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Installation Restoration Program

Phase II, Confirmation/Quantification

Stage 2

Hancock Air National Guard Base
Syracuse, New York 13211-7099

Volume 1 — Technical Report

Science Applications International Corporation
8400 Westpark Drive • McLean, Virginia 22102

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Occupational & Environmental Health Laboratory (USAFOEHL)
Brooks Air Force Base, Texas 78235-5501

INSTALLATION RESTORATION PROGRAM
PHASE II - CONFIRMATION/QUANTIFICATION
STAGE 2

FINAL REPORT

FOR

HANCOCK FIELD
SYRACUSE, NEW YORK 13211-7099

NATIONAL GUARD BUREAU
ANDREWS AIR FORCE BASE, MARYLAND 20331-7099

JUNE 1989

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ABSTRACT

Seven sits in two zones were investigated during this Phase II, Stage 2 effort at Hancock Field. The sites included one Fire Training Area (FT-1), three disposal sites (D-1, D-3, and D-5), two storage sites (S-1 and S-3), and one spill site (SP-1).

A soil gas survey was conducted at one site (FT-1) and geophysical surveys (magnetometry) were conducted at two sites (D-1 and D-3). Fifteen new groundwater monitoring wells were installed, nine in Zone 1 and six in Zone 2. Samples of wastes, groundwater, surface water, sediments, and soils were collected and submitted for laboratory analysis.

No significant health risk is posed by the presumably site-related metals found in sediments at the two disposal sites (D-1 and D-3). Low concentrations of pesticides were detected in soils around Site S-3, but no significant health risk is posed by these constituents. Sediments, and to a lesser extent surface water, below Site SP-1 contained organic residues, but pose no significant health risk. Organic compounds also were found in soils around Site S-1, but the concentrations found pose no significant risk. In Zone 1, site related organic compounds were detected in soils immediately surrounding the Fire Training Area (Site FT-1) but no significant health risk is posed. At Disposal Site D-5, the low levels of halogenated volatile organics are not site related and are well below applicable standards.

No further action is recommended for all seven sites investigated during this effort.

PREFACE

In August 1986, Science Applications International Corporation (SAIC) was contracted by the United States Air Force Occupational and Environmental Health Laboratory (USAFOEHL) and National Guard Bureau (NGB) to perform an Installation Restoration Program (IRP) Phase II, Stage 2 field evaluation at Hancock Field, Syracuse, New York. The objectives of the field evaluation were to determine whether environmental contamination had occurred at the base as the result of waste storage or disposal practices, fuel spills, and fire training activities; to provide estimates of the extent and magnitude of contamination, if found; and to identify additional monitoring efforts, if any, required to meet these objectives. To achieve these objectives, groundwater, surface water, sediment, and soil samples were obtained from seven sites in two zones that were identified as having a potential for environmental contamination. This report documents the methodology and the findings of the IRP Phase II, Stage 2 field evaluation and provides recommendations, where appropriate, for future IRP efforts at Hancock Field.

The SAIC Project Manager for this Phase II, Stage 2 study was Mr. Philip Spooner. Members of the field investigation team were Mr. John King and Mr. Eric Gibson. Technical data analysis and report writing input was provided by Mrs. Sara Hartwell, Mr. Frederic Zafran, Mr. Nand Kaushik, and Mrs. Mamie Brouwer.

The support and assistance of TSgt. Allan Smith of the 174 TAC Clinic, Maj. Temple Myers of 174 TAC Civil Engineering, and Mr. Paul Zimmerman of the Hancock Field Caretakers Office during the field activities is greatly appreciated.

The support and guidance of SMSgt. James Craig, the NGB Project Manager, and Ms. Judith Burris, the USAFOEHL Technical Program Manager, is gratefully acknowledged.

Approved:

Edward R. Saltzberg

Edward R. Saltzberg, Ph.D.
Corporate Vice President

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EXECUTIVE SUMMARY

The U.S. Air Force (USAF), as part of its primary mission of the defense of the United States, has been engaged in operations that involve the use or handling of toxic or hazardous substances. The U.S. Department of Defense (DOD), in recognition of potential public health and environmental impacts of such activities, has implemented the Installation Restoration Program (IRP). The objectives of the IRP in general are to identify the locations and contents of past hazardous waste disposal sites and to eliminate any hazards that these hazards may pose to public health and the environment. A four-phased approach is used by DOD:

- Phase I - Installation Assessment (Records Search) - During this phase, past disposal sites that may pose a threat to human health or the environment are identified and ranked by degree of concern, based on existing data and records.

- Phase II - Confirmation/Quantification - Phase II involves preliminary and comprehensive environmental and/or ecological surveys to define and quantify the presence or absence of contamination and its extent, and characterize any identified waste sites or locations requiring remedial actions. Phase II investigations generally consist of two stages:

    - Phase II, Stage 1 - Confirmation Study - Preliminary environmental and/or ecological surveys aimed at confirming the presence or absence of contaminants at the locations identified during Phase I are included in this Confirmation Study.

    - Phase II, Stage 2 - Quantification Study - The confirmation of contaminants established in the Phase II, Stage 1 Confirmation Study are built upon in this study. In addition, comprehensive environmental and/or ecological surveys are characterized and quantified, and off-site impacts on groundwater, surface water, and air are evaluated.

- Phase III - Technology Base Development - Phase III involves the development of new technologies for controlling contaminant migration or restoring an installation, and responding to research requirements.

- Phase IV - Operations/Remedial Actions - During Phase IV, a remedial action plan and, where appropriate, long-range monitoring programs are prepared and implemented.

This report summarizes the findings of the Phase I and Phase II, Stage 1 efforts and presents a detailed discussion of Phase II, Stage 2 activities at Hancock Field, New York.

Environmental Setting

Hancock Field is located near Syracuse, New York. It was originally built in 1942 as a staging area for World War II. Hancock Field is located within the Ontario-Mohawk Lowland Region of the Central Lowland Physiographic Province, characterized by relatively flat glacial topography. The base location originally was covered by large swamps and poorly drained areas, but has been altered by draining and filling activities.

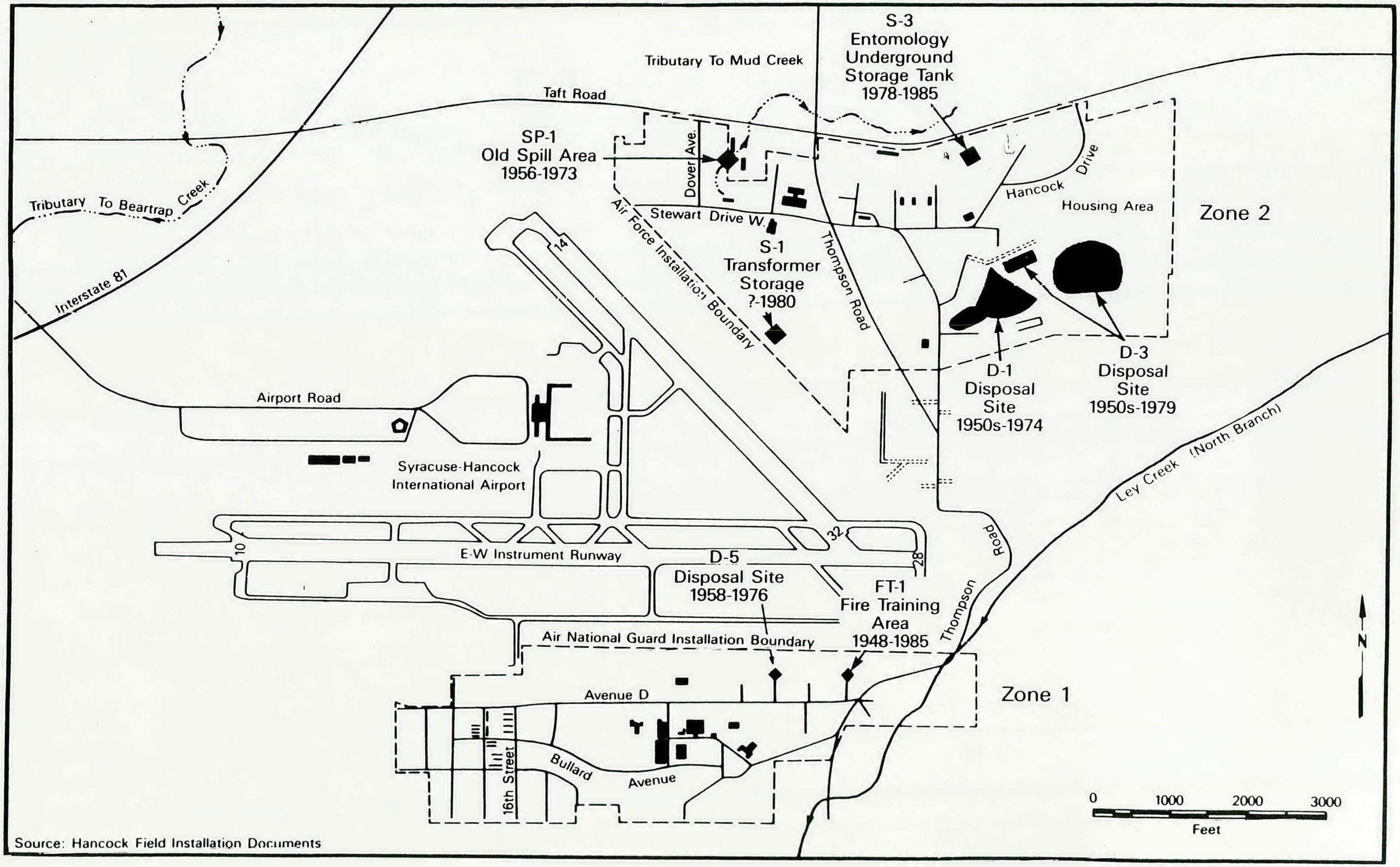
The surficial geology of Hancock Field consists of glaciofluvial sediments deposited by glacial meltwaters overlying poorly sorted till deposited directly by the glaciers. The glaciofluvial sediments include silty clays, sands, and gravels, with thicknesses ranging from 45 to 55 feet. The till encountered consists of gravel, cobbles, and boulders entrained in a silty clay matrix and ranges from 0 to 55 feet in thickness. Bedrock was encountered at depths ranging from 75 to 109 feet below land surface (BLS) and is of the Vernon Formation. The Vernon Formation is a thinly bedded, soft red shale with small beds of green shale, gypsum, halite, and dolomite.

Groundwater in the vicinity of Hancock Field exists in both the glaciofluvial sediments and the Vernon Shale, but not in the low-permeability till. The surficial (glaciofluvial) aquifer is low yielding and the groundwater is high in iron, calcium, and magnesium and is quite hard. Water in the bedrock aquifer exists under artesian conditions and is high in sulfate, chloride, and total dissolved solids (TDS). Water supplies in the vicinity of Hancock Field consist exclusively of surface water; therefore, neither aquifer is a source of drinking water.

Through the Phase I and Phase II, Stage 1 activities, the following seven potential contamination sources were identified for evaluation in the Phase II, Stage 2 investigation and are shown in Figure ES-1.

Fire Training Area: Site FT-1

Fire training exercises at Site FT-1 were conducted from 1948 to 1985 and used waste oils, solvents, paint thinners, and JP-4. This area is unlined. Based on visual inspection and soil sampling, the site soils have been



Source: Hancock Field Installation Documents

Figure ES-1. Locations of Sites Investigated at Hancock Field, New York contaminated with waste oil residue, and there was also evidence of contaminated runoff in the swampy depression north of the site.

Disposal Site: Site D-3

This is a landfill that was in use from the 1950's until 1979 and contains minor quantities of paint thinner residue. It was closed and covered with several feet of soil, but there was still concern about possible groundwater contamination.

Disposal Site: Site D-1

This 10-acre landfill, which is closed with local soil cover, was used from the 1950's to 1974 and contains old waste treatment lagoon sludge, general refuse, and potentially minor quantities of miscellaneous hazardous waste.

Disposal Site: Site D-5

This is another old landfill that was in use from 1950 to 1976. During that time, a few drums of hazardous shop materials from past operations may have been disposed of at this site. The site has been closed with local soil cover, but there was still concern about possible groundwater contamination.

Transformer Storage Area: Site S-1

This site was used to store electrical transformers, some of which leaked. As a result, the site was considered to have a minor potential for environmental contamination from polychlorinated biphenyls (PCBs) due to the small quantities of waste spilled.

Entomology Underground Storage Tank: Site S-3

This tank was used to contain pesticide equipment rinsewater and was identified as having potential for environmental contamination of either soil or groundwater.

Old Spill Area Near the SAGE Building: Site SP-1

This site is considered to have a minor potential for contaminant migration, since the majority of oil-contaminated soil was removed in 1973. However, verification of the effectiveness of the cleanup was still needed.

Field Activities

Table ES-1 presents the means by which the sites included under this Delivery Order and described above were investigated. Fifteen monitoring wells, seven deep and eight shallow, were installed and sampled along with the nine remaining Stage 1 wells. One Stage 1 well, GW-4, had been damaged and was formally abandoned during this field effort. A soil gas survey and two magnetometry surveys were conducted. In addition, 35 soil samples, 24 surface water and sediment samples, and 1 tank water sample were collected. Field determinations of pH, specific conductance, and temperature were obtained for all water samples at the time of sampling.

Analytical Findings

Laboratory quality assurance/quality control (QA/QC) duplicate and spiked samples were used for the Hancock Field analytical program to check the precision and accuracy of laboratory analysis. Field QA/QC during performance on site investigations consisted of field blanks, bailer washes, and replicate samples. QA/QC data presented in this report indicate acceptable laboratory procedures, but also reveal laboratory contamination by methylene chloride. Field blanks and bailer wash results indicate that field sampling procedures did not cause significant contamination in collected environmental samples. Bailer washes did not indicate problems associated with bailer decontamination procedures, and cross-contamination problems between samples were not evident. The analyses did indicate, however, that field blanks and bailer wash samples were contaminated by the commercially available distilled water used to prepare the samples. The levels of contaminants in these field blanks and bailer washes were below health criteria and are not considered to affect the analytical results for environmental samples adversely. Field replicate analyses indicated good QA/QC procedures associated with field sampling techniques and laboratory analyses.

TABLE ES-1. SUMMARY OF PHASE II, STAGE 2 INVESTIGATIONS, HANCOCK FIELD, NEW YORK

Site(s)	Investigation
Zones 1 and 2	9 existing wells sampled for: • Alkalinity • Common anions • Total dissolved solids • Petroleum hydrocarbons • Purgeable halocarbons • Aromatic volatile organics • 26 metals • Extractable priority pollutants
Fire Training Area: Site FT-1	30 point soil gas survey for: • Benzene • Toluene • Xylene • Total volatiles 26 soil samples analyzed for: • Petroleum hydrocarbons • Lead • Volatile organics 10 soil samples also analyzed for: • Semivolatile organics 1 background soil sample analyzed for: • Petroleum hydrocarbons • Lead • 13 metals 6 groundwater monitoring wells installed and analyzed for: • Petroleum hydrocarbons • Purgeable halocarbons • Aromatic volatile organics • Lead

TABLE ES-1. SUMMARY OF PHASE II, STAGE 2 INVESTIGATIONS, HANCOCK FIELD, NEW YORK (Continued)

Site(s)	Investigation
Zones 1 and 2: Surface Water and Sediments	23 surface water samples analyzed for: • Petroleum hydrocarbons • Purgeable halocarbons • Aromatic volatile organics • 13 metals • Extractable priority pollutants 23 sediments samples analyzed for: • Petroleum hydrocarbons • 13 metals • Volatile organics • Semivolatile organics
Zone 2: Disposal Sites D-1 and D-3	Magnetometry survey 6 groundwater monitoring wells installed, sampled, and analyzed for: • Alkalinity • Common anions • Total dissolved solids • Petroleum hydrocarbons • Purgeable halocarbons • Aromatic volatile organics • 26 metals • Extractable priority pollutants

TABLE ES-1. SUMMARY OF PHASE II, STAGE 2 INVESTIGATIONS, HANCOCK FIELD, NEW YORK (Continued)

Site(s)	Investigation
Entomology Underground Storage Tank: Site S-3	1 tank water sample 3 soil samples analyzed for: ● Organochlorine pesticides ● Organophosphorus pesticides ● Chlorinated herbicides
Transformer Storage Area: Site S-1	7 soil samples analyzed for: ● Petroleum hydrocarbons ● PCBs
Old Spill Area: Site SP-1	3 surface water samples analyzed for: ● Petroleum hydrocarbons ● Purgeable halocarbons ● Aromatic volatile organics ● Lead 3 sediment samples analyzed for: ● Petroleum hydrocarbons ● Volatile organics ● Lead
Disposal Site D-5	3 groundwater monitoring wells installed and analyzed for: ● Alkalinity ● Common anions ● Total dissolved solids ● Petroleum hydrocarbons ● Purgeable halocarbons ● Aromatic volatile organics ● Metals screen (26) ● Extractable priority pollutants

The analytical data collected during this study revealed site-related contamination at three sites, but no contamination at levels indicative of significant human health risk. The analytical findings are summarized in Table ES-2. Only those parameters that were found in concentrations above the background level are discussed.

