water levels until the level stabilized. The results of the slug tests were entered into a field logbook, including a computer printout of the time versus water level measurements.

The slug test results provided information used in the groundwater modeling for SWMU 13 (see Appendix A).

4.1.3.11 Product Recovery Testing

On the basis of the interface probe water level measurements performed on wells during the 1991 field investigation, it was determined that Well S-28-88 contained the most floating product. Well S-28-88 was selected for a product recovery test. Initial depth-to-product and depth-to-water measurements were taken to determine the initial product thickness prior to the test. The test was conducted using a bailer. The product was removed with the bailer and subsequent depth-to-product/depth-to-water measurements were made over specific time intervals to record how quickly the product thickness recovered over time (approximately 4 hours). The results of the product recovery test are discussed in Section 7.1.2.3.

4.1.3.12 Demobilization

Following completion of the 1991 and 1993 field investigations, all decontamination pads were removed. The plastic liner was placed in 55-gallon drums for proper disposal. Rust E&I provided TEAD-S personnel with the analytical data necessary to determine the hazardous characteristics of the drum contents. Wastes not requiring special treatment and/or disposal were disposed of at the TEAD-S Landfill. The remaining wastes that required special handling and/or were classified as hazardous wastes were disposed of through the Defense Reutilization and Marketing Office and were sent to a RCRA Treatment, Storage, and Disposal (TSD) facility as coordinated by the disposal contractor. Appendix E contains the Investigation Derived Waste (IDW) inventory.

4.1.3.13 Data Quality

4.1.3.13.1 Field Quality Assurance/Quality Control. Field QA/QC procedures—outlined in USAEC's *Quality Assurance Plan* (USATHAMA 1990) and the *Data Collection Quality Assurance Plan* (Donohue 1991)—consist of collection and analyses of field duplicates, field blanks, rinse blanks, and trip blanks to provide information pertaining to the precision, accuracy, representativeness, and comparability of the field data collected.

Field duplicates. Field duplicate samples are duplicative samples collected at the same location, consisting of the same matrix (soil, groundwater, etc.), and analyzed for a similar suite of analytes. Comparison of the results of field duplicates with collected sample results is indicative of the degree to which samples are homogeneous.

Field blanks. Field blanks are samples of deionized water used to determine whether any field conditions could have caused sample contamination by exposing the open sample containers to the field sampling environment while sampling operations were taking place.

Rinse blanks. Rinse blanks are aqueous samples collected from the water used to rinse field sampling equipment after sampling and decontamination. Results associated with these samples provide information on the effectiveness of field decontamination procedures.

Trip blanks. Trip blanks are aqueous samples transported with the actual samples from the field to the laboratory and are used to identify potential sample contamination during transport. Trip blanks accompany any cooler that contains a sample requiring VOC analysis.

The field QA/QC sample results are presented in Appendix D and are used in the data screening and evaluation process as described in Section 6.0.

4.1.3.13.2 *Laboratory Quality Assurance/Quality Control (QA/QC).* USAEC Laboratory QA/QC procedures, as described in the QAP (USATHAMA 1990), consist of the creation and analyses of method blanks, laboratory quality control spikes, and matrix spike/matrix spike duplicates (MS/MSDs). These samples were analyzed with the actual field samples to evaluate the quality of the resulting analytical data. A discussion of the laboratory QC procedures used to evaluate the analytical data generated for this RFI is presented below.

Method blanks. For each chemical analysis conducted by the laboratory, method blanks were included in the sample lots to identify any contamination that may have been introduced during sample preparation or analysis. Analytes detected above certified reporting limits (CRLs) in the method blank were used to delineate actual site contamination from potential laboratory contamination.

