DRAFT FINAL

SITE INVESTIGATION
FOR
FORMER FIRE TRAINING AREA
MARSHALL ARMY AIRFIELD
FORT RILEY, KANSAS

Volume I of II

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Prepared for:
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NOTE: Five wells/piezometers installed at the FFTA were renamed and renumbered in July 1995. Piezometer FP-94-12PZ in on-post, the other four wells are off-post. The following cross-reference list should be used when reviewing previously published documents:

Old Designation	New Designation
Piezometer FP-94-01PZ or Well FP-94-01	Well FP-94-08
Piezometer FP-94-02PZ or Well FP-94-02	Well FP-94-09
Piezometer FP-94-03PZ or Well FP-94-03	Well FP-94-10
Piezometer FP-94-04PZ or Well FP-94-04	Well FP-94-11
Piezometer FP-94-05PZ	Piezometer FP-94-12PZ

EXECUTIVE SUMMARY

A Site Investigation (SI) was conducted for the Former Fire Training Area (FFTA) located at Marshall Army Airfield (MAAF), Fort Riley, Kansas. The investigation was performed during the period of September 1993 through June 1994. The purpose of the SI was to collect data to confirm or deny that hazardous substances are present at the FFTA-MAAF. The results of the SI indicated that petroleum hydrocarbons and chlorinated solvents (including tetrachloroethylene, also known as perchloroethylene [PCE]) were present in the subsurface environment (soil and groundwater). Additionally, contaminants similar to those detected at the FFTA were detected in groundwater along the installation boundary and in an off-site private well located at a speedway, approximately 1,000 feet north of the FFTA-MAAF.

Based on the results of the SI, an Expanded Site Investigation (ESI) was performed during the period of June 1994 through April 1995. The purpose of this ESI was to characterize the nature of the environmental release, to evaluate the horizontal and vertical distribution of contaminants at the FFTA-MAAF, to characterize groundwater contamination on post and off post, and collect data to support selection and implementation of response actions and/or interim remedial measures. Data collected in this document are a result of a phased investigatory approach including soil gas, groundwater screening, soil, and groundwater sampling and analysis. Recognizing that the work performed under the ESI is more consistent with the initial investigations of a Remedial Investigation/Feasibility Study (RI/FS), the Environmental Protection Agency (EPA) and the Kansas Department of Health and Environment (KDHE) concurred with a proposal from Fort Riley to perform remaining site characterization activities as such. This SI Report will serve as interim reporting mechanism to facilitate decisions regarding further site characterization. The ESI is an ongoing project. This document reports information collected through January 1995.

In addition to the SI and ESI, Fort Riley implemented a soil vapor extraction (SVE) and bioventing pilot test study to address soil contamination at the FFTA-MAAF. The purpose of the pilot test study was to evaluate the feasibility of SVE and bioventing technologies to remediate the soils at FFTA-MAAF. The pilot test was operated during the period of November 1994 through January 1995, concurrent with the ESI. The pilot test was restarted in March 1995 to further study its effectiveness. The activities included in the ESI were based on an understanding of the types of data to be collected during the pilot study, which was focused on the soil contamination in the immediate area of the FFTA-MAAF. The data collected during the pilot test study, such as groundwater elevations, provided data to assist in the interpretation of data collected during the ESI. Only site characterization data collected as part of the pilot test study through January 1995 are included in this document.

Background

The SI and ESI were designed to collect data to fulfill 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.

Fort Riley was established in 1853 and has been owned and operated by the U.S. Department of the Army since that time. 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 had been released or had the potential to be 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, the EPA proposed inclusion of Fort Riley on the National Priorities List (NPL) pursuant to CERCLA. EPA included the site on the NPL, promulgated in August of 1990. Fort Riley is identified by EPA as Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) site KS6214020756.

Effective June 1991, Fort Riley, Kansas (and the Department of Army) entered into a Federal Facility Agreement (FFA), Docket No. VII-90-F-0015, with the State of Kansas and EPA Region VII to address environmental pollution subject to the Resource Conservation and Recovery Act (RCRA) and/or CERCLA. This agreement is also referred to as the Interagency Agreement (IAG). Pursuant to the IAG, Fort Riley conducted an Installation Wide Site Assessment (IWSA) in 1992 to identify sites having the potential to release hazardous substances to the environment. The IWSA identified the FFTA-MAAF as one of the sites where releases of hazardous substances to the environment had either occurred or was likely to have occurred. Subsequent to the IWSA, site investigations were planned for three groupings of sites. An SI for the first group, the Sensitive-Receptor lead sites, was initiated in June 1993. The Sensitive-Receptor Lead sites were later incorporated into the second group, the High Priority sites. The lead investigation field work was performed as part of the High Priority sites study, but was expedited due to various site locations being in close proximity to a housing area and schools. The High Priority sites SI was initiated in September 1993, and included the FFTA-MAAF as one of the High Priority sites. The remaining sites, known as "Other Sites", identified in the IWSA as requiring further investigation, were included in an SI initiated in March 1994.

The SI results for the FFTA-MAAF indicated that concentrations of organic compounds had been released to groundwater at concentrations exceeding federal and state drinking water standards. Also, similar contaminants were found in off-site, private wells at levels above drinking water standards. These results indicated that additional work at the FFTA-MAAF was necessary. Therefore, Fort Riley separated the FFTA-MAAF from the remainder of the High Priority sites into an ESI for purposes of further investigations and data reporting. The ESI represents Fort Riley's ongoing fulfillment of obligations under the IAG to investigate sites posing a potential threat to human health and the environment.

Site Location

The Fort Riley Military Reservation is located just north of Junction City in northeast Kansas. The FFTA-MAAF is located along the northern boundary to Marshall Field, approximately 1,000 feet off the northeast end of the north-south runway. The Fort Riley installation boundary is located approximately 300 feet north of the former fire training pit. Marshall Field is south of the Kansas River.

Overview of Site Investigations

The chronology of field activities at the FFTA-MAAF is presented in Table E-1. The data collected throughout the investigation, both analytical and geotechnical, were planned such that the specific objective of that phase of the investigation was met. For all analytical data, the same methodologies were employed throughout the field screening; similarly the same methodologies were employed throughout the laboratory analytical tests. EPA-approved methods were used in both cases. This protocol provides for the evaluation and assessment of the data that are directly comparable.

Summary of Findings

Waste Characteristics

The results of the SI show that both petroleum hydrocarbons and chlorinated solvents are present in the subsurface at, and in, the vicinity of the FFTA-MAAF.

- The petroleum contamination originating from the FFTA appears to be limited in both soils and groundwater to the area in and around the center of the former fire training pit. Soil, soil gas, groundwater screening, and groundwater samples outside the boundaries of the pit have no or only low detections of petroleum hydrocarbons.

- The substance that was detected during the SI at the greatest number of locations is PCE. The detected concentrations in soils do not exceed risk-based guidelines; however, concentrations in groundwater exceed regulatory standards for drinking water.

Groundwater Elevations

Groundwater elevations were recorded and gradients were prepared using data from the seven on-post monitoring wells for the months of October 1993 and January 1994 and for June through August 1994. By September 1994, one piezometer had been installed on-post by the Kansas River and four monitoring wells had been installed at the racetrack.

- While the regional groundwater flow is along the Kansas River to the north and east, the local groundwater flow at the FFTA includes a north-northwest component.

- Groundwater elevations during the month of October 1993 were exceptionally high (depth to groundwater was approximately 10 feet) as a result of the significant regional flooding that occurred in July 1993. High standing water was still present within the interior of the speedway upon completion of the SI field work in November 1993. The October 1993 groundwater elevation data shows that at the FFTA there is a westward component of groundwater flow. However, the groundwater elevation data for October 1993 is not representative of typical conditions. A second set of readings in January 1994 revealed that the groundwater elevation had dropped approximately 3 feet. Both sets of data indicated a north to northwest groundwater flow direction.

- Since October 1993 to January 1995, groundwater levels have receded to depths of approximately 17 feet beneath the surface. Further, the groundwater flow direction and gradient has remained similar from January 1994 through January

1995. There is a general groundwater flow direction to the north with a northeast component on the eastern portion of the FFTA and a northwestern component on the western portion of the FFTA. The more recent data in January 1995, however, indicates a more predominant northeast groundwater flow direction. Outside of the regional flooding in July 1993, the data indicate that groundwater flow directions at the FFTA are not greatly affected by seasonal changes (i.e., groundwater flow reversals have not been observed).

Soil Gas and Groundwater Screening

Soil gas and groundwater screening surveys were performed as part of the SI in September 1993, Phase I of the ESI in June and July 1994, and Phase II of the ESI in August 1994 through January 1995. These surveys consisted of the following:

- SI - 58 locations on-post for soil gas and groundwater screening samples
- Phase I ESI - 238 locations off-post for soil gas samples; 90 locations off-post for groundwater screening samples
- Phase II ESI - 154 locations off-post for groundwater screening samples

The results of the soil gas surveys in the SI and Phase I of the ESI correlated well with the results of the groundwater screening. Specifically, the soil gas and groundwater screening samples detected the same types of contaminants in the same areas and the magnitude of the detections were similar. The Phase II included only groundwater screening samples since they provided data on direct measurements of the media of concern. Also, groundwater screening results were higher than soil gas. Except in the immediate vicinity of the FFTA, soil gas detections may be a result of off-gasing of PCE from groundwater or residual PCE from fluctuations in the groundwater due to flooding and/or seasonal movement and would be attributed entirely to off-gassing at locations where PCE was not present in soils. Therefore, no soil gas surveys were used in Phase II.

- The soil gas results of the SI showed that chlorinated solvents were present in the subsurface at and in the vicinity of the FFTA-MAAF. The maximum concentrations detected were PCE at 50 μg/l, trichloroethylene (TCE) at 6.2 μg/l, and cis-1,2-dichloroethylene (c-1,2-DCE) at 21 μg/l.
- In general, during the ESI, there were few detections of non-chlorinated volatile organic compounds (VOCs), which would be indicative of migration of petroleum hydrocarbons. The primary contaminants detected during the ESI were PCE, TCE, and DCE. Isoconcentration contours were developed for each of these contaminants separately and for total chlorinated VOCs at each location. In compiling the isoconcentration contours, data from all sampling events over a period in excess of 15 months (October 1993 to January 1995) were used. The composite isoconcentrations provide an overview of the locations with detected concentrations of VOCs and the relative magnitude of the detections.
- The isoconcentrations for PCE, TCE, DCE, and total chlorinated VOCs show detections of chlorinated VOCs occur in an area downgradient of the FFTA,

extending from the FFTA across the racetrack property in a north-northeast direction. Detections were also recorded in agricultural fields located to the north of the racetrack property. The direction of detections away from the FFTA is consistent with the regional groundwater flow direction to the north. In general, the pattern of detections is similar for each contaminant; however, detections in the area of the racetrack and in the agricultural fields further to the north are not contiguous.

- Geophysical Survey Results. The ESI included a seismic reflection survey and electrical resistivity soundings to characterize depth to bedrock, the topography of the underlying bedrock surface, and geologic layering in the alluvial materials. The results of the geophysical surveys consist principally of a projected bedrock topography map. The results of the geophysical surveys were used to plan collection of deep alluvial groundwater screening samples.

- Deep Alluvial Groundwater Screening Samples. The U.S. Army Corps of Engineers Site Characterization Analysis Penetrometer System (SCAPS) rig was used to look for dense non-aqueous phase liquids (DNAPLs), to collect deep alluvial groundwater screening samples, and to collect cone penetrometer testing (CPT) and electrical resistivity data. The groundwater screening samples were analyzed for chlorinated VOCs. CPT and resistivity data were used to assist in identifying geologic layers from the surface to the top of bedrock and to provide stratigraphic and depth-to-bedrock data to calibrate the August 1994 geophysical results. The CPT data showed that there were no low permeability layers present from the water table to the top of bedrock.

  Chlorinated VOCs were detected at five CPT locations. There was one detection of DCE at 1.1 μg/l and four detections of TCE ranging from 1.0 to 2.8 μg/l. The SCAPS groundwater screening samples indicate that DNAPLs are not present at the FFTA. The results of the chemical analyses of the groundwater screening samples indicate that DNAPLs are not present - rather, low concentrations in groundwater of chlorinated VOCs were detected.

Soil

The Phase II soil samples were collected due to detections in the Phase I data, and focused on shallow soils to evaluate whether additional source areas may be present. Soil samples were collected at 29 boring locations off-post during Phase II of the ESI. At 26 boring locations, samples were collected from depths of 2 to 3 feet and 7 to 8 feet. At the remaining three locations, shallow soil samples were only collected from the 2- to 3-foot interval. All soil samples were analyzed for VOCs. VOCs were detected above practical quantitation limits (PQLs) at four of the soil boring locations. For the pilot test study, baseline soil borings were collected and analyzed from nine borings at about five depths, along with four co-located borings at two depths.

- The soil results of the SI showed that chlorinated solvents were present in the subsurface at and in the vicinity of the FFTA-MAAF. The maximum concentrations detected was PCE at 480 μg/kg.

- The results for soil borings in the deeper sample zone (7 to 8 feet) indicate that DCE was detected at 30 to 49 μg/kg, PCE at 17 to 44 μg/kg, and TCE at 6.6 μg/kg. The concentrations of DCE, PCE, and TCE detected in soils do not exceed risk-based guidelines.

- The concentrations of contaminants in four soil borings are in areas where there is known groundwater contamination. The detections in these soil borings occurred only in the deeper sample zone indicating that a separate shallow source area is not likely. Therefore, contamination is most likely due to adsorption to the soil due to the regional flooding in September 1993 when contaminated groundwater occupied the pore spaces of soils at depths of 7 to 8 feet from the surface.

- Total petroleum hydrocarbons (TPH) exceeded the cleanup standards or risk-based guidelines in 18 samples at three borings to a depth of about 13 feet. All these samples were taken in and around the former fire training pit. The maximum concentrations detected were TPH diesel range organic (DRO) fraction (TPH-DRO) at 23,000,000 μg/kg and TPH gasoline range organic (GRO) fraction (TPH-GRO) at 2,600,000 μg/kg. Two samples had DCE concentrations exceeding the KDHE cleanup guidance level, but well below the EPA risk-based guidelines. Concentrations of m- &/or p-xylenes in three samples exceeded both the EPA risk-based guidelines and the KDHE cleanup guidance levels for mixed xylenes. The maximum concentration detected of m- &/or p-xylenes was 170,000 μg/kg).

<u>Groundwater</u>

Groundwater samples were collected at the seven on-post monitor wells (FP-93-01 through FP-93-07) and four to eight of the off-post private wells (N-1, M-1, R-1, R-2, R-3, F-1, F-2, and B-1) during the months of October 1993 (R-2 and R-3 were not sampled), July 1994, October 1994, and January 1995. Off-post irrigation well I-1 was sampled for the first time in October 1994. In January 1995, groundwater samples were also collected from the on-post piezometer (FP-94-12PZ) and the four off-post monitoring wells (FP-94-08 through FP-94-11) installed in 1994. Wells R-1, R-2, F-1, and F-2 were shut down for the winter and were not sampled in January 1995. All samples were analyzed for VOCs, semi-volatile organic compounds (SVOCs), Priority Pollutant (PP) metals, and TPH. The primary contaminants detected were chlorinated VOCs (DCE, PCE, and TCE).

- Overall, off-post well R-1 is the most downgradient well with detected concentrations of VOCs, and the detected concentrations have been higher than other wells closer to the FFTA. Chlorinated VOCs have migrated from the FFTA towards the north-northeast, in the direction of groundwater flow. The areas of contamination based on isoconcentration maps are largely overlapping for the different contaminants. The concentrations of DCE at on-post well FP-93-04 nearest the center of the former pit decreased from 4,100 μg/l in October 1993 to 3.3 μg/l in January 1995. When reviewing data from on-post wells (FP-93-04 and FP-93-05), note that the pilot test study for the FFTA was conducted between November 1994 and January 1995 and it was removing contaminants from the soil. Reductions might also be attributable to horizontal or vertical migration, loss through vapors, natural attenuation, or groundwater levels receding below the zone of contamination.

Surface Water

- Although the drainage ditch transects the FFTA, there does not appear to be any overland transport of contaminants from the FFTA along the ditch.

Table E-1. Chronology of Field Activities Associated With the FFTA-MAAF

Date	Activity
September 1993	Initiated a Site Investigation (SI) for the High Priority Sites, which included the FFTA-MAAF.
	Collected SI Phase I and II samples at FFTA-MAAF including soil gas, groundwater screening, soil, and sediment samples.
October 1993	As part of the Phase III SI activities at FFTA-MAAF, seven monitor wells were installed within the installation boundary (on-post). Samples were collected from the seven on-post wells and six private wells located off-post, and laboratory analyzed.
January 1994	As part of SI activities, collected groundwater level measurements.
March 1994	As part of SI activities, collected groundwater level measurements.
April 1994	As part of SI activities, collected soil samples and field screened for polychlorinated biphenyls (PCBs).
June 1994	Initiated Phase I Expanded SI (ESI) activities.
	As part of Phase I ESI, collected Phase I (off-post) expanded soil gas and groundwater screening samples, performed seismic reflection (on-post) and electrical resistivity surveys, and collected groundwater level measurements. Additionally, soil samples for PCBs were resampled and analyzed in the laboratory.
July 1994	As part of Phase I ESI, collected and analyzed groundwater samples for the first quarterly sampling round, collected groundwater level measurements and installed piezometer adjacent to the Kansas River. Additionally, baseline soil samples for initiation of the soil vapor/ bioventing pilot test study were collected and analyzed.
August 1994	Initiated Phase II ESI activities.
	As part of Phase I ESI, collected monthly groundwater level measurements.
	As part of Phase II ESI, and collected and analyzed off-post soil samples and expanded groundwater screening samples.
	As part of Phase II ESI, installed four off-post monitor wells.
September 1994	As part of Phase I ESI, collected monthly groundwater level measurements.
October 1994	As part of Phase I ESI, collected and analyzed second quarterly groundwater samples and collected monthly groundwater level measurements.

Table 1. Chronology of Field Activities Associated With the FFTA-MAAF (continued)

Date	Activity
October 1994 (continued)	As part of pilot test study, soil samples were collected and analyzed from borings at eight well locations.
December 1994	As part of Phase I ESI, collected monthly groundwater level measurements.
	As part of the ESI, additional geophysical data and deep groundwater screening samples were collected using the Site Characterization Analysis Penetrometer System (SCAPS) rig.
January 1995	As part of Phase I ESI, collected monthly groundwater level measurements and collected and analyzed third quarterly groundwater samples.
February 1995	As part of Phase I ESI, collected monthly groundwater level measurements.
March 1995	As part of Phase I ESI, collected monthly groundwater level measurements.
April 1995	As part of Phase I ESI, collected monthly groundwater level measurements and collected and analyzed fourth quarterly groundwater samples.

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ACRONYM LIST

AOC	Area of Concern
ASTM	American Society of Testing Materials
Berger	Louis Berger & Associates, Inc.
bgs	Below Ground Surface
BOD	Biochemical Oxygen Demand
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
BTX	Benzene, Toluene, and Xylenes
BVW	Bioventing Well
°C	Degrees Celcius
CDSR	Comparative Data Summary Report
CEC	Cation Exchange Capacity
CEMRD	Corps of Engineers Missouri River Division
CEMRK	Corps of Engineers, Missouri River Division, Kansas City District
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
c-1,2-DCE	cis-1,2-Dichloroethylene
CFR	Code of Federal Regulations
CFU	Colony Forming Unit
CHPPM	Center for Health Policy and Preventative Medicine
COC	Chain-of-Custody
COD	Chemical Oxygen Demand
CPT	Cone Penetrometer Testing
DCA	Dichloroethane
DCE	1,2-Dichloroethylene
DCM	Dichloromethane
DNAPL	Dense Non-Aqueous Phase Liquid
DQO	Data Quality Objective
DRO	Diesel Range Organics
DSER	Data Summary and Evaluation Report
EB	Ethylbenzene
ECD	Electron Capture Detector
EPA	Environmental Protection Agency
ESI	Expanded Site Investigation
°F	Degrees Fahrenheit
FFA	Federal Facility Agreement
FFTA	Former Fire Training Area
FID	Flame Ionization Detector
FS	Feasibility Study
GC	Gas Chromatograph
g/cm^3	grams per cubic centimeter
gpd/ft	Gallons per day per foot
gpm	Gallons per minute
GPR	Ground Penetrating Radar
GRO	Gasoline Range Organics

HCl	Hydrochloric Acid
HRS	Hazardous Ranking System
HSWA	Hazardous and Solid Waste Amendments
IAG	Interagency Agreement
IDW	Investigation Derived Waste
IPE	Isopropyl Ether
IW	Injection Well
IWSA	Installation Wide Site Assessment
KAL	Kansas Action Levels (established by KDHE)
KDHE	Kansas Department of Health and Environment
KDWP	Kansas Department of Wildlike & Parks
KNL	Kansas Notification Levels (established by KDHE)
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LIMS	Laboratory Information Management System
MAAF	Marshall Army Airfield
MCL	Maximum Contaminant Levels (established by EPA under the Safe Drinking Water Act)
MDL	Method Detection Limit
MEK	Methyl Ethyl Ketone
MGD	Million Gallons Per Day
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MIBK	Methyl Isobutyl Ketone
MOGAS	Motor Gasoline
MPN	Most Probable Number
MPRC	Multi-Purpose Range Complex
MRD	Missouri River Division
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSL	Mean Sea Level
MTBE	Methyl-Tert-Butyl Ether
NA	Not Analyzed
NAv	Not Available
NAp	Not Applicable
NCP	National Contingency Plan
ND	Not Detected
NG	No Growth
NL	Non-Liquid
NM	Not Measured
NP	Non-Plastic
NPL	National Priorities List
NS	Not Sampled
NuAg	Nutrient Agar
OSWER	Office of Solid Waste and Emergency Response
PA	Preliminary Assessment
PARCC	Precision, Accuracy, Representativeness, Comparability, and Completeness
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethylene or Perchloroethylene

PID	Photoionization Detector
PP	Priority Pollutant
PQLs	Practical Quantification Limits
psi	Pounds per Square Inch
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QCSR	Quality Control Summary Report
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SCAPS	Site Characterization Analysis Penetrometer System
SI	Site Investigation
SINC	Species In Need Of Conservation
SS	Stainless Steel
SVE	Soil Vapor Extraction
SVOC	Semi-Volatile Organic Compound
t-1,2-DCE	trans-1,2-Dichloroethylene
TCA	Trichloroethane
TCE	Trichloroethylene
TCL	Target Compound List
THF	Tetrahydrofuran
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
TOX	Total Organic Halides
TPH	Total Petroleum Hydrocarbon
TVOC	Total Volatile Organic Compounds
ug/kg	micrograms per kilogram (approximately equivalent to parts per billion)
ug/L	micrograms per liter (approximately equivalent to parts per billion)
USACE	United States Army Corps of Engineers
USAEHA	United States Army Environmental Hygiene Agency
USCS	Unified Soil Classification System
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VOC	Volatile Organic Compound
μg/kg	micrograms per kilogram (approximately equivalent to parts per billion)
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1.0 INTRODUCTION

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1.2 Site Location

The Fort Riley Military Reservation is located just north of Junction City in northeast Kansas (Figure 1-1). Fort Riley contains 101,058 acres, including portions of Riley, Geary, and Clay Counties. Fort Riley is located approximately between latitudes 39° 02' and 39° 18' north and longitudes 96° 41' and 96° 58' west.

Fort Riley was founded near the confluence of the Republican and Smoky Hill Rivers that merge to form the Kansas River. The more widely developed areas of Fort Riley occur in the southern portion of the reservation in the areas along the Republican and Kansas Rivers. The developed areas are divided into six cantonment areas: Main Post, Camp Forsyth, Camp Funston, Camp Whitside, MAAF, and Custer Hill (Figure 1-2). (Custer Hill consists of the Custer Hill Troop

Area to the north and Custer Hill Family Housing to the south.). Marshall Field is south of the Kansas River. The FFTA-MAAF is located along the northern boundary to Marshall Field, approximately 1,000 feet off the northeast end of the north-south runway. The Fort Riley installation boundary is located approximately 300 feet north of the former fire training pit. The general location of the FFTA-MAAF is shown in Figures 1-3 and 1-4.

1.3 Overview of Site Investigations

The chronology of field activities at the FFTA-MAAF is presented in Table 1-1. In order to assist in an understanding of the interrelationship of the various site investigation programs conducted at the FFTA-MAAF, an overview of when data were collected by media is shown in Figure 1-5. The ESI is ongoing; this report reflects data collection activities through January 1995. The data collected throughout the investigation, both analytical and geotechnical, were planned such that the specific objective of that phase of the investigation was met. The objectives for each phase of the investigation are presented in Section 2.0. For all analytical data, the same methodologies were employed throughout the field screening; similarly the same methodologies were employed throughout the laboratory analytical tests. EPA-approved methods were used in both cases. This protocol provides for the evaluation and assessment of the data that are directly comparable.

1.4 Supporting Documents

Numerous documents include information or procedures that were used during the initial SI, ESI, and pilot test study and are relevant to this SI report. These documents are the following:

- *Draft Final Installation Wide Site Assessment for Fort Riley, Kansas,* 7 December 1992, as revised 16 February 1993 (Ref. 2).

- *Draft Final Sampling and Analysis Plan for Site Investigations of High Priority Sites at Fort Riley, Kansas,* 20 August 1993 (Ref. 5). (Modifications to this High Priority Sites Sampling and Analysis Plan [High Priority Sites SAP] were documented in Technical Memoranda provided in Appendix A.)

- *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 (Ref. 6). (Modifications to this Expanded Site Investigation Sampling and Analysis Plan [ESI SAP] were documented in Technical Memoranda #1 through #6 provided in Appendix A.)

- *Draft Final Work Plan Pilot Test Study Soil Vapor Extraction and Bioventing Systems, Former Fire Training Area, Marshall Army Airfield, Fort Riley, Kansas,* August 1994 (Ref. 7). (Modifications to this Pilot Test Study Work Plan were documented in Technical Memoranda #2 provided in Appendix A.)

- *Comprehensive Basic Documents for the Site Investigations at Fort Riley, Kansas* (Ref. 8). This includes the *Quality Assurance Project Plan (QAPP),* the

Monitoring Well Installation Plan, Soil Gas Services, and *Investigations-Derived Waste Management Plan.* The Basic Documents also include the *Site Safety and Health Plan for Site Investigations at Fort Riley, Kansas*, 11 October 1993 and 8 August 1994 revisions. The 29 October 1993 revision of the Basic Documents was used for the SI. The most recent revisions to the Basic Documents approved prior to the beginning of field work was used for each investigation (Ref. 9).

In addition, the laboratory analytical results of the SI, ESI, and pilot study for the FFTA-MAAF have been compiled in *Quality Control Summary Reports* (QCSR). The QCSR represents compilations of the raw chemical data along with the quality assurance reviews of the analytical findings. Field analyses are compared to laboratory analyses in the *Comparative Data Summary Reports* (CDSR). These reports are the following:

- *QCSR for Site Investigations of High Priority Sites at Fort Riley*, 17 December 1993 (Ref. 10)
- *QCSR for Site Investigation of the High Priority Sites at Fort Riley*, 22 July 1994 (Ref. 11)
- *QCSR for Pilot Test Study SVE and Bioventing Systems*, 9 September 1994 (Ref. 12).
- *QCSR for Off-Post Soil and Groundwater Screening Samples at FFTA-MAAF*, 11 November 1994 (Ref. 13)
- *QCSR for Periodic Groundwater Monitoring at FFTA-MAAF*, 11 November 1994 (Ref. 14).
- *QCSR for Periodic Groundwater Monitoring at FFTA-MAAF*, 8 December 1994 (Ref. 15).
- *QCSR for SCAPS Investigation for Deep Alluvial Well Siting for Groundwater Samples*, January 1995 (Ref. 16).
- *QCSR for Periodic Groundwater Monitoring at FFTA-MAAF*, March 1995 (Ref. 17).
- *Compendium of Comparative Data Summary Reports*, 7 December 1994 (Ref. 18). (This Compendium is only one document to which each new CDSR is included as completed.)

This SI report includes a presentation and analyses of the SI, ESI, and pilot test study data to support decision-making regarding further actions at the FFTA-MAAF.

1.5 Overview of the Document

Section 2.0 discusses activities performed for the SI, ESI, and pilot test study. Section 3.0 describes the site and the environmental setting. Section 4.0 describes site contamination, as well as contamination found on- and off-post. The results of the SI, ESI, and pilot test study investigations are discussed by media and activity in Sections 5.0 through 7.0 as follows: Section 5.0 - soil gas and groundwater screening; Section 6.0 - soil; and Section 7.0 - groundwater. Other exposure pathways that are not of concern are discussed in Section 8.0. Section 9.0 discusses the quality of the data. Section 10.0 summarizes the results of the various investigations. References are provided in Section 11.0. Excerpts of select references not otherwise available in public documents are provided in Section 12.0. Tables, figures, and photos are provided at the end of each section. Attachments of relevant data are provided as Appendices, and oversize figures are provided as Plates.

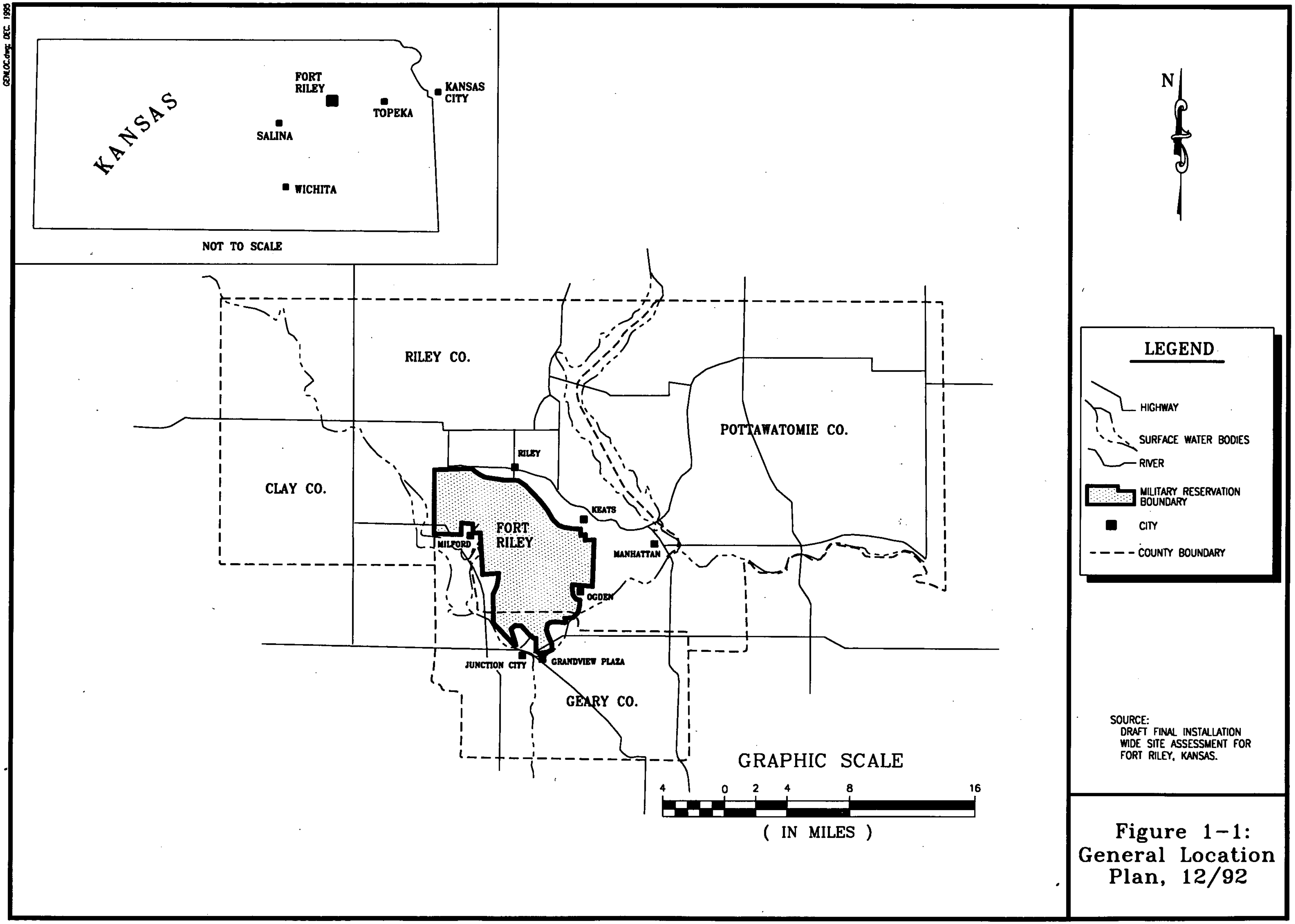
Table 1-1. Chronology of Field Activities Associated With the FFTA-MAAF

Date	Activity
September 1993	Initiated a Site Investigation (SI) for the High Priority Sites, which included the FFTA-MAAF.
	Collected SI Phase I and II samples at FFTA-MAAF including soil gas, groundwater screening, soil, and sediment samples.
October 1993	As part of the Phase III SI activities at FFTA-MAAF, seven monitor wells were installed within the installation boundary (on-post). Samples were collected from the seven on-post wells and six private wells located off-post, and laboratory analyzed.
January 1994	As part of SI activities, collected groundwater level measurements.
March 1994	As part of SI activities, collected groundwater level measurements.
April 1994	As part of SI activities, collected soil samples and field screened for polychlorinated biphenyls (PCBs).
June 1994	Initiated Phase I Expanded SI (ESI) activities.
	As part of Phase I ESI, collected Phase I (off-post) expanded soil gas and groundwater screening samples, performed seismic reflection (on-post) and electrical resistivity surveys, and collected groundwater level measurements. Additionally, soil samples for PCBs were resampled and analyzed in the laboratory.
July 1994	As part of Phase I ESI, collected and analyzed groundwater samples for the first quarterly sampling round, collected groundwater level measurements and installed piezometer adjacent to the Kansas River. Additionally, baseline soil samples for initiation of the soil vapor/ bioventing pilot test study were collected and analyzed.
August 1994	Initiated Phase II ESI activities.
	As part of Phase I ESI, collected monthly groundwater level measurements.
	As part of Phase II ESI, and collected and analyzed off-post soil samples and expanded groundwater screening samples.
	As part of Phase II ESI, installed four off-post monitor wells.
September 1994	As part of Phase I ESI, collected monthly groundwater level measurements.

Table 1-1. Chronology of Field Activities Associated With the FFTA-MAAF (continued)

Date	Activity
October 1994	As part of Phase I ESI, collected and analyzed second quarterly groundwater samples and collected monthly groundwater level measurements.
October 1994 (continued)	As part of pilot test study, soil samples were collected and analyzed from borings at eight well locations.
December 1994	As part of Phase I ESI, collected monthly groundwater level measurements.
	As part of the ESI, additional geophysical data and deep groundwater screening samples were collected using the Site Characterization Analysis Penetrometer System (SCAPS) rig.
January 1995	As part of Phase I ESI, collected monthly groundwater level measurements and collected and analyzed third quarterly groundwater samples.
February 1995	As part of Phase I ESI, collected monthly groundwater level measurements.
March 1995	As part of Phase I ESI, collected monthly groundwater level measurements.
April 1995	As part of Phase I ESI, collected monthly groundwater level measurements and collected and analyzed fourth quarterly groundwater samples.

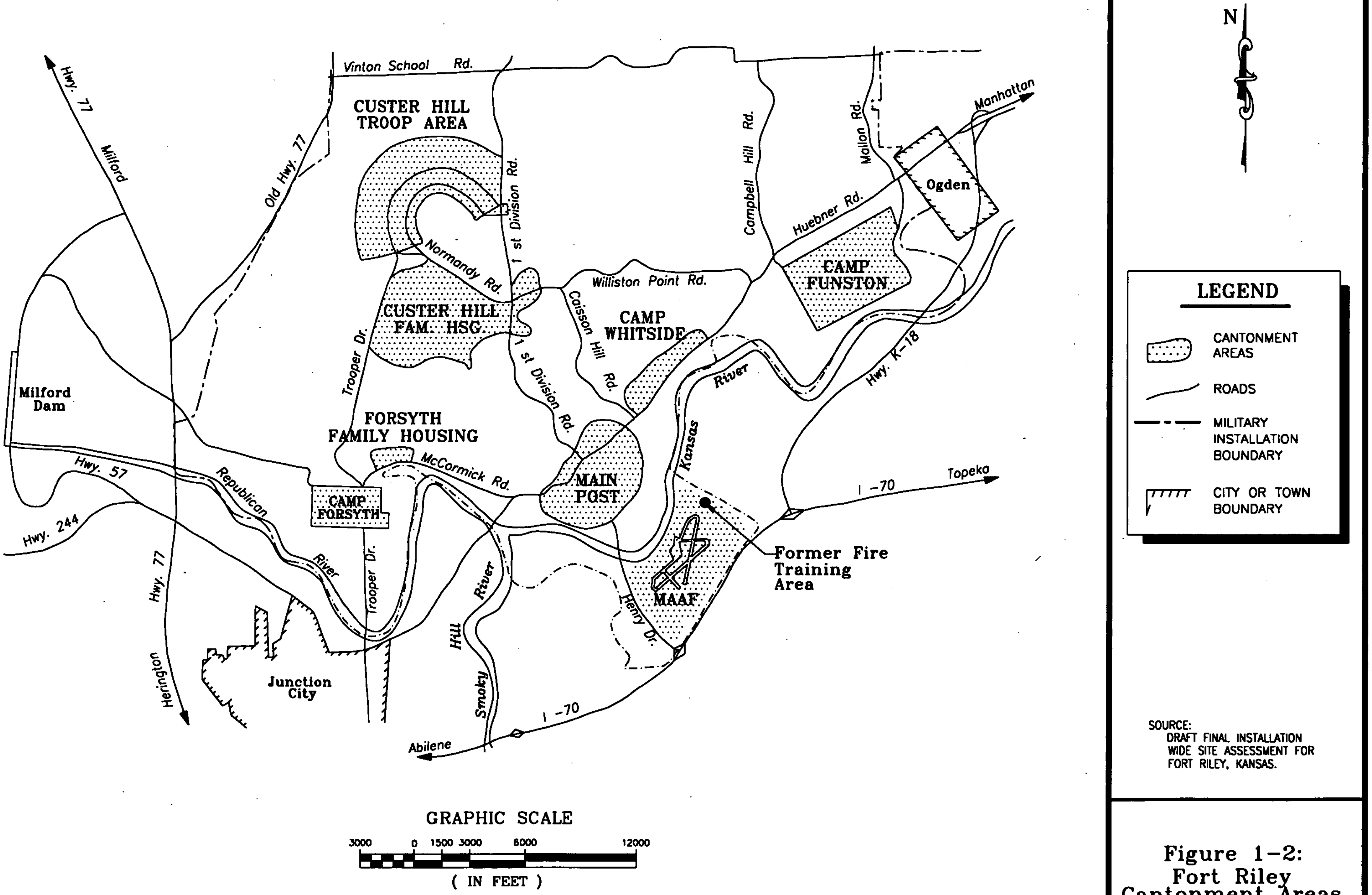
GENLOC.dwg DEC 1995



SOURCE:
DRAFT FINAL INSTALLATION WIDE SITE ASSESSMENT FOR FORT RILEY, KANSAS.

Figure 1-1:
General Location Plan, 12/92

CANTON.dwg; DEC. 1995



SOURCE:
DRAFT FINAL INSTALLATION WIDE SITE ASSESSMENT FOR FORT RILEY, KANSAS.

Figure 1-2: Fort Riley Cantonment Areas, 12/92

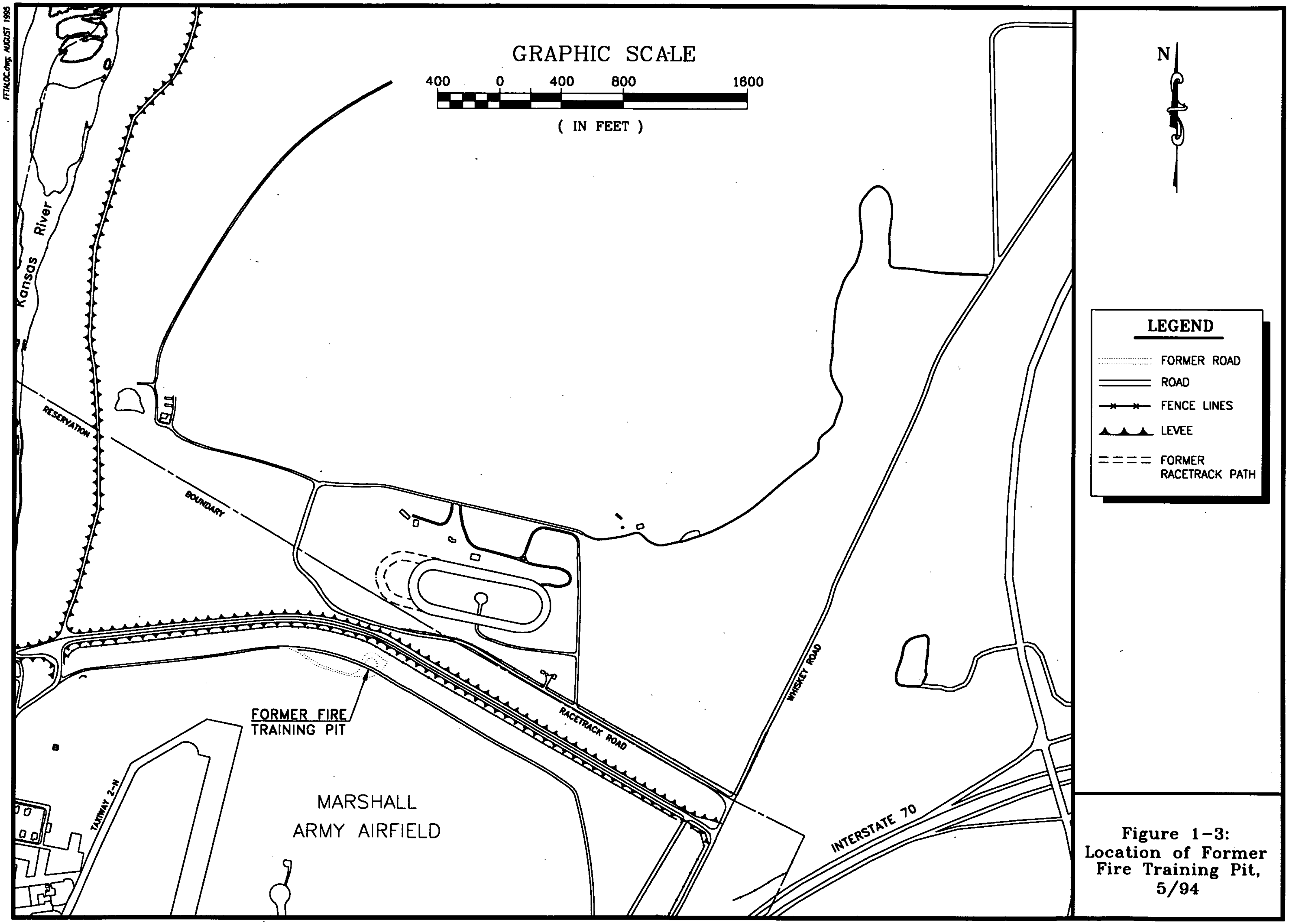
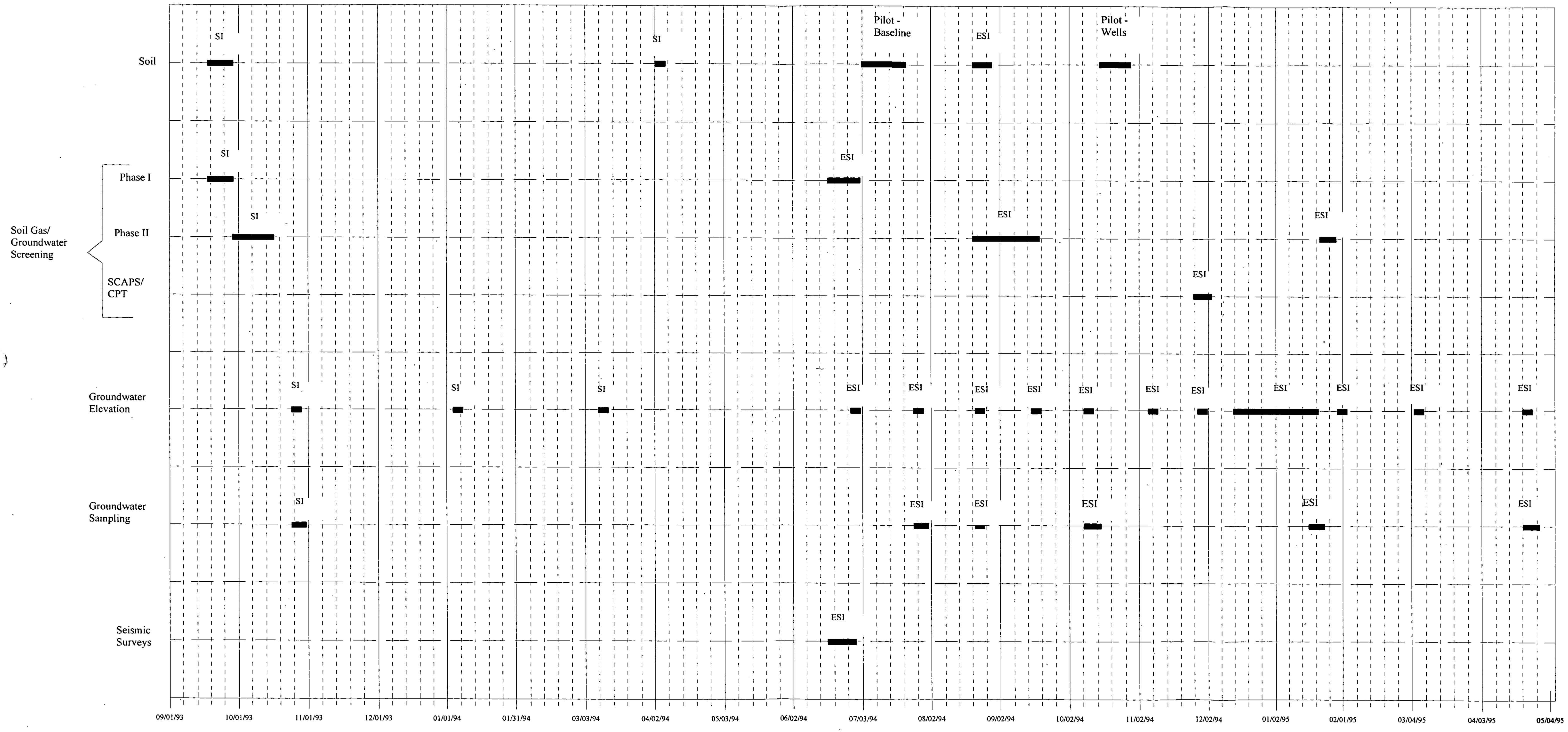


Figure 1-3: Location of Former Fire Training Pit, 5/94

FFTALOC.dwg; AUGUST 1995

Figure 1-4 Aerial Photograph of Former Fire Training Pit
(15 November 1984)

Figure 1-5: Overview of SI, ESI, and Pilot Test Study Data Collection Activities



SCAPS - Site Characterization Analysis Penetrometer System
CPT - Cone Penetrometer Testing

2.0 SI, ESI, AND PILOT TEST STUDY APPROACHES

This section presents the purposes and approaches of the investigative methodologies of the SI, ESI, and pilot test study. The information presented in this section is based on the requirements of the National Contingency Plan (NCP, 40 CFR Part 300, March 1990) and EPA's *Guidance for Performing Site Inspections Under CERCLA - Interim Final*, Office of Solid Waste and Emergency Response (OSWER) Directive 9345.1-05, September 1992 (Ref. 19), hereafter referred to as EPA Guidance. The SI, ESI, and pilot test study were performed by Louis Berger and Associates, Inc. (Berger) for the U.S. Army Corps of Engineers - Kansas City District (CEMRK) in support of Fort Riley.

For purposes of this SI report, FFTA-MAAF (or FFTA or site) refers to the entire area where fire training exercises were performed including the former fire training pit and the adjacent storage area for various materials used during the exercises. The former fire training pit (or former pit) refers to only the formerly bermed pit where the fires were ignited.

2.1 Interpretation of SI Data

The objective of an SI is to gather information to support a site decision regarding the need for further action. The SI data are compared against regulatory standards, risk-based guidelines, and federal and state agency guidelines as a means to assess the impact.

The compilation of standards and guidelines used and their description follow. A tabular compilation of this information is found in Table 2-1.

> <u>Federal Standards and State Guidelines</u>. (Refs. 20, 21, 22) The federal regulatory standards for drinking water are the EPA's Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act, and the state regulatory guidelines are the Kansas Notification Levels (KNLs) and Kansas Action Levels (KALs). The KNL represents the concentrations above which the state is to be notified of potential groundwater contamination; the KAL represents the concentrations at which long-term exposure to contaminant concentrations is unacceptable (Ref. 23). Detections that exceed the MCL or the KAL are noted and discussed. There are no comparable regulatory standards available for soils. KDHE has developed cleanup guidelines for a limited number of compounds and metals, including total petroleum hydrocarbons (TPH) and lead.
>
> The EPA screening level for lead at residential sites is 400 mg/kg (Ref. 24). The site investigated during this SI is a commercial/industrial site and there is no foreseeable use of the site for residential purposes. Therefore, the residential screening level is used for lead only due to the lack of an industrial guidance level.
>
> <u>Kansas Petroleum Site Remediation Levels</u>. The Kansas Petroleum Site Remediation Levels have been developed by the State of Kansas in conjunction with the Kansas Underground Storage Tank Program (Ref. 25). These levels are

the maximum contaminant level for screening indicators of petroleum contamination. If the contaminants concentrations are above the remediation levels, the state is to be notified and remedial action should be implemented as required. For soils, the remedial levels are equivalent to the KDHE cleanup guidelines. For groundwater, the remediation levels are equivalent to either the MCL or KAL, whichever is lower.

Risk-Based Guidelines. Risk-based guidelines referenced in this document were taken from EPA Regions III and IX (Refs. 26, 27). 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 differ. Data from Regions III and IX distinguish between residential and commercial/industrial sites when evaluating risks associated with soil contamination. All laboratory data from the SI are compared against the range of risk-based values provided by each of the two EPA Regions. For evaluating results of the soil sampling and analyses, values from Regions III and IX based on commercial/industrial sites are used, since the FFTA-MAAF is not currently used for residential purposes and is not 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.

For carbon disulfide and 4-methylphenol, EPA risk-based concentrations for tap water were used for comparison, since no other standard or guidance was available (Refs. 26, 27).

For ease of viewing the data presented in Sections 5.0, 6.0, and 7.0, the value is bold for all analytical data for which there was a detection. For aqueous samples, the values were generally compared against one standard, the MCL and one guidance, the KAL. For soil samples, the values were compared against guidance values: KDHE Interim Soil Cleanup Guidance and EPA risk-based concentrations. For cases where lead was analyzed it was compared against the EPA revised soil lead guidance and the KDHE Interim Soil Cleanup Guidance for lead. In both cases, the values found to exceed these numbers were shaded on the tables.

Comparison to Background

An additional consideration used in the evaluation and interpretation of the data involves the comparison to background. Background involves at least two considerations. The first is the determination of a background location for which there is little or no possibility that the activity at the subject site could have impacted it. The second involves the concentrations of naturally occurring concentration of chemicals. For this scenario, there are two distinct considerations, one for metals and inorganics, the other for organics.

For metals, the naturally occurring concentrations fall into a wide range. Data from the United States Geological Survey (USGS) (Ref. 28) were used for reference. During the course of the field sampling, Priority Pollutant (PP) metals were run for one soil sampling event and four groundwater sampling events. The results for the soil are described in Section 6.0 and the results of the groundwater in Section 7.0.

For organics, consideration must be given to two distinct chemical classifications, chlorinated and petroleum derived. Chlorinated compounds, such as PCE, trichloroethylene (TCE), and the like, are never naturally occurring, but result directly from human activity. Petroleum compounds, on the other hand, can be naturally occurring humic materials, and distinguishing between naturally occurring and refined by man can be difficult. Background, then, for chlorinated compounds is any value above non detect; for petroleum derived compounds, determination of the impact should consider the comparison against site location aspects of the background definition cited above.

This discussion of background is to be used in the context of determining if there has been an impact to the environment, and, at this point in the discussion, does not consider the extent of that impact or the implication and/or risk of that impact.

2.2 SI Purpose and Scope

The purpose of the SI activities (September 1993 to June 1994) was to confirm or deny whether contamination exists at the FFTA-MAAF and to support decision-making regarding the need for more detailed investigation, cleanup of the site, or no further action. There were three phases for the SI, the details of which can be found in the overview, Section 2.6. The objective of the environmental sampling was to characterize the contamination and the site.

The SI for the FFTA-MAAF included the following environmental sampling activities:

- Collection and chemical analyses of soil gas and groundwater screening samples at 58 locations in and around the former fire training pit and downgradient of the FFTA-MAAF along the Fort Riley installation boundary to the north.
- Collection and chemical analyses of eight soil samples at four locations within the former fire training pit and from adjacent soils.
- Collection and chemical analyses of five surface soils (sediments) along the drainage ditch transecting the FFTA-MAAF.
- Installation and sampling of seven groundwater monitor wells within the Fort Riley installation boundaries.
- Sampling of six private wells located to the north of the FFTA-MAAF.
- Collection and analysis of six (including two re-samples) soil samples for polychlorinated biphenyls (PCBs) at two locations within the former fire training pit (including four samples also analyzed for Target Compound List [TCL] pesticides).

More detailed information on the samples collected during the SI, and the results, are presented later in this document.

2.3 ESI Purpose and Scope

Based on the results of the SI, the purpose of the ESI (June 1994 to April 1995) was to collect additional information regarding the vertical and horizontal extent and concentrations of contaminants in groundwater; further characterize the hydrogeologic environment, including the physical, chemical and biological parameters to support selection of a cost-effective remedial technology for groundwater at the FFTA-MAAF; evaluate the extent of off-post migration confirmed during the SI; and collect data to refine the contaminant migration and identify the drinking water wells actually or potentially contaminated by migration from the FFTA-MAAF.

The ESI for the FFTA-MAAF included the following environmental sampling activities:

- Collection and chemical analyses of soil gas and groundwater screening samples at 238 locations off-post for soil gas samples and 90 locations off-post for groundwater screening samples during Phase I, and 154 locations off-post for groundwater screening samples during Phase II. The investigation included all areas between the FFTA-MAAF and private wells to the north, analyzing for petroleum hydrocarbons and chlorinated solvents. The details of the two phases for the ESI are found in the overview Section 2.8.

- Collection and chemical analyses of soil samples at 29 boring locations off-post during Phase II.

- Installation of one piezometer on-post near the Kansas River and four groundwater monitoring wells off-post at the racetrack property.

- Collection and chemical analysis of four quarterly sampling events for the seven on-post wells and one piezometer, four off-post wells, and four to eight off-post private wells and one irrigation well. [Data from only the first three events through January 1995 are provided in this document.]

- Performance of a seismic reflection survey and electrical resistivity soundings to characterize depth to bedrock, the topography of the underlying bedrock surface, and geologic layering (if any) in the alluvial materials.

- Use of the U.S. Army Corps of Engineers (USACE) Site Characterization Analysis Penetrometer System (SCAPS) to collect deep alluvial groundwater screening samples at nine locations and to collect cone penetrometer (CPT) and electrical resistivity data at four of the same locations. These data were also used to confirm the bedrock depth deduced from the seismic study, and generally corroborated the seismic data.

- Monthly measurement of groundwater elevations at on-post and off-post monitor wells.

More detailed information on the samples collected during the ESI, and the results, are presented later in this document.

2.4 Soil Remediation Pilot Test Study Purpose and Scope

The purpose of the pilot test study was to evaluate the feasibility of selected technologies to remediate the soil at the FFTA-MAAF. The pilot test study included installation and testing of a SVE system in the area of PCE soil contamination at the FFTA-MAAF, and installation and testing of a bioventing system in the area of petroleum hydrocarbon and low level volatile organic compound (VOC) soil contamination within the boundaries of the former fire training pit. The SVE system focused on removal of VOCs from soil, while the bioventing system focused primarily on biodegradation of TPH from soil.

The pilot test study for the FFTA-MAAF included the following environmental sampling activities related to site characterization:

- Soils were sampled at 12 boring locations for chemical analysis, geotechnical parameters, and microbe colony counts.
- Soils were sampled from borings at eight well locations for geotechnical parameters.

More detailed information on the samples collected during the pilot test study and the results are presented later in this document.

2.5 Data Quality Objectives

During the SI and the ESI several types of data were collected to meet a variety of data quality objectives (DQOs). The type of data collected was determined by the data's intended use and the confidence level needed for that use. Three general categories have been developed by EPA to describe data quality assurance (QA) and quality control (QC) objectives (Ref. 29).

> Screening Objective. This objective for data quality is for use with quick preliminary assessment of the site. This includes rapid, non-rigorous methods of analysis and QA. The primary reason for this objective is to allow for the collection of the greatest amount of data with the least expenditure of time and money. The data collected for this objective have neither definitive identification of pollutants nor the definitive quantification of their confidence level. Although there is no quality assurance data collected with the data at this objective, a calibration, or performance check of the method, is required along with verification of the detection level. Methods are applied as per standard operating procedures and equipment manufacturer's specifications. The primary uses of this objective include, but are not limited to, delineation of pollutant plume in groundwater (e.g., headspace or soil gas analysis techniques) and for monitoring well placement.

> Verification Objective. This objective is used to verify analytical (field or lab) results. A minimum of 10 percent verification of results is required. This objective for data quality is intended to give the decision maker a level of confidence for a selected portion of the field screening data. The results of the 10 percent of substantial data gives an associated sense of confidence for the remaining 90 percent. Generally the methods used for this objective are more rigorous as to analytical methodology and QA. This objective is generally used to determine the extent and degree of contamination, verify the contamination plume in groundwater, and verify the pollutant identification.
>
> Definitive Objective. This objective is used to assess the accuracy of the concentration level as well as identify the analyte(s) of interest. This objective for data quality is applicable for data collection activities that require a high degree of qualitative and quantitative accuracy of all findings using rigorous methods of analysis and QA for "critical samples" (i.e., those samples for which the data are considered essential for making decisions). This objective gives the decision maker a confidence level for a select group of "critical samples" so he/she can make a decision based on a threshold level with regard to treatment, disposal, pollutant source identification, or delineation of contamination.

The specific DQOs for each sample type are described in the following sections.

The analytical methods used during the SI and the fractions analyzed included: All samples collected during the SI and ESI were analyzed by the laboratory for VOCs using EPA Method 8240, SVOCs using EPA Method 8270, PP metals using EPA Methods 6010 and 7000 Series, and TPH using EPA Method 8015 modified. Additionally, during the July 1994 sampling event the on-post wells were tested for Biochemical Oxygen Demand (BOD) using EPA method 405.1, Chemical Oxygen Demand (COD) using EPA Method 410.4, Total Organic Carbon (TOC) using EPA Method 9060, and Total Organic Halides (TOX) using EPA Method 9020. During that event VOCs were analyzed using EPA 8010, a method that reports chlorinated volatiles only, and at lower Practical Quantification Limits (PQLs) than 8240.

The field screening analyses employed modified EPA Methods 601 and 602. The modifications for both methods are:

1) The direct injection of the vapor from the headspace, rather than purge and trap;
2) A 3-point calibration curve and linear regression with a correlation coefficient of 0.99 or better, rather than a 5-point curve; and
3) Site and client specific list of analytes to be determined.

In addition to the aforementioned modifications, EPA Method 601 employed an Electron Capture Detector (ECD) rather than the Electrolytic Conductivity or Coulometric Detectors specified in the method.

Throughout this SI report, reference is made to detections of 1,2-dichloroethylene. Two isomers of 1,2-dichloroethylene exist; cis-1,2-dichloroethylene and trans-1,2-dichloroethylene. Where possible, the specific isomer detected has been reported as cis-1,2-dichloroethylene (c-1,2-DCE) or trans-1,2-dichloroethylene (t-1,2-DCE). However, the two isomers co-elute during analysis using EPA Method 8240, and concentrations of each isomer are not obtainable. In those cases where no isomer is distinguished, only DCE is used.

2.5.1 SI Data Quality Objectives

During the SI, soil gas samples, groundwater screening samples, soil/sediment samples, soil samples, groundwater samples, and private well water samples were collected.

The soil gas samples were collected as field screening data to delineate the soil contamination., if any was present. Two soil gas samples were to be collected from each location. However, due to elevated groundwater levels caused by regional flooding, soil gas samples could not be collected from the lower depths. Therefore groundwater samples were collected at these depths for field screening purposes. However, field screening results showed detections at a much higher range than expected. The DQOs for the groundwater screening samples were changed to include verification, and the samples were recollected and transported to a laboratory for analysis.

Soil/sediment samples were collected to obtain definitive data to determine the threat of migration of contamination via surface water migration. Samples were collected from the culvert area and transported to the laboratory for analysis. Soil samples were collected to obtain definitive data locating soil contamination. Seven on-post wells were installed and sampled to collect definitive data on the on-post groundwater contamination. Six of eight off-post private wells were sampled to obtain definitive data regarding the quality of the water supply in these wells. These private wells are located downgradient of the site.

2.5.2 ESI Data Quality Objectives

Phase I of the ESI included a soil gas survey, groundwater screening, and groundwater sample collection. The soil gas samples were collected as screening data to be used to delineate the horizontal extent of contamination. Groundwater screening was conducted to collect screening data with verification to delineate the horizontal extent of contamination. Groundwater samples were collected from the on-post wells to provide definitive data on the on-post groundwater contamination and to evaluate changes over time of the concentrations of contaminants in the groundwater.

Phase II of the ESI included groundwater screening sample collection, soil borings, groundwater sample collection, and deep alluvial groundwater screening samples. Groundwater screening was performed to provide screening data with verification to further delineate the horizontal extent of contamination. After reevaluating the DQOs, the objective was modified as there was a need for data with higher confidence. Soil borings were installed to collect definitive data on the off-post soil contamination as a possible source for groundwater contamination. Groundwater samples were collected from the on-post wells to provide definitive data on the on-post groundwater contamination and to evaluate changes over time of the concentrations of contaminants in the groundwater. Additionally, a piezometer was installed on-post and four wells were installed off-post to provide definitive data on the off-post groundwater contamination and to provide additional hydrogeologic information. Four to eight off-post private wells and an irrigation well were samples to obtain definitive data regarding the quality of the water supply in these wells. The

SCAPS was used to provide additional screening data of bedrock location as well as additional geologic information. The SCAPS was also used to collect deep alluvial groundwater screening samples with verification. This groundwater data was collected to investigate for the presence of dense non-aqueous phase liquids (DNAPLs).

2.5.3 Pilot Test Study Baseline Borings Data Quality Objectives

Pilot test study baseline soil borings were installed prior to the start of the pilot test study. A total of 32 soil samples were collected from 12 soil borings. These soil samples were collected to obtain definitive data to determine the concentration of contaminants in the soil prior to the start of the pilot test study. In addition, soil samples were analyzed to obtain chemical, geotechnical, and biological data that was necessary for the pilot test study design.

2.6 Overview of SI Activities

Sampling at the FFTA-MAAF in September through November 1993 was performed according to the High Priority Sites SAP (20 August 1993). There were three phases of sampling at MAAF. Based on threshold levels proposed in the High Priority Sites SAP, which were used as guidance to determine whether further work was needed (i.e., 10 μg/l for specific analytes or the sum of those analytes for soil gas/groundwater screening field analyses or 20 μg/l for total flame ionization detector [FID]). All of the on-post SI sampling locations and off-post locations are shown on Figures 2-1 and 2-2.

2.6.1 Phase I Activities

Phase I was performed during the weeks of 20 through 27 September 1993 and included locating the FFTA, performing a soil gas survey and groundwater screening at 40 locations including collection of 10 duplicate groundwater screening samples for laboratory analysis, collection of eight soil samples for chemical analyses, and collection of five surface soil samples from the drainage ditch at the FFTA-MAAF.

Locating FFTA. The FFTA was located by surveying from three known points at the end of MAAF runways, using distances from the aerial photographs taken in 1984, which were used to prepare the base map. The boundaries located in the field matched with visual differences in vegetation and soils (e.g., the surficial soils in the pit area were noticeably blacker with higher silt content than surrounding soils and the vegetation was sparser and less uniform than surrounding areas).

Magnetic Survey. A magnetic survey of the area was performed with a hand-held magnetometer to determine whether buried drums or other metallic debris were potentially present in the subsurface at the FFTA-MAAF. The survey was performed over the entire area of the Phase I soil gas survey (discussed in the following section). A variety of small metallic debris appeared to be present. In general, metallic objects that were relatively long and thin (e.g., buried cable, steel rods) in shape were noted. The magnetometer produced background readings within 1 foot on either side of these anomalies. Therefore, none of the detected anomalies appeared to be greater than 2 feet in width – the minimum width for a buried drum. Based on the results of the magnetic survey, there does not appear to be any buried drums or other sizeable metallic objects in the subsurface of the FFTA-MAAF and surrounding area.

Phase I Soil Gas/Groundwater Screening Survey. The soil gas survey consisted of collecting two samples at each of the 40 locations for analyses using field screening techniques. One sample was collected from a depth of 4 feet and the second sample from a depth of approximately 8 feet. The 4-foot samples consisted of a soil gas sample and were identified with an "MAAF" prefix. However, the 8-foot samples were collected as groundwater screening samples because groundwater was consistently encountered at depths of approximately 8 feet. These samples were identified with an "MAAF" prefix followed by a "W". The Phase I soil gas survey also included the collection of 10 groundwater screening samples in duplicate and were identified with an "FP" prefix. One portion of the duplicate sample was analyzed in the field using groundwater headspace analyses to provide qualitative information. The other portion of the sample was analyzed in a laboratory to provide quantitative results. These groundwater screening samples were recollected at 10 of the same 40 sample locations. They were recollected for laboratory verification because the field screening results of the original samples showed detections at a much higher range than expected.

The soil gas samples and the headspace of groundwater screening samples were analyzed for chlorinated VOCs and petroleum constituents using modified EPA Methods 601 and 602. These samples were analyzed in the field using a portable gas chromatograph (GC) that can report detection for 32 analytes, with the GC calibrated for 16 analytes or compounds including chlorinated solvents and petroleum hydrocarbons. The target analytes for the field analyses are listed on Table 2-2. For groundwater screening samples collected in duplicate, the portion transported to the laboratory was analyzed for VOCs using EPA Method 8240.

Soil Sampling. Eight soil samples were collected at four locations, with two samples collected from different depths at each location. The sample locations were H7, K7, M8, and NY; all these locations are within areas of either petroleum hydrocarbon detections or PCE detections. The sampling depths ranged from 2 to 5 feet.

Soil samples were analyzed for VOCs using EPA Method 8240, semi-volatile organic compounds (SVOCs) using EPA Method 8270, PP metals using EPA Methods 6010 and 7000 Series, and TPH using EPA Method 8015 modified. TPH is reported as a gasoline range organic (GRO) fraction and a diesel range organic (DRO) fraction.

Surface Soil Sampling. Five surface soil samples, labeled as sediment samples, were collected in the drainage ditch. The five soil (sediment) samples were analyzed for VOCs using EPA Method 8240 and SVOCs using EPA Method 8270.

PCBs. On 4 April 1994, four soil samples were collected in duplicate at 3- and 6-foot depths from two soil borings at the southeast and northwest of well FP-93-04, at the center of the FFTA-MAAF. They were analyzed for PCBs by field screening and laboratory analysis. Of the duplicate samples sent to the laboratory, two were analyzed for PCBs and TCL pesticides, and two were analyzed for PCBs only using EPA Method 8080. The samples were found to have elevated levels of petroleum products, which interfered with the detection of PCBs. These two samples were recollected from the same area on 6 June 1994 for TCL pesticide and PCB analyses. Samples were collected at 3- and 6-foot depths from the soil boring located to the northwest of well FP-93-04.

2.6.2 Phase II Activities

Phase II was performed immediately after the Phase I activities from 29 September 1993 to 1 October 1993. Phase II was an expansion of the Phase I soil gas/groundwater screening grid and consisted of two separate sampling events, Phase IIa and Phase IIb.

Phase IIa Soil Gas/Groundwater Screening Survey. Phase IIa soil gas sampling consisted of a 12 sample location expansion. This expansion was performed to further delineate the extent of contamination from the FFTA. This soil gas survey also consisted of collecting two samples at each location and analyzing them in the field. One sample was collected from a depth of 4 feet and the second sample from a depth of approximately 8 feet. The 4-foot samples consisted of a soil gas sample and were identified by an "MF" prefix. However, the 8-foot samples were collected as groundwater screening samples because groundwater was consistently encountered at depths of approximately 8 feet and were identified by an "MF" prefix followed by a "W".

Phase IIb Soil Gas Survey. Phase IIb consisted of a six more sample locations toward the east of Phase IIa. This expansion was performed to aid in defining the boundaries of contamination from the FFTA-MAAF. These samples were collected in the same manner as Phase IIa soil gas samples.

Phase II soil gas samples and the headspace of groundwater screening samples chlorinated VOCs and petroleum constituents using modified EPA Methods 601 and 602.

2.6.3 Phase III Activities

Phase III was initiated during the week of 27 October 1993 and consisted of the installation and sampling of seven groundwater monitor wells within the uppermost saturated zone. Also, based on the initial findings from Phases I and II of the SI, Phase III was expanded to include the sampling of six of the eight existing (irrigation well I-1 did not exist at the time) private groundwater water wells located to the north of the Fort Riley installation boundary. The location of the private wells are depicted on Figure 2-2.

All on-post groundwater monitor wells were installed and sampled in accordance with the Basic Documents (Ref. 8), and all off-post private wells were also sampled in accordance with the Basic Documents, which included a method obtained from a U.S. Army document (Ref. 30). Groundwater samples collected from monitor wells and private wells during Phase III were analyzed in a laboratory for VOCs using EPA Method 8240, SVOCs using EPA Method 8270, PP metals using EPA Methods 6010 and 7000 Series, and TPH using EPA Method 8015 modified.

2.6.4 Field Modifications to the SI

The High Priority Sites SI had three Technical Memoranda, of which only Technical Memoranda #2 and #3 apply to the FFTA-MAAF. These are provided in Appendix A.

As described in the Draft Technical Memorandum #3/High Priority Sites, the High Priority Sites SAP specified that a ground penetrating radar (GPR) survey would follow location of the former pit area with land surveying techniques to provide additional information on the location of the pit and to determine that there were no buried containers or other subsurface features present at the site. The area of the former pit was located on 15 September 1993 using traditional land survey techniques and once the pit was field located, the location of the pit became readily apparent based on changes in vegetation and soils. Further, utilities in the area were identified by Fort Riley personnel. Because the GPR survey is not the most cost-effective means of fulfilling the remaining objective (i.e., determining whether containers were buried at the site), it was decided that in lieu of the GPR survey, a metal detector (Schonstedt Model GA-52C) be used to survey the entire area of the proposed soil gas grid. This metal detector is capable of locating an 18-inch by 3/4-inch pipe up to a depth of 7 feet and can detect larger objects at greater depths.

As described in the Draft Technical Memorandum #2/High Priority Sites, in the spring of 1993 and prior to the SI, the Kansas Department of Health and Environment (KDHE) performed groundwater sampling at the speedway just north of the installation boundary. One of the wells at the speedway was sampled and showed that chlorinated solvents were present in groundwater (PCE, dichloroethylene [DCE], trichloroethylene [TCE], and vinyl chloride).

Based on soil gas surveys and collection of groundwater screening samples during the SI, both around the immediate area of the former pit and along the nearby installation boundary, petroleum hydrocarbons and some chlorinated solvents (e.g., PCE, DCE) were also present in groundwater around the former pit. The regional groundwater flow direction is along the Kansas River to the north and east. Additional private wells (i.e., four properties with a total of eight private wells) are located within approximately one-half mile to the north of the installation boundary at this location. Wellheads at two of the wells at the speedway were underwater as a result of residual surface water from the summer flooding in the area. Groundwater sampling at the other six private wells was therefore proposed to be performed as part of the SI. Samples were collected from existing taps at locations in the systems as close to the wellhead as possible, and prior to any on-site treatment. The samples were analyzed for the same parameters as the groundwater wells installed in and around the former fire training pit.

<u>Soil Sampling Modifications</u>. Four soil samples were collected in the vicinity of the former pit and the former drum storage area. These samples were collected at locations that yielded high detection during the soil gas and groundwater screening surveys and served to confirm the soil gas results and provide definitive data.

<u>Surface Soil Sampling</u>. The five surface soil samples collected in the drainage ditch, labeled as sediment samples, were not included in the High Priority Sites SAP but were added to the SI activities once it was determined that the ditch transected the former pit location. These samples were collected in the vicinity of the FFTA and downgradient to determine if contaminants from the FFTA were being transported via runoff and surface flow. These samples were collected in

response to high levels of VOCs detected during the soil gas and groundwater screening surveys and to assess whether or not VOC contamination was being transported via surface water flow.

PCBs. Soil samples were collected and analyzed for PCBs as a precautionary measure to eliminate PCBs as a form of contamination to assess whether or not Fort Riley ever used oils from transformers for fire training.

2.7 ESI Approach Based on SI Results

The results of the SI indicated that further investigations were warranted at the FFTA-MAAF for soils and groundwater. Groundwater contamination at the FFTA-MAAF is present at concentrations above MCLs, but there is no current use of groundwater for drinking water purposes at the FFTA-MAAF. However, drinking water wells not within the FFTA-MAAF are potentially affected. Further, soil contamination, although not posing a threat for on-site exposures, is at levels above state cleanup guidelines for petroleum hydrocarbons and may represent an ongoing source for contamination of groundwater. The ESI did not include additional data collection to evaluate potential migration via surface water or air, and only addressed soil to the extent that soil potentially presents an ongoing source of groundwater contamination.

The SI data focused principally on the immediate area of the FFTA-MAAF and the area between the former pit and the Fort Riley installation boundary to the north. Once the initial findings of the SI indicated that groundwater contamination was present, the SI was modified to include the collection of groundwater samples from private wells located downgradient of the site. The ESI included investigations of both the immediate area of the former fire training pit as well as the areas north of the installation boundary where groundwater contamination was detected. Throughout the ESI, the activities were segregated into those that were performed on-post and those that were performed off-post, with the division between these activities based simply on whether they were performed on or off of Fort Riley property. The procedures and methodologies employed in the off-post investigations were the same as those used in the on-post investigations.

Similar to the SI for the FFTA-MAAF, the ESI included separate phases of investigation. The phasing of activities was important because it allowed for increased levels of investigations based on findings of the ESI as the data were being generated. Further, use of a phased approach resulted in a more cost-effective investigation overall since the findings of the ESI could not be predicted. The phased approach used was consistent with the phased approach used in the SI, which was effective in delineating areas of soil and groundwater contamination in the area of the former fire training pit.

2.8 Overview of ESI Activities

The ESI of the FFTA-MAAF was implemented in accordance with the ESI SAP (24 May 1994). There were three phases of sampling proposed at the FFTA-MAAF. The phases were organized in on-post and off-post activities. Phase I was initiated in June 1994 and included geophysical surveys to characterize the subsurface geology (seismic reflection on-post, and resistivity on-post and off-post), quarterly sampling of groundwater wells (on-post and off-post), soil gas and groundwater screening surveys (off-post), monthly measurements of groundwater elevations (on-post and off-post), and water quality testing (on-post).

Phase II was initiated in August 1994 and included activities to evaluate the hydrogeologic characteristics as well as the vertical and horizontal extent of contaminant migration in the off-post areas. Phase II included an expanded area of investigation for the groundwater screening survey, installation and sampling of one on-post piezometer and four off-post groundwater monitor wells, off-post soil sampling, and collection of deep alluvial groundwater screening samples (on-post).

Except for the installation of the deep alluvial well, all Phase I and II activities were completed with the quarterly groundwater sampling and monthly groundwater elevation measurements through April 1995. (This document reports information collected through January 1995.)

The ESI SAP served as the planning document for implementation of the ESI at the FFTA-MAAF. When field conditions arose that required revisions to field sampling activities not already discussed in the ESI SAP, Berger consulted with CEMRK, Fort Riley, and the regulatory authorities (EPA and KDHE), prior to implementing changes to the ESI SAP. Also, proposed modifications, including the rationale for the proposed modifications, were presented in a written Technical Memorandum to all parties. These Technical Memoranda are provided in Appendix A. All changes to the ESI were incorporated into this SI report, consistent with the provisions of the IAG. In addition, during actual field activities, Berger provided written weekly status reports to present preliminary findings and identify potential modifications to the ESI SAP that may have been necessary.

2.8.1 Phase I Activities

Geophysical Survey. Geophysical surveys, including high-resolution seismic reflection and vertical resistivity sounding, were performed to evaluate the subsurface stratigraphy of alluvial sediments below the depth of 30 feet, determine depth to bedrock, and characterize bedrock topography. Details regarding this survey are in the Technical Memorandum Preliminary Interpretation provided in Appendix A.

> *High Resolution Seismic Reflection Survey*. This survey was performed to determine the depth to bedrock, bedrock topography, and existence of any clay layers/lenses, if present. Berger performed the seismic reflection survey in the period between 20 and 28 June 1994. To conduct the test, 48 geophones were laid out from east to west with a 1-foot spacing. The shot point was set at locations of 1, 12, and 24 feet from the first geophone. A sledge hammer and Buffalo gun were utilized as seismic sources for the walkaway test. Upon completion of this walkaway test, the parameters selected for field seismic data acquisition included a geophone spacing of 2.5 feet, shotpoint spacing of 5 feet, and shot offset (distance between the shotpoint and the nearest geophone) of 10 feet. A total of five seismic lines were established: Line 1 (10,000), 730 feet; Line 2 (20,000), 1,540 feet; and Line 3 (30,000), 1,525 feet, were oriented in the east to west direction; while Line 4 (40,000), 600 feet; and Line 5 (50,000), 585 feet, were oriented in the north to south direction. The location of these lines is shown in Figure 2-3.

Vertical Resistivity Sounding. The primary purpose of the survey was to locate depth to bedrock, with a secondary objective of identifying clay lenses and other major lithological layers. The vertical soundings were placed along and between seismic lines and in areas beyond the area of the seismic survey to assist in the interpretation of subsurface lithology. Identification of bedrock and other features is possible due to differences in resistivity between the overburden and the bedrock. These differences can be identified by measuring the voltage drop and resistivity (voltage drop/current) when a known current flows through the earth between carefully spaced electrodes. Following each reading, the electrodes are spaced further apart, allowing the current to penetrate deeper into the ground. Berger performed an electrical resistivity survey the week of 27 June 1994. This survey consisted of 14 vertical soundings (locations R1 through R14), as shown in Figure 2-3. Eleven soundings were performed on MAAF (nine south of the levee and two north of the levee), and three were located on the racetrack north of MAAF. (One sounding failed to produce meaningful data and was not included in the data analysis and modelling. The electrical interference from the fiber optic cable caused this failure.) A Bison 2350 Earth Resistivity Meter, with four electrodes attached by cables, was used to generate the current and to measure the resistivity at each spacing.

When the Schlumberger array was used, most of the time only the current electrodes were moved. The current electrodes were expanded about six times per decade of distance. When the Wenner array was used, all four electrodes were moved as the electrode separation increased, resulting in a longer operation time.

Electrode spacings were selected to ensure that penetration of current to bedrock would occur. For the Wenner array, readings were taken at electrode spacings of 3, 5, 8, 12, 20, 30, 40, 60, 80, 100, and 150 feet. For the Schlumberger array, readings were taken with an inner electrode spacing of 1.64 feet and an outer spacing of 5, 8, 12, 20, 30, 40, and 60 feet. Additional readings were taken with an inner spacing of 15 feet and an outer spacing of 40, 60, 80, 100, 150, and 200 feet. Duplicate readings at 40 and 60 were taken for each inner spacing to facilitate data interpretation.

Quarterly Groundwater Sampling. Groundwater samples were collected during the months of July 1994, October 1994, January 1995, and April 1995 (April data are not included in this document) from the seven on-post wells (FP-93-01 through FP-93-07). These wells are shown in Figure 2-2. All samples collected during the ESI were analyzed for VOCs using EPA Method 8240, SVOCs using EPA Method 8270, PP metals using EPA Methods 6010 and 7000 Series, and TPH using EPA Method 8015 modified. The upgradient well (FP-93-07) was sampled first. Then, wells FP-93-01, FP-93-02, and FP-93-03 were sampled prior to moving to the interior of the airfield and sampling wells FP-93-06, FP-93-05, and FP-93-04, in this order. Prior to the installation of dedicated bladder pumps in the monitor wells, the order of sampling went from least contaminated to most contaminated wells based on the results of the SI.

To more clearly enumerate the specific off-post private wells and irrigation well that were sampled during each event, the following table was created.

Summary of Private Well Sampling Events

Private Well ID	SI	ESI			
	October 1993	July/August 1994	October 1994	January 1995	April 1995
B-1	✓	✓	✓	✓	✓
F-1	✓	✓	✓	Not Sampled - Shut Down for Winter	✓
F-2	✓	✓	✓		✓
M-1	✓	✓	✓	✓	✓
N-1	✓	✓	✓	✓	✓
R-1	✓	✓	✓	Not Sampled - Shut Down for Winter	✓
R-2	Not Sampled Due to Flooding	✓	✓		✓
R-3		✓	✓	✓	✓
I-1	Not Included in Sampling Events		✓	✓	✓

Quarterly Sampling of Private Wells. Groundwater samples were collected from the four to eight off-post private wells (R-1, R-2, R-3, M-1, F-1, F-2, B-1, and N-1) and irrigation well (I-1) north of the FFTA-MAAF. These wells are shown in Figure 2-2. These samples were collected at the same time as the seven on-post wells and analyzed for the same parameters: VOCs using EPA Method 8240, SVOCs using EPA Method 8270, PP metals using EPA Methods 6010 and 7000 Series, and TPH using EPA Method 8015 modified. The wells at and within the racetrack were sampled last.

The high volume of pumping (about 22 millions gallons from July to September 1994) from the irrigation well (I-1) north of the MAAF had the potential to influence the migration of contaminants detected in groundwater at the FFTA-MAAF and at the off-post properties. Therefore, the October 1994 sampling event included, for the first time, irrigation well I-1. A 1-inch diameter water level indicator pipe was installed along the outside of the well at the time the well was constructed. This pipe extends to the full depth of the well and is located in the gravel pack surrounding the well screen. The depth of the interval over which the access pipe is open to groundwater, however, is not known. The groundwater sample collected from this 1-inch pipe was transported to a laboratory for chemical analyses for the same parameters, VOCs using EPA Method 8240, SVOCs using EPA Method 8270, PP metals using EPA Methods 6010 and 7000 Series, and TPH using EPA Method 8015 modified.

Soil Gas/Groundwater Screening Survey. During the period 20 to 30 June 1994, a soil gas and groundwater screening survey was performed in the area between the Fort Riley installation boundary north of the FFTA-MAAF and the private wells further to the north where chlorinated solvents and/or petroleum hydrocarbons have been detected. The survey was performed using a grid with an overall spacing of 50 feet. Over the area as a whole, samples were collected at every other grid point along every other grid line, producing a 100-foot sample spacing. In specific areas of greater concern (i.e., surrounding supply wells, interior of speedway track, former culvert), samples were collected at every other grid point along every grid line, producing a 75-foot sample spacing. As shown in Figure 2-4, the survey included 238 sampling locations.

Two soil gas samples were collected at each Phase I sample location; a shallow soil gas sample and a deep soil gas sample. The shallow sample was collected at a depth of 4 feet below ground surface (bgs). The deep sample was collected at a depth of 16 feet bgs. However, if the groundwater was encountered above 16 feet but below 8 feet, then the deep sample was collected at a depth directly above the groundwater table. If groundwater was encountered above 8 feet, then a groundwater screening sample was collected at the interface. These samples were labeled with prefixes "ESISG4, ESISG12, and ESISG16" followed by the location number.

Groundwater screening samples were collected in duplicate at 78 of the 238 sampling locations by driving sampling probes to the necessary depth. The groundwater screening locations are included on Figure 2-4. These samples were labeled with the prefix "ESIGW" followed by the location number. Ten percent of the 78 groundwater screening samples were transported to a laboratory for chemical analyses.

Soil gas samples (and headspace of groundwater screening samples) were analyzed for petroleum compounds and chlorinated VOCs using modified EPA Methods 601 and 602. These samples were analyzed in the field using a portable GC. The groundwater screening samples transported to a laboratory were analyzed for VOCs using EPA Method 8240.

Groundwater Level Measurements. To assess changes in groundwater elevations and the potential impact on groundwater flow directions, the seven on-post monitor wells (FP-93-01 through FP-93-07) at the FFTA-MAAF were monitored monthly from June 1994 through April 1995.

Water Quality Testing of Groundwater. In addition to chemical analyses of groundwater from on-post monitoring wells, testing provided background information for evaluation of potential in-situ remedial technologies. Groundwater samples were collected from the four on-post monitoring wells (FP-93-02, FP-93-04, FP-93-05, and FP-93-07) and analyzed for water quality parameters during the quarterly sampling event in July 1994. These samples were analyzed for:

- BOD using EPA Method 405.1
- COD using EPA Method 410.4
- TOC using EPA Method 9060
- TOX using EPA Method 9020

The results of this testing provided information on whether current groundwater conditions are aerobic or anaerobic, on the ability of the groundwater environment to promote natural degradation of the contaminants, and on the quantities of carbon compounds naturally present in the groundwater environment relative to the concentrations released from the FFTA-MAAF.

2.8.2 Phase II Activities

Expanded Groundwater Screening Survey. Migration to the north and west is via the groundwater pathway and there were no suspected sources. Therefore, the groundwater screening samples by themselves provide the necessary data. The Phase II groundwater screening samples were collected as an expansion of the Phase I samples at 154 locations at the off-post property, north of FFTA-MAAF on 23 August through 1 September 1994, and 15 September through 17 September 1994. Phase II consisted of three sampling events, Phase IIa, Phase IIb, and Phase IIc. This expansion delineated the extent of groundwater contamination on the off-post properties. The prefix used for identifying these samples was "ESIGW2-" followed by the location number. The groundwater screening samples were collected and analyzed utilizing the same procedures used during the Phase I groundwater screening survey. The screening samples were analyzed on-site using the groundwater headspace techniques, and the samples were analyzed using modified EPA Methods 601 and 602. Twelve of the 105 groundwater screening samples collected during Phase II were transported to a laboratory for duplicate analysis.

Phase IIa groundwater screening samples were located to the north and west of the existing Phase I grid. Initially, a line of 16 samples were collected north of the Phase I grid (line North 1); the samples were spaced at 75 feet and aligned east to west. These locations are shown within Phase IIa in Figure 2-4. A similar line of 16 samples were collected west of the Phase I grid, aligned approximately north to south. The Phase II threshold levels used to determine whether to expand the sampling grid were the same as those used in the SI. The field analytical results for the initial 32 groundwater screening samples indicated detections at three locations below the established threshold levels. Samples were then collected along line North 2, south of the initial east-to-west line. The field analytical results of line North 2 revealed that there were detections at seven locations, four of which were above the established threshold levels. Therefore, samples were collected along line North 3, north of line North 2 and south of line North 1. There were four locations along line North 3 with detections, three of which were above the established threshold levels. The Phase IIa sample locations (1 to 64) are shown in Figure 2-4.

These Phase IIa results identified three areas that needed further investigation, which are sample locations 65 through 105, shown as Phase IIb, in Figure 2-4:

> Area 1. There were detections at the eastern end of each of the east-west lines at lines North 1, 2, and 3. Several of the detections exceeded the threshold levels. Therefore the Phase IIb expansion was extended toward the east. Initially six groundwater screening samples (locations 65 - 70) were collected east of lines North 2 and 3 at a 75-foot spacing. Because there were detections in some of these samples, additional samples were collected on the same spacing towards the north through location 105, at which point two adjacent samples were without detection. Line North 4 is locations 65 and 66, line North 5 is locations 91 - 95, line North 6 is locations 96 - 100, and line North 7 is locations 101 - 105.
>
> Area 2. There were two detections along the north-south line. The detections did not exceed threshold levels; however, the area to the west was investigated further to more fully characterize the site. Therefore, the Phase II expansion included locations (71 - 76) to the west of the two detections along the north-south line.

Initially six samples were collected to the west of the initial north-south line, but since there was a detection, an additional three samples were collected further west on a 75-foot spacing that did not have any detections.

Area 3. Location 34 had the highest concentration of any compound and appears to be isolated (there were no detections at the surrounding samples). There were no detections downgradient of location 34. However, there were few samples between location 34 and the speedway. Therefore, the Phase IIb included locations south of location 34 within the wooded area on the western portion of the speedway to determine whether there is a larger area of contamination associated with location 34 that has not been previously identified. Eleven samples (77 - 87) were collected south of sample location 34 on a 75-foot spacing.

Because detections of VOCs were measured along the exterior margins of the sampling grid, additional groundwater screening samples were collected to delineate the horizontal extent of groundwater contamination to the north of the speedway. The following 26 samples were initially collected as Phase IIc as shown in Figure 2-4:

- Two samples (locations 106 - 107) were collected at the end of line North 6, extending this line toward the east.

- Six samples (locations 108 - 113) were collected on line North 7, extending this line toward both the east and west. Three samples were located on each end of the existing line.

- Twelve samples (locations 114 - 125) were collected on line North 8 in an east-west line at a distance of 150 feet north of line North 7. The spacing between each sample location along the line was 75 feet, consistent with the east-west spacing of the remainder of the sampling grid.

- Four samples (locations 126 - 129) were initially collected along line North 9 in an east-west line 150 feet north of line North 8, however, extending toward the west (directly south of the irrigation well I-1). One additional sample was then collected at each end of the line (locations 130 - 131). The spacing between each sample location along the line was 75 feet, consistent with the east-west spacing of the remainder of the sampling grid. These samples provide data on groundwater directly south of the irrigation well.

Irrigation Well Sampling. Because there were detections along line North 9, six samples (locations 140 - 145) were collected along line North 9a, which is 100 feet north of line North 9, and eight samples (locations 132 - 139) were collected along line North 10, which is 75 feet north of line North 9a. Sampling continued north until the east-west sample line was at the irrigation well (I-1). These 49 samples collected under Phase IIc are shown in Figure 2-4. Six samples (locations 146 through 151) were collected directly south and upgradient of the irrigation well.

Figure 2-4 also depicts the location of an irrigation well placed into service in the spring of 1994. This well is located approximately 1,000 feet north of Phase II groundwater screening location 57 and due north of the MAAF FFTA. A low flow pump was used to collect a sample from this well which was analyzed in the field using modified EPA Method 601 and 602. There were no detections.

Groundwater Screening Data. The Phase I groundwater screening survey was performed in July 1994. The Phase II groundwater screening survey was initiated in August 1994 and continued into September 1994. Potential changes in groundwater concentrations at a location over time should be considered prior to performing a comparison of all the groundwater screening data collected as part of the ESI.

Therefore, six locations sampled as part of the Phase I and II groundwater screening survey were sampled again. The locations sampled were Phase I locations 98, 159, and 229 and Phase II locations 34, 46, and 32. This sampling was performed 26 August 1994 through 8 September 1994 when the Phase II additional groundwater screening samples were collected.

Phase I locations 98 and 229 and Phase II locations 46 and 32 were sampled again to assess changes in concentrations over time. Phase I location 159 was sampled again to assess whether contaminants had migrated from areas immediately to the south with previous detections. Phase II location 34 was sampled again due to the relatively high concentration of DCE (470 μg/l) detected during the initial sampling.

Soil Sampling. Soil samples were collected at 29 boring locations on 23 to 29 August 1994. At 26 boring locations (SB-1 through SB-23 and SB-27 through SB-29), samples were collected from depths of 2 to 3 feet and 7 to 8 feet. At the remaining three locations (SB-24 through SB-26), shallow soil samples were collected from the 2- to 3-foot interval only. The prefix used to identify these samples were "FPOP", then the soil boring location (e.g., "SB-#") and followed by the suffix "-1" for the shallow zone and "-2" for the deeper zone. The soil boring locations are shown in Figure 2-5. All soil samples were analyzed for VOCs using EPA Method 8240.

Monitoring Wells Installation. Groundwater levels during the SI in September and October 1993 were higher than normal due to the regional flooding that occurred in July 1993. The seven on-post monitor wells (FP-93-01 through FP-93-07) indicate that normal groundwater depths are about 18 to 20 feet beneath the surface as measured since June 1994. Depth to groundwater was 8 to 9 feet in October 1993 and approximately 12 feet in January 1994. One piezometer (FP-94-12PZ) was installed at the northern edge of the levee, outside the northwest corner of the airfield in July 1994. Because this piezometer is located close to the Kansas River, the groundwater levels in the piezometer reflect changes in water levels in the Kansas River more quickly than the existing monitor wells.

Well R-3, in combination with the seven on-post monitor wells (FP-93-01 to FP-93-07) used to measure groundwater elevations, did not provide sufficient data to characterize groundwater flow directions and gradients across the off-post properties. Therefore, four monitoring wells (FP-94-08 through FP-94-11) were installed on off-post properties to provide groundwater elevation data that can be used to form a better understanding of groundwater movement across the off-post properties. Two of the wells (FP-94-09 and FP-94-11) were installed in areas of detected contamination and provide additional data in the downgradient direction of groundwater flow (to the north of the FFTA-MAAF). The other two wells were installed to the northeast (FP-94-10) and northwest (FP-94-08) of the FFTA-MAAF so that groundwater elevation data can be used to evaluate groundwater flow gradients across the FFTA-MAAF. The well locations are shown in Figure 2-2. The four wells were installed the week of 26 August 1994 using driven stainless steel wellpoints.

The on-post wells were drilled using hollow stem augers and each one was constructed with polyvinyl chloride (PVC) screen and riser pipe. This construction included placing a filter pack around the screen (and seal above the screen) as the augers were withdrawn. Off-post wells were originally constructed to be used as piezometers to collect water level data. Off-post wells were drilled to the water table using 2-inch diameter hand augers. A 10-foot long, stainless steel, 2-inch nominal wellpoint screen and steel riser pipe were then driven approximately 6 feet below the water table. Since the diameter of the well casing was slightly larger than the drilled portion of the borehole, there was no annulus. Gaps existing around the well casing at the surface were sealed with bentonite. Stainless steel was used to construct the wells due to its ability to withstand the applied driving force. No formal boring logs were prepared because geologic descriptions were taken from soil cuttings brought to the surface during hand augering and therefore exact depth intervals could not be established. Copies of the field notes are provided in Appendix E.

> Groundwater Level Measurements. The groundwater elevation was measured monthly in the four off-post wells and the on-post piezometer at the same time as the seven on-post wells.
>
> Quarterly Sampling. The four off-post monitoring wells and on-post piezometer were sampled to assist in evaluating changes of concentrations in groundwater since the beginning of the ESI. Samples were collected from the wells and subsequently during the ESI quarterly (January and April 1995) sampling. These samples were analyzed for the same chemicals as the other wells.

SCAPS. The SCAPS investigation occurred between 28 November and 2 December 1994. The SCAPS is a hydraulic system that pushes a penetrometer through unconsolidated materials. For FFTA-MAAF, the SCAPS rig was used to collect deep, alluvial groundwater screening samples (above the bedrock surface) and to collect CPT/resistivity data from the surface to the top of bedrock to identify geologic layers.

Nine locations (as shown in Figure 2-6) were identified for collection of deep alluvial groundwater screening samples. The rationale for selecting each location is as follows:

CP-1:	Adjacent to monitor well FP-93-01 (northwest of FFTA) which is hydraulically and bedrock topographically downgradient of the FFTA
CP-2:	Northeast of the FFTA on a bedrock topographic high point
CP-3:	Near monitor well FP-93-02 (northeast of FFTA) which is also hydraulically and bedrock topographically downgradient of the FFTA
CP-4:	Approximately 175 feet to the west of FFTA in a bedrock depression

CP-5: At the former drum storage area east of the former fire training pit

CP-6: South of monitor well FP-93-05 in a bedrock topographic depression

CP-7: South of FFTA (200 feet) along a bedrock topographic channel (southwest direction from FFTA) and south of resistivity point R4

CP-8: South of FFTA (200 feet) along a bedrock topographic channel (southeast direction from FFTA)

CP-9: Adjacent to monitor well FP-93-05 (10 feet) and east of the former drum storage area, in a bedrock low area

Groundwater screening samples were collected in duplicate at sample locations CP-1 through CP-9. Groundwater screening samples were collected using the SCAPS rig equipped with a Hydropunch II™ Sampler. The Hydropunch II™ Sampler consists of a 5-foot disposable PVC screen and steel tip that are inserted into push rods. After reaching refusal, the rods were pulled back to expose the screen to the aquifer immediately above the bedrock. The samples were collected with a small diameter Teflon bailer. The headspace of the samples were analyzed in the field for VOCs using an on-site GC by modified EPA Methods 601 and 602. In addition, sample duplicates were collected at each location, transported to a laboratory, and analyzed for VOCs using EPA Method 8240.

Four locations (CP-4, CP-5, CP-6, and CP-9) were selected for the collection of CPT and electrical resistivity data. These samples were collected at separate, undisturbed locations several feet from the equivalent groundwater screening push locations. The CPT and resistivity devices were mounted on a single probe, and the data from the two were collected simultaneously during a single push. CPT/resistivity data were recorded in a computer file as the probes were advanced and displayed on the cabin monitor in real time.

For both types of pushes, the rods were pushed to refusal. Refusal is defined as approximately 36,000 pounds per square inch (psi) of hydraulic pressure, which is marginally below the breaking strength of the rods. The depth of the rod tip is determined with a motion transducer (mounted at the top of the hydraulic ram) and recorded on the on-board computer. To prevent vertical cross-contamination, after both the groundwater screening pushes and the CPT/resistivity pushes, the holes were grouted as the probes were retracted. Decontamination of all downhole equipment was performed with the steam cleaner that accompanies the SCAPS rig using Fort Riley's potable water. A duplicate and QA sample was collected at CP-8. A rinseate field blank sample was collected to check for cross-contamination and proper decontamination of the Hydropunch equipment.

2.8.3 Field Modifications to the ESI

Copies of Technical Memoranda #1 through #6 are provided in Appendix A.

<u>Expanded Groundwater Screening Survey (Technical Memoranda #1, #2, #6)</u>. Because soil gas and groundwater screening concentrations were above the Phase I thresholds levels, Phase II soil

gas/groundwater screening samples and off-post soil sampling were appropriate. However, revisions to the planned additional sampling within the Phase I grid to refine areas of contamination, additional sampling along the exterior of the Phase I grid to define the limits of contamination, and sampling at the same depths and for the same analytes as performed during the Phase I were warranted based on the Phase I findings.

First, the initial Phase I grid covered the extent of the off-post properties, and the Phase I data adequately identified areas of contamination. Therefore, additional refinement of the areas of contamination within the Phase I sampling grid was not warranted using soil gas/groundwater screening sampling techniques.

Second, detections indicated that additional Phase II sampling was appropriate to the north and west of the existing Phase I grid. The means of migration to these areas is clearly via the groundwater migration pathway. Therefore, groundwater screening samples in these areas by itself would provide the necessary data.

SCAPS/CPT (Technical Memoranda #5 and Addendum). The ESI SAP proposed the installation of one deep alluvial well as part of the Phase I on-post activities. The detected concentrations of PCE, TCE, and DCE in groundwater were well below the limits of solubility for these substances. Although higher concentrations of chlorinated VOCs may be present at other locations in the groundwater environment, these data indicated that DNAPLs may not be present as a separate phase since the releases may not have exceeded the limits of solubility. Therefore, one deeper alluvial well was included as part of this ESI to evaluate whether DNAPLs occur at a depth below the current groundwater sampling depth. Installation of the deep alluvial well was to follow geophysical investigations during Phase I.

A more detailed interpretation of the geophysical data was performed as described in Technical Memorandum #5. This included preparation of a bedrock surface topography map and identification of potential low permeability layers in the alluvial materials overlying bedrock. The contour map was created by interpolating the bedrock elevation data derived from the seismic and resistivity data.

Both the bedrock contour map and the cross sections were created with three assumptions: (1) the velocity used for the depth calculation is correct; (2) the clay and bedrock are correctly represented by the reflectors; and (3) the layered models used for the resistivity data simulation closely represent changes in subsurface lithology. To confirm these three assumptions and verify the results of the geophysical surveys, additional field data were required. Also, the reflectors depicted on the cross sections were believed to represent actual subsurface materials and were not expected to be shown as remnants of multiple reflections from a shallower reflector.

The geophysical data were intended to be used to provide insights into the character and trends of the top of the bedrock surface and the presence of low permeability layers between the water table and the top of bedrock. The assumptions used in interpreting the geophysical data did not account for lateral heterogeneities that exist within the geologic materials. Thus, actual layer thicknesses and depths may vary from that predicted, even with additional field data being collected to verify the data interpretations.

Technical Memorandum #5 proposed additional data collection to verify the geophysical survey results. Specifically, it proposed that the SCAPS rig be used to collect deep alluvial groundwater screening samples, CPT data, and electrical resistivity data to evaluate geologic layering of the alluvial materials between the surface and the top of bedrock and to evaluate groundwater quality in the alluvial materials immediately overlying bedrock.

The CPT/resistivity data showed that there are few clay layers present beneath the site. Therefore, any DNAPLs migrating from the FFTA would be expected to move vertically towards the top of bedrock with minimal lateral deflection.

The SCAPS data on depth to bedrock indicated that the depth to bedrock was deeper than initially predicted, but the projected shape of the bedrock surface is similar to that initially predicted. Therefore, the groundwater screening samples were in appropriate locations to determine whether DNAPLs were present beneath the site. The CPT/resistivity and SCAPS data are discussed in Section 3.1.3.3.

The results of the chemical analyses of the groundwater screening samples indicate that DNAPLs are not present - rather, low concentrations in groundwater of chlorinated VOCs were detected. These low concentrations are well below the limits of solubility for the chlorinated VOCs (which are three orders of magnitude greater), indicating that DNAPLs are not likely to be present in areas near to the locations sampled. The analytical results are discussed in Section 5.3.

Based on these results, no further investigations of groundwater quality in the deep alluvial materials in the immediate vicinity of the FFTA were recommended. No deep alluvial well was installed since its original purpose to determine whether DNAPLs were present was resolved using the SCAPS and CPT/resistivity data.

Soil Sampling (Technical Memorandum #1). Phase II soil sampling was appropriate to evaluate whether other potential source areas were present. Soil samples were collected at 29 locations in areas of detections based on the Phase I data. and the samples focused on shallow soils to evaluate whether additional source areas were present. As shown in Figure 2-5, samples were collected from depths of 2 to 3 feet and/or 7 to 8 feet at 29 locations. The 2- to 3-foot depth was selected to evaluate whether near-surface contamination was present. The 7- to 8-foot depth was selected to evaluate whether vertical migration of contaminants occurred. All soil samples were analyzed for VOCs using EPA Method 8240. The locations of these borings were:

- Six borings (SB-21. SB-22. SB-23. SB-27. SB-28. and SB-29) in the area where the highest concentrations of 1.1.1-trichloroethane (TCA) were detected (Phase I locations 115 and 57)

- Twenty borings (SB-1 to SB-20) in the western portion of the track where both chlorinated solvents and petroleum were detected (near Phase I locations 70. 98. 99. 132. and 159)

- Three shallow soil samples only (SB-24, SB-25, and SB-26) were collected from the 2- to 3-foot interval at well R-3 in the vicinity of the 1.1.1-TCA contamination. It was thought that the source of the 1,1,1-TCA in this area was potentially the result of a surface spill.

Off-Post Well Installations and Sampling (Technical Memorandum #1). Under Phase II, four monitoring wells were installed on the off-post properties to provide groundwater elevation data that provide a better understanding of groundwater movement across the off-post properties. Two of the wells were in areas of detected contamination and provide additional data in the downgradient direction of groundwater flow to the north of the FFTA-MAAF. The other two wells were to the northeast and northwest of the FFTA-MAAF so that groundwater elevation data could be used to evaluate groundwater flow gradients across the off-post properties. Groundwater elevations in these wells were monitored monthly and the wells were sampled quarterly along with all the other wells.

Quarterly Sampling (Technical Memorandum #4). The ESI SAP stated that following the first quarterly (July 1994) groundwater sampling event for the seven on-post wells and eight off-post private wells, the data would be compared with data collected during the SI and other groundwater quality data in the area to determine whether detected concentrations attributable to the FFTA were above background concentrations and warranted further investigation.

Upon review of the data, it was determined that the second quarterly (October 1994) groundwater sampling event for the seven on-post wells and eight off-post private wells would be analyzed for the same parameters (i.e., VOCs, SVOCs, PP metals, and TPH). The analytical parameters were retained for all wells for the second quarter sampling to establish a more complete set of data for comparative purposes for additional data that may be generated.

2.9 Overview of Pilot Test Study Activities

Sampling at the FFTA-MAAF was performed according to the Pilot Test Study Work Plan (August 1994) (Ref. 7) The pilot test study included a sampling program for soils within two areas of concern (AOC): one area being inside the former pit (AOC-1) and the other area being approximately 150 feet east of the former pit (AOC-2), as shown in Figure 2-7. Groundwater was sampled before the pilot study testing under the ESI program. The soil sampling program included further delineation of contamination, baseline sampling and analysis for treatment effectiveness and system design, and soil vapor sampling. The efficiency of the pilot test system was evaluated by analysis of soil respiration, soil permeability to air flow, and soil vapor concentrations at influent and effluent port locations. Initial results indicate that the pilot test study removed contaminants from the soil at the FFTA-MAAF.

2.9.1 Soil Sampling and Analysis

To assess the extent of contaminated soils within AOC-1 and AOC-2, soil borings were performed to establish baseline conditions and to further delineate the horizontal and vertical extent of impacted soils. The chemical analyses were used for delineation of contaminated soils, and the chemical, geotechnical, and biological tests were used for pilot test system design. Figure 2-7 shows the two AOCs, including the configuration of wells (three SVE wells, four bioventing wells, and one injection well), and the locations of the 12 baseline soil borings.

Soil samples included split-spoon samples and undisturbed samples (i.e., samples obtained with a Shelby tube for particular geotechnical testing [bulk density, etc.]). The samples were retrieved using American Society of Testing Materials (ASTM) procedures (ASTM Designation D-1586-84 [*"Penetration Test and Split-Barrel Sampling of Soils"*] and ASTM Designation D-1587-83 [*"Thin-Walled Tube Sampling of Soils"*], respectively).

Split-spoon samples were retrieved and used for determining index properties such as grain size distribution, specific gravity, and moisture content. The undisturbed samples were necessary to determine the bulk density and compute the degree of saturation and porosity by determining specific gravity and moisture content. Atterberg limits and cation exchange capacity (CEC) tests were performed because the soil samples were relatively cohesive and fine-grained. These soil characteristics were important to be considered because of their effect upon the efficiency of the SVE and bioventing processes. Atterberg limits refer to liquid and plastic limits corresponding to semi-liquid and plastic state of soil consistency, respectively, depending on the soil content. CEC is a measure of readily exchangeable, positively charged ions responsible for adsorption of specific ions in the soil. The higher liquid limit, plasticity index (difference between the liquid limit and plastic limit), and CEC are generally indicative of less efficient SVE and bioventing processes for a given design system.

