FINAL

FORSCOM

CORRECTIVE ACTION PLAN

for the

3d Inf Div (Mech)

CAMP OLIVER LANDFILL (SOLID WASTE MANAGEMENT UNIT 2) at FORT STEWART MILITARY RESERVATION FORT STEWART, GEORGIA

Prepared for

U.S. ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

Contract No. DACA21-95-D-0022
Delivery Order 0062

December 2000

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CAMP OLIVER LANDFILL
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at
FORT STEWART MILITARY RESERVATION
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<u>REGULATORY AUTHORITY</u>
Resource Conservation and Recovery Act
40 CFR 264, Title II, Subpart C, Section 3004;
42 USC 6901 et seq.

Prepared for
U.S. Army Corps of Engineers
Savannah District
Under Contract DACA21-95-D-0022
Delivery Order Number 0062

Prepared by
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December 2000

The undersigned certifies that I am a qualified groundwater scientist who has received a baccalaureate or postgraduate degree in the natural sciences or engineering and that I have sufficient training and experience in groundwater hydrology and related fields, as demonstrated by state registration and completion of accredited university courses, to enable me to make sound professional judgments regarding groundwater monitoring and contaminant fate and transport. I further certify that this report was prepared by myself or by a subordinate working under my direction.

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contributed to the preparation of this document and should not be considered an eligible contractor for its review.

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ACRONYMS

amsl	above mean sea level
AT123D	Analytical Transient 1-, 2-, 3-Dimensional (Model)
bgs	below ground surface
BHHRA	baseline human health risk assessment
BMP	Base Master Plan
CAP	Corrective Action Plan
CMCOC	contaminant migration constituent of concern
CMCOPC	contaminant migration constituent of potential concern
COC	constituent of concern
COPC	constituent of potential concern
DERP	Defense Environmental Restoration Program
DO	dissolved oxygen
DoD	U.S. Department of Defense
DPT	direct-push technology
DPW	Directorate of Public Works
ECOPC	ecological constituent of potential concern
EPA	U.S. Environmental Protection Agency
EPRE	ecological preliminary risk evaluation
ESV	ecological screening value
FSMR	Fort Stewart Military Reservation
GEPD	Georgia Environmental Protection Division
GSSL	Generic Soil Screening Level
HHCOC	human health constituent of concern
HHCOPC	human health constituent of potential concern
HHPRE	human health preliminary risk evaluation
HI	hazard index
HQ	hazard quotient
ILCR	incremental lifetime cancer risk
LAS	Land Application System
MCL	maximum contaminant level
O&M	operations and maintenance
ODAST	One-dimensional Analytical Solute Transport (Model)
PCB	polychlorinated biphenyl
RCRA	Resource Conservation and Recovery Act
Redox	oxidation-reduction potential
RFI	RCRA Facility Investigation
SAIC	Science Applications International Corporation
SESOIL	Seasonal Soil Compartment (Model)
SRC	site-related contaminant
SVOC	semivolatile organic compound
SWMU	solid waste management unit
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
VOC	volatile organic compound

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1.0 INTRODUCTION

1.1 SCOPE

This report documents the Corrective Action Plan (CAP) for the Camp Oliver Landfill, Solid Waste Management Unit (SWMU) 2 at the Fort Stewart Military Reservation (FSMR), Georgia. A Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) was conducted in November and December of 1997. The revised final Phase II RFI Report for 16 SWMUs (SAIC 2000) determined that this SWMU required a CAP to evaluate appropriate remedial actions to eliminate or minimize potential risks associated with the Camp Oliver Landfill. Implementation of the remedy selected in this CAP is required for this site to protect the health of humans coming in contact with the site. This report has been prepared by Science Applications International Corporation (SAIC) for the U.S. Army Corps of Engineers (USACE), Savannah District, under Contract DACA21-95-D-0022, Delivery Order No. 0062.

The Camp Oliver Landfill is located approximately 17 miles northwest of the Fort Stewart garrison area along Fort Stewart Road 129. It is just north of the bivouac area on the northern side of a small hill and is approximately 8.8 acres in size. The landfill is reported to be 15 feet wide by 300 feet long by 5 feet to 6 feet deep (Geraghty and Miller 1992). The waste disposed of at the landfill included garbage and refuse, grass clippings, tree branches, root stumps, and chunks of asphalt and concrete. Further background information concerning the landfill is provided in Chapter 2. The history of the Camp Oliver Landfill is summarized in Section 2.1.

Based on the findings presented in the revised final Phase II RFI Report for 16 SWMUs issued by SAIC in April 2000, a "no further action required" status has been assigned to the Camp Oliver Landfill for investigative purposes. As recommended by the revised final Phase II RFI Report for 16 SWMUs and as concurred to by GEPD (approval letter from Mr. Bruce Khaleghi to Colonel Gregory Stanley dated December 2000), a CAP has been prepared for SWMU 2 because buried waste will remain in place. Implementation of the selected remedy documented by this CAP is necessary to control intrusive activities at this site, to be protective of the health of humans potentially coming in contact with the buried waste, and to prevent the use of groundwater as a drinking water source. As recommended in the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000), this CAP has been prepared to evaluate the use of institutional controls to protect human health. A "no action" alternative is also presented and evaluated to provide a comparison to the institutional controls alternative.

The CAP describes and provides designs for the selected remedy and includes plans for its implementation, along with a plan for operations and maintenance (O&M) of the selected remedy. Also included in this plan are a detailed cost estimate and a schedule of implementation for the selected corrective action.

1.2 SITE BACKGROUND

In 1980 and 1981, a groundwater and surface water investigation was performed at the site. The investigation indicated the presence of iron in groundwater at levels that exceeded the drinking water standard. Surface water analysis indicated high iron concentrations near the landfill and fecal coliform contamination. A Phase I RFI was conducted at SWMU 2 to determine if a release to the environment had occurred and to decide if the site had the potential for a release to the environment. The results of the Phase I RFI conducted in July and October 1993 indicated that metals were present in the subsurface soil, groundwater, and surface water. Based on these findings, GEPD instructed the Fort Stewart Directorate of Public Works (DPW) to conduct a Phase II RFI of the landfill.

The objectives for the Phase II RFI, as defined by the Work Plan (SAIC 1997) approved by GEPD on October 10, 1997, were as follows:

- determine the horizontal and vertical extents of contamination;
- determine whether contaminants present a threat to human health or the environment;
- determine the need for future action and/or no further action; and
- gather data necessary to support a CAP, if warranted.

The scope of the Phase II RFI fieldwork included the activities listed below.

- Initial screening consisting of using direct-push technology (DPT) techniques to collect groundwater samples from three Geoprobe borings for volatile organic compound (VOC) analysis. Determination of the characteristics of the leachate at this site using Geoprobe screening locations.

- Installation of a vertical-profile boring in the center of the landfill to determine the vertical extent of groundwater contamination. Collection of groundwater grab samples at 10-foot intervals and analysis for VOCs.

- Installation of five soil borings.

- Installation of a new background monitoring well because the existing background well (MW1) was dry. Abandonment of MW1 in accordance with GEPD requirements. Installation of two new downgradient monitoring wells. Redevelopment of existing wells. Collection of geotechnical soil samples from the three monitoring well boreholes.

- Collection of a surface soil sample and a subsurface soil sample from each boring/well. Also, collection of three surface soil samples from within the boundary of SWMU 2. Analysis of all surface and subsurface soil samples for VOCs, semivolatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), and RCRA metals.

- Collection of groundwater samples from seven monitoring wells, and analysis for VOCs, SVOCs, pesticides/PCBs, and RCRA metals. Measurement of conductivity, temperature, pH, dissolved oxygen (DO), oxidation-reduction potential (Redox), and turbidity in the field during sampling.

- Collection of two surface water samples and two sediment samples from Canoochee Creek. The upstream location was northwest of the site, while the downstream location was north-northeast of the site.

1.3 REGULATORY BACKGROUND

Executive Order 12088, signed in 1978, requires federal facilities to comply with federal, state, and local pollution requirements. The Defense Environmental Restoration Program (DERP) was formally established in fiscal year 1984 to promote and coordinate efforts for the evaluation and cleanup of contamination at U.S. Department of Defense (DoD) installations. Executive Order 12580, signed January 23, 1987, relates to Superfund implementation and assigns responsibility to the Secretary of Defense for carrying out the DERP. The Installation Restoration Program was established as part of the

DERP to assess potential contamination at DoD installations and formerly used properties and to address site cleanups, as necessary. With the promulgation of RCRA and the subsequent approval of the Georgia Hazardous Waste Management Act by the U.S. Environmental Protection Agency (EPA), the state was granted RCRA permitting authority. In accordance with RCRA, the state issued to Fort Stewart, in August 1987, a Hazardous Waste Facility Permit [Georgia Environmental Division Permit No. HW-045 (S&T)]. The permit was renewed in August 1997. The Camp Oliver Landfill (SWMU 2) is a listed SWMU in Fort Stewart's Subpart B Permit (Appendix A) and, therefore, is subject to investigation according to Title 40, Code of Federal Regulations, Part 264.101(c) [as reported in Section 10.1 of the revised final Phase II RFI Report for 16 SWMUs, dated April 2000 (SAIC 2000)] and to corrective action (the subject of this CAP), if necessary.

1.4 REPORT ORGANIZATION

This CAP report is divided into six chapters: (1) Introduction, (2) Site Characterization and Remedial Investigation Results, (3) Justification/Purpose of Corrective Action, (4) Screening of Corrective Actions, (5) Conceptual Design and Implementation Plan, and (6) References. Chapter 1 (Introduction) provides an explanation of the scope of the CAP, presents general background information on the FSMR and specific background information on the site, and provides regulatory background information. Chapter 2 (Site Characterization and Remedial Investigation Results) provides an overview of the site; physical and environmental descriptions; and the nature and extent of contamination, contaminant fate and transport, and preliminary risk evaluation information. Chapter 3 (Justification/Purpose of Corrective Action) presents remedial response objectives and the purpose for corrective action and identifies and describes the corrective action alternatives under evaluation. Chapter 4 (Screening of Corrective Actions) presents an evaluation of corrective actions and screens the corrective actions against established objectives and balancing factors. Chapter 5 (Conceptual Design and Implementation Plan) identifies the selected corrective action, presents design and implementation details, and provides a cost estimate and schedule for the selected remedy. Reference information is presented in Chapter 6. The O&M Plan for the selected remedy is presented as Appendix A. Appendix B presents the Base Master Plan (BMP) and deed recordation requirements. Appendix C presents a site description, direction to the site, and the topographic surveys of SWMU 2. Appendix D presents cost estimates for the alternatives.

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2.0 SITE CHARACTERIZATION AND REMEDIAL INVESTIGATION RESULTS

Fort Stewart (then known as Camp Stewart) was established in June 1940 as an antiaircraft artillery training center. Between January and September 1945, the Installation operated as a prisoner-of-war camp. The Installation was deactivated in September 1945. In August 1950 Fort Stewart was reactivated to train antiaircraft artillery units for the Korean Conflict. The training mission was expanded to include armor training in 1953. Fort Stewart was designated a permanent Army installation in 1956 and became a flight training center in 1966. Aviation training at the Fort Stewart facilities was phased out in 1973. In January 1974 the 1st Battalion, 75th Infantry was activated at Fort Stewart. Fort Stewart then became a training and maneuver area, providing tank, field artillery, helicopter gunnery, and small arms training for regular Army and National Guard units. These activities comprise the Installation's primary mission today. The 24th Infantry Division, which was reflagged as the 3d Infantry Division in May 1996, was permanently stationed at Fort Stewart in 1975.

The FSMR is located in portions of Liberty, Bryan, Long, Tattnall, and Evans counties, Georgia, approximately 40 miles west-southwest of Savannah, Georgia (Figures 2-1 and 2-2). The cantonment, or garrison area, of the FSMR is located within Liberty County, on the southern boundary of the reservation. The Camp Oliver Landfill is located northwest of the garrison area within Evans County (Figure 2-3).

2.1 SITE LOCATION AND HISTORY

The Camp Oliver Landfill is located approximately 17 miles northwest of the Fort Stewart garrison area along Fort Stewart Road 129. It is just north of the bivouac area on the northern side of a small hill. From the 1960s to 1979, the area was used for disposal of refuse from troop training activities and nearby residents via open-pit burning. The landfill was officially closed in 1970; however, the trench method of solid waste disposal was reported to have continued. General refuse from ground maintenance activities and construction debris were placed in the landfill from 1979 to 1984 during the annual 3- to 4-month period of training activities. The landfill is reported to be 15 feet wide by 300 feet long by 5 feet to 6 feet deep (Geraghty and Miller 1992). The waste disposed of at the landfill included garbage and refuse, grass clippings, tree branches, root stumps, and chunks of asphalt and concrete. No evidence of disposal of toxic or hazardous wastes was indicated in the records searched by Environmental Science and Engineering (1982). There is little obvious surface evidence that a landfill or open dumping area existed. During a site reconnaissance in November 1995, small soil piles, some roofing tin, and wooden construction-type debris were observed. Also, spent small weapons cartridges were observed in the ditch along the site's southwestern and southeastern boundaries. A site reconnaissance in September 1996 indicated no evidence of any landfill operations. Grass, small trees, and bushes now cover the area.

Based on the findings presented in the revised final Phase II RFI Report for 16 SWMUs (SAIC 2000), a "no further action required" status was assigned to the investigation of the nature and extent of potential contamination associated with SWMU 2. As recommended by the revised final Phase II RFI Report for 16 SWMUs and as concurred to by GEPD (approval letter from Mr. Bruce Khaleghi to Colonel Gregory Stanley dated December 2000), a CAP was recommended for SWMU 2 because buried waste will remain in place. The CAP is necessary to control intrusive activities at this site, to be protective of the health of humans potentially coming in contact with the buried waste, and to prevent the use of groundwater as a drinking water source.