Laboratory quality control (QC) spikes. To verify method performance and provide information on analytical method accuracy and precision, the laboratory was required to analyze laboratory quality control spike samples (QC spikes). Three QC spikes were required for each analytical batch: one spiked at twice the concentration of the lower CRL for the method and the other two samples spiked at 10 times the concentration of the lower CRL for the method. Field samples were bracketed by the QC spikes during the actual analysis run; low spike analyzed initially, followed by the field samples, and then analysis of the two high spikes. The spike recovery data were plotted on "control charts" to determine if resulting recoveries were within acceptance tolerance ranges as set by USAEC. The "control charts" were also used to record results from the evaluation of method-specific holding times.

Matrix spike/matrix spike duplicates. MS/MSDs were analyzed in conjunction with blanks and replicates to provide quality control for the analytical methods used. The MS/MSDs were used to provide information regarding sample matrix effects and the capability of different methods to efficiently extract analytes of interest. The MS/MSDs are actual field samples split three ways: one control sample and two duplicate samples. The control sample is analyzed, and the result is used to establish the amount of analyte actually present in the field sample. This concentration can then be used to subtract from the concentration obtained for the spiked samples in order to establish a percent recovery for that particular analyte in that matrix. In addition, the relative percent difference (RPD) for the two spikes can also be estimated. These two factors, the percent recovery and the RPD, are used to assess the precision of the analytical method.

Each USEPA analytical method has established ranges of performance, and laboratories under contract to the USEPA are required to continually evaluate method-specific results of MS/MSDs to determine precision and accuracy criteria for utilized methods. Based on these results, laboratory and method-specific performance characteristics can be compared to USEPA method performance criteria. This approach is also utilized by USAEC for establishing upper and lower control chart limits.

Percent recovery values outside of established method-specific ranges may indicate matrix interference effects. For instance, when more than 100 percent of an analyte is recovered it is generally assumed that the sample matrix is contributing to the reported analyte concentration. Similarly, if percent recoveries are significantly less than 100 percent, the sample matrix may be influencing the analyte extraction process. Relative percent differences also provide information regarding possible matrix interference effects during analyses. If RPDs are outside of statistically significant ranges, then variability in sample results can be attributed to variability in the matrix or the capability of a method to extract a particular analyte from that matrix.

Under the IRDMIS system, the standard matrix control charts for each lot of data are reviewed by the USAEC Chemistry Branch. The lots are then flagged as acceptable with no qualifications (data qualifiers or flag codes), as acceptable with certain qualifications, or as unacceptable. For SWMU 13, 159 control chart letters for lots that were associated with the data that were collected during this RFI were reviewed by the USAEC Chemistry Branch. All but one of these lots (ADST) were determined to be acceptable, or acceptable with some qualification. Lot ADST was not acceptable for the analyte 1,3,5-trinitrobenzene, which was qualified with "JNR." These qualifiers mean that the low and high spike recoveries were low and the data are to be rejected. The 1,3,5-trinitrobenzene results for four samples from the Wastewater Lagoons (13WL-01 through 13WL-04) received these qualifiers, are considered unusable data, and are not included in data screening or evaluation. Appendix D includes all of the data along with any applicable flags or qualifiers. These flags and qualifiers are taken into account during the data screening and evaluation process as described in Section 6.0.

The above-mentioned laboratory QA/QC protocols were conducted in accordance with the USAEC QAP (USATHAMA 1990). In addition to these protocols, a Data Quality Assessment (DQA) was performed on approximately 16 (27 lots) percent of the lots that were analyzed during the 1993 field effort to compliment the USAEC QA program. These lots were chosen to provide DQA information for each of the analytical methods used. The purpose of the DQA was to evaluate both lot-wide and sample-specific data quality using USAEC's PAM 11-41 program requirements and additional criteria developed by the USEPA.

