FINAL

Supplemental Remedial Investigation

Site-Specific Field Sampling Plan and Site-Specific Safety and Health Plan Attachments for the Fenced Area at Range J - Pelham Range (Parcel 202)

Fort McClellan
Calhoun County, Alabama

November 1998

Delivery Order CK005
Contract Number DACA21-96-D-0018

IT CORPORATION
A Member of The IT Group

US Army Corps of Engineers
Mobile District

Final
Supplemental Remedial Investigation
Site-Specific Field Sampling Plan and
Site-Specific Safety and Health Plan Attachments
for the Fenced Area at Range J - Pelham Range, Parcel 202(7)

Fort McClellan
Calhoun County, Alabama

Delivery Order CK005
Contract No. DACA21-96-D-0018
IT Project No. 774645

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Revision 0

Site-Specific Field Sampling Plan

Fenced Area at Range J - Pelham Range, Parcel 202(7)

Supplemental Remedial Investigation

Final
Site-Specific Field Sampling Plan Attachment for the Fenced Area at Range J - Pelham Range, Parcel 202(7)

Fort McClellan
Calhoun County, Alabama

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Revision 0

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List of Acronyms

ADEM	Alabama Department of Environmental Management
Battelle	Battelle Memorial Institute Laboratory
bls	below land surface
°C	degrees Celsius
CERFA	Community Environmental Response Facilitation Act
CESAS	Corps of Engineers South Atlantic Savannah
CLP	Contract Laboratory Program
COC	chain of custody
CSEM	conceptual site exposure model
CNB	chloroacetophenone, benzene, and carbon tetrachloride
CNS	chloroacetophenone, chloropicrin, and chloroform
CWA	chemical warfare agent
DAAMS	Depot Area Air Monitoring System
DANC	decontamination agent (noncorrosive)
DOD	U.S. Department of Defense
DQO	data quality objective
DS2	Decontamination Solution Number 2
EBS	environmental baseline survey
EM	electromagnetic
EPA	U.S. Environmental Protection Agency
EPIC	Environmental Photographic Interpretation Center
ESE	Environmental Sciences and Engineering
FTMC	Fort McClellan
GPS	global positioning system
HD	distilled mustard
HTRW	hazardous, toxic, and radioactive wastes
IDW	investigation-derived waste
IT	IT Corporation
µg/L	micrograms per liter
MINICAMS	Miniature Continuous Air Monitoring System
msl	mean sea level
PCE	perchloroethene

PID	photoionization detector
ppb	parts per billion
PSSC	potential site-specific chemical
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QAP	installation-wide quality assurance plan
Quicksilver	Quicksilver Laboratories
RI	remedial investigation
RTAP	Real-Time Analysis Platform
SAIC	Science Application International Corporation
SAP	installation-wide sampling and analysis plan
SFSP	site-specific field sampling plan
SHP	installation-wide safety and health plan
SSHP	site-specific safety and health plan
SI	site investigation
STB	supertropical bleach
SVOC	semivolatile organic compound
TCE	trichloroethene
TCL	target compound list
USACE	U.S. Army Corps of Engineers
USAEHA	U.S. Army Environmental Hygiene Agency
USATEU	U.S. Army Technical Escort Unit
USATHMA	U.S. Army Toxic and Hazardous Materials Agency
UST	underground storage tank
VOC	volatile organic compound
WP	installation-wide work plan

Executive Summary

In accordance with Contract No. DACA21-96-D-0018, Task Order CK005, IT Corporation (IT) will conduct a supplemental remedial investigation of the Fenced Area at Range J, Former Chemical Agent Training and Disposal Area, Parcel 202(7) to determine the nature and extent of potential site-specific chemicals (PSSC) at the site resulting from U.S. Army chemical waste disposal and training activities. The purpose of this site-specific field sampling plan (SFSP) is to provide technical guidance for sampling activities of the Fenced Area at Range J.

The investigation conducted under this SFSP will include the following:

- Collection and analysis of 24 surface soil samples
- Collection and analysis of 24 subsurface soil samples
- Installation of 13 (7 residuum and 6 bedrock) monitoring wells
- Collection and analysis of 16 groundwater samples (from 3 existing monitoring wells and 13 proposed monitoring wells)
- Conduct a surface or near surface unexploded ordnance (UXO) survey over all areas to be included in the sampling effort.
- Provide downhole UXO support for all intrusive direct-push or drilling activity to determine the presence of potential downhole hazards.
- Provide MINICAMS support at the Fenced Area at Range J.

The Fenced Area at Range J, Parcel 202(7) falls within the "Possible Explosive Ordnance Impact Area" shown on Plate 10 of the FTMC Archive Search Report, Maps (USACE, 1998a). Therefore, IT will conduct unexploded ordnance (UXO) avoidance activities, including surface sweeps and downhole surveys of soil borings.

Range J was a former chemical agent training and disposal area located in the northcentral portion of Pelham Range (Figure 1-1). Due to conflicting documentation reported in the environmental baseline survey (EBS) (Environmental Science and Engineering [ESE], 1998) and in the Enhanced Preliminary Assessment Reports (Roy F. Weston, Inc., 1990), the exact acreage (size) of Range J is not known. The site was reportedly used for personnel training in various facets of chemical warfare exposure including; agent use, detection, chemical waste disposal, and use of decontaminating agents. Decontaminating agents were used on chemical warfare agents to reduce and eliminate their hazards after training exercises.

Chemicals used as decontaminating agents may be either inorganic or organic materials which contain chlorine readily available for use as an oxidizing or chlorinating agent. Inorganic materials include bleach in various forms, calcium hypochlorite, and chlorine itself. Inorganic materials decontaminate by oxidation and are used for large-scale decontamination. Organic compounds include the chloroamides and closely related compounds. Organic compounds decontaminate in the absence of moisture, by chlorination and, in the presence of moisture, by oxidation. These compounds were usually dissolved in an organic solvent such as carbon tetrachloride or 1,1,2,2-tetrachloroethane (acetylene tetrachloride). However, these materials are expensive and were used only for small scale operations such as destroying a blister agent on equipment (U.S. Department of the Army and Air Force, 1963).

Various types of chemical agents and decontaminants were reportedly used at Range J, some of which may have been used at different times throughout the history of the site. Below is a list of chemical agents and decontaminants, with descriptions of each, that were probably used at Range J:

- Decontamination agent (noncorrosive) (DANC)
- Distilled mustard (HD)
- Supertropical bleach (STB)
- Decontamination Solution Number 2 (DS2)
- Chloroacetophenone in benzene and carbon tetrachloride (CNB)
- Chloroacetophenone in chloropicrin and chloroform (CNS).

DANC. Prior to World War II, a well-known and often used decontaminating agent, DANC may have been used or disposed of at the site in conjunction with other types of decontaminants such as DS2 and/or STB. DANC is a 6.25 percent solution of RH-195 (1,3-dichloro-5, 5-dimethylhydantoin) in 1,1,2,2-tetrachloroethane (acetylene tetrachloride) and was adopted as a satisfactory HD decontaminant in small scale operations. It is an effective decontaminant for arsenicals, if sufficient time is allowed for it to react (U.S. Department of Army and Air Force, 1963).

DS2. DS2 is a clear solution general-purpose decontaminant consisting of 70 percent diethylenetriamine, 28 percent solvent (ethylene glycol monomethylether), and 2 percent active agent booster (sodium hydroxide). DS2 decontaminant reacts with (Sarin) GB and HD to effectively reduce their hazard within 5 minutes of application. It is effective for all toxic chemical agents. DS2 was applied manually or by using a portable decontaminating apparatus such as the M11 (U.S. Department of Army and Air Force, 1963).

STB. STB is referred to as bleach, bleaching powder, supertropical bleach, bleaching material, or chlorinated lime. STB is a white powder containing about 30 percent available chlorine (U.S. Department of Army and Air Force, 1963).

CNB/CNS. CNB does not have a chemical name. It is made of chloroacetophenone (10 percent), benzene (45 percent), and carbon tetrachloride (45 percent). CNB was adopted in 1920 for use in training and riot control as a tear agent. It remained in use until it was replaced by CNS. The exact date CNS replaced CNB is unknown. CNS does not have a chemical name. It is made of chloroacetophenone (23 percent), chloropicrin (38.4 percent), and chloroform (38.4 percent) (U.S. Department of Army and Air Force, 1963).

A chain link fence surrounds an area approximately 139 feet in length by 50 feet wide (0.16 acres) that was reportedly used until 1963 for training and chemical agent disposal (Science Application International Corporation [SAIC], 1993) (see Figure 1-2). The fenced area is reportedly a portion of a larger training area (approximately 60 acres) used as early as 1954 (ESE, 1998). The boundaries of this larger training area are not documented. However, SAIC was not provided with the 1983 Environmental Photographic Interpretation Center aerial photographs. Review of aerial photographs prepared by Environmental Photographic Interpretation Center for the U.S. Army Toxic and Hazardous Materials Agency indicates Range J was much larger than the reported 60 acres (U.S. Environmental Protection Agency, 1983). Based on review of the October 21, 1954 aerial photograph, Range J may have been approximately 170 acres. Historical evidence suggests this larger training area was used for tear gas agent training (SAIC, 1995). The objective of this investigation is to determine whether or not the fenced area is the source of contamination in groundwater and better define the extent of groundwater contamination.

The fenced area was reportedly used to dispose of drummed soil transported from a 110-gallon HD spill that occurred at the Main Post in 1955. The depth at which the drummed contaminated soil was buried is unknown. Field screening of soil samples and laboratory analyses conducted in 1993 and 1994 on soil samples located inside the chain link fence did not detect the presence of HD or HD breakdown products. Soil contaminated with HD would have been decontaminated under military protocols using STB or DS2 (SAIC, 1995).

Three groundwater samples collected from monitoring wells just outside the fenced area were analyzed for HD, HD breakdown products, and volatile organic compounds (VOC). Several organic solvents, including carbon tetrachloride, 1,1,2,2-tetrachloroethane, tetrachloroethene, and trichloroethene were detected in the groundwater samples collected. These VOCs may be associated with the use of DANC. The carbon tetrachloride detected in groundwater may be a result of the use of tearing agents CNB and CNS used outside the chain link fence. Because the primary source of carbon tetrachloride from military activities was the usage, storage, and/or manufacture of tearing agents (CNB and CNS) or from usage as a degreaser, the detected contamination at Range J may be unrelated to activities that occurred within the chain link fence (SAIC, 1995).

The main chemical of concern detected in groundwater at Range J is carbon tetrachloride. Carbon tetrachloride concentrations in groundwater ranged from 6.6 micrograms per liter (μg/L) in monitoring well RJR-202-MW01 to 2,000 μg/L in monitoring well RJR-202-MW03. In addition to carbon tetrachloride, several organic solvents were detected in groundwater at low concentrations including 1,1,2,2-tetrachloroethane, tetrachloroethene, and trichloroethene. These solvents detected in the groundwater are most likely associated with either tear gases used in training exercises, namely CNB and CNS, or disposal of decontaminated soils inside the chain link fence from training exercises using DS2, and DANC, or a combination of both.

Potential contaminants at the site include solvents, namely carbon tetrachloride, and possible HD or HD breakdown products. Chemical analyses of the soil and groundwater samples collected during the field program will include VOCs, semivolatile organic compounds, and HD breakdown products (thiodiglycol and organosulfur compounds). Results from these analyses will be compared with site-specific screening levels specified in the installation-wide work plan (WP), and regulatory guidelines.

This SFSP attachment to the installation-wide sampling and analysis plan (SAP) (IT, 1998a) for Range J, Pelham Range, Parcel 202(7) will be used in conjunction with the site-specific safety and health plan (SSHP), and the installation-wide WP, the habitat-specific screening ecological risk assessment work plan, and the SAP. The SAP includes the installation-wide safety and health plan, waste management plan, and quality assurance plan. Site-specific hazard analyses are included in the SSHP.

1.0 Project Description

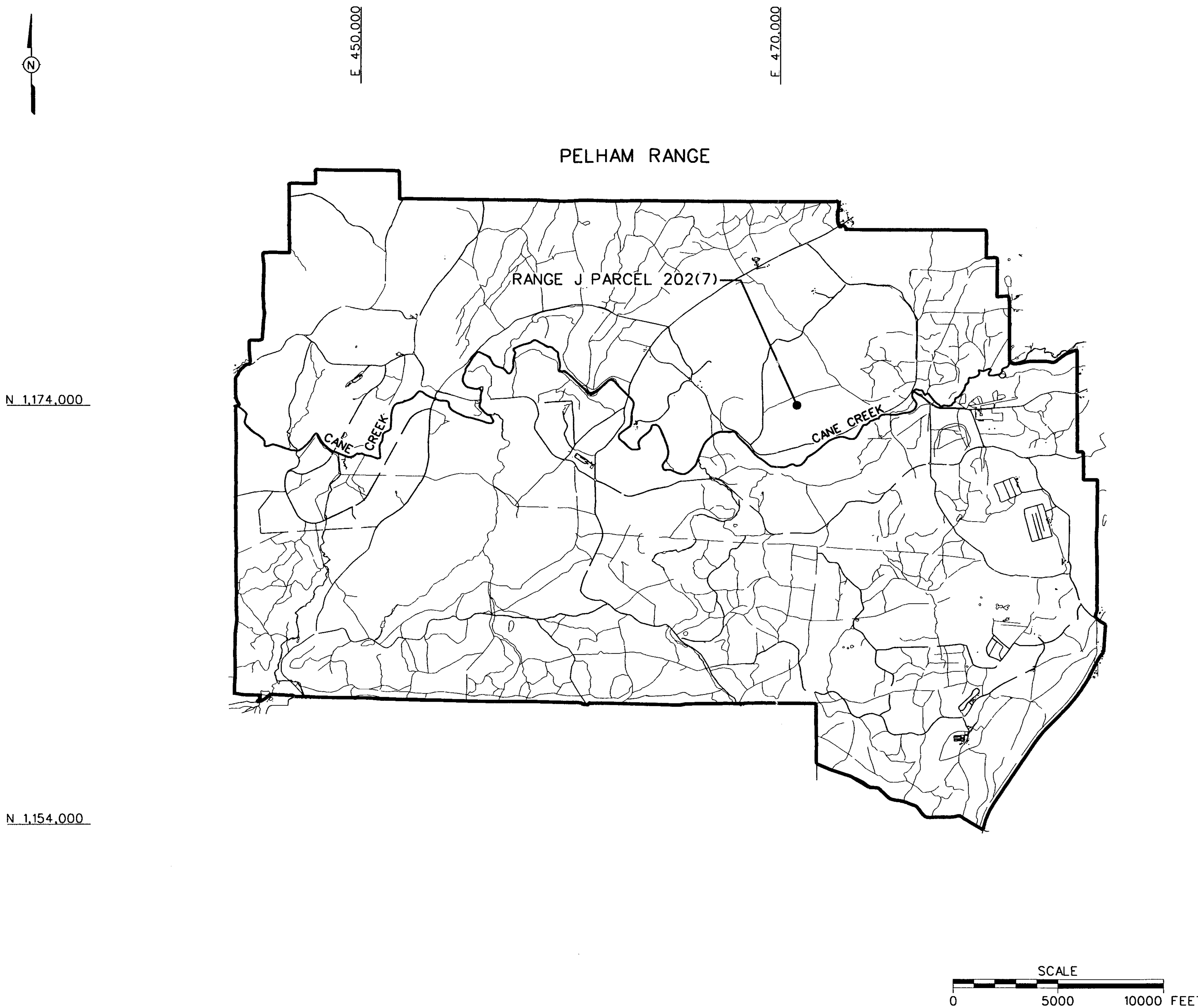
1.1 Introduction

The U.S. Army is conducting studies of the environmental impact of suspected contaminants at Fort McClellan (FTMC) in Calhoun County, Alabama, under the management of the U.S. Army Corps of Engineers (USACE)-Mobile District. The USACE has contracted IT Corporation (IT) to provide environmental services for the supplemental remedial investigation (RI) of the Fenced Area at Range J, Parcel 202 (7); under Task Order CK005, Contract Number DACA21-96-D-0018.

This supplemental RI site-specific field sampling plan (SFSP) attachment to the installation-wide sampling and analysis plan (SAP) (IT, 1998a) for FTMC has been prepared to provide technical guidance and rationale for sample collection and analysis of the Fenced Area at Range J, Parcel 202(7) (Figure 1-1). The objective of this investigation is to determine whether or not the fenced area is the source of contamination in groundwater and better define the extend of groundwater contamination. IT will collect samples at this site as part of a supplemental RI effort to characterize the source of potential site-specific chemicals (PSSC) of concern in various site matrices, determine the nature and extent of contamination, and evaluate the level of risk to human health and the environment posed by releases of the PSSC of concern. The results of this effort will determine whether there are contaminants at this site in concentrations high enough to warrant further remedial action. The supplemental RI SFSP will be used in conjunction with the site-specific safety and health plan (SSHP), the habitat-specific screening ecological risk assessment work plan, the installation-wide work plan (WP) (IT, 1998b), and the SAP. The SAP includes the installation-wide safety and health plan (SHP), waste management plan, and quality assurance plan (QAP).

1.2 FTMC Site Description and History

Fort McClellan is located in the foothills of the Appalachian Mountains of northeastern Alabama near the cities of Anniston and Weaver in Calhoun County (Figure 1-1). The post is approximately 60 miles northeast of Birmingham, 75 miles northwest of Auburn, and 95 miles west of Atlanta, Georgia. Fort McClellan consists of three main areas of government-owned and leased properties: Main Post, Pelham Range, and Choccolocco Corridor (leased). The size of each property is presented below:



LEGEND

PELHAM RANGE BOUNDARY

FIGURE 1-1
SITE LOCATION MAP
RANGE J - PELHAM RANGE,
CHEMICAL AGENT TRAINING AND
DISPOSAL AREA
PARCEL 202(7)

U. S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

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CORPORATION

STARTING DATE: 06/16/98	DATE LAST	DRAFT. CHCK. BY:	INITIATOR: J. TARR	DWG. NO.: 4645es.114
DRAWN BY: D. BILLINGSLEY	DRAWN BY:	ENGR. CHCK. BY: A. MAYILA	PROJ. MGR.: J. YACOUB	PROJ. NO.: 774645

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- Main Post 18,946 acres
- Pelham Range 22,245 acres
- Choccolocco Corridor (leased) 4,488 acres.

The Main Post is bounded on the east by the Choccolocco Corridor, which connects the Main Post with the Talladega National Forest. Pelham Range is located approximately 5 miles west of the Main Post and adjoins the Anniston Army Depot on the southwest. Pelham Range is bordered on the east by U.S Highway 431.

FTMC is under the jurisdiction of the U.S. Army Training and Doctrine Command (TRADOC). The installation houses three major organizations including the U.S. Army Military Police School, the U.S. Army Chemical School, and the Training Center (under the direction of the training brigade), in addition to other major support units and tenants.

The U.S. government purchased 18,946 acres of land near Anniston in 1917 for use as an artillery range and a training camp due to the outbreak of World War I. The site was named Camp McClellan in honor of Major General George B. McClellan, a former leader of the Union Army during the Civil War. Camp McClellan was used to train troops for World War I from 1917 until the armistice. It was then designated as a demobilization center. Between 1919 and 1929, Camp McClellan served as a training area for active army units and other civilian elements. Camp McClellan was redesignated as FTMC in 1929 and continued to serve as a training area.

In 1940, the government acquired an additional 22,245 acres west of FTMC. This tract of land was named Pelham Range. In 1941, the Alabama Legislature leased approximately 4,488 acres to the U.S. government to provide an access corridor from the Main Post to Talladega National Forest. This corridor provides access to additional woodlands for training.

The U.S. Army operated the Chemical Corps School at FTMC from 1951 until the school was deactivated in 1973. The Chemical Corps School offered advance training in all phases of chemical, biological, and radiological warfare to students from all branches of the military service.

To date, ongoing activities at FTMC can be divided into support activities, academic training, and practical training. Support activities include housing, feeding, and moving individuals during training. Academic training includes classroom, laboratory, and field instruction.

Practical training includes weapons, artillery and explosives, vehicle operation and maintenance, and physical and tactical training activities.

1.3 Range J Site Description and History

Range J was a former chemical agent training and disposal area located in the northcentral portion of Pelham Range (Figure 1-1). Range J was reportedly used for personnel training in various facets of chemical warfare exposure including; agent use, detection, chemical waste disposal, and use of decontamination agents. Decontaminating agents were used on chemical warfare agents to reduce and eliminate their hazard after training exercises.

A chain link fence surrounds an area approximately 139 feet long (east to west) by approximately 50 feet wide (north to south) (0.16 acres) and was reportedly used until 1963 for training and chemical agent disposal (Science Application International Corporation [SAIC], 1993) (Figure 1-2). As stated in Section 1.1, the objective of this investigation is to determine whether or not the fenced area is the source of contamination in groundwater and better define the extent of groundwater contamination.