Recommendations

The ultimate goal of every IRP Phase II study, beyond the confirmation and/or quantification of contaminants at each site investigated, is to categorize each site regarding the types of future actions required. The IRP defines three categories of sites:

- Category I - No Further Action - Contaminants were either not detected or pose no significant health risk at the site, and no further investigation of any type is warranted.
- Category II - Additional Monitoring - Contaminants were confirmed at these sites, but could not be fully quantified on the basis of the data and/or the data collection points used during the study.
- Category III - Require Remedial Action - Sites where contaminants have been confirmed and quantified, or where source areas are clearly defined, can be placed in this category. At such sites, remedial activities can be justified and initiated on the basis of the data available.

All of the sites investigated at Hancock Field have been placed in Category I. Category I sites include:

- Zone 2, Sites D-1 and D-3: No site-related contamination posing significant health hazard has been found.
- Entomology Underground Storage Tank, Site S-3: Tank contents qualify as hazardous waste, trace pesticides in soil pose no significant health hazard.
- Old Spill Area, Site SP-1: Low to trace levels of an organic solvent found in surface water, petroleum hydrocarbons found in sediment, no significant health hazard.
- Transformer Storage Area, Site S-1: Petroleum hydrocarbons in three soil samples and PCBs in one soil sample pose no significant health hazard.

TABLE ES-2. SUMMARY OF PHASE II, STAGE 2 RESULTS, HANCOCK FIELD, NEW YORK

Fire Training Area: Site FT-1	Benzene, toluene, and total volatiles found in soil gas. Petroleum hydrocarbons found within bermed area soils. Polynuclear aromatics and phthalates found within bermed area soils; no significant health risk. No site-related contamination found in groundwater.
Zones 1 and 2	Site-related contamination found in two Zone 2 surface water and sediment samples; no significant health risk.
Zone 2: Disposal Sites D-1 and D-3	Buried ferrous metal detected, but no site-related contamination found in groundwater.
Entomology Underground Storage Tank: Site S-3	Malathion found in tank water. Trace concentrations of DDE, DDT, dieldrin, and heptachlor epoxide found in soils; no significant health risk.
Transformer Storage Area: Site S-1	Concentrations of petroleum hydrocarbons found in three soil samples; detectable PCBs found in one sample; no significant health risk.
Old Spill Area: Site SP-1	Low concentrations of 1,1,1-trichloroethane found in all three surface water samples, trace concentration of 1,1,2,2-tetrachloroethane found in one surface water sample; no significant health risk. Petroleum hydrocarbons found in one sediment sample; no risk evaluation possible.
Disposal Site D-5	Low concentrations of halogenated volatile organic compounds found in groundwater are not site-related, and are well below applicable, relevant, and appropriate requirements (ARARs). Thallium detected in initial sampling proved to be analytical interference upon resampling and analysis.

- Fire Training Area, Site FT-1: The site-related contamination found does not pose a significant health hazard.

- Disposal Site D-5: Low levels of halogenated volatile organic compounds detected in groundwater samples do not represent site-related contamination.

1. INTRODUCTION

1.1 BACKGROUND

Many waste disposal practices once accepted as state-of-the-art by industry and government have been found in recent years to cause serious damage to the environment. As a result, Federal, state, and local governments have developed strict regulations that require disposers of toxic and hazardous wastes to identify the location and contents of waste disposal sites and to implement actions to eliminate any hazards to public health or the environment. Likewise, the U.S. Department of Defense (DOD) has addressed this issue by promulgating Defense Environmental Quality Program Policy Memorandum 81-5, which requires the identification and evaluation of past hazardous material disposal sites on DOD property, the control of hazardous contaminant migration, and the control of hazards to public health and the environment from past disposal activities. Since many U.S. Air Force (USAF) operations have resulted in on-site disposal of hazardous waste, the Installation Restoration Program (IRP) was implemented by the USAF under this memorandum. The IRP serves as the basis for response actions at USAF installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and the Superfund Amendments and Reauthorization Act (SARA) of 1986. The USAF IRP has been developed as a four-phase program, with each phase containing distinct tasks and outputs. These four phases are:

- Phase I - Installation Assessment (Records Search)
- Phase II - Confirmation/Quantification
- Phase III - Technology Base Development
- Phase IV - Operations/Remedial Actions.

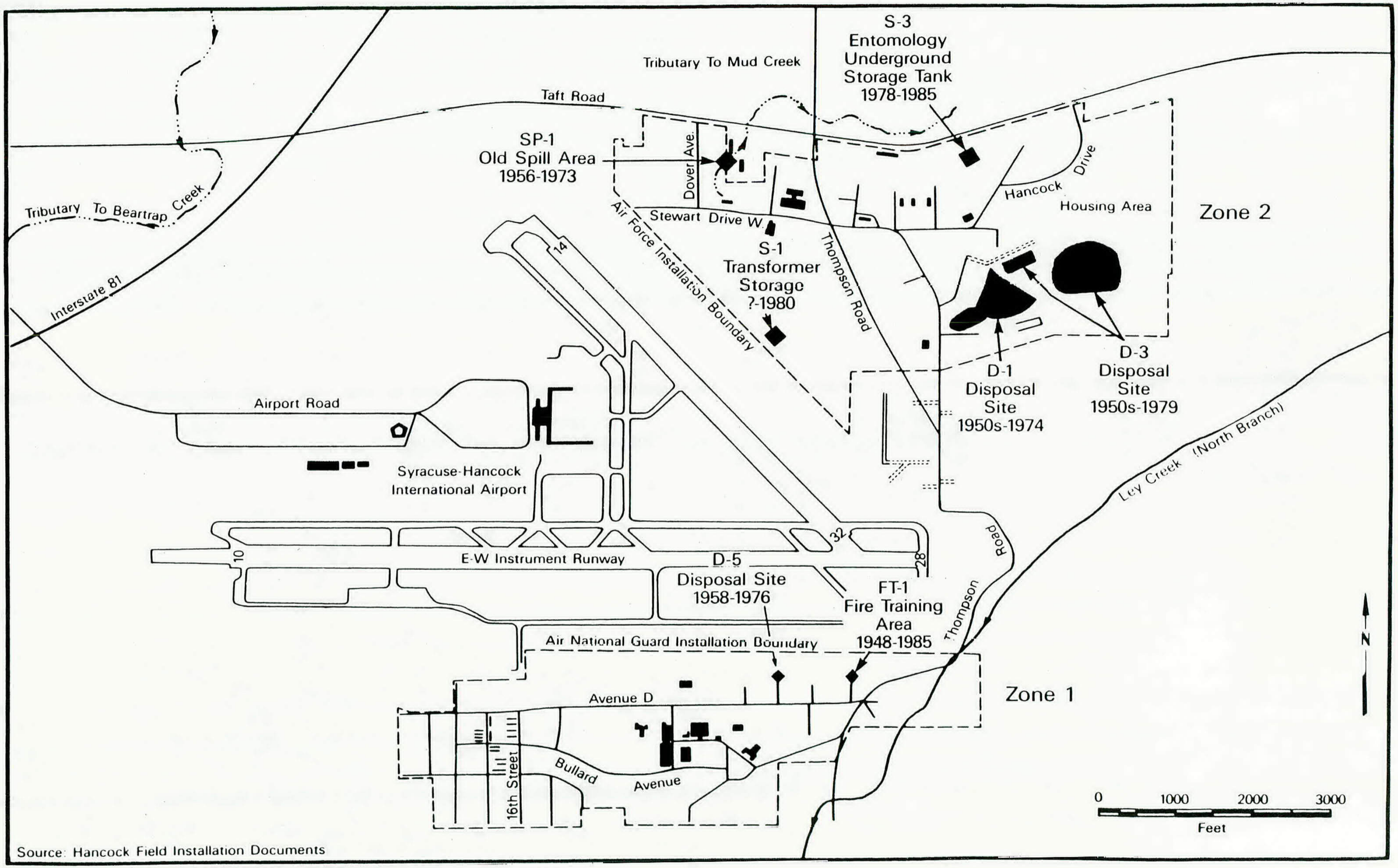
Hancock Field, which was built and activated in 1942 as a staging area for war planes bound for England, has been included in the IRP because of its long history of Air Force use and consequent concern about past hazardous waste disposal practices. Hancock Field is located in Onondaga County in central New York, approximately 2 miles north of Syracuse, New York. The sites of concern are located in two zones, as shown in Figure 1-1. The northern zone (Zone 2) encompasses the former USAF installation, and the southern zone (Zone 1) consists of the New York Air National Guard (NYANG) installation.

To date, Phase I and II activities have been conducted at Hancock Field. Phase I of the IRP was completed at Hancock Field, New York, in July 1982. Engineering-Science, Inc. conducted this study, during which seven past disposal sites that could pose a threat to public health or the environment through contaminant release or migration were identified and priority ranked. In 1983, Science Applications International Corporation (SAIC) was tasked to conduct Phase II, Stage 1 at Hancock Field, which consisted of a preliminary environmental survey (presurvey) to determine the presence and extent of any environmental contamination at four of the original seven Phase I sites. The results of the Phase II, Stage 1 investigation were documented in a final report dated October 1984. In this report, SAIC presents the results of the Phase II, Stage 2 effort and incorporates the results of the Phase I and Phase II, Stage 1 activities into findings, conclusions, and recommendations.

1.2 HANCOCK FIELD ORGANIZATION AND MISSION

Over the last few decades, both the mission and physical size of Hancock Field have been reduced from that initially established during World War II. Large parcels of land on the northern portion of the facility have been transferred to Onondaga County to expand Syracuse-Hancock International Airport, and many USAF units have been relocated. During the initial months of this Phase II, Stage 2 study in 1986, the northern portion of Hancock Field (Zone 2) was under a caretaker force. In October 1987, the caretaker force was deactivated and this area is currently controlled by Onondaga County.

NYANG is the current host unit for the remaining property (Zone 1), and also conducts the only flying mission at Hancock Field. A current list of Hancock Field tenant, guard, and reserve units is provided in Table 1-1.



Source: Hancock Field Installation Documents

Figure 1-1. Locations of Sites Investigated at Hancock Field, New York

TABLE 1-1. HANCOCK FIELD TENANT, GUARD, AND RESERVE UNITS

HOST	TENANT ORGANIZATIONS	GUARD AND RESERVE UNITS
New York Air National Guard	3513th USAF Recruiting Group	98th Division Aviation Support Facility 6 (U.S. Army Reserve)
	United States Army Communication Center - Northeast Telecommunications Switching Center	174th Tactical Fighter Wing (NYANG)
	Civil Air Patrol	138th Tactical Fighter Squadron
	Federal Aviation Administration	152nd Tactical Control Group
	Marine Corps Reserve Training Center	108th Tactical Control Flight
		113th Tactical Control Flight

1.3 PHASE I - INSTALLATION ASSESSMENT

The IRP Phase I installation assessment at Hancock Field was conducted in 1982 by Engineering-Science, Inc., which assessed the potential for adverse impacts to the environment. The Phase I report describes the installation and its environmental setting and addresses past and present waste management and disposal activities. The study consisted of a review of past activities that may have generated hazardous wastes, including:

- Industrial operations (shops)
- Fuels management (POL)
- Pesticide utilization
- Fire training.

In addition, Engineering-Science, Inc. conducted a review of the on-site facilities that had been used for management of solid and liquid wastes at Hancock Field, including:

- Hazardous waste storage areas
- Landfills and disposal areas
- Waste treatment system and seepage fields
- Storm sewers
- Sanitary sewers
- Oil/water separators.

On the basis of information obtained through interviews with past and present base personnel, file searches, and a site inspection, seven sites associated with previous activities and disposal operations at Hancock Field were identified as potentially containing hazardous wastes that could result in environmental contamination. These seven sites are described in Table 1-2 and their locations are shown in Figure 1-1.

These seven sites were assessed using the Hazard Assessment Rating Methodology (HARM), which addresses factors such as site and waste characteristics, potential for contamination, and waste management practices. HARM

TABLE 1-2. SUMMARY OF POTENTIAL CONTAMINATION SOURCES, HANCOCK FIELD, NEW YORK

Site No.	Site Name	Period of Operation	Approximate Area (Acres)	Suspected Types of Waste	Method of Operation	Closure Status	Surface Drainage	Geological Setting
FT-1	Fire Training Area	1948-1985	0.75	Oils, JP-4 waste solvents, foams, chlorobromomethane, combustion products	100-150 gallons of waste fuel burned at least once per month	Closed, but not covered	To Ley Creek	Silt/clay sand till, high water table
D-1	Disposal Site	1950s-1979	12	General refuse, garbage, construction rubble, hardfill, empty containers, paint residues	Area fill	Closed with several feet of local soils - grass cover	To Ley Creek	Loamy fine sand, fine sandy loam, high water table
D-3	Disposal Site	1950s-1974	10	General refuse, garbage, construction rubble, hardfill, empty containers, waste treatment sludge	Area fill - 2′-5′ lift depths - total fill depth 20′	Closed with several feet of local soils - grass cover	To Ley Creek	Fine sandy loam, loamy fine sand, high water table
D-5	Disposal Site	1958-1976	0.35	Construction rubble, ammunition boxes, sod, empty drums, drums partially containing solvents or thinners (unconfirmed)	Area fill 3′-4′ depth	Closed with 2′ of local soils cover-grass and wooded cover. Currently used as engine test pad.	To Ley Creek	Silty loam, high water table
S-1	Transformer Storage Area	1977-1980	<0.1	PCBs, PCB-contaminated oils, other dielectric fluids	Transformers stored inside building and on rack on northeast side	All transformers have been retrieved	To tributary to Mud Creek	Sandy/loamy fill, gravel, high water table
S-3	Entomology Underground Storage Tank	1975-1985	<0.1 (500 gal)	Dilute pesticide solutions	Received rinsewater and washdown from entomology shop operations	Cleaned out in 1980 and 1985, but contains infiltration drainage	To tributary to Mud Creek high water table	Sandy/loamy fill, gravel,
SP-1	Old Spill Area	1956-1973	<0.1	Occasional fuel spills	Fuels discharged to open ditch from storm sewer	Water contaminated soil removed and clean backfill emplaced	To tributary to Mud Creek	Sandy/loamy fill, gravel, high water table

Source: Engineering-Science, Inc. July 1982 scores for each of the seven sites are provided in Table 1-3. During Phase I, the following conclusions were developed for each site:

- Fire Training Area

  Fire Training Area FT-1 has a high potential for environmental contamination. Training exercises at FT-1, which have been conducted since 1948, have required the use of waste oils, solvents, paint thinners, and JP-4. This area is unlined. Based on visual inspection, the site soils appeared to be contaminated with waste oil residue, and evidence of contaminated runoff in the swampy depression north of the Fire Training Area was found. The site received a score of 67.

- Disposal Sites

  Disposal Site D-3 landfill, which is closed with local soil cover, contains minor quantities of paint thinner residue and has a moderate potential for environmental contamination. The site received a score of 57.

  Disposal Site D-1 landfill, which is closed with local soil cover, contains past waste treatment lagoon sludge, general refuse, and potentially minor quantities of miscellaneous hazardous waste and has a moderate potential for environmental contamination. The site received a score of 56.

  Disposal Site D-5, which is closed with local soil cover, probably contains a few drums of hazardous shop materials from past operations, and has a moderate potential for environmental contamination. The site received a score of 56.

- Hazardous Waste Storage Areas

  Transformer Storage Area (Site S-1) has a minor potential for environmental contamination due to the small quantities of waste spilled. The site received a score of 54.