The 12 soil borings (SB-01 to SB-12) were sampled using continuous split spoons retrieved for stratigraphic logging and for chemical analysis. (Note that these soil borings have the same numbers as the ESI Phase II soil borings, but they were collected at different locations and times.) The depth intervals were approximately 1 to 3 feet, 4 to 6 feet, 10 to 12 feet, and 12 to 14 feet. Samples were collected from the interval, within a designated 2-foot sampling zone with the highest reading on the photoionization detector (PID), or if no PID detections were encountered, from an interval determined by visual classification representative of the sampling zone.

The locations of the baseline soil borings in and around each AOC are as follows: Soil boring SB-02 through SB-05 were placed within the boundary of AOC-1. Soil Borings SB-01 and SB-07 were located between the boundaries of AOC-1 and AOC-2. Soil borings SB-06 through SB-12 were placed within the boundary of AOC-2.

For both AOC-1 and AOC-2, pairs of co-located (approximately 1-foot apart) borings (SB-02A and SB-03A in AOC-1 and SB-08A and SB-09A in AOC-2) were selected to compare local heterogeneities in soil with respect to chemical parameters prior to pilot testing. At these locations, soil samples were obtained at the same first two depths, about 1 to 3 feet and 4 to 7 feet below grade.

At AOC-1, samples collected from seven borings (SB-01 through SB-07) at four depths were analyzed for moisture content, grain size, VOCs using EPA Method 8240, TPH using EPA Method 8015 modified, TOC using EPA Method 9060, soil microbial population, nitrogen-ammonia using EPA Method 350.2, phosphorous and phosphorous-ortho using EPA Method 365.2, and pH using EPA Method 9045. Samples collected from the co-located borings (SB-02A and SB-03A) at two depths were analyzed for VOCs using EPA Method 8240, TPH using EPA Method 8015 modified, and TOC using EPA Method 9060.

At AOC-2, samples collected from five borings (SB-08 through SB-12) at four depths were analyzed for moisture content, grain size, VOCs using EPA Method 8240, and TOC using EPA Method 9060. Samples collected from the co-located borings (SB-08A and SB-09A) at two depths were analyzed for VOCs using EPA Method 8240 and TOC using EPA Method 9060. TPH testing was not included for these samples because TPH was not previously detected within AOC-2.

At each SVE well (SVE-1 to SVE-3), bioventing well (BVW-1 to BVW-4), and the injection well (IW-1), split-spoon samples were obtained from depths of approximately 1 to 3 feet, 4 to 6 feet, 10 to 12 feet, and 6 inches above the groundwater table. Eight undisturbed soil samples and 29 split-spoon samples (three or four depths at the same eight locations) were retrieved. All these samples were analyzed for bulk density (undisturbed samples only), moisture content, grain size, specific gravity, Atterberg limits, and CEC.

2.9.2 Groundwater Sampling and Analysis

Groundwater sampling and analysis was performed (under the ESI program) at the nearby wells (FP-93-04 and FP-93-05) during the quarterly sampling event (July 1994). These groundwater samples were collected and tested prior to the start of the pilot test study to determine baseline groundwater quality. In addition to the routine quarterly analysis for VOCs using EPA Method 8240 and SVOCs using EPA Method 8270, these nearby wells were also analyzed for BOD using EPA Method 405.1 and COD using EPA Method 410.1.

Weekly groundwater elevations were monitored at wells FP-93-04 through FP-93-06 (located nearest to AOC-1 and AOC-2, as shown on Figure 2-7) from 16 December 1994 through 19 January 1995 in combination with monthly monitoring (under the ESI program) of wells FP-93-01 through FP-93-07.

2.9.3 Sampling and Analysis for Bioventing Design

The sampling and testing for obtaining pertinent data for bioventing system design included soil microbial testing (using the Plating Technique). This technique uses serial dilutions of a sample that are spread onto the surfaces of agar plates. The serial dilution, between 0.1 and 1 ml is spread over the surface. The plates are then incubated and the numbers of colonies that develop are counted. The detailed procedures of the Plating Technique are provided in Appendix B of the Pilot Test Study Work Plan.

The on-site contaminants include VOCs and TPH. Therefore, the viability of the soil microorganisms were studied in the laboratory using the carbon product of the FFTA contaminants in the vapor phase. The resulting growth in the microorganisms indicate the efficiency of the bioventing technology. The increase in the count indicates a favorable environment. The need for additional nutrients are indicated if the reaction yields a reduced count.

2.9.4 Field Modifications to the Pilot Test Study Relevant to Site Characterization

<u>Groundwater Elevation</u>. The groundwater elevation (taken 18 September 1994) for the existing monitoring well FP-93-04, which is located approximately at the center of AOC-1, indicated a continuous lowering of the groundwater table from October 1993, though at a decreasing rate.

That is, the groundwater table was about 17 feet below the ground surface, and almost 8 feet lower than in October 1993.

As discussed in Technical Memorandum #2 for the Pilot Test Study (provided in Appendix A), it was proposed to conduct weekly groundwater elevation monitoring of wells FP-93-04 through FP-93-06 (located nearest to AOC-1 and AOC-2) in combination with monthly monitoring (under the ESI program) of wells FP-93-01 through FP-93-07 to assess changes in groundwater elevations with respect to the bottom of bioventing and SVE wells. It was therefore proposed to abandon the weekly monitoring of the seven bioventing and SVE wells because the well screens were modified from the original 18-foot lengths extending to below the water table (7- to 25-foot-depth interval) to 10-foot lengths positioned above the groundwater table (approximately 5 to 15 feet below grade), where the highest VOC and TPH concentrations were detected. As the revised screen intervals would be above the groundwater table, groundwater depth measurements could not be performed.

Re-sampling Soil. Soil samples were collected at soil borings SB-02B, SB-03B, and SB-06B on 8 July 1994. The integrity of the day's sampling event had been deemed compromised as the QA sample arrived at the Missouri River Division (MRD) laboratory exceeding the recommended storage temperature. Therefore, these three soil borings were re-sampled on 19 and 20 July 1994 and identified with an ending "R" as part of their sample identification number. This re-sampling is further discussed in Section 9.2.3.3.

Table 2-1. Summary of Federal Regulatory Standards, State Standards and State Guideline Levels for Water and Soils

Analyte	KAL +	KNL +	MCL ++	KAR +++	KDHE *	Region IX **	Region III ***
Date	11/23/88	11/23/88	5/95	7/14/1994	12/7/93	2/1/95	3/7/95
Matrix	Water	Water	Water	Water	Interim Soil Cleanup	Soil (Industrial)	Soil (Industrial)
Units	ug/l	ug/l	ug/l	ug/l	ug/kg	ug/kg	ug/kg
Organics							
Benzene	5	0.5	5	5	1400	3,200	200,000
Bis(2-ethylhexyl) phthalate	4,200	420	NAv	4	NAv	140,000	410,000
Bromodichloromethane	100	0.5	100/80^	100	NAv	3,400	92,000
Carbon Disulfide	NAv	NAv	NAv (a)	NAv	NAv	52,000	200,000,000
Dibromochloromethane	100	0.7	100/80^	100	NAv	23,000	68,000
Dibutyl phthalate	770	77	NAv	NAv	NAv	68,000,000	200,000,000
1,1-Dichloroethane	5	0.5	NAv	NAv	NAv	3,900,000	200,000,000
1,2-Dichloroethane	5	0.5	5	5	NAv	980	63,000
1,2-Dichloroethylene (mixture)	70 (b)	7 (b)	70 (b)	70 (b)	8,000	270,000	18,000,000
cis-1,2-Dichloroethylene	70	7	70	70	NAv	200,000	20,000,000
trans-1,2-Dichloroethylene	70	7	100	100	NAv	600,000	41,000,000
Dichloromethane	50	5	5	5	NAv	25,000	760,000
Ethylbenzene	680	68	700	700	NAv	3,100,000	200,000,000
2-Methyl Naphthalene	NAv	NAv	NAv	NAv	NAv	NAv	NAv
4-Methylphenol	NAv	NAv	NAv (c)	NAv	NAv	3,400,000	10,000,000
Naphthalene	143	14.3	NAv	NAv	NAv	800,000	82,000,000
Phenanthrene	0.029	0.0029	NAv	NAv	NAv	NAv	NAv
Tetrachloroethylene	7	0.7	5	5	NAv	25,000	110,000
Toluene	2,000	200	1000	1,000	288,000	2,700,000	410,000,000
Total Petroleum Hydrocarbons	NAv	NAv	NAv	NAv	100,000	NAv	NAv
1,1,1-Trichloroethane	200	20	200	200	NAv	3,000,000	180,000,000
Trichloroethylene	5	0.5	5	5	NAv	17,000	520,000
Tribromomethane	100	1.5	100/80^	100	NAv	240,000	720,000
Trichloromethane	100	0.5	100/80^	5	NAv	1,100	940,000
m- &/or p-Xylenes	440 (d)	44 (d)	10000 (d)	NAv	63000 (d)	980,000 (d)	1,000,000,000 (d)
o-Xylene	NAv	NAv	NAv	NAv	NAv	980,000	1,000,000,000
Xylenes (mixed)	440	44	10,000	10,000	63,000	980,000	1,000,000,000

Table 2-1. Summary of Federal Regulatory Standards, State Standards and State Guideline Levels for Water and Soils (continued)

Analyte	KAL +	KNL +	MCL ++	KAR +++	KDHE *	Region IX **	Region III **
Date	11/23/88	11/23/88	5/95	7/14/94	12/7/93	2/1/95	3/7/95
Matrix	Water	Water	Water	Water	Interim Soil Cleanup	Soil (Industrial)	Soil (Industrial)
Units	mg/l	mg/l	mg/l	mg/l	mg/kg	mg/kg	mg/kg
Metals							
Arsenic	0.05	NAv	0.05	0.05	NAv	NAv	610
Arsenic (as carcinogen)	NAv	NAv	NAv	NAv	NAv	2.0	3.3
Beryllium	0.00013	NAv	0.004	0.004	NAv	NAv	NAv
Beryllium and compounds	NAv	NAv	NAv	NAv	NAv	1.1	1.3
Cadmium	0.005	NAv	0.005	0.005	NAv	NAv	NAv
Cadmium and compounds	NAv	NAv	NAv	NAv	NAv	850	1,000
Chromium Total	NAv	NAv	0.1	0.1	NAv	NAv	NAv
Chromium Total (1/6 ratio of CrVI/CrIII)	NAv	NAv	NAv	NAv	NAv	1,600	NAv
Chromium III	0.05	NAv	NAv	0.05	NAv	NAv	NAv
Chromium III and compounds	NAv	NAv	NAv	NAv	NAv	NAv	1,000,000
Chromium III (resid./recreat.)	NAv	NAv	NAv	NAv	500	NAv	NAv
Chromium III (other areas)	NAv	NAv	NAv	NAv	1000	NAv	NAv
Chromium VI	0.05	NAv	NAv	0.05	NAv	230	NAv
Chromium VI and compounds	NAv	NAv	NAv	NAv	NAv	NAv	10,000
Chromium VI (resid./recreat.)	NAv	NAv	NAv	NAv	200	NAv	NAv
Chromium VI (other areas)	NAv	NAv	NAv	NAv	400	NAv	NAv
Copper	1	NAv	1.3 (f)	1.3	NAv	NAv	NAv
Copper and compounds	NAv	NAv	NAv	NAv	NAv	63,000	76,000
Lead (e)	0.05	NAv	0.015 (f)	0.015	500	1,000	NAv
Nickel	0.15	NAv	0.1	0.1	NAv	NAv	NAv
Nickel (Soluble Salts)	NAv	NAv	NAv	NAv	NAv	34,000	NAv
Nickel and compounds	NAv	NAv	NAv	NAv	NAv	NAv	41,000
Selenium	0.045	NAv	0.05	0.05	NAv	8,500	10,000
Silver	0.05	NAv	NAv	0.05	NAv	NAv	NAv
Silver and compounds	NAv	NAv	NAv	NAv	NAv	8,500	10,000
Zinc	5	NAv	NAv	NAv	NAv	100,000	610,000

^ 100/80 Total for all Tri-halogenated Methanes combined cannot exceed 80 mg/l level

NAv -- Not Available

\+ Kansas Department of Health and the Environment, Bureau of Environmental Remediation, Groundwater Contamination Cleanup Target Concentrations, November 1988.

++ U.S. EPA, Office of Water, Drinking Water Regualtions and Health Advisories, May 1995.

+++ Kansas Register, Department of Health and Environment, Vol. 13, No. 28, Article 16.- Water Pollution Control; Surface Water Quality Standards, July 14, 1994

* "Interim Soil Clean-up Standards, December 1993", Kansas Department of Health and Environment, Bureau of Environmental Remediation.

** Region IX Preliminary Remediation Goals (PRGs), February 1995, Stanford J. Smucker, PhD, Regional Toxicologist.

*** Region III Risk-based Concentration Table, March 1995, Roy L. Smith, Senior Toxicologist - Technical Support Section

(a) Although no MCL is available for carbon disulfide, EPA Risk-based Concentrations for Tap Water for both Region III and IX is 21 ug/l.

(b) Although a KAL, KNL, MCL and KAR for 1,2-DCE (mixed) is not available, concentrations reported as 1,2-DCE (mixed) will be compared to the more conservative KAL, KNL, MCL and KAR for 1,2-DCE isomers.

(c) Although no MCL is available for 4-methylphenol, EPA Risk-Based Concentrations for Tap Water for both Region III and IX is 180 ug/l.

(d) Although no standards or guidelines are available for m-&/or p-xylenes, concentrations reported as m- &/or p-xylenes will be compared to the standards and guidelines for xylenes (mixed).

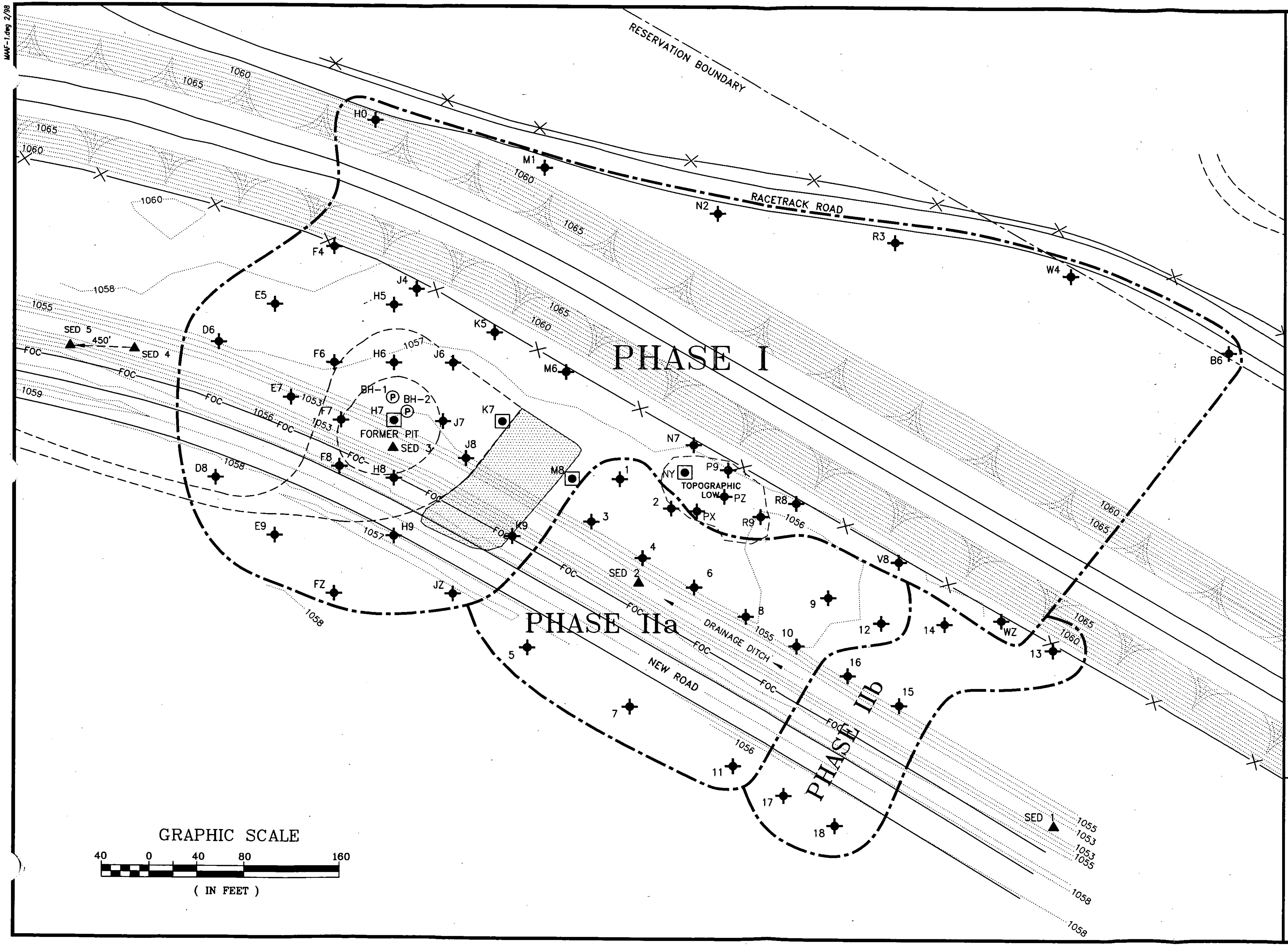
(e) OSWER Directive 9355.4-12, EPA Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, dated 14 July 1994, lead screening level is 400 mg/kg for residential setting

(f) Action Level, U.S. EPA, Office of Water, Drinking Water Regualtions and Health Advisories, May 1995.

Table 2-2. Analytes for Soil Gas and Groundwater Screening

GC/FID Analytes	GC/ECD Analytes
Acetone	Tetrachloromethane*
Benzene*	Trichloromethane*
1-Butanol	Dichlorodifluoromethane
2-Butanol	1,1-Dichloroethane (1,1-DCA)*
Chlorobenzene	1,2-Dichloroethane (1,2-DCA)
Ethylbenzene*	1,1-Dichloroethylene (1,1-DCE)*
Isopropyl Ether (IPE)	cis-1,2-Dichloroethylene (c-1,2-DCE)*
Methyl Ethyl Ketone (MEK)	trans-1,2-Dichloroethylene (t-1,2-DCE)*
Methyl Isobutyl Ketone (MIBK)	Dichloromethane*
4-Methyl-2-Pentanone	1,1,2,2-Tetrachloroethane
Methyl-Tert-Butyl Ether (MTBE)	Tetrachloroethylene (PCE)*
1-Propanol	1,1,1-Trichloroethane (1,1,1-TCA)*
2-Propanol	1,1,2-Trichloroethane (1,1,2-TCA)*
Toluene*	Trichloroethylene (TCE)*
m- &/or p-Xylene*	Trichlorofluoromethane
o-Xylene*	1,1,2-Trichloro-1,2,2-trifluoroethane

GC - Gas Chromatograph
FID - Flame Ionization Detector
ECD - Electron Capture Detector
* Analytes included in the standard calibration mix



N

LEGEND

- ▣ SOIL, SOIL GAS & GROUNDWATER SCREENING SAMPLE
- ✦ SOIL GAS & GROUNDWATER SCREENING SAMPLE
- Ⓟ BOREHOLE FOR PCB SAMPLING
- ▲ SEDIMENT SAMPLE
- ELEVATION CONTOUR
- ROAD
- FORMER FEATURE
- FENCE LINE
- LEVEE
- Fiber Optic Cable FOC FOC
- ▨ FORMER DRUM STORAGE AREA

NOTES:

1. ELEVATION CONTOUR UNITS ARE IN FEET.
2. "TOPOGRAPHIC LOW" AREA IS LOCATED ON FIGURE BASED UPON FIELD MEASUREMENTS DURING SI ACTIVITIES.

Figure 2-1:
Soil Gas, Groundwater Screening, Soil and Sediment Sample Locations SI Phases I and II, 9/93-5/95

GWSMPLLC.dwg; AUGUST 1995

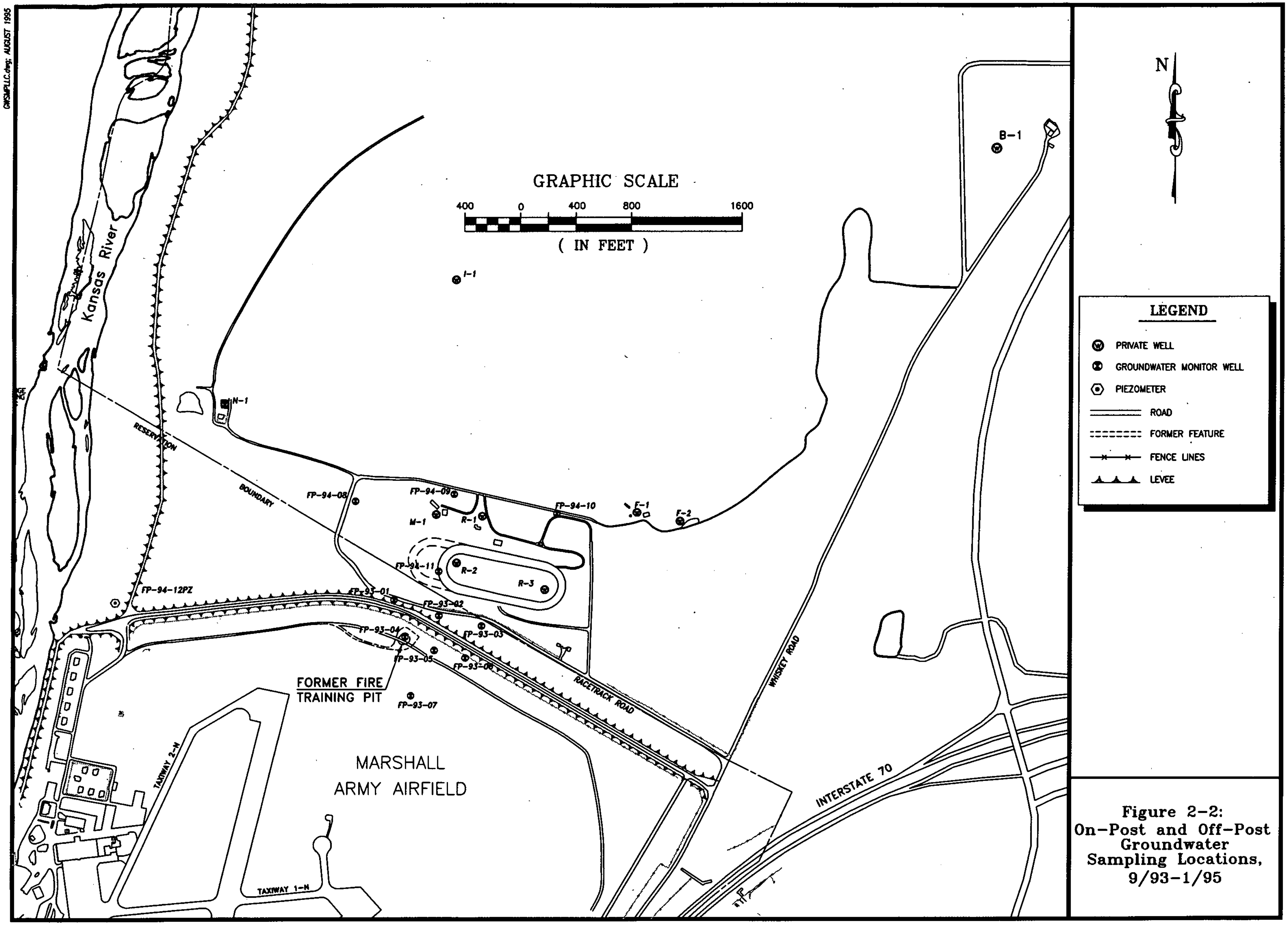


Figure 2-2:
On-Post and Off-Post Groundwater Sampling Locations, 9/93-1/95

SEISREFL.dwg; AUGUST 1995

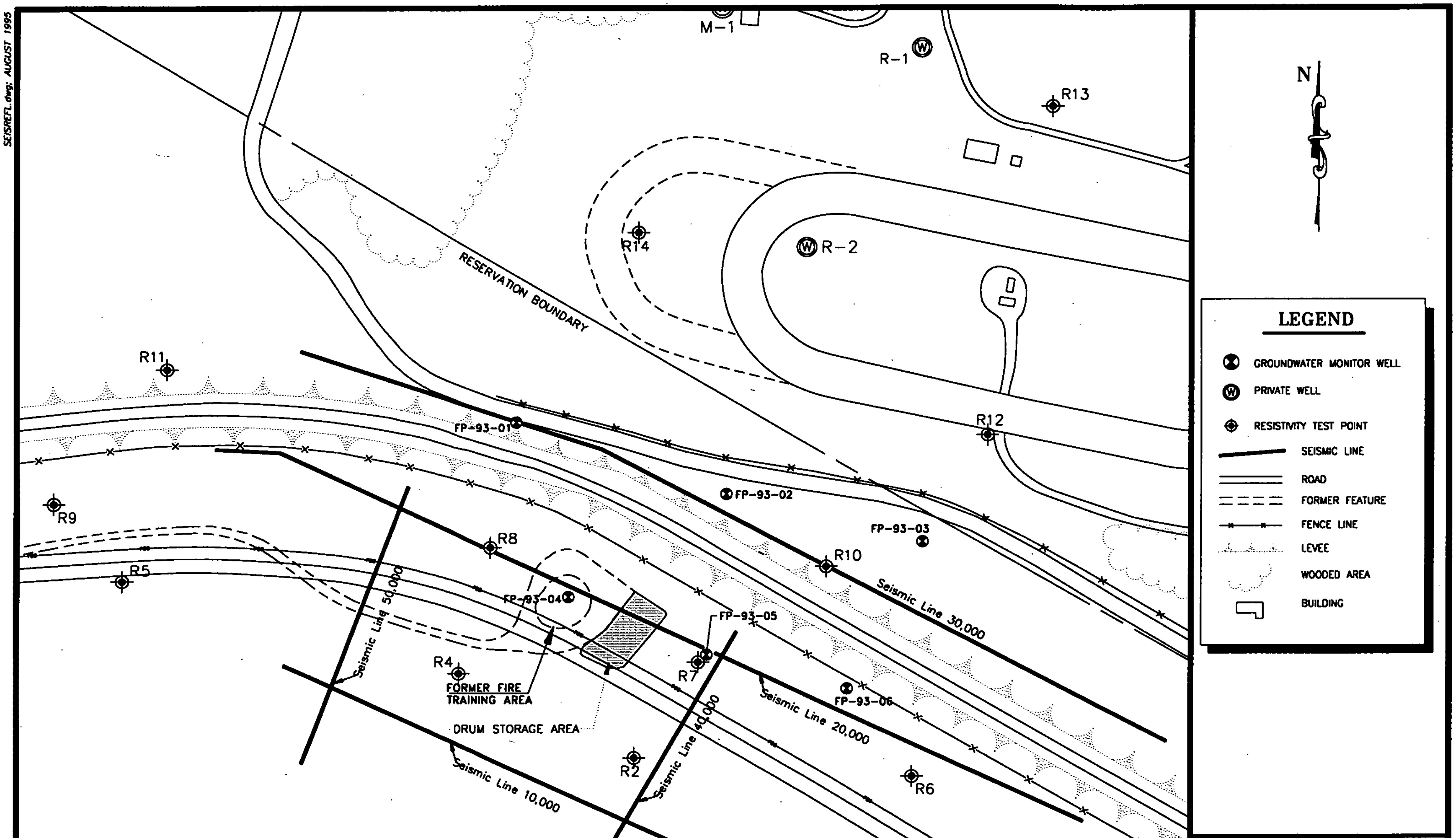
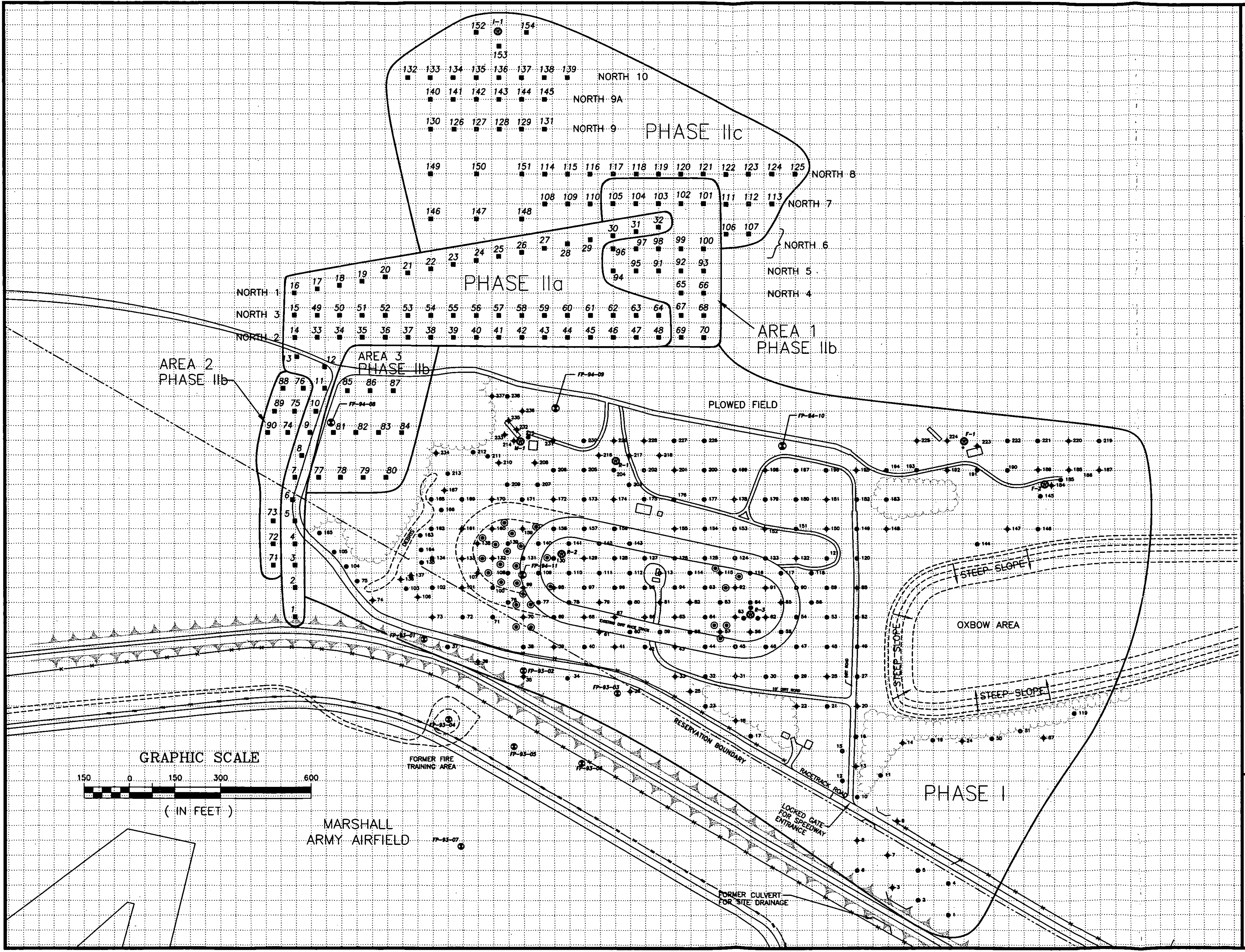


**Figure 2-3:
Seismic Profile
Line Locations and
Resistivity Points
ESI Phase I,
6/94**

ESISMLOC.dwg; AUGUST 1995

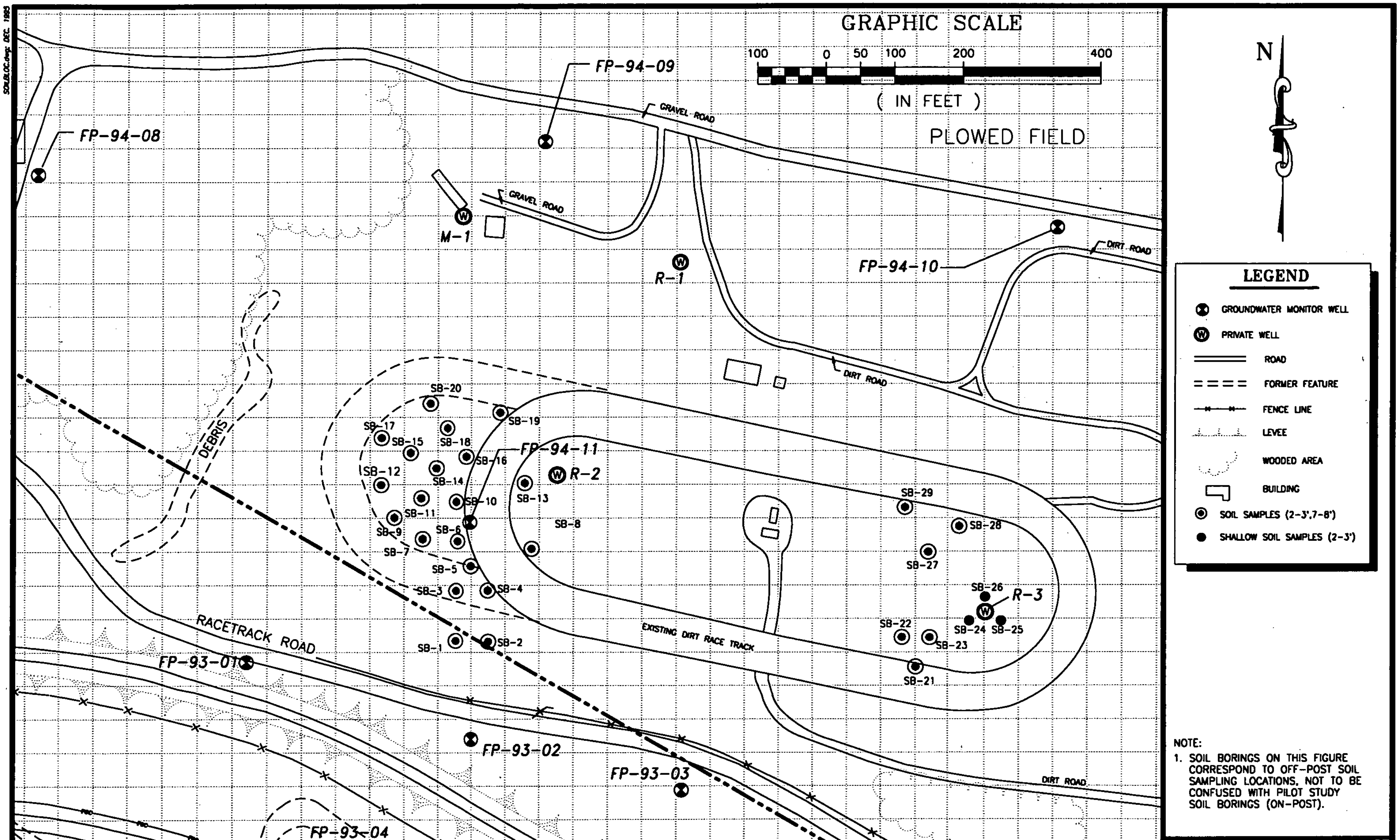


LEGEND

- ⊗ GROUNDWATER MONITOR WELL
- Ⓦ PRIVATE WELL
- ⊙ OFF-POST SOIL BORING
- ● SOIL GAS SAMPLE LOCATION
- ✦ SOIL GAS AND GROUNDWATER SCREENING SAMPLE LOCATION
- ■ GROUNDWATER SCREENING SAMPLE LOCATION
- ═ ROAD
- ╍ FORMER FEATURE
- —×— FENCE LINE
- ▲ LEVEE
- WOODED AREA
- ▭ BUILDING

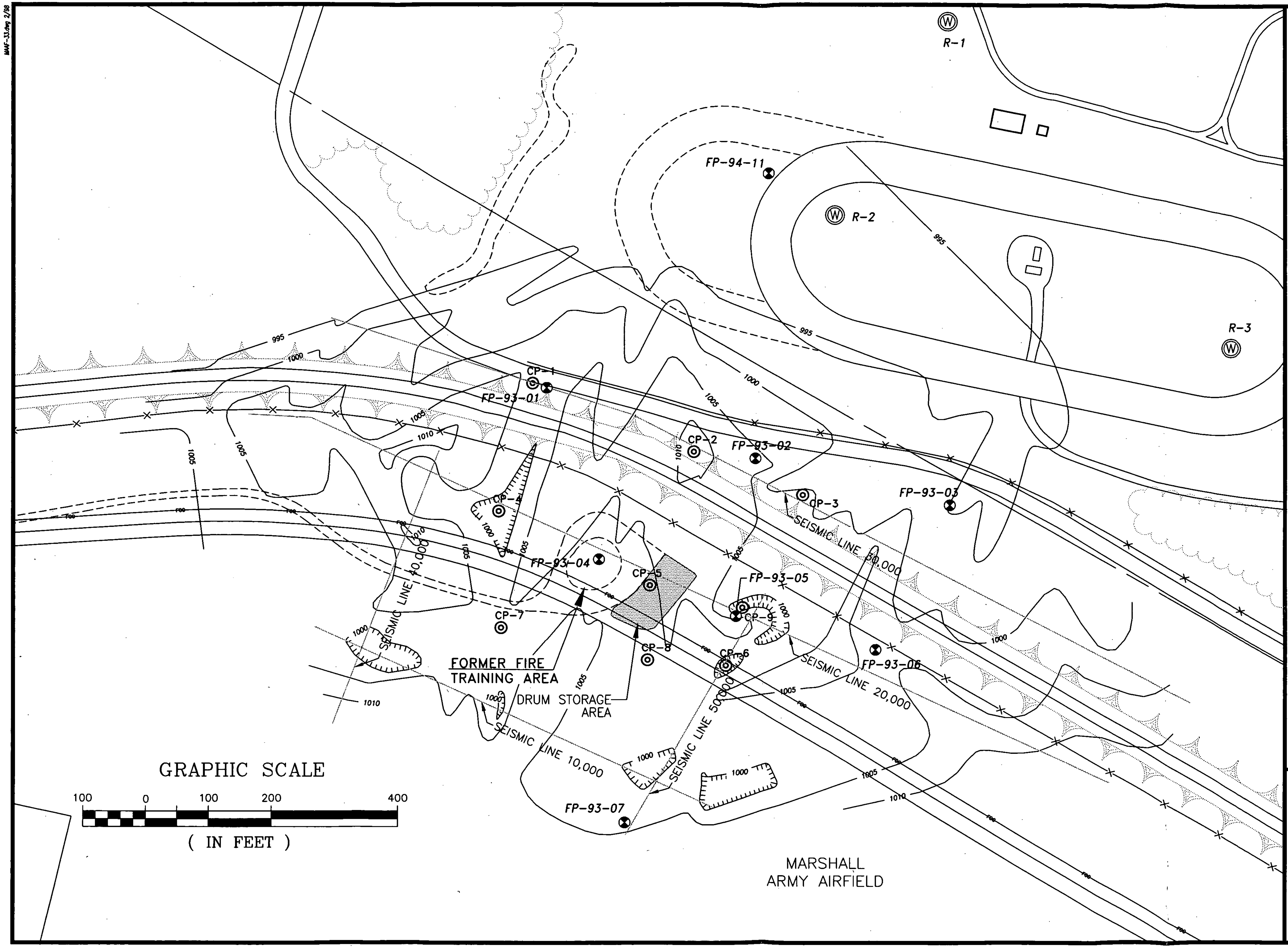
Figure 2-4:
Soil, Soil Gas, and
Groundwater Screening
Sample Locations
ESI Phases I and II,
6/94-1/95

SOILLOC.dwg; DEC. 1995



NOTE:
1. SOIL BORINGS ON THIS FIGURE CORRESPOND TO OFF-POST SOIL SAMPLING LOCATIONS, NOT TO BE CONFUSED WITH PILOT STUDY SOIL BORINGS (ON-POST).

Figure 2-5: ESI Phase II Soil Sample Locations, 8/94



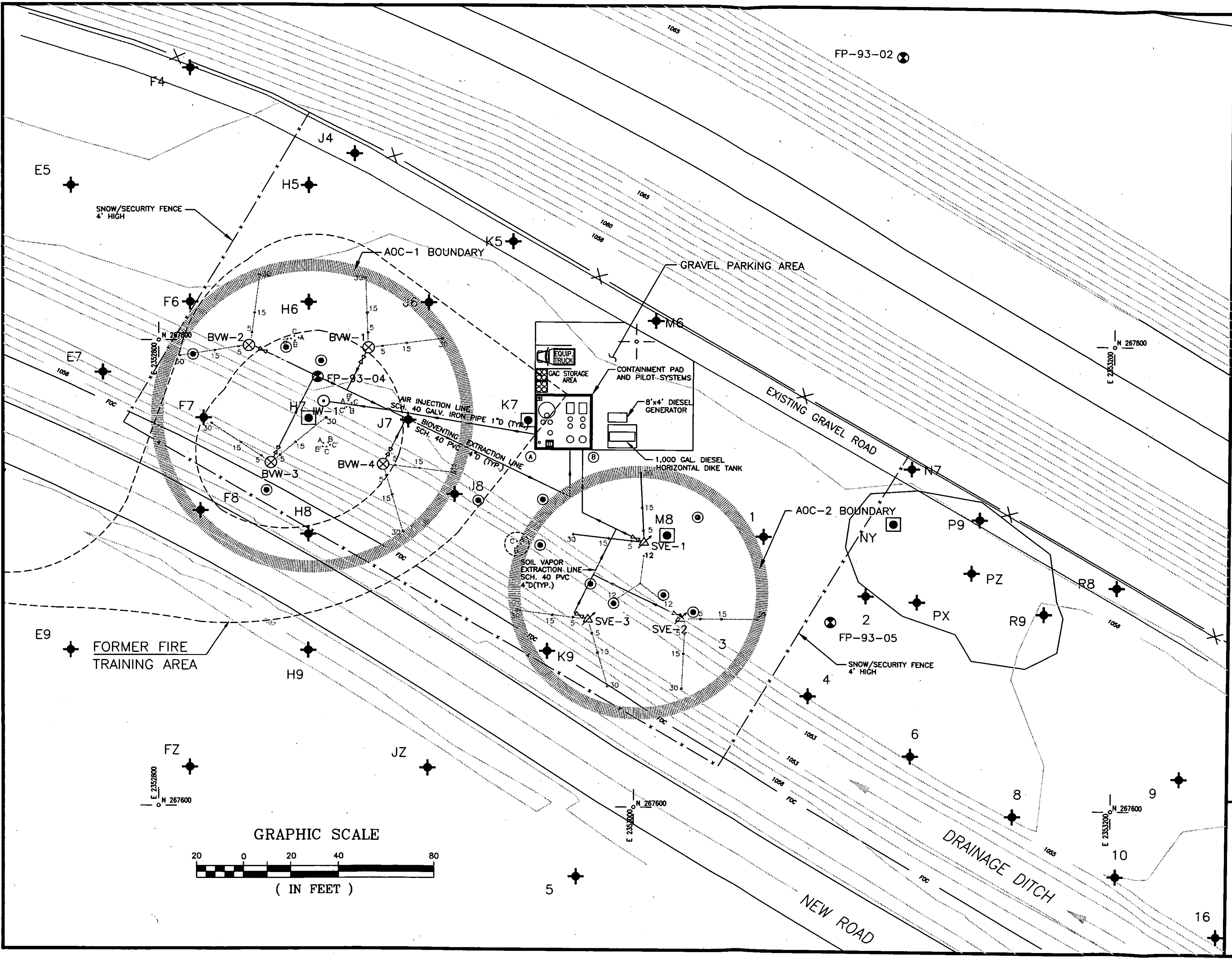
LEGEND

⊗	GROUNDWATER MONITOR WELL
Ⓦ	PRIVATE WELL
◎	SCAPS GEOPHYSICAL & GROUNDWATER SCREENING SAMPLE LOCATION
- - - -	FORMER FEATURE
═	ROAD
—×—×—	FENCE LINE
	LEVEE
	WOODED AREA
	BUILDING
∿	BEDROCK CONTOUR

NOTE:

1. THE BEDROCK CONTOURS ARE BASED ON SEISMIC REFLECTION SURVEY PERFORMED IN JUNE 1994.
2. BEDROCK CONTOURS ARE IN FEET.

Figure 2–6: Additional Geophysical Data Points Collected for the SCAPS Investigation 11/94



LEGEND:

✦	SOIL GAS SAMPLE AND GROUNDWATER SAMPLING LOCATION
═══	EXISTING ROAD
= = = =	FORMER FEATURE
—×—	EXISTING FENCE
—FOC—FOC—	FIBER OPTIC CABLE
⊗	GROUNDWATER MONITORING WELL
◉	BASELINE SOIL SAMPLE LOCATION FOR PILOT TEST STUDY
⌀	SOIL VAPOR EXTRACTION WELL
⊙	AIR INJECTION WELL
⊗	BIOVENTING WELL
- - - -5- - - -	VACUUM MONITORING PROBE WITH DISTANCE FROM WELL IN FEET. "A, B, AND C" INDICATE PROBE CLUSTER. "A" EXTENDS TO 4 FT BELOW GRADE, "B" EXTENDS TO 8 FT BELOW GRADE, "B'" 2 IN. PROBE WITH 5 FT SCREEN EXTENDING TO 8 FT BELOW GRADE "C" EXTENDS TO 12 FT BELOW GRADE. "C'" 2 IN. PROBE WITH 5 FT SCREEN EXTENDING TO 12 FT BELOW GRADE
▥	AREA OF CONCERN (AOC) BOUNDARY
— — — —	FORMER PIT BOUNDARY

NOTES:

1. THE BOUNDARIES INDICATED FOR AOC-1 AND AOC-2 REPRESENT THE EXPECTED EXTENT OF VOC AND SVOC (AOC-1) AND VOC (AOC-2) IMPACT TO SOIL.
2. DIMENSIONS AND LOCATIONS OF THE SOIL VAPOR EXTRACTION SYSTEM AND THE BIOVENTING SYSTEM SHOWN ARE DERIVED FROM POST-CONSTRUCTION FIELD SURVEY MEASUREMENTS.
3. THE HORIZONTAL COORDINATES SHOWN ARE BASED ON KANSAS STATE PLANE COORDINATE SYSTEM.
4. ALL ELEVATIONS SHOWN ARE WITH RESPECT TO THE NATIONAL GEODETIC VERTICAL DATUM OF 1929, AND ARE IN UNITS OF FEET.
5. SOIL BORING LOCATIONS AS DESIGNED.

Figure 2-7:
As-Built
Pilot Test Sampling/
System Plan,
10/94-1/95

3.0 SITE DESCRIPTION AND HISTORY

The FFTA-MAAF was operated from the mid 1960s through 1984 to conduct fire training exercises (Refs. 31, 32). During the period of use, the site consisted of a crushed stone pad approximately 200 feet by 200 feet in size with no subsurface liner. Historic aerial photographs were reviewed to assess site use and surrounding features over time. The aerial photographs indicate that the dimensions, configuration and features of the FFTA varied over time. Available aerial photographs as well as comprehensive analysis of the aerial photographs is provided as Appendix B. An overview of key features is provided below.

Some flammable liquids were stored at the site in drums until the next training exercise was conducted. The aerial photographs from 1977 and 1984 indicate that these drums were stored to the immediate east and southeast of the bermed fire pit. The 1984 aerial photograph depicts a large quantity of drums at the site. This photograph is provided as Photograph 3-1. An overview of historic site features is provided in Figure 3-1. Notable features include the drum storage area to the east and southeast and the use of the areas around the perimeter of the pit for storage of miscellaneous debris. In addition, there was a culvert located to the west of the site that flowed through the levee; a drainage ditch formerly existed from the area northwest of the fire pit to the culvert. Another culvert through the levee was located to the east. Remnants of this culvert are still visible along the levee, and the vegetation and topography north of the levee provide discernible traces of this former drainage from the airfield.

During its use, flammable liquids were dumped into the pit, ignited, then extinguished during fire training exercises. The predominant materials used for the fire training exercises were petroleum hydrocarbons, including JP-4, diesel, MOGAS (a generic term for motor gasoline often used to refer to gasolines with lead alkyls) and gasoline.

In August 1982, 55 gallons of PCE were inadvertently poured into the fire training pit. The next day it was pumped out of the pit prior to ignition. Hay was spread over the remaining liquid in the pit (Ref. 33).

Soil sampling was conducted at the site in 1985 by the United States Army Environmental Hygiene Agency (USAEHA, currently the Center for Health Policy and Preventative Medicine [CHPPM]). The results indicated that chlorinated solvents (in particular, PCE) were present in soils at the site. Six samples were collected from two areas, one sample of oil/water mixture from standing liquid and three samples of sludge from inside the bermed fire training pit, and two soil samples from the adjacent drum storage area. The sludge and soil samples were collected to a depth of 2 to 3 inches. Specific sampling locations were not identified. All six samples were analyzed for VOCs, PCB, and RCRA metals. The concentrations of PCB and RCRA metals were below the detection limit. Trichloromethane, t-1,2-DCE, and PCE were detected at concentrations ranging from 1,000 to 3,000 μg/kg. t-1,2-DCE was the only chlorinated compound detected in the drum storage area outside the bermed pit. In addition, #2 fuel oil was detected at concentrations ranging from 50,000 to 300,000 μg/kg for samples inside and outside the berm (Ref. 34).

3.1 Environmental Setting

The environmental setting for the FFTA-MAAF is described in terms of land features; nearby land uses; topography and geology; climatology; vegetation, wildlife and wetlands; threatened and endangered species; populations; groundwater; and surface water.

3.1.1 Land Features

The FFTA-MAAF is covered with soil and has a well-established grass cover; its location is not readily discernible in the field. Since 1984, a new road and associated drainage ditch have been constructed along the northern interior of the airfield. As shown in Figure 3-2, the new road runs south of the boundary of the former pit while the associated drainage ditch transects it. With the exception of the drainage ditch, and a wet, low area to the east of the pit (the wetness in this area at that time may have been due to regional flooding), the surrounding area is relatively flat with a gentle gradient to the south. Runoff from the former pit was observed flowing into this low area by airfield personnel during the time period the pit was in operation (Ref. 35).

The United States Department of Agriculture Soil Conservation Service, in cooperation with the Kansas Agricultural Experiment Station, has previously designated the soil type typically found at MAAF in the area of FFTA as the Haynie Series of the Eudora-Haynie-Sarpy association. This soil is described as very fine sandy loam soil which consists of deep, nearly level, calcareous soils on flood plains along the rivers. These soils form in calcareous alluvium. In a representative profile, the surface layer is light brownish-gray, very fine sandy loam about 10 inches thick. Light brown-gray coarse silt loam is at a depth of 10 to 20 inches. Gray very fine sandy loam is at a depth of 20 to 30 inches, and light gray very fine sandy loam is at a depth of 30 to 41 inches. All of these layers are soft when dry and are very friable when moist. Grayish-brown silty clay loam is at a depth of 41 to 47 inches. It is hard when dry and is firm when moist. Light brownish-gray light silty clay loam is at a depth of 47 to 60 inches. This soil is easily tilled. It takes in water well and releases it readily for plant use. It has high available water capacity and is subject to some flooding (Ref. 36).

The soils encountered during the SI were consistent with the descriptions for the Haynie Series; the soils observed had a light brown sandy surface underlain by organic silts, silty clays and clays. However, in the area of the former pit, the upper soil layer was distinctively darker than surrounding soils with a higher silt and organic content.

3.1.2 Nearby Land Uses

The area of the former fire training pit is within the boundaries of the airfield and is separated from the properties to the north by a levee and an 8-foot, continuous chain-link fence that surrounds the airfield. The nearest airfield building is over 2,000 feet to the southwest. No fire fighting training has been conducted at the FFTA since 1984. The FFTA-MAAF is used to harvest a cultivated hay meadow area with some invasion of species of native prairie hay that grows at the airfield. In December 1994, a temporary fence was installed around the pilot test study area (as shown in Figure 2-7). The area inside the fence is not currently used to harvest hay. Properties to the north are used for both private residences and farming. Private wells are located within approximately one-half mile to the north of the installation boundary at this location. Four properties with a total of eight private wells were initially identified -- two wells at two residences, three wells at the speedway, one at a trailer home adjacent to the speedway, and two on a farm. An irrigation well later went into service in the spring of 1994.

The property north of the FFTA-MAAF has been used as a racetrack for automobiles since the early 1980s. The speedway was used for racing standard and mini-sized automobiles. A cursory inspection of the speedway site by Berger (July 1993) identified an area just north of the track containing approximately fifty 55-gallon drums. These drums were subsequently scattered throughout the site as a result of the July 1993 flooding of the area. A former driver at the speedway indicated that the blue drums located on the property were used for spectator and crew trash (nonhazardous, solid waste) (Ref. 37). The majority of drums observed scattered at the speedway are blue with also some black and yellow colored drums. The former driver also indicated that some of the drums, not colored blue, were used for the storage of fuel to be used by the racers. The drums containing fuel were reportedly stored in the center of the speedway or in the vehicle maintenance pit area (depicted on Figure 3-3). There is an abandoned residence and potentially a former well located near the southeast corner of the racetrack. No information on the well has been located at this time.

Three groundwater wells are located at the speedway, one northwest of the track near the grandstands, and two located at each end of the track (Ref. 38). The water from these wells were used for dust control and vehicle washing and was not used for consumption. The KDHE sampled the well located to the northwest of the track at the speedway (well R-1) on 4 April 1993 (Ref. 38). The well was sampled because the owners applied for a public well permit and the county routinely test wells before issuing a permit. The well is approximately 43-feet deep, is completed in unconsolidated sands, and has a screened interval from 33 to 43 feet. The results of that sampling indicated that chlorinated solvents were present as follows: PCE at 263 μg/l, DCE at 155 μg/l, TCE at 36.8 μg/l, benzene at 2.1 μg/l, and vinyl chloride at 0.5 μg/l (Ref. 39).

3.1.3 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. The area is designated 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. Marshall Field and the FFTA-MAAF are located in the lowland areas where the land surface is relatively flat. The topography of the area is shown in Figure 3-4, which also shows the one mile radius of influence area and National Wetlands Inventory (Ref. 40). Whiskey Lake, as depicted, is an oxbow lake of Kansas River and has been routinely dry since at least the 1950s. However, when flooded, this area will retain water as indicated in the March 1960 and July 1993 regional flooding. During the July 1993 flooding, water was retained for approximately 5 months thereafter.

Characterization of the geology and bedrock topography of the FFTA-MAAF area during the course of this investigation has included various geotechnical and geophysical techniques in addition to visual classification of materials encountered during drilling operations. The techniques employed to provide data for interpretations of the site's geology and bedrock topography are discussed in detail in: Section 3.1.3.1 Geotechnical Testing of Subsurface Soils; Section 3.1.3.2 Geophysical Surveys; and Section 3.1.3.3 SCAPS/CPT.

All of Marshall Field is located on alluvial deposits of the Kansas River. These deposits provide relatively flat lowland topography for the FFTA-MAAF area. Were it not for the man-made features such as the levee to the north and the drainage ditch transecting the FFTA-MAAF, relief would generally be less than a few feet. A topographic map of the area investigated during the SI and ESI, generated with 2-foot contour intervals, is presented in Plate 2. The alluvial deposits underlying the FFTA-MAAF are on the order of 70 to 80 feet thick based on Site Characterization Analysis Penetrometer System (SCAPS) probe pushes to refusal.

The unconsolidated alluvial deposits consist predominantly of sands, with occasional clay and silt layers and lenses. This is supported by visual classification of soils during borehole drilling to depths of up to 30 feet below ground surface (bgs), available boring logs from private wells, and cone penetrometer data from the surface to the top of bedrock. In general, three units were encountered within the first 20 feet. Typically, clays and silts were encountered in the upper 1 to 6 feet, silty fine to medium sand was encountered down to approximately 10 to 15 feet, followed by fine to coarse sand and occasional gravel. Laboratory geotechnical testing of soils (grain size analysis) from the FFTA-MAAF also supports this with clay generally found in 1 to 3 foot samples, clay and silt/sand mixtures found in the 4 to 6 foot samples, and sand sometimes mixed with silt in samples greater than 10 feet. Groundwater in the alluvial material is generally found around 15 feet bgs.

Since no borings were advanced past approximately 30 feet bgs, there has been no direct observation of unconsolidated material between 30 feet bgs and bedrock. However, seismic data indicate a discontinuous clay layer ranging in depth from approximately 30 to 55 feet below ground surface. Both the seismic survey and the SCAPS cone penetrometer survey indicate that this clay layer is laterally discontinuous.

The bedrock underlying the area consists of interlayered beds of shales and limestones (Ref. 41). These formations dip gently (less than 10 degrees) to the west-northwest. This pattern of interbedded limestones and shales continues to depths of several hundred feet. Although none of the borings at the FFTA-MAAF were drilled to bedrock during this investigation, a USACE boring located approximately 1 mile to the south of the FFTA-MAAF encountered bedrock consisting of limestone (Ref. 42). The geologic literature for the area do not mention 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 of the area and under the site has been eroded by major rivers and streams. In order to characterize the topography of the eroded bedrock surface, a seismic reflection survey was performed. Depth control was obtained from electrical resistivity soundings and SCAPS probe pushes. The results of the seismic survey indicate that the bedrock surface slopes downward from south to north, with an overall decrease in elevation of about 10 feet from slightly south of the FFTA to slightly north of the levee (a distance of approximately 700 feet). There are two north-trending troughs, one to the east and one to the west of the FFTA. The maximum relief of the bedrock topography is approximately 13 feet.

Cross section A-A' (Figure 3-5 plan view), depicts the geology of the FFTA and the area to the north (hydraulically downgradient). The cross section profile is shown in Figure 3-6. The bedrock topography depicted in the cross section represents the results of the geophysical survey. The geologic information was derived from borings/wells including D-83-116 (drilled for the construction of buildings located southeast of the airfield, Ref. 42), A-84-110 (drilled for the installation of the new road that runs adjacent to the FFTA, Ref. 43), COE-B2 (drilled in 1941 for the installation of the levee, Ref. 44), and R-1 and R-2 (private wells on the speedway property, Ref. 45). Boring D-83-116 was located approximately 5,300 feet south of the FFTA, and was drilled to a depth of 65 feet below ground surface (or an elevation of 998 feet above mean sea level (MSL)). Boring D-83-116 was located near the intersection of the two runways shown on Figure 3-4, which was estimated by measuring 5,300 feet south of the FFTA, although boring D-83-116 is not shown on the figure. Bedrock was encountered at a depth of 61 feet below ground surface, and was described as light gray, soft, weathered limestone.

3.1.3.1 Geotechnical Testing of Subsurface Soils

All soil samples collected as part of the pilot test study were classified according to the Unified Soil Classification System (USCS). Two methods were utilized for classifying the soils: a visual geologic log generated by an on-site geologist, and geotechnical tests performed at a laboratory. Visual logs of the borings are provided in Appendix E.

During baseline soil sampling for the pilot study at the MAAF-FFTA, disturbed soil samples from 12 soil borings (SB-01 through SB-12) at depths of about 1 to 3 feet, 4 to 6 feet, and 10 to 12 feet were submitted for grain size analyses (as shown in Table 6-3). The ASTM-D422 analytical method [*Method for Particle-Size Analysis of Soils*] was performed on all of the baseline boring samples. The laboratory results for these analyses are included in Appendix G.

Disturbed and undisturbed soil samples were collected from the eight borings that were eventually constructed into the pilot study wells (SVE-1 through SVE-3, BVW-1 through BVW-4, and IW-1). The samples were sent to a laboratory for geotechnical testing in order to obtain their soil classification as shown in Table 3-1. The undisturbed samples were collected at depths of about 1 to 3 feet below grade. This involved the use of a thin walled tube sampler continuously driven at a constant rate to obtain a 2-foot long sample. The disturbed samples were collected at depths of approximately 4 to 6 feet, 10 to 12 feet, and 6 inches above the water table. The geotechnical analyses ASTM-D422 and ASTM-D421 [*Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Contents*] were performed on these samples. In addition to grain size distribution, the undisturbed samples were analyzed for Atterberg Limits. These tests were selected to quantitatively evaluate the permeable properties of the upper soils. These data are also presented in Table 3-1. These geotechnical parameters were obtained to assess the existence of an impermeable clay cap. The laboratory results for these analyses are included in Appendix G. Impermeability of the upper soils is an important factor to the pilot test study as it restricts air flow from the surface which may cause short circuiting of bioventing and SVE operations.

Figure 3-7 is a profile and Figure 3-8 is a cross section (B-B') of the FFTA compiled from the geotechnical analyses of all the pilot test study wells (BVW-1 through BVW-4, SVE-1 through SVE-3, and IW-1) and baseline borings SB-01, SB-07, SB-11, and SB-12. One to 3 feet was classified as low plasticity clay (CL) in boreholes BVW-1, BVW-2, BVW-3, IW-1, SVE-2 and SVE-3, and SB-11 and SB-12; as high plasticity clay (CH) in SVE-1; and low plasticity silt (ML) in BVW-4, SB-01, and SB-07. The analyses showed that low plasticity clay extended to a depth of 6 feet in boreholes BVW-1, BVW-2, SVE-1, SVE-2, and IW-1. BVW-3 analyses showed silty sand (SM) from 4 to 6 feet. Analyses from BVW-4, SVE-3, SB-01, SB-07, SB-11, and SB-12 showed either silt or sandy silt (ML). Analyses indicated a classification of sand - silty sand (SM), poorly graded sand with silt (SP-SM) or poorly graded sand (SP) - for all boreholes on this cross section below 10 feet.

The geologic units in Figure 3-8 were defined based on the general USCS classification (e.g. poorly graded sand (SP)). However, the lower hydraulic conductivity materials -- low- and high-plasticity clay and low-plasticity silt -- were grouped together. In part this was because the low plasticity silts in the upper 3 feet of the FFTA have a clay content of between 30 and 50 percent. In addition, based on grain size distribution, the soil sample collected from BVW-4, for example, contained 3 percent sand, 88 percent silt, and 9 percent clay and was classified as silt (ML). However, the liquid limit of 26 and plasticity index of 3 characterize this soil sample on the clay-silt boundary of the Plasticity Chart (nearly on the "A" line). Either a high-clay-content silt or a classification on the clay-silt boundary of the Plasticity Chart would cause these materials to act as a relatively impermeable barrier. Therefore, for ease of comparison, all of the low plasticity silts were grouped with the clay materials.

3.1.3.2 Geophysical Surveys

Geophysical surveys were performed at MAAF to gain an understanding of the topography of the bedrock surface underlying the alluvial material and evaluate the presence of low permeability layers in the alluvial materials. The geophysical surveys at the FFTA consisted of five lines of seismic reflection and 14 locations where electrical resistivity soundings were performed. The locations four cross sections based upon the seismic data -- C-C', D-D', E-E', and F-F' -- and the resistivity points are depicted in Figure 3-9. Lines C-C', D-D', and F-F' are coincident with three of the seismic survey lines. Cross section E-E' was interpolated between the lines of section D-D' and the unlabeled line southwest of line C-C' (seismic Line 1 (10,000) in Figure 2-3.) Details of the geophysical data are the Technical Memorandum Preliminary Interpretation provided in Appendix A. The results of the geophysical surveys were used to estimate the depth to bedrock within the study area. In general, the seismic reflection data provides a more detailed analyses of the bedrock surface than the resistivity data since each seismic line consists of data points spaced 5 feet apart (while the resistivity data provides a depth to bedrock evaluation at one point for each location). Interpretation of the geophysical data produced depth to bedrock projections beneath each data point. The depth to bedrock projections were corrected for surface elevation and used to generate an initial bedrock topographic map for the study area. This topographic map is shown in Figure 2-6 (which is Figure 2 in Technical Memorandum #5 provided in Appendix A.

The data presented in plan view in Figure 2-6 were then used to generate a three-dimensional view of the bedrock surface, looking from south to north. This projection of the bedrock surface is shown in Figure 3-10 and it includes the seismic resistivity data. Also, some of the key present and former features of the FFTA are shown in the plan view above the bedrock surface and projected vertically onto the top of the bedrock surface.

The depth to bedrock interpretation from the geophysical data was then compared to the depth to bedrock information obtained from the SCAPS subsurface probe pushes described in the next section. The depths to bedrock determined by the SCAPS penetrations differ from the depths predicted by the surface geophysical surveys, with the SCAPS pushes exceeding the predicted depths by about 15 to 25 feet. The most likely explanation is that the velocity assumed for the seismic waves through the alluvium when interpreting the seismic reflection data was less than the actual velocity. This means that the interpreted thickness was less than the actual thickness of the alluvium.

Table 3-2 compares the depths to bedrock based on the depth of the SCAPS pushes relative to the depth to bedrock predicted from the bedrock topography map developed from the initial seismic reflection and surface resistivity surveys. The depths of the SCAPS pushes, representing a minimum depth to bedrock, were then used to make adjustments to the bedrock topography map.

The adjustments to the bedrock topography were accomplished in the following steps. Five SCAPS push points (CP-1, CP-4, CP-5, CP-6, and CP-9) were chosen to compare to the seismic data because they were along seismic lines in areas where the bedrock reflectors are clearly identifiable on the seismic traces. The maximum difference between the seismic depth to bedrock and the SCAPS depth to bedrock was calculated and that difference was added to all of the seismic data. Points CP-4, CP-6, CP-7, and CP-9 were used to perform the same manipulation on the resistivity data. Then the revised seismic and resistivity data were contoured. The results of these adjustments are presented as a revised bedrock topography map (Figure 3-11).

The revised bedrock topography map was compared with the initial bedrock topography map (Figure 2-6) to determine whether changes in the character of the bedrock surface occurred. The gross features of the maps are similar: the bedrock topography generally slopes from south to north; there are two north-trending troughs, one to the east and one to the west of the FFTA; and the local highs and lows are still present at the same locations (with slightly modified shapes).

The bedrock topography slopes from south to north along the alluvial valley because it was cut that way by the erosion of the river. It also slopes from the east to the center of the alluvial valley, again due to erosion. The bedrock layers slope west-northwest beneath the eroded surfaces.

Figures 3-12, 3-13, 3-14, and 3-15 are four geologic cross sections derived from the seismic data and the available boring logs. The locations of these cross sections are shown in Figure 3-9. These cross sections are based on seismic Lines 2, 3, and 4, and a point on Line 1 (the point E on line E-E'.) These lines provide east to west views of the geology across the site and downgradient of the site (lines C-C' and D-D'); as well as north to south views through the site (E-E') and east of the site (F-F').

The vertical scales are exaggerated to highlight changes in the bedrock surface. The bedrock topography in these cross sections exhibits a maximum relief of approximately 13 feet. The variation in ground surface elevation at each of the seismic trace data points on these lines are incorporated into these figures.

In general, the bedrock surface slopes downward from south to north, as exemplified by the approximately 10-foot decrease in elevation from the southern tip of section E-E' to the western end of D-D', a distance of approximately 700 feet. The seismic data indicate a discontinuous clay layer ranging in depth from approximately 45 to 55 feet below ground surface, although it is depicted to be encountered locally as shallow as 30 feet below ground surface. Both the seismic survey and the SCAPS cone penetrometer survey indicate that this clay layer is laterally discontinuous. Therefore it is likely that any DNAPL constituents, if they were present, would migrate vertically downward to the bedrock surface and settle in the nearest topographic low.

3.1.3.3 SCAPS/CPT

The SCAPS rig was used as follows: 1) to look for DNAPLs, 2) to collect deep alluvial groundwater screening samples for groundwater quality evaluation in the alluvial materials immediately overlying bedrock, and 3) to collect CPT/resistivity data to evaluate geologic layering of the alluvial materials between the ground surface and the top of bedrock. In addition, the data collected with the SCAPS rig provided depth to bedrock control to calibrate the data generated from the geophysical surveys. Analytical results of the SCAPS investigation to look for DNAPLs and to collect deep alluvial well screening samples are discussed in Section 5.3 and in Technical Memorandum #5 and Addendum, which are provided in Appendix A.

The nine locations for the SCAPS groundwater screening, CP-1 through CP-9, are depicted on Figure 3-11. Four of these locations (CP-4, CP-5, CP-6, and CP-9) were also selected for the collection of CPT and electrical resistivity data. The CPT/resistivity samples were collected at separate, undisturbed locations several feet from the equivalent groundwater screening push locations. The CPT and resistivity devices are mounted on a single probe, and the data from the two are collected simultaneously during a single push.

Table 3-3 lists the actual depths at which refusal was encountered during SCAPS probe pushes during both CPT/resistivity and groundwater screening pushes. The SCAPS push depths ranged from 47.6 feet to 72.4 feet with an average penetration depth of 66.9 feet. Since the depth of pushes varied at a single location (e.g., CP-4 - pushes of 53, 65, and 72 feet), the depths of the SCAPS pushes are not definitely associated with the top of bedrock. Rather, they are indicative of the minimum depth at which the top of the bedrock surface occurs.

After each CPT/resistivity push was completed, the data was printed out in the form of a depth profile. Copies of these printouts are provided in Appendix A (Figures 2 through 5 of the Addendum to Technical Memorandum #5). The CPT data identified few clay layers at the site, and did not identify any clay layers greater than a few feet in thickness below a depth of 30 feet. The CPT data indicate that the alluvial materials consist principally of sands and sand mixtures.

The CPT data confirm both the presence and discontinuous nature of the clay layers beneath the site. As an example, at locations CP-4 and CP-5, a 3-foot-thick layer of fine-grained material (silt or clay) was recorded between 20 feet and 30 feet; however, this layer is thin to nonexistent at locations CP-6 and CP-9.

Tables 3-4 to 3-7 compare the stratigraphy of the first 20 feet of the CPT pushes CP-4, CP-5, CP-6, and CP-9, respectively, with the stratigraphy as noted by visual classification from the nearest soil boring and/or extraction well boring (SB-05, SVE-1, or SVE-2). Note that in all cases, the stratigraphy begins at zero feet with a clay-rich unit and grades to sand by about 15-feet deep. In general, the closer the CPT push to the soil boring, the greater the correlation.

3.1.4 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. The 24-hour rain events can exceed 3.5 inches (Ref. 46).

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 (Ref. 47).

3.1.5 Vegetation, Wildlife and Wetlands

Land cover on the undeveloped portions of Fort Riley consist 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. 48).

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-1800s 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.

The wetlands within 1 mile of the FFTA identified on the National Wetlands Inventory (Ref. 49) are shown and identified on Figure 3-4. Wetlands downgradient of the FFTA are limited to the oxbow and a small pond, both located to the north of the site, and wetlands adjacent the Kansas River, located west of the site. All of these wetlands are of the Palustrine system and are described below with their respective National Wetlands Inventory Classifications. These classifications are provided in the legend for Figure 3-4 and are also designated in Table 3-8.

<u>Oxbow Wetlands (PABG, PEMA, PEMC, and PUBF)</u>. An oxbow is located north, northeast of FFTA. The wetlands in the oxbow include a large area of the aquatic bed class with an intermittently exposed water regime (PABG). This area is located within the topographic boundaries of Whiskey Lake. Other intermittent wetland areas of the oxbow include emergent class wetlands which are either temporarily (PEMA) or seasonally flooded (PEMC) and unconsolidated bottom class wetlands which are semi-permanently flooded (PUBF).

Small Pond (PUBF). A small pond is located approximately 0.5 miles northwest of FFTA classified as unconsolidated bottom wetlands with a semi-permanently flooded water regime.

Areas adjacent to the Kansas River (PSSA). The Kansas River is located 0.4 miles west of the FFTA. Within the river boundary are several areas of scrub shrub wetlands with a temporarily flooded water regime.

3.1.6 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. 50) The USFWS concluded that eight federally-listed species, two category 1 candidate species and fourteen category 2 candidate species may potentially occur on Fort Riley. Of the species that may potentially occur, two federally-listed category 1 and eleven category 2 species are documented on Fort Riley. These species that are documented to occur on Fort Riley are included in Table 3-9 and are described below (Ref. 51).

Endangered and Threatened Species. Endangered species are defined as those species in danger of extinction throughout all or a significant portion of their range. Threatened species are defined as species that are likely to become endangered within the foreseeable future 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. One peregrine sighting was made by Fort Riley Natural Resources Division staff in the southeastern portion of the installation, and another sighting occurred along the Kansas River upstream from Marshall Airfield.

Candidate Species/In Need of Conservation (SINC). Category 1 species are species for which scientific evidence has been collected indicating the need to list that species, but the species has not yet been proposed for listing. Candidate species (federal category 2) are defined as those species under review for listing as a federal threatened or endangered species. Two federally-listed category 1 and eleven category 2 species have been documented to occur on Fort Riley. These species and their preferred habitats are as follows:

- **Topeka Shiner** (*Notropis tristis*). This small minnow prefers large, clear pools near the headwaters of small streams that maintain a stable water level due to weak springs. The Topeka shiner is proposed for state listing as a threatened species.
- **Sturgeon chub** (*Macrhybopsis gelida*). This small minnow inhabits turbulent areas where shallow water flows across sandbars. Sturgeon chubs are also state-listed as threatened.
- **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 irregularly seen during the spring of 1992 by Natural Resources Division Staff.

- **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.

- **Ferruginous hawk** (*Buteo regalis*). This hawk spends much of the time sitting on low perches or soaring high overhead, around farmland, marshes and other open areas.

- **Northern goshawk** (*Accipiter gentilis*). This hawk is primarily a bird of northern forests. When in Kansas it prefers wooded areas where it hunts below treetop level.

- **Western burrowing owl** (*Athene cunnicularia*). This grassland owl nests in ground burrows, usually abandoned prairie dog dens. It feeds upon insects and rodents.

- **False map turtle** (*Grptemys pseudogeographica*). This turtle occurs in slow moving rivers and oxbow lakes. An abundance of aquatic vegetation and basking sites is required.

Of the two federally designated endangered or threatened species, the bald eagle and the peregrine falcon, respectively, have the potential to use the lands along the Kansas River for nesting and eating. However, there has been no observed nesting of either species in areas downstream of the FFTA-MAAF. While the bald eagle feeds principally on fish and would be expected to stay close to the Kansas River, the peregrine falcon feeds on small land mammals and may feed on areas of land closer to the FFTA-MAAF. Of the candidate endangered species, the loggerhead shrike, the black tern,, the white-faced ibis, the sturgeon chub, the ferrugineous hawk and the false map turtle use habitats that occur around the FFTA-MAAF or along the Kansas River downstream of the FFTA-MAAF. However, none of the candidate species, except the false map turtle, have been documented in the area of the FFTA-MAAF. The false map turtle is known to occur in the Kansas River near FFTA-MAAF and is presumed to breed there as well. The state of Kansas has designated the Kansas River at Fort Riley as critical habitat for the sturgeon chub. The remaining candidate species have habitats in the uplands or tall prairie grasses, which do not occur in areas downgradient or downstream of the FFTA-MAAF.

3.1.7 Populations

MAAF is an active army airfield. MAAF includes all activities to support the living and working population of an airfield. Fort Riley has over 20,800 military personnel and workers plus 7,600 on-post dependents (Ref. 52). MAAF has 1,019 workers including 941 military, 55 civilian, 37 contractors, and 20 dependents with the majority of these personnel housed on Main Post, which is northwest of MAAF across the Kansas River. The nearest on-post housing is approximately 0.5 miles southwest of the FFTA.

The lands surrounding MAAF consist of undeveloped lands, farmlands, and nearby towns. In addition to the other cantonment areas of Fort Riley (all of which are within 4 miles), the following towns are located within 4 miles of the FFTA-MAAF: Junction City (adjacent to the south, including Grandview Plaza) and Ogden (approximately 3.8 miles to the northeast).

The approximate populations of the surrounding major towns are: Junction City with 20,604, Grandview Plaza with 1,233, and Ogden with 1,494 (Ref. 53).

Junction City is located in Geary County and Ogden is located in Riley County, and 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.

There are a few private residences scattered in primarily agricultural land areas north of the FFTA-MAAF. However, the property adjacent to the installation boundary north of the FFTA-MAAF is an active speedway for racing motor vehicles.

3.1.8 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. As outlined in the EPA Guidance, groundwater users were evaluated within 4 miles of the FFTA-MAAF. Regional groundwater flow for the alluvial acquifer is shown in Figure 3-16 (Ref. 54). There is a general flow along the Kansas River to the north and east.

3.1.8.1 Alluvial Aquifers

Fort Riley and the communities of Junction City and Ogden 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, and Ogden has three active wells (Refs. 55, 56, 57). Ogden also provides water to a rural water district in Riley County.

Figure 3-17 shows the general boundaries of the alluvial deposits in the Fort Riley area (Ref. 46), along with the locations of public drinking water wells or wellfields (see also Plate 3). As shown, the wells for Fort Riley are within 4 miles of the FFTA-MAAF. The nearest public water supply well is located at MAAF and is within 1 mile of the FFTA-MAAF. This well is located east of the airfield and south of the FFTA, near Interstate 70. The well at MAAF is only used to service the airfield in the event of an emergency affecting the Fort Riley water distribution system as a whole. There are no other private or public supply wells at MAAF. 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 the Main Post wells brought on-line from 1928 to 1943) and two new wells located approximately 1,300 feet west of the Main Post wells (brought online in 1993). Two former wells located further west towards Camp Forsyth were removed from service in 1993 but may still be used for irrigation. The Fort Riley drinking water wells are located approximately 3 miles from the FFTA. Within the Fort Riley system identified above, the water from the wells is mixed as part of the distribution throughout the supply network. There are no data on the wells to indicate that any one well contributes more than 40 percent of the annual system capacity (Refs. 58, 59, 60, 61). The wells for Ogden and Junction City are greater than 4 miles from the FFTA-MAAF.

The majority of private residences within 4 miles of Fort Riley are located within the boundaries of the public water supply systems. The boundaries of public water supply systems within 4 miles of the FFTA-MAAF are shown on Plate 3. An 8-inch line from Junction City provides all of the water to Grandview Plaza, which has no wells. Areas outside the boundaries of the public water supply systems rely on private wells.

During the IWSA, private residences within a 4-mile radius outside the areas served by public water were described. For the SI, the number of private wells within 4 miles of the site in the downgradient direction was refined. A private well survey was conducted during January 1994 to determine how many residences do not rely on a public water supply system. The area in which a private well survey was conducted includes the boundaries of the Kansas River to the north and west, Clark's Creek to the east, and the levee to the north of MAAF. Records from the KDHE, Bureau of Water were investigated for water well records within this area. The area of concern for these well records is located within the Township number 11 and Range number 6. All water well records on file with the KDHE within this township and range were obtained (Ref. 45). This included six domestic wells and one public water supply well. Of these seven wells, bedrock was encountered at a depth of 15 feet at one location, and the well was completed in a deeper limestone formation. The remaining wells are completed in alluvial deposits. In addition, the number of residences within this area were evaluated by reviewing 1993 aerial photographs from the USACE as well as USGS topographic maps. A total of 14 residences were identified. While only six well record reports were obtained, it is assumed that the remaining eight residences are also using private well water. There is no other information available in state files. The exact locations of the wells in the state records is not known, and locations and or current use of the wells has not been field verified by the state.

An irrigation well was placed into service in the spring of 1994. This well is located approximately 2,400 feet north of the FFTA-MAAF. According to the farmer who operates the irrigation well and the gauge on the well, the well has pumped approximately 22 million gallons of water from July to September 1994. This well record was obtained later (Ref. 45).

Aquifer Tests

Several aquifer tests were performed between 1974 and 1989 at three areas within the vicinity of Fort Riley, as well as, on-post. These tests were performed by contractors to the USACE, Kansas City District for the purpose of constructing a water supply well system for Junction City, Kansas and the army post at Fort Riley. Aquifer tests were also performed at MAAF for the purpose of potentially constructing a small groundwater production facility for use during airfield operations.

A 10-hour pump test was performed at the MAAF in March 1983. The test was comprised of pumping a test well at a rate of 1,000 gallons per minute (gpm) while monitoring four wells in the vicinity of the test well. The transmissivity values ranged from 203,894 to 367,304 gallons per day per foot (gpd/ft); the storativity values (which are unitless) ranged from 0.062 to 0.2 (Ref. 62).

A 7-day pump test was performed in 1975 at test wells installed along a section of McCormick Avenue, west of Camp Forsyth. The test was comprised of pumping a test well at a rate of 1,250 gpm while monitoring numerous wells in the vicinity of the test well. Twelve piezometer holes were drilled in 1974 and 14 test holes were drilled in 1975. The transmissivity values ranged from 275,000 to 767,440 gpd/ft; the storativity values ranged from 0.23 to 0.45 (Ref. 63).

Several pump tests were performed in the expansion well field east of the existing Main Post Well Fields (east of MP-1) within the town of Junction City, Kansas in 1984 and 1989. The pump rates varied from 1,000 to 1,056 gpm. The tests lasted from 300 to 660 minutes. Piezometers were drilled for monitoring and selection of pumped well. The transmissivity values ranged from 159,331 to 659,197 gpd/ft; the storativity values ranged from 0.000126 to 0.0143 (Ref. 64).

3.1.8.2 Groundwater Gradients

A description of the regional groundwater flow presented in Section 3.1.8 showed a general flow along the Kansas River to the north and east. This section presents site-specific information on measured groundwater directions and gradients. As is discussed in this section, the local groundwater flow includes a north-northwest component. This flow pattern on a local scale may be due to factors such as the pumping well I-1 producing an artificial gradient opposite the regional flow pattern, certain reaches along the Kansas River to the northwest of the FFTA behave, at times as a gaining stream in which the water level in the river is lower than the water level in the aquifer, or a groundwater divide may exist at the FFTA.

Groundwater levels were initially measured in all the seven on-post wells located to the north and downgradient of the airfield during the SI activities in October 1993. As a follow up to the initial SI activities, these were measured for a second and third time in January and March 1994. To assess changes in groundwater elevations and the potential impact on groundwater flow directions, the seven monitor wells at the FFTA-MAAF were monitored monthly as part of the ESI from June 1994 through April 1995. Four additional shallow wells (FP-94-08 through FP-94-11) were installed north of MAAF on the off-post properties in August 1994. Along with an on-post piezometer (FP-94-12PZ) installed outside the northwest corner of the airfield northwest of MAAF near the Kansas River in July 1994, these were included in the monthly groundwater level measurements beginning in September 1994. The elevation of the water table in each of the on-post wells and piezometer and off-post wells taken as part of the SI and ESI are presented in Table

3-10. This table also includes the depth of the well and the elevation of the top of the PVC riser (from which all measurements were made).

Groundwater levels during the SI activities in September and October 1993 were significantly higher than normal due to regional flooding that occurred in July 1993. The seven on-post monitor wells (FP-93-01 through FP-93-07) indicate that normal groundwater depths are about 18 to 20 feet beneath the surface as measured since June 1994. Depth to groundwater was 8 to 9 feet in October 1993, approximately 12 feet in January 1994, and approximately 19 feet in January 1995.

Groundwater levels were measured in the monitoring wells on 20 occasions between October 1993 and April 1995. Table 3-10 presents only data collected through January 1995, including six weekly groundwater elevation measurements taken during the pilot test study operation. Figure 3-18 depicts a groundwater gradient map using the October 1993 data. The groundwater level was exceptionally high due to the July 1993 flooding. The nearby speedway was under water, which is evidence of the flooding. The second set of groundwater levels measurements were taken on 6 January 1994 when the speedway was not flooded. Figure 3-19 depicts a groundwater gradient map using the 6 January 1994 data. The groundwater elevations dropped by approximately 3 feet between the two dates of measurement. Additional groundwater level measurements taken since that time reveal that levels dropped an average of 5 feet by March 1994 and 7 feet by May 1994 since the initial readings in October 1993. Overall, the data indicates that locally the groundwater flows toward the north-northwest.

From June 1994 through April 1995, groundwater level measurements were made on a monthly basis. The measurements were taken at the seven on-post wells only through August 1994. From September 1994 through April 1995, these were augmented by measurements taken at the on-post piezometer (FP-94-12PZ) and four off-post wells (FP-94-08 through FP-94-11). Groundwater gradient maps developed from these measurements through January 1995 are presented in Figures 3-20 through 3-27. As seen in these figures, groundwater generally flows locally in the north-northwest direction.

Kansas River Measurement

On 29 July 1994, a groundwater level measurement in the piezometer was coordinated with the elevation of the Kansas River (this location was not the same as that of the gaging station mentioned below). The groundwater elevation in piezometer FP-94-12PZ was taken concurrently with the surface water elevation in the Kansas River at a location closest to the piezometer. The groundwater elevation in the piezometer (N267.983, E2350.637) was 1,039.56 feet above mean sea level (MSL). The surface water level elevation in the Kansas River at that location (N268.072, E2350.471) was 1,039.02 feet above MSL. The percent difference between these measurements is about 0.05 percent.

Gaging Data

The Kansas River gaging data provided in Appendix C also correlates closely with groundwater level measurements taken between January 1994 and January 1995. Table 3-10, which shows all groundwater elevations for all wells and the piezometer, also shows Kansas River water level data taken at the gaging station between Main Post Landfill and Marshall Field (Latitude 390309, Longitude 0964633) on the same dates that groundwater elevations were measured in the wells and the piezometer. The levels were all within 0.2 percent of each other, demonstrating that groundwater elevations in the wells and piezometer closely reflect changes in water levels in the Kansas River during that time period. Because piezometer FP-94-12PZ is located close to the Kansas River, the groundwater levels in the piezometer reflect impacts due to changes in water levels in the Kansas River more quickly than the monitor wells.

Effect of Pilot Test Study

To determine whether operation of the pilot test study systems had an affect on groundwater levels, groundwater elevations were examined over the period of the pilot test study that was conducted at AOC-1 and AOC-2. It was concluded that the pilot test study had negligible impact on the groundwater elevations. The 60-day AOC-1 pilot test study occurred from 14 November 1994 to 16 January 1995. Within this period, the SVE system operated from 14 to 17 November, 1994, and the air injection system operated for the entire duration of the pilot test study (except during the two in-situ respiration tests). The AOC-2 system was initiated 30 days after the startup of AOC-1. The duration for this operation was 30 days, from 14 December 1994 to 16 January 1995, the end date of the pilot test study at AOC-1.

Weekly measurements were made at nearby wells (FP-93-04, FP-93-05, and FP-93-06) from 16 December 1994 through 17 January 1995, the period when the SVE system was in operation at AOC-2. Monitor wells FP-93-04 and FP-93-05 were selected because well FP-93-04 is located in the center of AOC-1 and well FP-93-05 is located in the center of AOC-2. Well FP-93-06 is located approximately 470 feet from AOC-1 and 230 feet from AOC-2. The data from well FP-93-06 was used for background comparison data (for groundwater elevation only). Table 3-10 includes the weekly groundwater level data collected prior to, during the operation of, and following the pilot test study as part of the monthly ESI measurement.

Figure 3-28 depicts the elevation changes over time for wells FP-93-04, FP-93-05, and FP-93-06. The water level in well FP-93-06, which provided comparative background data, gradually decreased from the October 1994 to January 1995, with a recedance of 1.29 feet.

At AOC-1, the initial groundwater elevation difference in wells FP-93-04 and FP-93-06 was 0.43 feet. The groundwater levels decreased gradually over time, similar to well FP-93-06, as shown on Figure 3-28. A measurement collected on 3 January 1995 indicated a small rise in elevation (less than 0.1 foot). Therefore, the pilot test study did not affect the groundwater level at FP-93-04.

For AOC-2, well FP-93-05 was at approximately the same elevation (difference of 0.01 foot) as the background well FP-93-06 before the initiation of the pilot test for AOC-2. During the pilot test study, the groundwater levels of wells FP-93-05 and FP-93-06 decreased gradually over time, as shown in Figure 3-28. No significant differences in the elevations were noted during this time. Therefore, the pilot test study did not affect the groundwater level at well FP-93-05.

3.1.8.3 Bedrock Aquifers

Fort Riley operates several wells in the upland areas of the installation that draw from bedrock formations. These include wells at Range Control, Multi-Purpose Range Complex (MPRC)/Douthit Range, Trainfire 4, and Range 18. The Range Control wells are used regularly a source of drinking water for approximately 12 workers. 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. None of these wells are within 4 miles of the FFTA-MAAF. Private residences in the upland areas, outside of town limits, use private wells. Many of the rural residences surrounding Fort Riley are located in the uplands area, and their wells tap bedrock 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. One private well was identified in the area downgradient of the FFTA-MAAF (Township 11, Range 6) drawing from limestone, as previously discussed (Ref. 45).

The depth to bedrock underneath the FFTA-MAAF is estimated to be 65 to 75 feet. In a boring at MAAF approximately 5,300 feet south of FFTA, bedrock was encountered at a depth of 61 feet and was described as light gray, soft, weathered limestone.

3.1.9 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 Kansas River, at its closest point, is located approximately 2,300 feet to the west of the FFTA-MAAF. The site is separated from the Kansas River by levees designed for the 100-year flood; the site was not flooded during the large-scale regional flooding that occurred in July 1993. All of MAAF is located within the 500-year floodplain (Ref. 65).

Aerial photographs from 1954 through 1993 (Ref. 66) were utilized to determine past drainage patterns occurring at MAAF (see Appendix B). Prior to the operation of the FFTA, surface water drained north toward the levee and then east along a swale adjacent to the levee. This water then discharged through a culvert (approximately 1,600 feet southeast of the future FFTA) into the oxbow which is located north of MAAF. Evidence of this culvert is still apparent. This culvert is depicted on Photographs 3-1 and 3-3 and can also be seen on the 1961 aerial photograph provided as Photograph 3-2. Photograph 3-3, which was taken in February 1994, depicts the south side of the levee where the former culvert aligns with drainage to the north. Photograph 3-4, also taken in February 1994, depicts the north side of the levee where there is a topographic low area implying a former drainage area. Figure 3-29 depicts the locations and directions in which Photographs 3-3 and 3-4 were taken. During the operational years of the FFTA (aerial photographs 1971 through 1984), drainage was diverted in several directions. There was still evidence that drainage from MAAF was toward the culvert to the east via the drainage swale adjacent to the levee. However a second culvert is present northwest of the FFTA which may also pass through the levee toward the oxbow. This second culvert is less apparent in later photographs where there is evidence of poorly drained soils (based on interpretation of photographs, as discussed in Appendix B) in this area. Drainage directly from the FFTA appears to travel toward a topographic low located to the northeast of the FFTA. Subsequent to the operation of the FFTA, a drainage ditch transecting the site diverts runoff to the west and, via a gate valve in the levee, to the Kansas River which is to the west of MAAF. This gate valve generally remains open and is only used to prevent water from entering MAAF during times of flooding. The location of the seven monitoring wells installed and sampled as part of the SI are shown in Photographs 3-5 and 3-6. Figure 3-29 depicts the locations and directions in which these photos were taken.

Stream flows for the surface water bodies of concern are based on data from stream gaging stations. Average annual flow for the Kansas River from 1964 through 1994 is 4,851,000 liters per minute (or 2,855 cubic feet per second). The Kansas River gaging and discharge data are provided in Appendix C.

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, measured in the downstream direction along the path of the river. The resultant point on the Kansas River is approximately 4 miles upstream of Manhattan. Berger was unable to identify any surface water intakes within 15 miles downstream of the FFTA-MAAF. Given that all communities along this stretch of water use groundwater for their supplies, Berger concluded that no surface water intakes exist for 15 miles downstream of the FFTA-MAAF.

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.

Table 3-1. Summary of Geotechnical Laboratory Testing of Soil Samples, October 1994

Soil Boring	Sample Identification	Sample Depth (feet)	Description	Natural Moisture (%)	Atterberg Limits			USCS Class
					LL	PL	PI	
Undisturbed Shallow Soil Samples								
BVW-1	MAAFBVW-1-S	1.0 - 3.3	Light brown lean clay	16.9	34	19	15	CL
BVW-2	MAAFBVW-2-S	0.9 - 2.9	Light brown lean clay	12.6	30	19	11	CL
BVW-3	MAAFBVW-3-S	1.0 - 3.2	Olive lean clay	11.1	28	19	9	CL
BVW-4	MAAFBVW-4-S	1.2 - 3.5	Olive-brown silt w/sand	27.1	26	23	3	ML
IW-1	MAAFIW-1-S	1.0 - 3.0	Light-brown lean clay	8.7	30	21	9	CL
SVE-1	MAAFSVE-1-S	0.9 - 2.9	Dark brown mottled light gray fat clay w/organics	18.2	50	20	30	CH
SVE-2	MAAFSVE-2-S	1.0 - 3.3	Brown mottled light olive-brown lean clay w/organics	9.7	37	19	18	CL
SVE-3	MAAFSVE-3-S	1.0 - 3.0	Brown lean clay	29.0	49	19	30	CL
Disturbed Soil Samples								
BVW-1	MAAFBVW-1-1	4.0 - 6.0	Dark brown lean clay	19.4	30	20	10	CL
	MAAFBVW-1-2	10.0 - 12.0	Brown Silty Sand	19.1	NL	NP	NAp	SM
	MAAFBVW-1-3	17.4 - 18.6	Light brown poorly graded sand (contamination odor)	3.7	NL	NP	NAp	SP
BVW-2	MAAFBVW-2-1	4.0 - 6.0	Brown lean clay	14.4	30	17	13	CL
	MAAFBVW-2-2	10.0 -12.0	Brown silty sand	10.1	NL	NP	NAp	SM
	MAAFBVW-2-3	18.0 - 18.5	Light brown poorly graded sand	2.3	NL	NP	NAp	SP

Table 3-1. Summary of Geotechnical Laboratory Testing of Soil Samples, October 1994 (continued)

Soil Boring	Sample Identification	Sample Depth (feet)	Description	Natural Moisture (%)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	USCS Class
BVW-3	MAAFBVW-3-1	4.0 - 6.0	Brown silty sand	12.2	24	22	2	SM
	MAAFBVW-3-2	9.0 - 10.0	Brown silty sand	11.8	NL	NP	NAp	SM
BVW-4	MAAFBVW-4-1	4.0 - 6.0	Brown silt	24.3	26	23	3	ML
	MAAFBVW-4-2	13.0 - 13.5	Brown poorly graded sand	3.9	NL	NP	NAp	SP
SVE-1	MAAFSVE-1-1	4.0 - 6.0	Olive mottled gray lean clay	15.0	39	21	18	CL
	MAAFSVE-1-2	10.0 - 11.8	Light brown poorly graded sand w/silt	2.7	NL	NP	NAp	SP-SM
	MAAFSVE-1-3	15.2 - 16.5	Light brown poorly graded sand	2.8	NL	NP	NAp	SP
SVE-2	MAAFSVE-2-1	4.0 - 6.0	Brown lean clay	22.6	45	18	27	CL
	MAAFSVE-2-2	10.0 - 12.0	Yellowish brown poorly graded sand w/silt	3.5	NL	NP	NAp	SP-SM
	MAAFSVE-2-3	17.0 - 17.8	Yellowish brown poorly graded sand	4.1	NL	NP	NAp	SP
SVE-3	MAAFSVE-3-1	4.0 - 6.0	Olive brown mottled gray sandy silt	18.9	21	NP	NAp	ML
	MAAFSVE-3-2	10.0 - 11.4	Yellowish brown poorly graded Sand	3.8	NL	NP	NAp	SP
IW-1	MAAFIW-1-1	4.0 - 6.0	Brown lean clay	14.3	26	13	13	CL
	MAAFIW-1-2	10.0 -12.0	Brown poorly graded sand w/silt (contamination odor)	5.6	NL	NP	NAp	SP-SM
	MAAFIW-1-3	18.0 18.5	Brown poorly graded sand (contamination odor)	2.9	NL	NP	NAp	SP

USCS	Unified Soil Classification System
NL	Non-Liquid
NP	Non-Plastic
NAp	Not Applicable

CL	Lean clay (does not expand upon contact with water)
CH	Fat clay (expands upon contact with water)
ML	Lean silt (does not expand upon contact with water)
SM	Silty sand
SP	Poorly graded sand

Table 3-2. Depth of Investigation

SCAPS		Seismic		Surface Resistivity	
Location	Push Refusal Depths (feet)	Line*	Depth to Bedrock Interpretation (feet)	Location	Depth to Bedrock Interpretation (feet)
CP-1	67.3	D' - D'	55	NM	NM
CP-2	68.3	D' - D'	42	NM	NM
CP-3	47.6	D' - D'	49	R10	55
CP-4	71.8	C' - C'	57	R8	56
CP-5	71.8	C' - C'	52	NM	NM
CP-6	71.4	F' - F'	53	R7	48
CP-7	67.2	NM	NM	R4	54
CP-9	68	C' - C'	51	R7	48

NM - Not Measured

* Location shown on Figure 3-9

Table 3-3. Depth of SCAPS Pushes, November/December 1994

SCAPS Location	CPT/Resistivity Locations (Depth in feet)	Groundwater Screening Locations (Depth in feet)
CP-9	55.0	68
CP-1	NM	67.3
CP-2	NM	68.3
CP-3	NM	47.6
CP-4*	64.7	53 71.8
CP-5	50.8	71.8
CP-6	65.3	71.4
CP-7	NM	67.2
CP-8	NM	72.4

* Two samples were collected at this location - CP4-GW1 was collected at 53 feet and CP4-GW2 was collected at 71.8 feet.

NM - Not Measured, no pushes

Table 3-4. Comparative Stratigraphy, CP-4 to MAAFSB-5

CPT, CP-4		Visual Classification, MAAFSB-5	
Depth Range (feet)	Classification	Depth Range (feet)	Classification
0.0 - 2.0	clay, silt, sand	0.0 - 1.5	clayey sand
2.0 - 3.0	sand	1.5 - 9.5	poorly sorted sand with silt
3.0 - 9.0	silty sand		
9.0 - 10.0	silt and/or clay	9.5 - 15.9	sand
10.0 - 11.0	sand		
11.0 - 12.5	silt and/or clay		
12.5 - 24.0	sand		

Table 3-5. Comparative Stratigraphy, CP-5 to SVE-1

CPT, CP-5		Visual Classification, SVE-1	
Depth Range (feet)	Classification	Depth Range (feet)	Classification
0.0 - 1.0	clay	0.0 - 0.9	clayey sand
1.0 - 9.2	silty sand	0.9 - 4.2	low plasticity clay with sand
9.2 - 9.5	clay	4.2 - 9.6	silty sand
9.5 - 15.5	sand	9.6 - 18.4	sand, clay interbed at 11.7 feet and 16.0 feet
15.5 - 15.8	silt		
15.8 - 20.0	sand		

Table 3-6. Comparative Stratigraphy, CP-6 to SVE-2

CPT, CP-6		Visual Classification, SVE-2	
Depth Range (feet)	Classification	Depth Range (feet)	Classification
0.0 - 1.5	clay	0.0 - 5.0	high plasticity clay
1.5 - 9.0	silty sand	5.0 - 8.2	silty sand
9.0 - 23.0	sand, silty interbed at 16 feet	8.2 - 18.3	sand, silty interbed at 16.2 and 17.0 feet

Table 3-7. Comparative Stratigraphy, CP-9 to SVE-2

CPT, CP-9		Visual Classification, SVE-2	
Depth Range (feet)	Classification	Depth Range (feet)	Classification
0.0 - 1.0	clay, silt	0.0 - 5.0	high plasticity clay
1.0 - 2.0	silty sand		
2.0 - 3.0	sand		
3.0 - 3.5	silty sand		
3.5 - 8.2	silty sand, clay, silt	5.0 - 8.2	silty sand
8.2 - 15.5	sand, silty sand	8.2 - 18.3	sand, silty interbed at 16.2 and 17.0 feet
15.5 - 16.0	silty or clayey sand		
16.0 - 20.0	sand		

R — RIVERINE

1 — TIDAL | 2 — LOWER PERENNIAL | 3 — UPPER PERENNIAL | 4 — INTERMITTENT | 5 — *UNKNOWN PERENNIAL*

RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	*SB — STREAMBED	AB — AQUATIC BED	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	**EM — EMERGENT	OW — *OPEN WATER/ Unknown Bottom*
1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble 3 Cobble-Gravel 4 Sand 5 Mud 6 Organic 7 Vegetated	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Nonpersistent	

*STREAMBED is limited to TIDAL and INTERMITTENT SUBSYSTEMS, and comprises the only CLASS in the INTERMITTENT SUBSYSTEM.
**EMERGENT is limited to TIDAL and LOWER PERENNIAL SUBSYSTEMS.

P — PALUSTRINE

RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	US — UNCONSOLIDATED SHORE	ML — MOSS-LICHEN	EM — EMERGENT	SS — SCRUB-SHRUB	FO — FORESTED	OW — *OPEN WATER/ Unknown Bottom*
1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	1 Moss 2 Lichen	1 Persistent 2 Nonpersistent	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*	

L — LACUSTRINE

1 — LIMNETIC

RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	OW — *OPEN WATER/ Unknown Bottom*
1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	

2 — LITTORAL

RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	EM — EMERGENT	OW — *OPEN WATER/ Unknown Bottom*
1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Nonpersistent	

MODIFIERS

In order to more adequately describe wetland and deepwater habitats one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

WATER REGIME

Non-Tidal

- A Temporarily Flooded
- B Saturated
- C Seasonally Flooded
- D *Seasonally Flooded/ Well Drained*
- E *Seasonally Flooded/ Saturated*
- F Semipermanently Flooded
- G Intermittently Exposed
- H Permanently Flooded
- J Intermittently Flooded
- K Artificially Flooded
- W Intermittently Flooded/Temporary
- Y Saturated/Semipermanent Seasonal
- Z Intermittently Exposed/Permanent
- U *Unknown*

Tidal

- K *Artificially Flooded*
- L Subtidal
- M Irregularly Exposed
- N Regularly Flooded
- P Irregularly Flooded
- *S Temporary-Tidal
- *R Seasonal-Tidal
- *T Semipermanent-Tidal
- *V Permanent-Tidal
- U *Unknown*

*These water regimes are only used in tidally influenced, freshwater systems.

WATER CHEMISTRY

Coastal Halinity

- 1 Hyperhaline
- 2 Euhaline
- 3 Mixohaline *(Brackish)*
- 4 Polyhaline
- 5 Mesohaline
- 6 Oligohaline
- 0 Fresh

Inland Salinity

- 7 Hypersaline
- 8 Eusaline
- 9 Mixosaline
- 0 Fresh

pH Modifiers for all Fresh Water

- a Acid
- t Circumneutral
- i Alkaline

SOIL

- g Organic
- n Mineral

SPECIAL MODIFIERS

- b *Beaver*
- d *Partially Drained/Ditched*
- f Farmed
- h *Diked/Impounded*
- r Artificial Substrate
- s *Spoil*
- x Excavated

TABLE 3-8

NATIONAL WETLANDS IDENTIFICATION SCHEMES

Table 3-9. Protected Species That May Occur at Fort Riley
(current as of 25 July 1995)

Listed Species	State Status	Fort Riley Documentation	Scientific Name
Endangered			
Peregrine Falcon[1]	E	X	*Falco peregrinus*
Whooping Crane	E		*Grus americanus*
Eskimo Curlew	E		*Numenius borealis*
Least Tern	E		*Sterna antillarum*
American Burying Beetle	E		*Nicrophorus americanus*
Threatened			
Bald Eagle	T	X	*Haliaeetus leucocephalus*
Piping Plover	T		*Charadrius melodus*
Western Prairie Fringed Orchid			*Platanthera praeclara*
Candidate 1 Species			
Sturgeon Chub	T	X	*Macrhybopsis gelida*
Topeka Shiner[2]		X	*Notropis tristis*
Candidate 2 Species			
Plains (Eastern) Spotted Skunk	T		*Spilogale putorius*
Baird's Sparrow			*Ammodramus bairdii*
Black Rail			*Laterallus jamaicensis*
Black Tern		X	*Chlidonias niger*
Ferruginous Hawk		X	*Buteo regalis*
Henslow's Sparrow		X	*Ammodramus henslowii*
Loggerhead Shrike		X	*Lanius ludovicianus*
Northern Goshawk		X	*Accipiter gentilis*
Western Burrowing Owl		X	*Athene cunicularia*
White-faced Ibis	T	X	*Plegadis chihi*
False/Ouachita Map Turtle		X	*Graptemys pseudogeographica*
Texas Horned Lizard		X	*Phrynosoma cornutum*
Plains Minnow			*Hybognathus placitus*
Prairie Mole Cricket		X	*Gryllotalpa major*
Regal Fritillary Butterfly		X	*Speyeria idalia*
State-listed, but not Federal-listed			
Snowy Plover	T		*Charadrius alexandrinus*

E - Endangered
T - Threatened
X - Documented to occur

Source: Fort Riley, 1995. Comments from T&E Species Biologist, "Review of Site Investigation Report for FFTA at Marshall Army Airfield (Ref. 51).

[1] The U.S. Fish and Wildlife Service (USFWS) has proposed to delist the peregrine falcon range-wide from the Threatened and Endangered species list.

[2] Kansas Department of Wildlife & Parks (KDWP) is preparing a regulation to list the Topeka Shiner as threatened in the state to be voted on by the KDWP Commission at a later meeting. Also, USFWS has finished writing the proposed rule to list this species as threatened throughout its range. However, that rule has not yet been published in the Federal Register.

Table 3-10. Groundwater Elevations for the FFTA-MAAF

Well I.D.	Well Depth (feet)	Top of PVC/Riser Elevation (feet)	Groundwater Elevation (feet)																	
			27,28-Oct-93	6-Jan-94	11-Mar-94	30-Jun-94	7,8-July-94	29-Jul-94	24-Aug-94	18-Sep-94	11-13-Oct-94	30-Nov-94	16-Dec-94	22-Dec-94	28-Dec-94	31-Dec-94	3-Jan-95	10-Jan-95	17-Jan-95	19,27,29-Jan-95
FP-93-01	25.0	1058.94	1047.17	1044.16	1042.24	1040.29	1040.26	1039.88	1039.43	1038.88	1038.59	1037.74	*	1037.46			*			1037.19
FP-93-02	31.0	1060.15	1047.28	1044.23	1042.27	1040.31	1040.22	1039.90	1039.43	1038.89	1038.50	1037.73		1037.45						1037.18
FP-93-03	24.0	1057.38	1047.31	1044.23	1042.27	1040.31	1040.25	1039.91	1039.43	1038.89	1038.47	1037.73		1037.43						1037.16
FP-93-04	31.3	1058.82	1047.20	1044.29	1042.39	1040.46	1040.52	1040.07	1039.62	1038.99	1038.20	1037.80	1037.56	1037.46	1037.40	1037.30	1037.20	1037.24	1038.22 (b)	1037.23
FP-93-05	31.0	1059.11	1047.31	1044.38	1042.27	1040.47	1040.46	1040.07	1039.64	1039.05	1038.63	1037.88	1037.69	1037.57	1037.51	1037.48	1037.44	1037.38	1037.34	1037.33
FP-93-06	30.0	1058.50	1047.39	1044.35	1042.29	1040.47	1039.67	1040.08	1039.60	1039.05	1038.63	1037.87	1037.66	1037.57	1037.50	1038.46(b)	1037.43	1037.37	1037.34	1037.31
FP-93-07	24.0	1059.66	1047.54	1044.58	1042.41	1040.72	1040.68	1040.31	1039.90	1039.31	1038.89	1038.09	*	1037.80			*			1037.55
FP-94-08	22.0	1057.42	Wells not in existence during this time period.							1038.39	1038.05	1037.42		1037.16						1036.87
FP-94-09	27.5	1061.12								1038.25	1037.85	1037.18		1036.89						1036.71
FP-94-10	27.2	1062.52								1038.21	1037.76	1037.08		1036.78						1036.42
FP-94-11	15.3	1048.09								1038.54	1038.15	1037.42		1037.14						1036.78
FP-94-12PZ	19.8	1054.70						1039.56	NM	1037.67	1037.93	1037.16		1037.28						1037.62
Kansas River (a)	NA	NA	1042.39	1042.69	1040.85	1039.36	1041.23	1040.98	1038.33	1038.00	1038.63	1037.49	1037.58	1037.77	1037.77	1037.81	1037.71	1038.34	1038.21	1038.46

(a) Kansas River Gaging Station data for the period September 1994 to January 1995. Additional information provided in Appendix C.