An entrance gate is located in the southeastern section of the chain link fence. A concrete monument is located inside the chain link fence near the entrance gate. Drums containing soil were disposed in a pit located inside the chain link fence. The pit is located in the northwest section of the site and is approximately 10 feet wide (north to south) by 40 feet long (east to west). The fenced area was reportedly used to dispose of drummed soil transported from a 110-gallon distilled mustard (HD) spill that occurred on the main post in 1955. The depth at which the drummed contaminated soil was buried is unknown. Surface topography at the site is generally flat over three-fourths of the site and slopes to the northwest in the western portion of the site near the pit. Generally, Range J is situated on a broad crest that slopes in all directions except to the northeast. The topography northeast of the site is flat. Cane Creek is located approximately 2,200 feet south of the chain link fenced area.

Due to conflicting documentation reported in the environmental baseline survey (EBS) (Environmental Science and Engineering, Inc [ESE], 1998) and in the Enhanced Preliminary Assessment Reports, the exact acreage (size) of Range J is not known. Range J is a small portion of a larger training area reportedly in use since 1954. This larger training area, approximately 60 acres, surrounds the chain link fence. The boundaries of this larger training area are not documented (SAIC, 1995). However, SAIC was not provided with the Environmental Photographic Interpre-

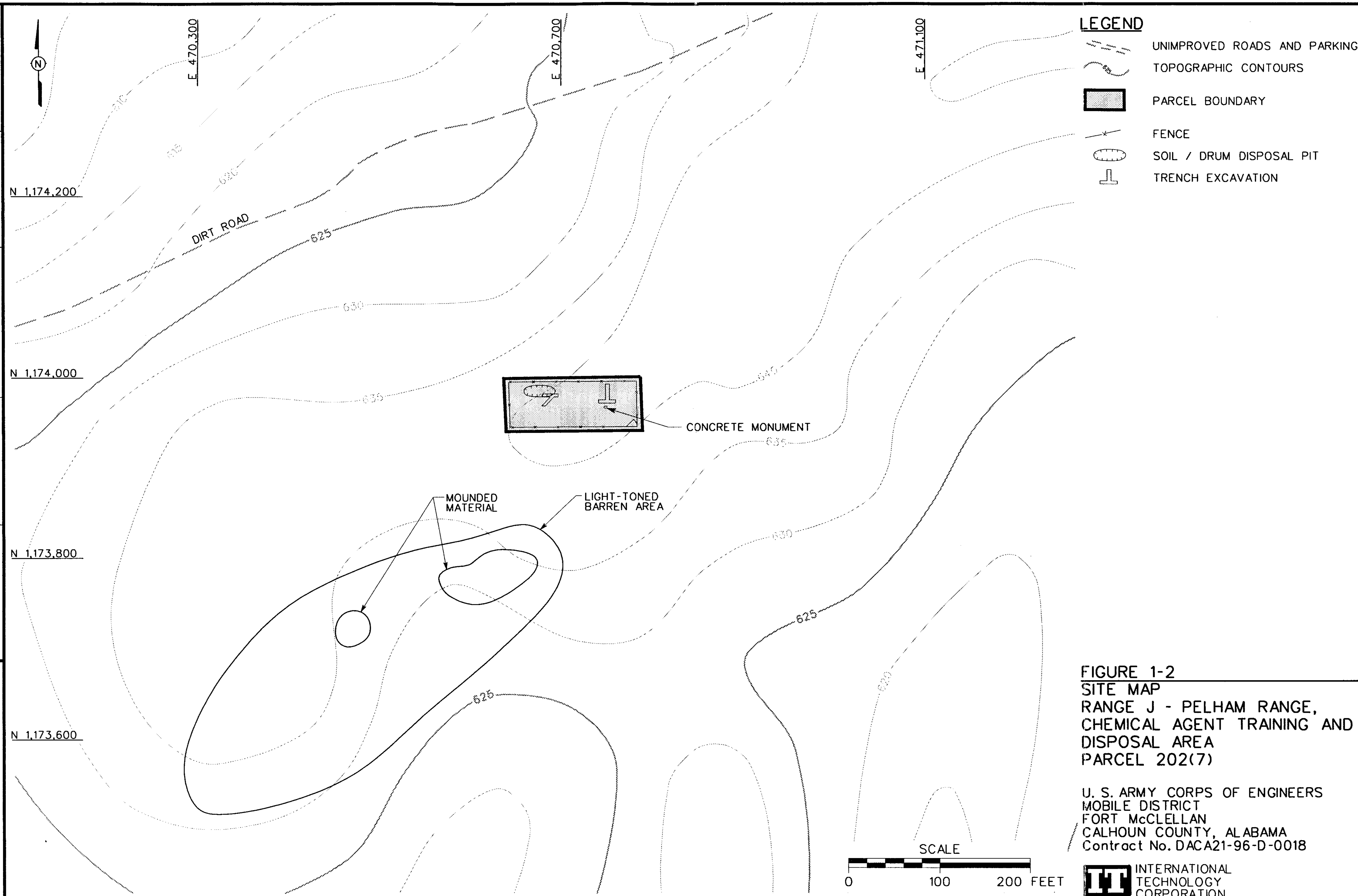

FIGURE 1-2
SITE MAP
RANGE J - PELHAM RANGE,
CHEMICAL AGENT TRAINING AND
DISPOSAL AREA
PARCEL 202(7)

U. S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

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STARTING DATE: 06/24/98	DATE LAST	DRAFT. CHCK. BY:	INITIATOR: J. TARR	DWG. NO. 645es.116
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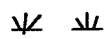
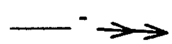
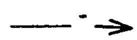
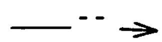
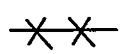
tation Center (EPIC) aerial photographs. Review of aerial photographs prepared by EPIC for the U.S. Army Toxic and Hazardous Materials Agency (USATHMA) indicates Range J was much larger than the reported 60 acres (EPA, 1983). Based on review of aerial photographs taken in 1954, 1957, and 1961, Range J could have been approximately 170 acres (Table 1-1). The following descriptions of anomalies found at Range J were obtained from aerial photographs taken in 1954, 1957, and 1961 (U.S. Environmental Protection Agency [EPA], 1983).

October 21, 1954. Range J appears active with 19 possible tanks (it is unknown if these tanks are aboveground storage tanks or Army vehicles) located on the sides of the eastern entrance road leading into the site. Seven smaller objects stand alongside the northern group of tanks. The eastern entrance road continues across the site, leading to a prominent, light-toned, barren and scarred area at the center of the range. Indistinct, probable mounded material and small objects stand atop the area. A square-shaped pattern of light-toned linear and parallel ground scars covers much of the range. Two heavy scars, possibly ditches, lead roughly northward from the range down to the adjacent road. Other local drainage patterns are noted on the overlay. Several drainage patterns have formed ditches. Several possible barren areas lie along the main roadway west of Range J (EPA, 1983). An aerial photograph with descriptive information of the anomalies described is provided on Figure 1-3.

December 21, 1957. Range J is apparently inactive and has been allowed to revegetate. A line of subtle ground scars and/or darkly vegetated areas mark the location of the previously assembled tanks. Several possible small objects remain. Light-toned, barren area noted in 1954 has largely revegetated; however, several ground scars remain visible in the east and west. Scarring is also evident along the road which leads to the area. The mounded material and small objects previously observed on the area are no longer evident. Dark-toned vegetation is now present immediately northwest of the previous light-toned barren area. The square pattern of light ground scars, which covered the central section of the range in 1954, has also revegetated. Some of the scars remain visible as varying-toned vegetation lines. Drainage patterns around the range are similar to those observed in 1954; however, new ditches are noted to the north of the range. A ditch noted east of the site is now indistinct and appears to support only intermittent drainage. Several of the barren areas along the main roadway west of the range have revegetated. A new scarred area is present northeast of the range, adjacent to the entrance road (EPA, 1983). An aerial photograph with descriptive information of the anomalies described is provided on Figure 1-4.

Table 1-1

Legend for Aerial Photographs
Fenced Area at Range J - Pelham Range, Parcel 202(7)
Fort McClellan, Calhoun County, Alabama

T	Tank
GS	Ground Scar
MM	Mounded Material
SL	Standing Liquid
GST	Ground Stain
	Culvert
	Wetlands
— —	Access Road
	Depressions
	Ditched Drainage
	Drainage
	Intermittent Drainage
	Escarpment
	Fence
— — — —	Historical Boundary

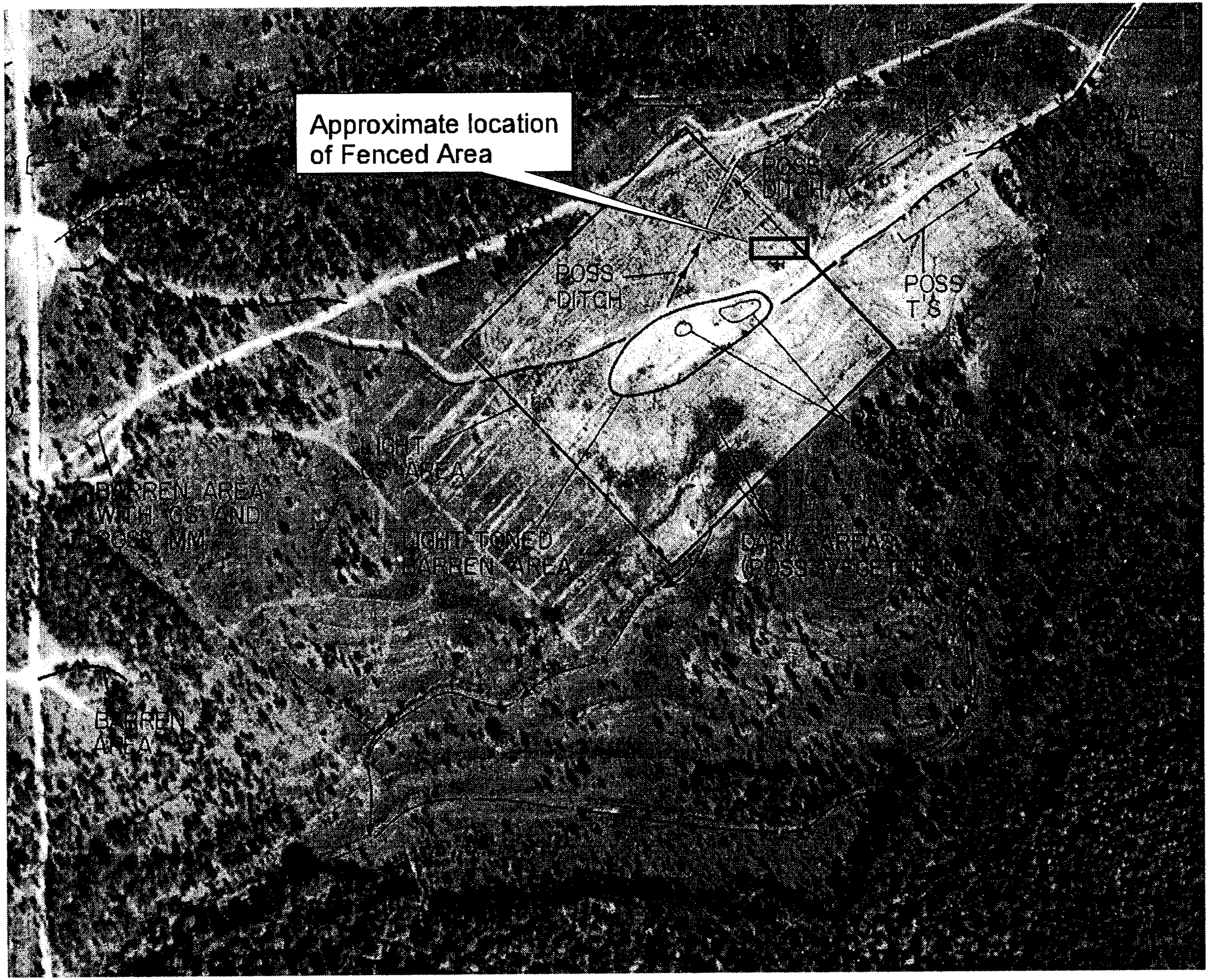


Figure 1-3

Range J - Pelham Range, Chemical Agent Training and Disposal Area
Parcel 202(7)

October 21, 1954
Aerial Photography
Approx. scale 1" = 420'

Source: U.S. EPA, 1983. Installation Assessment, Army Closure Program, Fort McClellan, Anniston, Alabama (TS-PIC-83003). Environmental Photographic Interpretation Center, Environmental Monitoring System Laboratory.

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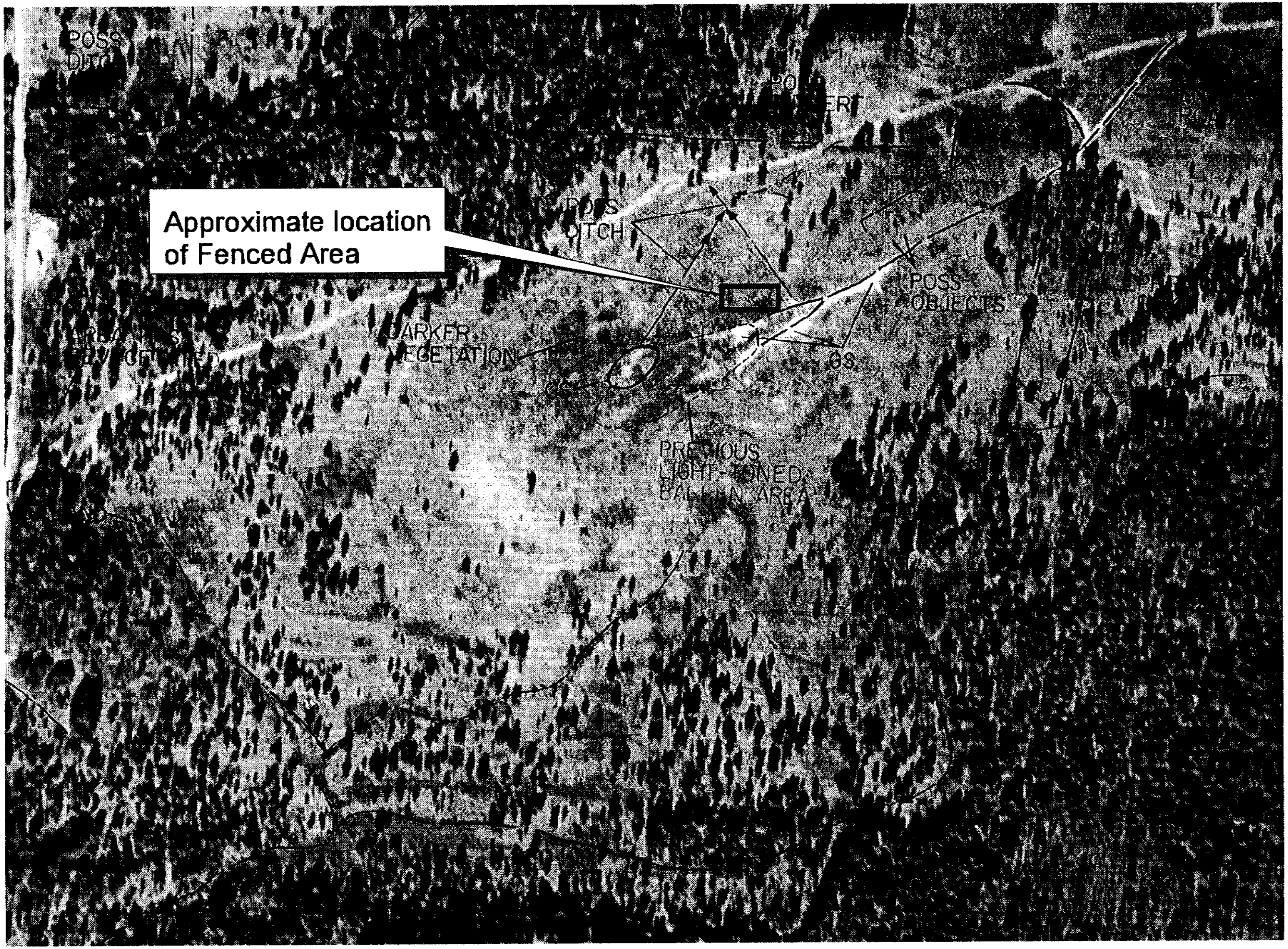

Figure 1-4

Range J - Pelham Range, Chemical Agent Training and Disposal Area Parcel 202(7)

December 21, 1957 Aerial Photography Approx. scale 1" = 442'

Source: U.S. EPA, 1983. Installation Assessment, Army Closure Program, Fort McClellan, Anniston, Alabama (TS-PIC-83003). Environmental Photographic Interpretation Center, Environmental Monitoring System Laboratory.

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February 11, 1961. Activity around Range J has increased, as evidenced by the numerous vehicle trails now in the area. Many of the trails are associated with barren clearings. Several trails lead down to the drainage ditch north of the range; possible mounded material is present along the easternmost of these. The range itself remains in disuse. Earlier ground scars across the surface can still be located by faint variations in vegetation tones. The central light-toned, barren area noted in 1954 continues to revegetate; however, ground scarring east of this area has increased. A depression, possibly containing mounded material or small objects, is present within the largest of these scarred areas. Vehicle access to these areas is still provided by the range entrance road from the east. The ground scars and/or vegetation patches along the entrance road, which marked the previous possible tank locations in 1957, are no longer evident. Barren and scarred areas are visible around Range J, particularly along the main road to the west as in previous years. A new culvert, ditch construction, and ground scarring are noted here. Drainage in the area remains similar to that in 1957 (EPA, 1983). An aerial photograph with descriptive information of the anomalies described is provided on Figure 1-5.

The soil type at Range J is classified as Fullerton Cherty Silt Loam 6 to 10 percent slope (FcC2). Fullerton soil type is generally characterized by strongly acidic, well drained soils that have developed from the residuum of cherty limestone. These soils occur on wide ridges with sloping tops and strongly sloping to moderately steep sides. The permeability of these soils is moderate to rapid. Some places have lost 75 percent of the original surface soil through erosion. The capacity to hold moisture is low to moderate. Natural fertility and organic matter are low.

These soils need larger quantities of all plant nutrients, lime, and organic matter. They respond well to these materials, but a high fertility level is difficult to maintain. The color of the surface soil ranges from yellowish brown to light brown-gray or brown to very brownish gray. Fragments of chert are normal throughout the soils. Depth to groundwater is typically 20 feet or greater. Typically, depth to bedrock is approximately 20 feet or greater (U.S. Department of Agriculture, 1961). However, the actual depth to groundwater at the site is approximately 55 to 70 feet below land surface (bls). Depth to bedrock is approximately 70 feet bls (SAIC, 1995).

1.4 Regional and Site-Specific Geology

FTMC (Main Post) and Pelham Range lie within the Appalachian fold and thrust structural belt (Valley and Ridge province) where southeastward-dipping thrust faults with associated minor folding are the predominant structural features. The fold and thrust belt consists of Paleozoic sedimentary rocks that have been asymmetrically folded and thrust-faulted with major structures

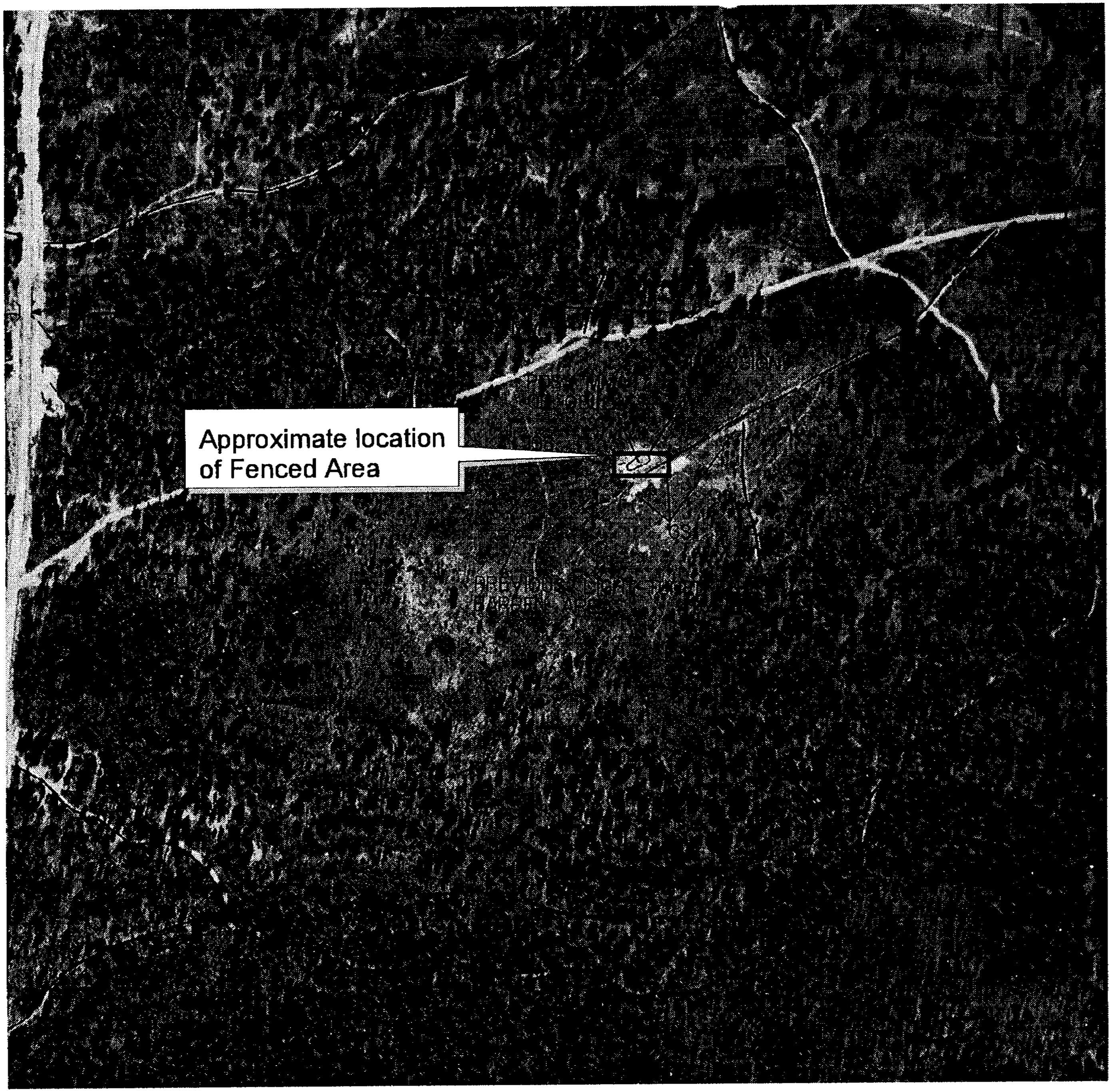

Figure 1-5

Range J - Pelham Range,
Chemical Agent Training
and Disposal Area
Parcel 202(7)

February 11, 1961
Aerial Photography
Approx. scale 1" = 420'

Source: U.S. EPA, 1983.
Installation Assessment, Army Closure
Program, Fort McClellan, Anniston
Alabama (TS-PIC-83003).
Environmental Photographic
Interpretation Center,
Environmental Monitoring
System Laboratory.