Level three data validation was performed on the analytical data reports received for the 27 lots assessed. The data validation process reviewed both the technical and evidentiary quality of the data. Level three validation includes the comparison of laboratory summarized QC and instrument performance standard results to the required control limits. The following QC elements were reviewed as appropriate for the specific analytical method:

- Analytical holding times
- Initial and continuing calibration checks
- Instrument performance, tuning, and interference check samples
- Laboratory blank contamination
- Precision (comparison of replicate sample, lab spike, and matrix spike results)
- Accuracy (surrogate and internal standard recoveries, blank spike recoveries, matrix spike recoveries, blank contamination)
- Compound identification and quantification
- Detection limits (compared to CRL)
- Presence and completeness of chain-of-custody documentation
- Completeness of laboratory documentation for sample receipt, sample analysis, and sample result reporting
- Overall documentation practices
- Field QC as evaluated using field duplicates, field equipment rinsates, and trip blanks

Appendix F presents all of the DQA information noted above. A summary of the results is included in the opening pages, followed by the lot-by-lot discussions.

4.2 DEACTIVATION FURNACE/MERCURY CONTAMINATION AREA, SWMU 17

4.2.1 SWMU Description and Waste Generation

SWMU 17, the TEAD-S Deactivation Furnace/Mercury Contamination area, as shown in Figure 4-2, is located in the north-central portion of TEAD-S across Blume Street north of former Building 533 (personal communication from Mack McEntire, TEAD personnel, 1993). Building 533 has been removed and only the foundation remains. This building was identified as a suspected release SWMU (SWMU 19) and is under investigation as part of the Group 3 RFI. The purpose of the Deactivation Furnace was to serve as a prototype of the CAMDS facility by disposing of fuses, first-fire mixes, primers, and small arms. The furnace operated as a one-pass burner at 1,200 °F, using No. 2 fuel oil and supplied air for combustion of test materials. The anticipated result was metal debris without contamination and off-gas treatment with scrubbers. From 1976 to 1982, experimental disposal tests were conducted on CS-filled M25 riot grenades, the M674 projectile (40 mm), and the M158 tactical canister, which also contains explosives B and RDX and agent simulator (i.e., ethylene glycol). The tests were not successful and the operations were aborted. The residual ash material was decontaminated and removed from the site (USATHAMA 1979) and the Deactivation Furnace was dismantled.

Following dismantling of the furnace, drums containing various hazardous materials used at TEAD-S (including mercury) were stored in Building 533. In 1986, according to the CAMDS plant manager, approximately 26 drums of solution containing mercury, which originated from sulphur dioxide and nitrogen dioxide air monitors, were tipped over outside Building 533,