  Entomology Underground Storage Tank (Site S-3) has a low potential for environmental contamination. The site received a score of 51.

- Spill Area

  Old Spill Area near the Semi-Automatic Ground Environment (SAGE) Building (Site SP-1) has a minor potential for contaminant migration, since the majority of oil-contaminated soil was removed in 1973. The site received a score of 6.

No other sites at Hancock Field were considered to pose a significant hazard of environmental contamination.

TABLE 1-3. PRIORITY RANKING OF POTENTIAL CONTAMINATION SOURCES HANCOCK FIELD, NEW YORK

Rank	Site Name	Score
1	FT-1 Fire Training Area	67
2	D-3 Disposal Site	57
3	D-1 Disposal Site	56
4	D-5 Disposal Site	56
5	S-1 Transformer Storage Area	54
6	S-3 Entomology Underground Storage Tank	51
7	SP-1 Old Spill Area	6

The results of the Phase I study are available from either Air Force Engineering and Services Center/DEV, Tyndall AFB, Florida, or the National Guard Bureau, Air National Guard Support Center/DEV, Andrews AFB, Maryland.

1.4 PHASE II, STAGE 1 - CONFIRMATION/QUANTIFICATION

Based on the Phase I findings, the USAF developed the Statement of Work (SOW) for Phase II, Stage 1, in July 1983, which focused on the confirmation of environmental contamination of four sites: FT-1 and D-5 in Zone 1, and D-1 and D-3 in Zone 2.

To accomplish Stage 1, the following monitoring plan was established in the SOW:

- Zone 1: Fire Training Area (FT-1) and Disposal Site D-5
    - Groundwater: Four wells within the zone
    - Surface water: Five sampling sites along the runoff area north of the zone
    - Sediments: Six sampling sites along the runoff area north of the zone
- Zone 2: Disposal Sites D-1 and D-3
    - Groundwater: Six wells within the zone
    - Surface water: Three sampling sites from the culvert adjacent to Site D-3
    - Sediments: Three sampling sites from the culvert adjacent to Site D-3.

Samples collected from the monitoring points listed above were analyzed for all or some of the following parameters:

- Total organic carbon (TOC)
- Total organic halogen (TOX)
- Oil and grease
- Volatile aromatics
- Volatile halocarbons.

The results of the Phase II, Stage 1 sampling effort conducted at Hancock Field did not provide sufficient data to confirm conclusively the occurrence of contaminant migration from the four sites studied. However, concentrations of halogenated organics above background levels were identified within both zones, which is indicative of environmental contamination and led to recommendations for further investigation.

The following general conclusions were reached in the Phase II, Stage 1 report for Hancock Field.

For Zones 1 and 2:

- Volatile aromatics were not detected in any of the groundwater, surface water, and sediment samples collected.
- Volatile halocarbons only were detected in one of the field samples analyzed (SW-4), which had a very low concentration of chloroform (0.56 µg/L). This level was not repeated in the duplicate sample and is not considered to be a result of environmental contamination.
- Concentrations of TOC above background were detected in all tested samples and are probably the result of naturally occurring organics rather than an indication of environmental contamination.
- Levels of oil and grease above background were detected only in sediments.
- Levels greater than those expected as background (0.015-0.020 mg/L) of TOX compounds were detected in groundwater, surface water, and sediment samples collected from each zone, indicating environmental contamination. However, chemical speciation, as well as the toxicity and persistence of the indicated chemicals, could not be determined because TOX scans only for halogenated ions.
- For the most part, trends in the data between samples (e.g., upstream versus downstream, surface water versus sediment) or among parameters measured within a sample did not exist.

For Zone 1, which contains Disposal Site D-5 and Fire Training Area FT-1, the following conclusions also were presented:

- Very high concentrations of oil and grease (up to 390,000 mg/Kg) were detected in the sediments at Site FT-1. These sediments also contained the highest concentrations of chlorinated and brominated organics of all samples collected at either zone. Leaching of these contaminants into the surface waters and sediments downstream of FT-1 appears to be occurring based on changes in surface water and sediment samples collected above and below the site. No contamination of the groundwater is apparent.

- Environmental contamination originating from Disposal Site D-5 was not apparent. Surface waters draining the area north of the site had high concentrations of chlorinated and brominated organics (up to 200 µg/L brominated); groundwater monitored at an upgradient well near this same area had elevated concentrations of iodinated organics only. Because relationships between surface water, groundwater, and sediments did not exist, the contamination present could not be attributed conclusively to Site D-5.

- Oil and grease in sediments and halogenated organics in surface water and groundwater appear throughout samples collected within Zone 1 and may not be the direct result of past disposal activities within the zone, except at SD-9 (Site FT-1).

For Zone 2, which contains Disposal Sites D-1 and D-3, the following conclusions were presented:

- Oil and grease concentrations were elevated at all sediment monitoring stations. These contaminants are probably residues of surface runoff from the surrounding area, which is industrialized.

- Environmental contamination resulting directly from Disposal Sites D-1 and D-3 was not apparent; an upgradient groundwater monitoring well contained higher concentrations of halogenated organics and organic carbons than the downgradient monitoring wells. Trends between surface water, groundwater, and sediment analyses were not indicated.

- The oil and grease in sediments and halogenated organics in surface water and groundwater that appear throughout samples collected within Zone 2 may not be directly related to past disposal activities within the zone.

To resolve the unanswered questions, additional surface water and groundwater monitoring was recommended in Zones 1 and 2 to determine the presence and magnitude of any environmental degradation that resulted from past disposal activities within these zones. The recommended monitoring program for both zones included installing additional wells, establishing additional surface water monitoring points, and sampling and analyzing all surface water and groundwater monitoring stations. In addition, the Fire Training Area (Site FT-1) was recommended for additional soil sampling.

1.5 PHASE II, STAGE 2 - CONFIRMATION/QUANTIFICATION

The USAF Occupational and Environmental Health Laboratory (USAFOEHL), at Brooks AFB, Texas, developed the SOW for the Phase II, Stage 2 effort at

Hancock Field based on findings and recommendations in both the Phase I and Phase II, Stage 1 reports. A copy of the Delivery Order (DO) and technical SOW is presented in Appendix B. Three sites on the northern portion of the base, S-1, S-3, and SP-1, that were not addressed during Stage 1 were added to this study along with the four sites recommended for further study in the Stage 1 report. The three new sites are on property that has been transferred to Onondaga County for planned airport expansion.

The objectives of the Phase II, Stage 2 effort at Hancock Field are to:

- Confirm the presence or absence of contamination within the specified areas of investigation
- If possible, determine the extent, degree of contamination, and potential for migration of those contaminants in the environment
- Identify public health and environmental hazards of stationary or migrating pollutants based on state or Federal standards for those contaminants
- Delineate additional investigations required beyond this stage to meet the objectives of Phase II.

SAIC was directed to conduct the following environmental monitoring program to accomplish the objectives of Phase II, Stage 2:

- Resample and slug test existing monitoring wells MW-1 through MW-3 and MW-5 through MW-10. Abandon well GW-4, which was damaged (see Section 3.1.3).
- Sample 9 existing and 12 new surface water and sediment points in Zones 1 and 2.
- Conduct a soil gas survey, collect soil samples, and install up to five additional well pairs around the Fire Training Area (Site FT-1).
- Conduct a magnetometry (geophysical) survey of Disposal Sites D-1 and D-3 to locate buried metal.
- Install two well pairs and two deep wells in Zone 2 around Sites D-1 and D-3.
- Sample tank contents and soils at the Entomology Underground Storage Tank (Site S-3).
- Sample soils in the vicinity of the Transformer Storage Area (Site S-1).

- Sample surface water and sediments at three points downstream of the SAGE Plant Outfall Old Spill Area (Site SP-1).
- Install three shallow groundwater monitoring wells at Site D-5 and sample these along with existing well MW-10.

All samples were to be analyzed for some or all of the following parameters as appropriate to the potential contamination source being investigated and as specified in the SOW:

Water Samples

Alkalinity
Common Anions
Specific Conductance
Lead
pH
Total Dissolved Solids
Temperature
Organochlorine Pesticides
Petroleum Hydrocarbons
Purgeable Halocarbons
Aromatic Volatile Organics
Metals Screens
Extractable Priority Pollutants
Priority Pollutant Metals
Chlorinated Phenoxy-Acid Herbicides
Organophosphorus Pesticides

Soil Samples

Petroleum Hydrocarbons
Lead
Priority Pollutant Metals
Volatile Organics
Semivolatile Organics
Pesticides
Polychlorinated Biphenyls

Sediment Samples

Petroleum Hydrocarbons
Priority Pollutant Metals
Volatile Organics
Semivolatile Organics

1.6 REPORT ORGANIZATION

The remainder of this report is divided into five sections:

2. Environmental Setting - An overview of regional and local geology and hydrology, aquifer systems, and disposal and storage area histories, historic groundwater quality, locations of wells on- and off-base, and demographics.
3. Field Program - A description of the design and implementation of field activities and procedures associated with the well drilling and construction program, aquifer tests, sampling and analytical procedures, and the quality assurance (QA) programs employed.
4. Discussion of Results and Significance of Findings - Site-specific geology, field sampling results, presence and extent of contamination, and evaluation of contamination.

5. Alternative Measures - The proposed options, by site, for future monitoring efforts or studies.

6. Recommendations - Conclusions of the study and recommendations for future IRP phases.

1.7 PROJECT TEAM

The SAIC Project Manager for this Phase II, Stage 2 study was Mr. Philip Spooner. Members of the field investigation team were Mr. John King and Mr. Eric Gibson. Technical data analysis and reporting input was provided by Ms. Sara Hartwell, Ms. Mamie Brouwer, Mr. Nand Kaushik, and Mr. Frederic Zafran.

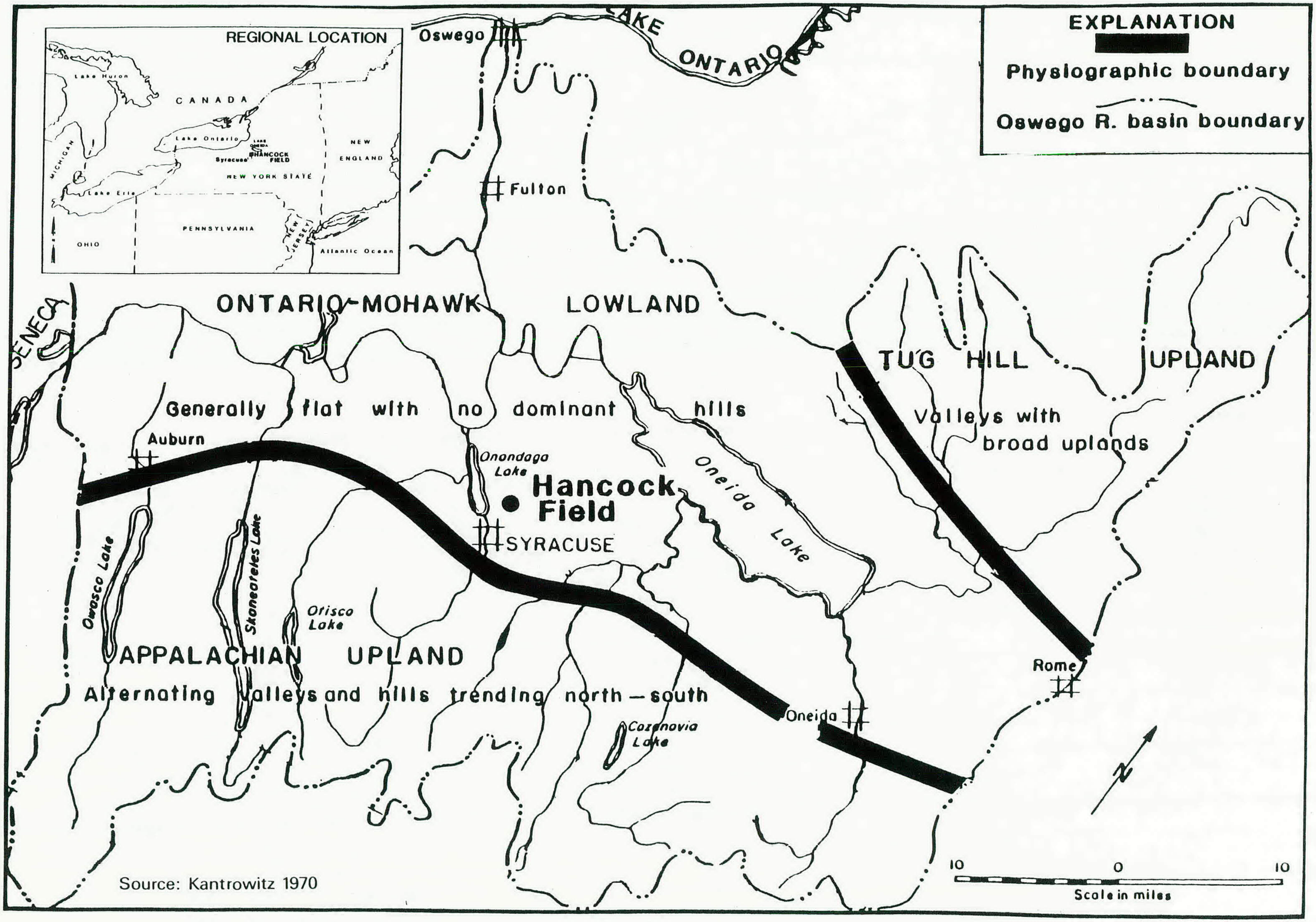
2. ENVIRONMENTAL SETTING

2.1 PHYSICAL GEOGRAPHY

Hancock Field adjoins Syracuse-Hancock International Airport and is located approximately 2 miles north-northeast of Syracuse in central New York. Hancock Field and the surrounding area are within the Ontario-Mohawk Lowland Region of the Central Lowland Physiographic Province, which extends from Albany to Buffalo, New York. This province has a relatively flat topography, which was caused by glacial erosion and deposition during the Wisconsin Ice Age. As Figure 2-1 illustrates, the Tug Hill and Appalachian Upland Regions flank the lowland area to the northeast and southwest, respectively. These regions are dominated by north-south trending hills and valleys.

These three physiographic regions (the Ontario-Mohawk Lowland Region, the Tug Hill Region, and the Appalachian Upland Region) constitute the Eastern Oswego River Basin, which drains into Lake Ontario. The basin includes almost all of Onondaga County and large sections of surrounding counties. The city of Syracuse lies in the approximate center of the basin and is the industrial and commercial center of this region of New York State.

The area within and around Hancock Field is typical of the Ontario-Mohawk Lowland Region. Dominant geomorphological features are not surficially obvious. Surrounding and within the base are naturally occurring swamps and poorly drained areas. The original extent of these naturally occurring lowlands has been drastically altered due to on- and off-base construction activities. Alterations to the land surface from 1938 to the present are illustrated in Figures 2-2 and 2-3. Figure 2-2 depicts the topography of Hancock Field in 1938, before base construction. Figure 2-3 shows Hancock Field as it appeared in a photo-revised topographic quadrangle from 1978. An obvious change in the original topography is the construction of the Ley Creek tributary, shown in Figure 2-3, that flows north to south along the eastern edge of the base boundary. This tributary was created to provide additional surface water drainage from the swamp to Ley Creek during construction activities associated with the airfield and base. Also, many of the natural lowlands and swampy areas were filled in to provide sites for the construction of housing and other base facilities.