U.S. Army Corp of Engineers
Mobile District
Fort McClellan
Calhoun County, Alabama
Contract No. DACA21-96-D-0018

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and faulting striking in a northeast/southwest direction. Northwestward transport of the Paleozoic rock sequence along the thrust faults has resulted in the imbricate stacking of large slabs of rock referred to as thrust sheets. Within an individual thrust sheet, smaller faults may splay off the larger thrust fault, resulting in imbricate stacking of rock units within an individual thrust sheet (Osborne and Szabo 1984). Geologic contacts in this region generally strike parallel to the faults and repetition of lithologic units is common in vertical sequences. Geologic formations within Fort McClellan and Pelham Range have been mapped by Warman and Causey (1962), Osborne and Szabo, (1984) (Geological Survey of Alabama, 1983), and Moser and DeJarnette (1992), and vary in age from Precambrian to Mississippian.

The Cambrian Weisner Formation consists of interlayered shale, siltstone, sandstone, quartzite, and conglomerate and is the basal formation of the sedimentary rock sequence (Warman and Causey, 1962) (Geological Survey of Alabama, 1983). The Weisner Formation is mapped by Osborne and Szabo (1984) as the uppermost formation in the undifferentiated Chilhowee Group (Geological Survey of Alabama, 1983).

The Cambrian Shady Dolomite overlies the Weisner Formation east and south of the Main Post and consists of interlayered limestone and dolomite. The Cambrian Formation is composed of red and green shale and siltstone with thinly interbedded light gray sandstone and calcareous layers. The Rome Formation locally occurs to the northwest and southeast of the Main Post as mapped by Warman and Causey (1962), Osborne and Szabo (1984), and immediately to the west of Reilly Airfield (Geological Survey of Alabama, 1983). The Conasauga Formation also occurs along anticlinal axes in the northeastern portion of Pelham Range (Warman and Causey, 1962) (Geological Survey of Alabama, 1983). The Conasauga Formation is composed of interbedded limestone, dolomite, and shale (SAIC, 1995).

Overlying the Conasauga Formation is the Knox Group, composed of the Copper Ridge and Chepultepec dolomite of Cambro-Ordovician age. The Knox Group carbonates consist of light medium gray, fine to medium crystalline, variably bedded to laminated, siliceous dolostone that weathers to a chert residuum (Osborne and Szabo, 1984) (Geological Survey of Alabama, 1983). The Knox Group underlies a large portion of the Pelham Range area. It is believed that Range J is underlain by the Knox Group. The Knox Group is overlain by Ordovician limestone and shale formations, including the Newala and Longview Limestones, Lenoir Limestone, Athens Shale, Little Oak Limestone, and Chickamauga Limestone. These units occur within an eroded "window" in the uppermost structural thrust sheet at FTMC and underlies much of the developed area of the Main Post. The Devonian Frog Mountain Sandstone consists of sandstone and quartzitic sandstone and locally occurs in the western portion of Pelham Range (SAIC, 1995).

The Mississippian Fort Payne Chert and the Maury Formation overlie the Frog Mountain Sandstone and are composed of claystone with increasing amounts of calcareous chert toward the upper portion of the formation. These units occur in the northwestern portion of Pelham Range. Overlying the Fort Payne Chert is the Floyd Shale, also of Mississippian Age, which consists of thin-bedded, fissile brown to black shale with thin intercalated limestone layers and interbedded sandstone. The Floyd Shale, which was mapped by Warman and Causey (1962) on the Main Post of Fort McClellan, was reassigned to the Ordovician Athens Shale by Osborne and Szabo (1984) (Geological Survey of Alabama, 1983) on the basis of fossil data (SAIC, 1998). A stratigraphic column (Moser and DeJarnette, 1992) for the FTMC area is shown in Appendix A.

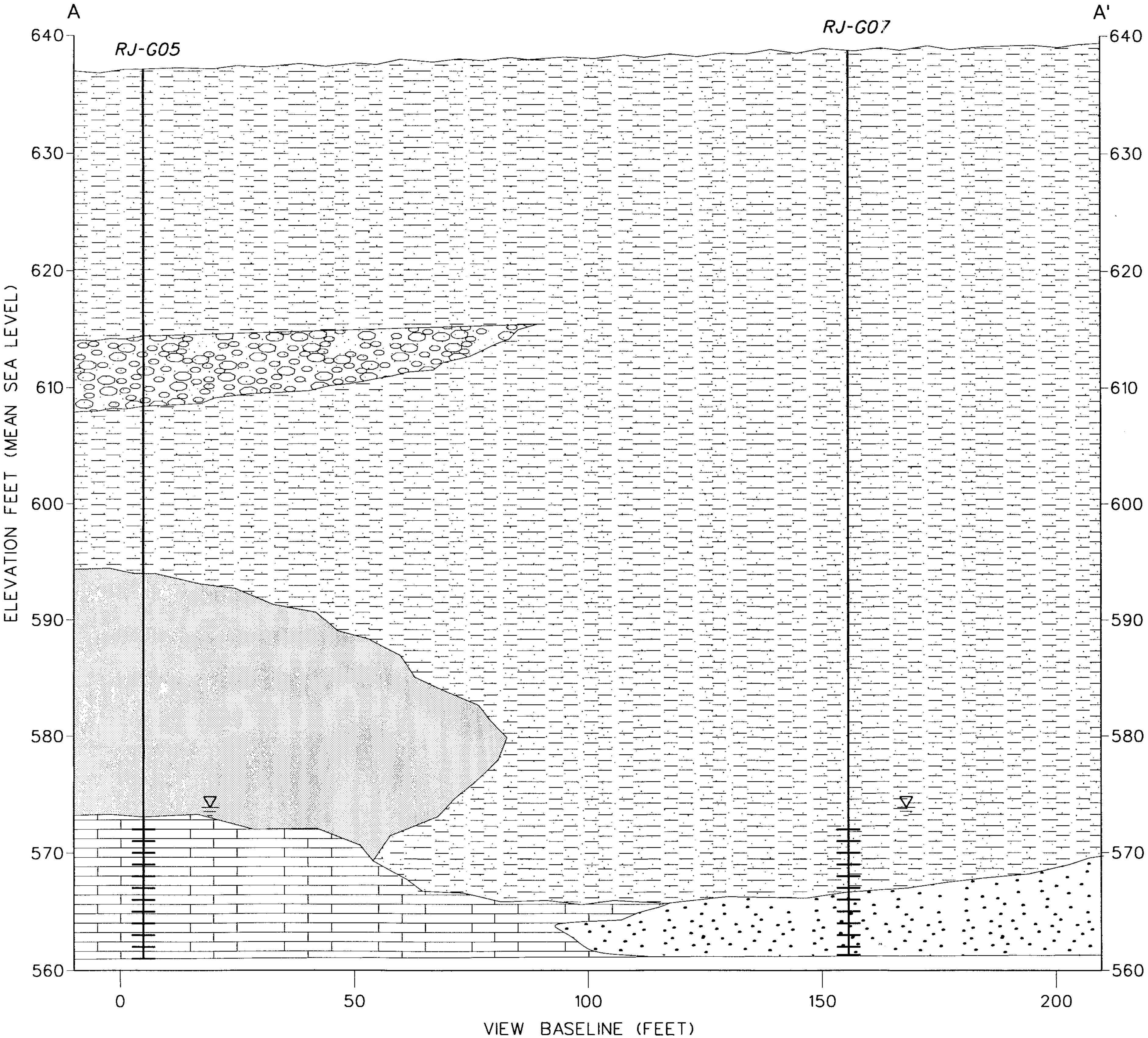
The Jacksonville Thrust Fault is the most significant structural geologic feature in the vicinity of FTMC, both for its role in determining the stratigraphic relationships in the area and for its contribution to regional water supplies. The trace of the fault extends northeastward for approximately 39 miles between Bynum, Alabama and Piedmont, Alabama. The fault is interpreted as a major splay of the Pell City fault (Osborne and Szabo, 1984) (Geological Survey of Alabama, 1983). The Ordovician sequence comprising the Eden thrust sheet is exposed at FTMC through an eroded "window" or "fenster" in the overlying thrust sheet. The FTMC window is framed on the northwest by the Rome and Conasauga formations, and by the Knox Group (SAIC, 1998). The window at FTMC presents problems in interpreting the structural style of the Jacksonville fault. The Jacksonville thrust fault slicing through the Pell City thrust sheet stratigraphy (Chilhowee Group, Rome Formation, Conasauga Formation, and Knox Group), and the presence of the lower level Eden block stratigraphy (Ordovician) limit the number of possible structural interpretations available. It is suggested that the window exposed rocks of the Eden thrust sheet below the position where the Jacksonville fault splays off of the Pell City fault. Based on present study, the Jacksonville fault is interpreted as a major splay off of the Pell City fault. Displacement on the fault decreases southwest of FTMC where the fault terminates on the foreland side of a large, southwest-plunging, imbricated, anticlinal fold that forms Coldwater Mountain. The anticline presumably formed when the leading edge of the thrust sheet warped as the Jacksonville fault ramped from a lower decollement level to a higher level. At Piedmont, near its northeast terminus, the Jacksonville fault terminates as a set of two splays on which the Chilhowee Group and Shady Dolomite plunge steeply to the northeast beneath the overlying Rome and Conasauga Formations. Northeast of Piedmont, the Jacksonville fault splays are at the same stratigraphic level as similar splays on the Pell City fault to the northwest. Thus, the Jacksonville fault and the overlying rock sequence are interpreted as a major thrust slice within the Pell City thrust sheet. The Jacksonville thrust slice terminates laterally on the northwest limb of an imbricated, plunging anticline at its southwestern terminus, and as two of a sequence of major imbricate splays in the Pell City thrust sheet at its northeast terminus (Geological Survey of Alabama, 1983).

Exposures of the Jacksonville Fault are rare because of deep weathering and thick colluvium accumulation. The fault contact has been observed (Osborne and Szabo, 1984) in an excavated trench at FTMC and was marked by approximately 6 feet of brecciated shale and mudstone in thrust contact with residuum of Shady Dolomite (Geological Survey of Alabama, 1983). The Jacksonville Fault is thought to provide a principal reservoir and conduit for groundwater movement in the region, including the consistent supply of groundwater to Coldwater Spring. Coldwater Spring has supplied water to the Anniston and FTMC areas since 1890, producing an average of 32 million gallons per day (Moser and DeJarnette, 1992). Large-scale lineaments have been mapped by the Geological Survey of Alabama, 1983 (Guthrie, 1993) from satellite imagery with conjugate lineament sets trending northeast-southwest and northwest-southeast crossing regional geological structures (SAIC, 1995).

The geologic conditions at the Range J site were assessed using monitoring well lithologic logs prepared by SAIC during the supplemental RI monitoring well installation program. In general, the sediments at Range J site are undifferentiated yellowish red to brownish red clayey-sand to sandy-clay with abundant white to light brownish-yellow chert fragments from land surface to approximately 65 feet bls. These deeper sediments are apparently part of the Lower Ordovician to Upper Cambrian undifferentiated Knox Group sediments. A geologic cross section showing the site geology is presented on Figure 1-6. Light gray to light brown, moderately weathered, well cemented, hard, fractured calcareous sandy limestone and sandstone was encountered from approximately 65 feet bls to approximately 78 feet bls.

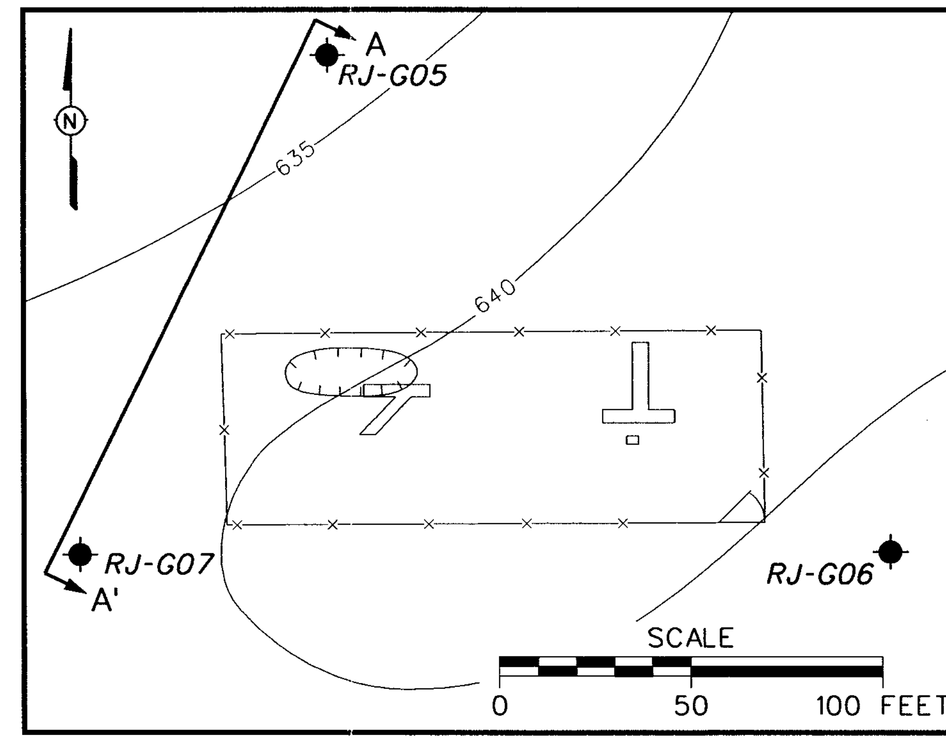
1.5 Site-Specific and Regional Hydrogeology

A hydrogeologic assessment of regional groundwater flow patterns to determine the approximate groundwater flow directions with respect to the various geologic units, surface water bodies, and known subsurface conduit (thrust fault) features in the area surrounding FTMC and Pelham Range has not been conducted. Aquifers in the vicinity of FTMC and Pelham Range are developed in residuum derived from bedrock decomposition; within fractured bedrock; along fault zones; and from the development of karst frameworks. Although detailed characterizations of



LEGEND

- SILTY - CLAYEY SANDS
- GRAVELLY - SILT
- CLAY
- CALCAREOUS SANDY LIMESTONE (BEDROCK)
- CALCAREOUS SANDSTONE (BEDROCK)
- WATER LEVEL ELEVATION BELOW LAND SURFACE, FEBRUARY 1995



SCALE
0 10 20 FEET
VERTICAL SCALE

SCALE
0 100 200 FEET
HORIZONTAL SCALE

SOURCE: SAIC, REMEDIAL INVESTIGATION REPORT, RANGE J - PELHAM RANGE, 1995.

FIGURE 1-6
GEOLOGIC CROSS-SECTION A-A'
RANGE J - PELHAM RANGE,
CHEMICAL AGENT TRAINING AND
DISPOSAL AREA
PARCEL 202(7)

U. S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

INTERNATIONAL
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DWG. NO. 774645es.115 | PROJ. NO. 774645 | INITIATOR: J. TARR | PROJ. MGR.: J. YACOUB | DRAFT. CHCK. BY: | ENGR. CHCK. BY: A. MAYILA | DATE LAST | DRAWN BY: | STARTING DATE: 06/16/98 | DRAWN BY: D. BILLINGSLEY

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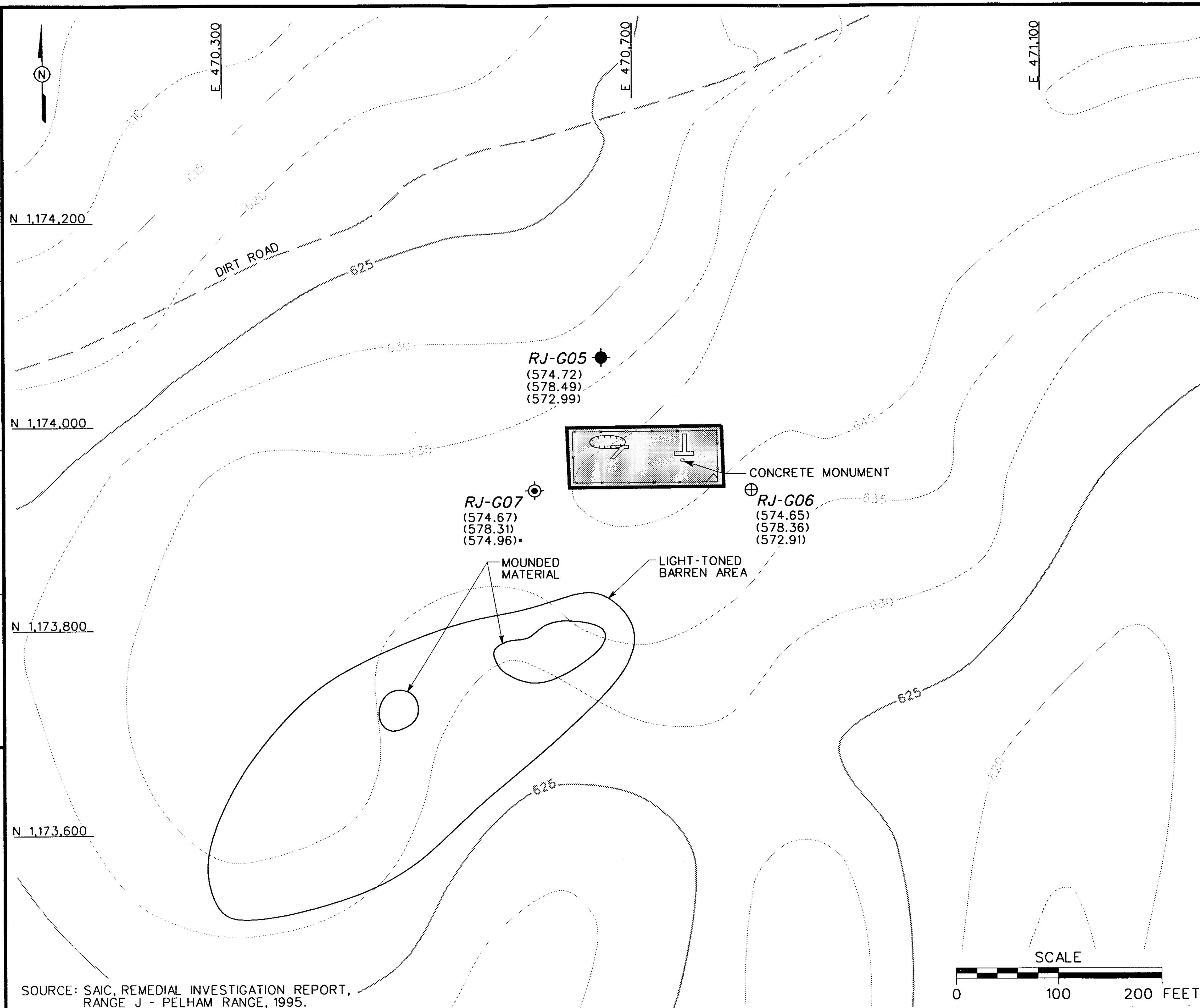
groundwater movement in the region have not been conducted, the ultimate flow of groundwater may be estimated to be toward major surface water features. However, because of the impacts of differential weathering, variable fracturing, and the potential for conduit flow development, the use of surface topography as an indicator for groundwater flow direction must be used with caution in the area. Areas with well-developed residuum horizons may subtly reflect the surface topography, but the groundwater flow direction also may exhibit the influence of pre-existing structural fabrics or the presence of perched water horizons on unweathered ledges or boulders. Because of the various geologic factors described above, the extension of groundwater elevation contours over distances on the size and scale of FTMC and Pelham Range is not practical without closely spaced control points (SAIC, 1998).

