DRAFT FINAL
SITE INVESTIGATION REPORT
FOR
HIGH PRIORITY SITES
AT
FORT RILEY, KANSAS

(Includes the Sensitive-Receptor Lead Sites, Open Burn/Open Detonation
Area, Custer Hill Wastewater Ponds and the Building 1301
and the Former Building 1605 Area)

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COMMENTS

ACRONYM LIST

AMCCOM	Army Armament Munitions and Chemical Command
ARARs	Applicable, Relevant and Appropriate Requirements
ASP	Ammunition Supply Point
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CFR	Camp Forsyth Ranges
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
CME	Chicago Mining Equipment
DCA	Dichloroethane
DCE	Dichloroethene
DEGN	Diethyleneglycol dinitrate
DEH	Directorate Engineering and Housing, Fort Riley
DLA	Denitrated Lead Azide
DMA	Defense Mapping Agency
DMMC	Division Material Management Center
DNB	Dinitrobenzene
DNT	Dinitrotoluene
DoA	Department of the Army
DoD	Department of Defense
DR	Demolition Range
DRMO	Defense Reutilization and Marketing Office
DRO	Diesel Range Organic
DSER	Data Summary and Evaluation Report
DU	Depleted Uranium
DWS	Drinking Water Standards
EMS	Emergency Medical Services
EOD	Explosive Ordnance Detachment
EODCC	Explosive Ordnance Detachment Command Center
EP	East Pond
EPA	Environmental Protection Agency
F	Fahrenheit
FFA	Federal Facility Agreement
FFTA	Former Fire Training Area
FID	Flame Ionization Detector
FMP	Former Mullins Park
ft	Foot
GC	Gas Chromatograph
GM	Geiger Muller (instrument)
gpd	Gallons per day
gpm	Gallons per minute
GPR	Ground Penetrating Radar
GRO	Gasoline Range Organics
GSA	General Services Administration
HC	Hexachloroethane
HCB	Hexachlorobenzene

ACRONYM LIST (continued)

HMX	Cyclotetramethylenetetranitramine
HPLC	High Pressure Liquid Chromatography
HRS	Hazardous Ranking System
HSA	Hollow Stem Auger
HSWA	Hazardous and Solid Waste Amendments
IAG	Interagency Agreement
ICP	Inductive Coupled Plasma
IWSA	(Draft Final) Installation Wide Site Assessment
KAL	Kansas Action Levels established by KDHE
KDHE	Kansas Department of Health and Environment
KNL	Kansas Notification Levels established by KDHE
K_{OC}	Octonol Carbon Coefficient
lpm	Liters per Minute
M&O	Munitions and Ordnance
MAAF	Marshall Army Air Field
MCL	Maximum Contaminant Levels established by EPA under the Safe Drinking Water Act
MCA	Multi-Channel Analyzer
MEK	Methylethylketone
mg/kg	milligrams per kilogram
mg/l	milligrams per liter
MPRC	Multi-Purpose Range Complex
NAAQS	National Ambient Air Quality Standards
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
NWC	Naval Weapons Center
OB/OD Area	Open Burn/Open Detonation Area
PA	Preliminary Assessment
PAOCs	Potential Areas Of Concern
PASCORE	Preliminary Assessment Scoring
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethylene or Perchloroethylene
PETN	Pentaerythritol tetranitrate
PID	Photoionization Detector
POL	Petroleum, Oils and Lubricants
PP	Priority Pollutant (Metals)
PPE	Personal Protective Equipment
ppm	parts per million
QCSR	Quality Control Summary Report
RCRA	Resource Conservation and Recovery Act
RDX	Cyclotrimethylenetrinitramine
RI/FS	Remedial Investigation/ Feasibility Study
ROI	Range of Interest
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act

ACRONYM LIST (continued)

SB	Soil Boring
SF	Square Feet
SI	Site Investigation
SINC	Species in Need of Conservation
SOP	Standard Operating Procedures
SS	Surface Soil
SVOCs	Semi-Volatile Organic Compounds
SWL	Static Water Level
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TCE	Trichloroethylene
TES	Tactical Equipment Shop
TF4	Trainfire 4
TM	Technical Manual
TNB	Trinitrobenzene
TNT	2,4,6-Trinitrotoluene
TPH	Total Petroleum Hydrocarbon
TPH-DRO	Total Petroleum Hydrocarbon - Diesel Range Organics
TPH-GRO	Total Petroleum Hydrocarbon - Gasoline Range Organics
μg/kg	micrograms per kilogram
μg/l	micrograms per liter
USAETL	United States Army Engineer Topographic Laboratories
USAFETAC	United States Air Force Environmental Technical Applications Center
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Society
UXO	Unexploded Ordnance
VOCs	Volatile Organic Compounds
WP	West Pond
WR	Old Wash Rack Reservoir
WWTP	Waste Water Treatment Plant
XRF	X-Ray Fluorescence

1.0 INTRODUCTION

This report presents the results of Site Investigations (SI) conducted at Fort Riley, Kansas in partial fulfillment of regulatory requirements under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 and its amendments, the Superfund Amendments and Reauthorization Act (SARA) of 1986, as well as requirements under the Resource Conservation and Recovery Act (RCRA) of 1976 and its Hazardous and Solid Waste Amendments (HSWA) of 1984. The SIs were performed in compliance with the Sensitive-Receptor Lead Sites Sampling and Analysis Plan, 10 May 1993 and the Draft Final Sampling and Analysis Plan (SAP) for Site Investigations of High Priority Sites at Fort Riley, Kansas, 20 August 1993. This report presents results of SIs for the following sites:

- Sensitive-Receptor Lead Sites (including Former Camp Forsyth Ranges, Former Mullins Park, Ware Elementary School and Custer Hill Elementary School);
- Open Burn/Open Detonation Area;
- Custer Hill Wastewater Ponds (including Old Wash Rack Reservoir, Cells 1 through 4, East Pond and West Pond); and
- Buildings 1301 and 1605.

The field investigation portion of the SIs for the Sensitive-Receptor Lead Sites was performed primarily in June 1993. The remaining sites presented in this report were investigated in September and October 1993. One additional site was included in the September-October SI -- the former fire training area at Marshall Army Airfield. The SI results identified releases of hazardous substances and petroleum hydrocarbons to soils and groundwater at the site. Because of the results of the SI at this site, the investigation is being expanded, and the SI results for the former fire training area have been presented in a separate document (Draft Final Expanded Site Investigation Sampling and Analysis Plan for Former Fire Training Area - Marshall Army Airfield, Fort Riley, Kansas and Nearby Off-Post Properties, 24 May 1994).

The SIs at the High Priority Sites were performed by Louis Berger and Associates, Inc. (Berger) for the Kansas City District Corps of Engineers in support of Fort Riley.

1.1 Background

Fort Riley contains 101,058 acres and encompasses portions of Riley, Geary and Clay Counties. The installation is located approximately between latitudes 39° 02' and 39° 18' north and longitudes 96° 41' and 96° 58' west. The general location of Fort Riley is shown in Figure 1-1.

Fort Riley was established in 1853 and has been owned and operated by the U.S. Department of the Army since that time. In August 1980, Fort Riley submitted to the United States Environmental Protection Agency (EPA) a "Notification of Hazardous Waste Activity" pursuant to RCRA (Ref. 1). In November 1980, Fort Riley filed a Part A Hazardous Waste Permit Application under RCRA, qualifying Fort Riley under Interim Status for treatment, storage and disposal of hazardous substances. In March 1985, Fort Riley submitted a Part B Hazardous Waste Permit Application under RCRA. Subsequent revisions for both the Part A and Part B applications have been submitted; these permits identified the following: an open burning and detonation area used for the removal of unexploded ordnance; an existing hazardous waste storage facility and a proposed hazardous waste storage facility, both at the Defense Reutilization and Marketing Office (DRMO).

Numerous environmental investigations and sampling events were performed at Fort Riley in the 1970s and 1980s. These investigations identified activities and facilities where hazardous substances may have been released to the environment. Potential sources of contamination include a variety of landfills; printing, dry cleaning, and furniture shops; and pesticide storage facilities. On 14 July 1989, EPA proposed inclusion of Fort Riley on the National Priorities List (NPL) pursuant to CERCLA and promulgated the installation on the NPL in August of 1990. Fort Riley is identified by EPA as Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) site KS6214020756.

In March 1991, the Department of Army and Fort Riley, Kansas entered into a Federal Facilities Agreement (FFA), Docket No. VII-90-F-0015, with the Kansas Department of Health and the Environment and EPA Region VII to address environmental pollution subject to RCRA and/or CERCLA. [This agreement is also referred to as the Interagency Agreement or IAG.]

The IAG requires Fort Riley to investigate previously identified potential areas of concern (PAOC) and conduct a systematic site assessment to identify all PAOCs located at Fort Riley. The systematic site assessment was performed in 1992 with the results presented in the Draft Final Installation Wide Site Assessment (IWSA) for Fort Riley, Kansas, dated 7 December 1992, as revised on 16 February 1993. The IWSA identifies 24 groupings of PAOCs, consisting of over 45 individual PAOCs. Information was collected on the PAOCs to evaluate their eligibility under CERCLA and RCRA authorities, the contaminants present, potential migration pathways and potentially exposed populations (hereafter referred to as "receptors"). The IWSA was conducted consistent with EPA requirements for Preliminary Assessments (PA) under CERCLA. Based on EPA's PA methodology, potential risk posed by the PAOCs was estimated using the Hazard Ranking System (HRS) (Ref. 2).

As outlined in the National Contingency Plan (Ref. 3), the results of the PA were used to identify sites requiring further investigation or SIs. Twenty (20) areas were identified, most consisting of individual sites; however, some were groupings of similar sites. Some of the 20 sites had the potential to pose a greater risk to human health and the environment than other sites. For this reason, the sites potentially posing the greatest amount of risk were considered a higher priority for conducting SIs with the SIs of the other sites to follow.

1.2 Scope

Based on the results of the IWSA, seven sites were identified as a high priority for SIs because of their potential risk or high likelihood for causing releases to the environment. Of these, four sites were identified and evaluated based on their potential to have lead contamination of shallow soils in areas readily accessible to the public -- Former Camp Forsyth Ranges, Custer Hill Elementary School, Ware Elementary School, and the Former Mullins Park. These sites are referred to as the Sensitive-Receptor Lead Sites. The SIs for the Sensitive-Receptor Lead sites were planned and implemented separately from the rest of the High Priority Sites; however, the results of those SIs are included in this report. Of the remaining PAOCs, four were selected as a high priority for field investigations as follows:

- Open Burn/Open Detonation (OB/OD) Area: The site is active and is currently within the RCRA permitting process.

- Former Fire Training Area - Marshall Army Air Field (FFTA-MAAF): The site had a high potential to release to groundwater because of the practice of pouring flammable liquids into an unlined pit as part of fire training exercises.

- Custer Hill Wastewater Retention Ponds: The site has a high potential to release to groundwater because the ponds are currently unlined (perimeter lining of some of the ponds is planned to prevent infiltration of floating petroleum hydrocarbons); some non-petroleum substances have been detected in some of the ponds.

- Former furniture repair shops at Building 1301 and Former Building 1605: Field work at these sites was originally scheduled for the Other Sites SIs because of the low potential threat they posed to the environment. However, Building 1301 was scheduled for demolition prior to completion of the Other Site SIs. Therefore, SI activities at this site were included with the other High Priority Sites to be performed prior to demolition. Because of the close proximity of Former Building 1605 to Building 1301, field work was performed here as well.

The general location of these sites on Fort Riley is shown on Plate 1-1.

The SI for the Sensitive-Receptor Lead Sites was expedited due to the accessibility of the potentially contaminated areas to the general public. The field work was conducted principally in June 1993. The SI field work for the remaining high priority sites was conducted in September through November 1993. (The remaining sites requiring SIs will be addressed in subsequent investigations; field investigations for the remaining sites began in March 1994.)

1.3 Objectives

The SIs of the high priority sites were conducted to gather additional information regarding the presence of hazardous substances at these sites and to support decision-making regarding the need for more detailed investigations and/or cleanup of the sites. The SIs were conducted in accordance with EPA's Guidance for Performing Site Inspections Under CERCLA - Interim Final, EPA/540-R-92-021, September 1992.

In general, the objective for site investigation activities was limited to confirming or denying whether significant contamination exists at the sites of concern. This was determined through strategic sampling of potential source areas and an evaluation of likely pathways for migration of hazardous substances from the source areas. Where contamination was detected and considered significant when compared with the criteria presented in the SAP (see Section 1.5), the SIs were designed to gather enough information to allow for assessment and planning of removal actions or interim remedial measures, as necessary. Furthermore, the SIs were designed to provide sufficient information to indicate that hazardous substances are not present, are not migrating, or are at levels too low to pose a significant threat to human health and the environment now or in the future. An overview of SI objectives for each site is presented below.

1.3.1 Sensitive-Receptor Lead Sites

The objectives for each of the four lead sites were the same. The background historical records review performed as part of the IWSA indicated that there was the potential for shallow contamination of soils with lead. However, no sampling of the areas for lead had been conducted. Therefore, the objectives were to perform sampling of shallow soils at each site at sufficient locations to determine whether elevated concentrations of lead were present. The EPA cleanup guidelines for soils in residential areas -- 500 milligrams per kilogram (mg/kg) -- was used to determine the concentration of concern. Where elevated concentrations of lead were detected, the SI allowed for the expansion and refinement of sampling grids to better characterize areas of elevated lead concentrations. The SI also included sampling of select drainage ways to determine whether lead was migrating via overland runoff. Where elevated concentrations of lead were not detected, the site is not considered to pose a potential risk to human health or the environment.

1.3.2 Open Burn/Open Detonation (OB/OD) Area

Fort Riley has recently submitted to EPA a Subpart X permit application to include the OB/OD area in their Part B permit for managing waste under RCRA. Fort Riley is awaiting regulatory review of the Subpart X permit application. The OB/OD area is located inside the perimeter road for the Impact Area, which encompasses approximately 20 square miles. While Fort Riley has already completed an environmental investigation of the Impact Area as a whole, this investigation focused specifically on the OB/OD area, which encompasses an area of approximately 8 to 9 acres. The SI included sampling of surface and subsurface soils to determine whether the site activities produced residual contamination. The SI also included sampling of groundwater and surface water at the site to assess potential migration of contaminants from the site.

1.3.3 Custer Hill Wastewater Ponds

The Custer Hill Wastewater Ponds are a network of ponds (connected by sewers) used to manage waters from storm drains and building sumps of the Custer Hill troop complex. The sanitary sewers and sewage treatment plants are a separate system. In general, drainage from the Custer Hill troop complex is divided into thirds. One-third is directed to the East Wastewater Pond, one-third to the Old Wash Rack Reservoir, and one-third to the West Wastewater Pond. In turn, the water from the East and West Ponds is pumped to the Old Wash Rack Reservoir. From the Old Wash Rack Reservoir, water is diverted through a series of ponds known as Cells 1 through 4. Water from Cells 1 through 4 can be recycled through the pond system or can be discharged to intermittent tributaries to Threemile Creek. The Custer Hill Wastewater Ponds refers collectively to the East and West Wastewater Ponds, the Old Wash Rack Reservoir and Cells 1 through 4. As of this date, none of the ponds are lined. The primary objectives of the SI were to characterize the aqueous and sediment characteristics of each pond, evaluate potential releases to groundwater, and assess releases to intermittent tributaries to Threemile Creek.

1.3.4 Building 1301 and Former Building 1605

Building 1301 and Former Building 1605 were furniture repair shops where solvents were used for furniture stripping. The primary objective of the SI was to determine if any hazardous substances have been released from these buildings to the environment. If releases were detected, the SI characterized the releases to soil.

1.4 Supporting Documents

Numerous documents include information or procedures that were used during the SI. These documents include the following:

- Draft Final Installation Wide Site Assessment for Fort Riley, Kansas, 7 December 1992, as revised 16 February 1993.
- Draft Final Impact Area Site Assessment Report for Fort Riley, Kansas, Two Volumes, 11 March 1993.
- Subpart X Portion of RCRA Part B Permit Application - Open Burning/Open Detonation Area for Fort Riley, Kansas, 21 May 1993.
- Work Plan for Expediated Investigation of Sites Potentially Contaminated with Lead for Fort Riley, Kansas, 10 May 1993.
- Draft Final Sampling and Analysis Plan for Site Investigations of High Priority Sites at Fort Riley, Kansas, 20 August 1993.
- Comprehensive Basic Documents for the Site Investigations at Fort Riley, Kansas (including revisions through 29 October 1993). This includes the Quality Assurance Project Plan for Site Investigations at Fort Riley, Kansas; the Basic Monitoring Well Installation Plan for Site Investigations at Fort Riley, Kansas; Basic Soil Gas Services for Site Investigations at Fort Riley, Kansas; and Basic Investigations-Derived Waste Management Plan for Site Investigations at Fort Riley, Kansas.

- Site Safety and Health Plan for Site Investigations at Fort Riley, Kansas, 12 October 1993 revision; UXO Safety and Health Work Plan Supplement, September 20, 1993.

In particular, the Work Plan and Sampling and Analysis Plan for the sites being investigated provide a description of the specific activities to be conducted as part of the SI. As necessary, based on site-specific conditions or findings, the planning documents were modified and documented in writing as Technical Memoranda. Written revisions to the SIs for the High Priority Sites, applicable to the sites included in this report, are provided in Appendix A.

1.5 Interpretation of SI Data

The concentrations of hazardous substances detected during this SI are compared with risk based guidelines for soil media and state and federal regulatory standards for aqueous media (e.g., groundwater, surface water). Also, where available, federal and state cleanup guidelines for soils are used.

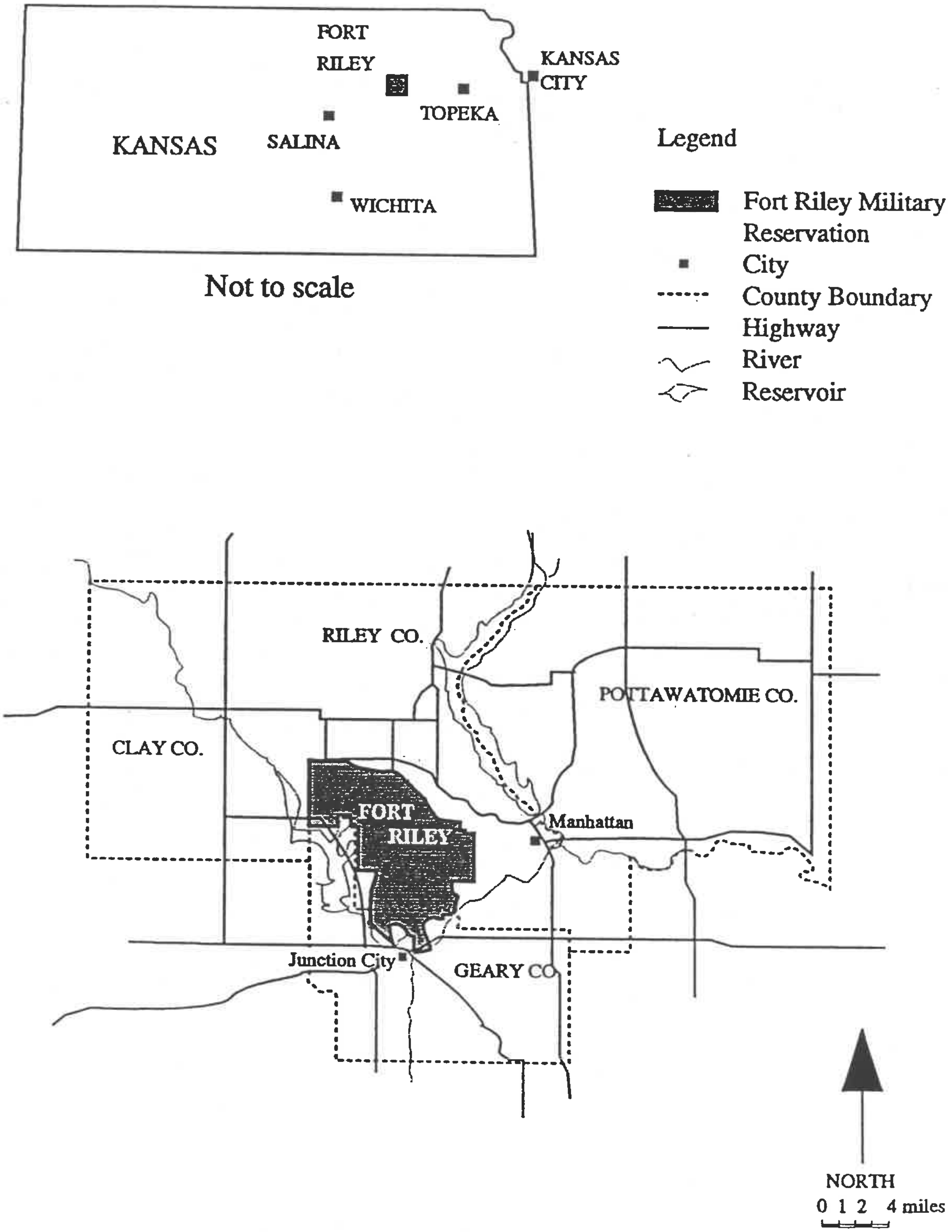
<u>Risk-Based Guidelines.</u> Risk based guidelines for the purposes of this document were based on guidelines from EPA Regions III, IX and X. The purpose of the guidelines developed by these EPA Regions is to allow for a quick evaluation of the concentrations of hazardous substances detected at a site relative to those likely to present an unacceptable health hazard. Since Region VII has not developed a separate set of risk-based guidelines, this report draws upon those guidelines developed by other Regions. However, the format and type of information presented in each of the regional risk-based guidelines differs. For example, Region X data distinguishes between cancer and non-cancer risk values whereas the Region III and IX data do not. Further, data from Regions III and IX distinguish between residential and commercial/industrial sites when evaluating risks associated with soil contamination whereas the Region X data is presented for residential exposures only. Therefore, direct comparison of risk-based guidelines developed by Regions III, IX and X should not be performed. Nonetheless, these guidelines are still valuable for providing a qualitative evaluation of the SI data results. For purposes of this report, the SI data are compared against the range of risk-based values provided by each of the three EPA Regions. For evaluating results of the soil sampling and analyses, values from Regions III and IX based on commercial/industrial sites are used, unless the site currently used for residential purposes, is near a residential area, or is likely to be used for residential purposes in the foreseeable future. Detections that exceed the maximum concentration of the range of risk-based values are noted and discussed within this document.

Federal and State Standards. The federal regulatory standards for drinking water are the EPA's Maximum Contaminant Levels (MCLs), and the state regulatory standards are the Kansas Notification Levels (KNLs) and Kansas Action Levels (KALs). Detections that exceed the MCL or the KAL are noted and discussed. There are no comparable regulatory standards available for soils. However, state regulatory guidelines for petroleum contaminated soils are used, as are EPA's cleanup guidelines for lead in soils.

1.6 SI Report Organization

The majority of this report is organized by the sites investigated. Section 2.0 of the report provides an overview of the site setting and potential receptors that is applicable to all sites. Section 3.0 addresses the sensitive-receptor lead sites; Section 4.0 addresses the OB/OD Area; Section 5.0 addresses the Custer Hill Wastewater Ponds; and Section 6.0 addresses Building 1301 and Former Building 1605. Within each of these site-specific sections, there are discrete discussions of the SI approach, site history, waste characteristics, groundwater, surface water, air, soils and a summary of site findings. Where the SI data show that hazardous substances are not present at a site, the discussions of potential migration pathways are limited, since, in effect there are no substances to migrate. Section 7.0 presents references for the report. Section 8.0 provides excerpts of relevant references not readily available.

FIGURE 1-1
GENERAL LOCATION PLAN



2.0 GENERAL DATA CONSIDERATIONS

This section provides an overview of Fort Riley and its setting that is applicable to the high priority sites. An overview is presented of activities at Fort Riley relevant to use and disposal of hazardous substances, as well as of the area features, land uses and populations that are relevant to the evaluation of migration pathways and relative risk posed by each of the sites.

2.1 Overview of Industrial and Waste Activities

Fort Riley has been used principally for the training of Army personnel. The post's history does not include large-scale manufacturing activities. Rather, development of Fort Riley included ancillary activities to support overall post operations, including print shops, photographic processing, laboratories, furniture repair, dry cleaning, paint shops, sewage treatment plants, and numerous vehicle maintenance and wash facilities. Hazardous materials used at the post include the following:

- ordnance (a RCRA hazardous waste, listed in 40 CFR 261.23(a)(b))
- chlorinated solvents associated with furniture repair, dry cleaning and cleaning of printing equipment;
- pesticides, insecticides and herbicides for clearing of brush, pest and termite control, and routine maintenance of facility grounds;
- small quantities of a variety of chemicals associated with laboratories;
- silver-bearing solutions from the photographic processing (and X-ray) facilities;
- PCB fluids in electrical equipment;
- large quantities of petroleum-based fuels and cleaners associated with vehicle use, maintenance and repair; and
- typical municipal waste.

In addition to the wastes outlined above, the post has generated construction debris throughout its operational life.

2.2 Environmental Setting

Fort Riley was founded near the confluence of the Republican and Smoky Hill Rivers which merge and form the Kansas River. Fort Riley consists of over 100,000 acres of undeveloped land, an approximately 20 square-mile Impact Area (which includes multiple ranges and the Artillery and Mortar Impact Area) and six cantonment areas: Main Post, Camp Forsyth, Camp Funston, Camp Whitside, Marshall Army Air Field and Custer Hill. (Custer Hill consists of the Custer Hill Troop Area to the north and Custer Hill Family Housing to the south.) Main Post is just north of the Kansas River primarily on the alluvial river lowlands and associated terraces. Marshall Army Air Field is situated south of the river from Main Post. Camp Funston, Camp Forsyth, and Camp Whitside are also situated north of the river, on the flat area between the meandering stream and the river bluffs that rise approximately 100 feet to the upland plateau. In the last 50 years, Fort Riley has been expanded by annexing large areas on the upland plateau for use as target ranges and impact areas. Also, development occurred on Custer Hill during this time period; Custer Hill is the only cantonment area that is located in the upland areas, outside the boundaries of the alluvial lowlands and associated terraces. The Impact Area is also located in the upland areas, north of the cantonment areas.

2.2.1 Topography and Geology

The topography of Fort Riley and the surrounding area can be most easily described as a low plain that has been eroded by streams and rivers (Ref. 4, 5). The area is designated as the Osage Plains section of the Central Lowlands physiographic province. The sedimentary bedrock strata dip gently to the west-northwest. East-facing escarpments of more resistant rock units are separated by gentle, westward sloping plains. The resulting topography can be divided into upland areas with bluffs along alluvial valleys and lowland areas which consist of alluvial plains and associated terraces. The upland areas are dissected by numerous intermittent and perennial streams; the lowland areas occur along the banks of the major rivers in the area: the Republican River, the Smoky Hill River and the Kansas River.

The upland plateau is at an elevation of approximately 1,300 feet above sea level. The surface is covered with a thin, glacially-derived, wind-deposited soil (loess) and decomposed sedimentary rock. The soil and subsoils typically are less than 30 feet thick on the plateau. Soil borings at Building 8100 -- the Consolidated Maintenance Facility on Custer Hill -- show that bedrock is consistently encountered within approximately 10 feet of the surface, with the overlying materials consisting predominantly of clays and topsoil.

The bedrock underlying the uplands area consists of interlayered beds of shales and limestones of the Chase and Council Grove Groups of the Permian System. These formations dip gently (less than 10 degrees) to the west-northwest. The Barneston formation of the Chase Group forms the upper layers of bedrock and consists of the Fort Riley limestone, Oketo shale and Florence limestone. The Fort Riley limestone is the upper rock unit over most of the installation. It is visible in stream cuts as white wall-like exposures often called the Fort Riley Rim Rock. Below this limestone is the Oketo shale member of the Barneston formation. This shale is calcareous and contains layers of limestone. Its color varies from blue-gray to yellow, and its thickness varies from a few inches to about 27 feet. The Florence limestone is the lowest member of the formation and contains imbedded steel-gray flint nodules (chert) and is approximately 33 to 45 feet thick. The irregular flint nodules occur in layers one to six inches thick in the limestone. This pattern of interbedded limestones and shales continues to depths of several hundred feet. The geologic literature for the area make no mention of karst features being present in the limestone formations. Further, no indications of karst features or terrain were identified during map review and field surveys.

The bedrock has been eroded by the major rivers and streams. The major streams tend to flow to the east and south. The rivers are broad, shallow, and slow-moving. They meander across the lowland areas, which are at an elevation of about 1,050 feet. The lowlands are underlain by a substantial thickness of alluvial deposits, consisting predominantly of sands and gravels, with occasional clay and silt layers. The alluvial deposits on Fort Riley are on the order of 100 feet in thickness near the river and thin out towards the bluffs.

The upland plateau is separated from the river lowlands by steep bluffs, which are frequently free of vegetation and expose the limestone and shale strata described above. The depth of erosion of the plateau is less for the small streams as they wind their way down to the river valley. There are no significant falls on the streams or rivers.

2.2.2 Climatology

The annual precipitation in the Fort Riley area ranges between 17 and 49 inches, and the temperature ranges between -32 degrees Fahrenheit (°F) and 115 °F. Average annual precipitation is approximately 31 inches. Twenty-four hour rain events can exceed 3.5 inches (Ref. 6). During the SI work, the average mean temperature was 61.9°F, with a total precipitation of 5.28 for the months of September and October.

The prevailing wind directions vary. The winds are predominantly from the south and southwest for ten months of the year, with winds predominantly from the north during the months of February and March. Mean wind speed is fairly constant at 8 miles per hour with a normal maximum of 12 miles per hour.

2.2.3 Vegetation and Wildlife

Land cover on the undeveloped portions of Fort Riley consists primarily of grassland or woodland, with very little acreage devoted to crop production. Cropland on the post is planted primarily as wildlife food plots or as a firebreak between private and federal lands. Grasslands are comprised of native prairie species, of cool-season tame grasses, and of naturally invaded grasses (Ref. 7).

The upland plateau is covered with grasses and forbs. Trees are generally small and limited to ravines or stream corridors. Numerous small ponds are present. In steep areas, the soil has been removed by erosion, and the bare bedrock formations are exposed. Wildlife inhabiting the area are predominately prairie species. However, because of the interspersed woodlands, sylvan species are also present. Most species present when Fort Riley was settled in the mid-1800's still occur here. Some large mammals, such as the bison, grizzly bear and gray wolf, have been extirpated.

The lowland valleys have larger trees and numerous waterways that attract waterfowl. Two large manmade lakes now flank Fort Riley -- Milford Lake on the Republican River in the west and Tuttle Creek Lake on the Big Blue River in the east. National Wetlands Inventory maps for the area illustrate a variety of wetland types located on or near Fort Riley, predominantly along existing rivers and streams. Wetlands within 1-mile of each of the sites are identified in the site-specific sections (Ref. 8).

2.2.4 Threatened and Endangered Species

The United States Fish and Wildlife Service (USFWS) completed a survey in 1992 of threatened and endangered species that could potentially occur on Fort Riley (Ref. 9). The USFWS concluded that eight federally-listed species and 13 federal category 2 candidate species potentially occur on Fort Riley. The federal protected species and federal category 2 candidate species that are documented to occur on Fort Riley are shown in Table 2-1.

Endangered Species. Endangered species are defined as those species in danger of extinction throughout all or a significant portion of their range. Two federally-listed species, the bald eagle (*Haliaeetus leucocephalus)* and the peregrine falcon (*Falcon peregrinus*) have been confirmed to occur on Fort Riley. Surveys have documented wintering bald eagles using mature trees or large snags along the Republican and Kansas Rivers, and along the Farnum and Madison Creek coves at Milford Reservoir. The peregrine sighting was made by Fort Riley Natural Resources Staff in the southeastern portion of the installation (Ref. 10). Both of these species are also state-listed as endangered.

Candidate Species/In Need of Conservation. Candidate species (federal category 2) are defined as those species under review for listing as a federal threatened or endangered species. Eight federal candidate species have been documented to occur on Fort Riley. These species and their preferred habitats are as follows:

- **Loggerhead Shrike** (*Lanius ludovicianus*). This bird has a preferred habitat of grassland areas with scattered woody vegetation or shrubland fields.

- **Black Tern** (*Chlidonias niger*). This bird species has a preferred habitat of large wetland areas with an even mixture of emergent vegetation and open water. Black terns were frequently observed by Natural Resources branch staff in the Madison Cove Area of Milford Lake during the summer of 1992.

- **White-faced Ibis** (*Plegadis chihi*). This medium-sized wading bird utilizes small ponds and shorelines for resting and feeding on aquatic prey items. The white-faced ibis is also state-listed as threatened.

- **Henslow's Sparrow** (*Ammodramus henslowii*). This small bird prefers to use tallgrass prairies and nest in dense, tall herbaceous vegetation.

- **Texas Horned Lizard** (*Phrynosoma cornutum*). This lizard has a preferred habitat of dry, flat, sandy, or rocky surfaces, and little vegetation. This lizard was observed in two occasions during the summer of 1992; one in Training Area 14 and once alongside Vinton School Road, just east of its intersection with Trainfire Road.

- **Regal Fritillary Butterfly** (*Speyeria idalia*). This insect inhabits moist prairie meadows and is often associated with milkweeds, prairie coneflowers, and thistle.

- **Prairie Mole Cricket** (*Gryllotalpa major*). This insect prefers tallgrass prairie, usually unmowed or ungrazed, with silt to sandy-loam soils. Prairie mole crickets were found at two sites in the northwestern portion of the post. One was in Maneuver Area J, and the other was in Maneuver Area N.

- **Hairy False Mallow** (*Sphaeralcea angusta*). This plant inhabits dry, upland prairie habitats, usually near limestone outcroppings.

Of the two federal designated endangered species, both the bald eagle and the perrigrine falcon have the potential to use the lands along the Kansas River for nesting and eating.

2.2.5 Land Uses and Populations

The land uses of Fort Riley are varied. The developed areas of the post include all activities to support the living and working population of the post. These include housing, office space, recreation areas, stores, post offices, gas stations, schools, entertainment areas and other activities. In addition, the developed areas include numerous buildings and facilities used to perform industrial-type activities. These include photographic processing, furniture stripping, vehicle maintenance and other activities. Much of the land at Fort Riley is undeveloped and used for training exercises. Hunting and fishing are permitted on some of the open lands. Relatively small and isolated parcels of land throughout the post are used for agriculture. The Main Post was placed on the National Register of Historic Places in 1974. The Historic District of the Main Post includes approximately 160 buildings and structures.

The lands surrounding Fort Riley consist predominantly of undeveloped lands and nearby towns. The following towns are located within 4 miles of Fort Riley: Junction City (adjacent to the south, including Grandview Plaza), Ogden (adjacent to the southeast), Manhattan (over three miles to the east), Keats (adjacent to the northeast), Riley (adjacent to the north), and Milford (to the west). Also, the Manhattan Municipal Airfield is located within 1 mile to the east, and private residences are scattered throughout the area surrounding Fort Riley. Some of the surrounding land is used for agricultural purposes. Milford Lake to the west and the primary rivers in the area are used for recreation and fishing.

The approximate populations of Fort Riley and the surrounding major towns are as follows (Ref. 11):

• Fort Riley	over 20,800 military personnel and workers plus 7,600 on-post dependents (a more detailed breakdown is presented in Table 2-2; Ref. 12, 13, 14);
• Junction City	20,804 (including Grandview Plaza);
• Ogden	1,494 (city limits) and 2,057 (township limits);
• Manhattan	37,569 plus 4,000 on-campus students at Kansas State University;
• Keats	677 (within Wildcat Township, encompassing Keats); and
• Riley	825.

Although other towns may also occur within 4 miles of Fort Riley, they are not within 4 miles of the sites being evaluated and are not specifically identified. As mentioned previously, there are private dwellings scattered throughout the area surrounding Fort Riley. Where these dwellings are significant in evaluating potential threats posed by the sites included in this SI, they are identified in the site-specific sections. According to the 1990 census data, there is an average of 2.58 persons per residence in Riley County and 2.71 persons per residence in Geary County (Ref. 12).

In addition to the total populations within the area of Fort Riley, the proximity of schools to sites evaluated in this SI are of particular importance for assessment of relative risk. There are five elementary schools, one junior high school and one child development center identified at Fort Riley. One elementary school -- Fort Riley Elementary School -- is located in Building 104 of the Main Post. Enrollment for 1992 was 354 (Ref. 15). The remaining schools are located on Custer Hill and include the following (Ref. 13, 15):

- Morris Hill Elementary - Building 4400; 1992 enrollment of 278
- Jefferson Elementary - Building 4720; 1992 enrollment of 311
- Custer Hill Elementary - Building 6344; 1992 enrollment of 308
- Ware Elementary - Building 6795; 1992 enrollment of 752
- Custer Hill Junior High - Building 4020; 1992 enrollment of 628
- Child Development Center - Building 6950; (variable enrollment, confidential information)

The 1992 enrollments are considered representative of the numbers of children potentially present at these schools on a regular basis.

2.2.6 Groundwater

This section provides an overview of groundwater resources and users around Fort Riley. Groundwater is the primary source of drinking water for Fort Riley and many of the surrounding communities. Alluvial sand and gravel deposits in the lowland areas are excellent aquifers in the area. In the upland areas, limestone formations are tapped as sources of water. Potential users of the alluvial aquifer and the limestone bedrock aquifers are identified below.

2.2.6.1 Alluvial Aquifers

The six cantonment areas of Fort Riley as well as the communities of Junction City, Ogden and Manhattan rely on groundwater withdrawn from alluvial materials for their municipal drinking water supplies. Fort Riley has eight active wells, Junction City has nine active wells, Ogden has three active wells, and Manhattan has nine active wells (Ref. 16, 17, 18, 19). Ogden also provides water to a rural water district in Riley

County. The rural water district is adjacent to the northeast border of Fort Riley and includes the town of Keats (Ref. 20). The majority of private residences within 4 miles of Fort Riley are located in upland areas and use wells drawing from a variety of bedrock formations. Private residences located within the alluvial lowlands, not served by one of the public water systems mentioned above, are expected to have wells tapping the alluvial materials. However, data is not always available to determine whether private wells overlying alluvial materials have wells tapping alluvial materials or bedrock formations. Private wells are used for both drinking water and irrigation. One private irrigation well was identified north within one-quarter mile of Fort Riley; it is located within the small area of private land that occurs north of the Kansas River between Camps Whitside and Funston. In the site-specific sections, private wells within 4 miles are identified where there is a potential threat posed to the wells by the sites being evaluated within this SI.

Figure 2-1 shows the general boundaries of the alluvial aquifer in the Fort Riley area along with the locations of public drinking water wells (or wellfields) (Ref. 21). A more detailed illustration of the well locations and their respective distribution boundaries is provided in Plate 2-1. As shown, the wells for Junction City and Ogden are within 4 miles of Fort Riley while the Manhattan wells are greater than 4 miles distant. Within each of the systems identified above, the water from the wells is mixed as part of the distribution throughout the supply network. Currently, the producing well field for Fort Riley is located west of Main Post along McCormick Road in the Camp Forsyth area. The supply system consists of six older wells (referred to as Main Post wells brought on-line from 1928 to 1943) and two newer wells (referred to as Forsyth wells brought on-line in 1993); all eight wells draw from the Kansas River alluvial materials. All eight wells are blended into a single distribution network that supplies the cantonment areas. Two former drinking water wells in Camp Forsyth have been taken out of service for drinking water.

Where multiple wells are present in a system, there are no data to indicate that any one well contributes more than 40% of the annual system capacity; thus, as specified in the HRS, potential populations for each well are assigned based on the total population served by the system divided by the number of wells in the system. This "apportioning" of populations to wells, in most cases, is not critical since supply wells for the systems identified above are located in close proximity to each other relative to the sites being evaluated.

2.2.6.2 Bedrock Aquifers

Fort Riley operates several wells that draw from bedrock formations. These include wells at Range Control, Multi-Purpose Range Complex (MPRC)/Douthit Range, Trainfire 4 (TF4) and Range 18. The Range Control wells are used regularly as a source of drinking water for approximately 12 people. The wells at MPRC/Douthit Range are used for drinking water on an as-needed basis, and can provide water for the current capacity of the facility (approximately 600 people). The wells at Range 18 and TF4 are not treated and are not used for drinking water.

The majority of communities surrounding Fort Riley rely on groundwater supplies for drinking water. Private residences in the upland areas, outside of town limits, use private wells. Additionally, there are residences within the Riley County rural water district and the town of Riley that continue to use private wells (Ref. 22). Riley and many of the rural residences surrounding Fort Riley are located in the uplands area, and their wells tap bedrock formations. For example, the town of Riley uses 7 wells ranging in depths from 90 to 110 feet, and the wells draw water from limestone formations. In general, the limestone formations are sufficiently transmissive to yield reliable groundwater supplies. However, given the interbedded nature of the uplands area, many of the wells will be drawing water from different limestone horizons. Groundwater in the uplands area is generally present within 100 feet of the ground surface.

2.2.6.3 Identification and Evaluation of Groundwater Receptors

The boundaries of public water supply systems on and near Fort Riley are shown on Plate 2-1. Areas outside the boundaries of the public water supply systems rely on private wells. In addition, some residences may be located within boundaries of public water supply systems yet continue to use and operate private wells. Data are often unavailable to quantify the number of such residences. The information from Plate 2-1 is used to identify groundwater users within 4 miles of sites being evaluated in this SI. All areas outside the service boundaries of the public water supply systems are assumed to be using private wells. Further, private residences overlying alluvial materials in the lowlands are assumed to be using wells tapping the alluvial materials while all other wells are assumed to be tapping bedrock. The boundaries of the alluvial materials are considered to coincide with the lowlands along the Kansas River, which are clearly demarcated by sharp rises in topography to the northwest and southeast.

2.2.7 Surface Water

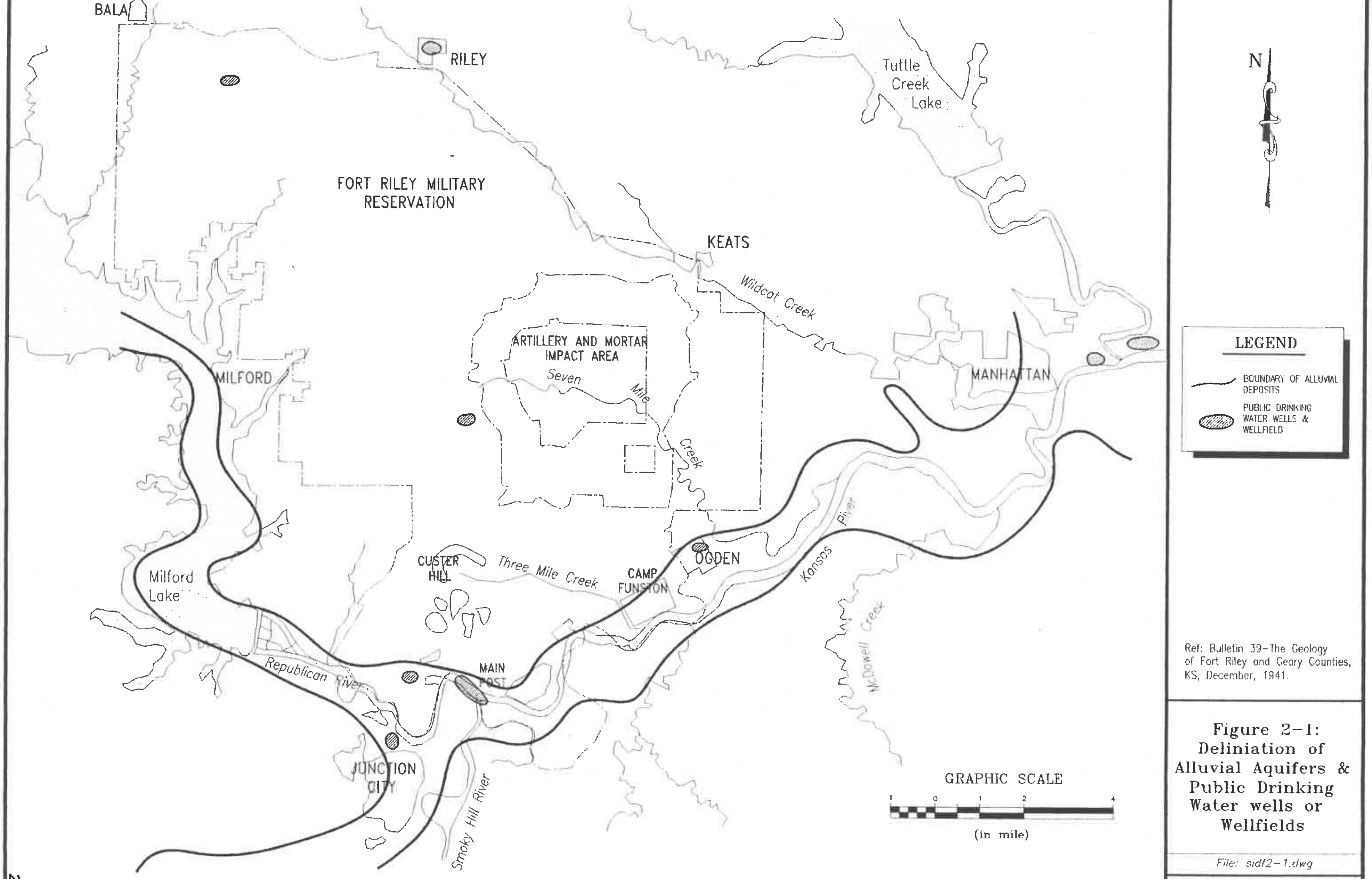
Fort Riley is located along the Kansas River and is surrounded by other large bodies of water associated with the Kansas River system. These include Milford Lake to the west, the Republican River (which drains Milford Lake) and the Smoky Hill River from the south. The Republican and Smoky Hill Rivers merge to form the Kansas River. There are numerous other intermittent and perennial creeks that dissect Fort Riley, eventually feeding into one of the larger bodies of water identified above. The dissected nature of Fort Riley is evident in Figure 2-2, which shows all the perennial and intermittent streams mapped on the post. Perennial bodies of surface water and drainages of Fort Riley are shown in Figure 2-3.

Fort Riley is drained by the following: Republican River, Kansas River, Threemile Creek, Sevenmile Creek, Honey Creek, Wildcat Creek, and numerous smaller tributaries. The United States Geological Society (USGS) 7.5 minute topographic maps (1982) for the area show all of the streams mentioned above as perennial (Ref. 23). In contrast, the Fort Riley Military Installation Map prepared by the Defense Mapping Agency (1985) shows Threemile Creek, Honey Creek and tributaries to Sevenmile Creek as intermittent (Ref. 24). During a separate investigation of the Impact Area, Berger attempted to sample portions of Sevenmile and Honey Creeks during the month of May, immediately following a precipitation event. However, there was insufficient water in the upstream locations of Sevenmile Creek and Honey Creek to collect samples. Therefore, Berger's field observations indicate that the distinctions between intermittent and perennial streams are more accurately depicted on the Defense Mapping Agency map of Fort Riley. Thus, the remainder of this SI uses the stream classifications based on the Defense Mapping Agency map. In addition, Threemile Creek now receives a discharge of approximately 3,900 liters per minute (1,485,000 gallons per day) from the Custer Hill Waste Water Treatment Plant (WWTP). This effluent places Threemile Creek in the perennial class, and the portions of Threemile Creek downstream of the Custer Hill WWTP are treated as perennial for this SI.

Stream flows for the surface water bodies of concern are based on data from stream gauging stations, augmented by field measurements and observations where no gauging stations were known to exist. Average annual flow for the primary drainages of concern are listed in Table 2-3 (Ref. 25). Flooding of Fort Riley occurs in the lowlands, along the Republican and Kansas Rivers. The data contained in floodplain maps for the area, as prepared by the Federal Emergency Management Agency (Ref. 26), are presented in Figure 2-4. As shown, the 100-year floodplain impacts Fort Riley lands along the major rivers, but does not impact the major cantonment areas. The 500-year floodplain impacts a significant portion of Camp Forsyth and almost all of Marshall Field.

To support evaluations of potential risk posed by sites at Fort Riley, surface water bodies and uses were identified and evaluated within 15 miles downstream. The farthest downstream point is achieved by using the southeast corner of Camp Funston. From this area, the nearest point on the Kansas River was selected, and 15 miles were measured in the downstream direction, along the path of the river. The resultant point is on the Kansas River just east of Manhattan, approximately one mile downstream of the confluence with Big Blue River. Berger was able to identify only one surface water intake within the surface waters potentially draining Fort Riley. The town of Milford, approximately 5 miles west of Fort Riley, draws water from Lake Milford. All of the sites included in this SI are downstream of Lake Milford and this intake. No other intakes were identified up to the 15 mile limit downstream of Fort Riley. Given that all communities along this stretch of water use groundwater for their supplies, Berger concluded that no surface water intakes exist below the Milford Dam and for 15 miles downstream of Fort Riley.

The Republican, Smoky Hill and Kansas River and other perennial water bodies are used for recreation and fishing. However, there are no data regarding commercial fishing within this 15 mile limit. According to the National Wetlands Inventory, there are numerous wetlands located on Fort Riley, up to this 15 mile limit. Wetlands within the area of each site are specified in the site-specific sections.



Ref: Bulletin 39-The Geology of Fort Riley and Geary Counties, KS, December, 1941.

Figure 2-1: Deliniation of Alluvial Aquifers & Public Drinking Water wells or Wellfields

File: sidf2-1.dwg

June, 1994

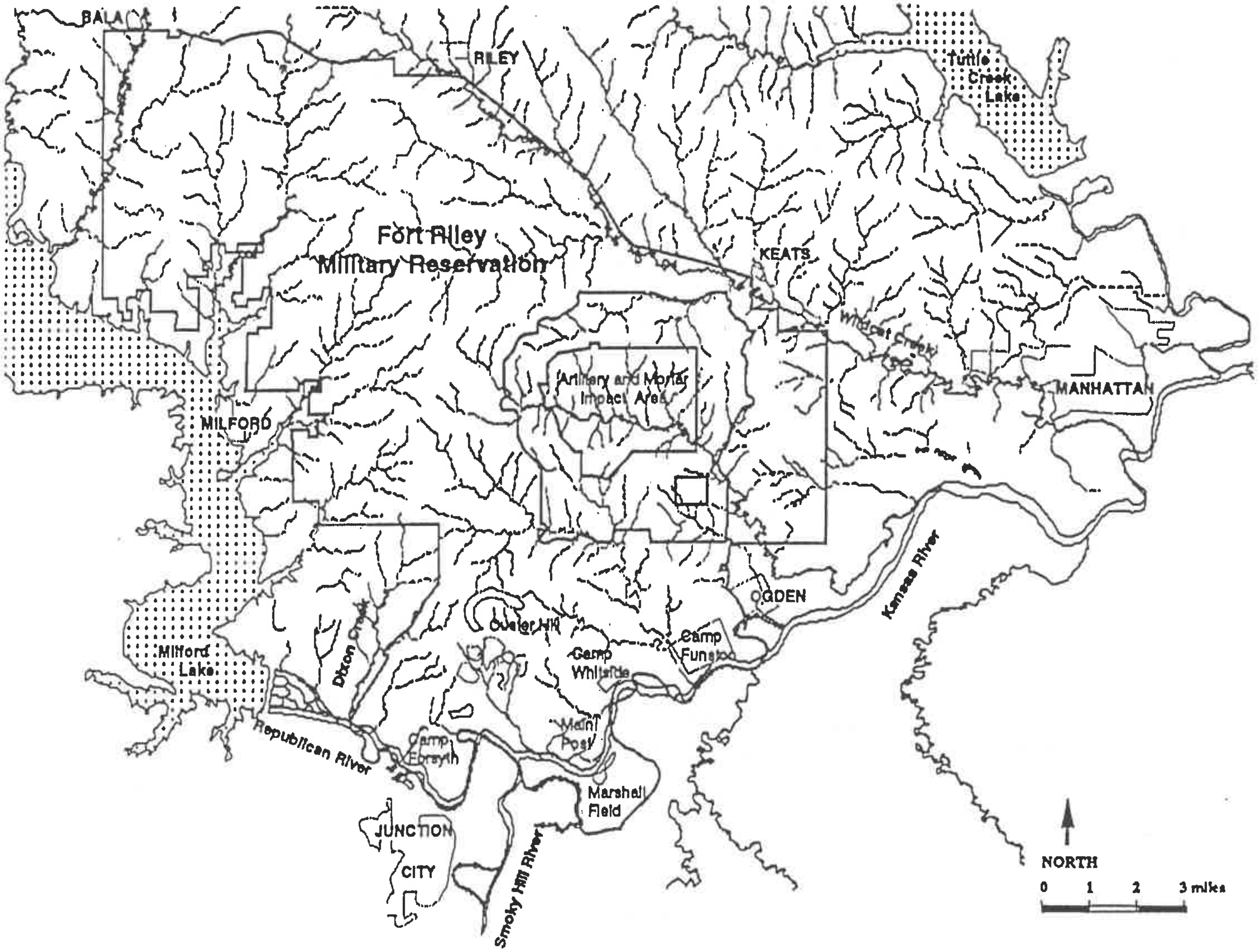


Figure 2-2:
Perennial and
Intermittent
Streams

File: sidf2-2.dwg

June, 1994

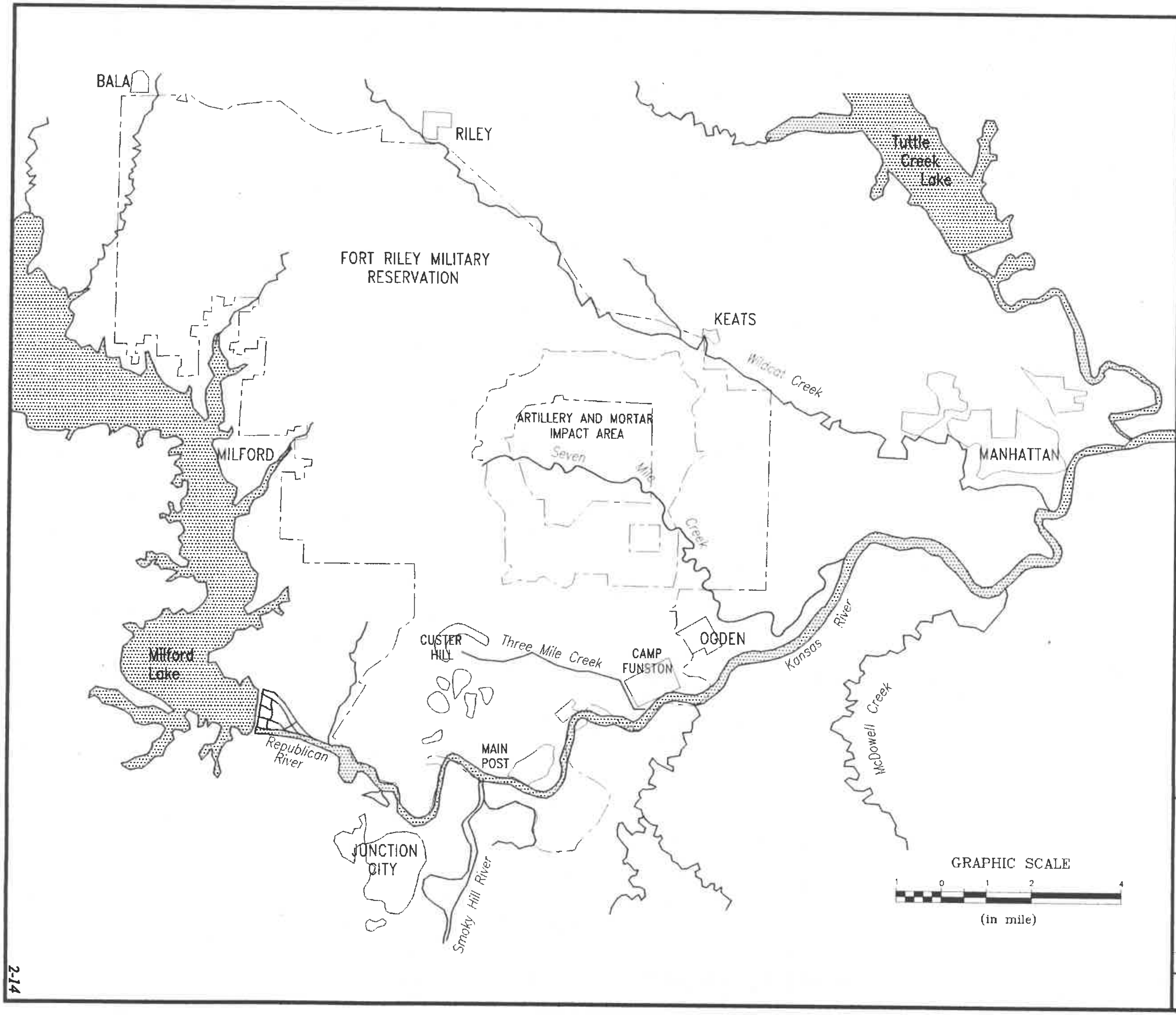
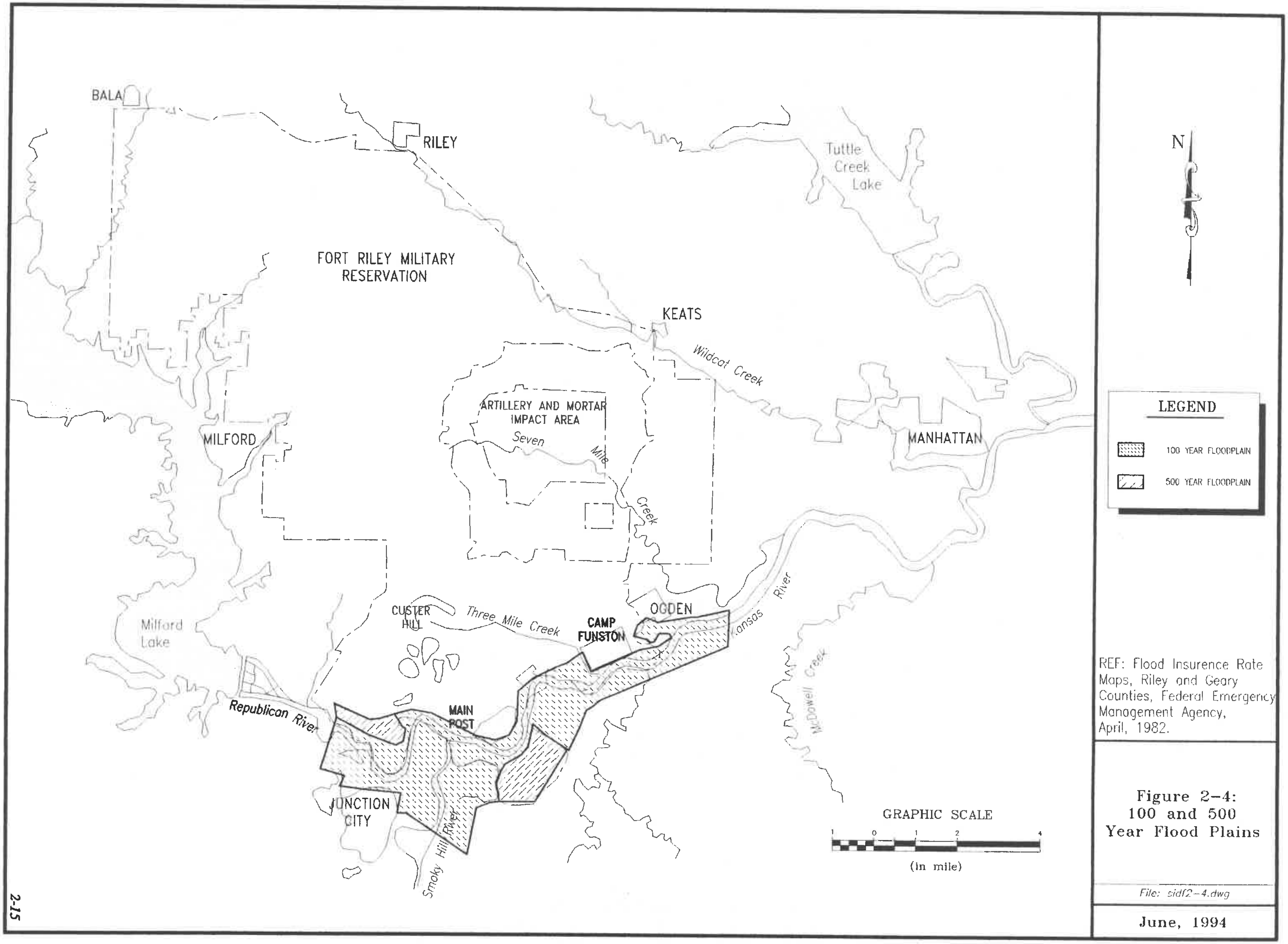


Figure 2-3: Perennial Surface Water Bodies

File: sidf2-3.dwg

June, 1994



REF: Flood Insurence Rate Maps, Riley and Geary Counties, Federal Emergency Management Agency, April, 1982.

Figure 2–4: 100 and 500 Year Flood Plains

File: sidf2–4.dwg

June, 1994

Table 2-1 Protected Species Documented to Occur at Fort Riley

Species	**Federal**	**Federal Category 2 Candidate**	**State**
bald eagle, *Haliaeetus leucocephalus*	E		E
peregrine falcon, *Falco peregrinus*	E		E
loggerhead shrike, *Lanius ludovicianus*		Yes	
black tern, *Chlidonias niger*		Yes	
white-faced ibis, *Plegadis chihi*		Yes	T
Henslow's sparrow, *Ammodramus henslowii*		Yes	
Texas horned lizard, *Phrynosoma cornutum*		Yes	
regal fritillary butterfly, *Speyeria idalia*		Yes	
prairie mole cricket, *Gryllotalpa major*		Yes	
hairy false mallow, *Sphaeralcea angusta*		Yes	

E= Endangered
T= Threatened

Source: Kansas Department of Wildlife and Parks

TABLE 2-2 FORT RILEY POPULATION STRENGTH
(Based on 10 December 1991)

Personnel Populations	
Military	17,378
DoD Civilian	2,440
Contract Personnel	1,009
Total Actual Population	20,827
Military Dependents (On-post)	7,618
Military Dependents (Off-post) (Estimated)	12,070
Family Housing Units	3,136
Permanent Barracks Spaces (90 SF / Person)	6,845
Temporary Barracks Spaces (90 SF / Person)	4,593

DEMOGRAPHIC STATISTICS

	Military	Civilian	Contractor	Dependent	Total
Custer Hill - Family Housing[1]	2,377	0	0	5,817	8,194
Custer Hill - Troop Housing	14,128	268	646	0	15,042
Camp Whitside	318	535	24	4	881
U.S. Army Marshall Airfield[2]	941	55	37	20	1,019
Main Post	1,666	1,518	264	660	4,108
Camp Forsyth[3]	302	23	77	1,137	1,539
Camp Funston[4]	347	246	229	0	812

[1] All civilian and military personnel working within the Custer Hill Family Housing area are included in the total population for the Custer Hill Troop Housing Area.

[2] A majority of personnel assigned to Marshall Airfield are housed in barracks on the Main Post Area.

[3] A majority of the personnel occupying barracks spaces in the Forsyth area are assigned to units on Custer Hill and are included in Custer Hill totals.

[4] Military strength includes 169 prisoners, this population was reduced to zero in summer of 1992.

Table 2-3 Stream Discharge Rates

Stream	**Mean Annual Discharge (lpm)**	**Mean Annual Discharge (Cfs)**
Wildcat Creek	20,962	12.33
Madison Creek	4,646	2.73
Sevenmile Creek	6,494	3.82
Threemile Creek	3,903	2.30
Timber Creek	6,217	3.65
Fourmile Creek	2,561	1.51
Kansas River	4,668,944	2,746.0
Republican River	1,471,302	865.0

lpm = liters per minute
cfs = cubic feet per second

(Ref. 25)

3.0 SENSITIVE-RECEPTOR LEAD SITES

As part of the IWSA conducted at Fort Riley, Kansas in 1992, four areas were identified where soil, in areas accessible to the general public, (especially children), had the potential of being contaminated with lead bullet fragments. The four areas were as follows:

- Former Camp Forsyth Range (CFR) areas including the Colyer Manor housing area;
- Former Mullins Park (FMP), which received soil from the pistol range area of the former Camp Forsyth Ranges; and
- Ware and Custer Hill Elementary Schools, which received fill material taken from near Range 55 on Custer Hill.

During the SI, a fifth site was sampled. This site represented a portion of a yard that had been used for gardening -- shell casings had been observed as the soil was being worked.

A Site Investigation for these five areas was conducted during a three week period from 19 May through 10 June 1993, as outlined in the Work Plan for Expediated Investigation of Sites Potentially Contaminated with Lead for Fort Riley, Kansas, 10 May 1993. The following information provides a detailed analysis of the site investigation.

3.1 SI Approach

As illustrated in the IWSA, the greatest potential threat posed by the lead sites to human health is based on incidental ingestion of lead contaminated soils. The sites do not pose a threat to human health or the environment via migration to groundwater, surface water or air. Thus, the SI focused on identifying and delineating areas of soil contamination. However, at Colyer Manor, drainage ditches were located in close proximity to the potential areas of contamination. Thus, in order to evaluate whether elevated levels of metals were accumulating in the ditches and potentially being transported via overland flow and runoff, soil samples were also collected from drainage ditches at Colyer Manor.

Areas of potential contamination and areas accessible to the public, (especially children), were identified based on the findings of the IWSA. Sampling grids were established for each site at sufficient density to determine whether elevated concentrations of metals were present. As noted in the SI Guidance Manual (Ref. 27), a typical SI includes approximately 20 samples of environmental media per site. The SIs of the potential-receptor lead sites included substantially more than 20 samples per site initially, greatly improving the ability of the SI results to indicate whether elevated levels of lead were present at a site.

The primary focus of the investigation was the 0 to 1 foot soil depth at all sites since the surface soils have the greatest accessibility to the public. However, samples were also collected from depths of 1 to 2, 2 to 3, 3 to 4, 4 to 5 and 5 to 6 feet at a portion of the grid locations to determine if any lead-contaminated soils had been buried beneath topsoil or whether lead had migrated to lower depths. Background soil sample locations were selected at each of the sites. These samples were collected from locations outside the areas of potential lead contamination, but near the sites being investigated.

Ground Penetrating Radar (GPR) was also used at the Camp Forsyth Range to determine whether it would be effective in delineating areas of soil containing metal fragments and other bullet debris. The GPR did not differentiate soils potentially contaminated with metallic fragments. Thus, use of GPR was discontinued.

The soil samples collected at each site were analyzed on-site using a bench-top X-Ray Fluorescence (XRF) detector. Specifically, soil samples were analyzed using a Spectrace 9000 portable XRF spectrophotometer. [Note: the Spectrace 9000 is distinct from hand-held XRF detectors and provides a higher level of precision and lower limits of detection.] The procedures and protocols for performing XRF analyses in the field are provided in the Work Plan. [Appendix B contains the Quality Control Summary Report (QCSR), laboratory reports and field notes for the Sensitive-Receptor Lead Sites.] Approximately 10% of the samples were collected in duplicate with the duplicate transmitted to an off-site laboratory for chemical analyses. The laboratory results were used to confirm that the field results were reliable for determining the approximate concentrations of lead and other metals in soils. The primary contaminant of concern at each of the sites was lead. However, the XRF provided data on other metals as well.

In addition to the analyses described above, select samples were analyzed using EPA's Toxicity Characteristic Leaching Procedure (TCLP). Samples were chosen for TCLP analysis based upon lead levels of over 100 milligrams/kilogram (mg/kg) in laboratory analysis. The TCLP results were used to evaluate whether soils with elevated levels of metals would potentially be considered a hazardous waste under RCRA, which would impact any subsequent removal actions.

The sampling locations for each site are presented in Section 3.3. During the SI, additional samples were collected within the interior and exterior of the grids, as necessary, to delineate the extent of contamination. EPA has established cleanup levels for concentrations of lead in soils. These levels are 500 milligrams per kilogram (mg/kg) for residential uses and 1,000 mg/kg for industrial uses (Ref. 28). Since several of the sites were located in housing areas and other areas used by children, the lower limit of

500 mg/kg was used to guide the SI. During the SI, all areas with soil concentrations greater than 200 mg/kg (based on field XRF data) were delineated. This lower limit of 200 mg/kg was used to provide a factor of safety until the field XRF data had been evaluated against the laboratory duplicates. At sites with concentrations of lead greater than 200 mg/kg, additional samples were collected at the site until the area of contamination had been characterized horizontally and vertically. As discussed in section 3.3.6, the 200 mg/kg concentration of lead based on XRF data was an appropriate indicator of soils exceeding 500 mg/kg based on off-site laboratory analysis.

3.2 Site Description and History

3.2.1 Camp Forsyth Ranges including Colyer Manor

Maps from the World War II era (See Map Appendix to the IWSA (Ref. 29), pages 11-13) show a cluster of small arms ranges in the area northeast of Camp Forsyth. These ranges formed a double horseshoe shape starting in Breakneck Canyon and arcing along Backstop Ridge, then following the base of the bluffs past Republican Point and along Sherman Heights. The eastern extent of the ranges was just past the area of former Range 5 along McCormick Road. Four firing points were identified in Breakneck Canyon, three near the National Rifle Range and two along Trooper Road. The safety fans for these ranges indicate that the axis of fire were towards Backstop Ridge. Even though the safety fans extend significantly beyond this ridge, the fired bullets were expected to have struck targets or backstops south of the ridge or struck the ridge itself. Although firing fans were not located for the ranges along McCormick road, a similar firing pattern was expected. Also, some soils along the bluffs had been reworked during construction at Coyler Manor.

Figure 3-1 shows the general area of the former ranges, in the area that is now used for residential purposes from the bluffs southward towards firing points. The area of concern consisted of the base of the bluffs where the majority of bullets were expected to come to rest and areas where former backstops were known to be located. In addition to the ranges, the SI focused on areas of the bluffs with residential populations. Plate 1-1 shows the location of the Sensitive-Receptor Lead Sites at Fort Riley.

The length of the historic range fans, as well as historic maps, identify the caliber of weapons used. All of the fans are essentially a sector of a circle, with the inner and outer line curved. The distance of the range itself is based upon the weapons used and the extent of their reach. The weapons at the ranges were mainly 0.30 caliber weapons and smaller. The National Rifle Range had been used for M16A1 rifles. This range may have also received a variety of small arms fire. Range 5 had been used for 0.45 caliber and smaller caliber pistols. Range 5 has been demolished and the backstop area for the range has been bulldozed under at the site (Ref. 30). During installation of a utility line behind Colyer Manor, the soils from the excavation were deposited in an area at the intersection of McCormick and Trooper Roads in Camp Forsyth. There are no buildings, playgrounds or residences located on or near the area of soil deposition and no recreation use of the area, due to its location adjacent to two busy roadways.

3.2.2 Former Mullins Park

Soils have been moved from a variety of former ranges, and used as fill in various places on the military reservation. The grassy, open area that was former Mullins Park had received soils from Range 5 and other ranges. According to the person directly responsible for the soil movements from Range 5 in Camp Forsyth, soils were taken only from vegetated areas of the range between the firing points and the target areas (Ref. 30). Further, in accordance with procedures followed by post staff in effect at the time, the soils were inspected visually for evidence of bullet fragments and casings; soils containing bullets were not moved from the range.