(b) Elevation questionable, not used in Figure 3-28.

*Only three wells sampled weekly during pilot test study.

NM - Not Measured

Table 3-11. Well Information

Well ID	Ground Surface Coordinates (Kansas State/feet above MSL)			NAD83 State Plane Coordinates (feet above MSL)		Well Type	Total Depth (feet bgs)	Screened Interval Elevation (feet above MSL)	Method of Sampling
	North	East	Elev.	North	East				
Monitor Wells									
FP-93-01	2352781.10	268044.91	1056.05	268046.0985	1665023.2303	2" PVC	25	1051 - 1031	Bladder[a]
FP-93-02	2353113.00	267931.25	1057.94	267932.5102	1665355.1010	2" PVC	31	1052 - 1027	Bladder[a]
FP-93-03	2353417.50	267855.62	1054.59	267856.9457	1665659.7016	2" PVC	24	1051 - 1031	Bladder[a]
FP-93-04	2352863.80	267771.27	1056.03	267772.4747	1665106.0279	2" PVC	31	1050 - 1025	Bladder[a]
FP-93-05	2353081.40	267676.38	1056.05	267677.6298	1665323.6189	2" PVC	31	1050 - 1025	Bladder[a]
FP-93-06	2353302.50	267621.84	1056.00	267623.1384	1665544.7099	2" PVC	30	1051 - 1026	Bladder[a]
FP-93-07	2352908.50	267343.95	1056.62	267345.1646	1665150.7809	2" PVC	24	1053 - 1033	Bladder[a]
FP-94-08	2352481.30	268768.01	1054.47	268769.1370	1664723.3156	2" Steel w/SS Screen	22	1042 - 1032	Bladder[a]
FP-94-09	2353240.10	268802.59	1060.22	268803.8705	1665482.0550	2" Steel w/SS Screen	27	1043 - 1033	Bladder[a]
FP-94-10	2353953.80	268664.78	1060.27	268665.9166	1666196.2472	2" Steel w/SS Screen	27	1043 - 1033	Bladder[a]
FP-94-11	2353097.90	268369.97	1048.42	268371.2279	1665339.9255	2" Steel w/SS Screen	15	1043 - 1033	Bladder[a]
FP-94-12PZ	2350652.00	267946.39	1053.27	267983.8952	1662875.4984	1" Steel w/SS Screen	20	1043 - 1033	Bailer[b]

Table 3-11. Well Information (continued)

Well ID	Ground Surface Coordinates (Kansas State/feet above MSL)			NAD83 State Plane Coordinates (feet above MSL)		Well Type	Total Depth (feet bgs)	Screened Interval Elevation (feet above MSL)	Method of Sampling
	North	East	Elev.	North	East				
Private Wells									
R-1	2353418.50	268636.40	1059.30	268637.7239	1665660.4888	5" PVC	41	1039 - 1029	Tap[c]
R-2	2353238.80	268319.30	1046.27	268320.5846	1665480.8847	5" PVC	43	1013 - 1003	Spout[d]
R-3	2353865.10	268115.40	1046.75	268116.8074	1666107.2303	5" PVC	30	1027 - 1017**	Bailer[b]
N-1	2351556.20	269502.01	1060*	not calculated		5" PVC	42	1028 - 1018	Spigot[e]
M-1	2353101.10	268704.81	1060.32	268706.0606	1665343.1074	5" PVC**	unknown		Spigot[e]
F-1	2354570.00	268704.28	1060.68	268705.8541	1666811.9849	5" PVC	40	1041 - 1021	Spigot[e]
F-2	2354868.20	268628.34	1058*	not calculated		5" PVC**	unknown		Spigot[e]
B-1	not surveyed		1068*	not surveyed		5" PVC	47	1036 - 1026	Spigot[e]
I-1	2353071.00	270144.32	1059.35	270145.5741	1665312.6909	Large Diam., Steel	63	1016 - 996	Bailer[b]

MSL - mean sea level; bgs - below ground surface; PVC - polyvinyl chloride; SS -stainless steel

Note: Groundwater is generally near 1040 feet above MSL for all wells. Seasonal variations and flooding events have caused fluctuations of ±7 feet.

* - Approximated from topographic map.

** - Estimated.

Sampling Methods:

a - *Bladder:* Purging and sampling performed with dedicated PVC bladder pumps w/teflon bladders and teflon lined tubing.

b - *Bailer:* Purging and sampling of non-volatile organic compounds (VOCs) with electric submersible or peristaltic pump, VOCs sampled with bailer.

The following sampling methods were performed on private groundwater wells with existing well pumps. The wells are sealed at the surface, so no direct measurement of water levels or total depth have been made.

c - *Tap:* Samples taken from bathroom sink tap after 3 minute purge

d - *Spout:* Samples taken from open overhead 5" diameter pipe used to fill water trucks.

e - *Spigot::* Samples taken from outdoor spigot after 3 minute purge. No direct access to well is available.

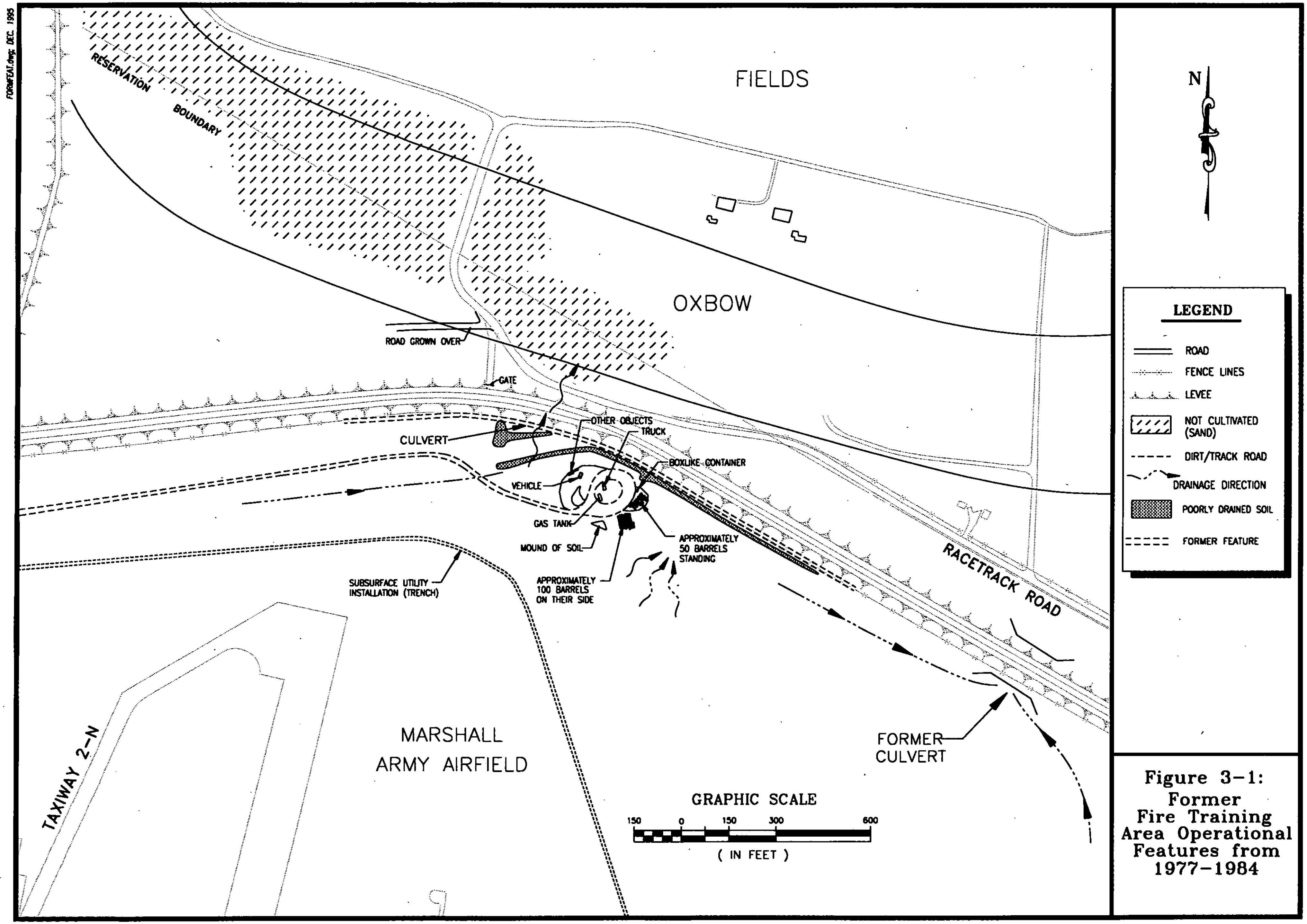
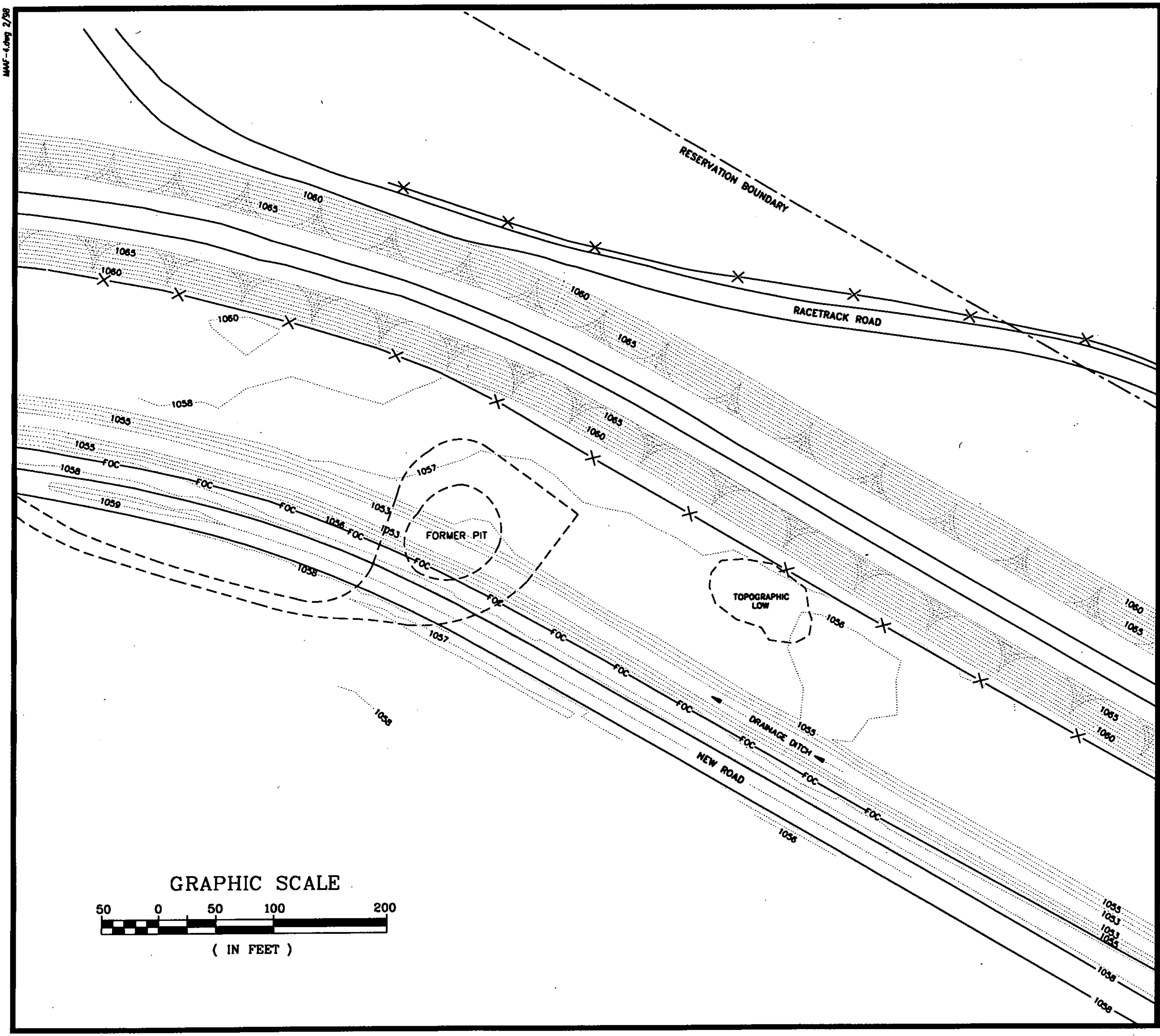


Figure 3-1: Former Fire Training Area Operational Features from 1977-1984



NOTES:

1. "TOPOGRAPHIC LOW" AREA IS LOCATED ON FIGURE BASED UPON FIELD MEASUREMENTS DURING SI ACTIVITIES.
2. ELEVATION CONTOURS ARE IN FEET.
3. CONTOURS REPRESENT CURRENT SITE FEATURES, NOT AT THE TIME OF THE FFTA OPERATIONS.

Figure 3–2:
Former Fire
Training Pit, 9/93

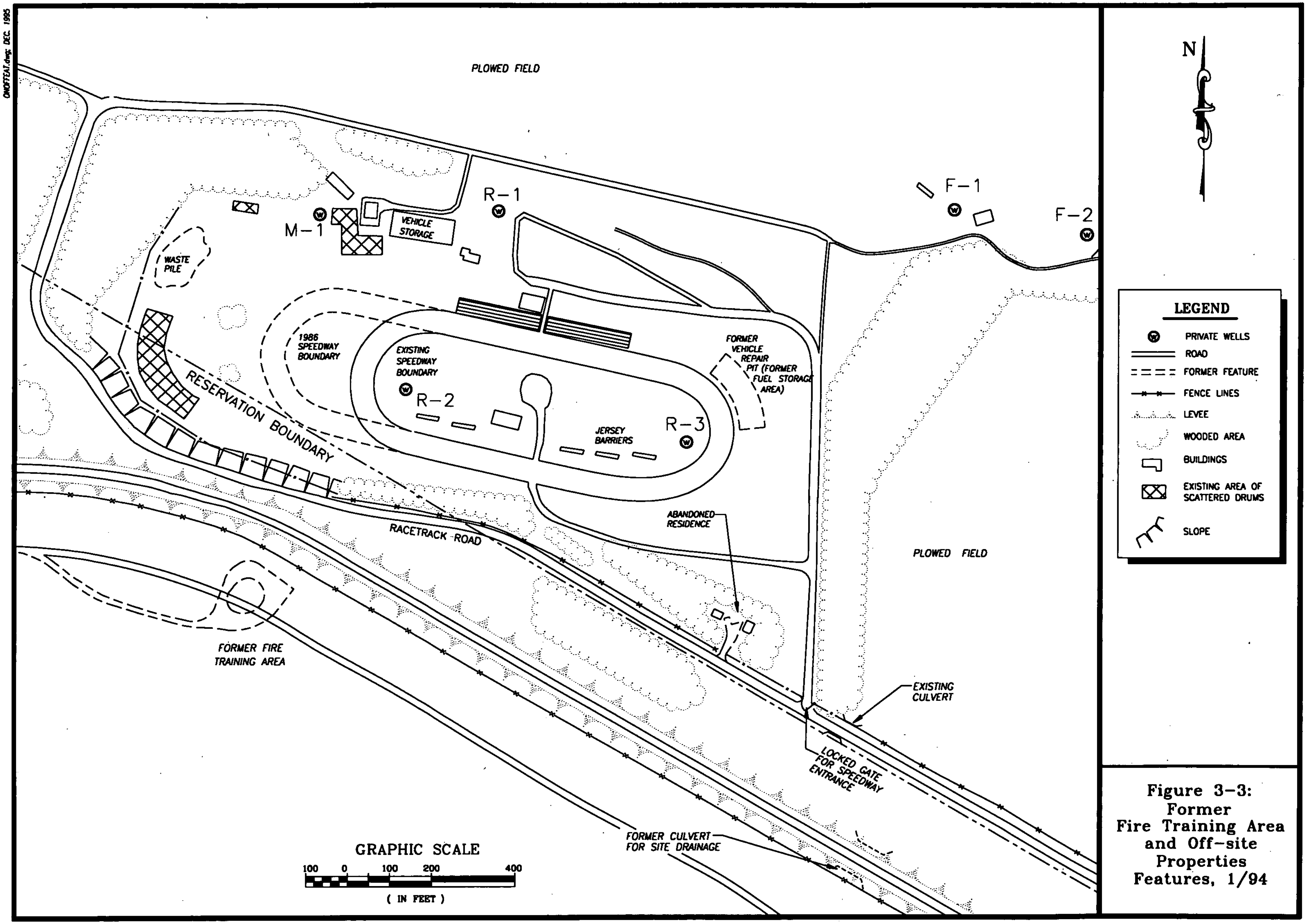
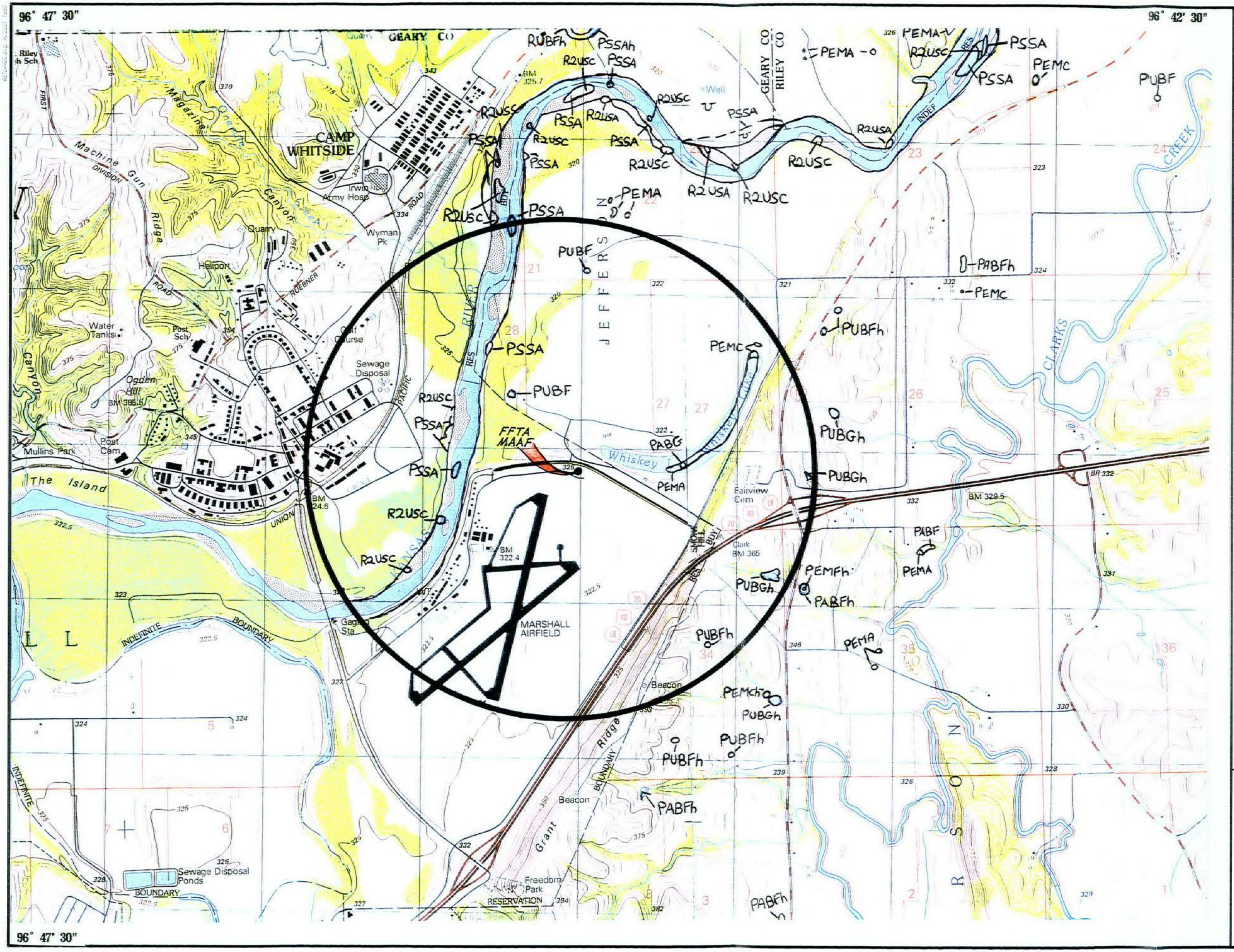


Figure 3-3: Former Fire Training Area and Off-site Properties Features, 1/94



N

National Wetland Identification LEGEND	
(WITHIN ONE MILE RADIUS OF FFTA-MAAF)	
PABC -	PALUSTRINE SYSTEM, AQUATIC BED CLASS INTERMITTENTLY EXPOSED
PEMA -	PALUSTRINE SYSTEM, EMERGENT CLASS, TEMPORARILY FLOODED
PEMS -	PALUSTRINE SYSTEM, EMERGENT CLASS, SEASONALLY FLOODED
PSSA -	PALUSTRINE SYSTEM, UNCONSOLIDATED BOTTOM CLASS, SEMIPERMANENTLY FLOODED
PUBFh -	PALUSTRINE SYSTEM, UNCONSOLIDATED BOTTOM CLASS, SEMIPERMANENTLY FLOODED (DIKED, IMPOUNDED)
PUBGh -	PALUSTRINE SYSTEM, UNCONSOLIDATED BOTTOM CLASS, INTERMITTENLY EXPOSED (DIKED, IMPOUNDED)
R2USC -	RIVENUE SYSTEM, LOWER PERENNIAL, UNCONSOLIDATED SHORE, SEASONALLY FLOODED
PUBF -	PALUSTRINE SYSTEM, UNCONSOLIDATED, BOTTOM CLASS, INTERMITTENTLY EXPOSED
PEMC -	PALUSTRINE SYSTEM, EMERGENT CLASS, UNCONSOLIDATED SHORE

GRAPHIC SCALE

(IN MILES)

Figure 3-4: Former Fire Training Marshall Army Airfield– One Mile Radius Area of Influence and National Wetlands Inventory, 5/94

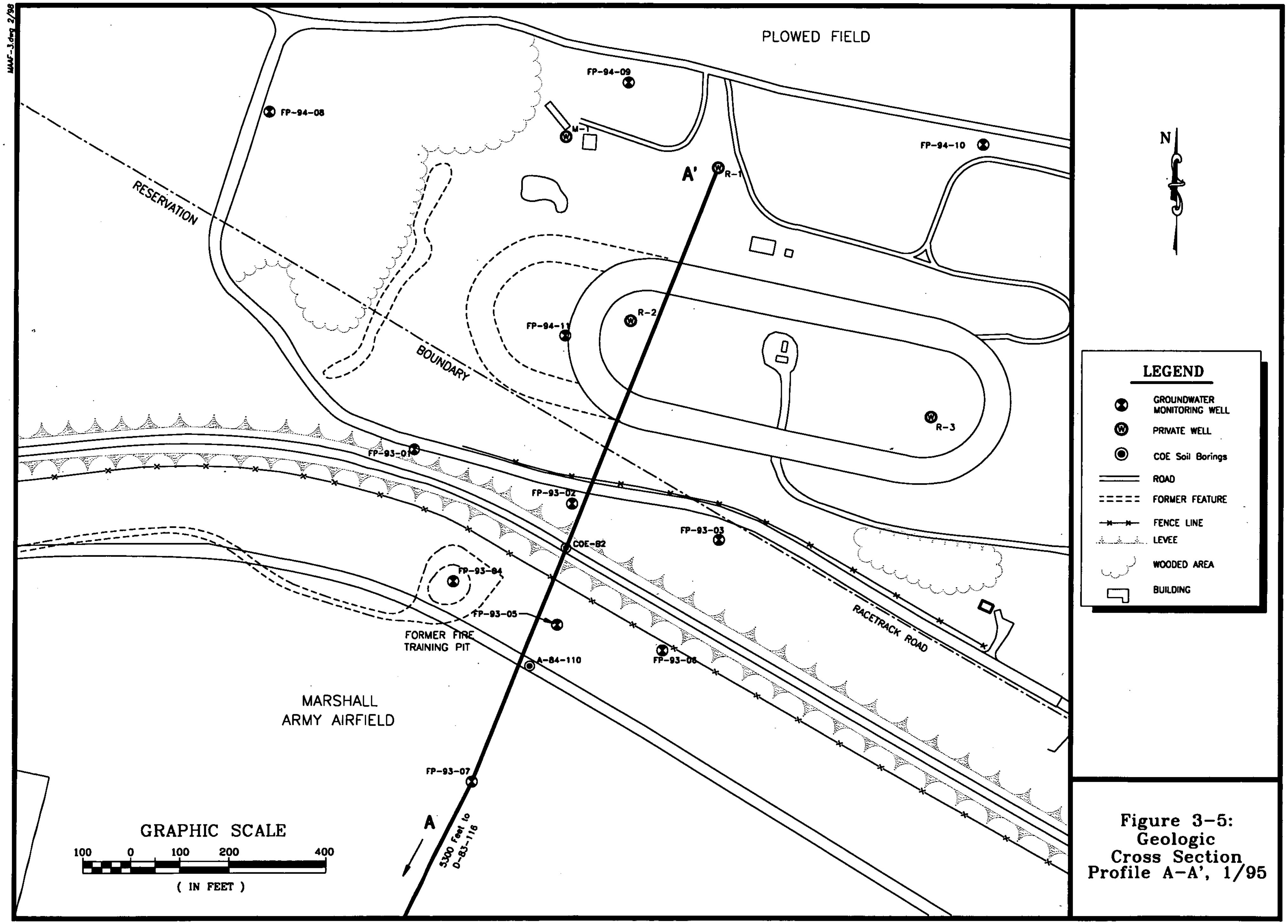


Figure 3-5: Geologic Cross Section Profile A-A', 1/95

MAAF-21.dwg 2/98

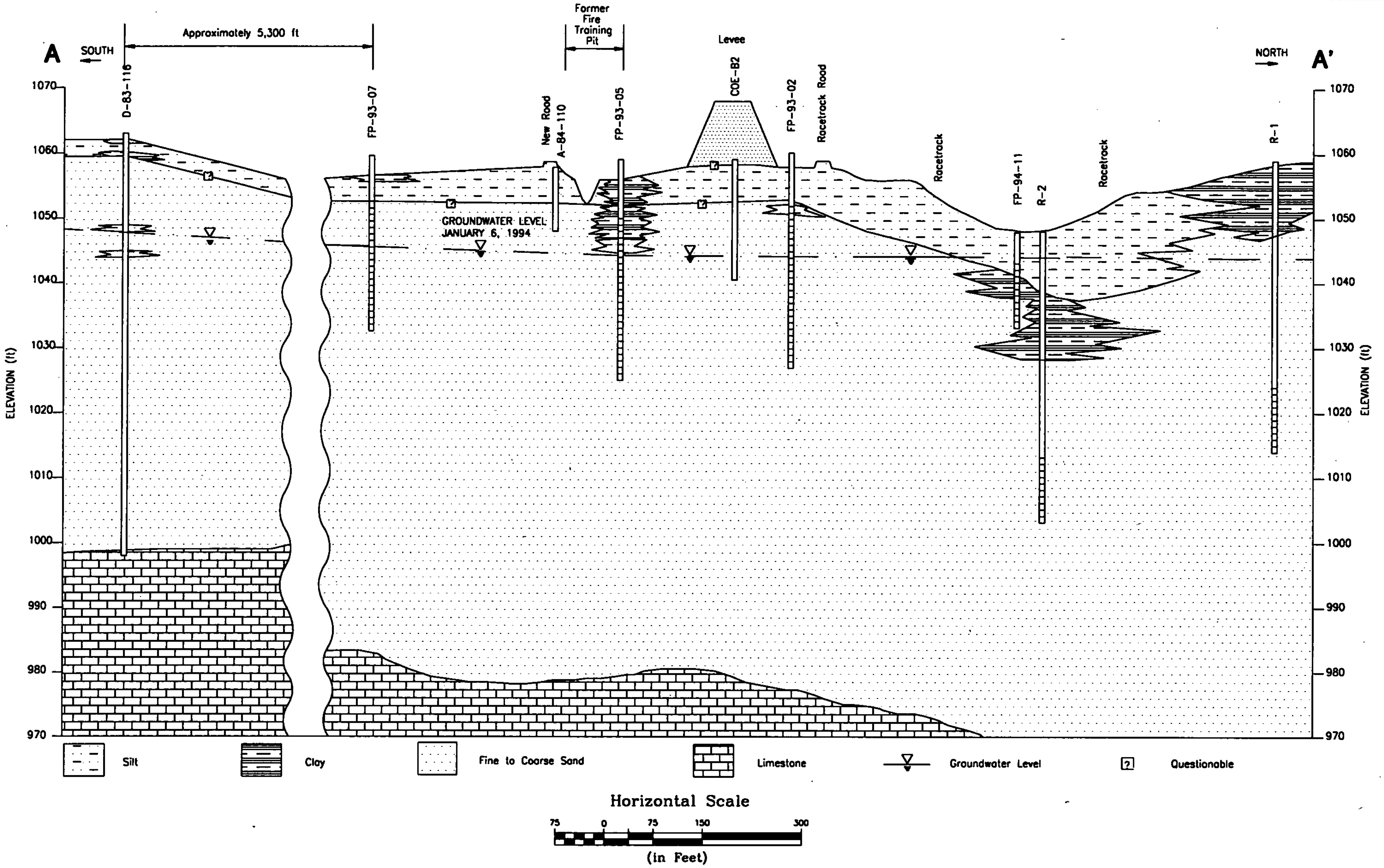


Figure 3-6: Geologic Cross Section at A-A'
Based on Visual Characterization, 1/94

MAAF-24.dwg 2/98

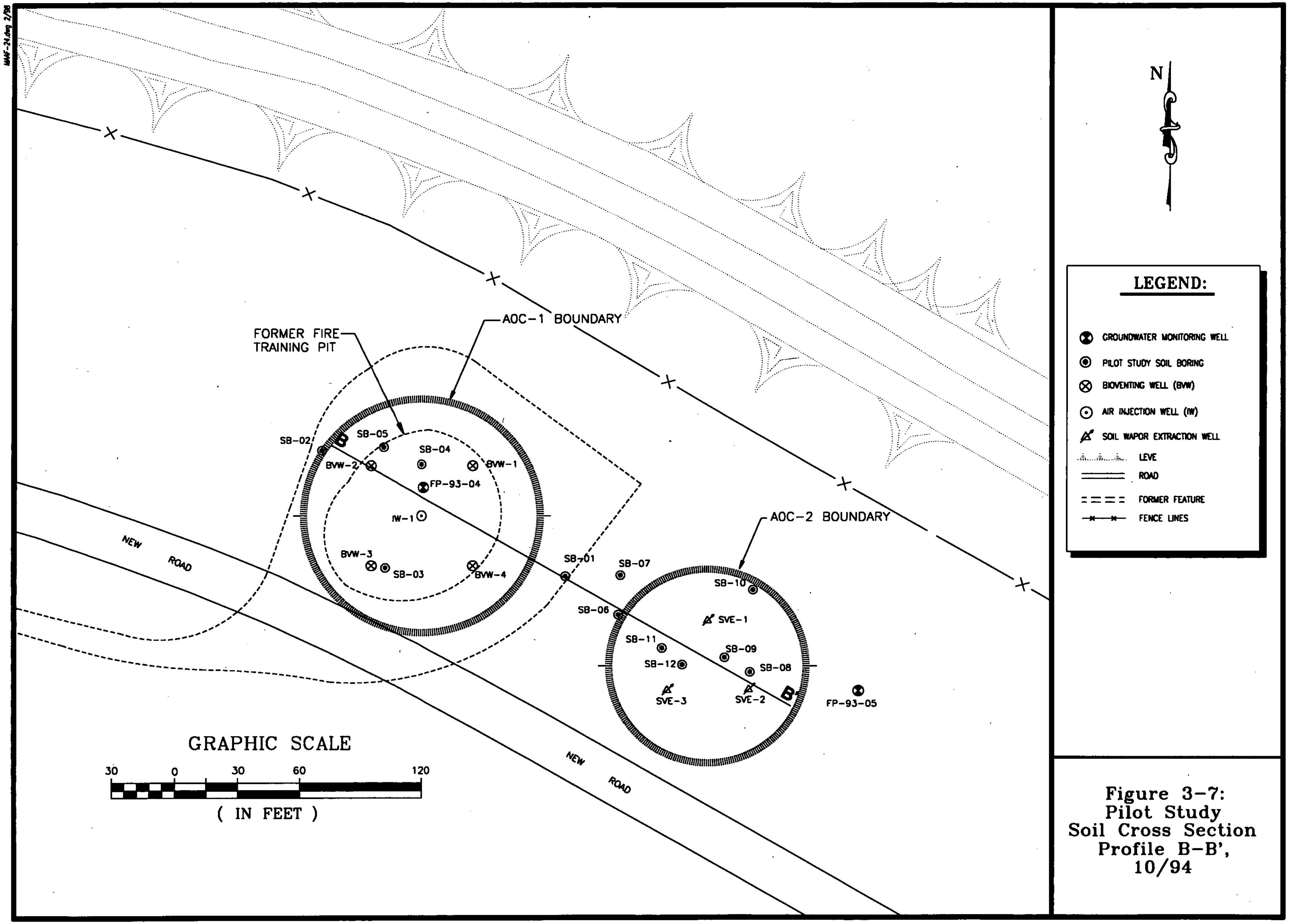
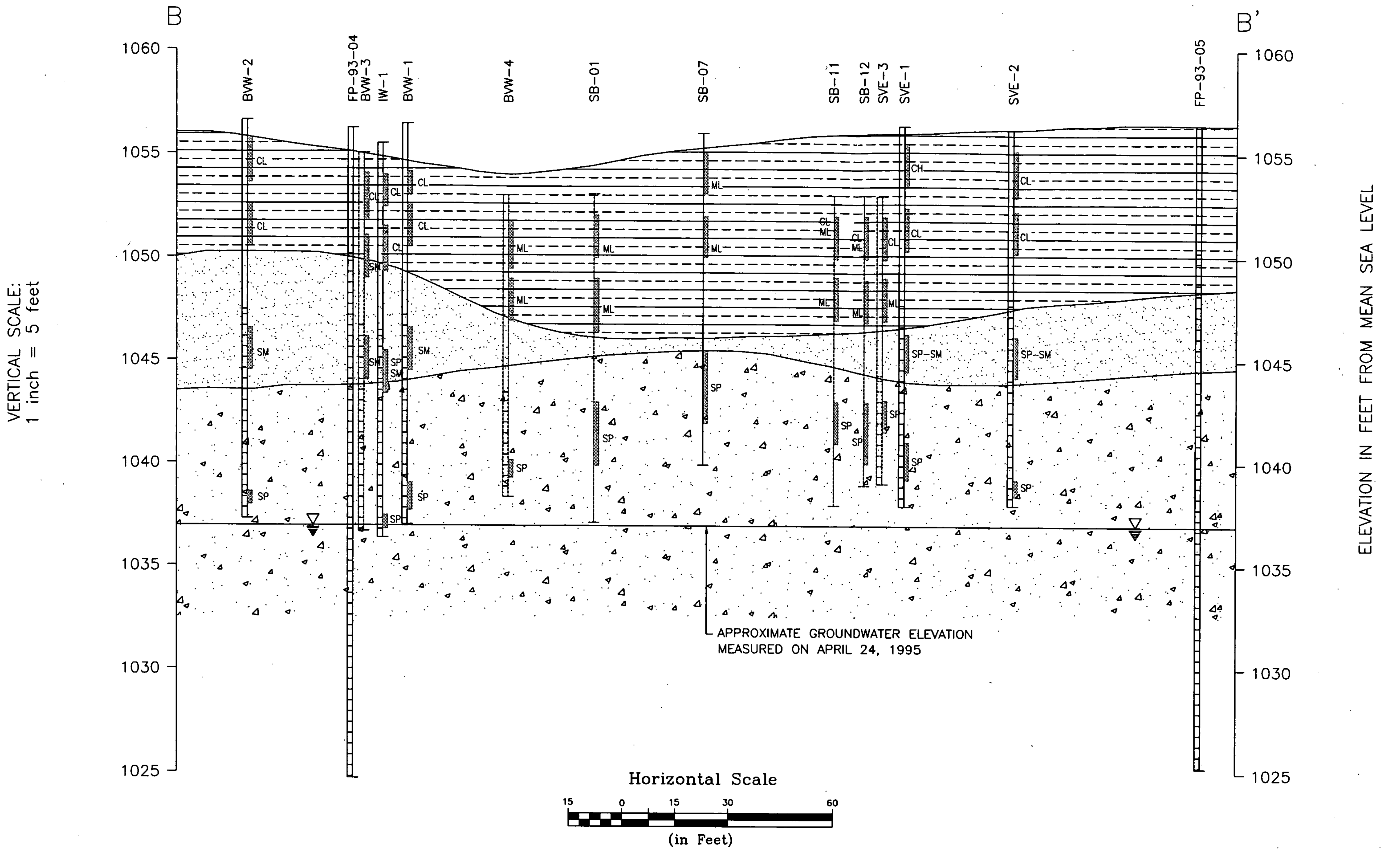


Figure 3-7:
Pilot Study
Soil Cross Section
Profile B-B',
10/94

MAAF-23.dwg 2/98



LEGEND

BVW – BIOVENTING WELL
IW – AIR INJECTION WELL
SVE – SOIL VAPOR EXTRACTION WELL
FP – EXISTING GROUNDWATER MONITORING WELL
SB – SOIL BORING

▤ DARK BROWN TO BROWN CLAY (CL & CH) AND SILT (ML)

▨ BROWN SILTY SAND AND POORLY GRADED SAND W/ SILT (SM & SP-SM)

▨ LIGHT BROWN TO BROWN POORLY GRADED SAND (SP)

▽ GROUNDWATER LEVEL

CL INDICATES LOCATION AND LENGTH OF GEOTECHNICAL SAMPLE AND USCS SYMBOL

WELL SCREEN INTERVAL

NOTES:

1. THIS CROSS-SECTION WAS DEVELOPED BASED UPON GEOTECHNICAL DATA (GRAIN-SIZE ANALYSIS AND ATTERBERG LIMITS) FROM SAMPLES WITH THE EXCEPTION OF FP-93-04 AND FP-93-05 COLLECTED DURING THE BIOVENTING. DATA (GRAIN-SIZE ANALYSIS ONLY) FROM SAMPLES COLLECTED DURING BASELINE SOIL BORING INSTALLATION WAS USED TO SUPPLEMENT THE DATA BETWEEN THE TWO AOC'S. SOIL CHARACTERIZATION WAS CLASSIFIED ACCORDING TO USCS.
2. WELLS AND BORINGS SHOWN AS DASHED OCCUR IN FOREGROUND OF CROSS-SECTION AND ARE PROJECTED ON THIS SECTION FOR THE PURPOSE OF GENERAL GEOTECHNICAL PROFILING.
3. TOP OF WELL SHOWN IN THIS FIGURE REPRESENT LAND SURFACE ELEVATION AT EACH WELL, NOT TOP OF CASING ELEVATION.
4. GROUNDWATER ELEVATION SHOWN IN THIS FIGURE REPRESENT LAND SURFACE ELEVATION AT EACH WELL.
5. VARIATIONS IN THE VERTICAL EXTENT OF GEOTECHNICAL SAMPLES ARE A FUNCTION OF SAMPLE RECOVERY.

Figure 3-8: Geological Cross Section B-B' Based on Geotechnical Data, 7/94, 10/94

CRSEILIN.dwg; AUGUST 1995

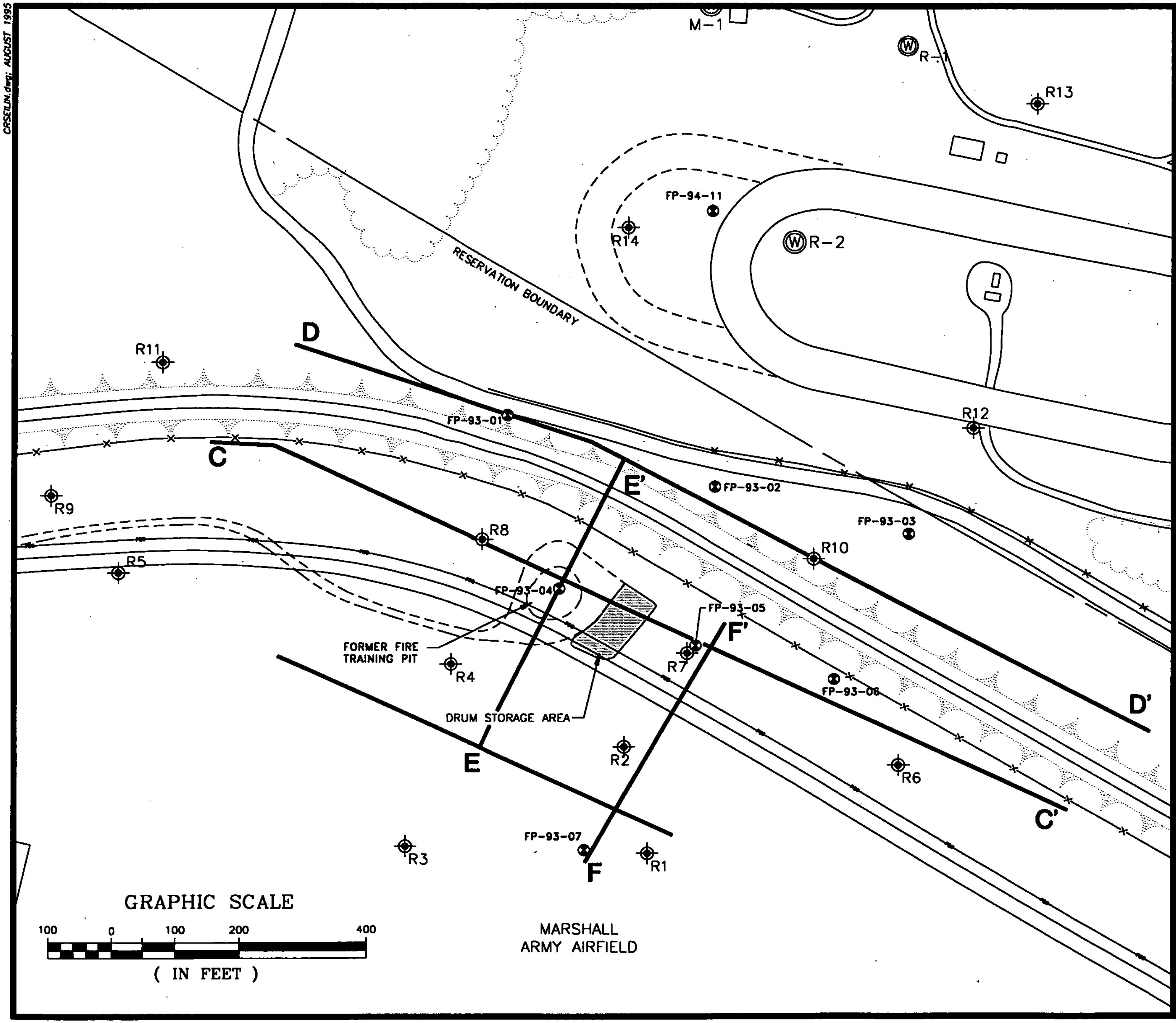
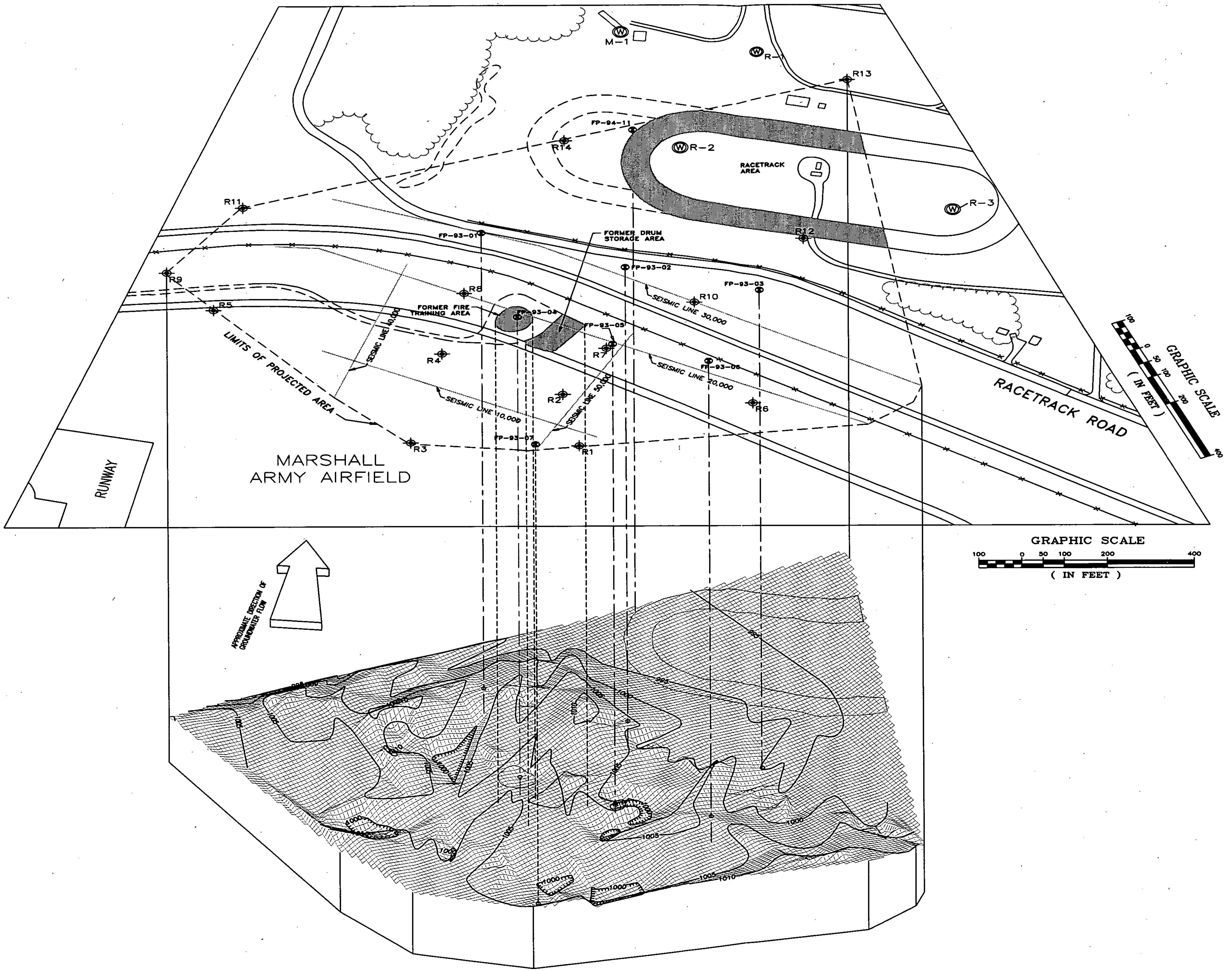


Figure 3-9:
Location of Geologic
Cross Section Lines
Based on Seismic
Reflection Survey,
6/94

MAAF-20.dwg 3/98



N

LEGEND:

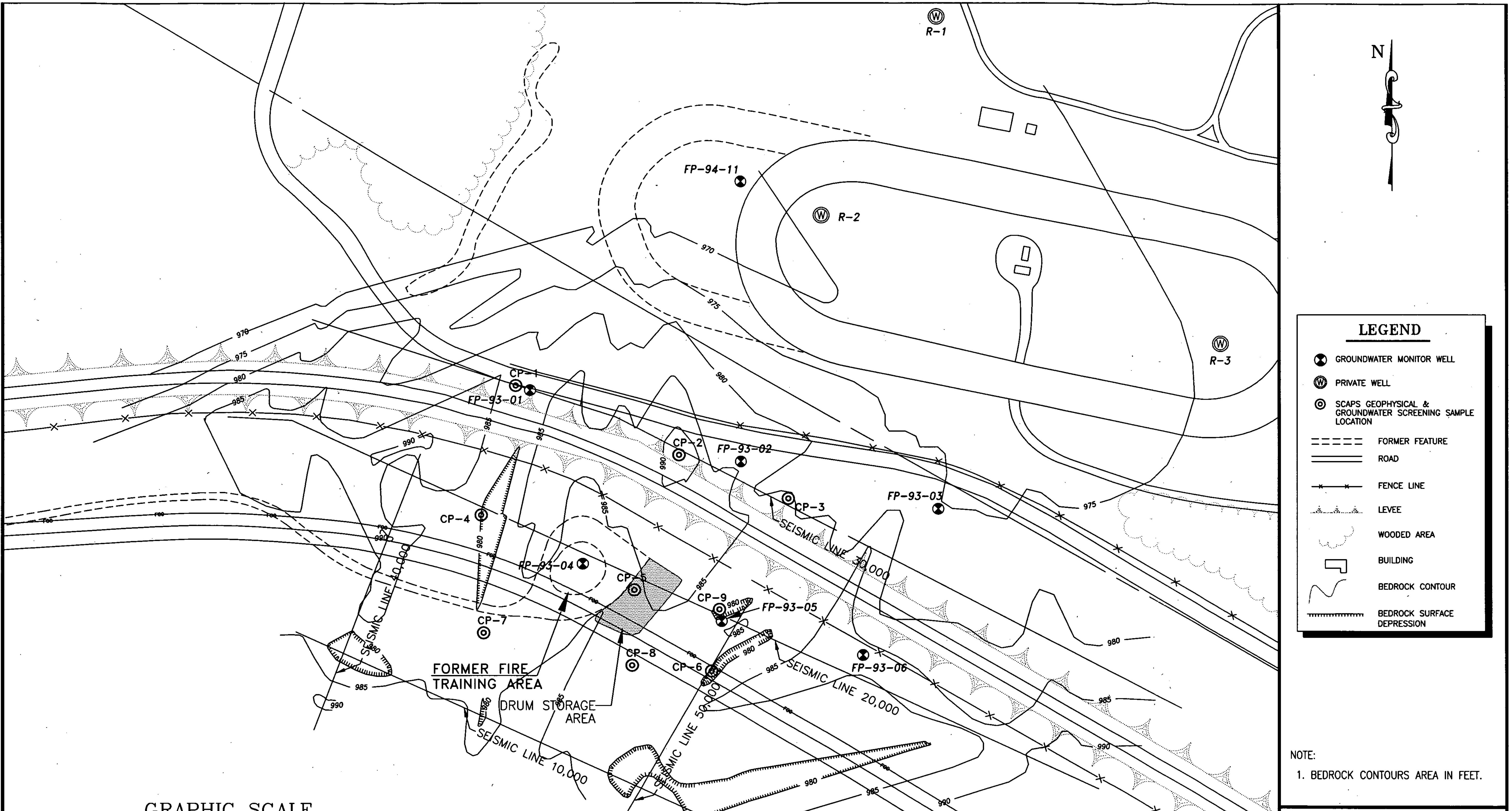
- GROUNDWATER MONITOR WELL
- Ⓦ PRIVATE WELL
- RESISTIVITY TEST POINT
- ═ ROAD
- —×— FENCE LINE
- WOODED AREA
- BUILDING
- BEDROCK ELEVATION CONTOUR (FEET)
- BEDROCK SURFACE

NOTES:

1. BEDROCK CONTOURS ARE IN FEET.
2. CONTOURS BASED ON SEISMIC AND RESISTIVITY DATA.

Figure 3–10: Projection of Site Features on Bedrock Surface, 6/94

CONTOUR.dwg; AUGUST 199

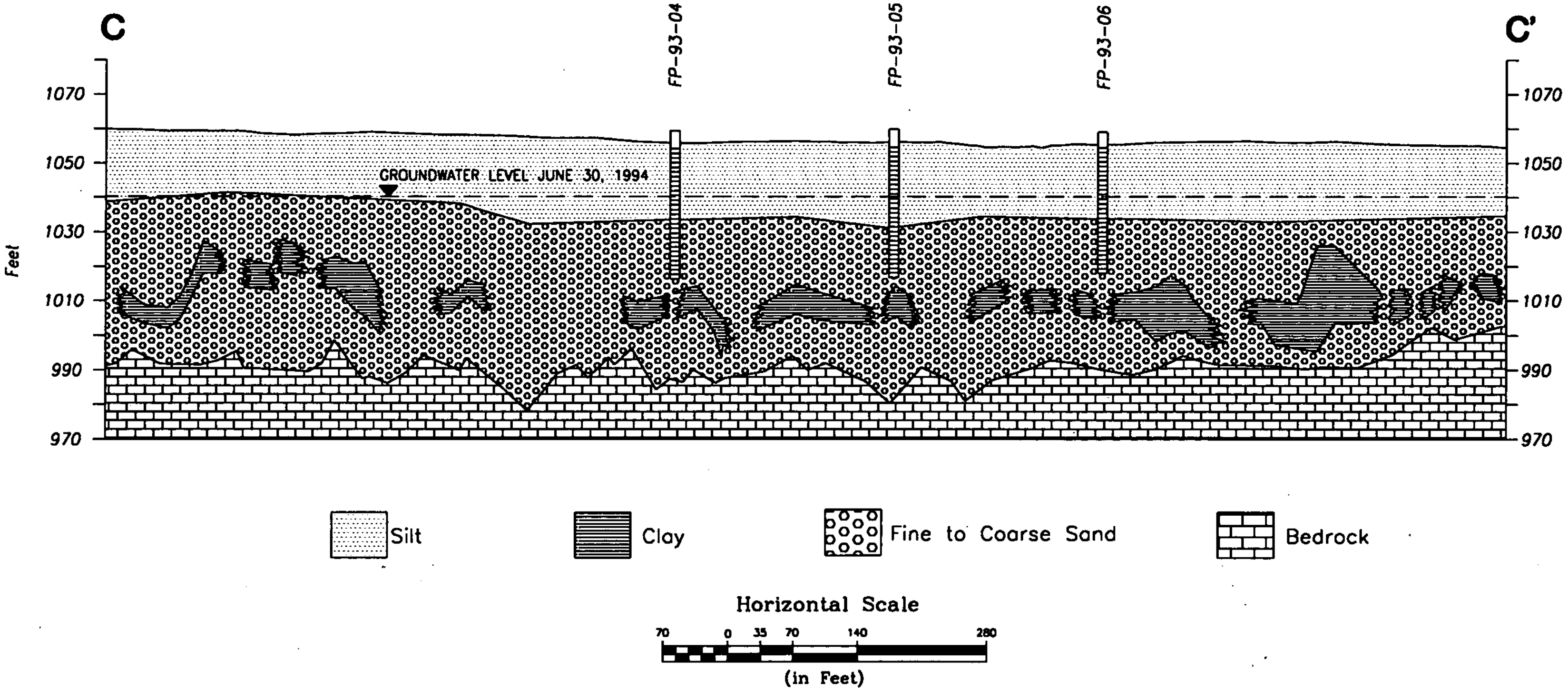


NOTE:

1. BEDROCK CONTOURS AREA IN FEET.

Figure 3-11: Bedrock Contour Map Based on SCAPS Investigation, 11/94

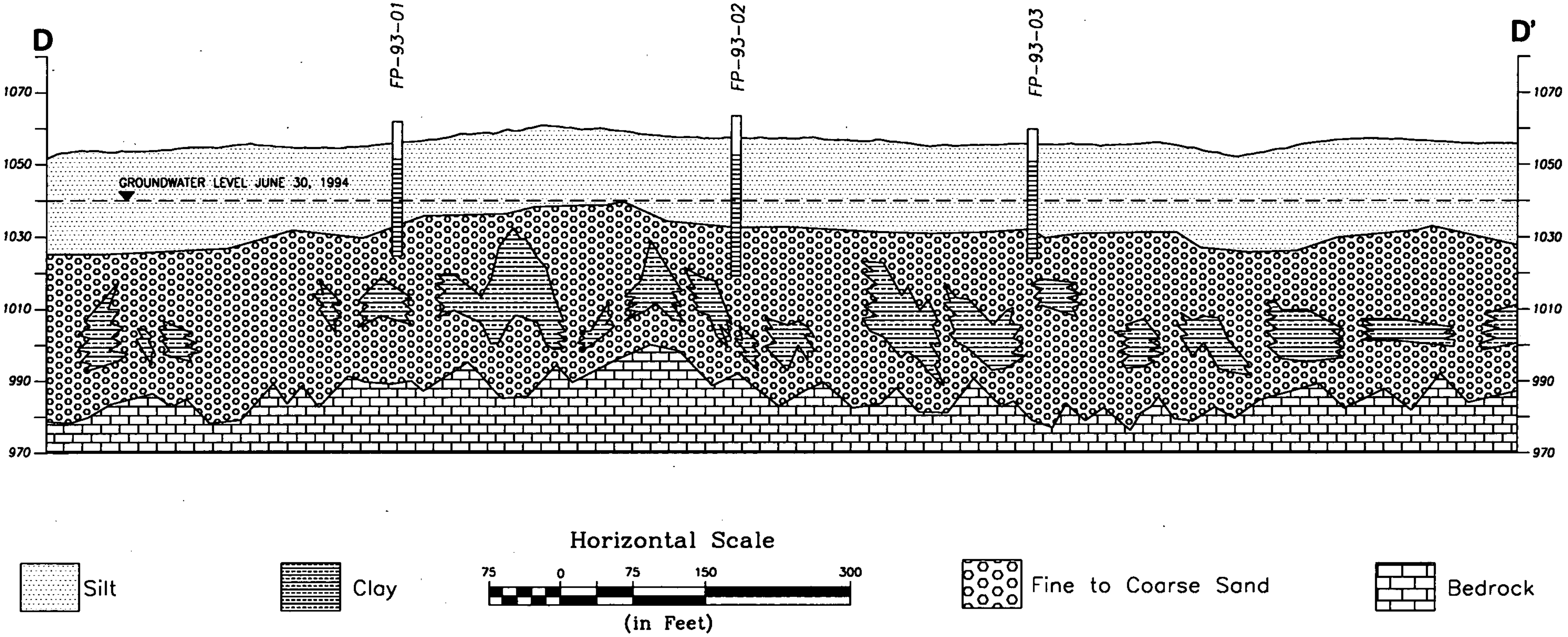
MAAF-10.dwg 2/98



NOTE:
BEDROCK HAS BEEN ADJUSTED BASED ON SCAPS INVESTIGATION.

Figure 3-12: Geologic Cross Section Based on Seismic Reflection Survey C-C', 6/94

MAAF-12.dwg 2/98



NOTE:
DEPTH TO BEDROCK HAS BEEN ADJUSTED BASED UPON THE SCAPS INVESTIGATION.

Figure 3–13: Geologic Cross–Section Based on Seismic Reflection Survey <u>D–D'</u>, 6/94

MWF-11.dwg 2/98

NOTE:
DEPTH TO BEDROCK HAS BEEN
ADJUSTED BASED UPON
THE SCAPS INVESTIGATION.

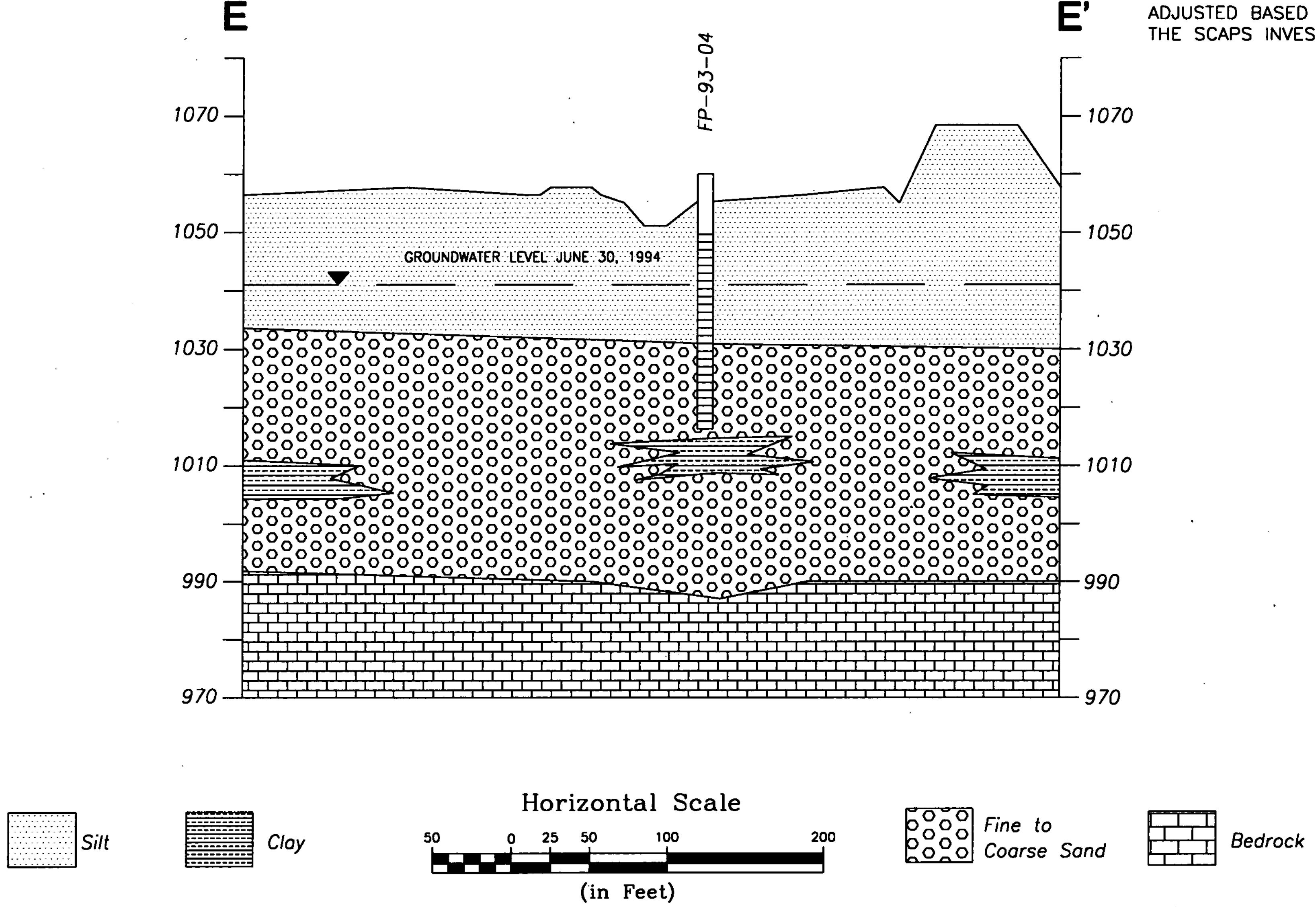
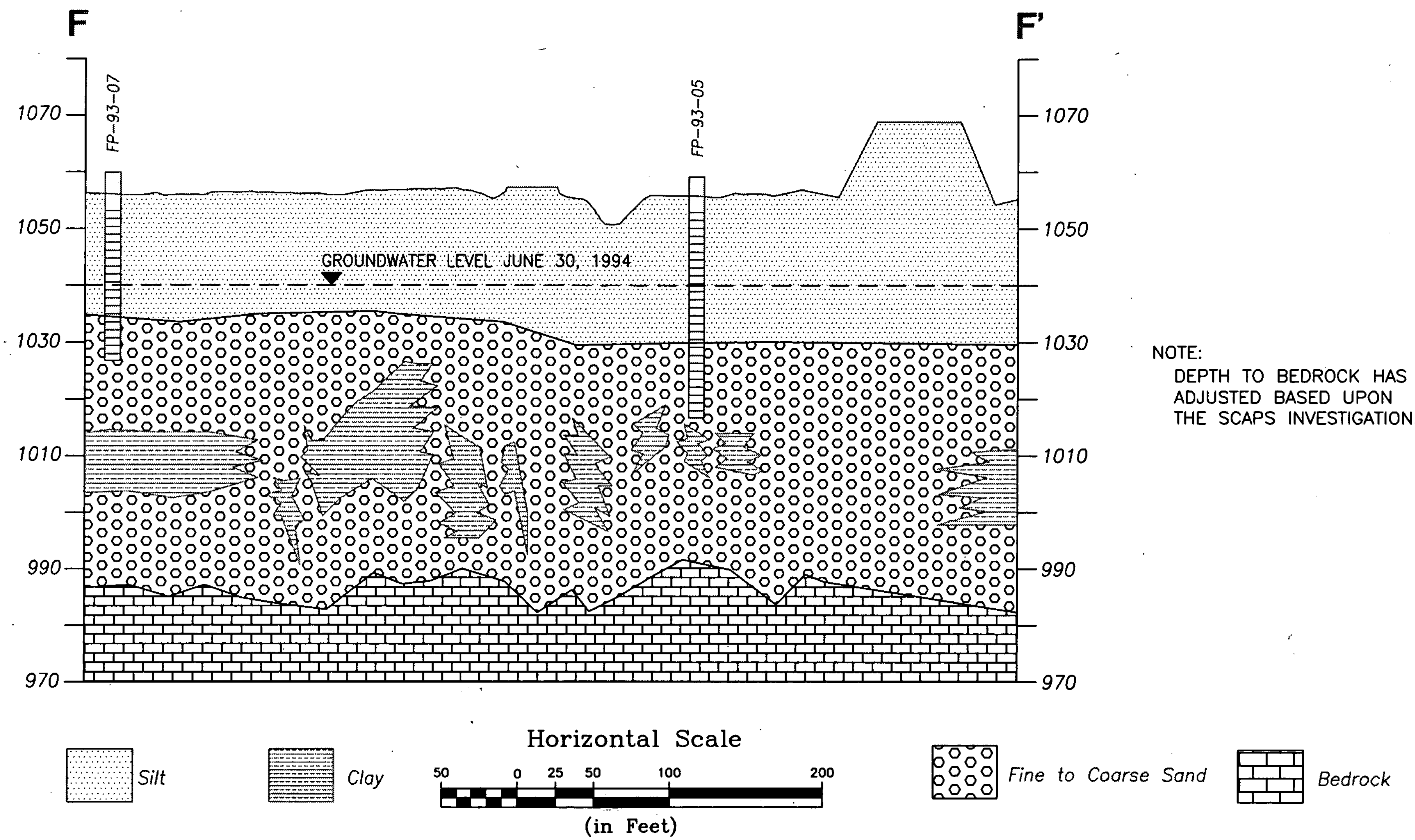


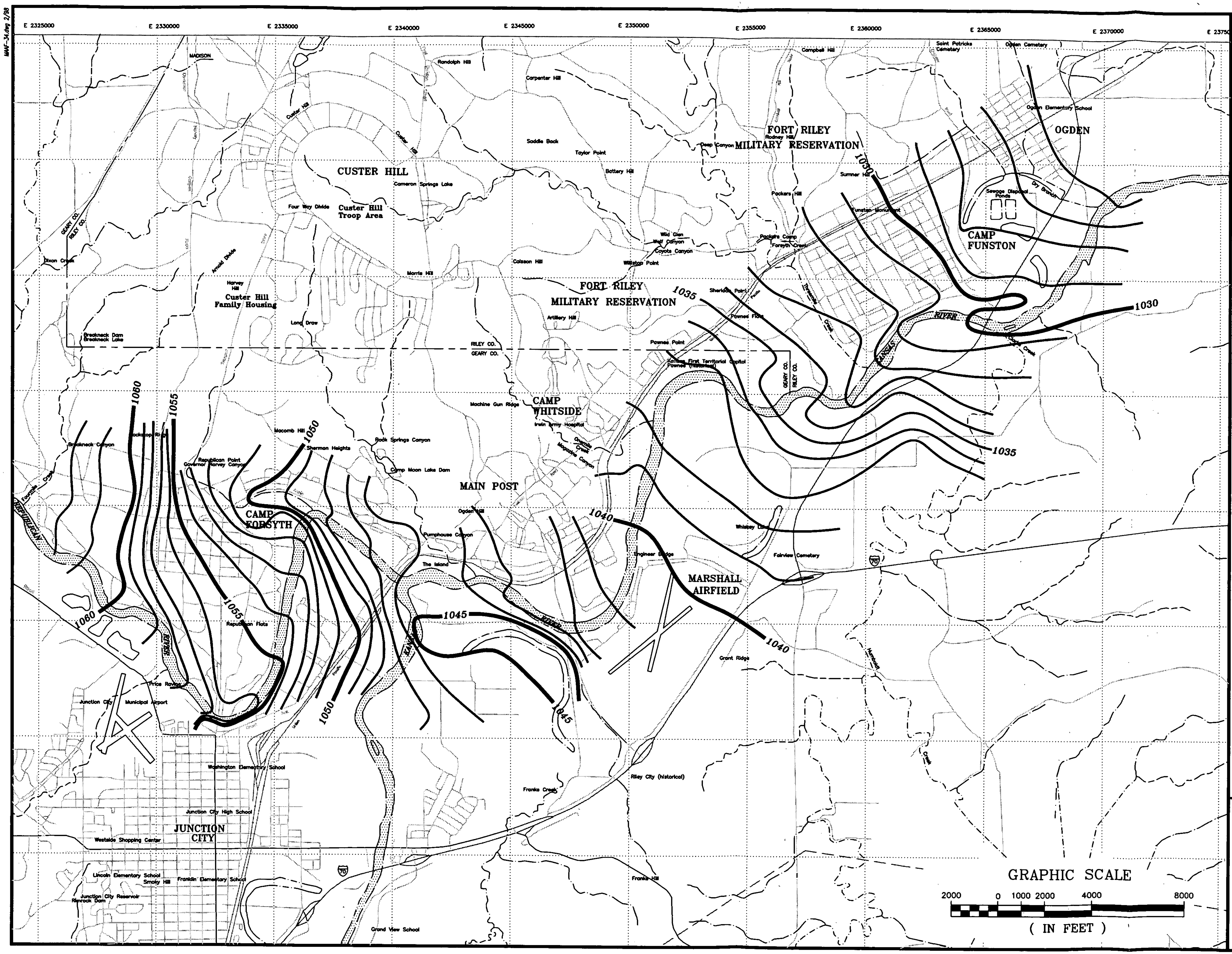
Figure 3-14: Geologic Cross Section Based on Seismic Reflection Survey E-E', 6/94



NOTE:
DEPTH TO BEDROCK HAS BEEN ADJUSTED BASED UPON THE SCAPS INVESTIGATION.

Figure 3-15: Geologic Cross Section Based on Seismic Reflection Survey F-F', 6/94

MAAF-34.dwg 2/98



LEGEND

- GROUNDWATER CONTOURS
- PAVED ROADS
- STREAMS

NOTE:

1. GROUNDWATER CONTOURS ARE IN FEET.

SOURCE:
IWSA, Appendix A,
"Fort Riley Reservation General Map Groundwater Survey, January 28, 1941.
Published by Widmer Engineering Company."

Figure 3–16:
Regional Groundwater Gradient Map,
1/41

MAAF-25.dwg 2/98

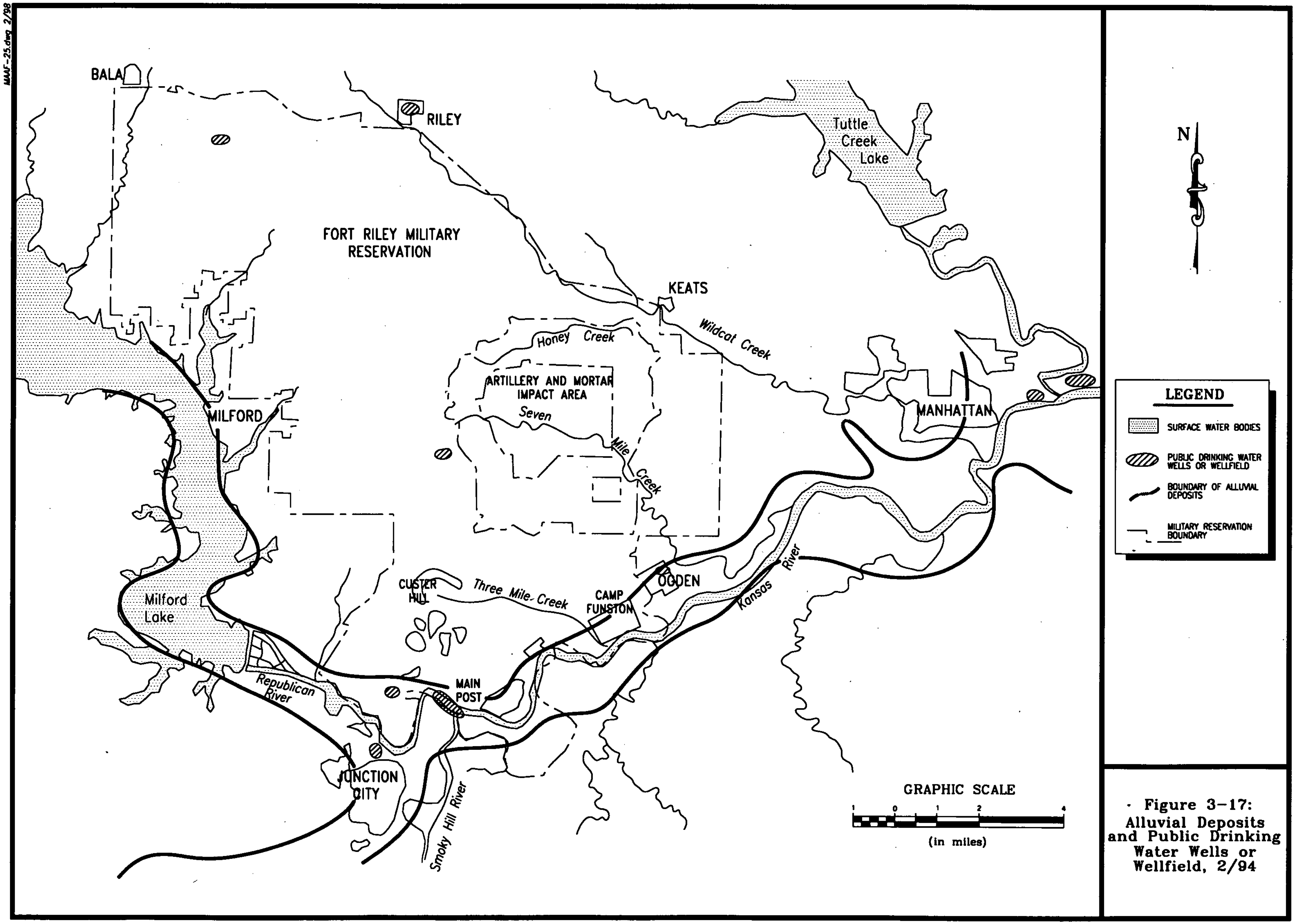
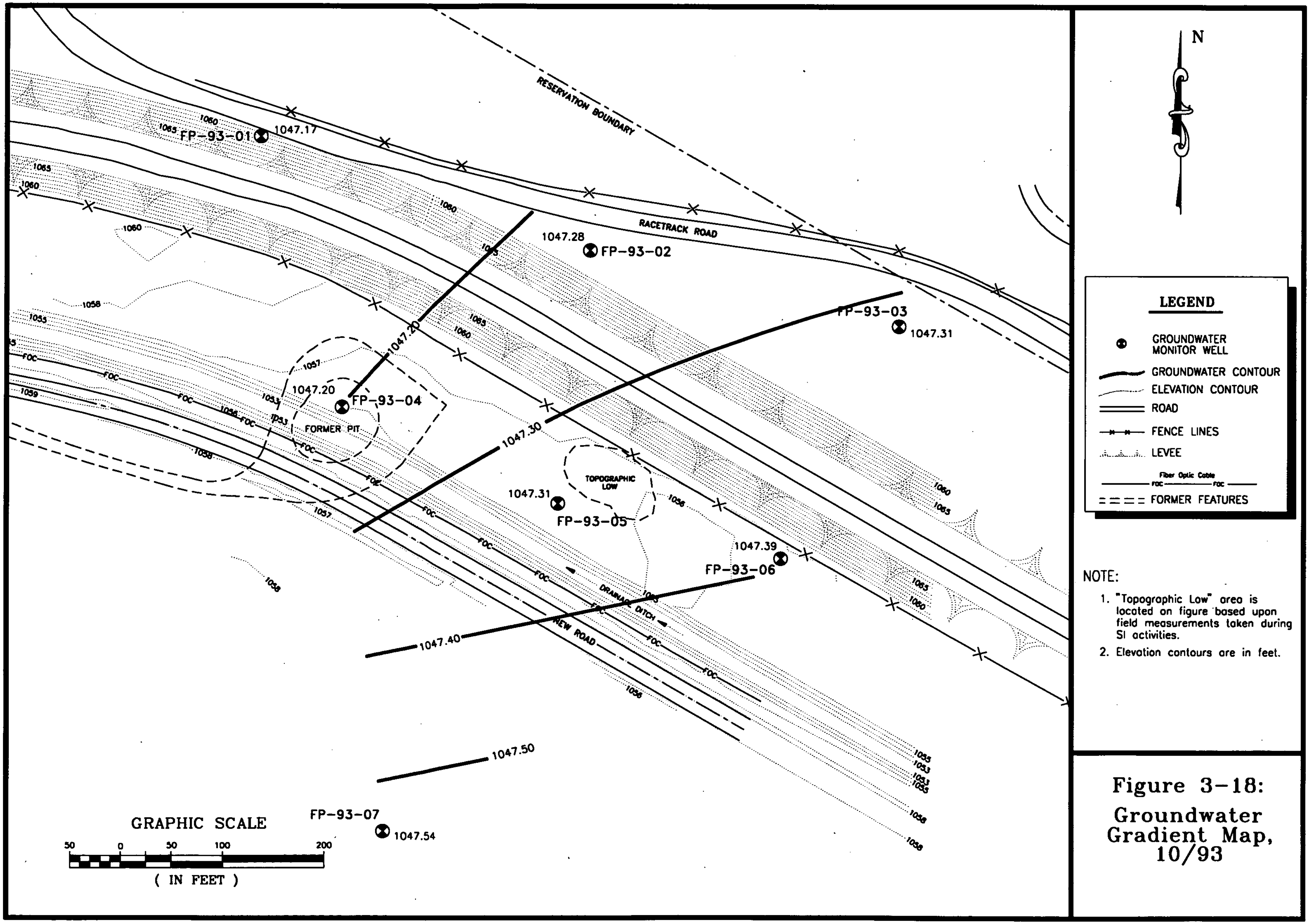


Figure 3–17: Alluvial Deposits and Public Drinking Water Wells or Wellfield, 2/94

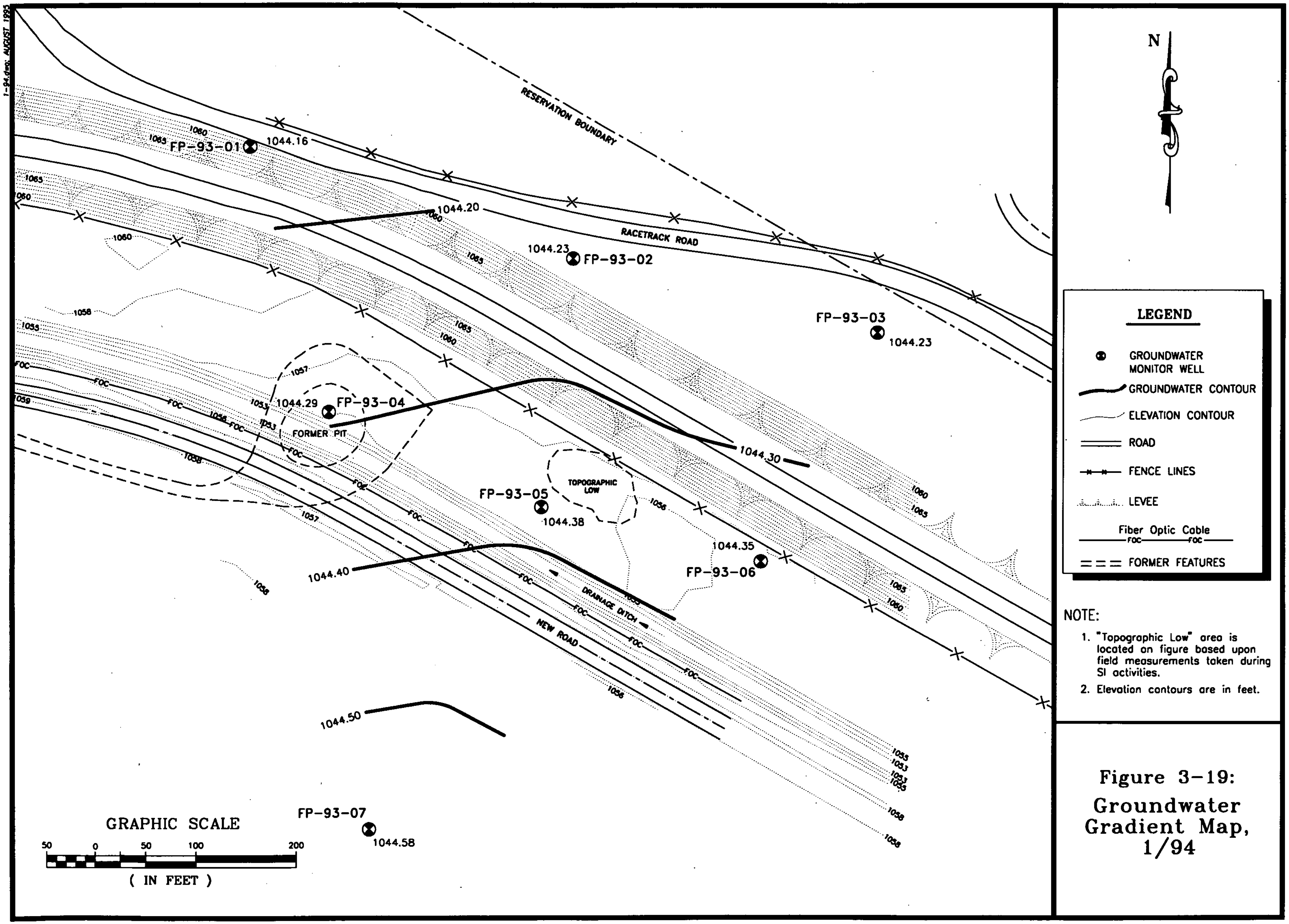


NOTE:

1. "Topographic Low" area is located on figure based upon field measurements taken during SI activities.
2. Elevation contours are in feet.

Figure 3-18: Groundwater Gradient Map, 10/93

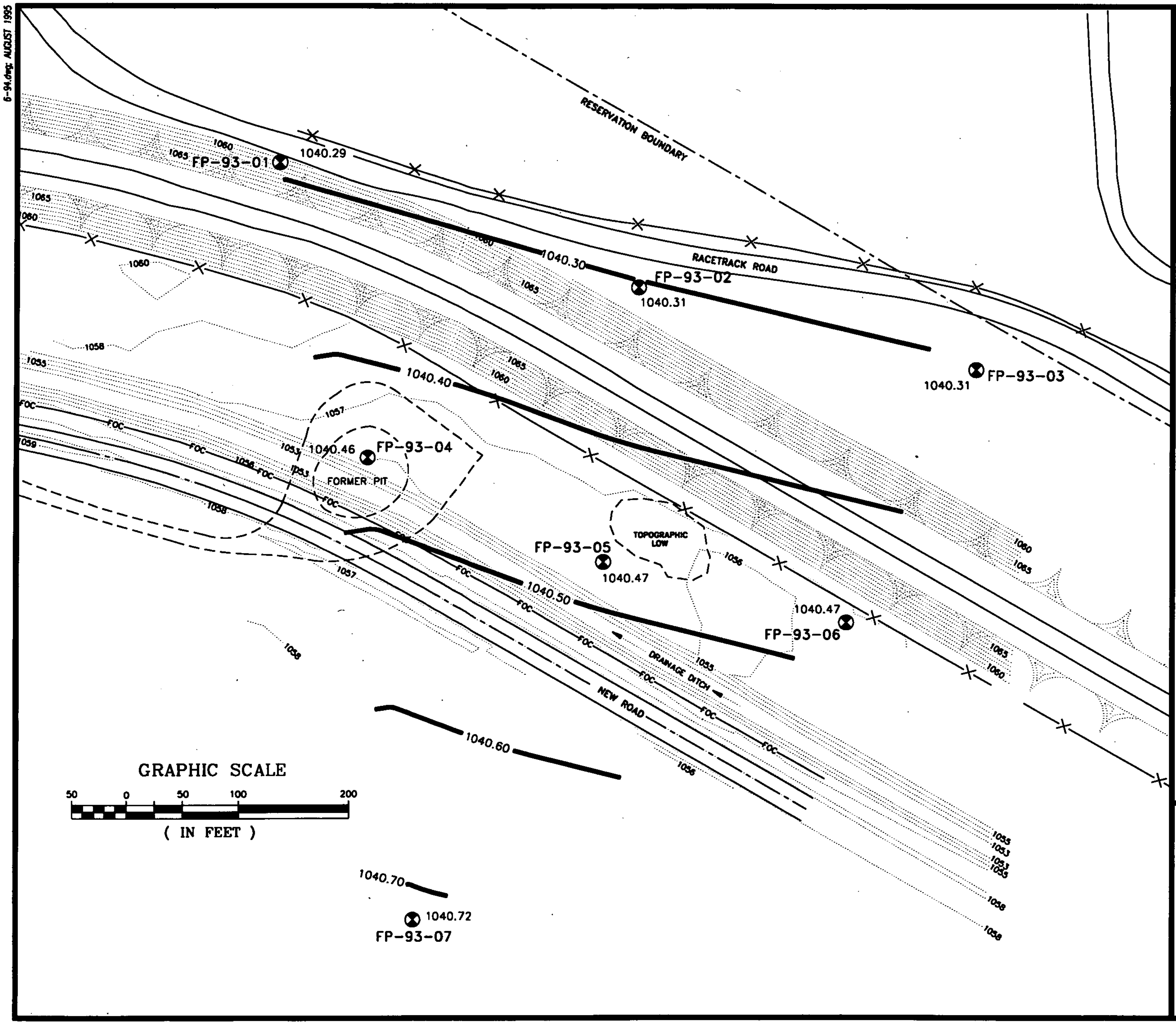
1-94.dwg; AUGUST 1995



NOTE:

1. "Topographic Low" area is located on figure based upon field measurements taken during SI activities.
2. Elevation contours are in feet.

Figure 3-19: Groundwater Gradient Map, 1/94

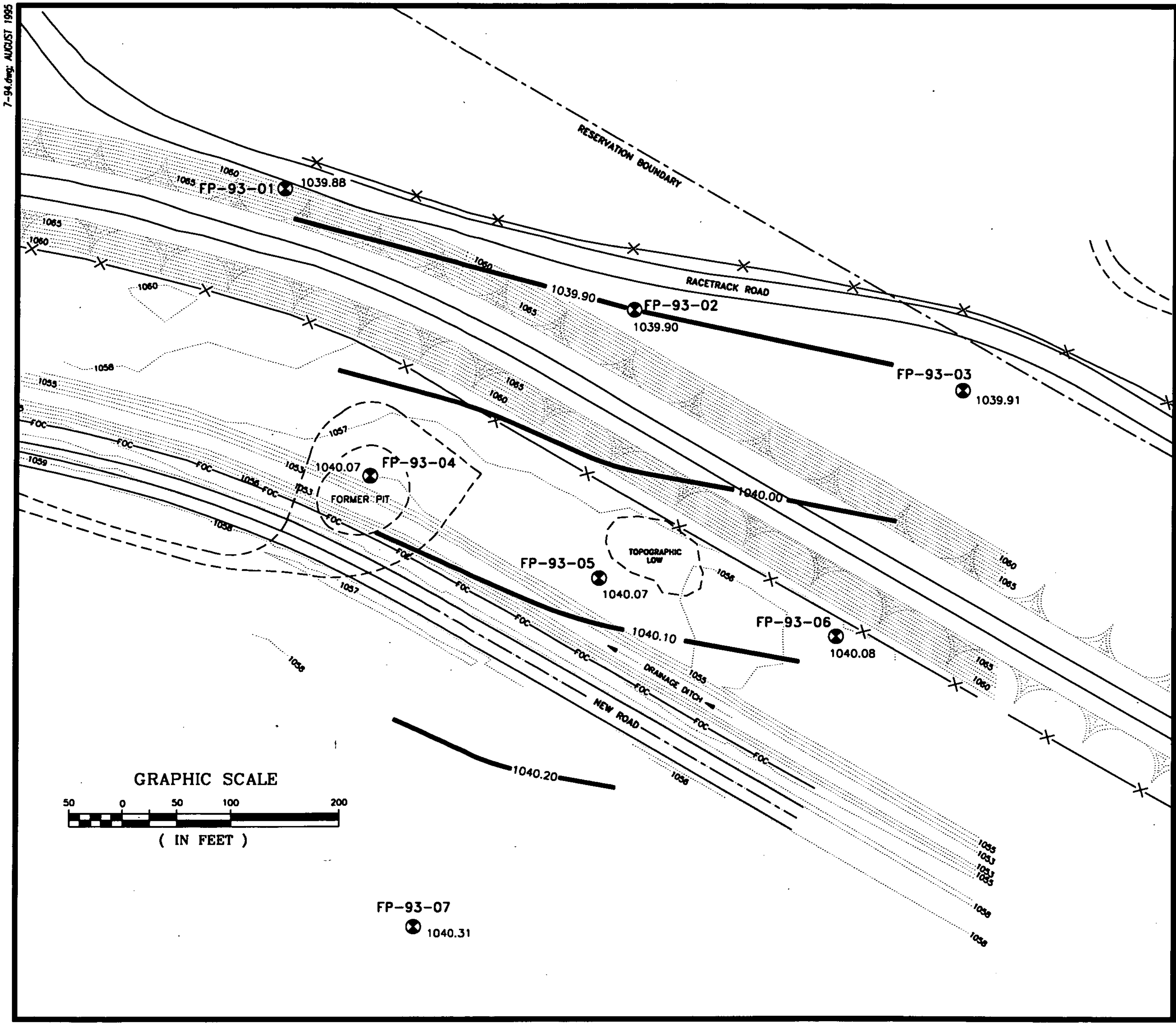


NOTE:

1. "TOPOGRAPHIC" LOW AREA IS LOCATED ON FIGURE BASED UPON FIELD MEASUREMENTS TAKEN DURING SI ACTIVITIES.
2. ELEVATION CONTOURS ARE IN FEET.
3. GROUNDWATER GRADIENTS ARE IN FEET.

Figure 3-20:
Groundwater Gradient Map
6/94

7-94.dwg; AUGUST 1995



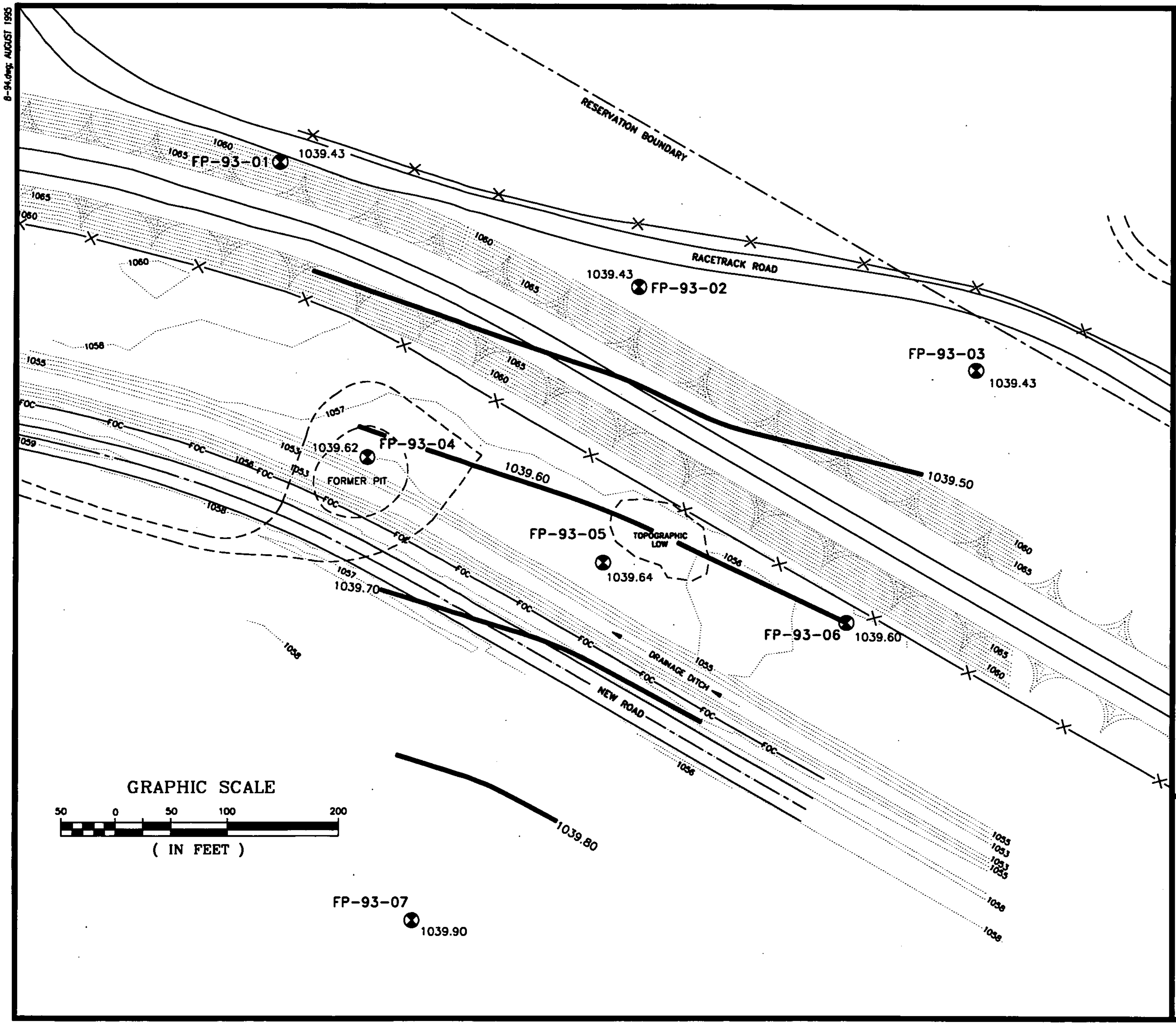
LEGEND

- ● GROUNDWATER MONITOR WELL
- GROUNDWATER CONTOUR
- ELEVATION CONTOUR
- ROAD
- FENCE LINES
- LEVEE
- Fiber Optic Cable
- FORMER FEATURES

NOTE:

1. "Topographic Low" area is located on figure based upon field measurements taken during SI activities.
2. Elevation contours are in feet.

Figure 3-21: Groundwater Gradient Map, 7/94



NOTE:

1. "Topographic Low" area is located on figure based upon field measurements taken during SI activities.
2. Elevation contours are in feet.

Figure 3-22: Groundwater Gradient Map, 8/94

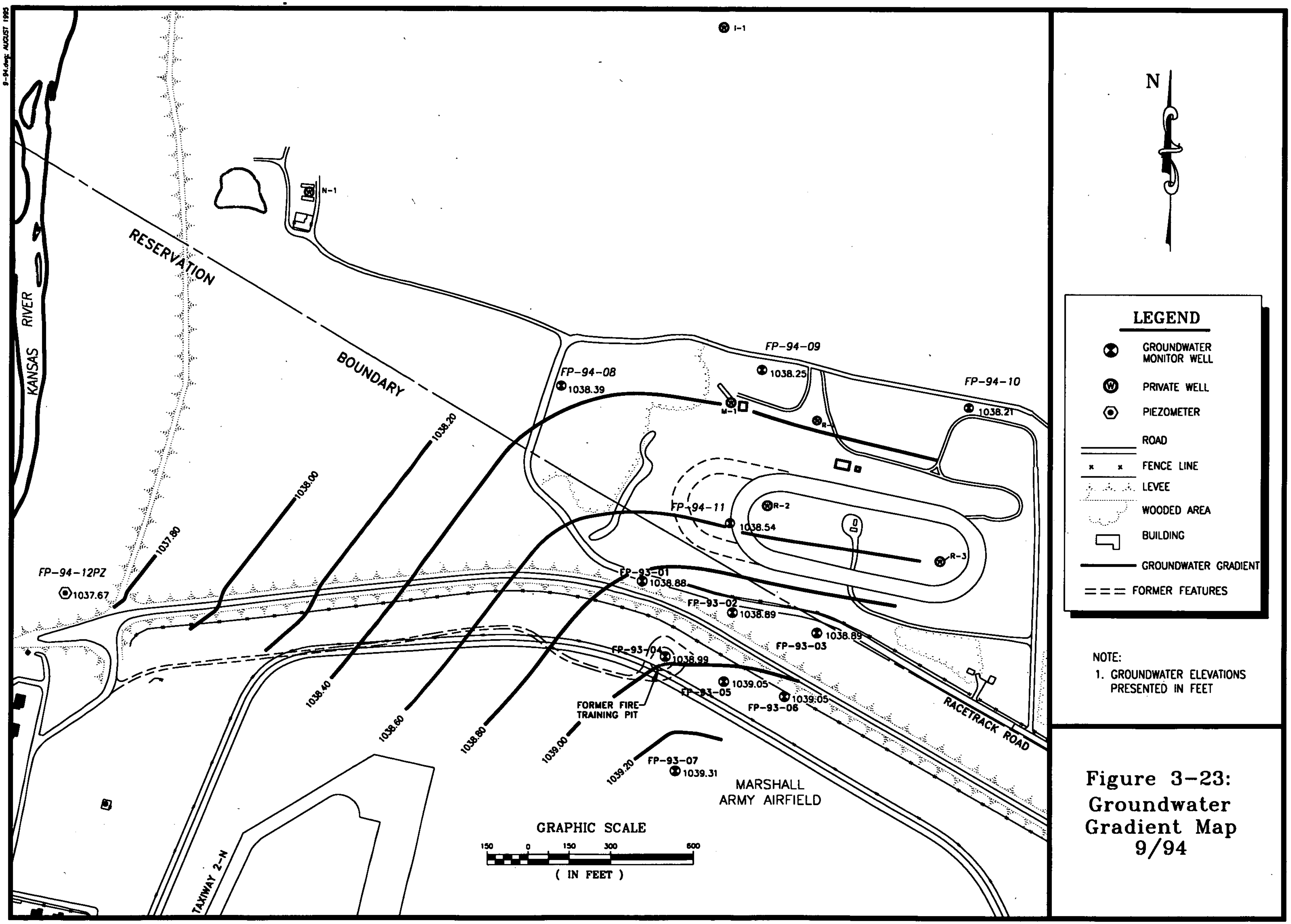
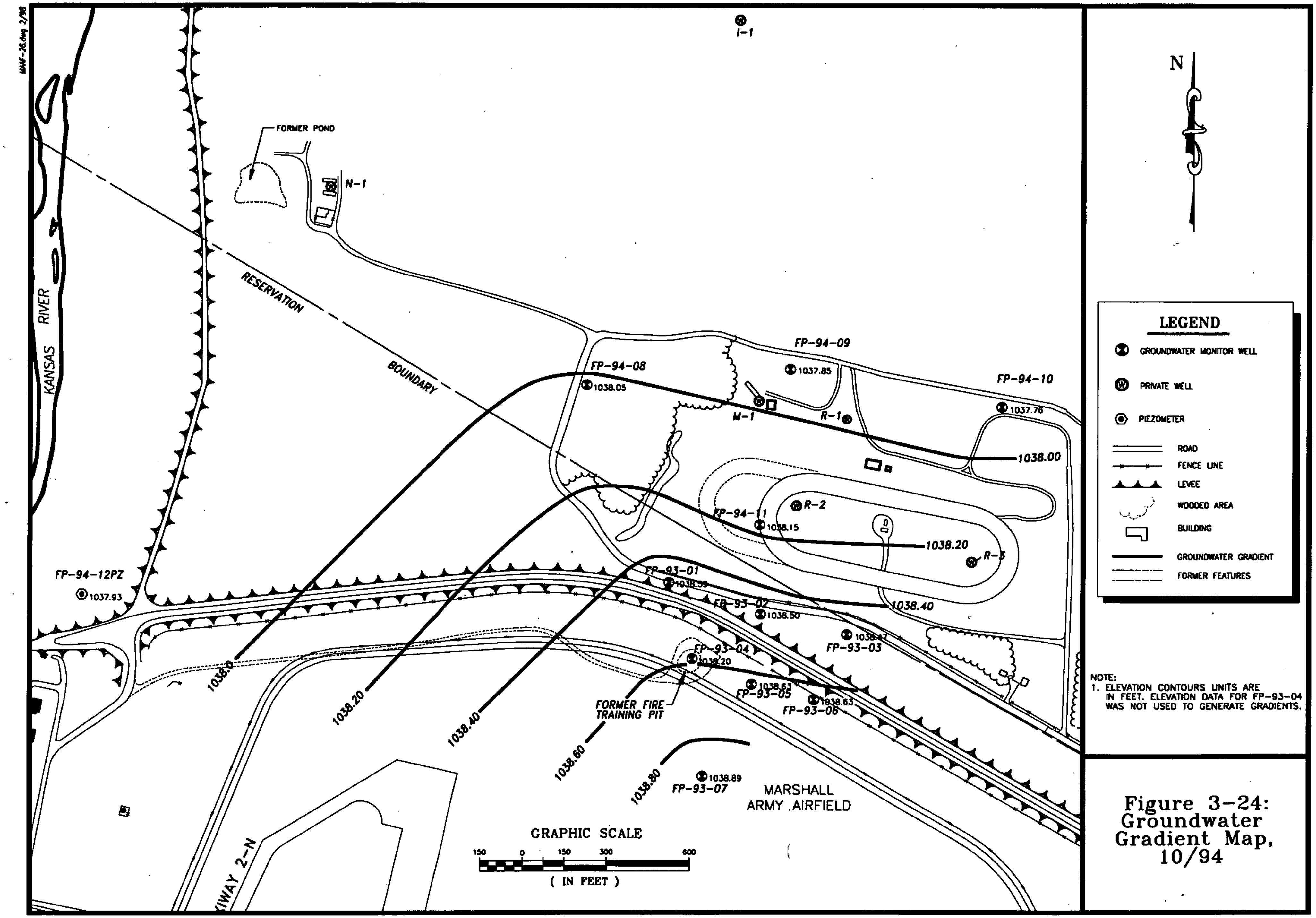


Figure 3-23: Groundwater Gradient Map 9/94



NOTE:
1. ELEVATION CONTOURS UNITS ARE IN FEET. ELEVATION DATA FOR FP-93-04 WAS NOT USED TO GENERATE GRADIENTS.