Source: Kantrowitz 1970

Figure 2-1. Physiographic Location of Hancock Field, New York

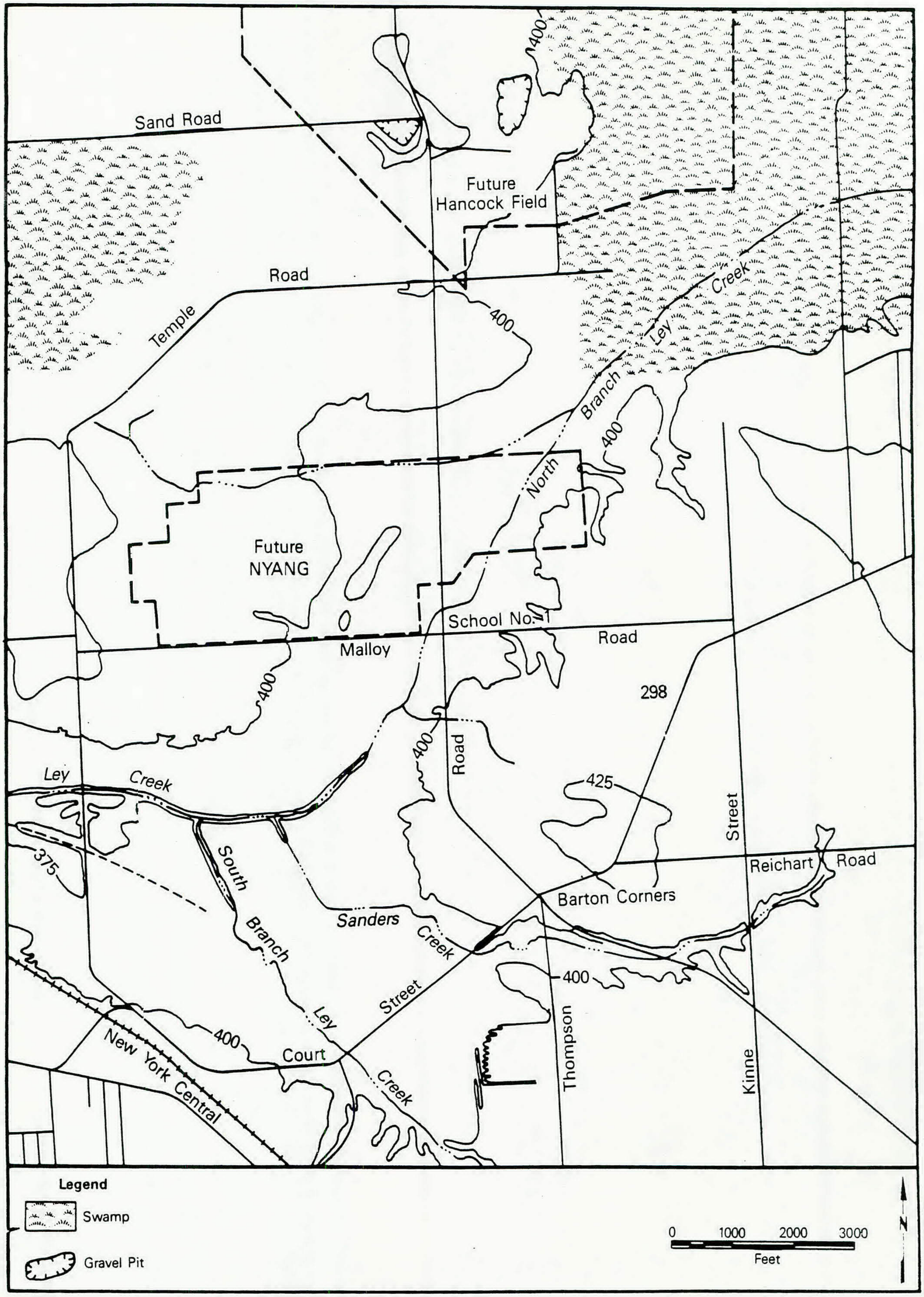


Figure 2-2. Topography of Area Prior to Base Construction (USGS 1938)

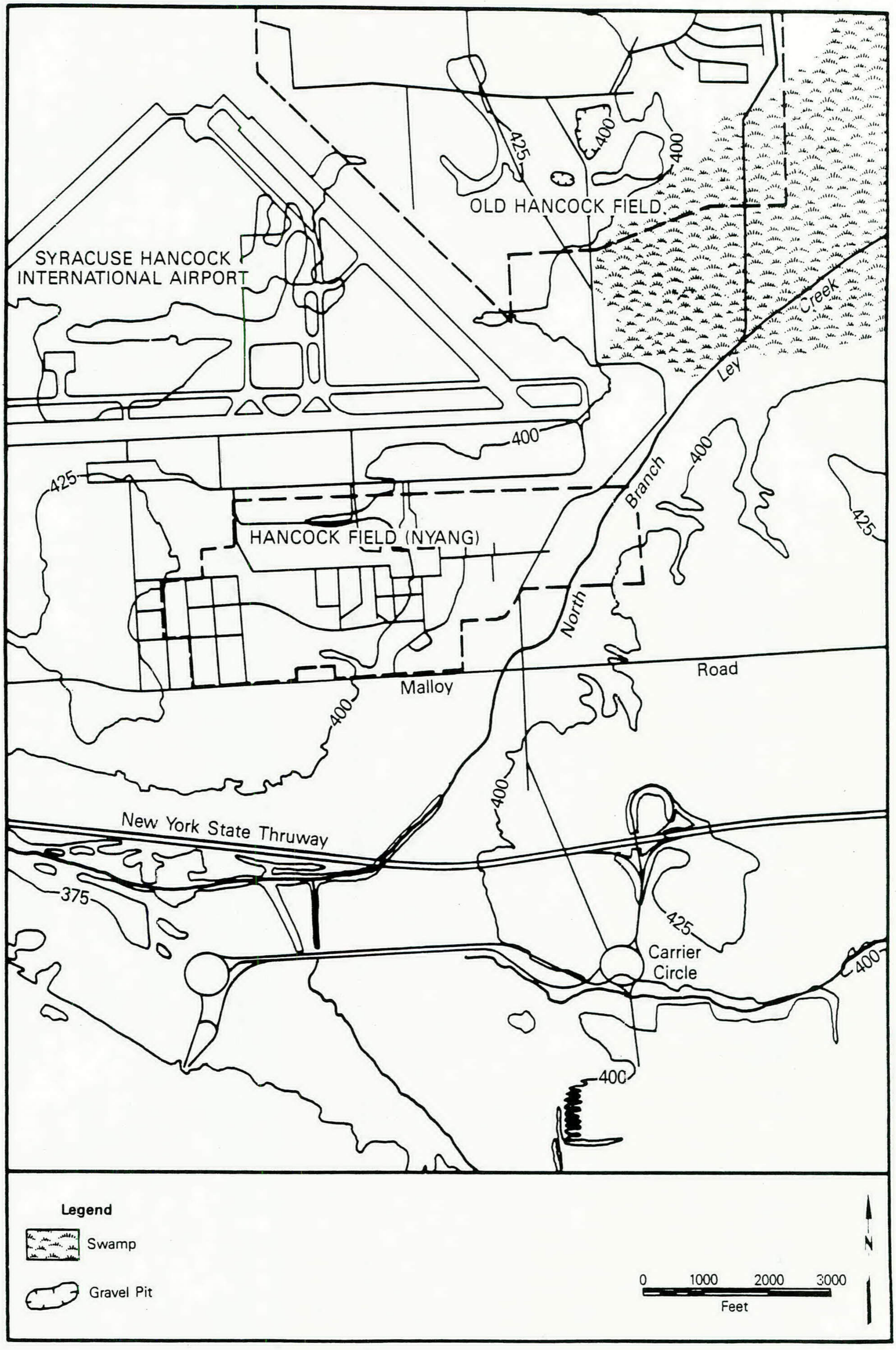


Figure 2-3. Topography of Hancock Field, 1978 (USGS 1978)

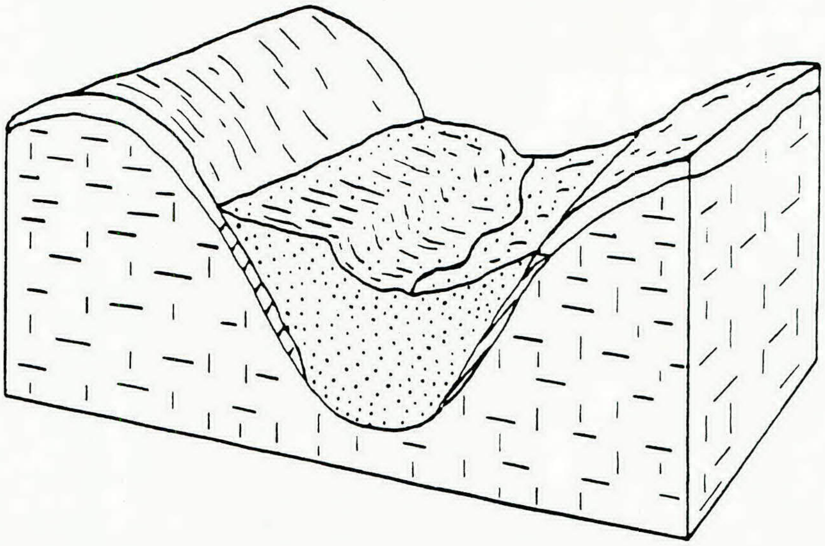
2.2 REGIONAL GEOLOGY AND HYDROGEOLOGY

2.2.1 Geology

The geology of the Ontario-Mohawk Lowlands that incorporates the city of Syracuse and its environs has been the subject of several investigative projects, including those conducted by Dale (1950), Fisher (1957), and Richard and Fisher (1970). The reports resulting from these investigations describe depositional environments, paleoecosystems, mineral resources, and structural features, as well as stratigraphic and age relationships. These studies and information revealed during drilling efforts indicate that the Hancock Field area is blanketed by a veneer of assorted unconsolidated glacial sediments of varying thicknesses. The local bedrock consists of a thick unit of shale, known as the Vernon Formation. The shale and the overlying glacial deposits are the principal sources of groundwater in the area.

The sediments in the region were deposited during the late Pleistocene Age by large sheets of glacial ice associated with Wisconsin Glaciation. The sediments were either deposited directly by the ice (i.e., till) or by meltwater streams and lakes (i.e., outwash) associated with continental glaciation. Typical depositional sequences are presented in Figure 2-4.

Those sediments that were laid down directly by glacial ice without being reworked by meltwaters include the morainal materials composed of till. Till essentially consists of an unstratified, unsorted, heterogeneous mixture of clay, silt, sand, gravel, and boulders. Two types of till are recognized in the field areas: lodgement till and ablation till. Lodgement till represents the basal till layer, which lies directly on top of the Vernon Formation. Lodgement till is deposited by moving ice and is derived directly from the subglacial load. Lodgement till is compact from being highly compressed, is rich in clay, and is nearly impermeable. Stones lodged in the till are oriented with their long axes parallel to ice flow direction. This thicker till layer often is overlain by a thinner, sometimes discontinuous, till deposit enriched in coarser materials that were presumably lowered from the englacial and supraglacial loads of the glacier by ablation. Ablation till can be distinguished from lodgement till not only by its stratigraphic position, but also by its inherent looseness (noncompactness) and lack of a



Distribution of Till and Outwash in the Appalachian
and Tug Hill Uplands

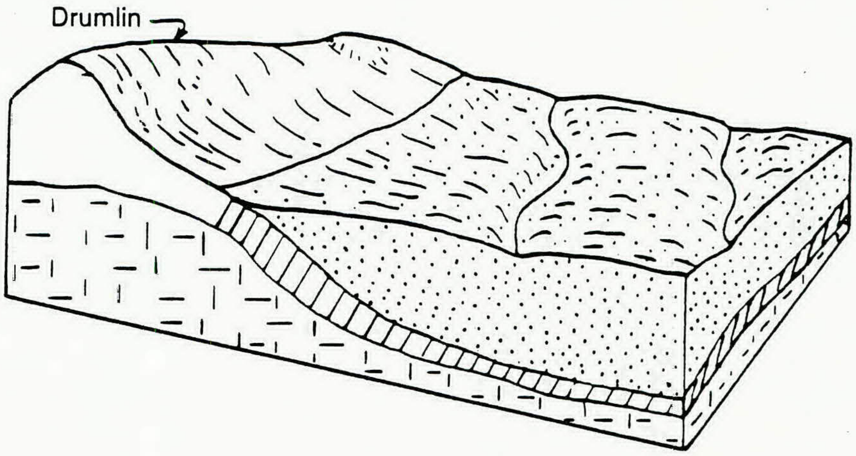
Legend

▭ Water Bearing Till (Ablation)

⁙ Other Unconsolidated Deposits (Outwash)

▨ Non-Water Bearing Till (Lodgement)

▦ Bedrock (Vernon Shale)



Distribution of Till and Outwash in the Ontario-Mohawk Lowland

Source: Kantrowitz 1970

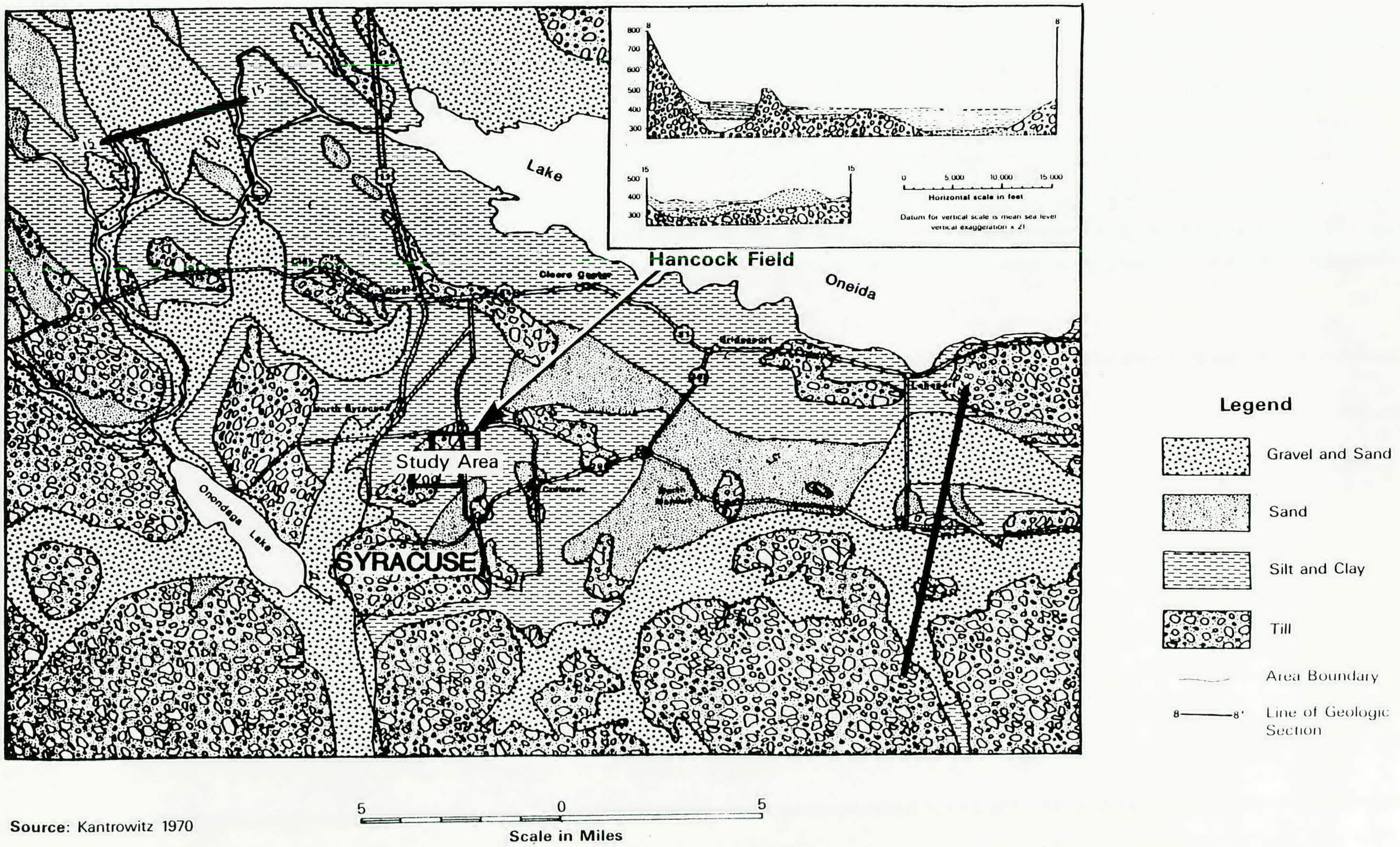
Figure 2-4. Typical Depositional Sequences of Glacial Material in the Eastern Oswego River Basin lineated fabric. Both till types comprise the ground moraine portion of these glacial deposits and are chiefly responsible for the swell and swale topography of this region.

The thickness of the till, which was controlled by the now buried preglaciated landscape, exhibits considerable variation in the Ontario-Mohawk Lowland Region. Thicknesses of 30 feet are considered common, and in some areas the till may be as much as 200 feet thick. At Hancock Field, the combined till thickness appears to be in the 100- to 150-foot range.