3.2.3 Ware and Custer Hill Elementary Schools

During the construction of Ware and Custer Hill Elementary Schools, soils were taken from near Range 55 on Custer Hill. The soils were taken from an area adjacent to the actual range, closer to the firing line than the target and backstop areas. At the time of construction of the schools (late 1989), Fort Riley Directorate Engineering and Housing (DEH) was contacted because bullet fragments were visible in the fill materials. Personnel were dispatched to recover visible fragments. Due to the visible evidence of bullet fragments in the fill materials at both elementary schools, the fill material used during construction was evaluated during this SI for the potential to be contaminated with lead.

3.3 Waste Characteristics

The contaminant of concern for the SI is lead shot from bullets. The lead would be imbedded in the surface soils with minimal penetration -- limited to the upper few feet. Due to the potential for contamination of shallow soils, there is a possibility of exposure from contaminated soils. Metals related to small caliber ordnance include copper, antimony and zinc. The primary metals characterized at these sites were lead, zinc, copper, iron and barium. [Uranium was also detectable with the XRF; there were no detections of uranium at any of the sites.] In order to determine whether any other metals were present and to confirm the XRF results, analyses for select metals were conducted by transmitting samples to a laboratory (EPA Method 6010/7000). The concentrations of lead are used as the principal indicator of contamination. The results for each site are summarized below. Following the site-specific data presentation, the results of the laboratory confirmatory sampling are presented with the corresponding XRF data.

3.3.1 Colyer Manor

The SI covered a large area, beginning in the west near Trooper Road and following along the base of the bluffs in a strip about 400 feet in width. The area of investigation extended for approximately one mile. Near the middle of the sampling area, the width of the sampling strip was extended to include recreational fields that border on McCormick Road. The area of the investigation is shown on Plate 3-1, which also depicts the locations with positive detections for lead. The positive detections for the XRF data are provided in Tables 3-1 and 3-2. More than 165 samples were collected at Colyer Manor, with all but 11 samples collected from 0-3 feet. The other 11 samples were collected from 3-6 feet.

The majority of samples from this area were found to be below the detection limit of the XRF for lead (less than 40 mg/kg), zinc (less than 200 mg/kg), and copper (less than 200 mg/kg). In contrast, iron and barium were found at detectable concentrations in almost all samples. Iron concentrations typically ranged from 10,000 to 20,000 mg/kg (1 to 2 percent), and barium concentrations ranged from 250 to 350 mg/kg. Based on background concentrations determined from areas outside the expected areas of contamination, the results at this and the other sites being investigated indicate that background concentrations for lead based on laboratory data are 10 to 30 mg/kg.

The entire area in the vicinity of the old pistol range at the east end of the CFR study area has XRF lead in the range of 100 to 200 mg/kg in the top one to two feet of soil. The samples having XRF lead in this range were CFR-001-1, CFR-003-1, CFR-003E-1 and CFR-003N-1. The berms that are shown on the 1985 Corps of Engineers topographic maps (Ref. 29) have been graded to produce a level area. Some soil from this area was moved to the former Mullins Park (see below) where similar lead levels were found. It appears that the grading activities spread the lead more or less evenly over the area. No areas of high concentration were found.

Lead content in the playgrounds, ball fields and near the houses were almost always below the XRF detection limit. However, concentrations of lead in soils above 500 mg/kg with XRF analysis were identified in one area behind Building 3135 of Colyer Manor. Additional soil samples were collected in this area to characterize the area of elevated concentrations. The results of the additional sampling are also shown on Plate 3-1. The lead results in this area are presented graphically in Figures 3-2, 3-3 and 3-4. These figures show the estimated distribution of lead concentrations for the 0 to 1 foot samples, 1 to 2 foot samples and 2 to 3 foot samples, respectively. The elevated concentrations of lead were determined to occur in an area approximately 150 feet by 200 feet. The lead concentrations in soils based on the field XRF ranged up to 1,700 mg/kg.

Within the area of elevated lead levels, soil samples were also collected from depths of up to six feet. No elevated lead levels were detected in samples below a depth of 3 feet.

One bullet fragment was tested for total metals in order to determine the chemical breakdown of the bullet; the results are as follows: 29,000 mg/kg lead, 910 mg/kg zinc and 8,800 mg/kg copper.

In order to determine the leachability of any lead found at the sites, leaching tests were performed on two selected samples to determine the RCRA regulatory status in the event that the soil was removed and disposed. Table 3-3 summarizes the TCLP results for samples that are believed to present typical materials with significant levels of lead. From these results, soils containing about 100 mg/kg lead by XRF do not produce significant amounts of leachable (soluble) lead under the TCLP conditions (i.e., concentrations of lead in the leachate are well below those considered a hazardous waste under RCRA). However, the soils containing high levels of lead (e.g., >1000 mg/kg) by XRF fail the TCLP. This result suggests that some soils with elevated concentrations of lead will produce substantial amounts of leachable lead.

1337.7 tons of soil at Coyler Manor were excavated and removed from the site. This soil was taken to the Highway 36 Landfill in Colorado (983.1 tons) and to ChemWaste Managment of Menomenie, Wisconsin (354.6 tons). (Ref. 31)

3.3.2 Former Mullins Park

Soil samples were collected from locations spaced approximately 200 feet apart. The area of sampling and a summary of the results are shown in Figure 3-5 and Table 3-4. A total of 35 samples were taken from 0-3 feet. Lead was detected in only four samples. The highest concentration detected was 160 mg/kg (XRF), which is below the EPA clean-up guideline of 500 mg/kg. In general, the levels of lead found in the soils here are similar to the levels found in the former pistol range area east of Colyer Manor (i.e., 100 to 200 mg/kg). This is consistent with the origin of the soils placed in the former Mullins Park area when the pistol range was removed in the mid-1980s. Zinc and copper were not detected at all locations, and concentrations of iron and barium were comparable to those detected at Colyer Manor. The results of the SI indicate that there is no significant soil contamination associated with the site.

3.3.3 Ware Elementary School

Soil samples were collected at locations spaced approximately 75 feet apart. A total of 52 samples were taken from 0-3 feet. There were no detections of lead, zinc or copper in any of the samples. The sampling grid and a summary of the results are shown on Figure 3-6, and Table 3-5. The results of the SI indicate that there is no detectable lead contamination associated with the site.

3.3.4 Custer Hill Elementary School

Soil samples were collected at locations spaced approximately 75 feet apart. A total of 69 samples were taken from 0-3 feet. There were no detections of lead, zinc or copper in any of the samples. The sampling grid and a summary of the results are shown on Figure 3-7, and Table 3-6. The results of the SI indicate that there is no detectable lead contamination associated with the site.

3.3.5 Other Site

As mentioned previously, during the course of the SI, three samples were obtained from a garden in the Burnside housing area adjacent to Building 6790. The results for these samples (in mg/kg) are as follows:

Sample	Lead	Copper	Zinc	Iron	Barium	Uranium
0-1 feet	<40	<200	<200	19000	220	<50
0-1 feet	<40	<200	<200	14000	290	<50
0-2 feet	<40	<200	<200	20000	290	<50

The results of the SI indicate that there is no soil contamination associated with the site.

3.3.6 Correlation of Field Results with Laboratory Data

The XRF technique was used as a method to quickly and cost-effectively screen large numbers of samples for lead. Quality control for the XRF included blanks, nonquantitative spikes, duplicates and check/reference standards throughout the investigation. The XRF technique has a detection limit of 40 mg/kg whereas the laboratory analysis has a detection limit of 2 mg/kg. It was realized that XRF would not have as favorable a detection limit as laboratory methods; this was determined not to be a significant disadvantage because the XRF could detect the concentrations of concern (i.e., 200 mg/kg). It was also understood that XRF is sensitive to lead in the surface of the sample and may tend to give lower results than laboratory methods that involve dissolving the entire sample for particulate lead. This is not regarded as an "error" in the XRF results but rather as an understood and explainable "bias" in the technique. This was accounted for by setting the level of concern for XRF at 200 mg/kg while the lowest EPA guideline for lead in soils is 500 mg/kg for residential soils. Because the bias is dependent on the specific nature of the particles being examined, it is not feasible to develop a "correction factor" to correlate the XRF results to the laboratory results. However, the comparisons that follow show the typical magnitude of the differences.

In addition to the duplicate analyses of samples using both XRF and off-site laboratory analyses, the accuracy of the XRF data was also evaluated by using an EPA standard with specified concentrations. The results of the field analyses of this standard are presented below. Both lead and zinc concentrations reported using the XRF were within the range specified for the EPA standard. As expected, lead was consistently on the low side of the range. Concentrations for iron and barium were reported above the range specified for the standard; however, this had no effect on meeting the goals of the SI.

Data for EPA Reference Soil Used as Check Sample
(all data in mg/kg)

Element:	Lead	Zinc	Copper	Iron	Barium
Advisory Ranges	45-146	135-369	17-52	5,420-12,640	173-321
XRF Date					
4 June	48	260	<200	15,000	580
4 June	52	260	<200	16,000	540
7 June	48	250	<200	15,000	580

Samples that covered the range of XRF results were analyzed in the laboratory for lead and other metals (i.e., antimony, zinc and copper). These results are compared in Table 3-7. Overall, there were over 190 soil samples analyzed using XRF. Of these, 34 were analyzed in the laboratory (approximately 17%). In general, there is a good correlation between XRF data and laboratory results. That is, low and non-detectable concentrations of lead using XRF also had low concentrations based on the laboratory. Also, samples with lead concentrations below 200 mg/kg via XRF had lead concentrations below 500 mg/kg based on laboratory results.

Statistical analysis of the results from the XRF analysis and laboratory analysis was performed using linear regression. To generate the data set, only those samples in which lead was reported at concentrations above the detection limit for both XRF and laboratory analyses were used. Because only a few number of samples had detections during this SI, the resultant data set is small. The linear regression yielded an 86% correlation between XRF and laboratory analyses. The ratio of XRF results to laboratory results is 1:2.46 with a standard error of ± 0.09. Based on this linear regression, a concentration of 200 mg/kg for lead using XRF would be expected to have a concentration of 492 mg/kg for lead using laboratory analyses.

The correlation of the laboratory results with the XRF data indicates that the XRF was reliable in detecting areas of high lead concentrations. Further, the action level of 200 mg/kg based on XRF concentrations was appropriate for identifying areas with lead concentrations potentially exceeding 500 mg/kg based on laboratory analyses.

3.4 Groundwater

Since there is no significant contamination associated with the Former Mullins Park site, and no detected contamination at Custer Hill and Ware Elementary Schools or the single residential area sampled, they pose no risk to groundwater and are not evaluated in this section. The remainder of this section discusses the area of elevated lead concentrations detected behind Building 3135 in the Colyer Manor housing area.

The SI Guidance states that groundwater targets are to be evaluated within four miles of a site. The four mile radius around the area of concern at Colyer Manor is shown on Plate 2-1. As shown, one Forsyth well and two of the Main Post wells are located between one-quarter to one-half mile from the area of elevated lead concentrations. The second Forsyth well and three more Main Post wells are located one-half to one mile from the area of concern. The remaining Main Post well along with the Junction City wells are located one to two miles from the site.

As discussed above, the bluffs behind Colyer Manor have been used as a natural backstop for firing ranges for many years, possibly since the post was created in the 1850s. The lead deposited in soils as a result of these activities has been in the environment for an extended period of time. However, the results of the SI indicate that even in areas with elevated concentrations of lead, there were no detectable concentrations below a depth of 3 feet. In addition, the Fort Riley drinking water supply wells are located downgradient from Colyer Manor (Ref. 29), and the nearest well is within 1,500 feet. Although the Fort Riley wells are tested on a regular basis, there has never been a problem with elevated levels of lead (Ref. 32). This data combined with the low relative mobility of lead in the subsurface environment and the fact that the area of elevated lead concentrations behind Building 3135 have been removed indicates that the soils at Coyler Manor do not pose a threat to groundwater.

3.5 Surface Water

Since there is no significant contamination associated with the Former Mullins Park site, and no detected contamination at Custer Hill and Ware Elementary Schools or the single residential area sampled, they pose no risk to surface water and are not evaluated in this section. The remainder of this section discusses the area of elevated lead concentrations detected behind Building 3135 of the Colyer Manor housing area.

Any migration of lead from the area of concern via surface water would result in transport by runoff from the site to the unnamed, intermittent tributaries to the Republican River. The nearest intermittent stream is approximately 1,200 feet to the east of the backstop areas. Distance to perennial surface water (the Republican River) along the potential migration pathway is an additional 1 mile. Sediment samples were taken along areas of surface water migration, to determine if in fact lead was migrating from the soils into surface water. The results are also provided on Plate 3-1.

Two samples had unexpectedly high levels of zinc. Both were sediment samples taken from the drainage ditch that runs east-west between Booth Avenue and Moore Avenue east of King avenue. CFR-S04 had 1900 mg/kg zinc and 61 mg/kg lead by XRF and CFR-S05 had 215 mg/kg zinc and less than 40 mg/kg lead by XRF. Initially, galvanized corrugated culverts were suspected, but none were observed in this area. Inspection of this ditch indicated that it was used for dumping grass cuttings by the local residents, and it had a dark oily appearance as though it may have also been used to dump engine oil. Analysis for hydrocarbons was conducted in order to explain the elevated zinc levels (zinc is a common motor oil additive). These samples were sent to the laboratory for confirmation of the metals and analysis for hydrocarbons. The following laboratory results are consistent with disposal of used engine oil that contains zinc anti-oxidants and residues from leaded gasoline.

Sample	**CFR-S04**	**CFR-S05**
Semivolatile Petroleum hydrocarbon (motor oil)	230 mg/kg	71 mg/kg
Lead (XRF)	61 mg/kg	<40 mg/kg
Lead (total)	112 mg/kg	50 mg/kg
Zinc (XRF)	1900 mg/kg	215 mg/kg
Zinc (total)	1100 mg/kg	180 mg/kg
Copper (total)	0 mg/kg	10 mg/kg
Antimony (total)	<5 mg/kg	<5 mg/kg

The findings illustrate that there has been no migration of lead from the former range area into the nearby drainage ditch. Further, the area of elevated concentrations of lead behind Building 3135 have been removed and are no longer a source for lead migration. As a result, the site does not pose a threat to surface water and this pathway is not evaluated further.

3.6 Air

Since there is no significant contamination associated with the Former Mullins Park site, and no detected contamination at Custer Hill and Ware Elementary Schools or the single residential area sampled, they pose no risk to air and are not evaluated in this section. The remainder of this section discusses the area of elevated lead concentrations detected behind Building 3135 of the Colyer Manor housing area.

The potential for migration of the lead in the air pathway is minimal. The lead projectiles, even when fragmented, do not readily form dust-size particles. Thus, the lead remains in a form that is too large and too heavy for transport in air. Further, the area of elevated lead concentrations is well vegetated with natural grasses and hay. Lastly, the area of elevated lead concentrations has been removed. Therefore, this pathway is not discussed further.

3.7 Soils

Since there is no significant contamination associated with the Former Mullins Park site, and no detected contamination at Custer Hill and Ware Elementary Schools or the single residential area sampled, they pose no risk to soils and are not evaluated in this section. The remainder of this section discusses the area of elevated lead concentrations detected behind Building 3135 of the Colyer Manor housing area.

The area within 1 mile of the elevated lead concentrations is shown in Figure 3-8. The soil types of the area are shown in Figure 3-9. The soils underlying the area of contamination are described as brown silty sandy loams with some limestone fragments. The soils typically increase in clay content with depth, grading to a silty clay at depths of approximately 4 feet.

The SI results indicate that elevated levels of lead are present in shallow soils. The area of contamination is presented in greater detail in Figures 3-2 through 3-4. These figures show that concentrations exceeding 500 mg/kg (EPA's standard for cleanup for soils in residential areas) are present at the 0 to 1, 1 to 2 and 2 to 3 foot depths. These figures also show that the maximum concentration at each depth decreases with depth and that the area of contamination exceeding 500 mg/kg decreases with depth.

The SI Guidance states that receptors for areas of shallow soil contamination should be evaluated within 200 feet and within 1 mile of the area of contamination. There are 3 housing units within approximately 200 feet of the soils with elevated concentrations of lead. Housing information indicates that there are two units per building (Ref. 14). Using the average population density for Riley County (2.58 persons per residence), the number of persons living in these 3 buildings is estimated to be 16. Given that the actual number of persons living in these units is subject to frequent change, the population based on the county average is considered a good indicator of nearby receptors.

The one mile radius for the area with elevated lead concentrations behind Building 3135 encompasses approximately two-thirds of the Camp Forsyth cantonment area. The total population of Camp Forsyth, including workers and residents, is 1,539 persons. Therefore, it is estimated that approximately 1,000 persons live and work within one mile of the site. This population includes the persons living in 123 housing units of Colyer Manor. The total number of residents in these housing units is estimated to be 635 (two residences per unit, 2.58 persons per residence). The actual number of residents varies over time, and this estimate is considered representative of the potential receptor population.

With the completion of the recent removal action for soils with elevated concentrations of lead, the soils at Coyler Manor no longer pose a threat to nearby residents.

3.8 Summary

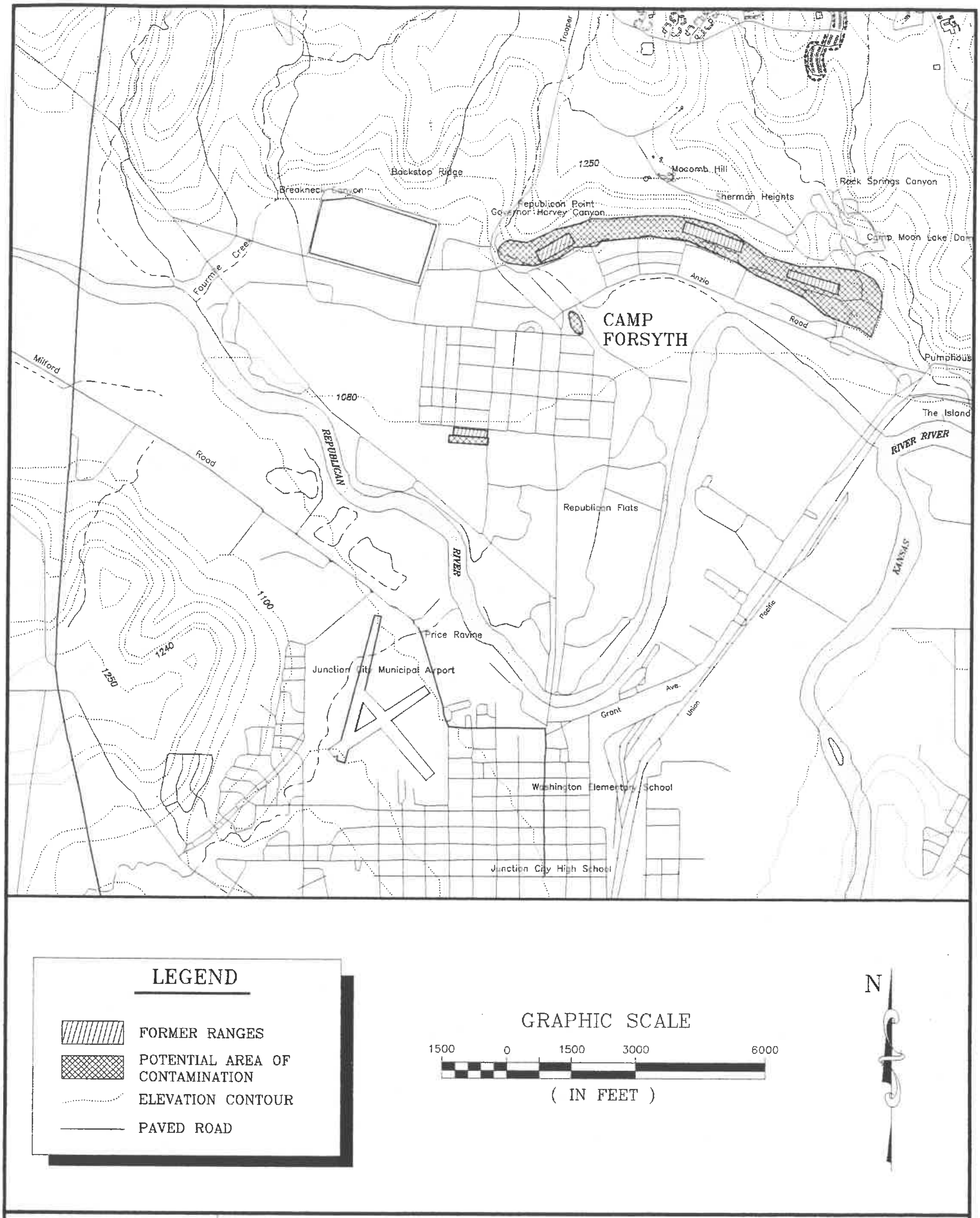
The samples analyzed in the laboratory suggest that the background levels of lead in these soils are typically in the range 10 to 30 mg/kg. Also, the laboratory data indicate that the XRF results are reliable for identifying areas of elevated lead concentrations in soils.

The EPA criterion of 500 mg/kg was used to determine the level of concern and, in anticipation of some bias in the XRF data towards lower results than the laboratory results, 200 mg/kg by XRF was set as the trigger for additional sampling to characterize areas of contamination. As the field work developed, it became feasible to determine the depth of contamination as well as its areal extent. The leaching tests allow the soil to be classified with respect to its potential to leach lead into ground water and to classify it with respect to the RCRA hazardous waste criteria.

Most of the areas evaluated in this study have no discernible contamination from lead. These include the playgrounds at Ware and Custer Hill Elementary Schools, the ball fields and playgrounds at Colyer Manor, and the area near the houses at Colyer Manor. Areas to the east of Colyer Manor and the former Mullins Park have levels of lead typically below 100 mg/kg, but about 10 percent of these samples had lead levels over 100 mg/kg. Allowing for any bias in the XRF results, as noted in the previous discussion on the correlation between XRF data and laboratory data, these results indicate that there are no areas of significant lead contamination above the EPA guidelines of 500 mg/kg. Lead detections in these areas was predominantly in the top 1 to 2 feet of soil.

The only area where levels of lead were found that exceeded the EPA guidelines of 500 mg/kg was north of Building 3135 adjacent to Colyer Manor. This area also had elevated concentrations of copper and zinc. EPA has not established protective guidelines for concentrations of copper and zinc in soil. An area roughly 150 feet by 200 feet is contaminated with lead and copper in concentrations up to 1700 mg/kg lead by XRF (3000 mg/kg total) and up to 390 mg/kg copper by XRF.

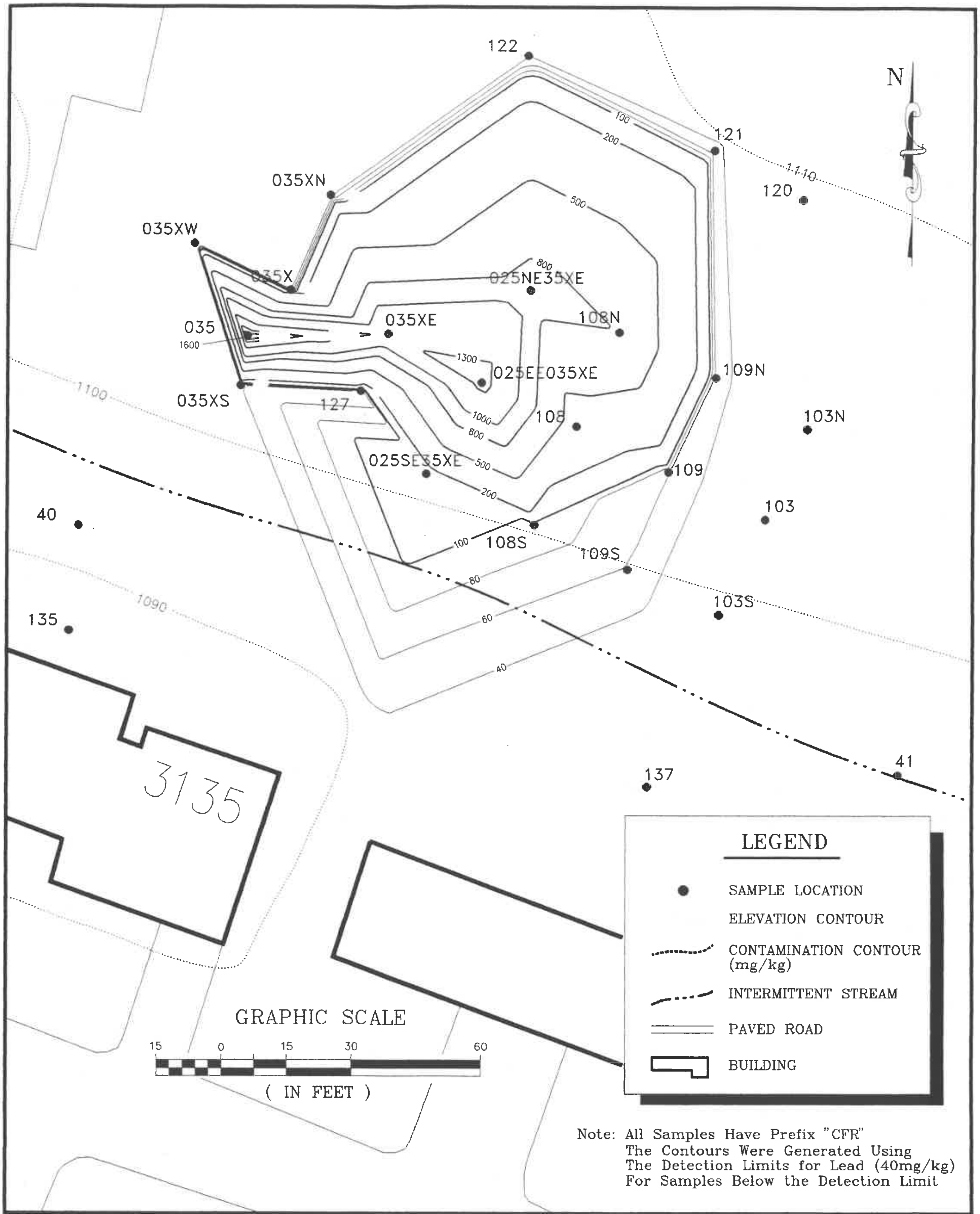
The area of elevated lead contamination does not pose a threat to groundwater, surface water or air. The excavation and removal of the soils with elevated levels of lead has eliminated any future exposures via incidental ingestion of soil.



File: sidf3-1.dwg

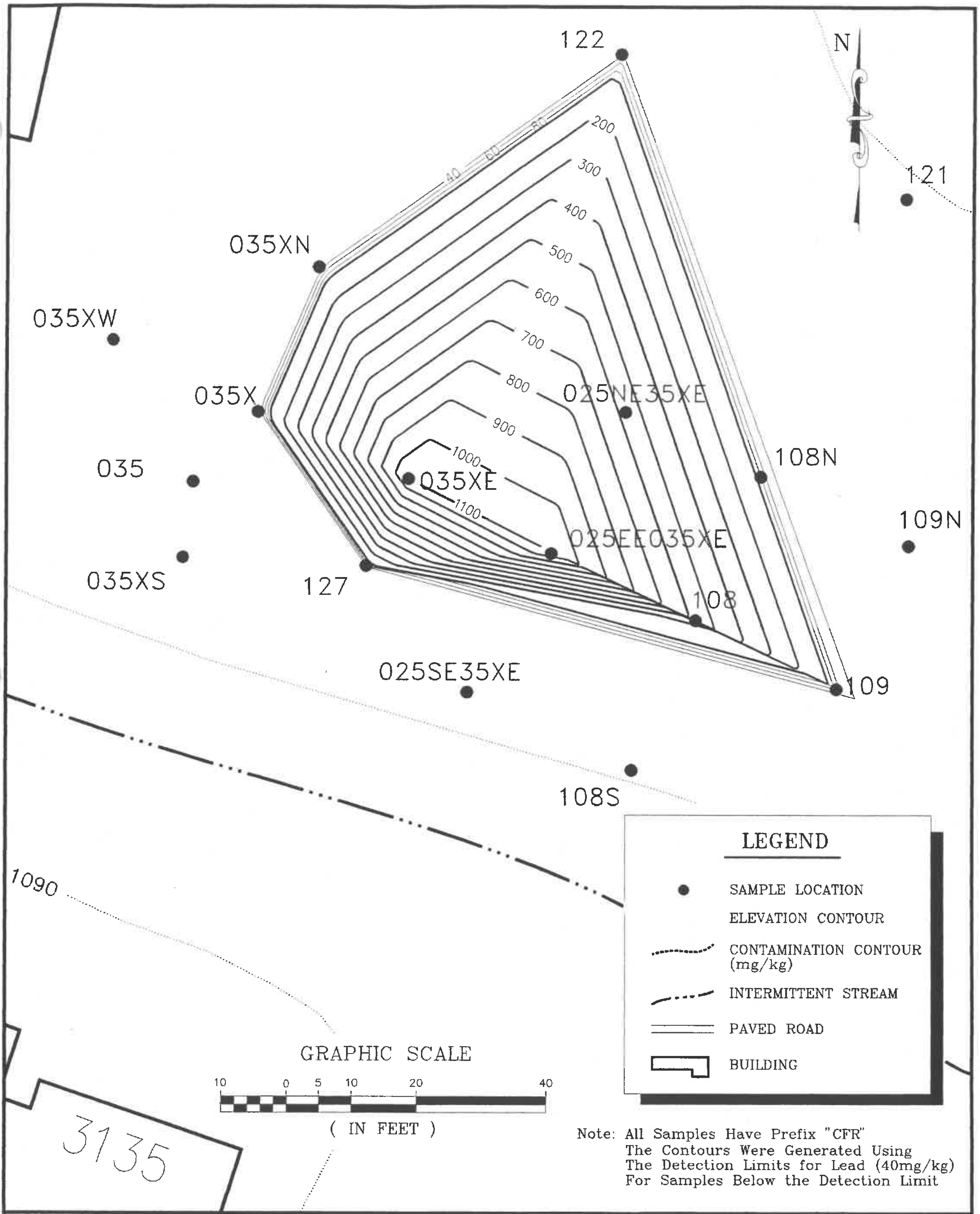
June, 1994

Figure 3-1: Former Camp Forsyth Ranges Sensitive-Receptor Lead Site



Note: All Samples Have Prefix "CFR"
The Contours Were Generated Using
The Detection Limits for Lead (40mg/kg)
For Samples Below the Detection Limit

File: SIDF3–2.dwg	Figure 3–2: 0 to 1 Foot Depth Lead Concentration Contours Behind Building 3135 at Colyer Manor
June, 1994	

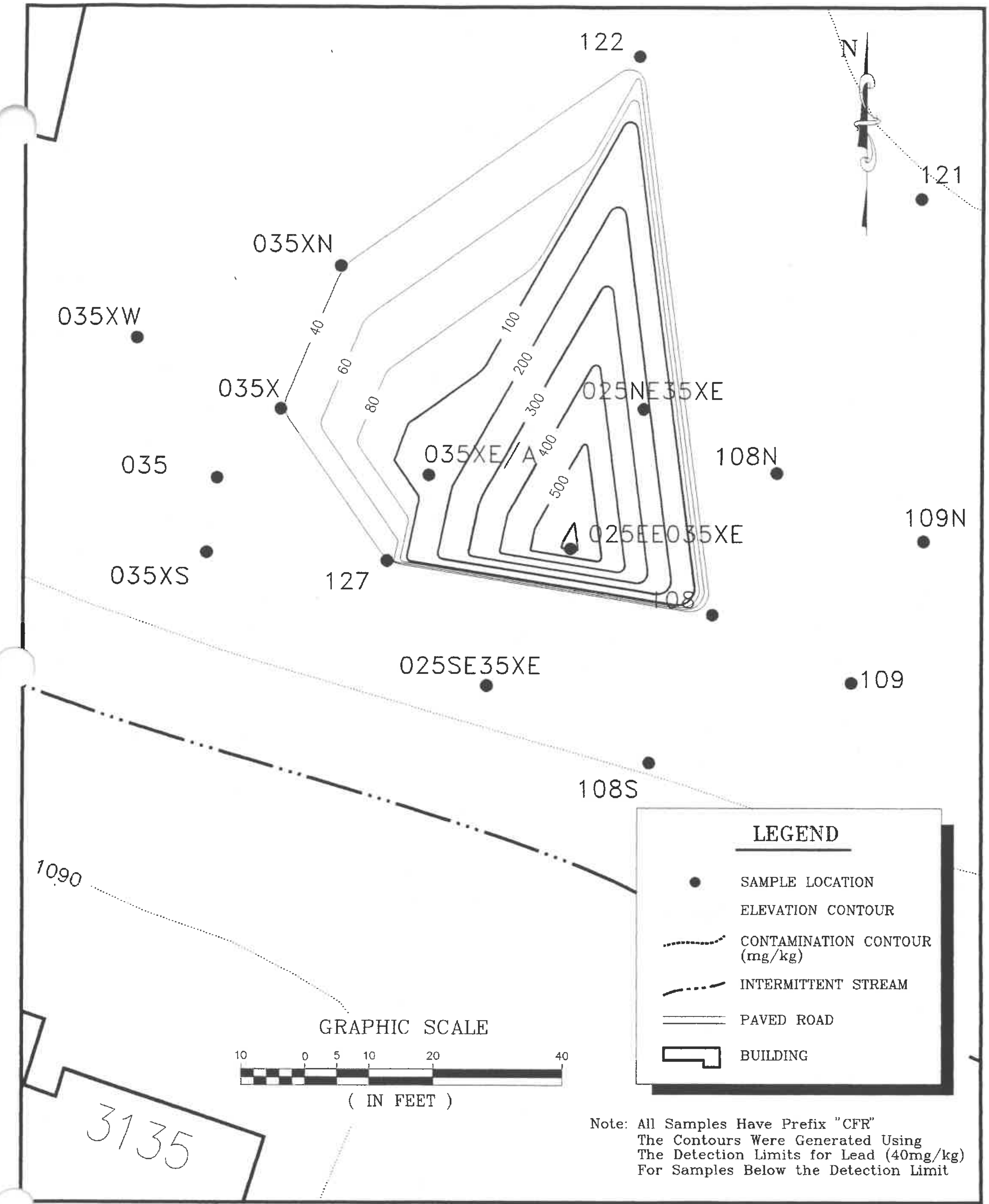


Note: All Samples Have Prefix "CFR"
The Contours Were Generated Using
The Detection Limits for Lead (40mg/kg)
For Samples Below the Detection Limit

File: SIDF3-3.dwg

June, 1994

Figure 3-3: 1 to 2 Foot Depth Lead Concentration Contours Behind Building 3135 at Colyer Manor

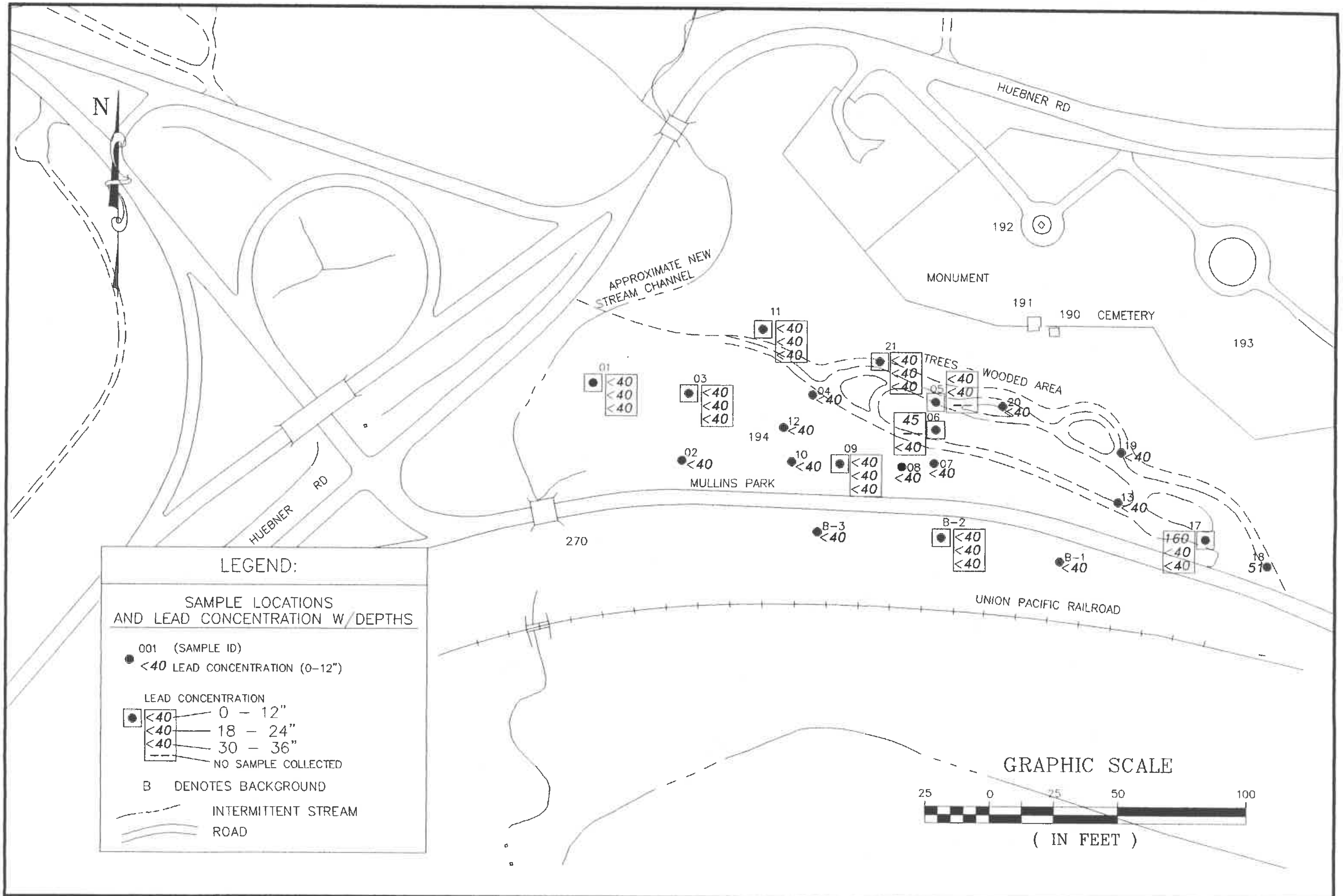


Note: All Samples Have Prefix "CFR"
The Contours Were Generated Using
The Detection Limits for Lead (40mg/kg)
For Samples Below the Detection Limit

File: SIDF3–4.dwg

June, 1994

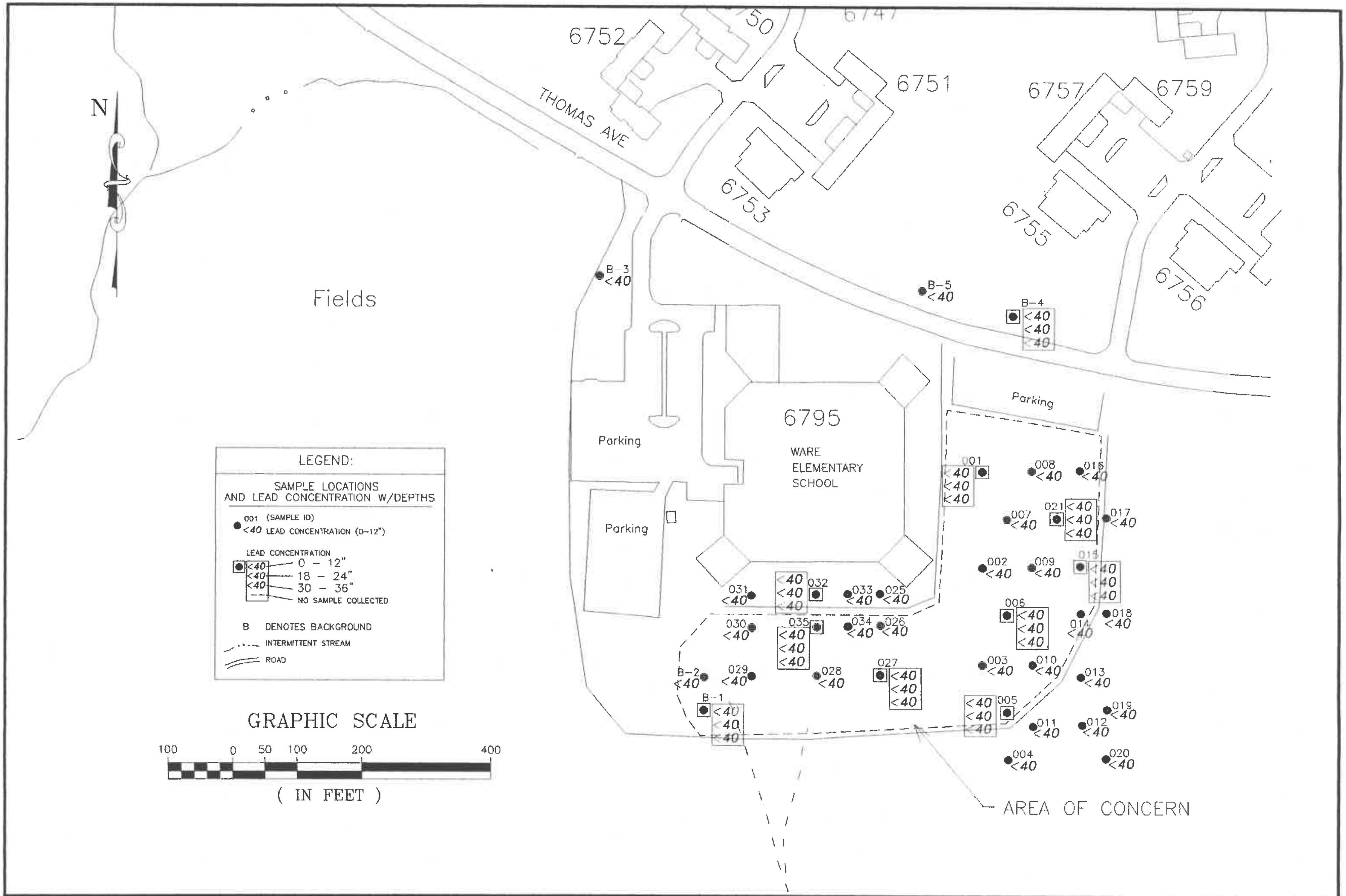
Figure 3–4: 2 to 3 Foot Depth Lead Concentration Contours Behind Building 3135 at Colyer Manor



File: SIDF3-5.dwg

June, 1994

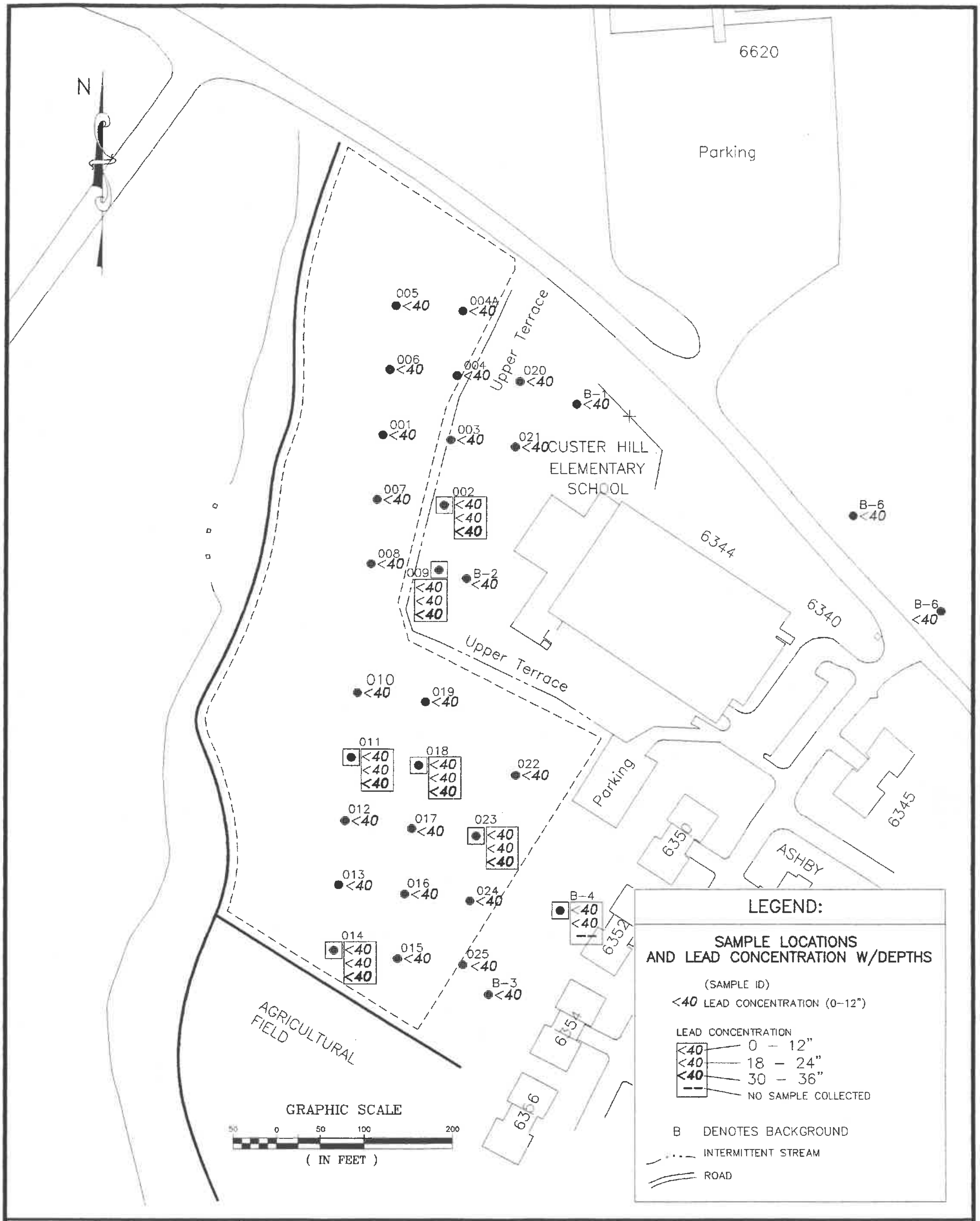
Figure 3-5: Former Millins Park Soil Sampling Locations



File: SIDF3–6.dwg

June, 1994

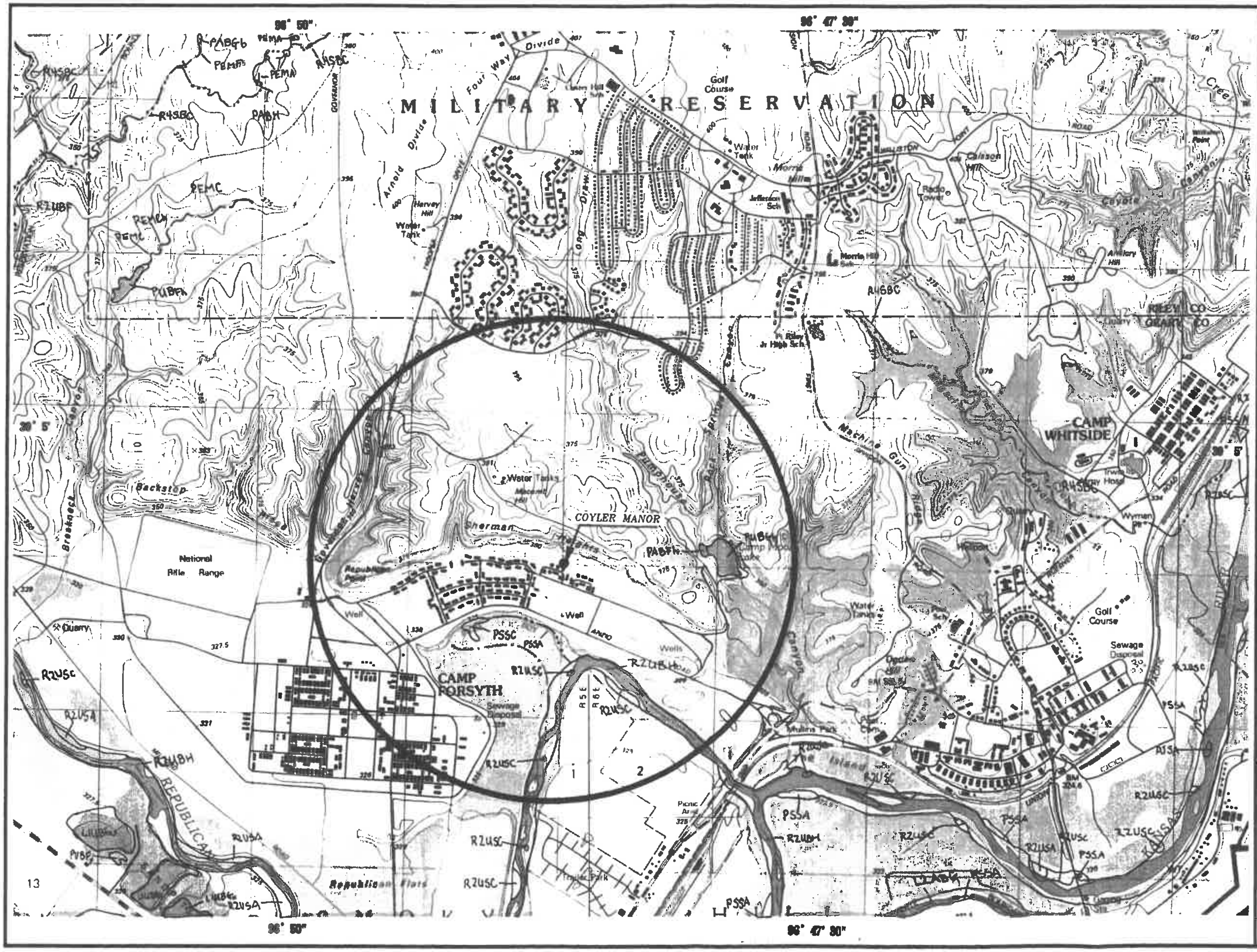
Figure 3–6: Ware Elementary School Soil Sampling Locations



File: sidf3-7.dwg

June, 1994

Figure 3-7: Custer Hill Elementary School Sampling Locations



LEGEND

PABFh	PALUSTRINE SYSTEM, AQUATIC BED CLASS, SEMIPERMANENTLY FLOODED (DIKED, IMPOUNDED)
PSSA	PALUSTRINE SYSTEM, SCRUB-SHRUB CLASS, TEMPORARILY FLOODED
PSSC	PALUSTRINE SYSTEM, SCRUB-SHRUB CLASS, SEASONALLY FLOODED
PUBGh	PALUSTRINE SYSTEM, UNCONSOLIDATED BOTTOM CLASS, INTERMITTENTLY EXPOSED (DIKED, IMPOUNDED)
R2UBH	RIVERINE SYSTEM, LOWER PERENNIAL, UNCONSOLIDATED BOTTOM CLASS, PERMANENTLY FLOODED
R2USC	RIVERINE SYSTEM, LOWER PERENNIAL, UNCONSOLIDATED SHORE CLASS, SEASONALLY FLOODED

Figure 3–8: Coyler Manor One Mile Radius

June, 1994

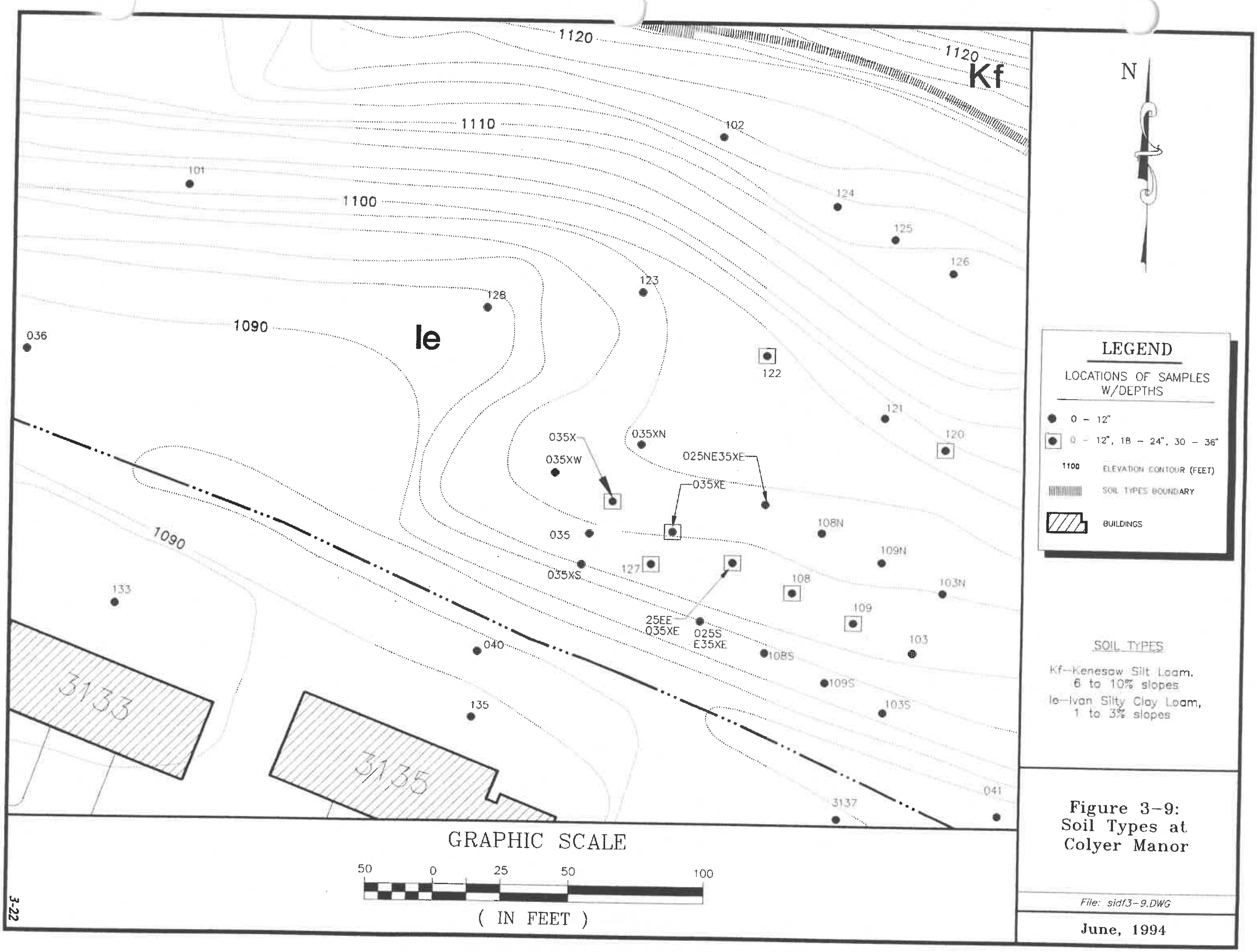


Figure 3-9: Soil Types at Colyer Manor

File: sidf3-9.DWG

June, 1994

Table 3-1 XRF Results For Colyer Manor

		Lead	**Zinc**	**Copper**	**Iron**	**Barium**
	Detection Limits (mg/kg)	40	200	200	7000	200
Sample ID	**Notes**					
CFR-001-1	0-1	110	<	<	15000	380
CFR-001-1 (B)	0-1'	<	<	<	11000	300
CFR-001-1 (B)	Duplicate XRF Run;0-1'	<	<	<	12000	360
CFR-001E-1	0-1'	<	<	<	15000	320
CFR-001N-1	0-1'	<	<	<	20000	350
CFR-001S-1	0-1'	<	<	<	14000	280
CFR-001S-1	0-1'	<	<	<	14000	320
CFR-001W-1	0-1'	90	<	<	17000	320
CFR-002-1	0-1'	<	<	<	12000	290
CFR-003-1	0-1'	110	<	<	14000	270
CFR-003-2	1-2'	74	<	<	15000	280
CFR-003-3	2-3'	<	<	<	14000	260
CFR-003E-1	0-1'	170	<	<	14000	310
CFR-003N-1	0-1'	280	<	<	15000	310
CFR-003S-1	0-1'	<	<	<	14000	300
CFR-003W-1	0-1'	<	<	<	14000	280
CFR-004-1	0-1'	<	<	<	13000	310
CFR-005-1	0-1'	<	<	<	12000	270
CFR-006-1	0-1'	<	<	<	13000	280
CFR-006-2	1-2'	<	<	<	14000	260
CFR-006-3	2-3'	<	<	<	16000	270
CFR-007-1	0-1'	<	<	<	14000	290
CFR-008-1	0-1'	<	<	<	13000	280
CFR-009-1	0-1'	<	<	<	13000	290
CFR-010-1	0-1'	<	<	<	14000	270
CFR-011-1	0-1'	<	<	<	14000	260

Table 3-1 (Continued)

		Lead	Zinc	Copper	Iron	Barium
	Detection Limits (mg/kg)	40	200	200	7000	200
Sample ID	**Notes**					
CFR-011N-1	0-1’	<	<	<	15000	300
CFR-011W-1	0-1’	<	<	<	16000	300
CFR-012-1	0-1’	<	<	<	13000	290
CFR-012-1	Duplicate XRF Run;0-1’	<	<	<	13000	270
CFR-012-2	1-2’	130	<	<	14000	340
CFR-012-3	2-3’	88	<	<	14000	280
CFR-012E-1	0-1’	<	<	<	14000	320
CFR-012N-1	0-1’	<	<	<	15000	300
CFR-012S-1	0-1’	<	<	<	14000	290
CFR-012W-1	0-1’	<	<	<	15000	340
CFR-013-1	0-1’	<	<	<	12000	300
CFR-014-1	0-1’	87	<	<	14000	310
CFR-015-1	0-1’	<	<	<	16000	300
CFR-016-1	0-1’	<	<	<	17000	310
CFR-018-1	0-1’	<	<	<	19000	350
CFR-018-1	Duplicate XRF Run; 0-1’	<	<	<	19000	290
CFR-018-2	1-2’	<	<	<	18000	390
CFR-019-1	0-1’	<	<	<	14000	250
CFR-019-2	1-2’	<	<	<	13000	310
CFR-019-3	2-3’	<	<	<	15000	250
CFR-020-1	0-1’	<	<	<	14000	270
CFR-021-1	0-1’	<	<	<	13000	360
CFR-022-1	0-1’	<	<	<	14000	280
CFR-022-2	1-2’	<	<	<	15000	280
CFR-022-3	2-3’	<	<	<	15000	280
CFR-023-1	0-1’	<	<	<	14000	250
CFR-023-1	Duplicate XRF Run; 0-1’	<	<	<	13000	230

Table 3-1 (Continued)

		Lead	Zinc	Copper	Iron	Barium
	Detection Limits (mg/kg)	40	200	200	7000	200
Sample ID	**Notes**					
CFR-024-1	0-1’	<	<	<	15000	340
CFR-025-1	0-1’	<	<	<	13000	360
CFR-026-1	0-1’	<	<	<	12000	270
CFR-027-1	0-1’	<	<	<	11000	310
CFR-027-2	1-2’	<	<	<	14000	350
CFR-027-3	2-3’	<	<	<	18000	300
CFR-028-1	0-1’	<	<	<	14000	310
CFR-029-1	0-1’	<	<	<	12000	350
CFR-030-1	0-1’	<	<	<	14000	260
CFR-030-2	1-2’	<	<	<	22000	350
CFR-030-3	2-3’	<	<	<	23000	350
CFR-031-1	0-1’	<	<	<	13000	320
CFR-032-1	0-1’	<	<	<	13000	360
CFR-033-1	0-1’	<	<	<	12000	330
CFR-034-1	0-1’	<	<	<	14000	310
CFR-035-1	0-1’	1700	<	390	15000	270
CFR-035-1	Duplicate XRF Run; 0-1’	1500	<	300	16000	320
CFR-036-1	0-1’	<	<	<	15000	220
CFR-037-1	0-1’	<	<	<	20000	360
CFR-038-1	0-1’	<	<	<	15000	270
CFR-039-1	0-1’	<	<	<	15000	300
CFR-039-2	1-2’	<	<	<	17000	310
CFR-039-3	2-3’	<	<	<	17000	320
CFR-040-1	0-1’	<	<	<	14000	230
CFR-041-1	0-1’	<	<	<	15000	320
CFR-042-1	0-1’	<	<	<	15000	290
CFR-043-1	0-1’	<	<	<	16000	260

Table 3-1 (Continued)

		Lead	Zinc	Copper	Iron	Barium
	Detection Limits (mg/kg)	40	200	200	7000	200
Sample ID	**Notes**					
CFR-044-1	0-1’	<	<	<	16000	330
CFR-045-1	0-1’	<	<	<	15000	300
CFR-045-1	Duplicate XRF Run; 0-1’	<	<	<	14000	320
CFR-046-1	0-1’	<	<	<	13000	260
CFR-047-1	0-1’	<	<	<	14000	300
CFR-047-2	1-2’	<	<	<	16000	320
CFR-047-3	2-3’	<	<	<	16000	300
CFR-049-1	0-1’	<	<	<	19000	360
CFR-050-1	0-1’	<	<	<	14000	250
CFR-050-2	1-2’	<	<	<	15000	240
CFR-050-3	2-3’	<	<	<	14000	280
CFR-051-1	0-1’	<	<	<	14000	290
CFR-052-1	0-1’	52	<	<	14000	290
CFR-052-2	1-2’	<	<	<	14000	280
CFR-052-3	2-3’	<	<	<	16000	340
CFR-053-1	0-1’	<	<	<	14000	250
CFR-054-1	0-1’	<	<	<	14000	310
CFR-054-2	1-2’	<	<	<	14000	270
CFR-054-3	2-3’	<	<	<	15000	310
CFR-055-1	0-1’	<	<	<	13000	240
CFR-056-1	0-1’	<	<	<	12000	250
CFR-056-1	Duplicate XRF Run; 0-1’	<	<	<	13000	260
CFR-056-2	1-2’	<	<	<	14000	290
CFR-056-3	2-3’	<	<	<	12000	340
CFR-057-1	0-1’	<	<	<	13000	260
CFR-057-1	Duplicate XRF Run; 0-1’	<	<	<	14000	290
CFR-058-1	0-1’	<	<	<	14000	270

Table 3-1 (Continued)

		Lead	**Zinc**	**Copper**	**Iron**	**Barium**
	Detection Limits (mg/kg)	40	200	200	7000	200
Sample ID	**Notes**					
CFR-059-1	0-1’	<	<	<	19000	380
CFR-060-1	0-1’	<	<	<	11000	300
CFR-061-1	0-1’	<	<	<	12000	250
CFR-062-1	0-1’	<	<	<	13000	260
CFR-063-1	0-1’	<	<	<	13000	320
CFR-063-2	1-2’	<	<	<	12000	360
CFR-063-3	2-3’	<	<	<	12000	290
CFR-064-1	0-1’	<	<	<	15000	350
CFR-065-1	0-1’	<	<	<	18000	280
CFR-065-2	1-2’	<	<	<	18000	320
CFR-065-3	2-3’	<	<	<	17000	350
CFR-066-1	0-1’	<	<	<	17000	310
CFR-067-1	0-1’	<	<	<	13000	250
CFR-068-1	0-1’	<	<	<	13000	270
CFR-069-1	0-1’	<	<	<	13000	310
CFR-069-2	1-2’	<	<	<	13000	290
CFR-069-3	2-3’	<	<	<	15000	310
CFR-070-1	0-1’	<	<	<	13000	260
CFR-071-1	0-1’	<	<	<	13000	290
CFR-072-1	0-1’	<	<	<	14000	280
CFR-072-1	0-1’	<	<	<	16000	260
CFR-072-3	2-3’	<	<	<	16000	270
CFR-073-1	0-1’	<	<	<	14000	290
CFR-074-1	0-1’	<	<	<	15000	290
CFR-074-1	Duplicate XRF Run; 0-1’	<	<	<	15000	240
CFR-075-1	0-1’	<	<	<	14000	290
CFR-076-1	0-1’	<	<	<	14000	250

Table 3-1 (Continued)

		Lead	Zinc	Copper	Iron	Barium
	Detection Limits (mg/kg)	40	200	200	7000	200
Sample ID	**Notes**					
CFR-077-1	0-1’	<	<	<	14000	300
CFR-078-1	0-1’	<	<	<	14000	300
CFR-078-2	1-2’	<	<	<	14000	330
CFR-078-3	2-3’	<	<	<	14000	250
CFR-079-1	0-1’	<	<	<	15000	310
CFR-080-1	0-1’	<	<	<	16000	340
CFR-082-1	0-1’	<	<	<	14000	320
CFR-083-1	0-1’	<	<	<	12000	270
CFR-084-1	Surface of ball field	<	<	<	16000	250
CFR-084-5.5	Surface of ball field	<	<	<	17000	290
CFR-085-5.5	Surface of ball field	<	<	<	17000	350
CFR-085-5.5	Surface of ball field	<	<	<	16000	270
CFR-085-5.5	Duplicate XRF Run	<	<	<	16000	270
CFR-086-5.5	Surface of ball field	<	<	<	17000	340
CFR-087-5.5	Surface of ball field	<	<	<	15000	260
CFR-113-1	Surface of playground	<	<	<	15000	310

Table 3-2 Samples Taken to Delineate the Area of Contamination Behind Building 3135

		Lead	**Zinc**	**Copper**	**Iron**	**Barium**
	Detection Limits	40	200	200	7000	200
Sample ID	**Notes**					
BLDG-3133-1	20' from building; 0-1'	<	<	<	15000	290
BLDG-3135-1	15' from building; 0-1'	<	<	<	13000	320
BLDG-3137-1	20' from building; 0-1'	<	<	<	15000	330
CFR-025E035XE-1	0-1'	1400	<	<	15000	270
CFR-025E035XE-2	1-2'	1100	<	<	15000	320
CFR-025E035EX-3	2-3'	630	<	<	15000	210
CFR-025NE35XE-1	0-1'	920	<	<	16000	340
CFR-025SE35XE-1	0-1'	140	<	<	14000	250
CFR-035-1	0-1'	1700	<	390	15000	270
CFR-035X-1	0-1'	<	<	<	14000	300
CFR-035X-2	1-2'	<	<	<	14000	270
CFR-035X-3	2-3'	<	<	<	16000	280
CFR-035X-4	3-4'	<	<	<	19000	360
CFR-035X5	4-5'	<	<	<	19000	350
CFR-035X-5.5	5-5.5'	<	<	<	19000	340
CFR-035XE-1	0-1'	1200	<	220	15000	290
CFR-035XE-1	Duplicate XRF Run; 0-1'	1300	<	310	16000	300
CFR-035XE-2	1-2'	1100	<	<	15000	300
CFR-035XE-2	Bullet Fragments; 1-2'	29000	910	8800	20000	<
CFR-035XE-3	2-3'	120	<	<	18000	320
CFR-035XN-1	0-1'	<	<	<	13000	230
CFR-035XS-1	0-1'	<	<	<	16000	300
CFR-035XW-1	0-1'	<	<	<	15000	290
CFR-036-1	0-1'	<	<	<	15000	220
CFR-040-1	35' from building; 0-1'	<	<	<	14000	230
CFR-041-1	45' from building; 0-1'	<	<	<	15000	320
CFR-101-1	In gully draining hillside;0-1'	<	<	<	21000	340
CFR-102-1	0-1'	<	<	<	16000	310

Table 3-2 (Continued)

		Lead	Zinc	Copper	Iron	Barium
	Detection Limits	40	200	200	7000	200
Sample ID	Notes					
CFR-103-1	0-1’	<	<	<	14000	270
CFR-103N-1	0-1’	52	<	<	13000	270
CFR-103S-1	0-1’	<	<	<	14000	340
CFR-108-1	0-1’	360	<	<	14000	290
CFR-108-2	1-2’	220	<	<	14000	240
CFR-108-3	2-3’	<	<	<	16000	270
CFR-108N-1	0-1’	790	<	<	15000	300
CFR-108S-1	0-1’	95	<	<	14000	290
CFR-109-1	0-1’	63	<	<	15000	320
CFR-109-2	1-2’	66	<	<	15000	320
CFR-109-3	2-3’	<	<	<	18000	250
CFR-109N-1	0-1’	<	<	<	14000	230
CFR-109N-1	0-1’	52	<	<	14000	310
CFR-109S-1	0-1’	59	<	<	14000	270
CFR-120-1	0-1’	46	<	<	19000	310
CFR-120-2	1-2’	<	<	<	21000	280
CFR-120-3	2-3’	<	<	<	19000	330
CFR-121-1	0-1’	44	<	<	14000	240
CFR-122-1	No Sample					
CFR-122-2	1-2’	<	<	<	15000	270
CFR-122-3	2-3’	<	<	<	13000	290
CFR-123-1	0-1’	41	<	<	13000	310
CFR-124-1	0-1’	<	<	<	13000	260
CFR-125-1	0-1’	<	<	<	13000	300
CFR-126-1	0-1’	<	<	<	12000	260
CFR-127-1	0-1’	<	<	<	13000	250
CFR-127-2	1-2’	<	<	<	13000	250
CFR-127-3	2-3’	<	<	<	17000	380
CFR-127-4	3-4’	<	<	<	17000	370

Table 3-2 (Continued)

		Lead	Zinc	Copper	Iron	Barium
	Detection Limits	40	200	200	7000	200
Sample ID	**Notes**					
CFR-127-5	4-5’	<	<	<	19000	310
CFR-128-1	0-1’	80	<	<	14000	270
CFR-132-1	0-1’ (duplicate sample, 035)	1100	<	<	16000	320
CFR-132-2	1-2’ (duplicate sample, 035)	700	<	230	16000	280
CFR-132-3	2-3’ (duplicate sample, 035)	210	<	<	16000	350
CFR-132-4	3-4’ (duplicate sample, 035)	49	<	<	19000	370
CFR-132-5	4-5’ (duplicate sample, 035)	<	<	<	17000	350
CFR-132-6	5-6’ (duplicate sample, 035)	<	<	<	19000	390
CFR-133-1	0-1’	1200	<	280	15000	230
CFR-133-1	Duplicate XRF Run; 0-1’	1200	<	240	15000	250
CFR-134-1	0-1’ (duplicate sample, 035)	990	<	<	16000	300
CFR-134-2	1-2’ (duplicate sample, 035)	460	<	<	16000	250
CFR-134-3	2-3’ (duplicate sample, 035)	64	<	<	17000	300
CFR-134-4	3-4’ (duplicate sample, 035)	<	<	<	19000	290
CFR-134-5	4-5’ (duplicate sample, 035)	<	<	<	18000	330
CFR-134-6	5-6’ (duplicate sample, 035)	77	<	<	19000	330

Table 3-3 TCLP Results

Sample	CFR-001-1			CFR-035-1		
Element	XRF (mg/kg)	Total (mg/kg)	TCLP (mg/l)	XRF (mg/kg)	Total (mg/kg)	TCLP (mg/l)
Arsenic	-----	----	<1	----	----	<1
Barium	380	----	2		----	<2
Cadmium	----	----	<0.5	----	----	<0.5
Chromium	----		<0.4	----	----	<0.4
Lead	110	260	<2	1700	3000	400 &110[a,b]
Mercury	----	----	<0.02	----	----	<0.02
Selenium	----	----	<0.5	----	----	<0.5
Silver	----	----	<0.5	----	----	<0.5
Copper	<200	26	----	390	410	----
Zinc	<200	48	----	<200	95	----
Acid	----	----	acetic	----	----	acetic
Initial pH	----	----	4.93	----	----	4.93
Final pH	----	----	6.19	----	----	4.88

a) Fails TCLP; characteristic hazardous waste. The TCLP criterion is 5.0 mg/L.

b) Sample was run twice. The theoretical maximum TCLP-Lead would be about 15 mg/L (i.e., twenty-fold dilution of total lead level).

---- Not Analyzed.