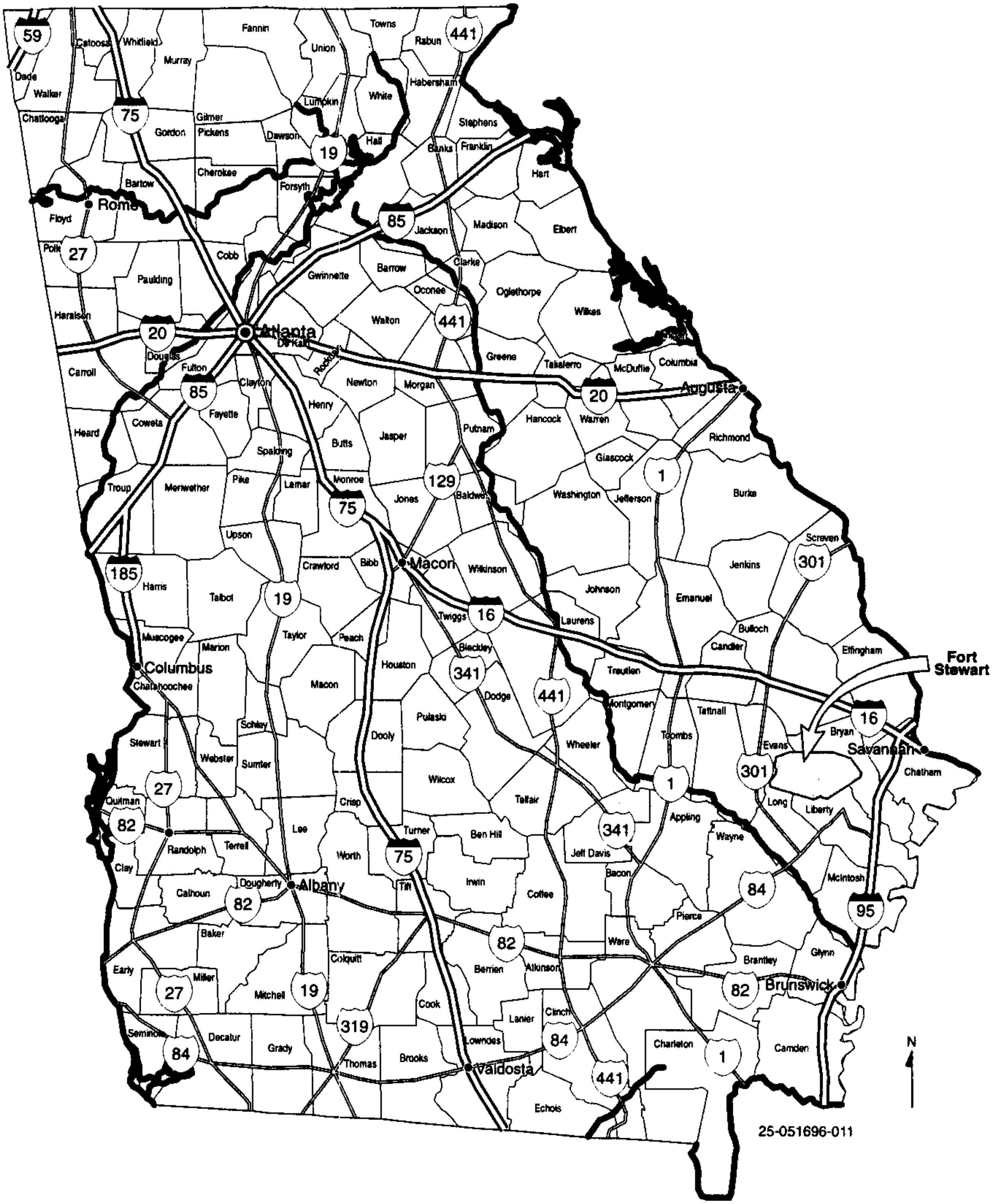

Figure 2-1. Regional Location Map for Fort Stewart Military Reservation, Georgia

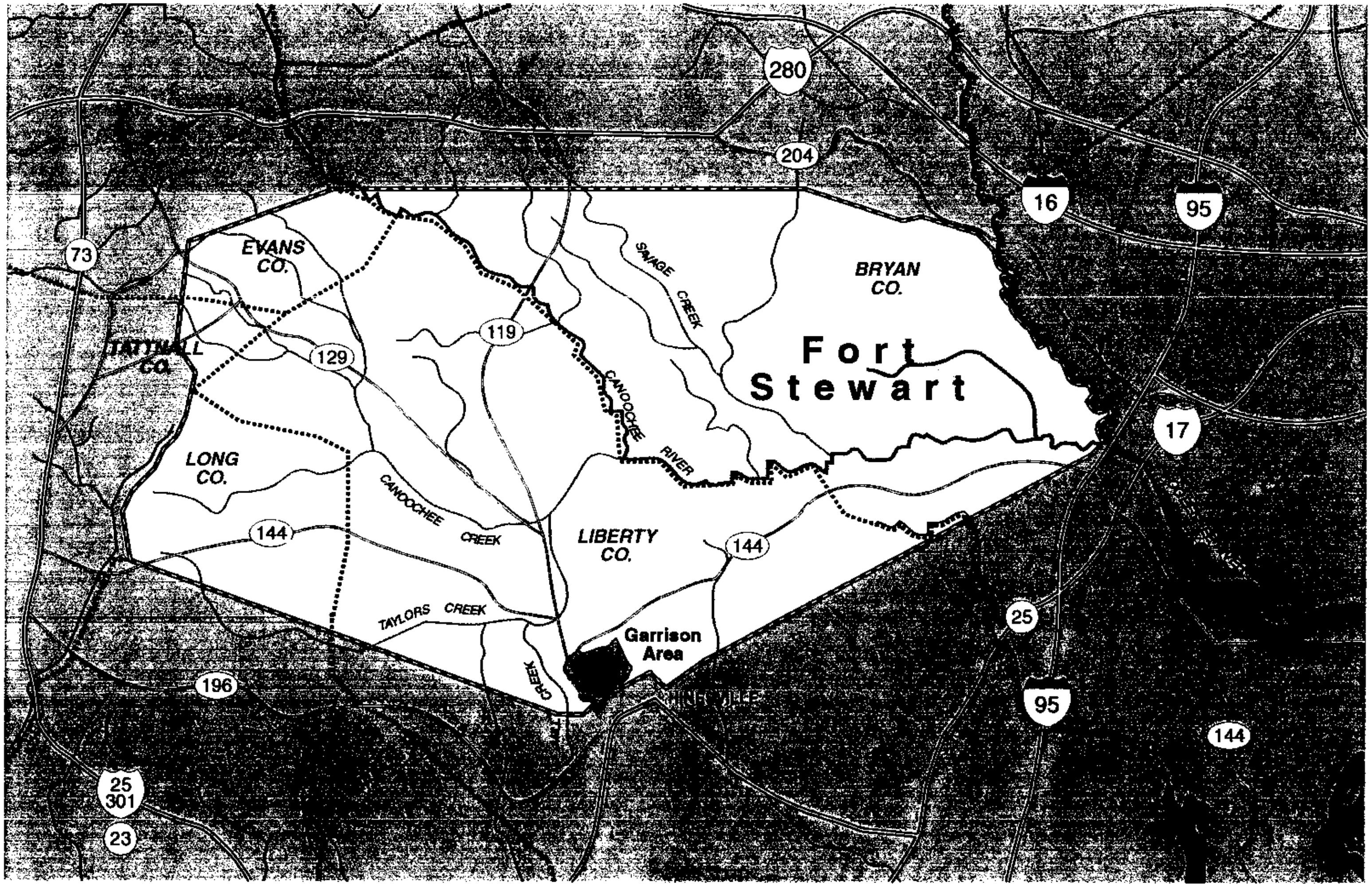

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Figure 2-2. Location Map for Fort Stewart Military Reservation, Georgia

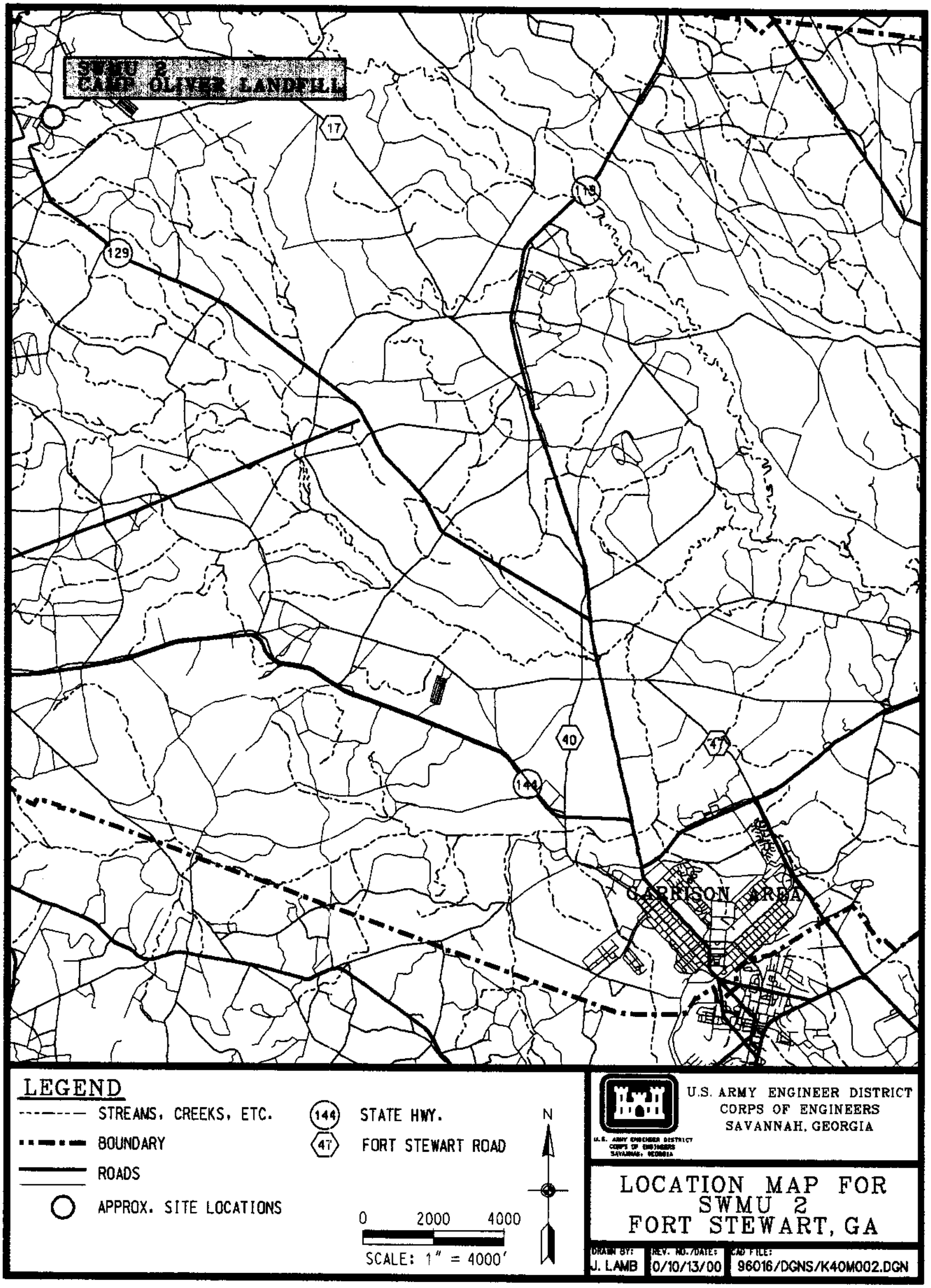

Figure 2-3. Location of the Camp Oliver Landfill (SWMU 2), Fort Stewart, Georgia

2.2 TOPOGRAPHY/PHYSIOGRAPHY/CLIMATE

The FSMR occupies a low-lying, flat region on the coastal plain of Georgia. Surface elevations range from approximately 20 feet to 100 feet above mean sea level (amsl) within the FSMR and generally decrease from northwest to southeast across the reservation. Terraces dissected by surface water drainages dominate the topography. The terraces are remnants of sea level fluctuations. The four terraces present within the FSMR are the Wicomico, Penholoway, Talbot, and Pamlico (Metcalf and Eddy 1996).

SWMU 2 is approximately 8.8 acres in size and consists mostly of unmanaged grasslands with immature trees. A barbed-wire fence runs along the western boundary of the landfill. Areas of dense trees cover some portions. Existing site features and topography are presented in Figure 2-4. There are approximately 25 feet of relief across the site. The elevation of the site is approximately 150 feet amsl along the southern boundary and slopes gently to approximately 125 feet amsl along the northern boundary. Canoochee Creek is located approximately 450 feet north of the northern boundary of SWMU 2. The surface water flow direction is from the northern boundary of SWMU 2 toward Canoochee Creek.

Fort Stewart has a humid, subtropical climate with long, hot summers. Average temperatures range from 50°F in the winter to 80°F in the summer. Average annual precipitation is 48 inches, with slightly more than half falling from June through September. Prolonged drought is rare in the area, but severe local storms (tornadoes and hurricanes) do occur. Under normal conditions wind speeds rarely exceed 5 knots, but gusty winds of more than 25 knots may occur during summer thunderstorms (Geraghty and Miller 1992).

2.3 SITE GEOLOGY

The FSMR is located within the coastal plain physiographic province. This province is typified by southeastward-dipping strata that increase in thickness from 0 feet at the fall line (located approximately 155 miles inland from the Atlantic coast) to approximately 4,200 feet at the coast. State geologic records describe a probable petroleum exploration well (the No. 1 Jelks-Rogers) located in the region as having encountered crystalline basement rocks at a depth of 4,254 feet below ground surface (bgs). This well provided the most complete record for Cretaceous, Tertiary, and Quaternary strata.

The Cretaceous section is approximately 1,970 feet in thickness and is dominated by clastics. The Tertiary section is approximately 2,170 feet in thickness and is dominated by limestone, with a 175-foot-thick cap of dark green phosphatic clay. This clay is regionally extensive and is known as the Hawthorn Group. The interval from approximately 110 feet to the surface is Quaternary in age and composed primarily of sand with interbeds of clay or silt. This section is undifferentiated.

State geologic records contain information regarding a well drilled in October 1942, 1.8 miles north of Flemington at Liberty Field of Camp Stewart (now known as Fort Stewart). This well is believed to have been an artesian well located approximately 0.25 mile north of the runway at Wright Army Airfield within the FSMR. The log for this well describes a 410-foot section, the lowermost 110 feet of which consisted predominantly of limestone, above which 245 feet of dark green phosphatic clay typical of the Hawthorn Group were encountered. The uppermost 55-foot interval was Quaternary-age interbedded sands and clays. The top 15 feet of these sediments were described as sandy clay.

Boring logs showing the types of soil encountered during the Phase II RFI at the Camp Oliver Landfill in soil screening probes, groundwater screening probes, and monitoring well boreholes are provided in Appendix B of the revised final Phase II RFI Report (SAIC 2000). Geological cross sections of the site, depicting the lithology and stratigraphy of the unconsolidated soil deposits beneath the site, as inferred

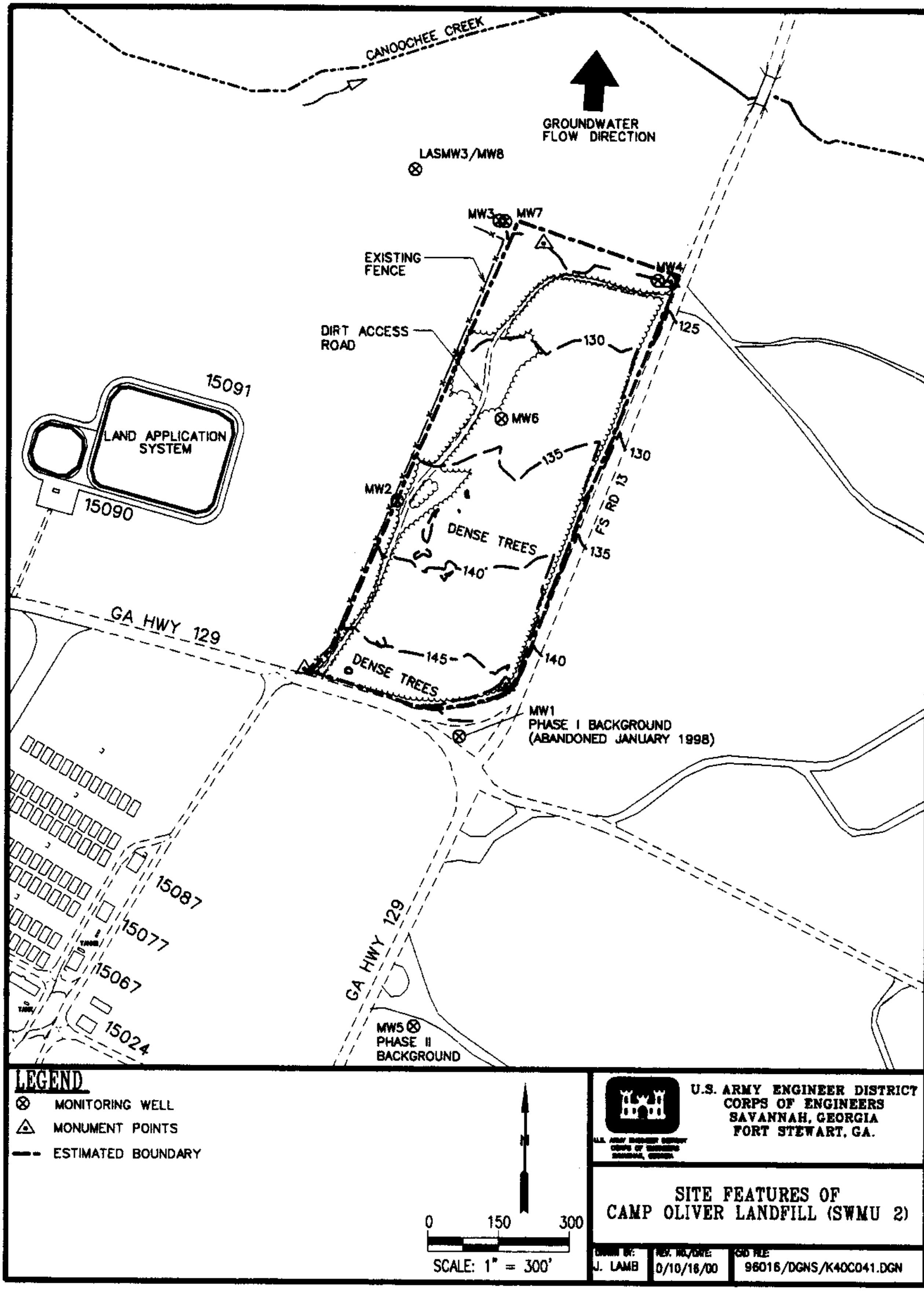

Figure 2-4. Site Features of the Camp Oliver Landfill (SWMU 2), Fort Stewart, Georgia

from the soil boring logs, are shown on Figures 10.1-2 and 10.1-3 of the revised final Phase II RFI Report (SAIC 2000).