Throughout the Hancock Field area, till is overlain by glaciofluvial sediments deposited entirely by meltwaters released by the glacier. These meltwaters reworked previously deposited materials and redeposited these materials in lakes and braided streams. A higher degree of sorting was achieved through this process, with average grain size in glaciofluvial sediments generally reflecting the energy level in any given portion of the transporting medium. Coarse-grained materials were likely deposited in fast-moving waters (i.e., stream channels), while fine-grained materials were deposited in quiescent waters (i.e., lakes and overbank deposits of streams).

The irregular surficial deposition patterns of glacial influence that occur within the Eastern Oswego River Basin are depicted in Figure 2-5. The pattern is the result of fluctuating depositional settings associated with an advancing, stagnating, and retreating ice sheet, in addition to modifications due to the present day drainage system.

The uppermost bedrock unit at Hancock Field, the Vernon Shale Formation, is of upper Silurian age. The outcrop pattern beneath the glacial overburden extends east to west from Rome, New York, to just north of Buffalo, New York. The Vernon Formation attains a maximum thickness of 600 feet at Vernon, New York. Like other units in this region of New York, the Vernon Formation dips gently to the south at approximately 50 feet per mile.



Source: Kantrowitz 1970

Figure 2-5. Geologic Map and Cross-Sections of a Portion of the Eastern Oswego River Basin, New York (After Kantrowitz 1970)

The Vernon Formation is a thin-bedded, soft red shale with interspersed beds of green shale, gypsum, halite, and dolomite. The competence of this unit varies from soft and crumbly to dense and hard. The degree of competence appears to be proportional to the density of fractures in the shale. Major faults have not been identified or mapped within the study area; however, the shale is characterized by solutionally enlarged fractures, joints, and bedding planes.

2.2.2 Hydrogeology

Hancock Field lies within the Glaciated Central Groundwater Region, as described by Heath (1982). The area consists of a thick glacial covermass atop a thick unit of fractured shale (Vernon Formation). Wells screened within the shale reportedly yield as much as 300 gallons per minute (gpm), although the average is only 25 gpm (Weist and Giese 1969). These wide ranges in yield are due to varying degrees of solutioning and infilling of openings with fines. The unconsolidated glacial deposits can yield anywhere from less than 1 gpm to over 500 gpm, depending upon grain size and degree of sorting. Hydraulic conductivities for the dominant aquifers can range from 5 to 1,000 feet per day. The principal aquifers in the study area include portions of the Vernon Formation that possess a large number of fractures and joints, and overlying well-sorted, fairly homogeneous glacial deposits consisting of sand and gravel.

Due to the nature of the lithology, the Vernon Formation is not particularly transmissive, and does not contain large volumes of accessible water. Groundwater movement and storage is achieved through localized fractures and bedding planes and is enhanced as a consequence of solutional widening of existing fractures and joints in dolomite- and gypsum-rich intervals. Although the Vernon Formation has potential as a viable groundwater aquifer, the water quality is poor, containing large concentrations of dissolved solids, salts, and/or sulfate, and may be very hard. The water typically is used only for cooling, fire protection, sanitation, and some agricultural purposes, and not for drinking.

Much of the groundwater stored within the Vernon Shale is under confining conditions because of a regionally continuous basal till layer, which acts as a confining layer. Recharge of the shale is accomplished via the downward migration of groundwater from overlying glacial deposits where till is absent, and/or direct infiltration at outcrops. By nature, these deposits are characterized by low effective porosities, low hydraulic conductivities (i.e., less than 10^{-7} ft/day), and low specific yields. Only small quantities of groundwater can be withdrawn from these units, enough perhaps for individual domestic wells. In the case of tills, rarely can more than 3 gpm be obtained.

The only glacial deposits that contain significant amounts of groundwater are the well-sorted, homogeneous sands and gravels. In areas where these deposits are laterally extensive and readily recharged, large quantities of groundwater are available. These deposits are found mainly in the valleys and in scattered deposits in the lowlands. Groundwater within the sands and gravels is often under artesian conditions when overlying confining units are present.

The variability of these unconsolidated deposits in terms of areal extent and distribution makes it difficult to predict the precise location and depth for adequately yielding wells. The depositional pattern in the area results in a zoning of deposits according to specific yields. Large variations in well yield can still occur within a given zone as a consequence of localized variations in depositional patterns. Recharge to the glacial deposits in the lowlands may occur directly from precipitation, localized infiltration along the bed of a stream, and from recharge of the water bearing till in the uplands.

2.2.3 Surface Water

As discussed in the Stage 1 report, and as shown by comparing Figures 2-2 and 2-3, surface water flow at Hancock Field has been drastically altered by construction activities. Surface water within Zone 1 is controlled by drainage ditches, which direct flow north to a small drainage channel. The drainage channel empties into Ley Creek, located east of Zone 1. Some runoff from the airport also is collected by this drainage channel.

Within Zone 2, the former U.S. Air Force (USAF) installation, water flows in all directions from Disposal Sites D-1 and D-3. Runoff leaving these sites to the north and west is collected in drainage ditches, and is discharged in the swampy area east and south of the site. Eventually, this water flows to Ley Creek via a channelized tributary. Surface runoff leaving the disposal area to the east and south flows directly into the swampy area.

2.2.4 Background Water Quality

The natural quality of groundwater is generally poor across the middle of the Central New York Region. This natural condition results primarily from the presence of salt and gypsum within the shale units. Water flowing through and along the upper surfaces of these units has dissolved the salt and gypsum deposits in the fractures and joints, resulting in the high sulfate, chloride, and total dissolved solids content of the water. At Hancock Field, the Vernon Shale that comprises the bedrock aquifer possesses the poorest quality (highly mineralized) groundwater in the region. Total dissolved solids range from 1,560 to more than 34,000 mg/L; hardness ranges from 490 to 5,050 mg/L; sulfate ranges from 439 to 3,510 mg/L; and chloride ranges from 3.6 to 21,200 mg/L.

The extent of development of the drainage basin, and the runoff volume, (which ultimately is controlled by the season), affects surface water quality. Surface water in streams is a composite of overland runoff and groundwater discharge. During periods of heavy precipitation, most of the flow in streams is composed of overland runoff that has had little time to dissolve mineral matter. During periods of light precipitation, most, if not all, of the stream base flow is derived from groundwater. Water quality tends to suffer during times of little precipitation due to higher amounts of dissolved mineral matter. The water quality of streams flowing over the Vernon and Camillos Shales shows significant signs of deterioration, since aquifers in these bedrock units are degraded. Reportedly, fluctuations of 500 to 1,000 mg/L of dissolved solids can be expected (Weist and Giese 1969).

The upgradient drainage areas around Hancock Field that contribute to Ley Creek vary from open land to industrialized or urbanized areas, and the surface water and sediment quality of the streams entering Hancock Field vary accordingly. However, the only constituents that historically have been measured at levels above water quality criteria are iron and manganese, which are considered to be due to the local geology.

2.3 DEMOGRAPHY

Hancock Field is located within Onondaga County, New York. It is bordered to the south and east by the town of DeWitt, to the north by the town of Cicero, to the west by the town of Salina, and to the northwest by Syracuse-Hancock International Airport. Land use in the vicinity of Hancock Field is primarily light industrial and retail.

Hancock Field and adjacent industrial or domestic activities purchase water supplies from the city of Syracuse municipal system. Municipal supplies typically are obtained from surface sources, such as Lake Ontario, Otisco Lake, and Skaneateles Lake. No active privately owned wells are known to exist within 3 miles of Hancock Field.

Table 2-1 presents the 1980 census data for the three towns adjoining Hancock Field and population projections through the year 2005. As the table shows, only Cicero is expected to increase in population, while a population decline is anticipated for DeWitt and Salina.

TABLE 2-1. SUMMARY OF ONONDAGA COUNTY POPULATION PROJECTIONS

Town	1980	1985	1990	1995	2000	2005
Cicero	23,689	25,563	25,503	25,826	26,083	26,078
DeWitt	26,868	26,446	26,010	25,677	25,244	25,021
Salina	37,400	36,997	36,223	35,753	35,126	34,543

Source: Syracuse-Onondaga County Planning Agency

3. FIELD PROGRAM

3.1 MONITORING PLAN DEVELOPMENT

The Phase II, Stage 2 field program proposed for Hancock Field was designed to:

- Determine if contamination exists at any of the identified sites, and if present, the degree of contamination
- Determine site-specific subsurface geologic and hydrologic conditions
- Define the direction and rate of groundwater movement
- Determine the need for additional investigations.

To accomplish these objectives, a program was designed that consisted of a soil gas investigation; geophysical surveys; monitoring well installation; and soil, sediment, surface water, and groundwater sampling. A combination of these investigative methods was used to delineate the extent and magnitude of environmental contamination. The following sections describe the procedures and methods used during this program.

The field program was initiated with a site visit by Science Applications International Corporation (SAIC) personnel during the week of September 22, 1986. At this time, a reconnaissance of the sites identified in the Statement of Work (SOW) was conducted and locations for groundwater monitoring wells, soil borings, and surface water and sediment sampling stations were chosen. In addition to the field reconnaissance, SAIC personnel reviewed aerial photographs to aid in determining the areal extent of several sites that were difficult to locate visually in the field. The extent of the field program for each site is summarized in Table ES-1 in the Executive Summary.

3.1.1 Soil Gas Survey

As an initial part of Stage 2 work at Site FT-1, soil gas monitoring was conducted by Target Environmental Services to determine the vertical and horizontal extent of hydrocarbon contamination around the site. The results of the soil gas survey were used as a guide for followup soil sampling and to position the well pairs around the site. A grid for the soil gas investigation was established around Site FT-1 and along predetermined transect lines, as shown in Figure 3-1. The thirty soil gas survey points were marked with wire flagging. Thirteen of these monitoring stations were established between the fire training pad and the earthen berm (considered the site boundary), an area suspected of being highly contaminated. Other points were located along the access road to Site FT-1, in the woods east of Site FT-1, and along the western edge of Thompson Road.

3.1.2 Geophysical Study

A magnetometry survey using a proton magnetometer was performed on Disposal Sites D-1 and D-3 by Delta Geophysical, Inc. to determine if buried drums or other large metal objects are located in either of the two Zone 2 disposal sites. The magnetometer measures the total intensity of the Earth's magnetic field relative to known and unknown external interferences. The presence of ferrous metals that cause local disturbances in the Earth's magnetic field enables the instrument to detect buried metal objects. The response of the magnetometer is proportional to the mass of the ferrous target and inversely proportional to the cube of the distance to the target, but can be hampered by background noise created by fences, buildings, and powerlines. In terms of resolution, a single drum can be detected at depths up to 20 feet, while massive piles of drums can be detected at depths up to or greater than 65 feet.

Before conducting the magnetometry survey of Sites D-1 and D-3, a grid system was established across both zones on an area of approximately 22 acres. Magnetic north was used instead of true north when laying out the grids. An east-west baseline was established at each site, with north-south transect lines spaced 50 feet apart. Wooden stakes were driven into the ground along each transect line at 100-foot intervals, producing a 50- by 100-foot reference grid. Magnetometer data were collected along each survey line at 100-foot intervals with 25-foot spacing between each survey line. The reference grid and data points are presented in Appendix M.

3.1.3 Monitoring Well Placement

A maximum of 19 wells, 9 deep and 10 shallow, were specified in the SOW. Three well pairs, each consisting of a deep well and a shallow well, were

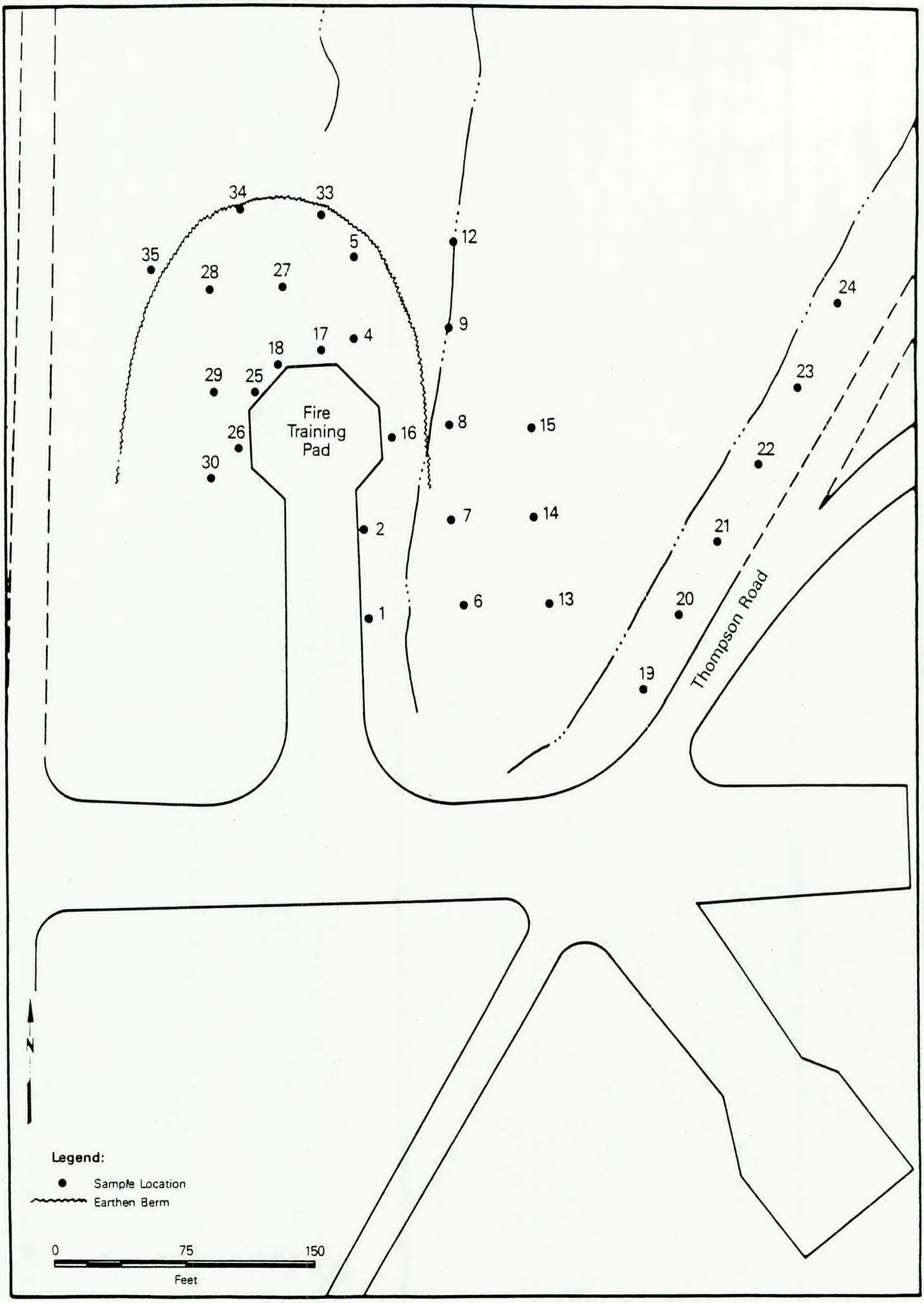


Figure 3-1. Soil Gas Sampling Stations at FT-1

installed in Zone 1, surrounding the Fire Training Area, Site FT-1. Three new shallow wells were installed around Disposal Site D-5, also in Zone 1. In addition, four deep and two shallow wells were installed in Zone 2 surrounding Disposal Sites D-1 and D-3. Two additional well pairs were planned to be installed farther downgradient of Site FT-1 if the initial wells failed to detect the leading edge of the groundwater contamination plume; however, they were not required, since no site-related contamination of groundwater was detected. The information obtained from the soil gas investigation was used to finalize the location of the monitoring wells around Site FT-1.

The locations of the 24 monitoring wells, 15 new and 9 existing, that were installed in the two zones are shown in Figures 3-2 and 3-3. Logs of all of the new wells are included in Appendix D. Logs of the existing wells are included in the Phase II, Stage 1 report.

3.1.4 Soil Sampling

Soil sampling during Stage 2 was conducted primarily at Site FT-1. A circular soil sampling grid was established, which consisted of 8 transect lines and 24 sampling points radiating out from the center of the octagonal fire training pad. Each transect line included three sampling stations. The first sampling station on each transect line was located at a distance halfway between the edge of the concrete pad and the site boundary, which is identified as the soil berm around the pads. The second sampling station on each transect line was placed at the intersection of the transect line and the site boundary, and the last station was placed a maximum of 100 feet past the boundary of the site. Each soil sampling station was marked with a wooden stake and flagging. A background soil sampling station was established and marked on the south side of the road leading to the flight line. The locations of the soil sampling stations around Site FT-1 are presented in Figure 3-4.