Table 3-4 XRF Sample Results For Former Mullins Park

		Lead	Zinc	Copper	Iron	Barium
	Detection Limits (mg/kg)	40	200	200	7000	200
Sample ID	Notes	---	---	---	---	---
FMP-001-1	0-1'	<	<	<	14000	280
FMP-001-2	1-2'	<	<	<	12000	320
FMP-001-3	2-3'	<	<	<	13000	270
FMP-002-1	0-1'	<	<	<	12000	270
FMP-003-1	0-1'	<	<	<	14000	290
FMP-003-2	1-2'	<	<	<	14000	320
FMP-003-3	2-3'	<	<	<	14000	300
FMP-004-1	0-1'	<	<	<	13000	290
FMP-005-1	0-1'	<	<	<	12000	290
FMP-005-2	1-2'	<	<	<	17000	260
FMP-006-1	0-1'	45	<	<	12000	280
FMP-006-2	1-2'	<	<	<	17000	255
FMP-006-3	2-3'	<	<	<	8900	420
FMP-007-1	0-1'	<	<	<	13000	310
FMP-007-1	Duplicate XRF Run; 0-1'	<	<	<	13000	290
FMP-008-1	0-1'	<	<	<	17000	260
FMP-009-1	0-1'	<	<	<	13000	280
FMP-009-2	1-2'	<	<	<	13000	340
FMP-009-3	2-3'	<	<	<	13000	350
FMP-010-1	0-1'	<	<	<	13000	250
FMP-011-1	0-1'	<	<	<	14000	270
FMP-011-2	1-2'	<	<	<	13000	230
FMP-011-3	2-3'	<	<	<	13000	350
FMP-012-1	0-1'	<	<	<	12000	270
FMP-013-1	0-1'	<	<	<	12000	300
FMP-017-1	0-1'	160	<	<	13000	290
FMP-017-2	1-2'	<	<	<	8000	290

Table 3-4 (Continued)

		Lead	Zinc	Copper	Iron	Barium
	Detection Limits (mg/kg)	40	200	200	7000	200
Sample ID	**Notes**	---	---	---	---	---
FMP-017-3	2-3'	<	<	<	11000	240
FMP-017B-1	Spike	320	<	<	14000	270
FMP-018-1	0-1'	51	<	<	13000	250
FMP-018-1	Duplicate XRF Run; 0-1'	52	<	<	13000	300
FMP-019-1	0-1'	<	<	<	9100	420
FMP-020-1	0-1'	<	<	<	9100	<
FMP-021-1	0-1'	<	<	<	14000	240
FMP-021-2	1-2'	<	<	<	12000	290
FMP-021-3	2-3'	<	<	<	13000	290
FMP-B01-1	Background; 0-1'	<	<	<	18000	290
FMP-B02-1	Background; 0-1'	<	<	<	17000	270
FMP-B02-2	Background	<	<	<	15000	320
FMP-B02-3	Background	<	<	<	17000	330
FMP-B03-1	Background; 0-1'	<	<	<	15000	280

"Spike"- a non quantitative sample.

"Duplicate XRF Run"- same sample preparation tested a second time by XRF.

"Background" - sample from an area not suspected of lead contamination.

Table 3-5 XRF Results For Ware Elementary School

		Lead	Zinc	Copper	Iron	Barium
	Detection Limits (mg/kg)	40	200	200	700	200
Sample ID	**Notes**					
WESS-001-1	0-1'	<	<	<	14000	<
WESS-001-2	1-2'	<	<	<	15000	250
WESS-001-3	2-3'	<	<	<	17000	340
WESS-002-1	0-1'	<	<	<	19000	320
WESS-003-1	0-1'	<	<	<	19000	350
WESS-004-1	0-1'	<	<	<	17000	310
WESS-005-1	0-1'	<	<	<	19000	290
WESS-005-2	1-2'	<	<	<	19000	370
WESS-005-3	2-3'	<	<	<	19000	340
WESS-006-1	0-1'	<	<	<	18000	240
WESS-006-2	1-2'	<	<	<	17000	300
WESS-006-3	2-3'	<	<	<	16000	270
WESS-007-1	0-1'	<	<	<	19000	280
WESS-008-1	0-1'	<	<	<	18000	260
WESS-009-1	0-1'	<	<	<	19000	260
WESS-010-1	0-1'	<	<	<	20000	340
WESS-011-1	0-1'	<	<	<	19000	250
WESS-012-1	0-1'	<	<	<	18000	260
WESS-013-1	0-1'	<	<	<	19000	280
WESS-014-1	0-1'	<	<	<	20000	360
WESS-015-1	0-1'	<	<	<	21000	290
WESS-015-2	1-2'	<	<	<	20000	310
WESS-015-3	2-3'	<	<	<	15000	350
WESS-016-1	0-1'	<	<	<	20000	260
WESS-017-1	0-1'	<	<	<	18000	280
WESS-018-1	0-1'	<	<	<	19000	310
WESS-019-1	0-1'	<	<	<	18000	340

Table 3-5 (Continued)

		Lead	Zinc	Copper	Iron	Barium
	Detection Limits (mg/kg)	40	200	200	700	200
Sample ID	Notes					
WESS-020-1	0-1’	<	<	<	22000	290
WESS-021-1	0-1’	<	<	<	18000	270
WESS-021-2	1-2’	<	<	<	17000	230
WESS-021-3	2-3’	<	<	<	19000	310
WESS-025-1	0-1’	<	<	<	<	570
WESS-026-1	0-1’	<	<	<	<	430
WESS-027-1	0-1’	<	<	<	18000	330
WESS-027-1	Duplicate XRF Run; 0-1’	<	<	<	17000	290
WESS-027-2	1-2’	<	<	<	19000	310
WESS-027-3	2-3’	<	<	<	18000	290
WESS-028-1	0-1’	<	<	<	18000	250
WESS-029-1	0-1’	<	<	<	15000	250
WESS-030-1	0-1’	<	<	<	16000	320
WESS-031-1	0-1’	<	<	<	17000	260
WESS-032-1	0-1’	<	<	<	17000	290
WESS-032-2	1-2’	<	<	<	17000	330
WESS-032-3	2-3’	<	<	<	16000	310
WESS-033-1	0-1’	<	<	<	16000	280
WESS-034-1	0-1’	<	<	<	15000	250
WESS-035-1	0-1’	<	<	<	17000	270
WESS-035-2	1-2’	<	<	<	18000	360
WESS-035-3	2-3’	<	<	<	19000	390
WESS-037-1	Surface	<	<	<	<	1500
WESS-038-1	Surface	<	<	<	<	1500
WESS-039-1	Surface	<	<	<	<	1800
WESS-040-1	Surface	<	<	<	<	1200
WESS-041-1	Surface	<	<	<	<	1300
WESS-042-1	Surface	<	<	<	<	1200

Table 3-5 (Continued)						
		Lead	**Zinc**	**Copper**	**Iron**	**Barium**
	Detection Limits (mg/kg)	40	200	200	700	200
Sample ID	**Notes**					
WESS-043-1	Surface	<	<	<	<	480
WESS-B1-1	Background; 0-1'	<	<	<	19000	250
WESS-B1-2	Background; 1-2'	<	<	<	19000	220
WESS-B1-3	Background; 2-3'	<	<	<	18000	250
WESS-B2-1	Background; 0-1'	<	<	<	14000	260
WESS-B3-1	Background; 0-1'	<	<	<	14000	240
WESS-B3-2	Background; 1-2'	<	<	<	15000	240
WESS-B3-3	Background; 2-3'	<	<	<	21000	240
WESS-B4-1	Background; 0-1'	<	<	<	17000	260
WESS-B4-2	Background; 1-2'	<	<	<	15000	310
WESS-B4-3	Background; 2-3'	<	<	<	16000	230
WESS-B5-1	Background; 0-1'	<	<	<	17000	220

"Duplicate XRF Run"- same sample preparation tested a second time by XRF.

"Background " - sample from an area not suspected of lead contamination.

"Surface" - samples were scooped from the surface as composites.

Table 3-6 XRF Sample Results For Custer Hill Elementary School

		Lead	**Zinc**	**Copper**	**Iron**	**Barium**
	Detection Limits (mg/kg)	40	200	200	7000	200
Sample ID	**Notes**	---	---	---	---	---
CHES-001-1	0-1’	<	<	<	18000	220
CHES-002-1	0-1’	<	<	<	19000	270
CHES-002-1	0-1’	<	<	<	20000	260
CHES-002-2	1-2’	<	<	<	18000	210
CHES-002-3	2-3’	<	<	<	19000	240
CHES-003-1	0-1’	<	<	<	19000	200
CHES-004-1	0-1’	<	<	<	20000	270
CHES-004A-1	0-1’	<	<	<	21000	260
CHES-005-1	0-1’	<	<	<	16000	250
CHES-006-1	0-1’	<	<	<	14000	<
CHES-007-1	0-1’	<	<	<	18000	280
CHES-008-1	0-1’	<	<	<	20000	270
CHES-009-1	0-1’	<	<	<	21000	240
CHES-009-2	1-2’	<	<	<	20000	250
CHES-009-3	2-3’	<	<	<	20000	230
CHES-010-1	0-1’	<	<	<	18000	230
CHES-011-1	0-1’	<	<	<	19000	220
CHES-011-2	1-2’	<	<	<	19000	<
CHES-011-3	2-3’	<	<	<	19000	210
CHES-011A-1	0-1’	<	<	<	19000	240
CHES-011A-2	1-2’	<	<	<	17000	220
CHES-011A-3	2-3’	<	<	<	21000	300
CHES-012-1	0-1’	<	<	<	14000	230
CHES-013-1	0-1’	<	<	<	16000	<
CHES-014-1	0-1’	<	<	<	21000	290
CHES-014-2	1-2’	<	<	<	22000	230
CHES-014-3	2-3’	<	<	<	24000	310
CHES-015-1	0-1’	<	<	<	19000	240

Table 3-6 (Continued)

		Lead	Zinc	Copper	Iron	Barium
	Detection Limits (mg/kg)	40	200	200	7000	200
Sample ID	**Notes**	---	---	---	---	---
CHES-016-1	0-1’	<	<	<	19000	270
CHES-017-1	0-1’	<	<	<	20000	250
CHES-017A-1	0-1’	<	<	<	18000	250
CHES-018-1	0-1’	<	<	<	19000	240
CHES-018-2	1-2’	<	<	<	21000	250
CHES-018-3	2-3’	<	<	<	21000	220
CHES-019-1	0-1’	<	<	<	20000	240
CHES-020-1	0-1’	<	<	<	16000	270
CHES-021-1	0-1’	<	<	<	20000	270
CHES-022-1	0-1’	<	<	<	21000	240
CHES-023-1	0-1’	<	<	<	20000	230
CHES-023-2	1-2’	<	<	<	13000	<
CHES-023-3	2-3’	<	<	<	<	<
CHES-024-1	0-1’	<	<	<	20000	280
CHES-025-1	0-1’	<	<	<	19000	240
CHES-B1-1	Background; 0-1’	<	<	<	15000	<
CHES-B2-1	Background; 0-1’	<	<	<	20000	240
CHES-B3-1	Background; 0-1’	<	<	<	23000	250
CHES-B4-1	Background; 0-1’	<	<	<	29000	400
CHES-B4-2	Background; 1-2’	<	<	<	25000	360
CHES-B5-1	Background; 0-1’	<	<	<	19000	280
CHES-B5-2	Background; 1-2’	<	<	<	16000	230
CHES-B5-3	Background; 2-3’	<	<	<	20000	340
CHES-B6-1	Background; 0-1’	<	<	<	23000	400

"Duplicate XRF Run"- same sample preparation tested a second time by XRF.

"Background " - sample from an area not suspected of lead contamination.

"Surface" - samples were scooped from the surface as composites.

Table 3-7 Comparison of XRF Results With Laboratory Results

All Data in mg/kg	LEAD		COPPER		ZINC	
SAMPLE	**Lab**	**XRF**	**Lab**	**XRF**	**Lab**	**XRF**
CFR-001-1	260	110	26	<200	48	<200
CFR-003-1 (5/19/93)	360	110	27	<200	40	<200
CFR-003-1 (6/06/93)	420	---	21	---	34	---
CFR-003-3 (5/19/93)	18	<40	8	<200	36	<200
CFR-017-3 Dup of CFR-003-3 (5/19/93)	22	----	10	----	36	-----
CFR-003-3 (6/06/93)	17	<40	10	<200	34	<200
CFR-012-1	44	<40	11	<200	36	<200
CFR-018-2	15	<40	16	<200	53	<200
CFR-022-1	60	<40	16	<200	40	<200
CFR-022-2	35	<40	37	<200	100	<200
CFR-022-3	60	<40	18	<200	73	<200
CFR-048-3 Dup of CFR-022-3	50	---	16	----	56	----
CFR-033-1	51	<40	11	<200	43	<200
CFR-035-1	3000	1700	410	390	95	<200
CFR-035X-1	58	<40	14	<200	59	<200
CFR-047-3	10	<40	9	<200	40	<200
CFR-127-3	17	<40	11	<200	45	<200
CFR-129-3 Dup of CFR-127-3	23	----	11	----	48	----
CFR-133-1	3700	1200	160	280	61	<200
CFR-133-1 XRF Duplicate	----	1200	----	240	----	<200
CFRB-006-1	23	<40	7	<200	34	<200
CFRB-006-2	16	<40	7	<200	32	<200
CFRB-006-3	13	<40	7	<200	30	<200

Table 3-7 (Continued)

All Data in mg/kg	LEAD		COPPER		ZINC	
SAMPLE	**Lab**	**XRF**	**Lab**	**XRF**	**Lab**	**XRF**
CFR-S04	112	61	10	<200	1100	1700
CFR-S05	50	<40	10	<200	180	215
WESS-015-1	15	<40	9	<200	45	<200
WESS-016-1	10	<40	8	<200	30	<200
WESS-022-1 Dup of WESS-016-1	11	----	9	----	34	----
WESS-035-1	14	<40	9	<200	36	<200
WESS-005-1	13	<40	9	<200	41	<200
WESS-010-1	14	<40	11	<200	44	<200
CHES-012-1	13	<40	9	<200	49	<200
CHES-014-2	10	<40	9	<200	36	<200
CHES-014-3	9	<40	9	<200	40	<200
CHES-015-1	14	<40	9	<200	39	<200
CHES-016-1	11	<40	9	<200	35	<200
CHES-025-1	14	<40	8	<200	37	<200

Listed dates are when the samples were collected. In some cases, notably CFR-003, a second sample was collected adjacent to the original sample.

4.0 OPEN BURN/OPEN DETONATION AREA

The open burn/open detonation (OB/OD) area is located on Range 16 on the southern part of the Impact Area, approximately 2,300 feet north of Vinton School Road. The site lies on the Fort Riley NE, Kansas USGS 7.5 minute quadrangle in the Northeast quarter, Section 33, Township 10 south, Range 6 east. The active portion of the site consists of an area approximately 1000 feet by 350 feet. The site is located on gently sloping ground that is bordered on the north by a hill; the relief between the OB/OD area and the top of the hill is approximately 50 feet. The land north of the OB/OD area is part of the Impact Area for the surrounding training ranges. A mesic area is located along the western boundary of the site. Open vacant fields surround the remainder of the site.

As stated above, the OB/OD area is located within the Impact Area used by Fort Riley and contains numerous active ranges. An environmental investigation was conducted for the Impact Area as a whole in 1992. The investigation consisted of the installation and sampling of ten groundwater monitoring wells around the perimeter of the Impact Area and the collection of stream sediment and aqueous samples along intermittent tributaries draining the Impact Area.

As discussed in Section 1.0, analytical results of environmental samples collected from the OB/OD area are compared to regulatory standards. In addition, OB/OD area analytical results are compared to applicable analytical results from the Impact Area site assessment performed in 1992 (Ref. 29). The Impact Area analytical results represent ambient or background since the OB/OD Area is located within the Impact Area and any contaminants detected in the OB/OD area may be the result of Impact Area activities. Only groundwater and stream sample results can be compared since no soil samples were collected from the Impact Area as part of that study (Impact Area 5A).

4.1 SI Approach

The SI was designed to collect samples from within pits active for burning and detonation of ordnance at the time of sampling. These sampling locations are those likely to produce the highest concentrations of explosive residues, if any are present. In addition, soil samples were collected from the surface and subsurface at locations throughout the OB/OD area to assess whether residual contamination is present from formerly used pits. Lastly, potential migration of contaminants via surface water and groundwater was assessed. Surface water migration was assessed by sampling the intermittent tributary to Threemile Creek located west of the site. The OB/OD facility is active and subject to RCRA permit requirements as a treatment unit; therefore, groundwater monitor wells were installed and sampled to assess the quality of groundwater pursuant to applicable portions of 40 CFR 264.601.

Detailed information regarding the SI sampling approach can be found in the SAP for the High Priority Sites. A detailed discussion of sample locations and results is presented in Section 4.3. A summary of sample locations, including sample identification numbers, are presented by media as follows:

- Surface Soil: Eight surface soil (SS) samples were collected from within pits and across the OB/OD area. These samples are designated as OBOD-SS1-001 through OBOD-SS8-001.

- Soil Borings: Eight deep soil borings (SB) were installed and from them 23 subsurface soil samples were collected and analyzed. Soil boring sample locations are designated as SB1 through SB8 with soil borings ranging in depth from 5 to 20 feet. [Appendix C contains boring logs for these soil borings.] Soil boring SB1 was also used for installation of groundwater monitoring well OB-93-04. (This soil boring is not shown separately on Figure 4-2). Three soil samples were collected from each soil boring except SB8, where only two samples were collected due to the shallowness of bedrock at this location.

  In addition to the eight deep soil borings specified in the SAP, two shallow soil borings were hand-augered near the opening of the open burn pit. Although these samples were not included in the SAP, they were added during field activities because the high amount of unexploded ordnance (UXO) debris near the opening of the open burn pit prevented use of a drill rig to collect deep soil samples. These samples are designated SB10a and SB10b.

- Surface Water and Sediment Samples: Two surface water and three sediment samples were collected along the tributary to Threemile Creek west of the OB/OD area. Flow within this tributary was intermittent during SI field activities. Sediment samples were collected upstream from the site, due west of the site, and downstream from the site. The surface water samples were collected near the due west and downstream sediment sample locations. Sediment and surface water sample locations are designated SD1 through SD3 and SW1 and SW2, respectively.

- Groundwater Monitoring Wells: Four groundwater monitoring wells were installed and sampled. These wells were located at the OB/OD area such that one well is hydrogeologically upgradient with the remaining wells located downgradient. Details pertaining to depths of monitoring well installation, and interpretation of the geology and hydrogeology are provided in the discussion on local hydrogeology (see Section 4.4). The four groundwater monitoring well locations are designated OB-93-01 through OB-93-04. The groundwater sample identification number format is as follows: site identification, well reference number, and sample number (e.g., OBOD-MW1-001).

A summary of the chemical analyses performed on the samples collected from the OB/OD area are presented in Table 4-1. All samples (soils, groundwater, surface water and sediment) collected at the OB/OD area were analyzed for the following:

- explosives using EPA Method 8330 HPLC,
- priority pollutant (PP) metals using EPA Method 200/7000 Series - Furnace AA and ICP, and
- uranium using EPA Method 6020 - ICP/MS.

Because of the use of flammable liquids at the open burn pit, the one surface soil sample and the three subsurface samples collected from the boring installed at or near the pit were also analyzed for volatile organic compounds (VOCs) using EPA method 8240 and semi-volatile organic (SVOCs) compounds using EPA method 8270. Surface soil samples collected at the opening of the burn pit were analyzed for total petroleum hydrocarbons (TPH) using EPA Method 8015 modified.

In addition to explosives, PP metals and uranium, groundwater samples were analyzed for VOCs and SVOCs using EPA methods 8240 and 8270, respectively. These analyses were used to assess whether liquids used for ignition at the site have been released to groundwater and will also be a measure of potential releases associated with burning and/or detonation of chemicals containing these organic compounds. Also, groundwater samples were analyzed for anions, including the following: nitrate (method 335.2), nitrite (method 354.1), sulfate (method 9036) and phosphate (method 406C).

Also, four soil samples were analyzed for TCLP Metals (two surface soils and two subsurface samples from borings) using EPA Method 1311 for digestion and EPA Method 200 Series for measurement. Selection of samples for TCLP analysis was made based on the analytical results for priority pollutant metals from samples having the highest total metals concentration. The following samples were selected for TCLP analysis:

- Surface soil samples SS1 and SS6;
- Soil boring SB3 from 1.0 to 3.5 feet below ground surface; and
- Soil boring SB7 from 7.5 to 8.5 feet below ground surface.

4.1.1 Field Modifications to the SI

The Draft Final Sampling and Analysis Plan for Site Investigations of High Priority Sites at Fort Riley, dated 20 August 1993, provided a site sketch and proposed sampling locations for the Open Burn/Open Detonation Area. During implementation of the SI, some modifications to the site features depicted on the site sketch were made. As a result, some sampling locations were modified, maintaining the relationships between the site features and the samples being collected.

Two site sketches (Figures 4-1 and 4-2) are attached. Figure 4-1 is a copy of the site sketch from the SAP; and Figure 4-2 is a map showing site features as they were noted in the field during the SI. The map generated during the SI was assisted by land surveying of boring locations and pertinent site features. The differences between the site depicted in the SAP and that depicted on the SI sketch were outlined in writing during the course of the field activities. All parties to the IAG were consulted regarding the changes to the SAP. The changes that were discussed and made are presented below.

> The most significant changes in site features are as follows: (1) the OB/OD area does not extend as far to the west as depicted in the SAP, (2) the active burn pit is located slightly further to the south, and (3) the active demolition pits were located more to the north and west.
>
> Also, conditions at the site limited access to certain areas, as follows: (1) the land elevation dropped abruptly (approximately 5-feet) to the west of the site along the boundary into the mesic area; thus, access with a truck-mounted drilling rig was limited to the west; and (2) a high quantity of metallic debris detected during the UXO clearing attempts in the area of the active burn pit prevented drilling in and immediately adjacent to the pit due to the potential explosive hazard.
>
> Soil boring locations were revised to continue to provide adequate coverage for the site. These revisions were consistent with the procedures outlined in the SAP. One soil boring was proposed for the active burn pit area. A high amount of metallic debris was located in and around the burn pit. One boring location was cleared for unexploded ordinance; however, auger refusal was encountered at approximately 4 feet. Attempts to clear several other boring locations near the burn pit were unsuccessful. Therefore, the proposed soil boring location was moved to the east approximately 50 feet, to an area free of metallic debris.
>
> As planned in the SAP, a surficial soil sample was collected from inside the fire burn pit. To gather more information on the potential for petroleum contamination in subsurface soils at the pit, two hand auger borings were collected on either side of the bermed opening to the pit. The hand auger borings

SB 08
in rock

were shallow (less than 3 feet). At one location by the opening to the pit, slight petroleum odors were observed, although petroleum vapors were not sufficient to register on the Photoionization Detector (PID). As a result, samples from both auger borings on either side of the opening to the fire pit were transmitted to the laboratory for chemical analyses. The soil samples were analyzed for total petroleum hydrocarbons using EPA method 8015 modified. These two subsurface soil samples at the opening to the active burn pit were beyond the proposed sampling effort in the SAP; however, they were collected because the proposed soil boring in that location was moved to the east and because they provided additional insight regarding potential soil contamination at the site.

The SAP proposed the installation of three groundwater monitor wells downgradient of the OB/OD area. The well locations were proposed to be downgradient of the southeastern and southwestern corners of the site and downgradient of the site in a central location. Because the site did not extend as far to the west as depicted in the SAP, the well locations were modified to provide a better spacing along the downgradient side of the site. Specifically, the center well was moved to the east (to inside the loop road) and the western well was moved to the east (due south of the active fire burn pit). The revised location of the westernmost well was restricted by the mesic area located south and west of the active burn pit. The western well was located along an abandoned roadbed downgradient of the active burn pit and a pit of unknown origin. These revised well locations are consistent with the objectives proposed in the SAP.

4.1.2 Methods of Investigation

Site inspection field activities at the OB/OD area were performed during two cycles. These work cycles were pre-arranged with Fort Riley Range Control to insure that no ordnance demolition activities and/or weapons firing activities would be occurring during field activities. The first cycle of field activities occurred from 24 September to 3 October 1993 and the second cycle occurred from 20 October to 25 October 1993. UXO was the primary potential hazard of concern during field activities.

UXB, International provided initial UXO clearance of the OB/OD area prior to all field work and supervised admittance of all non-UXB personnel onto the site. At least two UXB personnel were on-site at all times during field operations to provide health and safety protection as it pertained to ordnance, UXO identification, avoidance, and possible clearance. These services were particularly critical during intrusive activities such as drill rig operations and hand auguring.

Site clearance of the OB/OD area by UXB, International resulted in finding UXO within the metal debris pits. This area was marked off with flags and excluded from entry by site personnel due to the risk of UXO. These pits contained the following: general purpose MK-Series bombs; practice bombs (BUD-33); projectiles (105mm, 120mm, 155mm, and 8-inch); miscellaneous small arms and pyrotechnic items; and various fuses and detonators. Clearing the soil boring locations near the detonation craters and burning ground took more time to clear than the other drill sites due to the amount of live ordnance found in this vicinity. Several paths selected for drill access were abandoned, due to the high concentrations of ordnance, and alternate routes were selected. The live ordnance found here included the following: projectiles (30mm TP, 20mm TP, 0.50 cal, 3.5-inch RKT, and 40mm HE); M550 fuse; 81mm HE mortars; and 152mm HE. Appendix D contains the report from UXB's field work.

During the SI field work, a pit was identified approximately 300 feet south of the active burn pit. No information is available pertaining to the origin or the time of formation of this pit. The pit is circular with a low (approximately 3 to 4 foot high) berm of soil. The inner diameter is approximately 40 feet and the outer diameter is approximately 70 feet.

Layne-Western Environmental Services, Inc. was subcontracted to perform rock coring/drilling, deep soil boring, and groundwater monitoring well installation operations. Three types of drilling equipment were used and included two types of auger drills (Acker Soil Max 90 and Mobile B-57) with hollow-stem augers (8-1/4 x 8-inch and 4-1/4 x 12-inch HSA) and one dual-tube reverse-circulation air-rotary drill (Schramm Roto-Drill, with 5-1/4-inch bit). The sampling equipment used for obtaining soil samples for lithologic descriptions in the overburden of monitoring well OB-93-01 consisted of 8-1/4 x 12-inch augers with an 18-inch split-spoon (2-inch OD, 1.5-inch ID) sampler. The 4-1/4 x 8-inch auger stems with a 5-foot Chicago Mining Equipment (CME) continuous sampler (3-inch OD, 2.25-inch ID) were used for the other monitoring-well overburden lithologic descriptions and for all the soil borings. The Mobile B-57 rig was also used for the rock coring of one monitoring well, OB-93-04, using an NX conventional core barrel cutting a 2.060-inch diameter rock core. After coring, the boring was reamed to 5-1/4 inch diameter using the reverse-circulation rig. The remaining bedrock monitoring wells OB-93-01, OB-93-02, and OB-93-03 were drilled using the reverse-circulation rig.

As described in Section 4.2, one depleted uranium (DU) containing round of ammunition may have been detonated at the OB/OD area. As a result, there was concern that those persons performing the SI field work could be exposed to radiation. The primary exposure pathway to DU at the site would have been via inhalation of dust. To prevent DU exposure, radiation monitoring was conducted prior to and during the SI field work. A Multi-Channel Analyzer (MCA) was used to monitor for DU gamma-ray spectra and a Geiger Muller (GM) instrument was used to detect beta, gamma, and x-ray activity. Both instruments were checked daily for accuracy against a known thorium source, and daily background measurements were made at the entrance to the OB/OD area on Vinton School Road. An MCA survey was conducted prior to any boring activities. The MCA instrument was set up at each borehole and monitoring well location prior to drilling or hand augering, and 20-minute readings were taken. The MCA collects gamma spectra and displays the data as values in four range groups. The four range groups correspond to energy ranges (electron-volts) from gamma rays, and the groups are referred to as Range-of-Interest (ROI). These ROI groups are an aid to data segregation for analysis and display. Counts for each ROI are summed and displayed by the MCA. The gamma-signature field readings of the MCA are then compared to a set of readings made against a DU sample. Using this known DU spectra, action levels for the three highest ROI groups were determined. Action levels for the different ROI readings above background for the MCA instrument are: ROI-1 (2000); ROI-2 (1500); and ROI-3 (200). If any two out of the three levels were exceeded, field work in the area was to be suspended and a health physicist notified. Background levels were not exceeded during the MCA survey. The MCA ROI readings appear in Appendix E.

Geiger Muller (GM) surveys were conducted on all vehicle (e.g. drill rig) and personnel access ways by attaching the GM probe to a walking stick to facilitate keeping the detector within 2 inches of the ground surface. Specific sample collection locations, samples, drill cuttings, and personnel (gloves, hands, boots, and clothing) were also screened. Documentation of instrument accuracy source checks are included in Appendix F.

4.2 Site History and Activities

The explosive ordnance detachment (EOD) unit at Fort Riley recovers ordnance materials from Fort Riley and from a multi-state area for the Department of Defense and other state and federal agencies. Effective August 1991, the mission of the 74th EOD at Fort Riley, Kansas has been to provide routine and emergency EOD support to military installations, operations, and exercises, and to civilian and Federal authorities within its assigned geographical area of operation. This area of operation includes Kansas, Nebraska, parts of Missouri, and parts of South Dakota.

The 74th EOD Detachment currently performs ordnance disposal by open burning and open detonation at Range 16 within the Impact Area of Fort Riley. Figure 4-3 provides the general location of the EOD range, which is synonymous with the OB/OD area. The area currently used at the OB/OD area is approximately 1,000 feet by 350 feet and has been used for this purpose since 1941. At the time of the SI, three active detonation pits, one active burn pit, and two metal debris pits (Figure 4-2) were present.

As described in the Part B Subpart X Permit Application for Fort Riley (21 May 1993), open detonation is conducted whenever a sufficient amount of materials has been received, typically on a quarterly basis. The quantity of materials to be disposed of varies, but each detonation typically includes 50 to 500 rounds of high explosive and propellant rounds; however, some detonations have included up to 2,000 rounds. The materials are destroyed by detonation. The primary material used for detonation is C4 (91% Cyclotrimethylenetrinitramine (RDX) and 9% plastic desensitizer [pdiso-batylene]) (Ref. 33); other materials used for detonation include 2,4,6-Trinitrotoluene (TNT) and flexlinear (RDX). Open detonation is conducted on the open ground, and this creates crater-like pits in the natural soil of the OB/OD area. These pits are the result of the detonations and increase in size with use. The pits generally reach a maximum size of 10 to 20 feet deep and 25 feet in diameter. Open detonation pits are filled in approximately once per year by backfilling the blast-excavated soil surrounding the pits.

Open burning is conducted approximately once per year for ordnance materials containing relatively small amounts of explosives; these include small arms, pyrotechnic rounds, black powder, and phosphorous-based munitions. Open burning is performed at a specific, dedicated location within the OB/OD area referred to as the open burn pit. This area contains a small pit within the soil on which a metal grating rests. The pit measures approximately 3 feet by 7 feet wide and is surrounded by a horse-shoe shaped embankment approximately 9 feet above the surrounding ground surface. Materials are disposed of by dousing them with petroleum hydrocarbons (typically diesel fuel) and igniting them.

In December of 1990, one 105 millimeter DU round was inadvertently included in ordnance disposal activities (Ref. 34). The round contained an eight pound DU penetrator, described by the Army as a cylindrical object with a diameter of approximately one-inch and length of approximately one foot. The detonation of the DU round was accidental; the round had been mistakenly classified and labelled. Upon discovery of its detonation, the site was visually searched, and in June 1993, the surface of the detonation area (Area A, Figure 4-2) was surveyed for radioactivity using Radiac meters by an EOD lead search crew. Every square foot of the detonation area was measured; no trace of the DU penetrator was uncovered as a result of either search effort. The U.S. Army Armament Munitions and Chemical Command (AMCCOM) holds the license for handling DU. The AMCCOM Safety Office has sent a final letter (9 Aug 1993) to the Nuclear Regulatory Commission regarding this incident and considers the incident closed. (A fact sheet and a copy of the letter are provided in Section 8, Excerpts.)

Never Confirmed;
Probably misidentified

4.2.1 Site Setting

Figure 4-4 shows the topographic setting, the 1-mile radius area of influence, and existing wetlands. The OB/OD area lies between two tributaries to Threemile Creek. Both are intermittent streams. (As noted previously many of the streams on Fort Riley are depicted as perennial streams on the U.S.G.S. 7.5 minute topographic quadrangles but are depicted as intermittent streams on the Fort Riley installation map prepared by the Defense Mapping Agency. During previous investigations of the Impact Area and other sites, stream flow was absent from many of these streams; therefore, for purposes of this SI, the stream designations depicted on the Defense Mapping Agency map are used.) The tributaries located to the east and west of the site join about 1,000 feet south of the southern site boundary. This single tributary continues south another 2,000 feet where it joins Threemile Creek. From this point, Threemile Creek flows southeast and joins the Kansas River at the west side of Camp Funston. As shown on Figure 4-5, surface water runoff from the active area is to the south and west, towards the intermittent stream located to the west.

The nearest groundwater withdrawal well to the OB/OD area is located at Range 18 approximately 4,220 feet to the east-southeast of the site. This well is only used at the Range 18 maintenance facility for non-potable purposes. No other wells fall within the 1-mile radius. The next nearest wells are the Ogden supply wells located approximately 3 miles southeast of the site; these wells and other area wells are discussed below under Section 4.4.

There are no known uses of surface water as potable water within 15 miles downstream of the site.

The nearest residence lies 2.5 miles east of the site on Vinton School Road. The town of Ogden lies between 3 and 4 miles southeast of the site.

A mesic (wet) area approximately 700 feet by 600 feet in size (10 acres) is located between the OB/OD site and the west tributary to Threemile Creek. This area is not listed as a wetland on either the U.S.G.S. 7.5 minute topographic quadrangles, the Fort Riley installation map prepared by the Defense Mapping Agency, or the National Wetlands Inventory.

Human receptors within a 1-mile radius of the site include personnel of the OB/OD area during OB/OD activities and army personnel in areas adjacent to the OB/OD area. These receptors are considered transient since they only use the areas on a limited basis and do not regularly work or live at or near the site.

Surrounding land use consists of military training grounds to the south, an artillery and mortar impact area to the north, and some wheat and grass farmlands to the southeast. Access to the OB/OD area is restricted to EOD personnel, which only enter the area to perform disposals.

4.2.2 Photodocumentation

A photodocumentation log is provided to depict characteristics of the site, including site features, field operations, sample locations, and monitoring well installations. With two exceptions, all photographs were taken during the SI field activity. Taken in April 1993, a panorama of the site is included to indicate the general topography of the area. Also, a photograph indicating a typical open detonation pit is included and was also taken in April 1993. A site map is included with the photographic log showing each photograph location and viewing direction (see Figure 4-6).

4.2.3 Previous Investigations and Permit Status

Previous investigations pertaining to the OB/OD area include the *Impact Area Site Assessment Report, March 11, 1993* (Ref. 35) and a *Subpart X Portion of RCRA Part B Permit Application for OB/OD area, May 21, 1993* (Ref. 36). As discussed previously, the OB/OD area is located within the Impact Area, and the results of the Impact Area environmental investigation are used to compare with the results of the SI for this site. The Subpart X Permit Application was submitted to the Kansas Department of Health and Environment (KDHE) and state regulatory agencies. [Appendix G contains excerpts from the Subpart X RCRA permit application for the OB/OD Area.] The OB/OD area at Fort Riley currently operates under interim status.

Resource Conservation Recovery Act (RCRA) standards are applied on a case-by-case basis under Subpart X. Open burning/open detonation units are "miscellaneous units" covered by Subpart X of the Code of Federal Regulations (CFR) 40 Part 264 which contains the technical (and environmental) performance standards for owners and operators of hazardous waste management facilities.

Assessment of the potential for adverse effects on human health and the environment is of primary importance in developing a Part B Subpart X Permit Application. This includes assessment of the possible migration of any contaminants via soil, surface water, groundwater, or air pathways. According to *RCRA Guidance Manual for Permitting Commercial Explosives Industry Open Burning/Open Detonation Units* (Ref. 37), initial field investigations at a OB/OD site typically concentrate on near-surface soil (i.e., within 5 to 10 feet of the surface). It is recommended that samples be collected and analyzed to determine the physical and chemical parameters that affect contaminant migration. Also, it is recommended that monitoring wells be used to collect samples to determine water quality with the objective of defining the parameters for determining background water quality and, for existing units, the impact of unit operations on groundwater.

4.3 Waste Characteristics

According to the Subpart X Permit Application, the EPA RCRA hazardous waste codes for hazardous waste treated at the OB/OD area are D001 and D003. Wastes which exhibit an ignitability characteristic (i.e., the waste is a liquid, and has a flash point of less than 140 degrees Fahrenheit) are assigned the EPA hazardous waste number of D001. Wastes which exhibit the RCRA characteristic of reactivity are assigned the EPA hazardous waste number D003. Reactivity is more difficult to determine because there are no absolute quantitative tests to define it.

Excerpts of the Subpart X Portion of RCRA Part B Permit Application provided in Appendix G include the following:

- Table of Munitions and Ordnance Treated at the 74th EOD area OB/OD Range
- Table of Munitions and Ordnance Chemical Compositions
- Table of Typical Constituents of Various Types of Munitions and Ordnance
- Table of Physical and Chemical Properties of Explosives and Fillers
- Summary discussion of principal explosive and chemical specific components

In general, the potential contaminants include a broad range of nitroaromatic and nitroamine explosives as well as metals from fragments of shell casings. In addition to possible chemicals associated with munitions and ordnance disposed at the site, two other possible sources of contaminants are potentially present at the site. First, as previously discussed, one round containing DU is reported to have been disposed of at the site. Disposal of a DU-containing round was a one-time event, and no evidence of the DU is present at the site despite several thorough searches of the area. During the SI, radiation surveys were conducted along all pathways used for ingress and egress to the site. (See Figure 4-7) The GM and MCA radiation surveys conducted during the SI did not detect any activity above natural background. All MCA readings appear in Appendix E. The other possible source of contaminants pertains to the use of flammable liquids as a burn agent in the disposal of ordnance in the open burning pit. The predominant flammables used in recent times are diesel fuel and kerosene. However, since the site was in operation since 1941, it is possible that a variety of flammable liquids have been used at the site, including waste solvents.

A summary of the chemical analyses performed on the samples collected from the OB/OD area are presented in Table 4-1. A summary of analytical results are presented by media in Tables 4-2 through 4-7. The results are compared with regulatory standards, as discussed in Section 1.0. In addition, the results for the groundwater and stream sampling are compared with the findings for the Impact Area. (There are no comparable results for soils in the Impact Area investigation.)

Table 4-2 presents the positive detections for the eight surface soil samples. The samples were analyzed for VOCs, SVOCs, explosives, priority pollutant metals and uranium. Explosive compounds (RDX and Dinitrotoluene - DNT) were detected at two locations -- SS1 and SS3. SS1 was collected from within the open burn pit and contained DNT.

Di-n-butyl-phthalate was also detected in SS1. SS3 was collected from within a detonation pit and contained DNT and RDX. SS3 was collected in duplicate and while DNT was reported in both fractions, RDX was reported in only one fraction. This difference is attributed to heterogeneity in samples sent to the laboratory. The explosive materials visible at the site occur as fragments, and the presence of explosive fragments in one fraction of a duplicate but not the other could account for differences in analytical results. Metals, including uranium, were detected in all samples. No concentrations exceeded regulatory standards or risk-based guidelines.

Table 4-3 presents the positive detections for the 8 deep (23 samples) and the two shallow (two samples) soil borings. The samples from the deep soil borings were analyzed for VOCs, SVOCs, explosives, priority pollutant metals and uranium. Of the deep soil borings, seven of the eight borings were drilled to depths of 18 to 20 feet. At SB8, auger refusal was encountered at less than 10 feet. In general, undisturbed soils were encountered at depths of two to six feet beneath the surface. For borings SB1 through SB7, the shallowest sample includes disturbed soils, the middle sample is from undisturbed soils immediately beneath the disturbed soils, and the deep sample is from undisturbed soils at greater depth. At boring SB8, only the disturbed soils and the immediately underlying soils were sampled. As shown in Table 4-3 (page 3 of 3), the explosive DNT was detected in only one sample, the shallow sample from SB8. Metals, including uranium, were detected in all samples. None of the detections exceeded regulatory standards or risk-based guidelines. The samples from the shallow soil borings were analyzed for TPH; concentrations were below detection in both samples.

Table 4-4 presents the positive detections for the stream aqueous samples. The samples were analyzed for VOCs, SVOCs, explosives, priority pollutant metals and uranium. Only uranium and silver were detected. Uranium was detected in both samples; the detected concentrations were below the maximum concentration detected for the Impact Area investigation and below the MCL for uranium by one order of magnitude (0.0024 mg/l, 0.0021 mg/l v. 0.02 mg/l MCL). Silver was detected in one sample.

Table 4-5 presents the results of the stream sediment sampling. The samples were analyzed for VOCs, SVOCs, explosives, priority pollutant metals and uranium. No VOCs, SVOCs or explosives were detected. A variety of metals, including uranium, were detected in all samples. The concentrations in SD-1, the upstream sediment sample, are the same (and sometimes higher) than the concentrations in the downstream sediment samples. The detected concentrations were below regulatory standards and risk-based concentrations. The detected concentrations were also at or below the concentrations detected in the Impact Area Investigation.

Table 4-6 presents the results of the groundwater sampling. Following the discussion of the groundwater analytical data, an overview of the groundwater setting and well placement is provided. The samples were analyzed for VOCs, SVOCs, explosives, priority pollutant metals and uranium. There were no detections for SVOCs or explosives. The positive detections in groundwater include uranium, sulfate, nitrate and trichloroethylene (TCE). The highest concentration for uranium was reported for OB-93-01 (.0043 to .0057 mg/l) whereas the upgradient well, OB-93-02, had a reported concentration of .0023 mg/l. The highest uranium concentration for groundwater in the Impact Area investigation is 0.0048 mg/l (Ref. 35). The detected uranium concentrations do not exceed regulatory standards. Similarly, the detections of nitrate and sulfate do not exceed regulatory standards. The detections of TCE range from 1.3 μg/l in OB-93-03 to 29 μg/l in OB-93-04. The concentration in OB-93-04 exceeds the MCL and KAL of 5.0 μg/l.

Based on the initial results for the surficial and soil boring samples, the four samples with the highest metals concentrations were selected for TCLP analyses (metals only). These samples were OBODSB-3001, OBODSS-1001, OBODSS-6001, and OBODSB-7003. The positive detections for the TCLP analyses are shown in Table 4-7. As shown, only barium and lead were detected. Neither exceed the concentrations at which the soils would be considered a RCRA hazardous waste.

Uranium was detected at low concentrations in soils at the site. The uranium concentrations were lower than those detected in the Impact Area investigation. As part of the Impact Area investigation, samples were also analyzed for isotope specific uranium to distinguish naturally-occurring uranium from man-made sources. All isotope-specific analyses indicated that the uranium detections in the Impact Area investigation were all from naturally-occurring sources. Since the concentrations of uranium for the OB/OD area were lower than those determined to be naturally-occurring for the Impact Area as a whole, no uranium isotope-specific analyses were performed for this SI. All the uranium detections at this site are attributable to natural background.

4.4 Groundwater

4.4.1 Regional Hydrogeologic Setting

Riley and Geary Counties lie within the belt of outcropping Permian rocks that occurs in east-central Kansas. These strata encompass two groups of rocks within the Wolfcamp Series of the Permian System. These are the Chase and Council Grove Groups. All but the upper 25 to 35 feet of the Chase and the lower 15 to 30 feet of the Council Grove are present at the Fort Riley Impact Area. The stratigraphic section and description of the rock units are shown in Figure 4-8 and Table 4-8. These rocks form a sequence of alternating limestone and shale units. Some units have gradational characteristics (e.g. shaly limestone, calcareous shale). Also, some limestones are cherty, and some shale units contain gypsum and/or anhydrite stringers. The shales vary in color, having hues of gray, green, and red. This sequence of rocks dips gently (0.5-1.0 degrees) to the west-northwest. The dip is due to the position of Fort Riley with respect to the major regional geologic structures; it lies between the northeast/southwest-trending Abiline and Nemaha anticlines. Surface materials over the area consist of loess, soil, and highly weathered shale that typically make up the upper 20 feet of substrate in the Fort Riley area. Quaternary alluvial deposits locally associated with the major rivers locally are greater than 100 feet thick and form important aquifers in the Fort Riley area.

With respect to recharge, the soils found at the OB/OD area generally have a high available water capacity and, in general, readily take water. Surface run-off is moderate. Infiltration of precipitation would move downward through the soil layer. The soils at the site are depicted on Figure 4-9. As shown, the soils in the area of the OB/OD are characterized as silt loams and silty clay loams.

Although the top of bedrock is believed to be fractured and therefore relatively permeable, groundwater may locally accumulate at the contact between the unconsolidated materials and bedrock. This is especially likely if bedrock fractures are relatively few or are restrictive (i.e., tight) enough to inhibit downward percolation of groundwater. The movement of any groundwater occurring at this contact or in the unconsolidated material would typically be controlled by surface topography. The surface topography at the OB/OD area slopes to the south toward Threemile Creek and west toward the mesic area.

As described in the Impact Area Site Assessment, groundwater infiltrates fractures and joints of the alternating limestone and shale beds below the unconsolidated material. Some of the limestones, such as the Towanda, Fort Riley, and Funston, also have a degree of primary permeability and are able to store and transmit groundwater.

Groundwater flow directions in the bedrock have not been definitively determined throughout the Impact Area because of the wide distribution of wells and varying bedrock units in which the wells were completed. A three-point gradient calculation was made using water levels in wells IZ92-002, 003 and 004, that were all completed in the Fort Riley limestone. This correlation suggests that groundwater, at this position in the Impact Area, is moving west down structural dip.

Transmissivity estimates made for four of the ten monitoring wells completed in limestone in the Impact Area had values of 0.7 square feet per day in IZ92-010, 580 square feet per day in IZ92-008, and approximately 80 square feet per day in wells IZ92-004 and 005.

Because most recharge is to shallow intermittent aquifers, discharge is primarily to streams and tributaries, producing year-round flow in the lower reaches of Honey, Sevenmile and Threemile Creeks. Some groundwater does infiltrate deeper into underlying rock units and encounters the regional groundwater system that has flow components to the west, south, and east. Figures 4-10 and 4-11 present the regional and local groundwater flow systems. The local flow system, noted by the short-dash lines, is intermittent. That is, the shallower rock units that are able to store and transmit water, as evidenced by streamflow, seeps, and springs, are not fully saturated year round. The regional system, which is what maintains flow in the larger perennial streams, is fully saturated and is represented by the long-dash line on Figure 4-11. General flow direction can be determined by the slope of the flow system lines shown in these figures. In the local system, flow is intercepted by the various local stream valleys. In the regional system, it is the perennial streams that are intercepted. These figures are based on an interpretation using regional hydrogeologic principles, not solely upon extensive site-specific data.

Other groundwater discharge occurs as evapotranspiration where seeps and intermittent springs encounter the root zone of plants, and to an even lesser extent, through groundwater wells.

4.4.2 Site Hydrogeology

Four monitoring wells were drilled at the OB/OD site. The lithologic logs were developed from the drill cuttings and rock core, which provide the stratigraphic information for the site. The total depths of the wells range between 51 and 77 feet below ground surface. Lithologic logs are provided in Appendix C. Elevation differences of the wells resulted in approximately 100 feet of stratigraphic section being intercepted by these monitoring wells. These rocks lie mostly in the lower Chase Group. Depth to bedrock at the site ranges from approximately 10 to 20 feet. The stratigraphic members are as follows: Blue Springs shale, Kinney limestone, Wymore shale, Schroyer limestone, Havensville shale, Threemile limestone, and Speiser shale. The site cross-sections (Figures 4-12 and 4-13) show the stratigraphic correlations, depths, and the screened interval for each monitoring well. The Schroyer limestone and underlying Havensville shale provide the principal correlative units. The Havensville shale in particular provides a distinct marker bed of very dark grey to black shale found in all four OB/OD monitoring wells as well as in the nearby Impact Area monitoring wells IZ92-10 and IZ92-11. The lithologic units of the OB/OD monitoring wells were correlated to the Impact Area monitoring well IZ92-10. Well IZ92-10 was chosen over IZ92-11 because it intercepts stratigraphic units above the Havensville Shale comparable to that found in all the OB/OD monitoring wells. Also, a natural gamma downhole geophysical log (run in this well on November 19, 1993) serves as an indicator of lithology. Figure 4-14 shows the gamma log trace, stratigraphic units, and their correlation with the OB/OD wells OB-93-01 and OB-93-02.

The depth of each well was determined on an individual basis depending on the depth at which the first water-bearing zone containing sustainable groundwater (i.e., 1 gallon per minute or more) was encountered. If groundwater flowed into the open borehole at 1 gallon per minute or less, then it was determined that the yield was insufficient, and the boring was advanced to a greater depth. The Fort Riley area was subjected to excessive precipitation and regional flooding during the summer of 1993. There was concern during the SI field work that groundwater beneath the site may be abnormally elevated and/or present in subsurface units which do not typically contain water during normal precipitation years.

Moist zones within the overburden were encountered while drilling three of the four groundwater monitoring wells (OB-93-01, OB-93-03, and OB-93-04); none of the soil borings encountered any water in the overburden. The only saturated zone that occurred at the overburden/bedrock contact was in monitoring well OB-93-04. All of the saturated zones were associated with weathered limestone. The auger cuttings produced from these zones were limestone fragments with clay or limestone with sandy silt and clay. However, not all zones with limestone fragments were saturated. The water encountered on top of bedrock at OB-93-04 was several inches in thickness. This water was bailed, but did not recover within a period of several hours. Flow into these borings was estimated to be significantly less than 1 gallon per minute. Therefore, these wells were advanced into bedrock and completed in the first, sustainable, water-bearing zone. As outlined in the SAP, wells were completed in the first sustainable water as the most likely location to detect contaminants being released from the area.

Monitoring wells OB-93-01 and OB-93-02 are screened in the Schroyer limestone, and wells OB-93-03 and OB-93-04 are screened in the Threemile limestone. Since the uppermost sustainable water bearing unit varies from east to west across the site, there are only two static water level control points for each limestone unit. Consequently, the hydraulic gradients cannot be determined for either limestone as three points are the necessary minimum to determine groundwater flow direction; therefore, no potentiometric surface maps could be prepared.

The static water levels in all the OB/OD area monitoring wells are above the screened intervals, indicating confined conditions. Due to the alternating limestone/shale rock sequence, each limestone unit appears to be hydraulically confined by its overlying and underlying shales.

4.4.3 Groundwater Use

Groundwater wells used for potable water within the 4-mile radius of the OB/OD area are shown in Plate 2-1.

Fort Riley also operates several wells that draw from bedrock formations. These include wells at Range Control, MPRC/Douthit Range, Trainfire 4 (TF4), and Range 18. The Range Control well is approximately 3 miles northwest of the site and is regularly used as a source of drinking water for approximately 12 people. The wells at MPRC/Douthit

Range are approximately 12 miles northwest of the site and are used for drinking water on an as-needed basis; they can provide water for the current capacity of the facility (approximately 600 people). The closest groundwater withdrawal well is located at Range 18 approximately 4,220 feet to the east-southeast of the OB/OD area in the SE 1/4 of the NW 1/4 of the SW 1/4, Sec. 34, T10S, R6E, Fort Riley NE 7 1/2 minute quadrangle; however, groundwater from this well is only used at the Range 18 maintenance facility for non-potable purposes. Specific information pertaining to this well (such as depth and construction material) is unavailable. Given the location of this well on an upland area, it is probable that it is completed in a bedrock aquifer. As discussed above, groundwater flow at depth is most likely to the west, placing this well upgradient of the OB/OD area.

The historical and current sources of water at Fort Riley, Junction City, Ogden, Manhattan, and other communities along streams and rivers have been large production wells completed in the associated alluvial deposits within the river flood plains. These wells are generally less than 100 feet deep.

Currently, the producing well field for Fort Riley is located west of Main Post along McCormick Road in the Camp Forsyth area. The supply system consists of six older wells (referred to as Main Post wells brought on-line from 1928 to 1943) and two newer wells (referred to as Forsyth wells brought on-line in 1993); all eight wells draw from the Kansas River alluvial materials. All eight wells are blended into a single distribution network that supplies the cantonment areas. This group of wells is approximately 5.5 miles southwest of the OB/OD area.

The communities of Junction City, Ogden, and Manhattan rely on groundwater withdrawn from alluvium associated with the Kansas River as their municipal supply. Junction City has nine active wells, Ogden has three active wells, and Manhattan has nine active wells. Only the Ogden wells lie within the 4-mile radius of the OB/OD area and are approximately 3 1/4 miles southeast of the OB/OD area. The Ogden well group serves 1,494 persons within the Ogden city limits and another 2,057 persons within the township limits that make up a rural water district (Ref. 17). The rural water district is adjacent to the northeast boundary of Fort Riley and includes the town of Keats. One private irrigation well completed in alluvium was identified within one-quarter mile of Fort Riley. It is located within the small area of private land that occurs north of the Kansas River between Camp Whitside and Funston and is approximately 3 1/2 miles south of the OB/OD area.

4.4.4 Groundwater Analytical Results

Table 4-6 presents the results of the groundwater sampling. The positive detections in groundwater include uranium, sulfate, nitrate, and trichloroethylene (TCE). Section 4.3 provides a detailed discussion of the results.

4.5 Surface Water

The major river in the Fort Riley area is the Kansas River, which flows northeast along the southern boundary of Fort Riley. Two streams and their tributaries lie within the 4-mile radius of the OB/OD area. These streams are Sevenmile Creek and Threemile Creek; both streams are intermittent within and downstream of the Impact Area and become perennial as they approach the Kansas River. Only Threemile Creek is influenced by surface flow from the OB/OD area. Threemile Creek and its tributaries have fairly steep banks and essentially no floodplains.

The OB/OD area lies between two tributaries to Threemile Creek. Discharges for these streams have not been quantified. Between the site and the west tributary is a mesic area of approximately 10 acres. The surface water migration pathway from the site to the stream would pass through this mesic area (Figure 4-2).

There have been no previous samples taken from the streams adjacent to the site or downstream points along Threemile Creek. There are no known uses of surface water for drinking within 15-miles downstream of the site.

The mesic area may be considered a sensitive ecologic environment along the surface water and shallow groundwater migration pathway.

4.5.1 Surface Water Uses

The nearby streams are intermittent. There are no perennial streams within 1 mile of the site. Thus, no surface water migration pathways are evaluated.

4.5.2 Surface Water Analytical Results

Table 4-4 presents the results of the two stream aqueous samples. Uranium was detected in both samples. The concentrations are below regulatory standards and below the highest level reported in the Impact Area investigation. No other contaminants were detected.

Table 4-5 presents the results of the three stream sediment samples. A variety of metals, including uranium, were detected in all samples. The concentrations in SD-1, the upstream sediment sample, are the same (and sometimes higher) than the concentrations in the downstream sediment samples. With the exception of beryllium, the detected concentrations were below the highest reported concentration for the Impact Area investigation.

4.6 Air

There are no persons living on or within 200 feet of the site as it is a restricted area; in fact, there are no persons living within 2 and a half miles of the site. The active demolition area is approximately 3,000 feet north of Vinton School Road. Approximately half of the 20,800 military personnel and workers plus 7,600 on-post dependents (approximately 14,000 persons) are within the 3 to 4 miles of the OB/OD area. Also, the city of Ogden population (1,494) and its rural township limits population (2,057) occur mostly within 3 to 4 miles, resulting in another 3,551 persons. Therefore, the total population within a 4-mile radius of the site is approximately 18,000 (Ref. 11-14).

Air emissions from OB/OD area have not been monitored. Currently, the OB/OD area lies within the Impact Area. However, the nature of the treatment of munitions and ordnance is such that little ash and residue are generated. The prevailing wind directions vary. The winds are predominately from the south and southwest for ten months of the year, with winds predominately from the north during the months of February and March. Disregarding the effects of dilution and dispersion, it is highly unlikely that particulates resulting from activity at the OB/OD area could migrate via the air pathway the horizontal distances necessary to reach any populated areas.

4.7 Soils

The uppermost overburden at the OB/OD area generally consists of less than 1 foot of black, clayey soil with some organic content; this soil has developed on the underlying colluvial clay present throughout the site. Unconsolidated colluvium constitutes the overburden above bedrock and weathered bedrock throughout the OB/OD area, and ranges in thickness from 5 to 20 feet. The colluvium is dominated by clay, which is usually reddish brown to dark brown, and varies in consolidation and plasticity depending upon whether it is dry or slightly moist. The clay is commonly silty and contains sand and gravel-sized angular limestone fragments. Thin layers of clayey silt and medium to fine clayey sand are subordinate in the overburden, except at OBOD-93-01, where a 13-foot layer of silty clayey sand lies between the brown clay and bedrock. At three of the soil borings and one of the monitoring wells, 2 to 14 feet of weathered shale, distinct from the colluvial clay, were penetrated by auger drilling before refusal was encountered in harder bedrock. Total overburden thickness ranges from 4.5 to 37.3 feet. The presence of low yield (i.e., less than 1 gallon per minute) moist and wet zones within the overburden is discussed in Section 4.4.2.

The OB/OD area is within the Impact Area. Therefore, population and worker exposure to soils at the OB/OD area is very low since it has restricted and controlled access. The potential for the non-military public, such as passersby, to be exposed to any contamination originating at the site is extremely low to nonexistent. The nearest public land use would be farmland to the southeast, several miles from the site.

Army personnel involved with OB/OD activities periodically occupy the site. The number of personnel involved in these activities is typically from four to six. It is possible that potential exposures to Army personnel could result from working in and around the OB/OD pits. However, since OB/OD activities are conducted on an infrequent basis (i.e., approximately once every quarter), exposures to any contaminants are anticipated to be minimal.

4.8 Discussion

4.8.1 Groundwater

Groundwater analyses include: explosives, metals, uranium, anions (e.g., sulfate and nitrite), volatiles (e.g., trichloroethylene), and semi-volatiles.

The detected uranium concentrations in groundwater do not exceed regulatory standards. Similarly, the detections of nitrate and sulfate do not exceed regulatory standards. The detections of TCE in groundwater range from 1.3 μg/l in OB-93-03 to 29 μg/l in OB-93-04. The concentration in OB-93-04 exceeds the MCL and KAL of 5.0 μg/l.

In an effort to determine past practices of the explosive ordnance detachment (EOD) and to determine the origin of TCE in the groundwater at the OB/OD Area, personnel at the DEH (Ref. 38) contacted a former EOD employee who participated in OB/OD activities during the 1960s. This person stated that kerosene and diesel fuel were almost exclusively used except for the occasional use of gasoline as a fuel during demonstrations. This former employee had no knowledge of the use of TCE or the disposal of TCE at the site.

In addition, the present commanding officer of the 74th EOD at Fort Riley had no knowledge of the use or disposal of TCE at the site. The origin of the TCE in the groundwater beneath the OB/OD Area is, therefore, unknown.

Trichloroethylene was not detected in either the trip blank or field blank associated with this groundwater sample, indicating that TCE was not introduced into the sample as a result of shipping or equipment decontamination procedures in the field.

Trichloroethylene is not typically associated with munitions and ordnance or their disposal at OB/OD sites. The source of TCE in the groundwater at the OB/OD area is not readily apparent. However, a possible explanation may be that TCE (which is nonflammable), was used as a fire extinguishing agent. Some TCE may have also been present in waste fuels used at the site. The TCE fraction of the burn agent may have not been combusted, leaving the TCE to migrate (via soil and surface water) into the groundwater. TCE is a volatile organic with a low octanol carbon coefficient (K_{OC}) of 126 milliliters per gram (Ref. 39) indicating that it is relatively mobile in the environment. It is noteworthy that TCE was not detected in other sample media collected at the site, indicating that there does not appear to be a widespread source of TCE at the site.

K_{oc} is partition coefficient for organic carbon

K_{ow} is octanol-water partition coefficient

4.8.2 Stream Aqueous and Stream Sediment

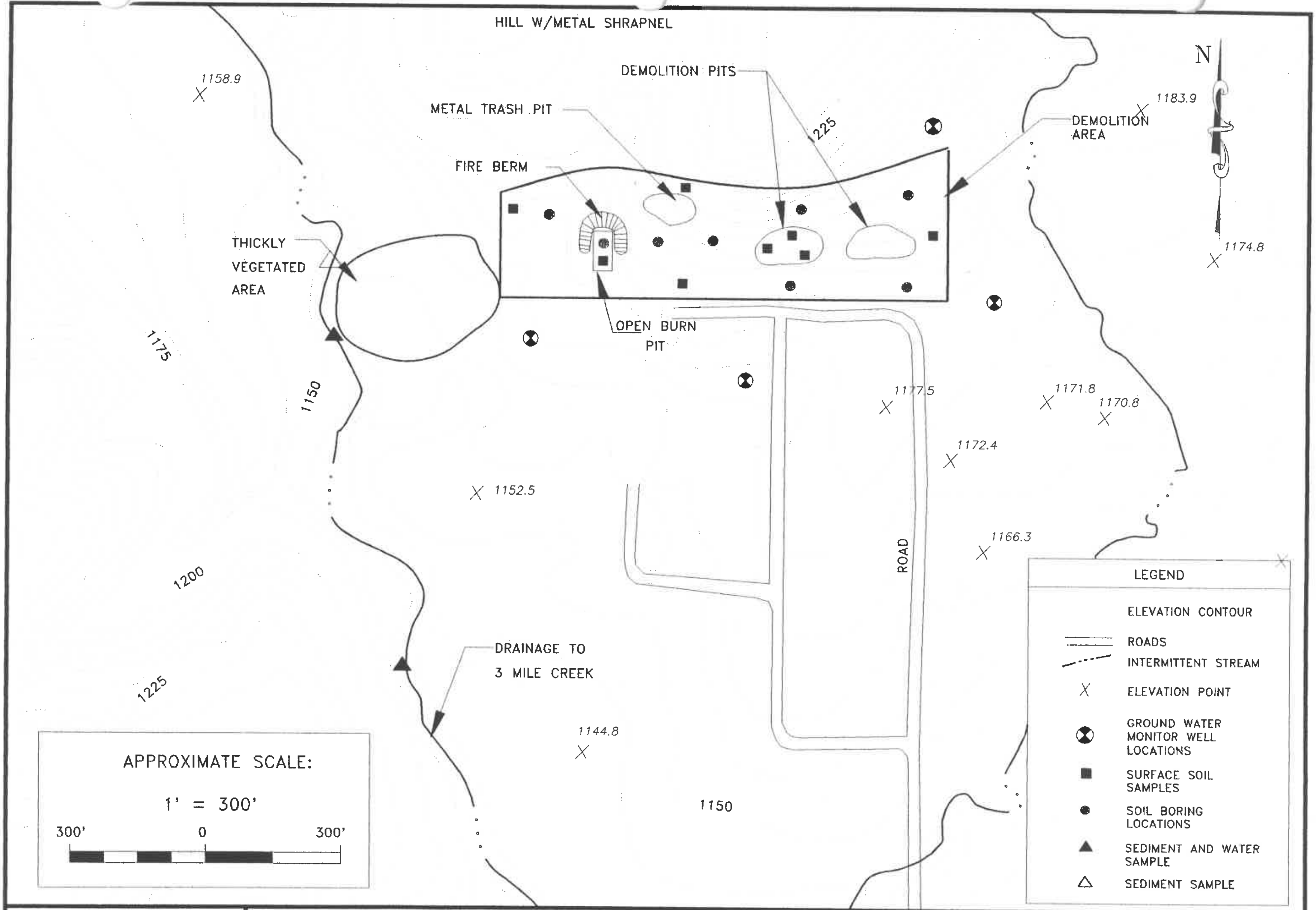
With the exception of beryllium, the detected concentrations were below the highest reported concentration for the Impact Area investigation. Only beryllium exceeded the risk-based concentrations for industrial/commercial soils. Beryllium is not typically associated with munitions, ordnance, or OB/OD activities (see Appendix G). Furthermore, beryllium was detected in all three samples, including the upstream sample, at similar concentrations. Therefore, the beryllium detections are considered representative of background concentrations.

4.8.3 Air

No air sampling was conducted as part of the SI. The detonation and burning of the ordnance is expected to result in a high degree of destruction of the explosive contaminants -- the by-products of which are principally carbon dioxide and water. Releases of particulates to the air during this process potentially occur. Current burning and detonation is conducted under the RCRA Part B permit application for Fort Riley. As a result, the State of Kansas has determined that this activity complies with the state's open burning regulations -- K.A.R. 28-19-47.

4.8.4 Soil

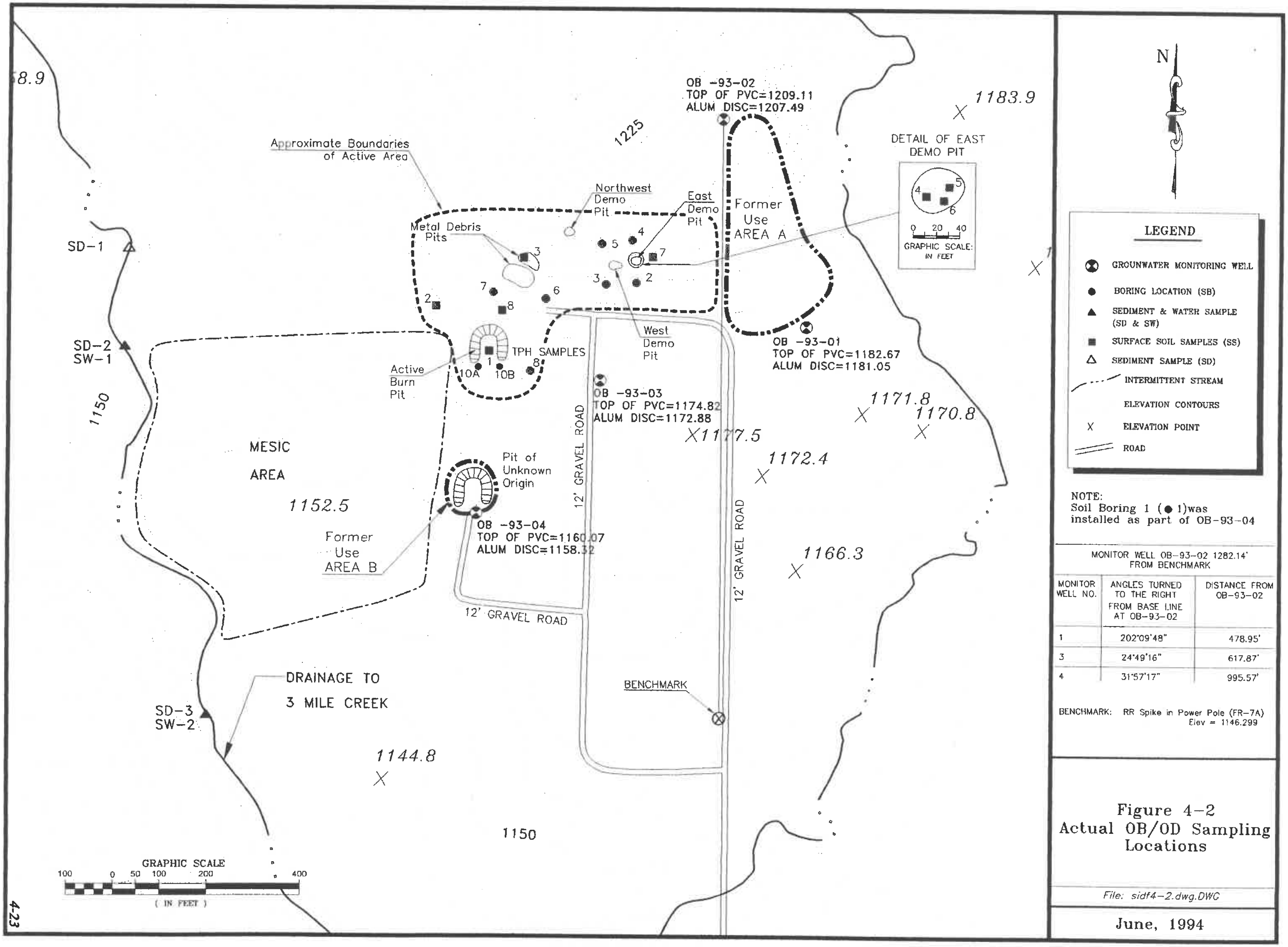
Given the total occurrence of only three detections of explosive chemicals within near-surface soils at the site, explosive residues within soils appear to be rare across the site. In addition, sample analysis indicates that these contaminants have not leached below surface soils. Therefore, contaminants resulting from explosive residues at the site do not appear to represent a risk to human health or the environment.