Figure 3-24: Groundwater Gradient Map, 10/94

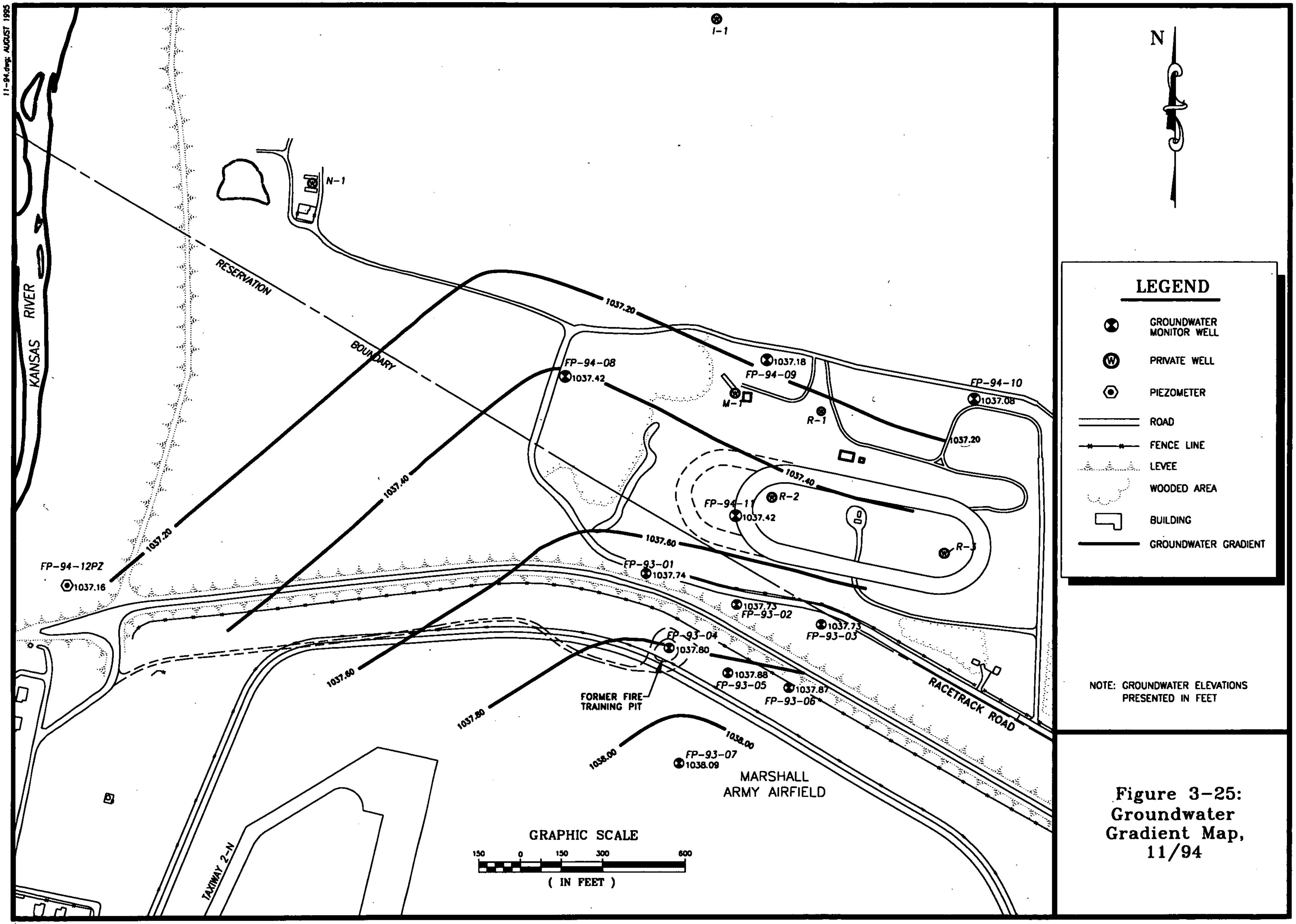


Figure 3-25: Groundwater Gradient Map, 11/94

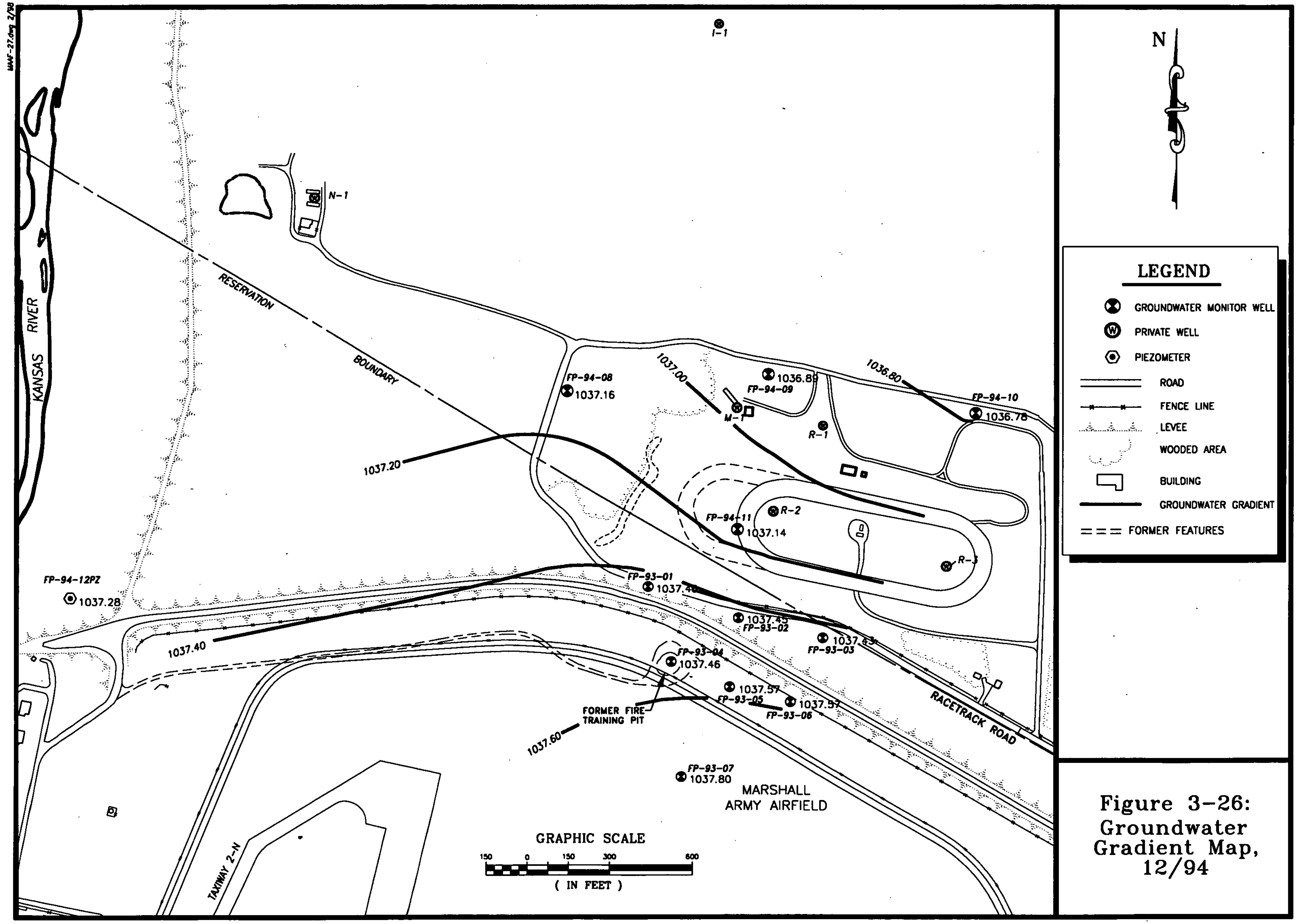


Figure 3-26: Groundwater Gradient Map, 12/94

1-95.dwg AUGUST 1995

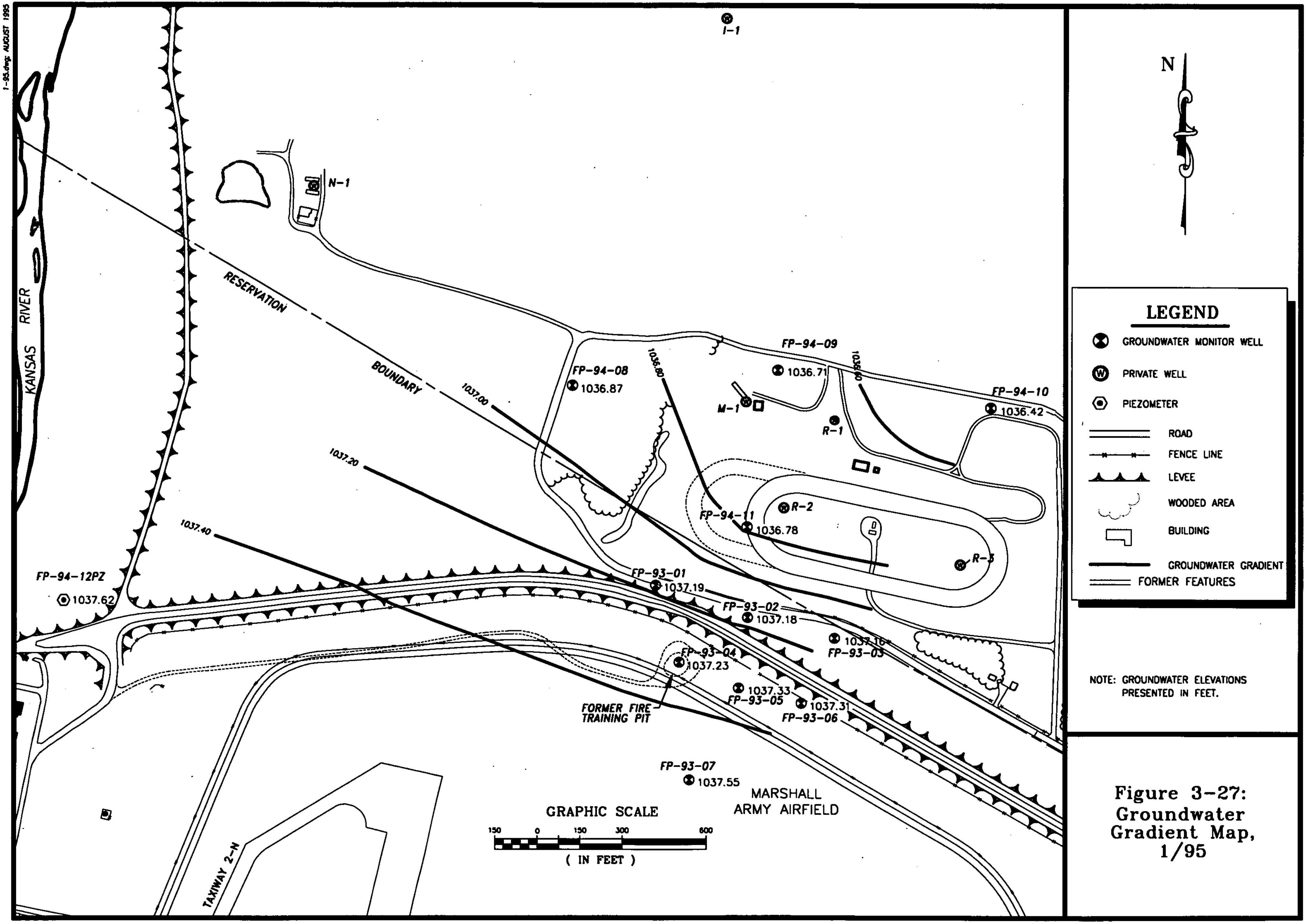
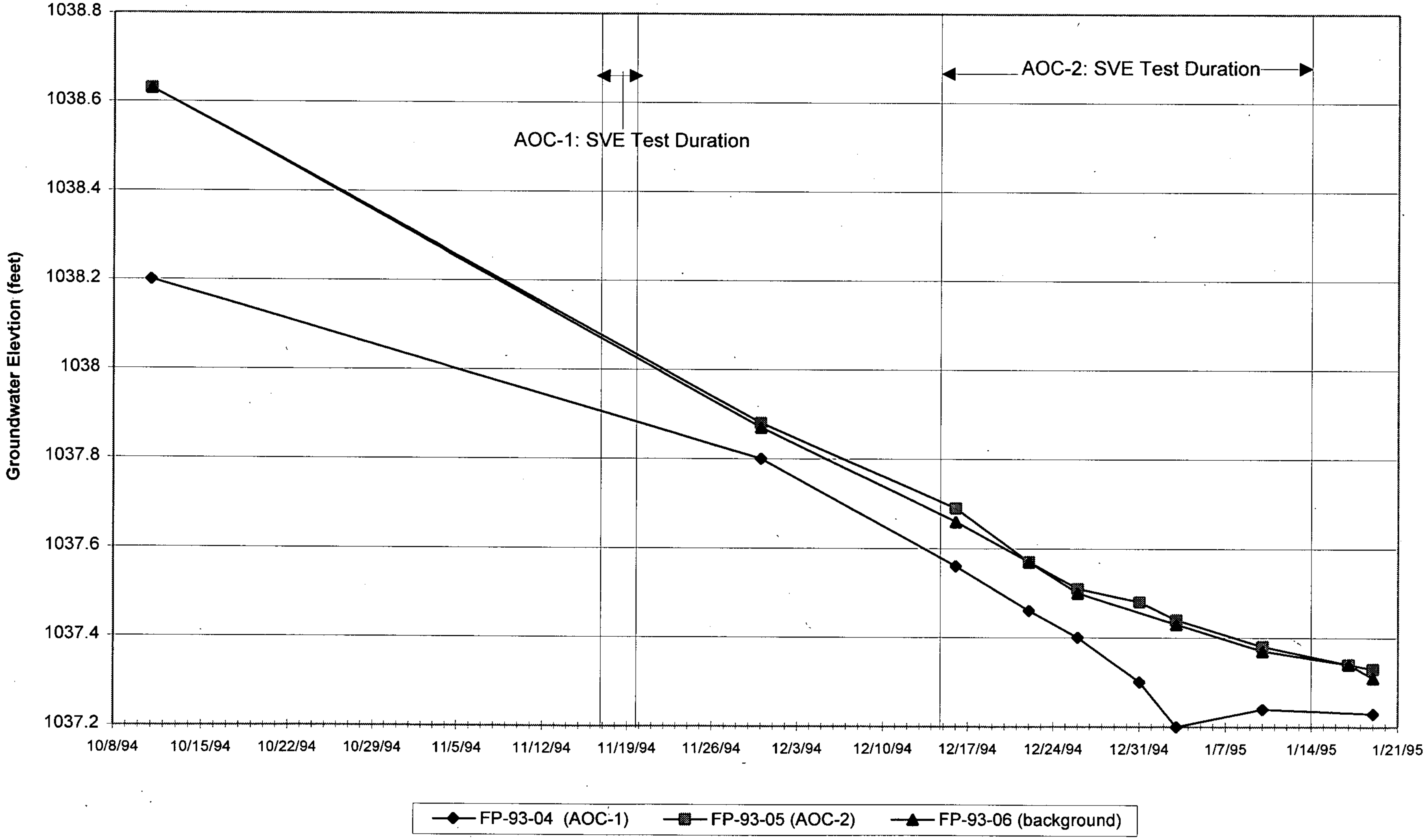


Figure 3-27: Groundwater Gradient Map, 1/95

Figure 3-28. Groundwater Elevation Data Collected During Pilot Test Study Operation



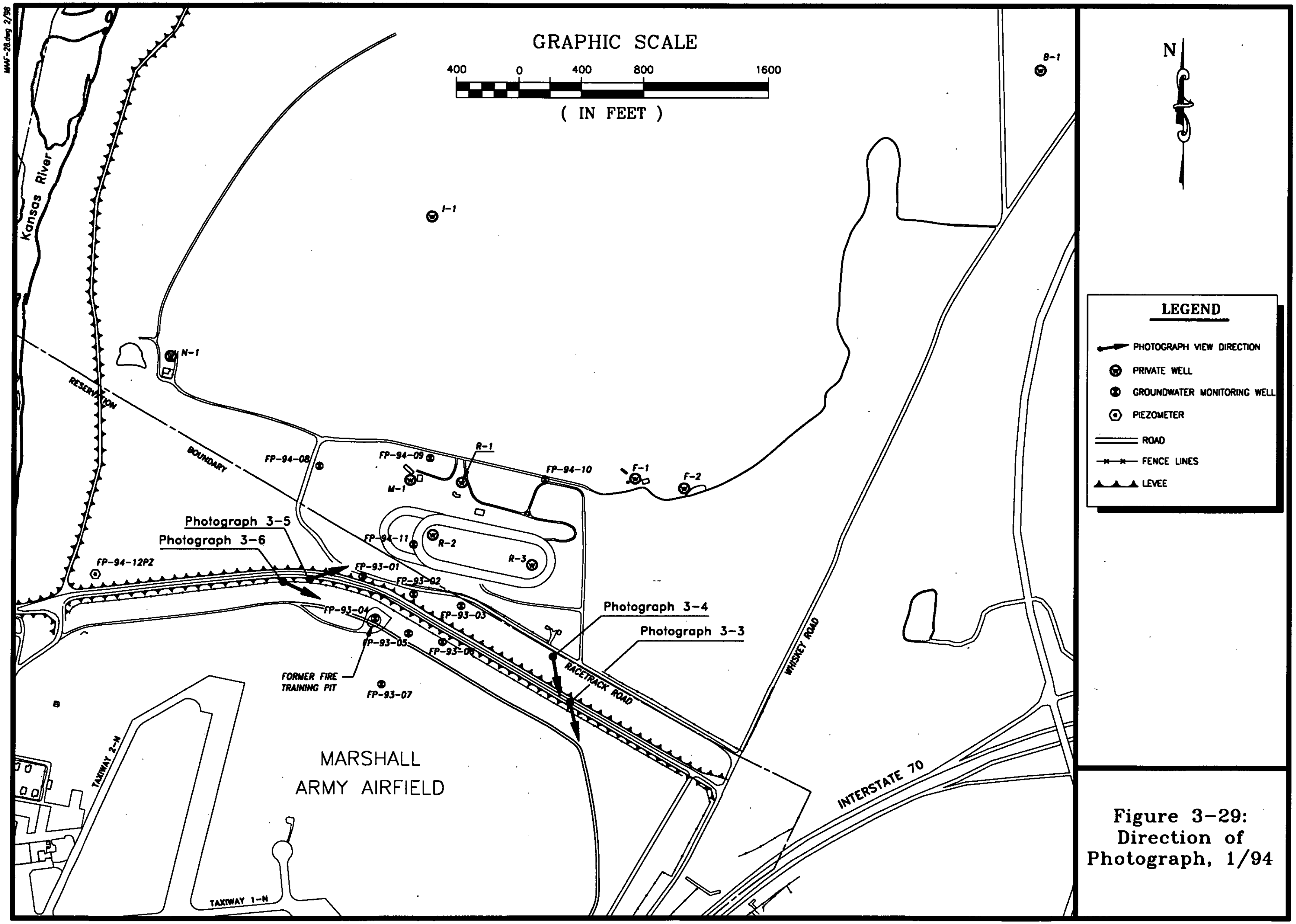
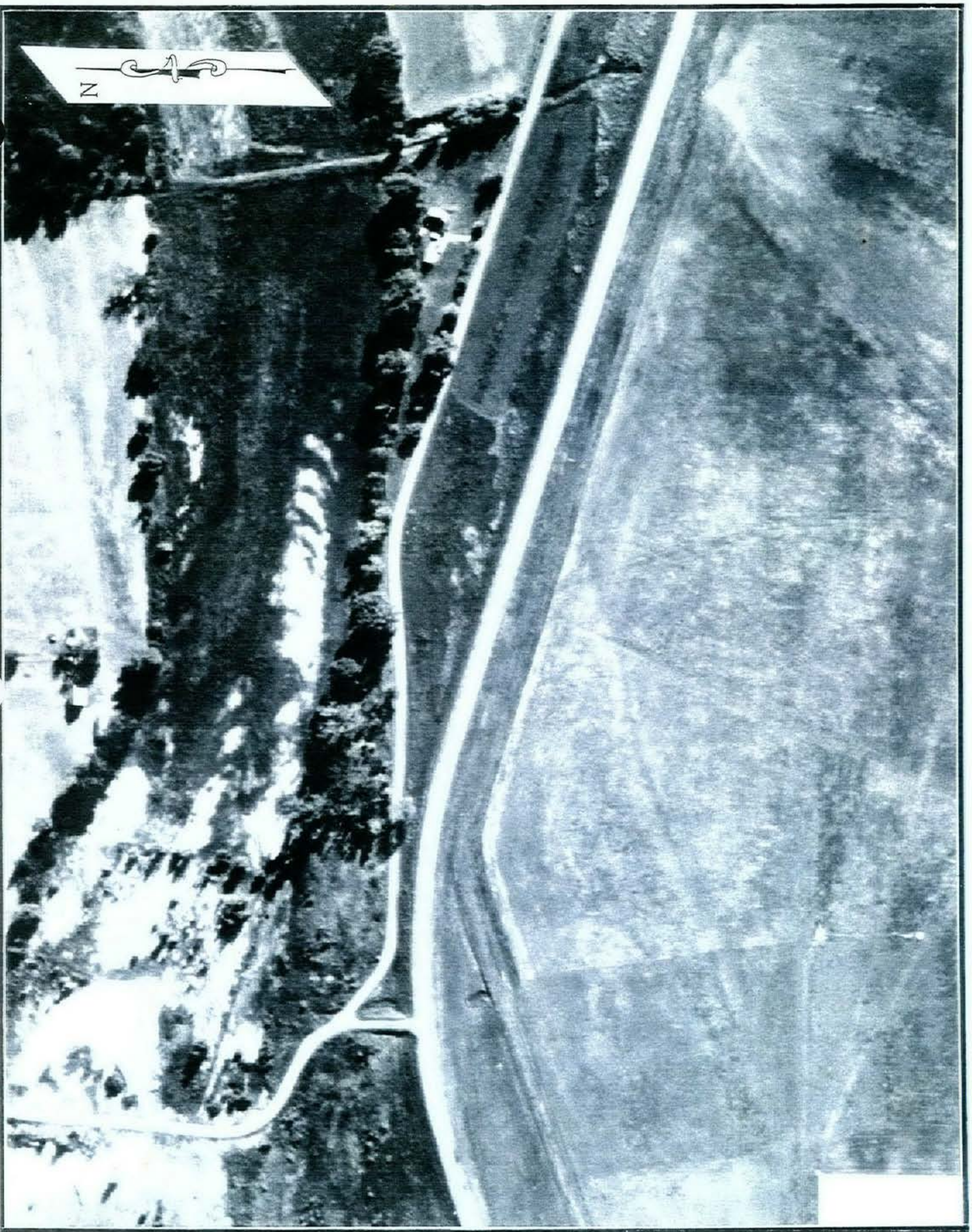


Figure 3-29: Direction of Photograph, 1/94

Graphic Scale:
1" = 470'

Photograph 3-1: Marshall Army Airfield - Former Fire Training Area - November 15, 1984 Aerial Photograph



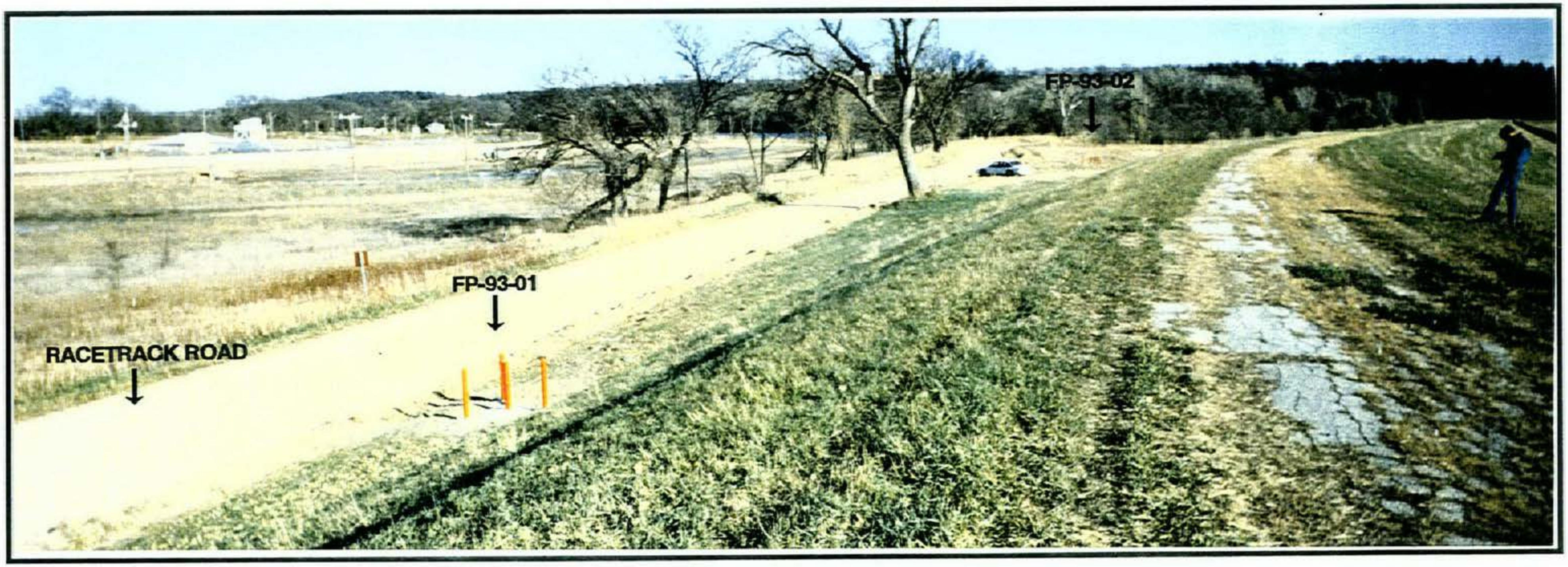
Graphic Scale:
1" = 265'

Photograph 3-2: Marshall Army Airfield - Former Fire Training Area - October 17,1961 Aerial Photograph

PHOTOGRAPH 3-3
Evidence of former culvert for site drainage prior to construction
of the drainage ditch (looking south from top of levee)
February 1994

PHOTOGRAPH 3-4
Evidence of former culvert for site drainage prior to construction
of the drainage ditch (looking south toward levee)
February 1994

PHOTOGRAPH 3-5
Photograph taken from levee looking east depicting monitor well FP-93-04, center of FFTA, FP-93-05 and FP-93-06, east of FFTA, and FP-93-02, north of FFTA (north side of levee)
November 1993



PHOTOGRAPH 3-6
Photograph taken from levee looking northeast depicting monitor well FP-93-01, down gradient of FFTA (northside of levee), Racetrack Road and the motor Speedway (north of FFTA)
November 1993

4.0 WASTE CHARACTERISTICS

The FFTA-MAAF was operated from the mid 1960s through 1984 to conduct fire training exercises. Flammable liquids were stored at the site in drums until the next training exercise was conducted. The 1984 aerial photograph (Photograph 3-1) depicts the largest quantity of drums located at the FFTA. These drums were stored to the immediate east and southeast of the bermed fire training pit. From historical photographs it was determined that approximately 50 drums stood to the east of the pit and approximately 100 drums were stored on their side to the southeast of the pit.

The predominant materials used for the fire training exercises were petroleum hydrocarbons, including JP-4, diesel, MOGAS, and gasoline. On one occasion in 1982, 55 gallons of PCE were inadvertently poured into the pit; however, it was subsequently pumped out of the pit prior to ignition (Ref. 33).

Soil sampling conducted at the site in 1985 by the USAEHA indicated that chlorinated solvents (in particular, PCE) were present in soils. Six samples were collected, four from standing liquids and sludge from within the bermed pit and two soil samples from the adjacent drum storage area. The sludge and soil samples were surface samples collected to a depth of 2 to 3 inches. Trichloromethane, t-1,2-DCE, and PCE were detected at concentrations ranging from 1,000 to 3,000 μg/kg. t-1,2-DCE was the only chlorinated compound detected in the drum storage area outside the bermed pit. In addition, #2 fuel oil was detected at concentrations ranging from 50,000 to 300,000 μg/kg for samples inside and outside the berm (Ref. 34).

As is discussed in further detail in Sections 5.0 through 7.0, the results of the SI in 1993 show that both petroleum hydrocarbons and chlorinated solvents are present in the subsurface at and in the vicinity of the FFTA-MAAF.

The maximum concentrations for petroleum hydrocarbons in both soils and groundwater were detected in the center of the former fire training pit in September and October 1993. The concentrations in the 4-foot soil sample from the center of the pit was 400,000 μg/kg for TPH-GRO and 8,100,000 μg/kg for TPH-DRO, both are well above the Kansas guideline for cleanup of 100,000 μg/kg. The 2-foot soil sample from the center of the pit also exceeded the state guideline for cleanup. Petroleum hydrocarbons were detected in monitor well FP-93-04 (located at the center of the pit) at concentrations of 13,000 μg/l for of TPH-GRO and 1,200 μg/l for TPH-DRO. Related hydrocarbons (benzene, toluene, ethylbenzene, and xylenes [BTEX]) were also detected, with benzene and toluene exceeding the state and federal drinking water standards. Soil gas data, groundwater screening results, and sampling of groundwater monitor wells did not show petroleum hydrocarbons at locations outside the immediate vicinity of the former fire training pit.

Several chlorinated organic compounds were detected in soils, soil gas, and groundwater at the FFTA. The most frequently detected compound was PCE; related compounds detected included TCE and DCE. These related compounds have industrial applications as solvents and can also result from the breakdown of PCE. The maximum detected concentrations from groundwater screening samples and well samples were:

Analyte	Soil (μg/kg)	Soil Gas (μg/l)	Groundwater (μg/l)
DCE	ND	21	4,100
PCE	480	50	210
TCE	ND	6.2	33

ND - Not Detected

There are no PCBs or pesticides associated with this site. Metals were only detected at background levels. Below is a summary of contaminants that were detected during the SI and/or ESI:

Potential Contaminant	Soil		Groundwater	
	On-post	Off-post	On-post	Off-post
Volatile Organic Compounds				
Benzene			✓	
DCE	✓	✓	✓	✓
Dichloromethane			✓	
Ethylbenzene	✓		✓	
PCE	✓	✓	✓	✓
TCE	✓	✓	✓	✓
Toluene	✓		✓	✓
m- and/or p-Xylenes	✓			✓
o-Xylene	✓		✓	
Semi-Volatile Organic Compounds				
Bis (2-ethylhexyl) Phthalate			✓	
di-n-Butylphthalate	✓			
2-Methyl Naphthalene	✓		✓	✓
4-Methylphenol			✓	
Naphthalene	✓		✓	✓
Phenanthrene	✓			
Total Petroleum Hydrocarbons (TPH)				
TPH-GRO	✓		✓	✓*
TPH-DRO	✓		✓	✓*

* There is the potential for leaks from the aboveground storage tanks containing diesel near the wells where TPH was detected.

5.0 SOIL GAS AND GROUNDWATER SCREENING

Soil gas and groundwater screening surveys were conducted to examine the presence of VOCs in the soil vapor and groundwater and delineate the extent of contamination in these materials. Both surveys were conducted in accordance with procedures defined in the Basic Documents for Field Investigations at Fort Riley, Kansas.

Soil gas and groundwater screening surveys were conducted during the SI activities and Phase I of the ESI activities. Only the groundwater screening survey was conducted during Phase II ESI activities. As part of the SCAPS investigation and during Phase II of the ESI, deep alluvial groundwater screening samples were also collected.

The soil gas and groundwater screening surveys were used to determine VOC contamination utilizing field screening techniques, using field analysis with laboratory confirmation. The analysis used for field screening was modified EPA Methods 601 and 602. The threshold levels used for both the soil gas and groundwater screening surveys were 10 μg/l for specific analytes or the sum of specific analytes, and 20 μg/l for total FID readings. These threshold levels were used to determine whether or not a sample grid should be expanded. As indicated in the Basic Documents, 10 percent of all field groundwater screening samples were collected in duplicate and analyzed in the laboratory for VOCs using EPA Method 8240.

5.1 SI Soil Gas and Groundwater Screening

A soil gas and groundwater screening survey was conducted during September 1993 as part of the Phase I and II SI activities. A summary of the soil gas and groundwater screening results from analyses conducted in the field during Phases I and II of the SI is presented in Table 5-1. The original analytical report for the soil gas and groundwater screening samples is presented as Appendix D. Table 5-2 presents the results of the groundwater screening samples that were analyzed by the laboratory for confirmation of field results. In most cases the contaminants detected in the field with the GC were confirmed by the laboratory results and are of the same order of magnitude. However, there were two instances where the comparison of the field and laboratory data showed a difference: field sample MAAF-H7W and laboratory sample FPH7, and field sample MAAF-M1W and laboratory sample FPM1. These differences were due to a higher detection limit by the laboratory (due to limited sample volume) or were detected below the detection limit of the field GC. In general, the groundwater screening samples analyzed in the field are expected to have lower values because they are based on concentrations present in the headspace of a heated container. In contrast, the groundwater screening samples that were analyzed in the laboratory were placed in a purging vessel; heated and purged with an inert gas, generally nitrogen. Then through a sampling port, the gas sample is injected into the GC.

Plate 4 depicts all the positive detections at each location for the soil gas and groundwater screening results, including the duplicate groundwater screening samples analyzed in both the field and the laboratory. As shown in Table 5-1 and Plate 4, the detected compounds include chlorinated organic compounds (c-1,2-DCE, TCE, and PCE) and petroleum hydrocarbons (BTEX). In addition, the measurement of total FID represents the sum of all petroleum hydrocarbons (i.e., TPH) detected on the FID assuming a relative response factor of one for noncalibrated compounds.

In general, the detections occurred in relatively low concentrations and/or at isolated locations, with the exception of PCE and TPH. PCE was detected more frequently and covered a larger area. The results of the PCE detections were used to generate concentration contours for 4-foot soil gas and groundwater screening samples analyzed in the field. These contours are presented in Figures 5-1 and 5-2, respectively. The 4-foot soil gas contours, Figure 5-1, indicate the possibility of two source areas for PCE. The most significant pattern of PCE detections is located southeast of the FFTA. This area is adjacent to the former drum storage area depicted in the 1977 through 1984 aerial photographs. The other possible source area, which contains lower concentrations of PCE, is located near and partially in the present topographic low, east of the FFTA. (This other possible source area was later ruled out as there were no detections in the groundwater screening or soil samples.) The pattern of PCE detections in the groundwater screening samples, as depicted in Figure 5-2, suggest a larger area of contamination with much higher concentrations of PCE. This pattern encompasses both areas in which PCE was detected in the 4-foot soil gas samples.

Overall, the detections in groundwater screening samples were higher than the detections in the 4-foot soil gas samples. These data indicate that the presence of PCE in the soil gas is potentially attributable to the presence of PCE in the groundwater and not the soil media. This may be a result of off-gassing of PCE from groundwater or residual PCE from fluctuations in the groundwater due to flooding and/or seasonal movement.

TPH, measured as total FID, was detected at high concentrations (660 μg/l) in the 4-foot soil gas samples located in the center of the former pit. The TPH detections, measured as total FID, in the groundwater screening samples were used to generate concentration contours depicted in Figure 5-3. TPH detections were reported at five locations (H7, E5, M1, K7, and M8). Only locations H7 and M8 exceeded 20 μg/l, and the highest detections occurred at H7 in the center of the former pit. There were insufficient data for any other analytes (including TPH readings in the soil gas samples) to prepare isoconcentration maps.

The results of the groundwater screening samples analyzed in the laboratory were compared against regulatory standards established by EPA and state guidelines established by KDHE in Table 5-2. Specifically, the detected concentrations were compared against MCLs established by EPA, and against the KALs established by KDHE. This comparison indicates that these standards were exceeded at locations H7, M8, M1, and N2. The concentration of PCE detected in sample M8 at a concentration of 250 μg/l is 50 times above the MCL (5 μg/l). The highest concentrations of toluene and DCE detected above the standards were in sample H7 at 2,600 μg/l and 2,100 μg/l, respectively. The concentration of DCE is approximately 30 times above the MCL (70 μg/l), and the concentration of toluene is 2.5 times above the MCL (1,000 μg/l). These concentrations are generally higher than the field analysis.

Detections of PCE in the 4-foot soil gas samples is attributed to the presence of PCE in soils and off-gassing of PCE from groundwater. As illustrated in Section 6.0, soil samples from the former drum storage area contained PCE at concentrations ranging from 15 to 650 μg/kg. However, PCE was detected in 4-foot soil gas samples at some locations where PCE was not detected in soils (e.g., SB-06). Since, in general, the detections of PCE in the groundwater screening samples were at higher concentrations than corresponding 4-foot soil gas samples, the soil gas detections can also be explained as PCE off-gassing from shallow groundwater, and would be attributed entirely to off-gassing at locations where PCE was not present in soils.

5.2 ESI Soil Gas and Groundwater Screening

5.2.1 Phase I

Phase I of the ESI was initiated on 20 June 1994 in accordance with the ESI SAP (24 May 1994) (Ref. 6). Phase I of the ESI SAP for the off-post properties included a soil gas survey at 238 locations (two depths where possible) and a groundwater screening survey at 78 of these locations. Soil gas samples were collected at a 4-foot depth and at a depth above groundwater (8 to 16 feet). [If groundwater was encountered above 8 feet then a groundwater screening sample was collected.] A summary of the positive detections for Phase I soil gas samples is provided on Table 5-3. Figure 5-4 depicts concentration contours for total chlorinated VOCs detected in the 4-foot soil gas samples for the SI and Phase I of the ESI. Only 4-foot concentrations were contoured because many of the deeper soil gas samples were collected as groundwater screening samples. The field analyses indicate that the threshold limits for Phase I soil gas samples were exceeded at locations 35, 36, 38, 77, 99, and 157 for chlorinated solvents and at locations 18 and 152 for petroleum.

The Phase I groundwater screening sample results are presented in Tables 5-4 and 5-5. Table 5-4 presents the field results and Table 5-5 the laboratory results. Phase I groundwater screening threshold levels were exceeded at locations 25 (when resampled), 35, 36, 39, 57, 70, 98, 99, 115, 132, 159, 216, 217, and 229 for chlorinated VOCs, and at locations 25 (when resampled), 36, 39, 70, 99, 159, 216, 217, and 229 for petroleum. Laboratory results for the Phase I groundwater screening samples indicate that MCLs were exceeded at locations 8, 70, and 99 for TCE (MCL = 5 μg/l); and at locations 70, 99, and 159 for DCE [MCL = 70 μg/l for DCE (mixture)]. Results for TCE were rejected at locations 8, 25, 70, 159, 217, and 223 through the data validation process due to documented analytical laboratory contamination of the storage cooler as explained in Technical Memorandum #3 to the ESI SAP (provided in Appendix A). Results were also rejected for DCE at location 214, 1,1,1-trichloroethane (TCA) at location 214, and PCE at location 217 due to the same documented laboratory storage contamination.

The locations for which data were rejected (8, 70, 159, and 217) were re-sampled in September 1994. Laboratory analysis of the re-collected samples showed the MCL and KAL for DCE was exceeded at location 70. The MCL and KAL for PCE was exceeded at locations 70 and 217. TCE was also detected above the MCL and KAL at locations 70 and 217.

Generally, laboratory detected concentrations were higher than field analytical results. This is to be expected, since field analysis was based on analyzing the sample headspace and laboratory analysis was performed with a purging vessel.

Due to soil gas and groundwater screening concentrations above the Phase I threshold levels identified in the ESI SAP, Phase II groundwater screening samples were collected. Soil gas samples were not collected in the Phase II because it was apparent from the Phase I results that groundwater was the media of concern.

5.2.2 ESI Phase II Groundwater Screening

Phase II of the ESI was initiated on 22 August 1994. A groundwater screening survey at the off-post properties was performed under Phase II. The Phase II groundwater screening was an expansion of the Phase I groundwater screening grid designed to determine the extent of groundwater contamination down gradient of the FFTA-MAAF.

Phase II consisted of three sampling events, Phases IIa, IIb, and IIc. In Phase IIa, samples were collected north and west of the Phase I samples. The grid was expanded in Phase IIb to investigate three areas -- Area 1 toward the east, Area 2 toward the west, and Area 3 toward the southeast of the Phase IIa samples. In Phase IIc additional samples were collected north of the Phase IIa and Phase IIb (Area 1) samples.

5.2.2.1 Initial Phase II Groundwater Screening

There were 64 samples collected for the initial Phase II survey along four lines. Figure 5-5 depicts sample locations for the initial Phase II groundwater screening. Locations where compounds were detected are depicted on Figure 5-6. First, a line of 16 samples were collected north of the Phase I grid, aligned east to west and labeled as North 1, and a line of 16 samples were collected west of the Phase I grid, which are aligned north to south. The field analysis results for the initial groundwater screening samples indicated detections at three locations below the threshold levels (locations 4, 10, and 32). As outlined in Technical Memorandum #1, samples were then collected along line North 2, south of the initial east-to-west line. The field analytical results of line North 2 however revealed that there were detections at seven locations (34, 39, 40, 44, 45, 46, and 47), four of which were above the threshold levels for chlorinated VOCs. Therefore, samples were then collected along line North 3, north of line North 2 and south of line North 1. There were four locations along line North 3 with detections (61, 62, 63 and 64), three of which were above the threshold levels. Table 5-6 summarizes the field screening results of Phase II groundwater screening. The detected compounds include PCE, TCE, 1,2-dichloroethane (1,2-DCA), t-1,2-DCE, c-1,2-DCE, toluene, and ethylbenzene.

Approximately 10 percent of the groundwater screening samples were collected in duplicate. The duplicate samples were sent to an analytical laboratory for confirmation of field results. Table 5-7 summarizes the laboratory results for these samples. The laboratory results indicate that the MCL for TCE, DCE, and PCE was exceeded at location 46, and the MCL for DCE was exceeded at location 61.

As seen in Table 5-6, concentrations of TCE, PCE, and 1,2-DCA detected through field headspace analysis were generally low. Concentrations ranged from 1 to 11 μg/l for TCE, 1 to 23 μg/l for PCE, and 2 to 47 μg/l for 1,2-DCA. Toluene was only detected in two locations along line North 1 (locations 4 and 10) at concentrations of 7 μg/l and 3 μg/l, respectively. Only one location showed a detection of ethylbenzene (location 40) at a concentration of 5 μg/l. t-1,2-DCE was detected at two locations (34 and 39). At location 34 the concentration of t-1,2-DCE was much higher, at 470 μg/l. This appears to be an isolated event, as no other surrounding locations showed higher concentrations of t-1,2-DCE.

Laboratory results confirmed the presence of toluene at location 4, and TCE, DCE, and PCE at location 46. Laboratory analysis also confirmed that the high concentration of DCE at location 34 was a discrepancy. Laboratory analysis did not detect DCE at location 34. Toluene was detected at low concentrations through laboratory analysis in samples 34 and 35, but not detected through field analysis. Xylenes were also detected at location 4 but not detected during field analysis. Alternately, field results of detectable concentrations of 1,2-DCA at location 46 were shown to be a false positive.

5.2.2.2 Phase II Expanded Groundwater Screening

Based on the findings of the initial Phase II groundwater screening, the Phase II groundwater screening expansion was initiated on 30 August 1994, as outlined in Technical Memorandum #2. The purpose of this expansion was to further delineate the extent of groundwater contamination.

These results identify three areas that needed further investigation (Tables 5-6 and 5-7):

- Phase IIb, Area 1 - due to detections at the eastern end of each of the east-west lines as follows: line North 1 (at location 32), line North 2 (at locations 44, 45, 46, 47), and line North 3 (at locations 61, 62, 63, and 64).
- Phase IIb, Area 2 - due to two detections along the north-south line at locations 4 and 10.
- Phase IIb, Area 3 - due to location 34, which had the highest concentration of any compound and appeared to be isolated.

Initially, 23 samples were collected in these three areas (6 samples [65 - 70] in Area 1, 6 samples [71 - 76] in Area 2, and 11 samples [77 - 87] in Area 3). The only detections were at locations 65 and 75. Total VOCs were detected at 28 μg/l, and toluene was detected at a concentration of 13 μg/l at location 75. Both detections were above the threshold levels which caused the grid to be expanded. At location 65, PCE was detected at 0.3 μg/l. However, laboratory results did not confirm the presence of PCE.

Due to the detections at location 75, additional samples (88, 89, and 90) were collected west of location 75. No compounds were detected at these locations through field analysis. Due to detections at location 65, three samples were collected north of location 65 (samples 91, 92, and 93). There was a detection of t-1,2-DCE at location 91, which was subsequently confirmed by laboratory analysis. Additionally, laboratory analysis detected toluene at a concentration of 1.2 μg/l at location 91.

Due to detections at location 91, samples 94 though 100 were collected west and north of location 91 in lines North 5 and 6. Samples 101 through 105 were collected north of North 1 in North 7. TCE was detected at sample locations 94, 95, 98, and 101 at concentrations of 4 μg/l, 1 μg/l, 2 μg/l, and 6 μg/l, respectively. Laboratory results confirmed TCE concentrations at only location

101. At locations 94, 95, 96, and 97, 1,2-DCA was detected. The greatest concentration (6 μg/l) was detected at location 94. Detections of t-1,2-DCE were found at locations 100 and 105. At location 100, it was detected at 15 μg/l, above the threshold level. Petroleum compounds (toluene and benzene) were also detected in the area. At location 95, benzene was detected at a concentration of 7 μg/l, toluene was detected at 6 μg/l, and Total VOC detections were 15 μg/l. Although no field detections were noted at location 99, TCE, DCE, PCE, and toluene were detected through laboratory analysis.

Additional groundwater screening samples were collected to delineate the horizontal extent of groundwater contamination to the north of the speedway. Sample locations are depicted on Figure 5-5. The following samples were collected as outlined in Technical Memorandum #6:

- Two samples were collected at the end of line North 6, extending this line toward the east (106, 107).
- Six samples were collected on line North 7, extending this line toward both the east and west. Three samples were located on each end of the existing line (108-113).
- Twelve samples were collected (line North 8) in an east-west line at a distance of 150 feet north of line North 7 (114-125).
- Six samples were collected (line North 9) in an east-west line at a distance of 150 feet north of line North 8, however, extending toward the west - directly south of the irrigation well (126-131).

At location 127, 1,1-dichloroethane (1,1-DCA) was detected through field analysis at a concentration of 5 μg/l. Trichloromethane was detected a location 128 at a concentration of 2 μg/l. There were no field detections at location 106, 107, 114-126, and 129-131.

Due to detections at locations 127 and to collect samples in areas previously not sampled, the sampling grid for groundwater screening was further expanded towards the west and north to the irrigation well. There were 23 samples collected (locations 132-154) and detections were found at only one location (153) through field analysis. At location 153, a duplicate was collected. Field analysis indicated that the field screening result contained 9 μg/l of c-1,2-DCE and the duplicate field screening sample contained 8 μg/l of c-1,2-DCE. Laboratory analysis showed detections of tribromomethane, trichloromethane, bromodichloromethane, and dibromochloromethane at location 153. These compounds were not detected during field analysis, nor in any other laboratory analyzed samples during Phase II.

Figure 5-6 provides an overview of all groundwater screening samples collected during the SI and ESI activities. As shown in Figure 5-7, three areas of PCE contamination were detected. The first location surrounds the former drum storage area and extends north off-post to the west side of the racetrack. The highest concentrations of PCE are in the area near the former drum storage area; however, another area of high concentration exists just south of the racetrack. The second area of PCE contamination is located north of the racetrack, along the dirt road. Another area of PCE contamination is north of the racetrack and the gravel road surrounding sample location 46. A final area of contamination exists at location 101. As shown in Figure 5-8, TCE was detected in the same general areas as PCE. TCE was detected near the former drum storage area and again an area of TCE contamination exists at the southwest corner of the racetrack. TCE was detected along the dirt road, and in the area surrounding location 46, north of the gravel road. TCE was also detected just east of location 46 at location 64 and in an area to the north, surrounding location 32, 98, and 101. DCE contamination was detected in all the same areas and at additional isolated locations (Figure 5-9). DCE was detected in the former pit area and north of the gravel road, surrounding location 34. As shown in Figure 5-10, the areas of highest total chlorinated VOC concentrations are the pit and former drum storage area, the west-side of the racetrack (especially in the southwest), north of the gravel road at location 34, and north of the gravel road surrounding sample location 45.

To evaluate changes in groundwater concentrations over time based on groundwater screening samples, six locations sampled as part of the Phase I and II survey were sampled again. This second sampling occurred at the same time as the additional groundwater screening samples, identified above, were collected. The locations sampled again included Phase I location 98, 159 and 229 and Phase II locations 34, 46, and 32. Phase I locations 98 and 229 were sampled again to assess changes in concentrations based on previous detections. Phase I location 159 was sampled again to assess whether contaminants had migrated from areas immediately to the south with previous detections. Phase II location 34 was sampled again due to the relatively high concentration of t-1,2-DCE (470 μg/l) detected during the initial sampling. Phase II locations 46 and 32 were sampled again to assess changes in concentrations over time along the apparent path of contaminant migration. During the collection of six re-samples, location 70 was inadvertently sampled again and only field analyzed. The results are also provided in Table 5-6. There were no detections for the initial sample at location 70.

At location 98, concentrations of PCE decreased, however, it was still above the threshold limits for Phase II expansion. One compound, 1,2-DCA was detected in the second sampling, but not during the original sampling. Sample 229 (the second sample) showed lower detected concentrations of PCE, however, TPH, TCE, and 1,2-DCA increased relative to the previous sampling event. The second sampling of location 32 showed no detections and location 46 showed marked decrease in concentrations of TCE, PCE, and 1,2-DCA. At location 159, field results for PCE and TCE were detected at only slightly higher concentrations than during the Phase I sampling. However, during Phase I sampling, c-1,2-DCE was detected at a concentration of 118 μg/l and benzene was detected at 2.4 μg/l, but not in the resample.

The sample from location 34 did not show the same high concentration of t-1,2-DCE as in the initial field sampling. Results from the second sampling showed no detection for t-1,2-DCE and a concentration of 3 μg/l of 1,1-DCA. It appears that the original field detected concentration was an isolated event.

5.3 Deep Alluvial Groundwater Screening

Additional field screening data was collected during the SCAPS investigation. Additional details of this investigation are discussed in Section 3.1.3.3 and in Technical Memorandum #5 and Addendum, which are provided in Appendix A. Specifically for MAAF-FFTA, the SCAPS rig was used to collect deep alluvial groundwater screening samples using a Hydropunch sampler to determine if DNAPLs were present above the bedrock surface. The depths of pushes ranged from approximately 48 feet to 72 feet. Table 3-3 lists the actual depth of the pushes. The groundwater screening samples collected via SCAPS were analyzed for VOCs in the field and the laboratory. Groundwater screening samples were collected in duplicate at sample locations CP-1 through CP-9. These locations are depicted on Figure 5-11.

Table 5-8 presents the analytical results for both the field screening and the laboratory analysis. Ten different analytes were detected including both chlorinated solvents and petroleum compounds. Trichloromethane was detected at low levels during field screening analysis, however, they were not confirmed in the laboratory analysis. The detected chlorinated solvents include both 1,1- and 1,2-DCA, DCE, and TCE. Both DCAs were detected at one location (CP-7) in the field analyses but were not detected in the duplicates analyzed in the laboratory. DCE was detected at one location (CP-2) at 1.1 μg/l in the laboratory duplicate; however, it was not detected during field analyses. TCE was detected in both field and laboratory analyses at 2.93 and 2.8 μg/l, respectively, at location CP-4 in the 53-foot sample. TCE was also detected at locations CP-9, CP-5, and CP-6 at concentrations of 1.0 to 2.7 μg/l; TCE was not detected in the field analyses of these samples. None of the chlorinated VOCs detected in the laboratory analyses were above drinking water standards.

The detected petroleum compounds include ethylbenzene, toluene, and xylenes. Based on field analyses, ethylbenzene was detected at locations CP-2 and CP-6 at concentrations of 0.57 and 0.68 μg/l, respectively. Ethylbenzene was not detected at the same locations in the laboratory duplicates. In addition, ethylbenzene was detected at locations CP-5 and CP-7 at concentrations of 0.7 to 0.9 μg/l, respectively, based on laboratory analyses. Toluene was detected at two locations (CP-6 and CP-9) based on field analyses and at all nine locations based on laboratory analyses. The concentrations of toluene ranged from 0.5 to 1.7 μg/l. Xylenes were detected at four locations (CP-9, CP-2, CP-6, and CP-7) based on field analyses at concentrations ranging from 0.57 to 0.92 μg/l. None of these samples contained xylenes in the duplicate laboratory analyses. In contrast, xylenes were detected in the laboratory at location CP-5 at 0.6 μg/l and were not detected in the field analyses. None of the petroleum compounds detected in the laboratory analyses were above drinking water standards.

The chlorinated methanes detected at the site include dichloromethane and trichloromethane. Dichloromethane was only detected at one location and was also detected in the blank. Trichloromethane was detected at four locations based on field analyses but was not detected in any of the laboratory duplicates. Trichloromethane is a common contaminant detected in chlorinated drinking water (Ref. 67). The MCL for trichloromethane is 100 μg/l and for dichloromethane is 5 μg/l. Neither dichloromethane or trichloromethane are attributed to the FFTA-MAAF nor are detected concentrations above drinking water standards. Therefore, the detected chlorinated methanes are not considered to be associated with the FFTA-MAAF.

In general, the field analyses revealed detections of 1,1- and 1,2-DCA, trichloromethane, and xylenes that were not confirmed by laboratory analysis. Also, the field analyses did not show detections for VOCs detected in the laboratory duplicates at concentrations of 2.7 μg/l and less (e.g., TCE at location CP-9). These data show that the field analyses has a slightly lower capability for detecting low concentrations, which is expected when performing headspace analyses of samples in the field. The primary purpose of the SCAPS groundwater screening samples was to evaluate whether DNAPLs are present in the deeper alluvial materials at the site. The only compounds with the potential to occur as DNAPLs that are related to the site and detected based on the laboratory analyses are as follows:

Locations	Detections (μg/l)	Specific Gravity (a)	Solubility in Water (μg/l) (a)
CP-9	TCE - 2.7	1.460	1,100,000
CP-2	DCE - 1.1	1.282	6,300,000
CP-4 (b)	TCE - 2.8	1.460	1,100,000
CP-5	TCE - 1.2	1.460	1,100,000
CP-6	TCE - 1.0	1.460	1,100,000

(a) units are: g/cm^3, at 15.5°C and 1 atmosphere (Ref. 68)
(b) Detected in the 53-foot sample, not the 72-foot sample

Although TCE and DCE have specific gravities which are greater than 1.0 (1.0 is the specific gravity of water), the detected concentrations are orders of magnitude lower than the limits of solubility. Therefore, these concentrations are not indicative of DNAPLs.

Petroleum compounds detected included toluene, ethylbenzene, and xylenes. The specific gravities of these compounds ranges from 0.86 to 0.87 (Ref. 69); thus, they are lighter than water. The occurrence of these petroleum compounds in the deep alluvial samples, even at the low concentrations detected (many of the detections were less than 1.0 μg/l), is not expected because of their specific gravity. During pushes of the Hydropunch with the SCAPS rig, the tool and push rods are designed to form a tight seal with the surrounding formation as it is being pushed to the sampling depth. As shown with the CPT data present in Section 3.0, the majority of the alluvial materials are sands. The sands will not form as effective a seal around the Hydropunch sampler and push rods as finer grained silts and clays. Therefore, it is possible that the detected petroleum compounds at depth are the result of carry-through from shallower depths. This carry-through, if it occurred, may also account for some of the detections of chlorinated VOCs in the deep alluvial samples. However, whether or not carry-through occurred **does not affect** the conclusions that DNAPLs are not likely present and that detected concentrations in the laboratory analyses do not exceed drinking water standards at any location.

The results of the chemical analyses of the groundwater screening samples indicate that DNAPLs are not likely present - rather, low concentrations in groundwater of chlorinated VOCs were detected (the greatest detected concentration was 2.8 μg/l for TCE at CP-4). These low concentrations are well below the limits of solubility for the chlorinated VOCs (which are six orders of magnitude greater), indicating that DNAPLs are not likely to be present in areas near to the locations sampled.

Table 5-1. Summary of Chemical Detections for SI Soil Gas and Groundwater Screening Results Former Fire Training Area, September 1993

Sample Identification	Depth (feet)	c-1,2-DCE	TCE	PCE	Benzene	Toluene	Ethyl-benzene	Xylenes	Total FID (a)
Reporting Limit (μg/l)		1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0
Soil Gas Samples (Results are reported in micrograms per liter - μg/l)									
Phase I									
MAAF-D6	4	<1.0	<1.0	<1.0	**1.0**	<1.0	<1.0	<1.0	<10
MAAF-H7	4	**21**	<1.0	<1.0	<1.0	**422**	**44**	**278**	**660**
MAAF-H8	4	<1.0	<1.0	**2.8**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-H9	4	<1.0	<1.0	**4.6**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-J7	4	<1.0	<1.0	**1.7**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-J8	4	<1.0	<1.0	**29**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-JZ	4	<1.0	<1.0	**9.7**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-K7	4	<1.0	<1.0	**9.3**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-K9	4	<1.0	<1.0	**50**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-M6	4	<1.0	<1.0	**1.2**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-M8	4	<1.0	<1.0	**9.3**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-M14 (b)	4	<1.0	<1.0	**4.0**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-N2	4	<1.0	<1.0	**3.5**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-N7	4	<1.0	<1.0	**16**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-NY	4	<1.0	<1.0	**1.5**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-P9	4	<1.0	<1.0	**1.6**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-PX	4	<1.0	<1.0	**3.8**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-PZ	4	<1.0	<1.0	**1.9**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-WZ	4	<1.0	<1.0	<1.0	<1.0	**3.1**	<1.0	<1.0	<10
Phase II									
MF-1	4	<1.0	<1.0	**3.9**	<1.0	**1.1**	<1.0	<1.0	<10
MF-2	4	<1.0	<1.0	**4.0**	<1.0	<1.0	<1.0	<1.0	<10
MF-3	4	<1.0	**6.2**	**44**	<1.0	<1.0	<1.0	<1.0	**11**
MF-4	4	<1.0	<1.0	<1.0	<1.0	**1.3**	<1.0	<1.0	<10
MF-5	4	<1.0	<1.0	**9.4**	<1.0	<1.0	<1.0	<1.0	<10
MF-6	4	<1.0	<1.0	<1.0	<1.0	**3.1**	<1.0	<1.0	<10
MF-8	4	<1.0	<1.0	<1.0	<1.0	**1.3**	<1.0	<1.0	<10
MF-9	4	<1.0	<1.0	<1.0	<1.0	**1.8**	<1.0	<1.0	<10
MF-12	4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**12**

Table 5-1. Summary of Chemical Detections for SI Soil Gas and Groundwater Screening Results Former Fire Training Area, September 1993 (continued)

Sample Identification	Depth (feet)	c-1,2-DCE	TCE	PCE	Benzene	Toluene	Ethyl-benzene	Xylenes	Total FID (a)
Reporting Limit (µg/l)		1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0
Groundwater Samples (Results are reported in micrograms per liter - µg/l)									
Phase I									
MAAF-H6W	8	**4.8**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
MAAF-H7W	7	**725**	<1.0	<1.0	**13**	**3,841**	**356**	**1,586**	**6,421**
MAAF-H8W	8	<1.0	<1.0	**1.6**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-H9W	8	<1.0	<1.0	**4.6**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-J7W	8	<1.0	<1.0	**4.4**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-J8W	6	<1.0	<1.0	**51**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-JZW	8	<1.0	<1.0	**6.7**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-K7W	9	**1.6**	<1.0	**56**	<1.0	<1.0	<1.0	<1.0	**17**
MAAF-K9W	9	<1.0	<1.0	**46**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-M6W	8	<1.0	<1.0	**8.6**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-M8W	8	**32**	**2.5**	**160**	<1.0	<1.0	<1.0	<1.0	**49**
MAAF-M1W	8	**129**	**1.3**	**17**	<1.0	<1.0	<1.0	<1.0	**15**
MAAF-N2W	8	<1.0	<1.0	**24**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-N7W	8	<1.0	<1.0	**10**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-NYW	7	<1.0	<1.0	**13**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-P9W	7	<1.0	<1.0	**2.8**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-PXW	7	<1.0	<1.0	**4.0**	<1.0	<1.0	<1.0	<1.0	<10
MAAF-PZW	7	<1.0	<1.0	**3.0**	<1.0	<1.0	<1.0	<1.0	<10
Phase II									
MF-1W	8	<1.0	<1.0	**41**	<1.0	<1.0	<1.0	<1.0	<10
MF-2W	8	<1.0	<1.0	**4.3**	<1.0	<1.0	<1.0	<1.0	<10
MF-3W	8	<1.0	<1.0	**6.2**	<1.0	<1.0	<1.0	<1.0	<10
MF-5W	8	<1.0	<1.0	**7.0**	<1.0	<1.0	<1.0	<1.0	<10
MF-7W	9	<1.0	<1.0	**1.2**	<1.0	<1.0	<1.0	<1.0	<10
FP-E5	10	<1.0	<1.0	<1.0	<1.0	**1.5**	<1.0	<1.0	**11**
FP-H7	7	**375**	<1.0	<1.0	**6.7**	**1,522**	**177**	**888**	**14,510**
FP-M1	9	**39**	<1.0	**6.5**	<1.0	<1.0	<1.0	<1.0	**16**
FP-M8	9	**13**	**1.6**	**78**	<1.0	**1.1**	<1.0	**1.5**	**23**
FP-N2	9	<1.0	<1.0	**7.3**	<1.0	<1.0	<1.0	<1.0	<1.0
FP-PZ	8	<1.0	<1.0	**1.4**	<1.0	<1.0	<1.0	<1.0	<1.0

Bold values represent detected compounds.

Shaded areas represent locations where concentrations exceed threshold levels (10 ug/l for specific compounds or the sum of specific compounds, and 20 ug/l for total FID readings).

(a) Represents the sum of all petroleum hydrocarbon compounds observed on the chromatogram for the FID.

(b) Represents the 4-foot sample from location M1.

< Below Practical Quantitation Limit

c-1,2-DCE cis-1,2-Dichloroethylene

TCE Trichloroethylene

PCE Tetrachlorothylene

FID Flame Ionization Detector

Table 5-2. Summary of Chemical Detections for SI Groundwater Screening Results - Laboratory Analyses, September 1993

(All results are reported in micrograms per liter - μg/l)

Analyte	FPN2	FPPZ	FPV8 (a)	FPN7	FPM8 (a)	FPH7 (a)	FPJ6 (a,b)	MFJ6W (a,c)	FPE5	FPW4	FPW4D (d)	FPM1 (a)	KNL (+)	KAL (+)	MCL (++)
Benzene	**0.5**	<0.4	<0.8	<0.4	<10	<40	<1.2	<2.0	<0.4	<0.4	<0.4	<10	0.5	5	5
1,2-Dichloroethylene (Total)	<0.5	<0.5	<1.0	<0.5	**95**	**2,100**	<1.5	<2.5	<0.5	<0.5	<0.5	**280**	7 (e)	70 (e)	70 (e)
Ethylbenzene	**1.1**	**0.7**	<1.4	<0.7	<18	**170**	<2.1	<3.5	<0.7	**0.7**	**1.0**	<18	68	680	700
Tetrachloroethylene	**32**	**3.7**	<2.2	**1.7**	**250**	<110	<3.3	<5.5	<1.1	<1.1	<1.1	**40**	0.7	7	5
Toluene	**1.2**	**0.6**	**1.0**	**0.6**	<10	**2,600**	**6.0**	<2.0	**1.1**	**0.6**	**1.0**	<10	200	2,000	1,000
m- &/or p- Xylene	<0.6	<0.6	<1.2	<0.6	<15	**380**	<1.8	<3.0	<0.6	<0.6	<0.6	<15	44 (f)	440 (f)	10,000 (f)
o-Xylene	<0.6	<0.6	<1.2	<0.6	<15	**400**	<1.8	<3.0	<0.6	<0.6	<0.6	<15	44	440	10,000

Bold values represent detected compounds.
Shaded areas represent concentrations that are equal to or exceed the MCL and/or the KAL.

(a) Samples with PQL raised due to limited sample volume.
(b) Original sample container broken in lab custody; analyses conducted on remainder of sample.
(c) Resample of FPJ6.
(d) Duplicate of FPW4.
(e) Although a KAL, KNL and MCL for 1,2-DCE (mixed) is not available, concentrations reported as 1,2-DCE (mixed) will be compared to the more conservative KAL, KNL and MCL for 1,2-DCE isomers.
(f) Although no standards or guidelines are available for m- &/or p-Xylenes, concentrations reported as m- &/or p-Xylenes will be compared to the standards and guidelines for Xylenes (mixed).
\+ Kansas Department of Health and the Environment, Bureau of Environmental Remediation, Groundwater Contamination Cleanup Target Concentrations, November 1988.
++ U.S. EPA, Office of Water, Drinking Water Regulations and Health Advisories, May 1995.
< Below Practical Quanititation Limit

For complete list of analytes determined, see QCSR Site Investigations of High Priority Sites, 17 December 1993.

Table 5-3. Summary of Chemical Detections for ESI Soil Gas Data - Off-Post Phase I, June 1994

(All units in ug/l)

Sample Identification	Chlorinated Solvents			Petroleum
	c-1,2-Dichloroethylene	Tetrachloroethylene	Trichloroethylene	Total VOCs
ESISG4-18	<1.0	<1.0	<1.0	**80**
ESISG4-35	<1.0	**6.4**	<1.0	<10
ESISG12-35	<1.0	**91**	**1.2**	<10
ESISG4-36	<1.0	**1.4**	<1.0	<10
ESISG12-36	**25**	**4.9**	<1.0	<10
ESISG4-38	<1.0	**14**	<1.0	<10
ESISG4-38D	<1.0	**14**	<1.0	<10
ESISG12-38	<1.0	**1.5**	<1.0	<10
ESISG4-39	<1.0	**2.5**	<1.0	<10
ESISG8-39	<1.0	**2.0**	<1.0	<10
ESISG4-70	<1.0	**2.9**	<1.0	<10
ESISG4-76	**1.6**	<1.0	<1.0	<10
ESISG12-77	**12**	**16**	**2.7**	<10
ESISG12-99	**23**	**13**	**1.1**	<10
ESISG12-99D	**23**	**13**	**1.1**	<10
ESISG12-131	**1.3**	<1.0	<1.0	<10
ESISG4-142	<1.0	**1.9**	<1.0	<10
ESISG4-152	<1.0	<1.0	<1.0	**33**
ESISG16-152	<1.0	<1.0	<1.0	**21**
ESISG4-152D	<1.0	<1.0	<1.0	**27**
ESISG4-157	**2.3**	**5.8**	**2.8**	<10
ESISG12-171	**2.4**	<1.0	<1.0	<10
ESISG12-173	<1.0	**4.9**	<1.0	<10

Bold values represent detected compounds.

Shaded areas represent locations where concentrations exceed threshold levels (10 ug/l for specific compounds or the sum of specific compounds, and 20 ug/l for total FID readings).

The sample identification contains the following information:

ESI Expanded Site Investigation
SG Soil Gas Media
\# the first number identifies the depth of the sample in feet (i.e., 4, 10, 12)
\# the second number identifies the sample location
All identifications with a "D" is a duplicate sample (from the corresponding identification).

< Below Practical Quantitation Limit

Table 5-4. Summary of Chemical Detections for ESI Groundwater Screening Data - Off-Post Phase I, Field Analysis, June & September 1994

(All units in ug/l)

Sample	Volatile Organic Compounds - Chlorinated Compounds							Volatile Organic Compounds - Petroleum				
Identification	1,1-Dichloroethylene	c-1,2-Dichloroethylene	t-1,2-Dichloroethylene	1,2-Dichloroethane	Tetrachloroethylene	1,1,1-Trichloroethane	Trichloroethylene	Benzene	Toluene	Xylenes	BTEX	Total VOCs
ESIGW-8	<1.0	<1.0	<1.0	<1.0	**1.1**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-18	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-22	<1.0	**2.6**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-25R	**2.0**	<1.0	<1.0	**215**	**280**	<1.0	**249**	<1.0	**10**	<1.0	**10**	**238**
ESIGW-26	<1.0	**1.4**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW8-33D	<1.0	**3.7**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-35	<1.0	**8.2**	**3.0**	<1.0	**6.3**	<1.0	**17**	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-36	<1.0	**214**	**2.6**	<1.0	<1.0	<1.0	<1.0	<1.0	**1.8**	<1.0	<1.0	**63**
ESIGW-36D	<1.0	**213**	**2.1**	<1.0	<1.0	<1.0	<1.0	<1.0	**1.5**	<1.0	<1.0	**49**
ESIGW-39	<1.0	**4.5**	**1.0**	<1.0	**1.1**	<1.0	**3.5**	<1.0	<1.0	<1.0	<1.0	**18**
ESIGW-57	<1.0	**2.0**	<1.0	<1.0	<1.0	**20**	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-61	<1.0	**1.5**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-70	<1.0	**322**	**1.3**	<1.0	**70**	<1.0	**120**	<1.0	**2.2**	<1.0	**2.2**	**147**
ESIGW-70D	<1.0	**291**	**1.6**	<1.0	**36**	<1.0	**76**	<1.0	<1.0	<1.0	<1.0	**110**
ESIGW-70R2 (b)	**2.8**	<1.0	<1.0	**212**	**156**	<1.0	**114**	**1**	**12**	<1.0	**13**	**285**
ESIGW-79	<1.0	<1.0	**1.5**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-91	<1.0	**1.6**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-91E	<1.0	<1.0	<1.0	<1.0	<1.0	**1.7**	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-92	<1.0	**1.6**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-92E	<1.0	<1.0	<1.0	<1.0	<1.0	**5.0**	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-98	**1.0**	**2.1**	<1.0	<1.0	**62**	<1.0	**12**	<1.0	<1.0	<1.0	<1.0	**16**
ESIGW-99	**1.8**	**254**	**2.9**	<1.0	**86**	<1.0	**85**	<1.0	**1.2**	<1.0	**1.2**	**148**
ESIGW-101A	<1.0	**1.4**	<1.0	<1.0	<1.0	<1.0	**1.4**	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-113	<1.0	**2.6**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**2.6**	**2.6**	<10
ESIGW-115	<1.0	<1.0	**1.2**	<1.0	<1.0	**15**	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-129	<1.0	<1.0	<1.0	<1.0	**1.1**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-132	<1.0	**9.5**	<1.0	<1.0	**1.1**	<1.0	**1.5**	<1.0	<1.0	<1.0	<1.0	<10
ESIGW8-133	<1.0	**2.3**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-159	<1.0	**118**	<1.0	<1.0	**1.7**	<1.0	**4.3**	**2.4**	<1.0	<1.0	**2.4**	**80**
ESIGW-159R	<1.0	<1.0	<1.0	**6.7**	<1.0	<1.0	**0.7**	<1.0	<1.0	<1.0	<1.0	**7**
ESIGW-167	<1.0	**1.6**	**1.0**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-170	<1.0	**6.3**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-172	<1.0	**1.7**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-174	<1.0	<1.0	<1.0	<1.0	**5.1**	<1.0	**1.7**	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-187	<1.0	<1.0	**1.8**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-189	<1.0	<1.0	**2.4**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-192	<1.0	<1.0	**2.2**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-210	<1.0	**1.7**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-214	<1.0	**3.9**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-216	<1.0	**30**	<1.0	<1.0	**65**	<1.0	**11**	<1.0	<1.0	<1.0	<1.0	**29**
ESIGW-217	<1.0	**1.2**	<1.0	<1.0	**26**	<1.0	**4.3**	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-217D	<1.0	<1.0	<1.0	<1.0	**11**	<1.0	**3.5**	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-217R	<1.0	<1.0	<1.0	**13**	**66**	<1.0	**14**	<1.0	<1.0	<1.0	<1.0	**35**
ESIGW-223	<1.0	**1.1**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-229	<1.0	**16**	<1.0	<1.0	**75**	<1.0	**6.9**	<1.0	<1.0	<1.0	<1.0	**25**
ESIGW-231	<1.0	**9.2**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESI-M1	<1.0	<1.0	**1.4**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW-B1R	<1.0	<1.0	**10**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10
ESIGW1-98A (a)	<1.0	<1.0	<1.0	**18**	**53**	<1.0	**38**	<1.0	**19**	<1.0	**19**	**60**
ESIGW1-159A (a)	<1.0	<1.0	<1.0	**91**	**2.0**	<1.0	**7**	<1.0	<1.0	<1.0	<1.0	<10
ESIGW1-229A (a)	<1.0	<1.0	<1.0	**10**	**32**	<1.0	**13**	<1.0	<1.0	<1.0	<1.0	**35**

Bold values represent detected compounds

Shaded areas represent locations where concentrations exceed threshold levels (10 ug/l for specific compounds or the sum of specific compounds, and 20 ug/l for total FID readings).

Samples ending in "R" were recollected and field analyzed on a different date than the record sample, in accordance with Technical Memorandum #3.

All identifications with a "D" is a duplicate sample (from the corresponding identification).

OB Compound concentration observed below reporting limits.

< Below Practical Quantitation Limit.

(a) Location sampled again in accordance with Technical Memorandum #6.

(b) Location 70 was inadvertently re-collected and field analyzed on 16 November 1994.

Table 5-5. Summary of Chemical Detections for ESI Groundwater Screening Data - Off-Post Phase I, Laboratory Analysis, June & September 1994

Analyte	Sample Identification (all samples have prefix ESIGW-) (Results in ug/l)																					**Standards and Guidelines**		
	8	8R (a)	25	25R	70	70R (a)	99	115	159	159R (a)	214	217	217R (a)	223	F1	F2	F2R	F3 (b)	F3R (a,b)	B1	M1	KNL (+)	KAL (+)	MCL (++)
1,1-Dichloroethane	<5.0 R	<0.5	<0.5	<0.5	<50R	<50	<50	**0.7**	<25R	<5.0	<0.5	<5.0R	<2.5	<13R	<5.0R	<5.0R	<0.5	<5.0R	<0.5	<5.0R	<5.0R	0.5	5	NAv
1,2-Dichloroethylene	<5.0 R	<0.5	<0.5	<0.5	**640J**	**1,800**	**1,000**	<0.5	**830J**	**55**	**4.8R**	<5.0R	**44**	<13R	<5.0R	<5.0R	<0.5	<5.0R	<0.5	<5.0R	<5.0R	7 (c)	70 (c)	70 (c)
Tetrachloroethylene	<11 R	<1.1	<1.1	<1.1	<110R	**130**	<110	<1.1	<55R	<11	<1.1	**34 R**	**31**	<28R	<11R	<11R	<1.1	<11R	<1.1	<11R	<11R	0.7	7	5
Toluene	<4.0 R	**0.4**	<0.4	**0.6**	<40R	<40	<40	<0.4	<20R	<4.0	<0.4	<4.0R	<2.0	<10R	<4.0R	<4.0R	**0.6**	<4.0R	**0.5**	<4.0R	<4.0R	0.7	7	5
1,1,1-Trichloroethane	<7.0 R	<0.7	<0.7	<0.7	<70R	<70	<70	**21**	<35R	<7.0	**2 R**	<7.0R	<3.5	<18R	<7.0R	<7.0R	<0.7	<7.0R	<0.7	<7.0R	<7.0R	20	200	200
Trichloroethylene	**86R**	<0.6	**4.4R**	**4.4**	**140R**	**330**	**240**	<0.6	**170R**	<6.0	<0.6	**180R**	**14**	**58R**	**97R**	**23R**	<0.6	**71R**	<0.6	**32R**	**39R**	0.5	5	5

Bold values represent detected compounds

Shaded compound values represent concentrations that are equal to or exceed the MCL and/or the KAL.

R Data rejected by QA data validator.
J Sample quantitative value estimated.

\+ Kansas Department of Health and the Environment, Bureau of Environmental Remediation, Groundwater Contamination Cleanup Target Concentrations, November 1988.
++ U.S. EPA, Office of Water, Drinking Water Regulations and Health Advisories, May 1995.

(a) Resampled.
(b) ESI-F3 is a duplicate of ESI-F2.
(c) Although a KAL, KNL and MCL for 1,2-DCE (mixed) is not available, concentrations reported as 1,2-DCE (mixed) will be compared to the more conservative KAL, KNL and MCL for 1,2- DCE isomers.

NAv Not Available
< Below Practical Quantitation Limit

For complete list of analytes determined, see QCSR Periodic Groundwater Monitoring Samples, 11 November 1994.

Table 5-6. Summary of Chemical Detections for ESI Groundwater Screening Field Analysis - Off-Post Phase II, August 1994, September 1994, January 1995

(All units in ug/l)

		Chlorinated Compounds								Petroleum				
Location	Sample (b) Identification	1,1-Dichloroethane	1,2-Dichloroethane	c-1,2-Dichloroethylene	t-1,2-Dichloroethylene	Tetrachloroethylene	Trichloroethylene	Carbon Tetrachloride	Trichloromethane	Benzene	Ethylbenzene	Toluene	BTEX	Total VOCs
Initial Line North 1	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**7**	**7**	ND
	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**3**	**3**	ND
	32	ND	ND	ND	ND	**1**	**1**	ND	ND	ND	ND	ND	ND	ND
Line North 2	34	ND	ND	ND	**470**	ND	ND	ND	ND	ND	ND	ND	ND	ND
	39	ND	ND	ND	**2**	ND	ND	ND	ND	ND	ND	ND	ND	ND
	40	ND	ND	ND	ND	ND	ND	ND	ND	ND	**5**	ND	**5**	ND
	44	ND	**18**	ND	ND	ND	**1**	ND	ND	ND	ND	ND	ND	ND
	45	ND	**47**	ND	ND	**6**	**5**	ND	ND	ND	ND	ND	ND	ND
	46	ND	**29**	ND	ND	**23**	**11**	ND	ND	ND	ND	ND	ND	ND
	47	ND	**3**	ND	ND	**1**	<1.0	ND	ND	ND	ND	ND	ND	ND
	47D	ND	**8**	ND	ND	**2**	**1**	ND	ND	ND	ND	ND	ND	ND
Line North 3	61	ND	**41**	ND	**13**	**2**	**4**	ND	ND	ND	ND	ND	ND	ND
	62	ND	**9**	ND	ND	**1**	**1**	ND	ND	ND	ND	ND	ND	ND
	63	ND	**4**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	64	ND	**2**	ND	ND	**6**	**2**	ND	ND	ND	ND	ND	ND	ND
	65	ND	ND	ND	ND	**0.2**	ND	ND	ND	ND	ND	ND	ND	ND
	70R (c)	ND	ND	ND	ND	**1**	**1**	ND	ND	ND	ND	ND	ND	ND
Area 2	75	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**13**	**13**	**28**
North of Area 1	91	ND	ND	ND	**7.8**	ND	ND	ND	ND	ND	ND	ND	ND	ND
	94	ND	**6**	ND	ND	ND	**4**	ND	ND	ND	ND	**1.5**	**1.5**	**3**
	95	ND	**5**	ND	ND	ND	**1**	ND	ND	**7**	ND	**6**	**13**	**15**
	96	ND	**4**	ND	ND	ND	ND	ND	ND	ND	ND	**2**	**2**	**5**
	97	ND	**1**	ND	ND	ND	ND	ND	ND	ND	ND	**7**	ND	**8**
	98	ND	ND	ND	ND	ND	**2**	ND	ND	ND	ND	ND	ND	ND
	100	ND	ND	ND	**15**	ND	ND	ND	ND	ND	ND	ND	ND	ND
Northeast of Line North 1	101	ND	ND	ND	ND	**9**	**6**	ND	ND	ND	ND	ND	ND	ND
	105	ND	ND	ND	**4**	ND	ND	ND	ND	ND	ND	ND	ND	ND
North of Line North 1	127	**5**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	128	ND	ND	ND	ND	ND	ND	ND	**2**	ND	ND	ND	ND	ND
	153	ND	ND	**9**	ND	ND	ND	**OB**	**OB**	ND	ND	ND	ND	ND
Location (a) Sampled Again	34	**3**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	46	ND	**2**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Bold values represent detected compounds

Shaded areas represent locations where concentrations exceed threshold levels (10 ug/l for specific compounds or the sum of specific compounds, and 20 ug/l for total FID readings).

The identification with a "D" is a duplicate sample (from the corresponding identification).

ND Not Detected

OB Compound concentration observed below reporting limits.

< Below Practical Quantitation Limit

(a) In accordance with Technical Memorandum #6.

(b) All samples have prefix ESIGW2-.

(c) Sample inadvertently recollected and field analyzed while recollecting the samples in accordance with Technical Memorandum #6.

Table 5-7. Summary of Chemical Detections for ESI Groundwater Screening Laboratory Analysis - Off-Post Phase II, August 1994, September 1994, January 1995

(Results are reported in ug/l)

Analyte	Sample Identification (all samples have prefix ESIGW2-)																	Standards and Guidelines		
	4	34	35	46 (a)	61	65	65X (b)	74	91	99	101	108	125	127	129	500 (c)	153	KNL (+)	KAL (+)	MCL (++)
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<13	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**12**	0.5	100	100/80^
Carbon Disulfide	**19**	<5.0	**8.9**	<5.0	<130	<5.0	<5.0	<5.0	<5.0	<5.0	**9.8**	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	NAv	NAv	NAv
Dibromochloromethane	<0.7	<0.7	<0.7	<0.7	<18	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	**17**	0.7	100	100/80^
1,2-Dichloroethylene	<0.5	<0.5	<0.5	**120**	**330**	<0.5	<0.5	<0.5	**4.1**	**0.8**	**4.0**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	7 (d)	70 (d)	70 (d)
Dichloromethane	<0.9	<0.9	<0.9	<0.9	<23	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	**1.0B**	<0.9	**1.3B**	**1.1B**	<0.9	**2.8B**	5	50	5
m- &/or p-Xylenes	**0.8**	<0.6	<0.6	<0.6	<15	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	44 (e)	440 (e)	10,000 (e)
Tetrachloroethylene	<1.1	<1.1	<1.1	**15**	<28	<1.1	<1.1	<1.1	<1.1	**2.4**	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	0.7	7	5
Toluene	**1.2**	**0.9**	**0.5**	**0.7**	<10	**0.5**	**0.6**	**1.1**	**1.2**	**0.4**	<0.4	**4.9**	**2.9**	**3.9**	**3.1**	**3.4**	<0.4	200	2,000	1,000
Tribromomethane	<1.5	<1.5	<1.5	<1.5	<38	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	**11**	1.5	100	100/80^
Trichloroethylene	<0.6	<0.6	<0.6	**10**	<15	<0.6	<0.6	<0.6	<0.6	**1.6**	**0.9**	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	0.5	5	5
Trichloromethane	<0.5	<0.5	<0.5	<0.5	<13	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**10**	0.5	100	100/80^

Shaded values represent concentrations that are equal to and/or exceed the MCL or KAL.

Bold values represent detected compounds.

B Analyte detected in the associated method blank; result has not been blank corrected.

^ 100/80 Total Halogenated Methanes cannot exceed 80 level

\+ Kansas Department of Health and the Environment, Bureau of Environmental Remediation, Groundwater Contamination Cleanup Target Concentrations, November 1988.

++ U.S. EPA, Office of Water, Drinking Water Regulations and Health Advisories, May 1995.

(a) Results for 1,2-Dichloroethylene are reported from analysis of diluted sample; all other analytes are reported from analysis of the undiluted sample

(b) ESIGW2-65X is a duplicate of ESIGW2-65.

(c) ESIGW2-500 is a duplicate of ESIGW2-129.

(d) Although a KAL, KNL and MCL for 1,2-DCE (mixed) is not available, concentrations reported as 1,2-DCE (mixed) will be compared to the more conservative KAL, KNL and MCL for 1,2- DCE isomers.

(e) Although no standards or guidelines are available for m- &/or p-Xylenes, concentrations reported as m- &/or p-Xylenes will be compared to the standards and guidelines for Xylenes (mixed).

NAv Not Available

< Below Practical Quantitation Limit.

For complete list of analytes determined, see QCSR Periodic Groundwater Monitoring Samples, 11 November 1994; QCSR Periodic Groundwater Sampling, March 1995.

Table 5-8. Summary of Chemical Detections for Field (Sample Headspace) vs. Laboratory Analytical Results, SCAPS Groundwater Screening Samples, November and December 1994

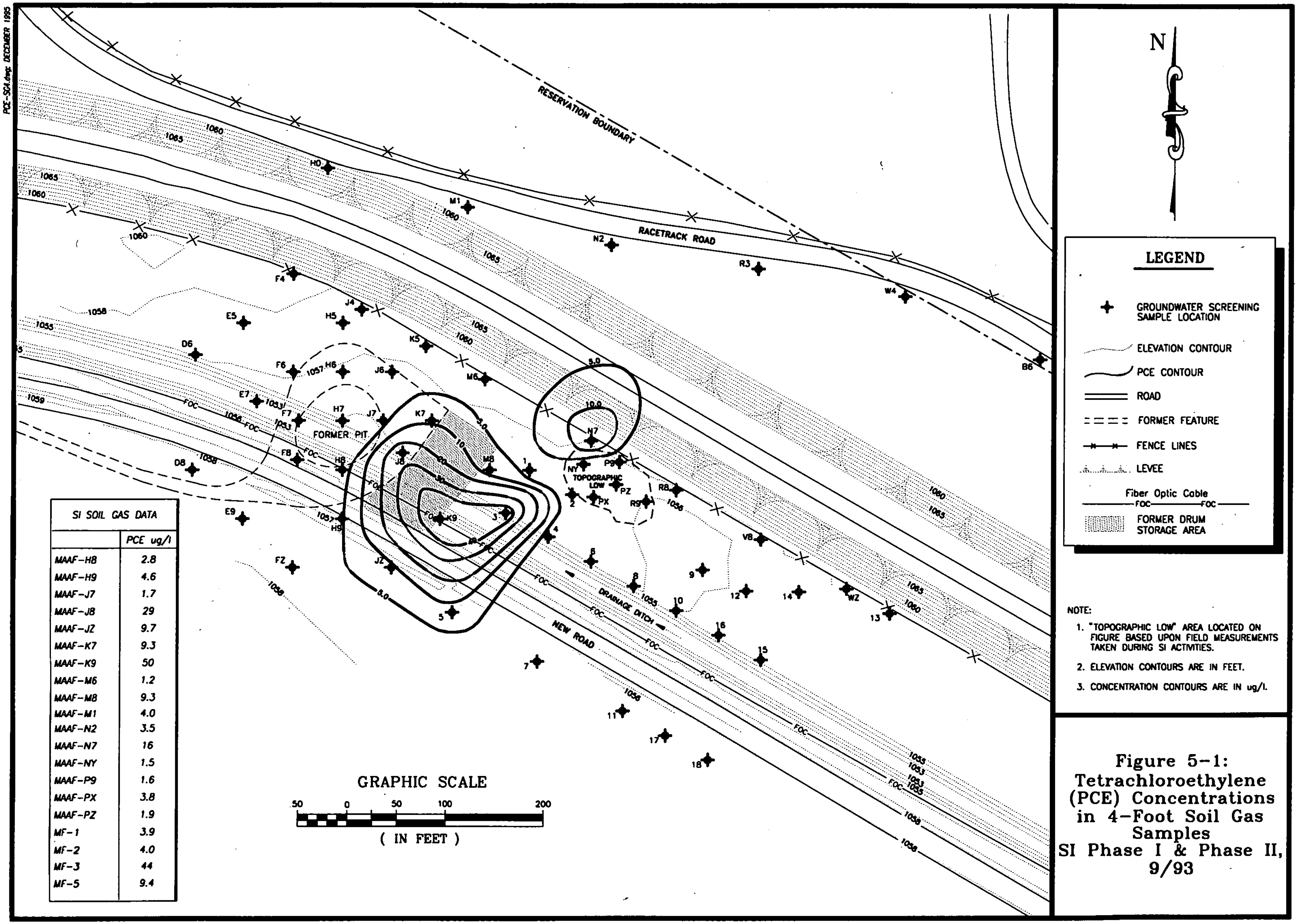
Analyte	Sample Identification (results in µg/l)																						Regulatory Guidelines		
	CP9 (a)		CP1-GW1 (b)		CP2-GW1 (b)		CP3-GW1		CP4-GW1		CP4-GW2		CP5-GW1		CP6-GW1		CP7-GW1		CP8-GW1		CP8-GW2 (c)				
	Field	Lab	Field	Lab	Field	Lab	Field	Lab	Field	Lab	Field	Lab	Field	Lab	Field	Lab	Field	Lab	Field	Lab	Field	Lab	KNL (+)	KAL (+)	MCL (++)
1,1-Dichloroethane	<2.51	<0.5	<2.51	<0.5	<2.51	<0.5	<2.51	<0.5	<2.51	<0.5	<2.51	<0.5	<2.51	<0.5	<2.51	<0.5	**5.26**	<0.5	<2.51	<0.5	<2.51	<0.5	0.5	5	NAv
1,2-Dichloroethane	<11.1	<0.6	<11.1	<0.6	<11.1	<0.6	<11.1	<0.6	<11.1	<0.6	<11.1	<0.6	<11.1	<0.6	<11.1	<0.6	**14.0**	<0.6	<11.1	<0.6	<11.1	<0.6	0.5	5	5
1,2-Dichloroethylene (d)	<2.05	<0.5	<2.05	<0.5	<2.05	**1.1**	<2.05	<0.5	<2.05	<0.5	<2.05	<0.5	<2.05	<0.5	<2.05	<0.5	<2.05	<0.5	<2.05	<0.5	<2.05	<0.5	7 (e)	70 (e)	70 (e)
Dichloromethane	<12.0	**0.9B**	<12.0	<0.9	<12.0	<0.9	<12.0	<0.9	<12.0	<0.9	<12.0	<0.9	<12.0	<0.9	<12.0	<0.9	<12.0	<0.9	<12.0	<0.9	<12.0	<0.9	5	50	5
Ethylbenzene	<0.51	<0.7	<0.51	<0.7	**0.57**	<0.7	<0.51	<0.7	<0.51	<0.7	<0.51	<0.7	<0.51	**0.7**	**0.68**	<0.7	<0.51	**0.9**	<0.51	<0.7	<0.51	<0.7	68	680	700
Toluene	**0.8**	**0.9J**	<0.62	**1.3**	<0.62	**0.5**	<0.62	**0.5**	<0.62	**0.5**	<0.62	**0.6**	<0.62	**1.1**	**0.78**	**0.8**	<0.62	**1.7**	<0.62	**0.6**	<0.62	**0.5**	200	2,000	1,000
Trichloroethylene	<2.11	**2.7J**	<2.11	<0.6	<2.11	<0.6	<2.11	<0.6	**2.93**	**2.8**	<2.11	<0.6	<2.11	**1.2**	<2.11	**1.0**	<2.11	<0.6	<2.11	<0.6	<2.11	<0.6	0.5	5	5
Trichloromethane	<10.3	<0.5	**27.8**	<0.5	<10.3	<0.5	<10.3	<0.5	<10.3	<0.5	<10.3	<0.5	**11.2**	<0.5	**11.6**	<0.5	**17.9**	<0.5	<10.3	<0.5	<10.3	<0.5	0.5	100	100/80^
m- &/or p-Xylenes	NA	<0.6	NA	<0.6	NA	<0.6	NA	<0.6	NA	<0.6	NA	<0.6	NA	**0.6**	NA	<0.6	NA	<0.6	NA	<0.6	NA	<0.6	44	440	10,000
Total Xylenes	**0.92**	NA	<0.53	NA	**0.66**	NA	<0.53	NA	<0.53	NA	<0.53	NA	<0.53	NA	**0.76**	NA	**0.57**	NA	<0.53	NA	<0.53	NA	44	440	10,000

Bold values represent detected compounds.

- B Analyte detected in the associated method blank; result has not been blank corrected.
- J Sample quantitative value estimated.
- \+ Kansas Department of Health and the Environment, Bureau of Environmental Remediation, Groundwater Contamination Cleanup Target Concentrations, November 1988.
- ++ U.S. EPA, Office of Water, Drinking Water Regulations and Health Advisories, May 1995.
- ^ 100/80 Total Halogenated Methanes cannot exceed 80 level
- (a) Sample Identification for the field analyses is SCAPS-GW-1-1 and for the laboratory analyses is SCAPS-GW-1-99. All other samples have the prefix MAAF.
- (b) Quantitation of the field analysis questionable due to insufficient sample volume.
- (c) CP8-GW2 is a duplicate of CP8-GW1.
- (d) The field analysis reports both c- and t- 1,2-dichloroethylene with a quantitation limits of 3.64 µg/l and 2.05 µg/l, respectively. Because there were no detections of either c- or t- 1,2-dichloroethylene in the field analysis, for the purposes of this table, the detection limit is reported as the smaller of the values, or 2.05 µg/l.
- (e) Although a KAL, KNL and MCL for 1,2-DCE (mixed) is not available, concentrations reported as 1,2-DCE (mixed) will be compared to the more conservative KAL, KNL and MCL for 1,2-DCE isomers.
- NAv Not available
- NA Not analyzed (for isomer specific, this table only)
- < Below Practical Quantitation Limit.

For complete list of analytes determined, see QCSR SCAPS Investigation - Deep Alluvial Well Site, January 1995.

PCE-SG4.dwg; DECEMBER 1995



SI SOIL GAS DATA	
	PCE ug/l
MAAF-H8	2.8
MAAF-H9	4.6
MAAF-J7	1.7
MAAF-J8	29
MAAF-JZ	9.7
MAAF-K7	9.3
MAAF-K9	50
MAAF-M6	1.2
MAAF-M8	9.3
MAAF-M1	4.0
MAAF-N2	3.5
MAAF-N7	16
MAAF-NY	1.5
MAAF-P9	1.6
MAAF-PX	3.8
MAAF-PZ	1.9
MF-1	3.9
MF-2	4.0
MF-3	44
MF-5	9.4

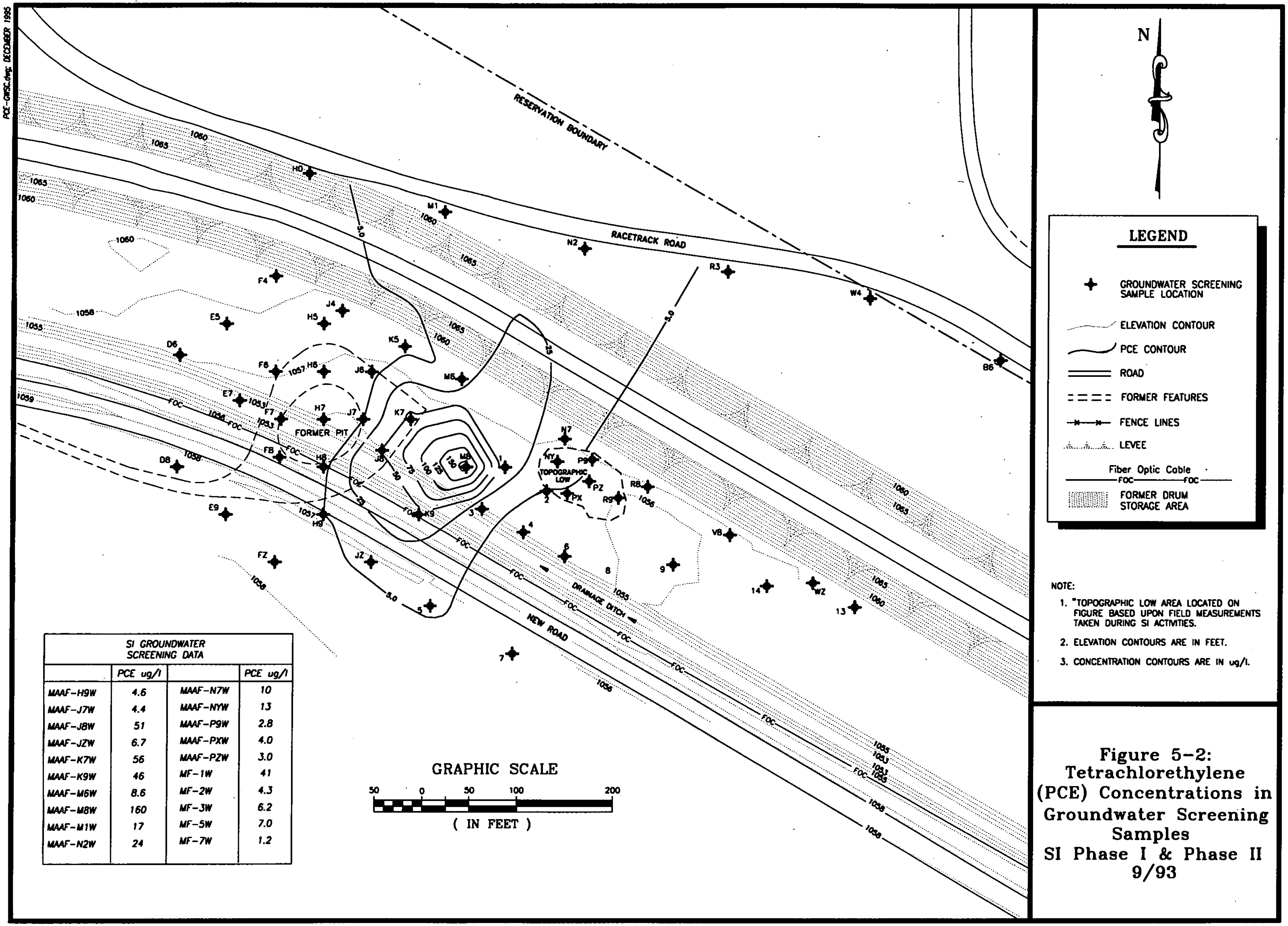
LEGEND

- ✦ GROUNDWATER SCREENING SAMPLE LOCATION
- ELEVATION CONTOUR
- PCE CONTOUR
- ROAD
- FORMER FEATURE
- FENCE LINES
- LEVEE
- Fiber Optic Cable —FOC——FOC—
- ▨ FORMER DRUM STORAGE AREA

NOTE:

1. "TOPOGRAPHIC LOW" AREA LOCATED ON FIGURE BASED UPON FIELD MEASUREMENTS TAKEN DURING SI ACTIVITIES.
2. ELEVATION CONTOURS ARE IN FEET.
3. CONCENTRATION CONTOURS ARE IN ug/l.

Figure 5-1: Tetrachloroethylene (PCE) Concentrations in 4-Foot Soil Gas Samples SI Phase I & Phase II, 9/93



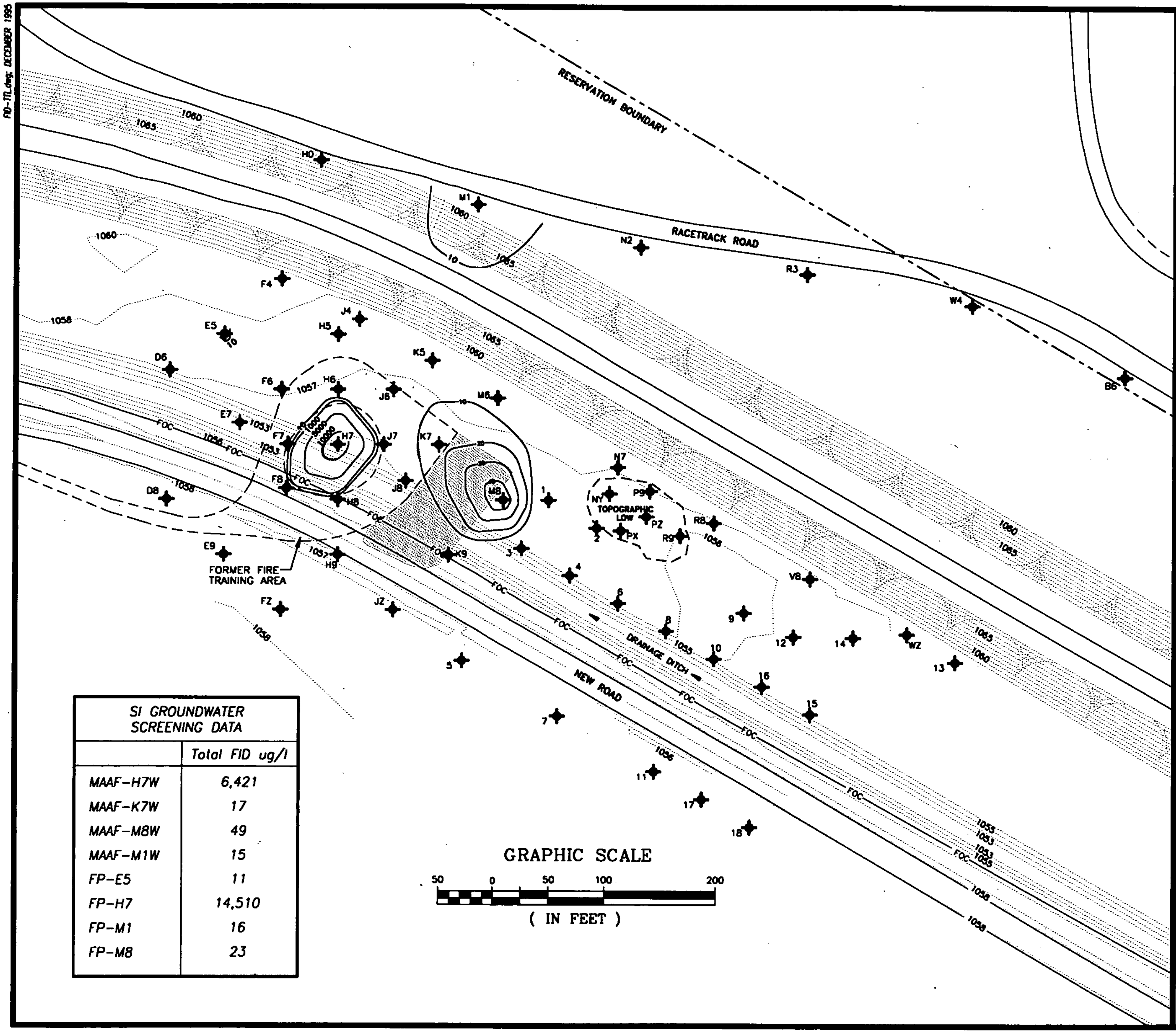
SI GROUNDWATER SCREENING DATA			
	PCE ug/l		PCE ug/l
MAAF-H9W	4.6	MAAF-N7W	10
MAAF-J7W	4.4	MAAF-NYW	13
MAAF-J8W	51	MAAF-P9W	2.8
MAAF-JZW	6.7	MAAF-PXW	4.0
MAAF-K7W	56	MAAF-PZW	3.0
MAAF-K9W	46	MF-1W	41
MAAF-M6W	8.6	MF-2W	4.3
MAAF-M8W	160	MF-3W	6.2
MAAF-M1W	17	MF-5W	7.0
MAAF-N2W	24	MF-7W	1.2

NOTE:

1. *TOPOGRAPHIC LOW AREA LOCATED ON FIGURE BASED UPON FIELD MEASUREMENTS TAKEN DURING SI ACTIVITIES.
2. ELEVATION CONTOURS ARE IN FEET.
3. CONCENTRATION CONTOURS ARE IN ug/l.

Figure 5-2: Tetrachlorethylene (PCE) Concentrations in Groundwater Screening Samples SI Phase I & Phase II 9/93

FID-TTL.dwg; DECEMBER 1995



SI GROUNDWATER SCREENING DATA	
	Total FID ug/l
MAAF-H7W	6,421
MAAF-K7W	17
MAAF-M8W	49
MAAF-M1W	15
FP-E5	11
FP-H7	14,510
FP-M1	16
FP-M8	23

N

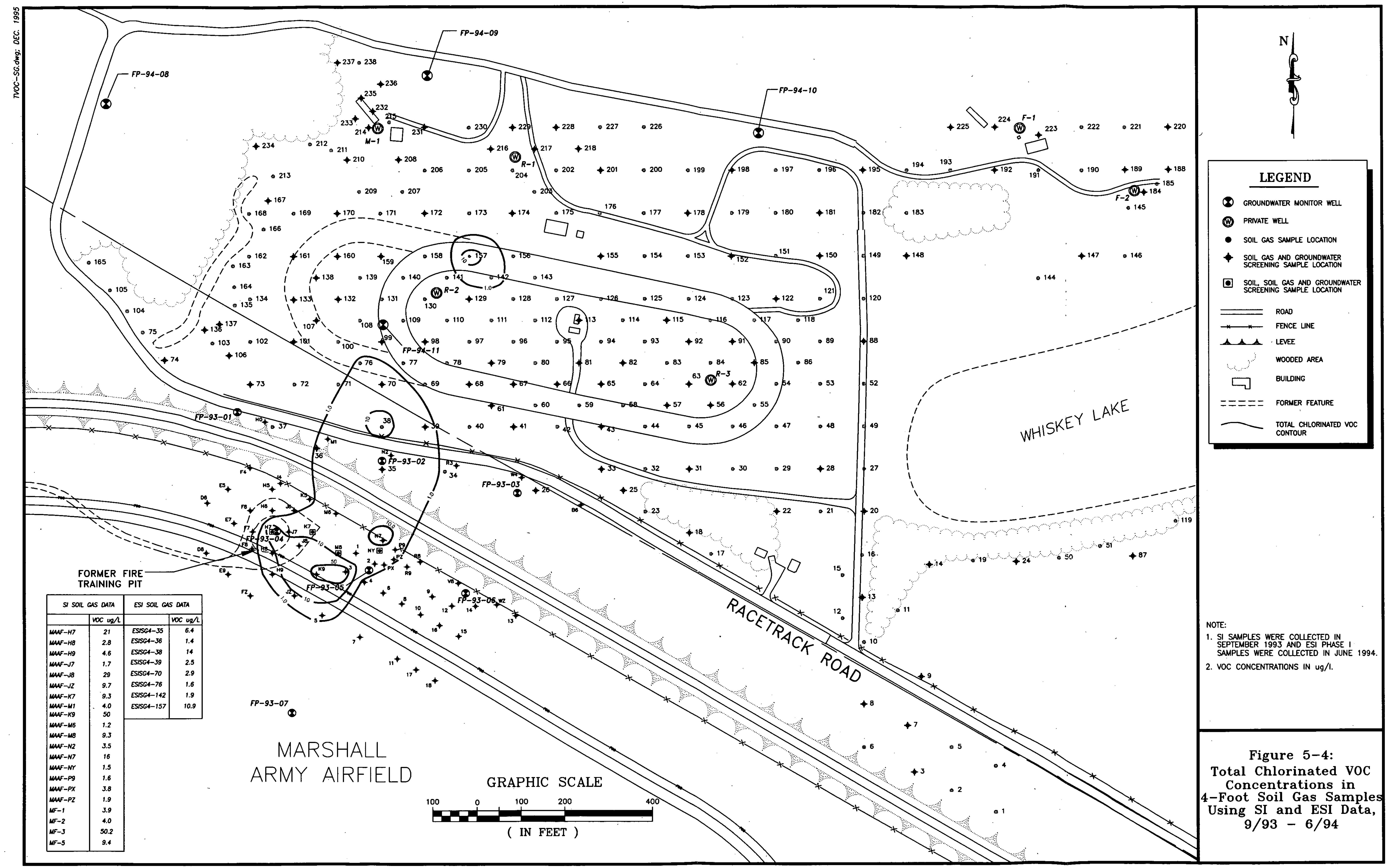
LEGEND

✚	GROUNDWATER SCREENING SAMPLE LOCATION
⋯	ELEVATION CONTOUR
—	TOTAL FID CONTOUR
═	ROAD
‒ ‒ ‒	FORMER FEATURE
—×—×—	FENCE LINES
⋯	LEVEE
—FOC—FOC—	Fiber Optic Cable
▨	FORMER DRUM STORAGE AREA

NOTE:

1. "TOPOGRAPHIC" LOW AREA IS LOCATED ON FIGURE BASED UPON FIELD MEASUREMENTS TAKEN DURING SI ACTIVITIES.
2. ELEVATION CONTOURS ARE IN FEET.
3. CONCENTRATION CONTOURS ARE IN ug/l.

Figure 5-3:
Total FID
Concentrations in
Groundwater Screening
Samples
SI Phase I & Phase II,
9/93



SI SOIL GAS DATA	VOC ug/L
MAAF-H7	21
MAAF-H8	2.8
MAAF-H9	4.6
MAAF-J7	1.7
MAAF-J8	29
MAAF-JZ	9.7
MAAF-K7	9.3
MAAF-M1	4.0
MAAF-K9	50
MAAF-M6	1.2
MAAF-M8	9.3
MAAF-N2	3.5
MAAF-N7	16
MAAF-NY	1.5
MAAF-P9	1.6
MAAF-PX	3.8
MAAF-PZ	1.9
MF-1	3.9
MF-2	4.0
MF-3	50.2
MF-5	9.4

ESI SOIL GAS DATA	VOC ug/L
ESISG4-35	6.4
ESISG4-36	1.4
ESISG4-38	14
ESISG4-39	2.5
ESISG4-70	2.9
ESISG4-76	1.6
ESISG4-142	1.9
ESISG4-157	10.9

NOTE:

1. SI SAMPLES WERE COLLECTED IN SEPTEMBER 1993 AND ESI PHASE I SAMPLES WERE COLLECTED IN JUNE 1994.
2. VOC CONCENTRATIONS IN ug/l.