3.1.5 Surface Water and Sediments

The nine Installation Restoration Program (IRP) Phase II, Stage 1 surface water and sediment sampling stations were re-established and resampled. In accordance with the SOW, eight new surface water and sediment monitoring stations also were established and sampled in Zone 1, and four new surface

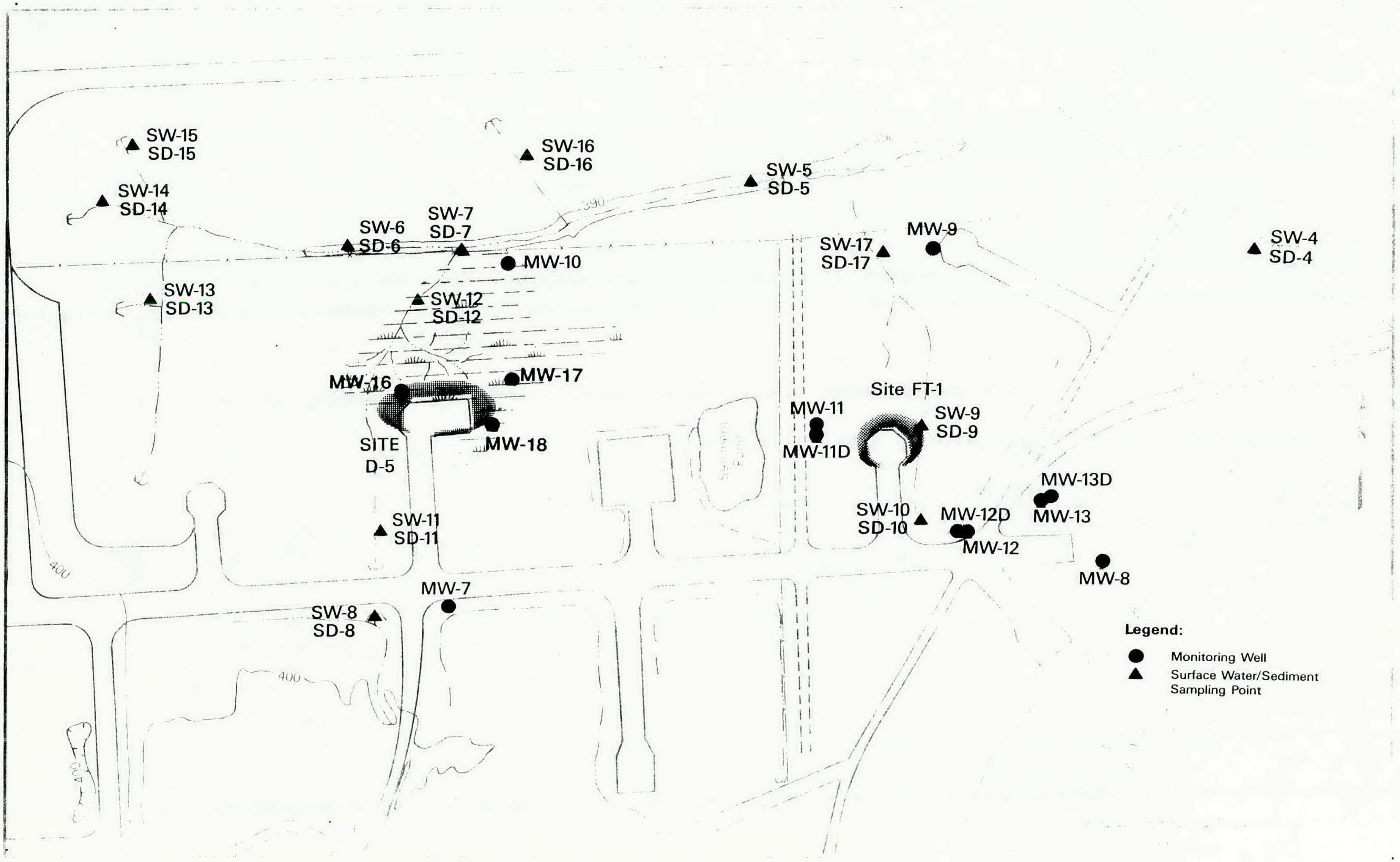


Figure 3-2. Zone 1 Sampling Point Locations at Hancock Field

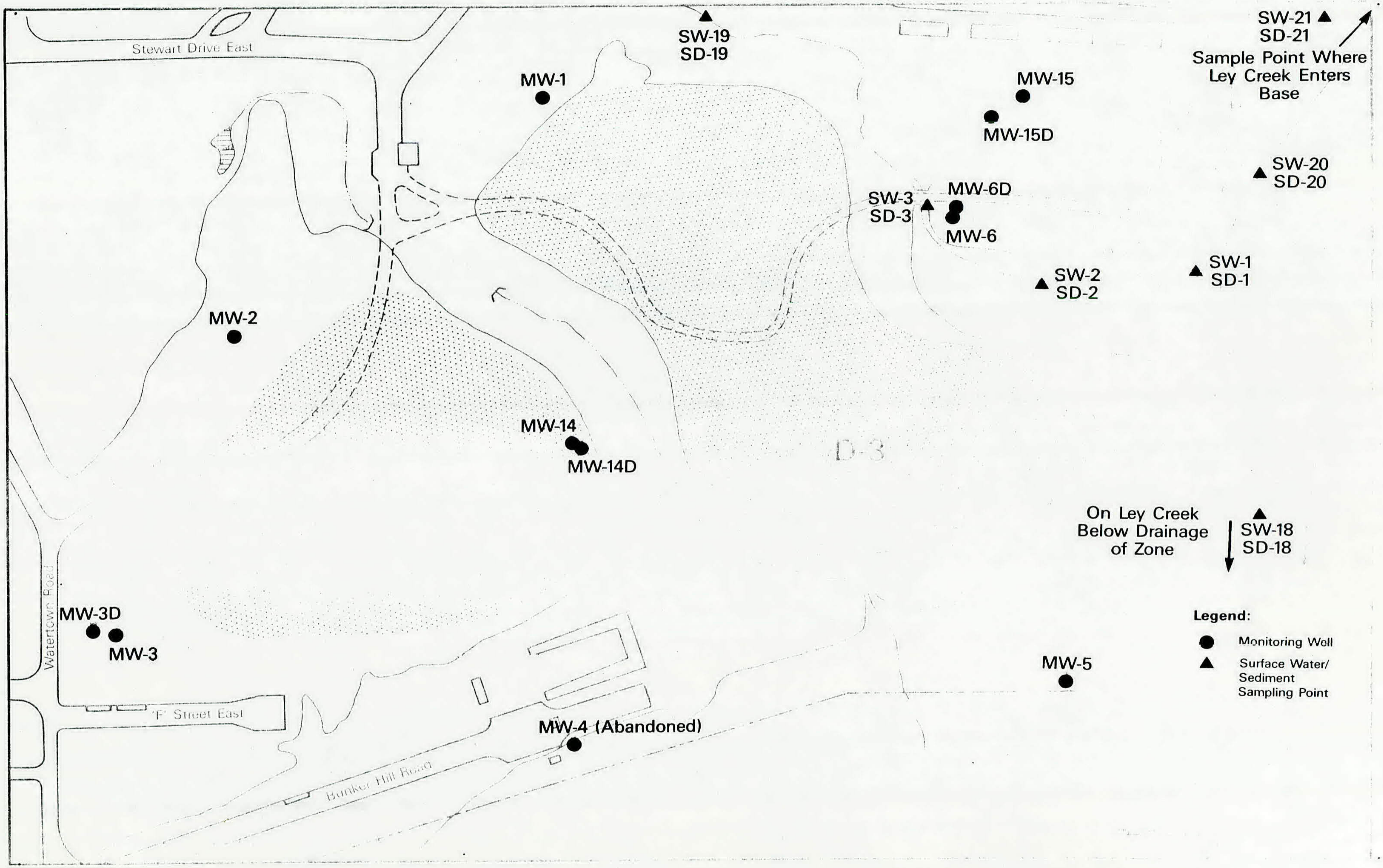


Figure 3-3. Zone 2 Sampling Point Locations at Hancock Field

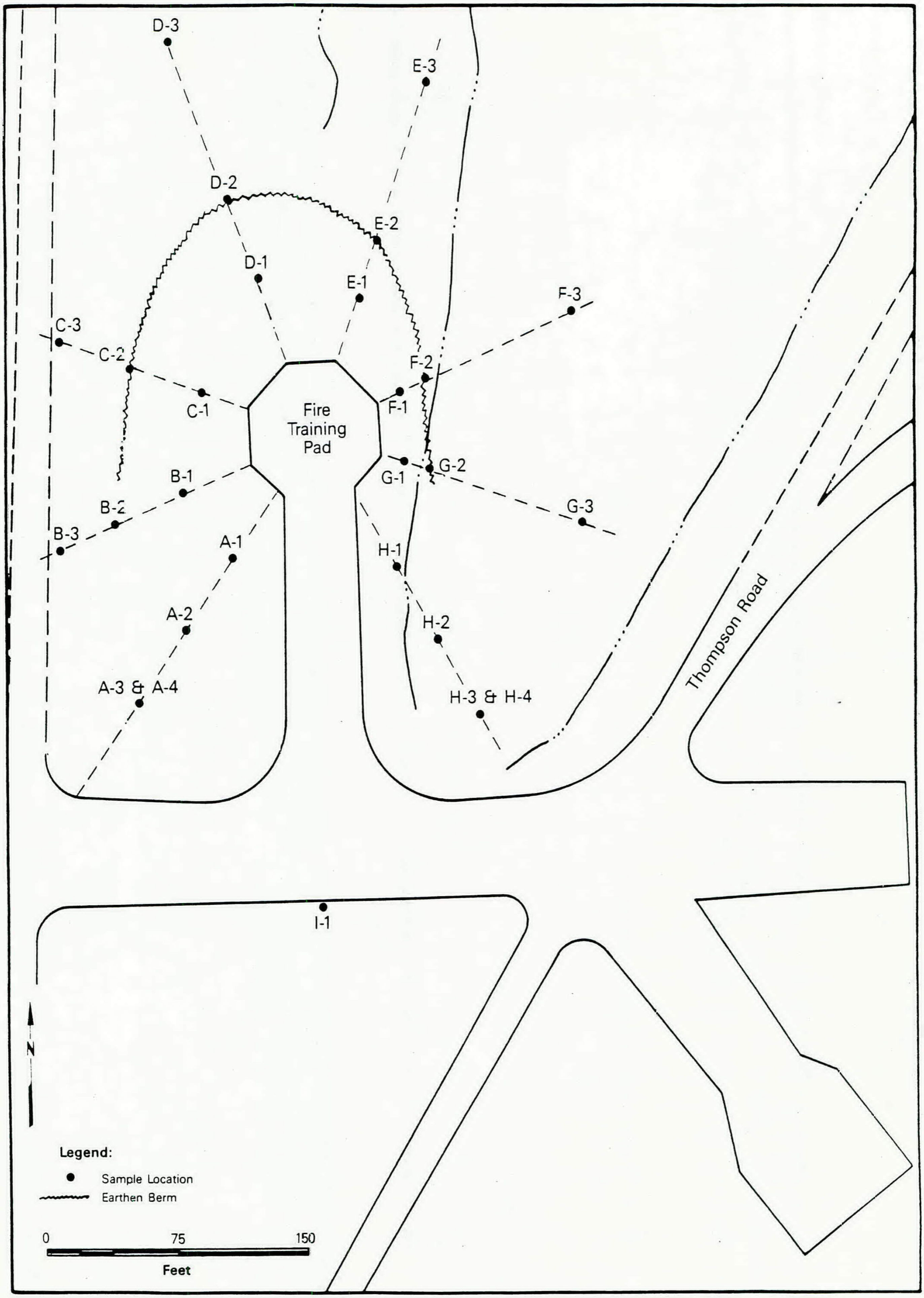


Figure 3-4. Soil Sampling Stations at FT-1

water and sediment monitoring stations also were established and sampled in Zone 2. The locations of these new monitoring points are as described in the SOW (Appendix B).

As in the Stage 1 investigation, individual surface water and sediment sampling stations represented one monitoring point (i.e., surface water station SW-1 was also sediment station SD-1). The locations of the surface water and sediment sampling stations in Zones 1 and 2 are illustrated in Figures 3-2 and 3-3.

3.1.6 Sampling at Three New Sites

Surface water, sediment, and/or soil samples were collected from monitoring points established at Site S-1 (Transformer Storage Area), Site S-3 (Entomology Underground Storage Tank), and Site SP-1 (Old Spill Area). All three sites have been identified as areas of potential environmental degradation.

One water sample was collected from the Entomology Underground Storage Tank (Site S-3), located adjacent to Building 259. A soil sampling station was positioned 20 feet downgradient from the tank. The soil sampling site was marked with a labeled wooden stake for future reference.

The Transformer Storage Area (Site S-1) is represented by Building 530. Five surface soil sampling stations were established around the perimeter of the building and one station was located inside the building. Each exterior station was located no farther than 5 feet from the building. All soil sampling stations were marked with labeled wooden stakes and are illustrated in Section 4.4.2 in Figure 4-16. Three sampling stations outside the building were located along the northeast wall adjacent to the transformer storage racks. The other two stations were located along the southwest and southeast walls.

Three surface water and sediment sampling stations were established at the Old Spill Area (Site SP-1). The site is the storm sewer outfall from the Semi-Automatic Ground Environment (SAGE) plant (Building 503). The first station was located at the outfall, the second and third monitoring points were located 50 and 100 feet downstream of the outfall, respectively.

3.2 MONITORING WELL INSTALLATION

Two types of monitoring wells were installed during this investigation. Eight shallow wells drilled to 30 feet below land surface (BLS) were installed to evaluate the quality of the surficial aquifer. Seven deep wells were installed to obtain groundwater samples from the bedrock and ranged in depth from 94 to 144 feet BLS.

On November 19, 1986, SAIC commenced drilling operations at Hancock Field using CATOH, Inc. as the subcontractor for all drilling activities conducted during Stage 2. SAIC personnel were on-site to supervise the drilling operation. The following sections describe the procedure used in drilling, installing, completing, and developing these wells. Before drilling and developing each well, all drilling, measuring, sampling, and developing equipment was decontaminated using a combination of pressurized steam and clean water.

3.2.1 Shallow Wells

All eight shallow wells were drilled using hollow stem auger techniques. The auger flights used had a 6-inch outside diameter (OD) and a 3 1/2 inch inside diameter (ID). During shallow well drilling, augers were advanced in 5-foot intervals. At 5-foot intervals to a depth 20 feet below the water table, a 2.0-foot split spoon was driven ahead of the augers to obtain lithologic and pedologic descriptions of strata to be drilled. Split spoon samples were described as follows:

- Sample interval
- Recovery
- Blow count per 6-inch travel interval
- Lithology
- Grain size
- Color (Munsell)
- Moisture
- Consistency
- Density
- Texture/fabric/bedding
- Other distinctive features.

The information on split spoon samples is contained in the well logs presented in Appendix D. An as-built diagram of a typical shallow well is presented in Figure 3-5.

Shallow wells were constructed using threaded flush joint, 2-inch ID, schedule 80 PVC casing, and a 20-foot length of 2-inch ID 304 stainless steel screen with 0.020-inch slots. The bottom of the screens were sealed with threaded stainless steel plugs. Screens were positioned to extend from the water table 20 feet into the saturated interval. When the desired depth was reached, the auger plug was removed and the stainless steel screen and PVC pipe were threaded together as each section was lowered through the hollow stem auger. When the well was in position, the auger was backed out of the borehole a few feet at a time while 0-grade sandpack was added down the flight of the auger to fill the annulus between the well screen and the borehole. Well risers extended approximately 2 1/2 feet above the land surface. The procedure of gradually backing the auger out while adding sandpack was continued until the sandpack extended 2 feet above the top of the screen. The annular space was sounded to verify the correct position of sandpack. Bentonite pellets were then added to create a 5-foot seal on top of the sandpack. Once the seal was in place and allowed to hydrate, a grout mixture, consisting of a mixture of 5 gallons of water, 3 pounds of bentonite powder, and 94 pounds of Rochester Portland cement, was pumped into the annular space. This grout provided an auxiliary surface seal and added structural integrity to the well. Each well was protected by 5 feet of 4-inch diameter protective steel casing that was recessed 2 1/2 feet into the ground and supported in a 2-foot square concrete pad. Three 3-inch diameter barrier posts were installed radially 3 feet away from each well. Locking metal caps were secured to the protective casing to prevent unauthorized entry.