File: SIDF4-1.dwg

June, 1994

FIGURE 4-1: PROPOSED OB/OD SAMPLING LOCATIONS



NOTE:
Soil Boring 1 (● 1)was installed as part of OB-93-04

MONITOR WELL OB-93-02 1282.14' FROM BENCHMARK

MONITOR WELL NO.	ANGLES TURNED TO THE RIGHT FROM BASE LINE AT OB-93-02	DISTANCE FROM OB-93-02
1	202°09'48"	478.95'
3	24°49'16"	617.87'
4	31°57'17"	995.57'

BENCHMARK: RR Spike in Power Pole (FR-7A) Elev = 1146.299

Figure 4-2
Actual OB/OD Sampling Locations

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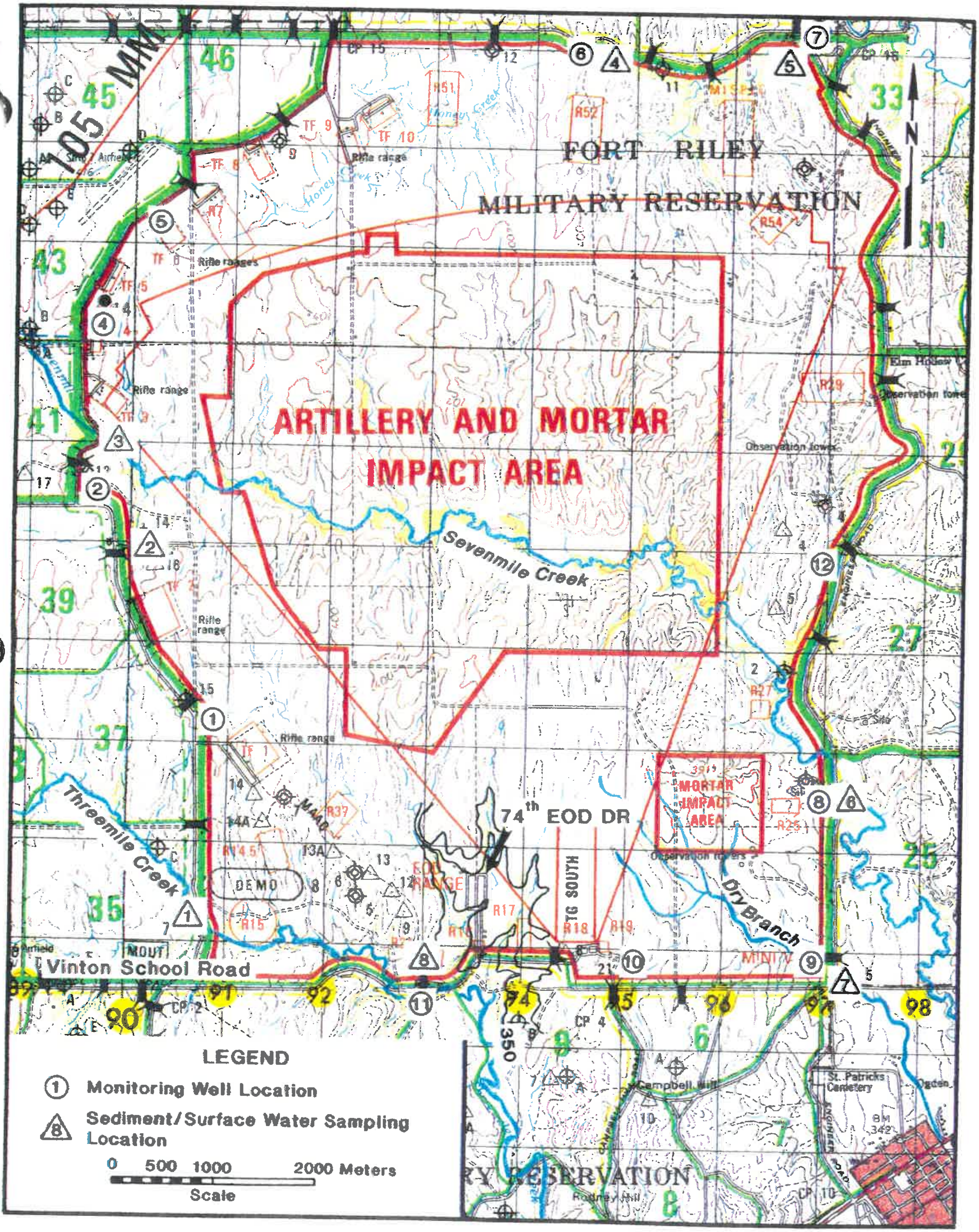
June, 1994



Contour Interval 10 Meters

Figure 4-3: EOD RANGE

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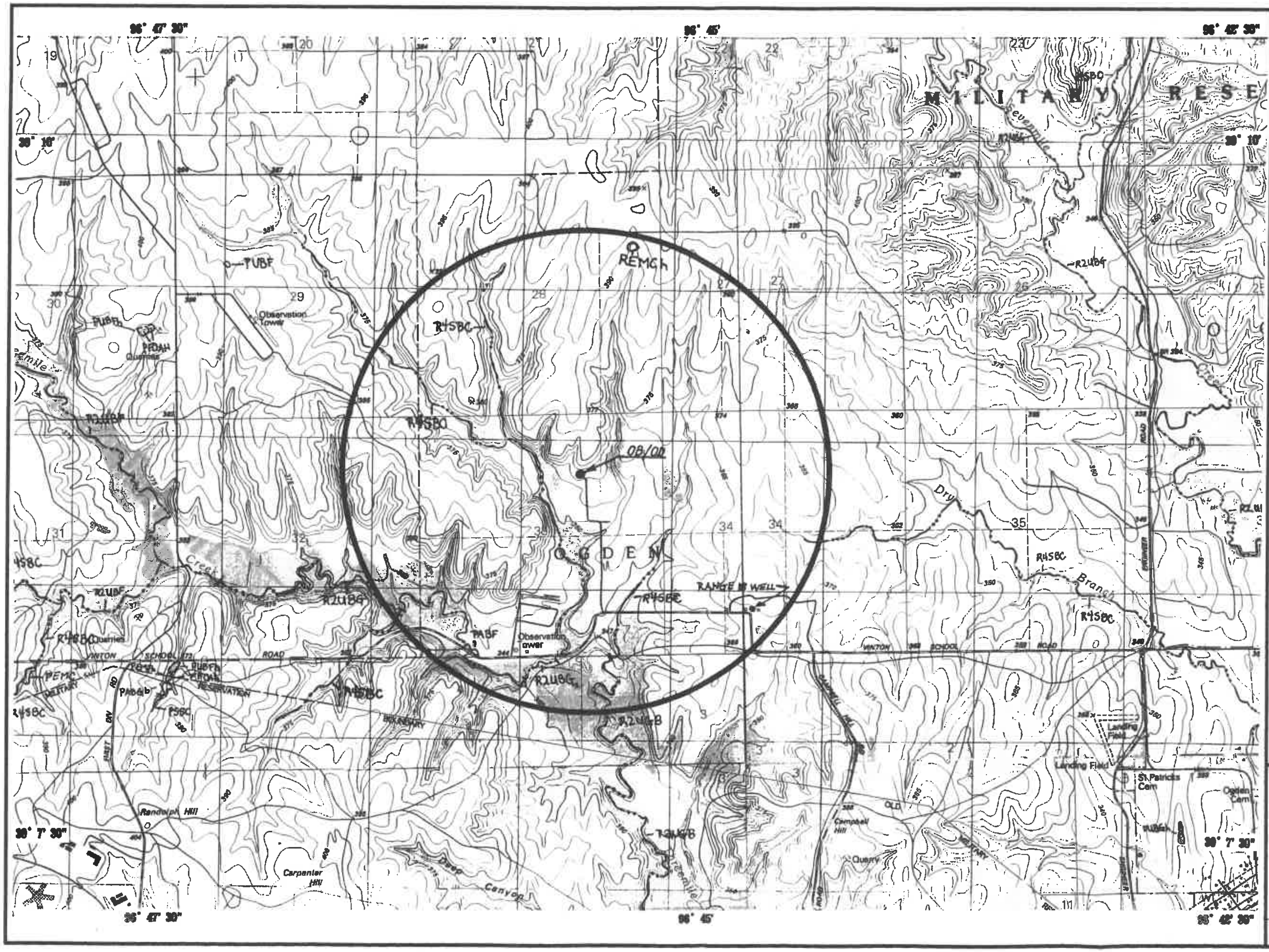

LEGEND

PABF	PALUSTRINE SYSTEM, AQUATIC BED CLASS, SEMIPERMANENTLY FLOODED
R4SBC	RIVERINE SYSTEM, INTERMITTENT STREAMBED CLASS, SEASONALLY FLOODED
R2UBGx	RIVERINE SYSTEM, LOWER PERENNIAL, UNCONSOLIDATED BOTTOM CLASS, INTERMITTENTLY EXPOSED EXCAVATED
REMCh	RIVERINE SYSTEM, EMERGENT CLASS, SEASONALLY FLOODED (DIKED, IMPOUNDED)

Figure 4-4:
OB/OD Area
One Mile
Radius

June, 1994

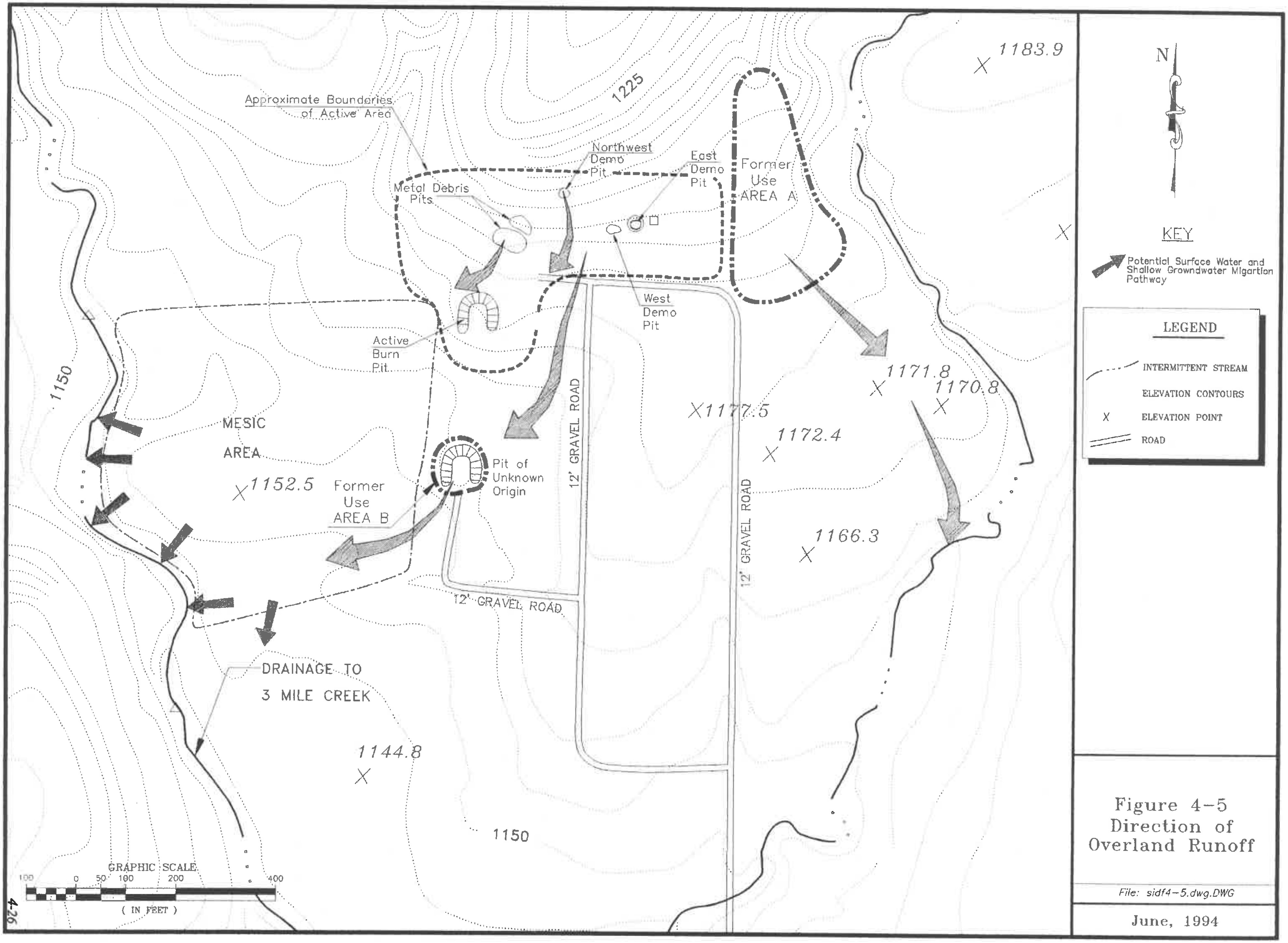

Figure 4-5
Direction of
Overland Runoff

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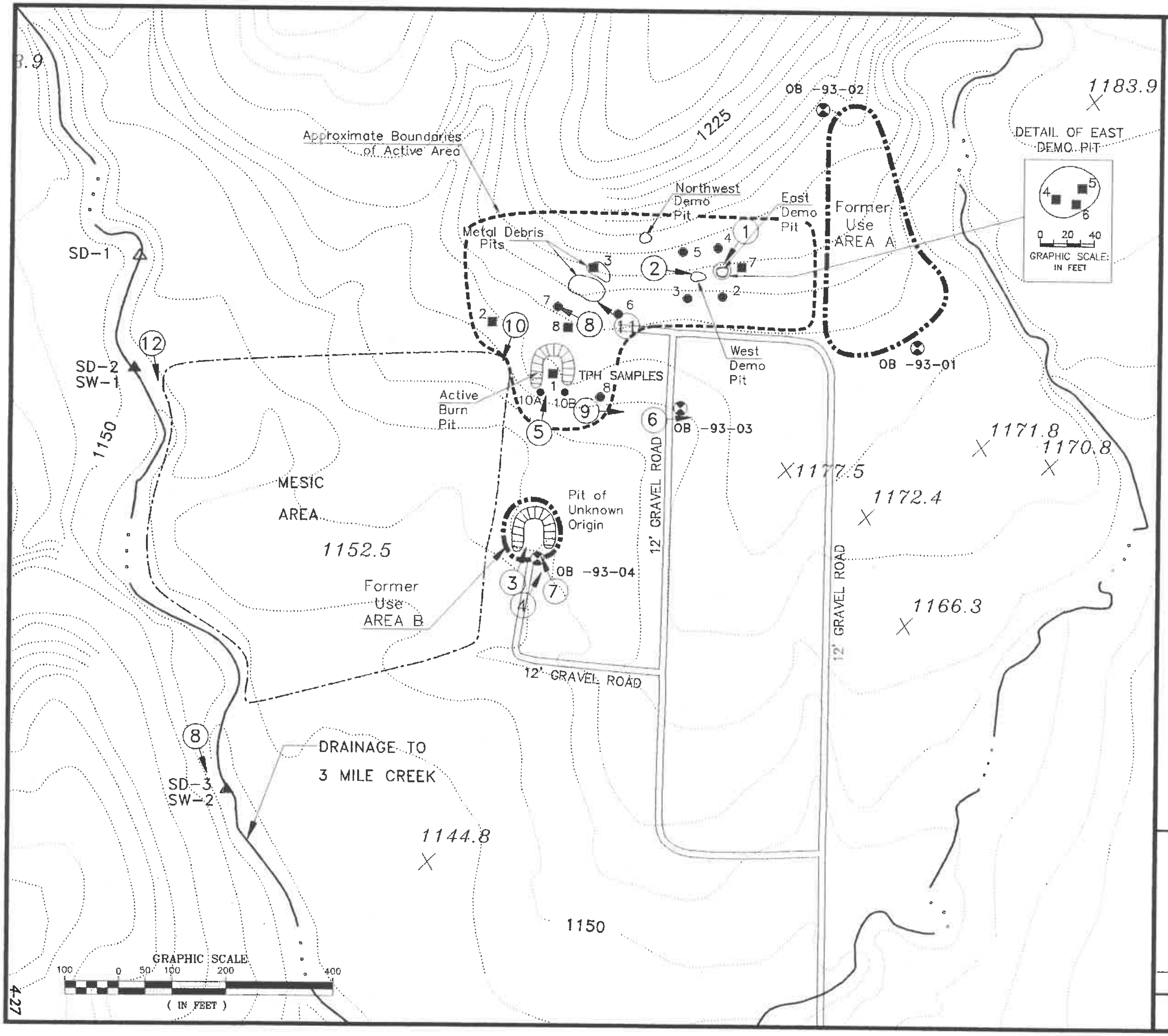
June, 1994



NOTE:
Soil Boring 1 (● 1)was installed as part of OB-93-04

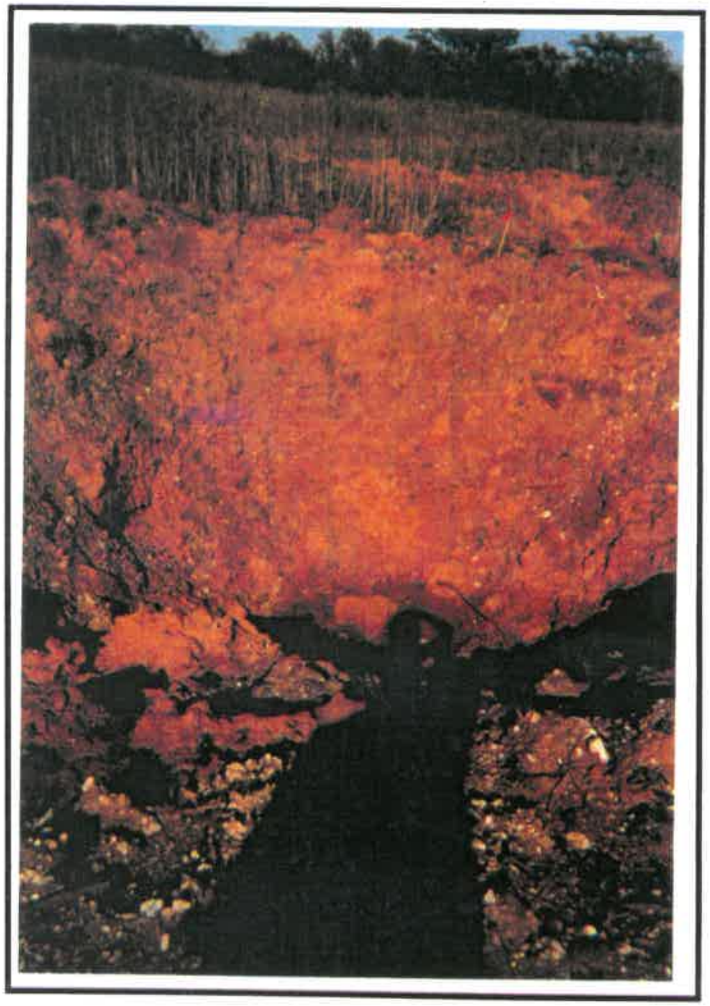
① Photograph Number and Viewing Direction

Figure 4-6
Location and
Viewing Direction
for Photographs

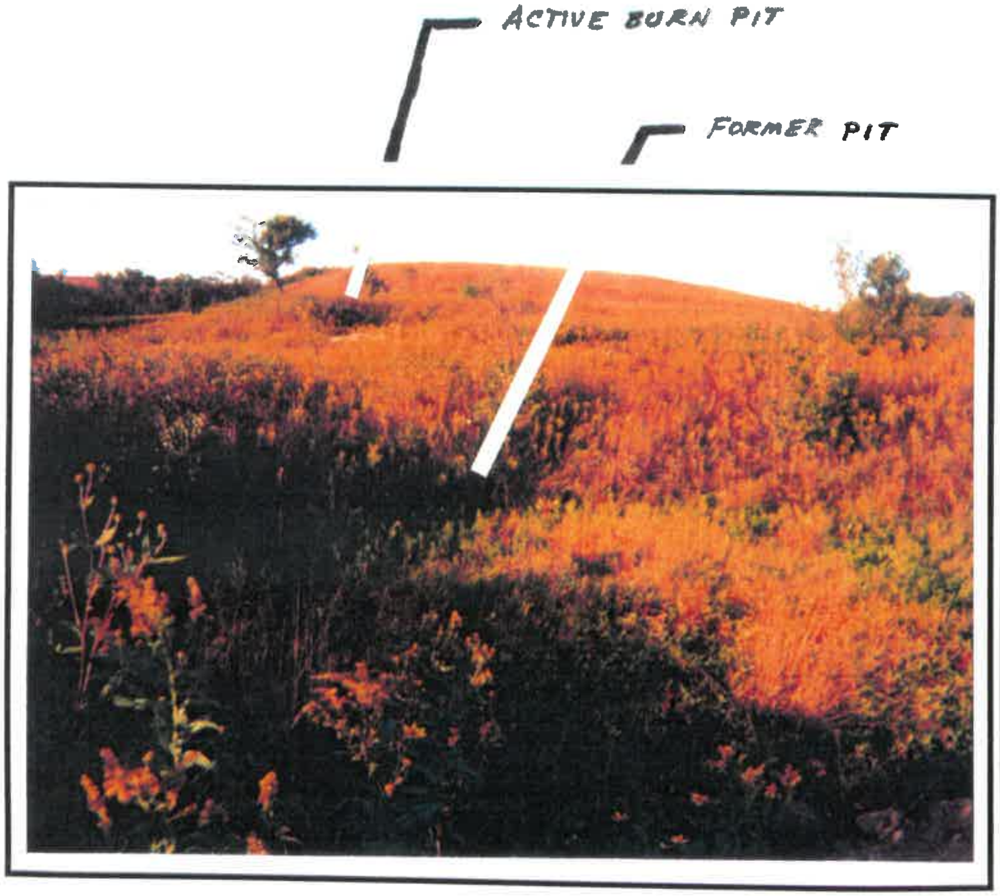
File: sidf4-6.dwg.DWG

June, 1994

Photograph Number 1
Southwest View Across
East Demolition Pit



Photograph Number 2
View East Across
West Demolition Pit



Photograph Number 3
View North, Former Pit
Just South of Active Burn Pit.

Photograph Number 4
View Toward Northeast
Monitoring Well OB-93-04
Just After Surface Completion

Photograph Number 5
View North, Active Burn Pit Close Up.
Note Small Dug Out Pit Within the U-Shaped Berm.

Photograph Number 6
View East. Monitoring Well OB-93-03
Just After Surface Completion

Photograph Number 7
View Toward the Northwest.
Mobile B-57 Drill Rig
Set Up On OB-93-04

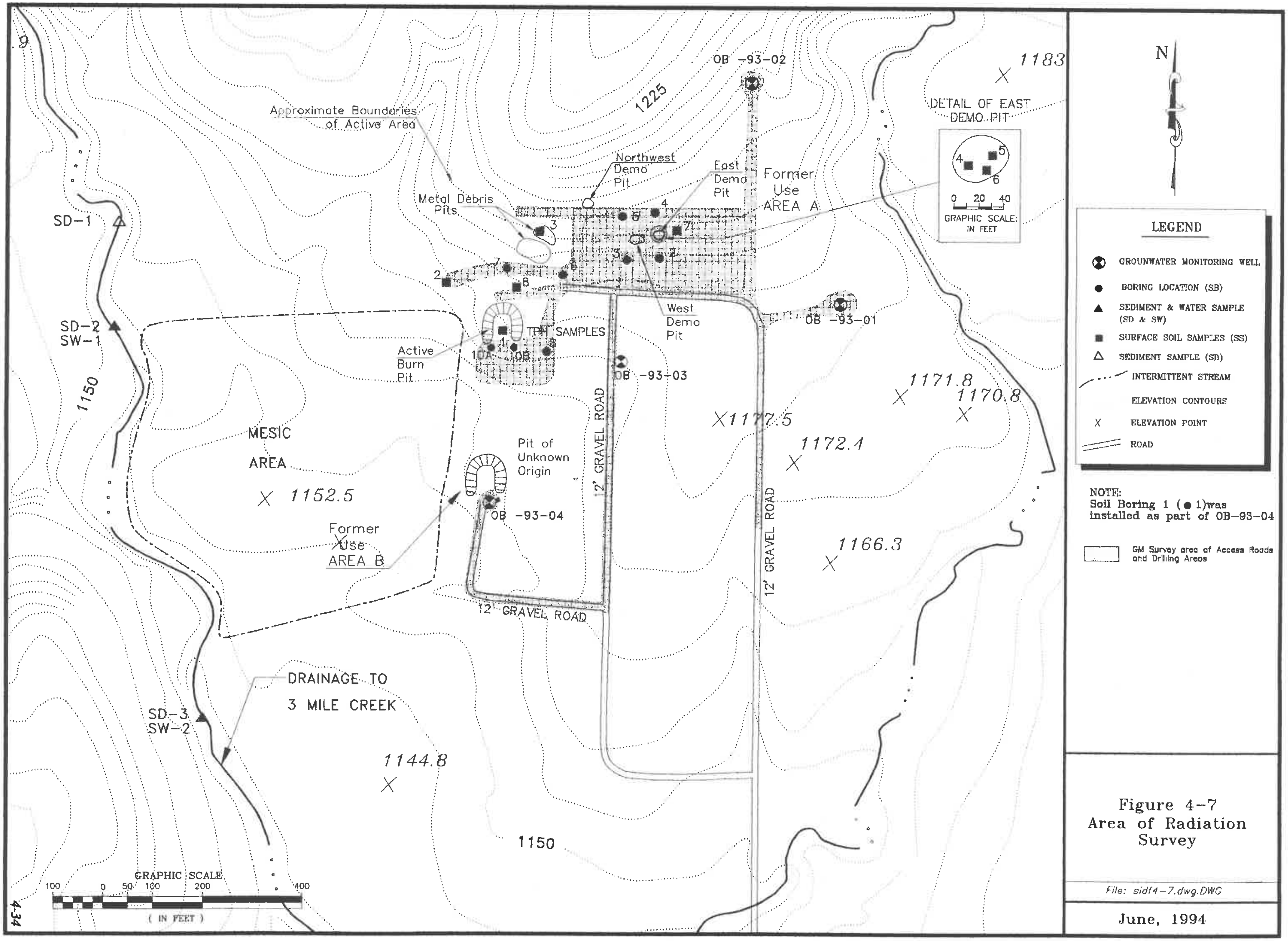
Photograph Number 8
View West. Radiological Screening of Soil
Boring Location Number 7
Using a Multi-Channel Analyzer

Photograph Number 9
View East. Soil Boring Location 8 (Flagged
Stake) with OB-9303 in Center Background

Photograph Number 10
Holding Area for Ordinance Found
During Pre-Field Activity Clearing Operations

Photograph Number 11
Close Up of Soil Boring Location
6, Just After Grouting to
Within Two Feet of Surface.

Photograph Number 12
View South. Southern Most Stream
Sediment Sampling Point.



NOTE:
Soil Boring 1 (● 1)was installed as part of OB-93-04

Figure 4-7
Area of Radiation Survey

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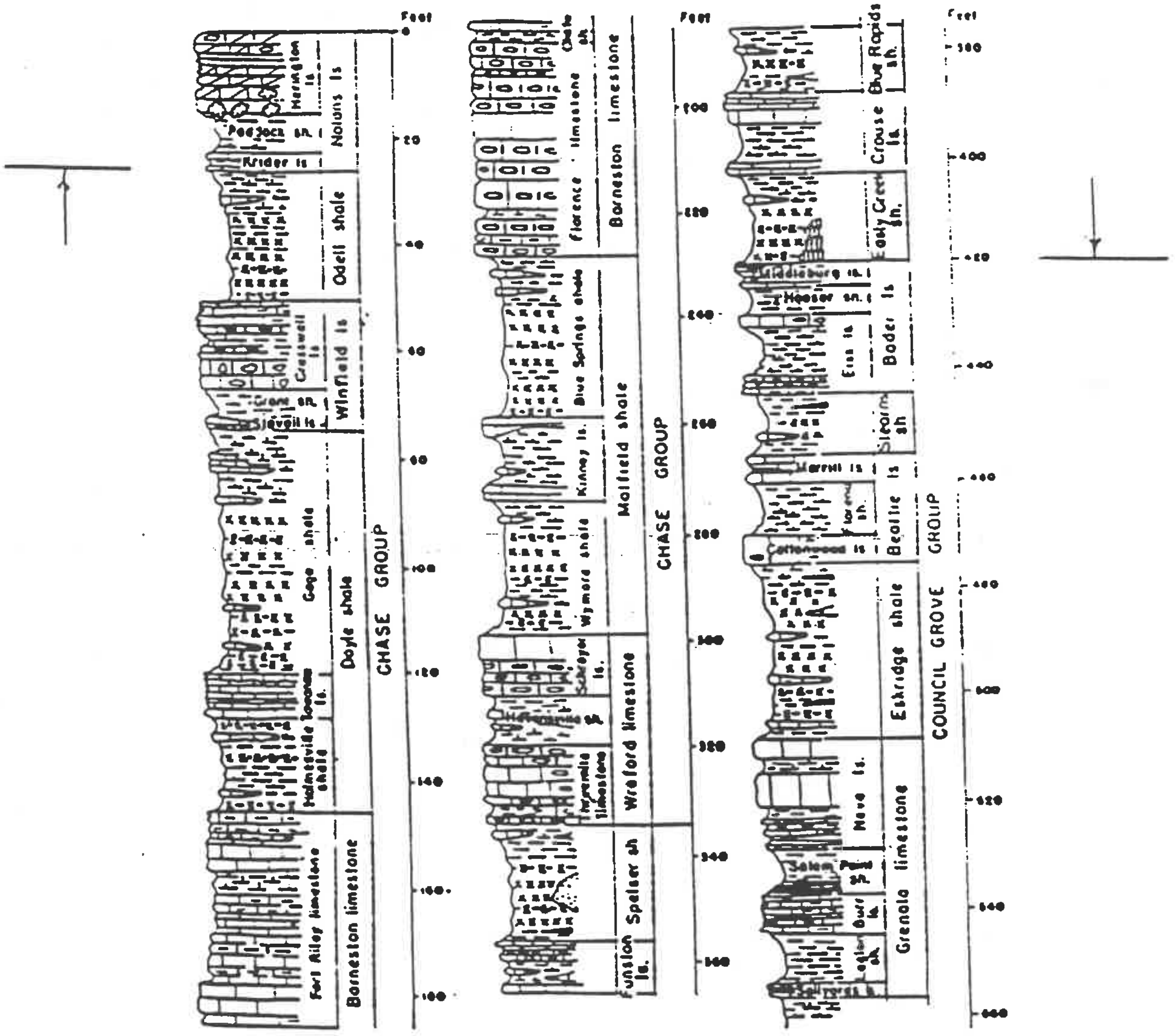
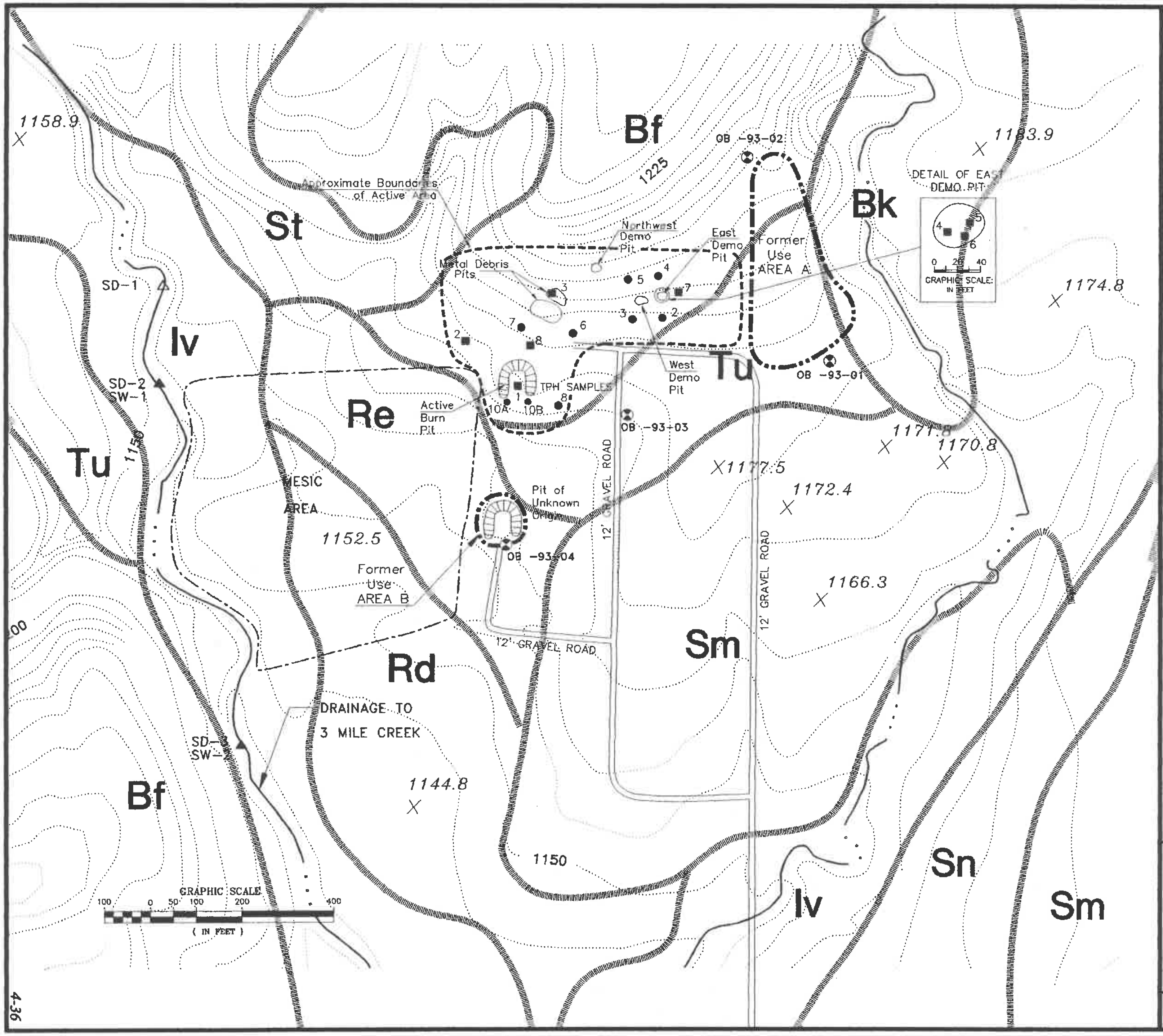
June, 1994



January, 1994

Figure 4–8
REGIONAL STRATIGRAPHIC COLUMN



N

LEGEND

- ⊗ GROUNWATER MONITORING WELL
- ● BORING LOCATION (SB)
- ▲ SEDIMENT & WATER SAMPLE (SD & SW)
- ■ SURFACE SOIL SAMPLES (SS)
- △ SEDIMENT SAMPLE (SD)
- INTERMITTENT STREAM
- ELEVATION CONTOURS
- X ELEVATION POINT
- ROAD
- SOIL BOUNDARY

NOTE:
Soil Boring 1 (● 1) was installed as part of OB-93-04

Soil Key

Iv –	Ivan and Kennebec Silt Loams
Rd–	Reading Silt Loam, 0 to 1% Slopes
Re–	Reading Silt Loam, 1 to 3% Slopes
Sm–	Smolan Silt Loam 1 to 4% Slopes
Tu–	Tully Silty Clay Loam 4 to 8% Slopes
St–	Stony Steep Land
Bk–	Breaks–Alluvial Land Complex
Bf–	Benfield–Florence Complex 5 to 20% Slopes
Sn–	Smolan Silt Loam 4 to 8% Slopes

Figure 4-9
Soil Types at
OB/OD Area

File: sidf4-9.dwg.DWG

June, 1994

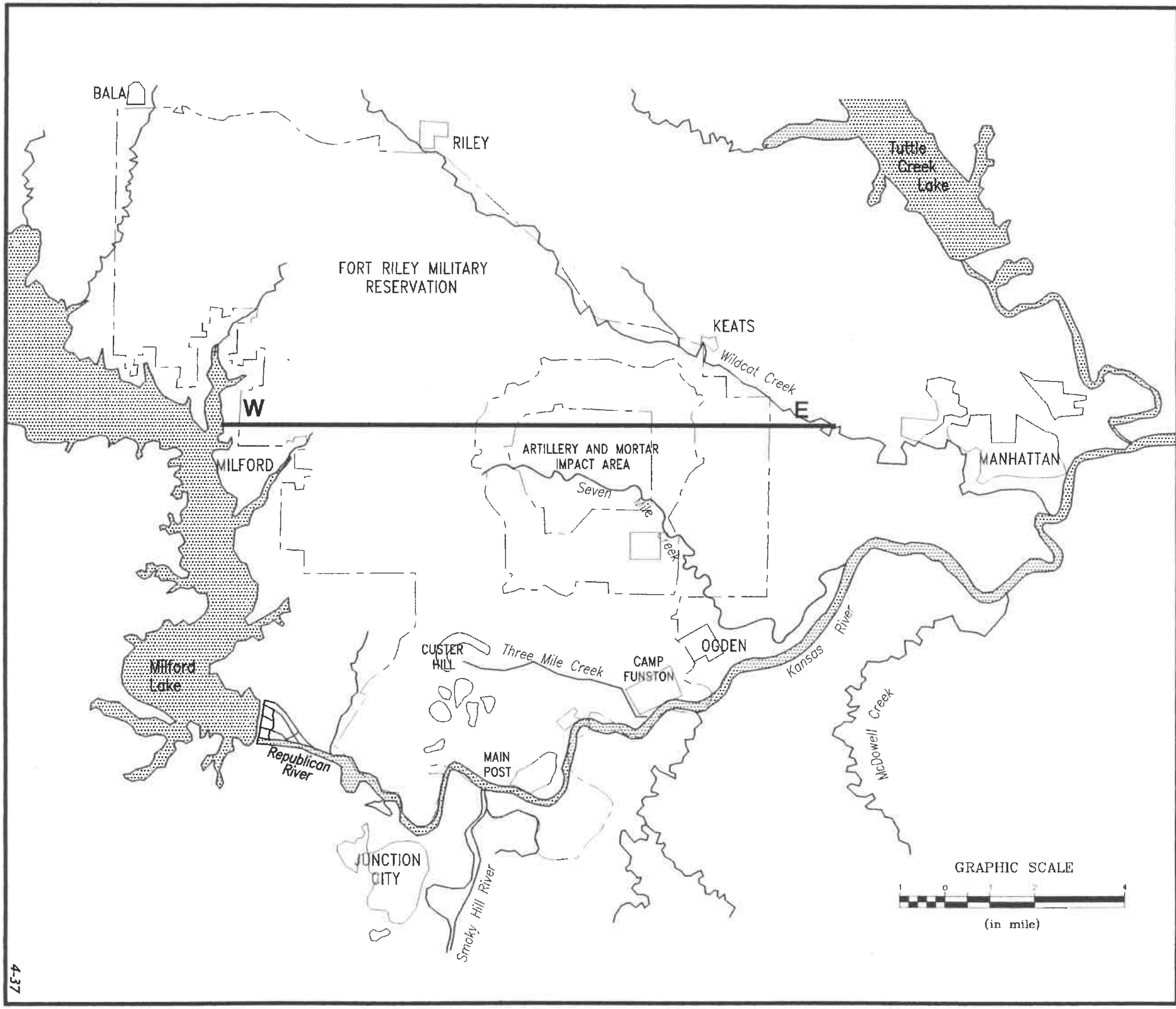
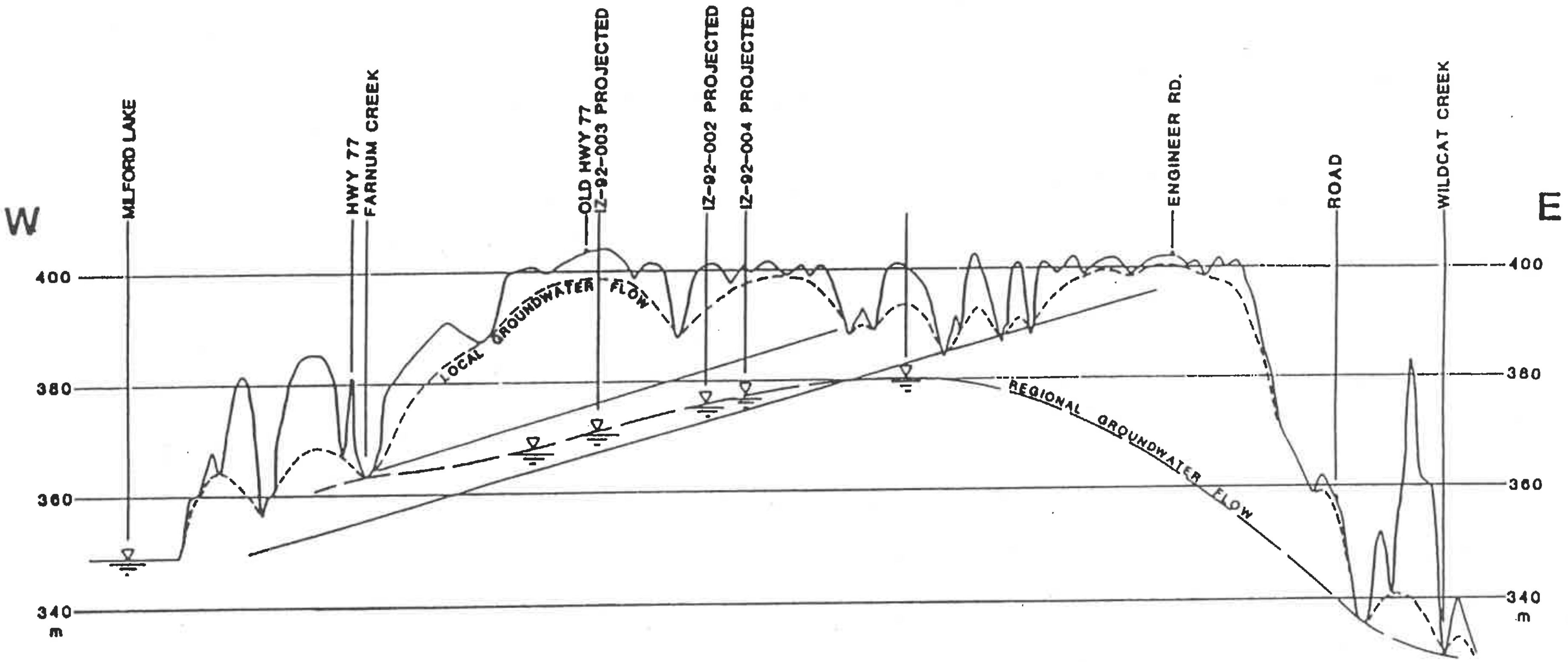


Figure 4-10: OB/OD Location of West-East Cross Section

File: sidf4-10.dwg

June, 1994



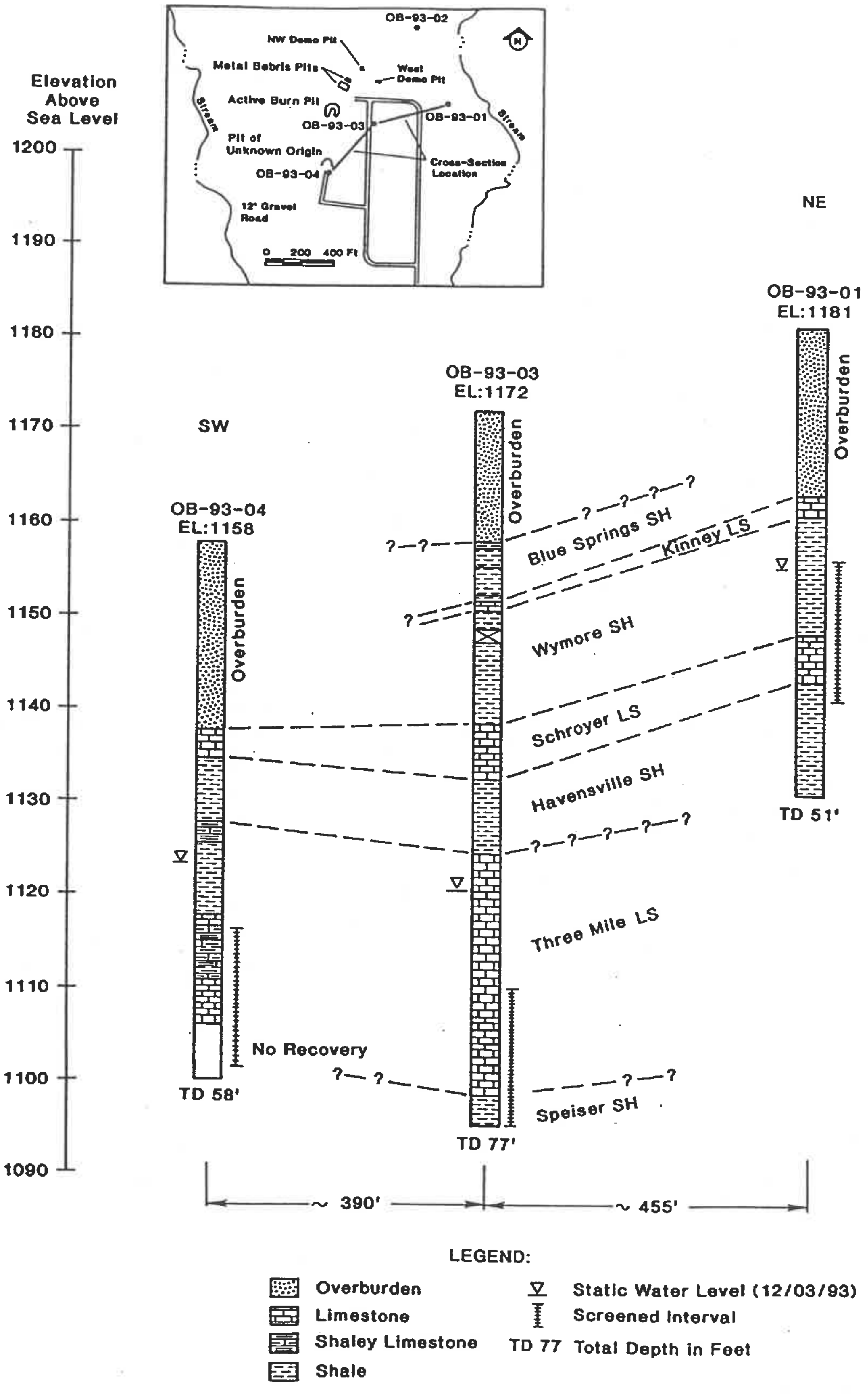
W-E Cross Section

Scale: horiz. 1 cm = 1.3 km
vert. 1 cm = 8 m

File: sidf4-11.dwg

June, 1994

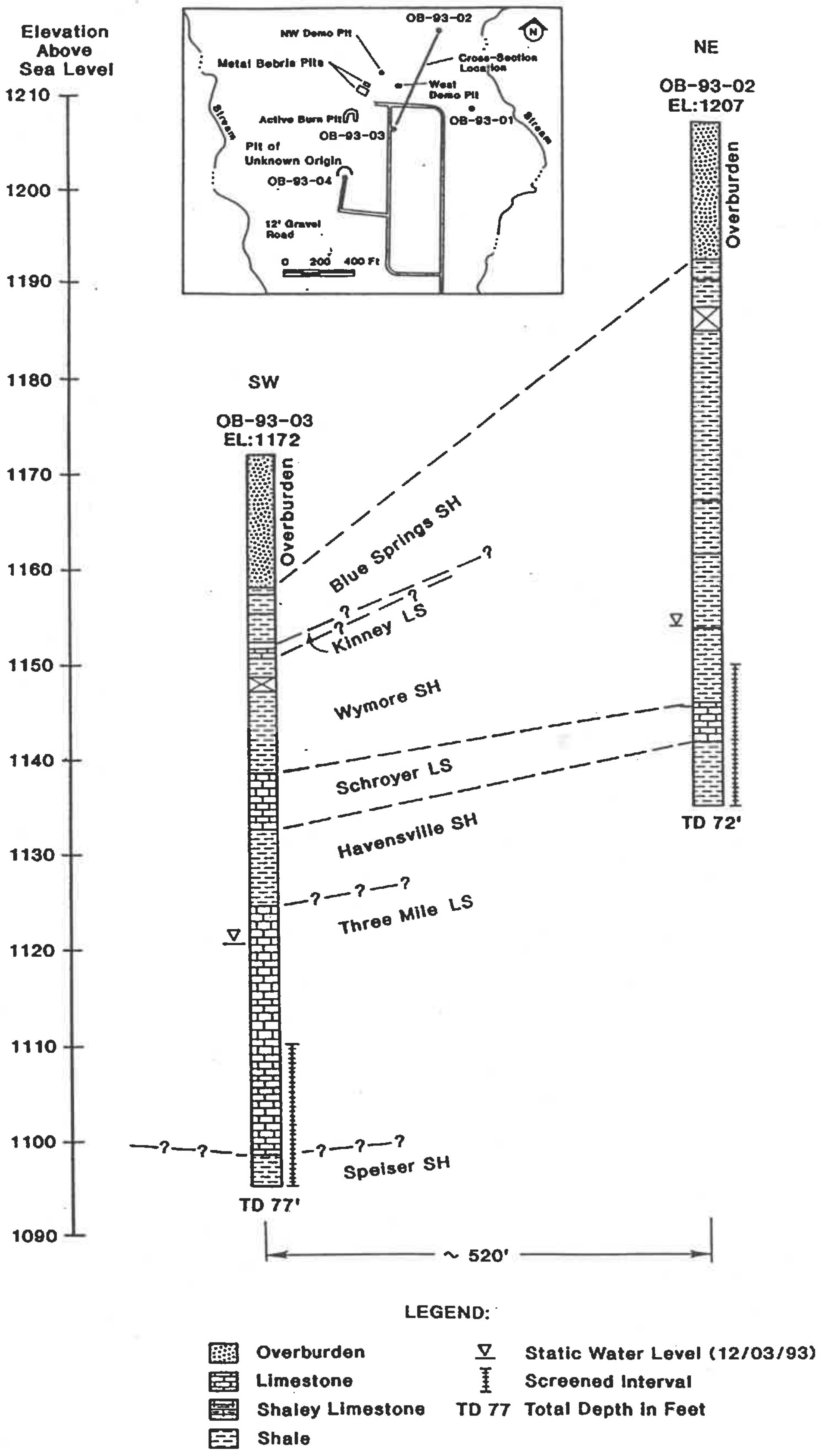
Figure 4-11: West-East Topographic and Groundwater Cross-Section



File:sidf4-12.dwg

Date: June, 1994

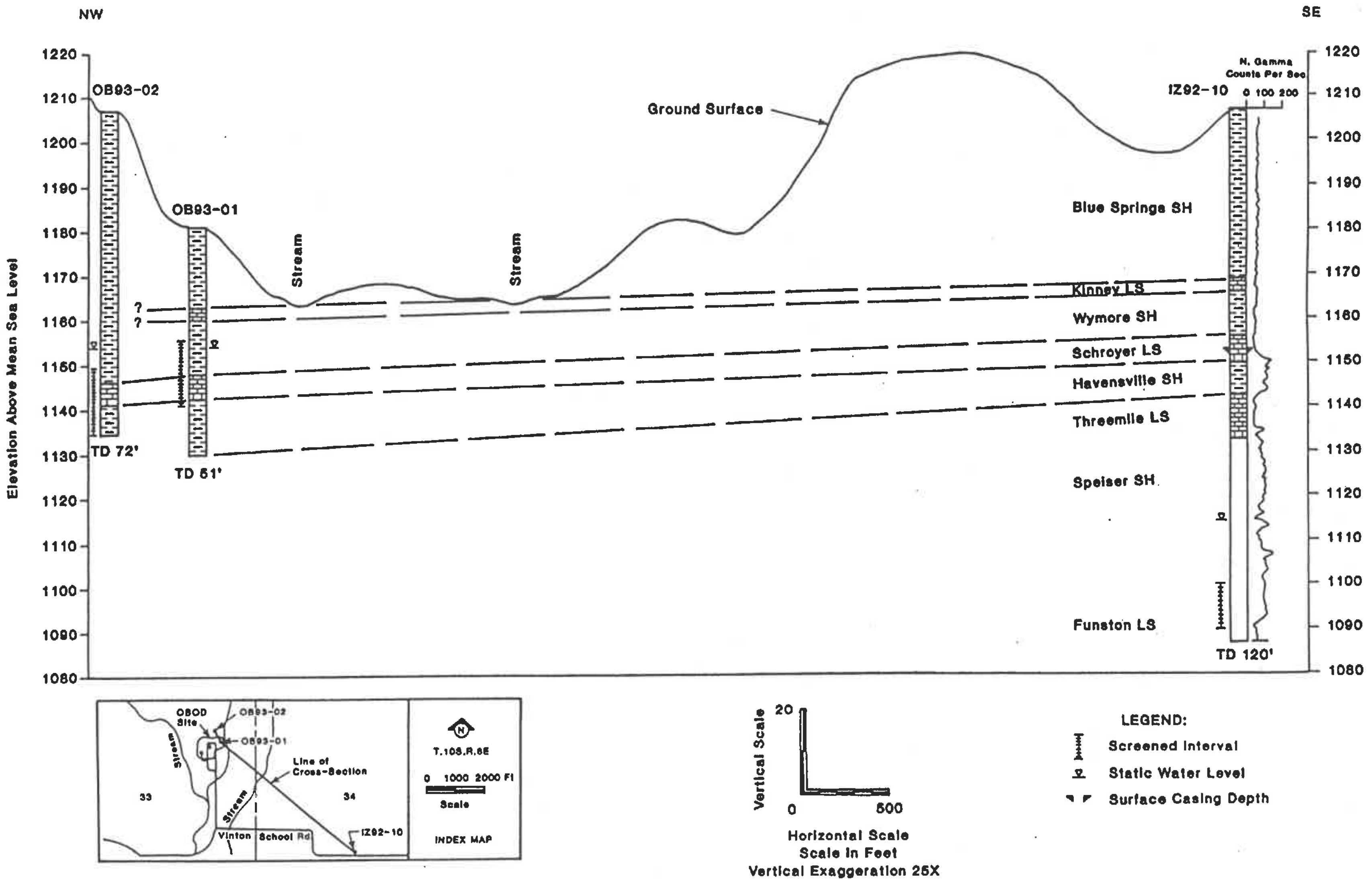
Figure 4-12: East-West Trending Cross-Section of the OB/OD Area



File:sidf4–13.dwg

Date: June, 1994

Figure 4–13: North–South Trending Cross-Section of the OB/OD Area



File: sidf4-14.dwg

June, 1994

Figure 4-14: Stratigraphic Correlation Between Impact Area Well IZ92-10 and OB/OD Area

Table 4-1 - Overview of Chemical Analyses for SI Samples

	Surface Soil	Shallow Soil Borings	Deep Soil Borings	Ground -water	Surface Water	Sediment
Explosives - EPA Method 8330	X		X	X	X	X
Priority Pollutant Metals - EPA Method 7000 Series/6010	X		X	X	X	X
TCLP Metals - EPA Methods 1311 & 7000 Series/6010	X		X			
Uranium - EPA Method 6020 (ICP MS)	X		X	X	X	X
Anions - EPA Methods 335.2, 345.1, 406C and 9036				X		
Volatiles - EPA Method 8240	X[1]		X[1]	X		
Semi-Volatiles - EPA Method 8270	X[1]		X[1]	X		
Total Petroleum Hydrocarbons - EPA Method 8015 Modified		X[2]				

1: Only samples nearest the active burn pit were analyzed by these methods (SB1001, SB1002, SB1003 and SS-1)

2: Only samples SB10A, SB10B analyzed by this method.

TABLE 4-2
OB/OD AREA DETECTED ANALYTES FOR SURFACE SOIL

Analyte (µg/kg organics) (mg/kg inorganics)	Sample Location Sample ID #									Kansas Department of Health and Environment Standards^{B}	EPA Risked-Based Concentrations ^{C}
	SS-1 OBOD SS1001	SS-2 OBOD SS2001	SS-3 OBOD SS3001	SS-3 OBOD SS9001^{A}	SS-4 OBOD SS4001	SS-5 OBOD SS5001	SS-6 OBOD SS6001	SS-7 OBOD SS7001	SS-8 OBOD SS8001		
Explosives											
2,4-Dinitrotoluene	1000^{H}	ND^{H}	580^{H}	1000^{H}	ND	ND	ND	ND	ND	---	900-4,100,000
RDX ^{D}	ND^{H}	ND^{H}	ND^{H}	2500^{H}	ND	ND	ND	ND	ND	---	26,000-52,000
Metals (Priority Pollutant)											
Arsenic	3^{λ}	$4^{\dagger}$	$4^{\dagger}$	2^{λ}	$4^{\dagger}$	3^{λ}	3^{λ}	3^{λ}	$6^{\dagger}$	---	0.4-310
Beryllium	ND	$0.8^{\ddagger}$	$0.9^{\ddagger}$	$0.9^{\ddagger}$	$1.0^{\ddagger}$	$1.1^{\ddagger}$	$1.0^{\ddagger}$	$0.9^{\ddagger}$	$1.0^{\ddagger}$	---	0.1-1000
Cadmium	1.0	0.9	1.3	1.6	0.9	0.8	0.9	1.0	0.7	---	100-1000
Chromium	15	15	24	18	23	22	26	23	25	200^{E}	5100-1,000,000
Copper	93	19	100	95	280	210	320	59	20	---	10,000-76,000
Nickel	22	15	20	18	18	17	19	17	22	---	5,000-41,000^{F}
Lead	140	30	50	50	50	110	180	45	60	500	500-1000^{G}
Zinc	320	60	190	250	180	140	230	100	61	---	80,000-310,000
Uranium	1.8	1.9	0.97	1.1	1.2	1.2	1.2	1.1	1.5	---	3100^{F}-6100
Semi-Volatiles											
Di-n-butyl phthalate	3700^{M}	NA	NA	NA	NA	NA	NA	NA	NA	---	100,000-100,000,000

Note: All results in dry weight.

Shaded values represent concentrations that exceed carcinogen levels.

ND: Not detected.
NA: Not analyzed.
---: Standard Not Available.
H: Result is an estimated value. Recommended holding time was exceeded.
M: Reporting limit higher than normal due to matrix interference.
λ: Sample concentration exceeded EPA Regions III and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
$\dagger$: Sample concentration exceeded EPA Regions III, IX and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
$\ddagger$: Sample concentration exceeded EPA Regions III and X (10^{-4}) risk based standard for Beryllium as a carcinogen.
A: Duplicate of OBODSB3001
B: Kansas Department of Health and Environment Bureau of Environmental Remediation, Interim Soil Clean-up Standards, August 1993.
C: Risk-based guideline concentrations are based on a range to represent EPA Regions III, IX & X from the following citations: Region III Risk-based Concentration Table, 2nd quarter 1994, Roy L. Smith, Senior Toxicologist - Technical Support Section; Region IX Preliminary Remediation Goals (PRGs) 1st quarter 1993, Stanford J. Smucker, PhD, Regional Toxicologist; and Region X-Appendix II-Human Health Risk-based Preliminary Remediation Goals for Water and Soil, October 1992.
D: RDX - Cyclotrimethylenetrinitramine or Hexa-1,3,5-trinitro-1,3,5-triazine
E: Hexavalent Chromium (residential/recreational areas).
F: Soluble salts.
G: EPA Directive Number OSWER 9355.4-02, Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites.

TABLE 4-3
OB/OD AREA DETECTED ANALYTES FOR SOIL BORINGS

(Page 1 of 3)

Analyte (μg/kg organics) (mg/kg inorganics)	Sample Location Sample ID # Sample Footage Interval									Kansas Department of Health and Environment Standards^{B}	EPA Risked-Based Concentrations^{C}
	SB-1 OBOD SB 1001 1-2	SB-1 OBOD SB 1002 7-9	SB-1 OBOD SB 1003 11.5-12.5	SB-2 OBOD SB 2001 3-5	SB-2 OBOD SB 2002 7-8.5	SB-2 OBOD SB 2003 10-11	SB-3 OBOD SB 3001 1-3.5	SB-3 OBOD SB 9001^{A} 1-3.5	SB-3 OBOD SB 3002 4.5-6		
Metals (Priority Pollutant) Arsenic	$4^{\dagger}$	$5^{\dagger}$	3^{λ}	$5^{\dagger}$	3^{λ}	3^{λ}	$5^{\dagger}$	$6^{\dagger}$	$4^{\dagger}$	---	0.4-310
Beryllium	$0.8^{\ddagger}$	$1.1^{\ddagger}$	$1.0^{\ddagger}$	$1.0^{\ddagger}$	$0.8^{\ddagger}$	$0.9^{\ddagger}$	$1.1^{\ddagger}$	$1.0^{\ddagger}$	$1.0^{\ddagger}$	---	0.1-1000
Cadmium	0.7	0.8	ND	0.7	ND	ND	0.6	0.7	0.6	---	100-1000
Chromium	17	23	23	21	19	16	23	21	17	200^{D}	5100-1,000,000
Copper	11	14	14	15	10	9	19	28	11	---	10,000-76,000
Nickel	13	18	16	18	15	14	19	17	15	---	5,000-41,000^{E}
Lead	18	18	15	15	19	20	22	30	14	500	500-1000^{F}
Zinc	44	61	54	52	40	38	63	62	44	---	80,000-310,000
Uranium	1.0	1.9	1.0	1.4	2.2	0.92	1.3	1.5	2.7	---	3100^{E}-6100

Note: All results in dry weight.

Shaded values represent concentrations that exceed carcinogen levels.

ND: Not detected.
---: Standard Not Available.
λ: Sample concentration exceeded EPA Regions III and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
†: Sample concentration exceeded EPA Regions III, IX and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
‡: Sample concentration exceeded EPA Regions III and X (10^{-4}) risk based standard for Beryllium as a carcinogen.
A: Duplicate of OBODSB3001

B: Kansas Department of Health and Environment Bureau of Environmental Remediation, Interim Soil Clean-up Standards, August 1993.
C: Risk-based guideline concentrations are based on a range to represent EPA Regions III, IX & X from the following citations: Region III Risk-based Concentration Table, 2nd quarter 1994, Roy L. Smith, Senior Toxicologist - Technical Support Section; Region IX Preliminary Remediation Goals (PRGs) 1st quarter 1993, Stanford J. Smucker, PhD, Regional Toxicologist; and Region X-Appendix II-Human Health Risk-based Preliminary Remediation Goals for Water and Soil, October 1992.
D: Hexavalent Chromium (residential/recreational areas).
E: Soluble salts.
F: EPA Directive Number OSWER 9355.4-02, Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites.

TABLE 4-3
DETECTED ANALYTES FOR SOIL BORINGS (continued)

(Page 2 of 3)

Analyte (µg/kg organics) (mg/kg inorganics)	Sample Location Sample ID # Sample Footage Interval									Kansas Department of Health and Environment Standards^{B}	EPA Risked-Based Concentrations ^{C}
	SB-3 OBOD SB 3003 12-13.5	SB-4 OBOD SB 4001 2-3	SB-4 OBOD SB 4002 5-6	SB-4 OBOD SB 4003 11.5-13.5	SB-5 OBOD SB 5001 0-4	SB-5 OBOD SB 5002 5-6	SB-5 OBOD SB 5003 9-10	SB-6 OBOD SB 6001 4.5-8	SB-6 OBOD SB 10001^{A} 4.5-8		
Metals (Priority Pollutant) Arsenic	3^{λ}	$5^{\dagger}$	3^{λ}	3^{λ}	$5^{\dagger}$	$4^{\dagger}$	$4^{\dagger}$	3^{λ}	3^{λ}	---	0.4-310
Beryllium	$1.0^{\ddagger}$	$1.0^{\ddagger}$	$1.0^{\ddagger}$	$0.9^{\ddagger}$	$1.0^{\ddagger}$	$1.0^{\ddagger}$	$1.0^{\ddagger}$	$1.0^{\ddagger}$	$1.1^{\ddagger}$	---	0.1-1000
Cadmium	ND	0.7	ND	ND	0.8	ND	ND	0.9	ND	---	100-1000
Chromium	14	18	22	17	19	19	14	20	20	200^{D}	5100-1,000,000
Copper	10	12	10	10	13	12	11	12	12	---	10,000-76,000
Nickel	19	14	17	19	16	23	19	16	21	---	5,000-41,000^{E}
Lead	13	14	9	10	17	16	11	15	15	500	500-1000^{F}
Zinc	42	43	49	69	50	73	59	48	53	---	80,000-310,000
Uranium	0.87	1.1	1.1	0.97	1.5	1.3	0.77	1.2	1.3	---	3100^{E}-6100

Note: All results in dry weight. Shaded values represent concentrations that exceed carcinogen levels.

ND: Not detected.
---: Standard Not Available.
λ: Sample concentration exceeded EPA Regions III and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
†: Sample concentration exceeded EPA Regions III, IX and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
‡: Sample concentration exceeded EPA Regions III and X (10^{-4}) risk based standard for Beryllium as a carcinogen.
A: Duplicate of OBODSB6001

B: Kansas Department of Health and Environment Bureau of Environmental Remediation, Interim Soil Clean-up Standards August 1993.
C: Risk-based guideline concentrations are based on a range to represent EPA Regions III, IX & X from the following citations: Region III Risk-based Concentration Table, 2nd quarter 1994, Roy L. Smith, Senior Toxicologist - Technical Support Section; Region IX Preliminary Remediation Goals (PRGs) 1st quarter 1993, Stanford J. Smucker, PhD, Regional Toxicologist; and Region X-Appendix II-Human Health Risk-based Preliminary Remediation Goals for Water and Soil, October 1992.
D: Hexavalent Chromium (residential/recreational areas).
E: Soluble salts.
F: EPA Directive Number OSWER 9355.4-02, Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites.

TABLE 4-3
DETECTED ANALYTES FOR SOIL BORINGS (concluded)

(Page 3 of 3)

Analyte (µg/kg organics) (mg/kg inorganics)	**Sample Location** / **Sample ID #** / **Sample Footage Interval**						Kansas Department of Health and Environment Standards^{A}	EPA Risked-Based Concentrations^{B}
	SB-6 OBOD SB 6002 11.5-12.5	SB-7 OBOD SB 7001 1-3	SB-7 OBOD SB 7002 4.5-5.5	SB-7 OBOD SB 7003 7.5-8.5	SB-8 OBOD SB 8001 1.8-2.8	SB-8 OBOD SB 8002 3-4		
Explosives 2,4-Dinitrotoluene	ND^{H}	ND	ND	ND	4900	ND	---	900-4,100,000
Metals (Priority Pollutant) Arsenic	3^{λ}	$5^{\dagger}$	$6^{\dagger}$	$8^{\dagger}$	3^{λ}	ND	---	0.4-310
Beryllium	0.6^{α}	$1.5^{\ddagger}$	$0.7^{\text{Ɪ}}$	$1.0^{\text{Ɪ}}$	$1.3^{\ddagger}$	$0.9^{\text{Ɪ}}$	---	0.1-1000
Cadmium	ND	1.2	0.7	1.0	0.9	ND	---	100-1000
Chromium	16	29	16	33	25	16	200^{C}	5100-1,000,000
Copper	16	17	12	16	14	10	---	10,000-76,000
Nickel	20	29	17	28	26	15	---	5,000-41,000^{D}
Lead	12	20	16	24	17	9	500	500-1000^{E}
Zinc	30	71	52	41	59	41	---	80,000-310,000
Uranium	0.91	0.76	1.1	2.7	0.98	1.3	---	3,100^{D}-6,100

Note: All results in dry weight. Shaded values represent concentrations that exceed carcinogen levels.

ND: Not detected.
---: Standard Not Available.
λ: Sample concentration exceeded EPA Regions III and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
†: Sample concentration exceeded EPA Regions III, IX and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
α: Sample concentration exceeded EPA Region X (10^{-4}) risk based standard for Beryllium as a carcinogen.
Ɪ: Sample concentration exceeded EPA Regions III and X (10^{-4}) risk based standard for Beryllium as a carcinogen.
‡: Sample concentration exceeded EPA Regions III, IX and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
A: Kansas Department of Health and Environment Bureau of Environmental Remediation, Interim Soil Clean-up Standards, August 1993.
B: Risk-based guideline concentrations are based on a range to represent EPA Regions III, IX & X from the following citations: Region III Risk-based Concentration Table, 2nd quarter 1994, Roy L. Smith, Senior Toxicologist - Technical Support Section; Region IX Preliminary Remediation Goals (PRGs) 1st quarter 1993, Stanford J. Smucker, PhD, Regional Toxicologist; and Region X-Appendix II-Human Health Risk-based Preliminary Remediation Goals for Water and Soil, October 1992.
C: Hexavalent Chromium (residential/recreational areas).
D: Soluble salts.
E: PA Directive Number OSWER 9355.4-02, Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites.

TABLE 4-4
OB/OD AREA DETECTED ANALYTES FOR SURFACE WATER

Analyte (µg/l organics) (mg/l inorganics)	Sample Location Sample ID #		Regulatory Comparison Values			1992 Impact Area Surface Water Comparison Values	
	SW-1 OBOD SW-1-001	SW-2 OBOD SW-2-001	KAL	KNL	MCL	Low Value	High Value
Metals (Priority Pollutant) Silver	0.02	ND	---	---	0.10*	ND	ND
Uranium	0.0024	0.0021	---	---	0.02	ND	.0057

ND: Not Detected
---: Standard Not Available
*: Secondary Maximum Contaminant Level

KAL: Kansas Action Level. From: Final 880607 Groundwater Contaminant Cleanup Target Concentrations.
KNL: Kansas Notification Level. From: Final 880607 Groundwater Contaminant Cleanup Target Concentrations.
MCL: Federal Maximum Contaminant Level. From: Drinking Water Regulations and Health Advisories, Office of Water, United States Environmental Protection Agency, December 1993.

TABLE 4-5
OB/OD AREA DETECTED ANALYTES FOR SEDIMENT SAMPLES

Analyte (µg/kg organics) (mg/kg inorganics)	Sample Location Sample ID #				KDHE	EPA Risk-Based	1992 Impact Area Sediment Concentrations	
	SD-1 OBOD SD1001	SD-1 OBOD SD9001[A]	SD-2 OBOD SD2001	SD-3 OBOD SD3001	Standards[B]	Concentration Levels[C]	Low Values	High Values
Metals (Priority Pollutant)								
Arsenic	4[†]	4[†]	4[†]	3[λ]	---	0.4-310	ND	14
Beryllium	0.8[‡]	0.9[‡]	0.9[‡]	0.7[‡]	---	0.1-1000	ND	ND
Cadmium	1.1	0.9	1.0	0.9	--	100-1000	1.0	1.6
Chromium	17	19	21	14	200[D]	5100-1,000,000	19	26
Copper	13	16	14	13	---	10,000-76,000	NA	NA
Nickel	16	19	19	18	---	5,000-41,000[E]	NA	NA
Lead	15	15	15	20	500	500-1000[F]	12	36
Zinc	67	73	57	46	---	80,000-310,000	NA	NA
Uranium	0.49	0.66	0.49	0.84	---	3100[E]-6000	0.26	1.51

Note: All results in dry weight.

Shaded values represent concentrations that exceed carcinogen levels.

ND: Not detected.
---: Standard Not Available.
NA: Not Analyzed.
†: Sample concentration exceeded EPA Regions III, IX and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
λ: Sample concentration exceeded EPA Regions III and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
‡: Sample concentration exceeded EPA Regions III and X (10^{-4}) risk based standard for Berillium as a carcinogen.
A: Duplicate of OBODSD1001
B: Kansas Department of Health and Environment Bureau of Environmental Remediation, Interim Soil Clean-up Standards, August 1993.
C: Risk-based guideline concentrations are based on a range to represent EPA Regions III, IX & X from the following citations: Region III Risk-based Concentration Table, 2nd quarter 1994, Roy L. Smith, Senior Toxicologist - Technical Support Section; Region IX Preliminary Remediation Goals (PRGs) 1st quarter 1993, Stanford J. Smucker, PhD, Regional Toxicologist; and Region X-Appendix II-Human Health Risk-based Preliminary Remediation Goals for Water and Soil, October 1992.
D: Hexavalent Chromium (residential/recreational areas).
E: Soluble salts.
F: EPA Directive Number OSWER 9355.4-02, Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites.

TABLE 4-6
OB/OD AREA DETECTED ANALYTES FOR GROUNDWATER

Analyte (µg/l organics) (mg/l inorganics)	Sample Location Sample ID #					Regulatory Comparison Values			1992 Impact Area Groundwater Comparison Values	
	OB-93-01 OBOD MW-1-001	OB-93-01 OBOD MW-9^{A}	OB-93-02 OBOD MW-2-001	OB-93-03 OBOD MW-3-001	OB-93-04 OBOD MW-4-001	KAL	KNL	MCL	Low Value	High Value
Metals (Priority Pollutant) Uranium	0.0057	0.0043	0.0023	ND	0.0029	---	---	.02	ND	0.0048
Anions Sulfate	52	33	26	97	87	250	---	---	14	2240
Nitrate	ND	ND	1.0	ND	ND	10	---	10^{B}	ND	2.8
Volatiles Trichloroethylene	ND	ND	ND	1.3	29	5	0.5	5.0	ND	ND

ND: Not Detected
---: Standard Not Available

A: Duplicate of OBOD-MW-1-001.
B: Total Nitrite and Nitrate.

KAL: Kansas Action Level. From: Final 880607 Groundwater Contaminant Cleanup Target Concentrations.
KNL: Kansas Notification Level. From: Final 880607 Groundwater Contaminant Cleanup Target Concentrations.
MCL: Federal Maximum Contaminant Level. From: Drinking Water Regulations and Health Advisories, Office of Water, United States Environmental Protection Agency, December 1993.

Shaded areas represent those concentrations exceeding either the MCL and/or the KAL.