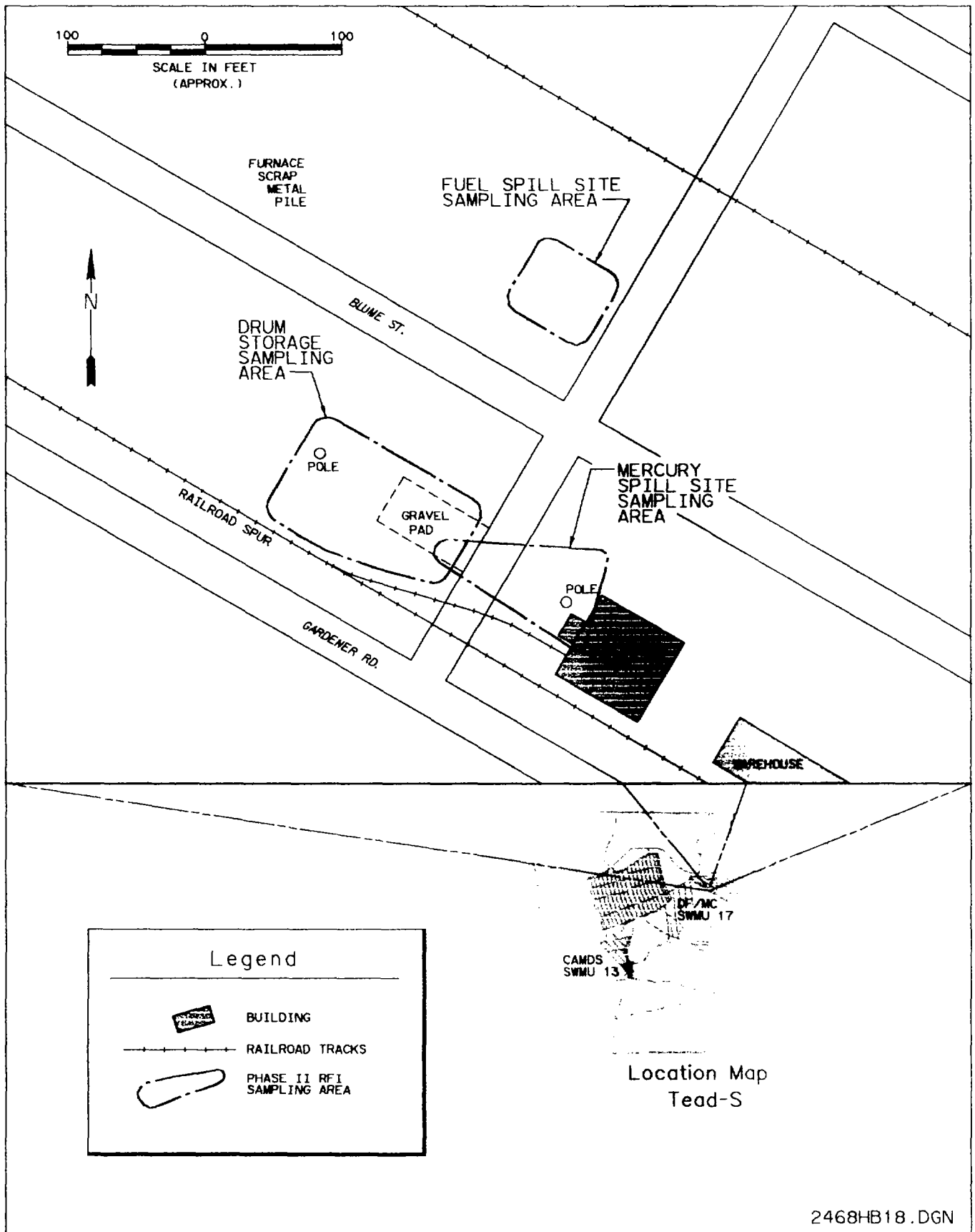


Figure 4-2. SWMU 17 Area Location Map

causing a mercury release to the soil. This area is called the **Mercury Contamination Subsite**. Besides mercury, the drums potentially contained the following chemicals:

- **Sulfur dioxide waste**
 - Hydrochloric acid
 - Mercuric chloride
 - Sodium chloride
 - Sulfamic acid
 - Formaldehyde
 - Rosaniline hydrochloride
 - Sodium meta bisulfite

- **Nitrogen dioxide waste**
 - Tartaric acid
 - Sulfanilamide
 - 2-Naphthol-3,6-disulfonic acid
 - Disodium salt
 - N-(1-Naphthyl) ethylenediamine dihydrochloride
 - Sodium nitrate

Confirmation sampling, conducted by TEAD-S personnel, at the mercury contamination spill site indicated that pre-existing mercury contamination has been remediated to below the regulatory clean-up level of 5.0 micrograms per gram ($\mu\text{g/g}$). State of Utah approval of the remediation of this area was received September 11, 1991.

In 1988, an above-ground tank, supported on a rack, was observed to be slowly leaking oil (i.e., diesel fuel) (Weston 1991). This tank was located across **Blume Street** to the north of **Building 533**. At that time, the oil spill had resulted in a stained surface area of less than 20 square feet. By the time of the site visit in 1990 (Rust E&I), the tank had been removed and there was no visual evidence of oil. It appeared that the stained soil had been removed and the area resurfaced. There were no records or additional information available as to the disposition of the tank or the stained soil that was removed. This area is called the **Fuel Spill Site**.