Figure 5-4:
Total Chlorinated VOC Concentrations in 4-Foot Soil Gas Samples Using SI and ESI Data, 9/93 - 6/94

ESISMLOC.dwg; AUGUST 1995

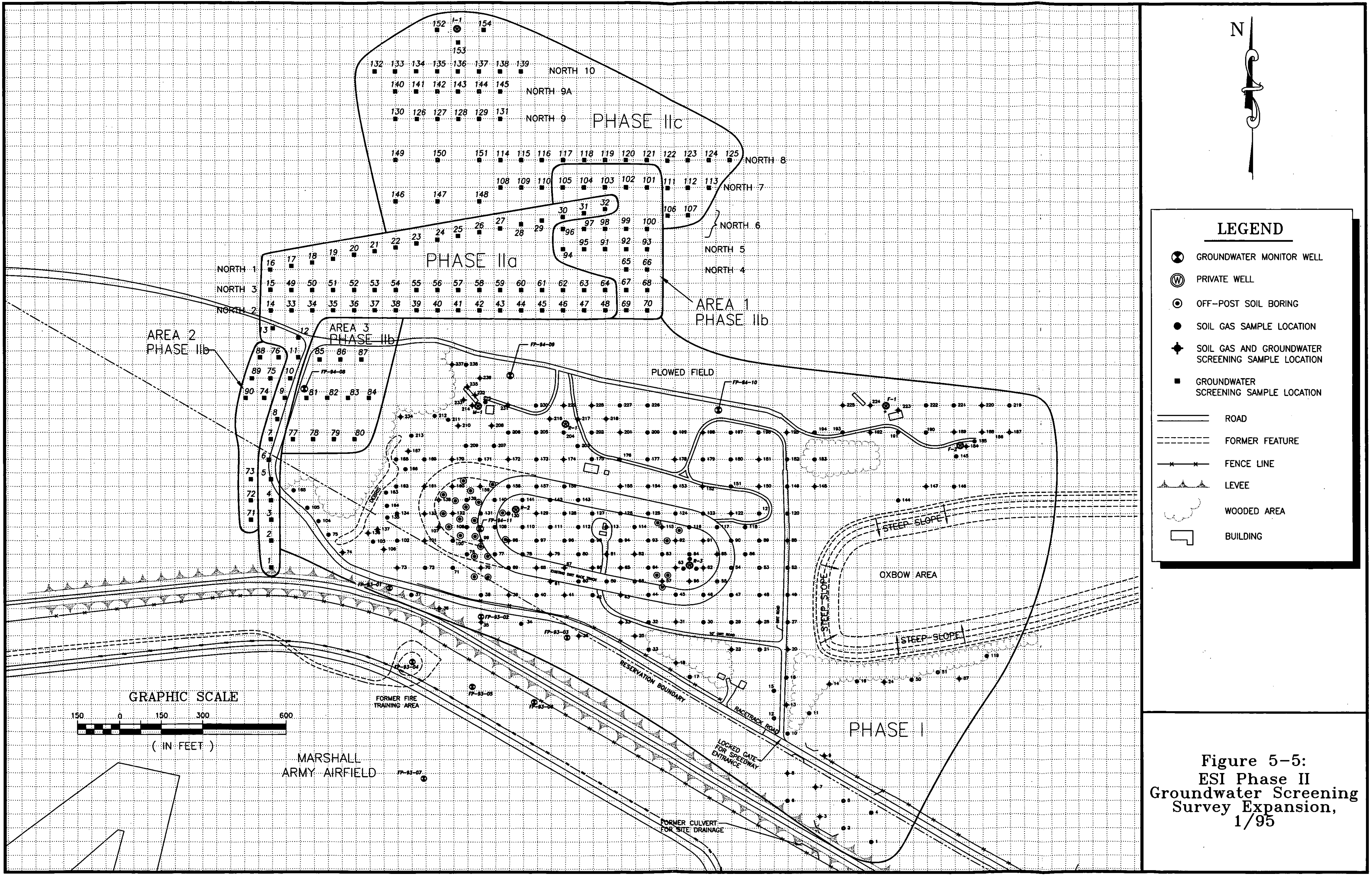


Figure 5-5:
ESI Phase II
Groundwater Screening
Survey Expansion,
1/95

ESI-OVER.dwg; AUGUST 1995

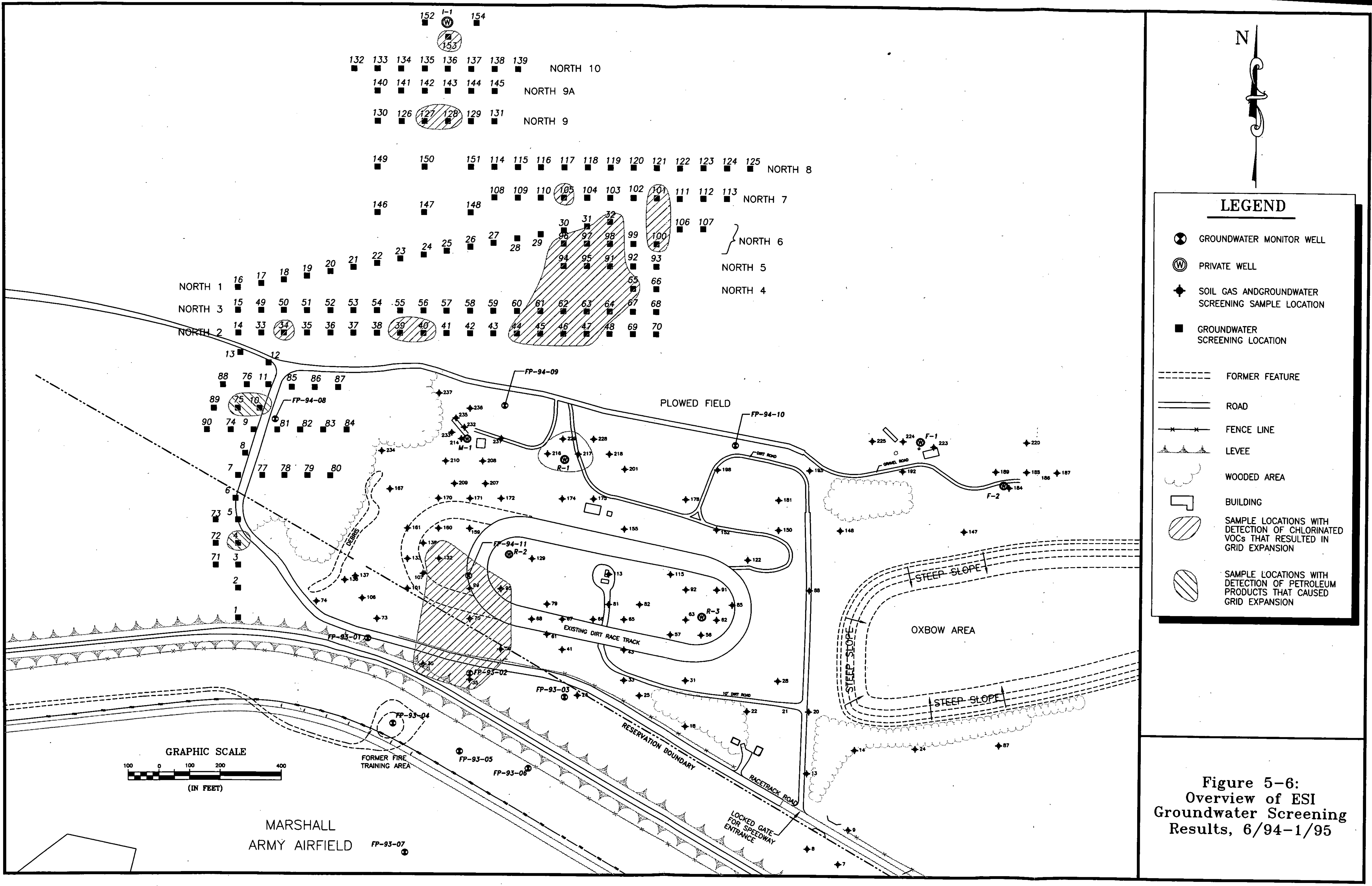
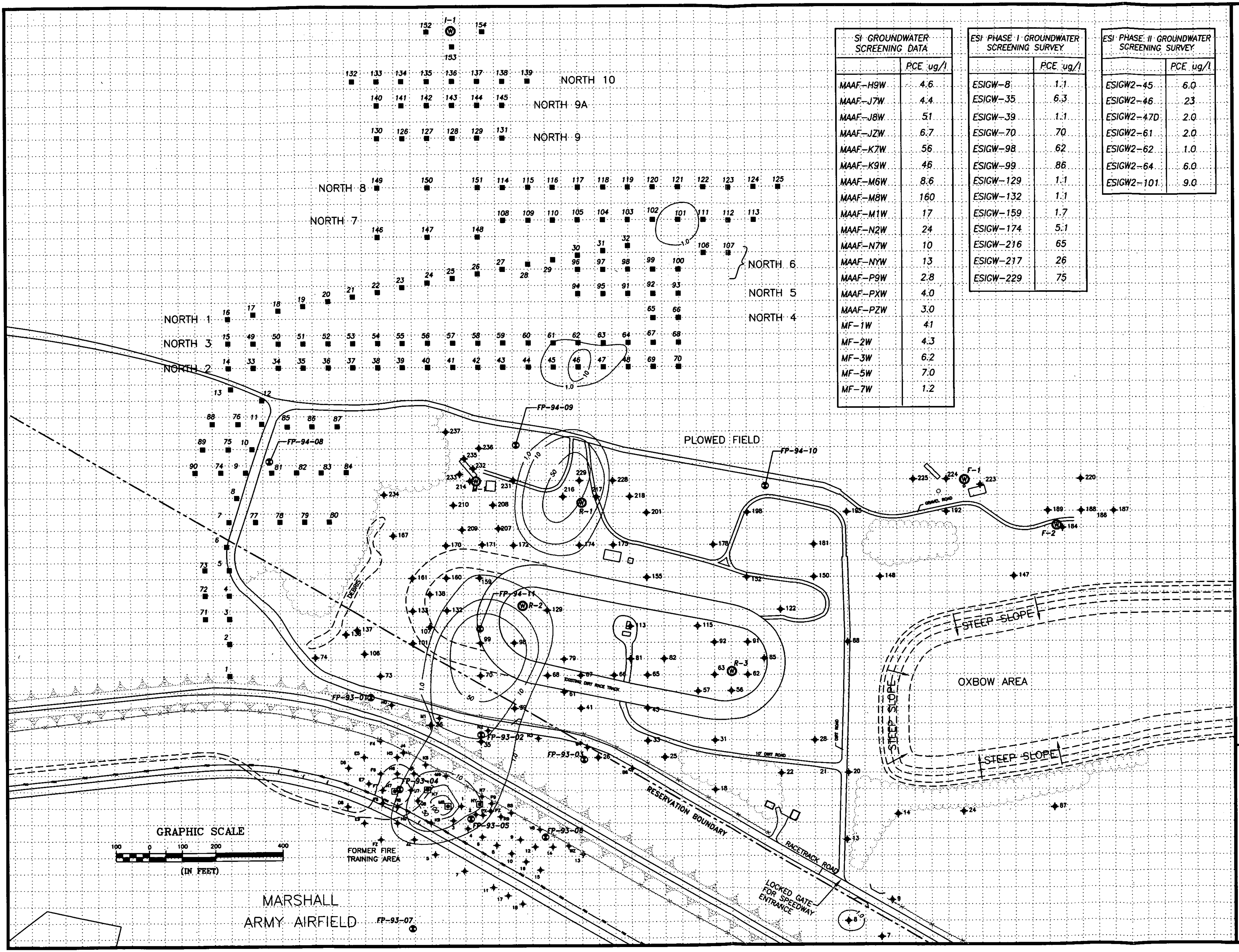


Figure 5–6: Overview of ESI Groundwater Screening Results, 6/94–1/95

PCE-GW.dwg



SI GROUNDWATER SCREENING DATA	PCE ug/l
MAAF-H9W	4.6
MAAF-J7W	4.4
MAAF-J8W	51
MAAF-JZW	6.7
MAAF-K7W	56
MAAF-K9W	46
MAAF-M6W	8.6
MAAF-M8W	160
MAAF-M1W	17
MAAF-N2W	24
MAAF-N7W	10
MAAF-NYW	13
MAAF-P9W	2.8
MAAF-PXW	4.0
MAAF-PZW	3.0
MF-1W	41
MF-2W	4.3
MF-3W	6.2
MF-5W	7.0
MF-7W	1.2

ESI PHASE I GROUNDWATER SCREENING SURVEY	PCE ug/l
ESIGW-8	1.1
ESIGW-35	6.3
ESIGW-39	1.1
ESIGW-70	70
ESIGW-98	62
ESIGW-99	86
ESIGW-129	1.1
ESIGW-132	1.1
ESIGW-159	1.7
ESIGW-174	5.1
ESIGW-216	65
ESIGW-217	26
ESIGW-229	75

ESI PHASE II GROUNDWATER SCREENING SURVEY	PCE ug/l
ESIGW2-45	6.0
ESIGW2-46	23
ESIGW2-47D	2.0
ESIGW2-61	2.0
ESIGW2-62	1.0
ESIGW2-64	6.0
ESIGW2-101	9.0

LEGEND

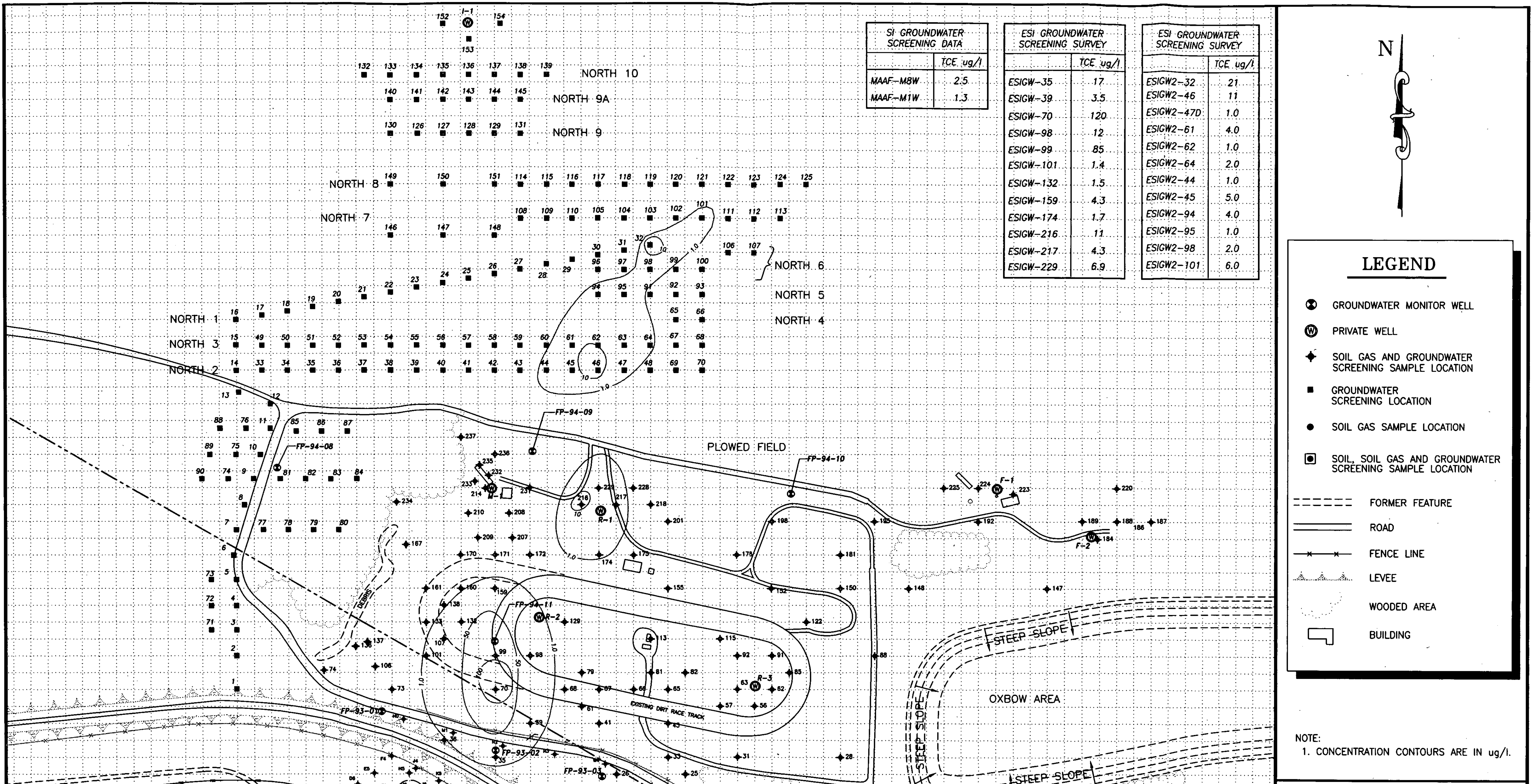
⊗	GROUNDWATER MONITOR WELL
Ⓦ	PRIVATE WELL
✦	SOIL GAS AND GROUNDWATER SCREENING SAMPLE LOCATION
■	GROUNDWATER SCREENING LOCATION
●	SOIL GAS SAMPLE LOCATION
▣	SOIL, SOIL GAS AND GROUNDWATER SCREENING SAMPLE LOCATION
═	ROAD
‐ ‐ ‐	FORMER FEATURE
—×—×—	FENCE LINE
▲	LEVEE
◌	WOODED AREA
▭	BUILDING
—	PCE CONTOUR

NOTE:

1. CONCENTRATION CONTOURS ARE IN ug/l.

Figure 5-7:
Tetrachloroethylene (PCE) Isoconcentration Contours Using Groundwater Screening SI-Phase I & Phase II & ESI-Phase I & Phase II Results, 9/93-1/95

TCE-GW.dwg AUGUST 1995



SI GROUNDWATER SCREENING DATA	
	TCE ug/l
MAAF-M8W	2.5
MAAF-M1W	1.3

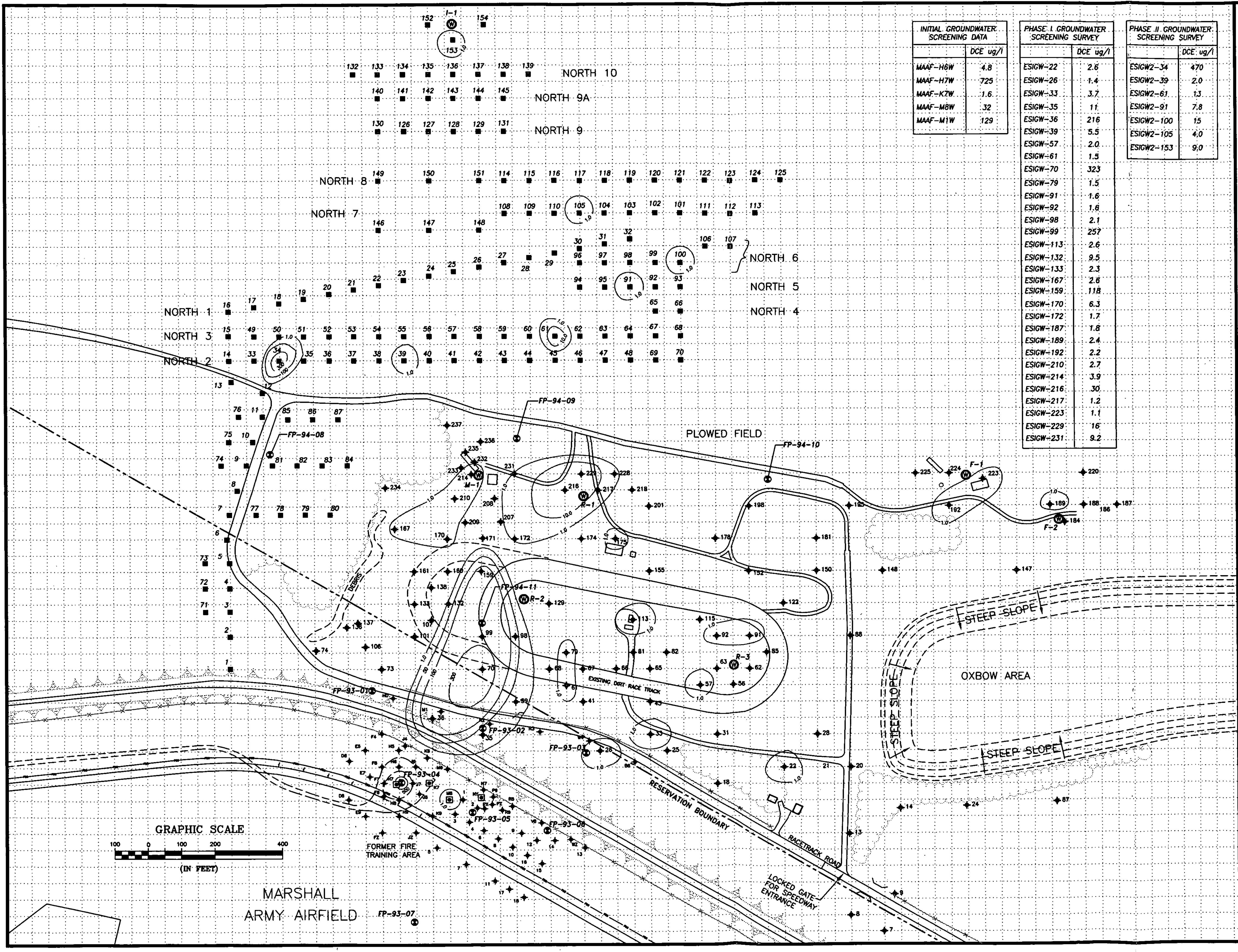
ESI GROUNDWATER SCREENING SURVEY	
	TCE ug/l
ESIGW-35	17
ESIGW-39	3.5
ESIGW-70	120
ESIGW-98	12
ESIGW-99	85
ESIGW-101	1.4
ESIGW-132	1.5
ESIGW-159	4.3
ESIGW-174	1.7
ESIGW-216	11
ESIGW-217	4.3
ESIGW-229	6.9

ESI GROUNDWATER SCREENING SURVEY	
	TCE ug/l
ESIGW2-32	21
ESIGW2-46	11
ESIGW2-47D	1.0
ESIGW2-61	4.0
ESIGW2-62	1.0
ESIGW2-64	2.0
ESIGW2-44	1.0
ESIGW2-45	5.0
ESIGW2-94	4.0
ESIGW2-95	1.0
ESIGW2-98	2.0
ESIGW2-101	6.0

NOTE:
1. CONCENTRATION CONTOURS ARE IN ug/l.

Figure 5-8: Trichloroethylene (TCE) Isoconcentration Contours Using Groundwater Screening SI-Phase I & Phase II & ESI-Phase I & Phase II Results, 9/93-1/95

DCE-GW.dwg; AUGUST 1995



INITIAL GROUNDWATER SCREENING DATA	DCE ug/l
MAAF-H6W	4.8
MAAF-H7W	725
MAAF-K7W	1.6
MAAF-M8W	32
MAAF-M1W	129

PHASE I GROUNDWATER SCREENING SURVEY	DCE ug/l
ESIGW-22	2.6
ESIGW-26	1.4
ESIGW-33	3.7
ESIGW-35	11
ESIGW-36	216
ESIGW-39	5.5
ESIGW-57	2.0
ESIGW-61	1.5
ESIGW-70	323
ESIGW-79	1.5
ESIGW-91	1.6
ESIGW-92	1.6
ESIGW-98	2.1
ESIGW-99	257
ESIGW-113	2.6
ESIGW-132	9.5
ESIGW-133	2.3
ESIGW-167	2.6
ESIGW-159	118
ESIGW-170	6.3
ESIGW-172	1.7
ESIGW-187	1.8
ESIGW-189	2.4
ESIGW-192	2.2
ESIGW-210	2.7
ESIGW-214	3.9
ESIGW-216	30
ESIGW-217	1.2
ESIGW-223	1.1
ESIGW-229	16
ESIGW-231	9.2

PHASE II GROUNDWATER SCREENING SURVEY	DCE ug/l
ESIGW2-34	470
ESIGW2-39	2.0
ESIGW2-61	13
ESIGW2-91	7.8
ESIGW2-100	15
ESIGW2-105	4.0
ESIGW2-153	9.0

LEGEND

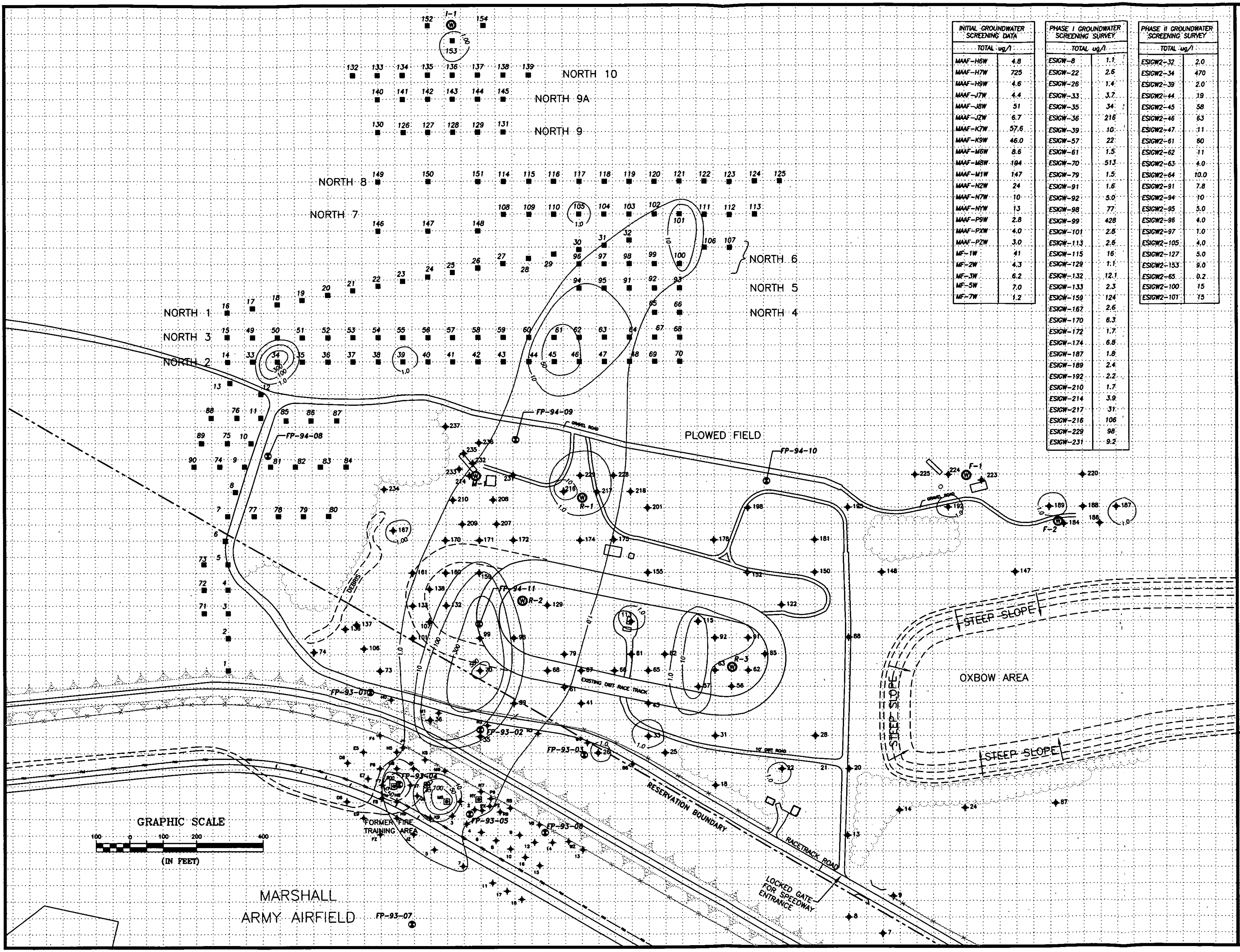
⊗	GROUNDWATER MONITOR WELL
Ⓦ	PRIVATE WELL
✦	SOIL GAS AND GROUNDWATER SCREENING SAMPLE LOCATION
■	GROUNDWATER SCREENING LOCATION
●	SOIL GAS SAMPLE LOCATION
◙	SOIL, SOIL GAS AND GROUNDWATER SCREENING SAMPLE LOCATION
=====	FORMER FEATURE
═══	ROAD
—×—×—	FENCE LINE
⩘⩘⩘	LEVEE
⌒⌒	WOODED AREA
▭	BUILDING
———	DCE CONCENTRATION CONTOUR

NOTE:

1. 1,2-DCE CONCENTRATIONS ARE BASED ON THE SUMMATION OF TRANS-1,2-DCE AND CIS-1,2-DCE DETECTED BY FIELD ANALYSIS.
2. LOCATION ESIGW2-34 WAS RESAMPLED IN JANUARY 1995 AND HAD 3.0 ug/l OF DCE. THE INITIAL SAMPLING AT THIS LOCATION WAS IN AUGUST 1994.
3. CONCENTRATION CONTOURS ARE IN ug/l.

Figure 5-9: DCE
1,2-Dichloroethylene (1,2-DCE) Isoconcentration Contours Using Groundwater Screening (SI-Phase I & Phase II) & (ESI-Phase I & Phase II) Results, 9/93-1/95

TOTAL-GW.dwg; AUGUST 1995



INITIAL GROUNDWATER SCREENING DATA	
TOTAL ug/l	
MAAF-H6W	4.8
MAAF-H7W	725
MAAF-H9W	4.6
MAAF-J7W	4.4
MAAF-J8W	51
MAAF-JZW	6.7
MAAF-K7W	57.6
MAAF-K9W	46.0
MAAF-M6W	8.6
MAAF-M8W	194
MAAF-M1W	147
MAAF-N2W	24
MAAF-N7W	10
MAAF-NYW	13
MAAF-P9W	2.8
MAAF-PXW	4.0
MAAF-PZW	3.0
MF-1W	41
MF-2W	4.3
MF-3W	6.2
MF-5W	7.0
MF-7W	1.2

PHASE I GROUNDWATER SCREENING SURVEY	
TOTAL ug/l	
ESIGW-8	1.1
ESIGW-22	2.6
ESIGW-26	1.4
ESIGW-33	3.7
ESIGW-35	34
ESIGW-36	216
ESIGW-39	10
ESIGW-57	22
ESIGW-61	1.5
ESIGW-70	513
ESIGW-79	1.5
ESIGW-91	1.6
ESIGW-92	5.0
ESIGW-98	77
ESIGW-99	428
ESIGW-101	2.8
ESIGW-113	2.6
ESIGW-115	16
ESIGW-129	1.1
ESIGW-132	12.1
ESIGW-133	2.3
ESIGW-159	124
ESIGW-167	2.6
ESIGW-170	6.3
ESIGW-172	1.7
ESIGW-174	6.8
ESIGW-187	1.8
ESIGW-189	2.4
ESIGW-192	2.2
ESIGW-210	1.7
ESIGW-214	3.9
ESIGW-217	31
ESIGW-216	106
ESIGW-229	98
ESIGW-231	9.2

PHASE II GROUNDWATER SCREENING SURVEY	
TOTAL ug/l	
ESIGW2-32	2.0
ESIGW2-34	470
ESIGW2-39	2.0
ESIGW2-44	19
ESIGW2-45	58
ESIGW2-46	63
ESIGW2-47	11
ESIGW2-61	60
ESIGW2-62	11
ESIGW2-63	4.0
ESIGW2-64	10.0
ESIGW2-91	7.8
ESIGW2-94	10
ESIGW2-95	5.0
ESIGW2-96	4.0
ESIGW2-97	1.0
ESIGW2-105	4.0
ESIGW2-127	5.0
ESIGW2-153	9.0
ESIGW2-65	0.2
ESIGW2-100	15
ESIGW2-101	15

LEGEND

⊗	GROUNDWATER MONITOR WELL
Ⓦ	PRIVATE WELL
✦	SOIL GAS AND GROUNDWATER SCREENING SAMPLE LOCATION
■	GROUNDWATER SCREENING LOCATION
●	SOIL GAS SAMPLE LOCATION
▣	SOIL, SOIL GAS AND GROUNDWATER SCREENING SAMPLE LOCATION
- - - - -	FORMER FEATURE
═	ROAD
—x—x—	FENCE LINE
	LEVEE
	WOODED AREA
	BUILDING
—	TVOC CONCENTRATION CONTOUR

NOTE:

1. TOTAL CHLORINATED VOC CONTOUR ARE IN ug/l.

Figure 5-10: Total Chlorinated VOC Isoconcentration Contours Using Groundwater Screening (SI-Phase I & Phase II & ESI-Phase I & Phase II) Results, 1/95

MAAF-19.dwg 2/98

ANALYTE	SAMPLE#	FIELD	LAB
		CONC. IN ug/l	
1,1-DCA	CP7-GW1	5.26	<0.5
1,2-DCA	CP7-GW1	14	<0.6
Dichloromethane	CP9	<0.5	0.98
Ethylbenzene	CP2-GW1	0.57	<0.7
	CP5-GW1	<0.51	0.7
	CP6-GW1	0.68	<0.7
	CP7-GW1	<0.51	0.9
Toluene	CP9	0.80	0.90J
	CP1-GW1	<0.62	1.3
	CP2-GW1	<0.62	0.5
	CP3-GW1	<0.62	0.5
	CP4-GW1	<0.62	0.5
	CP4-GW2	<0.62	0.6
	CP5-GW1	<0.62	1.1
	CP6-GW1	0.78	0.8
	CP7-GW1	<0.62	1.7
	CP8-GW1	<0.62	0.6
	CP8-GW2	<0.62	0.5
TCE	CP9	<2.11	2.7J
	CP4-GW1	2.93	2.8
	CP5-GW1	<2.11	1.2
	CP6-GW1	<2.11	1
Trichloromethane	CP1-GW1	28	<0.5
	CP5-GW1	11	<0.5
	CP6-GW1	11	<0.5
	CP7-GW1	18	<0.5
Total Xylenes	CP9	0.92	NAp
	CP2-GW1	0.66	NAp
	CP6-GW1	0.76	NAp
	CP7-GW1	0.57	NAp
	CP5-GW1	NAp	0.6

NAp–Not Applicable

1,2 DCA: 1,2 Dichloromethane
1,1 DCA: 1,1 Dichloromethane
B–Analyte also detected in method blank
J–Analyte positively identified; recorded concentration is an estimate

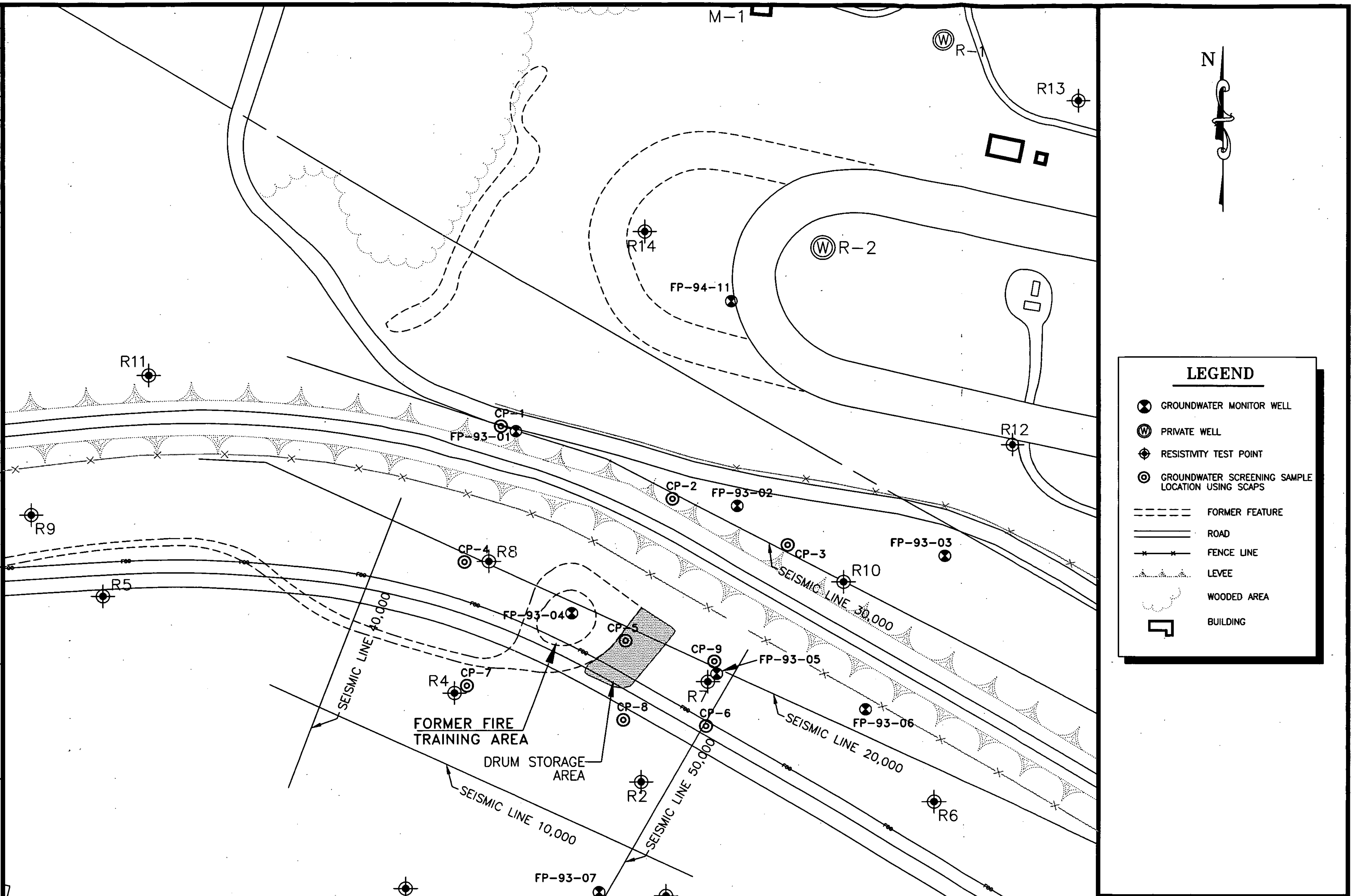


Figure 5-11: SCAPS Results, 11/94

6.0 SOIL

The soil type typically found at MAAF in the area of the FFTA is designated as the Haynie Series of the Eudora-Haynie-Sarpy association. This soil is described as very fine sandy loam soil that consists of deep, nearly level, calcareous soils on floodplains along the rivers. These soils formed in the calcareous alluvium. This soil takes in water well and releases it readily for plant use. It is subject to some flooding. The soils encountered during the SI and ESI were consistent with the description for the Haynie Series; the soils observed had a light brown sandy surface underlain by organic silts, silty clays and clays. However, in the area of the former fire training pit, the upper soil layer was distinctively darker than surrounding soils with a higher silt, clay, and organic content. All soil samples collected from on-post were from the Haynie series.

6.1 SI

Results of soil sampling conducted in 1985 by the USAEHA indicated that chlorinated solvents (e.g., PCE) were present in the soils at the site. Five sludge and soil samples were collected to a depth of 2 to 3 inches. Trichloromethane, t-1,2-DCE, and PCE were detected at concentrations ranging from 1,000 to 3,000 μg/kg. t-1,2-DCE was the only chlorinated compound detected in the drum storage area outside the bermed pit. In addition, #2 fuel oil was detected at concentrations ranging from 50,000 to 300,000 μg/kg for samples inside and outside the berm (Ref. 34).

The SI was conducted at the FFTA-MAAF during the period of September 1993 through June 1994. The purpose of the SI was to collect data to confirm or deny that hazardous substances were present at the site. The results of the SI indicated that petroleum hydrocarbons and chlorinated solvents, including PCE, were present in the subsurface environment.

Eight soil samples were collected at four locations, with two samples collected from different depths at each location. These sample locations are shown in Figure 6-1. The sample locations were H7, K7, M8, and NY; all these locations are within areas of either petroleum hydrocarbon detections or PCE detections. The sampling depths ranged from 2 to 5 feet. Soil samples were analyzed for VOCs using EPA Method 8240, SVOCs using EPA Method 8270, PP metals using EPA Methods 6010 and 7000 Series, and TPH using EPA Method 8015 modified. All soil samples collected during the SI were in the Haynie Series soil.

Data Summary. The soil sample results are shown in Table 6-1. Substances detected include VOCs (PCE and xylenes), both TPH-GRO and TPH-DRO, SVOCs (naphthalene, 2 methyl naphthalene, di-n-butyl phthalate, and phenanthrene), and metals.

Data Evaluation. The detected concentrations are compared against regulatory standards and guidelines. However, regulatory standards have not been widely established for contaminant concentrations in soils. Therefore, Table 6-1 also presents risk-based guidelines for contaminants in soils in industrial settings that are published by the EPA Regions III and IX. The soil concentrations at the FFTA are compared against the risk-based guidelines. As shown in Table 6-1, the concentrations of TPH-GRO at H7 is 400,000 μg/kg, and 880,000 to 8,100,000 μg/kg for

TPH-DRO, both of which exceed the KDHE cleanup guidance level of 100,000 μg/kg. Table 6-1 also indicates that the carcinogenic risk-based level for arsenic was exceeded at each soil sample location. USGS reference (Ref. 28) lists the average or median arsenic content of elements in soil and other surficial material as 0.1 to 97 mg/kg.

The five surface soil (sediment) samples collected in the drainage ditch were added to the SI activities once it was determined that the ditch transected the former pit. The sample locations are shown on Figure 6-1. These samples were collected to determine if contaminants from the FFTA were being transported via runoff and surface flow. The five surface samples collected were analyzed for VOCs using EPA Method 8240 and SVOCs using EPA Method 8270. No detections of VOCs or SVOCs were found in any of the five surface soil samples. TPH and PP metals would have been analyzed if there were detections of VOCs or SVOCs. The sediment sample collected furthest to the east would be considered background for the FFTA.

Soil samples were collected at 3- and 6-foot depths from two soil borings located southeast and northwest of well FP-93-04, at the center of the FFTA-MAAF, on 4 April 1994. The sample locations are shown on Figure 6-1. The sampling was performed to address concerns that PCBs may have been present at the site. Samples were collected in duplicate to field screen for PCBs and for laboratory analysis. Samples tested positive for PCBs during field screening, however, chlorinated organic compounds present in the sample will often result in false positives. Of the duplicate samples sent to the laboratory, two were analyzed for TCL pesticides and PCBs using EPA Method 8080, and two were analyzed for PCBs only using EPA Method 8080. All four samples were nondetect. However, due to interference caused by low boiling compounds, the analyses for two of the samples resulted in elevated detection limits. These two samples were recollected from the same area on 6 June 1994 for TCL pesticide and PCB analyses. Samples were collected at 3- and 6-foot depths from the soil boring located to the northwest of well FP-93-04. The laboratory used EPA cleanup methods prior to analysis in order to obtain a lower detection limit, however, detection limits were only slightly lower than the previous sampling. Both samples were nondetect for PCBs, although the PQLs were raised as cited above.

6.2 ESI

The SI results for the FFTA-MAAF indicated that organic compounds had been released to the subsurface at concentrations exceeding federal regulatory standards and state guidelines. These results indicated that additional work at the FFTA-MAAF was necessary. Therefore, an ESI was initiated for purposes of further investigations and data reporting.

Phase I of the ESI was initiated on 20 June 1994, and Phase II of the ESI was initiated on 22 August 1994, in accordance with the ESI SAP. In order to further evaluate the vertical and horizontal extent of contamination migration, soil samples were collected off-post in the area of the racetrack under Phase II.

Phase II soil samples were collected due to detections in the Phase I soil gas survey and groundwater screening data, and focused on shallow soils to evaluate whether additional source areas may be present. Soil samples were collected at 29 boring locations. The soil boring locations are depicted on Figure 6-2. At 26 boring locations (SB-1 through SB-23 and SB-27 through SB-29), samples were collected from depths of 2 to 3 feet and 7 to 8 feet. The first sampling depth was selected to evaluate whether near-surface contamination was present; the 0- to 2-foot zone was not sampled because it had been impacted by regional flooding of the area. Also, the 0- to 2-foot materials are subject to site disturbance and small spills and leaks of materials that may not be representative of large-scale releases potentially impacting groundwater. The 7- to 8-foot depth was selected to evaluate whether vertical migration of contaminants had occurred. At the remaining three locations (SB-24 through SB-26), shallow soil samples were collected from the 2- to 3-foot interval only as there was a potential source of a surface spill of 1,1,1-TCA. The prefix used to identify these samples were "FPOP", then the soil boring location (e.g., "SB-#") and followed by the suffix "-1" for the shallow zone and "-2" for the deeper zone.

Soil samples were collected using 2- and 4-inch stainless steel bucket augers. All soil samples were analyzed for VOCs using EPA Method 8240. Ten percent of the soil samples were collected in triplicate: one portion was sent as a normal field sample, one portion was a blind field duplicate, and one portion was a QA sample for MRD. Five percent of the samples included collection of samples for laboratory QA/QC as the matrix spike and matrix spike duplicate (MS/MSD). The MS/MSD was collected at a location where a field duplicate and MRD sample is located.

Data Summary. The results of the Phase II soil sampling are shown in Table 6-2. The results for soil boring SB-2 in the deeper sample zone (7 to 8 feet) indicate that DCE was detected at 49 μg/kg, PCE at 44 μg/kg, and TCE at 6.6 μg/kg. In soil boring SB-3, DCE was detected at 30 μg/kg in the deeper sample zone (7 to 8 feet). For soil boring SB-4, PCE was detected at 17 μg/kg in the deeper sample zone (7 to 8 feet). In soil boring SB-8, PCE was detected at 23 μg/l in the deeper sample zone (7 to 8 feet).

Data Evaluation. The results for the Phase II soil sampling indicate that VOCs were detected above method detection limits at 4 of 29 soil boring locations (SB-2, SB-3, SB-4, and SB-8). The concentrations of DCE, TCE, and PCE detected in soils do not exceed risk-based guidelines.

The contaminants in soil borings SB-2, SB-3, SB-4, and SB-8 were in areas where there was known groundwater contamination -- near contaminated groundwater screening locations ESIGW-70 and ESIGW-99. The detections in these soil borings were only in the deeper sample zone indicating that a separate shallow source area was not likely. Therefore, contamination was most likely due to adsorption to the soil due to the elevated groundwater levels in September 1993, when contaminated groundwater occupied the pore spaces of soils at depths of 7 to 8 feet from the surface.

6.3 Pilot Test Study Baseline Soil Borings

Based on the results of previous sampling, it was determined that two major AOCs for soils on-post existed. AOC-1 encompassed the FFTA-MAAF. AOC-2 was located in the former drum storage area, southeast of the FFTA-MAAF. These two AOCs were the focus of the pilot test study. Baseline borings were collected from these two AOCs to provide a snapshot of the current understanding of the contamination at the FFTA-MAAF prior to the beginning of the pilot test study.

Data Summary. The soil boring analytical results are shown in Table 6-3. Boring locations are shown in Figure 6-3. All samples collected from soil boring SB-01 had detections of TPH-GRO. Detected concentrations ranged from 190 μg/kg in the 1- to 3- foot range, to 21,000 μg/kg in the 12.3- to 12.8-foot range. All samples from soil boring SB-04 showed detections for TPH-GRO. Detected concentrations ranged from 350,000 μg/kg in the 1- to 3-foot range to 2,600,000 μg/kg in the 4- to 7-foot range. All samples collected from boring SB-07 had detections of TPH-GRO. Concentrations ranged from 170 μg/kg to 450 μg/kg. Additionally, TPH-GRO was detected in samples MAAFSB5A-2, MAAFSB5-3, and MAAFSB5-4 from soil boring SB-05. Concentrations detected were 130 μg/kg in sample MAAFSB5A-2; 1,800,000 μg/kg in sample MAAFSB5-3; and 1,500,000 μg/kg in sample MAAFSB5-4. TPH-GRO was not detected in samples from soil borings SB-02, SB-03 and SB-06. Samples from soil borings SB-08 through SB-11 were not analyzed for TPH-GRO.

All samples collected from SB-04 showed detections for TPH-DRO. Detected concentrations ranged from 980,000 μg/kg to 23,000,00 μg/kg. Sample MAAFSB4-2, collected from the 4- to 7-foot range, showed the highest detected concentration (23,000,000 μg/kg). TPH-DRO was detected in two samples (MAAFSB1-1 and MAAFSB1-4) from soil boring SB-01. TPH-DRO was detected at a concentration of 150,000 μg/kg in sample MAAFSB1-1 and at a concentration of 1,400,000 μg/kg in sample MAAFSB1-4. TPH-DRO was detected in samples collected from the 10- to 13-foot range in soil boring SB-05. Sample MAAFSB5-3 had a detection of 4,000,000 μg/kg, and sample MAAFSB5-4 had a detection of 6,000,000 μg/kg. One sample from soil boring SB-03 (MAAFSB3-1) had a detection of TPH-DRO at a concentration of 40,000 μg/kg. TPH-DRO was not detected in samples collected from soil boring SB-02, SB-06, and SB-07. Samples from soil borings SB-08 through SB-11 were not analyzed for TPH-DRO.

Data Evaluation. Analytical results are compared to the EPA risk-based guidelines and/or KDHE cleanup guidance level for VOCs and TPH. The KDHE cleanup guidance level for TPH-GRO and TPH-DRO combined is 100,000 μg/kg. This guidance level was exceeded in all samples collected from soil boring SB-04 (MAAFSB4-1, MAAFSB4A-1, MAAFSB4-2, MAAFSB4A-2, MAAFSB4-3, and MAAFSB4-4). Samples MAAFSB1-1 and MAAFSB1-4 collected from soil boring SB-01 and samples MAAFSB5-3 and MAAFSB5-4 collected from soil boring SB-05 also exceeded the KDHE cleanup guidance level for TPH.

Data Summary. Samples MAAFSB4-2 and its co-located sample MAAFSB4A-2 had detected concentrations of DCE of 13,000 μg/kg and 23,000 μg/kg, respectively. Sample MAAFSB4A-1, also collected from soil boring SB-04, had a detected concentration of DCE of 160 μg/kg. No other samples had detected concentrations of DCE. TCE was detected in sample MAAFSB4A-1 at a concentration of 8.6 μg/kg. PCE was detected in both AOC-1 and AOC-2. In AOC-1, PCE was detected in samples MAAFSB4A-1, MAAFSB7-2, and MAAFSB7-3. In AOC-2, PCE was detected in all but two samples collected in the 1- to 7.5-foot range. One of the samples (MAAFSB10-3) in which PCE was not detected was a duplicate sample. PCE was detected in the record sample MAAFSB10-2. The other nondetect occurred at MAAFSB12-2. PCE was also detected in the 10- to 12-foot range at boring MAAFSB9-3 and MAAFSB10-4.

Ethylbenzene was detected in samples MAAFSB4-2, MAAFSB4A-2, MAAFSB4-3, and MAAFSB4-4 from soil boring SB-04. Concentrations detected in those samples ranged from 1,300 μg/kg to 19,000 μg/kg. Ethylbenzene was also detected in samples MAAFSB5-3 and MAAFSB5-4 at concentrations of 9,900 μg/kg and 1,500 μg/kg, respectively. o-Xylene was detected in samples

MAAFSB4-2, MAAFSB4A-2, and MAAFSB4-3 at concentrations ranging from 18,000 μg/kg to 33,000 μg/kg. Samples MAAFSB5-3 and MAAFSB5-4 had detected concentrations of o-xylene of 24,000 μg/kg and 4,000 μg/kg, respectively. In all but one sample from soil boring SB-04, m- &/or p-xylenes were detected. Detected concentrations ranged from 850 μg/kg to 160,000 μg/kg. Two samples collected from soil boring SB-05 had detected concentrations of m- &/or p-xylenes. Sample MAAFSB5-3 had a detected concentration of 170,000 μg/kg, and sample MAAFSB5-4 had a detected concentration of 18,000 μg/kg. Toluene was detected in samples MAAFSB4-1, MAAFSB4-2, MAAFSB4A-2, MAAFSB4-3, and MAAFSB4-4 from soil boring SB-04. The detected concentrations ranged from 710 μg/kg in sample MAAFSB4-1 to 180,000 μg/kg in sample MAAFSB4-2. Toluene was also detected in samples MAAFSB5-3 and MAAFSB5-4 from soil boring SB-05. Sample MAAFSB5-3 had a concentration of 26,000 μg/kg, and sample MAAFSB5-4 had a concentration of 4,100 μg/kg.

Data Evaluation. DCE was detected in a total of three samples (MAAFSB4-1, MAAFSB4-2, and MAAFSB4A-2). Two samples (MAAFSB4-2 and MAAFSB4A-2) had concentrations exceeding the KDHE cleanup guidance level (8,000 μg/kg), but all three samples were well below the EPA risk-based guidelines. TCE was only detected at AOC-1 in sample MAAFSB4A-1, and was detected at a concentrations well below the cleanup levels and guidelines. TCE and DCE were not detected in AOC-2. All detections of PCE in both AOC-1 and AOC-2 were below KDHE cleanup guidance levels and EPA risk-based guidelines.

No detections of ethylbenzene exceeded the EPA risk-based guidelines. No detections of toluene or o-xylene exceeded the KDHE cleanup guidance levels or the EPA risk-based guidelines. Although there are no EPA risk-based guideline or KDHE cleanup guidance levels for m- &/or p-xylenes, detections were compared to the guidance values for xylenes (mixed). Concentrations of m- &/or p-xylenes in samples MAAFSB4-2, MAAFSB4A-2, and MAAFSB4-3 exceeded both cleanup guidance levels. Sample MAAFSB5-3 had a concentration (170,000 μg/kg) exceeding the KDHE cleanup guidance level (10,000 μg/kg).

The horizontal extent of TPH concentrations in soil for the 4- to 7-foot depth interval and the vertical extent of TPH concentrations are shown in Figures 6-3 and 6-4, respectively. The horizontal extent of total VOC (sum of each detection) concentrations in soil for the 4- to 7-foot depth interval and the vertical extent of total VOC concentrations are shown in Figures 6-5 and 6-6, respectively.

In AOC-1, TOC ranged from 419 mg/kg at MAAFSB6B-5 in the 13.4- to 13.9-feet range to 62,300 mg/kg at MAAFSB4-2 in the 4- to 7-feet range. At AOC-2, TOC ranged from 990 mg/kg at MAAFSB11 in the 10- to 12-feet range to 19,400 mg/kg at boring MAAFSB12 in the 1- to 3-foot range.

In addition to TPH and VOC analyses, samples in AOC-1 only were analyzed for total Kjeldahl nitrogen (TKN), ammonia content, phosphorus content, and pH. Samples were analyzed for these conventionals because SVOCs were found only at AOC-1 and the bioventing technology was to be used only at AOC-1. The pH of the soil ranged from 7.6 to 8.8.

6.3.1 Microbial Enumeration of Soils

A soil sample collection effort was initiated on 7 to 9 July 1994 to collect 28 soil samples as part of an evaluation for an in-situ bioventing pilot test study. The results of the plate counts for the soil samples are shown in Table 6-4. As shown in the table, it is apparent that all of the surficial samples (< 10 feet below ground surface) contain significant numbers of both heterotrophic bacteria and those able to degrade petroleum hydrocarbons. However, samples obtained from the 10- to 14-feet depths in MAAFSB-2 through MAAFSB-6 did not indicate large numbers of either heterotrophic bacteria or petroleum degraders. This may reflect a lack of exposure to petroleum products, which may be inhibiting microbial growth.

There were significant numbers of organisms, however, in samples MAAF-SB-4-3 and MAAF-SB-3-4 that were able to grow on dilute oil in the most probable number (MPN) test. In most cases, the numbers able to utilize benzene-toluene-xylene (BTX) were at least one-tenth of the total population indicating that the microorganisms have been exposed to petroleum products and are present in significant numbers.

6.4 Nearby Land Uses and Population

The area of the former fire training pit is within the boundaries of the airfield and is separated from the properties to the north by a levee and an 8-foot, continuous chain-link fence that surrounds the airfield. The nearest airfield building is over 2,000 feet to the southwest. The FFTA-MAAF has not been used for fire fighting training since 1984. The FFTA is currently used to harvest a cultivated hay meadow area with some invasion of species of native prairie hay that grows at the airfield, except for the area within the temporary fence installed in December 1994 around the pilot test. Properties to the north are used for both private residences and farming. The property the north of the FFTA-MAAF has been used as a racetrack for automobiles since the early 1980s.

No persons live on the FFTA-MAAF. The MAAF is an active army airfield located to the south of the FFTA, within a 1-mile radius. MAAF has 1,019 workers including 941 military, 55 civilian, 37 contractors and 20 dependents with the majority of these personnel housed on Main Post, located to the northwest of MAAF across the Kansas River.

There are a few private residences scattered among predominately agricultural areas located to the north of the FFTA-MAAF, within a 1-mile radius. The winds in the area blow predominantly towards the south during February and March. There is no one that works or lives within a 1-mile radius to the south. The winds blow predominately to the north the remaining 10 months of the year. There are two residences located due north of the FFTA, one residence located to the northeast, and one residence to the northwest. There are people working at the racetrack to the north during the months of April through October.

Table 6-1. Summary of Chemical Detections for SI Soil Sample Results - Former Fire Training Pit, September 1993

(Results are reported in dry weight)

Sample Location	H7	H7	K7	K7	K7	M8	M8	NY	NY	KDHE Cleanup Standards *	Risk-based Guidelines **
Sample Depth (feet)	2	4	2	4	4	2.5	4.5	2	5		
Sample Identification	MAAF H7S1	MAAF H7S2	MAAF K7S1	MAAF K7S2	MAAF K7S3 (a)	MAAF M8S1	MAAF M8S2	MAAF NYS1	MAAF NYS2		
Volatile Organic Compounds (micrograms per kilogram - µg/kg)											
Dichloromethane	**7.4B**	<26	**11B**	**12B**	**10B**	<22	<6.1	<6.1	<7.3	NAv	25,000 - 760,000
Tetrachloroethylene	<5.9	<26	**31**	**34**	**15**	**480**	**110**	<6.1	<7.3	NAv	25,000 - 110,000
m- &/or p-Xylenes	<5.9	**100**	**18**	<6.3	<5.9	<22	<6.1	<6.1	<7.3	63,000 (b)	980,000 - 1,000,000,000 (b)
o-Xylene	<12	**170**	**20**	<13	<12	<54	<12	<12	<15	NAv	980,000 - 1,000,000,000
Semi-Volatile (micrograms per kilogram - µg/kg)											
di-n-Butylphthalate	<1,500	<800	<800	<800	<800	<800	**900**	<800	<800	NAv	68,000,000 - 200,000,000
2-Methyl Naphthalene	<1,500	**2,700**	<800	<800	<800	<800	<800	<800	<800	NAv	NAv
Naphthalene	<1,500	**1,000**	<800	<800	<800	<800	<800	<800	<800	NAv	800,000 - 82,000,000
Phenanthrene	<1,500	**1,400**	<800	<800	<800	<800	<800	<800	<800	NAv	NAv
Total Petroleum Hydrocarbons (micrograms per kilogram - µg/kg)											
TPH-GRO	<120	**400,000**	<120	<120	<120	**380**	<120	<120	<130	100,000	NAv
TPH-DRO	**880,000**	**8,100,000**	<6,100	**15,000**	<6,100	<6,200	<6,200	<6,200	<6,300	100,000	NAv
Metals (milligrams per kilogram - mg/kg)											
Arsenic	**3 (c)**	**2 (c)**	**4 (c)**	**2 (c)**	**2 (c)**	**4 (c)**	**3 (c)**	**3 (c)**	**3 (c)**	NAv	2 - 610
Beryllium	<0.6	<0.6	<0.6	<0.6	<0.6	**0.9**	<0.6	**0.7**	**0.6**	NAv	1.1 - 1.3
Cadmium	<0.6	<0.6	**0.6**	<0.6	<0.6	**1.1**	<0.6	<0.6	**0.9**	NAv	850 - 1,000
Chromium	**9**	**10**	**10**	**9**	**6**	**15**	**11**	**12**	**14**	NAv	230 - 1,000,000
Copper	**9**	**8**	**10**	**6**	**5**	**16**	**9**	**12**	**10**	NAv	63,000 - 76,000
Lead	**30**	**30**	**11**	**7**	**7**	**15**	**8**	**10**	**10**	500	400 (d)
Nickel	**11**	**10**	**12**	**9**	**7**	**20**	**11**	**14**	**14**	NAv	NAv
Zinc	**35**	**31**	**40**	**26**	**22**	**67**	**34**	**53**	**44**	NAv	100,000 - 610,000

Bold values represent detected compounds.
Shaded values represent concentrations that exceed Regulatory Standards or maximum Risk-based Guidelines or Carcinogen Levels

B Analyte detected in the associated method blank; result has not been blank corrected.

* "Interim Soil Cleanup Standards, December 1993", Kansas Department of Health and Environment, Bureau of Environmental Remediation.

** Risk-based guideline concentrations are based on a range of the industrial guidelines to represent EPA Regions III & IX, from the following citations: Region III Risk-based Concentration Table, March 1995, Roy L Smith, Senior Toxicologist - Technical Support Section; Region IX Preliminary Remediation Goals (PRGs) February 1995, Stanford J. Smucker, PhD, Regional Toxicologist.

(a) Duplicate of MAAF K7S2.

(b) Although no standards or guidelines are available for m- &/or p-Xylenes, concentrations reported as m- &/or p-Xylenes will be compared to the standards and guidelines for Xylenes (mixed).

(c) Sample concentration exceeded EPA Region III (10^{-6}) risk-based standard for arsenic as a carcinogen.

(d) OSWER Directive 9355.4-12, Revised Interim Lead Guidance for CERCLA sites and RCRA Corrective Action Facilities, dated 14 July 1994, lead screening level is 400 mg/kg for residential setting.

NAv Not Available

< Below Practical Quanititation Limit

For complete list of analytes determined, see QCSR Site Investigations of High Priority Sites, 17 December 1993.

Table 6-2. Summary of Chemical Detections for ESI Soil Sampling - Off-Post Phase II, August 1994

(Results are reported in dry weight)

Sample Identification	FPOPSB2-2	FPOPSB3-2	FPOPSB4-2	FPOPSB4-21 (a)	FPOPSB8-2	KDHE Cleanup Standards *	Risk-Based Guideline Concentrations **
Soil Boring	SB-2	SB-3	SB-4	SB-4	SB-8		
Sample Interval (feet)	7 to 8	7 to 8	7 to 8	7 to 8	7 to 8		
Volatile Organic Compounds (ug/kg)							
1,2-Dichloroethylene	**49**	**30**	<6.3	<6.6	<6.3	8,000	270,000 - 18,000,000
Tetrachloroethylene	**44**	<6.1	**14**	**17**	**23**	NAv	25,000 - 110,000
Trichloroethylene	**6.6**	<6.1	<6.3	<6.6	<6.3	NAv	17,000 - 520,000

Bold values represent dected compounds.

(a) FPOPSB4-21 is a duplicate of FPOPSB4-2.

* Interim Soil Clean-up Standards, December 1993, Kansas Department of Health and Environment, Bureau of Environmental Remediation.

** Risk-based guideline concentrations are based on a range of the industrial guidelines to represent EPA Regions III & IX, from the following citations:
Region III Risk-based Concentration Table, March 1995, Roy L Smith, Senior Toxicologist - Technical Support Section; Region IX Preliminary Remediation Goals (PRGs) February 1995, Stanford J. Smucker, PhD, Regional Toxicologist.

< Below Practical Quantitation Limit.

For complete list of analytes determined, see QCSR Periodic Groundwater Monitoring Samples, 11 November 1994.

Table 6-3. Summary of Chemical Detections for Pilot Test Study Baseline Soil Sampling Data, July 1994

(Results are reported in dry weight)

			Total Petroleum Hydrocarbons		Volatile Organic Compounds								Conventional						USCS Symbols Based on Geotechnical Laboratory Analysis (o)
Soil Boring Identification	Sample Identification	Sample Interval (feet)	TPH-GRO (µg/kg)	TPH-DRO (µg/kg)	PCE (µg/kg)	TCE (µg/kg)	1,2-DCE (µg/kg)	Benzene (µg/kg)	Ethyl-benzene (µg/kg)	m- &/or p-Xylene (µg/kg)	o-Xylene (µg/kg)	Toluene (µg/kg)	TOC (mg/kg)	TKN (mg/kg)	Ammonia (mg/kg)	Phosphorus (mg/kg)	pH	Solid Content (percent by Weight)	
	AOC-1:																		
SB-01	MAAFSB1-1	1-3	**190**	**150,000**	<5.7	<5.7	<5.7	<5.7	<5.7	<5.7	<11	<5.7	**4,870**	**385**	<1.0	**27**	**8.3**	**88**	ML
	MAAFSB1-2	4-7	**270**	<5,400	<5.4	<5.4	<5.4	<5.4	<5.4	<5.4	<11	<5.4	**10,100**	**247**	<1	**34**	**8.5**	**92**	ML
	MAAFSB1-3	10-12	**200**	<5,100	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<10	<5.1	**6,620**	**769**	**1.7**	**33**	**8.4**	**98**	SP
	MAAFSB1-4	12.3-12.8	**21,000**	**1,400,000**	<5.4	<5.4	<5.4	<5.4	<5.4	<5.4	<11	<5.4	**7,340**	<100	<1.0	**26**	**8.2**	**92**	NS
	MAAFSB1-5 (a)	4-7	<110	<5,500	<5.5	<5.5	<5.5	<5.5	<5.5	<5.5	<11	<5.5	**8,720**	**123**	<1.0	**41**	**8.5**	**91**	NS
SB-02	MAAFSB2B-1	1-3	<110	<5,700	<5.7	<5.7	<5.7	<5.7	<5.7	<5.7	<11	<5.7	**9,120**	**500**	<1	**18**	**7.9**	**88**	ML (m)
	MAAFSB2B-2	4-7.5	<110	<5,700	<5.7	<5.7	<5.7	<5.7	<5.7	<5.7	<11	<5.7	**7,520**	**162**	<1	**470**	**8.4**	**88**	ML (m)
	MAAFSB2B-3 (b)	4-7.5	<110	<5,700	<5.7	<5.7	<5.7	<5.7	<5.7	<5.7	<11	<5.7	**8,770**	**127**	<1	**390**	**8.6**	**88**	SP (m)
	MAAFSB2B-4	10-12	<120	<5,900	<5.9	<5.9	<5.9	<5.9	<5.9	<5.9	<12	<5.9	**8,820**	<100	<1	**130**	**8.8**	**85**	NS
	MAAFSB2B-5	12-12.5	<100	<5,200	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<10	<5.2	**3,530**	<100	<1	**65**	**8.8**	**97**	NS
SB-03	MAAFSB3B-1	1-3	<120	**40,000**	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<12	<6.0	**9,940**	**465**	**1.4**	**480**	**8.0**	**84**	ML (m)
	MAAFSB3B-2	4-7	<110	<5,700	<5.7	<5.7	<5.7	<5.7	<5.7	<5.7	<11	<5.7	**8,540**	<100	<1	**320**	**8.5**	**88**	ML (m)
	MAAFSB3B-3	9.3-11.4	<110	<5,600	<5.6	<5.6	<5.6	<5.6	<5.6	<5.6	<11	<5.6	**3,460**	<100	<1	**380**	**8.4**	**90**	SP (m)
	MAAFSB3B-4 (c)	4 - 7	<110	<5,700	<5.7	<5.7	<5.7	<5.7	<5.7	<5.7	<11	<5.7	**36000**	<100	<1	**61**	**8.6**	**88**	NS
	MAAFSB3B-5	13.5-14.2	<100	<5,200	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<10	<5.2	**1,500**	<100	<1	**84**	**8.8**	**96**	NS
SB-04	MAAFSB4-1	1-3	**350,000**	**15,000,000**	<310	<310	<310	<310	<310	**850**	<610	**710**	**62,300**	**563**	**5**	**213**	**7.6**	**82**	ML
	MAAFSB4A-1 (d)	1-3	**1,800,000**	**7,000,000**	**170**	**8.6**	**160**	<5.9	<5.9	<5.9	<12	<5.9	**5,910**	NA	NA	NA	NA	**85**	NS
	MAAFSB4-2	4-7	**2,600,000**	**23,000,000**	<290	<290	**13,000 r,J**	**550**	**15,000 r,J**	**160,000 r,J**	**33,000 r,J**	**130,000 r,J**	**24,200**	**337**	**42**	**190**	**8.1**	**85**	ML
	MAAFSB4A-2 (d)	4-7	**2,200,000**	**980,000**	<290	<290	**23,000 r,J**	**1,400**	**19,000 r,J**	**160,000 r,J**	**29,000 r,J**	**180,000 r,J**	**32,100**	NA	NA	NA	NA	**87**	NS
	MAAFSB4-3	10-12	**2,200,000**	**6,000,000**	<260	<260	**310**	<260	**9,600 r,J**	**94,000 r,J**	**18,000 r,J**	**70,000 r,J**	**17,200**	**349**	**13**	**200**	**8.3**	**96**	SP
	MAAFSB4-4	12.5-13	**600,000**	**3,300,000**	<260	<260	<260	<260	**1,300**	**22,000 r,J**	**2,900**	**8,600 r,J**	**11,000**	**239**	**2**	**74**	**8.4**	**97**	NS
SB-05	MAAFSB5-1	1-3	<110	<5,500	<5.5	<5.5	<5.5	<5.5	<5.5	<5.5	<11	<5.5	**11,500**	**456**	<1.0	**180**	**8.3**	**91**	ML
	MAAFSB5A-1 (f)	1-3	<120	<6,000	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<12	<6.0	**8,620**	NA	NA	NA	NA	**83**	NS
	MAAFSB5-2	4-6	<110	<5,700	<5.7	<5.7	<5.7	<5.7	<5.7	<5.7	<11	<5.7	**7,740**	**215**	<1.0	**150**	**8.1**	**88**	ML
	MAAFSB5A-2 (f)	4-6	**130**	<6,000	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<12	<6.0	**7,510**	NA	NA	NA	NA	**84**	NS
	MAAFSB5-3	10-12	**1,800,000**	**4,000,000**	<280	<280	<280	<280	**9,900 r,J**	**170,000 r,J**	**24,000 r,J**	**26,000 r,J**	**15,800**	<100	**3**	**140**	**8.3**	**89**	SP
	MAAFSB5-4	12-13	**1,500,000**	**6,000,000**	<260	<260	<260	<260	**1,500**	**18,000**	**4,000**	**4,100**	**22,800**	**327**	**1**	**97**	**8.2**	**96**	NS
SB-06	MAAFSB6B-1	1-3	<120	<5,800	<5.8	<5.8	<5.8	<5.8	<5.8	<5.8	<12	<5.8	**11,500**	**678**	<1	**230**	**7.8**	**86**	ML (m)
	MAAFSB6B-2	3.5-7	<120	<6,300	<6.3	<6.3	<6.3	<6.3	<6.3	<6.3	<13	<6.3	**5,920**	**253**	<1	**80**	**8.2**	**80**	ML (m)
	MAAFSB6B-3	10-12	<100	<5,200	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<10	<5.2	**5,470**	<100	<1	**93**	**8.7**	**96**	SP (m)
	MAAFSB6B-4 (g)	3.5-7	<120	<6,100	<6.1	<6.1	<6.1	<6.1	<6.1	<6.1	<12	<6.1	**7,900**	**414**	**1.5**	**370**	**8.3**	**82**	NS
	MAAFSB6B-5	13.4-13.9	<120	<6,300	<6.3	<6.3	<6.3	<6.3	<6.3	<6.3	<13	<6.3	**419**	<100	**1.0**	**92**	**8.6**	**80**	NS
SB-07	MAAFSB7-2	1-3	**430**	<6,200	**250**	<6.3	<6.3	<6.3	<6.3	<6.3	<13	<6.3	**9,230**	**765**	<1.0	**<12**	**8.0**	**81**	ML
	MAAFSB7-3	5-7	**320**	<5,400	**130**	<5.4	<5.4	<5.4	<5.4	<5.4	<11	<5.4	**10,100**	**141**	<1.0	**<11**	**8.8**	**93**	ML
	MAAFSB7-4 (h)	5-7	**210**	<5,500	<5.5	<5.5	<5.5	<5.5	<5.5	<5.5	<11	<5.5	**8,530**	**37**	<1.0	**19**	**8.4**	**91**	NS
	MAAFSB7-5	10-12	**450**	<5,100	<5.1	<5.1	<5.1	<5.1	<5.1	<5.1	<10	<5.1	**4,660**	<100	<1.0	**39**	**8.5**	**99**	SP
	MAAFSB7-6	14-15.5	**170**	<5,200	<5.2	<5.2	<5.2	<5.2	<5.2	<5.2	<10	<5.2	**7,140**	**846**	<1.0	**79**	**8.6**	**96**	NS

Table 6-3. Summary of Chemical Detections for Pilot Test Study Baseline Soil Sampling Data, July 1994 (continued)

(Results are reported in dry weight)

			Total Petroleum Hydrocarbons		Volatile Organic Compounds								Conventional						
Soil Boring Identification	Sample Identification	Sample Interval (feet)	TPH-GRO (µg/kg)	TPH-DRO (µg/kg)	PCE (µg/kg)	TCE (µg/kg)	1,2-DCE (µg/kg)	Benzene (µg/kg)	Ethyl-benzene (µg/kg)	m- &/or p-Xylene (µg/kg)	o-Xylene (µg/kg)	Toluene (µg/kg)	TOC (mg/kg)	TKN (mg/kg)	Ammonia (mg/kg)	Phosphorus (mg/kg)	pH	Solid Content (percent by Weight)	USCS Symbols Based on Geotechnical Laboratory Analysis (o)
	AOC-2:																		
SB-08	MAAFSB8-2	1-3	NA	NA	**35**	<1.1	NA	NA	NA	NA	NA	NA	**6,370**	NA	NA	NA	NA	**89**	ML
	MAAFSB8B-1 (i)	1-3	NA	NA	**21**	<1.1	NA	NA	NA	NA	NA	NA	**6,380**	NA	NA	NA	NA	**93**	NS
	MAAFSB8B-2 (i)	4-6	NA	NA	**260**	<130	NA	NA	NA	NA	NA	NA	**18,400**	NA	NA	NA	NA	**78**	NS
	MAAFSB8-3	4-6	NA	NA	**560**	<130	NA	NA	NA	NA	NA	NA	**13,400**	NA	NA	NA	NA	**79**	CL-ML
	MAAFSB8-4	10-12	NA	NA	<1.1	<1.1	NA	NA	NA	NA	NA	NA	**6,000**	NA	NA	NA	NA	**93**	SP
	MAAFSB8-5	12.5-13	NA	NA	<1.0	<1.0	NA	NA	NA	NA	NA	NA	**5,580**	NA	NA	NA	NA	**97**	SP
SB-09	MAAFSB9-1	1-3	NA	NA	**220**	<5.6	NA	NA	NA	NA	NA	NA	**10,300**	NA	NA	NA	NA	**90**	ML
	MAAFSB9B-1 (j)	1-3	NA	NA	**103**	<5.6	NA	NA	NA	NA	NA	NA	**10,400**	NA	NA	NA	NA	**90**	NS
	MAAFSB9-2	4-6	NA	NA	**650**	<130	NA	NA	NA	NA	NA	NA	**17,800**	NA	NA	NA	NA	**79**	CL-ML
	MAAFSB9B-2 (j)	4-6	NA	NA	**240**	<130	NA	NA	NA	NA	NA	NA	**16,500**	NA	NA	NA	NA	**79**	NS
	MAAFSB9-3	10-12	NA	NA	**15**	<1.1	NA	NA	NA	NA	NA	NA	**1,920**	NA	NA	NA	NA	**88**	ML
	MAAFSB9B-3 (k)	4-6	NA	NA	**93**	<6.4	NA	NA	NA	NA	NA	NA	**16,700**	NA	NA	NA	NA	**78**	NS
	MAAFSB9-4	14.5-15	NA	NA	<1.1	<1.1	NA	NA	NA	NA	NA	NA	**4,900**	NA	NA	NA	NA	**95**	SP
SB-10	MAAFSB10-1	1-3	NA	NA	**170**	<120	NA	NA	NA	NA	NA	NA	**11,400**	NA	NA	NA	NA	**83**	CL-ML
	MAAFSB10-2	5-7.5	NA	NA	**19**	<1.2	NA	NA	NA	NA	NA	NA	**3,880**	NA	NA	NA	NA	**84**	ML
	MAAFSB10-3 (l)	5-7.5	NA	NA	<1.0	<1.0	NA	NA	NA	NA	NA	NA	**4860**	NA	NA	NA	NA	**98**	NS
	MAAFSB10-4	10.1-12	NA	NA	**26**	<1.2	NA	NA	NA	NA	NA	NA	**4,050**	NA	NA	NA	NA	**83**	NS
	MAAFSB10-5	12.5-13	NA	NA	<1.0	<1.0	NA	NA	NA	NA	NA	NA	**3,320**	NA	NA	NA	NA	**98**	SP
SB-11	MAAFSB11-1	1-3	NA	NA	**26**	<1.3	NA	NA	NA	NA	NA	NA	**7,750**	NA	NA	NA	NA	**77**	CL-ML
	MAAFSB11-2	4-6	NA	NA	**18**	<1.3	NA	NA	NA	NA	NA	NA	**5,790**	NA	NA	NA	NA	**77**	ML
	MAAFSB11-3	10-12	NA	NA	<1.0	<1.0	NA	NA	NA	NA	NA	NA	**990**	NA	NA	NA	NA	**96**	SP
SB-12	MAAFSB12-1	1-3	NA	NA	**38**	<1.3	NA	NA	NA	NA	NA	NA	**19,400**	NA	NA	NA	NA	**76**	CL-ML
	MAAFSB12-2	4-6	NA	NA	<1.2	<1.2	NA	NA	NA	NA	NA	NA	**5,520**	NA	NA	NA	NA	**80**	ML
	MAAFSB12-3	10-12	NA	NA	<1.0	<1.0	NA	NA	NA	NA	NA	NA	**3,780**	NA	NA	NA	NA	**97**	SP
	KDHE Cleanup Standards *		100,000		NAv	NAv	8,000	1,400	NAv	63,000 (mixed) (n)		288,000	NAv	NAv	NAv	NAv	NAv	NAv	NAv
	Risk-based Guidelines **		NAv		25,000 - 110,000	17,000 - 520,000	270,000 - 18,000,000	3,200 - 200,000	3,100,000 - 200,000,000	980,000 - 1,000,000,000 (n)		2,700,000 - 410,000,000	NAv	NAv	NAv	NAv	NAv	NAv	NAv

Bold values represent detected compounds.

Shaded values represent concentrations that exceed Regulatory Standards or maximum Risk-based Guidelines or Carcinogen Levels.

< Below Practical Quantitation Limit

r Laboratory reanalysis
J Sample quantitative value estimated
(a) MAAFSB1-5 is a duplicate sample of MAAFSB1-2
(b) MAAFSB2B-3 is a duplicate sample of MAAFSB2B-2
(c) MAAFSB3B-4 is a duplicate sample of MAAFSB3B-2
(d) Co-located to MAAFSB4-1 and 4-2
(f) Co-located to MAAFSB5-1 and 5-2
(g) MAAFSB6B-4 is a duplicate sample of MAAFSB6B-2
(h) MAAFSB7-4 is a duplicate sample of MAAFSB7-3
(i) Co-located sample to MAAFSB8-2 and 8-3
(j) Co-located sample to MAAFSB9-1 and 9-2
(k) Duplicate sample of MAAFSB9B-2
(l) Duplicate sample of MAAFSB10-2
(m) Geotechnical testing was performed on co-located samples (from adjacent boreholes within 3 feet horizontally)
(n) Although no standards or guidelines are available for m- &/or p-Xylenes, concentrations reported as m- &/or p-Xylenes will be compared to the standards and guidelines for Xylenes (mixed)
(o) Geotechnical results correlate to borehole sample intervals; geotechnical sample ID's for SB-07 are MAAFSB7-1, MAAFSB7-2, and MAAFSB7-3
NA Not analyzed
NAv Not Available
NS Not Sampled

Unified Soil Classification System (USCS) Symbols:
ML Silt
SP Poorly graded Sand
CL Lean clay

* "Interim Soil Cleanup Standards, December 1993", Kansas Department of Health and Environment, Bureau of Environmental Remediation.

** Risk-based Guideline concentrations are based on a range of the industrial guidelines to represent EPA Regions III & IX, from the following citations: Region III Risk-based Concentration Table, March 1995, Roy L Smith, Senior Toxicologist - Technical Support Section; Region IX Preliminary Remediation Goals (PRGs) February 1995, Stanford J. Smucker, PhD, Regional Toxicologist.

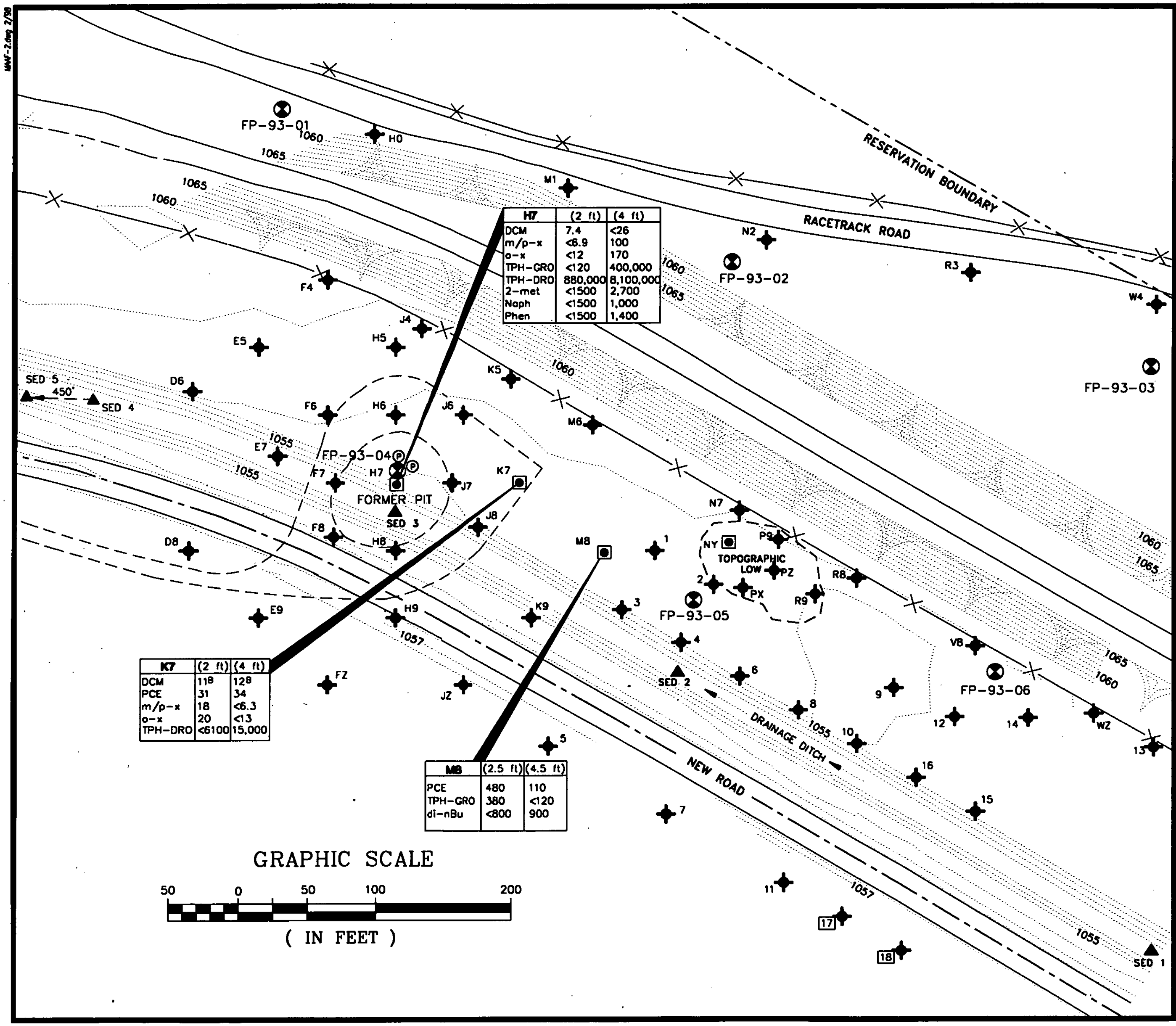
For complete list of analytes determined, see QCSR Pilot Test Study SVE and Bioventing Systems, 9 September 1994.

Table 6-4. Summary of Microbial Enumerations, July 1994

Sample No.	Depth (feet)	CFU/GM* NuAg	CFU/GM* BTX	MPN/GM* TPH
MAAFSB-1-1	1-3	3.7 X 10^{6}	6.4 X 10^{5}	<100
MAAFSB-1-2	4-6	>5 X 10^{8}	1.4 X 10^{5}	2.2 X 10^{3}
MAAFSB-1-3	10-12	8.0 X 10^{6}	3.6 X 10^{5}	1.2 X 10^{4}
MAAFSB-1-4	13-14	4.1 X 10^{7}	1.3 X 10^{7}	1.4 X 10^{4}
MAAFSB-2-1	1-3	3.6 X 10^{6}	4.1 X 10^{5}	<100
MAAFSB-2-2	4-6	2.9 X 10^{6}	6.9 X 10^{5}	DRY
MAAFSB-2-3	10-12	6.1 X 10^{5}	3.1 X 10^{4}	DRY
MAAFSB-2-4	13-14	1.2 X 10^{7}	NG	DRY
MAAFSB-3-1	1-3	6.9 X 10^{6}	1.1 X 10^{6}	<100
MAAFSB-3-2	4-6	2.1 X 10^{6}	1.8 X 10^{4}	DRY
MAAFSB-3-3	10-12	5.5 X 10^{6}	1.0 X 10^{4}	DRY
MAAFSB-3-4	13-14.5	1.1 X 10^{6}	NG	1.6 X 10^{4}
MAAFSB-4-1	1-3	3.8 X 10^{8}	2.0 X 10^{5}	<100
MAAFSB-4-2	4-6	4.3 X 10^{4}	NG	DRY
MAAFSB-4-3	10-12	1.4 X 10^{3}	NG	1.2 X 10^{4}
MAAFSB-4-4	13-14	1.7 X 10^{3}	NG	9.7 X 10^{3}
MAAFSB-5-1	1-3	6.1 X 10^{6}	2.1 X 10^{6}	4.4 X 10^{2}
MAAFSB-5-2	4-6	2.1 X 10^{5}	1.0 X 10^{4}	DRY
MAAFSB-5-3	10-12	1.7 X 10^{4}	NG	DRY
MAAFSB-5-4	13-14	2.2 X 10^{4}	NG	DRY
MAAFSB-6-1	1-3	>5 X 10^{8}	5.6 X 10^{5}	<100
MAAFSB-6-2	4-6	>5 X 10^{8}	4.4 X 10^{4}	3.1 X 10^{2}
MAAFSB-6-3	10-12	2.9 X 10^{4}	NG	DRY
MAAFSB-6-4	13.5-14	4.1 X 10^{4}	1.2 X 10^{4}	1.5 X 10^{4}
MAAFSB-7-1	1-3	1.2 X 10^{7}	7.7 X 10^{6}	<100
MAAFSB-7-2	4-6	4.8 X 10^{5}	1.2 X 10^{5}	<100
MAAFSB-7-3	10-12	1.1 X 10^{6}	4.4 X 10^{3}	2.2 X 10^{2}
MAAFSB-7-4	14-15.5	1.1 X 10^{5}	1.2. X 10^{4}	9.7 X 10^{3}

BTX Benzene, Toluene, Xylene
CFU/GM Colony Forming Units per Gram
DRY All liquid evaporated
MPN Most Probable Number

NuAg Nutrient Agar
NG No Grow
TPH Total Petroleum Hydrocarbons
* Dry Weight



H7	(2 ft)	(4 ft)
DCM	7.4	<26
m/p-x	<6.9	100
o-x	<12	170
TPH-GRO	<120	400,000
TPH-DRO	880,000	8,100,000
2-met	<1500	2,700
Naph	<1500	1,000
Phen	<1500	1,400

K7	(2 ft)	(4 ft)
DCM	11^{B}	12^{B}
PCE	31	34
m/p-x	18	<6.3
o-x	20	<13
TPH-DRO	<6100	15,000

M8	(2.5 ft)	(4.5 ft)
PCE	480	110
TPH-GRO	380	<120
di-nBu	<800	900

N

LEGEND:

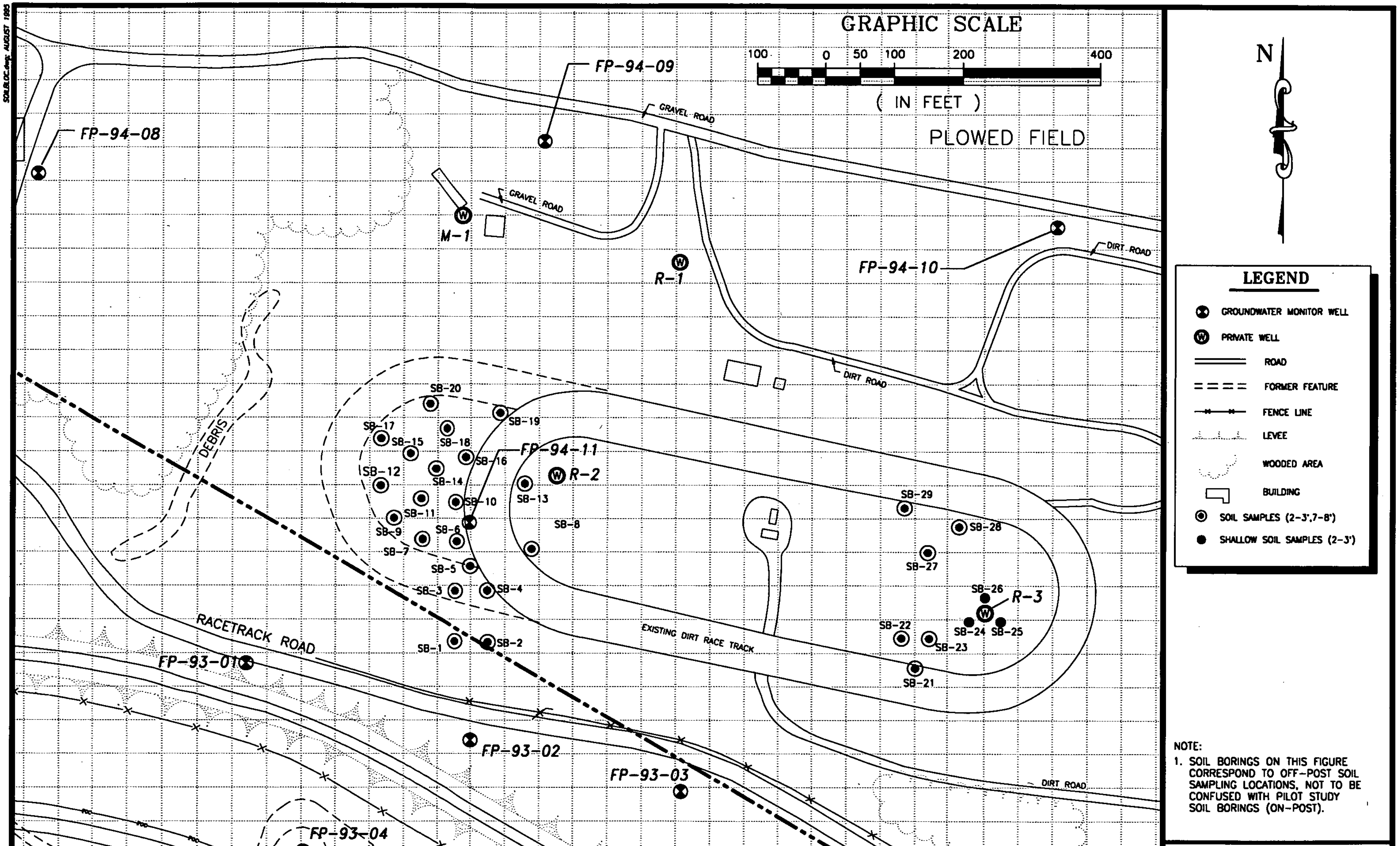
⊗ GROUNDWATER MONITOR WELL
✦ GROUNDWATER SCREENING SAMPLE LOCATION
⊡ SOIL, SOIL GAS AND GROUNDWATER SCREENING LOCATION
Ⓟ SOIL SAMPLE LOCATION FOR PCB ANALYSIS ONLY
▲ SEDIMENT SAMPLE
ELEVATION CONTOUR
ROAD
FORMER FEATURE
FENCE LINE
LEVEE

DCM	Dichloromethane
PCE	Tetrachloroethylene
m/p-x	m,p-Xylene
o-x	o-Xylene
TPH-GRO	Total Petroleum Hydrocarbons-Gasoline Range Organics
TPH-DRO	Total Petroleum Hydrocarbons-Diesel Range Organics
di-nB	di-n-Butylphthalate
2-met	2-Methylnaphthalene
Naph	Naphthalene
Phen	Phenanthrene
B	Analyte also present in the method blank at 9.4 ug/l

NOTE:

1. CONCENTRATIONS IN ug/kg.
2. AT LOCATION NY THERE WERE NO DETECTIONS ABOVE METHOD DETECTION LIMIT.
3. SOIL CLASSIFICATION IN THE STUDY AREA IS FROM THE HAYNIE SERIES.
4. *TOPOGRAPHIC LOW AREA LOCATED ON FIGURE BASED UPON FIELD MEASUREMENTS TAKEN DURING SI ACTIVITIES.
5. ELEVATION CONTOURS ARE IN FEET.

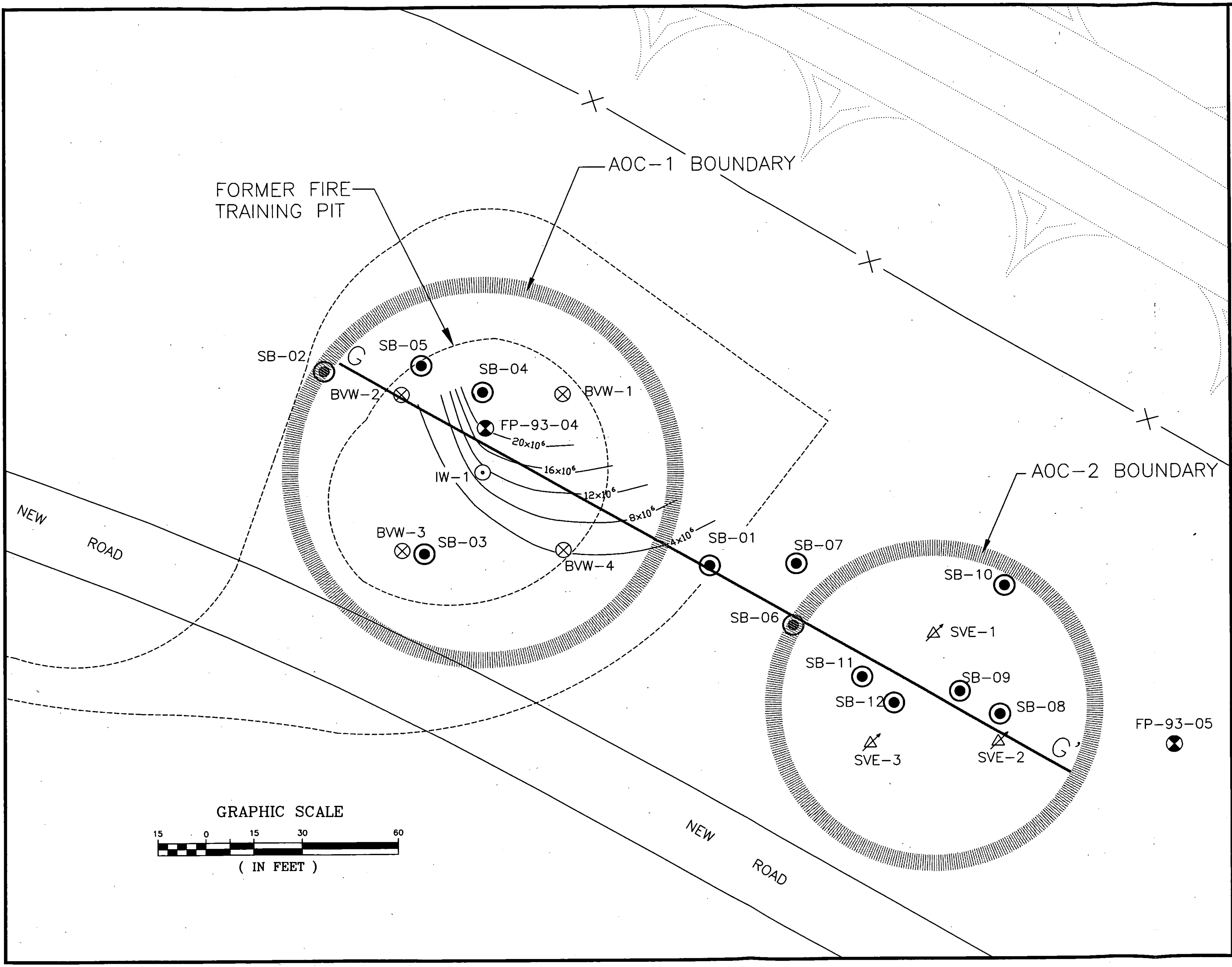
Figure 6-1:
Soil Sample Locations and VOC/SVOC Concentration Results, 9/93



NOTE:
1. SOIL BORINGS ON THIS FIGURE CORRESPOND TO OFF-POST SOIL SAMPLING LOCATIONS, NOT TO BE CONFUSED WITH PILOT STUDY SOIL BORINGS (ON-POST).

Figure 6-2: ESI Phase II Soil Sample Locations, 8/94

MAAF-14.dwg 2/98



LEGEND:

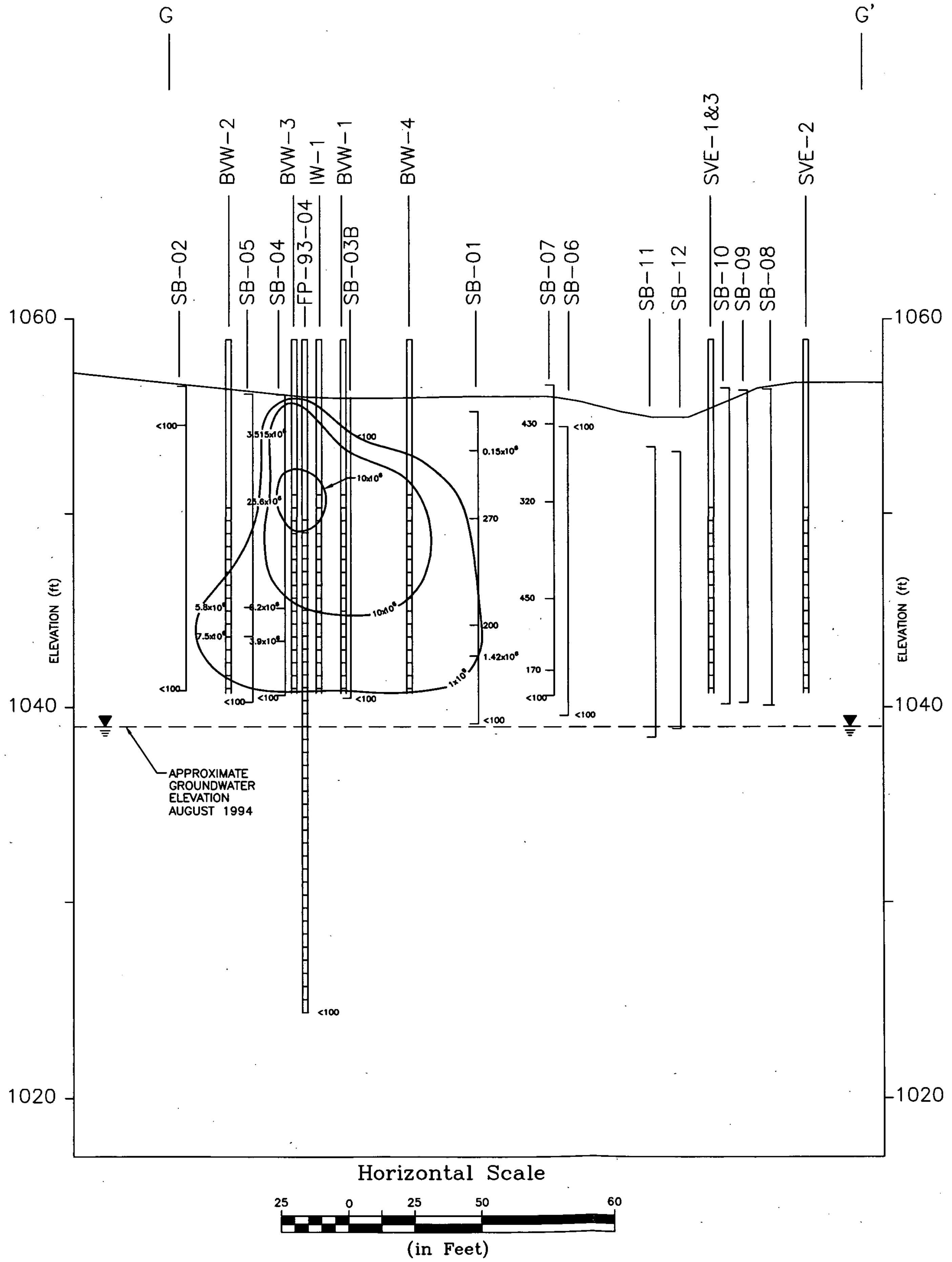
- ⊗ EXISTING GROUNDWATER MONITORING WELL
- ◉ PILOT STUDY SOIL BORING
- ⊗ BIOVENTING WELL
- ⊙ AIR INJECTION WELL
- SOIL VAPOR EXTRACTION WELL
- —— 4×10^6 TPH CONCENTRATION CONTOUR
- ---- FORMER FEATURE

NOTE:

1. TPH CONCENTRATION UNITS ARE ug/kg.
2. SOIL BORING LOCATIONS DEPICTED ON THIS FIGURE WERE USED FOR PILOT STUDY ACTIVITIES AND SHOULD NOT BE CONFUSED WITH ESI PHASE II SOIL BORING LOCATIONS.

Figure 6-3: Horizontal Extent TPH Concentrations in Soil from 4'-7' Depth Interval, 7/94

MAAF-31.dwg 2/98



LEGEND:

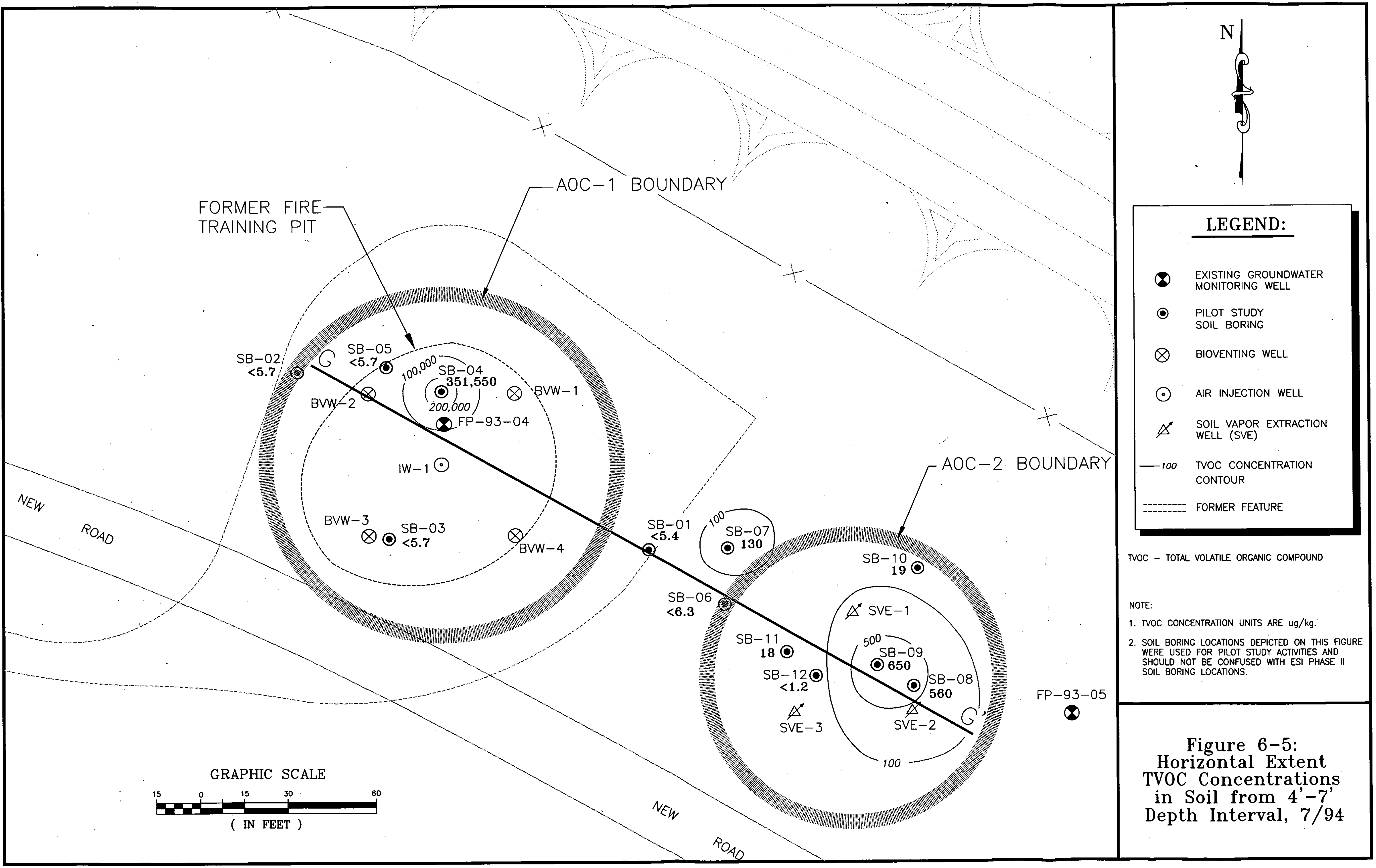
—$1\text{x}10^6$—	TPH CONTOUR CONCENTRATION VALUE (ug/kg)
<100	LESS THAN DETECTION LIMIT
450	TPH ANALYTICAL VALUES FOR SM SAMPLE AT INDICATED LOCATION (ug/kg)
▯	WELL SCREEN

NOTES:

1. WELLS AND SOIL BORING LOCATIONS HAVE BEEN PROJECTED ONTO THE CROSS SECTION LINE. ACTUAL DEPTH RELATIVE TO GROUND SURFACE SHOWN MAY DIFFER SLIGHTLY.
2. TPH CONCENTRATION UNITS ARE ug/kg.
3. SOIL BORING LOCATIONS DEPICTED ON THIS FIGURE WERE USED FOR PILOT STUDY ACTIVITIES AND SHOULD NOT BE CONFUSED WITH ESI PHASE II SOIL BORING LOCATIONS.

Figure 6-4:
Vertical Extent
of TPH Concentrations
in Soil, 7/94

TVOCHRZ.dwg, AUGUST 1995



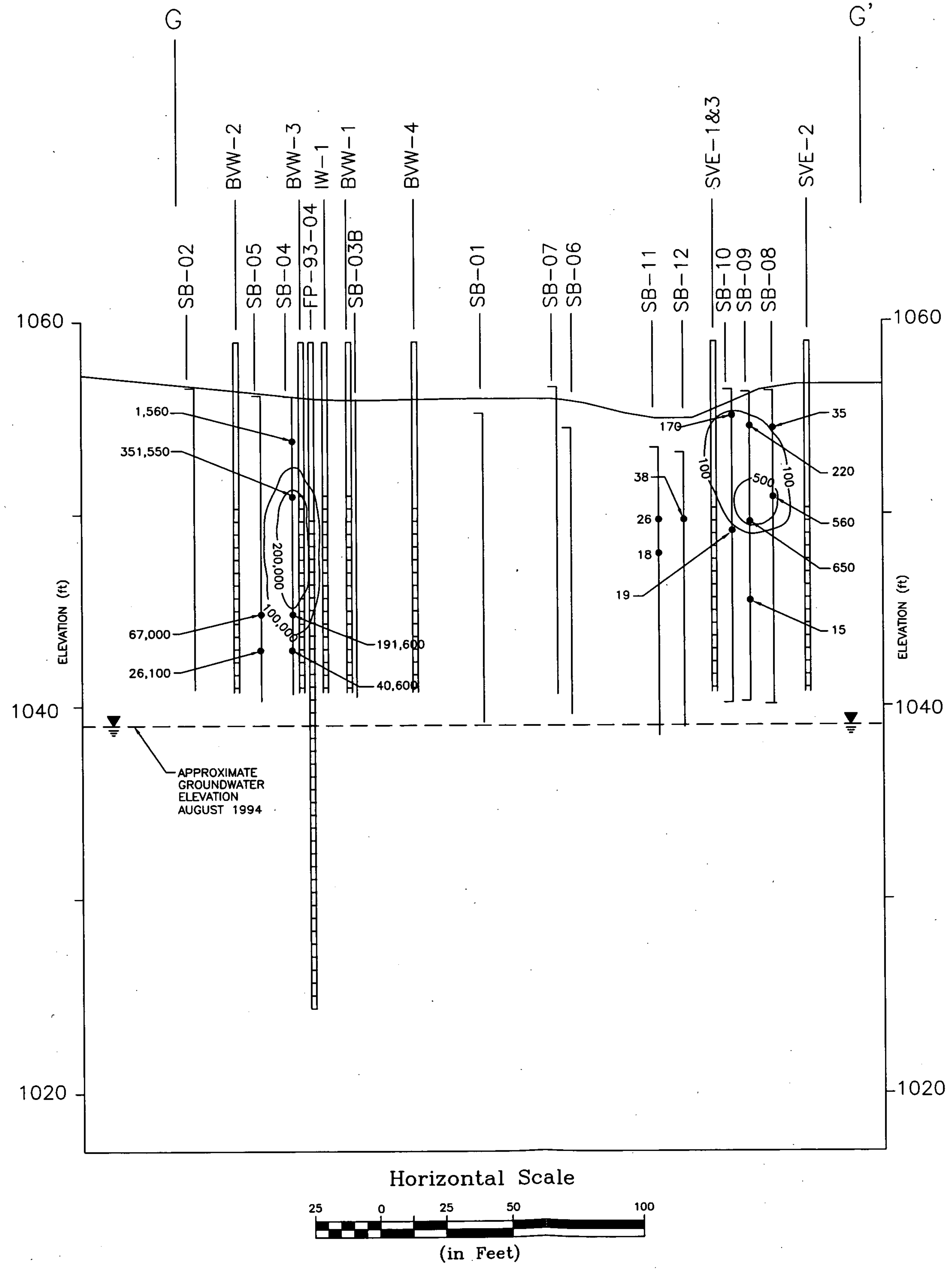
TVOC – TOTAL VOLATILE ORGANIC COMPOUND

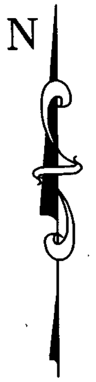
NOTE:

1. TVOC CONCENTRATION UNITS ARE ug/kg.
2. SOIL BORING LOCATIONS DEPICTED ON THIS FIGURE WERE USED FOR PILOT STUDY ACTIVITIES AND SHOULD NOT BE CONFUSED WITH ESI PHASE II SOIL BORING LOCATIONS.