Table 4-7 Positive Detections for the TCLP Analysis (in mg/l)

Analyte	OBOD-SB3-001	OBOD-SS1-001	OBOD-SS6-001	OBOD-SB7-003	TCLP Limits
Barium	2.4	2.4	2.7	1.8	100.0
Lead	ND	ND	ND	0.3	5.0

Table 4-8 Description of Rock Units Found within the Impact Area[1]

Permian System
Chase Group[1]

Formation[2] or Rock Unit Identified	Thickness (Feet)	Physical Characteristics
Odell Shale	20-40	Varicolored shale with red. green, some gray and yellow.
Winfield Limestone	25	Locally cherty limestone underlain by 10 feet of fossiliferous gray shale which is underlain by thin cherty limestone.
Cresswell Limestone	17	Limestone with calcareous concretions, geodes, and locally cherty - underlain by two shale units.
Gage Shale	45	Varicolored non-calcareous shale with red, green, purple, chocolate colored zones interbedded with yellow and gray layers. Upper part has calcareous shale, minor units 1s.
Towanda Limestone	5-10	Light bluish-gray to yellow limestone slabby and platy in middle and lower parts, brecciated in upper.
Holmesville Shale	7-30	Unfossiliferous shale with upper part green, also with gray, yellow and red, some impure limestone.
Fort Riley Limestone	30-45	Light gray tan, massive and thin bedded limestone - minor amount gray shale. Thin shaly beds, clay beds occur in middle part. Basal part massive "rim rock" w/conspicuous follil algae.
Oketo Shale	0-8	Gray calcareous shale generally between nonflinty LS above and flinty LS below.
Florence Limestone	35-45	Abundantly flinty LS in 6" layers, minor amount of shale. Limestone lighter in color than cherty nodules.
Blue Spring Shale	15-35	Cherty red-gray shale, minor amount limestone.Kinney Limestone
Kinney Limestone	1-24	Limestone and shale. Generally an upper and lower gray, fossilferous LS separated by gray shale.

Table 4-8 Description of Rock Units Found within the Impact Area[1] *(Cont.)*

Permian System
Chase Group[1]

Formation[2] or Rx Unit Identified	**Thickness (Feet)**	**Physical Characteristics**
Wymore Shale	9-25	Primarily gray-yellow shale but with red, green and purple bands. Bright colored shale.
Schroyer Limestone	8-20	Light gray to nearly white flint-bearing-may have 3 feet non-flinty bed in upper part.
Havensville Shale	6-18	Gray calcareous shale with thin limestone beds.
Threemile Limestone	7-22	Light gray to nearly white flinty limestone, massive non-flinty beds in middle and lower part.

Council Grove Group

Formation[2] or Rock Unit Identified	Thickness (Feet)	Physical Characteristics
Speiser Shale	18-35	Shale and limestone. Consists of an upper fossiliferous shale underlain by persistent limestone bed 1 foot thick and about 3 feet below the Threemile 25. Remainder in varicolored shale with red being predominant color.
Funston Limestone	5-26	Light gray to blue gray limestone separated by gray to yellow gray shale. May have bluish to nearly black shale in lower part. May contain flint.
Blue Rapids Shale	15-30	Gray, red, green, shale containing local limestone and locally a coal bed.
Crouse Limestone	10-18	Limestone and shale. An upper and lower limestone separated by a few feet of fossiliferous shale. Limestone beds are flinty.
Easly Creek Shale	15-20	Red, green, gray somewhat calcareous shale. Upper part light colored calcareous, lower part mostly red shale. Gypsum occurs in basal part in some locations.

[1] Data from references 21 and 40

[2] See idealized section after Moore, et.al. 1951

Shaded areas: Formations encountered at the OB/OD site.

5.0 CUSTER HILL WASTEWATER PONDS

This section provides the SI results for the Custer Hill Wastewater Ponds, which includes the East Pond (EP), West Pond (WP), Old Wash Rack Reservoir (WR), and Cells 1 through 4. The Old Wash Rack Reservoir and Cells 1 through 4 are located adjacent to each other and, for the most part, were investigated as a whole. Additionally, because the Old Wash Rack Reservoir is connected to Cell 2, which in turn is connected to the other Cells, Cells 1 through 4 are also included in the SI. Therefore, the results for the Old Wash Rack Reservoir and Cells 1 through 4 are presented together. The general location of these ponds is shown on Plate 1-1 and in Figure 5-1.

The purpose of this SI is to identify whether hazardous substances have been released to the ponds and whether releases have occurred from the ponds to the subsurface environment and/or nearby streams. Potential off-site receptors include streams and domestic drinking water supply wells. The East Pond, West Pond, and Old Wash Rack Reservoir were included in the SI for the following reasons:

- All three ponds are known to receive petroleum hydrocarbons -- petroleum booms and skimmer systems are in operation at East and West Ponds and a boom is in place at Cell 1;
- none of the ponds are lined;
- previous testing of the Old Wash Rack Reservoir by KDHE indicated that chlorinated solvents were present in sediments at low concentrations (Ref. 41);
- the East Pond receives water from Building 8100, which houses a consolidation of activities at Fort Riley that generate hazardous wastes; and
- there is potential for small quantities of hazardous substances to be inadvertently picked up by wastewaters and facility runoff from the tactical equipment shops (TES) on Custer Hill.

5.1 Approach

The approach of the SI was two-fold. First, sampling of the ponds was conducted to determine whether CERCLA or RCRA hazardous substances were present. Second, sampling of surrounding environmental media was conducted to determine whether the ponds have released hazardous substances to the environment. The sampling of the surrounding media included collection of soil gas samples, stream samples and groundwater samples.

The ponds were evaluated by collecting samples of water and sediments from within each pond and cell to assess whether hazardous substances were present.

> Pond aqueous samples were collected using a borosilicate glass bottle with a teflon lined cap attached to a subsurface type grab sampler as shown in photograph #1. [Figure 5-5 provides the location of the photographs illustrating the sampling equipment.] The borosilicate glass bottle was attached to an aluminum rod in such a manner that the bottle cap could be opened and closed at the depth required to take the appropriate sample. After lowering the rod to the desired depth within the pond, the sampler rod was actuated to release the bottle cap. After allowing sufficient time for the sample bottle to fill, the cap was replaced (bottle closed) and the sample was retrieved. The water was then transferred to appropriate sample bottles.
>
> Pond sediment samples were collected with a stainless steel, twenty-five pound Wildco™ Ponar dredge sampler with a six inch square opening as shown in photograph #2. The dredge sampler was lowered to the pond bottom and retrieved with a nylon rope as shown in photograph #3. A clean nylon rope was used for each sample retrieval. The contents were placed immediately into the appropriate sample containers for volatile organic compounds (VOCs) and total petroleum hydrocarbons - gasoline range organics (TPH-GRO) analyses prior to homogenization as shown in photograph #4. The remaining sample was homogenized in a stainless steel bowl, shown in photograph #2, prior to placement in the containers sent to the lab for analysis of semi-volatile organic compounds (SVOC), total petroleum hydrocarbon - diesel range organics (TPH-DRO), and priority pollutant metals. The pond sediment and aqueous samples were analyzed for volatile organic compounds using EPA Method 8240, Total Petroleum Hydrocarbons (TPH) using EPA Method 8015 modified, semi-volatile organic compounds using EPA Method 8270, and priority pollutant metals using EPA Method 7000 Series/6010. TPH analyses includes two fractions: the volatile fraction (gasoline range organics - GRO) and the semi-volatile fraction (diesel range organics - DRO).

The principal contaminants in the ponds were volatile organic compounds from the petroleum hydrocarbons picked up in the wastewaters discharged to the ponds. In addition, the SI evaluated whether other VOCs (e.g., chlorinated organics used as cleaners and solvents) were being picked up from the wastewater discharges. To evaluate whether releases of VOCs were occurring, soil gas samples were collected from the pond perimeters. Soil gas samples were analyzed for constituents of petroleum hydrocarbons and chlorinated organic compounds using modified EPA Methods 8010 and

8020. For each site, an initial grid of soil gas sampling locations was established. Then, additional soil gas samples were collected, if warranted, based on positive findings from Phase I; additional samples were collected when concentrations exceeded 10 μg/l.

Groundwater monitor wells were installed around both the Old Wash Rack Reservoir and the East Pond as part of the SI since they were considered to have the highest potential for releasing contaminants to groundwater, as follows:

- Previous sampling of the Old Wash Rack Reservoir indicated that chlorinated solvents had been released to it; and it receives the wastewater from both East and West ponds,

- The East Pond, which receives wastewater from Building 8100, was considered to have a high potential for receiving hazardous substances because of the hazardous waste generation activities that have been consolidated in Building 8100.

The SI included the installation of groundwater monitor wells at the other sites only if the results of the pond sampling and soil gas surveys indicated that significant concentrations of hazardous substances were present and would represent a potential threat for significant releases to groundwater.

Aqueous and sediment samples were collected from intermittent tributaries to Threemile Creek where the ponds were located in close proximity to the tributaries. Stream sampling was conducted at the East Pond and for the Old Wash Rack Reservoir/Cells 1 through 4 area. The stream sediment and surface aqueous samples and groundwater samples were analyzed for the same chemical constituents as those analyzed for the pond sediment and aqueous sampling discussed above.

5.2 Site Description and History

The Custer Hill industrial wastewater system consists of three ponds -- the East Pond, West Pond and Old Wash Rack Reservoir. Each of these ponds receives discharges from approximately one-third of the Custer Hill Troop Complex area. Specifically, the East Pond receives discharge from nine equipment shops, the West Pond receives discharge from seven motor pools, and the Old Wash Rack Reservoir receives discharge from six motor pools (Ref. 42). In addition, the water from the East and West Ponds is subsequently pumped to the Old Wash Rack Reservoir. The primary source of wastewater for the these ponds is stormwater runoff. The system flow varies significantly with precipitation. None of the ponds are currently lined.

The Custer Hill Troop Complex area is also serviced by a sanitary sewer system which feeds wastewater to the Custer Hill Wastewater Treatment Plant. The sanitary sewer system is not connected and does not discharge to the Custer Hill wastewater ponds.

The sources of contaminants for the wastewater ponds includes sediment, oil and debris from both equipment washing and vehicle maintenance, and transmission fluid from vehicle maintenance. The most commonly used cleaner at the motor pools is Citracleen, which is a non-hazardous composition of citric acid. The Custer Hill complex was constructed in the 1970s; other types of cleaners may have been used in the past.

The central vehicle wash facility is located on the northern portion of the Custer Hill Troop Area off of Track Road and began operation circa 1986. The facility includes Buildings 8550 through 8556 and 8560 through 8565. The facility is located adjacent to a tributary of Threemile Creek. In general, this facility serves to remove exterior dirt and grime from vehicles. The activities at the central vehicle wash facilities are not being evaluated in this SI since the wash activities do not generate hazardous wastes. The Cells associated with the wash facility are only being evaluated in this SI because of the transfer of water to them from the Old Wash Rack Reservoir.

At the central wash facility, the vehicles pass through a wash/dip area where the vehicles are washed. After the wash, the vehicles proceed to the post wash area where rinse water is used to remove any remaining dirt. Water from the wash area drains into a double sedimentation/oil-grit skimmer basin. The skimmer removes floating oils which are managed as waste oils. The water from the rinse facility flows to a sedimentation pond prior to joining the wash water before entering Cell 1. An overview of the processes at the wash facility, the flow of materials at that facility, and its relationship with the wastewater ponds is presented in Figure 5-2. As shown, the two wastewater retention ponds (i.e. East and West Pond) discharge to the old reservoir where petroleum hydrocarbons are recovered through the use of booms and skimmers. The water from the old reservoir, in turn, discharges to Cell 2. Cell 3 receives discharges from both Cell 2 and Cell 1, which is connected to the central vehicle wash facility. Water from Cell 4 is pumped back to the wash facility for reuse. The system is largely self-contained. The facility is designed to prevent surface runoff from entering the cell. Only in extremely rainy weather is any water from Cell 4 released into the head waters of Threemile Creek. Furthermore, the facility as a whole requires additional water due to compensate for evaporative losses; thus, releases to Threemile Creek to avoid overflows are not common.

Prior to construction of this facility, vehicles were washed at the TES. While most vehicle washing is conducted at the central facility, some vehicle washing is still performed at the TES. Wash racks at these shops are drained to one of the wastewater retention ponds feeding the central vehicle wash facility.

5.2.1 Old Wash Rack Reservoir/Cells 1 Through 4

As noted above, the Old Wash Rack Reservoir receives wastewater from motor pools directly as well as the discharges from East and West Pond. Therefore, any releases from motor pools on Custer Hill have the potential to be discharged to the Old Wash Rack Reservoir. According to previous investigations, drums of waste oil solution have been periodically dumped into the oil skimmer system at this reservoir (Ref. 43). There is no removal of sludge from the Old Wash Rack Reservoir. A review of files identified sludge samples that had been collected from the reservoir by KDHE. (Data information from this sampling can be found in Section 8, Excerpts.) The exact locations of the samples are not known. The detections included tetrachloroethene.

Cell 1 appears the least adversely affected pond within the Custer Hill Industrial Wastewater System. Abundant vegetation, plant, and aquatic life (i.e. muskrats, frogs, ducks, birds, cat-tails) lives within this Cell as shown in photograph #16. [The locations of the photographs for Cells 1 through 4 are provided in Figure 5-3.] Cell 1 contains a boom that stretches diagonally across the northern third of the Cell. The presence of the boom is more precautionary in nature to prevent any potentially contaminated water from entering Cell 3. There were no petroleum slicks observed at Cell 1.

Cell 2 is the discharge point for the Wash Rack Reservoir. This Cell, as shown in photograph #15, appears unaffected by pollution. Cell 2 is full of aquatic life and the banks are overgrown with vegetation (i.e. frogs, cat-tails, shrubbery). No surface boom exists in Cell 2.

Cells 3 and 4 are shown in photographs #17 and #18, respectively. Each contains a surface boom near the inlet portion of the Cells to prevent any potentially contaminated water from flowing to the outlets. Each Cell appeared clean and unaffected by pollution.

Cells 1 through 4 are surrounded by an eight-foot chain link fence with locking gate. The gate is kept locked and access is controlled by personnel at the central vehicle wash facility.

5.2.2 East Pond

The East Wastewater Retention Pond was built circa 1988. It is rectangular with dimensions of approximately 200 feet x 100 feet. The East Pond is surrounded by an eight-foot chain link fence with a locking gate. The gate is kept locked except to conduct periodic maintenance of the pond and its equipment. The inlet pipe is at the north end surrounded by several floating booms where oil is collected and skimmed. This oil is placed in tanks and managed as waste oil. The outlet is on the west side of the pond. Water is pumped to the Old Wash Rack Reservoir.

The East Pond receives water mainly from the washing activities conducted at the tactical equipment shops on the eastern portions of Custer Hill. As with the central vehicle wash facility, the contaminants associated with washing at the TES are petroleum hydrocarbons. However, this pond also receives water from drains at Building 8100, which uses a variety of chemicals and cleaners. Residues from activities at this building have the potential to enter the drain system leading to the East Pond since water from the industrial sumps at Building 8100 is pumped to the East Pond. The types of hazardous wastes generated at Building 8100 are illustrated below (Ref. 44). There are no direct discharges of these wastes to the East Pond; rather they would be carried to the East Pond as a result of spills within Building 8100.

Waste	Approx. rate/yr	Activity	Waste Code	Parameters
Lead battery solution	7200 gal/yr	DOL	D002	pH
Dry honer particles	1.5 gal/yr	Auto shop	D001 D004-D011	Flash point TCLP metals
Spray paint filters	600 gal/yr	Fuel/electronics shop Camp shop Auto body shop Furniture shop	D001 D004-D011 D035 D039	Flash point TCLP metals MEK Tetrachloroethylene
Trichloroethane and Tetrachloroethylene (mixed)	12 gal/yr	Oil Lab	D004-D011 D039 D040	TCLP metals Tetrachloroethylene Trichloroethylene
Paint and Paint related materials	varies	Furniture shop Auto Body shop	D035-D001	Vol. Organics Toxic
Radiator Caustic	varies	Radiator shop	D004-D011 D002	TCLP metals; pH Metals
Radiator Work tank water	varies	Radiator shop	D004-D011	TCLP metals; pH
Engine Cleaner	---	Radiator shop	D004-D011 D002	TCLP metals; pH Metals
Parts washer sludge	varies	8100	D004-D011	TCLP metals, pH

Because of the hazardous waste generation activities conducted in Building 8100, it is subject to regulation under RCRA and is inspected regularly. Also, the waste in Building 8100 has been tested on numerous occasions. An overview of typical results for testing conducted between 1992 and 1994 is as follows: (representative data sheets are provided in Section 8, Excerpts) (Ref. 45):

- Sampling of the Building 8100 dynamometer room trap in June 1993 indicated that the wastes in the trap were non-hazardous. [The dynamometer testing is one of the activities in Building 8100 that uses cleaning solvents and generates hazardous wastes.]

- Lead acid battery caps at Building 8100 tested hazardous for lead.

- Sludge at the East Pond sampled May 1993 and analyzed (using EPA's 8240 VOCs procedure) contained the following: 527 ppb benzene; 3,379 ppb toluene; 2,802 ppb ethylbenzene; 3,042 ppb xylenes; and 0.46 mg/l cadmium. Sampling of the water in May 1993 for TPH using EPA method 418.1 detected 113,000 ppm (data was not included to indicate where this water sample was collected relative to the oil boom at the pond).

- Testing of the auto shop, furniture shop, oil testing laboratory and sumps within the building identified a variety of metals, constituents of petroleum hydrocarbons and some chlorinated solvents (e.g., tetrachloroethene). In general, the materials tested (using TCLP and VOCs) in the sumps, which would eventually discharge to the East Pond, were non-hazardous.

The Petroleum, Oils and Lubricants (POL) storage facility for Fort Riley is located across First Division Street from the East Pond. There have been numerous oil spills at the nearby POL, some of which have had an impact on the East Pond. The POL facility is currently the subject of a separate environmental investigation and is not discussed in detail in this SI. However, two past spills are discussed, one which occurred in 1989 and the other in 1993 (Ref. 46). (Excerpts of these spills affecting East Pond are included in Section 8.0.) Other documented smaller spills, between 1980-1993, have also occurred.

On 8 September 1993, a malfunction in a sump system was discovered. This malfunction caused the collection of fuel in the waste fuel sump and the overflow of fuel through a clean out pipe. The fuel was primarily mogas (a generic term for motor gasoline often used to refer to gasolines with lead alkyls). The fuel flowed from tank 201B, and a total of 9537 gallons of fuel collected at the concrete slab encompassing the drain. One of the manholes was overflowing with mogas. Initially, the fuel spill was running down the hill from the POL Facility toward a small creek southwest of the facility. Underflow dams were constructed so that the fuel was stopped from flowing down the creek, and pooled in areas for recovery. Approximately 7600 gallons of the fuel was recovered.

An oil spill was recorded on 19 March 1989, when fuel was noticed leaking from manhole covers in the vicinity of the Tank Farm. Upon the discovery, the upper sump was checked, and found to be full and drained. The 701st Facility operators advised that a mogas valve was discovered open (which allowed fuel into the slop fuel system) approximately one week prior to the reported spill. On the day the spill was discovered, approximately 3000 gallons of mogas/diesel fuel were recovered from two manholes. Later, about 1000 gallons of additional fuel was pumped from the manhole system, and several tankers of water/fuel mixture was pumped from a boomed area of a new sedimentation pond in the industrial wash water system. According to the Division Material Management Center (DMMC), by the time of this spill, approximately 7764 gallons of mogas and approximately 30,000 plus gallons of diesel had been lost since the facility was opened (Ref. 47). Following the March 1989 spill, the downgradient manhole across the street from the POL Farm was inspected. In July 1989, approximately two feet of diesel was observed floating on the water in the manhole. This diesel was subsequently pumped from the manhole. It was also observed that the ground around the manhole had extensive stains from spilled petroleum. This manhole is located in close proximity to the East Pond.

There is a visible petroleum layer on the surface of the East Pond. The locations of the photographs taken of the East Pond are shown in Figure 5-4. As shown in photographs #11 and #13, oil booms are present at the East Pond to prevent surface spreading. In addition, an oil skimmer is in operation at this pond as shown in photograph # 10 which illustrates the housing for the system. Staining on the banks of the pond has occurred, as shown in photograph #13, as a result of changes in the pond surface level. Photograph #12 shows the East Pond looking southeast. The facility shown in the background is the tank farm in which several spills have occurred in the past. As shown in photograph #12, the booms coupled with the oil skimmer have effectively limited the spread of oil and confined it to the north portion of the pond.

5.2.3 West Pond

The West Wastewater Retention Pond was built circa 1980 and entered into use circa 1982. The pond is located several hundred feet west of Track Vehicle Road. This pond is round with an approximate diameter of 100 feet. Water from this pond is pumped to the Old Wash Rack Reservoir. The operation of the West Pond is similar to the East Pond in that it receives wash water collected from tactical equipment shops on western Custer Hill. Floating petroleum on the pond surface is the predominant contaminant of concern at the West Pond. The West Pond is not fenced.

The West Pond is not known to receive any CERCLA or RCRA listed contaminants from adjacent site activities (i.e., vehicle maintenance or washing conducted at the TES). The greatest threat posed by on-site exposures at the West Pond is due to non-CERCLA constituents of petroleum. The quality of the West Pond is evaluated periodically through chemical analyses. A sample analyses from May 1993 was selected as representative based on a review of available results. At that time, a sample from the pond was collected and analyzed using EPA's TCLP procedure. The only compound detected (from the extract) was toluene at 38.9 ppb.

Although the West Pond is not fenced, it is situated at a location that is away from the public. Only site personnel conducting authorized duties would congregate in the area near the West Pond.

The locations of photographs for the West Pond are shown in Figure 5-5. The West Pond has a noticeable petroleum layer on the surface as shown in photographs #5, #6, #7, and #8. A boom is present on the surface of this pond, as shown in the photographs, to prevent spreading of the petroleum from the inlet to other points within the pond. The boom behaves in a passive manner to prevent the surface spreading since an active oil skimmer is not in operation at the West Pond. As shown in photograph #9, the boom is only partially effective based on the presence of petroleum near the outlet side of the pond. This may be caused by the periodic rather than continuous operation of the boom on the pond surface. As shown in the photographs, staining of the pond banks has occurred as a result of the rise and fall of the pond water.

5.3 Waste Characteristics

Fort Riley has been used mainly for the training of Army personnel. Development of Fort Riley included activities to support overall post operations, including print shops, photographic processing, laboratories, furniture repair, dry cleaning, paint shops, sewage treatment plants, and numerous vehicle maintenance and wash facilities. A sampling of the hazardous materials used at the post include the following:

- chlorinated solvents associated with furniture repair, dry cleaning and cleaning of printing equipment; and

- large quantities of petroleum-based fuels and cleaners associated with vehicle use, maintenance and repair.

Many of the activities that use hazardous substances and generate hazardous waste have been consolidated into Building 8100 on Custer Hill. Building 8100 is located on Custer Hill east of the intersection of First Division Road and Appenines Drive, and southeast of the East Pond. A variety of activities are conducted at this facility, including vehicle repair shops, machine/weld shop, mechanical/electrical shop, paint booths, oil testing laboratory and furniture stripping and repair. The facility is known to have a number of activities that generate hazardous waste streams including the following:

- Trichloroethane from the oil laboratory,
- Paint waste and filters,
- Lead solder in air filters,
- Lead acid battery waste,
- Cutting oils, and
- Radiator cleaning solution.

A large volume of the materials used at Building 8100 are petroleum hydrocarbons. However, a large variety of activities occur that also use CERCLA or RCRA hazardous substances. The oil testing laboratory, in particular, has been identified as a source of such waste. The oil testing process has used PCE as part of the analytical procedures, and waste PCE occurs. However, recent testing of the floor trap in the oil testing laboratory indicated that these materials were non-hazardous. Other activities in the building that use hazardous materials include the paint shop, battery shop, photographic laboratory, and furniture repair. Sediment and sludges from the floor sumps are handled as a hazardous waste. Industrial wastes from the floor drains are pumped into industrial sewers that leave the building and flow to the East Pond.

Wastewaters from Building 8100, which discharge to the East Pond, have the potential to contain hazardous substances. Also, chlorinated solvents (e.g., trichloroethene and dichloroethene) have been detected in the Old Wash Rack Reservoir. The primary contaminants of concern at all the ponds are petroleum hydrocarbons. The petroleum hydrocarbons are visible on the East and West ponds, and there are active collection systems in place to recover free floating hydrocarbons.

The SI sampling results evaluated whether hazardous substances were associated with the ponds. In conjunction with collection of sediment samples at the ponds, the thickness of sludge was measured at each pond. The sludge thickness was measured to assess whether the sediment samples being collected would be representative of the sludge as a whole. As shown in this report, the thickness of sludge in the ponds was on the order of a few feet at most locations. The sludge sampler collects sediment from the upper six to eight inches of sediment. since the sludge was only few feet thick or less at most locations, the amount of sludge sampled represents a considerable percentage of the total thickness. Therefore, depth profiling of the pond sediments was not considered necessary.

5.3.1 East Pond

Sampling at the East Pond included the following:

- fifteen soil gas points in Phase 1 and fourteen soil gas points in Phase 2,
- three aqueous samples from the pond,
- two sediment samples from the pond,
- installation and sampling of three groundwater monitor wells, and
- stream samples (aqueous and sediment) at three locations.

The sampling locations are shown in Figure 5-6.

The positive detections during both phases of the soil gas survey are presented in Table 5-1. [Appendix H contains the analytical data from the soil gas survey.] During the Phase 1 survey, elevated levels of petroleum hydrocarbons were detected to the east of the pond, between the pond and First Division Road. This area is in the downgradient direction. Also, low levels of 1,2-dichloroethene (DCE) and 1,1-dichloroethane (DCA) were detected (samples EP-C4 and EP-H3). The detections of DCE and DCA were just slightly above the detection limits for soil gas. Both C4 and H3 are in the downgradient direction. In addition to their use as solvents, both DCE and DCA are used as additives in gasoline at low concentrations and may be associated with the petroleum hydrocarbons discharged to the pond. Because the concentrations of DCE and DCA were below the action levels provided in the SAP, they were not evaluated further using soil gas.

As a result of the detections of constituents of petroleum hydrocarbons southeast of the East Pond, fourteen additional locations were sampled during the Phase 2 soil gas survey; the Phase 2 samples can be identified as follows: EP-A__. During the Phase 2 survey, petroleum hydrocarbons were encountered at concentrations exceeding 5,000 μg/l, and detections of petroleum hydrocarbons were found on the opposite side of First Division Road, adjacent to the petroleum storage facility for Fort Riley. The soil gas data for total flame ionization detector (FID) concentrations (representing the sum of all petroleum hydrocarbons detected on the gas chromatograph-flame ionization detector) was used to prepare an isoconcentration map of the hydrocarbon contamination. The results are shown on Figure 5-7 and indicate that the highest concentrations are separated from the area of the East Pond by areas of no detections.

The detected analytes in the pond aqueous samples are shown in Table 5-2. The positive detections for the pond sediment sampling are shown in Table 5-3. The samples were analyzed for VOCs, SVOCs, TPH and PP metals. The pond aqueous samples contained components of toluene, xylene, petroleum hydrocarbons, bis-2-ethylhexyl phthalate, phenanthrene, lead and zinc. Similarly, the pond sediment samples contained components of petroleum hydrocarbons, toluene, ethylbenzene, xylene, naphthalene, 2-methylnaphthalene, phenanthrene, bis(2-ethylhexyl)phthalate, arsenic, beryllium, cadmium, chromium, copper, lead, nickel and zinc. None of the detected analytes exceeded the EPA Risk-Based Levels for soils. During the SI, the thickness of the pond sludge was measured at multiple locations; the results of these sludge thickness measurements is shown in Figure 5-8.

Three monitor wells, EP-93-01 (depth 18 feet), EP-93-02 (depth 6 feet), and EP-93-03 (depth 9 feet), were installed and sampled. The depth to bedrock varied from approximately 6 to 18 feet. The groundwater samples were analyzed for VOCs, SVOCs, TPH and PP metals. The uppermost bedrock consisted of weathered shale and shale. There was no groundwater encountered in materials overlaying bedrock. All three wells were installed in the first water-bearing units, which consisted of thin (less than two feet at some locations) limestone layers. Because of the low permeable shales overlying the limestone formations, groundwater was under confining conditions in the limestone layers and rose 5 to 10 feet inside the boreholes and completed wells.

Monitor Well EP-93-01 exhibited chemical concentrations below levels of detection for all analytes except for two volatile organic compounds: 1,1,1 trichloroethane and 1,1 dichloroethane. Monitor Well EP-93-02 exhibited chemical concentrations below levels of detection for all analytes measured. Monitor Well EP-93-03 was moved from its original location, as approved in the sampling and analysis plan (SAP), prior to installation. This well location was moved (approximately 100 feet to the south and east) to coincide with high readings obtained from the soil gas survey that was performed at the East Pond. During well installation at this location, the drill bit encountered significant contamination in the form of floating product. The well is screened across a limestone layer beginning at a depth of 29 feet. Periodic measurements of product thickness were made, and levels varied from 5 to 9 feet of product in the well. Approximately 15 gallons of free product was bailed from the well and containerized within the first few days following drilling. Additional petroleum recovery is being conducted under a separate effort. The results of chemical analysis for Monitor Well EP-93-03 found the following chemical constituents: petroleum hydrocarbons, 2-methylnaphthalene, naphthalene, phenanthrene, benzene, ethylbenzene, xylene, toluene, and arsenic. Naphthalene and benzene exceeded regulatory standards for groundwater. A sample of product from the well was sent to the laboratory for petroleum fingerprinting used to identify whether or not the product is a type of fuel, and if so, which fuel. As a result of the fingerprinting analysis, the product was identified as diesel fuel. The results of the analysis are listed below:

Analyte	Concentration
TPH-DRO	1,100,000 mg/kg
Total Organic Halides	840 mg/kg
Ethylbenzene	600 mg/l
m,p-xylene	2200 mg/l
o-xylene	910 mg/l
Toluene	1100 mg/l

For Ethylbenzene, m,p-xylene, o-xylene and toluene the recommended holding time was exceeded; result is an estimate.

These values document the presence of contamination as a result of spills at the tank farm, as documented in Section 8, Excerpts. Table 5-4 lists the detected analytes for groundwater samples.

The positive detections for the aqueous stream samples collected at the East Pond are shown in Table 5-5. The results for the sediment stream samples collected at the East Pond are shown in Table 5-6. These samples were analyzed for VOCs, SVOCs, TPH and PP metals. The aqueous samples had detections for petroleum hydrocarbons (diesel fraction) and zinc. The diesel fraction petroleum hydrocarbons were also detected in the upstream sediment sample. Additionally, the following metals were detected in the sediment samples: arsenic, beryllium, cadmium chromium, copper, lead, nickel and zinc. None of the detections for aqueous or sediment samples exceeded risk-based guidelines.

The groundwater levels in all three wells are below the level of the pond; however, the column of petroleum hydrocarbons in EP-93-03 may depress the measured groundwater elevation. A geologic cross-section for the site showing the shale bedrock and limestone stringers is presented in Figure 5-9; the location of the cross-section is shown in Figure 5-10. The limestone layers under the site dip regionally to the west-northwest. Accounting for the exaggerated vertical scale, the degree of dip illustrated on Figure 5-9 is 5 degrees. As shown, the limestone layer providing water at EP-93-01 is stratigraphically above and different than the limestone screened by the downgradient wells. Similarly, well EP-93-02 is screened in a limestone stringer stratigraphically above EP-93-03. Because the wells are screened in different limestone stringers, a groundwater gradient map cannot be prepared. Nonetheless, because the wells intercept first sustainable groundwater, samples from the wells serve to identify whether contaminants are being released from the pond to groundwater.

Petroleum hydrocarbons were detected in soil gas and groundwater to the southeast of the East Pond, along First Division Street. The soil gas data show that there are areas of no petroleum contamination between the East Pond and the area to the southeast. As discussed previously, spills from the POL facility have resulted in accumulations and overflows of petroleum hydrocarbons from the manhole located southeast of the East

Pond (Figure 5-6). Thus, this manhole is the likely source of contamination detected to the southeast of the pond. Also, although DCE and DCA were detected at low concentrations in soil gas (1.4 and 1.8 μg/l), they were not detected in groundwater.

5.3.2 West Pond

Sampling at the West Pond included the following:

- eight soil gas sampling points around the perimeter of the pond to determine the extent of contamination that may exist in the unsaturated zone. [Appendix H contains the analytical data from the soil gas survey.]
- Two aqueous samples from the pond, and
- two sediment samples were collected from the pond.

The sampling locations are shown in Figure 5-11.

During the SI, a petroleum layer characteristic of heavy end oils (e.g., high relative viscosity) was present on the surface of the West Pond. Petroleum odors were present; however, petroleum vapors were not sufficient to register on the PID. Black staining was observed on the bank of the pond. The staining likely occurred as a result of fluctuations in the water level of the pond. An oil boom has been placed across the inlet side of the pond surface to inhibit the spreading of the petroleum layer. The greatest accumulation of the surface petroleum layer is observed inside the perimeter of the boom.

The Phase 1 soil gas survey for the site included eight sampling locations. There were no detections in any of the soil gas samples (from depths of 4 and 12 feet at each location), and Phase 2 soil gas sampling was not conducted.

The positive analytical results for the pond aqueous samples are shown in Table 5-7. The detected analytes for the pond sediment sampling are shown in Table 5-8. The samples were analyzed for VOCs, SVOCs, TPH and PP metals. The aqueous samples from the pond contained a variety of components of petroleum hydrocarbons (benzene, ethylbenzene, toluene and xylene) and some chlorinated organic compounds (1,1,1-trichloroethane, 1,1-dichloroethane, methylene chloride and chloroform). Also, the diesel fraction of TPH, and cadmium, lead and zinc were detected. None of the detections exceed MCLs. Chloroform and benzene exceed the KNL, and cadmium equals the MCL and KAL.

The pond sediment samples had detections for both the gasoline and diesel fractions of TPH, xylene, toluene, naphthalene, phenanthrene, bis-2-ethylhexylphthalate, 2-methylnaphthalene, fluorene and dibenzofuran. In addition, there were detections for metals: arsenic, cadmium, chromium, copper, lead, nickel and zinc. None of these compounds were detected at concentrations above risk-based standards. Sludge thickness measurements were made at multiple locations during the SI; the results are shown in Figure 5-12. A geologic cross section showing pond and sample depths for West Pond is shown in Figure 5-13; a profile line for the West Pond geologic cross section is shown in Figure 5-14.

The pond sampling illustrates that the primary contaminants being discharged to the pond are related to petroleum hydrocarbons. The pond results do not indicate that CERCLA hazardous substances are being discharged to it. The soil gas survey was performed at depths of 4 and 12 feet at each location. Figure 5-13 shows that the 12 foot samples were below both the liquid depths in the pond but also the bottom of the pond sediments. In addition, these samples were within approximately 30 feet from the edge of the pond. Thus, the soil gas data indicate that the pond is not releasing petroleum hydrocarbons (or other volatile organic compounds) to groundwater.

5.3.3 Old Wash Rack Reservoir/Cells 1 through 4

The field investigation included a soil gas survey around the perimeter of all the Cells to evaluate whether releases had occurred to soils and/or groundwater. [Appendix H contains the analytical data from the soil gas survey.] This soil gas survey included an initial test of 20 locations. However, along the east and north sides of the Cells, the elevation drops sharply from the top of the berm surrounding the ponds towards natural elevations. Therefore, an additional eight soil gas sample locations were placed on the east and north, enabling sample collection from both the top of the pond berm and the base of the pond berm. Two aqueous and three sediment samples were collected from each pond for a total of 10 aqueous and 15 sediment samples. As shown on Figure 5-15, there are two primary intermittent streams -- they flow along the eastern and western sides of the Cells and join into a common intermittent stream north of Cell 4. Potential migration from the site along these intermittent streams was evaluated by collecting three stream aqueous and six stream sediment samples. The locations of the SI samples are shown in Figure 5-15. During the SI, the thickness of the sludge in each of the ponds was measured at multiple locations. The results of these measurements are shown in Figures 5-16 through 5-18.

The following observations were made during the pond sampling events. The Old Wash Rack Reservoir did not have visual petroleum hydrocarbons like the East and West Ponds. Plant life flourishes on the banks of the reservoir (e.g., cat-tails etc.) and algal blooms grow abundantly within the reservoir itself. A very thin sheen of petroleum is perceptible at the outlet location where a sediment sample was collected. Overall, the reservoir appeared clean. No odors were detected, and no vapors were detected with the sense of smell or from the on-site organic vapor meter. Similarly, Cells 1 through 4 were free of petroleum odors and visible petroleum product. In Cell 1, two beaver/muskrat dens, two muskrats, hundreds of frogs, and a family of ducks were found. In addition, the Cell was covered with plant life over its entire surface.

Of the 30 soil gas sampling locations, there were positive detections in only three samples. Specifically, toluene was detected at 1.6 and 1.1 μg/l in the 12 foot soil gas samples at locations WR-F0 and WR-H2. These locations are at the northeast and southeast corners of Cell 4, respectively. Also, there was a Total FID detection of 12 μg/l at location WR-C2, which is to the west of Cell 4. All three of these detections are just above the detection limits of 1.0 μg/l for toluene and 10 μg/l for Total FID. They were also below the action levels for soil gas identified in the SAP and were not investigated further.

The positive detections from the aqueous pond samples are shown in Table 5-9. The detected analytes from the pond sediment samples are shown in Table 5-10. The samples were analyzed for VOCs, SVOCs, TPH and PP metals. The only substances detected in the aqueous samples were the diesel fraction of TPH, bis-2-ethylhexyl phthalate in one sample, lead in one sample and silver in two samples. None of the detections exceed MCLs or KALs. Organic compounds detected in the sediment samples include both the gasoline and diesel fractions of TPH. The DRO fraction is detected with greater frequency and at higher concentrations and is present in all but one of the samples. Other organic compounds detected include methylene chloride, toluene, bis-2-ethylhexyl phthalate, xylene, and di-n-butylphthalate. A variety of metals were detected: arsenic, beryllium, cadmium chromium, copper, lead, nickel, and zinc. None of these detections exceed risk-based concentrations for soils.

Three monitor wells, WR-93-01, WR-93-02, and WR-93-03, were installed at the Old Wash Rack Reservoir. The wells were completed in unconsolidated clays and weathered shales. The groundwater gradient map for the site is presented in Figure 5-19. A geologic cross-section for the Wash Rack Reservoir is shown in Figure 5-20, and a sampling cross-section showing wells from the Wash Rack Reservoir, as well as sampling depths through Cell 4, is shown in Figure 5-21. The profile lines for these two cross-sections are shown in Figure 5-22.

As shown on Figures 5-19 and 5-20, the groundwater levels in the wells are lower than the water level in the Old Wash Rack Reservoir. The groundwater levels in the wells are more comparable to the water level in Cells 1 and 2. Based on this information, the water in the Old Wash Rack Reservoir was not considered to be continuous with groundwater levels in the nearby wells. Rather, water from the reservoir would migrate vertically and radially until encountering the zone of saturation.

Detected analytes for groundwater are shown in Table 5-11. Groundwater samples were analyzed for VOCs, SVOCs, TPH and PP metals. Monitor Well WR-93-01 exhibited chemical concentration values below levels of detection for all analytes measured except for the metal arsenic. Arsenic appeared in the groundwater at this well location at a concentration of 0.02 mg/l, which falls below all regulatory standards. Monitor Wells WR-93-02 and WR-93-03 exhibited chemical concentrations values below levels of detection for all analytes measured.

The positive detections from the stream aqueous samples are shown in Table 5-12. The detected analytes from the stream sediment samples are shown in Table 5-13. The samples were analyzed for VOCs, SVOCs, TPH and PP metals. The only substances detected were lead and zinc, both detected at only one location. The concentrations do not exceed MCLs or KALs. In the sediments, the diesel fraction of TPH was detected at two locations. The highest concentration (1,100,000 μg/kg) was off the northwest corner of Cell 4. No other organic compounds were detected. Metals were also detected: arsenic, beryllium, cadmium chromium, copper, lead, nickel and zinc. No metals exceeded risk-based guidelines for soils.

Figure 5-21 illustrates the depths of the groundwater monitor wells and soil gas samples relative to the ponds. For each pond, soil gas and/or groundwater samples were collected from elevations below the bottom of the pond. Thus, the samples were appropriately located to determine whether VOCs were being released to the environment.

5.4 Groundwater

The ponds are located in the upland area of Fort Riley where groundwater occurs primarily in fractured bedrock. Each well at East Pond was completed into bedrock. The depth of groundwater initially encountered during drilling was much lower than the depths observed after a period of stabilization (i.e., 24 hours after drilling concluded). The rise of water levels in these wells represents confined groundwater conditions beneath Custer Hill. The wells at the Old Wash Rack Reservoir encountered shallow, sustainable groundwater in unconsolidated weathered shales. Thus, locally, shallow groundwater occurs above bedrock in certain areas of Custer Hill.

The rate and magnitude of contaminant migration from the Custer Hill wastewater ponds to the subsurface is governed by the geology that is present beneath the sites. Stratigraphically, the surface of Custer Hill is covered with a thin, glacially derived, wind deposited soil, known as loess, and decomposed sedimentary rock. The soil and subsoils typically are less than 30 feet thick on the plateau. Soil borings at Building 8100 - the Consolidated Maintenance Facility on Custer Hill - show bedrock is consistently encountered within approximately 10 feet of the surface, with the overlying materials consisting predominately of clays and topsoils.

Three monitor wells, EP-93-01, EP-93-02, and EP-93-03, were installed at the East Pond to depths of 38, 23, and 33 feet below ground surface, respectively. (The locations of these wells is shown in Figure 5-6.) Each of the wells encountered bedrock at shallow depths (i.e., 18, 9 and 6 feet below ground surface, respectively). During drilling, the geology encountered above the bedrock at the East Pond was mainly of weathered bedrock consisting of silts and clays. The uppermost bedrock consists of weathered shale and limestone. All three wells are installed in the first water bearing units, which consists of thin (less than two feet at some locations) limestone layers. At the water bearing zones (based on coring), the limestone is highly weathered and fractured. Because of the low permeable shales overlying the limestone formations, groundwater is under a confined condition in the limestone. Groundwater rose 5 to 10 feet inside the boreholes and the completed wells.

Three monitor wells, WR-93-01, WR-93-02, and WR-93-03, were installed at the Wash Rack Reservoir to depths of 30, 39, and 34 feet below ground surface, respectively. (The locations of these wells is shown in Figure 5-19.) Each of the wells was installed to the top of bedrock and screened within the unconsolidated weathered shale and limestone. Each well was installed in the first water bearing unit (i.e., weathered bedrock). The weathered shales that make up the residuum imparts a low permeability to the water bearing zone. Groundwater occurs as unconfined at the Wash Rack Reservoir.

The four mile radius around the Custer Hill ponds is shown on Plate 2-1. Currently, the producing well field for Fort Riley is located west of Main Post along McCormick Road and in the Camp Forsyth area. The supply system consists of six older wells (referred to as Main Post wells brought on line in 1928 to 1943) and two newer wells (referred to as Forsyth wells brought on line in 1993). All eight wells draw from alluvial materials and are blended into a single distribution network that supplies the cantonment areas. Wells were formally located in the Camp Funston area, but these have been removed from service and plugged. Two other wells in Camp Forsyth were previously used for drinking water and are now used for irrigation. An additional well is located in the alluvial materials at Marshall Field. This well is not routinely used for drinking water but can be used to provide drinking water within the limits of Marshall Field on an emergency basis. Populations served by these wells is based on the population of Fort Riley and individual cantonment areas.

The communities of Junction City, Ogden, and Manhattan also rely on groundwater withdrawn from alluvial materials as their supplies. Junction City has nine active wells, Ogden has three active wells,and Manhattan has nine active wells. Ogden also provides water to a rural water district in Riley County. The rural water district is adjacent to the northeast border of Fort Riley and includes the town of Keats. While the majority of private residences located within 4 miles of Fort Riley are located in upland areas, private residences located within the alluvial lowlands are expected to have wells tapping the alluvial materials where not served by a public water supply system in the area. The private wells in the area are used for both drinking and irrigation. The wells of Junction City and Ogden are within 4 miles of Fort Riley while the Manhattan wells are greater than 4 miles distant.

Fort Riley operates several wells that draw from bedrock formations. These include wells at Range control, MPRC/Douthit Range, Trainfire 4 (TF4), and Range 18. The Range Control wells are used regularly as a source of drinking water for approximately 12 people. The wells at MPRC/Douthit Range are used for drinking water on an as-needed can provide water for the current capacity of the facility, which is approximately 600 people. The well at Range 18 and TF4 are not treated and are not used for drinking water.

5.5 Surface Water

Regionally, Fort Riley is located along the Kansas River and is surrounded by other large bodies of water associated with the Kansas River system. These include Milford Lake to the west, the Republican River (which drains Milford Lake) and the Smoky Hill River from the south. The Republican and Smoky Rivers form the Kansas River. There are numerous other intermittent and perennial creeks that dissect Fort Riley, eventually feeding into either the Republican, Smoky, or Kansas River. Threemile Creek, Honey Creek, and tributaries to Sevenmile Creek are naturally occurring intermittent streams. Threemile Creek, because of its close proximity to the Custer Hill Wastewater System, receives a discharge of approximately 3,900 liters per minute (1,485,000 gallons per day) from the Custer Hill Wastewater Treatment Plant. This effluent places Threemile Creek in the perennial class, and portions of Threemile Creek downstream of the Custer Hill Wastewater Treatment Plant are also classified as perennial.

The one mile radius of the area surrounding the Custer Hill wastewater ponds is shown on Figure 5-23. The area includes the majority of the Custer Hill Troop Complex area and a small fraction of the Custer Hill family housing area. Figure 5-23 shows the intermittent streams that drain Custer Hill and the wastewater ponds. Some small wetlands are located along these intermittent streams.

The Republican, Smoky Hill, and Kansas River and other perennial water bodies are used for recreation and fishing. There is no evidence that these water bodies are used as drinking sources. There are numerous small wetlands located along the surface waters draining Fort Riley.

5.6 Air

There were no air surveys conducted at Custer Hill during this site investigation. On-site PIDs were used for health and safety purposes and to determine whether environmental media contained VOCs. No releases to ambient air were measured from the ponds or during sampling of the ponds. The only positive detection of VOCs in the air occurred when EP-93-03 was installed and free phase petroleum hydrocarbons were encountered on groundwater. The ponds are not considered to pose a threat for air releases of hazardous substances.

5.7 Soils

Soils are evaluated to determine whether hazardous substances are present at a site that would pose a hazard for direct, on-site exposures of residents or workers.

All ponds within the Custer Hill Industrial Wastewater System are fenced, with the exception of the West Pond and the Old Wash Rack Reservoir. Public access to the Wash Rack Reservoir, however, is limited due to the site's location. Only authorized personnel with specific responsibilities and duties would know of the site's existence and have reason to enter the vehicle wash rack area. During the site investigation at this location, Berger personnel and their subcontractors were required to inform the civilian personnel managing the vehicle wash facility of their presence at the facility prior to entering. On several occasions, civilian personnel would commence a "drive-through" checking the security of the site during Berger's site investigation. The West Pond is very accessible from Kitty Drive. However, the West Pond is located in a topographic depression that is somewhat shielded from the road. Although easily accessed, only authorized personnel would have reason to enter the West Pond facility.

Based on the results of this SI, the ponds pose a physical hazard and could potentially result in the exposure of periodic on-site workers to petroleum hydrocarbons. Although there is staining along the banks of some ponds, the floating petroleum hydrocarbons at those is considered a greater hazard for physical contact than the stained soils. However, the ponds do not pose a threat for potential exposure to CERCLA hazardous substances.

5.8 Summary

The most significant finding during the SI of the East Pond was the presence of free petroleum product in EP-93-03. This well is located near a manhole to a sewer pipeline that runs by the petroleum storage facility. According to Fort Riley DEH personnel, several large spills (several thousands gallons each) have occurred at the storage facility.

When spills occur, product has been known to run into the sewer drains and overflow at the manhole near EP-93-03. Free product recovery at this well is ongoing, and a separate environmental investigation of the POL storage facility is being conducted.

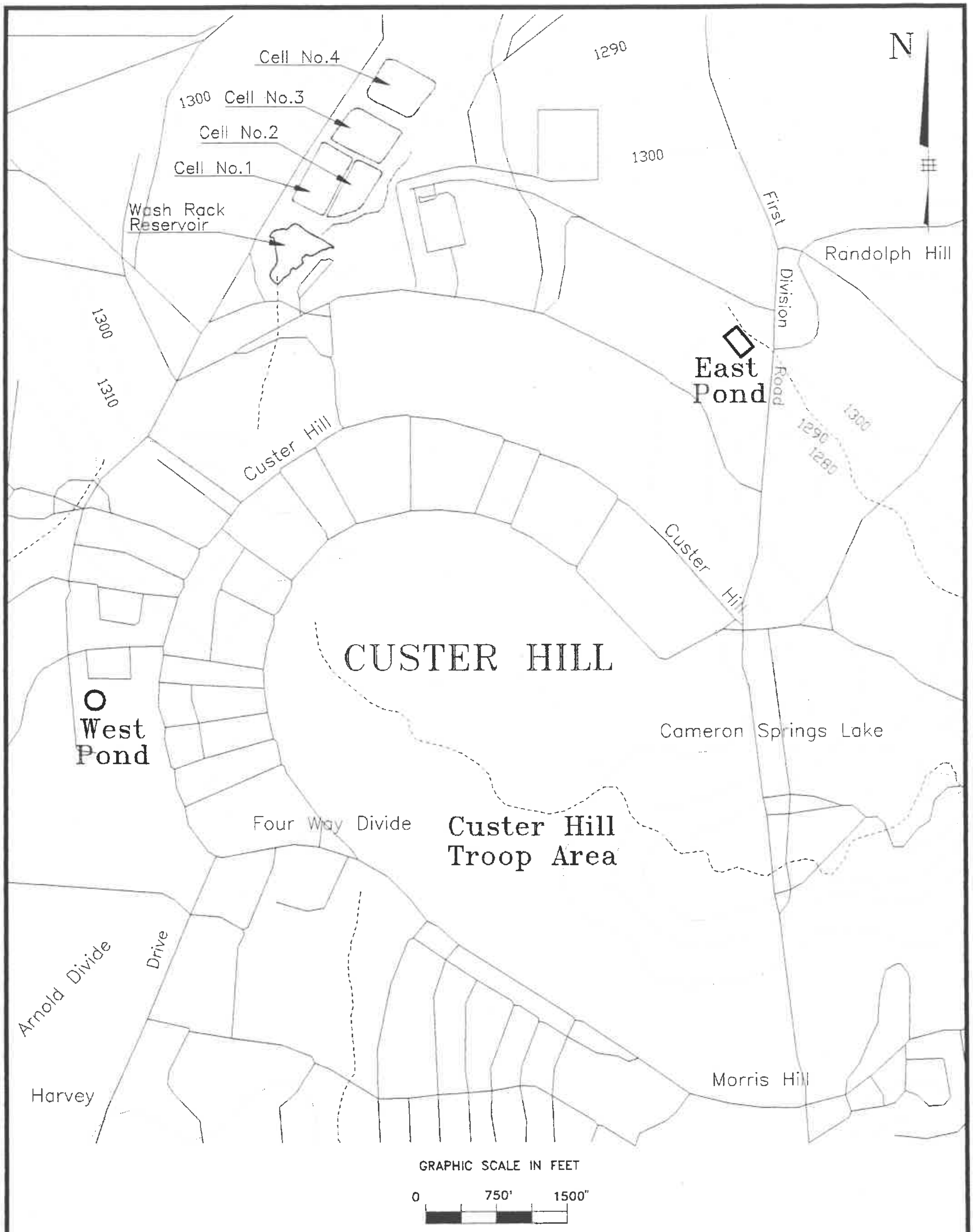
Soil gas techniques have been highly effective in delineating contamination at the Ponds and at other sites on Fort Riley. Furthermore, confirmation of contamination identified by soil gas sampling has been verified through soil sampling and groundwater sampling at these sites. In fact, the use of soil gas at East Pond and the Old Wash Rack Reservoir was directly supported by the findings of the groundwater sampling at both sites. Soil gas results indicated that there were no releases of VOCs from the Old Wash Rack Reservoir or the East Pond, but that petroleum was present in the subsurface between the East Pond and the POL storage facility. The groundwater results confirmed these findings exactly.

The soil gas results indicate that the West Pond has not released contaminants to the environment. The pond sampling indicates that some volatile, semi-volatile and metal contaminants are present in the pond; however, the detected concentrations are low relative to regulatory standards and guidelines.

The soil gas data and the groundwater monitoring data indicate that the Old Wash Rack Reservoir are not releasing contaminants to groundwater. The soil gas data also indicate that Cells 1 through 4 are not releasing contaminants to the environment.

The aqueous samples from the Old Wash Rack Reservoir and Cells 1 through 4 indicate that few contaminants are present. The most common contaminant in the pond sediments is the diesel fraction of TPH, with the highest concentrations in the Old Wash Rack Reservoir. Naturally-occurring metals were detected in the pond sediments. None of the metal concentrations exceeded risk-based guidelines for soils, and all appear to be representative of background.

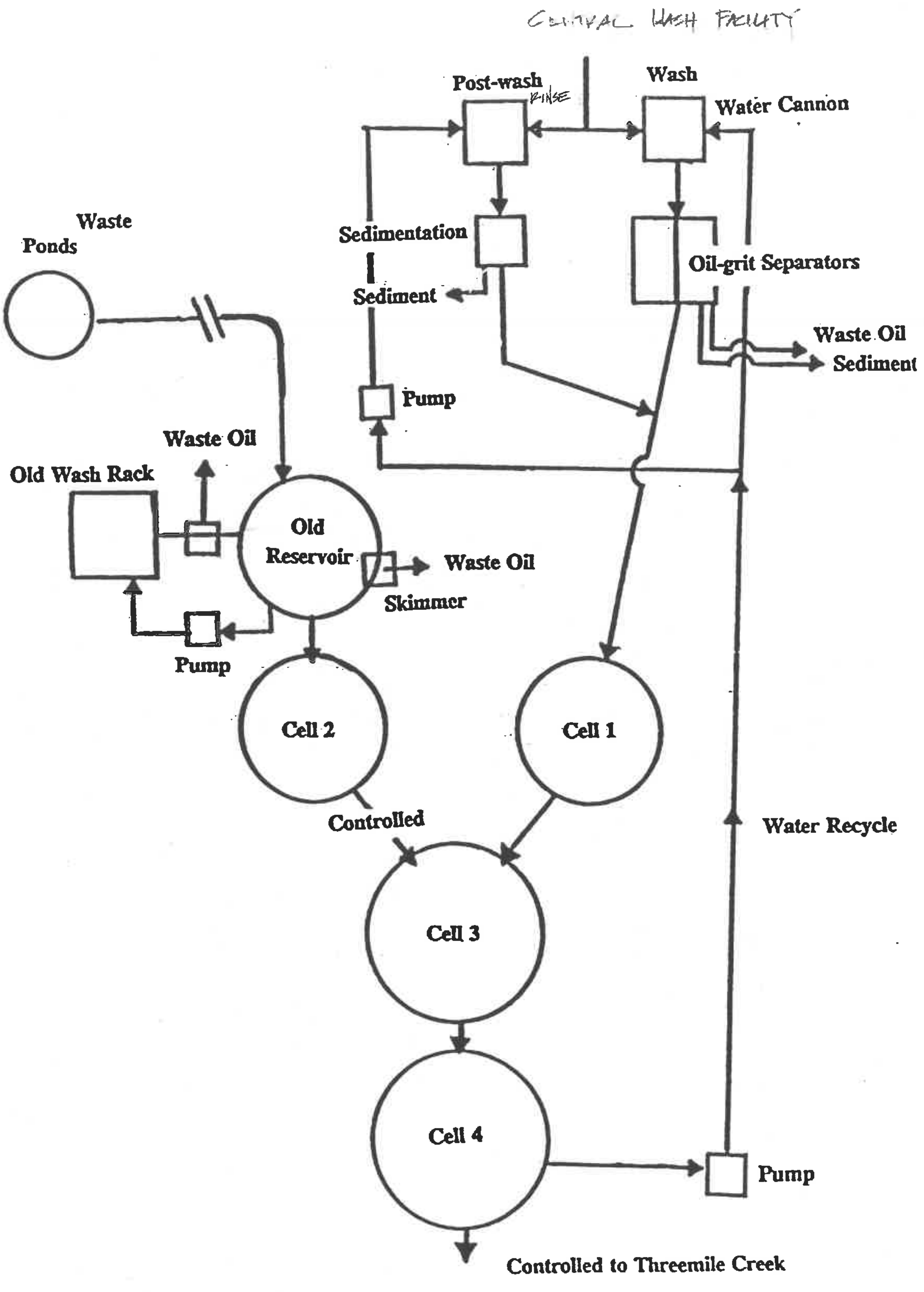
There were no releases to tributaries of Threemile Creek from any of the ponds.



File: sidf5-1.dwg

June, 1994

FIGURE 5-1: OVERVIEW OF CUSTER HILL INDUSTRIAL SEWER SYSTEM



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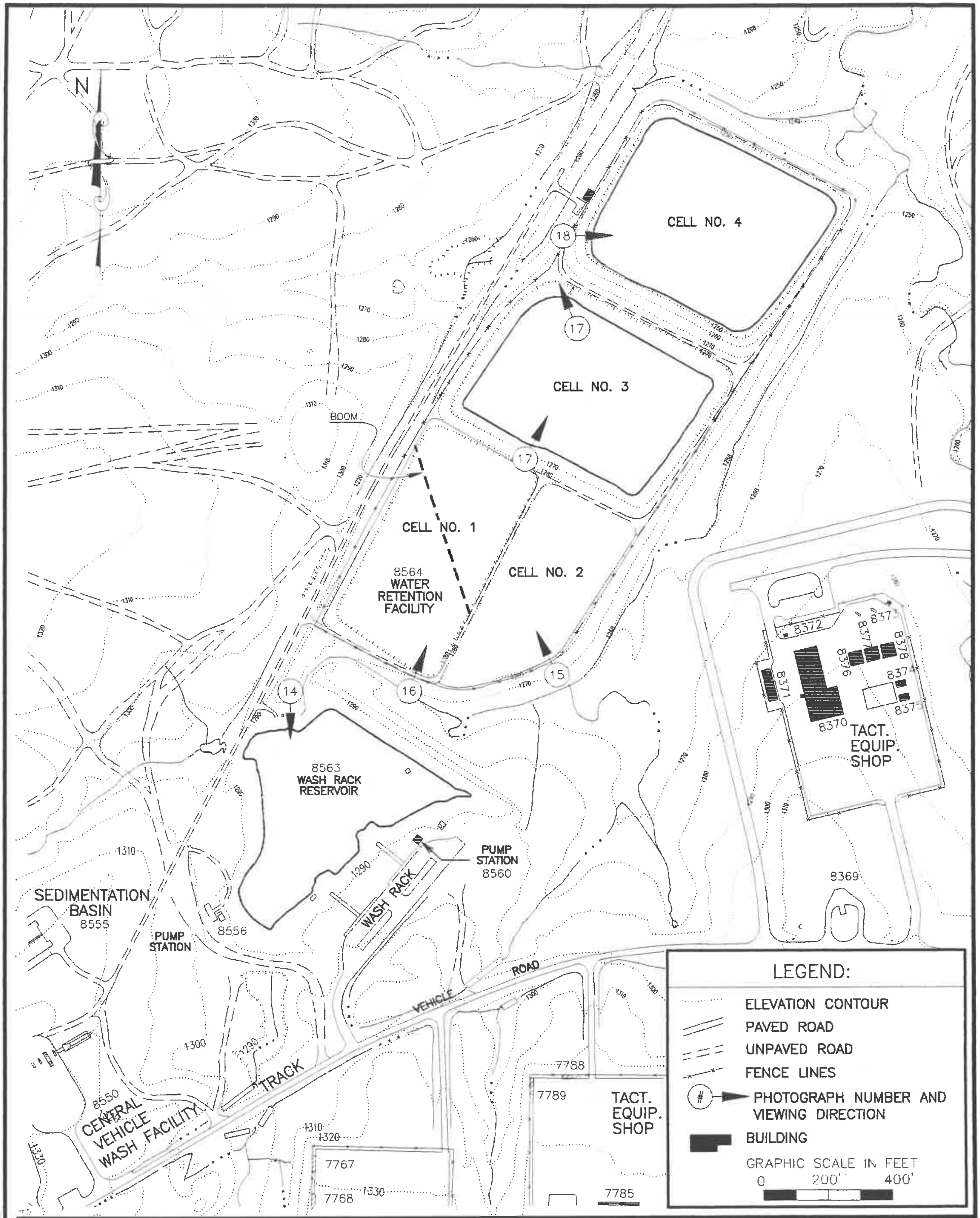
Date: June, 1994

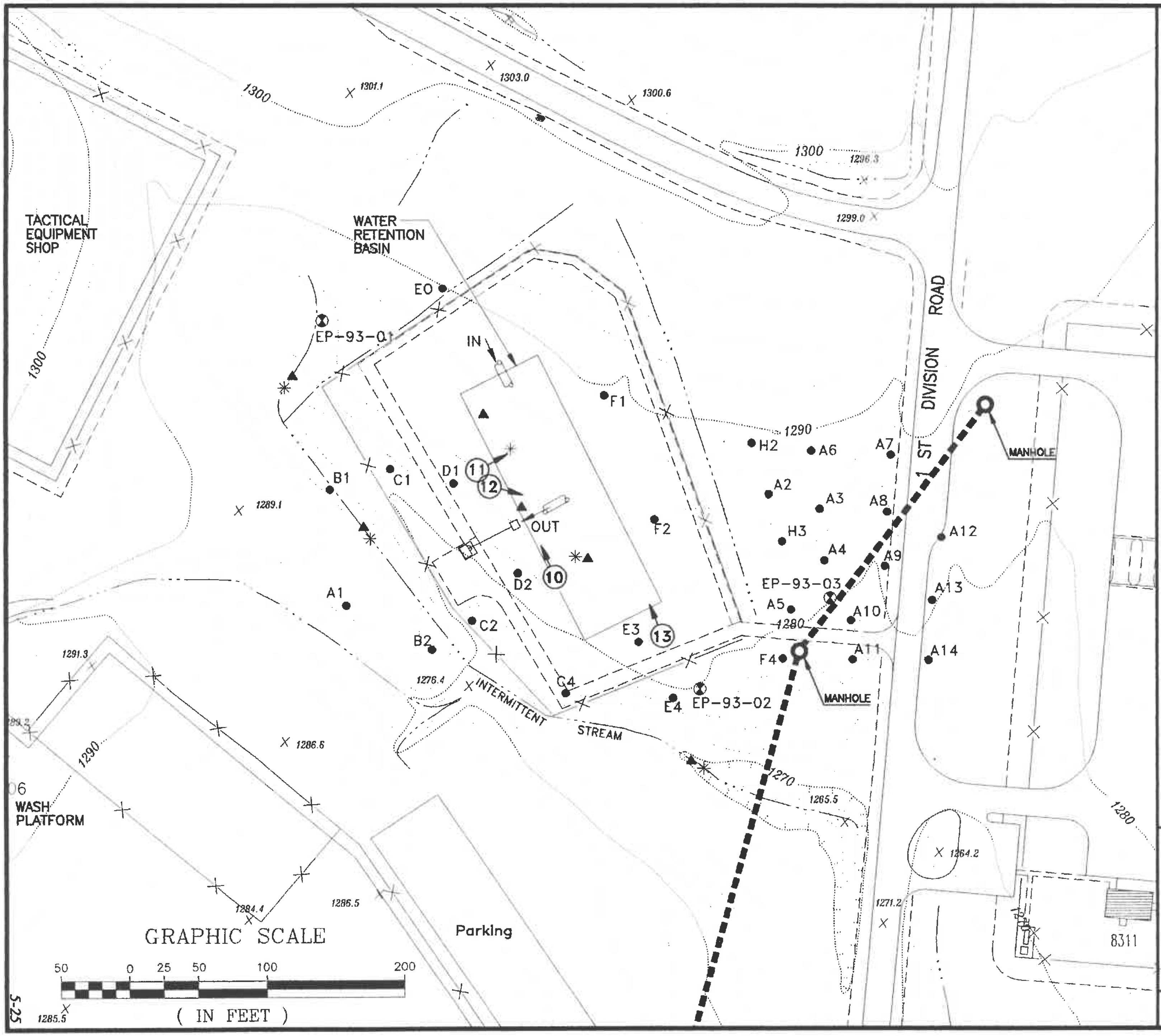
Figure 5-2: Custer Hill Industrial Wastewater System



File: sidf5-3.dwg

June, 1994

Figure 5-3: Location and Viewing Direction for Photographs at the Wash Rack Reservoir and Cells 1 through 4



LEGEND

- ● SOIL GAS SAMPLING LOCATIONS
- ▲ SEDIMENT SAMPLING LOCATIONS
- ✳ AQUEOUS SAMPLE LOCATIONS
- ⊗ GROUNDWATER MONITOR WELL
- ELEVATION CONTOUR
- ═ PAVED ROAD
- ╌ UNPAVED ROAD
- ─×─ FENCE LINES
- X ELEVATION POINT
- ■■■ SEWER LINE

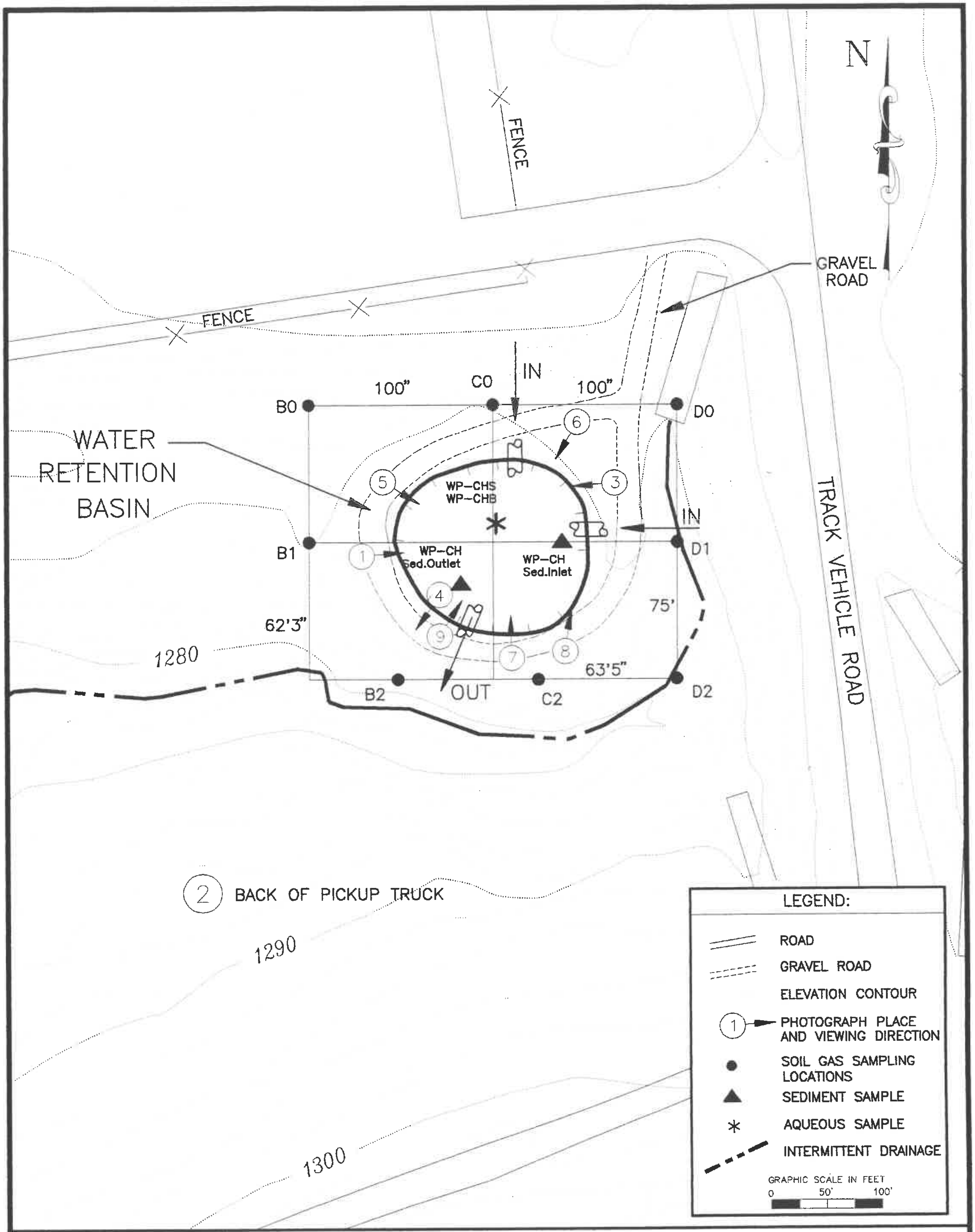
NOTE: Locations of Aqueous Samples From Pond are not Shown

(11) Photograph Number And Viewing Direction

Figure 5-4: Location and Viewing Direction for Photographs at East Pond

File: sidf5-4.DWG

June, 1994



File: sidf5-5.dwg

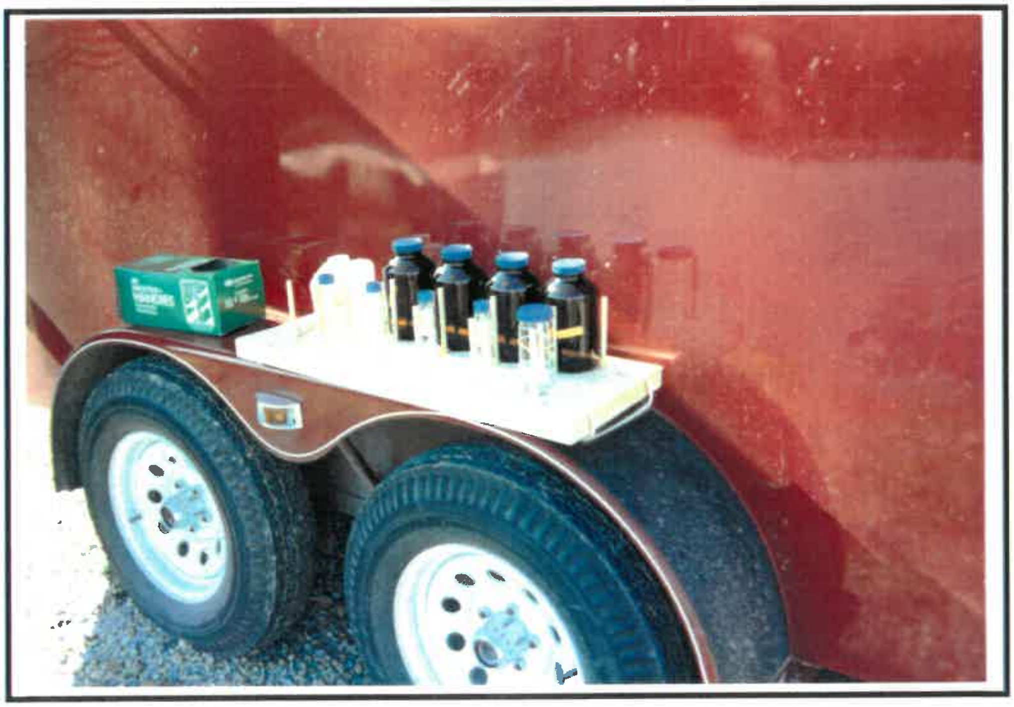
June, 1994

Figure 5-5: Location and Viewing Direction for Photographs at West Pond

Photograph Number 1
West Pond -- Aqueous Sampler
Looking Northeast

Photograph Number 2
West Pond
Field Blank with Ponar Dredge Sampler

Photograph Number 3
West Pond -- Sediment/Sludge Sampling
at Inlet, Looking West



Photograph Number 4
West Pond -- Sample Bottle Collection
Setup, Looking South

Photograph Number 5
West Pond -- Boom, Inlet
Looking East

Photograph Number 6
West Pond -- Looking South
Toward Outlet

Photograph Number 7
West Pond -- Boom, Inlet
Looking North

Photograph Number 8
West Pond -- Inlet/Booms
Looking Northeast

Photograph Number 9
West Pond -- Outlet
Looking Northeast

Photograph Number 10
East Pond -- Along the Pond
Looking Northwest

Photograph Number 11
East Pond -- From Sample Location D1,
Looking Northeast Straight Across Pond