Each shallow well was developed using a centrifugal pump and suction hose. The well was pumped until at least 5 well volumes of water had been removed, conductivity measurements had stabilized, and the water was of acceptable clarity to the Supervisory Geologist. Owing to the extremely fine texture of the glacial materials, clean wells often silted to some extent with time.

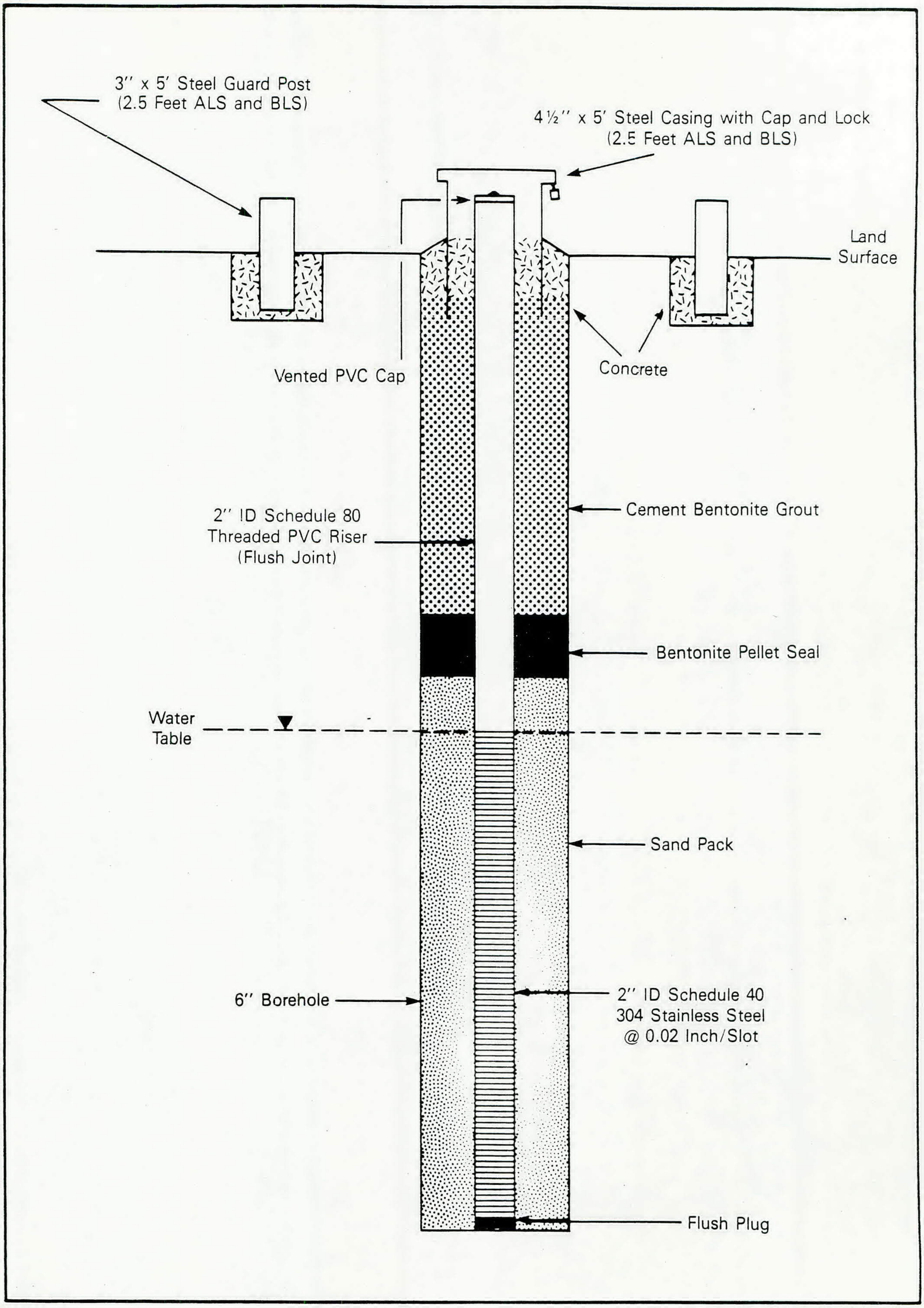


Figure 3-5. Schematic Diagram of Shallow Monitoring Well

3.2.2 Deep Wells

Seven deep wells were drilled as part of the Phase II, Stage 2 field program. Five of these deep wells were paired with shallow wells installed during this effort, and two were paired with shallow wells installed during the Phase II, Stage 1 study. All of the wells were screened in the underlying bedrock. The original SOW indicated the deep wells were to be screened in the lower portion of the surficial aquifer. However, a thick horizon of compact clay till, which yields very little water, overlies the fractured shale bedrock. Upon confirmation with the U.S. Air Force Occupational and Environmental Health Laboratory (USAFOEHL), the specifications on the deep wells were altered to require the screen to be set in the fractured shale, which was known to yield at least 25 gallons per minute (gpm). A typical as-built diagram for the deep wells is shown in Figure 3-6.

Drill-through-casing drive techniques were used for the deep wells. This technique used filtered air as the drilling fluid and allowed for easier development, since only a small quantity of clean water and no other drilling additive was added to the borehole. This drilling technique also was considered more appropriate for the glacial environment because:

- Lost circulation problems were eliminated
- Penetration rates were rapid
- The borehole was fully stabilized during the entire drilling operation
- The problem of running sands was eliminated.

The drilling technique involved the use of an 8 1/2 inch diameter eccentric bit attached to a percussion hammer. The drill rods were loaded into 20-foot sections of 8-inch ID steel casing. The bottom of the first section of casing was fitted with a cast alloy steel drive shoe. During drilling, both the drill bit and casing advanced as a single unit. The eccentric bit drilled and over-reamed the borehole, while the casing simultaneously was driven into the ground by the action of the hammer on the drive shoe. The air and water mixture that drove the hammer forced cuttings up through the annular space between the drill rods and the inner walls of the steel casing. The bit occasionally was pulled up a few feet to allow air pressure to clear cuttings

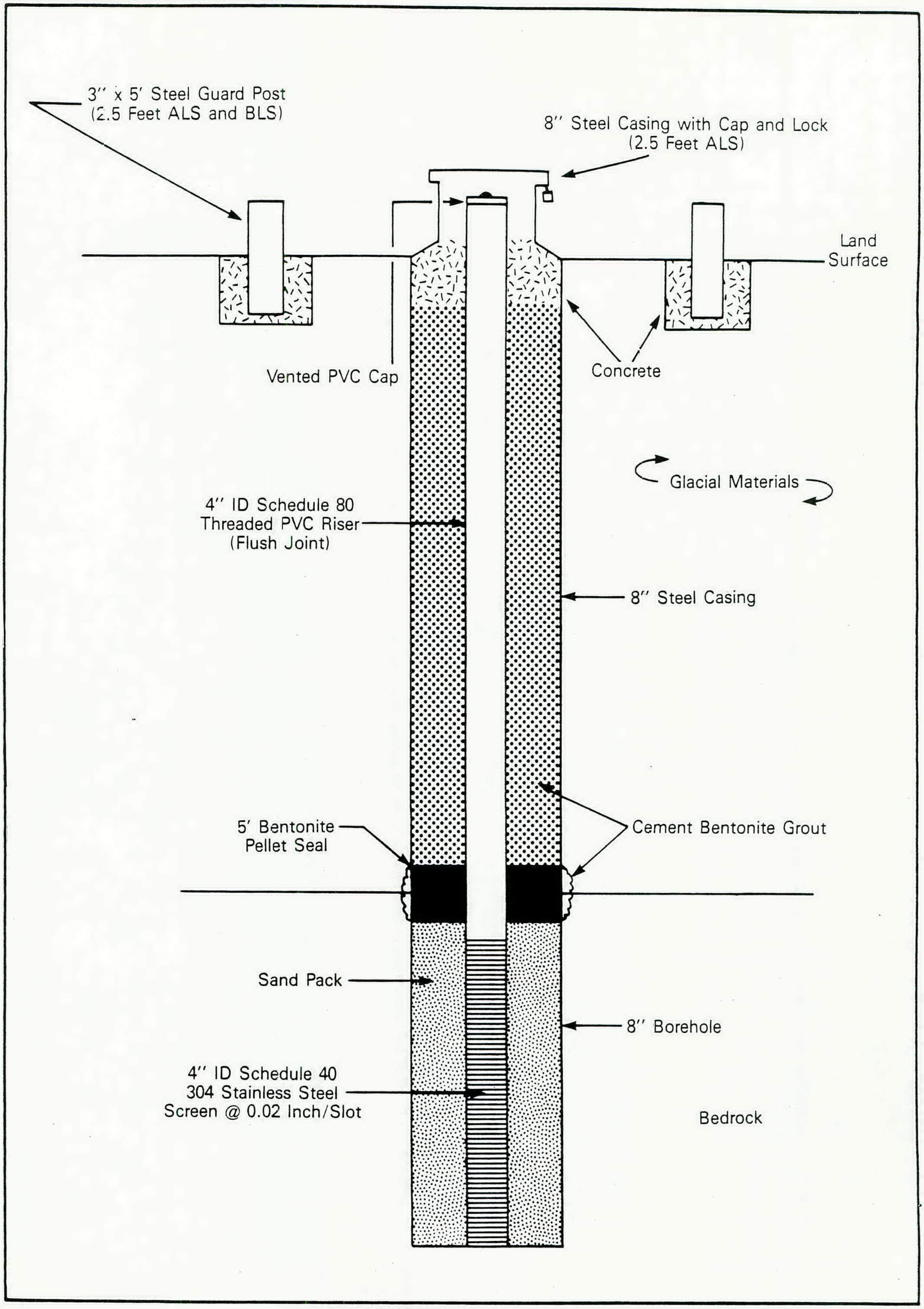


Figure 3-6. Schematic Diagram of an Installed Deep Monitoring Well

from the bottom of the hole. Cuttings were discharged through a hose attached to the top of the welded sections of steel casing. After the casing was advanced 5 feet into competent bedrock, the bit was changed to a 7 1/4 inch button bit and percussion techniques were used to drill an additional 20 feet into the bedrock. The 8-inch ID steel casing driven into the ground during drilling was left in the ground to act as a protective casing for the well, and to act as a seal to prevent cross-contamination between aquifers.

A single exception to this construction technique was monitoring well GW-14D. This well was drilled using 4-inch drill-through-casing-drive and the 2-inch material was used for the shallow wells because the well site was inaccessible to the drill rig capable of installing 4-inch wells. This change in drilling specifications was discussed with and approved by the USAFOEHL Technical Project Manager before execution.

Cuttings were continuously collected and described with special attention given to the drilling rate and hammer sound, which provided information used to describe changing subsurface conditions. Formation samples were described as follows:

- Depth BLS
- Lithology
- Grain size
- Color (Munsell)
- Water content
- Consistency
- Density
- Other distinctive features.

These characteristics were interpreted in light of the drilling technique used. For example, the grain size, moisture content, consistency, and density of a sample may be altered by the drilling method, and while they are descriptive of the material being brought to the surface, they may not be truly representative of the formation being drilled.

Information concerning subsurface formations encountered during deep well drilling is contained in the well logs presented in Appendix D.

After the borehole was completed, all drilling rods were removed and the well was constructed. Deep wells were constructed using threaded flush joint 4-inch ID, schedule 80 PVC casing and a 4-inch ID 304 stainless steel screen with 0.020-inch slots. The bottom of each screen was fitted with a stainless steel endplug. After the well was assembled inside the 8-inch steel casing, the entire string was raised 1 foot off the bottom of the hole and 0-grade sand was slowly poured down the annulus until the sandpack was 2 feet above the top of the screen. After the sandpack was sounded to ensure the correct position, bentonite pellets were added to create a 5-foot seal. After the bentonite pellets had hydrated adequately, a grout mixture of 5 gallons of water, 3 pounds of bentonite powder, and 94 pounds of Rochester Portland cement was tremied in place from the top of the pellets to the land surface. Like the shallow wells, the PVC riser extended approximately 2 1/2 feet above land surface. The outer steel casing was surrounded by a 2-foot square concrete pad. Three barrier posts were installed equidistant from each well to provide additional protection. A pin and lock system secured metal caps to the protective steel casings to prevent unauthorized entry.

All deep wells were developed using a 15 gpm surface centrifugal pump. Development was continued until at least 5 well volumes of water had been removed, the conductivity had stabilized, and the clarity of the water was acceptable to the Supervisory Geologist.

After each well was completed, all equipment used during drilling, measuring, and developing (i.e., drill rods, steel casing, bits, and wrenches) was decontaminated using a combination of pressurized steam and clean water.

3.2.3 Well Abandonment

During the initial field activities, an attempt was made to purge monitoring well MW-4, a Phase II, Stage 1 well. This attempt was unsuccessful because the pump hose continually plugged with sand. When visual examination of the sand showed it to be sandpack rather than formation sand, it was concluded that this well was broken below the surface and was no longer a valid monitoring point. Subsequently, the SOW for Stage 2 was modified to require formal abandonment of well MW-4. This was accomplished in November 1986 by pulling the steel protective casing and re-drilling the entire depth of the well with hollow stem augers. Once the well screen and riser were removed, the borehole was grouted to the surface with Portland cement grout as the augers were removed.

3.2.4 Surveying

At the completion of all drilling operations, the new wells were surveyed for their horizontal and vertical locations. Surveying was performed by Ryan Survey of Syracuse, New York. The locations and elevations of all surveyed points were established by differential leveling and checked by trigonometric leveling. Surveyed points were tied into supplemental bench marks established by Ryan Survey during the Phase 2, Stage 1 study in 1983. These supplemental bench marks were tied to a bench list established for Hancock Field by a base contractor several decades ago. This bench list was established from United States Geological Survey (USGS) bench marks, but the exact bench marks could not be determined. This contractor-established bench list has been used for all surveying at Hancock Field for the last several decades. Horizontal survey locations are shown in Figures 3-1 and 3-2, and Table 3-1 lists the elevations of both the old and new wells taken at the top of the PVC casing and at land surface.

3.3 SAMPLING PROCEDURES AND SAMPLE PRESERVATION

This section describes the procedures and methods used during the groundwater, surface water, soil, and sediment sampling activities conducted at Hancock Field. The analytes and methods used for analysis also are discussed in this section.

3.3.1 Groundwater

Water levels were obtained using an electronic water level indicator, which emits a high-pitched tone when the unit contacts water. The instrument was attached to the graduated tape. Readings were taken at each well from the top of the PVC riser pipe, the same point at which the vertical survey was made.

TABLE 3-1. WELL ELEVATIONS

Well Number	Elevation (ft MSL[a]) Top of Casing	Elevation (ft MSL[a]) Land Surface
MW-1	401.5	399.5
MW-2	415.6	413.4
MW-3	404.7	402.8
MW-3-D	407.0	404.9
MW-4[b]	--	--
MW-5	390.0	387.0
MW-6	397.3	394.8
MW-6-D	396.7	395.2
MW-7	399.6	397.4
MW-8	395.0	393.0
MW-9	397.7	395.7
MW-10	394.3	392.3
MW-11	400.0	396.7
MW-11-D	399.1	396.6
MW-12	399.0	396.4
MW-12-D	399.3	396.6
MW-13	398.8	396.3
MW-13-D	398.8	396.3
MW-14	404.3	402.6
MW-14-D	404.3	402.7
MW-15	400.4	398.0
MW-15-D	399.8	397.7
MW-16	398.7	395.7
MW-17	398.2	395.6
MW-18	398.1	395.9

Source: Ryan Survey 1983, 1987.