The cross sections indicate that the soil present across the SWMU 2 landfill consists of alternating layers of sand and clayey sands, as shown in cross sections A-A′ and B-B′ (Figures 10.1-2 and 10.1-3) of the revised final Phase II RFI Report (SAIC 2000).

Geotechnical soil samples were collected from the three monitoring well boreholes, and the results are presented in Table 10.1-3 of the revised final Phase II RFI Report (SAIC 2000). The geotechnical analytical results indicated that tested soil was sand, with the proportion of fine-grained particles varying from 3.7 percent to 11.8 percent by weight. Soil from the screened intervals in MW5 and MW6 indicated a plasticity limit of 21 and 21.8, respectively; however, soil from MW7 was nonplastic. The soil from the screened interval in MW5 had a permeability of 1.40×10^{-6} cm/sec, which is typical for clayey sands.

2.4 SITE HYDROLOGY

The principal surface water body accepting drainage from the FSMR is the Canoochee River, which joins the Ogeechee River (part of the northeastern boundary of the reservation). Canoochee Creek is a tributary of the Canoochee River that drains much of the western portion of the FSMR. Canoochee Creek is located approximately 450 feet north of the northern boundary of the landfill. Based on the topography, the surface water flow direction is to the north toward Canoochee Creek.

2.5 HYDROGEOLOGY

The hydrogeology in the vicinity of the FSMR is dominated by two aquifers, referred to as the Principal Artesian and the surficial aquifer, that are separated by a confining unit, the Hawthorn Group.

The Principal Artesian aquifer is the lowermost hydrologic unit; is regionally extensive from South Carolina through Georgia, Alabama, and most of Florida; and is regionally known as the Floridan Aquifer. This aquifer is subdivided into upper and lower hydrogeologic units. The upper hydrogeologic unit is composed primarily of Miocene-age argillaceous sands and clays and Oligocene- to Eocene-age limestones (including the Ocala Group and the Suwannee Limestone, where present) at the top. The upper hydrogeologic unit ranges in thickness from 200 feet to 260 feet and is most productive where it is thickest and where secondary permeability is most developed. The lower hydrologic unit is comprised of the Eocene-age Avon Park Limestone at the base. The transmissivity of the aquifer in the Savannah area ranges from about 28,000 square feet/day to 33,000 square feet/day (Krause and Randolph 1989). Groundwater from this aquifer is primarily used for drinking water (Arora 1984). Thirteen groundwater production wells are used for potable water supply on the FSMR, and one additional production well is used for fire protection.

The confining layer for the Principal Artesian Aquifer is the phosphatic clays of the upper Hawthorn Group. These sediments are regionally extensive and range from 60 feet to 80 feet in thickness at the FSMR. There are minor occurrences of aquifer material within the Hawthorn Group; however, they have limited utilization (Miller 1990).

The uppermost hydrologic unit is the surficial aquifer, which consists of widely varying amounts of sand, silt, and clay ranging from 35 feet to 150 feet in thickness. Well yields from this aquifer would range from 2 gallons to 180 gallons per minute based on geotechnical data from the monitoring wells installed during the Phase II RFI. This aquifer could be used for domestic lawn and agricultural irrigation; however, there are no wells in the area of SWMU 2 known to be used for these purposes.

Water levels were measured in January and February of 1998 in seven of the eight new and existing monitoring wells at the Camp Oliver Landfill. [One of the existing monitoring wells (MW1) was abandoned due to insufficient water in the well.] Elevation of the water table varied from approximately 119 feet amsl along the northern boundary of the site to approximately 135 feet amsl along the southern boundary of the site. Figure 10.1-4 of the revised final Phase II RFI Report (SAIC 2000) presents a map of the potentiometric surface based on the water levels measured during the Phase II RFI. The shallow groundwater flow direction across the site is to the north (Figure 2-4) toward Canoochee Creek, and the hydraulic gradient is 0.0148 foot/foot.

2.6 SITE ECOLOGY

Approximately 7.8 square miles of the 436.8 square miles at the FSMR comprise the garrison area. The remainder is used for ranges and training areas (approximately 11 percent) or held as non-use areas.

Eighty-four percent of the land is forested (approximately 367.2 square miles). Sixty-six percent of the forest area is pine, with the major species including the slash, loblolly, and longleaf pines. Thirty-four percent of the forest is composed of river bottomlands and swamps, whose major species include the tupelo, other gum trees, water oak, and bald cypress trees. The open range and training areas comprise 11 percent of the Installation and consist of grasses, shrubs, and scrub tree (oak) growth.

Aquatic habitats on the FSMR include a number of natural or man-made ponds and lakes, the Canoochee River, Canoochee Creek and its tributaries, and a number of bottomland swamps and pools. The Ogeechee River borders the Installation along its northeastern boundary. Organic detritus content is high, and dark coloring of the water is not unusual. Dense growths of aquatic vegetation are also typical, especially during the summer months.

Both terrestrial and aquatic fauna are abundant in the unimproved areas of the FSMR. Major game species found on the Installation include white-tailed deer, feral hog, wild turkey, rabbit, squirrel, and bobwhite in addition to numerous other mammal, bird, reptile, and amphibian species (Environmental Science and Engineering 1982). Dominant fish include bluegill, largemouth bass, crappie, sunfish, channel catfish, minnows, and shiners. Three federally listed threatened or endangered species reside at the FSMR: the American bald eagle, Eastern indigo snake, and red-cockaded woodpecker.

The habitats at SWMU 2 are classified as "unmanaged grasslands" and "aquatic habitats." The site includes successional fields of unmanaged grasses, with scattered mature hardwoods and immature pine. Unimproved roads run within 50 feet of the southern and eastern sides of the site's boundaries. A mature pine-oak forest borders the northern and northwestern sides. Surface water runoff flows into Canoochee Creek, which runs within 450 feet of the northern boundary of SWMU 2.

Groundhog holes were abundant throughout the grass-covered area of the site, and nine-banded armadillos were spotted on many occasions throughout the investigation. Evidence of white-tailed deer and coyote (*Canis latrans*) was also apparent.

2.7 NATURE AND EXTENT OF CONTAMINATION

The results of chemical analyses performed during the Phase I and Phase II RFIs indicate that soil, groundwater, and sediment contain organic and metal contaminants at concentrations greater than their reference background concentrations. No contaminants were detected in surface water.

The reference background criteria for the Camp Oliver Landfill have been developed based on data from background samples collected across the FSMR for SWMUs under Phase I and/or Phase II RFIs. In general, reference background samples were collected in each medium at locations upgradient or upstream of each site so as to be representative of naturally occurring conditions at SWMUs under investigation. In addition, soil collected during the Phase I RFI [from the Burn Pits (SWMUs 4A–4F), Active Explosive Ordnance Disposal Area (SWMU 12A), etc.] was included in the background data set if it was determined to come from upgradient of the site and to be of sufficient quality to be representative of natural background conditions at the FSMR. A summary of the sample locations by medium at each SWMU and the source of the data (Phase I and II RFI analytical data) is presented in Table 5-1 of the revised final Phase II RFI Report (SAIC 2000).

EPA Region IV methodology (EPA 1995) was used as guidance for the development of the background data set for screening metals data. In cases in which enough samples (e.g., more than 20) are collected to define background, a background upper tolerance level can be calculated. In cases in which too few samples (e.g., fewer than 20) are collected to define background, background can be calculated as two times the mean background concentration (EPA 1995). Given that fewer than 20 background samples were collected for the FSMR, the latter method was used for calculating reference background concentrations.

The reference background concentrations for surface soil, subsurface soil, groundwater, and sediment were calculated as two times the average concentration of all of the locations selected to be in the background data set. If a chemical was not detected at a site, then one-half the detection limit was used as the concentration when calculating the reference mean background concentration.

Inorganics were considered to be site-related contaminants (SRCs) if their concentrations were above the reference background concentrations. Organics were considered to be SRCs if they were simply detected because organic constituents are considered anthropomorphic in nature.

Appendix G of the revised final Phase II RFI Report (SAIC 2000) presents a summary of the background data as well as the two-times-mean background concentrations. Given the limited background data, the mean concentration established by the U.S. Geological Survey (USGS) for soil in the eastern United States (USGS 1984) is also presented for comparative purposes. Because of the limited number of background samples, the screening value for background may be heavily skewed as a result of an outlier in the sampling data. The nature and extent of contamination by medium is summarized below. A tabular summary of SRCs by medium for the Camp Oliver Landfill is presented in Table 2-1.

2.7.1 Surface Soil

Eleven surface soil samples were collected at SWMU 2 during the Phase II RFI from three surface soil locations, five soil boring locations, and three monitoring wells. 2-Butanone and acetone were detected in one surface soil sample from MW6. Acetone was also detected in surface soil samples collected from SB2 and SB5. Bis(2-ethylhexyl)phthalate was detected in one of the surface soil samples at SB2. Fourteen pesticides were detected in the surface soil. These pesticides were 4,4'-DDD; 4,4'-DDE; 4,4'-DDT; aldrin; alpha-chlordane; alpha-BHC; delta-BHC; dieldrin; endosulfan II; endosulfan sulfate; endrin ketone; heptachlor; heptachlor epoxide; and methoxychlor. Arsenic, barium, cadmium, chromium,

Table 2-1. Summary of Site-related Contaminants, SWMU 2

Analyte	Maximum Concentration (mg/kg)			Maximum Concentration (µg/L)	
	Surface Soil	Subsurface Soil	Sediment	Groundwater	Surface Water
Volatile Organic Compounds					
2-Butanone	0.0055	0.0076	ND	ND	ND
4-Methyl-2-pentanone	ND	ND	ND	9.9	ND
Acetone	0.511	ND	ND	ND	ND
Toluene	ND	ND	ND	15.6	ND
Xylenes, total	ND	ND	ND	15.3	ND
Semivolatile Organic Compounds					
Bis(2-ethylhexyl)phthalate	1.1	0.229	ND	ND	ND
Pesticides/PCBs					
4,4'-DDD	0.0032	ND	ND	ND	ND
4,4'-DDE	0.01	0.0088	ND	ND	ND
4,4'-DDT	0.0042	0.0089	ND	ND	ND
Aldrin	0.0011	ND	ND	ND	ND
alpha-BHC	0.00024	0.00056[a]	ND	ND	ND
alpha-Chlordane	0.00095	ND	0.00071	ND	ND
delta-BHC	0.0016	ND	ND	ND	ND
Dieldrin	0.003	ND	ND	ND	ND
Endosulfan II	0.0018	ND	ND	ND	ND
Endosulfan sulfate	0.0032	ND	ND	ND	ND
Endrin ketone	0.0026	ND	ND	ND	ND
Heptachlor	0.001	ND	ND	ND	ND
Heptachlor epoxide	0.00076	ND	ND	ND	ND
Methoxychlor	0.012	ND	ND	ND	ND
Metals					
Arsenic	3.4	BRBC	ND	ND	ND
Barium	29.5	24.5	ND	BRBC	BRBC
Cadmium	0.2	BRBC	ND	ND	ND
Chromium	47.5	22.5	ND	ND	BRBC
Lead	19.7	BRBC	ND	12.6[a]	ND
Mercury	0.04	0.23	ND	0.21	ND
Selenium	BRBC	BRBC	ND	2.5	ND

[a]Maximum concentration detected excluding data from the site-specific background location (MW5).
BRBC = Below reference background criterion.
ND = Not detected.

lead, and mercury were detected in surface soil samples from one or more of the monitoring wells, soil borings, and surface soil locations at concentrations above the reference background criteria and were considered to be potential SRCs. However, arsenic, barium, lead, and mercury might not be site related. Arsenic was detected at less than two times the reference background criterion, including the site-specific background concentration. While barium was elevated above background at most locations, the maximum concentration was less than two times background, and the sampling locations at which the exceedances of reference background occurred were widely distributed, suggesting that barium occurs naturally in surface soil in this area. Cadmium was detected at only one surface soil sampling location at a concentration only slightly above the reference background criterion. Lead was found in only one surface soil sample, SS3, at a concentration that was only slightly more than two times the reference background criterion. Mercury was detected at a maximum concentration of 0.04 mg/kg, compared to the reference background criterion of 0.03 mg/kg.

2.7.2 Subsurface Soil

Eight subsurface soil samples were collected from five soil borings and three monitoring wells during the Phase II RFI. 2-Butanone was the only VOC detected in subsurface soil samples and is considered to be an SRC in subsurface soil. Bis(2-ethylhexyl)phthalate was the only SVOC detected (SB5) and is considered to be an SRC in subsurface soil. Alpha-BHC was detected in subsurface soil samples from MW5 and SB1. No other pesticides/PCBs were detected in the subsurface soil samples from the monitoring wells. 4,4'-DDE and 4,4'-DDT were detected in soil boring SB1. No pesticides/PCBs were detected in the subsurface soil samples from SB2, SB3, SB4, and SB5. 4,4'-DDE; 4,4'-DDT; and alpha-BHC are considered to be SRCs in subsurface soil. Analytical results from subsurface soil samples collected during the Phase I RFI did not indicate concentrations of RCRA metals that exceeded reference background concentrations. However, analytical results from subsurface soil samples collected from SB2, SB3, and SB5 during the Phase II RFI indicated concentrations of barium, chromium, and mercury that did exceed reference background concentrations. RCRA metals that exceeded the reference background criteria at this site were primarily detected at locations around its perimeter, with no metals detected at the most central sampling location (MW6). Barium, chromium, and mercury are considered to be potential SRCs in subsurface soil.

2.7.3 Groundwater

Three groundwater screening wells and one vertical-profile boring (VP1) were installed within the boundary of the landfill using DPT techniques and were analyzed for VOCs. The analytical laboratory missed the holding times for VOCs for one of the intervals of the vertical-profile boring installed during the initial sampling endeavor (January 1998). Another vertical-profile boring (VP2) was installed next to the previous location, and groundwater was resampled in May 1998; however, the groundwater was inadvertently analyzed for only benzene, toluene, ethylbenzene, and total xylenes. In addition, seven groundwater samples were collected from three newly installed monitoring wells and four existing monitoring wells. The groundwater samples from the monitoring wells were analyzed for VOCs, SVOCs, pesticides/PCBs, and RCRA metals.

VOCs were detected in groundwater at relatively low concentrations at three sampling locations (MW6, VP1 and VP2). These VOCs included 4-methyl-2-pentanone, toluene, and total xylenes, which were considered to be potential SRCs in groundwater. Bis(2-ethylhexyl)phthalate was detected in MW8 at a concentration of 240 µg/L, which exceeds its maximum contaminant level (MCL). Bis(2-ethylhexyl)phthalate was believed to be the result of field or laboratory contamination; therefore, with the concurrence of GEPD (SAIC 1999), the groundwater at MW8 was resampled on July 10, 1999. Bis(2-ethylhexyl)phthalate was not detected in MW8 during the resampling. The elevated concentration of bis(2-ethylhexyl)phthalate initially detected was considered to be the result of field or laboratory contamination; therefore, bis(2-ethylhexyl)phthalate is not an SRC at SWMU 2. No pesticides/PCBs were detected in the groundwater samples.

Mercury was detected at four of the six groundwater sampling locations that were analyzed for RCRA metals at concentrations that slightly exceeded the reference background criterion. Lead was detected at two locations (MW5 and MW8) at concentrations that exceeded the reference background criterion. Lead exceeded its MCL at MW5, which is a background sampling location. Selenium was detected at only one location, MW3, at a concentration that slightly exceeded the reference background criterion. Barium was detected at all monitoring well sampling locations at concentrations that were below the reference background criterion. Lead, mercury, and selenium are considered to be potential SRCs in groundwater.

Lead is not considered to be site related because it was detected at an off-site location (MW8), it was not detected in any on-site wells above the reference background criterion, and it was detected at its highest concentration at the upgradient sampling location. Mercury was detected at levels near the detection limit and was detected above the reference background criterion at the upgradient sampling location; therefore, mercury is not considered to be site related. Selenium was detected in only one well (MW3), which is downgradient, but at a concentration only slightly above the reference background criterion (i.e., 2.5 µg/L versus 1.90 µg/L); therefore, selenium is not considered to be site related.

2.7.4 Surface Water and Sediment

Two surface water and sediment samples were collected from Canoochee Creek, one upstream sample and one downstream sample. The surface water and sediment samples were analyzed for VOCs, SVOCs, pesticides/PCBs, and RCRA metals.