Photograph Number 12
East Pond -- From Sample Location D1,
Looking Southeast Toward Fence Gate

Photograph Number 13
East Pond -- From Sample Location E3,
Looking Northeast, Showing Pond Bank

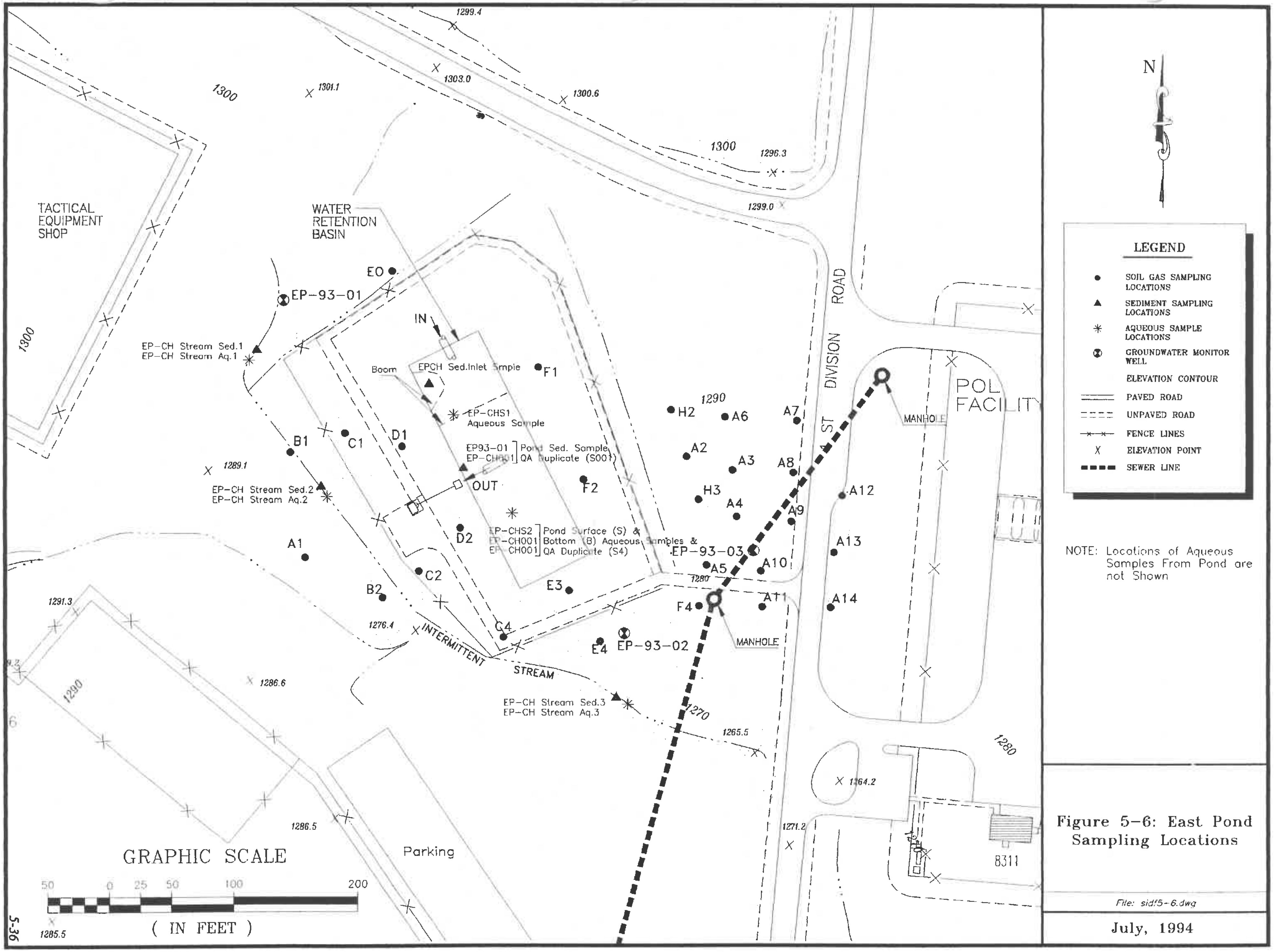
Photograph Number 14
Wash Rack Reservoir -- Outlet Sample Area
Looking Southeast

Photograph Number 15
Wash Rack Reservoir -- Diagonally Across
Cell 2, Looking Northwest

Photograph Number 16
Wash Rack Reservoir --Across Cell One
Looking Northeast

Photograph Number 17
Wash Rack Reservoir -- Cell 3
Looking North Toward Outlet

Photograph Number 18
Wash Rack Reservoir -- Cell 4
Looking West



NOTE: Locations of Aqueous Samples From Pond are not Shown

Figure 5-6: East Pond Sampling Locations

File: sidf5-6.dwg

July, 1994

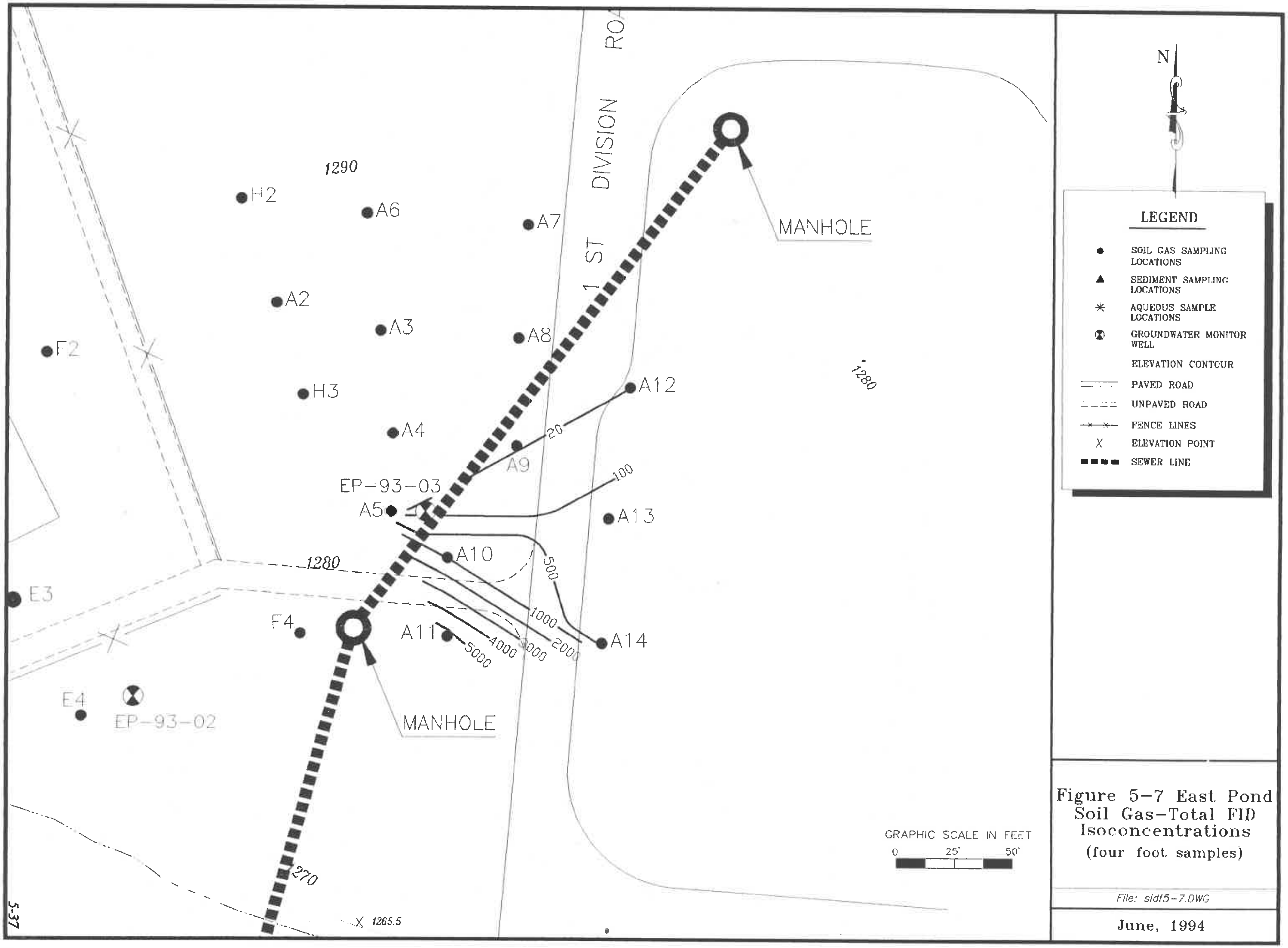
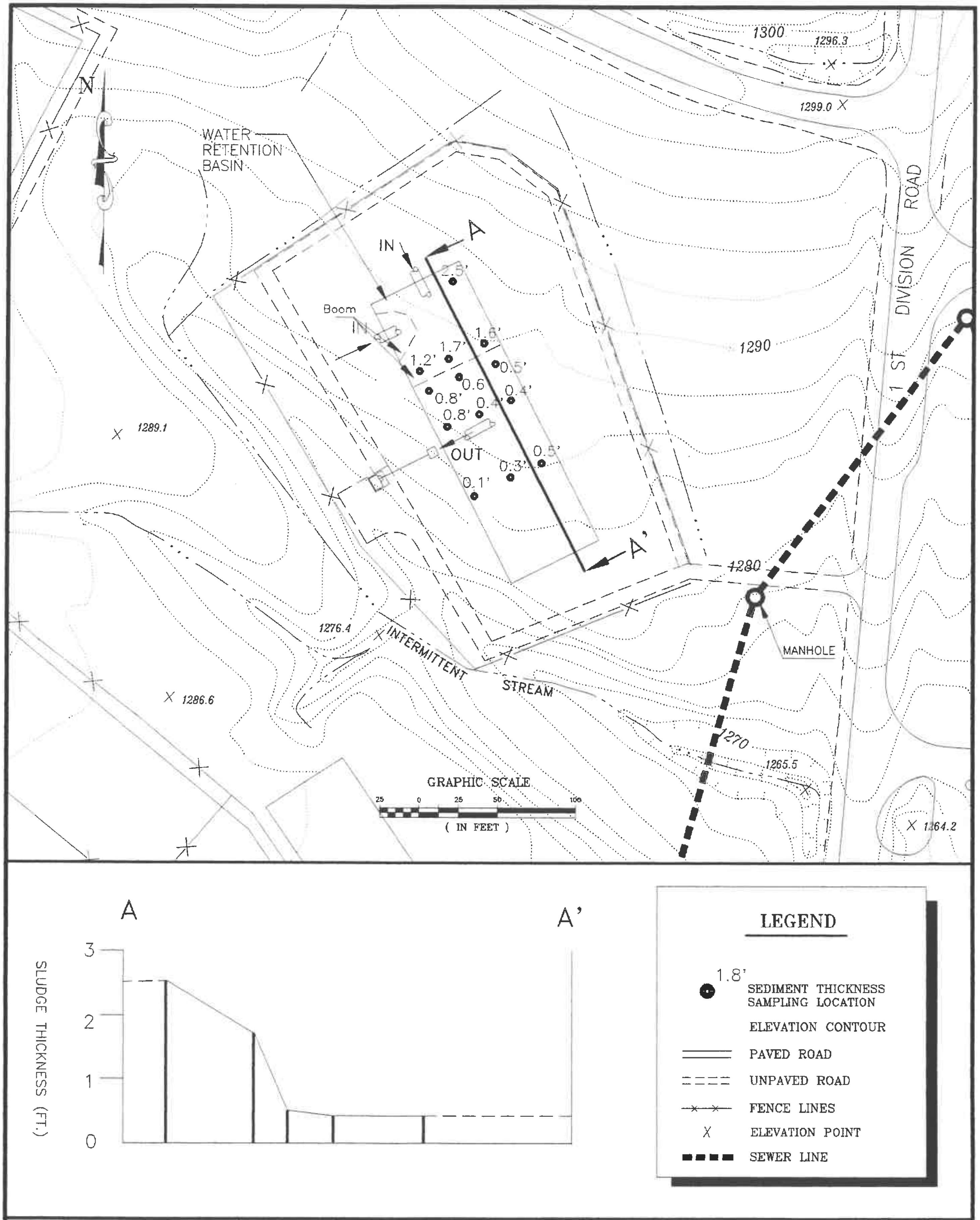


Figure 5-7 East Pond Soil Gas-Total FID Isoconcentrations
(four foot samples)

File: sidl5-7.DWG

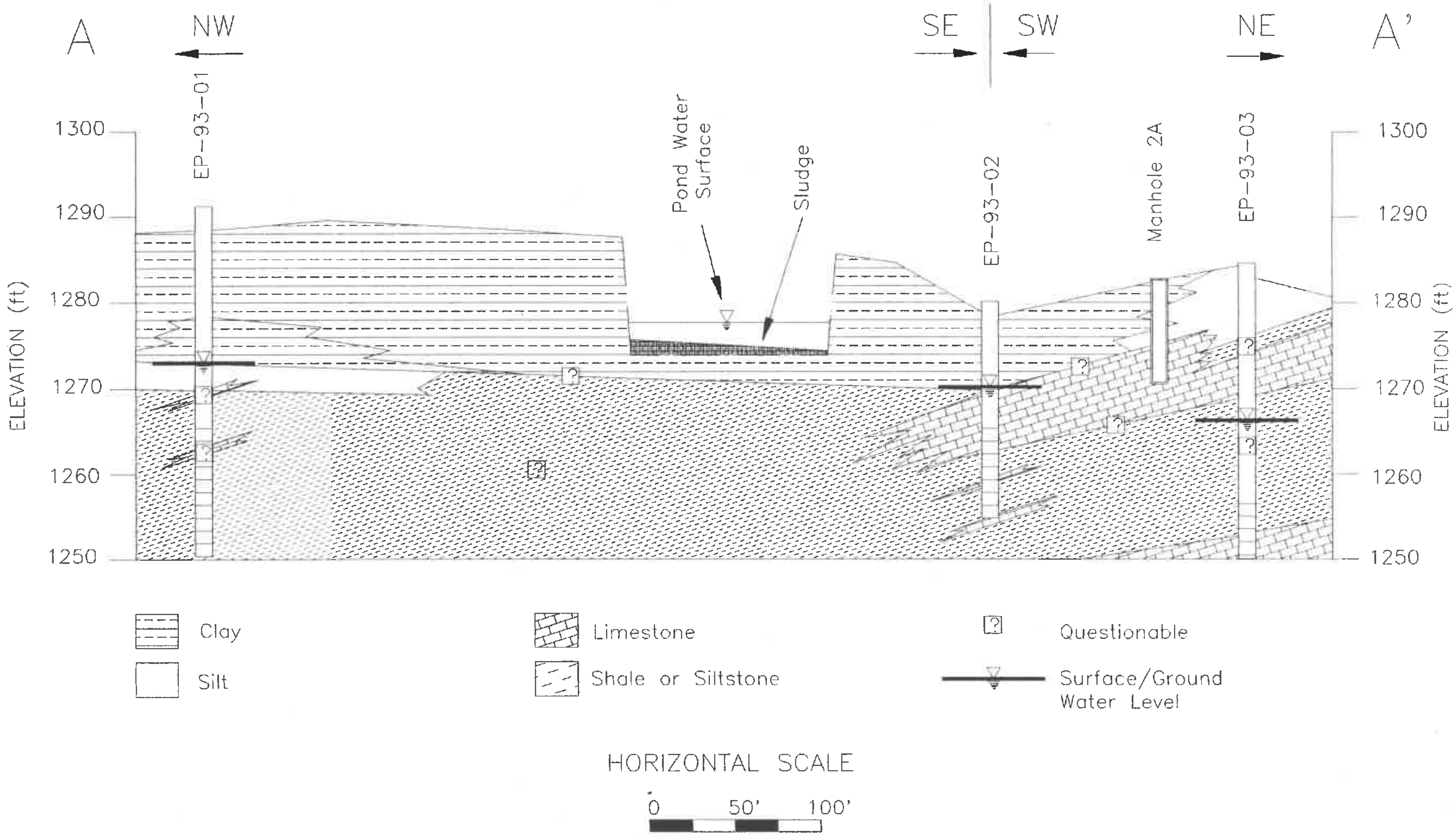
June, 1994



File: sidf5–8.dwg

June, 1994

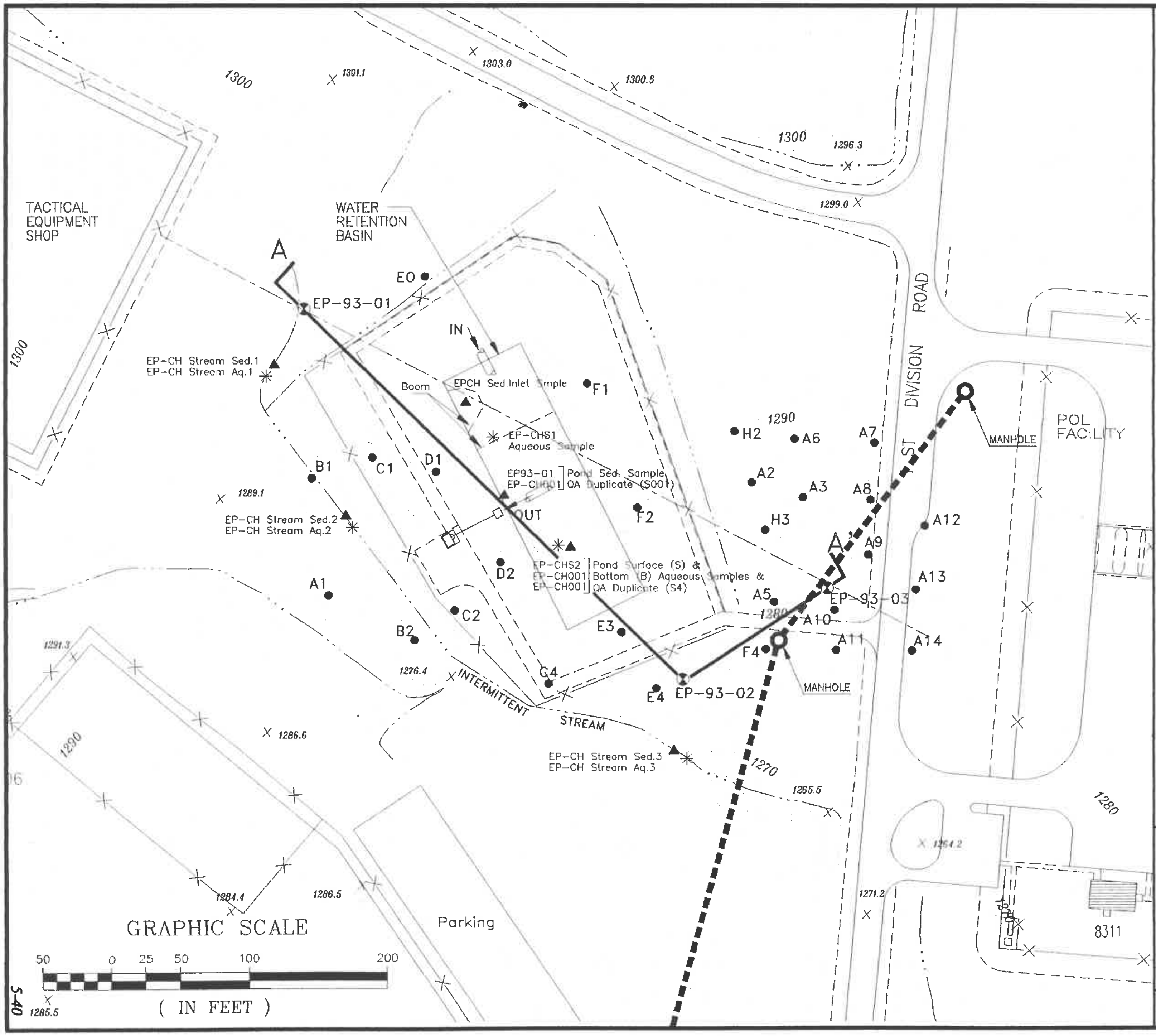
Figure 5–8: East Pond Sludge Thickness



File: sidf5-9.dwg

June, 1994

Figure 5-9: Geologic Cross Section at the East Pond



LEGEND

- ● SOIL GAS SAMPLING LOCATIONS
- ▲ SEDIMENT SAMPLING LOCATIONS
- ✳ AQUEOUS SAMPLE LOCATIONS
- ⊗ GROUNDWATER MONITOR WELL
- ELEVATION CONTOUR
- ═ ROAD
- —x—x— FENCE LINES
- X ELEVATION POINT
- ▬ ▬ ▬ SEWER LINE

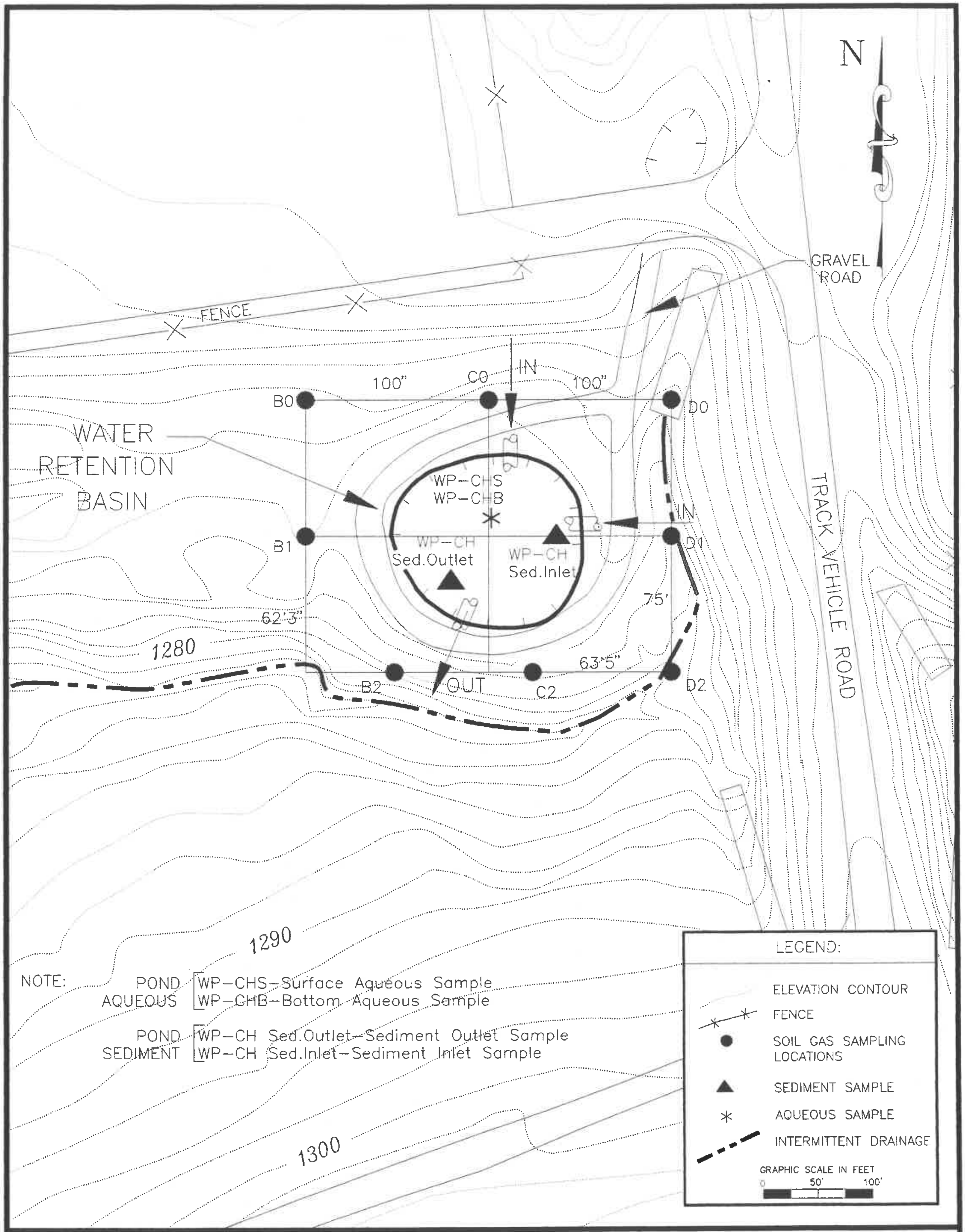
A–A'– Profile Line

NOTE: Locations of Aqueous Samples From Pond are not Shown

Figure 5–10:
Profile Line
For the East Pond
Geologic Cross Section

File: sidf5–10.DWG

June, 1994



NOTE:

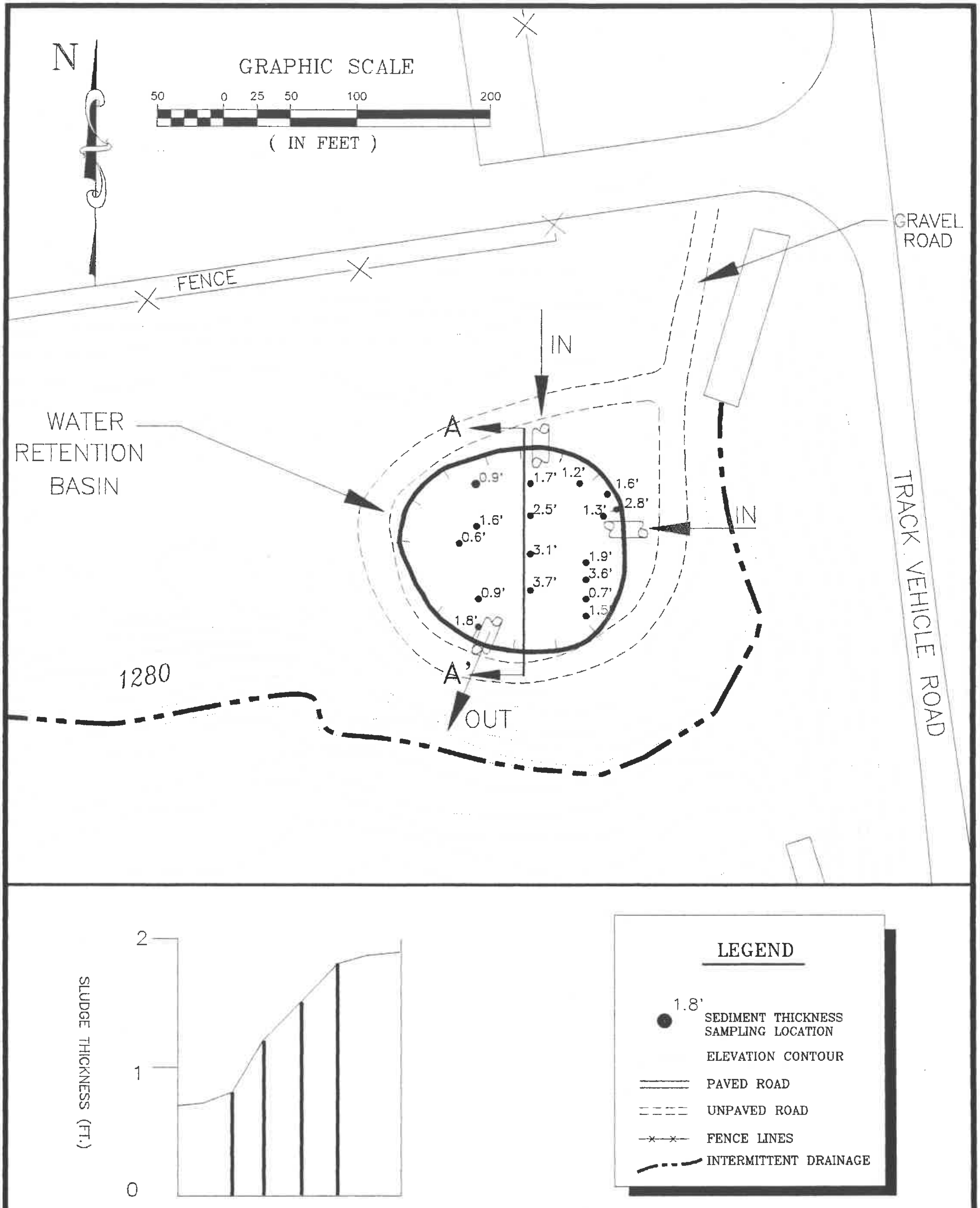
POND AQUEOUS
- WP-CHS-Surface Aqueous Sample
- WP-CHB-Bottom Aqueous Sample

POND SEDIMENT
- WP-CH Sed.Outlet-Sediment Outlet Sample
- WP-CH Sed.Inlet-Sediment Inlet Sample

File: sidf5-11.dwg

June, 1994

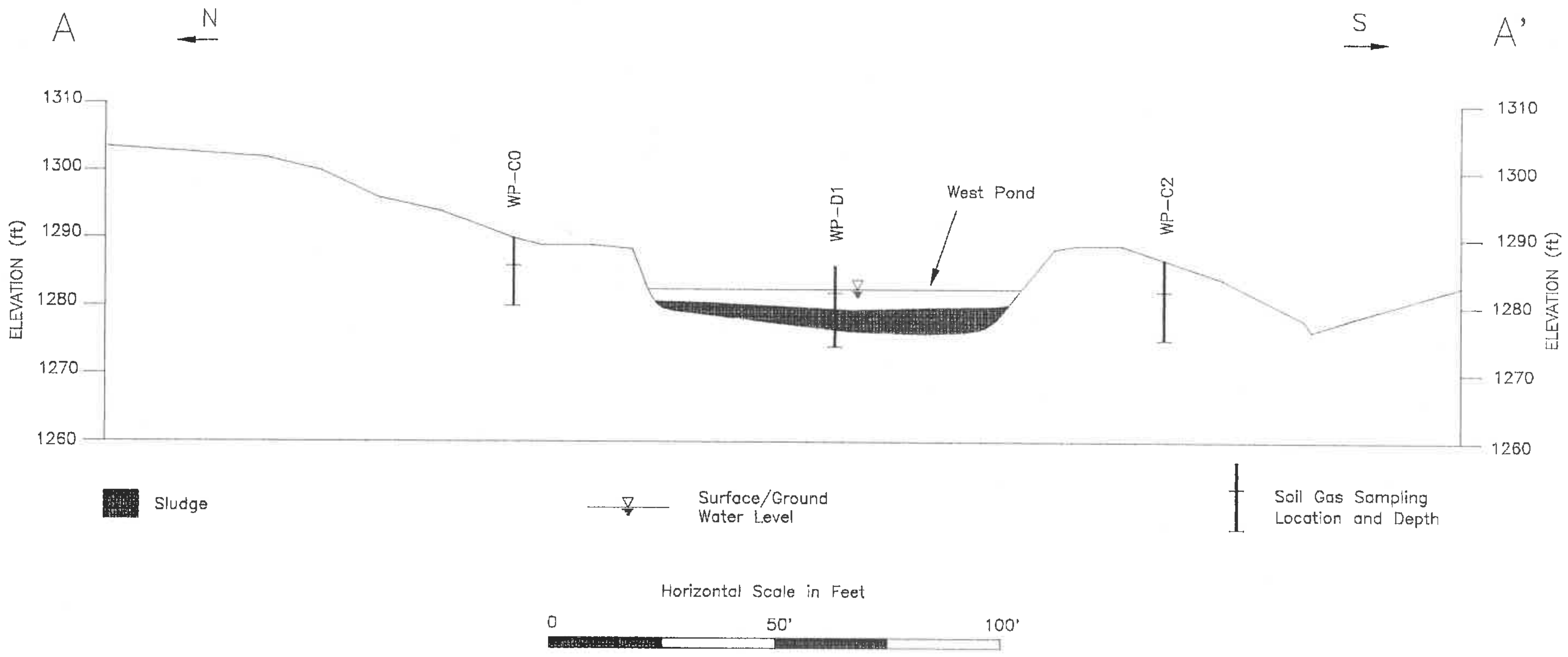
Figure 5-11: West Pond Sampling Locations



File: sidf5-12.dwg

June, 1994

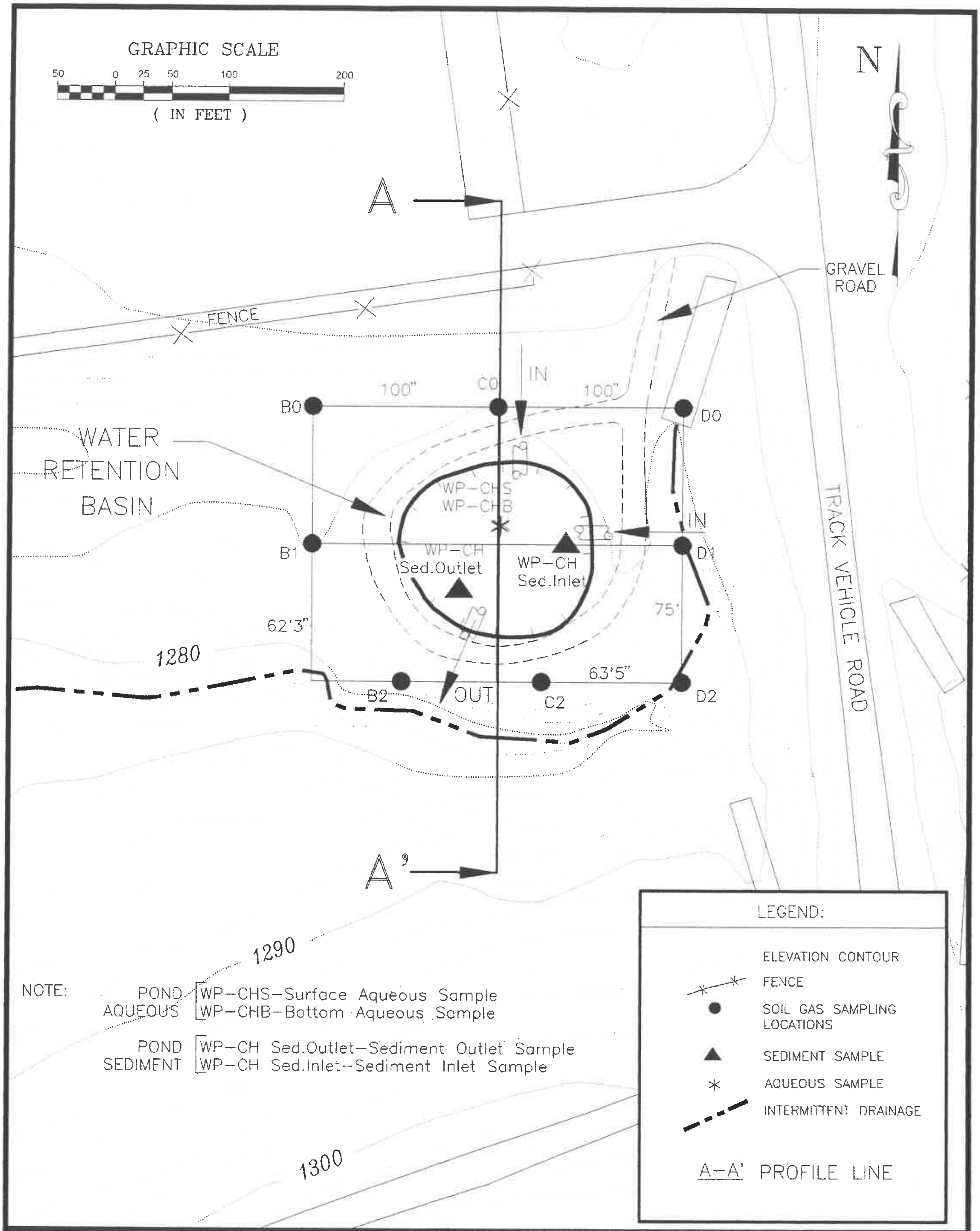
Figure 5-12: West Pond Sludge Thickness



File: sidf5-13.dwg

June, 1994

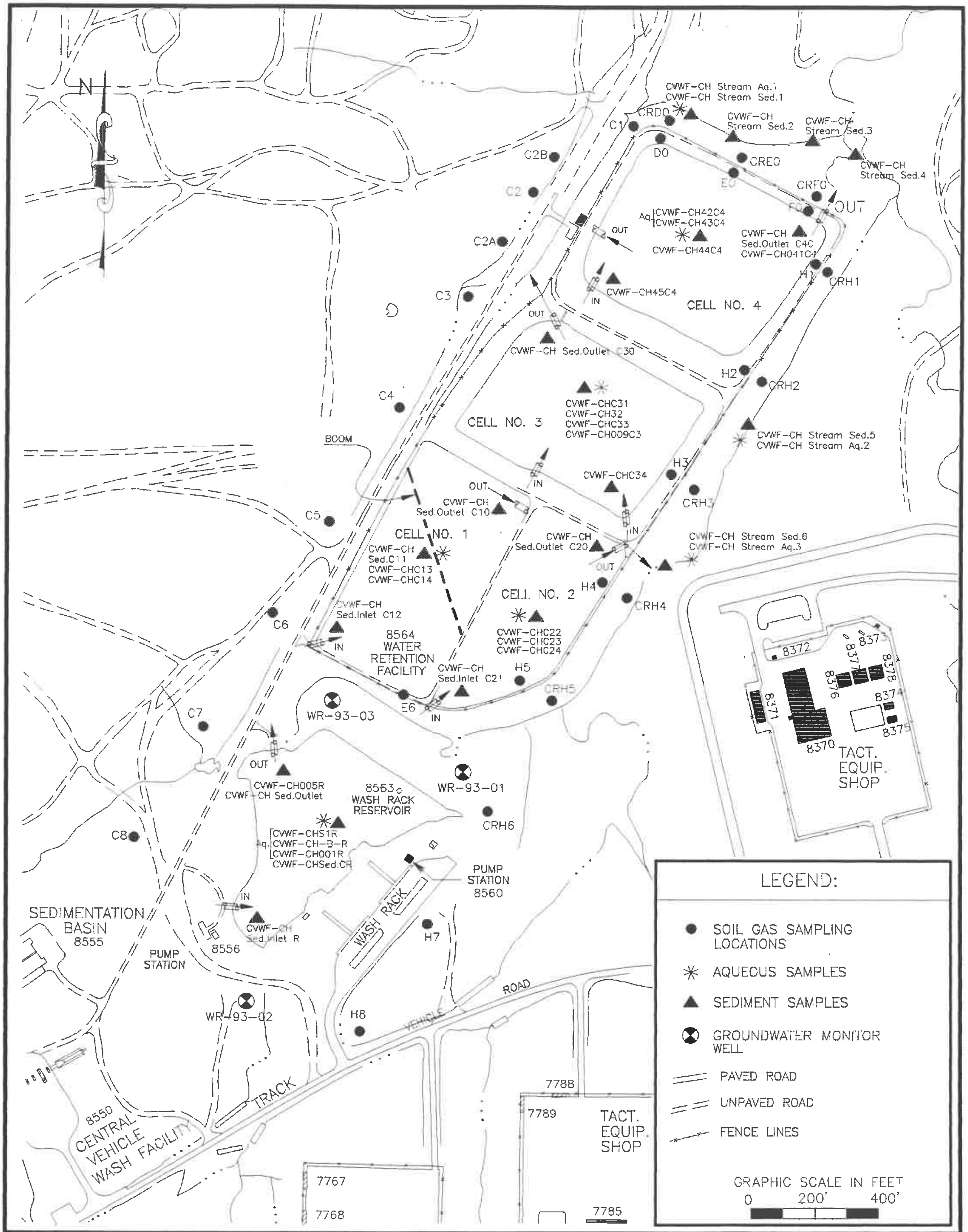
Figure 5-13: Cross Section of Sampling Depths - West Pond



File: sidf5-14.dwg

June, 1994

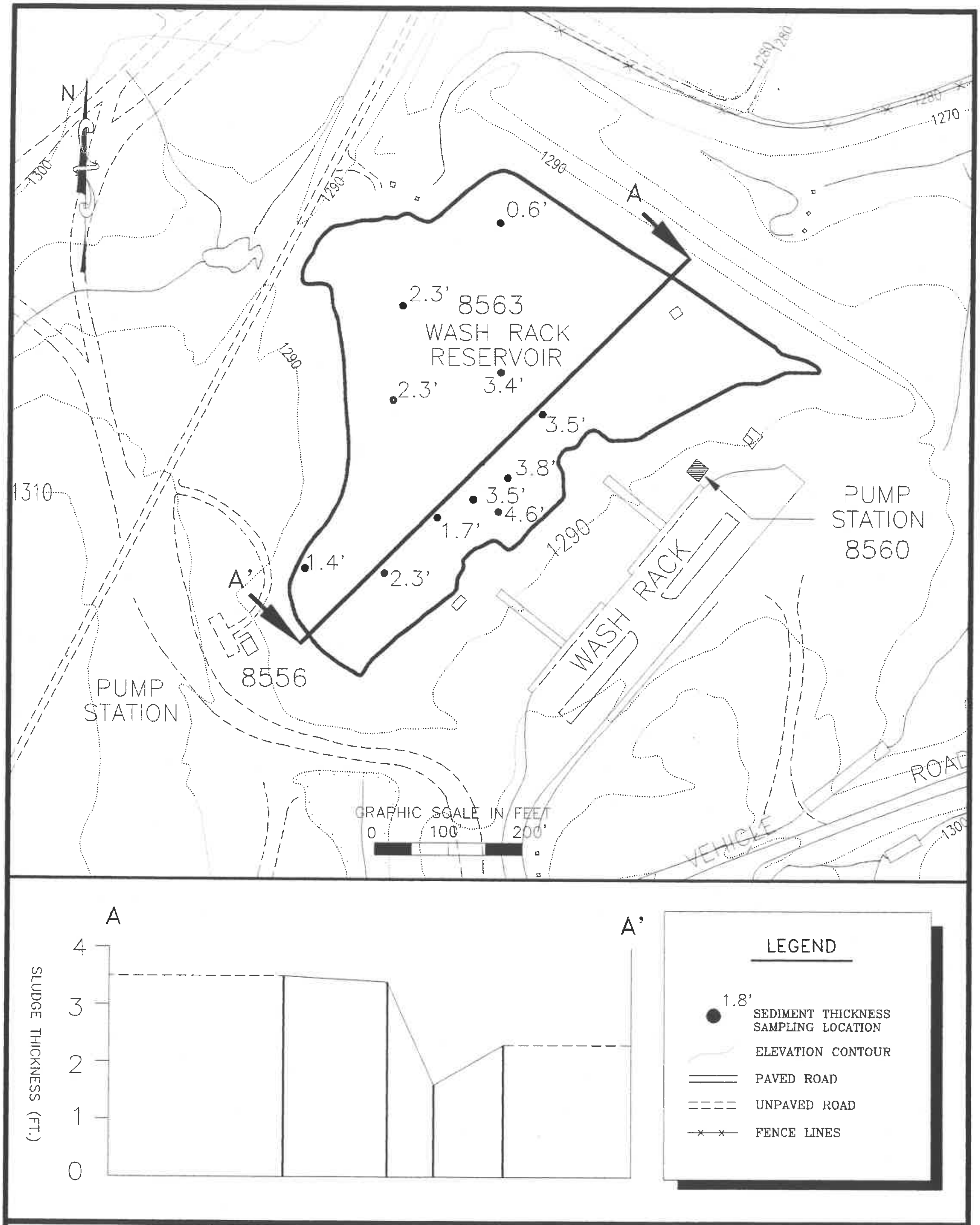
Figure 5-14: Profile Line for Geologic Cross-Section at West Pond



File: sidf5-15.dwg

June, 1994

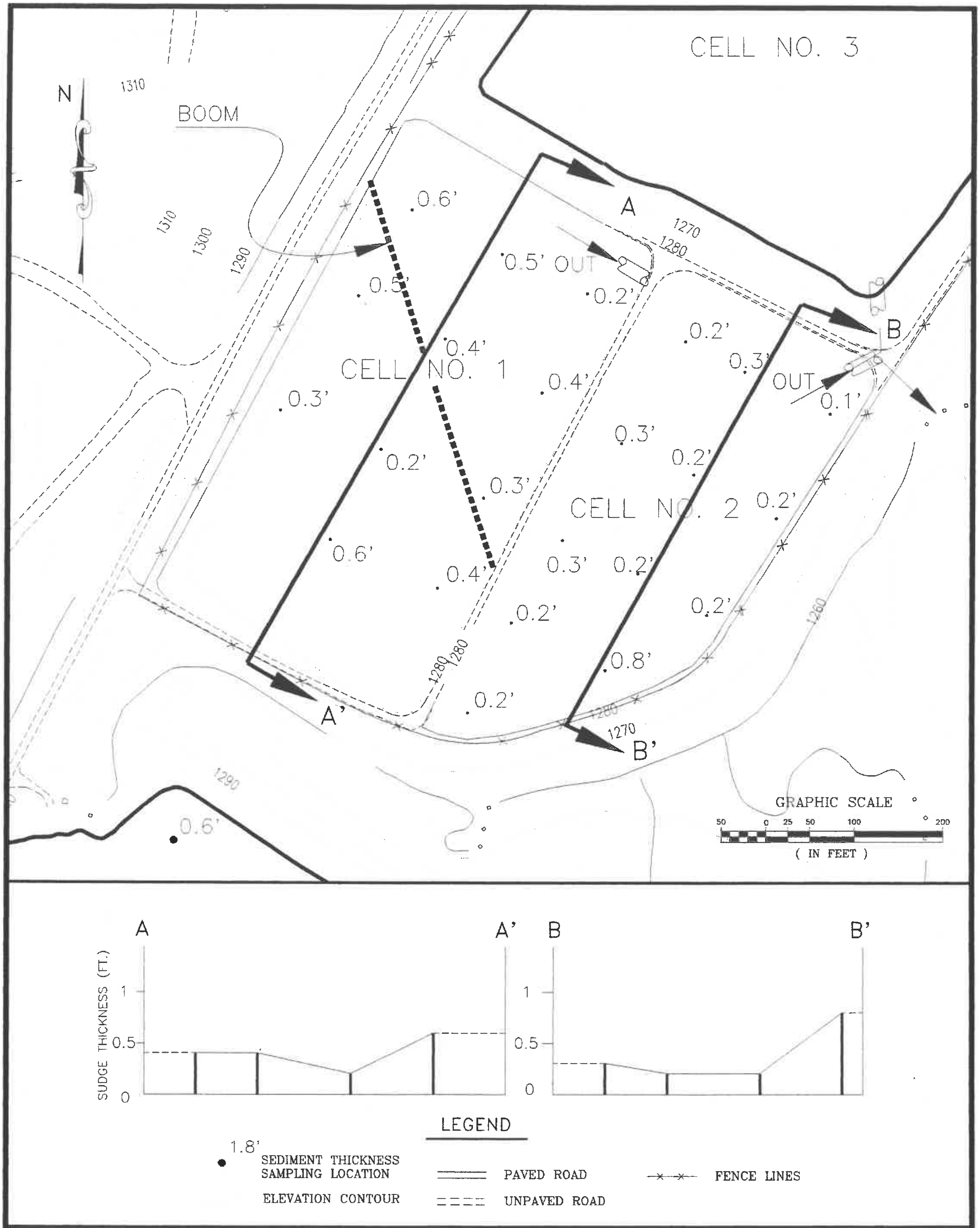
Figure 5-15: Sampling Locations at Old Wash Rack Reservoir and Cells 1 through 4



File: sidf5-16.dwg

June, 1994

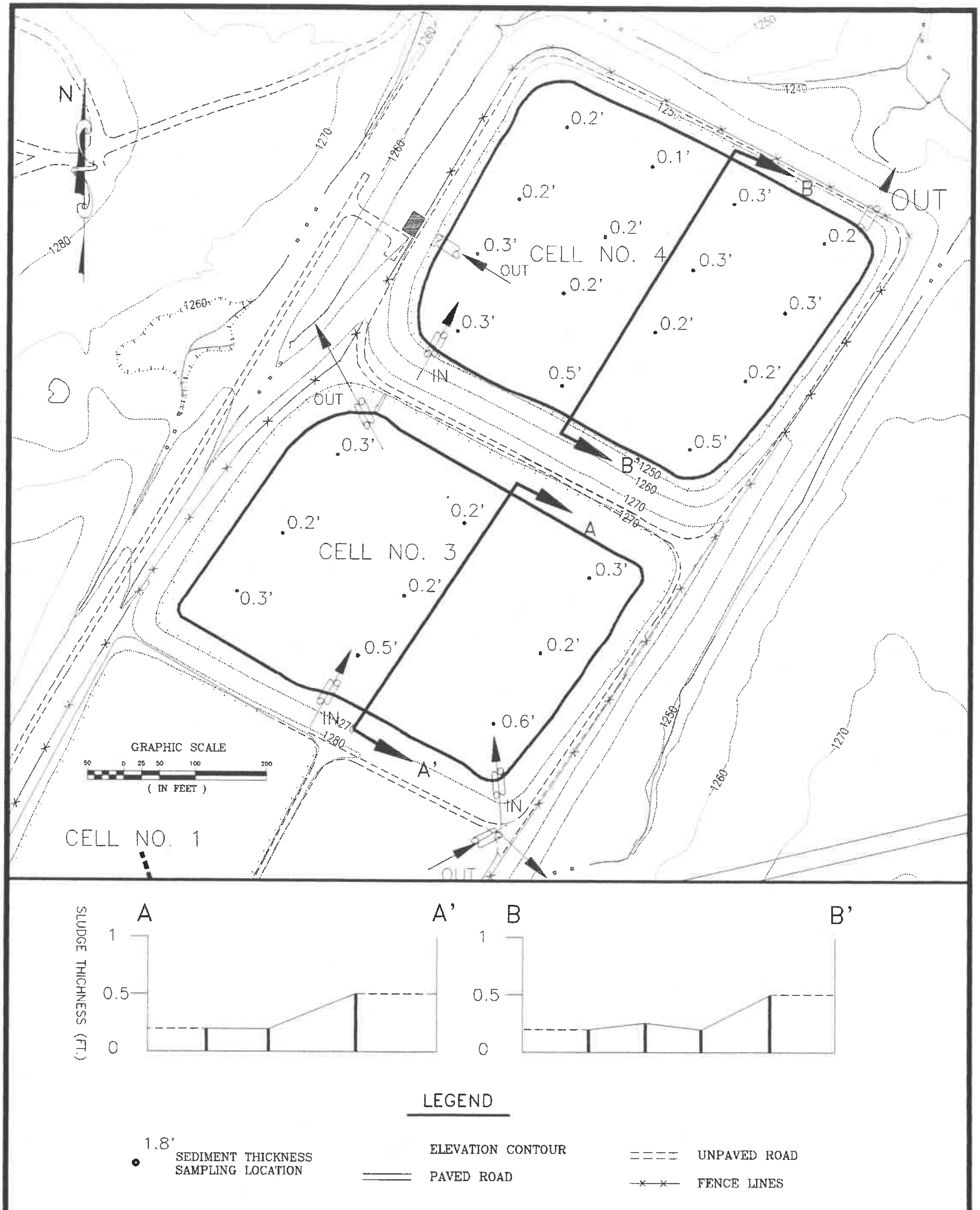
Figure 5-16: Wash Rack Reservoir Sludge Thickness



File: sidf5-17.dwg

June, 1994

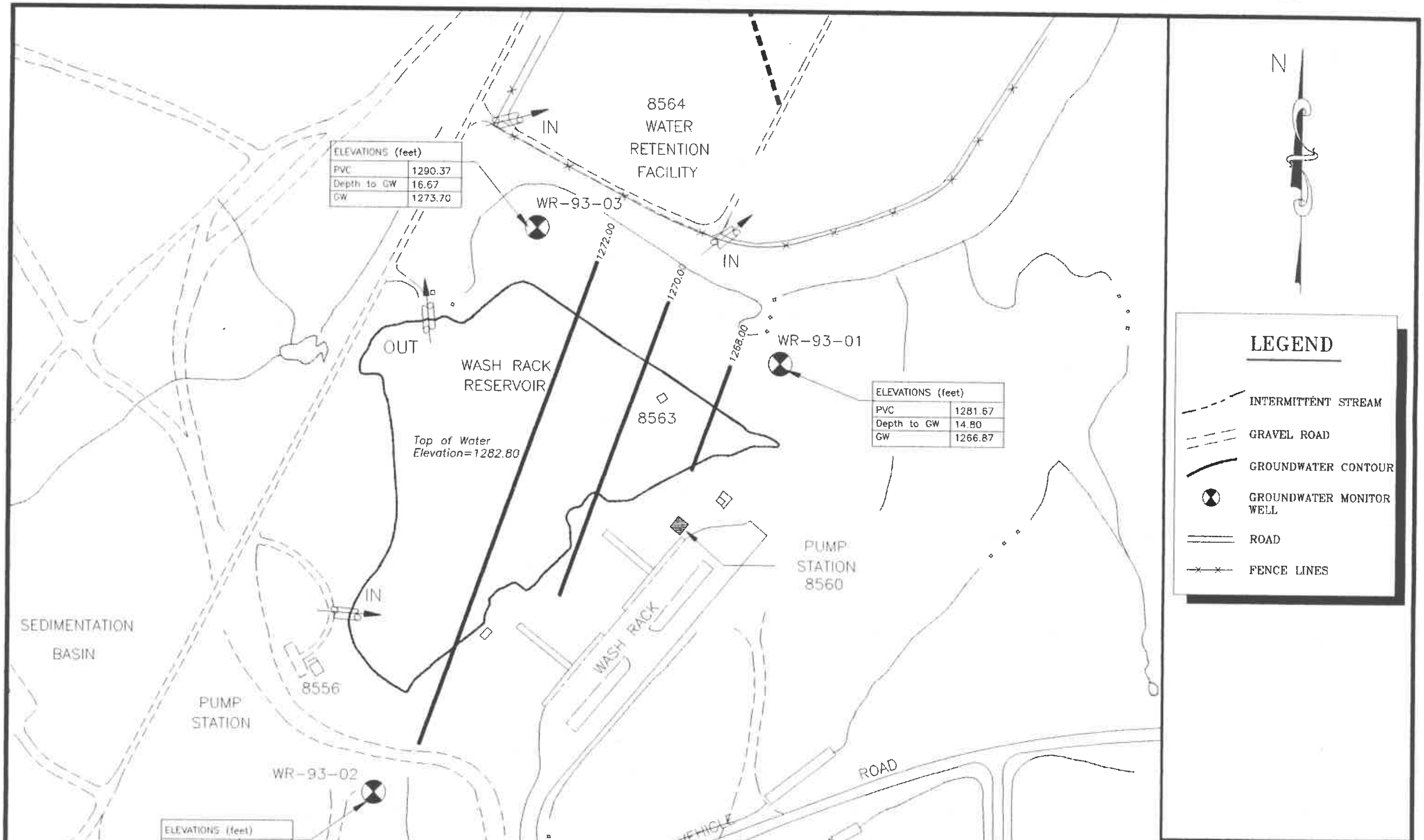
Figure 5-17: Cells 1 & 2 Sludge Thickness



File: sidf5-18.dwg

June, 1994

Figure 5-18: Cells 3 & 4 Sludge Thickness



ELEVATIONS (feet)	
PVC	1290.37
Depth to GW	16.67
GW	1273.70

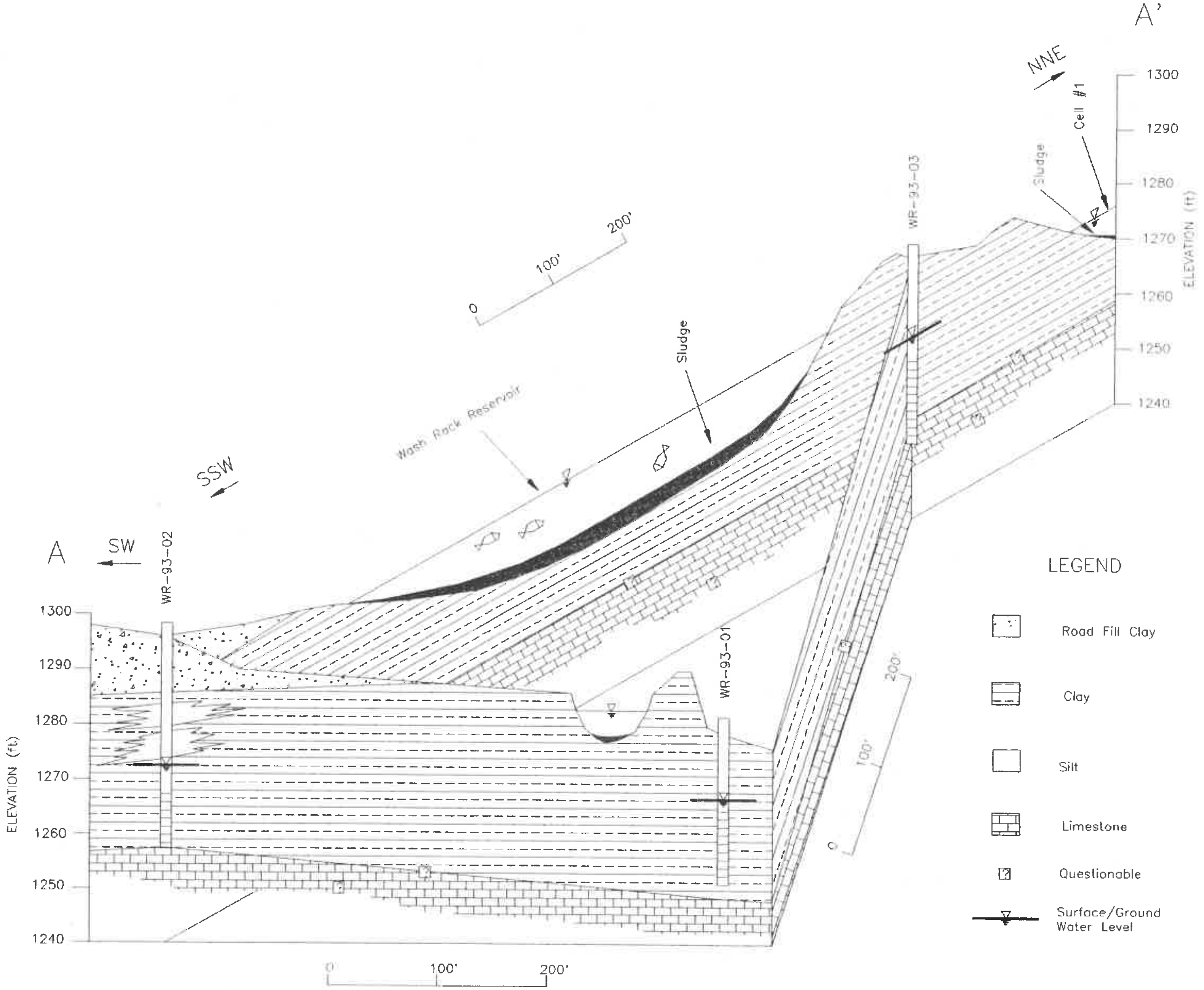
ELEVATIONS (feet)	
PVC	1281.67
Depth to GW	14.80
GW	1266.87

ELEVATIONS (feet)	
PVC	1298.39
Depth to GW	25.75
GW	1272.64

Figure 5-19:
Groundwater
Flow Gradient
Wash Rack Reservoir

File: sidf5-19.dwg

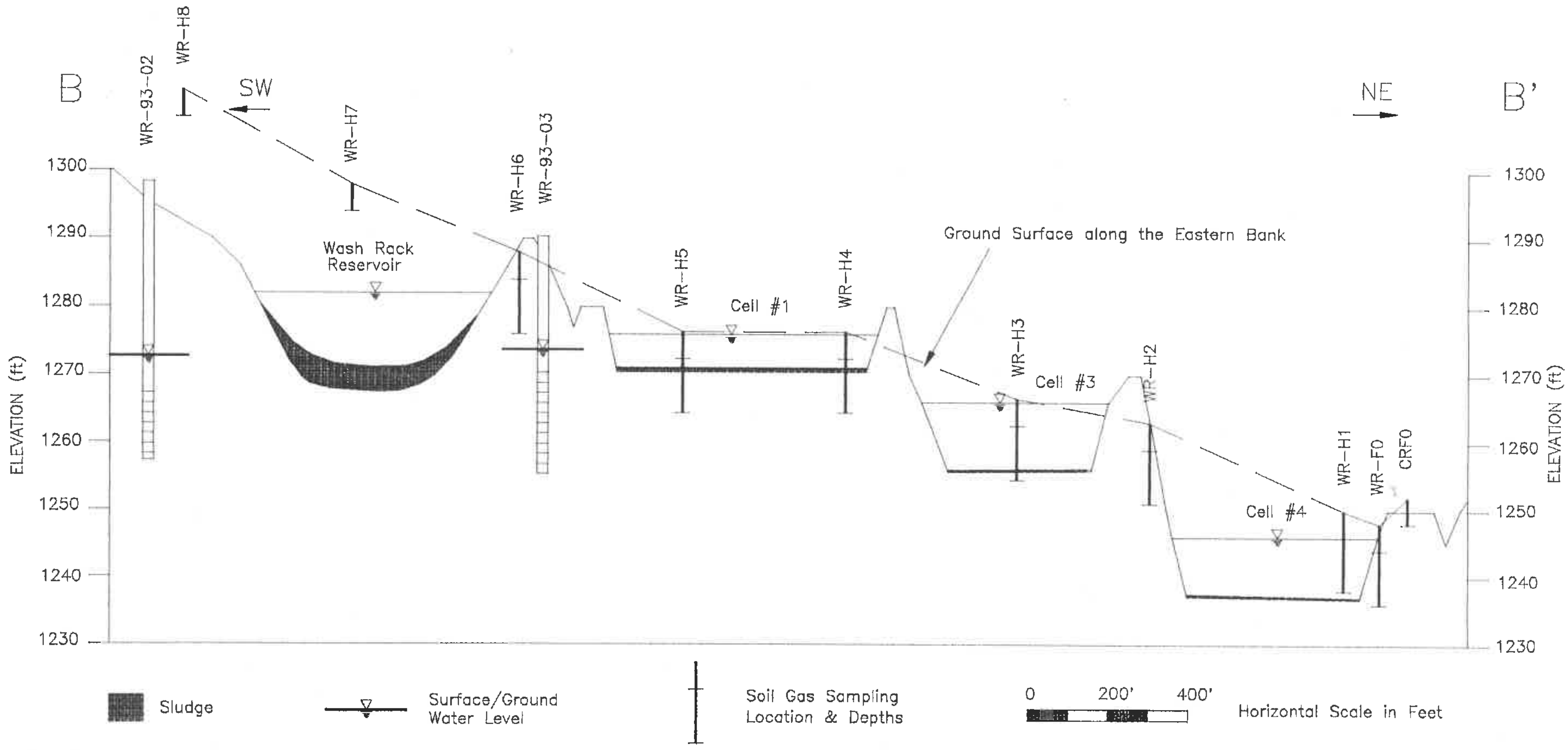
June, 1994



File: sisp5–20.dwg

June, 1994

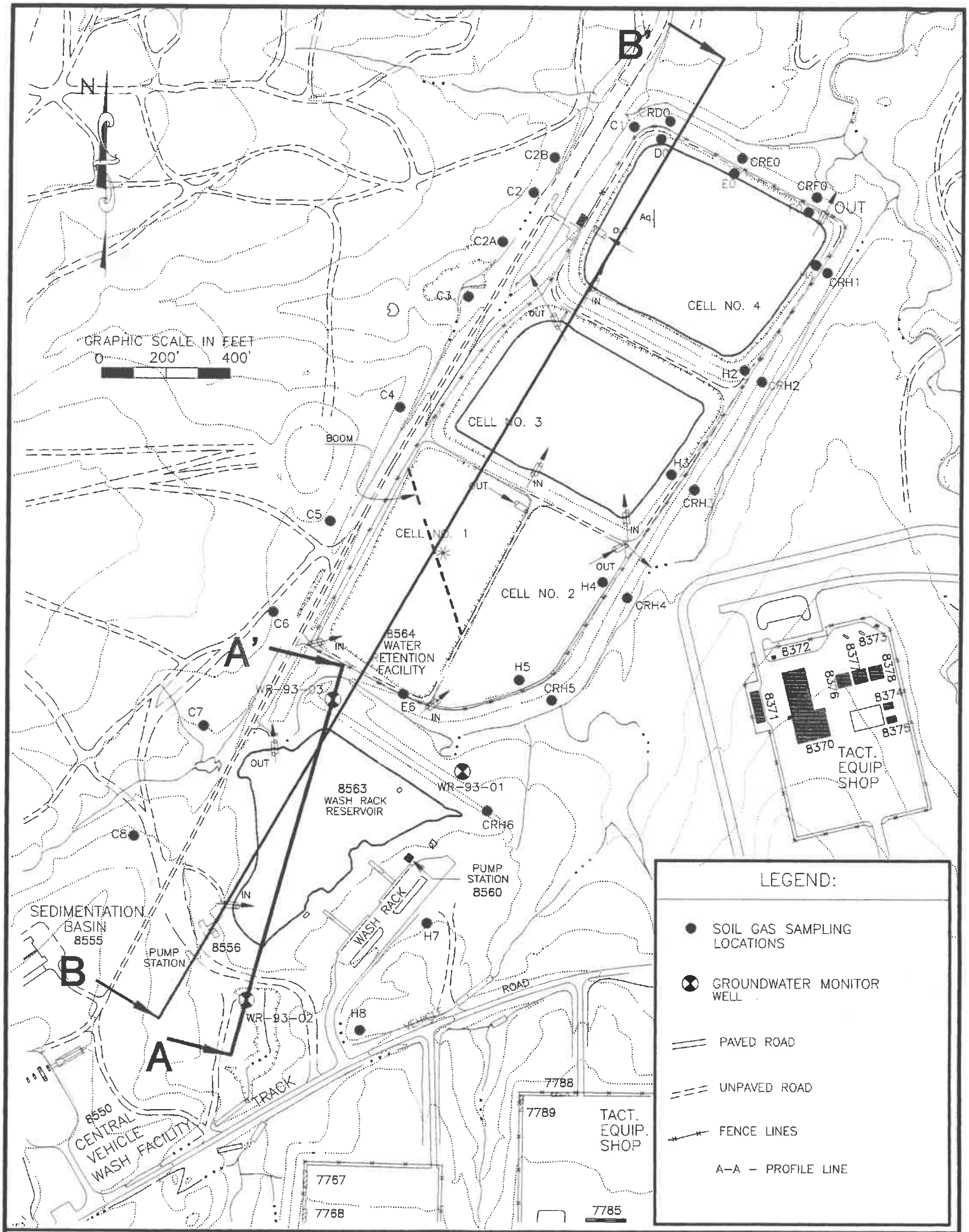
Figure 5–20: Geologic Cross-Section at the Wash Rack Reservoir



File: sidf5-21.dwg

June, 1994

Figure 5-21: Cross-Section of the Wash Rack Reservoir

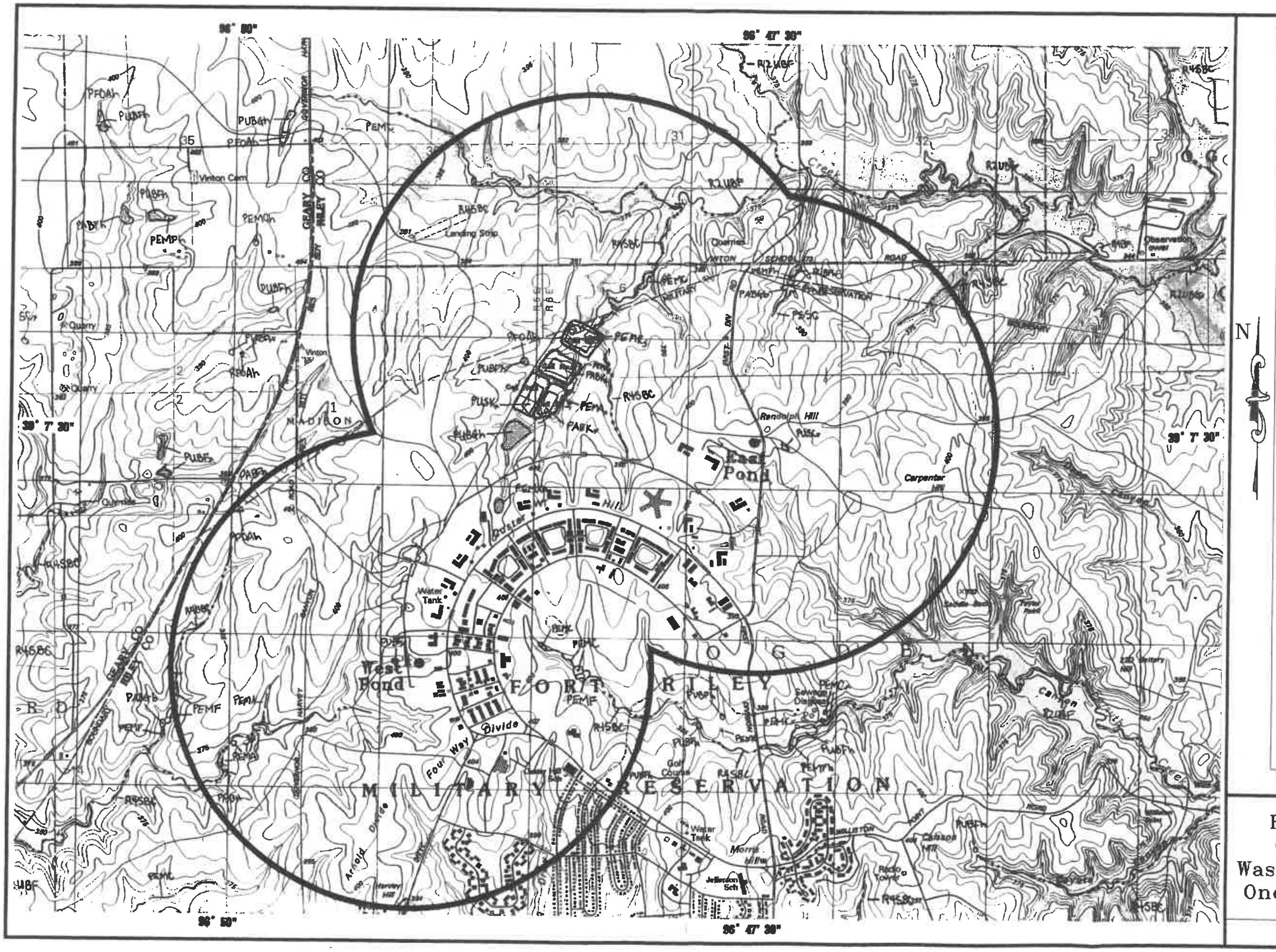


File: sidf5–22.dwg

June, 1994

Figure 5–22: Profile Lines for the Old Wash Rack Reservoir and Cells 1 through 4

File: sidf523.dwg



LEGEND

PABGb	PALUSTRINE SYSTEM, AQUATIC BED, INTERMITTENTLY EXPOSED, BEAVER
PABH	PALUSTRINE SYSTEM, AQUATIC BED CLASS, PERMANENTLY FLOODED
PABKx	PALUSTRINE SYSTEM, AQUATIC BED CLASS, ARTIFICIALLY FLOODED, EXCAVATED
PEMA	PALUSTRINE SYSTEM, EMERGENT CLASS, TEMPORARILY FLOODED
PEMAh	PALUSTRINE SYSTEM, EMERGENT CLASS, TEMPORARILY FLOODED, (DIKED, IMPOUNDED)
PEMAx	PALUSTRINE SYSTEM, EMERGENT CLASS, TEMPORARILY FLOODED, EXCAVATED
PEMC	PALUSTRINE SYSTEM, EMERGENT CLASS, SEASONALLY FLOODED
PEMF	PALUSTRINE SYSTEM, EMERGENT CLASS, SEMIPERMANENTLY FLOODED
PEMKx	PALUSTRINE SYSTEM, EMERGENT CLASS, ARTIFICIALLY FLOODED, EXCAVATION
PFOAh	PALUSTRINE SYSTEM, FORESTED CLASS, TEMPORARILY FLOODED, (DIKED, IMPOUNDED)
PSSC	PALUSTRINE SYSTEM, SCRUB-SHRUB CLASS, SEASONALLY FLOODED
PUBFh	PALUSTRINE SYSTEM, UNCONSOLIDATED BOTTOM CLASS, SEMIPERMANENTLY FLOODED (DIKED, IMPOUNDED)
PUBFx	PALUSTRINE SYSTEM, UNCONSOLIDATED BOTTOM CLASS, SEMIPERMANENTLY FLOODED, EXCAVATED
PUBGh	PALUSTRINE SYSTEM, UNCONSOLIDATED BOTTOM CLASS, INTERMITTENTLY EXPOSED (DIKED, IMPOUNDED)
PUSCx	PALUSTRINE SYSTEM, UNCONSOLIDATED SHORE CLASS, SEASONALLY FLOODED, EXCAVATED
PUSKx	PALUSTRINE SYSTEM, UNCONSOLIDATED SHORE CLASS, ARTIFICIALLY FLOODED, EXCAVATED
R2UBF	RIVERINE SYSTEM, LOWER PERENNIAL, UNCONSOLIDATED BOTTOM CLASS, SEMIPERMANENTLY FLOODED
R4SBC	RIVERINE SYSTEM, INTERMITTENT CLASS, STREAMBED, SEASONALLY FLOODED

Figure 5-23:
Custer Hill
Wastewater Ponds
One Mile Radius

June, 1994

Table 5-1 East Pond Detected Analytes from Soil Gas Survey Data

ANALYTE CONCENTRATIONS VIA GC/FID (ug/l)

SAMPLE	DEPTH (FT.)	BENZENE	TOLUENE	ETHYL-BENZENE	XYLENES	TOTAL FID *	t12DCE	11DCA
REPORTING LIMITS		1.0	1.0	1.0	1.0	10	1.0	1.0
SOIL GAS SAMPLES								
EP-A3-10	10	<1.0	<1.0	<1.0	<1.0	20	<1.0	<1.0
EP-A5	4	<1.0	<1.0	<1.0	<1.0	11	<1.0	<1.0
EP-A10	4	1.4	5.8	1.2	2.7	993	<1.0	<1.0
EP-A10-8	8	1.1	8.2	1.9	4.5	1,476	<1.0	<1.0
EP-A11	4	9	30	7.9	21	5,373	<1.0	<1.0
EP-A12-4	4	<1.0	<1.0	<1.0	<1.0	19	<1.0	<1.0
EP-A13-4	4	<1.0	2.2	<1.0	1.4	136	<1.0	<1.0
EP-A14-4	4	<1.0	3.1	<1.0	1.4	357	<1.0	<1.0
EP-A14-8	8	<1.0	3.1	1	<1.0	261	<1.0	<1.0
EP-C2-8	8	<1.0	<1.0	<1.0	<1.0	11	<1.0	<1.0
EP-C4	4	<1.0	1.2	<1.0	<1.0	<10	1.4	<1.0
EP-H3	4	<1.0	<1.0	<1.0	<1.0	<10	<1.0	1.8

11DCA = 1,1-dichloroethane
Total FID = sum of hydrocarbons detected on flame ionization detector
t12DCE = trans-1,2-dichloroethene

Table 5-2
Detected Analytes for Pond Aqueous Samples Collected at the East Pond, Ft. Riley, Kansas

	AQUEOUS [organics μg/L] [inorganics mg/L]				**REGULATORY STANDARDS**		
	EP-CH-SI	EP-CH-S2	EP-CH-S4^A	EP-CH-B01	MCL	KAL	KNL
Volatiles							
Toluene	1.0	1.1	1.2	1.4	1000	2000	200
Xylene (O/M/P)	0.9	1.7	1.6	2.6	10,000	440	44
Semi-volatiles							
TPH-DRO	68,000	2,600	2,600	2,600	---	---	---
Bis(2-Ethylhexyl)Phthalate	30	ND	ND	ND	---	---	---
Phenanthrene	▨ 10	ND	ND	ND	---	0.029	0.0029
Metals (Priority Pollutant)							
Lead	0.007	0.004	0.005	0.005	0.015	0.05	---
Zinc	0.05	0.02	0.03	0.03	---	5.0	---

ND: Not detected.
---: Standard Not Available.
A: Duplicate of EP-CH-S2

KAL: Kansas Action Level. From: Final 880607 Groundwater Contaminant Cleanup Target Concentrations.
KNL: Kansas Notification Level. From: Final 880607 Groundwater Contaminant Cleanup Target Concentrations.
MCL: Federal Maximum Contaminant Level. From: Drinking Water Regulations and Health Advisories, Office of Water, United States Environmental Protection Agency,December 1993.