Precipitation in the form of rain is the source of most groundwater in Calhoun County. The thrust fault zones typical of the county form large storage reservoirs for groundwater. Precipitation and subsequent infiltration provide recharge to the groundwater flow system. Points of discharge occur as springs, effluent streams, and lakes. Shallow groundwater on FTMC occurs principally in the residuum developed from Cambrian sedimentary and carbonate bedrock units of the Weisner Formation and locally in lower Ordovician carbonates. Bedrock permeability may be locally enhanced by fracture zones associated with thrust faults and by the development of solution (karst) features (predominantly on Pelham Range).

Several sinkholes have been mapped within Pelham Range boundaries (SAIC, 1998).

Groundwater elevations at the site were calculated by measuring depth to groundwater relative to top-of-casing elevations in each of the three existing monitoring wells RJ-G05, RJ-G06, and RJ-G07. Groundwater elevations were measured on February, April, and June, 1995. A groundwater elevation map is shown on Figure 1-7. Groundwater monitoring well construction and elevation data are presented in Table 1-2. The local groundwater flow direction at the site could not be determined using the existing data from the three monitoring wells installed by SAIC. However, Range J is located on a topographical high and it appears the groundwater flow direction in the residuum aquifer may flow radially away from the site in all directions. The groundwater flow in the bedrock aquifer is towards the west/northwest in the direction of the Coosa River (U.S. Department of the Army, 1977). The local groundwater flow direction in the residuum and bedrock aquifers will be determined after additional monitoring wells are installed during the supplemental RI field investigation. The three monitoring wells installed by SAIC have been renamed by IT to simplify the field investigation. All future work will report the wells



SOURCE: SAIC, REMEDIAL INVESTIGATION REPORT, RANGE J - PELHAM RANGE, 1995.

LEGEND

- UNIMPROVED ROADS AND PARKING
- TOPOGRAPHIC CONTOURS
- PARCEL BOUNDARY
- FENCE
- SOIL / DRUM DISPOSAL PIT
- TRENCH EXCAVATION
- EXISTING RESIDUUM/BEDROCK MONITORING WELL
- EXISTING BEDROCK MONITORING WELL
- EXISTING RESIDUUM MONITORING WELL
- (574.72) GROUNDWATER ELEVATION IN FEET; (FEBRUARY 1995)
- (578.49) GROUNDWATER ELEVATION IN FEET; (APRIL 1995)
- (572.99) GROUNDWATER ELEVATION IN FEET; (JUNE 1995)

NOTES:

1. ALL GROUNDWATER ELEVATIONS ARE IN FEET ABOVE SEA LEVEL.
2. * - POSSIBLE ERRONEOUS GROUNDWATER ELEVATION

FIGURE 1-7
GROUNDWATER ELEVATION MAP, FEBRUARY, APRIL, AND JUNE 1995
RANGE J - PELHAM RANGE, CHEMICAL AGENT TRAINING AND DISPOSAL AREA
PARCEL 202(7)

U. S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

INTERNATIONAL TECHNOLOGY CORPORATION

DWG. NO.: 774645es.113
PROJ. NO.: 774645
INITIATOR: J. TARR
PROJ. MGR.: J. YACOUB
DRAFT. CHCK. BY:
ENGR. CHCK. BY: A. MAYILA
DATE LAST REV.:
DRAWN BY:
STARTING DATE: 06/16/98
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Table 1-2

Groundwater Elevation Data
1994 Remedial Investigation
Fenced Area at Range J - Pelham Range, Parcel 202(7)
Fort McClellan, Calhoun County, Alabama

SAIC Monitoring Well Number	IT Monitoring Well Number	Screened Interval (feet-msl)	Measuring Point Elevation (feet-msl)	Feb-95		April 1995		June 1995	
				Depth to Water (feet-bls)	Water Level Elevation (feet-bls)	Depth to Water (feet-bls)	Water Level Elevation (feet-bls)	Depth to Water (feet-bls)	Water Level Elevation (feet-bls)
RJ-G05	RJR-202-MW01	63 to 73	636.44	61.72	574.72	57.95	578.49	63.45	572.99
RJ-G06	RJR-202-MW02	70 to 80	640.06	65.41	574.65	61.70	578.36	67.15	572.91
RJ-G07	RJR-202-MW03	60 to 70	640.47	65.80	574.67	62.16	578.31	65.51	574.96[a]

[a]Possible erroneous water level measurement.

IT - IT Corporation.
SAIC - Science Application International Corporation.
msl - Mean sea level.
Source: Science Applications International Corporation, *Remedial Investigation Report*, August, 1995.

with the new IT well designation and the previous well designation. Table 1-2 provides the SAIC monitoring well number and the new IT monitoring well number for each of the three existing monitoring wells.

1.6 Scope of Work

The scope of work for activities associated with the supplemental RI of the Fenced Area at Range J site, as specified in the statement of work (USACE, 1998a), includes the following tasks:

- Develop the supplemental RI SFSP attachment
- Develop the supplemental RI SSHP attachment
- Provide Miniature Continuous Air Monitoring System (MINICAM) support for intrusive drilling to determine buried downhole hazards
- Conduct a surface and near surface UXO survey over all areas to be included in the sampling effort.
- Provide downhole UXO support for all intrusive direct-push and drilling activity to determine the presence of potential downhole hazards.
- Install 13 groundwater monitoring wells.
- Collect 24 surface soil samples, 24 subsurface soil samples, and collect 16 groundwater samples (groundwater samples will be collected from 3 existing and 13 new monitoring wells).

At completion of the field activities and sample analyses, draft and final supplemental RI summary reports will be prepared. Reports will be prepared in accordance with current U.S. Environmental Protection Agency (EPA) Region IV and the Alabama Department of Environmental Management (ADEM) requirements.

2.0 Summary of Existing Environmental Studies

ESE conducted an environmental baseline survey (EBS) to document current environmental conditions of all FTMC property (ESE, 1998). The study identified sites that, based on available information, have no history of contamination and comply with U.S. Department of Defense (DOD) guidance on fast-track cleanup at closing installations. The EBS also provides a baseline picture of FTMC properties by identifying and categorizing the properties by seven criteria.

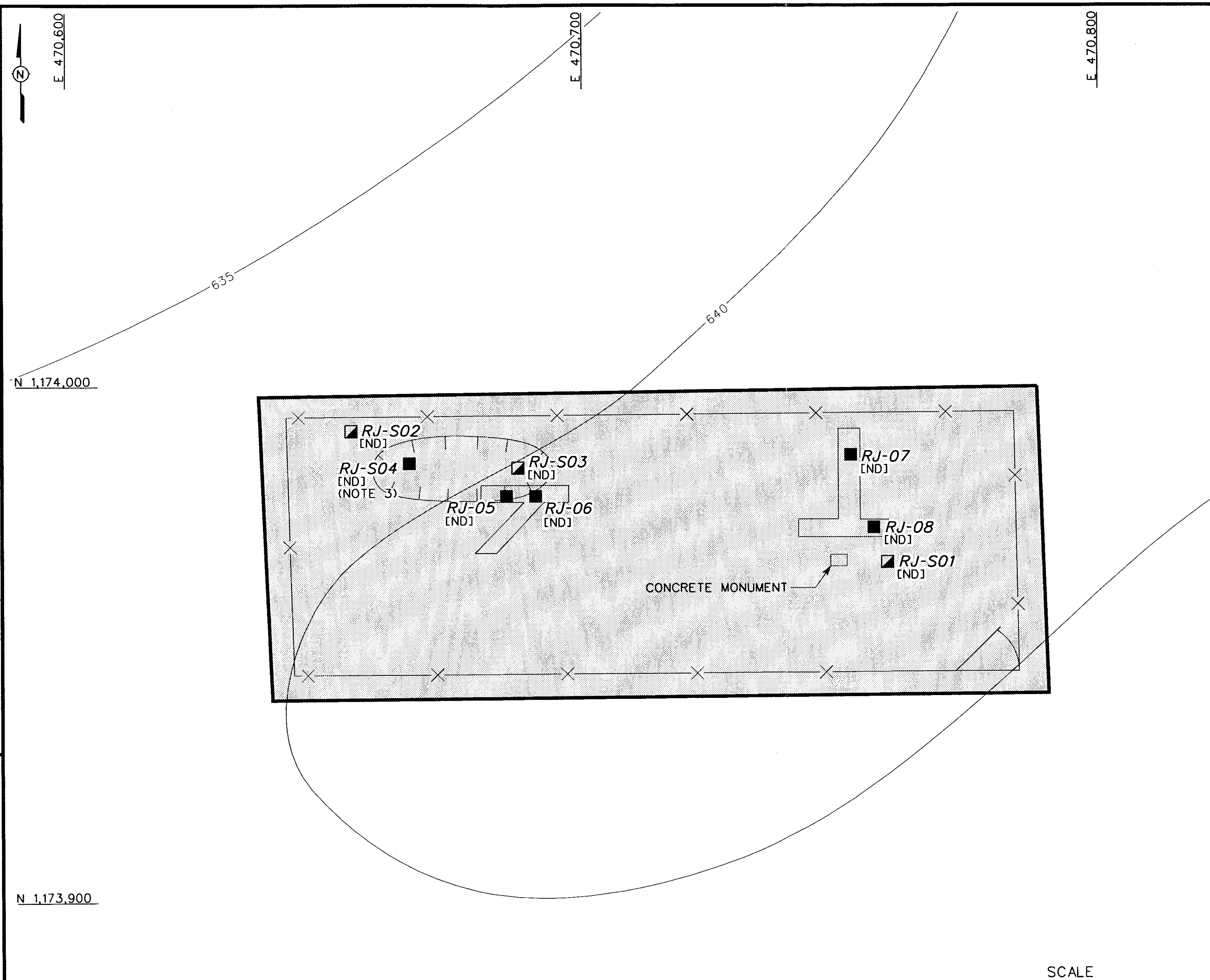
1. Areas where no storage, release, or disposal (including migration) has occurred.
2. Areas where only storage has occurred.
3. Areas of contamination below action levels.
4. Areas where all necessary remedial actions have been taken.
5. Areas of known contamination with removal and/or remedial action underway.
6. Areas of known contamination where required response actions have not been taken.
7. Areas that are not evaluated or require further evaluation.

The EBS was conducted in accordance with the Community Environmental Response Facilitation Act (CERFA) (CERFA-Public Law 102-426) protocols and DOD policy regarding contamination assessment. Record searches and reviews were performed on all reasonably available documents from FTMC, Alabama Department of Environmental Management (ADEM), EPA Region IV, and Calhoun County, as well as a database search of Comprehensive Environmental Response, Compensation, and Liability Act-regulated substances, petroleum products, and Resource Conservation and Recovery Act-regulated facilities. Available historic maps and aerial photographs were reviewed to document historic land uses. Personal and telephone interviews of past and present FTMC employees and military personnel were conducted. In addition, visual site inspections were conducted to verify conditions of specific property parcels.

SAIC conducted an initial site investigation (SI) in 1992 to determine the presence or absence of potential environmental contamination resulting from previous military training activities at the site. In April, 1992, three soil borings RJ-S01, RJ-S02, and RJ-S03 were advanced at the site. Soil sample locations were chosen based on suspected anomalies (disturbed soils, buried drums, soil discoloration, etc) detected by reconnaissance geophysical surveys (electromagnetics and metal detection). The soil samples were collected and screened in the field for chemical warfare agents, namely HD, using MINICAMS. The MINICAMS are capable of responding to 0.003 milligrams per cubic meter for HD in less than 5 minutes with alarm capabilities (U.S. Army Engineering Center, 1995). The soil samples were collected by the U.S. Army Technical Escort Unit (USATEU) with SAIC oversite. The USATEU determined that CWA were not present at the locations sampled using the MINICAMS (SAIC, 1995).

In addition to the field screening, two soil samples were collected from each of the three soil borings at 1 foot bls and 5 feet bls. One soil sample (RJ-S04) was collected from a drum located in the soil/drum disposal pit area. The soil samples were analyzed for HD breakdown products, using USATHMA Method LL03 (organosulfur compounds including 1,4-oxathiane, 1,4-dithiane, p-chlorophenylmethylsulfoxide, and p-chlorophenylmethylsulfone) and USATHMA Method LW18 (Thiodiglycol and Chloroacetic Acid). Soil samples from the three soil borings and the soil sample from the drum did not indicate the presence of HD breakdown products between a detection limit of 0.9 parts per billion (ppb) and 3.9 ppb. The location of the soil borings and soil samples collected during the SI field investigation are shown on Figure 2-1. Findings from the SI field investigation led to a supplemental RI. The supplemental RI was conducted in 1994 and 1995 to determine the presence, nature, and extent of potential environmental contamination resulting from previously controlled U.S. Army CWA training activities and chemical waste disposal activities at the site. The investigations included the following:

- Field screening of CWA using MINICAMS
- Digging trench excavations to collect surface and subsurface soil samples for chemical analysis of CWA
- Performing a surface electromagnetic (EM) geophysical survey to detect buried metallic material, potential contaminant source boundaries, and investigate the nature of potential subsurface anomalies.
- Delineate potential source boundaries and investigate the nature of potential subsurface buried materials
- Drilling and installation of groundwater monitoring wells and groundwater sampling and analysis.



LEGEND

- TOPOGRAPHIC CONTOURS
- PARCEL BOUNDARY
- FENCE
- SOIL / DRUM DISPOSAL PIT
- TRENCH EXCAVATION
- SI — SITE INVESTIGATION
- RI — REMEDIAL INVESTIGATION
- EXISTING SURFACE AND SUBSURFACE SOIL SAMPLE (SI SAMPLE APRIL, 1992)
- EXISTING SURFACE SOIL SAMPLE (RI SAMPLE, 1995)

NOTES

1. ALL SURFACE SOIL SAMPLES COLLECTED AT APPROXIMATE 1' BELOW LAND SURFACE (bls). ALL SUBSURFACE SOIL SAMPLES COLLECTED AT APPROXIMATE 5' bls.
2. ALL SAMPLES WERE ANALYZED FOR HD BREAKDOWN PRODUCTS; THIODIGLYCOL AND ORGANOSULFUR COMPOUNDS.

   [ND] NONE DETECTED

   HD DISTILLED MUSTARD

3. SAMPLE RJ-S04 WAS COLLECTED FROM A CORRODED DRUM EXPOSED AT GROUND SURFACE.

SOURCE: SAIC, SITE INVESTIGATION REPORT, AUGUST 1993
SAIC, REMEDIAL INVESTIGATION REPORT, AUGUST 1995

FIGURE 2-1
SOIL SAMPLE LOCATION MAP, 1992 AND 1995
RANGE J - PELHAM RANGE, CHEMICAL AGENT TRAINING AND DISPOSAL AREA
PARCEL 202(7)

U. S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

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STARTING DATE: 06/16/98	DATE LAST	DRAFT. CHCK. BY:	INITIATOR: J. TARR	DWG. NO. 774645es.117
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The investigations were conducted under the direction of the USATEU, with the assistance of the U.S. Army Environmental Center. In addition, an EM geophysical survey was conducted to detect buried metallic materials at proposed soil boring locations. The data obtained from the EM survey was used to place soil borings in safe locations because of the potential for encountering ordnance or CWA that may have been buried at the site.

In 1995, the USATEU, with oversight by SAIC personnel, excavated two test pit trenches using a backhoe at the site. The trenches were excavated to collect soil samples for HD breakdown products. One trench was located near the soil/drum disposal pit and the second trench was located north of the concrete monument. Trench locations were chosen based on anomalies detected from the electromagnetic geophysical survey, historical documentation of past site activities, and review of air photographs. These anomalies included the presence of disposed drums, soil disturbance, and soil discoloration. Four soil samples, RJ-S05, RJ-S06, RJ-S07, and RJ-S08 were collected from the trench excavations for laboratory analysis. The soil samples were collected from the backhoe bucket during trenching operations. Samples RJ-S05 and RJ-S06 were collected from the trench located near the soil/drum disposal pit. Samples RJ-S07 and RJ-S08 were collected from the trench located north of the concrete monument. The four soil samples were analyzed for HD breakdown products, which include thiodiglycol, organosulfur compounds, and chloroacetic acid. HD breakdown compounds were not detected in the four soil samples collected. The locations of the soil samples are shown on Figure 2-1.

Soil contaminated with HD and disposed inside the chain link fence would have been decontaminated under military protocol using supertropical bleach (STB) and/or Decontamination Solution Number 2 (DS2) (SAIC, 1995). Decontamination agent (noncorrosive) (DANC), STB and DS2 were probably used on soil contaminated with chemical warfare agents, including HD. DANC was developed prior to World War II and in 1,1,2,2-tetrachloroethane (acetylene tetrachloride) solution, was adopted as a satisfactory HD decontaminant in small scale operations. DANC is an effective decontaminant for arsenicals, if sufficient time is allowed for it to react. STB is a white powder containing 30 percent available chlorine. STB is referred to as bleach, supertropical bleach, bleaching powder, bleaching material, and chlorinated lime. DS2 is a general-purpose decontaminant that reacts with HD to effectively reduce their hazard within 5 minutes of application. It is effective for all toxic chemical agents (U.S. Department of the Army and Air Force, 1963).

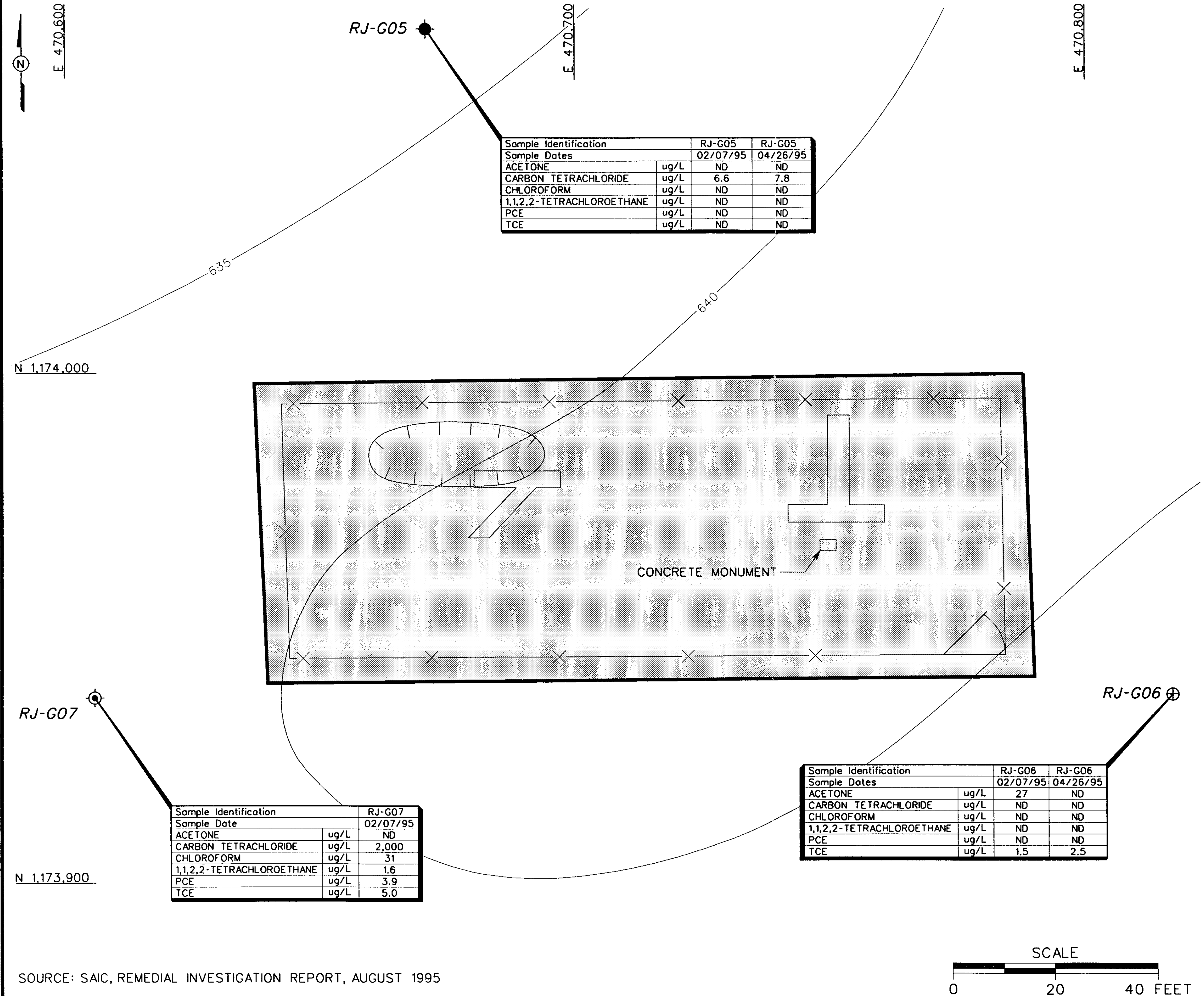
Three groundwater monitoring wells RJ-G05, RJ-G06, and RJ-G07 were installed at Range J during the 1994 RI field investigation (Figure 2-2). Groundwater samples from monitoring well RJ-G05 and RJ-G06 were collected and sampled on February 7 and April 26, 1995. Groundwater samples from monitoring well RJ-G07 were collected and sampled on February 7, 1995. The groundwater samples were analyzed for HD breakdown products; thiodiglycol, organosulfur compounds, chloroacetic acid, and volatile organic compounds (VOC). None of the samples analyzed indicated the presence of HD breakdown products. VOCs were detected in each of the three groundwater samples collected. A summary of organic compounds detected in groundwater are presented on Table 2-1. The locations and VOC concentrations in groundwater from each of the three monitoring wells installed by SAIC are shown on Figure 2-2.