Figure 6-5: Horizontal Extent TVOC Concentrations in Soil from 4'-7' Depth Interval, 7/94

MAAF-32.dwg 2/98





LEGEND:

—100— TVOC CONCENTRATION CONTOUR

650 TVOC VALUE AT SAMPLE LOCATIONS

▯ WELL SCREEN

TVOC – TOTAL VOLATILE ORGANIC COMPOUNDS

NOTE:

1. WELLS AND SOIL BORING LOCATIONS HAVE BEEN PROJECTED ONTO THE CROSS SECTION LINE. ACTUAL DEPTHS RELATIVE TO GROUND SURFACE SHOWN MAY DIFFER SLIGHTLY.
2. TVOC CONCENTRATION UNITS ARE ug/kg.
3. SOIL BORING LOCATIONS DEPICTED ON THIS FIGURE WERE USED FOR PILOT STUDY ACTIVITIES AND SHOULD NOT BE CONFUSED WITH ESI PHASE II SOIL BORING LOCATIONS.

Figure 6-6: Vertical Extent of TVOC Concentrations in Soil, 7/94

7.0 GROUNDWATER

The potential for groundwater contamination as a result of releases from the FFTA was evaluated by installing and sampling groundwater monitoring wells located in the vicinity of the FFTA and on nearby off-post properties. Drilling and sampling prior to monitoring well installation provided data on geology, and the sampling and analysis of on-post and off-post wells provided data on groundwater quality.

7.1 Well Installations

Seven groundwater wells (FP-93-01 through FP-93-07) were installed as part of the SI. The locations of these wells are depicted on Figure 2-2. These wells were installed in the vicinity of the FFTA. Well FP-93-04 is located at the center of the FFTA, and well FP-93-07 is located hydraulically upgradient from the FFTA. Therefore, well FP-93-07 is considered a background well. The boring logs, well completion diagrams, well specification forms, and well development records for each of these wells are provided in Appendix E. Additionally, in August 1994, four shallow off-post wells (FP-94-08 through FP-94-11) and, in July 1994, one shallow on-post piezometer (FP-94-12PZ) were installed in shallow alluvial materials. None of these wells are considered background wells. The locations of these wells and the piezometer are shown on Figure 2-2. Figure 10-2 presents a cross section to illustrate the depths of wells and other samples taken as part of this study.

7.2 Groundwater Analytical Results

Groundwater monitoring activities during both the SI and the ESI at MAAF included the chemical analysis of groundwater. The SI sampling occurred during October and November 1993, but is identified as the October 1993 event throughout this document. This included seven groundwater monitoring wells (FP-93-01 through FP-93-07), installed at the FFTA-MAAF as part of the SI, and six of eight private wells (B-1, F-1, F-2, M-1, N-1, and R-1), located off-post north of the FFTA. Two private wells (R-2 and R-3), scheduled to be included in the SI, were not sampled due to regional flooding in the area. The ESI sampling events were conducted in July/August 1994, October 1994, and January 1995. These initially involved only the seven on-post wells (FP-93-01 through FP-93-07) and eight off-post wells (B-1, F-1, F-2, M-1, N-1, R-1, R-2, and R-3), but more wells were included for the October 1994 and January 1995 sampling events. In October 1994 an off-post irrigation well (I-1) located north of MAAF was added. In January 1995 an additional four off-post monitoring wells (FP-94-08 through FP-94-11) and one on-post piezometer (FP-94-12PZ) were sampled. These wells and piezometer were installed to the north and northwest, respectively, of the FFTA-MAAF. Conversely, the January 1995 sampling event did not include four private wells (F-1, F-2, R-1, and R-2), which had been shut down for the winter. The details of which off-post private wells and irrigation well were sampled are summarized in the following table.

Summary of Private Well Sampling Events

	SI	ESI			
Private Well ID	October 1993	July/August 1994	October 1994	January 1995	April 1995
B-1	✓	✓	✓	✓	✓
F-1	✓	✓	✓	Not Sampled - Shut Down for Winter	✓
F-2	✓	✓	✓		✓
M-1	✓	✓	✓	✓	✓
N-1	✓	✓	✓	✓	✓
R-1	✓	✓	✓	Not Sampled - Shut Down for Winter	✓
R-2	Not Sampled Due to Flooding	✓	✓		✓
R-3		✓	✓	✓	✓
I-1	Not Included in Sampling Events		✓	✓	✓

Each of these sampling events is discussed below, and positive detections are compared to regulatory standards or guidance established by EPA and KDHE, and used as described in Section 2.0. In particular, the detected concentrations are compared against the MCLs established by EPA and the KALs established by KDHE. A comparison of the data from each of the sampling events is also presented. All positive detections are presented from the on-post wells in Table 7-1 and from the off-post wells in Table 7-2. KNLs are included for comparison in Tables 7-1 and 7-2.

One on-post and one off-post well are considered background wells. On-post well FP-93-07 is located hydraulically upgradient from FFTA-MAAF; therefore, it is considered a background well for the on-post wells. Well B-1, located hydraulically downgradient and approximately 5,600 feet northeast of FFTA-MAAF, is considered a background well for the off-post wells due to its distance from the site.

7.2.1 October 1993 Results

Samples were collected from the seven on-post monitor wells (FP-93-01 through FP-93-07) and six private wells (R-1, F-1, F-2, M-1, N-1, and B-1) in accordance with SI activities. Wells R-2 and R-3 could not be sampled due to regional flooding. Samples were collected on 27, 28, and 29 October 1993, except for wells M-1 and R-1, which were collected on 3 and 19 November 1993, respectively. This sampling event is identified as October 1993 throughout this document.

Positive detections for groundwater samples collected from the on-post monitoring wells are presented in Table 7-1. There were detections in four wells. VOCs were detected in FP-93-02, FP-93-04, and FP-93-05. SVOCs and TPH were detected only in FP-93-04. Metals were detected in FP-93-02, FP-93-04, and FP-93-07.

The highest concentrations of VOCs were found in FP-93-04, located in the center of the FFTA, and in FP-93-02, located downgradient of the FFTA. As shown in Table 7-1, the concentrations for DCE, TCE, and PCE exceed the MCL and the KAL in FP-93-02. In FP-93-04, DCE (4,100 μg/l), benzene (64 μg/l), and toluene (3,200 μg/l) all exceeded their respective KALs and MCLs. In FP-93-02, DCE at 76 μg/l was greater than both the KAL and the MCL. Also in FP-93-02, PCE at 210 μg/l was higher than the MCL and the KAL, and TCE at 21 μg/l exceeded the KAL and MCL. In FP-93-05, there were detections of TCE (1.2 μg/l) and PCE (1.2 μg/l), which did not exceed either the KAL or MCL.

2-Methyl naphthalene (31 μg/l), 4-methylphenol (15 μg/l), and naphthalene (73 μg/l) were all detected in FP-93-04. These were the only SVOCs detected in the on-post wells. Naphthalene was below the KAL. No MCL is available for naphthalene. KALs and MCLs have not been established for either 2-methyl naphthalene or 4-methylphenol. Both fractions of TPH were only detected in FP-93-04, with TPH-GRO at 13,000 μg/l and TPH-DRO at 1,200 μg/l. No regulatory standards or guidance are available for TPH. Seven metals were detected in the on-post wells. All the metals concentrations were less than three times the levels detected at FP-93-07, the background well. Therefore, these are considered within the range of background concentrations. The concentration of lead in FP-93-07 (0.017 μg/l) was slightly higher than the MCL. However, the lead level detected in FP-93-07 is not attributable to the FFTA because it is considered an upgradient, background monitoring well.

Positive detections for groundwater samples collected from the off-site private wells are presented in Table 7-2. VOCs were detected in R-1 and M-1. No SVOCs were detected. TPH-DRO was detected in F-2, and metals were detected in all the off-post wells.

As shown in Table 7-2, VOCs were detected in two off-post wells R-1 and M-1. Detections in R-1 exceeded regulatory standards or guidance. DCE (98 μg/l) was greater than both the KAL and the MCL of 70 μg/l. In R-1, PCE at 160 μg/l was higher than the MCL of 5 μg/l and the KAL of 7 μg/l, and the detection of TCE at 33 μg/l exceeded the KAL and MCL of 5 μg/l. In M-1, the detection of 2.2 μg/l of DCE was below regulatory standards or guidance.

Five metals (arsenic, copper, lead, selenium, and zinc) were detected in the off-post wells. All were detected in two or more wells, with zinc being detected in all of the wells. With the exception of one detection of lead in F-1, all detections were below regulatory standards or guidance. Lead was detected at 0.015 mg/l in F-1, which is equal to the MCL for lead, but below the KAL of 0.05 mg/l. Four detections were considered above background levels, or more than three times either the concentration detected at B-1 or the method detection limit. These were copper (0.24 mg/l) and zinc (0.24 mg/l) at N-1, zinc (0.34 mg/l) at M-1, and zinc (0.30 mg/l) at F-2.

7.2.2 July/August 1994 Results

Groundwater samples were collected from seven on-post monitor wells (FP-93-01 through FP-93-07) and eight off-post private wells (R-1, R-2, R-3, M-1, N-1, F-1, F-2, B-1) on 6, 7, and 8 July

1994 in accordance with the ESI SAP. Additionally, some on-post samples were analyzed for water quality parameters to support the pilot test study, specifically BOD using EPA Method 405.1, COD using EPA Method 410.4, TOC using EPA Method 9060, and TOX using EPA Method 9020.

As detailed in Technical Memorandum #3 to the ESI (provided in Appendix A), the July 1994 samples for VOC analysis were invalid due to cross-contamination in the laboratory storage cooler. The cross-contaminant was TCE, which is also a contaminant of concern for the ESI. On-post and off-post wells were resampled on 23 and 24 August 1994 and analyzed for VOCs only.

The results for the seven on-post monitor wells are presented in Table 7-1. There were concentrations of contaminants above detection limits in four of the sample locations (FP-93-02, FP-93-04, FP-93-05, and FP-93-07). VOCs were detected in wells FP-93-02, FP-93-04, and FP-93-05; SVOCs and TPH were only detected in well FP-93-04; and total metals were detected in wells FP-93-02 and FP-93-07.

The highest concentrations of VOCs were detected in monitor well FP-93-04, which is located in the center of the former fire training pit. The concentrations of contaminants detected in FP-93-04 were DCE at 820 μg/l and m- and/or p-xylene at 580 μg/l, both exceeding the MCL and KAL; ethylbenzene at 160 μg/l, o-xylene at 350 μg/l, and toluene at 150 μg/l, all below regulatory standards. VOCs detected in monitor well FP-93-02 include PCE at 140 μg/l and TCE at 56 μg/l, exceeding the MCL and KAL; and DCE at 29 μg/l, which is below regulatory standards. The VOCs detected in monitor well FP-93-05 did not exceed regulatory standards; the concentrations were PCE at 3.5 μg/l and TCE at 2.4 μg/l.

SVOCs and TPH-GRO were only detected in monitor well FP-93-04. The SVOCs include 2-methyl naphthalene at a concentration of 14 μg/l, and naphthalene at 45 μg/l, which is below the KAL standard (the MCL is not available). TPH was detected at a concentration of 4,400 μg/l. Regulatory standards are not available for 2-methyl naphthalene or TPH.

Metals were detected at or above method detection limits in monitor wells FP-93-02 and FP-93-07; silver was detected in FP-93-02 at three times the detection limit; and concentrations of lead and silver at the method detection limit were detected in FP-93-07, the background well. However, none of the concentrations exceeded regulatory standards; the detection at FP-93-02 is not considered above background, or more than three times the level at the background well.

The water quality parameters were detected above method detection limits in monitor wells FP-93-02, FP-93-04, FP-93-05, and FP-93-07. There are no regulatory standards available for the water quality parameters. TOC was detected at 26 mg/l, 13 mg/l, 3 mg/l, and 3 mg/l in wells FP-93-02, FP-93-04, FP-93-05, and FP-93-07, respectively. TOX was detected at 144 μg/l, 254 μg/l, 12 μg/l, and 6 μg/l in wells FP-93-02, FP-93-04, FP-93-05, and FP-93-07, respectively. COD was detected at 35 and 11 mg/l in wells FP-93-04 and FP-93-05, respectively. BOD was only detected in FP-93-04 at 8 mg/l. In general, TOC and TOX were elevated in wells with the highest VOC concentrations -- FP-93-02 and FP-93-04.

The results for the eight private wells indicate that there were detections above PQLs in all eight of the sample locations. These results are provided in Table 7-2. VOCs were detected in R-1, R-2, R-3, and F-1; SVOCs were detected in R-3; TPH-GRO was detected in R-1; and total metals were detected above the method detection limits in all eight of the off-post wells except R-3.

VOCs detected in R-1 and R-2 were DCE, PCE, and TCE. In R-1, DCE was detected at 96 μg/l, PCE at 170 μg/l, and TCE at 31 μg/l, all exceeding the KALs and MCLs. In R-2, DCE was detected at 88 μg/l, PCE at 140 μg/l, and TCE at 56 μg/l, all exceeding the KALs and MCLs. The only other VOC detected in the off-post wells was toluene, which was detected in R-3 at 0.5 μg/l and F-1 at 1.2 μg/l, which are below regulatory standards.

Two SVOCs were detected in R-3, 2-methyl naphthalene at 14 μg/l, for which no regulatory standards are available, and naphthalene at 52 μg/l, which is below the KAL (no MCL is available). TPH-GRO was detected in R-1 at 140 μg/l. No regulatory standards are available for TPH. Total metals were detected above method detection limits at all of the off-post sample locations except R-3. Metals detected include arsenic, copper, lead, selenium, and zinc. All metals detections were below regulatory standards or guidance. Zinc (1.2 mg/l) at F-2 was the only detection considered above background levels.

7.2.3 October 1994 Results

Groundwater samples were collected from seven on-post monitor wells (FP-93-01 through FP-93-07), eight off-post private wells (R-1, R-2, R-3, M-1, N-1, F-1, F-2, B-1), and one off-post irrigation well (I-1) between 9 and 11 October 1994 in accordance with the ESI SAP. While all other wells were sampled previously, this is the first time the irrigation well was sampled.

The results for the seven on-post monitor wells indicate that there were concentrations of contaminants above detection limits at four of the sample locations – FP-93-01, FP-93-02, FP-93-04, and FP-93-05. VOCs were detected in wells FP-93-01, FP-93-02, FP-93-04, and FP-93-05; SVOCs and TPH were detected only in well FP-93-04; and total metals were not detected in any well. These detections are shown in Table 7-1.

The highest concentrations of VOCs were detected in monitor well FP-93-04, which is located in the center of the former fire training pit. In FP-93-04, the two contaminants that exceeded the MCL and KAL were DCE at 710 μg/l and benzene at 7 μg/l. Additionally, dichloromethane was detected at 10 μg/l, which is above the MCL but not the KAL. However, because dichloromethane was also detected in the associated method blank, it is suspected that this detection is probably due to laboratory error. Detections below regulatory standard or guidance included m- and/or p-xylene at 380 μg/l, ethylbenzene at 110 μg/l, o-xylene at 200 μg/l, and toluene at 83 μg/l. VOCs detected in monitor well FP-93-02 include PCE at 100 μg/l and TCE at 43 μg/l, exceeding the MCL and KAL for both compounds; and DCE was detected at 21 μg/l, which is below regulatory standards. The VOCs detected in monitor well FP-93-05 did not exceed regulatory standards; the concentrations were TCE at 1.7 μg/l, PCE at 1.7 μg/l, toluene at 0.8 μg/l, and DCE at 0.8 μg/l. VOCs were detected in well FP-93-01 for the first time; o-xylene was detected at 0.7 μg/l, which is below regulatory standards or guidance.

SVOCs and TPH-GRO were only detected in monitor well FP-93-04. The SVOCs include 2-methyl naphthalene at 14 μg/l, bis (2-ethylhexyl) phthalate at 10 μg/l, and naphthalene at 38 μg/l; and TPH-GRO was detected at a concentration of 2,200 μg/l. The detection of bis (2-ethylhexyl) phthalate and naphthalene were both below their KALs (MCLs are not available for either compound). Regulatory standards are not available for 2-methyl naphthalene or TPH. There were no detections of metals in the on-post wells.

The results for the eight private wells and the irrigation well indicate that there were detections above PQLs in all nine of the sample locations. VOCs were detected in R-1, R-2, R-3, M-1, and B-1; TPH-GRO was detected in R-1, R-2, and I-1; and total metals were detected above method detection limits in all of the off-post wells except R-2 and R-3. These results are provided in Table 7-2.

The VOCs detected in both R-1 and R-2 were DCE, PCE, and TCE; in addition, in R-1 benzene was detected. In R-1, DCE was detected at 290 μg/l, PCE at 380 μg/l, and TCE at 78 μg/l, all exceeding the KALs and MCLs. The concentration of benzene was 2 μg/l, which is below regulatory standard or guidance. In R-2, DCE was detected at 110 μg/l, PCE at 130 μg/l, and TCE at 49 μg/l, all exceeding the KALs and MCLs. The only other VOCs detected in the off-post wells were toluene, which was found in R-3 at 24 μg/l, DCE at M-1 at 0.9 μg/l; and dichloromethane in B-1 at 0.9 μg/l, which are below regulatory standards or guidance. However, the detection of dichloromethane has been attributed to laboratory contamination, because it was also detected in the associated method blank within a factor of two.

TPH-GRO were detected in R-1 at 260 μg/l, in R-2 at 130 μg/l, and in the I-1 at 790 μg/l. No regulatory standards are available for TPH. Total metals were detected PQLs in all of the off-post sample locations except R-2 and R-3. Metals detected include arsenic, lead, selenium, and zinc. All metals detections were below regulatory standard or guidance. Only zinc (0.43 mg/l) at F-2 was considered above background levels; it was detected at more than three times the concentration at B-1, the background well.

Because no VOCs were detected in well I-1, the detection in well I-1 was investigated to determine the nature of the contaminants. The Total Ion Current Profile and the Mass Spectra for this sample indicate the presence of a single non-target compound tentatively identified as tetrahydrofuran (THF) as the source of contamination. THF is a common organic solvent found, for example, in PVC adhesives. THF elutes within the retention time window for gasoline range organics and is detected by the FID used in the TPH methodology. This compound, however, is not associated with gasoline range or other petroleum hydrocarbons, and is more likely a result of the leaching of the well pipe adhesive.

7.2.4 January 1995 Results

Groundwater samples were collected from seven on-post monitor wells (FP-93-01 through FP-93-07), four of the eight off-post private wells (R-3, M-1, N-1, and B-1) and one off-post irrigation well (I-1) between 21 and 27 January 1995 in accordance with the ESI SAP. Four of the off-post wells (R-1, R-2, F-1, and F-2) were not sampled because they were shut off by their owners for the winter. In addition, the four off-post monitoring wells (FP-94-08 through FP-94-11) and the on-post piezometer (FP-94-12PZ) were sampled for the first time.

The results for the seven on-post monitor wells and on-post piezometer, shown in Table 7-1, indicate that there were concentrations of contaminants above PQLs in three of the sample locations (FP-93-02, FP-93-04, and FP-93-05). VOCs were detected in wells FP-93-02, FP-93-04, and FP-93-05; SVOCs, TPH, and total metals were detected only in well FP-93-04.

The highest concentrations of VOCs were detected in monitor wells FP-93-04, located in the center of the former fire training pit, and FP-93-02, located downgradient of FP-93-04. The only contaminant that exceeded the MCL and KAL was PCE at 16 μg/l in FP-93-02. The two other VOCs detected in monitor well FP-93-02 were DCE at 5.5 μg/l and TCE at 4.4 μg/l. In FP-93-04, no contaminants exceeded either the MCL or KAL. Detections below regulatory standards or guidance in FP-93-04 included m- and/or p-xylene at 220 μg/l, ethylbenzene at 50 μg/l, o-xylene at 150 μg/l, toluene at 2.3 μg/l, DCE at 3.3 μg/l, trichloroethylene at 1.9 μg/l, and dichloromethane at 1.4 μg/l. The VOCs detected in monitor well FP-93-05 did not exceed regulatory standard or guidance; the concentrations were DCE at 0.8 μg/l and dichloromethane at 1.4 μg/l. The detections of dichloromethane in FP-93-04 and FP-93-05 are attributable to laboratory contamination, because dichloromethane was also detected in the method blank.

SVOCs, TPH, and total metals were only detected in monitor well FP-93-04. The only SVOC detected was naphthalene at a concentration of 13 μg/l, which is below the KAL (MCL is not available). Both TPH-GRO and TPH-DRO were detected at concentrations of 1,900 and 1,090 μg/l, respectively. Regulatory standards are not available for TPH. Lead, the only metal detected, was detected at 0.021 mg/l. This detection is considered above background levels, and is above the MCL of 0.015 mg/l, but below the KAL of 0.05 mg/l.

The results for the four private off-post wells (B-1, M-1, N-1, and R-1), four off-post monitoring wells (FP-94-08 through FP-94-11) and the irrigation well (I-1) indicate that there were detections above method detection limits in all of the sampled locations, as shown in Table 7-2. VOCs were detected in wells I-1, M-1, FP-94-08, FP-94-09, and FP-94-11. Total metals were detected above method detection limits in all of the off-post wells except FP-94-08 and FP-94-09. No TPH or SVOCs were detected.

The only detection of VOCs above regulatory standard or guidance was in FP-94-09; DCE was detected at 94 μg/l, above both the MCL and the KAL. The only other VOC detected in this well was TCE at 1.9 μg/l. In FP-94-11 there were detections of DCE at 51 μg/l, TCE at 1.0 μg/l, benzene at 0.9 μg/l, m- and/or p-xylenes at 1.1 μg/l, and toluene at 2.4 μg/l. Additionally, there was detections of DCE in M-1 at 0.5 μg/l and toluene in I-1 at 2.2 μg/l, both below regulatory standard or guidance. Additionally, dichloromethane was detected at 0.9 μg/l in FP-94-08. However, because this compound was also detected in the method blank, it is attributable to laboratory contamination.

Total metals were detected above method PQLs in all of the off-post sample locations except FP-94-08 and FP-94-09. Metals detected include arsenic, selenium, and zinc; none were above background levels. The only detection above regulatory standard or guidance was selenium in B-1 at a concentration of 0.1 mg/l, which is above the MCL and the KAL.

7.2.5 Comparison of Data

Analytical results from the one groundwater monitoring event conducted as part of the SI activities and the three quarterly groundwater monitoring events conducted as part of the ESI activities are compared. Quarterly isoconcentration contour maps are presented for the October 1993, July/August 1994, and October 1994 sampling events. Isoconcentration contour maps January 1995 were not produced for this sampling event because wells R-1 and R-2 could not be sampled. Without the data from these wells, any contours produced would not accurately represent conditions at the on-post and off-post properties. These events were carried out in October 1993, July/August 1994, October 1994, and January 1995. (The quarterly sampling event in April 1995 is not presented in this document.) The data for all four sampling events are presented in Tables 7-1 and 7-2. All of the groundwater data are compared to the background wells FP-93-01 and B-1.

7.2.5.1 October 1993

The VOCs detected in the wells during the SI investigation are the same as those detected during the soil gas and groundwater screening survey conducted as part of the SI. VOCs detected are DCE, TCE, PCE, BTEX, and TPH. SVOCs detected are naphthalene, 2-methyl napthalene, and 4-methylphenol. Seven metals were also detected. The concentrations for DCE, TCE, and PCE exceed regulatory standards in both FP-93-02 and R-1. Concentrations for DCE, benzene, and toluene exceed regulatory standard or guidance in FP-93-04, the well located at the center of the former fire training area. Lead was detected at slightly above the MCL in FP-93-07 and at the MCL in F-1.

Figure 7-1 displays four isoconcentration maps for concentrations of contaminants in groundwater from the on-post monitor wells: (1) PCE detections, (2) TCE detections, (3) DCE detections, and (4) overlay of PCE, TCE, and DCE detections. The off-post wells were not included in these maps since the chemical data are incomplete because R-2 and R-3 could not be sampled due to regional flooding. The PCE isoconcentration map demonstrates that the highest concentration of PCE detected is in monitor well FP-93-02, along the Fort Riley installation boundary downgradient of the FFTA-MAAF. There is only one other detection of PCE in well FP-93-05. TCE was only detected in two wells, FP-93-02 and FP-93-05. The TCE isoconcentration map depicts an area of contamination similar to that of PCE.

In contrast, DCE was detected at the highest concentration in well FP-93-04, which is the center of the former pit. DCE was also detected in FP-93-02. The DCE area of contamination is therefore, depicted from the center of the former pit toward the installation boundary. The final isoconcentration map was provided to visually show the distribution of contaminants, indicating that DCE was present in the center of the FFTA and that PCE and TCE may have migrated from the center of the FFTA toward a location downgradient of the original source. This is consistent with the soil gas and groundwater screening isoconcentration maps, which indicate that contaminants are moving from the center of the FFTA-MAAF towards FP-93-02.

For the metals data, four detections at off-post wells and no detections at on-post wells were considered above background levels, or more than three times either the concentration detected at B-1 or the method detection limit. These were copper (0.24 mg/l) and zinc (0.24 mg/l) at N-1, zinc (0.34 mg/l) at M-1, and zinc (0.30 mg/l) at F-2. In addition, at FP-93-07 total lead was detected above the MCL (0.017 mg/l), and at F-1 total lead was detected at the MCL (0.015 mg/l).

7.2.5.2 July/August 1994

For the on-post wells, the VOC data appear to show the greatest reductions in concentrations between October 1993 and July/August 1994. Isoconcentration maps for DCE, PCE, and TCE for data collected in July/August 1994 are depicted in Figures 7-2 through 7-4. Although DCE is detected in FP-93-04 for both sampling events, the July/August 1994 concentration is four times lower than the October 1993 concentration. Similarly, the concentration of toluene in FP-93-04 was reduced by a factor of 20, decreasing the concentration of toluene below the regulatory standards; and the concentration of TPH-GRO has also been reduced by a factor of three. The reductions in concentration are potentially accounted for by horizontal or vertical migration, loss through vapors, natural attenuation, or groundwater levels receding below the zone of contamination.

The concentrations of total metals and the SVOCs are similar between these two sampling events. The total metals data were also compared to concentrations in FP-93-07 and B-1, which are considered background levels. A comparison of this data to the background data is presented in Figure 7-5. The concentrations of metals in the background MAAF supply well in Building 802 is provided in Appendix F. Silver was the only metal detected above background in FP-93-02 at 0.3 mg/l. This concentration is more than three times the concentration in FP-93-07, which is considered background.

The well data for the off-post properties do not appear to have changed greatly between these two sampling events. The VOC and SVOC concentrations are consistent between the two sampling rounds. Small variations were noted for metals and TPH. In F-2, TPH-DRO was detected at 300 mg/l in October 1993 and was not detected above the PQL in July 1994. The TPH-DRO in F-2 is not attributable to FFTA-MAAF. This is apparent because there were no detections of TPH-DRO in wells FP-93-02, R-2, and R-3, which are located hydraulically between FFTA-MAAF and F-2.

The metals data also indicate that zinc was detected in F-2 (1.2 mg/l) at concentrations that exceed the background levels in B-1 and FP-93-07, as indicated in Figure 7-5. There were three other detections that exceeded background levels by more than three times in October 1993 that were not above background levels or below the method detection limit in July 1994. At F-1, total lead was detected in October 1993 at the MCL (0.015 mg/l); however, lead was not detected above the PQL in the July 1994 data.

7.2.5.3 October 1994

The VOC data appear to have the greatest decreases in concentrations over time. Isoconcentration contour maps for DCE, PCE, TCE, and total VOCs in October 1994 are depicted in Figures 7-6 through 7-9. Although DCE was detected in FP-93-04 for all three sampling events, the October 1994 concentration is only slightly (between 5 and 10 percent) lower than the July/August 1994 concentration. However, this concentration is four times lower than the October 1993 concentration (see Figure 7-1 and Table 7-1). Similarly, between October 1993 and July/August 1994 the concentration of toluene in FP-93-04 was reduced by a factor of 20, decreasing the concentration of toluene below the regulatory standards. This decrease has continued, with the October 1994 concentration slightly more than half the July/August concentration, or approximately 40 times lower than the original sampling event. The isoconcentration map for TPH in October 1994 is depicted in Figure 7-10. The concentration of TPH-GRO was also reduced by a factor of three. The reductions in concentration are potentially accounted for by horizontal or vertical migration, loss through vapors, natural attenuation, or groundwater levels receding below the zone of contamination.

The concentrations of total metals and the SVOCs were similar to previous sampling events. The total metals data were also compared to background concentrations. Concentrations in FP-93-07, and B-1 are considered representative background levels. A comparison of these data to the background data is presented in Figure 7-5. Silver was the only metal detected above background in FP-93-02 at 0.03 mg/l. This concentration is more than two times the concentration in FP-93-07, which is considered background.

The well data for off-post properties indicate that for the first time there were increases in concentrations of VOCs and TPH, while SVOCs and metals concentrations remained constant. While the concentrations of VOCs remained relatively constant between October 1993 and July/August 1994, the concentrations of DCE more than tripled between July/August 1994 and October 1994. Similarly, PCE doubled in concentration in this same period and TCE increased by nearly 2.5 times. TPH-GRO was detected in three off-post well, R-1, R-2, and I-1. The concentration detected in R-1 was nearly double the July 1994 concentration from that well, the first time it was detected. At R-2, TPH-GRO was detected for the first time. As detailed in Section 7.2.3, the detection of TPH-GRO is attributable to leaching from the glue used in the construction of the well. SVOCs were only detected in one well in July 1994. None were detected in either October 1993 or October 1994. Similar to the July 1994 sampling event, the metals data indicate that zinc was detected in F-2 at a concentration that exceed the background levels in B-1, as indicated in Figure 7-5. Zinc was exceeded background levels at this well in October 1993.

7.2.5.4 January 1995

For the on-post wells, the VOC data have generally continued to decrease in concentration over time. [Isoconcentration contour maps for DCE, PCE, TCE, and total chlorinated organics were not produced for this sampling event because wells R-1 and R-2 could not be sampled. Without the data from these wells, any contours produced would not accurately represent conditions at the on-post and off-post properties.] In FP-93-04, concentrations of DCE and toluene have shown the greatest reduction since the last sampling event, while benzene, ethylbenzene, m- and/or p-xylenes, and o-xylene show continued reductions. TCE is detected for the first time during this sampling event. Concentrations of DCE decreased from 710 μg/l to 3.3 μg/l, and toluene decreased from 83 μg/l to 2.3 μg/l. Concentrations of benzene were reduced from 7.0 μg/l to below the PQL of 0.4 μg/l. Ethylbenzene was reduced by more than 50 percent, m- and/or p-xylenes by more than 40 percent, and o-xylenes by 25 percent since the last sampling event. The reductions in the concentrations of VOCs are probably accounted for by the running of the SVE and the bioventing pilot studies at the FFTA, but might be attributable to horizontal or vertical migration, loss through vapors, natural attenuation, or groundwater levels receding below the zone of contamination.

Naphthalene was the sole SVOC detected in any of the on-post wells during the January 1995 sampling event; it was found only in well FP-93-04. This compound has been detected in this well during all four sampling events, and the concentrations have decreased steadily over time from 73 μg/l in October 1993 to 13 μg/l in January 1995. In the three previous sampling events, two or three SVOCs have been detected in well FP-93-04. The concentration of TPH-GRO was reduced by 10 percent since the previous sampling event in October 1994. TPH-DRO was detected at 1,090 µg/l. In both July/August and October 1994, this fraction was below the method detection limit of 100 µg/l. In October 1993, it was detected at a concentration of 1,200 µg/l. During this sampling event, lead was the only metal detected above background; it was found in FP-93-04 at 0.021 mg/l, which is above the MCL. During prior sampling events, concentrations of lead ranging from near the detection limit to 0.017 mg/l have been seen in on-post wells. The detection of lead in FP-93-04 is slightly greater than prior detections (0.017 mg/l) in the background well FP-93-07.

The data for the off-post wells B-1, R-3, and N-1 and the irrigation well I-1 do not appear to have changed much over time. Small variations were noted for VOCs, TPH, and metals. During the January 1995 sampling event, no detections of SVOCs or TPH were noted. In I-1, included in the periodic sampling since October 1994, there was the first detection of a VOC with toluene found at 2.2 µg/l. DCE was detected in M-1 at 0.5 µg/l, slightly lower than the October 1994 (0.9 µg/l) and October 1993 (2.2 µg/l) sampling events. The metals data also indicate that selenium was detected in B-1 at concentrations (0.1 mg/l), which exceed the MCL but not the KAL. No metals were detected at levels exceeding background concentrations.

7.3 Groundwater Use

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. As outlined in the EPA Guidance, groundwater users were evaluated within 4 miles of the FFTA-MAAF.

7.3.1 Alluvial Aquifers

Fort Riley and the communities of Junction City and Ogden 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, and Ogden has three active wells (Ref. 53, 54, 55). Ogden also provides water to a rural water district in Riley County. The wells for Ogden and Junction City are greater than 4 miles from the FFTA-MAAF.

The location of water supply boundaries and the 4-mile radius around the FFTA-MAAF are shown in Plate 3. The Fort Riley wells, which are upgradient of the FFTA-MAAF, serves the population of 28,400 on Fort Riley. The nearest public water supply well is located at MAAF and is within 1 mile of the FFTA-MAAF. This well is located east of the airfield and south, upgradient, of the FFTA. The well at MAAF is only used to service the airfield in the event of an emergency affecting the Fort Riley water distribution system as a whole. The Grandview Plaza wells are upgradient of the FFTA-MAAF. There are an estimated 14 residences using private well located potentially downgradient within 2 miles of the FFTA-MAAF.

An irrigation well placed into service in the spring of 1994 is located approximately 2,400 feet north, potentially downgradient, of the FFTA-MAAF. The well has pumped approximately 22 million gallons of water from July through September 1994.

7.3.2 Bedrock Aquifers

The alluvial aquifer is the primary source of drinking water within 4 miles of the FFTA-MAAF. The SCAPS investigation showed minimal vertical migration of contaminants through the soil. Groundwater flow is much greater in the alluvial aquifer in the Fort Riley area compared to the underlying bedrock aquifer, therefore, little movement of groundwater from alluvial aquifers to bedrock aquifers is expected.

Table 7-1. Summary of Chemical Detections for SI and ESI Groundwater Data - On-Post Wells, October 1993, July/August 1994, October 1994 and January 1995

(There were no detections in wells FP-93-03 and FP-93-06 or piezometer FP-94-12PZ)

Sample Location	FP-93-01 (a)	FP-93-02				FP-93-04							KNL (+)	KAL (+)	MCL (++)
Sample Identification	FP-93-01-02	MAAF-MW-2	FP-93-02	FP-93-02-02	FP-93-02	MAAF-MW-4	FP-93-04	FP-93-04R-1	FP-93-04-2	FP-93-09-2	FP-93-04	FP-93-08			
Sample Event	Oct-94	Oct-93	Jul/Aug-94	Oct-94	Jan-95	Oct-93	Jul/Aug-94		Oct-94		Jan-95				
Volatile Organic Compounds (ug/l)															
Benzene	<0.4	<10	<4.0	<0.4	<0.4	**64**	<20	<20	**6.0**	**7.0**	<0.4	<0.4	0.5	5	5
1,2-Dichloroethylene	<0.5	**76**	**29**	**21**	**5.5**	**4,100**	**820**	**750**	**710**	**690**	**3.3**	**2.8**	7 (c)	70 (c)	70 (c)
Dichloromethane	<0.9	<23	<9.0	<0.9	<0.9	<90	<45	<45	<9.0	**10B**	**1.4B**	<0.9	5	50	5
Ethylbenzene	<0.7	<18	<7.0	<0.7	<0.7	**190**	**150**	**160**	**100**	**110**	**50**	**46**	68	680	700
m &/or p-Xylenes	<0.6	<15	<6.0	<0.6	<0.6	**320**	**560**	**580**	**370**	**380**	**220**	**190**	44	440	10,000
ortho-Xylene	**0.7**	<15	<6.0	<0.6	<0.6	**330**	**310**	**350**	**200**	**200**	**150**	**130**	44	440	10,000
Tetrachloroethylene	<1.1	**210**	**140**	**100**	**16**	<110	<55	<55	<11	<11	<1.1	<1.1	0.7	7	5
Toluene	<0.4	<10	<4.0	<0.4	<0.4	**3,200**	**150**	**150**	**83**	**80**	**2.3**	**1.9**	200	2,000	1,000
Trichloroethylene	<1.1	**21**	**56**	**43**	**4.4**	<60	<30	<30	<6.0	<6.0	**1.9**	**1.8**	0.5	5	5
Semi-Volatiles (ug/l)															
Bis (2-Ethylhexyl) Phthalate	<10	<10	<10	<10	<10	<10	<10	<10	<10	**10**	<10	<10	420	4,200	NAv
2-Methyl Naphthalene	<10	<10	<10	<10	<10	**31**	**14**	<10	<10	**14**	<10	<10	NAv	NAv	NAv
4-Methylphenol	<10	<10	<10	<10	<10	**15**	<10	<10	<10	<10	<10	<10	NAv	NAv	NAv
Naphthalene	<10	<10	<10	<10	<10	**73**	**45**	<10	**29**	**38**	**13**	<10	14.3	143	NAv
Total Metals (mg/l)															
Arsenic	<0.01	<0.01	<0.01	<0.01	<0.01	**0.01**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NAv	0.05	0.05
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	< 0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NAv	0.05 (d)	0.1 (d)
Copper	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	NAv	1	1.3 (f)
Lead	<0.003	<0.003	<0.003	<0.003	<0.003	**0.004**	<0.003	<0.003	<0.003	<0.003	**0.013**	**0.021**	NAv	0.05	0.015 (f)
Nickel	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	NAv	0.15	0.1
Selenium	<0.005	**0.009**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NAv	0.045	0.05
Silver	<0.01	<0.01	**0.03**	<0.01	<0.01	< 0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NAv	0.05	NAv
Zinc	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	NAv	5	NAv
Water Quality Testing															
TOC (mg/l)	NA	NA	**26**	NA	NA	NA	**8**	**13**	NA	NA	NA	NA	NAv	NAv	NAv
TOX (ug/l)	NA	NA	**144**	NA	NA	NA	**216**	**254**	NA	NA	NA	NA	NAv	NAv	NAv
COD (mg/l)	NA	NA	<10	NA	NA	NA	**35**	**32**	NA	NA	NA	NA	NAv	NAv	NAv
BOD (mg/l)	NA	NA	<5	NA	NA	NA	**8**	**8**	NA	NA	NA	NA	NAv	NAv	NAv
Total Petroleum Hydrocarbons (ug/l)															
TPH-GRO (ug/l)	<100	<100	<100	<100	<100	**13,000**	**3,600**	**4,400**	**2,200**	**2,100**	**1,900**	**1,800**	NAv	NAv	NAv
TPH-DRO (ug/l)	<100	<100	<100	<100	<100	**1,200 (e)**	<100	<100	<100	<100	**1,090 (e)**	**730 (e)**	NAv	NAv	NAv

Bold values represent detected compounds

Shaded values represent concentrations that are equal to or exceed the MCL and/or the KAL.

The July 1994 samples were collected on 6, 7 and 8 July 1994; volatiles analyses is based on samples recollected in August 1994. The identification in the QCSR for all VOC resamples (July/August 1994) is the well identification followed by "-1R".

B Analyte detected in the associated method blank; result has not been blank corrected.

\+ Kansas Department of Health and the Environment, Bureau of Environmental Remediation, Groundwater Contamination Cleanup Target Concentrations, November 1988.

++ U.S. EPA, Office of Water, Drinking Water Regulations and Health Advisories, May 1995.

For complete list of analytes determined, see QCSR Site Investigations of High Priority Sites, 17 December 1993; QCSR Periodic Groundwater Monitoring Samples, 11 November 1994; QCSR Periodic Groundwater Monitoring Samples, 8 December 1994; QCSR Periodic Groundwater Sampling, March 1995.

(a) FP-93-01 had no detections in October 1993, July/August 1994, or January 1995..

(b) FP-93-07 had no detections in October 1994 or January 1995.

(c) Although a KAL, KNL and MCL for 1,2-DCE (mixed) is not available, concentrations reported as 1,2-DCE (mixed) will be compared to the more conservative KAL, KNL and MCL for 1,2- DCE isomers.

(d) The MCL and KAL represent values for both trivalent and hexavalent chromium.

(e) Calculated from a kerosene standard.

(f) Action Levels

NA Not Analyzed

NAv Not Available

< Below Practical Quantitation Limit.

Table 7-1. Summary of Chemical Detections for SI and ESI Groundwater Data - On-Post Wells, October 1993, July/August 1994, October 1994 and January 1995 (continued)

(There were no detections in wells FP-93-03 and FP-93-06 or piezometer FP-94-12PZ)

Sample Location	FP-93-05				FP-93-07 (b)			KNL (+)	KAL (+)	MCL (++)
Sample Identification	MAAF-MW-5	FP-93-05	FP-93-05-02	FP-93-05	MAAF-MW-600(c)	MAAF-MW-7	FP-93-07			
Sample Event	Oct-93	Jul/Aug-94	Oct-94	Jan-95	Oct-93		Jul/Aug-94			
Volatile Organic Compounds (ug/l)										
Benzene	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.5	5	5
1,2-Dichloroethylene	<0.5	<0.5	**0.8**	**0.8**	<0.5	<0.5	<0.5	7 (c)	70 (c)	70 (c)
Dichloromethane	<0.9	<0.9	<0.9	**1.4B**	<0.9	<0.9	<0.9	5	50	5
Ethylbenzene	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	68	680	700
m &/or p-Xylenes	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	44	440	10,000
ortho-Xylene	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	44	440	10,000
Tetrachloroethylene	**1.2**	**3.5**	**1.7**	<1.1	<1.1	<1.1	<1.1	0.7	7	5
Toluene	<0.4	<0.4	**0.8**	<0.4	<0.4	<0.4	<0.4	200	2,000	1,000
Trichloroethylene	**1.2**	**2.4**	**1.7**	<0.6	<0.6	<0.6	<0.6	0.5	5	5
Semi-Volatiles (ug/l)										
Bis (2-Ethylhexyl) Phthalate	<10	<10	<10	<10	<10	<10	<10	420	4,200	NAv
2-Methyl Naphthalene	<10	<10	<10	<10	<10	<10	<10	NAv	NAv	NAv
4-Methylphenol	<10	<10	<10	<10	<10	<10	<10	NAv	NAv	NAv
Naphthalene	<10	<10	<10	<10	<10	<10	<10	14.3	143	NAv
Total Metals (mg/l)										
Arsenic	<0.01	<0.01	<0.01	<0.01	<0.01	**0.01**	<0.01	NAv	0.05	0.05
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	**0.03**	<0.01	NAv	0.05 (d)	0.1 (d)
Copper	<0.02	<0.02	<0.02	<0.02	<0.02	**0.03**	<0.02	NAv	1	1.3 (f)
Lead	<0.003	<0.003	<0.003	<0.003	**0.017**	**0.01**	**0.003**	NAv	0.05	0.015 (f)
Nickel	<0.04	<0.04	<0.04	<0.04	<0.04	**0.05**	<0.04	NAv	0.15	0.1
Selenium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NAv	0.045	0.05
Silver	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.01**	NAv	0.05	NAv
Zinc	<0.02	<0.02	<0.02	<0.02	**0.05**	**0.15**	<0.02	NAv	5	NAv
Water Quality Testing										
TOC (mg/l)	NA	**3**	NA	NA	NA	NA	**3**	NAv	NAv	NAv
TOX (ug/l)	NA	**12**	NA	NA	NA	NA	**6**	NAv	NAv	NAv
COD (mg/l)	NA	**11**	NA	NA	NA	NA	<10	NAv	NAv	NAv
BOD (mg/l)	NA	<5	NA	NA	NA	NA	<5	NAv	NAv	NAv
Total Petroleum Hydrocarbons (ug/l)										
TPH-GRO (ug/l)	<100	<100	<100	<100	<100	<100	<100	NAv	NAv	NAv
TPH-DRO (ug/l)	<100	<100	<100	<100	<100	<100	<100	NAv	NAv	NAv

Bold values represent detected compounds

Shaded values represent concentrations that are equal to or exceed the MCL and/or the KAL.

The July 1994 samples were collected on 6, 7 and 8 July 1994; volatiles analyses is based on samples recollected in August 1994. The identification in the QCSR for all VOC resamples (July/August 1994) is the well identification followed by "-1R".

B Analyte detected in the associated method blank; result has not been blank corrected.

\+ Kansas Department of Health and the Environment, Bureau of Environmental Remediation, Groundwater Contamination Cleanup Target Concentrations, November 1988.

++ U.S. EPA, Office of Water, Drinking Water Regulations and Health Advisories, May 1995.

For complete list of analytes determined, see QCSR Site Investigations of High Priority Sites, 17 December 1993; QCSR Periodic Groundwater Monitoring Samples, 11 November 1994; QCSR Periodic Groundwater Monitoring Samples, 8 December 1994; QCSR Periodic Groundwater Sampling, March 1995.

(a) FP-93-01 had no detections in October 1993, July/August 1994, or January 1995.

(b) FP-93-07 had no detections in October 1994 or January 1995.

(c) Although a KAL, KNL and MCL for 1,2-DCE (mixed) is not available, concentrations reported as 1,2-DCE (mixed) will be compared to the more conservative KAL, KNL and MCL for 1,2- DCE isomers.

(d) The MCL and KAL represent values for both trivalent and hexavalent chromium.

(e) Calculated from a kerosene standard.

(f) Action Levels

NA Not Analyzed

NAv Not Available

< Below Practical Quantitation Limit.

Table 7-2. Summary of Chemical Detections for
SI and ESI Groundwater Data -- Off-Post Wells, October 1993, July/August 1994, October 1994 and January 1995

Sample Location	N-1				F-1			F-2			B-1				I-1		KNL (+)	KAL (+)	MCL (++)
Sample Identification	N-1	N-1	N-1-02	N-1	F-1	F-1	F-1-02	F-2	F-2	F-2-02	B-1	B-1	B-1-02	B-1	I-1-02	I-1			
Sample Event	Oct-93	Jul/Aug-94	Oct-94	Jan-95	Oct-93	Jul/Aug-94	Oct-94	Oct-93	Jul/Aug-94	Oct-94	Oct-93	Jul/Aug-94	Oct-94	Jan-95	Oct-94	Jan-95			
Volatile Organic Compounds (ug/l)																			
Benzene	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.5	5	5
1,2-Dichloroethylene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	7 (a)	70 (a)	70 (a)
Dichloromethane	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	**0.9B**	<0.9	<0.9	<0.9	5	50	5
m &/or p-Xylenes	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	44 (b)	440 (b)	10,000 (b)
Tetrachloroethylene	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	0.7	7	5
Toluene	<0.4	<0.4	<0.4	<0.4	<0.4	**1.2**	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	**2.2**	200	2,000	1,000
Trichloroethylene	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	0.5	5	5
Semi-Volatiles (ug/l)																			
2-Methyl Naphthalene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	NAv	NAv	NAv
Naphthalene	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	14.3	143	NAv
Total Metals (mg/l)																			
Arsenic	**0.01**	**0.02**	**0.01**	**0.01**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.02**	**0.02**	NAv	0.05	0.05
Copper	**0.24**	**0.02**	<0.02	<0.02	**0.02**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	NAv	1.0	1.3 (f)
Lead	**0.006**	**0.006**	<0.003	<0.003	**0.015**	<0.003	<0.003	**0.006**	**0.005**	**0.007**	<0.003	**0.004**	<0.003	<0.003	<0.003	<0.003	NAv	0.05	0.015 (f)
Selenium	<0.005	<0.005	<0.005	<0.005	**0.009**	<0.005	<0.005	<0.005	**0.006**	<0.005	**0.008**	**0.016**	**0.013**	**0.10**	<0.005	<0.005	NAv	0.045	0.05
Zinc	**0.24**	**0.06**	**0.07**	**0.04**	**0.04**	**0.02**	**0.04**	**0.30**	**1.20**	**0.43**	**0.04**	**0.06**	**0.06**	**0.04**	<0.02	**0.04**	NAv	5	NAv
Total Petroleum Hydrocarbons (ug/l)																			
TPH-GRO (ug/l)	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	**790**	<100	NAv	NAv	NAv
TPH-DRO (ug/l)	<100	<100	<100	<100	<100	<100	<100	**300**	<100	<100	<100	<100	<100	<100	<100	<100	NAv	NAv	NAv

Table 7-2 (continued) Summary of Chemical Detections for
SI and ESI Groundwater Data -- Off-Post Wells, October 1993, July/August 1994, October 1994 and January 1995

Sample Location	R-1					R-2		R-3				M-1						
Sample Identification	R-1	R-1R (VOC); R-1 (rest)	R-1R-1 (VOC); D-1 (rest) (c)	R-1-02	R-5-02 (d)	R-2R (VOC); R-2 (rest)	R-2-02	R-3	R-3-02	R-3-3	R-4-3 (e)	M-1	M-1	M-1-02	M-1	KNL	KAL	MCL
Sample Event	Oct-93	Jul/Aug-94		Oct-94		Jul/Aug-94	Oct-94	Jul/Aug-94	Oct-94	Jan-95		Oct-93	Jul/Aug-94	Oct-94	Jan-95	(+)	(+)	(++)
Volatile Organic Compounds (ug/l)																		
Benzene	<4.0	<4.0	<4.0	**2.0**	**2.0**	<4.0	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.5	5	5
1,2-Dichloroethylene	**98**	**96**	**64**	**290**	**290**	**88**	**110**	<0.5	<0.5	<0.5	<0.5	**2.2**	<0.5	**0.9**	**0.5**	7 (a)	70 (a)	70 (a)
Dichloromethane	<0.9	<9.0	<9.0	<4.5	<4.5	<9.0	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	5	50	5
m &/or p-Xylenes	<6.0	<6.0	<6.0	<0.6	<0.6	<6.0	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	44 (b)	440 (b)	10,000 (b)
Tetrachloroethylene	**160**	**170**	**150**	**330**	**380**	**140**	**130**	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	0.7	7	5
Toluene	<4.0	<4.0	<4.0	<2.0	<2.0	<4.0	<0.4	**0.5**	**24**	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	200	2,000	1,000
Trichloroethylene	**33**	**29**	**31**	**76**	**78**	**56**	**49**	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	0.5	5	5
Semi-Volatiles (ug/l)																		
2-Methyl Naphthalene	<10	<10	<10	<10	<10	<10	<10	**14**	<10	<10	<10	<10	<10	<10	<10	NAv	NAv	NAv
Naphthalene	<10	<10	<10	<10	<10	<10	<10	**52**	<10	<10	<10	<10	<10	<10	<10	14.3	143	NAv
Total Metals (mg/l)																		
Arsenic	**0.03**	**0.02**	**0.03**	**0.01**	**0.01**	**0.02**	**0.02**	<0.01	<0.01	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	NAv	0.05	0.05
Copper	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	NAv	1.0	1.3 (f)
Lead	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	NAv	0.05	0.015 (f)
Selenium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.006**	<0.005	<0.005	NAv	0.045	0.05
Zinc	**0.04**	<0.02	<0.02	**0.08**	**0.08**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	**0.34**	**0.09**	**0.06**	**0.05**	NAv	5	NAv
Total Petroleum Hydrocarbons (ug/l)																		
TPH-GRO (ug/l)	<100	**140**	<100	**260**	**240**	<100	**130**	<100	<100	<100	<100	<100	<100	<100	<100	NAv	NAv	NAv
TPH-DRO (ug/l)	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	NAv	NAv	NAv

Table 7-2 (continued) Summary of Chemical Detections for
SI and ESI Groundwater Data -- Off-Post Wells, October 1993, July/August 1994, October 1994 and January 1995

Sample Location	FP-94-08	FP-94-09	FP-94-10	FP-94-11	KNL (+)	KAL (+)	MCL (++)
Sample Identification	FP-94-01PZ-3	FP-94-02PZ-3	FP-94-03PZ-3	FP-94-04PZ-3			
Sample Event	Jan-95	Jan-95	Jan-95	Jan-95			
Volatile Organic Compounds (ug/l)							
Benzene	<0.4	<0.4	<0.4	**0.9**	0.5	5	5
1,2-Dichloroethylene	<0.5	**94**	<0.5	**51**	7 (a)	70 (a)	70 (a)
Dichloromethane	**0.9B**	<0.9	<0.9	<0.9	5	50	5
m &/or p-Xylenes	<0.6	<0.6	<0.6	**1.1**	44 (b)	440 (b)	10,000 (b)
Toluene	<0.4	<0.4	<0.4	**2.4**	200	2,000	1,000
Trichloroethylene	<0.6	**1.9**	<0.6	**1.0**	0.5	5	5
Semi-Volatiles (ug/l)							
2-Methyl Naphthalene	<10	<10	<10	<10	NAv	NAv	NAv
Naphthalene	<10	<10	<10	<10	14.3	143	NAv
Total Metals (mg/l)							
Arsenic	<0.01	<0.01	<0.01	**0.01**	NAv	0.05	0.05
Copper	<0.02	<0.02	<0.02	<0.02	NAv	1	1.3 (f)
Lead	<0.003	<0.003	<0.003	<0.003	NAv	0.05	0.015 (f)
Selenium	<0.005	<0.005	**0.006**	<0.005	NAv	0.045	0.05
Zinc	<0.02	<0.02	<0.02	<0.02	NAv	5	NAv
Total Petroleum Hydrocarbons (ug/l)							
TPH-GRO (ug/l)	<100	<100	<100	<100	NAv	NAv	NAv
TPH-DRO (ug/l)	<100	<100	<100	<100	NAv	NAv	NAv

Bold values represent detected compounds.

Shaded values represent concentrations that are equal to or exceed the MCL and/or the KAL.

The piezometers were installed and developed in January 1995. Therefore, no samples were collected for the October 1993, July 1994 and October 1994 sampling events.

Wells R-2 and R-3 were not sampled in October 1993 due to regional flooding.

The July 1994 samples were collected on 6, 7 and 8 July 1994; volatiles analyses is based on samples recollected on 23 and 24 August 1994.

The identification in the QCSR for all VOC resamples (July/August 1994) is the well identification followed by "-1R".

Irrigation well I-1 was included in the periodic groundwater monitoring activities for the first time in October 1994.

For the January 1995 samples, wells F-1, F-2, R-1 and R-2 had been shut down for the winter. Therefore, no samples were collected from these wells.

B Analyte detected in the associated method blank; result has not been blank corrected.

\+ Kansas Department of Health and the Environment, Bureau of Environmental Remediation, Groundwater Contamination Cleanup Target Concentrations, November 1988.

\+\+ U.S. EPA, Office of Water, Drinking Water Regulations and Health Advisories, May 1995.

(a) Although a KAL, KNL and MCL for 1,2-DCE (mixed) is not available, concentrations reported as 1,2-DCE (mixed) will be compared to the more conservative KAL, KNL and MCL for 1,2- DCE isomers.

(b) Although no standards or guidelines are available for m- &/or p-Xylenes, concentrations reported as m- &/or p-Xylenes will be compared to the standards and guidelines for Xylenes (mixed).

(c) R-1R-1 is a duplicate of R-1R.

(d) R-5-02 is a duplicate of R-1-02

(e) R-4-3 is a duplicate of R-3-3

(f) Action Levels

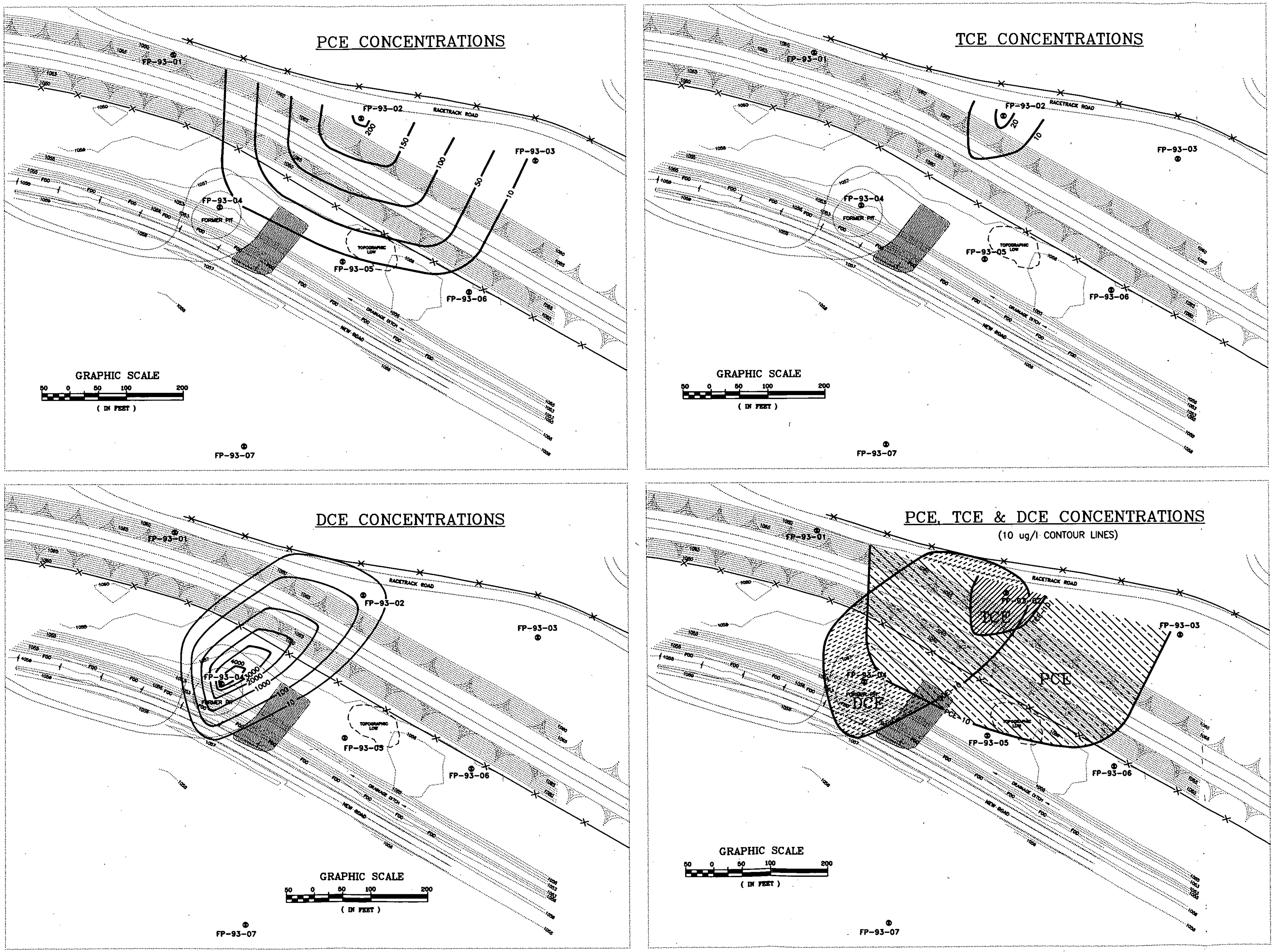
NA Not Analyzed

NAv Not Available

< Below Practical Quantitation Limit

For complete list of analytes determined, see QCSR Site Investigations of High Priority Sites, 17 December 1993; QCSR Periodic Groundwater Monitoring Samples, 11 November 1994; QCSR Periodic Groundwater Monitoring Samples, 8 December 1994; QCSR Periodic Groundwater Sampling, March 1995.

MAAF-18.dwg 2/98



N

LEGEND

⊗ GROUNDWATER MONITORING WELL

GROUNDWATER CONCENTRATIONS CONTOUR

ELEVATION CONTOUR

ROAD

FENCE LINES

LEVEE

Fiber Optic Cable

▨ FORMER DRUM STORAGE AREA

NOTE:

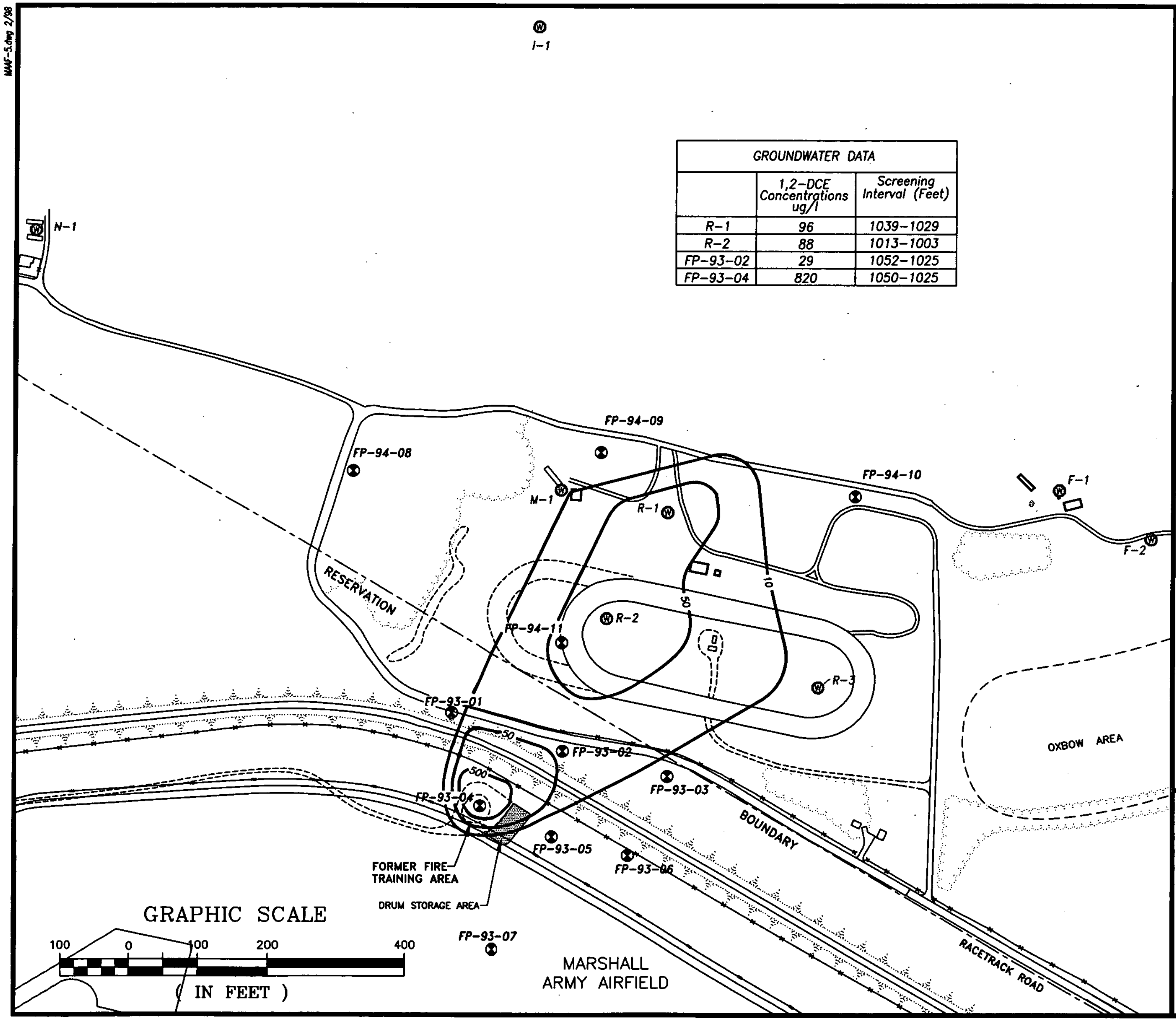
1. "TOPOGRAPHIC" LOW AREA IS LOCATED ON FIGURE BASED UPON FIELD MEASUREMENTS TAKEN DURING SI ACTIVITIES.

2. ELEVATION CONTOURS ARE IN FEET.

4. PCE = TETRACHLOROETHYLENE
TCE = TRICHLOROETHYLENE
DCE = 1,2 DICHLOROETHYLENE
ALL UNITS ARE ug/l.

Figure 7-1:
PCE, DCE, TCE Concentrations in Groundwater Samples from Wells During SI Activities, 10/93

MAAF-5.dwg 2/98



GROUNDWATER DATA

	1,2-DCE Concentrations ug/l	Screening Interval (Feet)
R-1	96	1039-1029
R-2	88	1013-1003
FP-93-02	29	1052-1025
FP-93-04	820	1050-1025

N

LEGEND

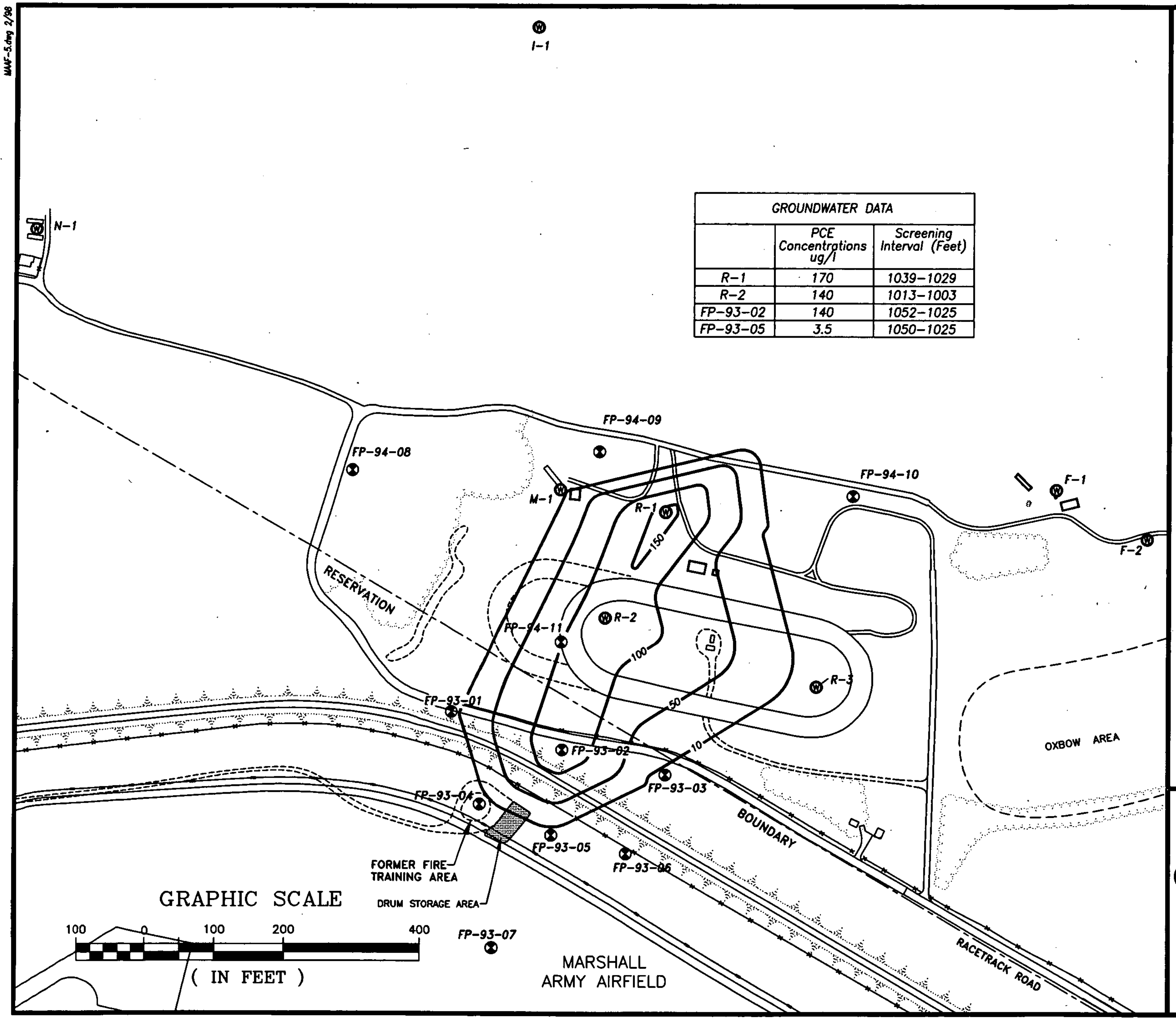
⊗	GROUNDWATER MONITOR WELL
Ⓦ	PRIVATE WELL
═	ROAD
═ ═	FORMER FEATURES
—×—	FENCE LINE
⁂	LEVEE
∿	WOODED AREA
⊐	BUILDING
—	1,2-DCE ISOCONCENTRATION CONTOUR

NOTE:

1. WELLS I-1 AND FP-94-08 THROUGH FP-94-11 WERE NOT SAMPLED DURING THIS SAMPLING EVENT.
2. CONCENTRATION CONTOURS ARE IN ug/l.

Figure 7-2: 1,2-Dichloroethylene (1,2-DCE) Concentrations in Groundwater from On-Post and Off-Post Wells, 8/94

MAAF-5.dwg 2/98



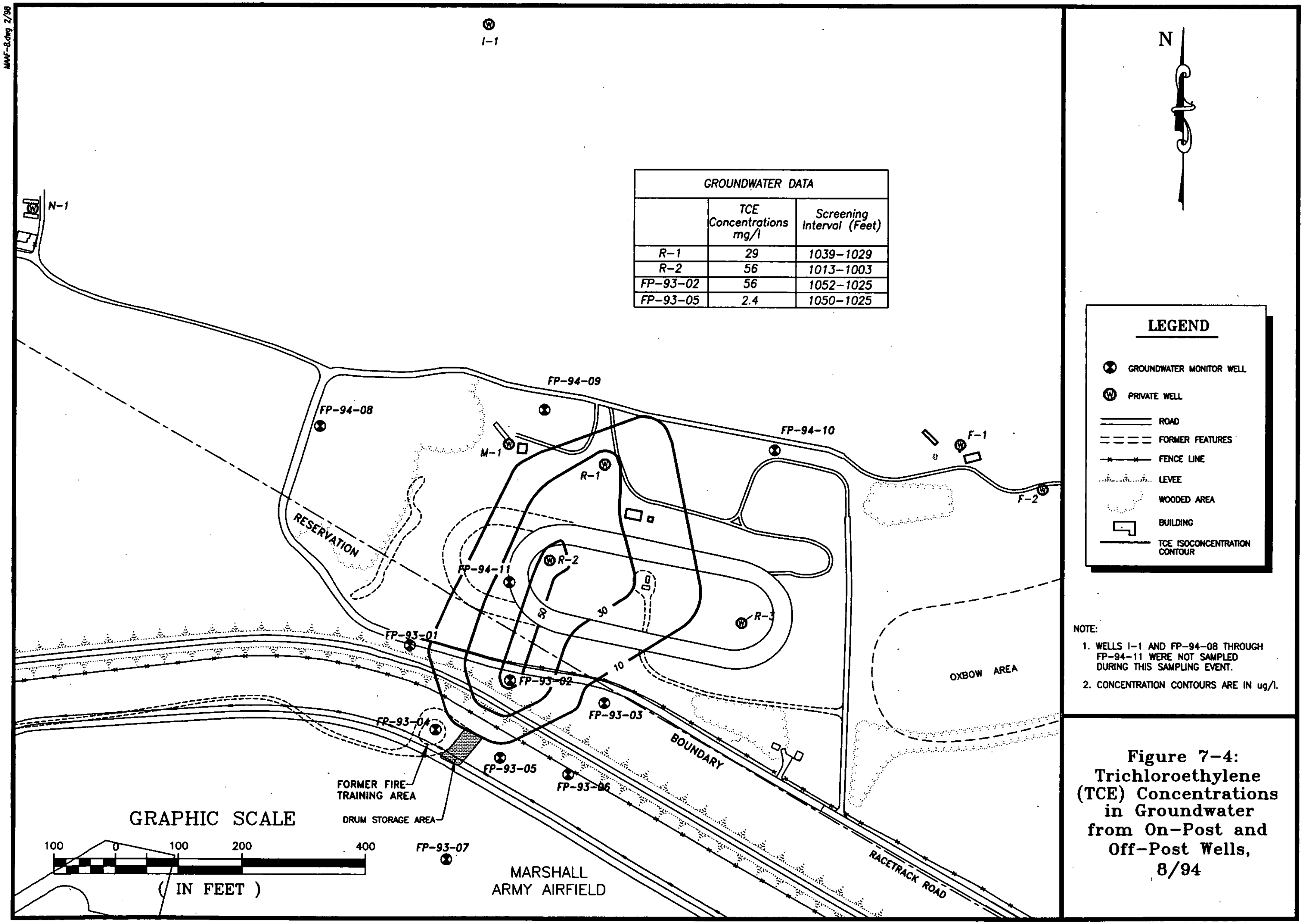
GROUNDWATER DATA		
	PCE Concentrations ug/l	Screening Interval (Feet)
R-1	170	1039–1029
R-2	140	1013–1003
FP-93-02	140	1052–1025
FP-93-05	3.5	1050–1025

NOTE:

1. WELLS I-1 AND FP-94-08 THROUGH FP-94-11 WERE NOT SAMPLED DURING THIS SAMPLING EVENT.
2. CONCENTRATION CONTOURS ARE IN ug/l.

Figure 7–3: Tetrachloroethylene (PCE) Concentrations in Groundwater from On–Post and Off–Post Wells, 8/94

MAAF-8.dwg 2/98



GROUNDWATER DATA

	TCE Concentrations mg/l	Screening Interval (Feet)
R-1	29	1039-1029
R-2	56	1013-1003
FP-93-02	56	1052-1025
FP-93-05	2.4	1050-1025

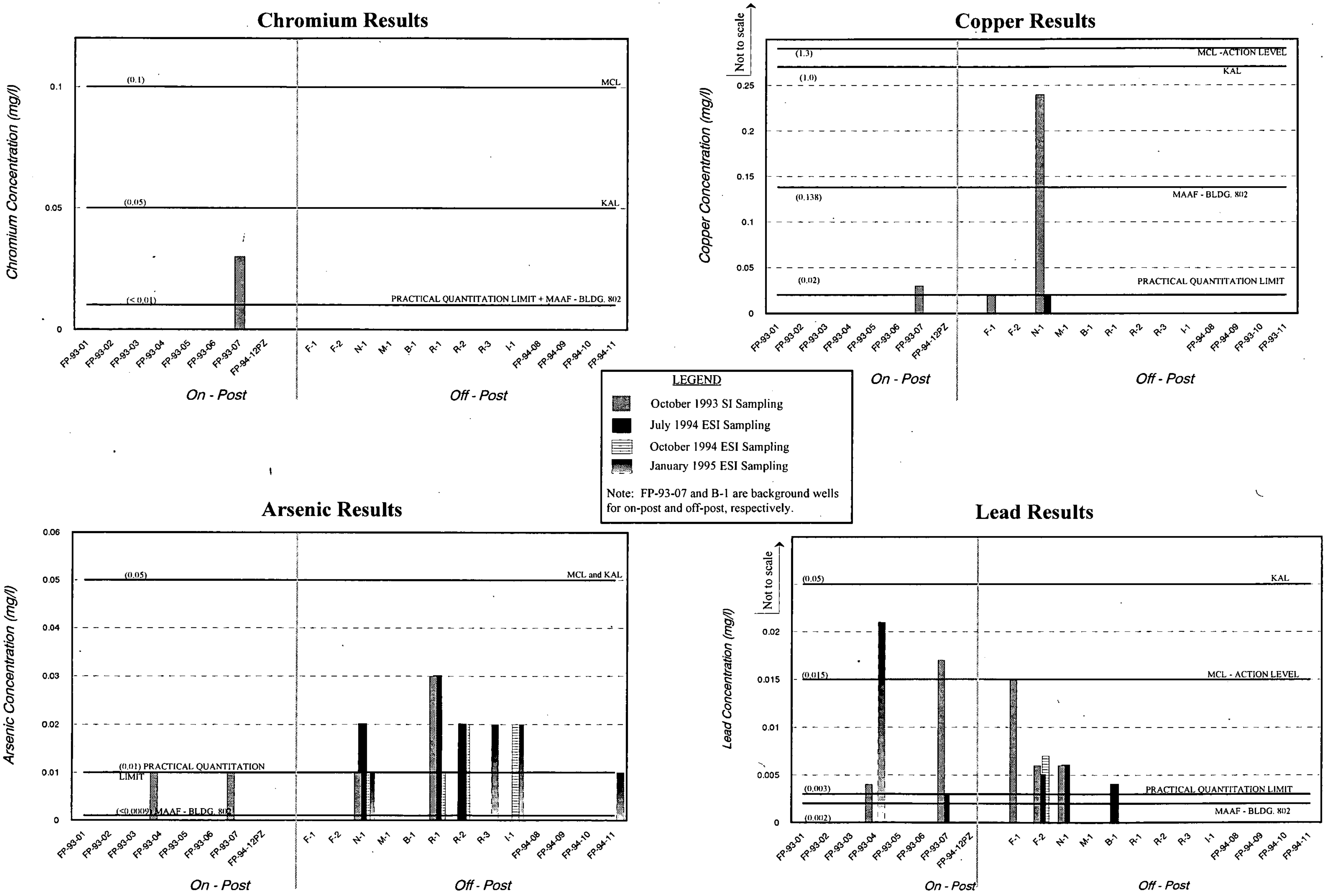
NOTE:

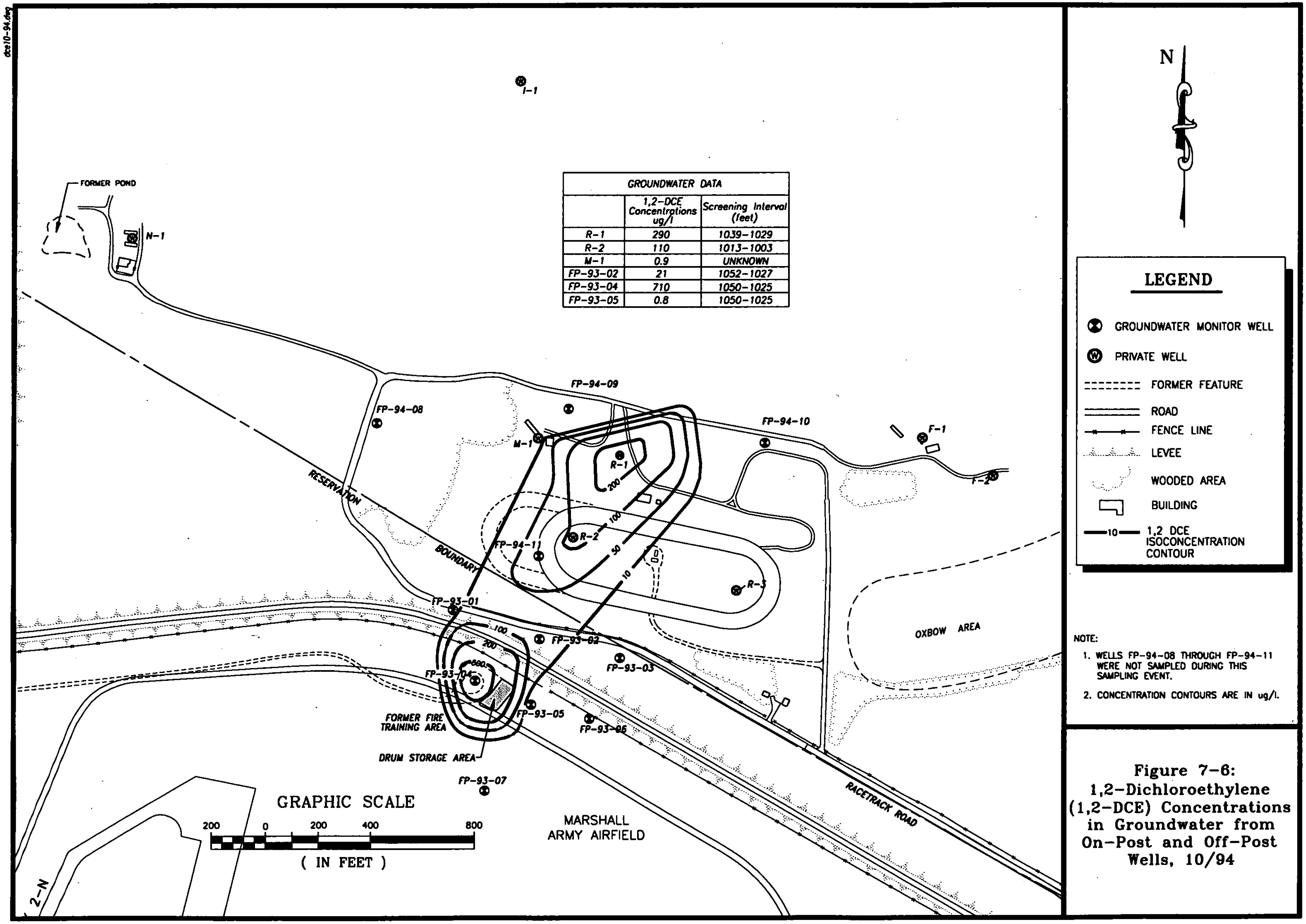
1. WELLS I-1 AND FP-94-08 THROUGH FP-94-11 WERE NOT SAMPLED DURING THIS SAMPLING EVENT.
2. CONCENTRATION CONTOURS ARE IN ug/l.

Figure 7-4: Trichloroethylene (TCE) Concentrations in Groundwater from On-Post and Off-Post Wells, 8/94

Figure 7-5: Overview of Metals Detections - FFTA - MAAF

(page 1 of 2)





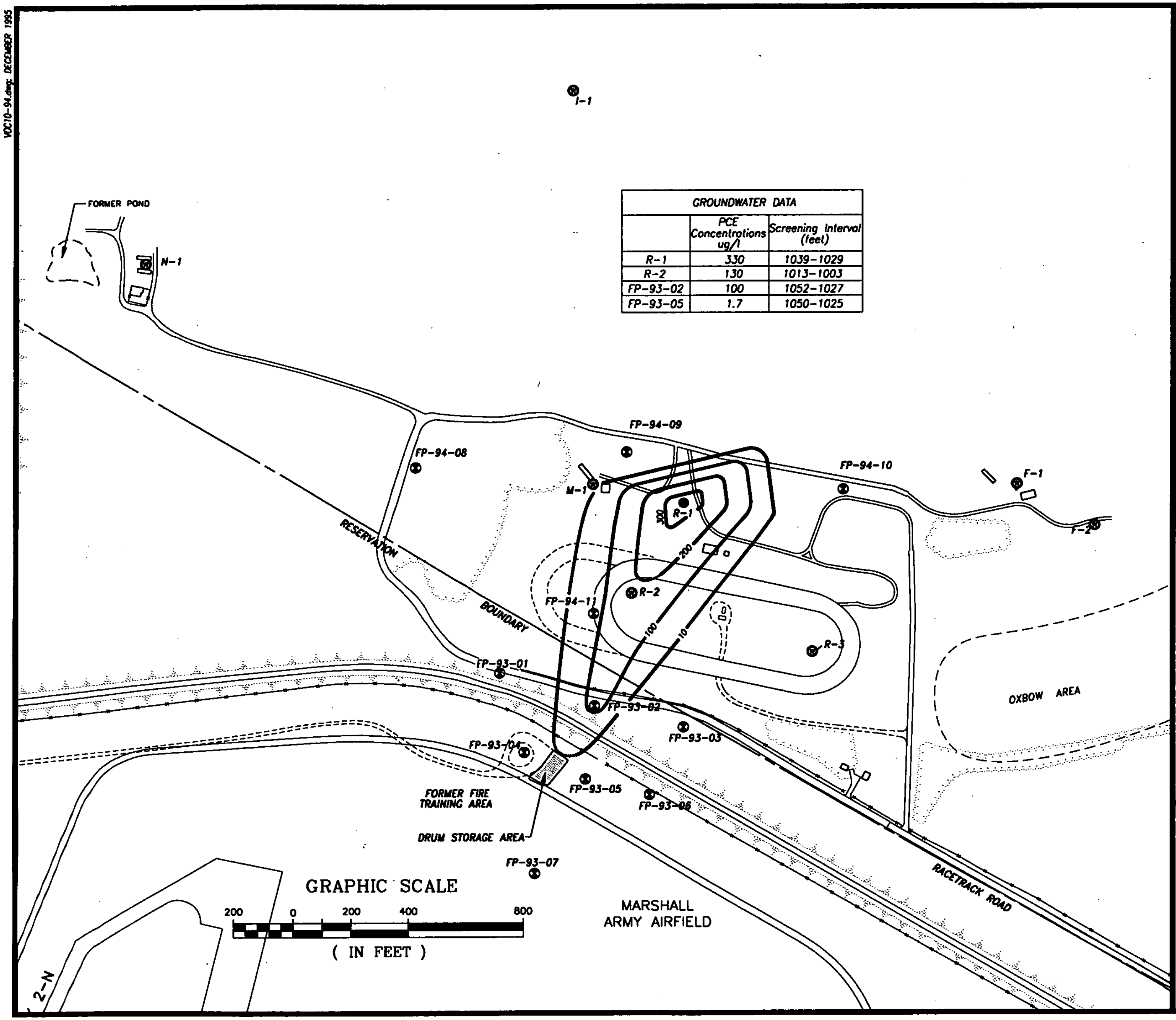
GROUNDWATER DATA		
	1,2-DCE Concentrations ug/l	Screening Interval (feet)
R-1	290	1039-1029
R-2	110	1013-1003
M-1	0.9	UNKNOWN
FP-93-02	21	1052-1027
FP-93-04	710	1050-1025
FP-93-05	0.8	1050-1025

NOTE:

1. WELLS FP-94-08 THROUGH FP-94-11 WERE NOT SAMPLED DURING THIS SAMPLING EVENT.
2. CONCENTRATION CONTOURS ARE IN ug/l.

Figure 7-6: 1,2-Dichloroethylene (1,2-DCE) Concentrations in Groundwater from On-Post and Off-Post Wells, 10/94

VOC10-94.dwg; DECEMBER 1995



GROUNDWATER DATA

	PCE Concentrations ug/l	Screening Interval (feet)
R-1	330	1039-1029
R-2	130	1013-1003
FP-93-02	100	1052-1027
FP-93-05	1.7	1050-1025

N

LEGEND

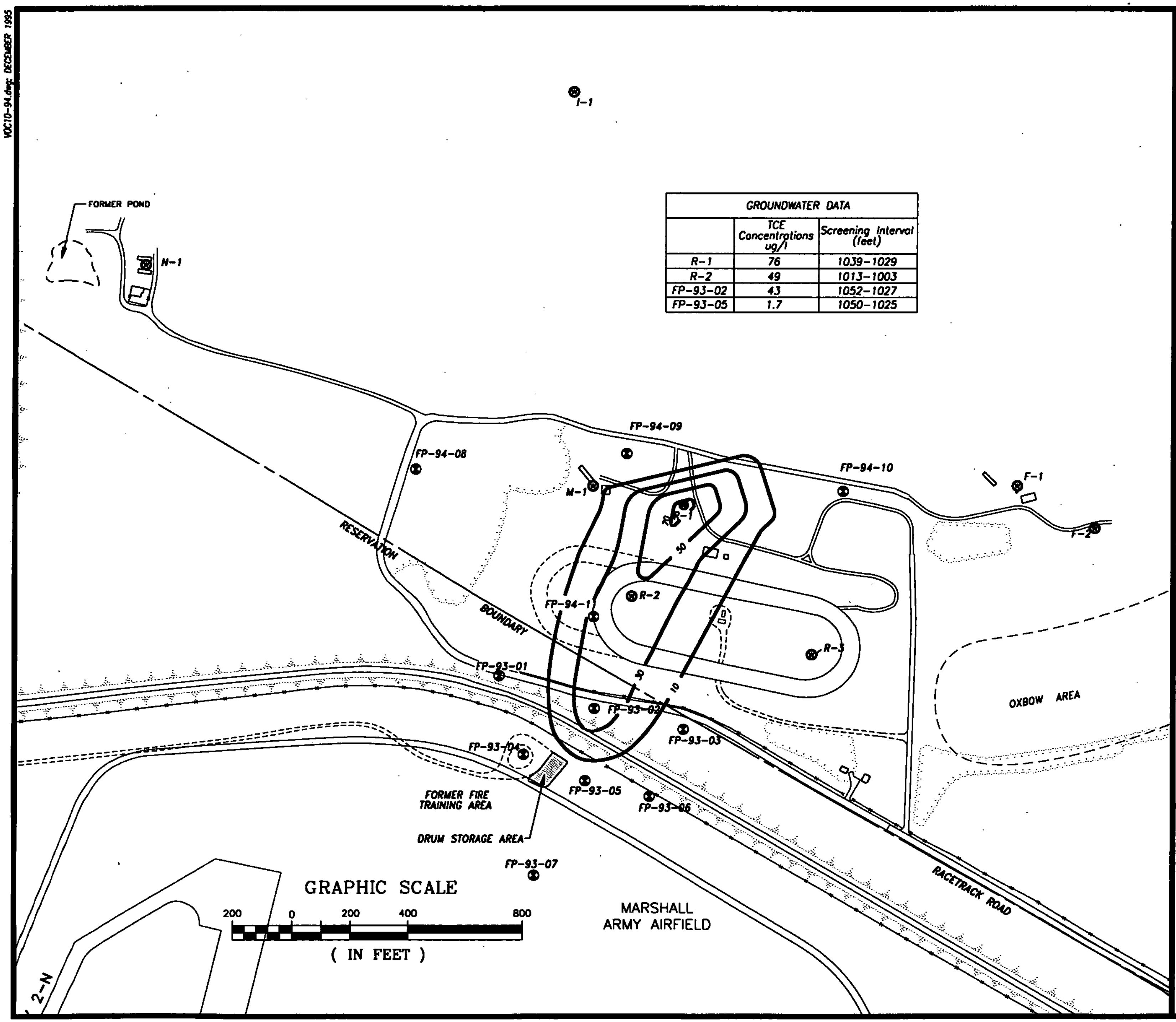
⊗	GROUNDWATER MONITOR WELL
Ⓦ	PRIVATE WELL
- - - -	FORMER FEATURE
═══	ROAD
—×—×—	FENCE LINE
	LEVEE
	WOODED AREA
▭	BUILDING
—10—	PCE ISOCONCENTRATION CONTOUR

NOTE:

1. WELLS FP-94-08 THROUGH FP-94-11 WERE NOT SAMPLED DURING THIS SAMPLING EVENT.
2. CONCENTRATION CONTOURS ARE IN ug/l.

Figure 7-7:
Tetrachloroethylene (PCE) Concentrations in Groundwater from On-Post and Off Post Wells, 10/94

VOC10-94.dwg DECEMBER 1995



GROUNDWATER DATA

	TCE Concentrations ug/l	Screening Interval (feet)
R-1	76	1039-1029
R-2	49	1013-1003
FP-93-02	43	1052-1027
FP-93-05	1.7	1050-1025

LEGEND

⊗ GROUNDWATER MONITOR WELL

Ⓦ PRIVATE WELL

- - - - FORMER FEATURE

═══ ROAD

—×— FENCE LINE

LEVEE

WOODED AREA

BUILDING

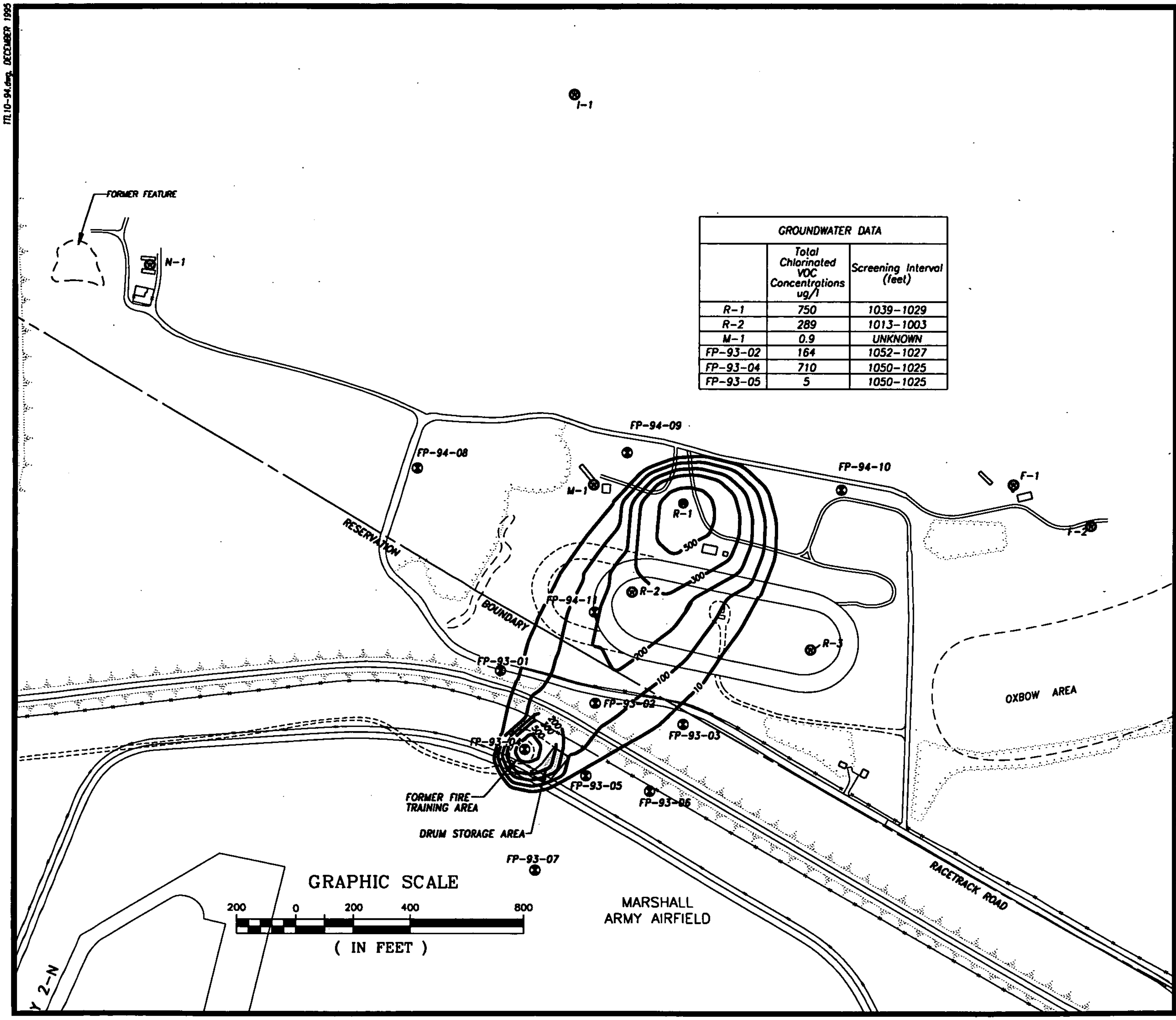
—10— TCE ISOCONCENTRATION CONTOUR

NOTE:

1. WELLS FP-94-08 THROUGH FP-94-11 WERE NOT SAMPLED DURING THIS SAMPLING EVENT.
2. CONCENTRATION CONTOURS ARE IN ug/l.

Figure 7-8: Trichloroethylene (TCE) Concentrations in Groundwater from On-Post and Off-Post Wells, 10/94

TTL10-94.dwg, DECEMBER 1995



GROUNDWATER DATA

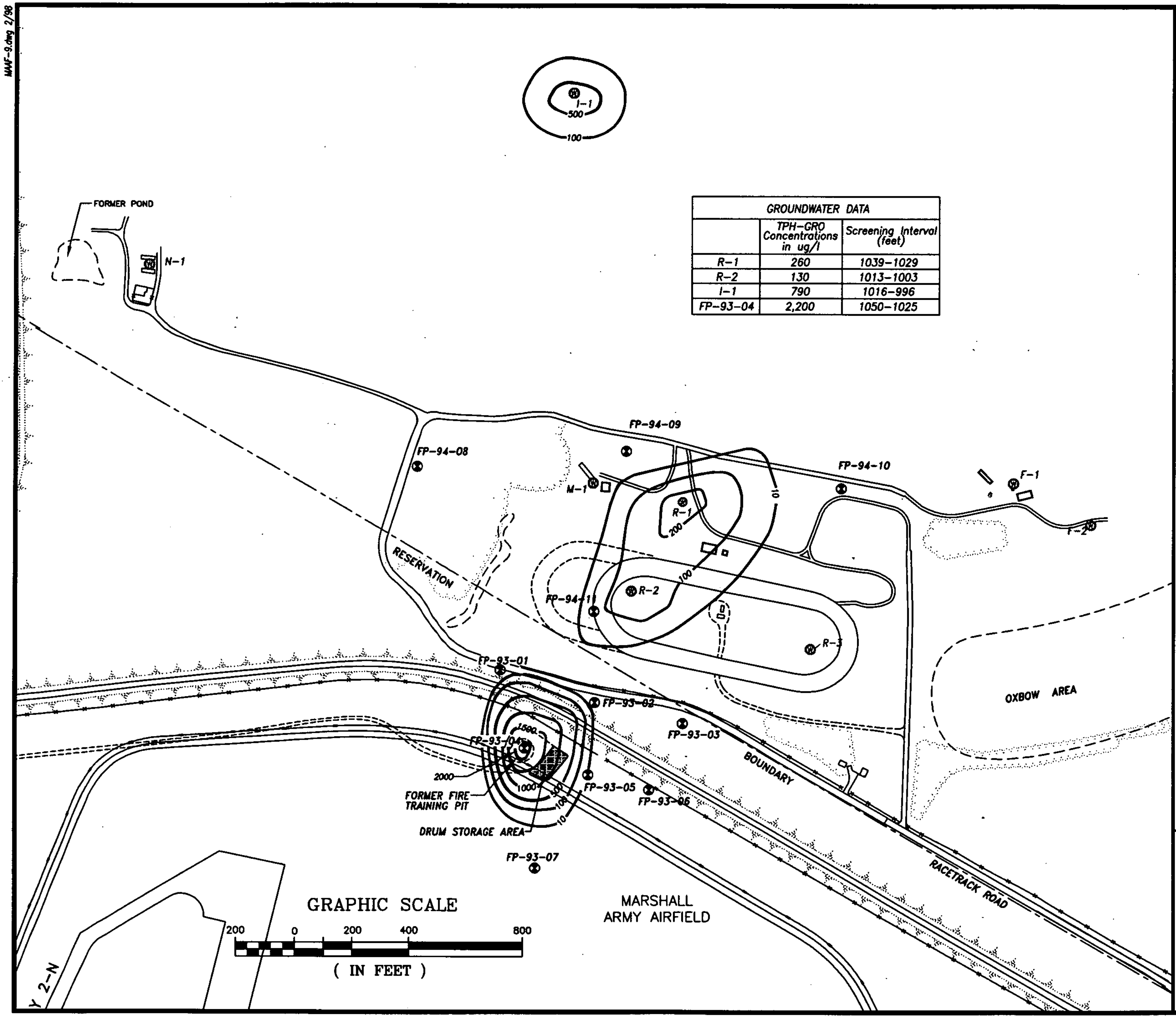
	Total Chlorinated VOC Concentrations ug/l	Screening Interval (feet)
R-1	750	1039-1029
R-2	289	1013-1003
M-1	0.9	UNKNOWN
FP-93-02	164	1052-1027
FP-93-04	710	1050-1025
FP-93-05	5	1050-1025

NOTE:

1. WELLS FP-94-08 THROUGH FP-94-11 WERE NOT SAMPLED DURING THIS EVENT.
2. CONCENTRATION CONTOURS ARE IN ug/l.

Figure 7-9: Total Chlorinated VOCs Concentrations in Groundwater from On-Post and Off-Post Wells, 10/94

MAAF-9.dwg 2/98



GROUNDWATER DATA

	TPH-GRO Concentrations in ug/l	Screening Interval (feet)
R-1	260	1039–1029
R-2	130	1013–1003
I-1	790	1016–996
FP-93-04	2,200	1050–1025

N

LEGEND

- ⊗ GROUNDWATER MONITOR WELL
- Ⓦ PRIVATE WELL
- FORMER FEATURE
- ROAD
- FENCE LINE
- LEVEE
- WOODED AREA
- BUILDING
- TPH-GRO ISOCONCENTRATION CONTOUR

NOTE:

1. TPH-GRO=TOTAL PETROLEUM HYDROCARBON GASOLINE RANGE ORGANICS.
2. WELLS FP-94-08 THROUGH FP-94-11 WERE NOT SAMPLED DURING THIS SAMPLING EVENT.
3. CONCENTRATION CONTOURS ARE IN ug/l.

Figure 7–10: Total Petroleum Hydrocarbon (TPH) Concentrations in Groundwater from On–Post and Off–Post Wells, 10/94

8.0 OTHER EXPOSURE PATHWAYS

8.1 Surface Water

Presently, surface water from MAAF is diverted by a drainage ditch that encircles the entire airfield discharging into the Kansas River via a gate valve at the northwest corner of the levee. This drainage ditch transects the FFTA. The purpose of the soil (sediment) samples collected during the SI was to determine if contaminants were being transported along the drainage ditch that transects the FFTA, as shown in Figure 3-1. This present ditch was constructed after the FFTA was no longer used. As discussed in Section 6.0, the results indicated that the five surface soil (sediment) samples from this drainage ditch showed no detection for VOCs and SVOCs. The sediment sample collected furthest to the east would be considered background for the FFTA.

Former drainage, as indicated in the aerial photographs from 1954 through 1984 (Appendix B), was primarily diverted toward the east along the levee, via a culvert through the levee and ultimately into the oxbow located north of the FFTA. Contamination from this drainage pattern was investigated further in the ESI. Soil gas and groundwater screening samples collected during Phase I of the ESI at locations 1 through 8 (Figure 5-5) showed no detections for VOCs and SVOCs.

Thus, the FFTA does not currently present a threat to surface water quality. Further, contaminants in groundwater have not been detected within 2,000 feet of the Kansas River in the direction of groundwater flow. Therefore, discharges of contaminated groundwater to surface water is not a concern.

8.2 On-site Soil Exposure

The FFTA does not pose a threat for on-site soil exposures for several reasons:

- It is located off the end of an airfield and has not been used for fire fighting training since 1984.
- It is separated from residential properties to the north by a continuous, 8-foot chain-link fence along the airfield boundary.
- There are only intermittent uses of the FFTA for mowing and cutting hay. In December 1994, a temporary fence was installed around the pilot test area. The area inside the fence is not currently used to harvest hay.

8.3 Air

The FFTA does not pose a threat to the air pathway for several reasons:

- The former fire training pit is now buried, and the area is well vegetated, thus minimizing or preventing releases to the air.
- The contamination detected at the FFTA is subsurface.
- There were no air surveys conducted at MAAF during these site investigations. On-site PIDs were used for health and safety purposes and to determine whether environmental media contained VOCs. There were no detectable releases to ambient air during the intrusive soil, soil gas, and groundwater sampling from the FFTA or private properties conducted during the SI or ESI. This indicated that VOCs are not present in sufficient concentrations to act as a source for measurable releases of contaminants to air.

9.0 EVALUATION OF DATA

This section discusses the type of data collected, as well as the different objectives for that data. The data collected included screening data, screening data with definitive verification, and the definitive data collected during the SI and ESI. The specific DQO for each type of data collected during the SI and ESI can be found in Section 2.5 of this report. For purposes of discussing DQOs, specific references are made to analytical findings presented in Sections 5.0, 6.0, and 7.0 of this report. Where variances in analytical data were identified, their significance with respect to the site being evaluated are discussed. The evaluation of the laboratory data contained in this section is a synopsis of the information provided in the QCSRs as described by the PARCC parameters - precision, accuracy, representativeness, comparability, and completeness.

9.1 Hydrogeologic Data

An evaluation of the hydrogeologic investigation results is best addressed through a discussion of the data presented as figures. Several geologic cross sections have been presented in Section 3.0 to illustrate the stratigraphy beneath the FFTA-MAAF, presented as Figures 3-6, 3-8, and 3-12 through 3-15. These figures show that the FFTA is underlain by silty materials to a depth of approximately 10 feet below ground surface. This material coarsens gradually to sand with depth. From this stratigraphic data collected for this SI, it can be concluded that there are no laterally continuous, low-permeability clay layers beneath the upper 10 feet of fine-grained sediment. Therefore, the migration of dissolved-phase contaminants in groundwater will be constrained by the rate and direction of the flow of water through the sands. Furthermore, because an intervening, continuous clay layer is not present, DNAPLs would tend to migrate vertically downward with little lateral displacement. However, four cone penetration tests and 10 Hydropunch™ pushes were performed in order to establish a depth to bedrock and to collect deep alluvial groundwater samples to test for the presence of DNAPLs. Based on the results presented in Section 3.0, no DNAPLs are found beneath the FFTA-MAAF.

Groundwater elevation contours were generated over about a 15-month period to evaluate the direction of groundwater flow. Based on information collected during this period, the regional groundwater flow direction is to the north and east. Intermittent climatic and cultural influences (i.e., heavy rainfall, flooding, irrigation for agricultural purposes) has produced localized groundwater flow to the north and west at the FFTA-MAAF.

9.2 Analytical Data

9.2.1 Screening Data

Screening data with definitive confirmation is appropriate for site characterization, the object of the SI. Compared with definitive data, screening data are generated by rapid, less precise methods of analysis with often a less rigorous sample preparation. While less rigorous, they are not without a level of QA/QC. For the procedures employed, the QA/QC procedures include initial and ongoing calibration with standards of known concentration, analysis of field and equipment blank, and analysis of field duplicate samples.