Shaded areas represent those concentrations equal to or exceeding either the MCL and/or the KAL or KNL.

Table 5-3
Detected Analytes for Pond Sediment Samples Collected at the East Pond, Ft. Riley, Kansas

	SEDIMENT [organics µg/kg] [inorganics mg/kg]			EPA Risk-Based Levels^{B}
	EP-CH- Sed Outlet; EP-CH-Sed Outlet*	EP-CH- S001^{A}; EP-CH-205*^{A}	EP-CH- Sed Inlet; EP-CH-Sed Inlet 2**	
Volatiles				
Toluene	ND^{M}	ND^{M}	1,800^{M}	280,000-200,000,000
Ethylbenzene	ND^{M}	ND^{M}	440^{M}	68,000-100,000,000
Xylene (O/M/P)	ND	ND^{M}	1,640^{M}	99,000-500,000,000
TPH-DRO	120,000	42,000^{H}	240,000^{H}	---
Semi-Volatiles				
TPH-GRO	14,000,000^{M}	4,800,000^{M}	6,100,000^{M}	---
Naphthalene	ND^{M}	ND^{M}	13,000^{M}	80,000-10,000,000
2-Methylnaphthalene	12,000^{M}	14,000^{M}	34,000^{M}	---
Phenanthrene	ND^{M}	ND^{M}	16,000^{M}	---
Bis (2-Ethylhexyl) Phthalate	11,000^{M}	14,000^{M}	ND	50,000-5,000,000
Metals (Priority Pollutant)				
Arsenic	6†	6†	4†	0.4-310
Beryllium	0.8‡	0.8‡	ND	0.1-1,000
Cadmium	10	12	9.4	100-1000
Chromium	28	28	15	5,100-1,000,000
Copper	41	47	32	10,000-76,000
Lead	57	80	60	500-1,000^{C}
Nickel	17	19	10	5,000-41,000^{D}
Zinc	200	230	250	80,000-310,000

Note: all results in dry weight

Shaded values represent concentrations that exceed carcinogen levels.

- * Resampled sediment outlet location; analyses included TCL VOAs, TPH-DRO only.
- ** Re-sampled sediment inlet location; analyses included TCL VOAs, TPH-DRO only.
- ND: Not detected.
- ---: Standard Not Available.
- H: Result is an estimated value.Recommended holding time was exceeded.
- M: Reporting limit higher than normal due to matrix interference.
- †: Sample concentration exceeded EPA Regions III, IX and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
- ‡: Sample concentration exceeded EPA Regions III and X (10^{-4}) risk based standard for Beryllium as a carcinogen.
- A: Duplicate of EP-CH-Sed Outlet.
- B: Risk-based guideline concentrations are based on a range to represent EPA Regions III, IX & X from the following citations: Region III Risk-based Concentration Table, 2nd quarter 1994, Roy L. Smith, Senior Toxicologist - Technical Support Section; Region IX Preliminary Remediation Goals (PRGs) 1st quarter 1993, Stanford J. Smucker, PhD, Regional Toxicologist; and Region X-Appendix II-Human Health Risk-based Preliminary Remediation Goals for Water and Soil, October 1992.
- C: EPA Directive Number OSWER 9355.4-02, Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund.
- D: Soluble salts.

TABLE 5-4
EAST POND DETECTED ANALYTES FOR GROUNDWATER

Analyte (μg/l organics) (mg/l inorganics)	Sample Location Sample ID #				Standards		
					Regulatory Comparison Values		
	EP-93-01	EP-93-02	EP-93-03	EP-93-07^{A}	KAL	KNL	MCL
1,1,1-Trichloroethane	5.1	ND	ND	ND	200	20	200
1,1-Dichloroethane	1.0	ND	ND	ND	5.0	0.5	---
TPH-GRO	ND	ND	6300	6300	---	---	---
TPH-DRO	ND	ND	2000	1900	---	---	---
2-Methylnaphthalene	ND	ND	180	170	---	---	---
Naphthalene	ND	ND	150	150	143	14.3	---
Benzene	ND	ND	280	270	5.0	0.5	5.0
Ethylbenzene	ND	ND	170	170	680	68	700
m,p-xylene	ND	ND	470	460	440	44	10,000
o-xylene	ND	ND	250	240	440	44	10,000
Toluene	ND	ND	360	350	2,000	200	1,000
Arsenic	ND	ND	0.04	0.04	0.05	---	0.05

ND:	Not Detected
---:	Standard Not Available.
A:	Duplicate of EP-93-03

KAL:	Kansas Action Level. From: Final 880607 Groundwater Contaminant Cleanup Target Concentrations.
KNL:	Kansas Notification Level. From: Final 880607 Groundwater Contaminant Cleanup Target Concentrations.
MCL:	Federal Maximum Contaminant Level. From: Drinking Water Regulations and Health Advisories, Office of Water, United States Environmental Protection Agency, December 1993.

Shaded areas represent those concentrations equal to or exceeding either the MCL and/or the KAL.

Table 5-5
Detected Analytes for the Aqueous Stream Sampling at the East Pond, Ft. Riley, Kansas

	AQUEOUS [organics μg/l] [inorganics mg/l]			**STANDARDS** [organics μg/l] [inorganics mg/l]		
	EP-CH-Stream AQ-1	EP-CH-Stream AQ-2	EP-CH-Stream AQ-3	MCL	KAL	KNL
Semi-Volatiles TPH-DRO	130	ND	220	---		
Metals (Priority Pollutant) Zinc	ND	ND	0.02	---	5.0	---

ND: Not Detected.
---: No Standards Available.
KAL: Kansas Action Level. From: Final 880607 Groundwater Contaminant Cleanup Target Concentrations.
KNL: Kansas Notification Level. From: Final 880607 Groundwater Contaminant Cleanup Target Concentrations.
MCL: Federal Maximum Contaminant Level. From: Drinking Water Regulations and Health Advisories, Office of Water, United States Environmental Protection Agency, December 1993.

Table 5-6
Detected Analytes for the Sediment Stream Sampling at the East Pond, Ft. Riley, Kansas

	SEDIMENT [organics μg/kg] [inorganics mg/kg)]			**EPA Risk-Based Levels**[A]
	EP-CH-Stream Sed 1	EP-CH-Stream Sed 2	EP-CH-Stream Sed 3	
Semi-Volatiles TPH-DRO	54 [H]	ND	ND [H,R]	---
Metals (Priority Pollutant) Arsenic	3[λ]	4[†]	7[†]	0.4-310
Beryllium	0.7[⧗]	0.7[⧗]	4.2[‡]	0.1-1,000
Cadmium	1	0.8	5.1	100-1,000
Chromium	24	16	96	5,100-1,000,000
Copper	12	10	60	10,000-76,000
Lead	13	16	22	500-1,000[B]
Nickel	18	13	72	5,000-41,000[C]
Zinc	51	34	220	80,000-310,000

Note: all results in dry weight

ND: Not detected.
---: Standard Not Available.
H: Result is an estimated value. Recommended holding time was exceeded.
R: Data rejected by data validator.
λ: Sample concentration exceeded EPA Regions III and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
†: Sample concentration exceeded EPA Regions III, IX and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
⧗: Sample concentration exceeded EPA Regions III and X (10^{-4}) risk based standard for Beryllium as a carcinogen.
‡: Sample concentration exceeded EPA Regions III, IX and X (10^{-4}) risk based standard for Beryllium as a carcinogen.
A: Risk-based guideline concentrations are based on a range to represent EPA Regions III, IX & X from the following citations: Region III Risk-based Concentration Table, 2nd quarter 1994, Roy L. Smith, Senior Toxicologist - Technical Support Section; Region IX Preliminary Remediation Goals (PRGs) 1st quarter 1993, Stanford J. Smucker, PhD, Regional Toxicologist; and Region X-Appendix II-Human Health Risk-based Preliminary Remediation Goals for Water and Soil, October 1992.
B: EPA Directive Number OSWER 9355.4-02, Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites.
C: Soluble salts.

Shaded values represent concentrations that exceed carcinogen levels.

Table 5-7

Detected Analytes for the Pond Aqueous Samples Collected at the West Pond, Ft. Riley, Kansas

	AQUEOUS [organics μg/L] [inorganics mg/L]		REGULATORY STANDARDS [organics μg/L] [inorganics mg/L]		
	WP-CH-S	WP-CH-B	MCL	KAL	KNL
Volatiles					
Benzene	0.6	0.7	5.0	5.0	0.5
Toluene	4.7	4.3	1,000	2,000	200
Ethylbenzene	1.0	1.1	700	680	68
Xylene (O/M/P)	3.7	3.9	10,000	440	44
1,1,1 Trichloroethane	3.4	3.7	200	200	20
1,1 Dichloroethene	ND	1.9	7	7	0.7
Methylene Chloride (Dichloromethane)	1.7	ND	5.0	50	5.0
Chloroform (Trichloromethane)	0.9	1.1	100	100	0.5
Semi-Volatiles					
TPH-DRO	10,000	6,000	---	---	---
Metals (Priority Pollutant)					
Cadmium	ND	▨ 0.005	0.005	0.005	---
Lead	0.004	ND	0.015	0.05	---
Zinc	0.09	0.10	---	5.0	---

ND: Not detected.
---: Standard Not Available.

KAL: Kansas Action Level. From: Final 880607 Groundwater Contaminant Cleanup Target Concentrations.
KNL: Kansas Notification Level. From: Final 880607 Groundwater Contaminant Cleanup Target Concentrations.
MCL: Federal Maximum Contaminant Level. From: Drinking Water Regulations and Health Advisories, Office of Water, United States Environmental Protection Agency, December 1993.

Shaded areas represent those concentrations equal to or exceeding either the MCL and/or the KAL.

Table 5-8
Detected Analytes for the Pond Sediment Samples Collected at the West Pond, Ft. Riley, Kansas

	SEDIMENT [organics µg/kg] [inorganics mg/kg]		**EPA Risk-Based Levels**[A]
	WP-CH-Sed. Outlet; WP-CH-Sed. Outlet*	WP-CH-Sed. Inlet; WP-CH--Sed. Inlet*	
Volatiles			
Toluene	1,200	1,200	280,000-200,000,000
Xylene (O/M/P)	ND	900	99,000-500,000,000
TPH-GRO	220,000	110,000	---
Semi-Volatiles			
TPH-DRO	24,000,000[M]	18,000,000[M]	---
Naphthalene	ND	13,000[M]	80,000-10,000,000
2-Methylnaphthalene	20,000[M]	34,000[M]	---
Phenanthrene	19,000[M]	19,000[M]	---
Bis (2-Ethylhexyl) Phthalate	18,000[M]	16,000[M]	50,000-5,000,000
Fluorene	ND	6,300[M]	10,000,000
Dibenzofuran	ND	5,300[M]	300,000
Metals (Priority Pollutant)			
Arsenic	5[†]	4[†]	0.4-310
Cadmium	11	10	100-1,000
Chromium	17	11	5,100-1,000,000
Copper	20	16	10,000-76,000
Lead	40	20	500-1,000[B]
Nickel	11	7	5,000-41,000[C]
Zinc	140	98	80,000-310,000

* :	Re-sampled location; analyses included VOA, SVOA GRO only.
ND:	Not detected.
---:	Standard Not Available.
H:	Result is an estimated value. Recommended holding time was exceeded.
M:	Reporting limit higher than normal due to matrix interference
†:	Sample concentration exceeded EPA Regions III, IX and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
A:	Risk-based guideline concentrations are based on a range to represent EPA Regions III, IX & X from the following citations: Region III Risk-based Concentration Table, 2nd quarter 1994, Roy L. Smith, Senior Toxicologist - Technical Support Section; Region IX Preliminary Remediation Goals (PRGs) 1st quarter 1993, Stanford J. Smucker, PhD, Regional Toxicologist; and Region X-Appendix II-Human Health Risk-based Preliminary Remediation Goals for Water and Soil, October 1992.
B:	EPA Directive Number OSWER 9355.4-02, Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites.
C:	Soluble salts.

Shaded values represent concentrations that exceed carcinogen levels.

Table 5-9
Detected Analytes for the Pond Aqueous Samples Collected at the Wash Rack Reservoir, Ft. Riley, Kansas

	AQUEOUS [organics $\mu g/l$] [inorganics mg/kg]								STANDARDS		
	Old Wash Rack Reservoir			Cell 1	Cell 2	Cell 3		Cell 4	MCL	KAL	KNL
	CVWF-CH-S1-R	CVWF-CH-B-R	CVWF-CH-001-R[A]	CVWF-CH-C14	CVWF-CH-C22	CVWF-CH-C31[B]	CVWF-CH-009-C3	CVWF-CH-43-C4			
Semi-Volatiles											
TPH-DRO	330	670	550	720	280	250	440	ND	---	---	---
Bis(2-Ethylhexyl) Phthalate	ND	23	ND	ND	ND	ND	ND	ND	---	---	---
Metals (Priority Pollutant)											
Lead	ND	ND	ND	ND	ND	ND	ND	0.004	0.015	0.05	---
Silver	ND	ND	ND	ND	0.03	.01	ND	ND	---	0.05	---

Note: all results in dry weight

ND:	Not Detected.
---:	Standard Not Available.
A:	Duplicate of CVWF-CH-S1-R
B:	Duplicate of CVWF-CH-009-C3
KAL:	Kansas Action Level. From: Final 880607 Groundwater Contaminant Cleanup Target Concentrations.
KNL:	Kansas Notification Level. From: Final 880607 Groundwater Contaminant Cleanup Target Concentrations.
MCL:	Federal Maximum Contaminant Level. From: Drinking Water Regulations and Health Advisories, Office Office of Water, United States Environmental Protection Agency, December 1993.

Shaded areas represent those concentrations exceeding either the MCL and/or the KAL .

Table 5-10
Detected Analytes for the Pond Sediment Samples Collected at the Wash Rack Reservoir, Ft. Riley, Kansas

	SEDIMENT [organics µg/kg] [inorganics mg/kg]																	
	Old Wash Rack Reservoir				Cell 1			Cell 2			Cell 3			Cell 4				EPA Risk-Based Levels[D]
	SED-CR; SED-CR1[A]	005-R[B]	Sed-Outlet-R	Sed-Inlet-R	Sed Outlet-C10	Sed C11	Sed Inlet-C12	Sed Outlet C20	Sed-Inlet C21	Sed C24	Sed Outlet C30	C34	C33	Sed Outlet-C40	041-C4[C]	44-C4	45-C4	Commercial/ Industrial Soil
Volatiles																		
Methylene Chloride (Dichloromethane)	ND	ND	ND	ND	ND	24	ND	ND	ND[M]	ND	ND	ND	ND	ND	ND	ND	ND	62,000-20,000,000
Toluene	ND[M]	ND	ND	ND	ND	ND	220	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	280,000-200,000,000
TPH-GRO	130,000	ND[H,M]	ND[H,M]	ND[H,M]	ND[H]	ND[H]	1,200[H]	ND[H]	3,700[H]	ND[H]	ND[H]	ND	ND	ND	ND[H]	ND	ND	---
m,p-Xylene	ND	ND	2,400	ND[M]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	99,000-500,000,000
Semi-Volatiles																		
TPH-DRO	4,400,000	32,000,000	8,000,000	18,000,000	210,000	180,000	570,000	322,000	3,100,000	ND	87,000	17,000[H]	31,000[H]	14,000[H]	20,000[H]	15,000[H]	10,000[H]	---
Bis(2-Ethylhexyl) Phthalate	ND	25,000[M]	27,000[M]	51,000[M]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	50,000-5,000,000
Di-n-butyl Phthalate	ND	ND	ND	21,000[M]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	100,000-100,000,000
Metals (Priority Pollutant)																		
Arsenic	6[†]	6[†]	6[†]	3[λ]	3[λ]	2[λ]	6[†]	3[λ]	5[†]	3[λ]	3[λ]	2[λ]	18[†]	4[†]	3[λ]	4	3[λ]	0.4-310
Beryllium	0.8[‡]	0.9[‡]	ND	0.5[α]	ND	0.8[‡]	ND	ND	ND	0.9[‡]	0.5[α]	0.5[α]	0.5[α]	0.7[‡]	0.6[α]	0.6[α]	0.7[‡]	0.1-1,000
Cadmium	4.7	8.4	7.5	4.7	0.8	1.0	4	0.8	4.3	1.0	1.1	0.8	1.5	0.8	0.7	0.7	0.7	100-1,000
Chromium	25	33	26	21	14	20	5	12	32	23	19	15	19	21	18	17	16	5,100-1,000,000
Copper	23	36	31	22	9	11	6	11	27	13	12	10	15	12	10	12	10	10,000-76,000
Lead	30	40	40	30	11	10	64	5	20	15	10	12	75	11	11	14	13	500-1,000[E]
Nickel	19	21	18	14	12	15	4	12	25	21	16	13	17	18	15	16	13	5,000-41,000[F]
Zinc	130	290	260	110	35	45	35	50	200	56	51	36	54	49	45	38	37	80,000-310,000

Shaded values represent concentrations that exceed carcinogen levels.

Note: All samples have the prefix "CVWF-CH-".

All results in dry weight

ND: Not detected.
---: Standard Not Available.
H: Result is an estimated value. Recommended holding time was exceeded.
M: Reporting limit higher than normal due to matrix interference.
†: Sample concentration exceeded EPA Regions III, IX and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
λ: Sample concentration exceeded EPA Regions III and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
‡: Sample concentration exceeded EPA Regions III and X (10^{-4}) risk based standard for Beryllium as a carcinogen.

α: Sample concentration exceeded EPA Region X (10^{-4}) risk based standard for Beryllium as a carcinogen.
A: Resample; analyses included VOA, TPH-GRO only.
B: Duplicate of CVWF-CH-Sed Outlet-R
C: Duplicate of CVWF-CH-Sed Outlet C40
D: Risk-based guideline concentrations are based on a range to represent EPA Regions III, IX & X from the following citations: Region III Risk-based Concentration Table, 2nd quarter 1994, Roy L. Smith, Senior Toxicologist - Technical Support Section; Region IX Preliminary Remediation Goals (PRGs) 1st quarter 1993, Stanford J. Smucker, PhD, Regional Toxicologist; and Region X-Appendix II-Human Health Risk-based Preliminary Remediation Goals for Water and Soil, October 1992.
E: EPA Directive Number OSWER 9355.4-02, Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund
F: Soluble salts.

TABLE 5-11
OLD WASH RACK RESERVOIR DETECTED ANALYTES FOR GROUNDWATER

Analyte (µg/l organics) (mg/l inorganics)	**Sample Location** **Sample ID #**			
	WR-93-01	Regulatory Comparison Values		
		KAL	KNL	MCL
Arsenic	0.02	0.05	---	0.05

---: Standard Not Available.

KAL: Kansas Action Level. From: Final 880607 Groundwater Contaminant Cleanup Target Concentrations.

KNL: Kansas Notification Level. From: Final 880607 Groundwater Contaminant Cleanup Target Concentrations.

MCL: Federal Maximum Contaminant Level. From: Drinking Water Regulations and Health Advisories, Office of Water, United States Environmental Protection Agency, December 1993.

Table 5-12
Detected Analytes for the Aqueous Stream Sampling to the North and East of the Cell Complex, Ft. Riley, Kansas

	AQUEOUS (mg/L)			STANDARDS (mg/L)		
	CVWF-CH-Stream AQ-1	CVWF-CH-Stream AQ-5	CVWF-CH-Stream AQ 6	MCL	KAL	KNL
Metals (Priority Pollutant)						
Lead	ND	0.008	ND	0.015	0.05	---
Zinc	ND	0.04	ND	---	5.0	---

ND: Not detected.
---: Standard Not Available.

KAL: Kansas Action Level. From: Final 880607 Groundwater Contaminant Cleanup Target Concentrations.
KNL: Kansas Notification Level. From: Final 880607 Groundwater Contaminant Cleanup Target Concentrations.
MCL: Federal Maximum Contaminant Level. From: Drinking Water Regulations and Health Advisories, Office of Water, United States Environmental Protection Agency, December 1993.

Table 5-13
Detected Analytes for the Sediment Stream Sampling to the North and East of the Cell Complex, Ft. Riley, Kansas

	SEDIMENT [organics μg/kg] [inorganics mg/kg)]							**EPA Risk-Based Levels**^{B}
	CVWF-CH-Stream Sed 1	CVWF-CH-101^{A}	CVWF-CH-Stream Sed 2	CVWF-CH-Stream Sed 3	CVWF-CH-Stream Sed 4	CVWF-CH-Stream Sed 5	CVWF-CH-Stream Sed 6	
Semi-Volatiles TPH-DRO	1,100^{H}	ND^{H,R}	ND^{H,R}	ND^{R}	ND^{H,R}	38^{H}	ND^{H,R}	---
Metals (Priority Pollutant) Arsenic	$9^{\dagger}$	$9^{\dagger}$	$4^{\dagger}$	$10^{\dagger}$	$8^{\dagger}$	$4^{\dagger}$	3^{λ}	0.4-310
Beryllium	1.1^{Ɪ}	0.8^{Ɪ}	0.7^{Ɪ}	ND	ND	0.6^{α}	0.7^{Ɪ}	0.1-1,000
Cadmium	1.3	0.9	0.8	1.1	1.0	0.8	0.7	100-1,000
Chromium	31	21	17	25	24	15	16	5,100-1,000,000
Copper	20	15	13	17	14	10	11	10,000-76,000
Lead	15	18	8	18	22	16	12	500-1,000^{C}
Nickel	27	21	16	22	21	13	18	5,000-41,000^{D}
Zinc	68	44	41	57	50	43	40	80,000-310,000

Note: all results in dry weight

ND: Not detected.
---: Standard Not Available.
H: Result is an estimated value. Recommended holding time was exceeded.
R: Data rejected by data validator.
†: Sample concentration exceeded EPA Regions III, IX and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
λ: Sample concentration exceeded EPA Regions III and X (10^{-4}) risk based standard for Arsenic as a carcinogen.
Ɪ: Sample concentration exceeded EPA Regions III and X (10^{-4}) risk based standard for Beryllium as a carcinogen.
α: Sample concentration exceeded EPA Region X (10^{-4}) risk based standard for Beryllium as a carcinogen.
A: Duplicate of CVWF-CH-Stream Sed 1.
B: Risk-based guideline concentrations are based on a range to represent EPA Regions III, IX & X from the following citations: Region III Risk-based Concentration Table, 2nd quarter 1994, Roy L. Smith, Senior Toxicologist - Technical Support Section; Region IX Preliminary Remediation Goals (PRGs) 1st quarter 1993, Stanford J. Smucker, PhD, Regional Toxicologist; and Region X-Appendix II-Human Health Risk-based Preliminary Remediation Goals for Water and Soil, October 1992.
C: EPA Directive Number OSWER 9355.4-02, Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites.
D: Soluble salts.

Shaded values represent concentrations that exceed carcinogen levels.

6.0 BUILDING 1301 AND FORMER BUILDING 1605

Building 1301 and Former Building 1605 are located in close proximity to each other -- between Fifth and Seventh Streets, and H and G Streets in Camp Funston. The general location is shown in Figure 6-1. The area was included in the High Priority SI because Building 1301 was scheduled for demolition and Former Building 1605 could be cost-effectively evaluated during the investigation of Building 1301. The purpose of the SI was to investigate environmental conditions around Building 1301 and Former Building 1605.

6.1 SI Approach

The SI consisted of soil gas surveys around Building 1301 and Former Building 1605. [Appendix H contains the analytical data from the soil gas survey.] The SI included soil samples from areas with soil gas detections. Extensive groundwater sampling was determined not to be necessary at these sites based on the results of the soil gas surveys.

The Phase 1 soil gas survey of Building 1301 included collection of four-foot soil gas samples at 10 locations. The soil gas samples were analyzed for petroleum hydrocarbons and chlorinated organic compounds using modified EPA Method 8010 and 8020.

The Phase 1 soil gas survey of Former Building 1605 included collection of soil gas samples at 10 locations; the samples were collected and analyzed as described above for Building 1301. Additional soil gas samples were collected around positive detections of the Phase 1 soil gas survey. Also, one groundwater sample and two soil samples were collected from the area of highest soil gas concentrations. The location, type and number of samples collected at Former Building 1605 following the completion of the Phase 1 soil gas survey are outlined in the Technical Memorandum, provided in Appendix A.

6.2 Site History

Building 1301 was used for furniture repair and paint stripping between 1988 and 1992. One room in the northwest corner has five, one-inch diameter holes in a regularly spaced pattern drilled in the floor for ventilation during the stripping operation.

Former Building 1605 was used for similar furniture repair and stripping operations circa 1984 to 1988 when it burned down. The Former Building is now a vacant lot covered with soil and used as a vehicle parking area.

6.3 Waste Characteristics

The contaminants of concern at this site are volatile organic compounds used in furniture stripping, cleaning and refurbishing. There is no evidence of environmental releases at either site, and no records of on-site dumping or disposal. The results of the SI are presented to provide site-specific information regarding the presence of these substances in the environment.

The sampling locations at Building 1301 are shown on Figure 6-2. There were no detections in any of the soil gas samples collected at this site.

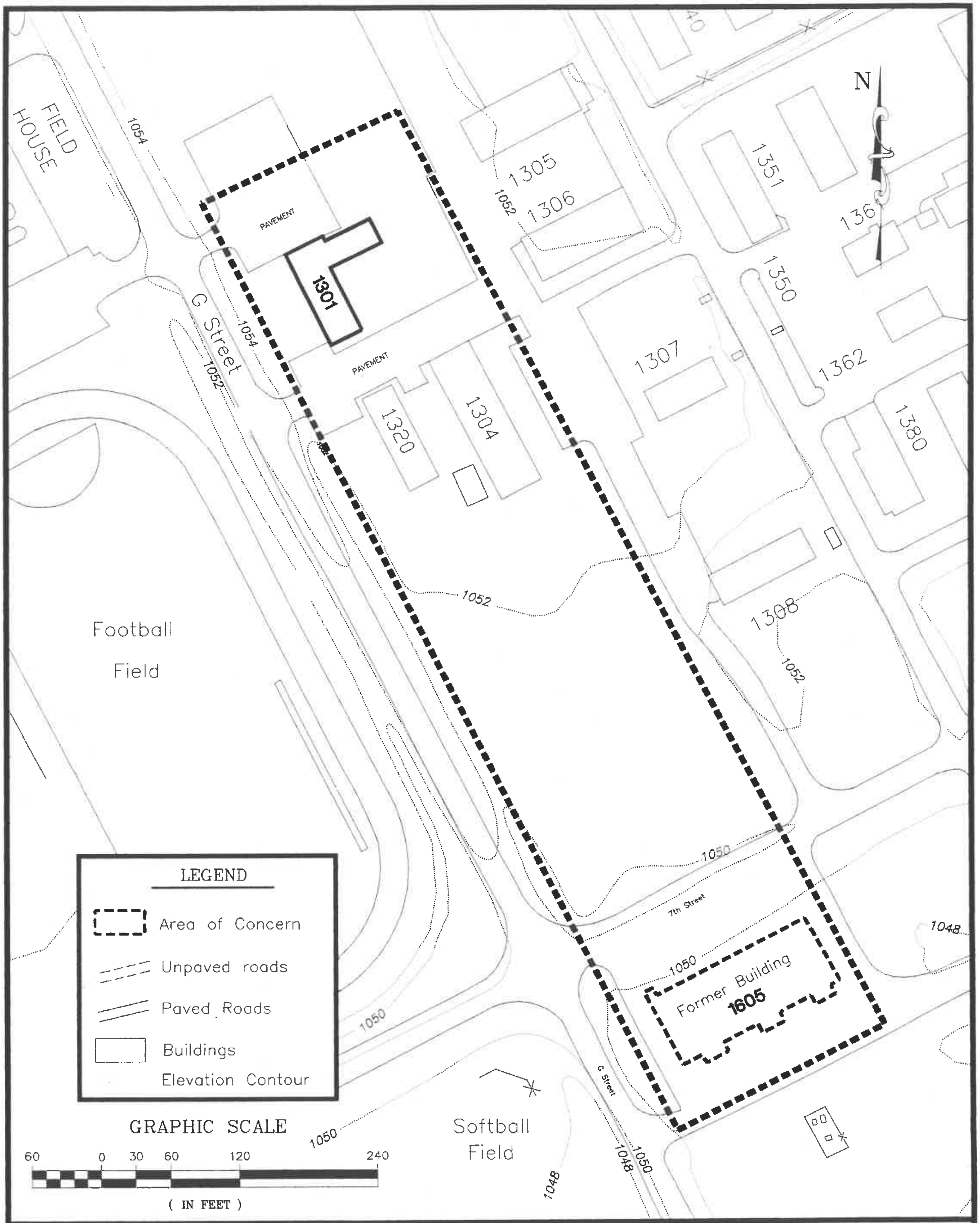
The sampling locations at Former Building 1605 are shown on Figure 6-3. There were no detections at 9 of the 10 Phase 1 sample locations. However, at one location (R9), Total FID concentrations were 660 μg/l. Consequently, a Phase 2 soil gas survey was conducted. The Phase 2 survey included collection of a groundwater screening sample from a depth of 10 feet below sample location R9 as well as the collection of soil gas samples at five new locations around R9. There were no detections in any of the Phase 2 soil gas or groundwater screening samples. In addition, two soil samples were collected at R9 at depths of 18 inches and 3 to 4 feet. The soil samples were analyzed in the laboratory for volatile organic compounds and TPH. There were no detections in either of the soil samples. No further investigations were conducted.

6.4 Summary

The SI consisted of a soil gas survey within and around the northwest corner of Building 1301 and a soil gas survey over the area of Former Building 1605 to determine whether volatile organic compounds had been released to the environment.

The SI results indicate that there are no releases to the environment from Building 1301. Further, the SI results indicate that there are no significant releases from Former Building 1605. The detection of petroleum hydrocarbons at one location is more likely attributable to the use of the area for vehicle parking than to the activities at the Former Building.

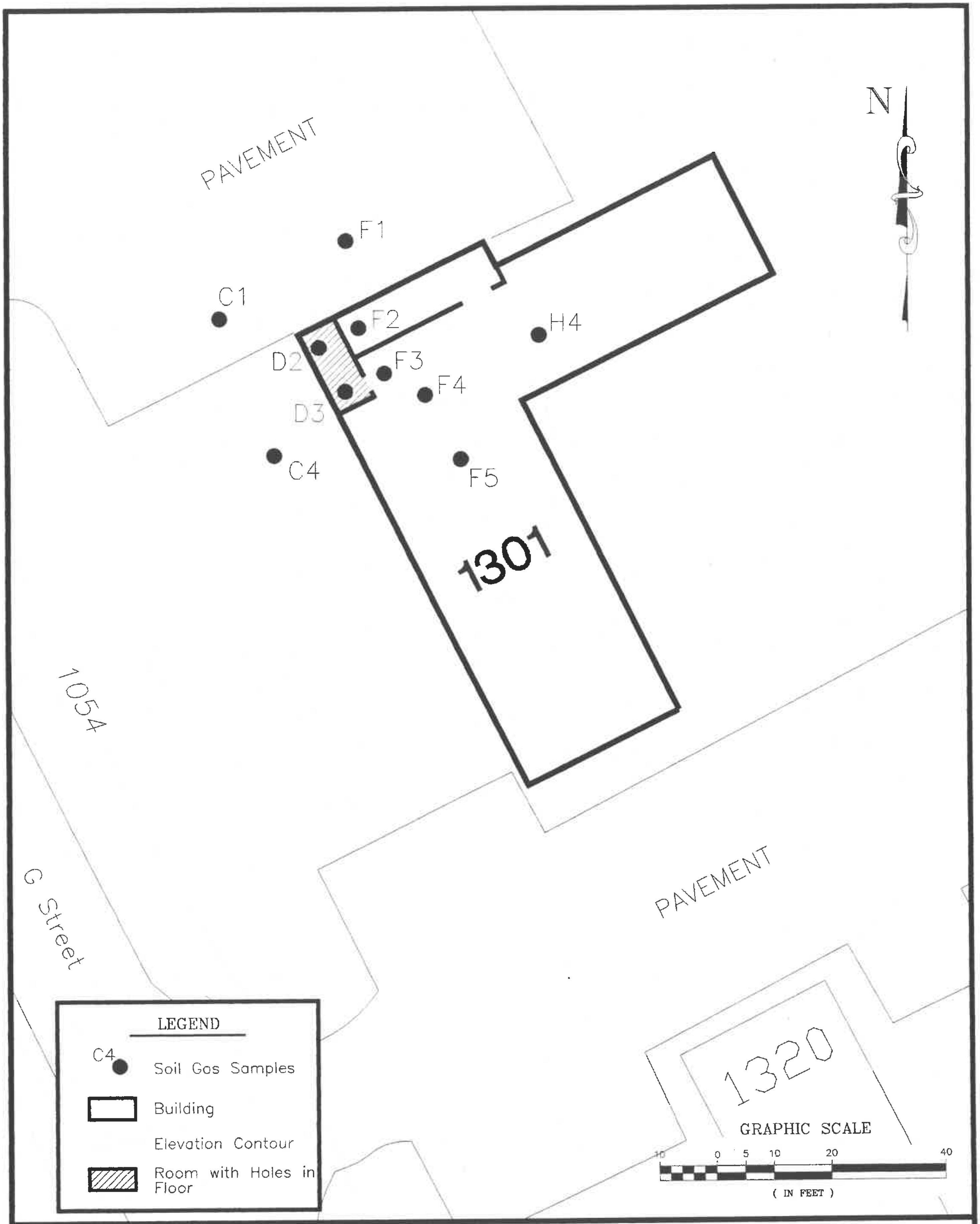
On 12 October 1993, Fort Riley contacted EPA and KDHE to notify them of the soil removal at Former Building 1605. On 26 October 1993, Fort Riley DEH personnel excavated a four foot by four foot by three (4 X 4 X 3) foot hole from Former Building 1605, and removed one dump truck load of soil/gravel mix to the Construction/Debris Landfill on Fort Riley (Ref. 48). The completion of this removal action eliminates any actual or potential threats posed by the site. Therefore, discussions regarding potential migration pathways (groundwater, surface water, soils and air) are not relevant and are not provided.



File: sidf6-1.dwg

June, 1994

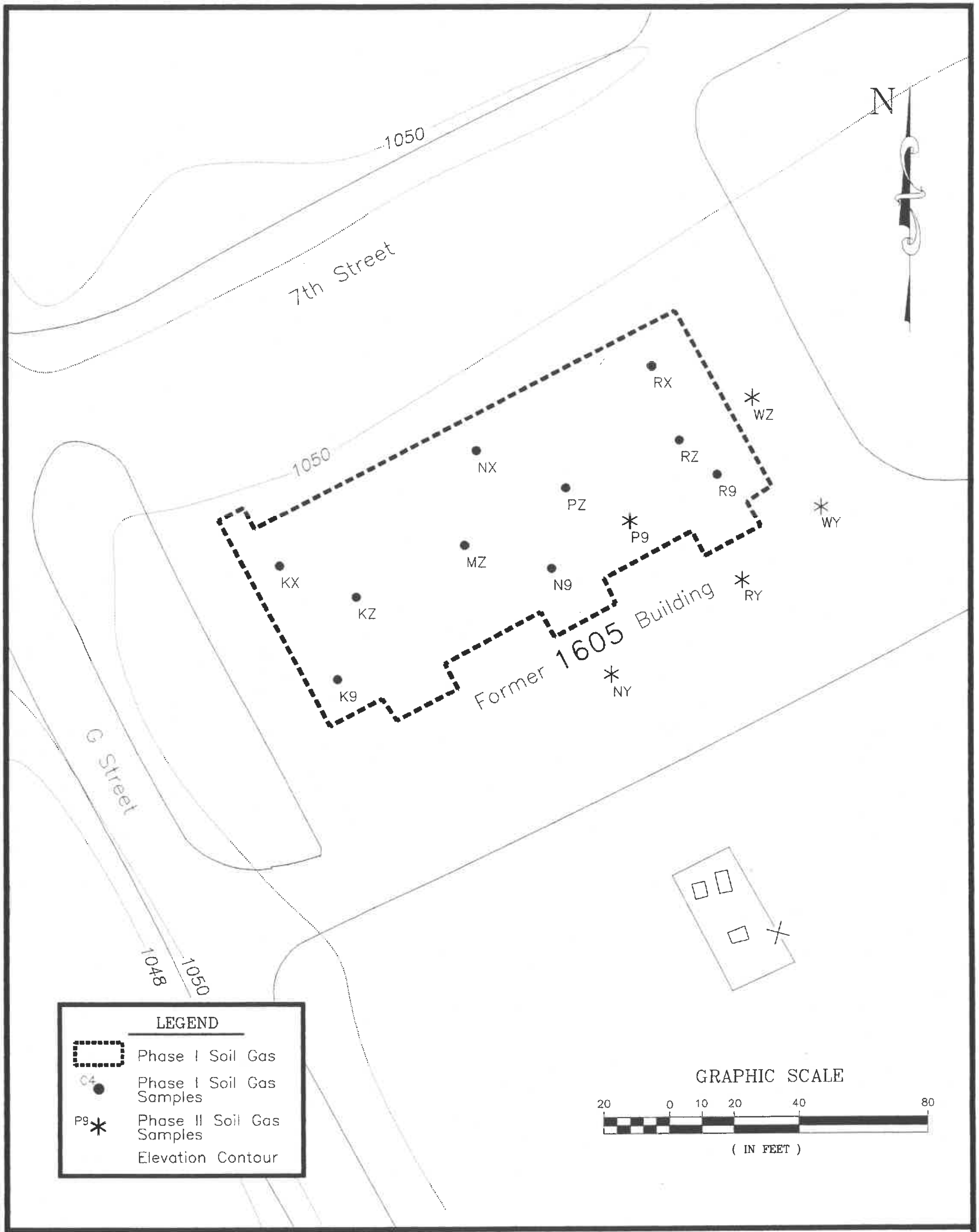
Figure 6-1: Location of Building 1301 and Former Building 1605



File: sidf6–2.dwg

June, 1994

Figure 6–2: Sampling Locations at Building 1301



File: sidf6--3.dwg

June, 1994

Figure 6-3: Sampling Locations at Former Building 1605

7.0 REFERENCES

1. Interagency Agreement between Fort Riley, Kansas and the state of Kansas and EPA Region VII, March 1991.
2. Hazard Ranking System, 55 Federal Register 51532, December 14, 1990.
3. National Contingency Plan, 40 CFR 300.
4. Zeller, Doris, E., 1968, *The Stratigraphic Succession in Kansas,* Kansas Geologic Survey Bulletin 189.
5. State Geological Survey of Kansas, *The Environment of Camp Funston*, Moore, R. C., 1951.
6. Climatology Data from the Monthly Climatology for each month of 1992 by Detachment 8, 5th Weather Squadron.
7. Communication with Fort Riley DEH, Division of Natural Resources, regarding grass species, November 1992.
8. U.S. Department of the Interior, *National Wetlands Inventory, Junction City KS, Quadrangle*, 1992 and *National Wetlands Inventory, Junction City KS, Quadrangle*, 1992.
9. Kansas Biological Survey letter regarding the *Threatened and Endangered Species Known or Likely to Occur in Riley County, KS.*
10. Communication with U.S. Fish and Wildlife regarding endangered species.
11. Communication with U.S. Department of Commerce, Bureau of the Census, Denver Division regarding population data.
12. Data from the Fort Riley Department of Environmental Health for demographic statistics.
13. Communication with Fort Riley employee at the Family Child Care Farm Support Division and the City of Olden regarding population data.

14. Data from the Fort Riley Department of Environmental Health for demographic statistics.

15. Communication with Junction City Unified School District, regarding elementary school enrollment, 4 December 1992.

16. Communication with Metcalf & Eddy, regarding Junction City well locations and monitoring well report, 25 September 1992.

17. Communication with a City of Ogden representative regarding water supply wells and their locations, 25 September 1992.

18. Communication with Fort Riley employee at the Family Child Care Farm Support Division and the City of Ogden regarding population data, 16 November 1992.

19. Communication with the an employee at the City of Milford regarding water supply, 16 November 1992.

20. Communication with Riley County Rural Water District Office, regarding water districts, 17 November 1992.

21. *Bulletin 39 - The Geology of Riley And Geary Counties, KS*, by John M. Jewett, University of Kansas Publications, December 1941.

22. Communication with Riley County Clerk's Office, regarding water system, 30 October 1992.

23. U.S. Department of the Interior, Geological Survey, *Ogden Quadrangle, Kansas, 7.5 Minute Series (Topographic)*, and *Junction City, Kansas, 7.5 Minute Series (Topographic)*.

24. Defence Mapping Agency Hydrographic/Topographic Center, *Fort Riley Military Installation Map*, 1981.

25. U.S. Army Engineer Topographic Laboratories (USAETL), Terrain Analysis Center, 1977.

26. FEMA Maps, *Flood Insurance Rate Maps, Riley and Geary Counties,* Federal Emergency Management Agency, April 1982.

27. U.S. EPA, *Guidance Manual for Performing Site Investigations Under CERCLA, Interim Final*, EPA540-R-92-021, Directive 9345.1-05, September 1992.

28. United States Environmental Protection Agency, *Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites*, OSWER Directive #9355.4-02, 1989.

29. *Draft Final Installation Wide Site Assessment for Fort Riley, Kansas, 7 December 1992.*

30. Communication with Fort Riley DEH, regarding Colyer Manor, 20 November 1992.

31. *For Rapid Response Removal of Contaminated soils at Pesticide Storage Facility and Coyler Manor Sites, Fort Riley, Kansas, 17 June 1992.*

32. KDHE, Bureau of Water, Public Water Supply System, *Draft Phase II/V Monitoring Requirements*, July 1993.

33. Davis, Tenney, L., *The Chemistry of Powder & Explosives,* Angriff Press, 1943.

34. Memorandum from Fort Riley DEH, Division of Natural Resources, concerning DU disposal, 23 June 1993.

35. *Impact Area Site Assessment Report for Fort Riley, Kansas, 11 March 1993.*

36. *Subpart X Portion of RCRA Part B Permit Application for OB/OD area, 21 May 1993.*

37. *RCRA Guidance Manual for Permitting Commercial Explosives Industry Open Burning/Open Detonation Units*, Institute of Makers of Explosives, 1989.

38. Communication with Kansas City Corps of Engineers and former Fort Riley EOD Employee, 25 January 1994.

39. United States Environmental Protection Agency, 1986.

40. *Bulletin 89 - The Kansas Rock Column,* by R. C. Moore, et.al., University of Kansas Publications, 1951.

41. Test results for Wash Rack Reservoir, by KDHE. On file at Fort Riley DEH.

42. USA Corps Environmental Research Lab, Trip Report for the Continuing Investigation of the Existing Industrial Wastewater System Located at Custer Hill, Fort Riley, Kansas, 17 May - 13 August 1993.

43. Communication with Fort Riley DEH, regarding the Industrial Wastewater System at Custer Hill, 8 February 1994.

44. Annual Resource Conservation and Recovery Act Inspections, Fort Riley, Kansas, 1985-1993.

45. Analytical Testing of the East Pond, West Pond, and Wastes and Sumps at Building 8100, on file at Fort Riley DEH.

46. Annual Records of POL Spills, on file at Fort Riley DEH.

47. Fort Riley Fact Sheet regarding Loss of Fuel from the POL Tank Farm, 23 March 1989.

48. Communication with Fort Riley DEH, regarding the Soil Removal at Former Building 1605, 3 February 1994.

8.0 EXCERPTS

This sections includes not easily available information from the following sections:

Section 4, Open Burn/Open Detonation Area:
  Fact Sheet: Depleted Uranium.
  Copy of Letter to NRC.

Section 5, Custer Hill Wastewater Ponds:
  KDHE Sludge Samples -- Wash Rack Reservoir.
  Information concerning POL spills that have affected East Pond.
  Selected chemical data sheets from Building 8100.

FACT SHEET: DEPLETED URANIUM
COPY OF LETTER TO NRC

Post Chemical
AFZN-PTM-C
[redacted]
16 Aug 93

FACT SHEET

SUBJECT: Depleted Uranium (DU) Incident Closeout

1. PURPOSE: To inform the Command Group regarding closeout of the Depleted Uranium Incident.

2. FACTS:

a. The AMCCOM Safety Office has published the final letter (9 Aug 93) to the Nuclear Regulatory Commission (NRC) relative to the Fort Riley incident (Enclosure 1). AMCCOM, as licensee, has directed that no further search for the DU penetrator, or pieces thereof, be done for reasons specified in their letter. AMCCOM stated that "the demolition range will remain open for use, but DU ammunition will not be destroyed there."

b. AMCCOM anticipates that the NRC will consider the incident closed, and unless the NRC breaks silence, AMCCOM considers the incident closed.

c. In anticipation of the above letter, the Fort Riley DEH notified the US EPA on 3 Aug 93 by letter of its intent to reopen Range 16 for demolition unless EPA objections were forthcoming (Enclosure 2). None were received by the Aug 6 cutoff. The range was reopened on Thurs 12 Aug 93 (Enclosure 3).

d. Per [redacted] of AMCCOM Safety Office, AMCCOM does not require further written report of the incident. Per [redacted], the FORSCOM Safety Office, therefore, does not either. Nonetheless detailed log and enclosures are on file at NBC Division.

e. The DEH letter of 3 Aug 93 stated that "investigations at the OB/OD (Range 16) will be augmented to include uranium as an analyte for laboratory analysis". It is recommended that with this exception, the incident be closed at Fort Riley as well.

____________________________ Additional Information Required.

Enclosures

CF:
CDR, 937 ENG GRP
CDR, 74TH EOD
DOL
DEH
DPTM

385-11F (2)

09 AUG 1993

AMSMC-SFS

Administrator
Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, Illinois, 60137

Dear Sir:

This is a final letter on an incident involving depleted uranium (U-238) at Fort Riley, which is an Army installation in Kansas.

This office manages license number SUC-1380 for the U.S. Army Armament Munitions and Chemical Command. This license is primarily for the storage, transportation, inspection, uploading, and minor maintenance of depleted uranium ammunition. The depleted uranium is in the form of a rod and is encased in an end item round of ammunition. This type of ammunition is fired from a weapon system, such as a tank, and upon impact penetrates and thus defeats enemy armored targets. The depleted uranium rod is commonly referred to as a penetrator.

In December 1990, a single round of depleted uranium tank ammunition was determined to be unfit for military use by a quality assurance specialist in ammunition surveillance and was destroyed by demolition on the 14th of that month at the Fort Riley, Kansas demolition range. The ammunition model number, of the round destroyed, is known as the M833 and contained 8 pounds of depleted uranium.

According to license SUC-1380 depleted uranium ammunition can be 'rendered-safe' (this a term for the action necessary to dispose of an explosive hazard with the least risk to personnel). The render-safe procedure is carried out by trained Explosive Ordnance Disposal personnel. The normal render-safe procedure for this round does not involve explosive destruction. Instead Fort Riley destroyed the M833 as it would other types of ammunition which is by demolition.

The demolition range at Fort Riley is approximately 4.5 kilometers from continuously occupied areas on, or off, post. The access road to the demolition range is restricted by a lockable metal cable. From this gate it is approximately 600 to 700 meters to the site where the M833 was destroyed. Only a small number of trained personnel are allowed on to the demolition range.

Although the actual fate of the penetrator is unknown it is assumed to have been broken into pieces during the demolition. No pieces of the penetrator have been found.

There are no known depleted uranium exposures to Government employees or the general public.

This incident was reported June 2, 1993, to this office by Fort Riley on secure phone. Due to a request for further information from this office Fort Riley also sent a secure fax on June 8, 1993. This office informed the Nuclear Regulatory Commission, Operations Center, of the incident on June 10, 1993, after determining that this incident was not classified. Nuclear Regulatory Commission Region III was notified on June 11, 1993.

This office, as licensee, has directed that no further search for the depleted uranium penetrator, or pieces thereof, be done because of the hazard of unexploded ammunition within the demolition range, the small amount of depleted uranium involved, and the low specific activity of depleted uranium.

The demolition range has been used since this incident occurred 2 1/2 years ago. The demolition range will remain open for use but depleted uranium ammunition is not to be destroyed there.

This office is in the process of sending out information to the depleted uranium ammunition community reminding them of proper disposal procedures.

The points of contact are [redacted], [redacted], AMSMC-SFS, commercial [redacted], or [redacted], AMSMC-SF, commercial [redacted].

SIGNED

[redacted]
Acting Chief, Safety Office

KDHE SLUDGE SAMPLES
WASH RACK RESERVOIR

RECEIVED
7 DEC 1992

PWI4

790

State of Kansas
Joan Finney, *Governor*

Department of Health and Environment
[redacted]
Robert C. Harder, Secretary

Reply to: 913-296-5569

Dear Sir:

Please find enclosed a copy of the analysis report representing your facilities' effluent for date shown on the report.

Sincerely,

[redacted]

[redacted]
Environmental Technician
Science and Standards Unit
Office of Science and Support

[redacted]

FORM.GD

Forbes Field • Building 740 • Topeka, Kansas 66620-0001 • (913) 296-1500

KANSAS HEALTH AND ENVIRONMENTAL LABORATORY
Department of Health and Environment
Inorganic Chemistry Laboratory
Bldg. 740, Forbes Field, Topeka, KS 66620-8420
(913) 296-1657

RESULTS OF LABORATORY ANALYSES

Report To:	[redacted], OSS [redacted]	Lab Number: 301148PT
Address:		Lab Acct Code: STP
		Env Acct Code: SE

Locality: FT. RILEY CENTRAL WASH FACILITY CM295055004 GRAB WEST

Collected By: OSS, [redacted] Time: 1030 Depth: ****

Site ID: Matrix: Water Date Collected: 11-17-92
Date Received: 11-17-92
Comments: ANNUAL COMPLIANCE MONITORING & TOXICITY Date Reported: 11-25-92

* *

Results Expressed In Milligrams/Liter

Total Hard.		pH (Units)	NA	Aluminum		0.
(CaCO3)	NA	Turbidity (NTU)	NA	Antimony	LT	0.01
Calcium	74.723	Spec. Conductance		Arsenic	LT	0.021
Magnesium	15.494	(micromhos/cm)	NA	Barium		0.198
Sodium	36.951	T. Dissolved Solids	NA	Beryllium	LT	0.001
Potassium	6.90	Total Phosphorus (P)	NA	Cadmium		0.009
		Silica (SiO2)	20.449	Chromium	LT	0.003
Total Alk.		Boron	0.427	Cobalt	LT	0.004
(CaCO3)	NA	Dissolved Oxygen	NA	Copper		0.020
Chloride	NA	BOD	NA	Iron		0.471
Sulfate	NA	COD	NA	Lead	LT	0.02
Nitrate (N)	NA	CBOD	NA	Manganese		0.342
Nitrite	NA	Ammonia (N)	NA	Mercury		NA
Fluoride	NA	T. Sus. Solids	NA	Molybdenum	LT	0.001
o-Phosphate	NA	Corrosivity (LI)	NA	Nickel	LT	0.007
Cyanide	NA	Kjeldahl Nitrogen	NA	Selenium	LT	0.03
Oil/Grease	5.6	Chromium (+6)	NA	Silver	LT	0.004
Phenols	NA	Tin	NA	Thallium	LT	0.015
TDP	NA	MBAS	NA	Vanadium		0.005
Sulfide	NA	Flash Pt (Celsius)	NA	Zinc		0.054

Total Coliform	NA
Fecal Coliform	NA
Fecal Strep	NA

Chemist: [redacted] NA - Not Analyzed LT - Less Than

* *

Copy To: File
[redacted] - BOW
NCDO

KANSAS HEALTH AND ENVIRONMENTAL LABORATORY
Department of Health and Environment
Inorganic Chemistry Laboratory
Bldg. 740, Forbes Field, Topeka, KS 66620-8420
(913) 296-1657

RESULTS OF LABORATORY ANALYSES

Report To: [redacted], OSS [redacted]
Address:

Lab Number: 301149PT
Lab Acct Code: STP
Env Acct Code: SE

Locality: FT. RILEY WASH FACILITY CM29505004 GRAB EAST

Collected By: OSS, [redacted]
Time: 1040
Depth: ****

Site ID:
Matrix: Water

Date Collected: 11-17-92
Date Received: 11-17-92
Date Reported: 11-25-92

Comments: ANNUAL COMPLIANCE MONITORING & TOXICITY

* *

Results Expressed In Milligrams/Liter

al Hard.		pH (Units)	NA	Aluminum		0.24
(CaCO3)	NA	Turbidity (NTU)	NA	Antimony	LT	0.01
Calcium	70.633	Spec. Conductance		Arsenic	LT	0.021
Magnesium	12.893	(micromhos/cm)	NA	Barium		0.142
Sodium	61.730	T. Dissolved Solids	NA	Beryllium	LT	0.001
Potassium	6.59	Total Phosphorus (P)	NA	Cadmium		0.005
		Silica (SiO2)	15.679	Chromium	LT	0.003
Total Alk.		Boron	1.424	Cobalt	LT	0.004
(CaCO3)	NA	Dissolved Oxygen	NA	Copper		0.012
Chloride	NA	BOD	NA	Iron		0.293
Sulfate	NA	COD	NA	Lead	LT	0.02
Nitrate (N)	NA	CBOD	NA	Manganese		0.325
Nitrite	NA	Ammonia (N)	NA	Mercury		NA
Fluoride	NA	T. Sus. Solids	NA	Molybdenum	LT	0.001
o-Phosphate	NA	Corrosivity (LI)	NA	Nickel	LT	0.007
Cyanide	NA	Kjeldahl Nitrogen	NA	Selenium	LT	0.03
Oil/Grease	2.1	Chromium (+6)	NA	Silver	LT	0.004
Phenols	NA	Tin	NA	Thallium	LT	0.015
TDP	NA	MBAS	NA	Vanadium		0.005
Sulfide	NA	Flash Pt (Celsius)	NA	Zinc		0.047
Total Coliform	NA					
Fecal Coliform	NA					
Fecal Strep	NA					

Chemist: [redacted]

NA - Not Analyzed

LT - Less Than

* *

Copy To: File
[redacted] - BOW
NCDO

WWT1

KANSAS HEALTH AND ENVIRONMENTAL LABORATORY
Department of Health and Environment
Inorganic Chemistry Laboratory
Bldg. 740, Forbes Field, Topeka, KS 66620-8420
(913) 296-1657

791

RESULTS OF LABORATORY ANALYSES

Report To: [redacted]-BEQ ✓
Address:

Lab Number: 201020PT
Lab Acct Code: STP
Env Acct Code: SE

Locality: FORT RIELY WASH FACILITY CM29505 SOUTH GRAB

Collected By: [redacted]

Time: 1010

Depth: ****

Site ID:

Matrix: Water

Date Collected: 11- 5-91
Date Received: 11- 5-91
Date Reported: 11-14-91

Comments: ANNUAL COMPLIANCE MONITORING
BOD HOLDING TIME EXCEEDED

* *

Results Expressed In Milligrams/Liter

Total Hard. (CaCO3)	NA	pH (Units)	NA	Aluminum		0.30
Calcium	59.477	Turbidity (NTU)	NA	Antimony	LT	0.01
Magnesium	12.607	Spec. Conductance (micromhos/cm)	NA	Arsenic	LT	0.021
Sodium	46.611	T. Dissolved Solids	NA	Barium		0.153
Potassium	9.16	Total Phosphorus (P)	NA	Beryllium	LT	0.0
		Silica (SiO2)	15.466	Cadmium		0.0
Total Alk. (CaCO3)	NA	Boron	0.976	Chromium		0.007
Chloride	NA	Dissolved Oxygen	NA	Cobalt		0.005
Sulfate	NA	BOD	112.5 ✓	Copper		0.033
Nitrate (N)	NA	COD	NA	Iron		0.393
Nitrite	NA	CBOD	NA	Lead		0.078
Fluoride	NA	Ammonia (N)	NA	Manganese		0.290
		T. Sus. Solids	NA	Mercury	LT	0.0005
Cyanide	NA	Corrosivity (LI)	NA	Molybdenum		0.004
Oil/Grease	7.9 ✓	Kjeldahl Nitrogen	NA	Nickel		0.007
Phenols	NA	Chromium (+6)	NA	Selenium	LT	0.03
TDP	NA	Tin	NA	Silver	LT	0.004
Sulfide	NA	MBAS	NA	Thallium	LT	0.015
		Flash Pt (Celsius)	NA	Vanadium		0.004
Total Coliform	NA			Zinc		0.134
Fecal Coliform	NA					
Fecal Strep	NA					

Chemist: [redacted]

NA - Not Analyzed

LT - Less Than

* *

Copy To: File
[redacted]-BOW
NCDO-SALINA

A1

KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT
Kansas Health & Environmental Laboratory
Organic Chemistry Laboratory
Topeka, Kansas 66620

GC/MS ANALYSIS REPORT

Report To: [redacted]-BEQ
Address: FORBES BLDG. 740, TOPEKA, KS. 66620

Lab Number: 20235900
Report Date: 11- 6-91

SAMPLE COLLECTION INFORMATION

Site ID No.:
Program Code: SE
Sample Type: WATER
Collection Site: FORT RILEY CENTRAL WASH FAC. CM29505 SOUTH GRAB
Collected By: [redacted]
Date: 11- 5-91
Time: 1010

RESULTS OF ANALYSIS

PURGABLE ORGANICS	Concentration (UG/L)	Reporting Limit (UG/L)
CHLOROMETHANE	NOT DETECTED	5.0
BROMOMETHANE	NOT DETECTED	1.2
VINYL CHLORIDE	NOT DETECTED	0.8
CHLOROETHANE	NOT DETECTED	3.7
DICHLOROMETHANE	7.9	0.9
1,1-DICHLOROETHYLENE	NOT DETECTED	0.6
1,1-DICHLOROETHANE	NOT DETECTED	0.5
TRANS &/OR CIS 1,2-DICHLOROETHYLENE	NOT DETECTED	0.5
TRICHLOROMETHANE (THM)	NOT DETECTED	0.5
1,2-DICHLOROETHANE	NOT DETECTED	0.6
1,1,1-TRICHLOROETHANE	NOT DETECTED	0.7
TETRACHLOROMETHANE	NOT DETECTED	0.7
BROMODICHLOROMETHANE (THM)	NOT DETECTED	0.5
1,2-DICHLOROPROPANE	NOT DETECTED	0.5
TRANS 1,3-DICHLOROPROPENE	NOT DETECTED	0.8
TRICHLOROETHYLENE	NOT DETECTED	0.6
BENZENE	NOT DETECTED	0.5
DIBROMOCHLOROMETHANE (THM)	NOT DETECTED	0.7
CIS 1,3-DICHLOROPROPENE	NOT DETECTED	0.9
1,1,2-TRICHLOROETHANE	NOT DETECTED	0.6
BROMOFORM (THM)	NOT DETECTED	1.5
1,1,2,2-TETRACHLOROETHANE	NOT DETECTED	0.6
TETRACHLOROETHYLENE	NOT DETECTED	1.1
TOLUENE	3.7	0.5
CHLOROBENZENE	NOT DETECTED	0.5
ETHYLBENZENE	1.0	0.7
META-XYLENE	2.7	0.6
ORTHO &/OR PARA-XYLENE	4.2	0.6
1,3-DICHLOROBENZENE	NOT DETECTED	1.0
1,2-DICHLOROBENZENE	NOT DETECTED	1.0
1,4-DICHLOROBENZENE	NOT DETECTED	1.0

Comment: THIOBISMETHANE, DIMETHYL DISULFIDE, AND SEVERAL PETROLEUM TYPE HYDROCARBONS WERE INDICATED.

Analyst: [redacted]

[redacted], Directo

Copy To: [redacted]-BOW
NCD-SALINA

A:

KANSAS HEALTH AND ENVIRONMENTAL LABORATORY
Department of Health and Environment
Inorganic Chemistry Laboratory
Bldg. 740, Forbes Field, Topeka, KS 66620-8420
(913) 296-1657

RESULTS OF LABORATORY ANALYSES

Report To: [redacted]-BEQ
Address:

Lab Number: 201019PT
Lab Acct Code: STP
Env Acct Code: SE

Locality: FORT RIELY CENTRAL WASH FACILITY CM29505 NORTH GRAB

Collected By: [redacted]

Time: 1030

Depth: ****

Site ID:

Matrix: Water

Date Collected: 11- 5-91
Date Received: 11- 5-91
Date Reported: 11-14-91

Comments: ANNUAL COMPLIANCE MONITORING
BOD HOLDING TIME EXCEEDED

* *

Results Expressed In Milligrams/Liter

Total Hard. (CaCO3)	NA
Calcium	45.535
Magnesium	7.086
Sodium	16.902
Potassium	5.94
Total Alk. (CaCO3)	NA
Chloride	NA
Sulfate	NA
Nitrate (N)	NA
Nitrite	NA
Fluoride	NA
Cyanide	NA
Oil/Grease	5.7
Phenols	NA
TDP	NA
Sulfide	NA
Total Coliform	NA
Fecal Coliform	NA
Fecal Strep	NA

pH (Units)	NA
Turbidity (NTU)	NA
Spec. Conductance (micromhos/cm)	NA
T. Dissolved Solids	NA
Total Phosphorus (P)	NA
Silica (SiO2)	8.867
Boron	0.942
Dissolved Oxygen	NA
BOD	175.5
COD	NA
CBOD	NA
Ammonia (N)	NA
T. Sus. Solids	NA
Corrosivity (LI)	NA
Kjeldahl Nitrogen	NA
Chromium (+6)	NA
Tin	NA
MBAS	NA
Flash Pt (Celsius)	NA

Aluminum		0.22
Antimony	LT	0.01
Arsenic	LT	0.021
Barium		0.092
Beryllium	LT	0.[illegible]
Cadmium		0.[illegible]
Chromium		0.004
Cobalt		0.005
Copper		0.025
Iron		0.792
Lead	LT	0.02
Manganese		0.185
Mercury	LT	0.0005
Molybdenum		0.003
Nickel	LT	0.007
Selenium	LT	0.03
Silver	LT	0.004
Thallium		0.027
Vanadium		0.004
Zinc		0.185

Chemist: [redacted]

NA - Not Analyzed

LT - Less Than

* *

Copy To: File
[redacted]-BOW
NCDO-SALINA

A3

KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT
Kansas Health & Environmental Laboratory
Organic Chemistry Laboratory
Topeka, Kansas 66620

GC/MS ANALYSIS REPORT

Report To: [redacted]-BEQ
Address: FORBES BLDG. 740, TOPEKA, KS. 66620

Lab Number: 2023600C
Report Date: 11- 6-91

SAMPLE COLLECTION INFORMATION

Site ID No.:
Program Code: SE
Sample Type: WATER
Collection Site: FORT RILEY CENTRAL WASH FAC. CM29505 'NORTH GRAB'
Collected By: [redacted]
Date: 11- 5-91
Time: 1030

RESULTS OF ANALYSIS

PURGABLE ORGANICS	Concentration (UG/L)	Reporting Limit (UG/L)
CHLOROMETHANE	NOT DETECTED	5.0
BROMOMETHANE	NOT DETECTED	1.2
VINYL CHLORIDE	NOT DETECTED	0.8
CHLOROETHANE	NOT DETECTED	3.7
DICHLOROMETHANE	NOT DETECTED	0.9
1,1-DICHLOROETHYLENE	NOT DETECTED	0.6
1,1-DICHLOROETHANE	NOT DETECTED	0.5
TRANS &/OR CIS 1,2-DICHLOROETHYLENE	NOT DETECTED	0.5
TRICHLOROMETHANE (THM)	NOT DETECTED	0.5
1,2-DICHLOROETHANE	NOT DETECTED	0.6
1,1,1-TRICHLOROETHANE	NOT DETECTED	0.7
TETRACHLOROMETHANE	NOT DETECTED	0.7
BROMODICHLOROMETHANE (THM)	NOT DETECTED	0.5
1,2-DICHLOROPROPANE	NOT DETECTED	0.5
TRANS 1,3-DICHLOROPROPENE	NOT DETECTED	0.8
TRICHLOROETHYLENE	NOT DETECTED	0.6
BENZENE	1.0	0.5
DIBROMOCHLOROMETHANE (THM)	NOT DETECTED	0.7
CIS 1,3-DICHLOROPROPENE	NOT DETECTED	0.9
1,1,2-TRICHLOROETHANE	NOT DETECTED	0.6
BROMOFORM (THM)	NOT DETECTED	1.5
1,1,2,2-TETRACHLOROETHANE	NOT DETECTED	0.6
TETRACHLOROETHYLENE	NOT DETECTED	1.1
TOLUENE	7.1	0.5
CHLOROBENZENE	NOT DETECTED	0.5
ETHYLBENZENE	1.9	0.7
META-XYLENE	4.1	0.6
ORTHO &/OR PARA-XYLENE	5.2	0.6
1,3-DICHLOROBENZENE	NOT DETECTED	1.0
1,2-DICHLOROBENZENE	NOT DETECTED	1.0
1,4-DICHLOROBENZENE	NOT DETECTED	1.0

Analyst: [redacted]

[redacted], Directo:

Copy To: [redacted]-BOW
NCD-SALINA

AL

WWTP

KANSAS HEALTH AND ENVIRONMENTAL LABORATORY
Department of Health and Environment
Biochemical Analysis Laboratory
Bldg. 740, Forbes Field, Topeka, KS 66620-8420
(913) 296-1657

RESULTS OF LABORATORY ANALYSES

Lab Number: 101418PT
Lab Acct Code: STP
Env Acct Code: SE

Report To: [redacted]--BEQ
Address:

(actually West Pond)

Locality: FT RILEY CENT WASH FAC EFFLUENT CM29505004 GRAB

Collected By: [redacted] Time: 1030 Depth: ****

Site ID: Matrix: Water

Date Collected: 11-27-90
Date Received: 11-27-90
Date Reported: 12- 4-90

Comments: ANNUAL COMPLIANCE MONITORING

* *

Results Expressed In Milligrams/Liter

Total Hard. (CaCO3)	NA	pH (Units) Field	6.8 ~~NA~~	Aluminum		1.23
Calcium	72.343	Turbidity (NTU)	NA	Antimony	LT	0.03
Magnesium	13.230	Spec. Conductance (micromhos/cm)	NA	Arsenic	LT	0.01
Sodium	30.977	T. Dissolved Solids	NA	Barium		0.170
Potassium	8.26	Total Phosphorus (P)	NA	Beryllium	LT	0.003
		Silica (SiO2)	21.045	Cadmium		0.010
Total Alk. (CaCO3)	NA	Boron	1.484	Chromium	LT	0.0
Chloride	NA	Dissolved Oxygen	NA	Cobalt	LT	0.004
Sulfate	NA	BOD	NA	Copper		0.022
Nitrate (N)	NA	COD	419	Iron		1.296
Nitrite	NA	CBOD	NA	Lead		0.013
Fluoride	NA	Ammonia (N)	NA	Manganese		0.535
		T. Sus. Solids	NA	Mercury	LT	0.0005
		Corrosivity (LI)	NA	Molybdenum		0.020
Cyanide	NA	Kjeldahl Nitrogen	NA	Nickel		0.020
Oil/Grease	11.2	Chromium (+6)	NA	Selenium	LT	0.001
Phenols	NA	Tin	NA	Silver	LT	0.005
TDS	NA	MBAS	NA	Thallium	LT	0.02
Sulfide	NA	Flash Pt (Celsius)	NA	Vanadium	LT	0.01
				Zinc		0.122
Total Coliform	NA					
Fecal Coliform	NA					
Fecal Strep	NA					

Chemist: [redacted] NA - Not Analyzed LT - Less Than

* *

Copy To: File
BOW-TECH
NCD

KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT
Kansas Health & Environmental Laboratory
Organic Chemistry Laboratory
Topeka, Kansas 66620

GC/MS ANALYSIS REPORT

Report To: [redacted]-BEQ
Address: FORBES BLDG. 740, TOPEKA, KS. 66620

Lab Number: 1013100C
Report Date: 12- 5-90

SAMPLE COLLECTION INFORMATION

Site ID No.:
Program Code: SE
Sample Type: WATER
Collection Site: FT. RILEY CENT. WASH FAC. (EFFLUENT) CM29505004
Collected By: KDHE [redacted]
Date: 11-27-90
Time: 1030

RESULTS OF ANALYSIS

PURGABLE ORGANICS	Concentration (UG/L)	Detection Limit (UG/L)
CHLOROMETHANE	NOT DETECTED	5.0
BROMOMETHANE	NOT DETECTED	1.2
VINYL CHLORIDE	NOT DETECTED	0.8
CHLOROETHANE	NOT DETECTED	3.7
DICHLOROMETHANE	NOT DETECTED	0.9
1,1-DICHLOROETHYLENE	NOT DETECTED	0.6
1,1-DICHLOROETHANE	NOT DETECTED	0.5
TRANS &/OR CIS 1,2-DICHLOROETHYLENE	NOT DETECTED	0.5
TRICHLOROMETHANE (THM)	0.7	0.5
1,2-DICHLOROETHANE	NOT DETECTED	0.6
1,1,1-TRICHLOROETHANE	3.3	0.7
TETRACHLOROMETHANE	NOT DETECTED	0.7
BROMODICHLOROMETHANE (THM)	NOT DETECTED	0.5
1,2-DICHLOROPROPANE	NOT DETECTED	0.5
TRANS 1,3-DICHLOROPROPENE	NOT DETECTED	0.8
TRICHLOROETHYLENE	NOT DETECTED	0.6
BENZENE	20.9	0.5
DIBROMOCHLOROMETHANE (THM)	NOT DETECTED	0.7
CIS 1,3-DICHLOROPROPENE	NOT DETECTED	0.9
1,1,2-TRICHLOROETHANE	NOT DETECTED	0.6
BROMOFORM (THM)	NOT DETECTED	1.5
1,1,2,2-TETRACHLOROETHANE	NOT DETECTED	0.6
TETRACHLOROETHYLENE	NOT DETECTED	1.1
TOLUENE	114	0.5
CHLOROBENZENE	NOT DETECTED	0.5
ETHYLBENZENE	24.1	0.7
META-XYLENE	69.8	0.6
ORTHO &/OR PARA-XYLENE	68.8	0.6
1,3-DICHLOROBENZENE	NOT DETECTED	1.0
1,2-DICHLOROBENZENE	NOT DETECTED	1.0
1,4-DICHLOROBENZENE	NOT DETECTED	1.0

Comment: THIS SAMPLE FOAMED. MANY PETROLEUM TYPE HYDROCARBONS WERE INDICATED. SEVERAL UNIDENTIFIED HYDROCARBONS WERE PRESENT.