No organic contaminants were detected in surface water, and metals constituents were detected below reference background criteria; therefore there are no SRCs in surface water.

No VOCs, SVOCs, or RCRA metals were observed in the downstream sediment sample (SWS1). Alpha-chlordane, a pesticide, was observed in the downstream and upstream sediment samples. The downstream concentration of alpha-chlordane was less than the upstream concentration. Alpha-chlordane is considered to be a potential SRC in sediment.

2.8 CONTAMINANT FATE AND TRANSPORT

2.8.1 Leachability Analysis

Contaminant fate and transport analysis provided an assessment of the potential migration pathways and transport mechanisms affecting the chemicals at the site. In particular, the leachability of contaminants from soil and sediment to groundwater and their natural attenuation in groundwater were evaluated.

The site characterization identified inorganic, organic, and pesticide SRCs in surface soil and subsurface soil. Two VOCs, one SVOC, six metals, and 14 pesticides were identified as SRCs in soil. These constituents were compared to EPA Generic Soil Screening Levels (GSSLs; EPA 1996a) to determine if these constituents may leach from soil into groundwater at concentrations that exceed groundwater standards [i.e., concentrations that exceed the MCL or, in the absence of an MCL, the risk-based concentration for drinking water (EPA 1996b)].

Based on the leachability analysis, arsenic, chromium, mercury, alpha-BHC, and delta-BHC exceeded their respective GSSLs and were indicated as contaminant migration constituents of potential concern (CMCOPCs) in soil.

No CMCOPCs were identified in sediment.

Of the CMCOPCs, alpha-BHC, delta-BHC, chromium, and arsenic were not detected in groundwater. Mercury was detected in groundwater, but at concentrations that did not exceed its MCL.

2.8.2 Fate and Transport Modeling

Fate and transport modeling was performed to quantitatively assess the risks associated with exposure to CMCOPCs (alpha-BHC, delta-BHC, arsenic, chromium, and mercury) in soil and ecological constituents of potential concern (ECOPCs; see Section 2.9.2) for the baseline human health risk assessment (BHHRA; see Section 2.9.3) and ecological risk evaluation, respectively.

2.8.2.1 Migration to groundwater beneath the source

Potential groundwater concentrations resulting from leaching of CMCOPCs (arsenic, chromium, mercury, alpha-BHC, and delta-BHC) were estimated using the Seasonal Soil Compartment (SESOIL) Model. The maximum concentrations of constituents detected above the water table were used as the source concentrations for the SESOIL model. A description of the SESOIL model and the results of the SESOIL modeling are summarized in Appendix K of the revised final Phase II RFI Report (SAIC 2000).

Alpha-BHC and arsenic were eliminated as CMCOPCs and were not modeled. Alpha-BHC was not modeled because the maximum concentration (0.00056 mg/kg) was detected below the water table and would not be a source of alpha-BHC leaching into the groundwater from the unsaturated zone. The other soil samples collected above the water table did not have concentrations of alpha-BHC that exceeded its GSSL. In addition, alpha-BHC was not detected in the groundwater; therefore, alpha-BHC was not considered to be a CMCOPC and was not evaluated further.

The maximum concentration of arsenic was identified in surface soil. However, this concentration (3.4 mg/kg) did not exceed the subsurface soil reference background criterion for arsenic (8.04 mg/kg). Given the relative thickness of subsurface soil and the higher concentrations of arsenic present in this soil stratum, the contribution of arsenic to groundwater from surface soil is not likely to be significant. In addition, arsenic was not identified as a constituent of potential concern (COPC) in groundwater, indicating that arsenic is not leaching to groundwater in significant concentrations; therefore, the potential for arsenic to leach into groundwater was not addressed further.

SESOIL modeling input parameters and results for delta-BHC, mercury, and chromium are presented in Appendix K, Tables K-2.1, K-3.1, and K-4.1 of the revised final Phase II RFI Report (SAIC 2000), respectively. Modeling results indicated that delta-BHC naturally attenuates before reaching the water table. The SESOIL model estimated the maximum groundwater concentrations of mercury and chromium to be 0.0025 mg/L and 1.73 mg/L, respectively.

2.8.2.2 Migration of groundwater to surface water

COPCs [CMCOPCs leaching to groundwater and ECOPCs (see Section 2.9.2)] in groundwater may migrate to Canoochee Creek. The One-dimensional Analytical Solute Transport (ODAST) Model was used to estimate groundwater concentrations of the CMCOPCs (mercury and chromium) and ECOPCs [lead and mercury (see Section 2.9.2)] at Canoochee Creek. The Analytical Transient 1-,2-,3-Dimensional (AT123D) Model was used to estimate the surface water concentration of organic constituents (total xylenes, an ECOPC) in groundwater. The models assumed that the concentrations in Canoochee Creek are equal to the concentrations in the adjacent groundwater. This assumption is conservative, given that it assumes that there is no dilution of the constituents upon discharge of groundwater into the surface water body.

The ODAST model assumed that the concentration of metals at the source location remains constant at the SESOIL-predicted concentration for a period of 70 years. The ODAST model was simulated for a period of 1,000 years. The ODAST modeling results indicated that chromium and lead do not migrate to Canoochee Creek and estimated that the maximum concentration of mercury in groundwater adjacent to Canoochee Creek was 0.45 μg/L.

The AT123D model predicted the concentration of total xylenes at Canoochee Creek (the nearest surface water body) to be 0.31 μg/L.

2.9 PRELIMINARY RISK EVALUATION

2.9.1 Human Health Preliminary Risk Evaluation

The human health preliminary risk evaluation (HHPRE) included a Step 1 risk evaluation to determine potential human health risks associated with the contaminants present at the site. Human health constituents of potential concern (HHCOPCs) were defined as those constituents present at concentrations higher than their reference background criteria and higher than their respective risk-based or applicable or relevant and appropriate requirement–based screening criteria. SRCs for surface soil, subsurface soil, groundwater, surface water, and sediment evaluated under the HHPRE are presented in Table 2-1.

Arsenic and chromium in surface soil are considered to be HHCOPCs because they exceeded their risk-screening criteria for exposure of a residential receptor.

No HHCOPCs were identified in subsurface soil, groundwater, surface water, or sediment.

A BHHRA (see Section 2.9.3) was performed to quantitatively assess the risks associated with exposure to the HHCOPCs, arsenic and chromium, in surface soil.

2.9.2 Ecological Preliminary Risk Evaluation

The Phase II RFI performed an ecological preliminary risk evaluation (EPRE) for potential terrestrial and aquatic receptors [see Chapter 8 of the revised final Phase II RFI Report (SAIC 2000)]. The EPRE for the Camp Oliver Landfill identified ECOPCs in groundwater (total xylenes, lead, and mercury) based on a comparison of their maximum site concentrations to EPA Region IV ecological screening values (ESVs; EPA 1996c). No SRCs were identified in surface water. No ECOPCs were identified in sediment. Preliminary risk calculations for ECOPCs identified in surface soil (4,4'-DDE; cadmium; chromium; and lead) and groundwater (total xylenes, lead, and mercury) were based on a comparison of detected concentrations to toxicity reference values for surrogate species representing ecological receptors. Uncertainty analysis of the ECOPCs in surface soil and groundwater resulted in their being eliminated as ECOPCs. The uncertainty analysis is summarized below.

4,4'-DDE; cadmium; chromium; and lead in surface soil at SWMU 2 were identified as ECOPCs because the preliminary hazard quotients (HQs) exceeded 1. Supplemental risk calculations for 4,4'-DDE; cadmium; chromium; and lead resulted in HQs less than 1; therefore, 4,4'-DDE; cadmium; chromium; and lead in surface soil are unlikely to pose a risk to robins (surrogate species), and further investigation and/or evaluation of these constituents in surface soil is not warranted.

Total xylenes, lead, and mercury were identified as ECOPCs because they occur at levels that exceed the EPA Region IV surface water ESVs (EPA 1996c). These ECOPCs are unlikely to be potential hazards to aquatic biota living in downgradient surface water bodies because the maximum concentrations at the point of discharge to the nearest surface water body predicted by modeling do not exceed the EPA Region IV surface water ESVs under current conditions and are unlikely to do so under future conditions.

Mercury in surficial groundwater at SWMU 2 was identified as a potential ECOPC for terrestrial receptors at this site during the preliminary risk evaluation. Supplemental risk calculations resulted in an HQ of less than 1, and modeling indicated that the maximum concentrations at the point of discharge to the nearest surface water body do not exceed surface water ESVs; therefore, mercury is not considered to be an ECOPC in groundwater for terrestrial receptors.

In summary, the Phase II RFI Report (SAIC 2000) concluded that there is no present ecological risk at SWMU 2 and that the site is unlikely to pose an ecological risk in the future.

2.10 BASELINE HUMAN HEALTH RISK ASSESSMENT

A BHHRA was performed to assess surface soil, potential migration of contaminants from soil to groundwater, and subsequent migration of contaminants to surface water around SWMU 2. The COPCs addressed in the baseline risk assessment included HHCOPCs (arsenic and chromium) and CMCOPCs (alpha-BHC, delta-BHC, arsenic, chromium, and mercury). After further analysis of the potential for the CMCOPCs to migrate to groundwater (see Section 2.8), it was concluded that alpha-BHC, delta-BHC, and arsenic are not likely to leach into groundwater at concentrations that present an unacceptable risk to human health; therefore, the potential risks associated with these constituents as CMCOPCs were not quantified in the HHBRA. In addition, modeling indicated that chromium in groundwater was not likely to migrate to surface water (see Section 2.8.2.2); therefore, chromium in surface water was not quantified as an HHCOPC. The baseline risk assessment included an evaluation of the risks associated with exposure to the following COPCs: arsenic (surface soil), chromium (surface soil and groundwater), and mercury (groundwater and surface water). The potential risks associated with exposure to COPCs in groundwater were based on the estimated groundwater concentrations derived from the leachate modeling (see Section 2.8.2.1). The surface water concentration for mercury was estimated based on the groundwater migration model (see Section 2.8.2.2).

Ingestion, dermal absorption, and inhalation were evaluated as the potential exposure pathways (i.e., routes of exposure of the constituent to the body). The risks associated with carcinogenic hazardous constituents were estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen [i.e., the incremental lifetime cancer risk (ILCR)]. The ILCRs for the individual carcinogens are summed to provide the total ILCR. A total ILCR of less than 1×10^{-6} does not represent a significant carcinogenic risk. The risks associated with the systemic effects of noncarcinogenic toxicity were evaluated by comparing an estimated intake (mg/kg/day) to a reference dose. This ratio of estimated intake over the reference dose is the HQ. The sum of all of the HQs for a given exposure route (i.e., oral, inhalation, or dermal) is the hazard index (HI). HIs less than 1.0 indicate that the sum of exposures to all of the constituents present is not likely to result in adverse health effects.

Given the absence of potential migration pathways resulting in exposure of a receptor population, current land-use receptor populations are limited to on-site receptors. The receptor populations assessed for current land use include an Installation worker and a juvenile trespasser. The hunter is also a potential current land-use receptor, but it was determined that exposure via bioaccumulation into venison is not likely to be a significant pathway, so this receptor was not assessed. Future land-use populations include an Installation worker, an on-site trespasser, an off-site juvenile wader, and an off-site sportsman fishing in Canoochee Creek. The Installation worker and resident adult represent both on-site and off-site receptors. The resident population was divided into a child and an adult resident because the differences in behavior, exposure duration, and physiology between an adult and a child result in different intakes. The child is more sensitive to noncarcinogenic toxicity because this receptor has a higher intake relative to body weight. Although the resident adult is often more sensitive to carcinogenic effects, given the receptor's longer exposure duration, the resident child has significantly higher intake rates for certain exposure pathways that offset the adult's longer exposure duration, resulting in higher carcinogenic risks for the resident child; therefore, the resident adult was evaluated for only carcinogenic risks, but the resident child was evaluated for both noncarcinogenic and carcinogenic risks. The reader is referred to the revised final Phase II RFI Report (SAIC 2000), Appendix I, Section I.2.2 ("Identification of Potential Receptor Populations and Associated Exposure Pathways") for a more detailed discussion on the potential exposure pathways and the differences between the exposures of adult and child resident receptors.

All of the identified COPCs are considered to be constituents of concern (COCs) based on the results of the risk characterization. The risk values for chromium and mercury in groundwater exceeded the systemic target risk value for all of the potentially exposed receptors. The risk values for arsenic in soil exceeded the target risk values for the current and future on-site Installation worker, the on-site resident child, and the on-site resident adult. The risk values for chromium in surface soil exceeded the target risk values for the on-site resident child. Mercury migrating to surface water exceeded the systemic target risk value for the sportsman.

Remedial levels in surface soil were derived for arsenic and chromium based on direct exposure of a receptor population. Remedial levels in soil were derived for chromium and mercury based on the potential of these constituents to leach into groundwater and for mercury to subsequently migrate to surface water. The development of the remedial levels for each constituent is summarized below:

Arsenic. The risk-based remedial levels for this human health constituent of concern (HHCOC) were calculated for both carcinogenic and noncarcinogenic risks. Arsenic was the only HHCOC that contributed significantly to the carcinogenic risks at this site. A risk-based remedial level based on an HI of 0.5 (11.68 mg/kg) was recommended. This value takes into account the potential contribution of other HHCOCs to the noncarcinogenic risks associated with the site; the ILCR associated with this remedial level would be below the target ILCR of 1×10^{-4} (Table 2-2).

The recommended risk-based remedial level for arsenic (11.68 mg/kg) is higher than the maximum detected value of 3.4 mg/kg; therefore, arsenic is not an HHCOC in soil.

Chromium. Chromium was identified as both an HHCOC and a contaminant migration constituent of concern (CMCOC). All of the risk-based remedial levels for direct exposure to chromium in surface soil were less than the reference background concentration. Similarly, all of the risk-based remedial levels based on leaching to groundwater were less than the reference background concentration. Therefore, the reference surface soil background criterion (6.21 mg/kg) is recommended as the remedial level for chromium in surface soil based on direct exposure.

Chromium in surface soil was also identified as possible CMCOPC based on its potential to leach to groundwater. The recommended risk-based soil remedial level (4.6 mg/kg) for chromium based on leaching to groundwater was less than the reference subsurface soil background concentration (11.60 mg/kg). Given the comparative thickness of the subsurface soil and its proximity to groundwater relative to surface soil, the amount of chromium (CMCOC) potentially leaching to groundwater from the subsurface soil is likely to be much greater than the contribution from the chromium in the surface soil; therefore, the reference subsurface soil background criterion (11.60 mg/kg) was recommended as the remedial level (based on leaching) for chromium in soil.

Mercury. Mercury was identified as a CMCOC for both groundwater and surface water. The remedial level for protection of groundwater was based on the MCL, given that this value was less than the remedial level based on the recommended HI of 0.5. However, the risk-based remedial level for the protection of surface water (0.003 mg/kg) was less than the remedial level based on the protection of groundwater (0.13 mg/kg) based on the MCL for mercury (Table 2-2); therefore, the surface water point of exposure will determine the remedial level.

Table 2-2. Remedial Levels, SWMU 2

SOIL BASED ON DIRECT EXPOSURE								
	Maximum Detected Concentration (mg/kg)	Reference Background Criterion Surface Soil	Risk-based Remedial Levels (mg/kg)					
			HI			ILCR		
Constituent of Concern			1	0.5	0.1	1×10^{-6}	1×10^{-5}	1×10^{-4}
Arsenic	3.4[a]	2.10	23.37	**11.68**	2.34	0.6	6.1	60.6
Chromium	47.5	**6.21**	1.53	0.77	0.15	NA[b]	NA[b]	NA[b]

SOIL BASED ON PROTECTION OF GROUNDWATER AND SURFACE WATER							
	Maximum Detected Concentration (mg/kg)	Reference Background Criterion Subsurface Soil	Risk-based Remedial Levels (mg/kg)				Remedial Levels Based on the MCL (mg/kg)
			HI				
Constituent of Concern			3	1	0.5	0.1	
Groundwater Point of Exposure[c]							
Chromium	47.5	**11.60**	3.74	1.25	0.62	0.12	4.6
Mercury	0.23	0.05	1.28	0.43	0.21	0.04	0.13[d]
Surface Water Point of Exposure[c]							
Mercury	0.23	**0.05**	0.02	0.006	0.003[e]	0.001	NA[f]

[a]Maximum detected concentration of constituent below recommended remedial level.
[b]NA = Not applicable; toxicity data required for calculation of remedial level were not available.
[c]Groundwater represents groundwater underlying the site, and surface water represents surface water in Canoochee Creek.
[d]Remedial level for mercury based on protection of groundwater.
[e]Risk-based remedial level for mercury based on protection of surface water.
[f]NA = Not applicable; MCLs are not applicable to surface water.
Bold indicates values that are the recommended remedial values.