Carbon tetrachloride was detected in groundwater samples collected from monitoring wells RJ-G05 and RJ-G07, ranging in concentration from 7.8 micrograms per liter (μg/L) to 2,000 μg/L, respectively. The highest concentration was detected in monitoring well RJ-G07 at 2,000 μg/L. Carbon tetrachloride was not detected in the groundwater sample collected from monitoring well RJ-G06.

Trichloroethene (TCE) was detected in groundwater samples collected from monitoring wells RJ-G06 and RJ-G07, ranging in concentration from 1.5 μg/L to 5 μg/L. The highest concentration was detected in monitoring well RJ-G07 at 5 μg/L. TCE was not detected in the groundwater sample collected from monitoring well RJ-G05.

Tetrachloroethene (PCE) (3.9 μg/L), 1,1,2,2-tetrachloroethane (1.6 μg/L), and chloroform (31 μg/L) were detected in groundwater samples collected from monitoring well RJ-G07. PCE, 1,1,2,2-tetrachloroethane, and chloroform were not detected in the groundwater samples collected from monitoring well RJ-G05 or monitoring well RJ-G06.

Chemicals used as decontaminating agents may be either inorganic or organic materials which contain chlorine readily available for use as an oxidizing or chlorinating agent. Inorganic materials include bleach in various forms, calcium hypochlorite, and chlorine itself. Inorganics decontaminate by oxidation and are used for large-scale decontamination. Organic compounds include the chloroamides and closely related compounds. Organic compounds decontaminate in the absence of moisture, by chlorination and, in the presence of moisture, by oxidation. These compounds were usually dissolved in an organic solvent such as carbon tetrachloride or 1,1,2,2-tetrachloroethane (acetylene tetrachloride. However, organic materials are expensive and were



Sample Identification		RJ-G05	RJ-G05
Sample Dates		02/07/95	04/26/95
ACETONE	ug/L	ND	ND
CARBON TETRACHLORIDE	ug/L	6.6	7.8
CHLOROFORM	ug/L	ND	ND
1,1,2,2-TETRACHLOROETHANE	ug/L	ND	ND
PCE	ug/L	ND	ND
TCE	ug/L	ND	ND

Sample Identification		RJ-G07
Sample Date		02/07/95
ACETONE	ug/L	ND
CARBON TETRACHLORIDE	ug/L	2,000
CHLOROFORM	ug/L	31
1,1,2,2-TETRACHLOROETHANE	ug/L	1.6
PCE	ug/L	3.9
TCE	ug/L	5.0

Sample Identification		RJ-G06	RJ-G06
Sample Dates		02/07/95	04/26/95
ACETONE	ug/L	27	ND
CARBON TETRACHLORIDE	ug/L	ND	ND
CHLOROFORM	ug/L	ND	ND
1,1,2,2-TETRACHLOROETHANE	ug/L	ND	ND
PCE	ug/L	ND	ND
TCE	ug/L	1.5	2.5

SOURCE: SAIC, REMEDIAL INVESTIGATION REPORT, AUGUST 1995

LEGEND

- TOPOGRAPHIC CONTOURS
- PARCEL BOUNDARY
- FENCE
- SOIL / DRUM DISPOSAL PIT
- TRENCH EXCAVATION
- EXISTING RESIDUUM/BEDROCK MONITORING WELL
- EXISTING BEDROCK MONITORING WELL
- EXISTING RESIDUUM MONITORING WELL

NOTES

1. ALL GROUNDWATER SAMPLES WERE ANALYZED FOR HD BREAKDOWN COMPOUNDS; THIODIGLYCOL, ORGANOSULFUR COMPOUNDS AND VOCs.
2. ALL SAMPLES ANALYZED FOR HD BREAKDOWN COMPOUNDS WERE BELOW DETECTION LIMITS:

HD	DISTILLED MUSTARD
VOCs	VOLATILE ORGANIC COMPOUNDS
ug/L	MICROGRAMS/LITER (PARTS PER BILLION)
TCE	TRICHLOROETHENE
PCE	TETRACHLOROETHENE

FIGURE 2-2
ORGANIC COMPOUND CONCENTRATIONS IN GROUNDWATER, 1995
RANGE J - PELHAM RANGE, CHEMICAL AGENT TRAINING AND DISPOSAL AREA
PARCEL 202(7)

U. S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

INTERNATIONAL TECHNOLOGY CORPORATION

DWG. NO.: 774645es.118 | PROJ. NO.: 774645
INITIATOR: J. TARR | PROJ. MGR.: J. YACOUB
DRAFT. CHCK. BY: | ENGR. CHCK. BY: A. MAYILA
DATE LAST REV.: | DRAWN BY:
STARTING DATE: 06/16/98 | DRAWN BY: D. BILLINGSLEY
30 OCT 98 12:37:06
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Table 2-1

Summary of Detected Analytes for Monitor Well Sample Data
1994/1995 Remedial Investigation[a]
Fenced Area at Range J - Pelham Range, Parcel 202(7)
Fort McClellan, Calhoun County, Alabama

Site ID (Monitor Well Number):		RJ-G05	RJ-G05	RJ-G06	RJ-G06	RJ-G06	RJ-G07
Field Sample Number:		SAIC01	SAIC02	SAIC01	SAIC02	SAIC03	SAIC02
Laboratory Sample Number:		UC0046	UC00995	UC00467	UC00468D	UC00954	UC00469
Site Type:		Well	Well	Well	Well	Well	Well
Sample Matrix:		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Collection Date:		02/07/95	04/26/95	02/07/95	02/07/95	04/26/95	02/07/95
Depth (bls):		61.62	57.87	65.2	65.2	61.54	66.72
QC Sample		Original	Original	Original	Duplicate	Original	Original
Parameters	Units						
Acetone	μg/L	ND (8)	ND (8)	ND (8)	27 D	ND (8)	ND (8)
Carbon Tetrachloride	μg/L	6.6	7.8	ND (1)	ND (1 D)	ND (1)	2,000
Chloroform	μg/L	ND (1)	ND (1)	ND (1)	ND (1D)	ND (1)	31
1,1,2,2-Tetrachloroethane	μg/L	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5 D)	ND (1.5)	1.6
PCE	μg/L	ND (1)	ND (1)	ND (1)	ND (1 D)	ND (1)	3.9
TCE	μg/L	ND (1)	ND (1)	1.5	1.4 D	2.5	5

[a]Science Applications International Corporation (SAIC), 1995, *Remedial Investigation Report, Fort McClellan, Alabama*, August.

ND - Not detected at the reporting limit in the parenthesis (X).
μg/L - Micrograms per liter (ppb).
ppb - Parts per billion.
TCE - Trichloroethene.
PCE - Tetrachloroethene.
bls - Below land surface.
D - Diluted sample.

used only for small scale operations such as destroying a blister agent on equipment (U.S. Department of the Army and Air Force, 1963).

The organic solvents detected in groundwater at Range J; carbon tetrachloride, 1,1,2,2-tetrachloroethane, PCE, and TCE are most likely associated with the use of DANC, chloroacetophenone, benzene, and carbon tetrachloride (CNB), and chloroacetophenone, chloropicrin, and chloroform (CNS). Because the primary source of carbon tetrachloride from military activities was the usage, storage, and/or manufacture of tearing agents (CNB and CNS) or from usage as a degreaser, the detected contamination at Range J may be unrelated to activities that occurred within the chain link fence. The carbon tetrachloride detected in groundwater may be a result of the use of tearing agents CNB and CNS used outside the chain link fence (SAIC, 1995).

3.0 Site-Specific Data Quality Objectives

3.1 Overview

The data quality objective (DQO) process (EPA, 1993) is followed to evaluate data requirements and to support the decision-making process associated with future action for the Fenced Area at the Range J site. The DQO process as applied to the Fenced Area at Range J supplemental RI SFSP is described in more detail in Sections 3.2 and 4.3. Table 3-1 provides a summary of the factors used to determine the sampling quantity and procedures necessary to meet the objectives of the supplemental RI SFSP and to establish a basis for future action at the site.

The samples will be analyzed using EPA SW-846 Methods, including Update III methods where applicable, as presented in Chapter 4.0 in this SFSP and Table 6-1 in the QAP. Data will be reported and evaluated in accordance with Corps of Engineers South Atlantic Savannah (CESAS) Level B criteria (USACE, 1994) and the stipulated requirements for the generation of definitive data (Section 3.1.2 of the QAP). Chemical data will be reported via hard copy data packages by the laboratory using Contract Laboratory Program (CLP)-like forms. These packages will be validated in accordance with EPA National Functional Guidelines by Level III criteria.

3.2 Data Users and Available Data

The intended data users and available data related to the supplemental RI SFSP at the Range J site, presented in Table 3-1, have been used to formulate a site-specific conceptual model. This conceptual model was developed to support the development of this supplemental RI SFSP, which is necessary to meet the objectives of these activities and to establish a basis for future action at the site. The data users for information generated during field activities are primarily EPA, USACE, ADEM, FTMC, and the USACE supporting contractors. This supplemental RI SFSP, along with the necessary companion documents, has been designed to provide the regulatory agencies with sufficient detail to reach a determination as to the adequacy of the scope of work. The program has also been designed to provide defensible information required to confirm or deny the existence and nature of residual chemical contamination in site media.

3.3 Conceptual Site Exposure Model

The conceptual site exposure model (CSEM) provides the basis for identifying and evaluating the potential risks to human health in the risk assessment. Graphically presenting possible pathways by which a potential receptor may be exposed, including sources, release and transport pathways,

Table 3-1

Summary of Data Quality Objectives
Fenced Area at Range J - Pelham Range, Parcel 202(7)
Fort McClellan, Calhoun County, Alabama

Potential Data Users	Available Data	Conceptual Site Model	Media of Concern	Data Uses and Objectives	Data Types	Analytical Level	Data Quantity
EPA ADEM USACE DOD IT Corporation Other Contractors Possible future land users	SAIC, Site Investigation Report, 1993 SAIC, Remedial Investigation Report, 1995 ESE, 1998 ERDEC, 1995 EPA, 1983	Contaminant Source Decontaminating agents used on CWA. Tear gas. Migration Pathways Infiltration to subsurface soils, infiltration and leaching to groundwater. Dust emissions and volatilization from soil to ambient air. Potential Receptors Groundskeeper, construction worker, resident, and recreational site user. PSSC VOCs (specifically carbon tetrachloride) HD Breakdown Products	Surface Soil Subsurface Soil Groundwater	Obtain sufficient data to support, as appropriate, the following: - Implementing an immediate response. - No further action. - Proceeding with an remedial action. RI to determine the nature and extent of contamination in the site media.	Surface Soil TCL-VOCs TCL-SVOCs HD Breakdown Products	Definitive + CESAS Level B data	24 surface soil samples 16 direct-push locations 8 monitoring well boreholes +QC
					Subsurface Soil TCL-VOCs TCL-SVOCs HD Breakdown Products	Definitive + CESAS Level B data	24 surface soil samples 16 direct-push locations 8 monitoring well boreholes +QC
					Groundwater TCL-VOCs TCL-SVOCs HD Breakdown Products	Definitive + CESAS Level B data	16 monitoring wells + QC (13 proposed wells, 3 existing wells)

ADEM - Alabama Department of Environmental Management.
CESAS - Corps of Engineers South Atlantic Savannah.
CWM - Chemical warfare materials.
DOD - U.S. Department of Defense.
EBS - Environmental Baseline Survey.
EPA - U.S. Environmental Protection Agency.

EPA - U.S. Environmental Protection Agency.
ESE - Environmental Science and Engineering.
HD - Distilled mustard.
PSSC - Potential site-specific chemicals.
QC - Quality control.
RI - Remedial Investigation.
SAIC - Science Application International Corporation.

TCL - Target compound list.
USACE - U.S. Army Corps of Engineers.
ERDEC - U.S. Army Edgewood Research, Development, and Engineering Center.
VOC - Volatile organic compound.

and exposure routes, facilitates consistent and comprehensive evaluation of risk to human health, and helps to ensure that potential pathways are not overlooked. The elements necessary to construct a complete exposure pathway and develop the CSEM include:

- Source (i.e., contaminated environmental) media
- Contaminant release mechanisms
- Contaminant transport pathways
- Receptors
- Exposure pathways.

Contaminant release mechanisms and transport pathways are not relevant for direct receptor contact with a contaminated source medium.

Potential contamination at the Fenced Area at Range J, Parcel No. 202(7), is due to the use of this area as a disposal site for decontaminated chemical warfare training materials. Drums containing soil were disposed in a pit located inside a chain link fence. As described in Section 1.2, Range J is located in the northcentral portion of Pelham Range. The study area is bounded on all sides by a chain link fence. The pit is located in the northwest section of the site. Cane Creek is located approximately 2,200 feet south of the site and is not expected to be impacted by this site. Potential contaminant transport pathways include infiltration to subsurface soil, infiltration and leaching to groundwater, and dust emissions and volatilization from soil to ambient air.

Current site use is best described as open space/industrial with restricted access. Basic maintenance may be applied to the site; therefore, a plausible receptor under current site use is limited to the groundskeeper. Other potential receptors considered but not included under current site use are:

- Resident: The site is not currently used for residential development.

- Construction worker: The site is currently undeveloped, and no excavation or building is occurring or expected to occur.

- Recreational site user: The site does not offer public access, and hunting or fishing in the area is unlikely.

Because the U.S. Army plans to retain this site, no future land use scenario has been defined (FTMC, 1997). It is assumed that the site will be restricted and the most plausible receptors under the future site-use scenario include the groundskeeper, construction worker, resident, and recreational user. The Fenced Area at Range J will be evaluated for human health and ecological risk in accordance with the installation-wide work plan (IT, 1998b).

The contaminant release and transport mechanisms, source and exposure media, receptors and exposure pathways are summarized in Figure 3-1.

Assessment of potential ecological risk associated with sites or parcels (e.g., surface water and sediment sampling, specific ecological methods, etc.) will be addressed in a separate document to be issued as the habitat-specific screening ecological risk assessment work plan.

3.4 Decision-Making Process, Data Uses, and Needs

The decision-making process consists of a seven-step process that is presented in detail in Sections 3.2 and 4.3 of the installation-wide WP and will be followed during the supplemental RI at the Range J site. Data uses and needs are summarized in Table 3-1.

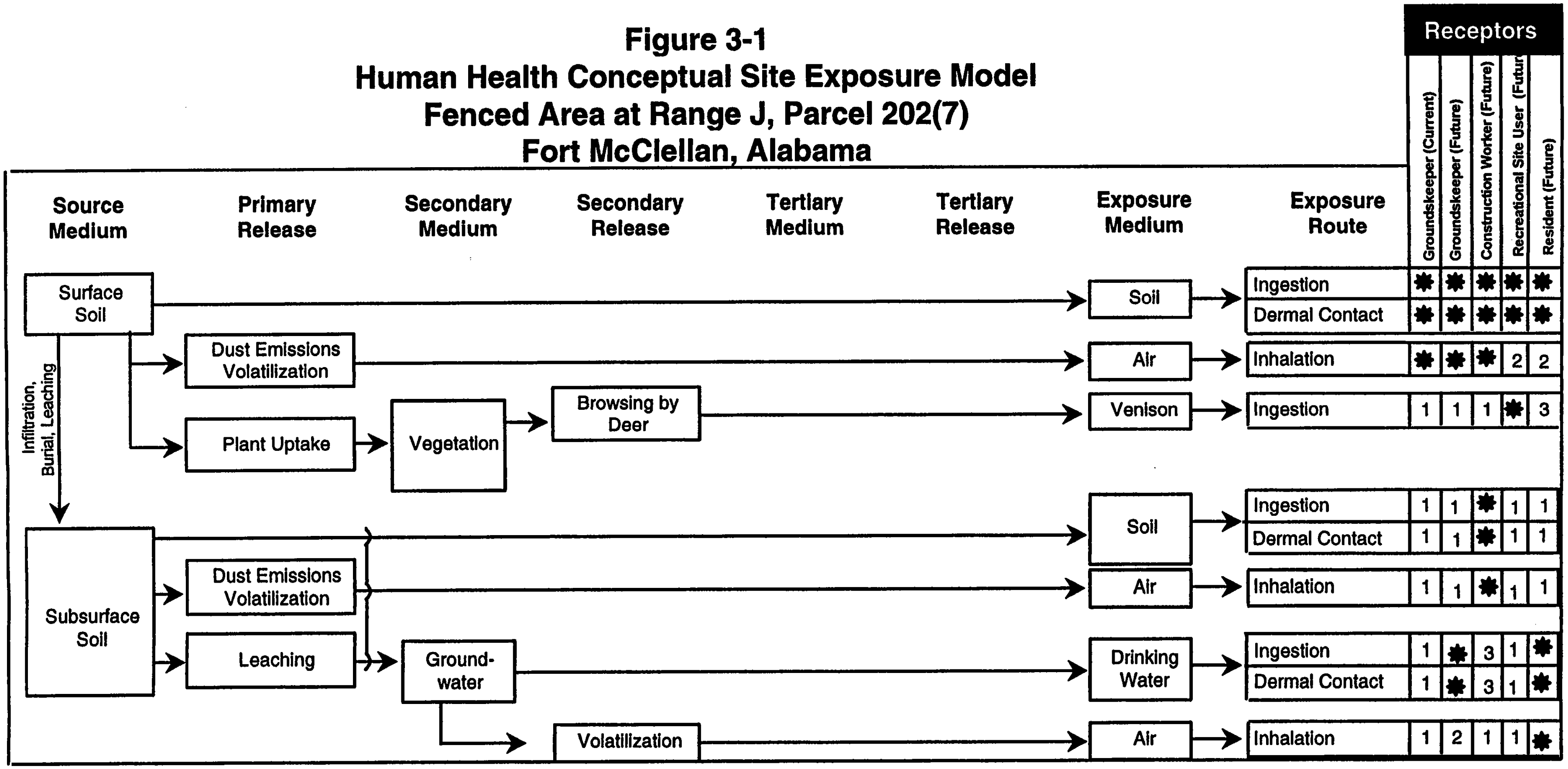
3.4.1 Risk Evaluation

Confirmation of contamination at the Fenced Area of Range J site will be based upon a comparison of detected site contaminants to the most current guidance criteria. The data will be reported and evaluated using EPA definitive data with CESAS Level B criteria. Data packages will contain reporting limits sufficient to determine whether the established guidance criteria are exceeded in site media. Definitive data will be adequate for confirming the presence of site contamination and for supporting additional decision-making steps, such as remedial action and risk assessment, if necessary.

3.4.2 Data Types and Quality

Soil and groundwater will be sampled and analyzed to meet the objectives of the supplemental RI for the Fenced Area at Range J. Quality assurance/quality control (QA/QC) samples will be collected for sample types as described in Chapter 4.0 of this SFSP. Samples will be analyzed by EPA-approved SW-846 methods, where available; comply with EPA definitive data requirements; and be reported using hard copy data packages. In addition to meeting the quality needs of this supplemental RI SFSP, data analyzed at this level of quality are appropriate for all phases of site characterization, remedial investigation, and risk assessment.

Figure 3-1
Human Health Conceptual Site Exposure Model
Fenced Area at Range J, Parcel 202(7)
Fort McClellan, Alabama



Exposure Medium	Exposure Route	Groundskeeper (Current)	Groundskeeper (Future)	Construction Worker (Future)	Recreational Site User (Futur	Resident (Future)
Soil	Ingestion	✱	✱	✱	✱	✱
	Dermal Contact	✱	✱	✱	✱	✱
Air	Inhalation	✱	✱	✱	2	2
Venison	Ingestion	1	1	1	✱	3
Soil	Ingestion	1	1	✱	1	1
	Dermal Contact	1	1	✱	1	1
Air	Inhalation	1	1	✱	1	1
Drinking Water	Ingestion	1	✱	3	1	✱
	Dermal Contact	1	✱	3	1	✱
Air	Inhalation	1	2	1	1	✱

✱ = Complete exposure pathway evaluated in baseline risk assessment.
1 = Incomplete exposure pathway.
2 = Although theoretically complete, this pathway is judged to be insignificant.
3 = Although theoretically complete, this exposure pathway is evaluated under an equally restrictive or more restrictive receptor scenario.

3.4.3 Precision, Accuracy, and Completeness

Laboratory requirements of precision, accuracy, and completeness for this supplemental RI are provided in Chapter 9.0 of the QAP.