Analyst: [redacted]

[redacted], Directo

Copy To: [redacted]-BOW
NCD-SALINA

B2

1993 POL SPILL

ROUTING AND TRANSMITTAL SLIP

Date 1430 28-JAN-93

TO: *(Name, office symbol, room number, building, Agency/Post)*	Initials	Date
1. [redacted]		
2.		
3.		
4.		
5.		

☐	Action	☐	File	☐	Note and Return
☐	Approval	☐	For Clearance	☐	Per Conversation
☐	As Requested	☐	For Correction	☐	Prepare Reply
☐	Circulate	☐	For Your Information	☐	See Me
☐	Comment	☐	Investigate	☐	Signature
☐	Coordination	☐	Justify	☐	

REMARKS

2nd Manhole from P.O.L. Tank Farm has oil/diesel coming from it, need [redacted]'s Peaple to dig contaminated soil,

The Pipe system might be blocked causing back-up

DO NOT use this form as a RECORD of approvals, concurrences, disposals, clearances, and similar actions

FROM: *(Name, org. symbol, Agency/Post)*	Room No.—Bldg.
[redacted]	Phone No.

5041-102
GPO : 1990 0 - 276-978

OPTIONAL FORM 41 (Rev. 7-76)
Prescribed by GSA
FPMR (41 CFR) 101-11.206

29 JAN 93

W.O. #

0745 29 Jan 93

- W.O. to clear partial blockage -07609

- " " cleanup soil -07611

- remove soil to CD landfill

Date

ROUTING AND TRANSMITTAL SLIP

TO: *(Name, office symbol, room number, building, Agency/Post)*	Initials	Date
1. File (Spills)		
2.		
3.		
4.		
5.		

	Action		File		Note and Return
	Approval		For Clearance		Per Conversation
	As Requested		For Correction		Prepare Reply
	Circulate		For Your Information		See Me
	Comment		Investigate		Signature
	Coordination		Justify		

REMARKS

8-9 Sept 93 Fuel Farm
Spill Information

DO NOT use this form as a RECORD of approvals, concurrences, disposals, clearances, and similar actions

FROM: *(Name, org. symbol, Agency/Post)*	Room No.—Bldg.
	Phone No.

5041-102

GPO : 1990 0 - 276-978

OPTIONAL FORM 41 (Rev. 7-76)
Prescribed by GSA
FPMR (41 CFR) 101-11.206

APPENDIX K

AFZN-DE-VE 200-1a HW W

HAZARDOUS MATERIAL SPILL REPORT

DATE: 8 Sept 93 TIME: 10:30 am

SUBSTANCE: Mogas

QUANTITY: ~ 6,000 gals

LOCATION: Consolidated POL Facility Bldg 8311

UNIT/ACTIVITY: 701 st

POC: [redacted] [redacted] (NCOIC) [redacted] (Cdr)

PHONE: 9-9551

CAUSE: Malfunction caused fuel to collect in the waste fuel sump. Sump pump ~~failed~~ on manual. Fuel then overflowed through a clean out pipe.

CLEAN UP ACTIONS: Dammed stream, placed booms & pads in stream to absorb floating fuel. Presently excavating contaminated soil, gravel + sand to the CD landfill.

DISPOSAL COMPLETION DATE:

COMMENTS: Could not get adequate support to excavate contaminated soil.
Initially Fire Dept contained the spill with earthen dams.

[redacted] - KDHE on-scene 9 Sept 93

ENVIRONMENTAL STAFF MEMBER RECORDING THIS REPORT: [redacted]

SIGN[redacted] DATE: 10 Sept 93

DEPARTMENT OF THE ARMY
REPORT OF SURVEY
For use of this form, see AR 735-11; the proponent agency is DCSLOG.

1. DATE PREPARED
16 SEP 93

2. SURVEY NUMBER
93-120

3. TYPE OF PROPERTY
Expendable

4. ADDRESS OF ACCOUNTABLE OFFICER
UIC:WAHHAA
DMMC, 1st Infantry Division (Mech) Ft Riley, Kansas 66442

5. ORIGINATOR *(Accountable officer, or primary hand receipt holder)*
[redacted] ACCOUNTABLE OFFICER, DMMC 1ST INFANTRY DIVISION (M)

6. NATIONAL STOCK NUMBER	7. ITEM DESCRIPTION	8. QTY	9. UNIT PRICE	10. TOTAL COST
9130-00-148-7103	Gasoline, Automotive	9740 gal	$.83	$8,084.20

11. DATE AND CIRCUMSTANCES

At 081110SEP93, [redacted] was notified by [redacted], [redacted], that there was a fuel leak at the Consolidated Bulk Petroleum Facility (Tank Far Upon my arrival at the tank farm, the ground surrounding a drain between BLDG 8311 and BLDG 8312 was discolored indicating dampness. A strong fuel odor was evident and a liquid was flowing at the corner of the concrete slab encompassing the drain. [redacted], [redacted], commander of A Co, 701 MSB, and his facility NCOIC, [redacted], [redacted], were already at the tank farm. The fuel odor indicated that it was primarily MOGAS and therefore, would have been escaping from Tank 201B. [redacted] had instructed [redacted], to walk the line and [redacted] reported all valves were closed. This was verified by [redacted]. DEH and EPA personnel were on the premises who, along with myself and [redacted], attempted to determine the cause of the fuel loss. [redacted] had found that the pump at the sump tank had been in the automatic mode and had not started when the fluid level in the tank rose. [redacted] placed the pump in the manual mode and was able to lower the fluid level in the sump by pumping the fluid into the water separator and the into the slop tank, thereby halting the flow of fuel into the environment at the drain near BLDG 8311. The A Co, 701 MSB, personnel continually gauged the tank (201B). Accounting records indicated that a total of 9537 gallons of MOGAS had been lost from 201B. That tank wa drained into 5K tankers belonging to A Co, 701 MSB, and the engineers from DEH initiated a search into the cause of the loss. Statements (Exhibits A-G) are attached.

12. AFFIDAVIT
I do solemnly swear *(or affirm)* that *(to the best of my knowledge and belief)* the articles of public property shown above and/or on attached sheets were lost, destroyed, damaged, or worn out in the manner stated, while in the public service.

SIGNATURE AND DATE
[redacted]

TYPED NAME, GRADE, AND SSN
[redacted]

13. Subscribed and sworn to *(or affirmed)* before me at
this day of

NAME AND GRADE *(type and sign)*

14. DATE
16 Sep 93

15. NAME, GRADE, AND SIGNATURE OF AC [redacted]

16. DOCUMENT NUMBER
W5SVZL 3259-3100

17. APPOINTING AUTHORITY

I have received the evidence pertaining to the lost, damaged, or destroyed property, and have determined that the following action is required.

a. ☒ No further investigation is required. There is no positive evidence of negligence. I do not suspect willful misconduct, or deliberate unauthorized use. I hereby forward this document to the approving authority for final action. *(Proceed to block 37.)*

b. ☐ The circumstances surrounding the lost, damaged or destruction warrants further investigation. *(Proceed to block 21.)*

c. ☐ Conduct an investigation according to AR 15-6. Attach this document, as an exhibit, to the investigation and forward it to the approving authority.

18. DATE
27 Sep 93

19. TYPED NAME, GRADE, AND TITLE OF APPOINTING AUTHORITY
[redacted] (M)

20. SIGNATURE
[redacted]

DA FORM 4697 SEP 81

DA FORM 4696(TEST), 1 JUL 78 and DA FORM 4697(TEST), 1 JUL 78 ARE OBSOLETE.

No Customers That day. ON 8 Sept 93 I
~~AT about 10:00~~ had Duty So [redacted]
[redacted] was in charge. While I was
on Duty I called The Tank farm looking
For Big spray. This was about 10:00. SPC
[redacted] answered The phone, because
~~SPC~~ SPC [redacted] was not There yet [redacted] was
Taking a P.T. Test. AT That Time [redacted]
Told me There was a fuel Spill. I called
The first Sergeant and Told him I needed
To go The Tank farm, could he Send me Some
~~Releif~~ Relieve. AT about 1040 SPC
[redacted] called me at The Guard Shack and
Told me The fire department was on site.
I was relived at 10:50 ~~f~~ from my post.
I came straight down to The Tank Farm.
when I got on site I went and Checked
The ~~s~~ Sump. There was no over flow. page Two
There. So I looked for The Spill. I found
IT up by The Building. AT That point
We proceded To put Down absorbent
material To Soak up The fuel. AT about
11:30 we started gaging Tank 201B to See
if we were still losing fuel. We did This every
20 minuets. AFTer The first Twenty minuets
we lost an 1/8 of an inch, we went from 6'6 1/8 To
6'6. We did not lose any more after That
according to our gages. About 1400 we started
issuing fuel out of 201B into Fuel Tankers.
We Drained ~~The~~ the Fuel Down to 4".

[redacted]

Nothing Follows

PAGE 1 OF 2

STaTement

[redacted] [redacted] 8 Sept 93
1526

0930 7 Sept 93

We recc ed 16,807 gallons of mogas. we know This because at about 1330 SPC [redacted] went up an Took an all level sample from The mogas Tanker 261B. At 1630 SPC [redacted] ~~locked up The~~ AW went out and closed all valves and locked up as usual. We had no customers That day. On 8 Sept 93 I ~~At about 10:00~~ AW had Duty so SPC [redacted] was in charge. while I was on Duty I called The Tank farm looking for Bug spray. This was about 10:00. SPC [redacted] answered The phone, because SPC [redacted] was not There yet she was Taking a P.T. Test. AT That Time she Told me There was a fuel Spill, I called The first Sergeant and Told him I needed To go The Tank farm, could he send me some ~~Relief~~ [redacted] Relieve. AT about 1040 SFC [redacted] called me at The Guard Shack and Told me The fire department was on site. I was relived at 10:50 ~~f~~rom my post. I came straight Down to The Tank Farm. when I got on site I went and Checked The ~~s~~ Sump. There was no over flow, page Two → There. so I looked for The Spill. I found it up by The Building. AT That point

[redacted]

[redacted]

BuT iT was up pretty High. Every Time we Turned iT on To pump iT OUT The fuel ShoT up where The Spill was. So AfTer a ~~while~~ And While Ace The Guy from Envorinmental Told us to leave The pump on. a4 We pumped about 5'll inches inTo The Slop Tank, To Bring iT To 6'l. None of The Fuel ThaT was spilled wenT into The slop Tank, Till we pumped iT There. Back to page one

[redacted]

Nothing Follows

-----------------------------STATEMENT-----------------------

At 081110SEP93, [redacted] took a telephonic message from [redacted], Class III NCOIC, stating that there was a fuel leak at the tank farm. At 081115SEP93, I returned to the General Supply Office, DMMC, from the 701 MSB S-3 shop. The telephone was ringing and I answered it to find [redacted] calling to see if I had received the message about the leak. I told him that I had just come into the office and would be leaving for the tank farm immediately. I then called [redacted], DISCOM XO, to inform him of the leak and that I would provide details as soon as I had them. Upon my arrival at the tank farm, I found several soldiers from 701 MSB and DMMC working to contain the spill. The fire department personnel were on hand, as were representatives from EPA and DEH. [redacted], A Co 701 MSB, was on hand and the tank in question had been gauged to determine that nearly 9400 gallons of MOGAS had been lost from the end of day balance of 7 Sep 93. I then went to the DISCOM headquarters to update [redacted] and at the same time briefed [redacted].

---------------------------END OF STATEMENT-----------------

[redacted]

CPT, QM
Class III Accountable Officer

Exhibit G

[redacted]

Run # 1692
FY 93-49

On September 8, 1993 at 1057 hrs., Fire Dept. Inspector [redacted] radioed the dispatcher and reported a fuel spill at bldg. 8311. Engine 2, Rescue 1 and the Haz Mat Van were dispatched to the scene.

At 1106 E-2, R-1 and Haz Mat arrived on the scene and [redacted] took over as Incident Commander. Gasoline was found coming up out of the ground between bldg. 8311 and 8312 and running down the hill side towards a small creek south west of bldg 8311. Fire Department personnel immediately checked for fuel downstream and fuel was found floating on the top of the water. Since the fuel was a petroleum product, Firefighters were directed to put down hydrocarbon booms a short distance down stream from where the fuel was entering the creek and then survey further down stream to try and determine how far the fuel had gone.

At 1112 [redacted] requested that Engine 1 respond, stop by Headquarters and pick up some pipe for underflow dams and to have one of their men take Chief 1 to get the Haz Mat trailer and bring it to the scene. At this time [redacted] also requested that Environmental be contacted and asked if they could send someone. They said they would send someone right away.

The Fire Department personnel placed three small hydrocarbon socks 300 yrds. downstream where there was a small amount of fuel floating down the creek. Approximately 100 yrds. further down, the creek made a sharp turn and at this point, there was no sign of fuel on the water. A large 20 ft. hydrocarbon boom was put down in this area.

[redacted] requested that underflow dams be constructed so that the fuel could be stopped from flowing on down the creek and also so it could be pooled in areas for recovery. The first dam was constructed about 50 yrds downstream from where the fuel was entering the creek. The second dam was started about 700 yards downstream. This area was picked since no fuel had reached this area yet and also because the area upstream was so heavily covered with brush it made it almost impossible to work.

Because of the large amount of dirt that needed to be moved to build the dams and the rough terrain, [redacted] requested a back hoe from DEH. It arrived at around 1230 hrs. By 1145 hrs, the first two underflow dams had been constructed well enough to start pooling the water. When the backhoe arrived, he built up the second dam and then constructed a third underflow dam about 100 ft. downstream from the second. Hydrocarbon booms and hydrocarbon pads were placed about 10 ft. upstream from the second and third dams to help absorb any of the fuel pooling at the dam sites.

1989 POL SPILL

POL TANK FARM Spill

FACT SHEET

30 march Sent copy to [redacted] requesting he send me copies of other's statements.

~~23~~ MARCH 1989
30

SUBJECT: LOSS OF FUEL FROM POL TANK FARM

1. TO PROVIDE INFORMATION PERTAINING TO THE CAUSE OR CAUSES OF LOSS OF DIESEL FUEL AND MOGAS INTO THE SEWAGE/DRAINAGE SYSTEM.

2. FACTS:

a. ON MARCH 19, 1989 AT APPROXIMATELY 0800, FUEL WAS NOTICED LEAKING FROM MANHOLE COVERS IN THE VICINITY OF THE TANK FARM BY [redacted] AND [redacted].

b. I WAS CALLED BY THE FIRE DEPT AT APPROXIMATELY 0845/0900.

c. UPON DISCOVERING THE OVERFLOW, THE UPPER SUMP WAS CHECKED, FOUND TO BE FULL, AND WAS DRAINED.

d. 701st FACILITY OPERATORS ADVISED THAT A MOGAS VALVE WAS DISCOVERED OPEN (WHICH ALLOWED FUEL INTO THE SLOP FUEL SYSTEM) APPROXIMATELY ONE WEEK PRIOR TO THE REPORTED SPILL.

e. A CAUSE OF THE REPORTED LEAK WAS DISCOVERED ON MONDAY, THE DAY AFTER THE SPILLAGE WAS REPORTED. A VALVE WAS DISCOVERED OPEN ON THE PRESSURE RELIEF SYSTEM ON THE PUMP WHICH ALLOWED FUEL TO LEAK INTO THE SLOP FUEL SYSTEM. THE SELF ACTUATED PUMP ON THE UPPER SUMP TANK DID NOT ACTIVATE, ALLOWING THE FUEL TO FILL THE SUMP TANK AND OVERFLOW INTO THE INDUSTRIAL WASHWATER SYSTEM. THIS MAY HAVE BEEN DUE TO ONE OF TWO CAUSES: EITHER THE CONTROLS FAILED TO ACTIVATE THE PUMP OR THE MANUAL SELECTOR SWITCH FOR THE PUMP WAS NOT IN THE AUTOMATIC OPERATION MODE.

f. ON THE DAY SPILL WAS DISCOVERED, APPROXIMATELY 3000 GALLONS OF MOGAS/DIESEL FUEL WERE RECOVERED FROM TWO MANHOLES. LATER, ABOUT 1000 GALLONS OF ADDITIONAL FUEL WAS PUMPED FROM THE MANHOLE SYSTEM AND SEVERAL TANKERS OF WATER/FUEL MIXTURE WAS PUMPED FROM A BOOMED AREA OF A NEW SEDIMENTATION POND IN THE INDUSTRIAL WASH WATER SYSTEM.

g. DMMC STATED THAT APPROXIMATELY 7764 GALLONS OF MOGAS AND APPROXIMATELY 30,000 PLUS GALLONS OF DIESEL HAD BEEN LOST SINCE THE FACILITY WAS OPENED.

h. ACCORDING TO 701st OPERATORS, DEH DID WORK ON THE PUMP SYSTEM EITHER THE THURSDAY OR FRIDAY BEFORE THE SPILL OCCURRED.

i. DEH DOES HAVE A CURRENT SOP OR SPILL PLAN FOR HANDLING EMERGENCY SPILLS. HOWEVER, THE LATEST FINALIZED SPILL PLAN DATED 20 APRIL 1979, IS CURRENTLY BEING UPDATED AND WILL BE USED WHEN REVISION IS COMPLETE.

I, [redacted], HEREBY SWEAR OR AFFIRM THAT THE ABOVE STATEMENTS WERE MADE BY ME AND ARE TRUE AND CORRECT TO THE BEST OF MY RECOLLECTION.

[redacted]

[redacted]
DIRECTORATE of ENGINEERING and HOUSING

* Check w/ COE

Diesel - ½ of 1% loss is acceptable
Mogas - 1% " " "

ROUTING AND TRANSMITTAL SLIP

Date 23 Mar

TO: (Name, office symbol, room number, building, Agency/Post)	Initials	Date
1. [redacted]		
2.		
3.		
4.		
5.		

☐	Action	☐	File	☐	Note and Return
☐	Approval	☐	For Clearance	☐	Per Conversation
☐	As Requested	☐	For Correction	☐	Prepare Reply
☐	Circulate	☒	For Your Information	☐	See Me
☐	Comment	☐	Investigate	☐	Signature
☐	Coordination	☐	Justify		

REMARKS

① Man Holes are dry
2600 gal total

② Had to go backwards
from 6 to 3. would not
drain because sediment.
Please call 9-5624/9278
SSG Foster

Per SSG Jones, yesterday had some ½ ≈ 1000 gal [illegible] fuel

DO NOT use this form as a RECORD of approvals, concurrences, disposals, clearances, and similar actions

FROM: (Name, org. symbol, Agency/Post) [redacted]	Room No.—Bldg.
	Phone No.

5041-102
GPO : 1987 170-636

OPTIONAL FORM 41 (Rev. 7-76)
Prescribed by GSA
FPMR (41 CFR) 101-11.206

POL Tank Farm Spill

31 March 89
0845

[redacted] called. He may be able to stop by this P.M., but is not unsure. If not, he may make it in next 1-2 days. Not too worried since we have under control.

POL Tank Farm

31 Mar 89
1130hr [redacted]

Total Mogas Loss = 7764 gal

Checking Diesel Now = ?

1345 Hrs [redacted] called in. He says # for diesel is 33k gallons!
(33,000 gallons)

SFC [redacted] – 37,000 gallons

200-1a OSK
S

MEMORANDUM FOR RECORD

SUBJECT: MOGAS Spill at POL Farm 26 Jun 89

1. [redacted] inspected the down gradient manhole across the street from the POL Farm approximately 1100, 30 Jun 89. He reported finding approximately 2 feet of diesel floating on the water in the manhole

2. [redacted] informed both [redacted] DMMC and [redacted] 701st NCO's who supervise POL Farm operations. These NCO's prepared ~~a plan~~ and implemented a plan to pump the diesel from the manhole.

3. [redacted] inspected the manhole by removing the lid at 0830, 3 Jul 89. [redacted] reported the liquid surface ~~at~~ even with the eight ladder step from the top and a heavy, oily liquid on the surface.

4. [redacted] also noted that the ground around the manhole had extensive stains from spilled petroleum.

[redacted]

Reproduced At Government Expense

CONVERSATION RECORD

TIME 1545

DATE 30 Jun 89

TYPE ☐ VISIT ☐ CONFERENCE ☒ TELEPHONE ☐ INCOMING ☒ OUTGOING

Location of Visit/Conference:

ROUTING	
NAME/SYMBOL	INT

NAME OF PERSON(S) CONTACTED OR IN CONTACT WITH YOU [redacted]

ORGANIZATION (Office, dept., bureau, etc.) KDHE, Salina

TELEPHONE NO: 913 827 9639

SUBJECT 1200 MOGAS Spill at POL Farm 26 Jun 89

SUMMARY I informed him that we found approximately 2 feet of diesel fuel in a manhole downgradient from the POL Farm when we surveyed for lost fuel as a result of subject spill. I also said we found trace diesel at a retention pond downgradient from the manhole.

I said we were recovering fuel from the manhole and would place it in the waste separator system. I said the diesel at the pond would be recovered when waste oil collection occurs.

He said since the spill was within the manhole and pond he judged the spill to be not serious. He did commit to visit Fort Riley within 30 days to view POL Farm and manhole.

ACTION REQUIRED Inform [redacted], Done 1555. CDH. Brief [redacted] & [redacted] on status. Done Check manhole 3 July for diesel.

NAME OF PERSON DOCUMENTING CONVERSATION [redacted]

SIGNATURE [redacted]

DATE 30 Jun 89

ACTION TAKEN [redacted] asked if pumps wired in staged at POL Farm? He also asked if some diesel might be escaping the POL Farm

SIGNATURE [redacted]

TITLE

DATE 30 Jun 89

50271-101 ☆U.S. G.P.O. 1985-485-494 CONVERSATION RECORD OPTIONAL FORM 271 (12-76) DEPARTMENT OF DEFENSE

WEST POND SAMPLES
TCLP EXTRACT (11 MAY 1993)
SLUDGE (3 JUNE 1993)

KDPS

west pond
Light Brown phase
Clear phase heavy

Analytical Laboratory Report

Customer Reference Number: 9307 / Sample 49 (clear)
Sample Identifier: g93-tclpm49c
Customer Identifier: EMR / [redacted]

Date Sampled: 5-11-93
Date Received: 7-30-93
Date Analyzed: 8-02-93

Project Location: Fort Riley, KS

Sample 44 of 47
Method: EPA 1311/7060,7080,7030,7190,7420,7470,7740,7760
Matrix: TCLP Extract

Analyte	Concentration in TCLP Extract (mg/l)	Detection Limit (mg/l)	EPA TCLP Limit (mg/l)
Arsenic	Not detected	0.01	5.0
Barium	Not detected	0.1	100
Cadmium	Not detected	0.01	1.0
Chromium	Not detected	0.01	5.0
Lead	Not detected	0.01	5.0
Mercury	Not detected	0.01	0.2
Selenium	Not detected	0.01	1.0
Silver	Not detected	0.01	5.0
Nickel	Not detected	0.01	-
Copper	Not detected	0.01	-
Zinc	Not detected	0.01	-

Units Conversion:
1. **ppm** (parts per million) = µg/ml, mg/l (water based or aqueous liquids), ng/mg, µg/g, mg/kg (solids).
2. **ppb** (parts per billion) = ng/ml, µg/l (water based or aqueous liquids), pg/mg, ng/g, µg/kg (solids).

Signed [redacted]
[redacted]
President.

Analytical Laboratory Report

Customer Reference Number: 9307/Sample #49
Sample Identifier: G93-M033
Customer Identifier: EMR / [redacted]

Date Sampled: 6-03-93
Date Received: 7-30-93
Date Analyzed: 7-31-93

Project Location: Fort Riley, KS

Sample 34 of 35

Method: EPA 8240/5030
Matrix: Sludge

Analyte	Concentration	Detection limit	Flag
2-chloroethyl vinyl ether	Not Detected	1.0 ppb	1
Vinyl chloride	Not Detected	1.0 ppb	-
Trichlorofluoromethane	Not Detected	1.0 ppb	-
1,1 Dichloroethylene	Not Detected	1.0 ppb	-
Dichloromethane	Not Detected	1.0 ppb	-
trans 1,2 Dichloroethylene	Not Detected	1.0 ppb	-
1,1 Dichloroethane	Not Detected	1.0 ppb	-
Trichloromethane	Not Detected	1.0 ppb	-
1,1,1 Trichloroethane	Not Detected	1.0 ppb	-
Tetrachloromethane	Not Detected	1.0 ppb	-
Benzene	Not detected	1.0 ppb	-
1,2 Dichloroethane	Not Detected	1.0 ppb	-
Trichloroethylene	Not Detected	1.0 ppb	-
1,2 Dichloropropane	Not Detected	1.0 ppb	-

Bromodichloromethane	Not Detected	1.0 ppb	-
trans 1,3 Dichloropropene	Not Detected	1.0 ppb	-
Toluene	38.9 ppb	1.0 ppb	-
cis 1,3 dichloropropene	Not Detected	1.0 ppb	-
1,1,2 Trichloroethane	Not Detected	1.0 ppb	-
Tetrachloroethylene	Not Detected	1.0 ppb	-
Dibromochloromethane	Not Detected	1.0 ppb	-
Chlorobenzene	Not Detected	1.0 ppb	-
Ethylbenzene	Not detected	1.0 ppb	-
Bromoform (tribromomethane)	Not Detected	1.0 ppb	-
1,1,2,2 Tetrachloroethane	Not Detected	1.0 ppb	-
m,p xylene	Not detected	1.0 ppb	2
o xylene	Not detected	1.0 ppb	-
m dichlorobenzene	Not Detected	1.0 ppb	-
p dichlorobenzene	Not Detected	1.0 ppb	-
o dichlorobenzene	Not Detected	1.0 ppb	-

Key to Flags
1. Chromatogram matches that derived from commercial standard.
2. Detection limit is for the sum of the two xylenes.
3. Retention time varies from the standard by more than 0.1 minute.

Units Conversion:
1. ppm (parts per million) = μg/ml, mg/l (water based or aqueous liquids), ng/mg, μg/g, mg/kg (solids).
2. ppb (parts per billion) = ng/ml, μg/l (water based or aqueous liquids), pg/mg, ng/g, μg/kg (solids).

Signed [redacted]

[redacted]

President.

EAST POND

G93-M021

28 MAY 1993

SLUDGE

KDPS

Analytical Laboratory Report

Customer Reference Number: 9307/Sample #23
Sample Identifier: G93-M021
Customer Identifier: EMR /[redacted]

Date Sampled: 5-28-93
Date Received: 7-30-93
Date Analyzed: 7-31-93

Project Location: Fort Riley, KS

Sample 23 of 35

Method: EPA 8240/5030
Matrix: Sludge

Analyte	Concentration	Detection limit	Flag
2-chloroethyl vinyl ether	Not Detected	1.0 ppb	1
Vinyl chloride	Not Detected	1.0 ppb	-
Trichloro-fluoromethane	Not Detected	1.0 ppb	-
1,1 Dichloroethylene	Not Detected	1.0 ppb	-
Dichloromethane	Not Detected	1.0 ppb	-
trans 1,2 Dichloroethylene	Not Detected	1.0 ppb	-
1,1 Dichloroethane	Not Detected	1.0 ppb	-
Trichloromethane	Not Detected	1.0 ppb	-
1,1,1 Trichloroethane	Not Detected	1.0 ppb	-
Tetrachloromethane	Not Detected	1.0 ppb	-
Benzene	527 ppb	1.0 ppb	-
1,2 Dichloroethane	Not Detected	1.0 ppb	-
Trichloroethylene	Not Detected	1.0 ppb	-
1,2 Dichloropropane	Not Detected	1.0 ppb	-

Bromodichloromethane	Not Detected	1.0 ppb	-
trans 1,3 Dichloropropene	Not Detected	1.0 ppb	-
Toluene	3,379 ppb	1.0 ppb	-
cis 1,3 dichloropropene	Not Detected	1.0 ppb	-
1,1,2 Trichloroethane	Not Detected	1.0 ppb	-
Tetrachloroethylene	Not Detected	1.0 ppb	-
Dibromochloromethane	Not Detected	1.0 ppb	-
Chlorobenzene	Not Detected	1.0 ppb	-
Ethylbenzene	2,802 ppb	1.0 ppb	-
Bromoform (tribromomethane)	Not Detected	1.0 ppb	-
1,1,2,2 Tetrachloroethane	Not Detected	1.0 ppb	-
m,p xylene	3,042 ppb	1.0 ppb	2
o xylene	Not detected	1.0 ppb	-
m dichlorobenzene	Not Detected	1.0 ppb	-
p dichlorobenzene	Not Detected	1.0 ppb	-
o dichlorobenzene	Not Detected	1.0 ppb	-

Key to Flags

1. Chromatogram matches that derived from commercial standard.
2. Detection limit is for the sum of the two xylenes.
3. Retention time varies from the standard by more than 0.1 minute.

Units Conversion:

1. **ppm** (parts per million) = μg/ml, mg/l (water based or aqueous liquids), ng/mg, μg/g, mg/kg (solids).
2. **ppb** (parts per billion) = ng/ml, μg/l (water based or aqueous liquids), pg/mg, ng/g, μg/kg (solids).

Signed [redacted]

[redacted]

President.

G93-IR23

29 MAY 1993

WATER

KDPS

Analytical Laboratory Report

Customer Reference Number: 9307/Sample 23 East Pond
Sample Identifier: g93-IR23
Customer Identifier: EMR / [redacted]

Date Sampled: 5-29-93
Date Received: 7-30-93
Date Analyzed: 7-30-93

Project Location: Forty Riley, KS
Sample 1 of 03

Method: EPA 418.1
Matrix: Water

Analyte	Concentration	Detection limit	Flag
Total Recoverable Petroleum Hydrocarbons	113,000 ppm	0.5 ppm	-

Key to Flags

1. Average of multiple extractions
2. Insufficient sample for multiple extractions

Units Conversion:

1. ppm (parts per million) = µg/ml, mg/l (water based or aqueous liquids), ng/mg, µg/g, mg/kg (solids).
2. ppb (parts per billion) = ng/ml, µg/l (water based or aqueous liquids), pg/mg, ng/g, µg/kg (solids).

Signed [redacted]
[redacted]
President.

G93-tclpm4

11 MAY 1993

KDPS

Analytical Laboratory Report

Customer Reference Number: 9307 / Sample 4 East Pond
Sample Identifier: g93-tclpm4
Customer Identifier: EMR / [redacted]

Date Sampled: 5-11-93
Date Received: 7-30-93
Date Analyzed: 8-02-93

Project Location: Fort Riley, KS

Sample 2 of 47
Method: EPA 1311/7060,7080,7030,7190,7420,7470,7740,7760
Matrix: TCLP Extract

Analyte	Concentration in TCLP Extract (mg/l)	Detection Limit (mg/l)	EPA TCLP Limit (mg/l)
Arsenic	Not detected	0.01	5.0
Barium	Not detected	0.1	100
Cadmium	0.46	0.01	1.0
Chromium	Not detected	0.01	5.0
Lead	Not detected	0.01	5.0
Mercury	Not detected	0.01	0.2
Selenium	Not detected	0.01	1.0
Silver	Not detected	0.01	5.0
Nickel	Not detected	0.01	-
Copper	Not detected	0.01	-
Zinc	Not detected	0.01	-

Units Conversion:

1. ppm (parts per million) = µg/ml, mg/l (water based or aqueous liquids), ng/mg, µg/g, mg/kg (solids).
2. ppb (parts per billion) = ng/ml, µg/l (water based or aqueous liquids), pg/mg, ng/g, µg/kg (solids).

Signed [redacted]
[redacted]
President.

BUILDING 8100
WASTES AND SUMPS

SUMP

5 JANUARY 1994

KDPS

Analytical Laboratory Report

Customer Reference Number: 9401-76
Sample Identifier: j94-091
Customer Identifier: Fort Riley / [redacted]

Date Sampled: 1-05-94
Date Received: 1-07-94
Date Analyzed: 1-13-94

Project Location: Fort Riley

Sample 5 of 14
Method: EPA 8240/5030
Matrix: Water

Analyte	Concentration	Detection limit	Flag
2-chloroethyl vinyl ether	<2.0 ppb	2.0 ppb	-
Vinyl chloride	<2.0 ppb	2.0 ppb	-
Trichlorofluoromethane	<2.0 ppb	2.0 ppb	-
1,1 Dichloroethylene	<2.0 ppb	2.0 ppb	-
Dichloromethane	<2.0 ppb	2.0 ppb	-
trans 1,2 Dichloroethylene	<2.0 ppb	2.0 ppb	-
1,1 Dichloroethane	<2.0 ppb	2.0 ppb	-
Trichloromethane	<2.0 ppb	2.0 ppb	-
1,1,1 Trichloroethane	<2.0 ppb	2.0 ppb	-
Tetrachloromethane	<2.0 ppb	2.0 ppb	-
Benzene	<2.0 ppb	2.0 ppb	-
1,2 Dichloroethane	<2.0 ppb	2.0 ppb	-
Trichloroethylene	<2.0 ppb	2.0 ppb	-
1,2 Dichloropropane	<2.0 ppb	2.0 ppb	-
Bromodichloromethane	<2.0 ppb	2.0 ppb	-
trans 1,3 Dichloropropene	<2.0 ppb	2.0 ppb	-

KDPS

Toluene	<2.0 ppb	2.0 ppb	-
cis 1,3 dichloropropene	<2.0 ppb	2.0 ppb	-
1,1,2 Trichloroethane	<2.0 ppb	2.0 ppb	-
Tetrachloroethylene	<2.0 ppb	2.0 ppb	-
Dibromochloromethane	<2.0 ppb	2.0 ppb	-
Chlorobenzene	<2.0 ppb	2.0 ppb	-
Ethylbenzene	59,600 ppb	2.0 ppb	-
Bromoform (tribromomethane)	<2.0 ppb	2.0 ppb	-
1,1,2,2 Tetrachloroethane	<2.0 ppb	2.0 ppb	-
m,p xylene	14,000 ppb	2.0 ppb	2
o xylene	10,000 ppb	2.0 ppb	-
m dichlorobenzene	<2.0 ppb	2.0 ppb	-
p dichlorobenzene	<2.0 ppb	2.0 ppb	-
o dichlorobenzene	<2.0 ppb	2.0 ppb	-

Key to Flags

1. Chromatogram matches that derived from commercial standard.
2. Detection limit is for the sum of the two xylenes.
3. Retention time varies from the standard by more than 0.1 minute.

Units Conversion:

1. **ppm** (parts per million) = µg/ml, mg/l (water based or aqueous liquids), ng/mg, µg/g, mg/kg (solids).
2. **ppb** (parts per billion) = ng/ml, µg/l (water based or aqueous liquids), pg/mg, ng/g, µg/kg (solids).

Signed [redacted]

[redacted]

President.

SUMP

13 DECEMBER 1993

LIQUID

KDPS

Analytical Laboratory Report

Customer Reference Number: 9401 / 29 / Battery Acid out of Bat
Sample Identifier: j94-TCLP-15
Customer Identifier: Fort Riley /[redacted]

Date Sampled: 12-13-93
Date Received: 12-17-93
Date Analyzed: 01-07-94

Project Location: Fort Riley

Sample: 15 of 27
Method: EPA 1311/7060,7080,7030,7190,7420,7470,7740,7760
Matrix: Liquid

Analyte	Concentration in TCLP Extract (mg/l)	Detection Limit (mg/l)	EPA TCLP Limit (mg/l)
Arsenic	2.1 mg/l	0.01	5.0
Barium	12.0 mg/l	0.1	100
Cadmium	0.05 mg/l	0.01	1.0
Chromium	Not detected	0.01	5.0
Lead	2.1 mg/l	0.01	5.0
Mercury	Not detected	0.01	0.2
Selenium	0.1 mg/l	0.01	1.0
Silver	Not detected	0.01	5.0
Copper	0.1 mg/l	0.01	-
Zinc	0.08 mg/l	0.01	-
Nickel	6.0 mg/l	0.01	-

Units Conversion:
1. ppm (parts per million) = µg/ml, mg/l (water based or aqueous liquids), ng/mg, µg/g, mg/kg (solids).

Signed [redacted]
[redacted]
President.

FURNITURE SHOP FILTERS

14 APRIL 1992

COMP-SOLID

TCLP EXTRACT ANALYSIS - METALS

Sample Collected By: Client
Date Collected: 4/14/92 @1440
Received in Lab: 8/21/92
Date Reported: 9/15/92

Lab No. 925531
Client: DEH
Bldg. 408
Fort Riley, KS 6644[illegible]000
Attn: AFZN-DE-EN [redacted]
Project No: FE040025
Project Name: Hazardous Waste Analyses
Sample Description: Comp-Solid
8100 Furniture Shop(filters)

ANALYTES	TCLP EXTRACT RESULTS mg/l	EPA TCP LIMIT mg/l	EPA SW-846 METHOD	DATE ANALYZED
Arsenic	0.009	5.0	1311/7060	8/26/92
Barium	0.1	100	1311/7080	8/27/92
Cadmium	0.06	1.0	1311/7030	8/26/92
Chromium	ND(0.08)	5.0	1311/7190	8/26/92
Lead	0.39	5.0	1311/7420	8/26/92
Mercury	ND(0.005)	0.2	1311/7470	8/26/92
Selenium	ND(0.005)	1.0	1311/7740	8/26/92
Silver	ND(0.05)	5.0	1311/7760	8/26/92
Copper	0.09	NA	1311/7210	8/26/92
Nickel	0.11	NA	1311/7520	8/26/92
Zinc	4.77	NA	1311/7950	8/26/92

COMMENTS:

1. Test Procedures as per EPA TCLP regulations in 40 CFR 261, Appendix II, as amended.

2. **This sample does not exhibit EPA TCLP Metal Toxicity.**

3. mg/l (milligram per liter) = part per million

4. ND( ), where noted, indicates none detected with detection limits in parentheses.

Analysis by Hal Kennedy, Jr.

TEST PARAMETER	Results	Date Analyzed	Analyst	Test Method
Flash Point	>1[illegible]F	9/1[illegible]92	FD	Open Cup

< = less than
> = greater than

Approved By: [redacted]
Lab Manager

M.D. Chemical and Testing Co., Inc., P.O. Box 19321, Topeka, Kansas 66619

FURNITURE SHOP PAINT FILTERS

6 MAY 1991

SOLID

027 FURNITURE SHOP 06 May 91 Sol 910614-002 TCLP Metals (to EHRT) C71
PAINT FILTERS/ 910614-002 Flash Point (to EHRT) C90

1

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

614002

Lab Name: ENVIRONMENTAL_HEALTH_RESE Contract: 1194______

Lab Code: W88___ Case No.: #1405 SAS No.: 13351_ SDG No.: 000000

Matrix (soil/water): WATER Lab Sample ID: 002_______

Level (low/med): LOW__ Date Received: 06/28/91

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum				NR
7440-36-0	Antimony				NR
7440-38-2	Arsenic	1.0	U		F
7440-39-3	Barium	1.4	B		P
7440-41-7	Beryllium				NR
7440-43-9	Cadmium	4.0	U		P
7440-70-2	Calcium				NR
7440-47-3	Chromium	47.3			P
7440-48-4	Cobalt				NR
7440-50-8	Copper	202			P
7439-89-6	Iron				NR
7439-92-1	Lead	13.0	U		P
7439-95-4	Magnesium				NR
7439-96-5	Manganese				NR
7439-97-6	Mercury	0.20	U		CV
7440-02-0	Nickel	10.3	B		P
7440-09-7	Potassium				NR
7782-49-2	Selenium	2.0	U		F
7440-22-4	Silver	10.0	U		P
7440-23-5	Sodium				NR
7440-28-0	Thallium				NR
7440-62-2	Vanadium				NR
7440-66-6	Zinc	283			P
	Mo				NR

Color Before: ________ Clarity Before: ______ Texture: ______

Color After: ________ Clarity After: ______ Artifacts: ______

Comments:
910614-002__FURNITURE_SHOP_PAINT_FILTERS/8100
TCLP_METALS_ANALYSIS

FORM I - IN

3/90

BATTERY ACID
19 APRIL 1991
WATER

006 8100 BATTERY ACID 19 Apr 91 Liquid 910513-011 TCLP Metals (to EHRT) C8 —
910513-011 BNA ([illegible]T) C40-C42
910513-011 pH (to [illegible]) C1

1

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

513011

Lab Name: ENVIR._HEALTH_RESEARCH_TE Contract: 1194

Lab Code: W88 Case No.: #1342 SAS No.: 13156_ SDG No.: 000000

Matrix (soil/water): WATER Lab Sample ID: 006

Level (low/med): Date Received: 05/22/91

% Solids:

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum				NR
7440-36-0	Antimony				NR
7440-38-2	Arsenic	1160			F
7440-39-3	Barium	0.40	U		P
7440-41-7	Beryllium				NR
7440-43-9	Cadmium	5150			P
7440-70-2	Calcium				NR
7440-47-3	Chromium	1360		N	P
7440-48-4	Cobalt				NR
7440-50-8	Copper	420			P
7439-89-6	Iron				NR
7439-92-1	Lead	835		N	P
7439-95-4	Magnesium				NR
7439-96-5	Manganese				NR
7439-97-6	Mercury	0.2	U	N	CV
7440-02-0	Nickel	1780		N	P
7440-09-7	Potassium				NR
7782-49-2	Selenium	1.6	U		F
7440-22-4	Silver	10	U		P
7440-23-5	Sodium				NR
7440-28-0	Thallium				NR
7440-62-2	Vanadium				NR
7440-66-6	Zinc	4390			P
	Cyanide				NR

Color Before: Clarity Before: Texture:

Color After: Clarity After: Artifacts:

Comments:

910513-011__8100_BATTERY_ACID____TCLP_METALS_ANALYSIS
POST_DIGEST_SPIKE_(ARSENIC)_=_101%_RECOVERY
POST_DIGEST_SPIKE_(SELENIUM)_=_87%_RECOVERY

OIL LAB SOLY
19 APRIL 1991
WATER

D31 8100 OIL LAB SOLV. 19[illegible] Water 910621-001 TCLP Metals [illegible] RT) C77
910621-001 Flash Point [illegible] RT) C90
910621-001 TCLP VOA (to EHRT) C96-C97

ENVIRONMENTAL HEALTH RESEARCH AND TESTING, INC.

VOLATILE ORGANIC ANALYSIS

TCLP

CUSTOMER NAME:	U.S. ARMY CORPS OF ENGINEERS		
SAMPLE SOURCE:	Fort Riley - RCRA Wastes (8100 OIL LAB SOLV)		
WORK ORDER NO.:	1405	PROJECT NO.:	13351
DATE EXTRACTED:	N/A	DATE ANALYZED:	07-05-91
SAMPLE TYPE:	Water Sample	SAMPLE VOLUME:	0.01 mL
ANALYST:	[redacted]	DILUTION FACTOR:	1.00
CUSTOMER SAMPLE NO.:	910621-001	EHRT SAMPLE NO.:	13351-006
LAB NOTEBOOK NO.:	183, Pg. 87	METHOD NO.:	EPA 8240

	COMPOUNDS		RESULT ug/L
1.	Acetone	<	500.00
2.	Benzene	<	250.00
3.	n-Butyl Alcohol	<	375000.00
4.	Carbon Disulfide	<	250.00
5.	Carbon Tetrachloride	<	250.00
6.	Chlorobenzene	<	250.00
7.	Chloroform	<	250.00
8.	1,2-Dichloroethane	<	250.00
9.	1,1-Dichloroethylene	<	250.00
10.	Ethyl Acetate	<	500.00
11.	Ethyl Benzene	<	250.00
12.	Ethyl Ether	<	250.00
13.	Isobutanol	<	375000.00
14.	Methanol		N/A
15.	Methylene Chloride	<	500.00
16.	Methyl Ethyl Ketone	<	1000.00
17.	Methyl Isobutyl Ketone	<	1000.00
18.	Tetrachloroethylene		173695.00
19.	Toluene	<	250.00
20.	1,1,1-Trichloroethane	<	250.00
21.	Trichloroethylene	<	250.00
22.	Trichlorofluoromethane	<	250.00

OIL LAB SOLVENT

19 APRIL 1991

WATER

031	8100 OIL LAB SOLV.	19 Apr 91	Water	910621-001	TCLP Metals (to EHRT)	C77—
				910621-001	Flash Poin' 'to EHRT)	C90
				910621-001	TCLP VOA (HRT.)	C96-C97

1

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

621001

Lab Name: ENVIRONMENTAL_HEALTH_RESE Contract: 1194______

Lab Code: W88___ Case No.: #1405 SAS No.: 13351_ SDG No.: 000000

Matrix (soil/water): WATER Lab Sample ID: 006_______

Level (low/med): LOW__ Date Received: 06/28/91

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum				NR
7440-36-0	Antimony				NR
7440-38-2	Arsenic	1.0	U		F
7440-39-3	Barium	1.2	B		P
7440-41-7	Beryllium				NR
7440-43-9	Cadmium	4.0	U		P
7440-70-2	Calcium				NR
7440-47-3	Chromium	16.8			P
7440-48-4	Cobalt				NR
7440-50-8	Copper	23.0	B		P
7439-89-6	Iron				NR
7439-92-1	Lead	13.0	U		P
7439-95-4	Magnesium				NR
7439-96-5	Manganese				NR
7439-97-6	Mercury	0.20	U		CV
7440-02-0	Nickel	2.0	U		P
7440-09-7	Potassium				NR
7782-49-2	Selenium	2.0	U		F
7440-22-4	Silver	10.0	U		P
7440-23-5	Sodium				NR
7440-28-0	Thallium				NR
7440-62-2	Vanadium				NR
7440-66-6	Zinc	24.2			P
	Mo				NR

Color Before: ________ Clarity Before: ______ Texture: ______

Color After: ________ Clarity After: ______ Artifacts: ______

Comments:
910621-001__8100_OIL_LAB_SOLV.
TCLP_METALS_ANALYSIS

FURNITURE SHOP PAINT WASTE
8 APRIL 1993
LIQUID

VOLATILE ORGANICS - EPA SW-846 Method 8260

Sample Collected By: [redacted]
Date Collected: 4/8/93 @10:28
Received in Lab: 6/24/93
Date Analyzed: 7/26/93
Date Reported: 7/28/93

Lab No: 936290
Client: Dir. of Engineering & Housing
Bldg. 408
Fort Riley, KS 66442-6000
ATTN: AFZN-DE-EN, [redacted]
Sample Description: **Liquid**
Station Location: **8100-Furniture Shop Paint Waste**
Contract Number: **DAKF19-93-M-4820**

COMPOUND	RESULTS µg/l(ppb)	DETECTION LIMIT µg/l(ppb)
2-Chloroethyl vinyl ether	Not Detected	1,250,000
Vinyl Chloride	Not Detected	1,250,000
Trichlorofluoromethane (Freon II)	Not Detected	1,250,000
1,1-Dichloroethylene	Not Detected	1,250,000
Dichloromethane	Not Detected	1,250,000
Trans 1,2-Dichloroethylene	Not Detected	1,250,000
1,1-Dichloroethane	Not Detected	1,250,000
Trichloromethane (THM)	Not Detected	1,250,000
1,1,1-Trichloroethane	Not Detected	1,250,000
Tetrachloromethane	Not Detected	1,250,000
Benzene	Not Detected	1,250,000
1,2-Dichloroethane	Not Detected	1,250,000
Trichloroethylene	Not Detected	1,250,000
1,2-Dichloropropane	Not Detected	1,250,000
Bromodichloromethane(THM)	Not Detected	1,250,000
Trans 1,3-Dichloropropene	Not Detected	1,250,000
Toluene	73,770,000	1,250,000
Cis-1,3-Dichloropropene	Not Detected	1,250,000
1,1,2-Trichloroethane	Not Detected	1,250,000
Tetrachloroethylene	Not Detected	1,250,000
Dibromochloromethane (THM)	Not Detected	1,250,000
Chlorobenzene	Not Detected	1,250,000
Ethylbenzene	4,110,000	1,250,000
Bromoform (THM)	Not Detected	1,250,000
1,1,2,2-Tetrachloroethane	Not Detected	1,250,000
1,3/1,4-Xylene(m/p)	16,400,000	1,250,000
1,2-Xylene(o)	5,510,000	1,250,000
1,3-Dichlorobenzene(m)	Not Detected	1,250,000
1,4-Dichlorobenzene(p)	Not Detected	1,250,000
1,2-Dichlorobenzene(o)	Not Detected	1,250,000

Analysis By: [redacted]

Approved By: [redacted]
[redacted]
Lab Manager

FURNITURE SHOP PAINT WASTE

MAY 1991

LIQUID

033	FURNITURE SHOP PAINT WASTE/8100	06 May 91	Liquid	910621-003 TCLP Metals (to EHRT) 910621-003 TCLP VOA (to EHRT) 910621-003 Flash Po (to EHRT)	C79 C100-C101 C90

ENVIRONMENTAL HEALTH RESEARCH AND TESTING, INC.

VOLATILE ORGANIC ANALYSIS

TCLP

CUSTOMER NAME:	U.S. ARMY CORPS OF ENGINEERS		
SAMPLE SOURCE:	Fort Riley - RCRA Wastes (FURNITURE SHOP PAINT WASTE/8100)		
WORK ORDER NO.:	1405	PROJECT NO.:	13351
DATE EXTRACTED:	N/A	DATE ANALYZED:	07-03-91
SAMPLE TYPE:	Water Sample	SAMPLE VOLUME:	0.001 mL
ANALYST:	N. Lac	DILUTION FACTOR:	1.00
CUSTOMER SAMPLE NO.:	910621-003	EHRT SAMPLE NO.:	13351-008
LAB NOTEBOOK NO.:	183, Pg. 87	METHOD NO.:	EPA 8240

	COMPOUNDS		RESULT ug/L
1.	Acetone	<	5000.00
2.	Benzene	<	2500.00
3.	n-Butyl Alcohol	<	3750000.00
4.	Carbon Disulfide	<	2500.00
5.	Carbon Tetrachloride	<	2500.00
6.	Chlorobenzene	<	2500.00
7.	Chloroform	<	2500.00
8.	1,2-Dichloroethane	<	2500.00
9.	1,1-Dichloroethylene	<	2500.00
10.	Ethyl Acetate	<	5000.00
11.	Ethyl Benzene		52600.00
12.	Ethyl Ether	<	2500.00
13.	Isobutanol	<	3750000.00
14.	Methanol		N/A
15.	Methylene Chloride	<	5000.00
16.	Methyl Ethyl Ketone		12,578,000.00
17.	Methyl Isobutyl Ketone		176,600.00
18.	Tetrachloroethylene	<	2500.00
19.	Toluene		1,517,700.00
20.	1,1,1-Trichloroethane	<	2500.00
21.	Trichloroethylene	<	2500.00
22.	Trichlorofluoromethane	<	2500.00

OIL LAB
8 JUNE 1993
LIQUID

ATILE ORGANICS - EPA SW-846 Meth .260

Sample Collected By: [redacted]
Date Collected: 6/8/93 @1:00
Received in Lab: 6/24/93
Date Analyzed: 7/6/93
Date Reported: 7/26/93

Lab No: 936379
Client: Dir. of Engineering & Housing
Bldg. 408
Fort Riley, KS 66442-6000
ATTN: AFZN-DE-EN, [redacted]
Sample Description: Liquid
Station Location: 8100-Oil Lab
Contract Number: DAKF19-93-M-4926

COMPOUND	RESULTS mg/kg(ppm)	DETECTION LIMIT mg/kg(ppm)
2-Chloroethyl vinyl ether	Not Detected	10
Vinyl Chloride	Not Detected	10
Trichlorofluoromethane (Freon II)	Not Detected	10
1,1-Dichloroethylene	Not Detected	10
Dichloromethane	Not Detected	10
Trans 1,2-Dichloroethylene	Not Detected	10
1,1-Dichloroethane	Not Detected	10
Trichloromethane (THM)	Not Detected	10
1,1,1-Trichloroethane	69,500	10
Tetrachloromethane	Not Detected	10
Benzene	Not Detected	10
1,2-Dichloroethane	52	10
Trichloroethylene	28	10
1,2-Dichloropropane	Not Detected	10
Bromodichloromethane(THM)	Not Detected	10
Trans 1,3-Dichloropropene	Not Detected	10
Toluene	12	10
Cis-1,3-Dichloropropene	Not Detected	10
1,1,2-Trichloroethane	Not Detected	10
Tetrachloroethylene	Not Detected	10
Dibromochloromethane (THM)	Not Detected	10
Chlorobenzene	Not Detected	10
Ethylbenzene	Not Detected	10
Bromoform (THM)	Not Detected	10
1,1,2,2-Tetrachloroethane	Not Detected	10
1,3/1,4-Xylene(m/p)	Not Detected	10
1,2-Xylene(o)	Not Detected	10
1,3-Dichlorobenzene(m)	Not Detected	10
1,4-Dichlorobenzene(p)	Not Detected	10
1,2-Dichlorobenzene(o)	Not Detected	10

Analysis By: [redacted]

Approved By: [redacted]
[redacted]
Lab Manager

RAD CAUSTIC
APRIL 1991
LIQUID

003 8100 RAD CAUSTIC [illegible]Apr 91 Liquid 910513-008 pH (to F[illegible] C1
910513-008 TCLP Met[illegible] to EHRT) C6

1

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

513008

Lab Name: ENVIR._HEALTH_RESEARCH_TE Contract: 1194

Lab Code: W08 Case No.: #1342 SAS No.: 13156 SDG No.: 000000

Matrix (soil/water): WATER Lab Sample ID: 003

Level (low/med): ______ Date Received: 05/22/91

% Solids: ______

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum				NR
7440-36-0	Antimony				NR
7440-38-2	Arsenic	8.1	B		F
7440-39-3	Barium	5.4	B		P
7440-41-7	Beryllium				NR
7440-43-9	Cadmium	4.1	U		P
7440-70-2	Calcium				NR
7440-47-3	Chromium	26000		N	P
7440-48-4	Cobalt				NR
7440-50-8	Copper	31900			P
7439-89-6	Iron				NR
7439-92-1	Lead	61400		N	P
7439-95-4	Magnesium				NR
7439-96-5	Manganese				NR
7439-97-6	Mercury	0.6		N	CV
7440-02-0	Nickel	260		N	P
7440-09-7	Potassium				NR
7782-49-2	Selenium	1.6	U		F
7440-22-4	Silver	10	U		P
7440-23-5	Sodium				NR
7440-28-0	Thallium				NR
7440-62-2	Vanadium				NR
7440-66-6	Zinc	3700			P
	Cyanide				NR

Color Before: ______ Clarity Before: ______ Texture: ______

Color After: ______ Clarity After: ______ Artifacts: ___

Comments:

910513-[illegible]__8100_RAD_CAUSTIC
TCLP_ME[illegible]_ANALYSIS

FORM I - IN 7/87

RADIATOR WORK TANK
8 APRIL 1993
LIQUID

WASTE CHARACTERIZATION

Sample Collected By: [redacted]
Date Collected: 4/8/93 @11:30
Received in Lab: 6/24/93
Date Reported: 7/26/93

Lab No. 936295
Client: Dir. of Engineering & Housing
Bldg. 408
Fort Riley, KS 66442-6000
ATTN: AFZN-DE-EN, [redacted]

Sample Description: Liquid
Station Location: 8100-Radiator work tank
Contract Number: DAKF19-93-M-4820

ANALYTES	TCLP Extract Results mg/l	EPA TCLP Limit mg/L	EPA SW-846 Method	Date Analyzed	Analyst
Arsenic	0.93	5.0	1311 / 7060	7/15/93	HK
Barium	6.5	100	1311 / 7080	7/19/93	HK
Cadmium	1.96	1.0	1311 / 7030	7/19/93	HK
Chromium	56.8	5.0	1311 / 7190	7/19/93	HK
Lead	718	5.0	1311 / 7420	7/19/93	HK
Mercury	ND(0.005)	0.2	1311 / 7470	7/16/93	HK
Selenium	0.024	1.0	1311 / 7740	7/15/93	HK
Silver	0.22	5.0	1311 / 7760	7/19/93	HK
Copper	167	NA	1311/7210	7/19/93	HK
Nickel	1.70	NA	1311/7520	7/19/93	HK
Zinc	167	NA	1311/7950	7/19/93	HK

COMMENTS:

1. Test procedures as per EPA TCLP regulation in 40 CFR 261, Appendix II, as amended.
2. **This sample does exhibit EPA TCLP Metal Toxicity.**
3. mg/l = milligram per liter = parts per million
4. ND ( ), where noted, indicates none detected with detection limits in parentheses.

TEST PARAMETER	Results	Date Analyzed	Analyst	Test Method
Flash Point	NA			SW846/Method 1010
pH	11.7	7/12/93	TC	SW846

> = greater than
< = less than

Approved By: [redacted]
[redacted]
Lab Manager

M.D. Chemical and Testing Co., Inc., P.O. Box 19321, Topeka, Kansas 66619

AUTO BODY SHOP CARC PAINT
8 APRIL 1993
SOLID

VOLATILE ORGANICS - EPA SW-846 Method 8260

Sample Collected By: [redacted]
Date Collected: 4/8/93 @11:30
Received in Lab: 6/24/93
Date Analyzed: 7/13/93
Date Reported: 7/27/93

Lab No: 936299
Client: Dir. of Engineering & Housing
Bldg. 408
Fort Riley, KS 66442-6000
ATTN: AFZN-DE-EN, [redacted]
Sample Description: Solid
Station Location: 8100-Auto body shop carc paint
Contract Number: DAKF19-93-M-4820

COMPOUND	RESULTS mg/kg(ppm)	DETECTION LIMIT mg/kg(ppm)
2-Chloroethyl vinyl ether	Not Detected	2.0
Vinyl Chloride	Not Detected	2.0
Trichlorofluoromethane (Freon II)	Not Detected	1.0
1,1-Dichloroethylene	Not Detected	2.0
Dichloromethane	Not Detected	2.0
Trans 1,2-Dichloroethylene	Not Detected	2.0
1,1-Dichloroethane	Not Detected	2.0
Trichloromethane (THM)	Not Detected	1.0
1,1,1-Trichloroethane	Not Detected	1.0
Tetrachloromethane	Not Detected	1.0
Benzene	Not Detected	0.5
1,2-Dichloroethane	Not Detected	1.0
Trichloroethylene	Not Detected	1.0
1,2-Dichloropropane	Not Detected	1.0
Bromodichloromethane(THM)	Not Detected	1.0
Trans 1,3-Dichloropropene	738	1.0
Toluene	23800	1.0
Cis-1,3-Dichloropropene	Not Detected	1.0
1,1,2-Trichloroethane	Not Detected	2.0
Tetrachloroethylene	Not Detected	1.0
Dibromochloromethane (THM)	Not Detected	1.0
Chlorobenzene	Not Detected	1.0
Ethylbenzene	5770	1.0
Bromoform (THM)	Not Detected	2.0
1,1,2,2-Tetrachloroethane	Not Detected	2.0
1,3/1,4-Xylene(m/p)	19150	1.0
1,2-Xylene(o)	6560	1.0
1,3-Dichlorobenzene(m)	Not Detected	1.0
1,4-Dichlorobenzene(p)	Not Detected	1.0
1,2-Dichlorobenzene(o)	Not Detected	1.0

Analysis By: [redacted]

Approved By: [redacted]
[redacted]
Lab Manager

PARTS WATER WASHER - LARGE
8 APRIL 1993
LIQUID

WASTE CHARACTERIZATION

Sample Collected By: [redacted]
Date Collected: 4/8/93 @ 11:10
Received in Lab: 6/24/93
Date Reported: 7/26/93

Lab No. 936292
Client: Dir. of Engineering & Housing
Bldg. 408
Fort Riley, KS 66442-6000
ATTN: AFZN-DE-EN, [redacted]

Sample Description: Liquid
Station Location: 8100-Parts washer water-large
Contract Number: DAKF19-93-M-4820

ANALYTES	TCLP Extract Results mg/l	EPA TCLP Limit mg/L	EPA SW-846 Method	Date Analyzed	Analyst
Arsenic	0.019	5.0	1311 / 7060	7/15/93	HK
Barium	1.2	100	1311 / 7080	7/19/93	HK
Cadmium	2.06	1.0	1311 / 7030	7/19/93	HK
Chromium	1.59	5.0	1311 / 7190	7/19/93	HK
Lead	4.20	5.0	1311 / 7420	7/19/93	HK
Mercury	ND(0.005)	0.2	1311 / 7470	7/16/93	HK
Selenium	0.005	1.0	1311 / 7740	7/15/93	HK
Silver	ND(0.05)	5.0	1311 / 7760	7/19/93	HK
Copper	3.09	NA	1311/7210	7/19/93	HK
Nickel	0.27	NA	1311/7520	7/19/93	HK
Zinc	6.80	NA	1311/7950	7/19/93	HK

COMMENTS:

1. Test procedures as per EPA TCLP regulation in 40 CFR 261, Appendix II, as amended.
2. **This sample does exhibit EPA TCLP Metal Toxicity.**
3. mg/l = milligram per liter = parts per million
4. ND ( ), where noted, indicates none detected with detection limits in parentheses.

TEST PARAMETER	Results	Date Analyzed	Analyst	Test Method
Flash Point	NA			SW846/Method 1010
pH	10.1	7/12/93	TC	SW846

> = greater than
< = less than

Approved By: [redacted]
[redacted]
Lab Manager

M.D. Chemical and Testing Co., Inc., P.O. Box 19321, Topeka, Kansas 66619

PARTS WASH
APRIL 1991
WATER

N3h
C15

U.S. EPA - CLP

1

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

020067

Lab Name: ENVIR._HEALTH_RESEARCH_TE Contract: 1194______

Lab Code: W88___ Case No.: W0563 SAS No.: 10964_ SDG No.: 000000

Matrix (soil/water): SOIL_ Lab Sample ID: 21281_____

Level (low/med): _____ Date Received: 10/26/89

% Solids: _98.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

Assume all metals leachable ∴ mg/kg (1/20) yields mg/l per method 1:20 solid to extraction liquid (TCLP)
mg/l

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum				NR	
7440-36-0	Antimony				NR	
7440-38-2	Arsenic	5.0			F	– .25
7440-39-3	Barium	1050			P	– 52.5
7440-41-7	Beryllium				NR	
7440-43-9	Cadmium	244			P	– 12.2
7440-70-2	Calcium				NR	
7440-47-3	Chromium	948			P	– 47.4
7440-48-4	Cobalt				NR	
7440-50-8	Copper				NR	
7439-89-6	Iron				NR	
7439-92-1	Lead	6040			P	–302
7439-95-4	Magnesium				NR	
7439-96-5	Manganese				NR	
7439-97-6	Mercury	0.1			CV	.005
7440-02-0	Nickel				NR	
7440-09-7	Potassium				NR	
7782-49-2	Selenium	0.18	U		F	.009
7440-22-4	Silver	2.0			P	.1
7440-23-5	Sodium				NR	
7440-28-0	Thallium				NR	
7440-62-2	Vanadium				NR	
7440-66-6	Zinc				NR	
	Cyanide				NR	

Color Before: ________ Clarity Before: ______ Texture: ______

Color After: ________ Clarity After: ______ Artifacts: ___

Comments:

091020-067__FTR-10-18-20

Bldg 8100 Parts Washer Sludge

PARTS WASHER WATER - SMALL

8 APRIL 1993

LIQUID

WASTE CHARACTERIZATION

Sample Collected By: [redacted]
Date Collected: 4/8/93 @11:15
Received in Lab: 6/24/93
Date Reported: 7/26/93

Lab No. 936293
Client: Dir. of Engineering & Housing
Bldg. 408
Fort Riley, KS 66442-6000
ATTN: AFZN-DE-EN, [redacted]

Sample Description: Liquid
Station Location: 8100-Parts washer water-small
Contract Number: DAKF19-93-M-4820

ANALYTES	TCLP Extract Results mg/l	EPA TCLP Limit mg/L	EPA SW-846 Method	Date Analyzed	Analyst
Arsenic	0.012	5.0	1311 / 7060	7/15/93	HK
Barium	0.5	100	1311 / 7080	7/19/93	HK
Cadmium	0.26	1.0	1311 / 7030	7/19/93	HK
Chromium	0.14	5.0	1311 / 7190	7/19/93	HK
Lead	1.66	5.0	1311 / 7420	7/19/93	HK
Mercury	0.006	0.2	1311 / 7470	7/15/93	HK
Selenium	ND(0.005)	1.0	1311 / 7740	7/15/93	HK
Silver	ND(0.05)	5.0	1311 / 7760	7/19/93	HK
Copper	2.14	NA	1311/7210	7/19/93	HK
Nickel	0.16	NA	1311/7520	7/19/93	HK
Zinc	7.23	NA	1311/7950	7/19/93	HK

COMMENTS:

1. Test procedures as per EPA TCLP regulation in 40 CFR 261, Appendix II, as amended.
2. **This sample does not exhibit EPA TCLP Metal Toxicity.**
3. mg/l = milligram per liter = parts per million
4. ND ( ), where noted, indicates none detected with detection limits in parentheses.

TEST PARAMETER	Results	Date Analyzed	Analyst	Test Method
Flash Point	NA			SW846/Method 1010
pH	9.96	7/12/93	TC	SW846

\> = greater than
< = less than

Approved By: [redacted]
[redacted]
Lab Manager

M.D. Chemical and Testing Co., Inc., P.O. Box 19321, Topeka, Kansas 66619

LEAD ACID BATTERY CAPS #1
20 SEPTEMBER 1993
SOLID

WASTE CHARACTERIZATION

Sample Collected By: [redacted]
Date Collected: 9/20/93
Received In Lab: 9/22/93
Date Reported: 10/21/93

Lab No. 939164
Client: Dir. of Engineering & Housing
Bldg. 408
Fort Riley, KS 66442-6000
ATTN: AFZN-DE-EN, [redacted]

Sample Description: Solid
Station Number: 8
Station Location: 8100-Lead Acid Battery Caps #1
Contract Number: DAKF19-93-M-5631

ANALYTES	TCLP Extract Results mg/l	EPA TCLP Limit mg/L	EPA SW-846 Method	Date Analyzed	Analyst
Copper	0.06	NA	1311/7210	10/5/93	HK
Arsenic	0.006	5.0	1311 / 7060	10/6/93	HK
Barium	0.4	100	1311 / 7080	10/6/93	HK
Cadmium	ND(0.05)	1.0	1311 / 7030	10/5/93	HK
Chromium	ND(0.08)	5.0	1311 / 7190	10/5/93	HK
Lead	20.3	5.0	1311 / 7420	10/5/93	HK
Mercury	ND(0.005)	0.2	1311 / 7470	9/29/93	HK
Selenium	ND(0.005)	1.0	1311 / 7740	10/6/93	HK
Silver	ND(0.05)	5.0	1311 / 7760	10/5/93	HK
Nickel	ND(0.08)	NA	1311/7520	10/5/93	HK
Zinc	0.45	NA	1311/7950	10/5/93	HK

COMMENTS:

1. Test procedures as per EPA TCLP regulation in 40 CFR 261, Appendix II, as amended.
2. **This sample does exhibit EPA TCLP Metal Toxicity.**
3. mg/l = milligram per liter = parts per million
4. ND ( ), where noted, indicates none detected with detection limits in parentheses.

TEST PARAMETER	Results	Date Analyzed	Analyst	Test Method
Flash Point	NA			Open Cup
pH	Not enough sample	10/11/93	TC	SW846

> = greater than
< = less than

Approved By: [redacted]
Lab Manager

M.D. Chemical and Testing Co., Inc., P.O. Box 19321, Topeka, Kansas 66619