The risk-based remedial level of 0.003 mg/kg was less than the subsurface soil background concentration (0.05 mg/kg); therefore, the recommended remedial value for mercury is 0.05 mg/kg, the subsurface soil background concentration.

In conclusion, chromium and mercury were identified as COCs for soil at SWMU 2. Chromium was identified as a COC based on direct exposure and its potential migration (leaching) to groundwater. Chromium was detected above its respective remedial level in surface and subsurface soil across the SWMU 2 site, including at the background location (MW5), indicating that chromium may be naturally elevated in this area. The observed chromium concentrations in surface and subsurface soil were on the low end of the concentration range (1 mg/kg to 1,000 mg/kg) established by the USGS for the eastern United States (USGS 1984) and may represent natural variability in the soil. Chromium was not detected in groundwater.

Mercury was identified as a COC based on its potential migration (leaching) to groundwater. Mercury was elevated in only one out of seven subsurface soil samples. The mercury concentrations in the remaining subsurface soil locations were either nondetect (four locations) or below the subsurface reference background criterion (two locations). The observed mercury concentration in soil was on the low end of the concentration range (0.01 mg/kg to 3.4 mg/kg) established by the USGS for the eastern United States (USGS 1984). The only elevated mercury detection could be attributable to natural variability or an anomaly in the soil rather than representative of widespread contamination. Mercury was not detected above its MCL in groundwater, indicating that its movement/migration is highly retarded by its physiochemical properties and by site conditions.

The Phase II RFI concluded that chromium in surface and subsurface soil and mercury in subsurface soil do not require additional investigation and/or evaluation. In addition, the Phase II RFI recommended that institutional controls be implemented at the site to be protective of human health because the source will remain in place.

3.0 JUSTIFICATION/PURPOSE OF CORRECTIVE ACTION

3.1 PURPOSE

EPA has established corrective action standards that reflect the major technical components that should be included with a selected remedy (EPA 1988). These include the following: (1) protect human health and the environment; (2) attain media cleanup standards set by the implementing agency; (3) control the source of releases so as to reduce or eliminate, to the extent practicable, further releases that may pose a threat to human health and the environment; (4) comply with any applicable standards for management of wastes; and (5) other factors.

3.2 REMEDIAL RESPONSE OBJECTIVES

Based on the findings of the site characterization at this SWMU, the primary goal and purpose for implementing corrective measures at SWMU 2 is limited to protection of human health and safety. To achieve this goal, two primary remedial response objectives have been established for SWMU 2: (1) to prohibit the ingestion of shallow groundwater from the subject site and (2) to prohibit the disturbance of surface and subsurface soil to minimize contact with soil and buried waste. Any corrective measures that pose a significant threat to human health during implementation (e.g., methods that would involve disturbance of subsurface soil) will not be evaluated. Implementation of the selected remedial response will achieve the best overall results with respect to such factors as long-term reliability and effectiveness, short-term effectiveness, implementability, and cost.

3.3 IDENTIFICATION OF REMEDIAL LEVELS

As discussed in Chapter 2, remedial levels were developed for the HHCOCs and CMCOCs at SWMU 2. Chromium and mercury were identified as COCs for soil at the site. Chromium was identified as a COC in soil based on direct exposure and its potential migration (leaching) to groundwater. Mercury was identified as a COC in soil based on only its potential migration (leaching) to groundwater and subsequent potential migration to surface water. The remedial level for the protection of human health from direct contact with chromium in soil took into consideration an HI of 0.5 and the reference background concentration. The selection of the remedial level for soil potentially leaching to groundwater was based on the soil's leaching to groundwater at levels exceeding MCLs. In addition, because mercury may subsequently migrate to surface water, its remedial level was based on the lower of the level for protection of surface water or the level for protection of groundwater. In addition, soil remedial levels defaulted to surface and/or subsurface soil reference background criteria if the risk-based remedial level was less than the reference background criterion. The recommended remedial levels for chromium and mercury are presented in Table 2-2.

Chromium was detected above its respective remedial level in surface and subsurface soil (6.21 mg/kg and 11.60 mg/kg, respectively) across the SWMU 2 site, including at the background location (MW5), indicating that chromium may be naturally elevated in this area. The observed chromium concentrations in surface and subsurface soil were on the low end of the concentration range (1 mg/kg to 1,000 mg/kg) established by the USGS for the eastern United States (USGS 1984) and may represent natural variability in the soil. Chromium was not detected in groundwater.

Mercury was elevated above its remedial level (0.05 mg/kg) in only one out of seven subsurface soil samples. The mercury concentrations in the remaining subsurface soil locations were either nondetect (four locations) or below the subsurface reference background criterion (two locations). The observed mercury concentration in soil was on the low end of the concentration range (0.01 mg/kg to 3.4 mg/kg) established by the USGS for the eastern United States (USGS 1984). The only elevated mercury detection could be attributable to natural variability or an anomaly in the soil rather than representative of widespread contamination. Mercury was not detected above its MCL in groundwater, indicating that its movement/migration is highly retarded by its physiochemical properties and by site conditions.

The revised final Phase II RFI Report for 16 SWMUs (SAIC 2000) concluded that chromium in surface and subsurface soil and mercury in subsurface soil do not require additional investigation and/or evaluation. There are presently no constituents in the groundwater around SWMU 2 at concentrations above remedial levels. With the concurrence of GEPD (approval letter from Mr. Bruce Khaleghi to Colonel Gregory Stanley dated December 2000), the revised final Phase II RFI Report for 16 SWMUs recommended that institutional controls be implemented at SWMU 2. Institutional controls will be protective of human health because land-use restrictions will limit direct contact with the surface and subsurface soil and remaining buried refuse and will restrict the use of shallow groundwater for drinking purposes.

4.0 SCREENING OF CORRECTIVE ACTIONS

This section identifies corrective action technologies applicable to the Camp Oliver Landfill. The technologies that are retained following screening are then presented as corrective action alternatives that address limiting exposure to subsurface contamination. These alternatives are then evaluated with respect to protection of human health and life-cycle cost.

4.1 SCREENING CRITERIA

The first step in the development of corrective action alternatives involves the identification and screening of technologies applicable to the site. The purpose of this step is to list and evaluate the general suitability of remedial technologies for meeting the stated corrective action objectives. The options presented here will be evaluated for their general ability to protect and reduce the risk to human health.

The technologies will be discussed sufficiently to allow them to be compared using three general criteria that will function as balancing factors: effectiveness, implementability, and cost. An explanation of each criterion is provided below.

4.1.1 Effectiveness

This criterion evaluates the extent to which a corrective action reduces overall risk to human health and the environment. It also considers the degree to which the action provides sufficient long-term controls and reliability to prevent exposures that exceed levels protective of human and environmental receptors. Factors considered include performance characteristics, maintenance requirements, and expected durability.

4.1.2 Implementability

This criterion evaluates the technical and administrative factors affecting implementation of a corrective action and considers the availability of services and materials required during implementation. Technical factors assessed include ease and reliability of initiating construction and operations, prospects for implementing any additional future actions, and adequacy of monitoring systems to detect failures. Technical feasibility considers the performance history of the technologies in direct applications or the expected performance for similar applications. Uncertainties associated with construction, operations, and performance monitoring are also considered.

Service and material considerations include equipment and operator availability and applicability or development requirements for prospective technologies. The availability of services and materials is addressed by analyzing the material components of the proposed technologies and then determining the locations and quantities of materials. Administrative factors include ease of obtaining permits, enforcing deed recordation requirements, and maintaining long-term control of the site.

4.1.3 Cost

Relative costs are included for the corrective actions. The estimates are intended to facilitate evaluation and comparison among alternatives; therefore, typical cost-estimating contingencies common to all alternatives have been excluded from the estimates at the screening level of evaluation because all of the alternatives will have similar contingencies.

4.2 EVALUATION OF CORRECTIVE ACTION TECHNOLOGIES

Three categories of corrective actions were identified: (1) no action, (2) institutional controls: land-use controls, and (3) institutional controls: physical barriers. Additionally, an option to monitor groundwater will be evaluated for both corrective action categories involving institutional controls. These corrective action technologies are described in Table 4-1. The technologies were evaluated using the screening criteria of effectiveness, implementability, and cost. Results of that screening evaluation are also shown in Table 4-1.

The no action alternative provides a baseline against which other options can be compared. Under the no action alternative, no further action would be taken. No cost would be associated with the selection of this alternative. The acceptability of the no action alternative is judged in relation to the assessment of known site risks and by comparison with other corrective action alternatives.

The no action alternative is not considered to be viable because it provides no reliable or effective method for protecting human health; therefore, the no action alternative will be eliminated from further evaluation.

Institutional controls include actions taken to restrict access to contaminated areas by establishing legal land-use controls and/or by providing physical barriers to access. Physical barriers and/or land-use restrictions would provide effective, readily implementable, and cost-effective methods for preventing human exposure to buried waste at the site. Land-use controls include deed recordation, controls implemented through the BMP, zoning controls, and placement of signs restricting access. Physical barriers include installation of a barbed-wired, chain-link fence around the site boundary. Abandonment of groundwater wells no longer needed for site monitoring is also considered as a method for discouraging the use of groundwater at the site. Groundwater monitoring of selected wells would provide information associated with constituent concentration trends, as constituents may continue to leach to groundwater over time. This activity would involve the use of selected wells for groundwater monitoring purposes only and the abandonment of the remaining wells.

4.3 CORRECTIVE ACTION ALTERNATIVES

The technologies retained following the screening-level step were combined in various ways to develop alternatives that would meet the remedial response objective of protection of human health. Two alternatives were identified and subsequently evaluated. The option of groundwater monitoring instead of well abandonment will also be evaluated for each of the two alternatives.

- Alternative 1: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Well Abandonment, Post-mounted Warning Signs, Implementation of O&M Plan

- Alternative 1a: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Groundwater Monitoring, Abandonment of Unused Wells, Post-mounted Warning Signs, Implementation of O&M Plan

- Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Well Abandonment, Chain-link Fence Barrier, Maintenance of Existing Physical Barriers, Fence-mounted Warning Signs, Implementation of O&M Plan

Table 4-1. Evaluation of Corrective Actions, SWMU 2

Action	Description	Effectiveness	Implementability	Cost[a]
No Action	The no action alternative provides a baseline against which other actions can be compared. Under the no action alternative, all source materials, soil, and groundwater would be left "as is," without implementation of any removal, treatment, or other mitigating actions to reduce existing or potential future human exposure to buried waste by human disturbance.	This alternative would not address the corrective action objectives for the site. This alternative would not provide protection of human health because there would not be sufficient controls to prevent human exposure to buried waste.	There would be no implementability involved for this alternative because no action would be taken.	There would be no cost associated with the no action alternative.
Institutional Controls: Land-use Controls	Land-use controls would reduce potential hazards by limiting exposure of humans to contaminated soil. Land-use restrictions and institutional control requirements that would be enforced would include restrictions through deed recordation, the BMP and zoning controls, warning signs posted around the site, groundwater use restriction (monitoring only, if necessary), well abandonment, and applicable state land-use control management systems in effect at the time of transfer. Activities, such as excavation or construction, that would disturb surface soil would be prohibited under the deed recordation.	Land-use restrictions would be effective and provide long-term reliability with respect to preventing human exposure to buried waste within the boundaries of the site. The technology would not provide physical barriers to restrict access to the site; therefore, noncompliance with these land-use restrictions could result in exposure to contaminated media. The BMP is an effective tool for ensuring establishment of land-use restrictions because requirements of the BMP are enforced by the FSMR in accordance with written policies and procedures.	These institutional controls would be readily implementable. The property will remain under federal ownership for the foreseeable future. The BMP is implementable because procedures and policies are in place at the FSMR to facilitate its implementation.	The costs would be low. The cost for deed recordation, the BMP and zoning controls, post-mounted signs, abandonment of the wells, and implementation of the O&M Plan for 30 years would range between approximately $120,000 and $130,000.
Institutional Controls: Physical Barriers	Physical barriers would reduce potential hazards by limiting exposure of humans to contaminated soil. Physical barriers would include chain-link fencing topped with barbed wire, landfill access gates, and warning signs around the site.	This technology would be effective and provide long-term reliability with respect to minimizing human exposure to buried waste within the boundaries of the site by physically restricting access.	Physical barriers would be readily implementable. The property will remain under federal ownership for the foreseeable future. The BMP is implementable because procedures and policies are in place at the FSMR to facilitate its implementation.	Installation of fencing would be expensive. The costs for fencing, including 30 years of O&M, would range between approximately $125,000 and $145,000.

Note: Footnote appears on page 4-4.

Table 4-1. Evaluation of Corrective Actions, SWMU 2 (continued)

Action	Description	Effectiveness	Implementability	Cost[a]
Groundwater Monitoring	Groundwater monitoring would serve to provide information concerning trends associated with the concentrations of constituents over time. Monitoring would continue on an annual basis for a period of 5 years to evaluate potential constituent leaching from the buried waste.	Monitoring would provide an effective method for evaluating concentrations of constituents in groundwater over time.	Technologies and resources are available for collection and analysis of groundwater resources.	Groundwater sampling is relatively expensive. The cost for groundwater sampling for 5 years would range between approximately $80,000 and $100,000. This includes other direct costs (e.g., pumps, meters), travel and per diem for the sampling crew, laboratory analysis, quality assurance, and reporting for five sampling events.

[a]An approximate range of the capital and O&M costs for 30 years is presented for evaluation of the relative costs of the alternative. The range does not include engineering management, health and safety, contractor profit, or contingency costs.

- Alternative 2a: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Chain-link Fence Barrier, Fence-mounted Warning Signs, Groundwater Monitoring, Abandonment of Unused Wells, Implementation of O&M Plan

4.3.1 Evaluation Factors

Based on the results of the technology screening, each of the retained technologies is considered applicable to the site and implementable; therefore, two primary evaluation factors were used in the preferred corrective action alternative: protection of human health and life-cycle costs.

4.3.1.1 Protection of human health

The effectiveness of each proposed alternative at protecting human health at this site is dependent upon its ability to prohibit human activity associated with disturbance of subsurface soil and usage of shallow groundwater. For each alternative the level of protection of human health was evaluated and compared with those of the other alternatives. For retained Alternatives 1 and 2, usage of groundwater would be prohibited through abandonment of existing wells and through legal land-use controls (i.e., BMP, deed recordation, and zoning). For both options to these alternatives, usage of groundwater for drinking would be prohibited, and environmental monitoring would be required for 5 years to evaluate potential constituent leaching from the buried waste through legal land-use controls (i.e., BMP and deed recordation). For both alternatives and their options, legal land-use controls and warning signs would also restrict activities associated with disturbance of subsurface soil. In Alternative 2 additional protection would be provided through the use of fencing to restrict access to the site.

4.3.1.2 Life-cycle costs

The life-cycle cost estimates are budget estimates based on conceptual design and are to be used for purposes of comparison. Costs are estimated for capital construction, administration, and O&M. The cost estimates were derived from current information, including vendor quotes and conventional cost estimating guides (e.g., Means 1999 and ECHOS 1998). The actual costs of the project would depend on the labor and material costs, site conditions, competitive market conditions, final project scope, and implementation schedule at the time the corrective action is initiated. The life-cycle cost estimates are not adjusted to present worth costs, and no escalation factors have been applied.

4.3.2 Evaluation of Corrective Action Alternatives

The corrective action alternatives are summarized in Table 4-2, along with the associated level of protection of human health and the associated life-cycle costs.

The alternatives would include the following common features:

- BMP, deed recordation, and zoning controls to prohibit the use of groundwater for drinking water and intrusion into subsurface soil;

- abandonment of site monitoring wells;

- installation of warning signs; and

- implementation of an O&M Plan to maintain the conditions of the signage.