4.0 Field Activities

4.1 UXO and Chemical Warfare Agent Survey Requirements

The Fenced Area at Range J falls within the "Possible Explosive Ordnance Impact Area" shown on Plate 10 of the FTMC Archive Search Report, Maps (USACE, 1998a). The presence of UXO and chemical warfare agents is suggested at the Fenced Area of Range J. Therefore, IT will conduct UXO and chemical warfare agent avoidance activities, including surface sweeps and downhole surveys of soil borings in addition to conducting utility clearances before installing soil borings.

4.1.1 Surface UXO Survey

An UXO sweep will be conducted over areas that will be included in the sampling and surveying activities to identify UXO on or near the surface that may present a hazard to on-site workers during field activities. Low-sensitivity magnetometers will be used to locate surface and shallow-buried metal objects. UXO located on the surface will be identified and conspicuously marked for easy avoidance. UXO personnel requirements, procedures, and detailed descriptions of the geophysical equipment to be used are provided in Chapter 4.0 and Appendices D and E of the approved SAP (IT, 1998a).

4.1.2 Downhole UXO and Chemical Warfare Agent Survey

During the soil boring and downhole sampling activities, a downhole UXO survey will be performed to determine if buried metallic objects are present. UXO monitoring, as described in Chapter 4.0 of the SAP (IT, 1998a), will continue until undisturbed soils are encountered or the borehole has been advanced to 12 feet below ground surface, whichever is reached first. Additionally, the borehole will be screened continuously with a miniature continuous air monitoring system for CWM.

4.2 Utility Clearances

Prior to performing any intrusive sampling, a utility clearance will be performed at all locations where soil and groundwater samples will be collected, using the procedure outlined in Section 4.2.6 of the SAP. The site manager will mark the proposed locations with stakes, coordinate with the installation to clear the proposed locations for utilities, and obtain digging permits. Once the locations are cleared, the stakes will be labeled as cleared.

4.3 Environmental Sampling

The environmental sampling program during the supplemental RI for the Fenced Area at Range J site include the collection of surface soil samples, subsurface soil samples, and groundwater samples for chemical analysis.

4.3.1 Surface Soil Sampling

Twenty-four surface soil samples will be collected during the supplemental RI to determine if the area within the fence is the source of VOCs detected in groundwater at the site. For health and safety precautions, all soil samples collected will be screened for HD and HD breakdown products by Quicksilver Laboratories (Quicksilver). Quicksilver will maintain control of all monitoring equipment and provide guidance on monitoring operations.

4.3.1.1 Sample Locations and Rationale

The surface soil sampling rationale is presented in Table 4-1. A total of 24 surface soil samples will be collected from the Range J site. Surface soil samples will be collected from the upper 1.0 foot of the soil at each sampling location. The proposed surface soil sampling locations are presented on Figure 4-1.

4.3.1.2 Sample Collection

Surface soil sample designations, depths, and required QA/QC sample quantities are listed in Table 4-2. Twenty surface soil samples will be collected using the direct-push procedures specified in Section 4.7.1.1 of the SAP.

Sample containers, sample volumes, preservatives, and holding times for the analyses required in this SFSP are listed in Section 5.0, Table 5-1 of the QAP. Sample documentation and chain of custody (COC) will be recorded as specified in Section 4.13 of the SAP. The samples will be analyzed for the parameters listed in Section 4.5.2 of this SFSP.

4.3.2 Subsurface Soil Sampling

Twenty-four subsurface soil samples will be collected during the supplemental RI. Subsurface soil samples will be collected from sixteen direct-push soil borings and from eight monitoring well boreholes. The soil sample from each boring exhibiting the highest reading on a photoionization detector (PID) will be sent to the laboratory for analysis. If none of the sample intervals indicate elevated PID readings, the deepest sample interval will be submitted to the

Tab... 4-1

Site Sampling Rationale
Range J - Pelham Range
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Media	Sampling Location Rationale
RJR-202-GP01	SURFACE SOIL SUBSURFACE SOIL	Samples will be collected in the northwest corner of the site inside the chainlink fence to confirm or deny the presence of HD breakdown compounds, volatiles, and semivolatile compounds. In addition, to determine if Range J is the source area for carbon tetrachloride detected in groundwater.
RJR-202-GP02	SURFACE SOIL SUBSURFACE SOIL	Samples will be collected inside the soil/drum disposal pit to confirm or deny the presence of HD breakdown compounds, volatile, and semivolatile compounds. In addition, to determine if Range J is the source area for carbon tetrachloride detected in groundwater.
RJR-202-GP03	SURFACE SOIL SUBSURFACE SOIL	Samples will be collected approximately 50 feet outside the chainlink fence on the north side of the site to confirm or deny the presence of HD breakdown compounds, volatile, and semivolatile compounds. In addition, to determine if Range J is the source area for carbon tetrachloride detected in groundwater.
RJR-202-GP04	SURFACE SOIL SUBSURFACE SOIL	Samples will be collected northwest of the trench excavation area to confirm or deny the presence of HD breakdown compounds, volatiles, and semivolatile compounds. In addition, to determine if Range J is the source area for carbon tetrachloride detected in groundwater.
RJR-202-GP05	SURFACE SOIL SUBSURFACE SOIL	Samples will be collected in the northeast corner of the site inside the chainlink fence to confirm or deny the presence of HD breakdown compounds, volatiles, and semivolatile compounds. In addition, to determine if Range J is the source area for carbon tetrachloride detected in groundwater.
RJR-202-GP06	SUBSURFACE SOIL SURFACE SOIL	Samples will be collected approximately 50 feet outside the chainlink fence on the west side of the site to confirm or deny the presence of HD breakdown compounds, volatiles, and semivolatile compounds. In addition, to determine if Range J is the source area for carbon tetrachloride detected in groundwater.
RJR-202-GP07	SUBSURFACE SOIL SURFACE SOIL	Samples will be collected approximately inside the soil drum disposal pit to confirm or deny the presence of HD breakdown compounds, volatiles, and semivolatile compounds. In addition, to determine if Range J is the source area for carbon tetrachloride detected in groundwater.
RJR-202-GP08	SUBSURFACE SOIL SURFACE SOIL	Samples will be collected inside the chainlink fence to confirm or deny the presence of HD breakdown compounds, volatiles, and semivolatile compounds. In addition, to determine if Range J is the source area for carbon tetrachloride detected in groundwater.
RJR-202-GP09	SUBSURFACE SOIL SURFACE SOIL	Samples will collected in the trench excavation to confirm or deny the presence of HD breakdown compounds, volatiles, and semivolatile compounds. In addition, to determine if Range J is the source area for carbon tetrachloride detected in groundwater.
RJR-202-GP10	SUBSURFACE SOIL SURFACE SOIL	Samples will be collected approximately 50 feet outside the chainlink fence on the east side of the site. Samples will be collected and analyzed to confirm or deny the presence of HD breakdown compounds, volatiles, and semivolatiles. In addition, to determine if Range J is the source area for carbon tetrachloride detected in groundwater.

Tab.e 4-1

Site Sampling Rationale
Range J - Pelham Range
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Media	Sampling Location Rationale
RJR-202-GP11	SURFACE SOIL SUBSURFACE SOIL	Samples will be collected inside the chainlink fence to confirm or deny the presence of HD breakdown compounds, volatiles, and semivolatile compounds. In addition, to determine if Range J is the source area for carbon tetrachloride detected in groundwater.
RJR-202-GP12	SURFACE SOIL SUBSURFACE SOIL	Samples will be collected inside the chainlink fence to confirm or deny the presence of HD breakdown compounds, volatiles, and semivolatile compounds. In addition, to determine if Range J is the source area for carbon tetrachloride detected in groundwater.
RJR-202-GP13	SURFACE SOIL SUBSURFACE SOIL	Samples will be collected in the northwest corner of the trench to confirm or deny the presence of HD breakdown compounds, volatiles, and semivolatile compounds. In addition, to determine if Range J is the source area for carbon tetrachloride detected in groundwater.
RJR-202-GP14	SURFACE SOIL SUBSURFACE SOIL	Samples will be collected south of the concrete monument, inside the chainlink fence to confirm or deny the presence of HD breakdown products, volatiles, and semivolatile compounds. In addition, to determine if Range J is the source area for carbon tetrachloride detected in groundwater.
RJR-202-GP15	SURFACE SOIL SUBSURFACE SOIL	Samples will be collected inside the chainlink fence in the southeastern corner of the site of the site next to the entrance gate to confirm or deny the presence of HD breakdown products, volatiles, and semivolatile compounds. In addition, to determine if Range J is the source area for carbon tetrachloride detected in groundwater.
RJR-202-GP16	SURFACE SOIL SUBSURFACE SOIL	Samples will be collected in approximately 50 feet outside the chainlink fence on the south side of the site. Samples will be collected for HD breakdown products, volatiles, and semivolatile compounds. In addition, to determine if Range J is the source area for carbon tetrachloride detected in groundwater.
RJR-202-MW01	GROUNDWATER	Samples will be collected from the existing monitoring well to confirm or deny the presence of HD breakdown compounds, volatiles, and semivolatiles. In addition, to compare previous analytical data obtained by SAIC in 1995.
RJR-202-MW02	GROUNDWATER	Samples will be collected from the existing monitoring well to confirm or deny the presence of HD breakdown compounds, volatiles, and semivolatiles. In addition, to compare previous analytical data obtained by SAIC in 1995.
RJR-202-MW03	GROUNDWATER	Samples will be collected from the existing monitoring well to confirm or deny the presence of HD breakdown compounds, volatiles, and semivolatiles. In addition, to compare previous analytical data obtained by SAIC in 1995.
RJR-202-MW04	SURFACE SOIL SUBSURFACE SOIL GROUNDWATER	Residuum monitoring well RJR-202-MW04 will be installed approximately 275 feet southeast of existing monitoring well RJ-G06. The residuum monitoring well location will be used to establish a local groundwater flow direction, site specific geology, and provide information on groundwater quality in the residuum aquifer. Subsurface soil and groundwater samples will be analyzed for HD breakdown compounds, volatiles, and semivolatile compounds.

Table 4-1

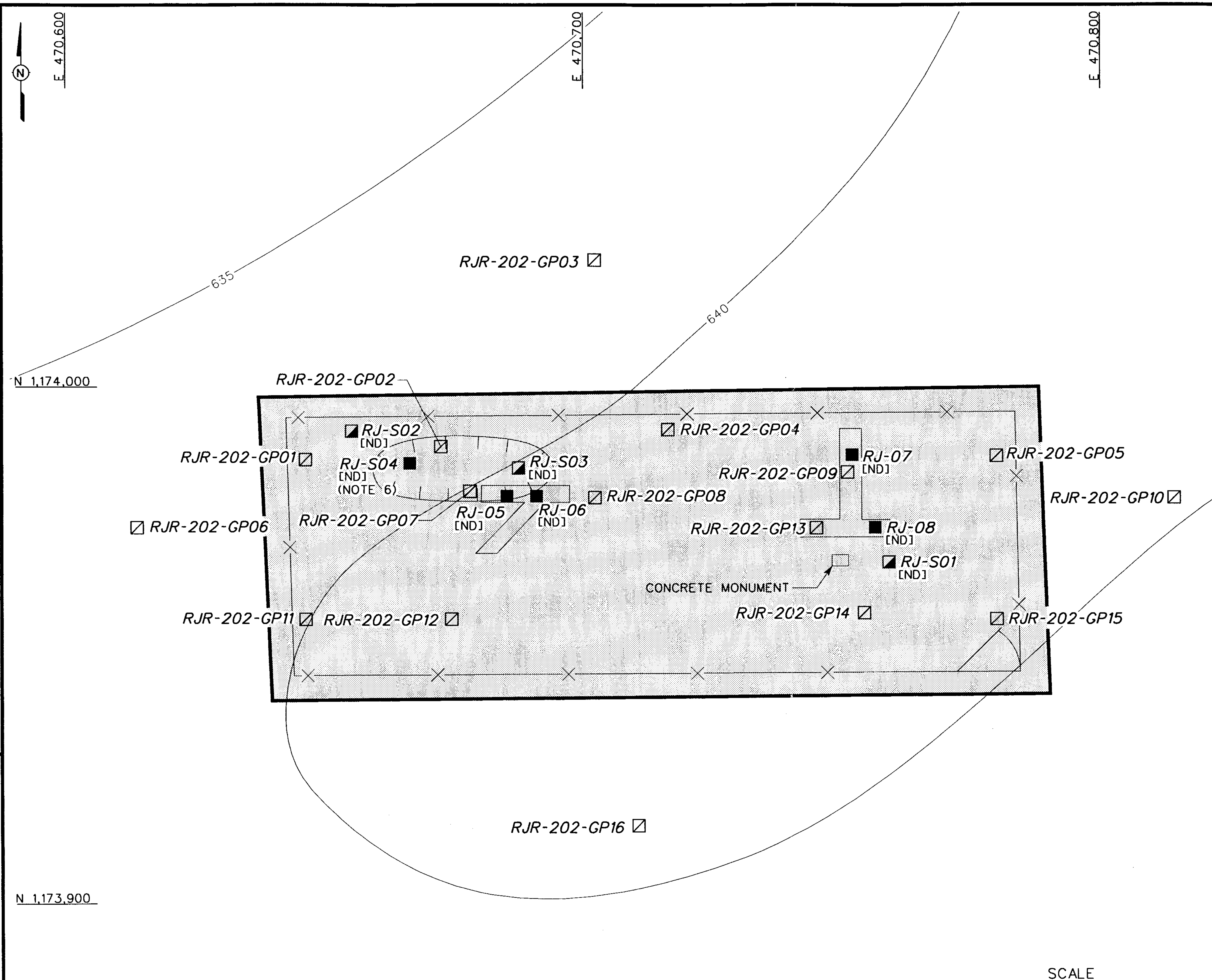
Site Sampling Rationale
Range J - Pelham Range
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Media	Sampling Location Rationale
RJR-202-MW05	SURFACE SOIL SUBSURFACE SOIL GROUNDWATER	Monitoring well RJR-202-MW05 will be installed approximately 250 feet southeast of existing monitoring well RJ-G07. This perimeter monitoring well location will be used to establish a local groundwater flow direction, site specific geology, and provide information on groundwater quality. Subsurface soil and groundwater sample will be analyzed for HD breakdown products, volatiles, and semivolatile compounds.
RJR-202-MW06	SURFACE SOIL SUBSURFACE SOIL GROUNDWATER	Residuum monitoring well RJR-202-MW06 will be installed approximately 250 feet southwest of existing monitoring well RJ-G07. This perimeter monitoring well location will be used to establish a local groundwater flow direction, site specific geology, and provide information on groundwater quality. Subsurface soil and groundwater will be analyzed for HD breakdown products, volatiles, and semivolatile compounds.
RJR-202-MW07	SURFACE SOIL SUBSURFACE SOIL GROUNDWATER	Residuum monitoring well RJR-202-MW07 will be installed approximately 300 feet northwest of the site. This perimeter monitoring well location to establish a local groundwater flow direction, site specific geology, and provide information on groundwater quality. Subsurface soil samples will be analyzed for HD breakdown products, volatiles, and semivolatile compounds.
RJR-202-MW08	SURFACE SOIL SUBSURFACE SOIL GROUNDWATER	Residuum monitoring RJR-202-MW08 will be installed approximately 250 feet north of the site. This perimeter monitoring well location to establish a local groundwater flow direction, site specific geology, and provide information on groundwater quality. Subsurface soil and groundwater samples will be analyzed for HD breakdown compounds, volatile, and semivolatile compounds.
RJR-202-MW09	SURFACE SOIL SUBSURFACE SOIL GROUNDWATER	Residuum monitoring well RJR-202-MW09 will be installed next to existing bedrock monitoring well RJ-G05. This residuum monitoring well location to provide the horizontal extent of potential contamination from the site. Subsurface soil samples will be analyzed for HD breakdown products, volatiles, and semivolatile compounds.
RJR-202-MW10	SURFACE SOIL SUBSURFACE SOIL GROUNDWATER	Residuum source area monitoring well RJR-202-MW10 will be installed next to existing monitoring well RJ-G07. Groundwater samples collected from monitoring well RJ-G07 detected Carbon Tetrachloride at a concentration of 2,000 µg/L. Source area sample to delineate the vertical extent of groundwater contamination within the suspected source area. Subsurface soil samples will be analyzed for HD breakdown products, volatiles, and semivolatile compounds.
RJR-202-MW11	GROUNDWATER	Proposed bedrock monitoring well will be installed next to existing well RJ-G07 near the suspected source area in the southwestern section of the site outside the fence. RJR-202-MW11 will be installed to delineate the vertical extent of groundwater contamination.
RJR-202-MW12	SURFACE SOIL SUBSURFACE SOIL GROUNDWATER	Proposed monitoring well RJR-202-MW12 will be installed into competent bedrock to delineate the vertical extent of groundwater contamination. RJR-202-MW12 will be installed next to RJ-G06 in the southeastern section of the site. Subsurface soil samples will be analyzed for HD breakdown products, volatiles, and semivolatile compounds.
RJR-202-MW13	GROUNDWATER	Proposed bedrock monitoring well RJR-202-MW13 will be installed approximately 250 feet south of the site, next to residuum monitoring well RJR-202-MW05. This well will help delineate the vertical extent of groundwater contamination and is an assumed upgradient bedrock monitoring well.
RJR-202-MW14	GROUNDWATER	Proposed bedrock monitoring well RJR-202-MW14 will be advanced approximately 300 feet northwest of the site, next to residuum monitoring well RJR-202-MW07. RJR-202-14 will be installed to delineate the vertical extent of groundwater contamination and is an assumed downgradient bedrock monitoring well.
RJR-202-MW15	GROUNDWATER	Proposed bedrock monitoring well RJR-202-MW15 will be advanced approximately 300 feet southwest of the site, next to residuum monitoring well RJR-202-MW06. RJR-202-15 will be installed to delineate the vertical extent of groundwater contamination.

Table 4-1

Site Sampling Rationale
Range J - Pelham Range
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Media	Sampling Location Rationale
RJR-202-MW16	GROUNDWATER	Proposed bedrock monitoring well RJR-202-MW16 will be advanced approximately 300 feet east of the site, next to residuum monitoring well RJR-202-MW04. RJR-202-16 will be installed to delineate the vertical extent of groundwater contamination.



SOURCE: SAIC, SITE INVESTIGATION REPORT, AUGUST 1993
SAIC, REMEDIAL INVESTIGATION REPORT, AUGUST 1995

LEGEND

- TOPOGRAPHIC CONTOURS
- PARCEL BOUNDARY
- FENCE
- SOIL / DRUM DISPOSAL PIT
- TRENCH EXCAVATION
- SI — SITE INVESTIGATION
- RI — REMEDIAL INVESTIGATION
- EXISTING SURFACE AND SUBSURFACE SOIL SAMPLE (SI SAMPLE APRIL, 1992)
- EXISTING SURFACE SOIL SAMPLE (RI SAMPLE, 1995)
- PROPOSED SURFACE AND SUBSURFACE SOIL SAMPLE
- SAIC — SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

NOTES

1. ALL SOIL SAMPLES INSIDE THE FENCE ARE BEING COLLECTED FOR DETERMINING IF RANGE J IS THE SOURCE AREA OF CARBON TETRACHLORIDE AND OTHER SOLVENTS FOUND IN GROUNDWATER.
2. ALL SOIL SAMPLES OUTSIDE THE PARCEL BOUNDARY ARE BEING COLLECTED TO DETERMINE IF PSSCs ARE PRESENT OUTSIDE THE FENCED AREA.
3. PROPOSED SOIL SAMPLE LOCATIONS ARE APPROXIMATED.
4. SURFACE SOIL SAMPLE WILL BE COLLECTED AT 0.5 FEET BELOW LAND SURFACE (bls) AND SUBMITTED TO THE LABORATORY FOR ANALYSIS.
5. SUBSURFACE SOIL SAMPLES WILL BE COLLECTED CONTINUOUSLY FROM 1 FOOT (bls) TO 10 FEET (bls) AT EACH LOCATION. ONE SUBSURFACE SOIL SAMPLE FROM EACH LOCATION WILL BE SUBMITTED TO THE LABORATORY FOR ANALYSIS.
6. SAMPLE RJ-S04 WAS COLLECTED FROM A CORRODED DRUM EXPOSED AT GROUND SURFACE.