During operation, an area across the road northwest of **Building 533** was used as a lay-down area (i.e., drum storage). This area, including a portion of the western edge of the road, is known as the **Drum Storage Site**. During a site visit in 1988 (Weston 1991), stained soil and stained road material were noted; however, no staining was observed in a 1990 (Rust E&I) site visit, and approximately 3 to 5 feet of soil had been piled on the site prior to the Phase II Field Investigation. Although specific contaminants and spill events are unknown, this site is included in **SWMU-17** because of the stained areas and possible drum leakage.

4.2.2 Previous Investigations

Prior to 1987, there were a number of environmental investigations conducted at TEAD-S (identified in Section 4.1.2). In the earliest one (USATHAMA 1979), this SWMU was identified presumably because of the high-release potential due to the furnace operation. Although it continued to be listed as a SWMU in subsequent investigations, it was not until 1987 that the first samples were taken at SWMU 17.

In 1987, TEAD collected 3 surface-soil samples and analyzed them for mercury to determine if mercury was present from the tipping over of the 26 drums. In 1989, Weston performed a Phase I Remedial Investigation at the DF/MC Area. This involved the following effort at each of the three release sites:

- Four samples from one borehole were taken at the Fuel Spill Subsite below the above-ground tank at depths of 0 to 1 foot, 1 to 2 feet, 2 to 3.5 feet, and 4 to 5 feet.
- Ten samples at four locations were taken at depths of 0 to 6 inches, 6 inches to 1.5 feet, and 1.5 to 2.5 feet from stained areas on the road and at the Drum Storage Subsite.
- Twenty-three samples were taken at eight locations at the Mercury Contamination Subsite. At seven of these eight locations, three samples were taken at depths of 0 to 0.5 inches, 0.5 to 1.5 feet, and 1.5 to 2.5 feet. One sample was taken at a depth of 0 to 0.5 feet, approximately 20 feet west of the edge of the road adjacent to the storage facility.

4.2.3 Phase II RFI Field Investigation Program

The objective of the RFI Phase II investigation at SWMU 17 was to (1) verify contaminants previously identified; (2) determine the vertical and horizontal extent and nature of contamination, if present; (3) compare contamination values to regulatory standards; (4) assess potential risks to human health and the environment; and (5) make recommendations for any future action at this SWMU.

In order to obtain adequate characterization data, the SWMU was divided into three sites of suspected contaminant releases for various field studies. Each site was selected on the basis of results of previous investigations or reports of previous spills or releases described in the Phase I investigation (Ebasco 1991). The three study areas at SWMU 17 are as follows:

- Mercury Contamination Site
- Fuel Spill Site
- Drum Storage Area

To obtain the necessary data, the field work was performed according to approved work plans prepared by a previous contractor (Ebasco 1991). This plan provided details of the proposed

field investigation program to be conducted at SWMU 17 and provided the basis for the Rust E&I field investigation program.

4.2.3.1 Mobilization

Mobilization for field activities performed at SWMU 17 followed the field investigation work for SWMU 13 (CAMDS).

Appropriate training requirements for field personnel were obtained prior to commencement of field activities associated with the SWMU 13 field investigation program. This training was also applicable to field activities at SWMU 17.

All soil boring and utility/digging permits were obtained prior to the start of field work.

4.2.3.2 Soil Boring Drilling, Logging, and Sampling

Soil borings at SWMU 17 were drilled using a truck-mounted hollow-stem auger rig (CME 750 drilling rig) according to requirements set forth in the USAEC Geotechnical Requirements (USATHAMA 1987). A 7-5/8-inch O.D. by 4-1/4-inch I.D. auger was used to drill the borings and a 3-inch O.D. by 24-inch-long stainless-steel split-spoon sampler was used for soil-sample collection. A utility survey and a UXO survey were performed prior to drilling at each soil-boring location. A borehole drilling log, which documented subsurface lithology and sampling intervals, was prepared for each soil boring. Soils were characterized and described using the Unified Soil Classification System (ASTM D 2487-69 equivalent, Table 4-3), and soil color was described using a Munsell Color Chart. Samples were obtained at prescribed intervals using a stainless-steel split-spoon sampler. The samples were screened immediately with a PID for the presence of VOCs prior to sample collection and bottling. Samples were bottled, properly labeled, and packaged for shipment to the laboratory for analysis.