Table 4-2. Corrective Action Alternatives, SWMU 2

Corrective Action	Description	Protection of Human Health	Cost	Comments
Alternative 1: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Physical Barriers, Well Abandonment, Post-mounted Warning Signs, Implementation of O&M Plan	This action would require legal and local land-use controls and signage to enforce restrictions on land and groundwater usage. This alternative would also include abandonment of six groundwater monitoring wells (MW2–MW7).	Protection of human health would be primarily dependent upon enforcement of compliance with land-use controls. Existing natural (creek, heavily forested, etc.) and physical barriers (barbed-wire fence on west side) provide effective restrictions on human access to the site to further discourage any unauthorized excavation activities.	$194,662	Least expensive providing sufficient level of protection.
Alternative 1a: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Physical Barriers, Groundwater Monitoring, Abandonment of Unused Wells, Post-mounted Warning Signs, Implementation of O&M Plan	This action has similar requirements to those of Alternative 1; however, four of the wells (MW2, MW4, MW5, and MW7) would be used for groundwater monitoring for a 5-year period to evaluate potential constituent leaching from buried waste. MW3 and MW6 would be abandoned, and MW2, MW4, MW5, and MW7 would be abandoned at the completion of the groundwater monitoring program.	Protection of human health would be similar to that afforded by Alternative 1. Data generated from groundwater monitoring could be used to determine the need to provide further protection of human health.	$340,148	Moderately expensive providing increased level of protection.
Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Well Abandonment, Chain-link Fence Barrier, Maintenance of Existing Physical Barriers, Fence-mounted Warning Signs, Implementation of O&M Plan	This action would require legal and local land-use controls and signage to enforce restrictions on land and groundwater usage. Physical barriers to be installed would include a 2,807-linear-foot chain-link fence topped with barbed wire along the entire perimeter of the site. This alternative would also include abandonment of six groundwater monitoring wells.	In addition to the protection provided by Alternative 1a, human access would be further restricted by fencing along the boundaries of the site. The fencing would be more effective than signs alone in deterring or discouraging unauthorized entry and/or excavation activities.	$344,876	Significantly more expensive with only slight increase in level of protection compared to that afforded by Alternative 1.
Alternative 2a: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Chain-link Fence Barrier, Maintenance of Existing Physical Barriers, Groundwater Monitoring, Abandonment of Unused Wells, Fence-mounted Warning Signs, Implementation of O&M Plan	This action has similar requirements to those of Alternative 2; however, four of the wells (MW2, MW4, MW5, and MW7) would be used for groundwater monitoring for a 5-year period to evaluate potential constituent leaching from buried waste. MW3 and MW6 would be abandoned, and MW2, MW4, MW5, and MW7 would be abandoned at the completion of the groundwater monitoring program.	Protection of human health would be similar to that afforded by Alternative 2. Data generated from groundwater monitoring could be used to determine the need to provide further protection of human health.	$488,815	Most expensive providing highest level of protection.

The paragraphs below summarize the evaluation of the two corrective action alternatives with respect to the primary evaluation factors of protection of human health and life-cycle cost.

Alternative 1: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Physical Barriers, Well Abandonment, Post-mounted Warning Signs, Implementation of O&M Plan

This alternative would provide for the implementation of land-use controls during the period of ownership by DoD through enforcement of the BMP and deed recordation. This alternative would protect human health by preventing human exposure to buried waste by the establishment of legal land-use restrictions. The BMP is an effective tool for ensuring that unauthorized disturbance of subsurface soil at the site and ingestion of groundwater from the site are prohibited while the property is under DoD ownership. If this property was to be transferred in the future, notification of the property transfer would be made to regulatory authorities. The following provisions would ensure implementation of land-use controls subsequent to property transfer: deed recordation; the purchase agreement or lease; zoning controls; applicable state land-use control management systems in effect at the time the property is transferred; community, transferee, or governmental notice (if needed); and self-certification (if feasible). To reduce potential exposure to health hazards associated with SWMU 2, warning signs stating restrictions on human activity within the SWMU would be posted at 200-foot intervals around the boundary of the site. The placement of signs for Alternative 1 is shown in Figure 4-1. Signs and existing natural barriers would be effective for restricting human access to the site because they would discourage any inadvertent or unsuspecting excavation activities. Warning signs and posts would be repaired and/or replaced as needed through implementation of a documented O&M Plan. Natural barriers presently exist and will remain at SWMU 2 that restrict easy human access to the site. These include Canoochee Creek to the north, dense trees on and around the perimeter of the site, and ditches and steep slopes along the southern (along Fort Stewart Road 129) and eastern perimeters (along Fort Stewart Road 13) of the SWMU. Existing physical barriers (barbed-wire fence on the west side), which provide additional land-use restrictions, would also be maintained. Shallow groundwater is not used as a source of drinking water at the site, and given the availability of the underlying Floridan Aquifer, it is unlikely that the shallow groundwater would ever be used for drinking water. The six monitoring wells (MW2, MW3, MW4, MW5, MW6, MW7) installed as part of either the Phase I or Phase II RFI and remaining at the SWMU 2 site would be abandoned. Monitoring well LAS/MW8, which was discovered during the Phase II RFI, would remain because it was installed as part of the groundwater monitoring plan for the Land Application System (LAS) that is adjacent to SWMU 2. Institutional controls prohibiting the use of groundwater would, therefore, be effective in protecting human health.

This is the least expensive of the two alternatives and options, with a life-cycle cost of approximately $194,662.

Alternative 1a: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Physical Barriers, Groundwater Monitoring, Abandonment of Unused Wells, Post-mounted Warning Signs, Implementation of O&M Plan

This optional alternative has the same features as described in Alternative 1 with the exception that four wells (MW2, MW4, MW5, and MW7) would be used for groundwater monitoring, and the remaining wells (MW3 and MW6) would be abandoned. Use of groundwater wells for the purpose of drinking water would be expressly prohibited by land-use restrictions provided by the BMP and deed recordation. Provisions for groundwater monitoring would be documented in both the BMP and deed recordation. These provisions would include monitoring of one upgradient well (MW5) and three downgradient wells (MW2, MW4 and MW7). Groundwater samples would be collected from these wells once every year for a period of 5 years to evaluate potential constituent leaching from the buried waste. No specific monitoring requirements are specified under RCRA for corrective action at SWMUs; however, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires a 5-year review to evaluate the performance and residual risk associated with a selected alternative (including alternatives in which wastes remains in place). Five years of groundwater monitoring was selected based on the 5-year review requirement for remedial actions under CERCLA. The results would be presented in an annual report, in association with the O&M report. Groundwater samples would be analyzed for only the soil COCs: chromium and mercury. With the concurrence of GEPD, monitoring wells MW2, MW4, MW5, and MW7 would be abandoned after the completion of the groundwater monitoring program. The monitoring wells to be sampled and to be abandoned are identified on Figure 4-1.

The sampling of groundwater annually for 5 years has a significant impact on the costs of this alternative. The groundwater monitoring alone costs $88,063, resulting in a life-cycle cost of approximately $340,148, or nearly one and a half times Alternative 1's life-cycle cost.

Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Well Abandonment, Chain-link Fence Barrier, Fence-mounted Warning Signs, Implementation of O&M Plan

This alternative is similar to Alternative 1 in that the land-use control provisions would remain the same (i.e., BMP, deed recordation, zoning control). Also, the six existing wells (MW2–MW7) would be abandoned, existing natural barriers (creek, dense trees, etc.) would remain. However, the barbed wire fence along the western perimeter of SWMU 2 would be removed. Approximately 2,807 linear feet of 6-foot-high chain-link fencing topped with three strands of barbed wire would be installed around the perimeter of the SWMU. The fence would provide a physical deterrent to public access around the entire landfill. Fence-mounted warning signs would be positioned approximately every 200 feet. Two 20-foot-wide gates would be installed to allow access to the site for inspection and maintenance. The placement of signage and fencing for Alternative 2 is shown in Figure 4-2. The effectiveness of Alternative 2 would be significantly greater to that of Alternative 1 due to the greater level of protection against inadvertent intruders as a result of the fencing. The effectiveness of Alternative 2 at preventing the use of groundwater would be equal to that of Alternative 1. An O&M Plan would be implemented as discussed under Alternative 1 that would also include maintenance and repair of the fence and signs.

This alternative is more expensive than Alternative 1, with a life-cycle cost of approximately $344,876 or nearly one and a half times Alternative 1's life-cycle cost.

Alternative 2a: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Physical Barriers, Groundwater Monitoring, Abandonment of Unused Wells, Chain-link Fence Barrier, Fence-mounted Warning Signs, Implementation of O&M Plan

This optional alternative has the same features as described in Alternative 2 with the exception that four wells would be used for groundwater monitoring, and the remaining wells (MW3 and MW6) would be abandoned. Use of groundwater wells for the purpose of drinking water would be expressly prohibited by land-use restrictions provided by the BMP and deed recordation. Provisions for groundwater monitoring would be documented in both the BMP and deed recordation. These provisions would include monitoring of one upgradient well (MW5) and three downgradient wells (MW2, MW4 and MW7). Groundwater samples would be collected from these wells once every year for a period of 5 years to evaluate potential constituent leaching from the buried waste. No specific monitoring requirements are specified under RCRA for corrective action at SWMUs; however, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires a 5-year review to evaluate the performance and residual risk associated with a selected alternative (including alternatives in which wastes remains in place). Five years of groundwater monitoring was selected based on the 5-year review requirement for

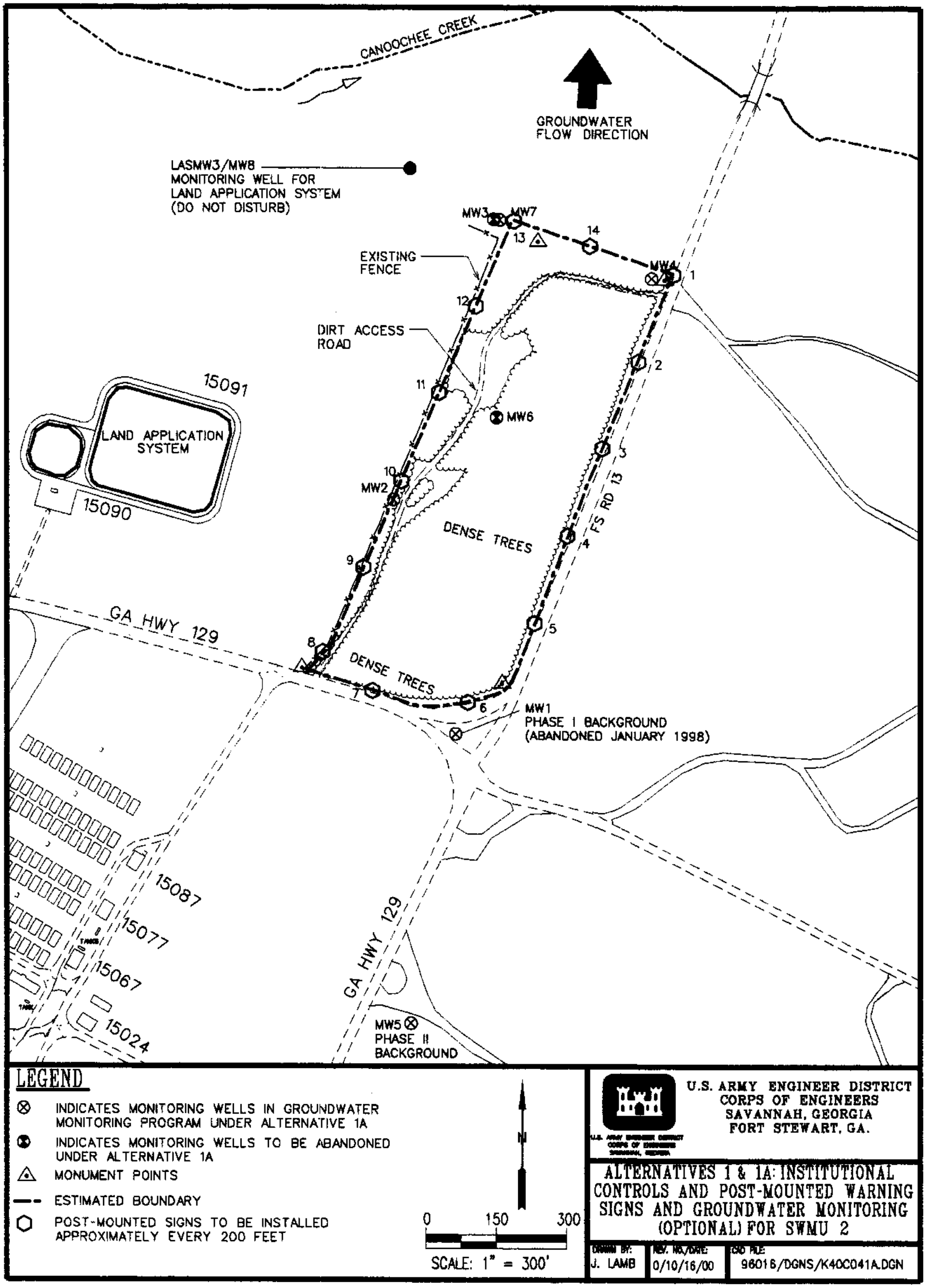

Figure 4-1. Alternatives 1 and 1a: Institutional Controls with Post-mounted Warning Signs and Groundwater Monitoring (Optional)

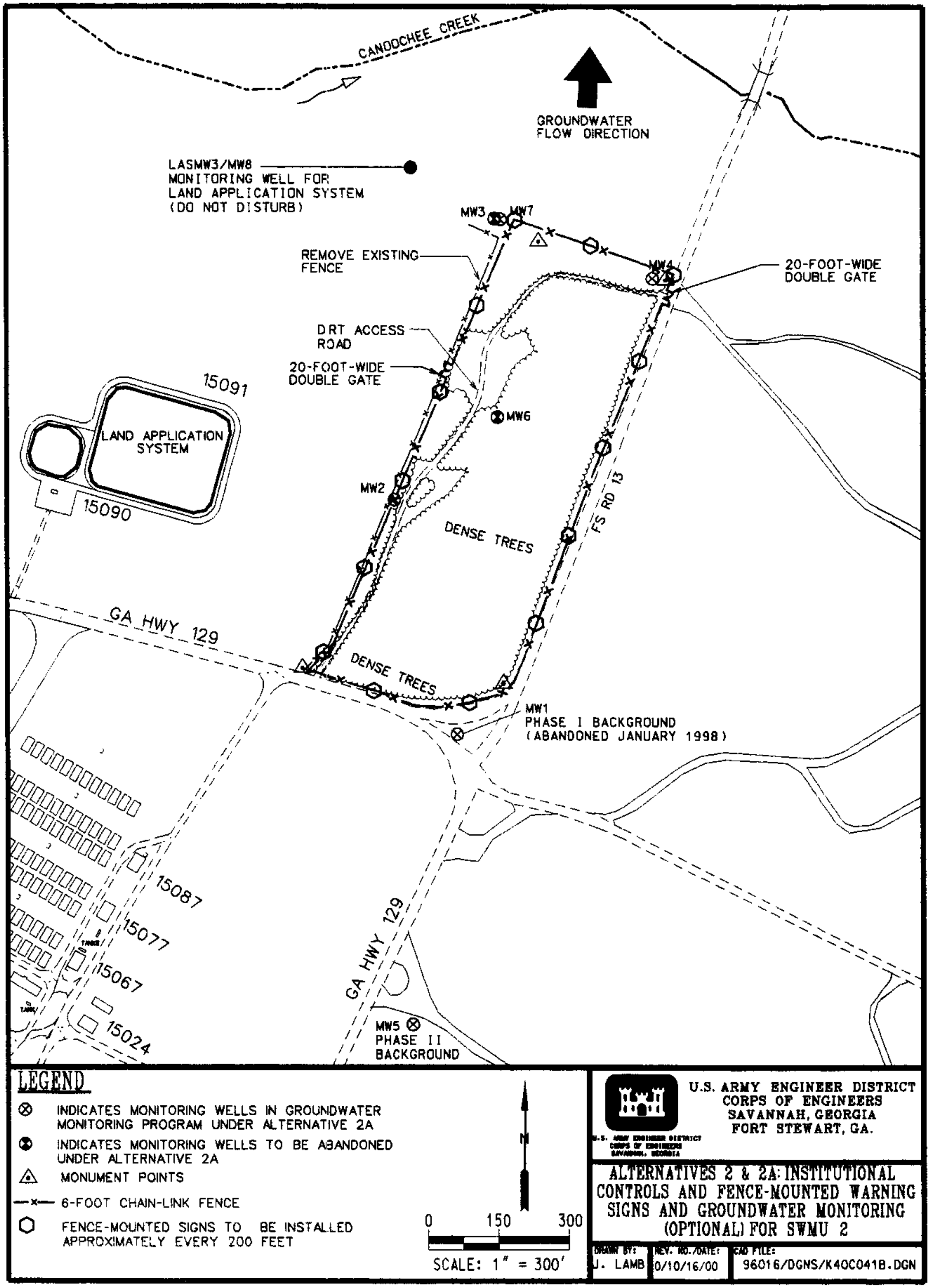

Figure 4-2. Alternatives 2 and 2a: Institutional Controls with Chain-link Fence Barrier and Fence-mounted Warning Signs and Groundwater Monitoring (Optional)

remedial actions under CERCLA. The results would be presented in an annual report, in association with the O&M report. Groundwater samples would be analyzed for only the soil COCs: chromium and mercury. With the concurrence of GEPD, monitoring wells MW2, MW4, MW5, and MW7 would be abandoned after the completion of the groundwater monitoring program. The monitoring wells to be sampled and to be abandoned are identified in Figure 4-2.