FIGURE 4-1

PROPOSED SOIL SAMPLE LOCATIONS RANGE J - PELHAM RANGE, CHEMICAL AGENT TRAINING AND DISPOSAL AREA PARCEL 202(7)

U. S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 08/06/98 | DRAWN BY: D. BILLINGSLEY | DRAFT. CHCK. BY: | ENGR. CHCK. BY: A. MAYILA | INITIATOR: J. TARR | PROJ. MGR.: J. YACOUB | DWG. NO. | PROJ. NO.: 774645

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Table 4-2

Surface and Subsurface Soil Sample Designations and QA/QC Sample Quantities
Range J - Pelham Range, Parcel 200(7)
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates	Field Splits	MS/MSD	
RJR-202-GP01	RJR-202-GP01-SS-JB0001-REG RJR-202-GP01-DS-JB0002-REG	0 - 1.0 a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-GP02	RJR-202-GP02-SS-JB0003-REG RJR-202-GP02-DS-JB0004-REG	0 - 1.0 a			RJR-202-GP02-SS-JB0003-MS RJR-202-GP02-SS-JB0003-MSD	TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-GP03	RJR-202-GP03-SS-JB0005-REG RJR-202-GP03-DS-JB0008-REG	0 - 1.0 a	RJR-202-GP03-SS-JB0006-FD	RJR-202-GP03-SS-JB0007-FS		TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-GP04	RJR-202-GP04-SS-JB0009-REG RJR-202-GP04-DS-JB0010-REG	0 - 1.0 a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-GP05	RJR-202-GP05-SS-JB0011-REG RJR-202-GP05-DS-JB0012-REG	0 - 1.0 a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-GP06	RJR-202-GP06-SS-JB0013-REG RJR-202-GP06-DS-JB0014-REG	0 - 1.0 a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-GP07	RJR-202-GP07-SS-JB0015-REG RJR-202-GP07-DS-JB0016-REG	0 - 1.0 a	RJR-202-GP07-DS-JB0017-FD	RJR-202-GP07-DS-JB0018-FS		TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-GP08	RJR-202-GP08-SS-JB0019-REG RJR-202-GP08-DS-JB0020-REG	0 - 1.0 a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-GP09	RJR-202-GP09-SS-JB0021-REG RJR-202-GP09-DS-JB0022-REG	0 - 1.0 a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-GP10	RJR-202-GP10-SS-JB0023-REG RJR-202-GP10-DS-JB0024-REG	0 - 1.0 a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-GP11	RJR-202-GP11-SS-JB0025-REG RJR-202-GP11-DS-JB0028-REG	0 - 1.0 a	RJR-202-GP11-SS-JB0026-FD	RJR-202-GP11-SS-JB0027-FD		TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds

Table 4-2

Surface and Subsurface Soil Sample Designations and QA/QC Sample Quantities
Range J - Pelham Range, Parcel 200(7)
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates	Field Splits	MS/MSD	
RJR-202-GP12	RJR-202-GP12-SS-JB0029-REG RJR-202-GP12-DS-JB0030-REG	0 - 1.0 a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-GP13	RJR-202-GP13-SS-JB0031-REG RJR-202-GP13-DS-JB0032-REG	0 - 1.0 a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-GP14	RJR-202-GP14-SS-JB0033-REG RJR-202-GP14-DS-JB0034-REG	0 - 1.0 a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-GP15	RJR-202-GP15-SS-JB0035-REG RJR-202-GP15-DS-JB0036-REG	0 - 1.0 a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-GP16	RJR-202-GP16-SS-JB0037-REG RJR-202-GP16-DS-JB0038-REG	0 - 1.0 a			RJR-202-GP16-SS-JB0037-MS RJR-202-GP16-SS0JB0037-MSD	TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW04	RJR-202-MW04-DS-JB0049-REG RJR-202-MW04-SS-JB0050-REG	0-1				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW05	RJR-202-MW05-DS-JB0051-REG RJR-202-MW05-SS-JB0052-REG	0-1				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW06	RJR-202-MW06-DS-JB0053-REG RJR-202-MW06-SS-JB0054-REG	0-1			RJR-202-MW06-DS-JB0053-MS RJR-202-MW06-DS-JB0053-MSD	TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW07	RJR-202-MW07-DS-JB0055-REG RJR-202-MW07-SS-JB0056-REG	0-1	RJR-202-MW07-DS-JB0057-FD			TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW08	RJR-202-MW08-DS-JB0058-REG RJR-202-MW08-SS-JB0059-REG	0-1				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds

Table 4-2

Surface and Subsurface Soil Sample Designations and QA/QC Sample Quantities
Range J - Pelham Range, Parcel 200(7)
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples			Analytical Suite
			Field Duplicates	Field Splits	MS/MSD	
RJR-202-MW09	RJR-202-MW09-DS-JB0060-REG RJR-202-MW09-SS-JB0061-REG	0-1				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW10	RJR-202-MW10-DS-JB0062-REG RJR-202-mW10-SS-JB0063-REG	0-1				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW12	RJR-202-MW12-DS-JB0064-REG RJR-202-MW12-SS-JB0065-REG	0-1 a	RJR-202-MW12-SS-JB0066-FD			TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds

[a] Actual sample depth selected for analysis will be at the discretion of the on-site geologist and will be based on field observation.

QA/QC - Quality assurance/quality control.
MS/MSD - Matrix spike/matrix spike duplicate.
TCL - Target compound list.
VOC - Volatile organic compound.
SVOC - Semivolatile organic compound.

laboratory. For health and safety precautions, all soil samples will be screened for HD and HD breakdown products by Quicksilver. Quicksilver will maintain control over all monitoring equipment and provide guidance on monitoring operations conducted.

4.3.2.1 Sample Locations and Rationale

Subsurface soil sampling rationale is presented in Table 4-1. A total of 24 subsurface soil samples will be collected. The proposed subsurface soil sampling locations are presented on Figure 4-1.

4.3.2.2 Sample Collection

Subsurface soil samples will be collected using either direct-push methodology or hollow-stem auger drilling equipment specified in Section 4.7.1.1 of the SAP.

Subsurface soil samples will be continuously collected from 1 to 12 feet bls at each of the proposed soil boring locations. A detailed lithological log of each borehole will be recorded by the on-site geologist. The log will serve as an aide to the geologist to determine if additional sampling locations are necessary, or determine if a change to the planned sampling depth is warranted. Samples from the entire length of the boring will be field screened using a PID. Samples will be collected for headspace screening as specified in Section 4.15 of the SAP. The soil sample from each boring exhibiting the highest reading on a PID will be sent to the laboratory for analysis. If none of the sample intervals indicate elevated PID readings, the deepest sample interval will be submitted to the laboratory. Subsurface soil sample designations, depths, and required QA/QC sample quantities are listed in Table 4-2.

Sample documentation and COC will be recorded as specified in Section 4.13 of the SAP. Sample containers, sample volumes, preservatives, and holding times for the analyses required in this supplemental RI SFSP are listed in Chapter 5.0, Table 5-1 of the QAP. The samples will be analyzed for the parameters listed in Section 4.5.2 of this SFSP.

4.3.3 Monitoring Well Installation

Seven residuum and six bedrock monitoring wells are proposed at Range J. The monitoring wells will be installed using a combination of hollow-stem auger and air-rotary drilling methods depending on the thickness of the overburden at each proposed well location. A drill rig able to employ both methods will be used, if possible, to minimize mobilization costs. These wells will be installed to provide information on water quality and groundwater flow in both the residuum and bedrock aquifers. Based on previous investigations by SAIC, it appears groundwater contamination may or may not be present in the residuum overlying the bedrock at the Range J site. Bedrock monitoring wells will be drilled using air-rotary drilling methods and the screen section of each well will be placed a minimum of 15 feet into competent bedrock. The monitoring wells will be installed and developed as specified in Section 4.8 and Appendix C of the SAP.

4.3.3.1 Monitoring Well Locations and Rationale

Seven proposed residuum monitoring wells RJR-202-MW04, RJR-202-MW05, RJR-202-MW06, RJR-202-MW07, RJR-202-MW08, RJR-202-MW09, and RJR-202-MW10 will be installed approximately 200 to 300 feet radially away from the chain link fence in all directions to determine the local groundwater flow direction and delineate the extent of contamination in the residuum aquifer. Monitoring well RJR-202-MW09 will be installed in the residuum aquifer and next to existing bedrock monitoring well RJ-G05 to determine groundwater quality in the residuum aquifer north-northwest of the site. Monitoring well RJR-202-MW10 will be installed in the residuum aquifer and next to existing monitoring well RJR-G07. The groundwater sample collected by SAIC during the 1994 supplemental RI field investigation from monitoring well RJ-G07 contained 2,000 μg/L of carbon tetrachloride. Based on drilling log data obtained from monitoring well RJ-G07, the well is screened from 572 to 562 feet above mean sea level (msl) and is partially screened in bedrock and partially screened in overlying residuum material. Therefore, proposed monitoring wells RJR-202-MW10 and RJR-202-MW11 will be installed next to existing monitoring well RJ-G07. Monitoring well RJR-202-MW10 will be installed into the residuum and monitoring well RJR-202-MW11 will be installed into competent bedrock. These two wells will be completed just outside the chain link fence to the southwest and will determine if the groundwater contamination present in monitoring well RJ-G07 is present in the bedrock, residuum, or both.

Proposed monitoring well RJR-202-MW12 will be installed next to existing monitoring well RJ-G06, located southeast of the chain link fence. This well will be drilled into competent bedrock to determine the vertical extent of groundwater contamination to the southeast. Proposed bedrock monitoring wells, RJR-202-MW13 and RJR-202-MW14, will be installed to the southeast and northwest, respectively. These two proposed bedrock wells will be installed to delineate groundwater contamination in the bedrock if present. Monitoring well RJR-202-MW13 will serve as an upgradient monitoring well and monitoring well RJR-202-MW14 will serve as a downgradient monitoring well. Proposed bedrock monitoring well RJR-202-MW15 and RJR-202-MW16 will be installed to the southwest and southeast, respectively. These two proposed bedrock wells will be installed to delineate groundwater contamination in the bedrock if present. Monitoring well(s) are not proposed northeast of the site because its topographically level with a contour interval of approximately 640 feet above msl; therefore, theoretically, groundwater in the residuum would not flow towards the northeast from the site. The location of the existing monitoring wells and proposed monitoring wells are presented on Figure 4-2.

4.3.3.2 Residuum Monitoring Wells

Residuum monitoring well boreholes will be drilled and installed using 6 5/8-inch inside diameter (ID) hollow stem augers. Residuum monitoring wells will be drilled to the top of bedrock. Depth to bedrock is approximately 70 to 90 feet bls at the site. The well casing will consist of new four-inch ID, Schedule 80, threaded, flush-joint, polyvinyl chloride (PVC) pipe. Attached to the bottom of the well casing will be a section of new threaded, flush-joint, 0.010-inch continuous wrap PVC well screen, approximately 10 feet long.

Soil samples will be collected continuously for the first 12 feet and every 5 feet thereafter to the total depth of the hole during hollow-stem auger drilling. Samples will be collected using a 24-inch long, 2-inch diameter or-larger-diameter split-spoon samplers. Lithologic samples will be collected for all monitoring wells during drilling to provide a detailed lithologic log. All soil borings will be logged in accordance with ASTM Method D 2488 using the Unified Soil Classification System. All soil samples will be screened in the field using a PID. The subsurface soil sample that exhibits the highest reading on a PID will be sent to the laboratory for analysis. If none of the sample intervals indicate elevated PID readings, the soil sample collected from the deepest sample interval will be submitted to the laboratory. The residuum monitoring wells will be drilled and installed as specified in Section 4.8 and Appendix C of the SAP.

4.3.3.3 Bedrock Monitoring Wells

Six bedrock monitoring well boreholes will be drilled using a combination of hollow stem auger (HSA) and air rotary drilling techniques. Bedrock monitoring wells will be drilled a minimum of 20 feet into competent bedrock, approximately 100 to 120 feet bls.

The residuum well at each cluster location will be installed prior to installation of the bedrock wells. Therefore, split-spoon samples will not be collected in any of the bedrock borings except

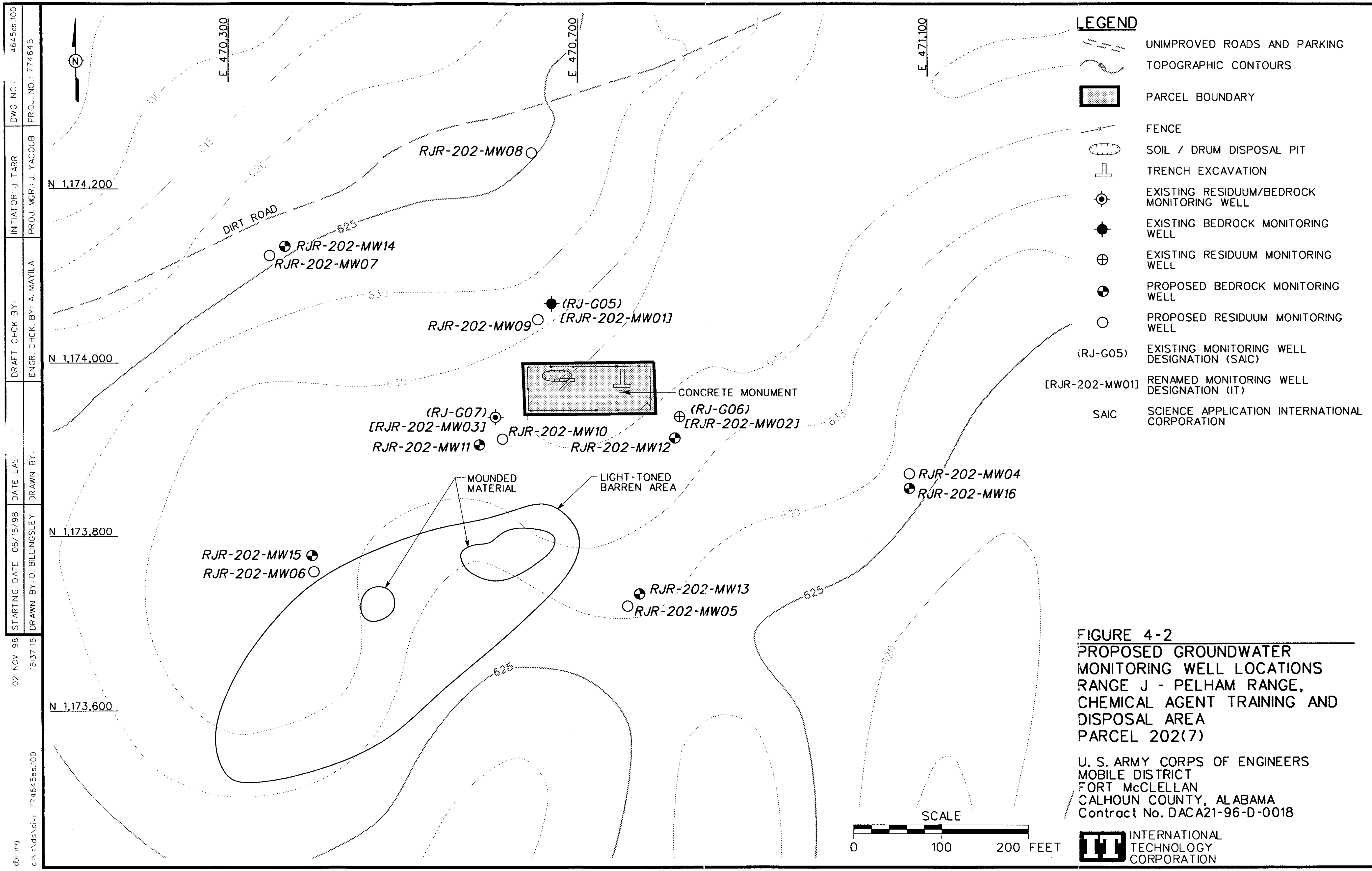


FIGURE 4-2
PROPOSED GROUNDWATER MONITORING WELL LOCATIONS
RANGE J - PELHAM RANGE,
CHEMICAL AGENT TRAINING AND DISPOSAL AREA
PARCEL 202(7)

U. S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

for RJR-202-MW12. An air rotary rig with a 12-inch percussion bit or rotary bit will be used to drill the borehole from land surface to 5 feet into competent bedrock. Ten inch ID carbon steel International Pipe Standard (IPS) outer casing will be installed into the borehole from land surface to 5 feet into bedrock. A minimum of 2-inch annular space between the outer casing and borehole wall will be required. The 10-inch carbon steel outer casing will be grouted in-place using a tremie pipe suspended in the annulus outside of the casing. Bentonite-cement grout will be mixed using approximately 6.5 to 7 gallons of water, and 5 pounds of bentonite per 94 pound bag of Type I Portland cement. After the grout has cured a minimum of 48 hours, an HQ wire-line core barrel will be used to collect core samples continuously from the top of bedrock to a minimum of 20 feet into competent bedrock. The hole depth into competent bedrock will be increased if groundwater is not encountered. After completion of core sample collection, an 8-inch air percussion bit will be used to ream the hole a minimum of 15 feet below the bottom of the surface casing and into competent bedrock. The compressor on the drill rig will be equipped with an air filter between the compressor and the drill bit. Water will be the only lubricant allowed during drilling operations.

Four-inch monitoring wells will be installed inside the outer casing at each proposed well location. The well casing will consist of new, four-inch ID, Schedule 80, threaded, flush-joint, polyvinyl chloride (PVC) pipe. Attached to the bottom of the well casing will be a section of new threaded, flush joint 0.010-inch continuous wrap PVC well screen, approximately 10 feet long. Attached to the bottom of the screen will be a sump, approximately five feet long, composed of new, four-inch ID, Schedule 80, threaded, flush joint PVC pipe. After the casing and screen materials are lowered into the boring, a gravel pack will be installed around the well screen and the inside casing will be grouted from the top of the gravel pack to land surface. The gravel pack will be tremied into place from the bottom of the sump to approximately five feet above the top of the screen. The gravel pack consist of 20/40 silica sand. A bentonite seal, approximately 5 feet thick, will be place above the gravel pack. The remaining annular space will be grouted with a bentonite-cement mixture (described above) and tremied in place with a side discharge tremie from the top of the bentonite seal to ground surface. The bedrock monitoring wells will be developed as specified in Section 4.8 and Appendix C of the SAP. Groundwater samples will not be collected from bedrock wells for a period of at least 14 days after well development. IDW will be containerized and staged in accordance with Section 4.8 of the SFSP.

4.3.4 Groundwater Sampling

Sixteen groundwater samples will be collected from three existing well and thirteen new monitoring wells at Range J to determine the nature and extent of HD, HD breakdown products, VOCs, and semivolatile organic compounds (SVOC) in the groundwater.

4.3.4.1 Sample Locations and Rationale

Groundwater sampling rationale is presented in Table 4-1. A total of 16 groundwater samples will be collected at Range J. Three groundwater samples will be collected for chemical analysis from the 3 existing monitoring wells (RJ-G05, RJ-G06, and RJ-G07) and the 13 proposed monitoring wells. The existing and proposed monitoring well locations are presented on Figure 4-2.

4.3.4.2 Monitoring Well Groundwater Sample Collection

Prior to sampling monitoring wells, static water levels will be measured from the 16 monitoring wells at the site to define the groundwater flow in the residuum and bedrock aquifers. Water level measurements will be performed as outlined in Section 4.18 of the SAP. Groundwater samples will be collected from the existing and proposed monitoring wells for the parameters listed in Table 4-3. Monitoring well locations are presented on Figure 4-2. Groundwater samples will be collected in accordance with the procedures outlined in Section 4.9.1.4 of the SAP.

Sample containers, sample volumes, preservatives, and holding times for the analyses required in this supplemental RI SFSP are listed in Chapter 5.0, Table 5-1 of the QAP.

4.4 Decontamination Requirements

Decontamination will be performed on sampling and nonsampling equipment primarily to ensure that contaminants are not introduced into samples from location to location. Decontamination of sampling equipment will be performed in accordance with the requirements presented in Section 4.10.1.1 of the SAP. Decontamination of nonsampling equipment will be performed in accordance with the requirements presented in Section 4.10.1.2 of the SAP.

4.5 Surveying of Sample Locations

Sampling locations will be marked with pin flags, stakes, and/or flagging and will be surveyed using either global positioning system (GPS) or conventional civil survey techniques, as neces-

Table 4-3

Groundwater Sample Designations and QA/QC Sample Quantities
Fenced Area at Range J - Pelham Range, Parcel 202(7)
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples Field Duplicates	Field Splits	MS/MSD	Analytical Suite
RJR-202-MW01	RJR-202-MW01-GW-JB3001-REG	63-73				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW02	RJR-202-MW02-GW-JB3002-REG	70-80				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW03	RJR-202-MW03-GW-JB3003-REG	60-70	RJR-202-MW03-GW-JB3004-FD	RJR-202-MW03-GW-JB3005-FS		TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW04	RJR-202-MW04-GW-JB3006-REG	a			RJR-202-MW04-GW-JB3006-MS RJR-202-MW04-GW-JB3006-MSD	TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW05	RJR-202-MW05-GW-JB3007-REG	a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW06	RJR-202-MW06-GW-JB3008-REG	a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW07	RJR-202-MW07-GW-JB3009-REG	a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW08	RJR-202-MW08-GW-JB3010-REG	a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW09	RJR-202-MW09-GW-JB3011-REG	a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW10	RJR-202-MW10-GW-JB3012-REG	a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW11	RJR-202-MW11-GW-JB3013-REG	a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW12	RJR-202-MW12-GW-JB3014-REG	a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW13	RJR-202-MW13-GW-JB3015-REG	a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW14	RJR-202-MW14-GW-JB3016-REG	a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds

Table 4-3

Groundwater Sample Designations and QA/QC Sample Quantities
Fenced Area at Range J - Pelham Range, Parcel 202(7)
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	QA/QC Samples Field Duplicates	Field Splits	MS/MSD	Analytical Suite
RJR-202-MW15	RJR-202-MW15-GW-JB3017-REG	a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds
RJR-202-MW16	RJR-202-MW16-GW-JB3018-REG	a				TCL VOCs, TCL SVOCs, Thiodiglycol, Organosulfur compounds

[a] Actual sample depth selected for analysis will be at the discretion of the on-site geologist and will be based on field observation.