The proposed soil-boring program versus the actual soil borings completed, as well as the number of proposed samples and associated analyses versus the actual number of samples collected and analyzed, is presented in Appendix B.

ASTM Standard Testing Procedures (ASTM D4318-84) for Atterberg limits were used to perform liquid limit, plastic limit, and plasticity index tests on selected soil samples representative of site soils collected during the 1991 field investigation. Representative soil samples from SWMU 17 were tested using these procedures (see Appendix C).

Following drilling and sample collection, the remaining drill cuttings and sampling material wastes were drummed in DOT-approved 55-gallon containers, and the borings were grouted to the surface with USAEC-approved neat cement grout. Soil-boring locations were restored to their natural condition following grouting.

Although soil sampling was identified in the work plans for the Mercury Contamination Spill Site, this area was remediated prior to the field investigation (see Section 8.2.2). Therefore, there was no activity at this site.

Eight soil borings were completed at the Fuel Spill Site with samples collected at 0-to-1-foot, 4-to-5-foot, 9-to-10-foot, 12-to-13-foot, and 15-to-16-foot intervals to determine the vertical extent of petroleum hydrocarbons.

The 0-to-1-foot and 4-to-5-foot interval samples were also analyzed for explosives as well as petroleum hydrocarbons to provide data to determine the horizontal extent of contamination. One sample was also analyzed by toxicity characteristic leaching procedures for VOCs and SVOCs. Determination of bulk density, grain size, moisture content, and pH was also made.

Twelve soil borings were completed at the Drum Storage Site. The lateral placement of the sample location was estimated to provide horizontal extent of contamination. The borings were 20 feet deep with sample intervals at 0-to-1 foot, 4-to-5 feet, 9-to-10 feet, 14-to-15 feet, and 19-to-20 feet to assess the vertical extent of the contamination. The 0-to-1-foot and 4-to-5-foot intervals were in the fill material that had been previously placed on top of the site. These samples were analyzed for VOCs, SVOCs, explosives, and metals, with one sample analyzed for total organic carbon, bulk density, grain size, and pH.

4.2.3.3 Demobilization

Following completion of field work at SWMU 17, Rust E&I demobilized from the SWMU 17 area and returned to SWMU 13. The decontamination pad was dismantled and the plastic liner was placed into 55-gallon drums for disposal. IDW was handled similarly to the procedures followed at SWMU 13, which are presented in Section 4.1.4.11.

4.2.3.4 Data Quality

Data quality assurance and quality control protocols for SWMU 17 are the same as those presented in Section 4.1.3.12 for SWMU 13. The information is presented again in this section for report completeness.

4.2.3.4.1 Field Quality Assurance/Quality Control. Field QA/QC procedures, outlined in USAEC's QAP (USATHAMA 1990) and the Data Collection Quality Assurance Plan (Donohue 1991), consist of collection and analyses of field duplicates, field blanks, rinse blanks, and trip blanks to provide information pertaining to the precision, accuracy, representativeness, and comparability of the field data collected.

Field duplicates. Field duplicate samples are duplicative samples collected at the same location, consisting of the same matrix (soil, groundwater, etc.), and analyzed for a similar suite of analytes. Comparison of the results of field duplicates with collected sample results is indicative of the degree to which samples are homogeneous.

Field blanks. Field blanks are samples of deionized water used to determine whether any field conditions could have caused sample contamination by exposing the open sample containers to the field sampling environment while sampling operations were taking place.

Rinse blanks. Rinse blanks are aqueous samples collected from the water used to rinse field sampling equipment after sampling and decontamination. Results associated with these samples provide information on the effectiveness of field decontamination procedures.