During the SI and ESI soil gas survey was collected as field screening data. Soil gas surveys were conducted under the SI and ESI Phase I. The soil gas survey was conducted to obtain preliminary data on the extent of contamination in the soil and groundwater. Results for the soil gas survey are provided in Appendix D. There was no verification of field results through laboratory analysis. Although no rigorous quality assurance data was collected, blank samples were collected at the beginning of each day, the end of each day, and after every 20 samples. Every tenth sample was collected in duplicate. The protocol for the methods employed utilized calibration mixes of the analytes identified in Table 2-2. This provided for an identification check of the analyte identified against the retention time of the calibration mix, as well. Although not with the rigor of the laboratory, the equipment provided data of sufficient quality to meet the objective stated. The duplicate samples correlated well with the record samples, within approximately 90 percent. The data provided preliminary results for soil gas, and therefore the DQOs were met.

9.2.2 Screening with Definitive Verification

Groundwater screening data were collected under the SI and ESI (Phases I and II). This section discusses the quality of the data collected through both screening methods and compares the screening data to the definitive confirmation data collected through laboratory analysis. Definitive verification is as defined by guidance manual and not by analytical method.

Groundwater screening surveys are used to determine the presence of VOCs in the saturated zone. During the SI, a groundwater screening survey was conducted at the FFTA-MAAF. This represents a total of 58 groundwater screening samples collected (not including duplicates and QA/QC samples) and analyzed in the field. An evaluation of the quality of the groundwater screening data is presented below based on comparisons of groundwater screening samples analyzed in the field and in the laboratory.

At 10 of these locations (17 percent), the groundwater screening samples were recollected in duplicate and also sent to the laboratory for analysis. The field analyses identified chlorinated VOCs (c-1,2-DCE, TCE, and PCE) and BTEX. The laboratory analyses identified the same compounds with the exception of TCE, which was not detected. In all cases for which the laboratory analyses had a detection of 3.7 μg/l or higher for each analyte, the compound was also detected in the field screening. The groundwater screening results identified high levels of petroleum compounds in the center of the former pit and chlorinated VOCs to the east and north of the former pit. The results of the groundwater screening survey were used to locate seven groundwater monitoring wells. Sampling of the wells identified three chlorinated VOCs (PCE, TCE, and DCE) and BTEX. Also, the samples from the wells identified high levels of petroleum compounds in the center of the former pit and chlorinated VOCs to the east and north of the former pit, in the same locations as the groundwater screening samples. Based on the data outlined above, the groundwater screening data provided results that correlated well with definitive data collected from monitoring wells.

A comparison of the data from the field and the laboratory analysis from the SI is shown in Table 9-1. This table examines the summation of petroleum products detected and the summation of chlorinated compounds detected. In general, the laboratory will detect analytes at lower concentrations than the field analysis will. Of the eight samples analyzed in the laboratory that had detections of less than 10 μg/l, two of the duplicate samples analyzed in the field had detections. Three of the four samples that had detections in the field of less than 10 μg/l were verified by the laboratory. There was one instance when a compound was detected in the field and not in the laboratory, for FPM8, which had the PQL raised due to limited sample volume.

During the ESI, groundwater screening samples were collected and analyzed in the field at 80 locations during the Phase I investigation. In addition, groundwater screening samples were collected adjacent to five off-post wells (B1, F1, F2, M1, and N1) during the Phase I investigations. During the Phase II investigation, groundwater screening samples were collected at 154 locations. During the SCAPS investigation, 10 samples were collected. Fifteen Phase I samples, including all five private well locations, and 17 Phase II samples (not including duplicates) had the field analysis confirmed by laboratory analysis. [Twelve of the 15 Phase I samples had to be recollected due to TCE cross-contamination, discussed in Section 9.2.5. These samples are denoted by the suffix R.] All 10 SCAPS samples were analyzed in both the field and the laboratory.

A comparison of the data from the field and the laboratory analysis from the ESI is shown in Table 9-2. This table examines the summation of petroleum products detected and the summation of chlorinated compounds detected. In general, the laboratory will detect analytes at lower concentrations than the field analysis will. Of the 33 samples analyzed in the laboratory that had detections of less than 10 μg/l, 10 of the duplicate samples analyzed in the field had detections. Thirteen samples, of the 17 that had detections in the field of at less than 10 μg/l, were verified by the laboratory.

There were a total of seven instances when a compound was detected in the field and not in the laboratory, most notably ESIGW-25R, ESIGW2-34, CP1-GW1, and CP7-GW1. Based on the laboratory verification, these values were determined to be false positives. By having false positives the grid was expanded further than proved to be necessary based on the verification sampling. This expansion though resulting from these false positives did not compromise the objective. Sample CP1-GW1 was collected near well FP-93-01, which was sampled in October of 1994. Results from that time showed total chlorinated solvents as non-detect, as did the laboratory results for CP1-GW1. Sample CP7-GW1 was collected in the area of the groundwater screening sample E9 from the SI, which was non-detect for all compounds of interest. No other samples collected around sample ESIGW2-34 showed such high detections, and location 34 was resampled at a later date and did not show the same high detects at that time. The field analysis for the initial collection of sample ESIGW-25 was nondetect for all analytes, and the laboratory analyses for both the initial and re-sampling (ESIGW-25, ESIGW-25R, respectively) confirmed these results (although low concentrations of TCE and toluene were detected in the laboratory analyses). The false positive detections of VOCs in the field analysis of ESIGW-25R (Table 9-2) had no effect on the project objectives as this location was re-sampled due to possible laboratory contamination of the initial sample and did not result in grid expansion or alteration of sampling points.

9.2.3 Definitive Data - Laboratory Results

Definitive data are generated using approved EPA methodologies and protocols and are more rigorous than the screening methods described above. Data are analyte specific, and, for organics, often entail secondary confirmation. For the data to be considered definitive, analytical, instrument, and measurement error must be determined. Depending on the analyte and the instrument and the method used, the QA/QC procedures could employ the following: determination of instrument detection limit; calibration of the instrument, single point or multi point- initial and continuing; standardization; interference check samples; analyses of QA/QC samples including method blanks, equipment blanks, trip blanks, field blanks, laboratory control samples; determination of matrix spikes and spike duplicates; determination of blank spikes and spike duplicates; and surrogate analysis.

The QA/QC process ensures that the data meets the data quality objectives described in Section 2.5 and in the QAPP of the Basic Documents (Ref. 8). The analytical methodologies and protocol requirements for sampling and analyzing data are laid out in Exhibit 1-2 of the QAPP. Exhibits 1-3, 1-4, 1-6, and 1-8 of the QAPP provide detection limits for groundwater and soils for VOCs, SVOCs, pesticides, and metals. The QCSRs of 17 December 1993 (Volume I of II), 9 September 1994, 11 November 1994 (2 Volumes), 8 December 1994, January 1995, and March 1995 provide the results of the detailed QA/QC review of the SI and data associated with the SI and the ESI. A summary of the findings of the QCSRs is presented in the following sections. Overall, the laboratory data meets the DQOs established in the Section 2.5. The explanation of the data that was rejected due to TCE cross-contamination is addressed in Section 9.2.5. Data qualified as estimated is addressed in Section 9.2.4.

9.2.3.1 Detection Limits

The method detection limits (MDL) is the minimum amount of an analyte that can be routinely identified using a specific method, under conditions of 100 percent recovery. PQLs are matrix and sample dependent and are the levels that the laboratory can routinely and reliably detect and quantitate in a variety of sample matrices, and as such, take into account the percent moisture (for non aqueous samples), the initial sample weight or volume analyzed, and the cleanup procedures that affect quantitation.

Dilution may be necessary either to bring the concentration of an analyte into the linear dynamic range of the instrument or to overcome matrix interference. The source of this interference could be either in the sample preparation (e.g., during sample extraction) or as an analyte peak that either obscures or distorts the instrument signal for the analyte of interest. All of the data from the SI and ESI sampling were reviewed. A summary of samples where the PQLs were higher than defined by the method due to sample dilution, and thus exceeded the MDLs is presented in Table 9-3. This table lists the sample, analyte fraction affected, dilution factor, and the reporting limit for the analyte of lowest detection limit.

As shown in Table 9-3, 50 soil samples and 45 groundwater samples required dilution. Eight fractions required dilution as indicated. Twenty-one samples required dilution for more than one analytical fraction, the other 74 were diluted only for one fraction. A total of 130 analyses required dilution. The reasons for dilution were matrix interference, high analyte concentrations, and TCE cross-contamination (this is dealt with in Section 9.2.5; 15 samples were diluted due to TCE cross-contamination). Limited sample volume will result in the elevation of PQLs. Limited sample volume of some samples results in an effective dilution. Matrix interference was the reason 11 samples required dilution. For samples with matrix interference, the dilution factors were either 1 to 2 or 1 to 10. Approximately 100 analyses were diluted due to high analyte concentration. For samples with high analyte concentration, greater dilutions tended to be necessary; these ranged from 1 to 2 and 1 to 10 on the low end, to 1 to 1,000 and 1 to 10,000 on the high end. In particular, both soil and groundwater samples from the center of the FFTA required dilution because the concentrations of petroleum hydrocarbons were high relative to the linear dynamic range of the instrument. Three samples had elevated detection limits for TCL volatiles due to limited sample volume; these effective dilutions were 1 to 2, 3, and 4. Approximately 90 percent of the analyses performed under the SI and ESI did not involve a diluted sample.

9.2.3.2 Data Qualifiers

Following the QA/QC review, the laboratory data are either accepted, qualified, or rejected. If the data are accepted, the values of the detected compounds and the detection limits can be used. Data that are qualified means that some event occurred that requires additional review and consideration of the data prior to its use. Rejected data means that the data cannot be used.

During the SI no data were rejected outright as unusable. During the ESI, data were rejected due to TCE contamination. In addition, 13 groundwater samples had dichloromethane detections in both the sample and the associated method blank. These samples are listed on Table 9-4. These detections were all qualified with a B, which means the analyte is present in the method blank within 10 times the concentration detected in their respective method blanks. Therefore, the dichloromethane in these samples is attributable to laboratory contamination.

During the ESI, 16 samples were analyzed after their recommended holding time had been exceeded. These samples are listed on Table 9-5. The affected methods were TCL volatiles, TPH-GRO, and TCL semivolatiles. Of the 16, 11 samples exceeded the recommended holding time for TCL volatiles (9 soil and 2 groundwater). Ten of the TCL volatile analyses exceeded the holding time due to multiple analyses and repeated dilutions required to bring the sample into the linear dynamic range of the instrument. The other sample (SCAPS-GW-1-99) was not analyzed promptly and thus the recommended time was exceeded. Three soil samples exceeded the recommended holding time for TPH-GRO. This was due to multiple analyses and repeat dilutions that were necessary to obtain concentrations within the linear dynamic range of the instrument. Finally, six groundwater samples exceeded the recommended holding time to extraction and subsequent analysis for TCL semivolatiles. All of these samples had to be reanalyzed and reprepared due to low recovery of surrogate phenol compounds during the original sample run. Initially, D-1, N-1, and FP-94-02PZ-3 had low surrogate recovery rates for 2-fluorophenol and phenol; R-1 had low recoveries of 2-fluorophenol, phenol, and 2,4,6-tribromophenol; and I-1 and N-1-02 had no recovery rates for 2,4,6-tribromophenol, 2-fluorophenol, and phenol. However, because the reprepared and reanalyzed samples also had low recoveries for the phenol surrogates, the low recovery rate is attributed to matrix interference.

9.2.3.3 Soil Samples

Soil samples were collected from location SB-02B in AOC-1 on 8 July 1994 as part of the baseline soil sampling for the pilot test study. A duplicate sample from that boring was sent to MRD as a QA sample. When the QA sample was received by MRD, the sample temperature exceeded storage temperature requirements. The integrity of all samples collected on 8 July 1994 was judged to have been compromised. On 19 July 1994, samples were recollected from SB-02B and analyzed. The recollected samples received by the laboratory met storage temperature requirements. The DQOs for these samples were met through the recollection of the samples.

On 4 April 1994, four samples were collected from the former pit area and analyzed for PCBs. The samples were found to have elevated levels of petroleum products, which interfere with the detection of PCBs. On 6 June 1994, two samples were recollected from the former pit. The laboratory used a Florisil cleanup procedure prior to analysis in order to remove the matrix interference, thus improving the PQL. However, due to the ineffectiveness of the Florisil cleanup procedure, the original sample matrix extract was diluted 10 fold prior to analysis. Therefore, the detection limits for PCBs were still elevated.

9.2.4 Data Assessment

Data validation for analyses of samples collected during the SI and the ESI since September 1993 was performed as described in the U.S. EPA's National Functional Guidelines for Organic and Inorganic Data Review (Refs. 70, 71). The guidelines address the quality requirements for precision and accuracy through the assessment of the laboratory quality control program. This program demonstrates the laboratory's ability to detect and quantify the analytes of interest at the concentrations specified in the Sampling and Analysis Plan. Accuracy of the analytical results is expressed through recovery data for laboratory spiked samples, i.e., matrix spike (MS), laboratory control (LCS), and surrogate samples. Precision is assessed through analysis of the matrix spike and laboratory control sample duplicates (MS, LCSD) and calculation of their Relative Percent Difference (RPD).

Method blanks were run to ensure that contamination was not introduced during laboratory procedures. Laboratory Quality Control procedures were performed at a minimum of once per sample batch (maximum of 20 samples) and for each sample matrix. Complete data packages from the laboratory, including QC reports, for all sampling events at the FFTA-MAAF have been released under separate cover (Refs. 10, 11, 12, 13, 14, 15, 16, 17), while this report presents an overview of the information contained there.

Data usability is assessed by evaluating proper sample preservation procedures and adherence to sample holding times as stated in ER 1110-1-263. Comparability of the analytical data is addressed through split samples sent to the U.S. Army Corps of Engineers, MRD (CEMRD) laboratory for analysis and evaluation. Completeness based on the sampling and data objectives is assessed for the overall sampling effort through evaluation of the previously described parameters, as well as review of field notes, chain-of-custody (COCs) records and cooler receipt forms.

QC of the data is assessed through the analysis of blind field duplicates of record samples, field blanks and trip blanks. Blind field duplicates address the representativeness of the field samples through calculation of the RPD. The field quality objective to collect duplicates for 10 percent of the field samples was met or exceeded for each media sampled.

9.2.4.1 Data Assessment: Soil and Sediment

The analytical results for soil and sediment samples were reviewed for all parameters. Preservation temperatures were within or below acceptable limits (4° ± 2°C) for all samples. The integrity of the samples stored in coolers below acceptable temperatures were not compromised through loss of sample or analytes, and the data quality objectives are not affected. Two COCs were found to be in error, due to incorrect sample identification or number of sample bottles. These errors were discovered upon receipt at the laboratory, Berger QA personnel were notified of the discrepancies, and the COCs corrected by the laboratory's project manager prior to entry in the Laboratory's Information Management System (LIMS) computer system.

Holding times were met for all sediment samples for all methodologies; however, 12 soil samples were analyzed beyond holding time, 9 for TCL volatiles, and 3 for TPH-GRO. In all cases the samples were initially analyzed within holding time, but due to high analyte concentrations, multiple dilutions were necessary to bring the analytes into the calibration range of the instrument. The specific samples are shown on Table 9-5.

Nondetected analytes were reported at higher sample quantitation limits for VOCs in 22 samples due to high target analyte concentration requiring sample dilution. The data for these samples meet the DQOs for characterizing the nature and extent of contamination at the site. Six soil samples collected for PCB/pesticide analysis all required dilution due to matrix interferences experienced during sample extraction. EPA recommended cleanup methods failed to eliminate these interferences. In all six samples, all target analytes were nondetect at the elevated sample quantitation limits. For this reason, the nature and extent of PCB/pesticide contamination below these limits cannot be evaluated.

The laboratory demonstrated accuracy and precision within control limits as specified in EPA SW-846 (Ref. 72) for all analytical techniques to support the data quality requirements through evaluation of their quality control data, with the following exceptions. Precision could not be calculated for the MS/MSD analyses for TPH-GRO for samples MAAFSB-4A-2 and MAAFSB-4-2, and for TPH-DRO MS/MSD analyses for samples MAAFSB-4A-1 and MAAFSB-4-2. Surrogate recoveries of o-terphenyl were outside of control limits for eight samples, surrogate recovery of 4-BFB(MS) was outside control limits for sample MAAFSB-4A-2. In all cases the spiking compound was diluted out of range due to high analyte concentration of the sample. Low recovery of TCE were exhibited for the MS and MSD analyses of sample MAAFSB-1-1. As TCE was not detected in this sample, the nondetection cannot be confirmed as the results may be biased low.

Representativeness is assessed through the analysis of field QC samples. Fourteen blind duplicate samples were collected and analyzed for soil samples; no duplicates were collected for sediment samples. The RPDs for these duplicate pairs show "good" precision (<35%) for approximately 67% of the analytes detected, "fair" precision (<80%) for approximately 14%, and "poor" precision (>80%) for approximately 19%. In 5 of the 14 duplicate pairs, target compounds were detected in one or the other sample, but not both. Most notable among these were TPH-DRO detected at 15,000 μg/kg in sample MAAF K7S2 and nondetect at 6,100 μg/kg in the duplicate, and PCE detected at 130 μg/kg in sample MAAFSB-7-3 and nondetect at 5.5 μg/kg in the duplicate. Soil samples can exhibit a great deal of variability due to their nonhomogeneous nature, and specifically for volatile compounds as the samples are not homogenized in the field. It is concluded that a sufficient percentage of duplicate samples were collected (11%) and the precision demonstrated by analysis of the duplicate pairs confirms the representativeness of the field sampling effort.

Completeness of the sampling effort is assessed through collection of a sufficient quantity of samples to determine the horizontal and vertical extent of contamination at the FFTA-MAAF. The collection of 117 soil samples, 5 sediment samples, 14 duplicate, and 14 QA split samples, satisfies the overall sampling objective as stated in the QAPP and Basic Documents. As none of the data were rejected as unusable, completeness of the data has been satisfied.

The data for the soil and sediment samples meet the stated DQOs for sufficient and reliable data to evaluate the horizontal and vertical distribution of contaminants at the FFTA-MAAF.

9.2.4.2 Data Assessment: Groundwater

Groundwater was analyzed for samples collected from on- and off-post monitoring wells and piezometers, and for verification of groundwater screening analyses. The analytical results for groundwater samples were reviewed for all parameters. Preservation temperatures were within or below acceptable limits (4° ± 2°C) for all samples. The integrity of the samples stored in coolers below acceptable temperatures were not compromised through loss of sample or analytes, and the data quality objectives are not affected. Two COCs were found to be in error, due to omission of trip blanks or incorrect number of sample bottles. These errors were discovered upon receipt at the laboratory, Berger QA personnel were notified of the discrepancies, and the COCs corrected by the laboratory's project manager prior to entry in the laboratory's LIMS computer system.

Holding times were exceeded for TCL semivolatiles during repreparation of six samples which failed QC criteria. The original analyses were performed within holding time and the reanalysis confirmed low surrogate recoveries. One sample exceeded holding time for TCL volatiles (SCAPS-GW-1-99) as the samples were not hydrochloric acid (HCl) preserved in the field. The laboratory was not informed of this fact before the holding time was exceeded. Detected analytes for the volatile sample are qualified with a "J" as estimated concentrations.

Occasional low recoveries of semivolatile phenol and chlorobenzene compounds occurred for samples collected during periodic groundwater monitoring. Repreparation and reanalysis performed on these samples confirmed matrix interference through low surrogate recoveries, despite exceeding holding times. This has limited effect on the data usability, as phenols and chlorobenzene compounds are not among the analytes of concern at the FFTA-MAAF.

Twelve blind field duplicate samples were collected for groundwater samples. The RPDs for the analytes detected in the duplicate pairs show approximately 70% exhibit "good" precision (<20%), 12% exhibit "fair" precision (<50%), and 5% exhibit "poor" precision (>50%). Approximately 13% show analytes detected in one sample but nondetect in the duplicate. All of these compounds are detected near or slightly above the detection limit and may be due to sample variability. One field blank, collected from a grundfos pump following the sampling of a well with relatively high concentrations of target analytes, showed positive detections of chlorinated VOCs and BTEX compounds. Detections of these compounds and naphthalene compounds detected in the sample from well R-3 immediately following collection of the field blank, are attributed to cross contamination. This is discussed in the QCSR dated 11 November 1994. It is concluded that a sufficient percentage of duplicate samples were collected (10%) and the precision demonstrated by analysis of the duplicate pairs confirms the representativeness of the field sampling effort.

The objectives of the groundwater data for completeness are met through the collection of 10 percent duplicate and 10 percent QA samples, and are of sufficient quantity to characterize groundwater quality at the FFTA-MAAF. The groundwater samples that were cross-contaminated by exposure to TCE at the laboratory were rejected for volatile analyses and subsequently resampled and analyzed. Results from these and all other samples, except sample ESI-N1 collected 30 June 1994, which broke prior to analysis, are usable as reported. It can be concluded that the data presented for groundwater samples are of sufficient quality to meet the stated objectives of providing reliable and sufficient data to characterize the horizontal and vertical distribution of contaminants at FFTA-MAAF.

9.2.5 TCE Cross-Contamination

During June and July 1994, certain laboratory samples were contaminated with TCE while at the laboratory. This contamination affected the TCL volatile analysis and resulted in the resampling of affected and potentially affected samples. Quarterly groundwater sampling took place at on-post and off-post wells from 6 to 8 July 1994, and Phase I soil gas and groundwater screening occurred from 21 to 30 June 1994. [A more detailed description of the events can be found in Technical Memorandum #3, which is provided in Appendix A].

A total of 154 groundwater screening locations were sampled during Phase II of the ESI activities on the off-post properties. Fifteen samples were sent to the laboratory for confirmation. Twelve of these samples and six daily trip blanks were collected and sent to the off-site lab between 24 and 30 June 1994. These samples and trip blanks were received and logged in by the lab and were assigned storage locations in a walk-in cooler until analysis. The on-post and off-post quarterly groundwater samples arrived at the lab from 6 to 8 July 1994.

Analysis of the groundwater samples, groundwater screening samples and daily trip blanks began on 2 July 1994 and continued through 14 July 1994. TCE was detected in all of the trip blanks, the five off-post wells, and all but one of the groundwater screening samples. Due to the presence of TCE in trip blanks prepared and received on different days, and the detection of TCE at locations where previous sampling indicated that no TCE was present, cross-contamination of samples was suspected. On 11 July 1994, the detected TCE concentrations were traced to another sample in the cooler. The suspect sample had been received from another client on 30 June 1994 for priority pollutant analysis and assigned to the same cooler as the groundwater screening and off-post well samples. Upon arrival at the lab, the sample in question was clear, slightly amber in color, and had no noticeable odor. Unaware of high TCE levels in the non-aqueous sample, the sample receipt personnel and project manager assigned it to a cooler designated for regular sampling. Later analysis of this non-aqueous sample showed TCE and DCE to be present in the mg/kg range.

Some of the on-post wells sampled on 7 July 1994, including the upgradient well, showed TCE contamination. These samples were stored, along with their trip blank, in a different non-contaminated cooler. While some of the wells showed TCE contamination, the trip blank and field blank did not. However, the on-post well samples were analyzed on the same day and in the same batch as the off-post well samples, which had become contaminated.

According to the DQOs for screening data, 10 percent of all groundwater screening results are to be definitively confirmed by an off-site laboratory. Because of the cross-contamination, only three samples were confirmed by the laboratory. Therefore the DQOs for definitive confirmation by a laboratory were not met.

Because of TCE contamination of the off-post well samples and the trip blank, the results of the VOC analysis of the groundwater wells sampled on 6 July 1994 could not be confirmed for the off-post private wells: M-1, F-1, F-2, B-1, and N-1. Furthermore, TCE was detected in FP-93-06 and FP-93-07, which were sampled on 7 July 1994. Although TCE was not detected in the field blank, method blanks, trip blanks or in FP-93-01, all from 7 July 1994, the presence of TCE in the upgradient well (FP-93-07) and a well with no prior detections of TCE (FP-93-06) raised concern about potential cross-contamination of the on-post well samples. The specifics on samples with rejected data are presented in Table 9-6.

All the on-post and off-post wells were resampled for VOC analysis only. This occurred on 23 and 24 August 1994. While TCE contamination affects the results of the VOC analysis, it does not affect analytical results for SVOCs, TPH, or PP metals. The 12 groundwater screening locations identified in the previous section were also resampled; and duplicate samples were collected for both field and laboratory analysis. This resampling occurred during the week of 12 September 1994. The resampling provided definitive results for the on-post and off-post wells. The resampling of the groundwater screening provided definitive confirmation of groundwater screening results. Therefore, the DQOs for this project were met through the resampling of the affected samples.

Table 9-1. Laboratory Data Versus Field Data
SI MAAF - On-Post Phase I Groundwater Screening Survey

(Only includes sample locations which were analyzed in the laboratory)

Sample Identification	Total Chlorinated VOCs		Total Petroleum VOCS	
	Field Analysis (a)	Laboratory Analysis (b)	Field Analysis (c)	Laboratory Analysis (d)
Phase II Groundwater Screening (micrograms per liter - μg/l)				
FPN2	7.3	32	ND	2.8
FPPZ	1.4	3.7	ND	1.3
FPV8 (e)	ND	ND	ND	1.0
FPN7	ND	1.7	ND	0.6
FPM8 (e)	92.6	345	2.6	ND
FPH7 (e)	375	2,100	2,593.7	3,550
FPJ6 (e,f)	ND	ND	ND	6.0
MFJ6W (e,g)	ND	ND	ND	ND
FPE5	ND	ND	1.5	1.1
FPW4	ND	ND	ND	1.3
FPW4D (h)	ND	ND	ND	2.0
FPM1 (e)	45.5	320	ND	ND

(a)	Summation of field concentrations for VOCs - chlorinated solvents only
(b)	Summation of laboratory concentrations for VOCs - chlorinated solvents only
(c)	Summation of field concentrations for VOCs not including "Total VOCs" - petroleum compounds only
(d)	Summation of laboratory concentrations for VOCs not including "Total VOCs" - petroleum compounds only
(e)	Samples with PQL raised due to limited sample volume.
(f)	Original sample container broken in lab custody; analyses conducted on remainder of sample.
(g)	Resample of FPJ6.
(h)	Duplicate of FPW4.
ND	Not Detected above PQL. For compound specific PQLs, see Section 5.0 Tables.

Table 9-2. Laboratory Data Versus Field Data
ESI MAAF - Off Post Phase I and Phase II Groundwater Screening Surveys

(Only includes sample locations which were analyzed in the laboratory)

Sample Identification	Total Chlorinated VOCs		Total Petroleum VOCS	
	Field Analysis (a)	Laboratory Analysis (b)	Field Analysis (c)	Laboratory Analysis (d)
Phase I Groundwater Screening (micrograms per liter - μg/l)				
ESIGW-8R	ND	ND	ND	0.4
ESIGW - 25R	746	4.4	10	0.6
ESIGW - 70R	513.3	2260	2.2	ND
ESIGW - 99	429.7	1240	1.2	ND
ESIGW - 115	16.2	21.7	ND	ND
ESIGW - 159R	7.4	55	ND	ND
ESIGW - 217R	31.5	89	ND	ND
ESI - F2R	ND	ND	ND	0.6
Phase II Groundwater Screening (micrograms per liter - μg/l)				
ESIGW2 - 04	ND	ND	7	21
ESIGW2 - 34	470	ND	ND	0.9
ESIGW2 - 35	ND	ND	ND	9.4
ESIGW2 - 46	63	145	ND	0.7
ESIGW2 - 61	60	330	ND	ND
ESIGW2 - 65	0.2	ND	ND	0.5
ESIGW2 - 74	ND	ND	ND	1.1
ESIGW2 - 91	7.8	4.1	ND	1.2
ESIGW2 - 99	7	4.8	ND	0.4
ESIGW2 - 101	15	4.9	ND	9.8
ESIGW2 - 108	ND	ND	ND	4.9
ESIGW2 - 125	ND	ND	ND	2.9
ESIGW2 - 129	ND	ND	ND	3.1
ESIGW2 - 127	5	ND	ND	3.9
ESIGW2 - 153	9	50	ND	ND

Table 9-2. Laboratory Data Versus Field Data
ESI MAAF - Off Post Phase I and Phase II Groundwater Screening Surveys (continued)

(Only includes sample locations which were analyzed in the laboratory)

Sample Identification	Total Chlorinated VOCs		Total Petroleum VOCS	
	Field Analysis (a)	Laboratory Analysis (b)	Field Analysis (c)	Laboratory Analysis (d)
Phase I Groundwater Screening (micrograms per liter - μg/l)				
CP-9	ND	2.7J	1.72	0.9J
CP1-GW1	27.8	ND	ND	1.3
CP2-GW1	ND	1.1	1.23	0.5
CP3-GW1	ND	ND	0.57	0.5
CP4-GW1	2.93	2.8	0.57	0.5
CP4-GW2	ND	ND	0.57	0.6
CP5-GW1	11.2	1.2	ND	2.4
CP6-GW1	11.6	1	2.22	0.8
CP7-GW1	37.16	ND	0.57	2.6
CP8-GW1	ND	ND	ND	0.6

(a) Summation of field concentrations for VOCs - chlorinated solvents only
(b) Summation of laboratory concentrations for VOCs - chlorinated solvents only
(c) Summation of field concentrations for VOCs not including "Total VOCs" - petroleum compounds only
(d) Summation of laboratory concentrations for VOCs not including "Total VOCs" - petroleum compounds only
ND Not Detected above PQL. For compound specific PQLs, see Section 5.0 Tables.
J Analyte positively detected; reported concentration is an estimate.
All samples that begin with CP have the prefix MAAF except CP-9. It has the prefix SCAPS-GW-1-1 for the field analysis and SCAPS-GW-1-99 for the lab analysis.

Table 9-3. Samples with Elevated Practical Quantitation Limits Due to Dilution of Sample

Sample Identification	Date	Media	TCL Volatiles	Volatiles Method 8010	TPH-GRO	TPH-DRO	Lead	TCL Semivolatiles	PCBs	Pesticides
MAAF-FPV8	24-Sep-93	Groundwater	1 to 2 (L)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAF-FPM8	24-Sep-93	Groundwater	1 to 25	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAF-FPH7	24-Sep-93	Groundwater	1 to 100	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAF-FPJ6	24-Sep-93	Groundwater	1 to 3 (L)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAF-FPM1	24-Sep-93	Groundwater	1 to 25	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MFJ6W	29-Sep-93	Groundwater	1 to 5 (L)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAF H7S1	30-Sep-93	Soil	Not Diluted	Not Diluted	Not Diluted	1 to 10	1 to 5	1 to 2 (M)	Not Diluted	Not Diluted
MAAF H7S2	30-Sep-93	Soil	1 to 4	Not Diluted	1 to 200	1 to 100	1 to 5	Not Diluted	Not Diluted	Not Diluted
MAAF H7S2MS	30-Sep-93	Soil	1 to 4	Not Diluted	1 to 200	1 to 100	1 to 5	Not Diluted	Not Diluted	Not Diluted
MAAF H7S2MSD	30-Sep-93	Soil	1 to 4	Not Diluted	1 to 200	1 to 100	1 to 5	Not Diluted	Not Diluted	Not Diluted
MAAF K7S1	30-Sep-93	Soil	Not Diluted	Not Diluted	Not Diluted	Not Diluted	1 to 5	Not Diluted	Not Diluted	Not Diluted
MAAF K7S2	30-Sep-93	Soil	Not Diluted	Not Diluted	Not Diluted	Not Diluted	1 to 5	Not Diluted	Not Diluted	Not Diluted
MAAF K7S3	30-Sep-93	Soil	Not Diluted	Not Diluted	Not Diluted	Not Diluted	1 to 5	Not Diluted	Not Diluted	Not Diluted
MAAF M8S1	30-Sep-93	Soil	1 to 4	Not Diluted	Not Diluted	Not Diluted	1 to 5	Not Diluted	Not Diluted	Not Diluted
MAAF M8S2	30-Sep-93	Soil	Not Diluted	Not Diluted	Not Diluted	Not Diluted	1 to 5	Not Diluted	Not Diluted	Not Diluted
MAAF NYS1	30-Sep-93	Soil	Not Diluted	Not Diluted	Not Diluted	Not Diluted	1 to 5	Not Diluted	Not Diluted	Not Diluted
MAAF NYS2	30-Sep-93	Soil	Not Diluted	Not Diluted	Not Diluted	Not Diluted	1 to 5	Not Diluted	Not Diluted	Not Diluted
MAAF-MW-7	27-Oct-93	Groundwater	Not Diluted	Not Diluted	Not Diluted	Not Diluted	1 to 2	Not Diluted	Not Diluted	Not Diluted
MAAF-MW-7MS	27-Oct-93	Groundwater	Not Diluted	Not Diluted	Not Diluted	Not Diluted	1 to 2	Not Diluted	Not Diluted	Not Diluted
MAAF-MW-7MSD	27-Oct-93	Groundwater	Not Diluted	Not Diluted	Not Diluted	Not Diluted	1 to 2	Not Diluted	Not Diluted	Not Diluted
MAAF-MW-2	27-Oct-93	Groundwater	1 to 25	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAF-MW-4	28-Oct-93	Groundwater	1 to 100	Not Diluted	1 to 25	1 to 4	Not Diluted	Not Diluted	Not Diluted	Not Diluted
R-1	19-Nov-93	Groundwater	1 to 10	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFFT1-1	5-Apr-94	Soil	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	1 to 10 (M)	Not Diluted
MAAFFT1-2	5-Apr-94	Soil	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	1 to 10 (M)	Not Diluted
MAAFFT1-3	5-Apr-94	Soil	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	1 to 10 (M)	1 to 10 (M)
MAAFFT1-4	5-Apr-94	Soil	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	1 to 10 (M)	1 to 10 (M)
ESIGW-99	21-Jun-94	Groundwater	1 to 100 (C)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
ESIGW-70	25-Jun-94	Groundwater	1 to 100 (C)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
ESIGW-223	27-Jun-94	Groundwater	1 to 25 (C)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
ESIGW-159	28-Jun-94	Groundwater	1 to 50 (C)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
ESIGW-217	29-Jun-94	Groundwater	1 to 10 (C)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
ESIGW-8	29-Jun-94	Groundwater	1 to 10 (C)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAF-1-3A	29-Jun-94	Soil	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	1 to 10 (M)	1 to 10 (M)
MAAF-1-4A	29-Jun-94	Soil	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	1 to 10 (M)	1 to 10 (M)
ESI-MI	30-Jun-94	Groundwater	1 to 10 (C)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted

Table 9-3: Samples with Elevated Practical Quantitation Limits Due to Dilution of Sample (continued)

Sample Identification	Date	Media	TCL Volatiles	Volatiles Method 8010	TPH-GRO	TPH-DRO	Lead	TCL Semivolatiles	PCBs	Pesticides
ESI-F1	30-Jun-94	Groundwater	1 to 10 (C)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
ESI-F2	30-Jun-94	Groundwater	1 to 10 (C)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
ESI-F3	30-Jun-94	Groundwater	1 to 10 (C)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
ESI-B1	30-Jun-94	Groundwater	1 to 10 (C)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-8-3	5-Jul-94	Soil	Not Diluted	1 to 100	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
Trip Blank	6-Jul-94	Groundwater	1 to 10 (C)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-9-1	6-Jul-94	Soil	Not Diluted	1 to 5	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-9-2	6-Jul-94	Soil	Not Diluted	1 to 100	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-10-1	6-Jul-94	Soil	Not Diluted	1 to 100	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-1-4	7-Jul-94	Soil	Not Diluted	Not Diluted	Not Diluted	1 to 20	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-7-3	7-Jul-94	Soil	Not Diluted	Not Diluted	Not Diluted	1 to 5	Not Diluted	Not Diluted	Not Diluted	Not Diluted
FP-93-02	8-Jul-94	Groundwater	1 to 10 (C)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
FP-93-08	8-Jul-94	Groundwater	1 to 50 (C)	Not Diluted	1 to 5	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
FP-93-04	8-Jul-94	Groundwater	1 to 50 (C)	Not Diluted	1 to 5	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
R-1	7-Jul-94	Groundwater	1 to 10 (C)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
D-1	7-Jul-94	Groundwater	1 to 10 (C)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
R-2	8-Jul-94	Groundwater	1 to 10 (C)	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-4A-1	9-Jul-94	Soil	Not Diluted	Not Diluted	1 to 1000	1 to 100	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-4A-2	9-Jul-94	Soil	1 to 50	Not Diluted	1 to 10,000	1 to 5	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-4A-2MS	9-Jul-94	Soil	Not Diluted	Not Diluted	1 to 10,000	1 to 100	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-4A-2MSD	9-Jul-94	Soil	Not Diluted	Not Diluted	1 to 10,000	1 to 100	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-5-3	9-Jul-94	Soil	1 to 50	Not Diluted	1 to 10,000	1 to 40	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-5-4	9-Jul-94	Soil	1 to 50	Not Diluted	1 to 1000	1 to 40	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-4-1	9-Jul-94	Soil	1 to 50	Not Diluted	1 to 1000	1 to 200	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-4-2	9-Jul-94	Soil	1 to 50	Not Diluted	1 to 10,000	1 to 20	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-4-2MS	9-Jul-94	Soil	Not Diluted	Not Diluted	1 to 10,000	1 to 20	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-4-2MSD	9-Jul-94	Soil	Not Diluted	Not Diluted	1 to 10,000	1 to 20	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-4-3	9-Jul-94	Soil	1 to 50	Not Diluted	1 to 100	1 to 40	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-4-4	9-Jul-94	Soil	1 to 50	Not Diluted	1 to 10,000	1 to 20	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-4A-2 Reanalysis	9-Jul-94	Soil	1 to 1000	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-4A-2MS Reanalysis	9-Jul-94	Soil	1 to 1000	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-4A-2MSD Reanalysis	9-Jul-94	Soil	1 to 1000	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-5-3 Reanalysis	9-Jul-94	Soil	1 to 1000	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-4-2 Reanalysis	9-Jul-94	Soil	1 to 1000	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-4-2MS Reanalysis	9-Jul-94	Soil	1 to 1000	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted

Table 9-3: Samples with Elevated Practical Quantitation Limits Due to Dilution of Sample (continued)

Sample Identification	Date	Media	TCL Volatiles	Volatiles Method 8010	TPH-GRO	TPH-DRO	Lead	TCL Semivolatiles	PCBs	Pesticides
MAAFSB-4-2MSD Reanalysis	9-Jul-94	Soil	1 to 1000	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-4-3 Reanalysis	9-Jul-94	Soil	1 to 1000	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-4-4 Reanalysis	9-Jul-94	Soil	1 to 1000	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-8B-2	20-Jul-94	Soil	Not Diluted	1 to 100	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-8B-2MS	20-Jul-94	Soil	Not Diluted	1 to 100	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-8B-2MSD	20-Jul-94	Soil	Not Diluted	1 to 100	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-9B-1	20-Jul-94	Soil	Not Diluted	1 to 5	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-9B-2	20-Jul-94	Soil	Not Diluted	1 to 100	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
MAAFSB-9B-3	20-Jul-94	Soil	Not Diluted	1 to 5	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
ESIGW2-61	22-Aug-94	Groundwater	1 to 25	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
R-2R	23-Aug-94	Groundwater	1 to 10	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
FP-93-02R	24-Aug-94	Groundwater	1 to 10	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
R-1R-1	24-Aug-94	Groundwater	1 to 10	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
FP-93-04R	24-Aug-94	Groundwater	1 to 50	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
FP-93-04R-1	24-Aug-94	Groundwater	1 to 50	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
R-1R	24-Aug-94	Groundwater	1 to 10	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
ESIGW2-46	28-Aug-94	Groundwater	1 to 10	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
ESIGW-159R	15-Sep-94	Groundwater	1 to 10	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
ESIGW-217	15-Sep-94	Groundwater	1 to 5	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
ESIGW-70R	15-Sep-94	Groundwater	1 to 100	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
FP-93-09-02	13-Oct-94	Groundwater	Not Diluted	Not Diluted	1 to 2	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
FP-93-04-02	13-Oct-94	Groundwater	Not Diluted	Not Diluted	1 to 5	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
FP-93-04	20-Jan-95	Groundwater	Not Diluted	Not Diluted	1 to 5	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
FP-93-04MS	20-Jan-95	Groundwater	Not Diluted	Not Diluted	1 to 5	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
FP-93-04MSD	20-Jan-95	Groundwater	Not Diluted	Not Diluted	1 to 5	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted
FP-93-08	20-Jan-95	Groundwater	Not Diluted	Not Diluted	1 to 5	Not Diluted	Not Diluted	Not Diluted	Not Diluted	Not Diluted

C Dilution due to TCE contamination.
L Dilution due to limited sample volume.
M Dilution due to matrix interference.
Dilution of all other samples listed was due to high analyte concentration.

Table 9-4. Samples with Analytes in the Corresponding Method Blank

Sample Indentification	Status	Date	Media	Method	Analyte Detected
B-1-02	B	11-Oct-94	Groundwater	TCL Volatiles	Dichloromethane
FP-93-09-02	B	13-Oct-94	Groundwater	TCL Volatiles	Dichloromethane
SCAPS-GW-1-99	B	28-Nov-94	Groundwater	TCL Volatiles	Dichloromethane
MAAF-CP2-R	B	30-Nov-94	Groundwater	TCL Volatiles	Dichloromethane
MAAF-CP6-R	B	1-Dec-94	Groundwater	TCL Volatiles	Dichloromethane
FP-93-04	B	20-Jan-95	Groundwater	TCL Volatiles	Dichloromethane
FP-93-05	B	21-Jan-95	Groundwater	TCL Volatiles	Dichloromethane
Trip Blank	B	23-Jan-95	Groundwater	TCL Volatiles	Dichloromethane
ESIGW2-108	B	23-Jan-95	Groundwater	TCL Volatiles	Dichloromethane
ESIGW2-129	B	25-Jan-95	Groundwater	TCL Volatiles	Dichloromethane
ESIGW2-127	B	26-Jan-95	Groundwater	TCL Volatiles	Dichloromethane
FP-94-01PZ-3	B	27-Jan-95	Groundwater	TCL Volatiles	Dichloromethane
ESIGW2-153	B	27-Jan-95	Groundwater	TCL Volatiles	Dichloromethane

B Analyte detected in the method blank; results have not been blank corrected.

Table 9-5. Analyses Exceeding Holding Time

Sample Identification	Status	Date	Media	TCL Volatiles	TPH-GRO	TCL Semivolatiles
D-1 Reprep/Analysis	H	7-Jul-94	Groundwater	NAp	NAp	Extraction
R-1 Reprep/Analysis	H	7-Jul-94	Groundwater	NAp	NAp	Extraction
MAAFSB-4A-1	H	9-Jul-94	Soil	NAp	Analysis	NAp
MAAFSB-5-4	H	9-Jul-94	Soil	NAp	Analysis	NAp
MAAFSB-4-1	H	9-Jul-94	Soil	NAp	Analysis	NAp
MAAFSB-4A-2 Reanalysis	H	9-Jul-94	Soil	Analysis	NAp	NAp
MAAFSB-5-3 Reanalysis	H	9-Jul-94	Soil	Analysis	NAp	NAp
MAAFSB-4-2 Reanalysis	H	9-Jul-94	Soil	Analysis	NAp	NAp
MAAFSB-4-3 Reanalysis	H	9-Jul-94	Soil	Analysis	NAp	NAp
MAAFSB-4-4 Reanalysis	H	9-Jul-94	Soil	Analysis	NAp	NAp
MAAFSB-4A-2MS Reanalysis	H	9-Jul-94	Soil	Analysis	NAp	NAp
MAAFSB-4A-2MSD Reanalysis	H	9-Jul-94	Soil	Analysis	NAp	NAp
MAAFSB-4-2MS Reanalysis	H	9-Jul-94	Soil	Analysis	NAp	NAp
MAAFSB-4-2MSD Reanalysis	H	9-Jul-94	Soil	Analysis	NAp	NAp
SCAPS-GW-1-99	H	28-Nov-94	Groundwater	Analysis	NAp	NAp
N-1 Reprep/Analysis	H	22-Jan-95	Groundwater	NAp	NAp	Extraction
I-1 Reprep/Analysis	H	23-Jan-95	Groundwater	NAp	NAp	Extraction
FP-94-02PZ-3 Reprep/Analysis	H	27-Jan-95	Groundwater	NAp	NAp	Extraction
N-1-02 Reprep/Analyses	H	11-Oct-94	Groundwater	NAp	NAp	Extraction
B-1-02 Re-analysis	H	11-Oct-94	Groundwater	Analysis	NAp	NAp

H Recommended holding time exceeded.
Analysis Holding time to analysis exceeded.
Extraction Holding time to extraction exceeded.
NAp - Not Applicable, holding times were not exceeded.

Table 9-6. Samples with Rejected Data

Sample Identification	Status	Date	Media	TCL Volatiles
M-1 (Offpost Well)	R	6-Jul-94	Groundwater	Rejected
F-2	R	6-Jul-94	Groundwater	Rejected
F-1	R	6-Jul-94	Groundwater	Rejected
B-1	R	6-Jul-94	Groundwater	Rejected
N-1	R	6-Jul-94	Groundwater	Rejected
Trip Blank	R	6-Jul-94	Groundwater	Rejected
FP-93-07	R	7-Jul-94	Groundwater	Rejected
FP-93-06	R	7-Jul-94	Groundwater	Rejected
D-1	R	7-Jul-94	Groundwater	Rejected
R-1	R	7-Jul-94	Groundwater	Rejected
FP-93-02	R	8-Jul-94	Groundwater	Rejected
FP-93-03	R	8-Jul-94	Groundwater	Rejected
FP-93-05	R	8-Jul-94	Groundwater	Rejected
FP-93-08	R	8-Jul-94	Groundwater	Rejected
FP-93-04	R	8-Jul-94	Groundwater	Rejected
FP-93-10	R	8-Jul-94	Groundwater	Rejected
R-2	R	8-Jul-94	Groundwater	Rejected
R-3	R	8-Jul-94	Groundwater	Rejected

R - Data rejected by data validator

10.0 SUMMARY

Figure 10-1 shows the location of a cross section profile at the FFTA. Figure 10-2 presents a cross section to illustrate the depth of samples taken as part of this study. This cross section spans monitor wells FP-93-07, FP-93-05, and FP-93-02, FP-94-09; private wells R-1 and R-2; soil gas and groundwater screening samples MAAF-FZ, MAAF-H9, MAAF-H8, MAAF-J6, MAAF-K5, and MAAF-N2; and soil sample H7. This cross section also depicts three water table elevations from the start of the SI (September 1993) through January 1995. The locations selected for this cross section provide a large area of coverage for the FFTA investigation. All sampling locations are shown in Plate 1.

This section summarizes observations regarding the data presented as part of the SI, the ESI, and the pilot test study:

Waste Characteristics

The results of the SI show that both petroleum hydrocarbons and chlorinated solvents are present in the subsurface at, and in, the vicinity of the FFTA-MAAF.

- The petroleum contamination originating from the FFTA appears to be limited in both soils and groundwater to the area in and around the center of the former fire training pit. Soil, soil gas, groundwater screening, and groundwater samples outside the boundaries of the pit have no or only low detections of petroleum hydrocarbons.

- The substance that was detected during the SI at the greatest number of locations is PCE. The detected concentrations in soils do not exceed risk-based guidelines; however, concentrations in groundwater exceed regulatory standards for drinking water.

Groundwater Elevations

Groundwater elevations were recorded and gradients were prepared using data from the seven on-post monitoring wells for the months of October 1993 and January 1994 and for June through August 1994. By September 1994, one piezometer had been installed on-post by the Kansas River and four monitoring wells had been installed at the racetrack.

- While the regional groundwater flow is along the Kansas River to the north and east, the local groundwater flow at the FFTA includes a north-northwest component.

- Groundwater elevations during the month of October 1993 were exceptionally high (depth to groundwater was approximately 10 feet) as a result of the regional flooding that occurred in July 1993. High standing water was still present within the interior of the speedway upon completion of the SI field work in November 1993. The October 1993 groundwater elevation data shows that at the FFTA there is a westward component of groundwater flow. However, the groundwater elevation data for October 1993 is not representative of typical conditions. A second set of readings in January 1994 revealed that the groundwater elevation had dropped approximately 3 feet. Both sets of data indicated a north to northwest groundwater flow direction.

- Since October 1993 to January 1995, groundwater levels have receded to depths of approximately 17 feet beneath the surface. Further, the groundwater flow direction and gradient has remained similar from January 1994 through January 1995. There is a general groundwater flow direction to the north with a northeast component on the eastern portion of the FFTA and a northwestern component on the western portion of the FFTA. The more recent data in January 1995, however, indicates a more predominant northeast groundwater flow direction. Outside of the regional flooding in July 1993, the data indicate that groundwater flow directions at the FFTA are not greatly affected by seasonal changes (i.e., groundwater flow reversals have not been observed).

Soil Gas and Groundwater Screening

Soil gas and groundwater screening surveys were performed as part of the SI in September 1993, Phase I of the ESI in June and July 1994, and Phase II of the ESI in August 1994 through January 1995. These surveys consisted of the following:

- SI - 58 locations on-post for soil gas and groundwater screening samples
- Phase I ESI - 238 locations off-post for soil gas samples; 90 locations off-post for groundwater screening samples
- Phase II ESI - 154 locations off-post for groundwater screening samples

The results of the soil gas survey and groundwater screening showed that the same types of contaminants were detected in about the same area. The detections in the groundwater screening were generally higher than the detections in the soil gas samples. The Phase II included only groundwater screening samples since they provided data on direct measurements of the media of concern. Also, groundwater screening results were higher than soil gas. Except in the immediate vicinity of the FFTA, soil gas detections may be a result of off-gasing of PCE from groundwater or residual PCE from fluctuations in the groundwater due to flooding and/or seasonal movement and would be attributed entirely to off-gassing at locations where PCE was not present in soils. Therefore, no soil gas surveys were used in Phase II.

- The soil gas results of the SI showed that chlorinated solvents were present in the subsurface at and in the vicinity of the FFTA-MAAF. The maximum concentrations detected were PCE at 50 μg/l, TCE at 6.2 μg/l, and c-1,2-DCE at 21 μg/l.
- An overview of the results of the ESI groundwater screening survey is presented in Figure 5-6. The shaded areas represent locations where detections of field data exceeded exceed 10 μg/l. In general, there were few detections of non-

chlorinated VOCs, which would be indicative of migration of petroleum hydrocarbons. The primary contaminants detected were PCE, TCE, and DCE. Isoconcentration contours were developed for each of these contaminants separately and for total chlorinated VOCs at each location. In compiling the isoconcentration contours, data from all sampling events over a period in excess of 15 months (October 1993 to January 1995) were used. Thus, a direct comparison does not account for temporal variations or migration of contaminants over time. Nonetheless, the composite isoconcentrations provide an overview of the locations with detected concentrations of VOCs and the relative magnitude of the detections.

- The isoconcentrations for PCE, TCE, DCE, and total chlorinated VOCs are presented in Figures 5-7 to 5-10, respectively. The detections of chlorinated VOCs occur in an area downgradient of the FFTA, extending from the FFTA across the racetrack property in a north-northeast direction. Detections were also recorded in agricultural fields located to the north of the racetrack property. The direction of detections away from the FFTA is consistent with the regional groundwater flow direction to the north. In general, the pattern of detections is similar for each contaminant; however, detections in the area of the racetrack and in the agricultural fields further to the north are not contiguous.

- <u>Geophysical Survey Results</u>. The ESI included a seismic reflection survey and electrical resistivity soundings to characterize depth to bedrock, the topography of the underlying bedrock surface, and geologic layering in the alluvial materials. The results of the geophysical surveys consist principally of a projected bedrock topography map. This map is presented in Figure 3-10. The results of the geophysical surveys were used to plan collection of deep alluvial groundwater screening samples.

- <u>Deep Alluvial Groundwater Screening Samples</u>. The USACE SCAPS rig was used to look for DNAPLs, to collect deep alluvial groundwater screening samples, and to collect CPT and electrical resistivity data. The groundwater screening samples were analyzed for chlorinated VOCs. CPT and resistivity data were used to assist in identifying geologic layers from the surface to the top of bedrock and to provide stratigraphic and depth-to-bedrock data to calibrate the August 1994 geophysical results. The CPT data showed that there were no low permeability layers present from the water table to the top of bedrock.

  Chlorinated VOCs were detected at five CPT locations. There was one detection of DCE at 1.1 μg/l and four detections of TCE ranging from 1.0 to 2.8 μg/l. The SCAPS groundwater screening samples indicate that DNAPLs are not present at the FFTA. The results of the chemical analyses of the groundwater screening samples indicate that DNAPLs are not present - rather, low concentrations in groundwater of chlorinated VOCs were detected.

Soil

The Phase II soil samples were collected due to detections in the Phase I data, and focused on shallow soils to evaluate whether additional source areas may be present. Soil samples were collected at 29 boring locations off-post during Phase II of the ESI. At 26 boring locations, samples were collected from depths of 2 to 3 feet and 7 to 8 feet. At the remaining three locations, shallow soil samples were only collected from the 2- to 3-foot interval. All soil samples were analyzed for VOCs. VOCs were detected above PQLs at four of the soil boring locations. For the pilot test study, baseline soil borings were collected and analyzed from nine borings at about five depths, along with four co-located borings at two depths.

- The soil results of the SI showed that chlorinated solvents were present in the subsurface at and in the vicinity of the FFTA-MAAF. The maximum concentrations detected was PCE at 480 μg/kg.

- The results for soil borings in the deeper sample zone (7 to 8 feet) indicate that DCE was detected at 30 to 49 μg/kg, PCE at 17 to 44 μg/kg, and TCE at 6.6 μg/kg. The concentrations of DCE, PCE, and TCE detected in soils do not exceed risk-based guidelines.

- The concentrations of contaminants in soil borings SB-2, SB-3, SB-4, and SB-8 are in areas where there is known groundwater contamination (i.e., near contaminated groundwater screening locations ESIGW-70 and ESIGW-99). The detections in these soil borings occurred only in the deeper sample zone indicating that a separate shallow source area is not likely. Therefore, contamination is most likely due to adsorption to the soil due to the regional flooding in September 1993 when contaminated groundwater occupied the pore spaces of soils at depths of 7 to 8 feet from the surface.

- TPH exceeded the cleanup standards or risk-based guidelines in 18 samples at three borings to a depth of about 13 feet. All these samples were taken in and around the former fire training pit. The maximum concentrations detected were TPH-DRO at 23,000,000 μg/kg and TPH-GRO at 2,600,000 μg/kg. Two samples had DCE concentrations exceeding the KDHE cleanup guidance level, but well below the EPA risk-based guidelines. Concentrations of m- &/or p-xylenes in three samples exceeded both the EPA risk-based guidelines and the KDHE cleanup guidance levels for mixed xylenes. The maximum concentration detected of m- &/or p-xylenes was 170,000 μg/kg.

Groundwater

Groundwater samples were collected at the seven on-post monitor wells (FP-93-01 through FP-93-07) and four to eight of the off-post private wells (N-1, M-1, R-1, R-2, R-3, F-1, F-2, and B-1) during the months of October 1993 (R-2 and R-3 were not sampled), July 1994, October 1994, and January 1995. Off-post irrigation well I-1 was sampled for the first time in October 1994. In January 1995, groundwater samples were also collected from the on-post piezometer (FP-94-12PZ) and the four off-post monitoring wells (FP-94-08 through FP-94-11) installed in 1994. Wells R-1, R-2, F-1, and F-2 were shut down for the winter and were not sampled in January 1995. All samples were analyzed for VOCs, SVOCs, PP metals, and TPH. The primary contaminants detected were chlorinated VOCs (DCE, PCE, and TCE).

- Overall, R-1 is the most downgradient well with detected concentrations of VOCs, and the detected concentrations have been higher than other wells closer to the FFTA. Chlorinated VOCs have migrated from the FFTA towards the north-northeast, in the direction of groundwater flow. The areas of contamination based on these isoconcentration maps are largely overlapping for the different contaminants. The concentrations of DCE at on-post well FP-93-04 nearest the center of the former pit decreased from 4,100 μg/l in October 1993 to 3.3 μg/l in January 1995. When reviewing data from on-post wells (FP-93-04 and FP-93-05), note that the pilot test study for the FFTA was conducted between November 1994 and January 1995 and it was removing contaminants from the soil. Reductions might also be attributable to horizontal or vertical migration, loss through vapors, natural attenuation, or groundwater levels receding below the zone of contamination.

Surface Water

- Although the drainage ditch transects the FFTA, there does not appear to be any overland transport of contaminants from the FFTA along the ditch.

MAAF-6.dwg 2/98

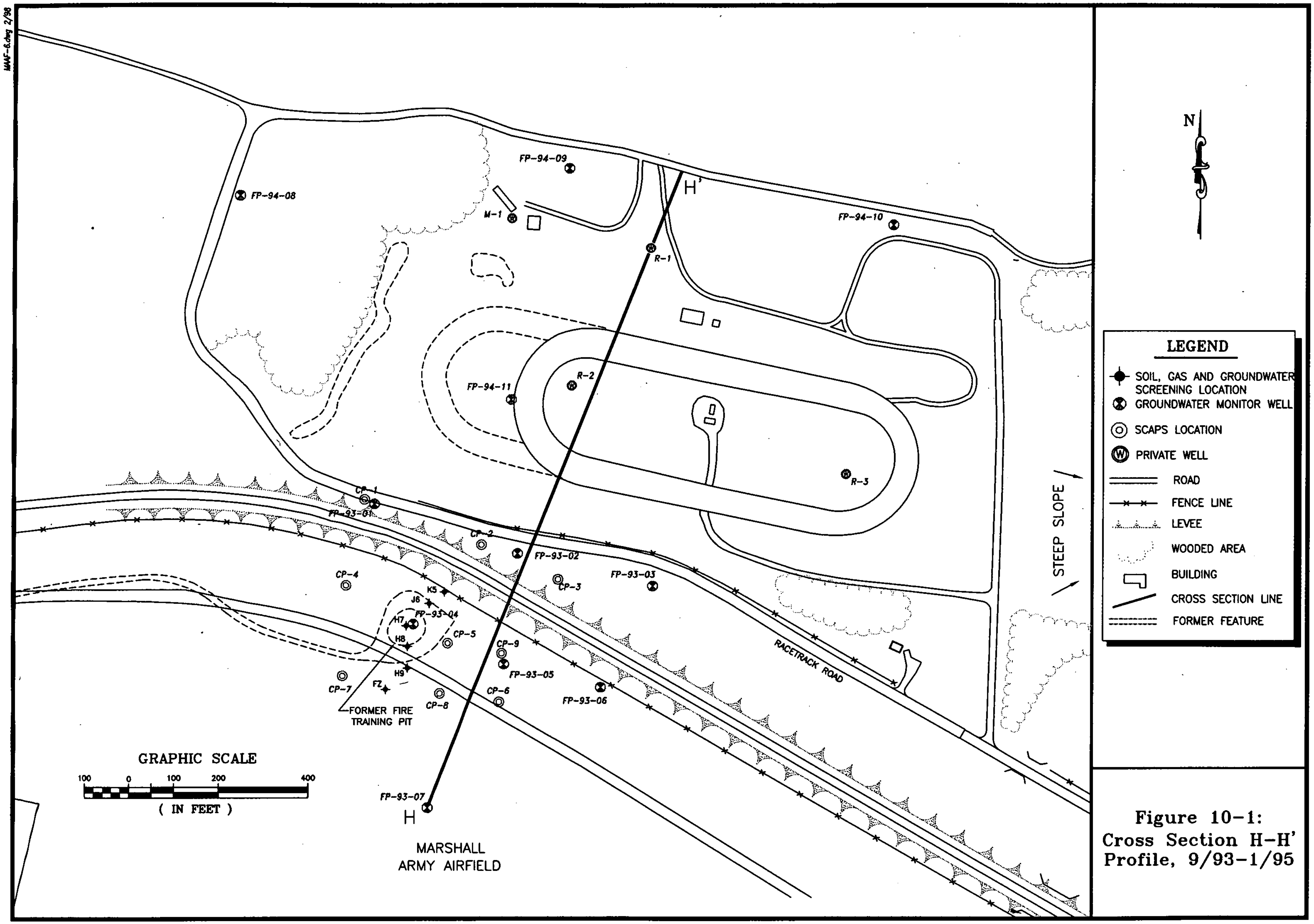


Figure 10-1: Cross Section H-H' Profile, 9/93-1/95

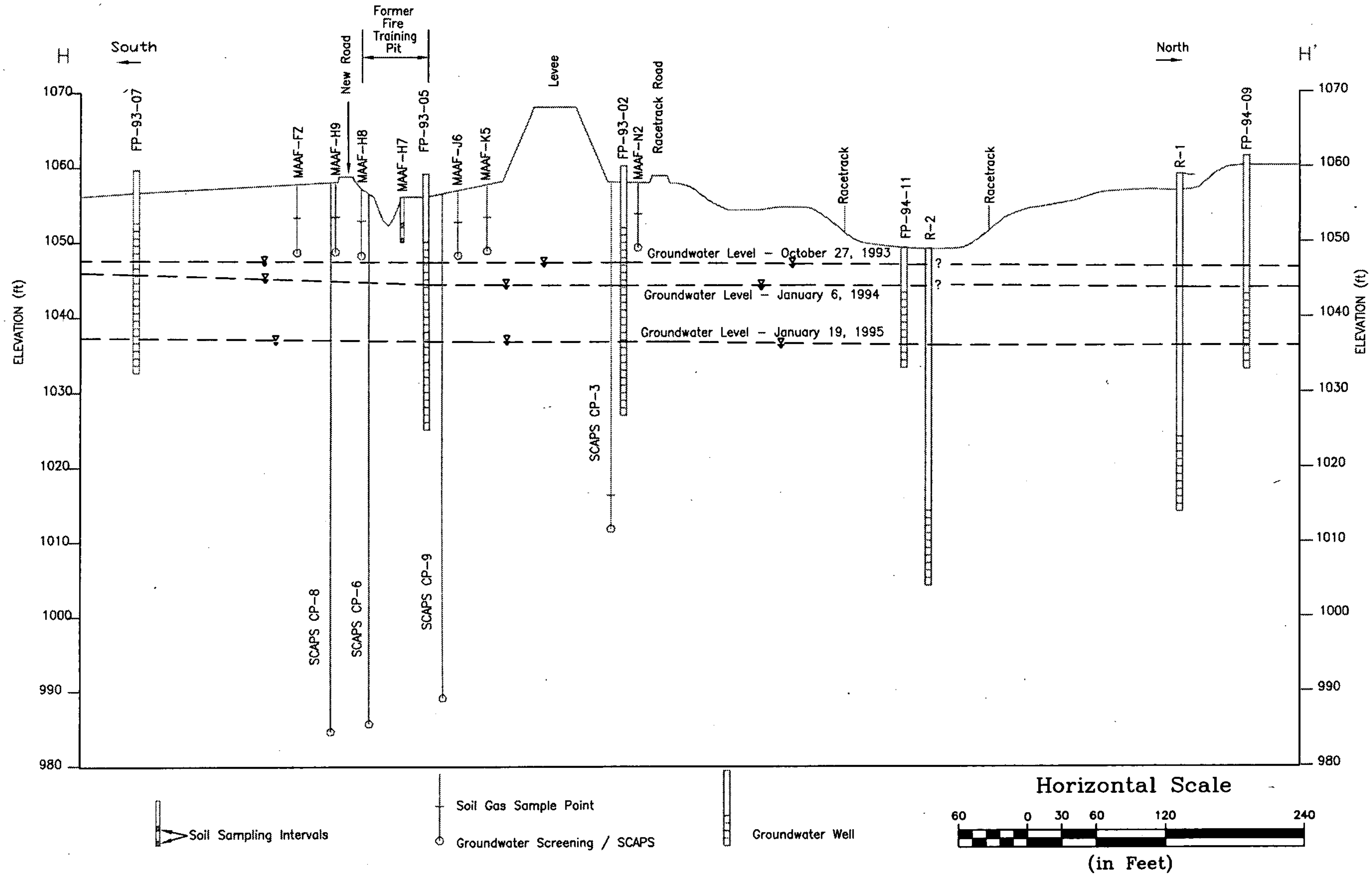


Figure 10-2: Sample Location Cross Section at H-H' FFTA, 9/93-1/95

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48. *Integrated Natural Resources Management Plan,* Prepared by Louis Berger & Associates, Inc., for U.S. Army Corps of Engineers, Missouri River Division, Kansas City District, November 1994.

49. U.S. Department of the Interior, *National Wetlands Inventory, Junction City, KS, Quadrangle*, 1992 and *National Wetlands Inventory, Junction City, KS, Quadrangle*, 1992.

50. U.S. Department of the Interior Fish and Wildlife Service, Kansas State Office, *A Survey of Threatened and Endangered Species on Fort Riley Military Reservation, Kansas*, for U.S. Department of the Army, Directorate of Engineering and Housing, Fort Riley, Kansas, February 1992.

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52. Data from the Fort Riley Department of Environmental Health for demographic statistics (included as an excerpt).

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54. Fort Riley Reservation, *General Map Groundwater Survey*, January 28, 1941, prepared by Widmer Engineering Company.

55. Highlight from AEHA report memo entitled "Results of Synthetic Organic Chemical Survey for 1st Infantry Division (Mechanized) and Fort Riley", U.S. Army Environmental Hygiene Agency, 20 March 1992 (included as an excerpt).

56. Communication the Junction City Plant Manager at the Water Treatment Plant regarding water supply wells (included as an excerpt).

57. Communication with a City of Ogden representative regarding water supply wells and their locations (included as an excerpt).

58. U.S. Army Corps of Engineers, Kansas City District, *Clean/Repair Major Water Lines, Fort Riley, KS, Project F5-0007 5-0J, 1992.*

59. Junction City, Geary County, KS, *Water Supply System Plan*, revised October 1992.

60. City of Grandview Plaza, KS, *Water Distribution System Map, January 1989*, prepared by Schwab-Eaton, P.A.

61. City of Ogden, KS, provided a street directory with hand-drawn water boundaries for water supply and Riley County Water Supply System provided an outline of the water supply system boundaries prepared by Schwab-Eaton, P.A.

62. Fort Riley Marshall Army Air Field water wells - Data on pump tests performed in March 1983 for the U.S. Army Corps of Engineers, Kansas City District, Kansas City, Missouri.

63. Installation of test well & aquifer tests, Fort Riley, Kansas - Data on pump tests performed by Schwab-Eaton, Inc. in 1974 and 1975 for the U.S. Army Corps of Engineers, Kansas City District, Kansas City, Missouri.

64. Pump tests and expansion of the well field along McCormick Avenue, Fort Riley, Kansas - Data on pump tests performed by The Benham Group, Inc. in June and December 1989 for the U.S. Army Corps of Engineers - Kansas City District, Kansas City, Missouri.

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

66. Aerial photographs of the MAAF area from Kansas Department of Revenue, Board of County Commissioners for the years 1954, 1960, 1961, 1971, 1976, 1977, 1979, 1984, 1986, and 1993.

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71. U.S. Environmental Protection Agency, Contract Laboratory Program (CLP), *National Functional Guidelines for Organic Data Review,* 1988, revised February 1994.

72. U.S. Environmental Protection Agency, *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, 3rd Edition, plus updates, SW-846, Washington D.C., November 1986.

12.0 REFERENCE EXCERPTS

This section includes the actual excerpt for reference numbers 9, 33, 34, 37, 38, 39, 42, 43, 44, 45, 52, 55, 56, and 57.

REFERENCE 9
FROM SECTION 11.0

History of Submission of the Basic Documents for Investigations at Fort Riley, Kansas, 14 January 1995

History By Document

QAPP History:

29 May 1992	Draft Final SAP for Field Investigations at Fort Riley Impact Zone included the QAPP. Document was issued in its entirety.
21 May 1993	QAPP written for High Priority Sites in accordance with D.O. 2. Document was issued in its entirety. Disregard previous versions.
25 June 1993	Document was issued in its entirety. Disregard previous versions.
20 August 1993	Revision pages only.
15 October 1993	Revision pages only.
29 October 1993	Revision pages only.
13 May 1994	Army - Only Draft. Responding to [redacted] comments dated 2/14/94.
8 August 1994	Revised to incorporate continuing expansion of work at Fort Riley, including the Other Sites Investigations, the ESI at MAAF, the pilot study at MAAF and the pilot study at DCF. Changes included the addition of information regarding control samples, calibration of instruments, SOPs for various new technologies, procedures for tap water sampling, procedures for PCB field screening and test kits, and the addition of QA manual from new certified laboratory. Document was issued in its entirety. Disregard previous versions.
9 January 1995	Revised to better accommodate the addition of new laboratories as required by the continuing expansion of the work at Fort Riley. Changes were editorial in nature, and no additional information was added. Document was issued in its entirety. Document was issued in its entirety. Disregard previous versions.

MWIP History:

29 May 1992	Draft Final SAP for Field Investigations at Fort Riley Impact Zone included the WMIP. Document was issued in its entirety.
21 May 1993	WMIP written for High Priority Sites in accordance with D.O. 2. Document was issued in its entirety. Disregard previous versions.
20 August 1993	Revision pages only.
4 October 1993	Revision pages only.
29 October 1993	Revision pages only.

13 May 1994	Army - Only Draft. Responding to [redacted] comments 2/14/94.
8 August 1994	Revised to incorporate continuing expansion of work at Fort Riley, including the Other Sites Investigations, the ESI at MAAF, the pilot study at MAAF and the pilot study at DCF. Revisions included the addition of material regarding collection of groundwater screening samples, construction of extraction/injection points, construction of piezometers, well construction cheat sheets, and boring log requirements. Document was issued in its entirety. Disregard previous versions.

SGS History:

21 May 1993	SGS written for High Priority Sites in accordance with D.O. 2. Document issued in its entirety.
20 August 1993	Revision pages only.
8 August 1994	Revision pages only. Revised to incorporate continuing expansion of work at Fort Riley, including the Other Sites Investigations, the ESI at MAAF, the pilot study at MAAF and the pilot study at DCF. Additional information added regarding the collection of groundwater screening samples utilizing Geoprobe equipment.

SSHP History:

13 March 1992	Original plan written.
2 May 1992	Written for the field investigations at Fort Riley Impact Zone. Document was issued in its entirety. Disregard previous versions.
26 April 1993	SSHP written for High Priority Sites in accordance with D.O. 2. Document issued in its entirety.
4 August 1993	Revision pages only.
11 October 1993	Revision pages only.
8 August 1994	Addendum added as necessitated by the ESI and pilot study at MAAF. Revised to include seismic activities, off-post activities, and confined-entry.

IDW History:

3 June 1993	Document was issued in its entirety.
1 September 1993	Document was issued in its entirety. Disregard previous versions.

History By Date

13 March 1992	Original SSHP written.
2 May 1992	SSHP written for the field investigations at Fort Riley Impact Zone. Document was issued in its entirety. Disregard previous versions.
29 May 1992	Draft Final SAP for Field Investigations at Fort Riley Impact Zone included the QAPP and WMIP. Document was issued in its entirety.
26 April 1993	SSHP written for High Priority Sites in accordance with D.O. 2. Document issued in its entirety.
21 May 1993	QAPP, MWIP, and SGS written for High Priority Sites in accordance with D.O. 2. Document was issued in its entirety. Disregard previous versions.
3 June 1993	IDW Plan was issued in its entirety.
25 June 1993	QAPP was issued in its entirety. Disregard previous versions.
4 August 1993	SSHP revised. Revision pages only.
20 August 1993	QAPP, MWIP, and SGS revised. Revision pages only.
1 September 1993	IDW Plan was issued in its entirety. Disregard previous versions.
4 October 1993	MWIP revised. Revision pages only.
11 October 1993	SSHP revised. Revision pages only.
15 October 1993	QAPP revised. Revision pages only.
29 October 1993	QAPP and MWIP revised. Revision pages only.
13 May 1994	Army - Only Draft QAPP and MWIP. Responding to [redacted] comments dated 2/14/94.
8 August 1994	QAPP, MWIP was issued in its entirety. Disregard previous versions. SGS and SSHP revision pages only submitted. Revised to incorporate continuing expansion of work at Fort Riley, including the Other Sites Investigations, the ESI at MAAF, the pilot study at MAAF and the pilot study at DCF.
9 January 1995	QAPP revised to better accommodate the addition of new laboratories as required by the continuing expansion of the work at Fort Riley. Changes were editorial in nature, and no additional information was added. Document was issued in its entirety. Document was issued in its entirety. Disregard previous versions.

REFERENCE 33
FROM SECTION 11.0

DEPARTMENT OF THE ARMY
HEADQUARTERS 1ST INFANTRY DIVISION (MECH) AND FORT RILEY
FORT RILEY, KANSAS 66442

AFZN-FE-E

3 September 1982

MEMORANDUM FOR RECORD

SUBJECT: Perchloroethylene Spill

1. On 30 August 1982, Mr. Charles Harris of this office came to my residence at approximately 2145 hours to inform me of the subject spill. Assistant Fire Chief Newell had reported the spill. I called Assistant Chief Newell who stated that 55 gallons of perchloroethylene had inadvertently been emptied into the "fire training pit" at Marshall Army Airfield at approximately 1930 hours. A drum of the chemical had been "illegally" left as contaminated POL at the training site. The firemen emptied the chemical into the pit thinking it was a POL product. I then called LTC Carlisle and left a message for him to return my call. Assistant Chief Newell was called again to obtain additional information. After waiting for LTC Carlisle's call, Assistant Chief Newell was called again at approximately 2300 hours to recommend that pumping and/or absorption of the liquid begin. LTC Carlisle called shortly after 2300 hours. and was briefed on the spill and possible removal techniques. He stated that he would call Assistant Chief Newell.

2. On 31 August 1982, I talked to LTC Carlisle at approximately 0745 hours about the spill. He stated that he had instructed Assistant Chief Newell to begin pumping the liquid into containers. I told him that we needed to verify that the drum actually contained perchloroethylene. I called the laundry COR (Mr. Krause) and explained the situation. He and two (2) laundry personnel came by our office and we visited the site. They verified the chemical via olfaction. Upon checking the site for additional drums one (1) more 55 gallon drum of perchloroethylene was located and verified. Upon returning to the office, I called Mr. Phil Worley of the Kansas Department of Health and Environment (KDHE), Salina District, to notify the State of the spill event. Chief Mathes and I discussed the problem, and estimated the number of 55 gallon drums required to store the remaining liquid. We went to PDO and talked to Mr. Dick Spittles and Mrs. Brown. They were very cooperative. The Fire Department arranged for USARB troops to load and unload the drums. Three (3) old, unservicable tents were also obtained to cover any stored waste. The drums were unloaded at approximately 1430 hours. The drums were filled and covered. Mr. John Paul Goetz (Chief of the KDHE Hazardous Waste Management Section) called our office, and left word that he would call back.

3 September 1982

3. On 1 September 1982, Mr. Goetz called in the early morning. We discussed the situation, and I told him that we needed assistance in the proper disposal of the drummed and absorbed (hay) wastes. He stated that he would get back in touch with us. The Fire Department used USARB troops to spread hay over the remaining liquid in the pit.

4. On 2 September 1982, MAJ Uveling (Chief of the DIO Supply & Services Division) called with a note from COL Ashby (DPC) and Mr. Sheridan (Deputy DIO) wanting some information on the chemical. I visited the site at approximately 1330 hours, and obtained information from the drums (see file for information taken from drums). I called MAJ Uveling and gave him the information. He then traced the drums to the 701st Maintenance Battalion.

5. On 3 September 1982, MAJ Uveling called and said the he (DIO) would take the remaining drum of perchloroethylene for "recycling" back to the laundry.

JIM DAY
Chief, Environmental Office

CF:
LTC Carlisle
Mr. William Barrett
Chief Richard S. Mathes

REFERENCE 34
FROM SECTION 11.0

736

DATA CONTROL FORM

PROJECT NAME: FORT RILEY INSTALLATION-WIDE SITE ASSESSMENT

PROJECT NUMBER: XA-1088-91 Contract #

DELIVERY / TASK #: Delivery Order 1 Task 1

AGENCY / TITLE:

DATE / TIME / PLACE:

RECORDER:

DOCUMENT TYPE: MAP ____ DRAWING ____ DATA ____

LEGAL ____ LETTER ✓ REPORT/MEMO ____

RETRIEVAL:

POST AREA: ____ BUILD. NUM / NAME: ____

DRAWER / CABINET / BOX:

DOCUMENT NUMBER:

SOURCE DATE: 7/May 1985

POTENTIAL AREA OF CONCERN:

POST AREA:

BUILD NUM / NAME:

MAP NUM / COORD:

SUBJECT CODE: YIT HAZ

COMMENTS:

FORM QAQC#2
FT RILEY INSTALLATION-WIDE ASSESSMENT

12/17/91
REVISION 2

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY CPT Leggieri/rb/AUTOVON
U.S. ARMY ENVIRONMENTAL HYGIENE AGENCY 584-3651
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

HSHB-ES-H 7 MAY 1985

SUBJECT: Results of Analyses Performed on Soil and Sludge Samples from the Fire Training Pit, Fort Riley, Kansas

Commander
U.S. Army Forces Command
ATTN: AFMD
Fort McPherson, GA 30330-6000

1. Reference:

a. Letter, this Agency, HSHB-ES-H, 17 December 1984, subject: Hazardous Waste Management Study No. 37-26-0388-85, Fort Riley, Kansas, 20-24 August 1984.

b. Kansas Administrative Regulation, Title 28 - Department of Health and Environment, Article 31 - Hazardous Waste Management Standards and Regulations, 1 May 1982, as amended.

c. Kansas Administrative Regulation, Title 28 - Department of Health and Environment, Article 29 - Solid Waste Management, 1 January 1972, as amended.

d. Public Law 98-616, 8 November 1984, Hazardous and Solid Waste Amendments of 1984.

2. The results of analyses performed on six surface samples collected on 1 Dec 84 from the fire training pit and adjacent drum storage area are provided as enclosure 1. A physical description of each sample and sampling point, the analytical testing procedures used, and the detection limits for each analytical procedure are provided as enclosures 3, 4, and 5, respectively.

3. Based on these analytical results, the sludge and liquid within the fire training pit and the soil in the adjacent drum storage area are not hazardous wastes as defined in the Kansas hazardous waste regulation (reference 1c).

4. The major contaminant identified in these samples was fuel oil. The State of Kansas does not regulate waste fuel oil as a hazardous waste but does regulate it as a solid waste (reference 1d). The State solid waste regulation prohibits the disposal of waste fuel oil on the ground. While it is true that the act of placing fuel oil on the ground for the sole purpose of burning in support of the fire training does not constitute disposal, the management of the residues remaining on the ground would probably be governed by this solid waste regulation. Furthermore, the EPA is planning to regulate waste oils (including waste fuel oil) as hazardous wastes (reference 1d). When this occurs, the contaminated soils in this fire training area will have to be removed and disposed of as a hazardous waste.

5. In light of the information provided in paragraph 4, serious consideration should be given to removing the fuel-oil-contaminated soil from this area now and disposing of it in accordance with the State solid waste regulation. In the future, burning in support of fire training should prevent soil contamination (e.g., by burning in a tank or other vessel that will contain fuel and water runoff).

6. Questions regarding this matter may be referred to CPT Michael Leggieri or Chief, Waste Disposal Engineering Division, this Agency, AUTOVON 584-3651.

FOR THE COMMANDER:

ORIGINAL SIGNED

5 Encls

KARL J. DAUBEL
Colonel, MS
Director, Environmental Quality

CF (w/encls):
Cdr, FORSCOM (AFEN-TSF/AFEN-MSE)
→Cdr, Ft Riley
Cdr, HSC (HSCL-P)
Cdr, FAMC (PVNTMED Svc)
Cdr, MEDDAC, Ft Riley
C, USAEHA-Rgn Div West

HB-ES-H
BJECT: Results of Anaylses Performed on Soil and Sludge Samples from the Fire Training Pit, Fort Riley, Kansas

TABLE 1

ANALYTICAL RESULTS

Parameter (µg/g) unless otherwise stated	Sample Point Identification 1	2	3	4	5	6
TEP METALS (mg/l)	ND[a]	ND	ND	ND	ND	ND
PCB (ppm)	<25	<50	<50	<50	<1.0	<1.0
VOLATILE ORGANICS[b]						
Chloroform	NA[c]	ND	ND	2	ND	ND
1,2-Dichloroethene (Trans)	NA	2	2	1	3	ND
Tetrachloroethylene	NA	1	1	ND	ND	ND
OTHER ORGANIC COMPOUNDS						
Fuel Oil	Fuel oil #2	ND	50-200	100-300	50-200	ND
Methyl Naphthalenes[d]	ND	10	1.0-50	1.0-50	1.0-50	ND
Dimethyl Naphthalenes[d]	ND	20	1.0-50	1.0-50	1.0-50	ND
Diethyl Phthalate[e]	ND	ND	ND	ND	ND	50-150

[a] ND - not detected
[b] A complete list of all of the volatile organic compounds for which the samples were analyzed is provided as Table 2. Only those compounds detected are included in this Table.
[c] NA - not analyzed
[d] These substances are constituents of fuel oil contaminated soil.
[e] Diethyl phthalate is frequently detected during GC/MS scans of soil samples and can be attributed to contamination resulting from contact with plastic sampling equipment.

Encl 1

TABLE 2

LIST OF VOLATILE ORGANICS

BENZENE
BROMOMETHANE
BROMODICHLOROMETHANE
BROMOFORM
CARBON TETRACHLORIDE
CHLOROBENZENE
CHLOROETHANE
2-CHLOROETHYLVINYL ETHER
CHLOROFORM
CHLOROMETHANE
DIBROMOCHLOROMETHANE
1,1-DICHLOROETHANE
1,2-DICHLOROETHANE
1,1-DICHLOROETHENE
1,2-DICHLOROETHENE (TRANS)
1,2-DICHLOROPROPANE
1,3-DICHLOROPROPENE (CIS)
1,3-DICHLOROPROPENE (TRANS)
ETHYL BENZENE
METHYLENE CHLORIDE
1,1,2,2-TETRACHLOROETHANE
TETRACHLOROETHYLENE
1,1,1-TRICHLOROETHANE
1,1,2-TRICHLOROETHANE
TRICHLOROETHYLENE
TRICHLOROFLUOROMETHANE
TOLUENE
VINYL CHLORIDE

Encl

TABLE 3

PHYSICAL DESCRIPTION OF SAMPLES AND SAMPLING POINTS

SAMPLE NUMBER	SAMPLING POINT DESCRIPTION	SAMPLE DESCRIPTION
1	Inside bermed fire training pit	oil/water mixture sampled from standing liquid
2	Same as 1	Sludge *
3	Same as 1	Sludge
4	Same as 1	Sludge
5	Drum storage area adjacent to fire training pit	Soil
6	Same as 5	Soil

*All sludge and soil samples were surface samples collected to a depth of 2-3 inches

Encl.

TABLE 4

ANALYTICAL TESTING PROCEDURES

Parameter	Method
TEP Metals Arsenic Barium Cadmium Chromium Lead Mercury Selenium Silver	Extraction in accordance with 40 CFR 261; Nitric acid and hydrochloric acid digestion in a Paar bomb followed by EPA[1] atomic absorption via direct aspiration (copper, cadium, chromium, lead, and silver), hydride generation (arsenic and selenium), and the ICP techniques (barium) and flameless method (mercury)
PCB	Solvent extraction followed by GC analysis
Volatile Organics	GC/MS Method for Volatile Organics, EPA Method No. 8240
Other Organics	Methanol extraction followed by GC/MS analysis, EPA Method No. 503*

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*Test Methods for Evaluating Solid Waste, SW-846, EPA, July 1982.

Encl 4

TABLE 5

DETECTION LIMITS

Parameter	Detection Limit
TEP METALS (mg/1)	
Arsenic	0.5
Barium	10.0
Cadmium	0.1
Chromium	0.5
Lead	0.5
Mercury	0.02
Selenium	0.1
Silver	0.5
PCB (ppm)	1.0*
VOLATILE ORGANICS (µg/g)	1.0
OTHER ORGANICS	1.0

*The detection limit for sample no. 1 was 25 ppm. For samples 2, 3, and 4, the detection limit was 50 ppm. Lower detection limits for these samples could not be attained because of interference from long chain hydrocarbons (fuel oil)

Encl

DATA CONTROL FORM

PROJECT NAME: FORT RILEY INSTALLATION-WIDE SITE ASSESSMENT

PROJECT NUMBER: XA-1088-91 Contract #

DELIVERY / TASK #: Delivery Order 1 , 4 Task # 3

AGENCY / TITLE: FORT RILEY, KS

DATE / TIME / PLACE: 11/19/92

RECORDER: [illegible]

DOCUMENT TYPE: MAP ___ DRAWING ___ DATA X

LEGAL ___ LETTER [illegible] REPORT/MEMO ✓

RETRIEVAL:

POST AREA: ___ BUILD. NUM / NAME: [redacted] [illegible]

DRAWER / CABINET / BOX:

DOCUMENT NUMBER:

SOURCE DATE: 14 May 85

POTENTIAL AREA OF CONCERN:

POST AREA:

BUILD NUM / NAME:

MAP NUM / COORD:

SUBJECT CODE: HAZ PIT

COMMENTS: [illegible]

[illegible] PIT

FORM QAQC#2
FT RILEY INSTALLATION-WIDE ASSESSMENT

Reference 34
9 of 16

12/17/91
REVISION 2

AFMD-PC (7 May 85) 1st End LTC Vavra/lw/AUTOVON 588-2816
SUBJECT: Results of Analyses Performed on Soil and Sludge Samples from the Fire Training Pit, Fort Riley, KS

HQ FORSCOM, Fort McPherson, GA 30330-6000 14 May 85

TO: Commander, 1st Infantry Division and Fort Riley, Fort Riley, KS 66442-5036

Subject report has been reviewed by this office and is forwarded for information and necessary action.

FOR THE COMMANDER:

John F Taylor

JOHN F. TAYLOR, MD
Colonel, Medical Corps
Command Surgeon

Encl
nc

CF:
Commander, FORSCOM, ATTN: AFEN-MSE

DEPARTMENT OF DEFENSE UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY CPT Leggieri/rb/AUTOVON
U.S. ARMY ENVIRONMENTAL HYGIENE AGENCY 584-3651
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

7 MAY 1985

HSHB-ES-H

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Commander
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1. Reference:

a. Letter, this Agency, HSHB-ES-H, 17 December 1984, subject: Hazardous Waste Management Study No. 37-26-0388-85, Fort Riley, Kansas, 20-24 August 1984.

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3. Based on these analytical results, the sludge and liquid within the fire training pit and the soil in the adjacent drum storage area are not hazardous wastes as defined in the Kansas hazardous waste regulation (reference 1c).

4. The major contaminant identified in these samples was fuel oil. The State of Kansas does not regulate waste fuel oil as a hazardous waste but does regulate it as a solid waste (reference 1d). The State solid waste regulation prohibits the disposal of waste fuel oil on the ground. While it is true that the act of placing fuel oil on the ground for the sole purpose of burning in support of the fire training does not constitute disposal, the management of the residues remaining on the ground would probably be governed by this solid waste regulation. Furthermore, the EPA is planning to regulate waste oils (including waste fuel oil) as hazardous wastes (reference 1d). When this occurs, the contaminated soils in this fire training area will have to be removed and disposed of as a hazardous waste.

5. In light of the information provided in paragraph 4, serious consideration should be given to removing the fuel-oil-contaminated soil from this area now and disposing of it in accordance with the State solid waste regulation. In the future, burning in support of fire training should prevent soil contamination (e.g., by burning in a tank or other vessel that will contain fuel and water runoff).

6. Questions regarding this matter may be referred to CPT Michael Leggieri or Chief, Waste Disposal Engineering Division, this Agency, AUTOVON 584-3651.

FOR THE COMMANDER:

Karl J Daubel

5 Encls

KARL J. DAUBEL
Colonel, MS
Director, Environmental Quality

CF (w/encls):
Cdr, FORSCOM (AFEN-TSF/AFEN-MSE)
Cdr, Ft Riley
Cdr, HSC (HSCL-P)
Cdr, FAMC (PVNTMED Svc)
Cdr, MEDDAC, Ft Riley
C, USAEHA-Rgn Div West

HSHB-ES-H
SUBJECT: Results of Anaylses Performed on Soil and Sludge Samples from the Fire Training Pit, Fort Riley, Kansas

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Parameter (µg/g) unless otherwise stated	Sample Point Identification 1	2	3	4	5	6
TEP METALS (mg/l)	ND[a]	ND	ND	ND	ND	ND
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VOLATILE ORGANICS[b]						
Chloroform	NA[c]	ND	ND	2	ND	ND
1,2-Dichloroethene (Trans)	NA	2	2	1	3	ND
Tetrachloroethylene	NA	1	1	ND	ND	ND
OTHER ORGANIC COMPOUNDS						
Fuel Oil	Fuel oil #2	ND	50-200	100-300	50-200	ND
Methyl Naphthalenes[d]	ND	10	1.0-50	1.0-50	1.0-50	ND
Dimethyl Naphthalenes[d]	ND	20	1.0-50	1.0-50	1.0-50	ND
Diethyl Phthalate[e]	ND	ND	ND	ND	ND	50-150

[a] ND - not detected

[b] A complete list of all of the volatile organic compounds for which the samples were analyzed is provided as Table 2. Only those compounds detected are included in this Table.

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CHLOROFORM
CHLOROMETHANE
DIBROMOCHLOROMETHANE
1,1-DICHLOROETHANE
1,2-DICHLOROETHANE
1,1-DICHLOROETHENE
1,2-DICHLOROETHENE (TRANS)
1,2-DICHLOROPROPANE
1,3-DICHLOROPROPENE (CIS)
1,3-DICHLOROPROPENE (TRANS)
ETHYL BENZENE
METHYLENE CHLORIDE
1,1,2,2-TETRACHLOROETHANE
TETRACHLOROETHYLENE
1,1,1-TRICHLOROETHANE
1,1,2-TRICHLOROETHANE
TRICHLOROETHYLENE
TRICHLOROFLUOROMETHANE
TOLUENE
VINYL CHLORIDE

TABLE 3

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HSHB-ES-H
SUBJECT: Results of Analyses Performed on Soil and Slude Samples from the Fire Training Pit, Fort Riley, Kansas

TABLE 4

ANALYTICAL TESTING PROCEDURES

Parameter	Method
TEP Metals Arsenic Barium Cadmium Chromium Lead Mercury Selenium Silver	Extraction in accordance with 40 CFR 261; Nitric acid and hydrochloric acid digestion in a Paar bomb followed by EPA[1] atomic absorption via direct aspiration (copper, cadium, chromium, lead, and silver), hydride generation (arsenic and selenium), and the ICP techniques (barium) and flameless method (mercury)
PCB	Solvent extraction followed by GC analysis
Volatile Organics	GC/MS Method for Volatile Organics, EPA Method No. 8240
Other Organics	Methanol extraction followed by GC/MS analysis, EPA Method No. 503*

---

*Test Methods for Evaluating Solid Waste, SW-846, EPA, July 1982.

REFERENCE 37
FROM SECTION 11.0

MEMORANDUM

JOB NO.: JH1019H

REFERENCE: Ft. Riley - FFTA-MAAF - Interview for ESI SAP

FROM: [redacted]

DATE: February 21, 1994

On 4 February 1994 I spoke to [redacted] a former driver at the speedway and present employee at the Ft. Riley Recycling Facility in Camp Funston regarding the drums located on the property.

He stated that fuel (VP Fuel) was delivered to the speedway on race days in black colored drums. Most drivers were very careful with the fuel and did not readily spill or drip the fuel onto the ground due to the cost. The blue colored drums located on the property was used for trash disposal for employees and spectators. The blue drums were not used as barriers for the races because it is required that "jersey barriers" or the equivalent be used to for protection reasons. The fuel drums were located in the vehicle maintenance pits. In the past, the vehicle maintenance pit was located in the center of the speedway until approximately two years ago when this pit was relocated to the north east corner of the facility. Did not know how long fuel was stored on the property.

[redacted] said that drivers were told not to consume the water from the speedway well. They were allowed to use for their radiators and dust control only. He did not recall any storage of parts cleaner on the property for use by the drivers, however, there is a small building in which parts are stored in the center of the track.

Others contacts include a promoter [redacted], who was not amenable to talking about the speedway and a fuel distributor, [redacted]

REFERENCE 38
FROM SECTION 11.0

INTEROFFICE MEMORANDUM

DATE: May 13, 1994

TO: [redacted]

FROM: [redacted]

SUBJECT: The racetrack wells north of Marshall Army Airfield

At 3:05PM, I Called [redacted] at KDHE. According to [redacted], KDHE sampled one above water well at the racetrack (in April 1993), in response to their request for a Public Water Supply Permit. The well sampled was located in the east, within the grandstand area. The other two wells are on the ends of the racetrack.

ADDENDUM: The sampled well was confirmed to be R-1 during a conversation on 27 July 1995 with [redacted] *of KDHE who performed the sampling. The sample was taken from a sink within the grandstand building.*

REFERENCE 39
FROM SECTION 11.0

Made from best available copy

BUREAU OF ENVIRONMENTAL REMEDIATION
IDENTIFIED SITES LIST
FACT SHEET

RECEIVED
MAY 27 1993
BUREAU OF ENVIRONMENTAL REMEDIATION

LOCATION

	(LAST NAME)	(DATE)
Prepared by:	Lang	4-30-93
Reviewed by:		
UPDATED BY:		
UPDATED BY:		
		MO DA YR

SITE NAME [redacted] (PRIOR NAME)
PROJECT CODE [redacted] EPA ID NO.
ADDRESS [redacted]
CITY Junction City ZIP CODE 66441 COUNTY Geary

CENTER LEGAL - - - NW - 27 - 11 - 6E
1/4 1/4 1/4 1/4 S T R

ADDITIONAL SECTIONS AFFECTED:

DISTRICT OFFICE: ☐ SW ☐ SC ☐ SE ☐ NE ☒ NC ☐ NW

RIVER BASIN:
- ☐ Cimarron
- ☐ Lower Arkansas
- ☒ Kansas-Lower Republican
- ☐ Marais des Cygnes
- ☐ Missouri
- ☐ Neosho
- ☐ Smoky Hill-Saline
- ☐ Solomon
- ☐ Upper Arkansas
- ☐ Upper Republican
- ☐ Verdigris
- ☐ Walnut

CONTAMINATION

CONTAMINANT:
- ☐ ACID
- ☐ HEAVY METAL
- ☐ OTHER ( )
- ☐ BASE-NEUTRAL
- ☐ INORGANIC
- ☐ PESTICIDE
- ☐ CRUDE OIL
- ☒ VOC
- ☐ REFINED PETROLEUM

CONTAMINATED MEDIA:
- ☒ GROUNDWATER
- ☒ PUBLIC WATER SUPPLY
  Owner applied for a PWS denied due to contaminants
- ☐ SURFACE WATER
- ☒ PRIVATE WELL
- ☐ SOIL
- ☐ AIR

POTENTIALLY CONTAMINATED MEDIA:
- ☐ GROUNDWATER
- ☐ PUBLIC WATER SUPPLY
- ☐ SURFACE WATER
- ☐ PRIVATE WELL
- ☐ SOIL
- ☐ AIR

MAJOR CONTAMINANT(S) AND CONCENTRATION(S):
vinyl chloride .5 ug/l .... 1-2 DCE 155 ug/l Trichloroethylene 36.8
Tetrachloroethylene 263 ug/l

SOURCE:
- ☐ UNDERGROUND TANK/PIPING
- ☐ LAGOON/IMPOUNDMENT
- ☐ ABANDONED FACILITY
- ☐ AGRICULTURAL FACILITY
- ☐ ABOVE GROUND TANK
- ☐ SPILL
- ☐ SALT PROD.-LPG
- ☐ OIL PRODUCTION
- ☐ SEPTIC TANK
- ☒ OTHER (unsure - possible Ft. Riley Source
- ☐ PIPELINE LEAK
- ☐ DUMPING/DRUMS
- ☐ LANDFILL
- ☒ FACILITY OPERATIONS suspected

FORM REVISED 4/28/92

SITE DESCRIPTION

LAND USE

INDUSTRIAL/COMMERCIAL
RESIDENTIAL
AGRICULTURAL
[✓ OTHER] (Racetrack)

AREA WELLS

[✓ PWS] Applied for
MONITORING
INDUSTRIAL
OTHER ( )
[✓ DOMESTIC]
IRRIGATION

DEPTH TO GROUNDWATER: 15'-20' ft.
DEPTH TO BEDROCK: ? ft.
DIRECTION OF GROUNDWATER FLOW: ≈East
POTENTIAL AQUIFER YIELD: High
IS THIS AQUIFER THE ONLY SOURCE IN AREA? YES NO [✓ UNKNOWN]

TEXT

This site is located just NE of Marshall Field a part of Fort Riley. Suspected possibly sources are 1) Racetrack activities - automotive solvents 2) military activities

REMEDIATION

SPILLED MATERIAL REMOVED
CONTAMINATED SOIL REMOVED
WASTE DISPOSED ELSEWHERE
ON SITE BURIAL
TANK REMOVED/REPLACED
NONE IN PROGRESS
NEUTRALIZATION
STABILIZATION
ENCAPSULATION
CAPPING/COVERING
GRNDWATR WITHDRAWAL
OTHER ( )
BIODEGRADATION
PHOTODEGRADATION
EMERGENCY DIKING
CUTOFF WALLS

CLEANUP FUNDED BY: RESPONSIBLE PARTY EPA SUPERFUND OTHER ( ) EPA EMERGENCY RESPONSE STATE FUNDED (100%)

STATUS OF SITE

STATUTE: RCRA CERCLA FIFRA STATE OTHER ( )

LEAD AGENCY: [✓ KDHE-BER] EPA KDHE-BAWM KCC KDHE-BOW KBA KDHE-BEQ OTHER ( )

NEEDED (N), UNDERWAY (U), OR COMPLETED (C)

	RESPONSIBLE PARTY INVOLVED: (Y)es	DATE COMPLETED
N INVESTIGATION OR MONITORING		
(EPA PRELIMINARY ASSESSMENT)		
(EPA SCREENING SITE INVESTIGATION)		
(EPA LISTING SITE INVESTIGATION)		
MONITORING (LONG TERM, PRE-CLEANUP		
REMEDIAL INVESTIGATION/FEAS. STUDY		
(EPA RECORD OF DECISION)		
NO ACTION NECESSARY		
REMEDIAL DESIGN		
CLEANUP/REMEDIAL ACTION		
MONITORING (POST CLEANUP)		
RESOLVED (NO FURTHER ACTION NECESSARY)		

STATEMENT OF PROBLEM

DISCOVERY DATE 4 27 93
MO DA YR

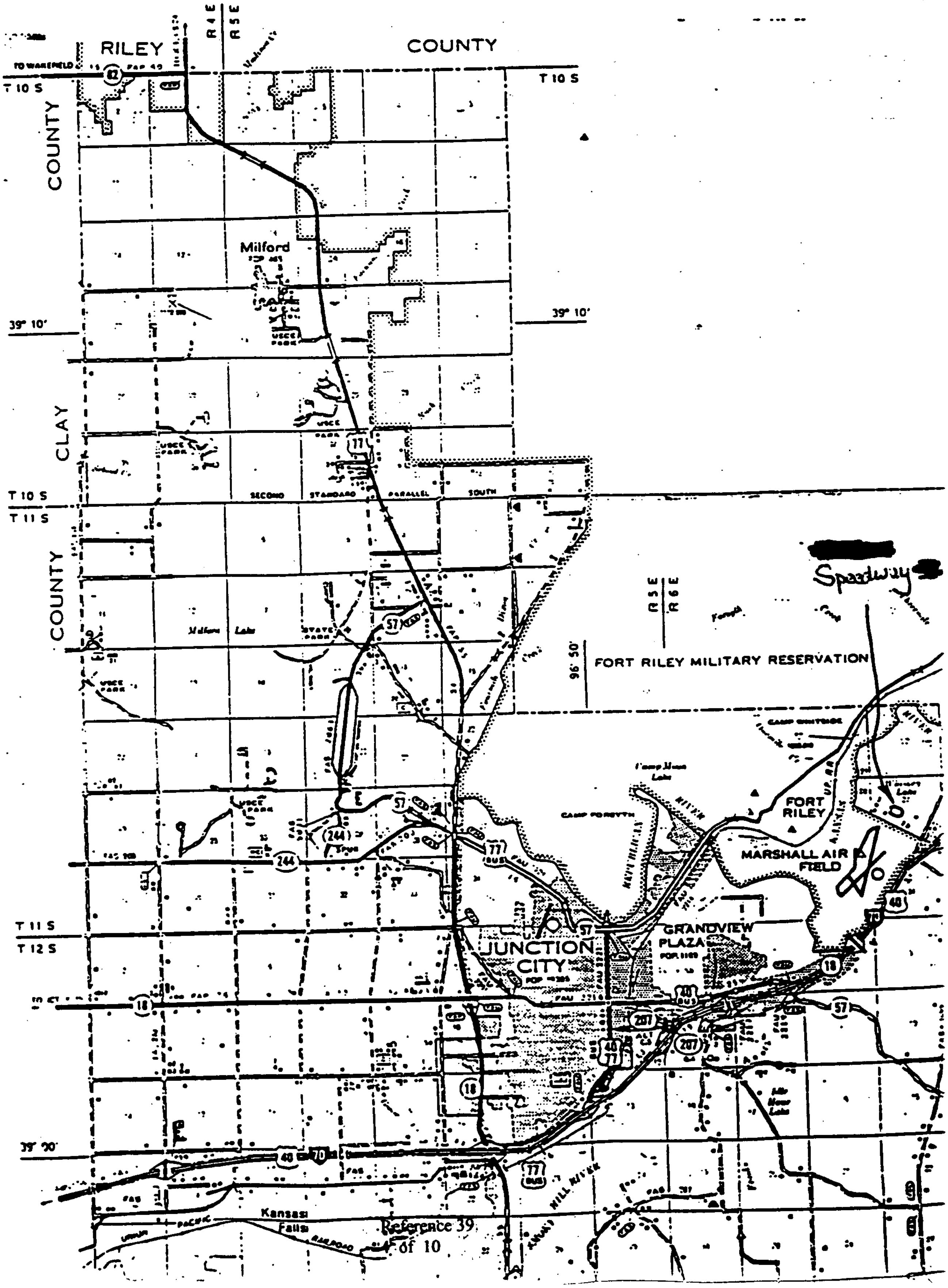
KDHE-BOW sampled well as owner applied for a PWS permit. Analitical required for PWS well permit failed due to several VOC's above the MCL's.