MS/MSD - Matrix spike/matrix spike duplicate.
NA - Not available until after wells are installed.
QA/QC - Quality assurance/quality control.
SVOC - Semivolatile organic compound.
TCL - Target compound list.
VOC - Volatile organic compound.

Table 4-4

Analytical Samples
Fenced Area at Range J - Pelham Range, Parcel 202(7)
Fort McClellan, Calhoun County, Alabama

Parameters	Analysis Method	Sample Matrix	TAT Needed	Field Samples: No. of Sample Points	Field Samples: No. of Events	Field Samples: No. of Field Samples	QA/QC Samples[a]: Field Dups (10%)	QA/QC Samples[a]: Splits w/ QA Lab (5%)	QA/QC Samples[a]: MS/MSD (5%)	QA/QC Samples[a]: Trip Blank (1/ship)	QA/QC Samples[a]: Eq. Rinse (1/wk/matrix)	Quanterra Total No. Analysis	QA Lab Total No. Analysis
Range J Pelham Range - Parcel 202(7): 16 water matrix: 16 groundwater, 48 soil matrix: 24 surface, 24 subsurface soil borings													
TCL VOCs	8260B	water	normal	16	1	16	1	1	1	4	1	24	1
TCL SVOCs	8270C	water	normal	16	1	16	1	1	1		1	20	1
8321 Modified		water	normal	16	1	16	1	1	1		1	20	1
Organosulfur	8270 CWM	water	normal	16	1	16	1	1	1		1	20	1
TCL VOCs	8260B	soil	normal	48	1	48	5	3	3		3	62	3
TCL SVOCs	8270C	soil	normal	48	1	48	5	3	3		3	62	3
8321 Modified		soil	normal	48	1	48	5	3	3		3	62	3
Organosulfur	8270 CWM	soil	normal	48	1	48	5	3	3		3	62	3
Range J - Pelham Range Parcel 202(7) Subtotal:						256	24	16	16	4	16	332	16

[a] Field duplicate, QA split, and MS/MSD samples were calculated as a percentage of the field samples collected per site and were rounded to the nearest whole number. Trip blank samples will be collected in association with water matrix samples for VOC analysis only. Assumed four field samples per day to estimate trip blanks. Equipment blanks will be collected once per event whenever sampling equipment is field decontaminated and re-used. They will be repeated weekly for sampling events that are anticipated to last more than 1 week. Assumed 20 field samples will be collected per week to estimate number of equipment blanks.

Ship samples to:

Quanterra Environmental Services
5815 Middlebrook Pike
Knoxville, Tennessee 37921
Attn: John Reynolds
Tel: 423-588-6401
Fax: 423-584-4315

USACE Laboratory split samples are shipped to:

USACE South Atlantic Division Laboratory
Attn: Sample Receiving
611 South Cobb Drive
Marietta, Georgia 30060-3112
Tel: 770-919-5270

Cl - Chlorinated.
MS/MSD - Matrix spike/matrix spike duplicate.
OP - Organophosphorus.
QA/QC - Quality assurance/quality control.
SVOC - Semivolatile organic compound.
TAL - Target analyte list.
TAT - Turnaround time.
VOC - Volatile organic compound.

sary to obtain the required level of accuracy. Horizontal coordinates will be referenced to the Alabama State Plane Coordinate System, 1983 North American Datum (NAD83). Elevations 4will be referenced to the National Geodetic Vertical Datum of 1929 or the North American Vertical Datum of 1988 (soon to be established on site).

Horizontal coordinates for soil locations will be recorded using a GPS to provide accuracy within 1 meter. Permanent monitoring well locations will be surveyed by a registered professional land surveyor to provide the required accuracy of 0.1 foot for horizontal coordinates and 0.01 foot for elevations.

Procedures to be used for GPS surveying are described in Section 4.3 of the SAP. Conventional land survey requirements are presented in Section 4.17 of the SAP.

4.6 Analytical Program

Samples collected at the locations specified on Chapter 4.0 will be analyzed for various chemical constituents (including agent breakdown products) and physical properties. These constituents and properties will be referred to as the hazardous, toxic, and radioactive waste (HTRW) program. The HTRW analytical program will be implemented by the Quanterra Environmental Services (Quanterra) laboratory in Knoxville, Tennessee and West Sacramento, California. In addition to this program, a chemical agent screening program is also required since the Fenced Area at Range J has been identified as a potential chemical agent site, where agents were possibly used or disposed. For the HTRW and chemical agent screening, the onsite sample coordinator will provide sampling containers, preservatives, and coordinate sampling procedures with the field sampling crews in accordance with Table 5-1 of the QAP.

4.6.1 Chemical Agent Screening

The Fenced Area at Range J has been identified as a site where chemical agents were potentially used or disposed, therefore, special precautions will be required when collecting, screening, and analyzing soil and water samples collected from this area. The purpose of implementing a chemical agent screening program is to verify that both the area sampled and the collected samples themselves, do not pose an exposure risk to the sampling technicians, sample shipment personnel, or laboratory analysts. To perform this verification, multiple levels of agent screening will be performed in the field and at onsite and offsite laboratory facilities. Field screening and onsite laboratory services will be provided by Quicksilver with offsite analytical services provided by Battelle Memorial Institute Laboratory (Battelle) in Columbus, Ohio. Battelle is currently certified by the Army's Edgewood Research and Development Engineering Center and the Chemical and Biological Defense Command to receive and handle chemical agent standards. The generalized screening and analysis program for chemical agent and their breakdown products is summarized on Figure 4-3.

The initial level of screening is conducted at the site of sample collection using MINICAMS instruments. The MINICAMS is a real-time portable air analyzer that provides the concentration of agents in the vapor phase. In addition to MINICAMS measurements, samples will be collected directly in the breathing zone of the sampling technicians using Depot Area Air Monitoring System (DAAMS) sorbent tubes. If the MINICAMS and DAAMS tube results indicate the area is safe to sample, then sample aliquots will be collected from the prescribed matrices to complete the HTRW program designated in Section 4.6.2 of this SFSP. These samples will be stored onsite under custody and preserved at 4 degrees Celsius (°C) until notification has been received to send them to Quanterra.

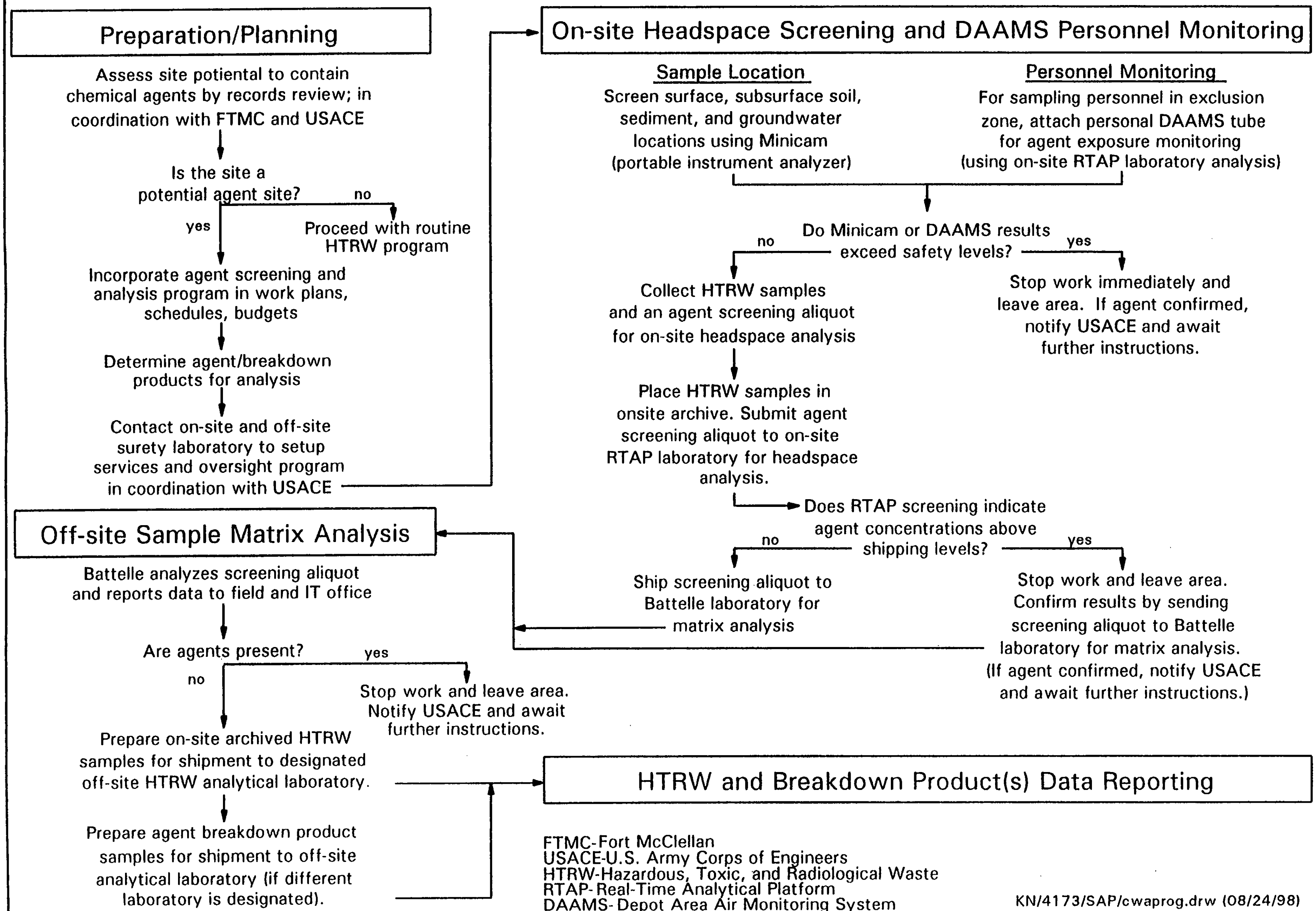
Along with the HTRW samples, a separate aliquot will be collected and submitted for agent headspace screening at the real-time analytical platform (RTAP) laboratory located onsite. If the RTAP laboratory results indicate the agent concentration is below a level that is safe to ship, the aliquot will be forwarded to the Battelle laboratory for quantitative matrix analysis. Once the results are evaluated and the area sampled has been verified to be free of chemical agents, the collected HTRW samples that have been stored onsite will be released for shipment to the Quanterra laboratory for routine chemical analysis and agent breakdown product analysis.

4.6.2 Analytical Program

The suite of analytical analyses to be performed is based on the PSSC historically used at the site and EPA, ADEM, FTMC, and USACE requirements. Target analyses for soil samples collected from the Fenced Area at Range J consist of the following list of parameters:

- Target Compound List (TCL) VOCs by EPA Method 5035/8260B
- TCL SVOCs by EPA Method 8270C
- Mustard breakdown products including:
  - Thiodiglycol by EPA Method 8321 (modified) and USATHMA methods: UW22 (water)/UW18 (soil)

Figure 4-3. Chemical Agent Analytical Program
Fort McClellan, Calhoun County, Alabama



FTMC-Fort McClellan
USACE-U.S. Army Corps of Engineers
HTRW-Hazardous, Toxic, and Radiological Waste
RTAP-Real-Time Analytical Platform
DAAMS-Depot Area Air Monitoring System

KN/4173/SAP/cwaprog.drw (08/24/98)

- Organosulfur compounds: 1,4-dithiane and 1,4-oxathiane by EPA Method 8270 (modified) and USATHMA methods: UL04 (water)/LL03 (soil).

These tests will be performed by the cited EPA SW-846 Update III method or modified SW-846/ USATHMA method, as presented in Table 4-4 of this SFSP and Table 6-1 of the QAP. The Quanterra laboratory has been validated for these SW-846 methods by the USACE Center of Expertise. VOC and SVOC data will be reported and evaluated in accordance with CESAS Level B criteria (USACE, 1994) and the stipulated requirements for the generation of definitive data (Section 3.1.2 of the QAP). VOC and SVOC data will be validated in accordance with EPA National Functional Guidelines by Level III criteria.

4.7 Sample Preservation, Packaging, and Shipping

Separate protocols will be applied to chemical agent aliquots and HTRW analyses for sample preservation and handling. HTRW samples must be archived onsite at conditions (temperature and pH) that meet the specifications found in the QAP. Chemical agent data will determine when the HTRW samples can be removed from onsite storage and shipped to the Quanterra laboratory for analysis. Any delays in receiving data from Battelle may result in HTRW samples exceeding their recognized EPA holding times. If this situation occurs, the USACE will be contacted for guidance.

HTRW Analyses. Sample preservation, packaging, and shipping for HTRW analyses will follow the procedures as specified in the Section 4.12.2 of the SAP. This includes secure, onsite refrigerated storage within a temperature range of 4°C ± 2°C while waiting for chemical agent results. Verification of the storage temperature will be performed using temperature blanks and will be recorded twice per day on a temperature monitoring log.

Completed analysis request/COC records will be secured and included with each shipment of coolers to Quanterra. Chemical agent breakdown product analyses will be conducted at Quanterra's West Sacramento laboratory while the remaining HTRW analyses will be performed at Quanterra's Knoxville laboratory. To meet holding times, direct shipments from the field to both laboratories are possible. The addresses are:

Quanterra-Knoxville
Attention: Sample Receiving
Quanterra Environmental Services
5815 Middlebrook Pike
Knoxville, Tennessee 37921
Telephone: (423) 588-6401

Quanterra-West Sacramento
Attention: Sample Receiving
Quanterra Environmental Services
880 Riverside Parkway
West Sacramento, California 95605
Telephone: (916) 373-5600.

The collected QA split samples will be shipped via overnight courier service to the USACE-designated laboratory directly from FTMC under custody, with storage on sufficient ice to maintain 4°C ± 2°C until laboratory receipt.

Chemical Agent Screening. Sample aliquots collected and successfully screened onsite at the RTAP laboratory will be shipped to Battelle for confirmation analysis as soon as possible. This will facilitate the receipt of the chemical agent confirmation data and allow subsequent HTRW analyses to be conducted in a timely manner. Sample aliquots for chemical agent screening will be chilled to 4°C ± 2°C and shipped via overnight courier to the following address:

Attention: Sample Receiving
Battelle Memorial Institute
505 King Avenue
Columbus, Ohio 43201
(614) 424-5123.

If chemical agent concentration(s) exceed safety levels in the samples submitted to Battelle, all work in the area sampled will be stopped and the USACE will be notified. HTRW samples from the affected area will not be sent to their laboratory, and additional work in the area will not proceed until further instruction is received from the USACE.

4.8 Investigation-Derived Waste Management

Management and disposal of the investigation-derived wastes (IDW) will follow procedures and requirements as described in Appendix D of the SAP. The IDW expected to be generated at the Range J site will include purge water from permanent monitoring well development and sampling activities, spent well materials, decontamination fluids, and disposable personal protective equipment. The IDW will be stored within the open fenced area surrounding Buildings 335 and 336 while awaiting final disposal.

4.9 Site-Specific Safety and Health

Safety and health requirements for the supplemental RI are provided in the SSHP attachment for the Fenced Area at Range J. The SSHP attachment will be used in conjunction with the SHP.

5.0 Project Schedule

The project schedule for the supplemental RI activities will be provided by the IT project manager to the BRAC closure team on a monthly basis.

6.0 References

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APPENDIX A

GEOLOGIC STRATIGRAPHIC COLUMN FOR CALHOUN COUNTY, ALABAMA

EXPLANATION

System	Map symbols	Descriptions	
Pennsylvanian	ℙpv	Pottsville Formation	Light-gray thin- to thick-bedded quartzose sandstone and conglomerate
Mississippian	ℙMpw	Parkwood Formation	Parkwood Formation—interbedded medium- to dark-gray shale and light- to medium-gray sandstone, locally contains dusky-red and grayish-green mudstone, argillaceous limestone, and clayey coal Floyd Shale—Dark-gray shale, sideritic in part; thin beds of sandstone, limestone, and chert are locally present
	ℙMpwf	Parkwood Formation and Floyd Shale undifferentiated	
	Mf	Floyd Shale	
	Pzu	Paleozoic shale undifferentiated	Dark-gray shale and mudstone, locally containing thin interbeds and lenses of dark-greenish-gray sandstone. Includes Athens Shale and probable Floyd Shale in the structural windows near Fort McClellan
	Mtfp	Tuscumbia Limestone and Fort Payne Chert undifferentiated	Tuscumbia Limestone—light- to dark-gray, fossiliferous and oolitic, partly argillaceous and cherty limestone Fort Payne Chert—dark-gray to light-gray limestone with abundant irregular light-gray chert nodules and beds. Commonly present below the Fort Payne is greenish-gray to grayish-red phosphatic shale (Maury Formation) which is mapped with the Tuscumbia Limestone and Fort Payne Chert undifferentiated
Devonian	Dcfm	Chattanooga Shale and Frog Mountain Formation undifferentiated	Chattanooga Shale—brownish-black to black organic shale containing light- to dark-gray sandstone interbeds near the base Frog Mountain Sandstone—Light- to dark-gray sandstone with thin dark-gray shale interbeds; light-gray to black dolomudstone, glauconitic limestone, and fossiliferous chert locally in lower part
	Dfm	Frog Mountain Formation	
Silurian	Srm	Red Mountain Formation	Interbedded yellowish-gray to moderate-red sandstone, siltstone and shale; greenish-gray to moderate-red fossiliferous partly silty and sandy limestone; few thin hematitic beds.
Ordovician	Oscmg: Os, Ocm, Og	Sequatchie Formation, Colvin Mountain Sandstone and Greensport Formation undifferentiated in part	Sequatchie Formation—Dusky-red to light-olive-gray siltstone, sandstone, shale, and dolomite, regular but uneven bedding. Colvin Mountain Sandstone—Light-gray quartzose sandstone, pebbly in part. Locally contains thin beds of bentonite in the upper part. Greensport Formation—Variegated dusky-red and dark-yellowish-orange shale, calcareous mudstone, limestone, siltstone, and minor sandstone
	Oa	Athens Shale	Athens Shale—Black graptolitic shale, locally contains interbedded dark-gray limestone. Lenoir Limestone—Dark-gray medium- to thick-bedded argillaceous limestone; locally contains an interval of fenestral mudstone at the base (Mosheim Limestone Member). Little Oak Limestone—Dark-gray medium- to thick-bedded fossiliferous, argillaceous to silty limestone containing chert nodules. Locally includes thin beds of bentonite in the upper part Newala Limestone—Light- to dark-gray thick-bedded micritic and peloidal limestone and minor dolomite
	Olol	Little Oak and Lenoir Limestones undifferentiated	
	Olo	Little Oak Limestone	
	Olon	Little Oak and Newala Limestones undifferentiated	
	On	Newala Limestone	
Cambrian	OЄk	Knox Group undifferentiated in part	Light-gray to light-brown locally sandy dolomite, dolomitic limestone, and limestone, characterized by abundant light-colored chert.
	Єc	Conasauga Formation	Light- to dark-gray finely to coarsely crystalline, medium- to thick-bedded dolomite containing minor greenish-gray shale and light-bluish-gray chert
	Єcl	Unnamed Lower Member	Dark-green to pale-olive fossiliferous shale with a few dark-gray limestone interbeds
	Єr	Rome Formation	Variegated thinly interbedded mudstone, shale, siltstone, and sandstone, limestone and dolomite occur locally. Quartzose sandstone commonly present near top of formation.
	Єs	Shady Dolomite	Bluish-gray or pale-yellowish-gray thick-bedded siliceous dolomite; characterized by coarsely crystalline porous chert.
	Єch: Єww	Chilhowee Group undif. in part: Weisner and Wilson Ridge Formations undifferentiated	Interbedded quartzose to slightly feldspathic sandstone and laterally continuous conglomerate in ledge-forming units separated by greenish-gray silty mudstone.
	Єch: Єn	Chilhowee Group undif. in part: Nichols Formation	Massive to laminated greenish-gray and black micaceous mudstone containing minor interbeds of siltstone and very fine-grained sandstone.
	Єch: Єcn	Chilhowee Group undif. in part: Cochran Formation	Poorly sorted arkosic sandstone and conglomerate containing interbedded greenish-gray siltstone and mudstone.
Silurian(?) to Devonian	tld	Lay Dam Formation	Interbedded dark-green phyllite, medium-gray to light-brown and black metasiltstone, dark-green feldspathic metagraywacke, and white to light-gray and dark-gray medium- to coarse-grained arkosic quartzite and metaconglomerate; graphitic phyllite common in upper part. Includes the Abel Gap Formation of Bearce (1973) which consist of interbedded greenish-gray metasiltstone and quartzite, black phyllitic metasiltstone, medium-gray to greenish-gray arkosic quartzite, and dark-gray pyritic quartzite.
Cambrian(?)	hp	Heflin Phyllite	Grayish-green, medium-gray, and medium-bluish-gray calcareous sandy metasiltstone interbedded with minor greenish-gray fine- to coarse-grained metasandstone and rare thin lenses of calcite and dolomite marble, an interval of greenish-gray to dark-gray phyllitic quartzite or quartz-pebble metaconglomerate is locally present near the base.