The fencing combined with the sampling of groundwater annually for 5 years makes this alternative the most expensive. The groundwater monitoring alone costs $88,063, resulting in a life-cycle cost of approximately $488,815, or approximately 44 percent more than Alternative 1a and Alternative 2.

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5.0 CONCEPTUAL DESIGN AND IMPLEMENTATION PLAN

This section presents a conceptual design and plan for implementation of the selected corrective action alternative. Based on the level and type of subsurface soil and groundwater contamination, a cost-effective corrective action was selected that would adequately protect human health. The technology evaluation presented in Chapter 4 compared two different corrective action alternatives and two optional alternatives based on their effectiveness for protecting human health and their life-cycle costs. Based on that evaluation, Alternative 1 was selected because it will provide a sufficient level of protection of human health at a relatively low cost.

5.1 SELECTED CORRECTIVE ACTION

The selected corrective action alternative involves a multi-layered approach to restricting human activity within the boundaries of the subject site. The selected set of institutional controls comprising this alternative will provide a combination of land-use restrictions and prohibitions and natural physical barriers. Land-use restrictions will be documented and/or enforced through deed recordation, BMP, zoning restrictions, and signage. Alternative 1, which consists of institutional controls (i.e., land-use restrictions) and warning signs, is protective of human health for the COCs (i.e., chromium and mercury) because it limits the potential disturbance of the surface and subsurface soil and prevents the use of groundwater for drinking water and irrigation use. Chromium was identified as a COC because of the possibility of direct exposure and because of its potential migration (leaching) to groundwater. Mercury was identified as a COC only because of its potential migration (leaching) to groundwater. Chromium was not detected in groundwater, and mercury was not detected above its MCL. Implementation of institutional controls would put in place administrative procedures that would prevent/control the disturbance of surface and subsurface soil, eliminating the possibility of continual and long-term exposure to chromium in soil. Warning signs would inform the occasional on-site receptor (e.g., workers, hunters) of the restrictions, thereby reducing the potential risk from inadvertent surface soil disturbance. Institutional controls would also put in place administrative procedures that would prevent/control the use of groundwater for drinking water and irrigation purposes, eliminating the potential exposure of humans to chromium and mercury in groundwater. As discussed in Section 3.3, chromium and mercury have not been identified in groundwater as current risks to human health and have been only estimated to be potential COCs in groundwater based on very conservative modeling (assuming the maximum soil concentration, a constant source, etc.).

Alternative 1 has been selected because it will provide effective protection of human health at a relatively low cost. Although the installation of fencing would provide an additional degree of protection, Alternative 2 is not considered cost-effective. The additional protection that the fence would provide against inadvertent access to the site and unauthorized soil excavation would be minimal and would not justify the significantly greater expense of implementing Alternative 2. Groundwater monitoring as described under Alternatives 1a and 2a does not provide enough additional protection to human health to justify its increased costs. The groundwater presently does not present a risk to human health. The institutional controls described for Alternative 1 will provide a sufficient level of protection of human health and an adequate degree of long-term reliability and effectiveness as well as short-term effectiveness. The institutional controls under Alternative 1 can be easily and cost-effectively implemented. Justification for selection of this corrective action alternative is further detailed in the following evaluations of effectiveness, implementability, and cost.

5.1.1 Effectiveness

Post-mounted warning signs and documented land-use restrictions will be highly effective and provide long-term reliability with respect to preventing human exposure to physical contact with the buried waste within the boundaries of SWMU 2. To maintain an acceptable level of long-term reliability and effectiveness, the BMP will establish land-use controls during ownership by DoD. Prior to the planning of any construction activities at the FSMR, the BMP must be reviewed. In addition, all construction projects will be reviewed during the planning stages for approval by the Base Master Planner and the FSMR DPW. These land-use controls will remain in effect after transfer of DoD ownership by restrictions imposed through deed recordation.

Additionally, the proposed abandonment of monitoring wells (MW2, MW3, MW4, MW5, MW6, and MW7) and the groundwater-use restrictions will provide an effective method for preventing the use of groundwater for drinking water or for irrigation at the site. The surficial aquifer is not an adequate source of drinking water at the FSMR and is not used. The BMP will be modified to officially restrict its use, further preventing use of the surficial groundwater at the site.

An annual O&M program will be administered to replace or repair warning signs, which may deteriorate over time (see Appendix A). Implementation of the O&M Plan will ensure the effectiveness of this program. The O&M program for this CAP will involve inspection as well as potential replacement or repair of warning signs.

Providing institutional controls over the short term will be a very effective means of minimizing or eliminating human exposure to buried waste within the boundaries of SWMU 2. Warning signs will be most effective over the short term. There is no current risk, and the site is not being used, so access is already limited.

5.1.2 Implementability

Very few factors limit implementability of the institutional controls under evaluation. On-site personnel or contractors can readily perform posting of signs. The materials for the installation of warning signs are easily available to local contractors. Annual O&M inspections require few resources with respect to inspection personnel and materials for repair. Establishment of an adequate combination of land-use management tools will require additional time and effort for development, preparation, and processing of the necessary paperwork; however, the time and resources are available to administer and acquire the necessary land-use controls because the property is not expected to be sold or leased in the near future. Administrative provisions already exist to allow for incorporation of land-use controls into the BMP and to facilitate deed recordation.

5.1.3 Cost

The estimated total life-cycle cost of installation of warning signs, well abandonment, administrative activities associated with acquisition of legal controls, O&M activities, and management and oversight is $194,662. This alternative provides adequate protection of human health and the environment.

5.2 CONCEPTUAL DESIGN

During the period of ownership by DoD, institutional controls will be recorded to ensure implementation in the BMP. Notification of transfer will be made to regulatory authorities upon transfer of the property. Land-use restrictions and institutional control requirements that are expected to be enforced subsequent to property transfer include the following: deed recordation; the purchase agreement or lease; zoning controls; applicable state land-use control management systems in effect at the time the property is transferred; community, transferee, or governmental notice (if needed); and self-certification (if feasible). To reduce potential exposure to human health hazards associated with SWMU 2, warning signs stating restrictions on human activity within SWMU 2 will be mounted on poles around the boundary of the SWMU (see Figure 4-1).

All activities that would involve disturbance of the subsurface will be minimized in accordance with all land-use control mechanisms. Activities that will be prohibited include military training exercises, hunting, recreational activities, and construction of residential facilities. However, the following activities, conducted in a manner that would minimize disturbance of the subsurface, will be permitted:

- timber harvesting (possible in the future),
- performance of wildlife studies, and
- provision and maintenance of feed lots for deer.

5.2.1 Establishment of Institutional Controls

Prior to installation of warning signs at the SWMU, land-use and "zoning-like" requirements for the subject site will be incorporated into the BMP, which will include all restrictions and provisions documented in Appendix B of this report. The BMP will include a description of institutional controls provided in this CAP. The appropriate implementing document(s) will include land-use prohibitions and restrictions, including those related to activities that disturb the subsurface and to construction of new buildings. The appropriate implementing document(s) will also provide allowances for those activities that do not impact the subsurface, as described above. Reference to documents relevant to the corrective actions performed at this SWMU will also be included in the BMP.

Deed recordation and the purchase or lease agreement upon property transfer will also incorporate land-use controls. Deed recordation provisions and requirements are described in Appendix B. The deed recordation will, in perpetuity, notify any potential purchaser of the property that SWMU 2 has been used as a landfill. The purchase agreement(s) and deed recordation or lease agreement will reference this CAP and other environmental documents that contain the rationale for the restrictions. As required by the DoD policy "Responsibility for Additional Environmental Cleanup after Transfer of Property," the property disposal agent will ensure that the transfer documents for real property reflect the land-use controls. The legal office of the USACE and its telephone number will be included as a point of contact in the purchase agreement and deed in case a problem arises with a use control, additional contamination is found, or the transferee wishes to revise or terminate a land-use control. All applicable and appropriate state land-use control management systems in effect at the time of transfer will also be implemented. Additional land-use control mechanisms related to property transfer (e.g., notices, media-use restrictions, self-certification) will be evaluated and implemented as necessary and appropriate.

A survey plat has been prepared (Appendix C) by a professional land surveyor certified in the state of Georgia. The plat will be included in the BMP. The survey plat indicates the location and dimensions of the SWMU 2 with respect to permanently surveyed benchmarks. The plat contains a prominently displayed note that states Fort Stewart's obligation to prohibit disturbance of SWMU 2 in accordance with this CAP.

5.2.2 Warning Signs

Fourteen permanent warning signs will be mounted on poles at approximately 200-foot intervals surrounding the perimeter of SWMU 2, as shown in Figure 4-1. These signs will be worded as shown below.

FORMER LANDFILL
NO TRESPASSING
CONTACT DPW
REGARDING USE RESTRICTIONS
767-2010

Each sign will have the dimensions of 24 inches by 24 inches. Warning signs will be metal plates with reflective painting and of weather-resistant construction. The signs will have a brown background and white lettering.

The positioning of each sign will provide maximum visibility from all locations outside the SWMU's boundaries. All signs will be permanently labeled (for identification purposes) on the back with a numerical identification number as shown on Figure 4-1.

The warning signs at the Camp Oliver Landfill will be inspected annually in accordance with the O&M Plan. Damaged signs will be repaired or replaced as needed. Repair or replacement of signs will occur within 1 month after inspection. Should damage be observed between inspections, repair or replacement will occur within 1 month following observation.

5.2.3 Well Abandonment

Six monitoring wells (MW2, MW3, MW4, MW5, MW6, and MW7) will be properly abandoned. The abandonment of monitoring wells will include removal of the protective guard posts, concrete pad and surface casing and grouting the wells to ground surface. The debris from the abandonment of the monitoring wells will be disposed of at the Fort Stewart Sanitary Landfill.

5.3 COST ESTIMATE

A detailed cost estimate is provided in Appendix D for implementation of institutional controls at the Camp Oliver Landfill. The life-cycle cost estimate for the selected institutional controls alternative is $194,662, which includes $24,350 for capital costs and $101,237 for O&M for 30 years.

5.4 IMPLEMENTATION SCHEDULE

Implementation of the corrective action will begin once approval of this CAP is received from GEPD. The schedule presented in Table 5-1 has been established for implementation of institutional controls at this site.

Table 5-1. Corrective Action Implementation Schedule, SWMU 2

Task	Time from GEPD Approval of CAP (days)
Procure signs and materials.	90
Record institutional controls in BMP and any other approved implementing document.	120
Perform well abandonment.	120
Install warning signs.	120
Perform inspections (implement O&M Plan).	Annually[a]
Repair/replace signs.	As needed
Notify GEPD of property transfer.	Prior to property transfer
Establish appropriate legal land-use controls for property transfer (e.g., deed recordation, lease or purchase agreements)	Prior to property transfer

[a]The first O&M report will be submitted to GEPD 455 days after the installation of the warning signs, with subsequent reports submitted annually thereafter.

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APPENDIX A

OPERATIONS AND MAINTENANCE PLAN

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OPERATIONS AND MAINTENANCE PLAN

The following Operations and Maintenance (O&M) Plan will be implemented for a period of 30 years to ensure that signs and barriers remain in good condition. O&M will include documented inspections as well as any necessary repairs to or replacement of materials (e.g., signs). This plan outlines the roles and responsibilities for O&M (Table A-1) and provides a detailed description of O&M requirements for this site.

Table A-1. O&M Roles and Responsibilities

Role	Responsibilities
Inspection and Maintenance Supervisor	• Facilitate assignment of qualified personnel to perform inspections. • Provide instruction to qualified personnel. • Establish dates for annual inspections. • Collect, sign, and maintain field inspection and maintenance logs. • Facilitate acquisition and provision of materials for repair or replacement of warning signs. • Acquire maintenance support to make any necessary repairs or replacements of warning signs by preparing work requests. • Provide any necessary instruction to maintenance personnel regarding repair or replacement of warning signs. • File documentation associated with repairs/replacements. • Prepare and submit annual O&M reports to the Georgia Environmental Protection Division (GEPD).
O&M Inspector	• Walk/drive around perimeter of site. • Observe any damage to warning signs and any signs of human activity within the boundary of the solid waste management unit (SWMU). • Document all findings and repair/replacement recommendations on Inspection and Maintenance Logsheet. • Submit Inspection and Maintenance Logsheet and Site Inspection Map to Inspection and Maintenance Supervisor. • Verbally clarify findings to Inspection and Maintenance Supervisor as needed.
Maintenance Personnel	• Acquire materials necessary for repair/replacement of warning signs. • Perform repairs or replace signs as described by work request. • Document that work request has been performed. • Provide documentation of completed work to Inspection and Maintenance Supervisor.

Detailed Description of O&M Activities

General. An Inspection and Maintenance Supervisor will be assigned to provide oversight and administration of O&M activities performed at the Camp Oliver Landfill (SWMU 2). The supervisor will ensure that qualified and trained personnel are selected to perform inspection and maintenance activities. Inspections and maintenance will be performed annually beginning 1 year after installation of the warning signs at the SWMU. All activities associated with field inspections and maintenance activities will be recorded in field inspection logs and maintenance documentation.

Inspections. The O&M Inspector will walk or drive the perimeter of SWMU 2 and observe any damage or deterioration of the warning signs. Any evidence of human activity within the boundaries of the SWMU will also be noted. Information from the field inspection observations shall be documented in the Inspection and Maintenance Logsheet (Figure A-1) and on the Site Inspection Map (Figure A-2). Information to be documented in the log will include the year of inspection, the number of signs to be repaired/replaced, the identification number of signs that require repair or replacement, an indication of the type of damage to the warning sign, and the signature of the inspector. The inspector will present the field logs and Site Inspection Map to the Inspection and Maintenance Supervisor within 24 hours of inspection. The inspector will also verbally report any findings that require clarification.

The Site Inspection Map (Figure A-2) will also be used to document which signs will require repair or replacement as well, as which signs were checked but will not require repair or replacement. Markings on the Site Inspection Map shall be made in accordance with the instructions provided on Figure A-2.

Maintenance. The Inspection and Maintenance Supervisor will ensure procurement of any additional materials and supplies needed to repair or replace warning signs using work requests. The supervisor will ensure that maintenance personnel are assigned to perform any needed repairs or replacements. The Inspection and Maintenance Supervisor shall provide a detailed description of the needed repairs or replacements to the maintenance personnel. The maintenance personnel will acquire the necessary supplies to make repairs or replace signs. The maintenance personnel, in accordance with the schedule requested by the supervisor, will perform the repair and/or replacement of warning signs. The maintenance personnel will document the repairs and replacements in the Inspection and Maintenance Logsheet provided by the Inspection and Maintenance Supervisor (see Figure A-1). The completed maintenance log will be signed and dated by the maintenance personnel and submitted to the Inspection and Maintenance Supervisor for review and approval. All documentation associated with maintenance will be filed and maintained by the supervisor.

Reporting. Inspections and maintenance activities will also be summarized in an annual report entitled the *Corrective Action Plan Progress Report for SWMU 2*. The Inspection and Maintenance Supervisor will be responsible for preparing the report based on information provided in the Inspection and Maintenance Logsheets. The Inspection and Maintenance Supervisor will prepare and submit the initial Corrective Action Plan Progress Reports for SWMU 2 to GEPD for review and approval within 455 days after the installation of the warning signs at the Camp Oliver Landfill.