Trip blanks. Trip blanks are aqueous samples transported with the actual samples from the field to the laboratory and are used to identify potential sample contamination during transport. Trip blanks accompany any cooler that contains a sample requiring VOC analysis.

The field QA/QC sample results are presented in Appendix D and are used in the data screening and evaluation process as described in Section 6.0.

4.2.3.4.2 Laboratory Quality Assurance/Quality Control (QA/QC). USAEC Laboratory QA/QC procedures, as described in the QAP (USATHAMA 1990), consist of the creation and analyses of method blanks, laboratory quality control spikes, and matrix spike/matrix spike duplicates (MS/MSDs). These samples were analyzed with the actual field samples to evaluate the quality of the resulting analytical data. A discussion of the laboratory QC procedures used to evaluate the analytical data generated for this RFI is presented below.

Method blanks. For each chemical analysis conducted by the laboratory, method blanks were included in the sample lots to identify any contamination that may have been introduced during sample preparation or analysis. Analytes detected above CRLs in the method blank were used to delineate actual site contamination from potential laboratory contamination.

Laboratory QC spikes. To verify method performance and provide information on analytical method accuracy and precision, the laboratory was required to analyze laboratory quality control spike samples (QC spikes). Three QC spikes were required for each analytical batch: one spiked at twice the concentration of the lower CRL for the method and the other two samples spiked at 10 times the concentration of the lower CRL for the method. Field samples were bracketed by the QC spikes during the actual analysis run; the low spike was analyzed initially, followed by the field samples, and then analysis of the two high spikes. The spike recovery data were plotted on "control charts" to determine if resulting recoveries were within acceptance tolerance ranges as set by USAEC. The "control charts" were also used to record results from the evaluation of method-specific holding times.

Matrix spike/matrix spike duplicates. MS/MSDs were analyzed in conjunction with blanks and replicates to provide quality control for the analytical methods used. The MS/MSDs were used to provide information regarding sample matrix effects and the capability of different methods to efficiently extract analytes of interest. The MS/MSDs are actual field samples split three ways: one control sample and two duplicate samples. The control sample is analyzed, and the result is used to establish the amount of analyte actually present in the field sample. This concentration can then be used to subtract from the concentration obtained for the spiked samples to establish a percent recovery for that particular analyte in that matrix. In addition, the RPD for the two spikes can also be estimated. These two factors, the percent recovery and the RPD, are used to assess the precision of the analytical method.

Each USEPA analytical method has established ranges of performance, and laboratories under contract to USEPA are required to continually evaluate method-specific results of MS/MSDs to determine precision and accuracy criteria for utilized methods. Based on these results, laboratory and method-specific performance characteristics can be compared to USEPA method performance criteria. This approach is also utilized by USAEC for establishing upper and lower control chart limits.

Percent recovery values outside of established method-specific ranges may indicate matrix interference effects. For instance, when more than 100 percent of an analyte is recovered, it is generally assumed that the sample matrix is contributing to the reported analyte concentration. Similarly, if percent recoveries are significantly less than 100 percent, the sample matrix may be influencing the analyte extraction process. Relative percent differences also provide information regarding possible matrix interference effects during analyses. If RPDs are outside of statistically significant ranges, then variability in sample results can be attributed to variability in the matrix or the capability of a method to extract a particular analyte from that matrix.

Under the IRDMIS system, the standard matrix control charts for each lot of data are reviewed by the USAEC Chemistry Branch. The lots are then passed as acceptable with no qualifications (data qualifiers or flag codes), acceptable with certain qualifications, or qualified as unacceptable. For SWMU 17, 13 control chart letters for lots that were associated with the data that were collected during this RFI were reviewed by the USAEC Chemistry Branch. All 13 of these lots were determined to be acceptable.

The above-mentioned laboratory QA/QC protocols were conducted in accordance with the USAEC QAP (USATHAMA 1990). Appendix D includes all of the data along with any applicable flags or qualifiers. These flags and qualifiers are taken into account during the data screening and evaluation process as described in Section 6.0.