INVESTIGATION, CLEANUP, CONTAINMENT

RECOMMENDATIONS

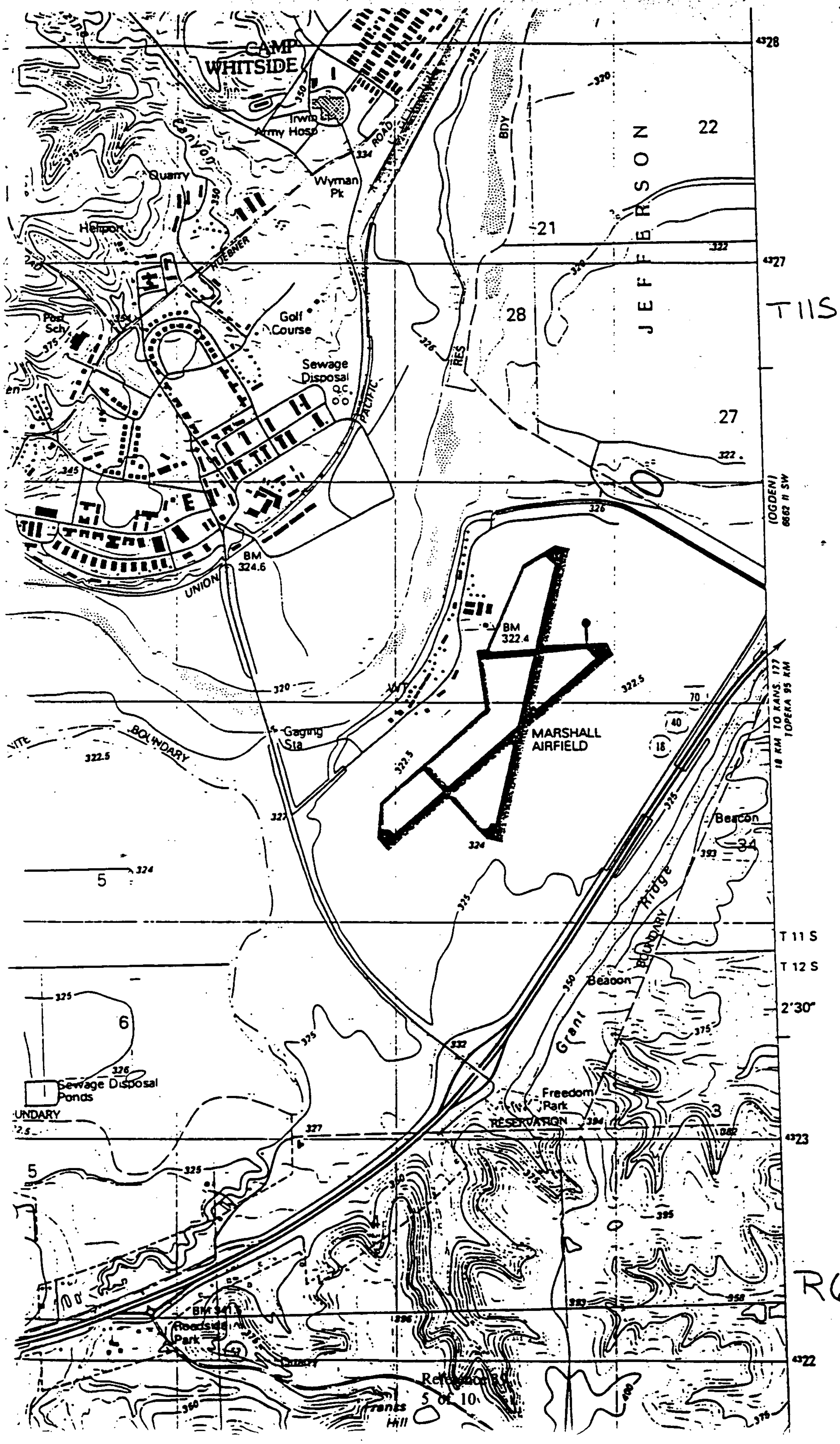
a investigation is needed to see if the contamination is a result of on-site activities such as use of solvents to clean auto parts or if it may be from nearby military operations at Ft Riley

FORM REVISED 4/28/92



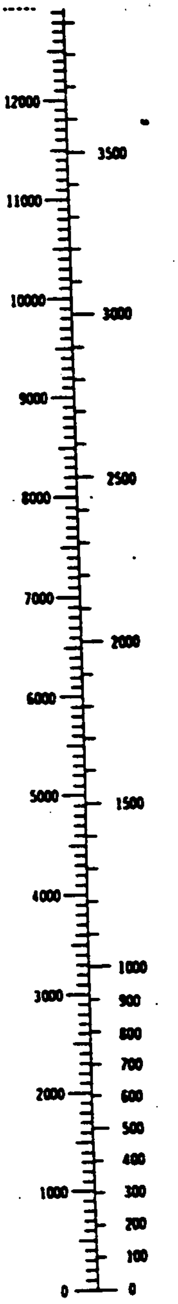
[redacted] Speedway

Reference 39
[illegible] of 10



T11S

R6E



Feet	Meters
1	.3048
2	.6096
3	.9144
4	1.2192
5	1.5240
6	1.8288
7	2.1336
8	2.4384
9	2.7432
10	3.0480

To convert feet to meters multiply by .3048

To convert meters to feet multiply by 3.2808

Reference 54
5 of 10

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

PESTICIDE ANALYSIS REPORT

Report To: GE CO. H.D. %J MALINOWSKI
Address: 1212 W. ASH, JUNCTION CITY, KS 66441

Lab Number: 3030550
Report Date: 4-14-9

SAMPLE COLLECTION INFORMATION

Site ID No.: 00051336
Sample Type: WATER
Program Code: P
Collection Site: [redacted] SPEEDWAY-JUNCTION CITY
Collected By: BOW-B. ROBERTS
Date: 4- 9-93
Time: 110

RESULTS OF ANALYSIS

ROUTINE PESTICIDES	CONCENTRATION (UG/L)	REPORTING LIMI (UG/L)
ALACHLOR	NOT DETECTED	0.10
ALDRIN	NOT DETECTED	0.025
ATRAZINE	NOT DETECTED	0.3
CYANAZINE (BLADEX)	NOT DETECTED	0.50
CHLORDANE	NOT DETECTED	0.20
DCPA (DACTHAL)	NOT DETECTED	0.050
DIELDRIN	NOT DETECTED	0.050
METOLACHLOR (DUAL)	NOT DETECTED	0.25
HEPTACHLOR	NOT DETECTED	0.020
HEPTACHLOR EPOXIDE	NOT DETECTED	0.020
PCB-1016	NOT DETECTED	0.50
PCB-1221	NOT DETECTED	2.5
PCB-1232	NOT DETECTED	0.50
PCB-1242	NOT DETECTED	0.50
PCB-1248	NOT DETECTED	0.50
PCB-1254	NOT DETECTED	0.50
PCB-1260	NOT DETECTED	0.50
PROPAZINE	NOT DETECTED	0.3
PROPACHLOR (RAMROD)	NOT DETECTED	0.25
METRIBUZIN (SENCOR)	NOT DETECTED	0.10
ENDRIN	NOT DETECTED	0.10
GAMMA BHC (LINDANE)	NOT DETECTED	0.025
METHOXYCHLOR	NOT DETECTED	0.20
TOXAPHENE	NOT DETECTED	2.0
2,4-D AS ACID	NOT DETECTED	0.80
SILVEX AS ACID	NOT DETECTED	0.40
2,4,5-T AS ACID	NOT DETECTED	0.40
PICLORAM (TORDON)	NOT DETECTED	0.80

RECEIVED
APR 20 1993
SALINA OFFICE
KDHE

Comment:

Analyst: John Gould

Roger H. Carlson, Ph.D., Direct

Copy To: BERT ZERR-NCD SALINA
DARREL PLUMMER-BOW

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

PESTICIDE ANALYSIS REPORT

Report To: GE CO. H.D. %J MALINOWSKI
Address: 1212 W. ASH, JUNCTION CITY, KS 66441

Lab Number: 303055C
Report Date: 4-14-9

SAMPLE COLLECTION INFORMATION

Site ID No.: 00051336
Sample Type: WATER
Program Code: I
Collection Site: [redacted] SPEEDWAY-JUNCTION CITY
Collected By: BOW-B. ROBERTS
Date: 4- 9-93
Time: 11

RESULTS OF ANALYSIS

ROUTINE PESTICIDES	CONCENTRATION (UG/L)	REPORTING LIMI (UG/L)
ALACHLOR	NOT DETECTED	0.10
ALDRIN	NOT DETECTED	0.025
ATRAZINE	NOT DETECTED	0.3
CYANAZINE (BLADEX)	NOT DETECTED	0.50
CHLORDANE	NOT DETECTED	0.20
DCPA (DACTHAL)	NOT DETECTED	0.050
DIELDRIN	NOT DETECTED	0.050
METOLACHLOR (DUAL)	NOT DETECTED	0.25
HEPTACHLOR	NOT DETECTED	0.020
HEPTACHLOR EPOXIDE	NOT DETECTED	0.020
PCB-1016	NOT DETECTED	0.50
PCB-1221	NOT DETECTED	2.5
PCB-1232	NOT DETECTED	0.50
PCB-1242	NOT DETECTED	0.50
PCB-1248	NOT DETECTED	0.50
PCB-1254	NOT DETECTED	0.50
PCB-1260	NOT DETECTED	0.50
PROPAZINE	NOT DETECTED	0.3
PROPACHLOR (RAMROD)	NOT DETECTED	0.25
METRIBUZIN (SENCOR)	NOT DETECTED	0.10
ENDRIN	NOT DETECTED	0.10
GAMMA BHC (LINDANE)	NOT DETECTED	0.025
METHOXYCHLOR	NOT DETECTED	0.20
TOXAPHENE	NOT DETECTED	2.0
2,4-D AS ACID	NOT DETECTED	0.80
SILVEX AS ACID	NOT DETECTED	0.40
2,4,5-T AS ACID	NOT DETECTED	0.40
PICLORAM (TORDON)	NOT DETECTED	0.80

RECEIVED
APR 20 1993
SALINA OFFICE
KDHE

Comment:

Analyst: John Gould

Roger H. Carlson, Ph.D., Direct

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DARREL PLUMMER-BOW

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

GC/MS ANALYSIS REPORT

Report To: GE CO. H.D. %J MALINOWSKI
Address: 1212 W. ASH, JUNCTION CITY, KS 66441

Lab Number: 3030540C
Report Date: 4-19-93

SAMPLE COLLECTION INFORMATION

Site ID No.: 00051336
Sample Type: WATER
Program Code: PT
ollection Site: [redacted] SPEEDWAY-JUNCTION CITY
ollected By: BOW-B. ROBERTS
Date: 4- 9-93
Time: 1107

RESULTS OF ANALYSIS

OLATILE ORGANICS	CONCENTRATION (UG/L)	REPORTING LIMIT (UG/L)
HLOROMETHANE	NOT DETECTED	0.5
BROMOMETHANE	NOT DETECTED	0.5
VINYL CHLORIDE	0.5	0.5
HLOROETHANE	NOT DETECTED	0.5
ICHLOROMETHANE	NOT DETECTED	0.5
1,1-DICHLOROETHYLENE	NOT DETECTED	0.5
1,1-DICHLOROETHANE	NOT DETECTED	0.5
RANS &/OR CIS 1,2-DICHLOROETHYLENE	155	0.5
RICHLOROMETHANE (THM)	NOT DETECTED	0.5
1,2-DICHLOROETHANE	NOT DETECTED	0.5
1,1-TRICHLOROETHANE	NOT DETECTED	0.5
TRACHLOROMETHANE	NOT DETECTED	0.5
ROMODICHLOROMETHANE (THM)	NOT DETECTED	0.5
1,2-DICHLOROPROPANE	NOT DETECTED	0.5
RANS 1,3-DICHLOROPROPENE	NOT DETECTED	0.5
RICHLOROETHYLENE	36.8	0.5
BENZENE	2.1	0.5
DIBROMOCHLOROMETHANE (THM)	NOT DETECTED	0.5
IS 1,3-DICHLOROPROPENE	NOT DETECTED	0.5
,1,2-TRICHLOROETHANE	NOT DETECTED	0.5
BROMOFORM (THM)	NOT DETECTED	0.5
,1,2,2-TETRACHLOROETHANE	NOT DETECTED	0.5
ETRACHLOROETHYLENE	263	0.5
OLUENE	NOT DETECTED	0.5
CHLOROBENZENE	NOT DETECTED	0.5
THYLBENZENE	NOT DETECTED	0.5
ETA-XYLENE	NOT DETECTED	0.5
ORTHO &/OR PARA-XYLENE	NOT DETECTED	0.5

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

GC/MS ANALYSIS REPORT

Report To: GE CO. H.D. %J MALINOWSKI
Address: 1212 W. ASH, JUNCTION CITY, KS 66441

Lab Number: 30305
Report Date: 4-19-

SAMPLE COLLECTION INFORMATION

Site ID No.: 00051336
Sample Type: WATER
Program Code:
Collection Site: [redacted] SPEEDWAY-JUNCTION CITY
Collected By: BOW-B. ROBERTS
Date: 4- 9-93
Time: 1

RESULTS OF ANALYSIS

VOLATILE ORGANICS	CONCENTRATION (UG/L)	REPORTING LI (UG/L)
1,3-DICHLOROBENZENE	NOT DETECTED	0.5
1,2-DICHLOROBENZENE	NOT DETECTED	0.5
1,4-DICHLOROBENZENE	NOT DETECTED	0.5
DIBROMOMETHANE	NOT DETECTED	0.5
2,2-DICHLOROPROPANE	NOT DETECTED	0.5
1,1-DICHLOROPROPENE	NOT DETECTED	0.5
1,3-DICHLOROPROPANE	NOT DETECTED	0.5
1,1,1,2-TETRACHLOROETHANE	NOT DETECTED	0.5
1,2,3-TRICHLOROPROPANE	NOT DETECTED	0.5
BROMOBENZENE	NOT DETECTED	0.5
STYRENE	NOT DETECTED	0.5
ORTHO-CHLOROTOLUENE	NOT DETECTED	0.5
PARA-CHLOROTOLUENE	NOT DETECTED	0.5

Comment:

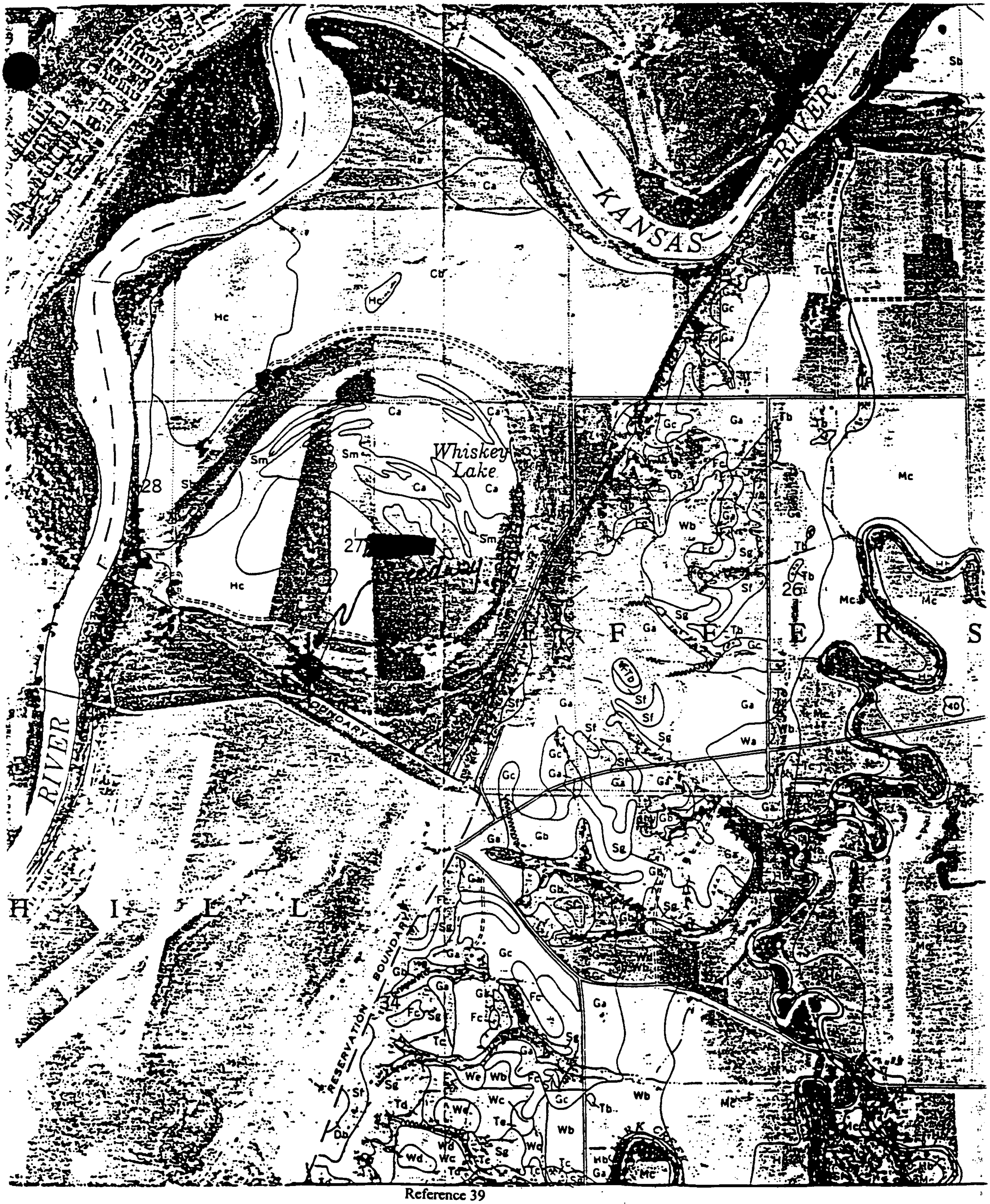
Analyst: Frank Zhang

Roger H. Carlson, Ph.D., Direc

Copy To: BERT ZERR-NCD SALINA
DARREL PLUMMER-BOW

GEARY COUNTY, KANSAS

(Inset Sheet 7)



[redacted]

Reference 39

10 of 10

1 Mile Scale 1:20000 0 5000 Feet

Range.

REFERENCE 42
FROM SECTION 11.0

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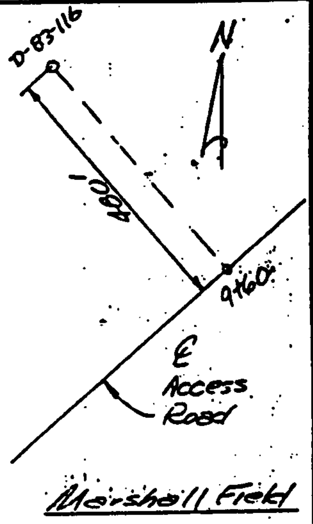
DRILLING LOG

DIVISION MRD	INSTALLATION KCDO	SHEET OF 7 SHEETS
1. PROJECT Ft. Riley PN 358	10. SIZE AND TYPE OF BIT 6" Drive & 4" Drive	
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY USCEC	12. MANUFACTURER'S DESIGNATION OF DRILL 71 Star	
4. HOLE NO. (As shown on drawing title and file number) D-83-116	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 13 Sacks	UNDISTURBED
5. NAME OF DRILLER Marquis	14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE ☑ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER	
	16. DATE HOLE: STARTED 1/11/83	COMPLETED 1/11/83
7. THICKNESS OF OVERBURDEN 64.1	17. ELEVATION TOP OF HOLE	
8. DEPTH DRILLED INTO ROCK 0.9	18. TOTAL CORE RECOVERY FOR BORING %	
9. TOTAL DEPTH OF HOLE 65.0	19. SIGNATURE OF INSPECTOR William Stone	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1		Topsoil Lean Clay moist medium dark brown 1.5	D-2.0 R-2.0 22 Str		
	2		Silty Fine Sand moist loose tan 2.5	2.0		
	3		Lean Clay moist stiff dark brown 3.5	50 Str		
	4 5		Silty Fine Sand moist loose tan 5.0	4.0 30 Str		1/12/82 Water level at 21.0' after over-night stand with one joint of casing removed.
	6 7 8 9 10		Fine Sand damp loose clean tan	6.0 22 Str 8.0 15 Str 10.0		

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT Ft. Riley PN 358

HOLE NO. D-83-116

DRILLING LOG	DIVISION MRD	INSTALLATION KCDO	SHEET 2 OF 7 SHEETS

1. PROJECT Ft. Riley PN358	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY US CEC	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number) D-83-116	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE — STARTED — COMPLETED
	17. ELEVATION TOP OF HOLE
7. THICKNESS OF OVERBURDEN	18. TOTAL CORE RECOVERY FOR BORING %
8. DEPTH DRILLED INTO ROCK	19. SIGNATURE OF INSPECTOR William Stone
9. TOTAL DEPTH OF HOLE	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	11		Fine Sand loose damp clean tan 11.5	D-2.0 R-2.0 21 Str		
	12 13		Fine Sand moist compact clean tan 13.7	12.0 D-2.0 R-2.0 41 Str		
	14		Sandy silt moist compact tan 14.5	14.0 D-2.0 R-2.0		
	15 16 17		Fine to medium Sand moist loose tan 17.5	39 Str 16.0 D-2.0 R-2.0 24 Str		Mixed mud 150 gal. water 25 lb. Quik-Gel 800 lb. Macober bank Wt. = 12lb/gal.
	18		Silt saturated compact gray 18.6	18.0 D-2.0 R-2.0		
	19 20		Med. Sand wet loose tan	45 Str 20.0		

Reference 42
2 of 7

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

PROJECT Ft. Riley PN358
HOLE NO. D-83-116

DRILLING LOG	VISION MRD	KCDO	OF 7 SHEETS

1. PROJECT Ft Riley PN358
2. LOCATION (Coordinates or Station)
3. DRILLING AGENCY
4. HOLE NO. (As shown on drawing title and file number) D-83-116
5. NAME OF DRILLER
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE
10. SIZE AND TYPE OF BIT
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
12. MANUFACTURER'S DESIGNATION OF DRILL
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN | DISTURBED | UNDISTURBED
14. TOTAL NUMBER CORE BOXES
15. ELEVATION GROUND WATER
16. DATE HOLE | STARTED | COMPLETED
17. ELEVATION TOP OF HOLE
18. TOTAL CORE RECOVERY FOR BORING %
19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			Med Sand wet loose tan	D-2.0 R-2.0		
	21			25 Str		
				22.0	22.0	
	22			D-2.0 R-2.0	Sect 1	Water encountered on drive to 24.0
			23.0	22 Str		
	23		Med Sand Saturated loose tan Clean			
				24.0	24.0	
	24			D-2.0 R-2.0		Added mud at 24.0
	25			40 Str	Sect 2	
				26.0	26.0	
	26			D-2.0 R-2.0		
	27			31 Str	Sect 3	
			28.0	28.0	28.0	
	28		Med Sand dirty loose saturated gray & tan	D-2.0 R-2.0		
	29			71 Str	Sect 4	
	30			30.0	30.0	

Reference 42
3 of 7

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71
(TRANSLUCENT)

PROJECT Ft. Riley PN358
HOLE NO. D-83-116

DRILLING LOG	DIVISION MRD
INSTALLATION KCDO	SHEET 4 OF 7 SHEETS
1. PROJECT Ft. Riley PN 358	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number) D-83-116	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.	15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN	16. DATE HOLE — STARTED — COMPLETED
8. DEPTH DRILLED INTO ROCK	17. ELEVATION TOP OF HOLE
9. TOTAL DEPTH OF HOLE	18. TOTAL CORE RECOVERY FOR BORING %
	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	31		Med. Sand dirty loose saturated gray f-m	D-2.0 R-0.5 63 Str		Sample 30.0 -32.0 too contaminated with mud
			32.0	32.0	32.0	Change to flapper shoe at 32.0
	32 33		Fine to Med. Sand loose saturated Clean gray	D-2.0 R-2.0 72 Str	Sack 5	
				34.0	34.0	
	34 35			D-2.0 R-2.0 63 Str		Sample 34.0–36.0 too contaminated with mud
			36.0	36.0	36.0	Samples no good. Poor recovery hole stability problems and contaminated samples. Change to 4" barrel and 5½" casing at 36.0'
	36 37		Medium to coarse dirty sand compact saturated brown	D-2.0 R-2.0 83 Str	Sack 6	~~Set~~ Set 36.1 5½" Csg.
				38.0	38.0	Flushed mud from hole.
	38 39 40			D-2.0 R-2.0 71 Str	Sack 7	Sack 6 slightly contaminated with mud. Added 5.1' 5½" casing to 40.0
				40.0		

Reference 42
4 of 7

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.
MAR 71

PROJECT Ft. Riley PN358
HOLE NO. D-83-116

DRILLING LOG

DIVISION MRD

INSTALLATION KCDO

SHEET 5 OF 7 SHEETS

1. PROJECT Ft. Riley PN358
2. LOCATION (Coordinates or Station)
3. DRILLING AGENCY
4. HOLE NO. (As shown on drawing title and file number) D-83-116
5. NAME OF DRILLER
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE
10. SIZE AND TYPE OF BIT
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
12. MANUFACTURER'S DESIGNATION OF DRILL
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN | DISTURBED | UNDISTURBED
14. TOTAL NUMBER CORE BOXES
15. ELEVATION GROUND WATER
16. DATE HOLE | STARTED | COMPLETED
17. ELEVATION TOP OF HOLE
18. TOTAL CORE RECOVERY FOR BORING %
19. SIGNATURE OF INSPECTOR William Stone

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	41 42		Med. to coarse dirty sand loose saturated brown	D-2.0 R-2.0 47. 42.0	Sack 7 42.0	Add 5.1' 5½" casing total 46.3'
	43 44			D-2.0 R-2.0 51 44.0	Sack 8 44.0	
	45 46			D-2.0 R-2.0 4 Str 46.0	46.0	Add 5.1' casing total 51.4 No Recovery 44.0-46.0
	47 48			D-2.0 R-2.0 71 48.0	Sack 9 48.0	Add 5.1' casing total - 56.5
	49 50			D-2.0 R-2.0 24 Str 50.0		No Recovery 48.0-50

Reference 42
5 of 7

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT Ft. Riley PN358

HOLE NO. D-83-116

HOLE NO. D 83-116

DRILLING LOG	DIVISION MRD	INSTALLATION KCDO	SHEET 6 OF 7 SHEETS

1. PROJECT Ft. Riley PN358	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number) D-83-116	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE — STARTED — COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR Willard Stone

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			Med. to Coarse Sand loose saturated brown	D-2.0 R-2.0 46 Str	50.0 Sack 10	
	51					
	52			52.0 D-2.0 R-2.0 53 Str		
	53					
	54			54.0 D-2.0 R-0.0 68 Str	54.0	Add 5.1' casing total 61.6
	55					No Recovery 54.0-56.0
	56			56.0 D-2.0 R-2.0 78 Str	56.0 Sack 11	
	57					
	58			58.0 D-2.0 R-2.0 144		Add 5.1' casing total 66.7
	59					
	60			60.0	60.0	

Reference 42
6 of 7

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT Ft. Riley PN358 HOLE NO. D-83-116

Hole No. D-83-116

DRILLING LOG	DIVISION MRD	INSTALLATION KCDO	SHEET 7 OF 7 SHEETS

1. PROJECT Ft. Riley PN 358
2. LOCATION (Coordinates or Station)
3. DRILLING AGENCY
4. HOLE NO. (As shown on drawing title and file number) D-83-116
5. NAME OF DRILLER
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE
10. SIZE AND TYPE OF BIT
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
12. MANUFACTURER'S DESIGNATION OF DRILL
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN | DISTURBED | UNDISTURBED
14. TOTAL NUMBER CORE BOXES
15. ELEVATION GROUND WATER
16. DATE HOLE | STARTED | COMPLETED
17. ELEVATION TOP OF HOLE
18. TOTAL CORE RECOVERY FOR BORING %
19. SIGNATURE OF INSPECTOR Willard Stone

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
				D-2.0 E-2.0	60.0	
			Med to Coarse Sand loose saturated brown			
			60.5	105 Str	Sack 12	
	61					
			Med. Sand loose saturated dirty tan			
	62			62.0	62.0	
			62.5	D-2.0 E-2.0 120 Str	Sack 13	
	63		Med to Coarse Sand loose saturated Clean tan			
	64		Top of Bedrock 64.1	64.0	61.0	Change to straight shoe at 650
			Limestone weathered soft light gray	120 Str		
	65		65.0	65.0		
			Bottom of Hole			
	66		Hole backfilled w/sand	66.0		
	67					
	68			68.0		
	69					
	70			70.0		

Reference 42
7 of 7

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT PN 358 | HOLE NO. D-83-116

REFERENCE 43
FROM SECTION 11.0

10 AUG 1984

Hole No. A-84-110

DRILLING LOG | DIVISION: MRD | INSTALLATION: KCD | SHEET 1 OF 1 SHEETS

1. PROJECT: FT RILEY PN 291
2. LOCATION (Coordinates or Station): Sketch on separate sheet
3. DRILLING AGENCY: USCE-C
4. HOLE NO. (As shown on drawing title and file number): A-84-110
5. NAME OF DRILLER: R. Hunter
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: —
8. DEPTH DRILLED INTO ROCK: —
9. TOTAL DEPTH OF HOLE: 10.0
10. SIZE AND TYPE OF BIT: 5½" box auger
11. DATUM FOR ELEVATION SHOWN (TBM or MSL):
12. MANUFACTURER'S DESIGNATION OF DRILL: FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED — UNDISTURBED —
14. TOTAL NUMBER CORE BOXES: —
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 8-7-84 COMPLETED 8-7-84
17. ELEVATION TOP OF HOLE:
18. TOTAL CORE RECOVERY FOR BORING: — %
19. SIGNATURE OF INSPECTOR: John Mance

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–0.9		SILTY SAND (f-gr.) loose damp dark brown			
	0.9–2.5		SAND (f-gr.) tan loose damp silty			
	2.5–5.5		SILTY SAND (v.f.) damp sl. cohesive tan brown			
	5.5–10		SAND (med-f.) loose damp brown v. clean			B.O.H. 10.0 No Refusal Soil backfill Dry when drilled

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

FT RILEY PN-291
Hole Locations to follow
Hole 5404
8-7-84
John M

Reference 43
1 of 1

Made from best available copy

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT HOLE NO.

REFERENCE 44
FROM SECTION 11.0

HES-CD-3

LOG OF DRILL HOLE NO. 2 SITE Marshall Field Levee

CONTRACTOR USED

GROUND ELEVATION 1062.05

STATION 10+00 RANGE 0+00

STARTED 3-17-41 COMPLETED 3-17-41

TOTAL DEPTH 20.0

OVERBURDEN 20.0

DEPTH CORE DRILLING STARTED —

CORE DRILLING — CORE RECOVERED —

PERCENT RECOVERED 95

NUMBER OF DRY SAMPLES 11

NUMBER OF WASH AND BAILER SAMPLES —

NUMBER OF CORE SAMPLES, SEALED —

CASING PLACED —

CASING LEFT IN PLACE —

DEPTH TO WATER TABLE 17.5

REMARKS

LOGGED BY C S Osborn

CHECKED BY E L O'Donnell SUBMITTED BY E L O'Donnell

WAR DEPARTMENT
United States Engineer Office
601 Davidson Building
Kansas City, Missouri

E&FC-UE-1

FIELD REPORT OF UNDERGROUND EXPLORATIONS

Project: Marshal Field Levee
Hole No. 2, Location: 10+00 0+00
Surface Elevation: 106205 Feet m.s.l.
Method: 3" Drive

Date started: 3-17-41
Date completed: 3-17-41
Inspector: C S Osborn
Weather: Clear Cold

Sample No.	Depth of Drive In feet		Elevation in feet m. s. l.		Core Rec. Inches	Field Classification	
	From	To	From	To		U. S. Bureau of Soils	Description
1	0.0	2.0	1062.05	1060.05	24 8	sandy loam	soft, wet, dk. brown
2	2.0	4.0	1060.05	1058.05	24 20	" "	stiff, moist " "
3	4.0	6.0	1058.05	1056.05	24 35	fine sand	cement, damp. lite "
4	6.0	8.0	1056.05	1054.05	22 32	" "	" " "
5	8.0	10.0	1054.05	1052.05	22 35	" "	" " "
6	10.0	12.0	1052.05	1050.05	22 16	" "	" " "
7	12.0	14.0	1050.05	1048.05	22 16	" "	" " "
8	14.0	16.0	1048.05	1046.05	22 17	" "	" " "
9	16.0	18.0	1046.05	1044.05	22 21	" "	" saturated gray
10	18.0	19.0	1044.05	1043.05	~~22 42~~ 22 42	cl "	Plastic " "
11	19.0	20.0	1043.05	1042.05		coarse "	compact " lite brown clear

W.T. 17.5'

95
240)2260
2160
1000

REFERENCE 45
FROM SECTION 11.0

Cross-Reference for Water Well Records for Reference 45

Record in Order Provided in Reference 45	Well ID	Identification	Completion Date
1	Not used or sampled	Section 26	4/9/82
2	Assumed to be N-1	Section 27	7/31/80
3	Not used or sampled	Section 26	2/27/91
4	F-1 or F-2	Section 27	3/13/91
5	B-1	Section 27	9/13/83
6	R-2	Section 27, completed to 43 feet	2/9/84
7	R-1	Section 27, completed to 40 feet	2/9/84
8	I-1	Section 27	4/15/94

Well records are not available for R-3, M-1, and F-1 (or F-2).

WATER WELL RECORD Form WWC-5 KSA 82a-1212

1 LOCATION OF WATER WELL: County: Geary | Fraction SW ¼ NW ¼ SE ¼ | Section Number 26 | Township Number T 11 S | Range Number R 6 E

Distance and direction from nearest town or city street address of well if located within city? at Junction City on 70 H. to 57 Hiway & east on 70 4½ mi north ½ mi ~~east~~ north 5/8 mi east on east side of road at cor

2 WATER WELL OWNER: [redacted]

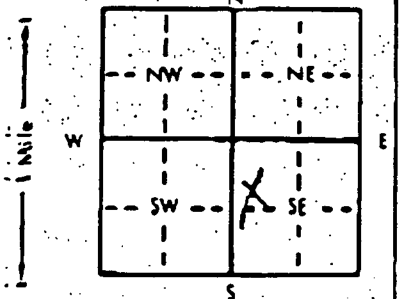
RR#, St. Address, Box # [redacted]

City, State, ZIP Code [redacted] Junction City Kans 66441

Board of Agriculture, Division of Water Resou

Application Number:

3 LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:



4 DEPTH OF COMPLETED WELL 98 ft. ELEVATION:

Depth(s) Groundwater Encountered 1. 90 ft. 2. ft. 3.

WELL'S STATIC WATER LEVEL 82 ft. below land surface measured on mo/day/yr 4-9-82

Pump test data: Well water was ft. after hours pumping g

Est. Yield 6 gpm: Well water was ft. after hours pumping g

Bore Hole Diameter 10 in. to 16 ft., and 6½ in. to 98

WELL WATER TO BE USED AS: [✓ 1 Domestic] 2 Irrigation 3 Feedlot 4 Industrial 5 Public water supply 6 Oil field water supply 7 Lawn and garden only 8 Air conditioning 9 Dewatering 10 Observation well 11 Injection well 12 Other (Specify below)

Was a chemical/bacteriological sample submitted to Department? Yes.... No X ; If yes, mo/day/yr sample was s mitted

Water Well Disinfected? Yes X No

5 TYPE OF BLANK CASING USED: 1 Steel [✓ 2 PVC] 3 RMP (SR) 4 ABS 5 Wrought iron 6 Asbestos-Cement 7 Fiberglass 8 Concrete tile 9 Other (specify below)

CASING JOINTS: Glued X Clamped Welded Threaded

Blank casing diameter 5 in. to ft., Dia in. to ft., Dia in. to

Casing height above land surface 12 in., weight lbs./ft. Wall thickness or gauge No. .267

TYPE OF SCREEN OR PERFORATION MATERIAL: 1 Steel 2 Brass 3 Stainless steel 4 Galvanized steel 5 Fiberglass 6 Concrete tile [✓ 7 PVC] 8 RMP (SR) 9 ABS 10 Asbestos-cement 11 Other (specify) .267 12 None used (open hole)

SCREEN OR PERFORATION OPENINGS ARE: 1 Continuous slot 2 Louvered shutter 3 Mill slot 4 Key punched 5 Gauzed wrapped 6 Wire wrapped 7 Torch cut [✓ 8 Saw cut] 9 Drilled holes 10 Other (specify) 11 None (open hole)

SCREEN-PERFORATED INTERVALS: From 98 ft. to ~~50~~ 48 ft., From ft. to

From ft. to ft., From ft. to

GRAVEL PACK INTERVALS: From 98 ft. to 16 ft., From ft. to

From ft. to ft., From ft. to

6 GROUT MATERIAL: 1 Neat cement [✓ 2 Cement grout] 3 Bentonite 4 Other

Grout Intervals: From 16 ft. to 6 ft., From ft. to ft., From ft. to

What is the nearest source of possible contamination: 1 Septic tank 2 Sewer lines 3 Watertight sewer lines 4 Lateral lines 5 Cess pool 6 Seepage pit 7 Pit privy 8 Sewage lagoon [✓ 9 Feedyard] 10 Livestock pens 11 Fuel storage 12 Fertilizer storage 13 Insecticide storage 14 Abandoned water well 15 Oil well/Gas well 16 Other (specify below)

Direction from well? north How many feet? 180

FROM	TO	LITHOLOGIC LOG	FROM	TO	LITHOLOGIC LOG
		Casing pulled out of old Well			
		Well Cleaned out & new PVC.			
		Casing installed			

RECEIVED
JUN 8 1982
DIVISION OF ENVIRONMENT

Made from best available copy

Reference 45
1 of 8

7 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and w completed on (mo/day/year) apr 1 1982 and this record is true to the best of my knowledge and belief. Kans Water Well Contractor's License No. 137 This Water Well Record was completed on (mo/day/yr) april 1 82 under the business name of Strader Drilling Co by (signature) Harold Strader

INSTRUCTIONS: Use typewriter or ball point pen. PLEASE PRESS FIRMLY and PRINT clearly. Please fill in blanks, underline or circle the correct answers. Send t

WATER WELL RECORD Form WWC-5 KSA 82a-1212

OCATION OF WATER WELL
unty: Geary
Fraction SW ¼ NW ¼ SE ¼
Section Number 27
Township Number T 11 S
Range Number R 6 E/W

tance and direction from nearest town or city? 4 miles east, 2 north of Junceion City
Street address of well if located within city?

WATER WELL OWNER: John Landis
ddress, Box #: Junction City, Kansas
, ZIP Code
Board of Agriculture, Division of Water Resources Application Number:

DEPTH OF COMPLETED WELL 42 ft. Bore Hole Diameter 9 in. to 42 ft. and in. to

ll Water to be used as: 1 Domestic 3 Feedlot [✓ 5 Public water supply] 6 Oil field water supply 7 Lawn and garden only 2 Irrigation 4 Industrial 8 Air conditioning 9 Dewatering 10 Observation well 11 Injection well 12 Other (Specify below)

ll's static water level 22 ft. below land surface measured on May month 14 day 1980 year

mp Test Data Well water was ft. after hours pumping gpm

Yield 20 gpm Well water was ft. after hours pumping gpm

TYPE OF BLANK CASING USED: 1 Steel [✓ 2 PVC] 3 RMP (SR) 4 ABS 5 Wrought iron 6 Asbestos-Cement 7 Fiberglass 8 Concrete tile 9 Other (specify below)

Casing Joints: [✓ Glued] Clamped Welded Threaded

nk casing dia 5 in. to 42 ft., Dia in. to ft., Dia in. to

sing height above land surface 18 in., weight ~~10258~~ 200 lbs./ft. Wall thickness or gauge No. 0.258

PE OF SCREEN OR PERFORATION MATERIAL: 1 Steel 2 Brass 3 Stainless steel 4 Galvanized steel 5 Fiberglass 6 Concrete tile [✓ 7 PVC] 8 RMP (SR) 9 ABS 10 Asbestos-cement 11 Other (specify) 12 None used (open hole)

een or Perforation Openings are: 1 Continuous slot 2 Louvered shutter 3 Mill slot 4 Key punched 5 Gauzed wrapped 6 Wire wrapped 7 Torch cut [✓ 8 Saw cut] 9 Drilled holes 10 Other (specify) 11 None (open hole)

een-Perforation Dia 5 in. to 10 ft., Dia in. to ft., Dia in. to

een-Perforated Intervals: From 32 ft. to 42 ft., From ft. to
From ft. to ft., From ft. to

avel Pack Intervals: From 10 ft. to 42 ft., From ft. to
From ft. to ft., From ft. to

G T MATERIAL: [✓ 1 Neat cement] 2 Cement grout 3 Bentonite 4 Other

tervals: From 0 ft. to 20 ft., From ft. to ft., From ft. to

at is the nearest source of possible contamination: 1 Septic tank [✓ 2 Sewer lines] 3 Lateral lines 4 Cess pool 5 Seepage pit 6 Pit privy 7 Sewage lagoon 8 Feed yard 9 Livestock pens 10 Fuel storage 11 Fertilizer storage 12 Insecticide storage 13 Watertight sewer lines 14 Abandoned water well 15 Oil well/Gas well 16 Other (specify below)

ection from well west How many feet 125 ? Water Well Disinfected? [✓ Yes] X No

s a chemical/bacteriological sample submitted to Department? Yes No X If yes, date sample

s submitted month day year Pump Installed? Yes No X

es: Pump Manufacturer's name Model No. HP Volts

pth of Pump Intake ft. Pumps Capacity rated at gal./min.

e of pump: 1 Submersible 2 Turbine 3 Jet 4 Centrifugal 5 Reciprocating 6 Other

CONTRACTOR'S OR LANDOWNER'S CERTIFICATION This water well was [✓ (1) constructed], (2) reconstructed, or (3) plugged under my jurisdiction and was

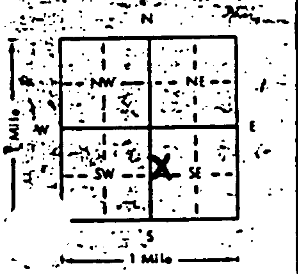
npleted on 5 month 14 day 80 year

this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. 194

s Water Well Record was completed on 7 month 31 day 1980 year under the business

me of Rader Drilling Co. by (signature) Brant E. Rader

LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:



EVATION:

FROM	TO	LITHOLOGIC LOG	FROM	TO	LITHOLOGIC LOG
~~Sand~~					
0	10	Sandy silt			
10	18	Grey clay			
18	28	Sand 1/16 - 1/8			
28	42	Gravel 1/16 - 1/4			

RECEIVED
AUG 15 1980
DIVISION OF ENVIRONMENT
OF & EG SEC.

pth(s) Groundwater Encountered 1. ft. 2. ft. 3. ft. 4. ft.

(Use a second sheet if needed)

STRUCTIONS: Use typewriter or ball point pen, *please press firmly* and *PRINT* clearly. Please fill in blanks, underline or circle the correct answers. Send top three pies to Kansas Department of Health and Environment, Division of Environment, Water Well Contractors, Topeka, KS 66620. Send one to WATER WELL OWNER and ain one for your records.

WATER WELL RECORD Form WWC-5 KSA 82a-1212 203

LOCATION OF WATER WELL:	Fraction	Section Number	Township Number	Range Number
County: Geary 031	NE ¼ NE ¼ SE ¼	26	T 11 S	R 6 [✓ E] W

Distance and direction from nearest town or city street address of well if located within city? From J.C. Go 6 Miles East on I 70 Exit 303 Then Go North 40th & Turn East & Go ½ mile & ¼ South

WATER WELL OWNER: Kevin Aschen
Address, Box #: RR 2 Box 77
City, State, ZIP Code: J.C., Kansas 66441

Board of Agriculture, Division of Water Resources
Application Number:

LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:
N
NW NE
W E
SW X
S

DEPTH OF COMPLETED WELL 80 ft. ELEVATION:
Depth(s) Groundwater Encountered 1. 58 ft. 2. ft. 3. ft.
WELL'S STATIC WATER LEVEL 46 ft. below land surface measured on mo/day/yr
Pump test data: Well water was ft. after hours pumping gpm
Est. Yield 40 gpm: Well water was ft. after hours pumping gpm
Bore Hole Diameter 9 in. to 80 ft., and in. to ft.

WELL WATER TO BE USED AS: [✓ 1 Domestic] 2 Irrigation 3 Feedlot 4 Industrial 5 Public water supply 6 Oil field water supply 7 Lawn and garden only 8 Air conditioning 9 Dewatering 10 Monitoring well 11 Injection well 12 Other (Specify below)

Was a chemical/bacteriological sample submitted to Department? Yes.....No.....; If yes, mo/day/yr sample was submitted
Water Well Disinfected? Yes X No

TYPE OF BLANK CASING USED: 1 Steel [✓ 2 PVC] 3 RMP (SR) 4 ABS 5 Wrought iron 6 Asbestos-Cement 7 Fiberglass 8 Concrete tile 9 Other (specify below)
CASING JOINTS: Glued Clamped Welded Threaded Screwed
Blank casing diameter 5 in. to 60 ft., Dia in. to ft., Dia in. to ft.
Casing height above land surface 2' in., weight 160 lbs./ft. Wall thickness or gauge No.

TYPE OF SCREEN OR PERFORATION MATERIAL: 1 Steel 2 Brass 3 Stainless steel 4 Galvanized steel 5 Fiberglass 6 Concrete tile [✓ 7 PVC] 8 RMP (SR) 9 ABS 10 Asbestos-cement 11 Other (specify) 12 None used (open hole)

SCREEN OR PERFORATION OPENINGS ARE: 1 Continuous slot 2 Louvered shutter [✓ 3 Mill slot] 3/1,000s 4 Key punched 5 Gauzed wrapped 6 Wire wrapped 7 Torch cut 8 Saw cut 9 Drilled holes 10 Other (specify) 11 None (open hole)

SCREEN-PERFORATED INTERVALS: From 60 ft. to 80 ft., From ft. to ft.
From ft. to ft., From ft. to ft.
GRAVEL PACK INTERVALS: From 20 ft. to 80 ft., From ft. to ft.
From ft. to ft., From ft. to ft.

GROUT MATERIAL: 1 Neat cement 2 Cement grout [✓ 3 Bentonite] 4 Other Enviroplug
Grout Intervals: From 0 ft. to 20 ft., From ft. to ft., From ft. to ft.

What is the nearest source of possible contamination: 1 Septic tank 2 Sewer lines 3 Watertight sewer lines [✓ 4 Lateral lines] 5 Cess pool 6 Seepage pit 7 Pit privy 8 Sewage lagoon 9 Feedyard 10 Livestock pens 11 Fuel storage 12 Fertilizer storage 13 Insecticide storage 14 Abandoned water well 15 Oil well/Gas well 16 Other (specify below)
Direction from well? EAST How many feet? 100'

FROM	TO	LITHOLOGIC LOG	FROM	TO	PLUGGING INTERVALS
0	8 21	Brown Clay	58	70 20	Limestone (Water)
8	14 35	Brown Clay & Gravel	70	75 19	Grey Shale
14	15 20	Limestone	75	78 20	Limestone
15	17	yellow Shale	78	80 19	Grey Shale
17	22	Greenish Shale			
22	27 19	Brown Shale			
29	32 20	Limestone			
32	37	Grey Shale			
37	41 19	Green Shale			
41	43 20	Limestone			
43	47 19	Brown Shale			
47	50 20	Limestone			
50	55 19	Grey Shale			
55	56 20	Limestone			
56	58 19	Grey Shale			

RECEIVED
MAR 05 1991
DIVISION OF ENVIRONMENT

CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was [✓ (1) constructed], (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/year) 2/27/91 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. 451 This Water Well Record was completed on (mo/day/yr) 2/27/91
under the business name of Haldeman Well Drilling by (signature) Craig CWD/PI

INSTRUCTIONS: Use typewriter or ball point pen. PLEASE PRESS FIRMLY and PRINT clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66620-7320. Telephone: 913-296-5545. Send one to WATER WELL OWNER and retain one for your records.

WATER WELL RECORD Form WWC-5 KSA 82a-1212

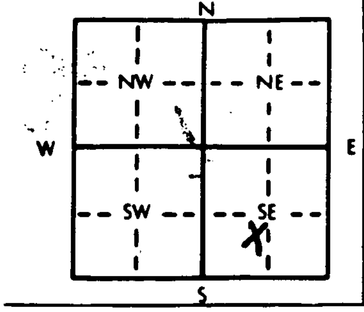
LOCATION OF WATER WELL: ounty: Geary 031
Fraction: NE ¼ SW ¼ SE ¼
Section Number: 27
Township Number: T 11 [✓ S]
Range Number: R 6 [✓ E]W

istance and direction from nearest town or city street address of well if located within city? From J.C. Go East on I 70 To Exit 301 hen Go North to Marshal Fld Frontage Road Then Go North East Miles To Speedway Road Go 1.5 Miles North East To Dead End

WATER WELL OWNER: Mr. Paul Franklin
Address, Box # : 304 S. Adams
it, .te, ZIP Code : J.C., Kansas 66441

Board of Agriculture, Division of Water Resources
Application Number:

LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:



4 DEPTH OF COMPLETED WELL 40 ft. ELEVATION:
Depth(s) Groundwater Encountered 1. 20 ft. 2. ft. 3. ft.
WELL'S STATIC WATER LEVEL 20 ft. below land surface measured on mo/day/yr
Pump test data: Well water was ft. after hours pumping gpm
Est. Yield 20 gpm: Well water was ft. after hours pumping gpm
Bore Hole Diameter 10 in. to 40 ft., and in. to ft.

WELL WATER TO BE USED AS:
[✓ 1 Domestic]
2 Irrigation
3 Feedlot
4 Industrial
5 Public water supply
6 Oil field water supply
7 Lawn and garden only
8 Air conditioning
9 Dewatering
10 Monitoring well
11 Injection well
12 Other (Specify below)

Was a chemical/bacteriological sample submitted to Department? Yes No ; If yes, mo/day/yr sample was submitted
Water Well Disinfected? [✓ Yes] No

TYPE OF BLANK CASING USED:
1 Steel
[✓ 2 PVC]
3 RMP (SR)
4 ABS
5 Wrought iron
6 Asbestos-Cement
7 Fiberglass
8 Concrete tile
9 Other (specify below)

CASING JOINTS: [✓ Glued] Screwed Clamped
Welded
Threaded

lank casing diameter 5 in. to 20 ft., Dia in. to ft., Dia in. to ft.
asing height above land surface 2' in., weight Sch 40 lbs./ft. Wall thickness or gauge No.

YPE OF SCREEN OR PERFORATION MATERIAL:
1 Steel
2 Brass
3 Stainless steel
4 Galvanized steel
5 Fiberglass
6 Concrete tile
[✓ 7 PVC]
8 RMP (SR)
9 ABS
10 Asbestos-cement
11 Other (specify)
12 None used (open hole)

CREEN OR PERFORATION OPENINGS ARE: 16/1,000
1 Continuous slot
2 Louvered shutter
[✓ 3 Mill slot]
4 Key punched
5 Gauzed wrapped
6 Wire wrapped
7 Torch cut
8 Saw cut
9 Drilled holes
10 Other (specify)
11 None (open hole)

CREEN-PERFORATED INTERVALS: From 20 ft. to 40 ft., From ft. to ft.
From ft. to ft., From ft. to ft.
GRAVEL PACK INTERVALS: From 20 ft. to 40 ft., From ft. to ft.
From ft. to ft., From ft. to ft.

GROUT MATERIAL: 1 Neat cement 2 Cement grout [✓ 3 Bentonite] 4 Other
rout Intervals: From 0 ft. to 20 ft., From ft. to Enviroplug From ft. to ft.

hat is the nearest source of possible contamination:
1 Septic tank
2 Sewer lines
3 Watertight sewer lines
[✓ 4 Lateral lines]
5 Cess pool
6 Seepage pit
7 Pit privy
8 Sewage lagoon
9 Feedyard
10 Livestock pens
11 Fuel storage
12 Fertilizer storage
13 Insecticide storage
14 Abandoned water well
15 Oil well/Gas well
16 Other (specify below)

irection from well? North West
How many feet? 200'

FROM	TO	LITHOLOGIC LOG	FROM	TO	PLUGGING INTERVALS
0	2	01 Top Soil			
2	21	04 Sandy Clay			
21	26	07 Fine Sand			
26	40	08 Medium-Course Sand			

RECEIVED
APR 03 1991
DIVISION OF ENVIRONMENT

C NTRACTOR'S OR LANDOWNER'S CERTIFICATION This water well was [✓ (1) constructed], (2) reconstructed, or (3) plugged under my jurisdiction and was d on (mo/day/year) 3/13/91 and this record is true to the best of my knowledge and belief. Kansas ater Well Contractor's License No. 451 This Water Well Record was completed on (mo/day/yr) 3/13/91
der the business name of Haldeman Well Drilling by (signature) Craig Hof CWD/PJ

INSTRUCTIONS: Use typewriter or ball point pen. *PLEASE PRESS FIRMLY* and *PRINT* clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66620-7320. Telephone: 913-296-5545. Send one to WATER WELL OWNER and retain one for your records.

Reference 45

1077

WATER WELL RECORD Form WWC-5 KSA 82a-1212

OCATION OF WATER WELL: unty: Geary 061	Fraction NW ¼ SE ¼ SE ¼	Section Number 27	Township Number T 11 [✓ S]	Range Number R 6 [✓ E]W

tance and direction from nearest town or city street address of well if located within city? 4 E 2 N OF JUNCTION CITY

WATER WELL OWNER: Dominik A. Bucher
Address, Box #: 1117 West 6th
, State, ZIP Code: JUNCTION CITY 66441

Board of Agriculture, Division of Water Resources
Application Number:

LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:

N
NW NE
W E
SW SE X
S

4 DEPTH OF COMPLETED WELL 47 ft. ELEVATION:

Depth(s) Groundwater Encountered 1. 26 ft. 2. ft. 3. ft.

WELL'S STATIC WATER LEVEL 20 ft. below land surface measured on mo/day/yr Sept. 13-83

Pump test data: Well water was ft. after hours pumping gpm

Est. Yield 50 gpm: Well water was ft. after hours pumping gpm

Bore Hole Diameter 12 in. to ft., and in. to ft.

WELL WATER TO BE USED AS: 5 Public water supply 8 Air conditioning 11 Injection well
[✓ 1 Domestic] 3 Feedlot 6 Oil field water supply 9 Dewatering 12 Other (Specify below)
2 Irrigation 4 Industrial 7 Lawn and garden only 10 Observation well

Was a chemical/bacteriological sample submitted to Department? Yes [✓ No] If yes, mo/day/yr sample was submitted

Water Well Disinfected? [✓ Yes] No

TYPE OF BLANK CASING USED: 5 Wrought iron 8 Concrete tile CASING JOINTS: [✓ Glued] Clamped
1 Steel 3 RMP (SR) 6 Asbestos-Cement 9 Other (specify below) Welded
[✓ 2 PVC] 4 ABS 7 Fiberglass Threaded

nk casing diameter 5 in. to 0-32 ft., Dia 5 in. to 42-47 ft., Dia in. to ft.

sing height above land surface 24 in., weight 282 lbs./ft. Wall thickness or gauge No. .258

PE OF SCREEN OR PERFORATION MATERIAL: 7 PVC 10 Asbestos-cement
1 Steel 3 Stainless steel 5 Fiberglass 8 RMP (SR) 11 Other (specify)
2 Brass 4 Galvanized steel 6 Concrete tile 9 ABS 12 None used (open hole)

REEN OR PERFORATION OPENINGS ARE: 5 Gauzed wrapped [✓ 8 Saw cut] 11 None (open hole)
1 Continuous slot 3 Mill slot 6 Wire wrapped 9 Drilled holes
2 Louvered shutter 4 Key punched 7 Torch cut 10 Other (specify)

REEN-PERFORATED INTERVALS: From 32 ft. to 42 ft., From ft. to ft.
From ft. to ft., From ft. to ft.

GRAVEL PACK INTERVALS: From 10 ft. to 47 ft., From ft. to ft.
From ft. to ft., From ft. to ft.

GROUT MATERIAL: 1 Neat cement 2 Cement grout [✓ 3 Bentonite] 4 Other

out Intervals: From 0 ft. to 10 ft., From ft. to ft., From ft. to ft.

at is the nearest source of possible contamination: 10 Livestock pens 14 Abandoned water well
[✓ 1 Septic tank] 4 Lateral lines 7 Pit privy 11 Fuel storage 15 Oil well/Gas well
2 Sewer lines 5 Cess pool 8 Sewage lagoon 12 Fertilizer storage 16 Other (specify below)
3 Watertight sewer lines 6 Seepage pit 9 Feedyard 13 Insecticide storage

ection from well? S How many feet? 250

ROM	TO	LITHOLOGIC LOG	FROM	TO	LITHOLOGIC LOG
0	6	Top Soil			
6	18 01	Clay brown			
18	25 07	Fine Sand brown			
23	41 17	FineSand, Course Sand, med gr. brown			
41	47 19	Shale grey			

RECEIVED
OCT 7 1983
DIVISION OF ENVIRONMENT
OF & EC SEC

ACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was [✓ (1) constructed] (2) reconstructed, or (3) plugged under my jurisdiction and was d on (mo/day/year) 9-13-83 and this record is true to the best of my knowledge and belief. Kansas ter Well Contractor's License No. 182 This Water Well Record was completed on (mo/day/yr) 10-4-83
ler the business name of STrader Drlg Co Inc by (signature) Dale

STRUCTIONS: Use typewriter or ball point pen, *PLEASE PRESS FIRMLY* and *PRINT* clearly. Please fill in blanks, underline or circle the correct answers. Send top e copies to Kansas Department of Health and Environment, Division of Environment, Environmental Geology Section, Topeka, KS 66620. Send one to WATER WELL NER and retain one for your records.

WATER WELL RECORD Form WWC-5 KSA 82a-1212

OCATION OF WATER WELL: unty: Geary	Fraction SE ¼ SE ¼ NW ¼	Section Number 27	Township Number T 11 [✓ S]	Range Number R 6 [✓ W]

tance and direction from nearest town or city street address of well if located within city? 4E 2N of Junction City

WATER WELL OWNER: J.C. Race way Inc.
Address, Box #: RR 2 Box 99
y, e, ZIP Code: Junction City 66441
Board of Agriculture, Division of Water Resources
Application Number:

OCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:

	N	
W	NW X	NE
	SW	SE
	S	E

4 DEPTH OF COMPLETED WELL 43 ft. ELEVATION:
Depth(s) Groundwater Encountered 1. 20 ft. 2. ft. 3. ft.
WELL'S STATIC WATER LEVEL 9 ft. below land surface measured on mo/day/yr 2-9-84
Pump test data: Well water was ft. after hours pumping gpm
Est. Yield 150 gpm: Well water was ft. after hours pumping gpm
Bore Hole Diameter in. to ft., and in. to ft.
WELL WATER TO BE USED AS: 5 Public water supply 8 Air conditioning 11 Injection well
[✓ 1 Domestic] 3 Feedlot 6 Oil field water supply 9 Dewatering 12 Other (Specify below)
2 Irrigation 4 Industrial 7 Lawn and garden only 10 Observation well
Was a chemical/bacteriological sample submitted to Department? Yes [✓ No] If yes, mo/day/yr sample was submitted
Water Well Disinfected? [✓ Yes] No

TYPE OF BLANK CASING USED: 5 Wrought iron 8 Concrete tile CASING JOINTS: [✓ Glued] Clamped
1 Steel 3 RMP (SR) 6 Asbestos-Cement 9 Other (specify below) Welded
[✓ 2 PVC] 4 ABS 7 Fiberglass Threaded
nk casing diameter 5 in. to 0-33 ft., Dia in. to ft., Dia in. to ft.
sing height above land surface 24 in., weight 2.82 lbs./ft. Wall thickness or gauge No. .258
PE OF SCREEN OR PERFORATION MATERIAL: [✓ 7 PVC] 10 Asbestos-cement
1 Steel 3 Stainless steel 5 Fiberglass 8 RMP (SR) 11 Other (specify)
2 Brass 4 Galvanized steel 6 Concrete tile 9 ABS 12 None used (open hole)
REEN OR PERFORATION OPENINGS ARE: 5 Gauzed wrapped [✓ 8 Saw cut] 11 None (open hole)
1 Continuous slot 3 Mill slot 6 Wire wrapped 9 Drilled holes
2 Louvered shutter 4 Key punched 7 Torch cut 10 Other (specify)
REEN-PERFORATED INTERVALS: From 33 ft. to 43 ft., From ft. to ft.
From ft. to ft., From ft. to ft.
RAVEL PACK INTERVALS: From 10 ft. to 43 ft., From ft. to ft.
From ft. to ft., From ft. to ft.

GROUT MATERIAL: 1 Neat cement 2 Cement grout [✓ 3 Bentonite] 4 Other
out Intervals: From 0 ft. to 10 ft., From ft. to ft., From ft. to ft.
at is the nearest source of possible contamination: 10 Livestock pens 14 Abandoned water well
[✓ 1 Septic tank] 4 Lateral lines 7 Pit privy 11 Fuel storage 15 Oil well/Gas well
2 Sewer lines 5 Cess pool 8 Sewage lagoon 12 Fertilizer storage 16 Other (specify below)
3 Watertight sewer lines 6 Seepage pit 9 Feedyard 13 Insecticide storage
ection from well? N How many feet? 400

ROM	TO	LITHOLOGIC LOG	FROM	TO	LITHOLOGIC LOG
0	10	02 fine silt-yellow			
10	20	01 clay brown			
20	43	17 fs-cs-medgr. Pea gr.			

RECEIVED
MAR 1984
BUREAU OF OIL FIELD & ENVIRONMENTAL

C RACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was [✓ (1) constructed], (2) reconstructed, or (3) plugged under my jurisdiction and was on (mo/day/year) 2-9-84 and this record is true to the best of my knowledge and belief. Kansas ter Well Contractor's License No. 182 This Water Well Record was completed on (mo/day/yr) 2-14-84 ter the business name of Strader Drlg Co., Inc by (signature) Dale

STRUCTIONS: Use typewriter or ball point pen, PLEASE PRESS FIRMLY and PRINT clearly. Please fill in blanks, underline or circle the correct answers. Send top ee copies to Kansas Department of Health and Environment, Division of Environment, Environmental Geology Section, Topeka, KS 66620. Send one to WATER WELL VNER and retain one for your records.

WATER WELL RECORD Form WWC-5 KSA 82a-1212

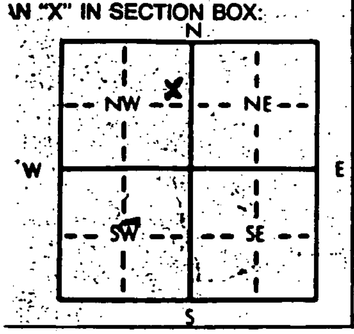
OCATION OF WATER WELL:	Fraction	Section Number	Township Number	Range Number
nty: ~~Riley~~ Geary 061	SE ¼ NE ¼ NW ¼	27	T 11 [✓ S]	R 6 [✓ E] W

tance and direction from nearest town or city street address of well if located within city? 4E-2N of Junction City

WATER WELL OWNER: J C Raceway Inc.
ddress, Box # : RR2 BOX 99
, ZIP Code : Junction City 66441

Board of Agriculture, Division of Water Resources
Application Number:

OCATE WELL'S LOCATION WITH
N "X" IN SECTION BOX:



4 DEPTH OF COMPLETED WELL 41 ft. ELEVATION:
Depth(s) Groundwater Encountered 1. 30 ft. 2. ft. 3. ft.
WELL'S STATIC WATER LEVEL 20 ft. below land surface measured on mo/day/yr 2-9-84
Pump test data: Well water was ft. after hours pumping gpm
Est. Yield 10 gpm: Well water was ft. after hours pumping gpm
Bore Hole Diameter 12 in. to ft., and in. to ft.
WELL WATER TO BE USED AS: 5 Public water supply 8 Air conditioning 11 Injection well
1 Domestic [✓] 3 Feedlot 6 Oil field water supply 9 Dewatering 12 Other (Specify below)
2 Irrigation 4 Industrial 7 Lawn and garden only 10 Observation well
Was a chemical/bacteriological sample submitted to Department? Yes [✓ No]; If yes, mo/day/yr sample was submitted
Water Well Disinfected? [✓ Yes] No

TYPE OF BLANK CASING USED: 5 Wrought iron 8 Concrete tile CASING JOINTS: Glued ✓ Clamped
1 Steel 3 RMP (SR) 6 Asbestos-Cement 9 Other (specify below) Welded
2 PVC [✓] 4 ABS 7 Fiberglass Threaded
nk casing diameter 5 in. to 0-20 ft., Dia 5 in. to 30-40 ft., Dia in. to ft.
sing height above land surface 24 in., weight 2.82 lbs./ft. Wall thickness or gauge No. #258
PE OF SCREEN OR PERFORATION MATERIAL: 7 PVC [✓] 10 Asbestos-cement
1 Steel 3 Stainless steel 5 Fiberglass 8 RMP (SR) 11 Other (specify)
2 Brass 4 Galvanized steel 6 Concrete tile 9 ABS 12 None used (open hole)
REEN OR PERFORATION OPENINGS ARE: 5 Gauzed wrapped 8 Saw cut [✓] 11 None (open hole)
1 Continuous slot 3 Mill slot 6 Wire wrapped 9 Drilled holes
2 Louvered shutter 4 Key punched 7 Torch cut 10 Other (specify)
REEN-PERFORATED INTERVALS: From 20 ft. to 30 ft., From ft. to ft.
From ft. to ft., From ft. to ft.
RAVEL PACK INTERVALS: From 10 ft. to 41 ft., From ft. to ft.
From ft. to ft., From ft. to ft.

GROUT MATERIAL: 1 Neat cement 2 Cement grout 3 Bentonite [✓] 4 Other
ut Intervals: From 0 ft. to 10 ft., From ft. to ft., From ft. to ft.
at is the nearest source of possible contamination:
1 Septic tank [✓] 4 Lateral lines 7 Pit privy 10 Livestock pens 14 Abandoned water well
2 Sewer lines 5 Cess pool 8 Sewage lagoon 11 Fuel storage 15 Oil well/Gas well
3 Watertight sewer lines 6 Seepage pit 9 Feedyard 12 Fertilizer storage 16 Other (specify below)
13 Insecticide storage
ection from well? S
How many feet? 90

ROM	TO	LITHOLOGIC LOG	FROM	TO	LITHOLOGIC LOG
0	3	top soil			
3	100/	Clay, brown			
10	300/	fs-brown			
30	40/7	fs-cs-mdgr. pegr. blue			

RECEIVED
MAR 1 1984
BUREAU OF OIL FIELD &
ENVIRONMENTAL GEOLOGY

CO ACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed [✓], (2) reconstructed, or (3) plugged under my jurisdiction and was on (mo/day/year) 2-9-84 and this record is true to the best of my knowledge and belief. Kansas
ter Well Contractor's License No. 182 This Water Well Record was completed on (mo/day/yr) 2-14-84
ter the business name of Strader Drlg Co Inc by (signature) Dale [illegible]
STRUCTIONS: Use typewriter or ball point pen, *PLEASE PRESS FIRMLY* and *PRINT* clearly. Please fill in blanks, underline or circle the correct answers. Send top ee copies to Kansas Department of Health and Environment, Division of Environment, Environmental Geology Section, Topeka, KS 66620. Send one to WATER WELL VNER and retain one for your records.

WATER WELL RECORD Form WWC-5 KSA 82a-1212

OCATION OF WATER WELL: unty: Geary 0 31
Fraction: N.W¼ S.E.¼ N.W.¼
Section Number: 27
Township Number: T 11 S
Range Number: R 6 [✓ E]W

ance and direction from nearest town or city street address of well if located within city? 3 miles south and 2 miles west of Ogden Ks.

WATER WELL OWNER: Daniel P. Boller
#, dress, Box #: Rt. 2 Bx. 78
ZIP Code: Junction City, Ks. 66441
Board of Agriculture, Division of Water Resources
Application Number: 40876

OCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:

	N		
W	NW X	NE	E
	SW	SE	
	S		

4 DEPTH OF COMPLETED WELL 63 ft. ELEVATION:
Depth(s) Groundwater Encountered 1. 21 ft. 2. ft. 3.
WELL'S STATIC WATER LEVEL 21 ft. below land surface measured on mo/day/yr 4-15-94
Pump test data: Well water was 32 ft. after 1 hours pumping 1000 gpm
Est. Yield 1500 gpm: Well water was 43 ft. after 2 hours pumping 1200 gpm
Bore Hole Diameter 32 in. to 63 ft., and in. to

WELL WATER TO BE USED AS: 1 Domestic; [✓ 2 Irrigation]; 3 Feedlot; 4 Industrial; 5 Public water supply; 6 Oil field water supply; 7 Lawn and garden only; 8 Air conditioning; 9 Dewatering; 10 Monitoring well; 11 Injection well; 12 Other (Specify below)

Was a chemical/bacteriological sample submitted to Department? Yes ...... No xx If yes, mo/day/yr sample was submitted
Water Well Disinfected? Yes ...... No xx

TYPE OF BLANK CASING USED: 1 Steel; 2 PVC; 3 RMP (SR); 4 ABS; 5 Wrought iron; 6 Asbestos-Cement; 7 Fiberglass; 8 Concrete tile; 9 Other (specify below)
CASING JOINTS: Glued xx Clamped xx Welded Threaded
nk casing diameter 16 in. to 43 ft., Dia in. to ft., Dia in. to ft.
sing height above land surface 12 in., weight lbs./ft. Wall thickness or gauge No. .50

PE OF SCREEN OR PERFORATION MATERIAL: 1 Steel; 2 Brass; 3 Stainless steel; 4 Galvanized steel; 5 Fiberglass; 6 Concrete tile; 7 PVC; 8 RMP (SR); 9 ABS; 10 Asbestos-cement; 11 Other (specify); 12 None used (open hole)

REEN OR PERFORATION OPENINGS ARE: 1 Continuous slot; 2 Louvered shutter; 3 Mill slot; 4 Key punched; 5 Gauzed wrapped; 6 Wire wrapped; 7 Torch cut; [✓ 8 Saw cut]; 9 Drilled holes; 10 Other (specify); 11 None (open hole)

REEN-PERFORATED INTERVALS: From 43 ft. to 63 ft., From ft. to ft.
From ft. to ft., From ft. to ft.
RAVEL PACK INTERVALS: From 20 ft. to 63 ft., From ft. to ft.
From ft. to 23 ft., From ft. to ft.

GROUT MATERIAL: 1 Neat cement; [✓ 2 Cement grout]; 3 Bentonite; 4 Other
out Intervals: From 0 ft. to 20 ft., From ft. to ft., From ft. to ft.
NA

at is the nearest source of possible contamination: 1 Septic tank; 2 Sewer lines; 3 Watertight sewer lines; 4 Lateral lines; 5 Cess pool; 6 Seepage pit; 7 Pit privy; 8 Sewage lagoon; 9 Feedyard; 10 Livestock pens; 11 Fuel storage; 12 Fertilizer storage; 13 Insecticide storage; 14 Abandoned water well; 15 Oil well/Gas well; 16 Other (specify below) none
ection from well? How many feet?

ROM	TO	LITHOLOGIC LOG	FROM	TO	PLUGGING INTERVALS
0	2 01	Black top soil			
2	9 02	Brown silt			
9	21 01	Fine brown sand			
21	27	Medium-large brown gravel			
27	63	Medium-large green gravel			NA
	63 11	Large cobbles, stopped			
		NA			
		NA			
		NA		NA	

RECEIVED
MAY 16 199[illegible]
BUREAU OF WATER

RACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/year) 4-15-94 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. 323 This Water Well Record was completed on (mo/day/yr) [illegible]
the business name of Hoebler Drilling Co. by (signature)

TRUCTIONS: Use typewriter or ball point pen. PLEASE PRESS FIRMLY and PRINT clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66620-0001. Telephone: 913-296-5545. Send one to WATER WELL OWNER and retain one for your records.

DF1

REFERENCE 52
FROM SECTION 11.0

726

DATA CONTROL FORM

PROJECT NAME: FORT RILEY INSTALLATION-WIDE SITE ASSESSMENT

PROJECT NUMBER: XA-1088-91 Contract #

DELIVERY / TASK #: Delivery Order 1 Task 1

AGENCY / TITLE:

DATE / TIME / PLACE:

RECORDER:

DOCUMENT TYPE: MAP ___ DRAWING ___ DATA ✓

LEGAL ___ LETTER ___ REPORT/MEMO ___

RETRIEVAL:

POST AREA: Main BUILD. NUM / NAME:

DRAWER / CABINET / BOX:

DOCUMENT NUMBER: DEH

SOURCE DATE: 1992

POTENTIAL AREA OF CONCERN:

POST AREA:

BUILD NUM / NAME:

MAP NUM / COORD:

SUBJECT CODE:

COMMENTS: Ft. Riley Demographic Statistics from DEH

Custer Hill Troop Housing

Barracks Spaces	5,011
Barracks Occupancy	4,911
Family Housing Units	
Sponsers	
Dependents	
Total	
Population	
Military	14,128
Civilian	268
Contractor	646
Dependent	
Total	15,042

Facility	Troop Auth	Troop Exist	FH Auth	FH Exist
Fitness Center/Gymnasium		4		
Swimming Pool		2		
Tennis Court		3		
Running Trail/Fitness Cluster		3		
Running Track		1		
Football/Soccer Field	14	2		
Basketball Goal/Court	28			
Handball/Racquetball Court	14	6		
Baseball Backstop/Field		1		
Softball Backstop/Field	28	8		
Tot Lot/Play Area				
Jogging Path				
Volley Ball	28			
Parks/Picnic Areas				
Community Center				
Shopette				
Service Station				
Theater		1		
School				
Snack Bar		4		

Swimming pool in Long Gym is officially listed as a training tank.

There are two running trails. One has a fitness cluster. There is also a stand alone fitness cluster.

In addition to snack bars listed, there are snack trucks which go to all locations on the installation.

Custer Hill Family Housing

Barracks Spaces	
Barracks Occupancy	
Family Housing Units	2,386
Sponsers	2,377
Dependents	5,817
Total	8,194
Population	
Military	2,377
Civilian	
Contractor	
Dependent	5,817
Total	8,194

Facility	Troop Auth	Troop Exist	FH Auth	FH Exist
Fitness Center/Gymnasium				
Swimming Pool				
Tennis Court			23	4
Running Trail/Fitness Cluster				
Running Track				
Football/Soccer Field				
Basketball Goal/Court			48	24
Handball/Racquetball Court			48	
Baseball Backstop/Field				
Softball Backstop/Field				3
Tot Lot/Play Area			95	36
Jogging Path			1	
Volley Ball				
Parks/Picnic Areas				
Community Center				1
Shopette				1
Service Station				1
Theater				
School				5
Snack Bar		3		

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.

Schools consist of four elementary and one middle school. All schools are under control and owned by USD 475.

The Burger King restaurant is counted as a snack bar.

Camp Forsyth

Troop and Family Housing

Barracks Spaces	2,485
Barracks Occupancy	921
Family Housing Units	465
Sponsers	458
Dependents	1,137
Total	1,595
Population	
Military	302
Civilian	23
Contractor	77
Dependent	1,137
Total	1,539

Facility	Troop Auth	Troop Exist	FH Auth	FH Exist
Fitness Center/Gymnasium				
Swimming Pool				
Tennis Court			4	
Running Trail/Fitness Cluster				
Running Track				
Football/Soccer Field		2		
Basketball Goal/Court			9	7
Handball/Racquetball Court			9	
Baseball Backstop/Field				4
Softball Backstop/Field		3		
Tot Lot/Play Area			18	9
Jogging Path			1	
Volley Ball				
Parks/Picnic Areas		2		
Community Center				1
Shopette				1
Service Station				1
Theater				
School				
Snack Bar		1		

Barracks occupancy and capacity include the NCO Academy with a capacity of 250 persons.

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.

Soccer fields (4) and baseball fields (4) shown in the Family Housing area are reserved for youth activities.

Parks and recreation areas are indicated under Troop Exist but are open to all

Main Post

Troop and Family Housing

Barracks Spaces	587
Barracks Occupancy	575
Family Housing Units	273
Sponsers	274
Dependents	660
Total	934
Population	
Military	1,666
Civilian	1,518
Contractor	264
Dependent	660
Total	4,108

Facility	Troop Auth	Troop Exist	FH Auth	FH Exist
Fitness Center/Gymnasium		1		
Swimming Pool		1		
Tennis Court		4	2	
Running Trail/Fitness Cluster		1		
Running Track				
Football/Soccer Field	1	1		
Basketball Goal/Court	2		5	16
Handball/Racquetball Court	1		5	
Baseball Backstop/Field				
Softball Backstop/Field	2	4		
Tot Lot/Play Area			11	19
Jogging Path			1	
Volley Ball	2			1
Parks/Picnic Areas		1		
Community Center				
Shopette				
Service Station				1
Theater				
School				1
Snack Bar		1		

Swimming pool on the Main Post Area is located at the Leaders Club.

Parks and recreations are listed under Troop Auth but are open to all personnel and family members.

The softball complex in Camp Whitside serves both the Main Post and Camp Whitside.

Marshall U.S. Army Airfield

Troop and Family Housing

Barracks Spaces	
Barracks Occupancy	
Family Housing Units	11
Sponsers	12
Dependents	20
Total	32

Population	
Military	941
Civilian	55
Contractor	37
Dependent	20
Total	1,019

Facility	Troop Auth	Troop Exist	FH Auth	FH Exist
Fitness Center/Gymnasium				
Swimming Pool				
Tennis Court				
Running Trail/Fitness Cluster				
Running Track				
Football/Soccer Field	1			
Basketball Goal/Court	2			1
Handball/Racquetball Court	1			
Baseball Backstop/Field				
Softball Backstop/Field	2			
Tot Lot/Play Area				1
Jogging Path				
Volley Ball	2			
Parks/Picnic Areas				
Community Center				
Shopette				
Service Station				
Theater				
School				
Snack Bar				

A majority of personnel assigned to MUSAAF are housed in barracks on the Main Post Area.

Facility requirements for recreational needs for troops are recommended for PT and for unit intramural activities.

Camp Whitside

Troop and Family Housing7

Barracks Spaces	84
Barracks Occupancy	84
Family Housing Units	1
Sponsers	1
Dependents	4
Total	5
Population	
Military	318
Civilian	535
Contractor	24
Dependent	4
Total	881

Facility	Troop Auth	Troop Exist	FH Auth	FH Exist
Fitness Center/Gymnasium				
Swimming Pool				
Tennis Court				
Running Trail/Fitness Cluster				
Running Track				
Football/Soccer Field	1			
Basketball Goal/Court	2			
Handball/Racquetball Court	1			
Baseball Backstop/Field				
Softball Backstop/Field	2			
Tot Lot/Play Area				
Jogging Path				
Volley Ball	2			
Parks/Picnic Areas				
Community Center				
Shopette		1		
Service Station				
Theater				
School				
Snack Bar		1		

Shopette and snack bar (vending area) are located in Hospital.

Camp Funston

Barracks Spaces	1,650
Barracks Occupancy	
Family Housing Units	
Sponsers	
Dependents	
Total	
Population	
Military	347
Civilian	246
Contractor	229
Dependent	
Total	812

Facility	Troop Auth	Troop Exist	FH Auth	FH Exist
Fitness Center/Gymnasium		1		
Swimming Pool				
Tennis Court				
Running Trail/Fitness Cluster				
Running Track		1		
Football/Soccer Field	1	3		
Basketball Goal/Court	2			
Handball/Racquetball Court	1			
Baseball Backstop/Field				
Softball Backstop/Field	2	1		
Tot Lot/Play Area				
Jogging Path				
Volley Ball	2			
Parks/Picnic Areas				
Community Center				
Shopette				
Service Station				
Theater				
School				
Snack Bar				

Military strength include 169 prisoners.

REFERENCE 55
FROM SECTION 11.0

727

(734)

DATA CONTROL FORM

PROJECT NAME: FORT RILEY INSTALLATION-WIDE SITE ASSESSMENT

PROJECT NUMBER: XA-1088-91 **Contract #**

DELIVERY / TASK #: Delivery Order 1 Task 1

AGENCY / TITLE:

DATE / TIME / PLACE:

RECORDER:

DOCUMENT TYPE: **MAP** ____ **DRAWING** ____ **DATA** ____

LEGAL ____ **LETTER** ____ **REPORT/MEMO** ____

RETRIEVAL:

POST AREA: ____ **BUILD. NUM / NAME:** ____

DRAWER / CABINET / BOX:

DOCUMENT NUMBER: AEHA Report

SOURCE DATE: 20 March 1992

POTENTIAL AREA OF CONCERN:

POST AREA:

BUILD NUM / NAME:

MAP NUM / COORD:

SUBJECT CODE: WELL HAZ

COMMENTS:

FORM QAQC#2
FT RILEY INSTALLATION-WIDE ASSESSMENT

12/17/91
REVISION 2

- USATHAMA Site 8 Waste Treatment Area
  This is the main post sludge drying bed (932/265) included in PAOC Sewage Treatment Plant and Sludge Drying Beds, Section 3.11 above.

- USATHAMA Site 9 Possible Piles of Debris and Cases
  This site is encompassed in the ongoing study of the pesticide storage building (925/260) that is at the RI/FS level under a different program. It may partially overlap an area included within the PAOC Former Livestock Dipping Facility, Section 3.26 above.

- USATHAMA Site 10 Possible Landfill
  This site is one of the Forsyth landfills (863/260) included in PAOC Former Landfills or Main Post and Camp Forsyth, Section 3.8 above.

- USATHAMA Site 11 Landfill
  This landfill is south of the Republican River and west of Grant Avenue in Junction City (898/258) outside Fort Riley.

- USATHAMA Site 12 Possible Landfill
  This site (935/280) is part of PAOC Former Incinerators at Camp Funston and Camp Whitside and Adjacent Landfills, Section 3.7 above.

6.2 AEHA Report Dated 20 March 1992

A report entitled "Results of Synthetic Organic Chemical Survey for 1st Infantry Division (Mechanized) and Fort Riley" dated 20 March 1992 was submitted by Robert S. Ryczak LTC, MS Chief, Water Quality Engineering Division of the U.S. Army Environmental Hygiene Agency.

Highlights from the memo are as follows:

> *4. Water Systems. Fort Riley's portable water originates from 14 wells. Six of these wells serve the cantonment area, two wells serve Camp Forsyth, two wells serve the Tank Gunnery area, and one well serves Range Control. The two wells located at the Milford Recreational Area have been removed from service. The well at Keats is in the process of being capped. The cantonment area and Forsyth potable water systems are classified by definition as community water systems (system which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents). The Tank Gunnery system is classified as nontransient-noncommunity (NTNC) water system (a system that serves the same 25 or more people at least 6 months of the year). The Range Control system is classified as a private water systems (a system that serves less than the same 25 people at least 6 months of the year).*

Exhibit 4 From AEHA Memo: Significant Synthetic Organic Chemicals Detected, ug/L.

Well Location	Chemical	Initial	Confirm
Cantonment Area:			
Main Post #1	Methylene chloride	<0.50	0.70 B
Main Post #3	Atrazine	NS	1.26
	Methylene chloride	NS	0.60 B
Main Post #4	Atrazine	NS	0.83
	Methylene chloride	<0.50	0.70 B
Main Post #5	Atrazine	NS	1.13
	Trichlorofluoromethane	NS	1.1
Main Post #6	Trichlorofluoromethane	<0.50	1.7
Main Post #7	Methylene chloride	NS	1.40 B
	Trichlorofluoromethane	NS	0.7
Camp Forsyth:			
Forsyth #1	Trichlorofluoromethane	NS	1.0
Forsyth #2	Trichlorofluoromethane	NS	2.2
	Methylene chloride	NS	0.90 B
	Chloroform	NS	1.9
	Bromodichloromethane	NS	2.2
	Dibromochloromethane	NS	1.0
Milford Recreation Area:			
Milford Area Marina	Butylbenzyl phthalate	10	NS
Milford Area Campground	alpha-BHC	0.37	NS
	gamma-BHC (Lindane)	0.31	NS
Other Locations:			
Keats	Methylene chloride	1.8 B	NS
Tank Gunnery-Mess Hall	Trichlorofluoromethane	<0.50	1.6
Tank Gunnery-Shower	Trichlorofluoromethane	<0.50	1.3
Range Control	Trichlorofluoromethane	<0.50	2.3
	Methylene Chloride	0.64 B	<0.50

NS - No Sample was taken for VOC Analysis
B - Compound also detected in the blank.

6. Discussion and Conclusions.

a. Even though TTHM's rarely occur in well water, it was found in Forsyth Well #2 at low levels. The SOCS samples are usually taken at the wellhead, before any treatment. Usually, the maximum concentration of TTHMs occurs after chlorination, when the chlorine disinfectant combines with naturally occurring organic compounds in the water. TTHM concentration in the water at point of consumption may be much higher than that measured during the sampling. The EPA is considering reducing the TTHM standard to 25-5-ug/L. The measured levels of TTHMs do not pose a health problem.

b. Methylene chloride was detected in 7 wells during either initial or confirmatory sampling (see Exhibit 4). In both sets of instances, methylene chloride was detected in the blank and slightly above the detection limit. Since methylene chloride was not detected in both samples and was detected in the blank, methylene chloride is probably a laboratory contaminant and is not considered significant at this time.

c. Atrazine was detected in the Main Post Wells #3, #4, and #5 during confirmatory sampling at levels below the promulgated MCL. Since there was no initial sample taken for atrazine analysis, the presence of atrazine can not be verified. Atrazine is a water-soluble herbicide which readily migrates and is one of the most frequent herbicide contaminants detected in groundwater. Once atrazine has been detected, repeat monitoring must be done during periods of likely contamination (i.e., after rainfall and/or periods pesticide application) (reference 1c). The frequency of monitoring must be four consecutive quarterly samples during each compliance period until a reliable baseline has been established. Additional monitoring is required to determine the extent and variability of pesticide contamination. Atrazine at the detected levels does not pose significant problems at this time.

d. The presence of alpha-BHC and gamma-BHC was not confirmed in the Milford Area Campground Well due to the well being sealed. Lindane is an insecticide used to control wood inhabiting beetles and seeds and for soil treatment, foliage application on fruit and nut trees, vegetables, ornamentals, timber, and wood protection (reference 1e). Since there is no water drawn from this area for consumption, lindane does not pose a problem at this time. However, if new wells are put in, the water will have to be analyzed for the presence of alpha-BHC and gamma-BHC.

e. The presence of butyl benzyl phthalate was not confirmed because of the well at Milford Area Marina being closed. However, phthalates are used as a plasticizer in the production of plastics and is a common laboratory contaminant. The presence of butyl benzyl phthalate does not pose significant problems at this time.

f. Trichlorofluoromethane was detected in eight wells during confirmatory sampling (see Table 2). In two of the wells, trichlorofluoromethane was not detected in initial samples. No initial samples were collected in the other six wells. Trichlorofluoromethane is used as a refrigerant, a propellant, and as a solvent to clean metal and plastic parts during manufacturing. Trichlorofluoromethane is very volatile and a common laboratory contaminant. Therefore, the presence of trichlorofluoromethane is questionable and does not pose a problem at this time.

9. Recommendations.

Monitor all Main Post Wells #3, #4, and #5 for atrazine (paragraph 6c). Check with the State regulators to determine if it has been detected in other wells in the area. If atrazine is detected in the future, find a less water-soluble replacement herbicide for any atrazine which is used on the installation. Information concerning replacements may be obtained by calling the DoD Pesticide Hotline, DSN 584-3773 or commercial (410) 671-3773. Request State assistance if the source appears to be off-post.

In addition to the recommendations of the USAEHA, it is recommended (1) that the Fort Riley well head area along McCormick Road (identified as Main Post wells #1 through #7 and Forsyth wells #1 and #2) be the subject of a hydrogeological study to determine the ground water flow pattern in the area under different hydrogeological conditions (e.g., the effect of rainfall, river stage, pumping rate), (2) that early warning wells be established to monitor water moving towards the wells, and (3) that once ground water flow is understood, this information be used in planning future development and land use. This approach is discussed in Chapter 8.

REFERENCE 56
FROM SECTION 11.0

731

COMMUNICATION RECORD

MEETING MINUTES ______ **TELECON RECORD** ______ **INTERVIEW** X

PROJECT NAME: FT RILEY INSTALLATION-WIDE SITE ASSESSMENT

PROJECT NUMBER: XA-1088-91 **Contract #** DACA41-92-D-0001

DELIVERY / TASK #: Delivery Order 1 MOD 4 **Task** 3

CONTACT: [redacted]; Plant Manager

AGENCY / TITLE: METCALF + Eddy Services

PHONE #: 913-762-5855 (water plant) 913-238-4101 (wastewater plant)

DATE / TIME / PLACE: 9.25.92

RECORDER: Lisa Johns

COMMENTS: (See Attached) WELL

Called for Junction City well locations + their monitoring well report

RECEIVED
OCT 5 1992
LBI/LBA D.C.

Metcalf & Eddy
M&E
Services

Metcalf & Eddy Services
P.O. Box 686
Junction City, KS 66441-0686
Water Plant (913) 762-5855
Wastewater Plant (913) 238-4601

September 29, 1992

Louis Berger and Associates, Inc.
1819 H Street NW
Suite 900
Washington, DC
20006

Att: Lisa Johns

Dear Lisa:

Enclosed please find the map of the Junction City, Kansas area showing the location of the water treatment facility and the adjacent well field.

We presently have nine (9) active raw water wells located within the yellow highlighted area of the map. The rectangular areas on the map indicate our four lime sludge drying lagoons.

To the north and northeast, across from the Republican River, is Fort Riley.

Also enclosed is a recent well monitoring report. Please note that wells "17" and "19" are test wells only. We include them for monitoring the static water levels without the influence of any well usage.

We hope this provides you the information you requested.

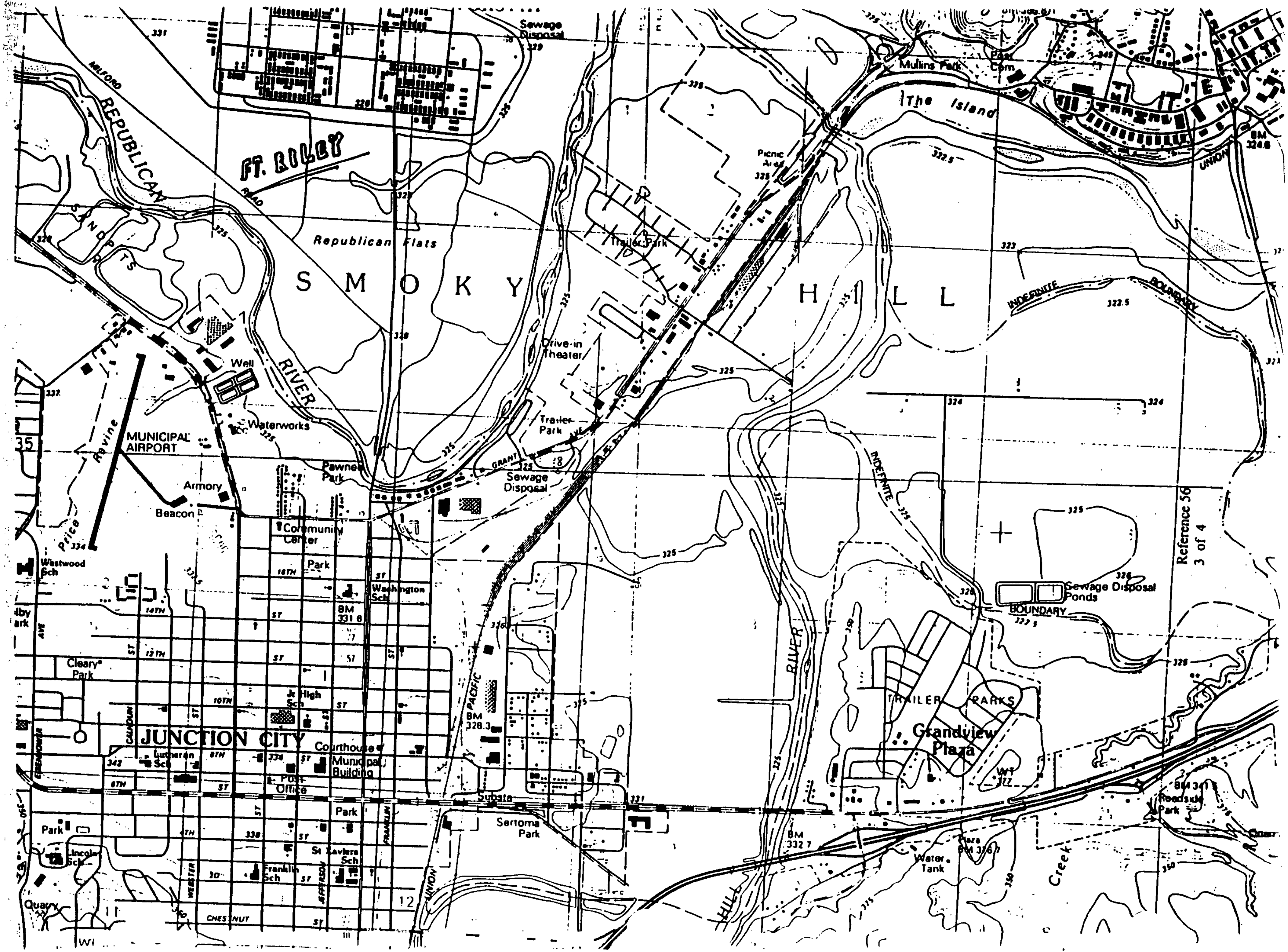
Sincerely,

METCALF & EDDY SERVICES

Dennis Taggart
Plant Manager

enclosures

"We Make Technology Work"


Sewage Disposal
FT. RILEY
MILFORD
REPUBLICAN
ROAD
SAND PITS
Republican Flats
SMOKY
HILL
RIVER
Mullins Park
Post Cem
The Island
UNION
BM 324.6
Picnic Area
Trailer Park
Drive-in Theater
INDEFINITE BOUNDARY
Well
Waterworks
MUNICIPAL AIRPORT
Ravine
Price
Armory
Beacon
Pawnee Park
GRANT AVE
Sewage Disposal
Community Center
Park
Westwood Sch
16TH
14TH
12TH
10TH
8TH
6TH
4TH
3D
CHESTNUT
ST
Washington Sch
BM 331.6
Cleary Park
Jr High Sch
BM 328.3
JUNCTION CITY
Courthouse
Municipal Building
Lutheran Sch
Post Office
Substa
Sertoma Park
Park
St Xaviers Sch
Franklin Sch
Lincoln Sch
Quarry
CALHOUN
WEBSTER
JEFFERSON
FRANKLIN
EISENHOWER
AVE
UNION PACIFIC
Sewage Disposal Ponds
BOUNDARY
TRAILER PARKS
Grandview Plaza
WT
BM 332.7
Water Tank
BM 341.5
Roadside Park
Creek
Reference 56
3 of 4
35
12
325
328
331
332
334
336
338
342
350

METCALF & EDDY SERVICES WELL FIELD DATA

DATA DATE: 09/23/92

WELL NUMBER	TEST HOLE ELEVATION	BENCHMARK	STATIC READING	CORRECTION FACTOR	ACTUAL STATIC	WATER ELEVATION
6	1084.99	1083.20	34.50	-1.79	32.7	1050.5
8	1083.21	1082.52	34.33	-0.69	33.6	1048.9
10	1074.11	1066.35	22.28	-7.76	14.5	1051.8
[illegible]	1071.18	1070.88	22.54	-0.30	22.2	1048.6
[illegible]	1069.31	1070.87	20.00	1.56	[illegible]	1049.3
[illegible]	1082.76	1070.88	0.00	-11.88	-11.9	1082.8
14	1069.69	[illegible]	0.00	-0.34	-0.3	1069.9
15	1071.87	1070.24	22.75	-1.63	21.1	1049.1
16	1072.83	1070.40	25.25	-2.43	22.8	1047.6
17	1072.04	1071.46	22.23	-0.58	21.7	1049.8
[illegible]	1084.10	1082.33	32.92	-1.85	31.1	1051.2

[illegible]	WELL DEPTH	SCREEN ELEVATION	RUN LEVEL	DRAWDOWN	DISTANCE TO SCREEN
6	72 FT	1026.20	36.42	1.92	[illegible]
8	72 FT	1025.50	35.67	1.34	[illegible]
10	53.5 FT	1027.90	0.00	-22.28	46.2
11	62.6 FT	1028.30	25.00	2.46	17.9
12	57.7 FT	1033.20	24.29	4.29	11.3
13	58 FT	1032.90	24.71	24.71	25.2
14	56 FT	1033.40	26.88	26.88	9.6
15	56 FT	1034.20	26.35	3.60	11.3
16	60.5 FT	1029.90	24.54	-0.71	18.4
17					
18 #	74 FT	1028.30			

Reference 56
4 of 4

REFERENCE 57
FROM SECTION 11.0

765

DATA CONTROL FORM

PROJECT NAME: FORT RILEY INSTALLATION-WIDE SITE ASSESSMENT

PROJECT NUMBER: XA-1088-91 Contract #

DELIVERY / TASK #: Delivery Order 1 Task 1

AGENCY / TITLE:

DATE / TIME / PLACE: 16 Nov 1992

RECORDER: J. C[illegible]

DOCUMENT TYPE: MAP ______ DRAWING ______ DATA ______

LEGAL ______ LETTER ______ REPORT/MEMO Interview

RETRIEVAL:

POST AREA: ______ BUILD. NUM / NAME: ______

DRAWER / CABINET / BOX:

DOCUMENT NUMBER:

SOURCE DATE: 11/[illegible]/92

POTENTIAL AREA OF CONCERN:

POST AREA: Ogden

BUILD NUM / NAME:

MAP NUM / COORD:

SUBJECT CODE: WELL

COMMENTS: Water District

Memorandum to File

16 Nov 1992

Telephone Conversation

[redacted] - City of Ogden
539-0311

→ City of Ogden water district uses three wells within the city limits. No wells on the river or outside of city limits.

→ There are 425 water meters in the district. Some meters may represent several customers, however (e.g., trailer parks with up to 60 trailers may have 1 meter).

→ Approximately 5 residences outside city limits, but adjacent to it, are serviced on city water.

→ All water sold to the Riley County Rural Water District has the 3 city wells as its source.

Plate 1:
FFTA–MAAF
Sample Location Plan
SI & ESI, 9/93–1/95

MAAF-16.dwg 2/98

Plate 2:
Site Area With
2 Foot Contours,
7/94

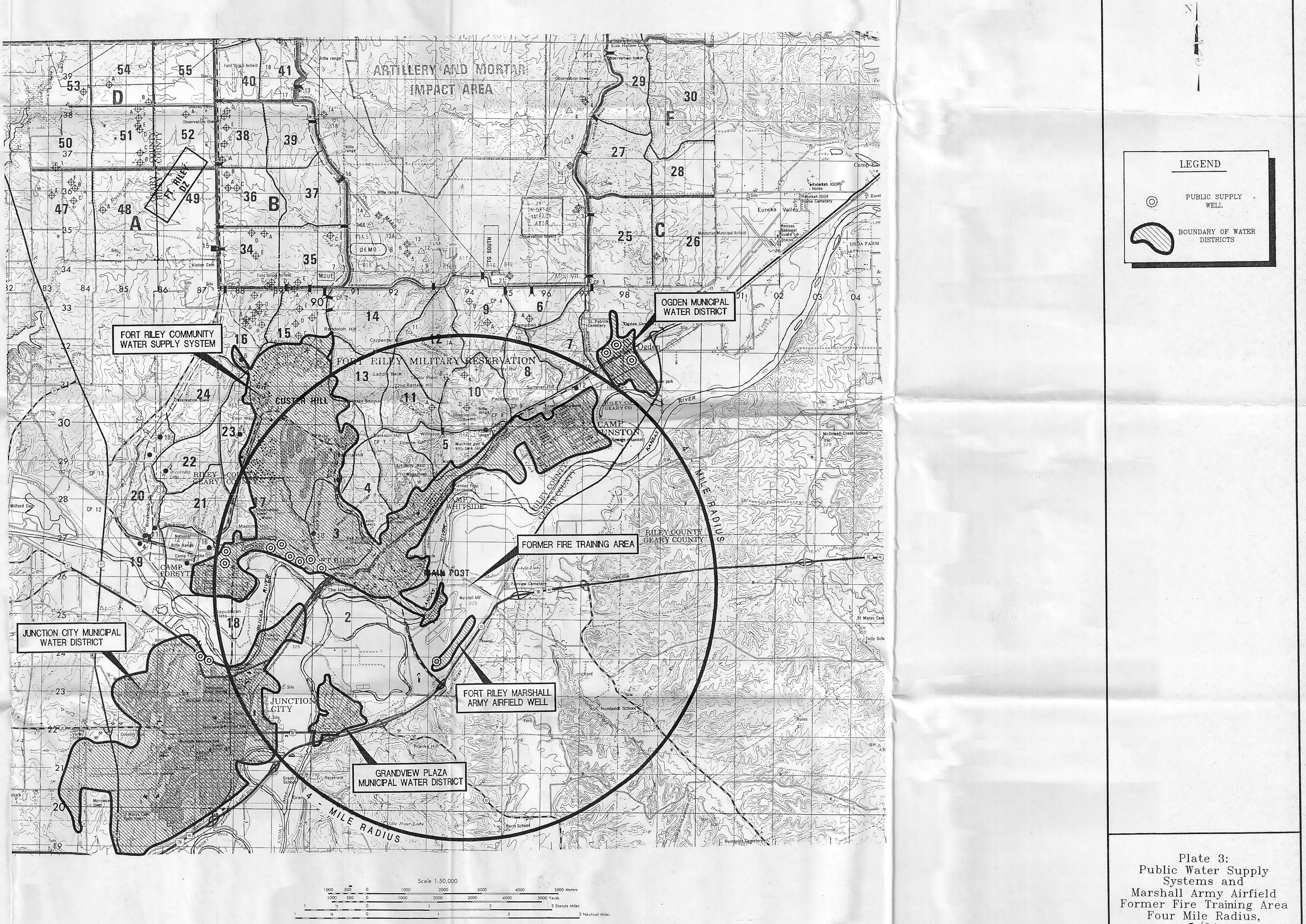
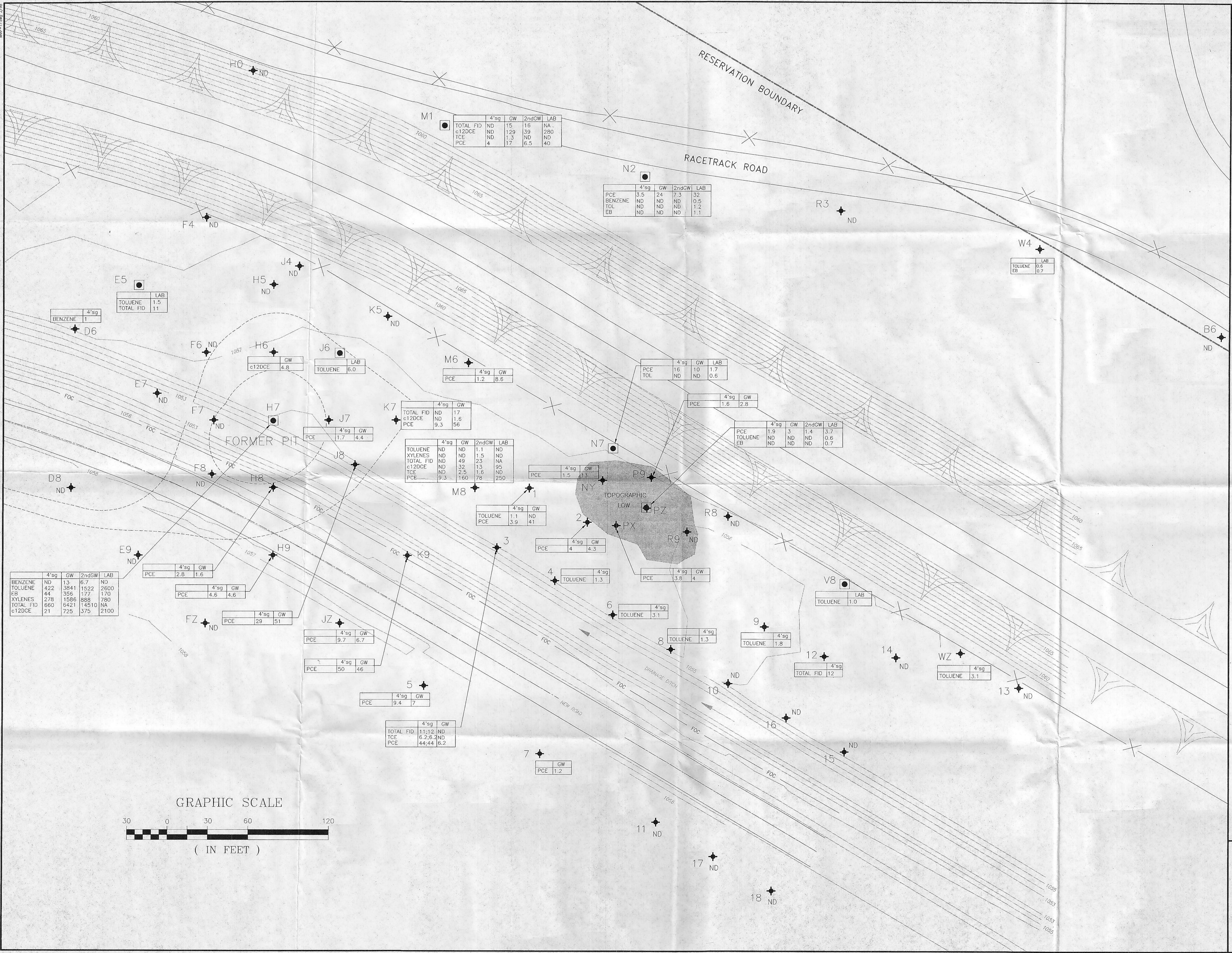


Plate 3:
Public Water Supply
Systems and
Marshall Army Airfield
Former Fire Training Area
Four Mile Radius,
5/94



M1

	4'sg	GW	2ndGW	LAB
TOTAL FID	ND	15	16	NA
c12DCE	ND	129	39	280
TCE	ND	1.3	ND	ND
PCE	4	17	6.5	40

N2

	4'sg	GW	2ndGW	LAB
PCE	3.5	24	7.3	32
BENZENE	ND	ND	ND	0.5
TOL	ND	ND	ND	1.2
EB	ND	ND	ND	1.1

W4

	LAB
TOLUENE	0.6
EB	0.7

E5

	LAB
TOLUENE	1.5
TOTAL FID	11

D6

	4'sg
BENZENE	1

H6

	GW
c12DCE	4.8

J6

	LAB
TOLUENE	6.0

M6

	4'sg	GW
PCE	1.2	8.6

K7

	4'sg	GW
TOTAL FID	ND	17
c12DCE	ND	1.6
PCE	9.3	56

J7

	4'sg	GW
PCE	1.7	4.4

M8

	4'sg	GW	2ndGW	LAB
TOLUENE	ND	ND	1.1	ND
XYLENES	ND	ND	1.5	ND
TOTAL FID	ND	49	23	NA
c12DCE	ND	32	13	95
TCE	ND	2.5	1.6	ND
PCE	9.3	160	78	250

H7

	4'sg	GW	2ndGW	LAB
BENZENE	ND	13	6.7	ND
TOLUENE	422	3841	1522	2600
EB	44	356	177	170
XYLENES	278	1586	888	780
TOTAL FID	660	6421	14510	NA
c12DCE	21	725	375	2100

H8

	4'sg	GW
PCE	2.8	1.6

H9

	4'sg	GW
PCE	4.6	4.6

J8

	4'sg	GW
PCE	29	51

JZ

	4'sg	GW
PCE	9.7	6.7

K9

	4'sg	GW
PCE	50	46

5

	4'sg	GW
PCE	9.4	7

3

	4'sg	GW
TOTAL FID	11;12	ND
TCE	6.2;6.2	ND
PCE	44;44	6.2

7

	GW
PCE	1.2

1

	4'sg	GW
TOLUENE	1.1	ND
PCE	3.9	41

NY

	4'sg	GW
PCE	1.5	13

N7

	4'sg	GW	LAB
PCE	16	10	1.7
TOL	ND	ND	0.6

P9

	4'sg	GW
PCE	1.6	2.8

PZ

	4'sg	GW	2ndGW	LAB
PCE	1.9	3	1.4	3.7
TOLUENE	ND	ND	ND	0.6
EB	ND	ND	ND	0.7

2

	4'sg	GW
PCE	4	4.3

PX

	4'sg	GW
PCE	3.8	4

4

	4'sg
TOLUENE	1.3

6

	4'sg
TOLUENE	3.1

8

	4'sg
TOLUENE	1.3

9

	4'sg
TOLUENE	1.8

V8

	LAB
TOLUENE	1.0

12

	4'sg
TOTAL FID	12

WZ

	4'sg
TOLUENE	3.1

LEGEND

✦	SAMPLE LOCATION–FIELD ANALYSIS ONLY
▣	SAMPLE LOCATION–FIELD AND LABORATORY ANALYSIS
⌒	ELEVATION CONTOUR
═	ROAD
======	FORMER FEATURE
—×—×—	FENCE LINES
▲▲▲	LEVEE
—FOC—FOC—	Fiber Optic Cable

ND = Non Detect
NA = Not Analyzed
EB = Ethylbenzene
c12DCE = cis–1,2–Dichloroethylene
TCE = Trichloroethylene
PCE = Tetrachloroethylene
2ndGW = Second Round of GW Screening
LAB = Duplicate of Second Round, Laboratory Analysis
sg = Soil Gas Sample
GW = Groundwater Screening Samples

NOTE:

1. ELEVATION CONTOURS ARE IN FEET.
2. CONCENTRATIONS ARE IN ug/l.
3. "TOPOGRAPHIC LOW" AREA IS LOCATED ON FIGURE BASED UPON FIELD MEASUREMENTS TAKEN DURING SI ACTIVITIES.

Plate 4:
Summary of SI Soil Gas and Groundwater Screening Detections, 9/93

Louis Berger & Associates, Inc.
1819 H Street, NW, Suite 900, Washington, DC 20006
Tel 202.331.7775 • Fax 202.293.6224

A MEMBER OF THE BERGER GROUP

ENGINEERS • PLANNERS • SCIENTISTS • ECONOMISTS • ARCHAEOLOGISTS

12 March 1998

Glen Shonkwiler
U.S. Army Engineer District, Kansas City
ATTN: CENWK-EP-EA
601 East 12th Street
Kansas City, MO 64106-2896

RE: Draft Final Site Investigation for the Former Fire Training Area - Marshall Army Airfield, Fort Riley, Kansas
Contract No. DACA41-92-D-0001

Dear Glen:

Enclosed are four copies of the Draft Final Site Investigation (SI) for Former Fire Training Area - Marshall Army Airfield, Fort Riley, Kansas. This document is dated 19 December 1995 as it presents information current at that time. Copies are also being forwarded to Fort Riley and the other parties on the attached distribution list. Also enclosed are Responses to Comments received on the Draft SI dated 1 August 1995.

This document has been checked and coordinated during Berger's internal review prior to this submittal.

Should you have any questions, please call me at (202) 331-7775 Extension 422.

Sincerely,

LOUIS BERGER AND ASSOCIATES, INC.

Barry Millman

Barry Millman, P.E.
Program Manager

Enclosures (4)

copy: Directorate of Environment & Safety
(6 copies)
AFZN-ES-L (Attn: Kyle Kirchner)
Bldg 407 Pershing Court (1st Floor)
Fort Riley, KS 66442-6016

Bob Koke (2 copies)
Federal Facilities/Special Emphasis
Section
Superfund Division
U.S. Environmental Protection Agency,
Region VII
726 Minnesota Avenue
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