INSPECTION AND MAINTENANCE LOGSHEET
WARNING SIGNS AND POSTS
AT THE CAMP OLIVER LANDFILL (SWMU 2)

Year	Signs/Posts Requiring Repair		Signs/Posts Requiring Replacement		Inspector Signature	Maintenance Personnel Signature	Supervisor Approval Signature	Comments
	Qty	Identification Numbers	Qty	Identification Numbers				

Figure A-1. Inspection and Maintenance Logsheet

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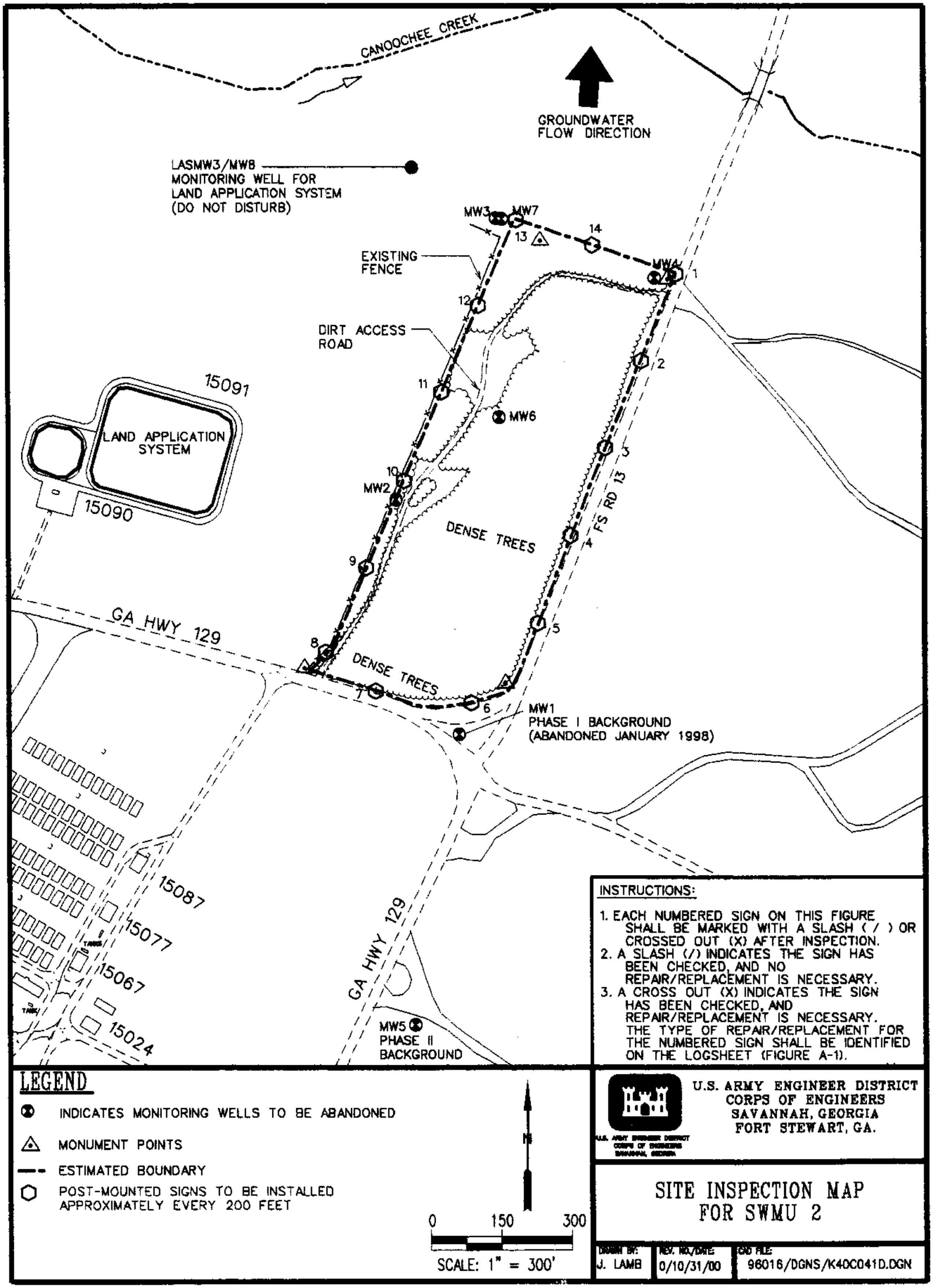

Figure A-2. Site Inspection Map

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APPENDIX B

BASE MASTER PLAN AND DEED RECORDATION REQUIREMENTS

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I certify that I have read and concur with the land recordation requirements presented in the Base Master Plan for the Camp Oliver Landfill (SWMU 2).

______________________________	______________________
Principal Executive Officer or Authorized Agent Fort Stewart Military Reservation	Date

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Introduction

This appendix presents the requirements for the Base Master Plan (BMP) and deed recordation for the implementation of the selected remedial alternative for the area identified as the Camp Oliver Landfill [Solid Waste Management Unit (SWMU) 2]. The selected remedial alternative for the Camp Oliver Landfill is protective of human health and includes the following features:

- BMP, deed recordation, and zoning controls that restrict the use of groundwater and prohibit intrusion into subsurface soil;
- abandonment of six monitoring wells (MW2, MW3, MW4, MW5, MW6, and MW7);
- installation of warning signs; and
- implementation of an Operations and Maintenance (O&M) Plan to maintain the conditions of the signage.

The selected alternative is fully described in Chapter 5 of this report.

The requirements for the BMP identify land-use restrictions and requirements to be incorporated into and enforced by the Fort Stewart Military Reservation BMP until transfer of ownership of the Camp Oliver Landfill from the federal government. The requirements for deed recordation identify the present (i.e., as of December 2000) applicable requirements for the area identified as the Camp Oliver Landfill upon its future transfer out of government ownership.

Base Master Plan
for
Solid Waste Management Unit 2,
Camp Oliver Landfill

The following information/items and restrictions will be included in the BMP, which will be effective until the transfer of ownership of the Camp Oliver Landfill property.

1. The following information will be documented in the BMP:

    a. All activities on the property that may result in disturbance of subsurface soil and/or substantially interfere with implementation of the O&M Plan are prohibited.

    b. Although use of groundwater beneath the subject property is not expressly prohibited, installation of groundwater wells, including monitoring wells, within the boundaries of this property is expressly prohibited.

    c. Military training exercises, hunting, and recreational activities are expressly prohibited.

    d. All construction within the property boundaries is expressly prohibited.

    e. The O&M Plan for the Camp Oliver Landfill, which requires maintenance of permanent markers (signs) every 200 feet to delineate the restricted area, is to be implemented. The BMP shall reference the O&M Plan or include the plan as an attachment or appendix.

    f. The BMP will also document the following specific activities that will be permitted within the boundaries of the subject site:

        1. timber harvesting,
        2. performance of wildlife studies, and
        3. provision and maintenance of feed lots for deer.

2. Site Survey:

    a. The BMP will include a written description of the boundaries of the site in accordance with the survey plat included in this Corrective Action Plan. Both the written description and the survey plat are presented in Appendix C.

    b. A copy of the survey plat, which indicates the location and dimensions of the disposal unit with respect to permanently surveyed benchmarks, will be included in the BMP. The survey plat is presented in Appendix C.

Deed Recordation

Deed recordation will be provided at the time of transfer out of government ownership and will comply with *DoD Guidance on Land Use Controls for Property Transferred Out of Federal Ownership* (Working Draft). Deed recordation for the Camp Oliver Landfill (SWMU 2) will conform to the following requirements:

1. Deed recordation will be made through the execution of a restrictive covenant for the property. The covenant will be recorded with the clerk of the superior court for the county of Evans. The language will be consistent with applicable state property and environmental laws in effect at the time of transfer.

2. A copy of the restrictive covenant should be provided to the zoning or land-use planning authority that has jurisdiction over this property. Such restrictions should run with the land and be binding on the owner's successors and assignees.

3. The restrictive covenant will be written by the real estate office of the Savannah District of the U.S. Army Corps of Engineers. As required by the real estate office, the following items will be provided to facilitate preparation of the deed:

    a. a survey plat (see Appendix C of this Corrective Action Plan),
    b. a legal description of the property, and
    c. use restrictions and other provisions (see Item 4 below).

4. The following restrictions/provisions may be documented in the restrictive covenant:

    a. The subject area will be limited to industrial use only.

    b. Activities on the property that may result in disturbance of subsurface soil and/or substantially interfere with implementation of the O&M Plan will be restricted.

    c. Any use of shallow groundwater beneath the subject property will be prohibited, except where monitoring is determined to be necessary by regulatory authorities.

    d. Maintenance of permanent markers (signs) approximately every 200 feet around the perimeter of the site that meet the requirements established by this Corrective Action Plan for SWMU 2 will be required to delineate the restricted area.

    e. The legal office of the U.S. Army Corps of Engineers and its telephone number will be included as the point of contact and documented in the deed in case a problem arises with a use control, additional contamination is found, or the transferee wishes to revise or terminate a land-use control.

5. After the language is drafted, the disposal agent should coordinate with the GEPD for verification that the restrictions reflect the environmental concerns of the site.

6. The property disposal agent's office should also provide a copy of the deed to local offices such as the Building Permits Division and the Water Resources Branch.

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APPENDIX C

SITE DESCRIPTION, DIRECTIONS TO SITE, AND SURVEY PLAT

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SITE DESCRIPTION AND DIRECTIONS TO SITE FOR THE CAMP OLIVER LANDFILL (SWMU 2) AS OF DECEMBER 2000

Site Description

The Camp Oliver Landfill is located approximately 17 miles northwest of the Fort Stewart garrison area along Fort Stewart Road 129. It is just north of the bivouac area on the northern side of a small hill. The site consists of almost 8.8 acres, mostly of unmanaged grasslands with immature trees. Areas of dense trees cover some portions of the site. Four topographic survey points define the northeast, northwest, southeast, and southwest corners of Solid Waste Management Unit (SWMU 2). There is a slight relief across the site from south [approximately 145 feet above mean sea level (amsl)] to north (125 feet amsl). Canoochee Creek is located approximately 450 feet north of the northern boundary of SWMU 2. The surface water flow direction is from the northern boundary of SWMU 2 toward Canoochee Creek. There is little obvious surface evidence that a landfill or open dumping area existed. During a site reconnaissance in November 1995, small soil piles, some roofing tin, and wooden construction-type debris were observed. A site reconnaissance in September 1996 indicated no evidence of any landfill operations. Some small mounds are located within the landfill. The enclosed plat, based on a survey performed in April 2000, defines the current site features of SWMU 2.

Directions to Site

Unpaved Roads. Starting from the intersection of Georgia Highways 119 and 144 on the northern perimeter of the Fort Stewart garrison area, proceed 3.4 miles north on Georgia Highway 119. Turn left onto Fort Stewart Road 129. Proceed 13.8 miles on Fort Stewart Road 129. (*Note*: Fort Stewart Road 129 makes a 90-degree turn to the west where Fort Stewart Road 13 begins.) At the fork in the road, bear right and continue 0.21 mile on Fort Stewart Road 13 to the entrance of SWMU 2, which is on the left.

Paved Roads. Starting from the intersection of Georgia Highways 119 and 144 on the northern perimeter of the Fort Stewart garrison area, proceed 18.2 miles north on Georgia Highway 119. Turn left onto Georgia Highway 280W. Proceed 10 miles on Georgia Highway 280W. Turn left onto Sunburry Road (County Road 204). Proceed 3.8 miles on Sunburry Road (County Road 204) to a stop sign and turn left onto Old Highway 250. Proceed 2.2 miles on Old Highway 250 and turn left onto John Todd Road (County Road 209). Proceed 1.8 miles on John Todd Road (County Road 209) to a fork in the road. Bear left at the fork. There will be another fork in the road 0.45 mile after the first fork. Again, bear left at the fork. SWMU 2 is located on the left side of the road 0.2 mile past the second fork.

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APPENDIX D

COST ESTIMATE

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	Cost Estimate	Alternative 1 Institutional Controls: Land Use Controls with Signs	Alternative 1A Institutional Controls: Land Use Controls with Signs and Groundwater Monitoring	Alternative 2 Institutional Controls: Land Use Controls with Signs and Fence	Alternative 2A Institutional Controls: Land Use Controls with Signs, Fence, and Groundwater Monitoring
1.0	**Capital Costs**				
1.1	Engineering Services				
1.1.1	Work Plan/Site Safety and Health Plan	$2,000	$5,000	$3,000	$5,000
1.1.2	Contracting/Procurement	$1,000	$2,000	$1,000	$2,000
1.1.3	Engineering Oversight	$1,200	$3,000	$1,200	$3,000
1.1	**Total Costs for Engineering Services**	**$4,200**	**$10,000**	**$5,200**	**$10,000**
1.2	**Installation/Establishment of Institutional Controls**				
1.2.1	*Tree and Brush Clearing and Chipping*			$1,450	$1,450
1.2.2	*Existing Fence Removal*			$500	$500
1.2.3	*Signs and Posts Installation*				
	1.2.3.1 Warning Signs	$11,108	$11,108	$11,108	$11,108
	1.2.3.2 Posts (includes shipping)	$242	$242	--	
	1.2.3.3 Sign/Post Installation Labor	$1,400	$1,400	$0	$0
	Subtotal of Warning Signs Installation	$12,750	$12,750	$11,108	$11,108
1.2.4	*Chain Link (6' high, 3 strands barbed wire) Fence with Two Swing Gates*				
	1.2.4.1 Chain-link Fence Installation	--		$58,382	$58,382
	1.2.4.2 Gate Installations	--		$2,912	$2,912
	Subtotal of Fence and Gate Installation	$0	$0	$61,294	$61,294
1.2.5	*Abandonment of Groundwater Wells*				
	1.2.5.1 Mobilization and Demobilization	$2,000	$2,000	$2,000	$2,000
	1.2.5.2 Well Abandonment	$2,400	$2,400	$2,400	$2,400
	Subtotal of Well Abandonment	$4,400	$4,400	$4,400	$4,400
1.2.6	*Groundwater Monitoring*				
	1.2.6.1 Mobilization and Demobilization		$10,000		$10,000
	1.2.6.2 Technical Labor		$26,000		$26,000
	1.2.6.3 Other Direct Costs (pumps, meters, travel, per diem)		$25,000		$25,000
	1.2.6.4 Laboratory Analysis		$1,375		$1,375
	1.2.6.5 Data Quality Assurance		$688		$688
	1.2.6.6 Groundwater Monitoring Report		$25,000		$25,000
	Subtotal of Groundwater Monitoring	$0	$88,063	$0	$88,063
1.2.7	*Deed Recordation*				
	Allowance*	$3,000	$3,000	$3,000	$3,000

	Cost Estimate	Alternative 1 Institutional Controls: Land Use Controls with Signs	Alternative 1A Institutional Controls: Land Use Controls with Signs and Groundwater Monitoring	Alternative 2 Institutional Controls: Land Use Controls with Signs and Fence	Alternative 2A Institutional Controls: Land Use Controls with Signs, Fence, and Groundwater Monitoring
1.2	**Total Installation/Establishment of Institutional Controls**	**$20,150**	**$108,213**	**$81,752**	**$169,815**
1.0	**Total Capital Costs**	**$24,350**	**$118,213**	**$86,952**	**$179,815**
2.0	**Operations and Maintenance (30 years)**				
2.1	Replacement/Repair of Warning Signs and/or Posts**	$19,126	$19,126	$16,662	$16,662
2.2	Replacement/Repair of Fencing***	--	--	$36,776	$36,776
2.3	Annual Inspection and Reports	$77,111	$77,111	$77,111	$77,111
2.4	Administration of Operations and Maintenance Plan Requirements	$5,000	$5,000	$5,000	$5,000
2.0	**Total Costs for Operations and Maintenance**	**$101,237**	**$101,237**	**$135,549**	**$135,550**
	Subtotal Project Costs	$125,588	$219,450	$222,501	$315,365
	Engineering Management (10 percent of subtotal)	$12,559	$21,945	$22,250	$31,536
	Contingency (20 percent of subtotal)	$25,118	$43,890	$44,500	$63,073
	Health and Safety (15 percent of subtotal)	$18,838	$32,918	$33,375	$47,305
	Contractor Profit (10 percent of subtotal)	$12,559	$21,945	$22,250	$31,536
	Total Project Costs	**$194,662**	**$340,148**	**$344,876**	**$488,815**

* Allowance based upon estimate using best professional judgment.

** Assumes sign and/or post repair/replacement allowance of 25 percent of total installation cost every 5 years for a period of 30 years.

*** Assumes fence repair/replacement allowance of 10 percent of total installation cost every 5 years for a period of 30 years.