[a] Mean Sea Level

[b] Well Abandoned

Before groundwater sampling, each well was purged to ensure that a representative sample was obtained. A centrifugal pump and hoses were used to purge all wells. At least three well volumes of water were removed from each well. The pump and hoses were decontaminated before and between each well by scrubbing with an Alconox/water solution followed by a distilled water rinse. Groundwater samples were collected within a 24-hour period after purging and were obtained by lowering a clean, point source Teflon® bailer into the well. Samples were collected at the midpoint of the well screen (i.e., 10 feet from the bottom of the well). The Teflon® bailer was decontaminated between wells by washing with an Alconox/water solution, a demineralized water rinse, a methanol rinse, and allowed to air dry. Groundwater samples were obtained directly from the bailer using a Teflon® bottom emptying device to minimize the potential for sample agitation and contamination.

Seven separate sampling events were conducted during this investigation, in September 1986, December 1986, January 1987, October 1987, and resampling events in September 1987, September 1988, and January 1989. During the first sampling round in September 1986, all existing wells in Zones 1 and 2 were sampled. During the second sampling round in December 1986, the new wells in Zone 1 were sampled. The January 1987 sampling included new wells in Zones 1 and 2. Due to laboratory error, several wells had to be resampled for orthophosphate, lead, and mercury in September 1987. Sampling of newly installed wells at Site D-5 was conducted in October 1987. These wells were resampled for thallium in January 1989 to show that the October 1987 values were the result of interference. In September 1988, soils at Site FT-1 and groundwater at Site D-5 were resampled for volatile organics because of laboratory error. Table 3-2 lists the groundwater sampling points, sampling dates, analytes, and analytical methods for each well. In addition, field measurements for temperature, specific conductance, and pH were taken during all groundwater sampling efforts.

All groundwater samples were preserved and stored in containers according to methods prescribed by the U.S. Environmental Protection Agency (EPA) in "Methods for Chemical Analysis of Water and Wastes" (EPA 1979) and ERG and SAIC laboratories. Table 3-3 lists the preservation methods and sample container types used during the study.

TABLE 3-2. GROUNDWATER SAMPLING ANALYSIS PLAN, INCLUDING SAMPLING POINT, ANALYTES, ANALYTICAL METHODS, AND SAMPLING DATES, FOR HANCOCK FIELD, NEW YORK

Sample Location	Alkalinity[a] Method A403			Common Anions Method A429			Total Dissolved Solids Method E160.1			Petroleum Hydrocarbons Method E418.1			Aromatic Volatile Organics Method SW5030/8020			Metals Methods[b] E200.7, E206.2, E245.1, E245.1, E270.1			Extractable Priority Pollutants Method E625			Purgeable Halocarbons Method E601		
	9/86	12/86	1/87	9/86	12/86 9/87	1/87	9/86	12/86	1/87	9/86	12/86	1/87	9/86	12/86	1/87	9/86	12/86 9/87	1/87 1/89	9/86	12/86	1/87	9/86	12/86	1/87
Old Wells																								
MW-1	x			x	x		x			x			x			x	x		x			x		
MW-2	x			x	x		x			x			x			x	x		x			x		
MW-3	x			x	x		x			x			x			x	x		x			x		
MW-4 (abandoned)	-		-	-	-	-	-		-	-		-	-		-	-	-	-	-		-	-		-
MW-5	x			x	x		x			x			x			x	x		x			x		
MW-6	x			x	x		x			x			x			x	x		x			x		
MW-7	x			x	x		x			x			x			x	x		x			x		
MW-8	x			x	x		x			x			x			x	x		x			x		
MW-9	x			x	x		x			x			x			x	x		x			x		
MW-10	x			x	x		x			x			x			x	x		x			x		
Duplicate (MW-7)	x			x	x		x			x			x			x	x		x			x		
New Wells																								
MW-11											x	x		x	x			x[c]					x	x
MW-11D											x	x		x	x			x[c]					x	x
MW-12											x	x		x	x			x[c]					x	x
MW-12D											x	x		x	x			x[c]					x	x
MW-13											x	x		x	x			x[c]					x	x
MW-13D											x	x		x	x			x[c]					x	x
MW-3D			x			x			x			x			x			x			x			x
MW-6D			x			x			x			x			x			x			x			x
MW-14			x			x			x			x			x			x			x			x
MW-14D			x			x			x			x			x			x			x			x
MW-15			x			x			x			x			x			x			x			x
MW-15D			x			x			x			x			x			x			x			x
Duplicate (MW-6D)			x			x			x			x			x			x			x			x
MW-16 (10/87)	x				x			x			x			x			x			x			x	
MW-17 (10/87)	x				x			x			x			x			x			x			x	
MW-18 (10/87)	x				x			x			x			x			x			x			x	
Duplicate (MW-16) (10/87)	x				x			x			x			x			x			x			x	

[a] Alkalinity, Carbonate, Bicarbonate
[b] 26-Total Metals
[c] Lead Only

TABLE 3-3. SAMPLE PRESERVATION AND STORAGE FOR SAMPLES COLLECTED AT HANCOCK FIELD, NEW YORK

Sample Type	Analysis	Container	Preservation	Special Instructions
Aqueous	Alkalinity: Carbonate and Bicarbonate	1 L Borosilicate Glass Bottles	Cool to 4°C	No Air Space
	Common Anions	1 L Polyethylene Bottles	Cool to 4°C	Fill Container 90% Full
	Total Dissolved Solids	500 ml Plastic	Cool to 4°C	Fill Container 90% Full
	Petroleum Hydrocarbons	1 L Glass	5 ml HCl/L; Cool to 4°C	Fill Container 90% Full
	Aromatic Volatile Organics	40 mL screw cap Borosilicate Glass Vials, Teflon® Septa	Cool to 4°C	No Air Space
	Purgeable Halocarbons	40 mL screw cap Borosilicate Glass Vials, Teflon® Septa	Cool to 4°C	No Air Space
	BNA Extractable Priority Pollutants	1 L Amber Glass, Teflon® Cap Liner	Cool to 4°C	Fill Container 90% Full
	Metals	1 L Polyethylene	1.5 ml HNO_3/L	Fill Container 90% Full
	Organochlorine Pesticides	1 L Glass, Teflon® Cap Liner	Cool to 4°C	Fill Container 90% Full
	Organophosphorus Pesticides	1 L Glass, Teflon® Cap Liner	Cool to 4°C	Fill Container 90% Full
	Chlorinated Phenoxy Acid Herbicides	1 L Glass, Teflon® Cap Liner	Cool to 4°C	Fill Container 90% Full

TABLE 3-3. SAMPLE PRESERVATION AND STORAGE FOR SAMPLES COLLECTED AT HANCOCK FIELD, NEW YORK (Continued)

Sample Type	Analysis	Container	Preservation	Special Instructions
Sediment/ Soil	Petroleum Hydrocarbons	1 Pint Glass Jar	Freeze	Fill Container 90% Full
	Metals	1 Pint Glass Jar	Freeze	Fill Container 90% Full
	Aromatic Volatile Organics	40 mL screw cap Borosilicate Glass Vial, Teflon® Septa	Freeze	Fill Container 90% Full
	Semivolatile Organics	40 mL screw cap Borosilicate Glass Vial, Teflon® Septa	Freeze	Fill Container 90% Full
	Polychlorinated Biphenyls	1 Pint Glass Jar	Freeze	Fill Container 90% Full

During the sampling operations, collected samples were stored on ice to maintain a temperature of 4°C. At the end of a sampling day, all samples were packaged in ice chests with Blue Ice® to maintain the 4°C temperature, and shipped via overnight carrier to the contracted laboratory.

3.3.2 Surface Water and Sediments

A surface water and sediment sample was collected at each of the 21 sampling stations in December 1986. Due to laboratory error, all surface water points that were not dry were resampled for purgeable halocarbons, aromatic volatiles, and mercury in September 1987. Sediment points also were resampled for mercury. All stations were marked by brightly painted and labeled wooden stakes. The surface water and sediment sampling analysis plan is presented in Table 3-4. This table includes sampling point analyses and analytical methods.

Surface water samples were collected using the grab techniques specified by USGS (1977). Sample containers were used to collect samples directly from surface water bodies when no preservatives were needed. Sample containers were filled by submerging the container below the surface of the water body. Care was taken during sampling not to disturb bottom sediments, which could inadvertently become incorporated into the water sample. The farthest downstream station was sampled first followed by each successive upstream station. When wading into the stream became necessary, samples were collected upstream from the disturbance created during wading. Because of weather conditions, it became necessary at some of the more remote sampling stations to break through up to 3 inches of ice.

Sediment samples were collected at each surface water monitoring station using a clean stainless steel trowel. Table 3-4 details the sediment sampling plan, including location, analytes, and analytical methods.

Samples were obtained from the top layer of sediments and placed directly into the sample containers. The trowel was decontaminated between surface water monitoring stations using an Alconox/water solution wash, a distilled water rinse, and a methanol rinse. All samples were preserved and stored according to the methods prescribed in Table 3-3.

TABLE 3-4. SURFACE WATER AND SEDIMENT SAMPLING ANALYSIS PLAN INCLUDING LOCATIONS, ANALYTES, AND ANALYTICAL METHOD FOR HANCOCK FIELD, NEW YORK DECEMBER 1986 AND SEPTEMBER 1987

Sample Location	Petroleum Hydrocarbons Method E418.1		Purgeable Halocarbons Method E601		Aromatic Volatile Organics Method SW5030/8020		Volatile Organics Method SW5030/8240		Priority Pollutants Metals[c] Method E200.7		Extractable Priority Pollutants Method E625		Semivolatile Organics Method SW3550/8270	
	SW[a]	SD[b]	SW	SD	SW	SD	SW	SD	SW	SD	SW	SD	SW	SD
SW,SD-1	x	x	x		x			x	x	x	x			x
SW,SD-2	x	x	x		x			x	x	x	x			x
SW,SD-3	x	x	x		x			x	x	x	x			x
SW,SD-4	x	x	x		x			x	x	x	x			x
SW,SD-5	x	x	x		x			x	x	x	x			x
SW,SD-6	x	x	x		x			x	x	x	x			x
SW,SD-7	x	x	x		x			x	x	x	x			x
SW,SD-8	x	x	x		x			x	x	x	x			x
SW,SD-9	x	x	x		x			x	x	x	x			x
SW,SD-10	x	x	x		x			x	x	x	x			x
SW,SD-11	x	x	x		x			x	x	x	x			x
SW,SD-12	x	x	x		x			x	x	x	x			x
SW,SD-13	x	x	x		x			x	x	x	x			x
SW,SD-14	x	x	x		x			x	x	x	x			x
SW,SD-15	x	x	x		x			x	x	x	x			x
SW,SD-16	x	x	x		x			x	x	x	x			x
SW,SD-17	x	x	x		x			x	x	x	x			x
SW,SD-18	x	x	x		x			x	x	x	x			x
SW,SD-19	x	x	x		x			x	x	x	x			x
SW,SD-20	x	x	x		x			x	x	x	x			x
SW,SD-21	x	x	x		x			x	x	x	x			x
SW,SD-22 (SW-4 Dup)	x	x	x		x			x	x	x	x			x
SW,SD-23 (SW-1 Dup)	x	x	x		x			x	x	x	x			x

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[a] SW - Surface Water

[b] SD - Sediment

[c] Total of 13 Metals

3.3.3 Soil Gas Survey

The soil gas sampling system consisted of a stainless steel probe, hand operated vaccuum pump system of tubing, and pre-evacuated sampling vials.

At each of the established soil gas monitoring stations, a 1/2-inch hole having a depth of at least 2 feet was created with a slide hammer. The stainless steel probe was then inserted to the full depth of the hole and packed off at the surface. A soil gas sample was withdrawn through the probe to purge the sampling system. A second sample of soil gas was then withdrawn through the probe and collected in a glass vial pre-evacuated to a negative two atmospheres of pressure. The self-sealing vial was detached from the sampling system and stored until analysis. In addition to the 30 soil gas samples collected, 2 ambient air samples and 2 nitrogen blanks were collected as part of the quality assurance/quality control (QA/QC) program of the survey.

Between sampling points, the probe was decontaminated by washing with soapy distilled water, rinsed with distilled water, and dried by rinsing with reagent-grade methanol. The methanol was evaporated by passing nitrogen gas through the equipment.

All samples collected were analyzed using a Varian 4000 gas chromatograph (GC) equipped with a flame ionization detector for benzene, toluene, xylenes, and total volatile organics content. The GC equipment was brought to Hancock Field and set up in an office so samples could be analyzed within hours of collection. The details of the soil gas program are presented in Appendix L.

3.3.4 Soil Sampling

The SOW indicated that soil samples around Site FT-1 were to be collected at each point along a transect line at 5-foot intervals to a depth of 15 feet BLS or until groundwater was encountered. Since groundwater generally was found less than 5 feet BLS, only one soil sample was collected above the water table at each point using a stainless steel bucket auger. This change was identified to and approved by the USAFOEHL Technical Project Manager. Soil samples were collected on November 18, 1980 and analyzed using analytical methods listed in Table 3-5. Holding times were exceeded for semivolatile

TABLE 3-5. FIRE TRAINING AREA SOIL SAMPLING ANALYSIS PLAN, INCLUDING SAMPLE LOCATIONS, ANALYTES, AND ANALYTICAL METHODS, FOR HANCOCK FIELD, NEW YORK

Sample Location	Petroleum Hydrocarbons Method SW3550/ E418.1	Lead Method SW3050/7420	Aromatic Volatile Organics Method SW5030/8240	Semivolatile Organics Method SW3550/8270
FS-A-1	x	x	x	
FS-A-2	x	x	x	
FS-A-3	x	x	x	
FS-A-4	x	x	x	
FS-B-1	x	x	x	x
FS-B-2	x	x	x	
FS-B-3	x	x	x	
FS-C-1	x	x	x	x
FS-C-2	x	x	x	x
FS-C-3	x	x	x	
FS-D-1	x	x	x	x
FS-D-2	x	x	x	x
FS-D-3	x	x	x	
FS-E-1	x	x	x	x
FS-E-2	x	x	x	x
FS-E-3	x	x	x	
FS-F-1	x	x	x	x
FS-F-2	x	x	x	x
FS-F-3	x	x	x	
FS-G-1	x	x	x	x
FS-G-2	x	x	x	
FS-G-3	x	x	x	
FS-H-1	x	x	x	
FS-H-2	x	x	x	
FS-H-3	x	x	x	
FS-I-1	x	x	x	

organics; therefore, they were resampled on September 12, 1987. Later, a review of laboratory practices indicated that holding times for volatile organics also may have been exceeded. As a precaution, volatile organics were resampled on August 31, 1988.

The data obtained from the soil gas investigation were evaluated and 10 soil sampling points closest to the soil gas sampling points having the highest concentration of volatile organics were selected for semivolatile organic analysis. These 10 points were resampled in September 1987 because of exceeded holding times.

The stainless steel bucket auger was decontaminated thoroughly according to procedures outlined in Section 3.3.2. All samples were preserved and stored according to the requirements listed in Table 3-3.

3.3.5 Environmental Sampling at Three New Sites

The SOW identified three sites at Hancock Field that had not been investigated during previous studies. These sites, Entomology Underground Storage Tank (Site S-3), Transformer Storage Area (Site S-1), and the Old Spill Area (Site SP-1) were identified in the current SOW for various sampling activities. The procedures and media that were sampled are discussed in the following sections. The sampling plan for these sites is presented in Table 3-6.

3.3.5.1 Entomology Underground Storage Tank (Site S-3)

At the Entomology Underground Storage Tank (Site S-3), a water sample was extracted from the tank through the access pipe using a clean Teflon® point source bailer. A clean stainless steel bucket auger was used to collect three soil samples from the designated sampling station at 0.66, 1.5, and 3.0 feet BLS. Table 3-6 presents the media sampled, analytes, and analytical methods used. All sampling equipment was decontaminated by washing with a laboratory-grade detergent, rinsing with distilled water, and finally rinsing with methanol.

3.3.5.2 Transformer Storage Area (Site S-1)

Surface soil samples were collected at pre-selected sites around the Transformer Storage Area (Site S-1) using the stainless steel bucket auger. Soil withdrawn by the auger was transferred to a pre-labeled container using a stainless steel spatula. All sampling equipment was decontaminated by washing with a laboratory-grade detergent, and rinsing with distilled water and then with methanol. Media sampled, analytes, and analytical methods are presented in Table 3-6.

3.3.5.3 Old Spill Area (Site SP-1)

At the Old Spill Area (Site SP-1), samples were collected in a manner identical to the surface water and sediment samples discussed in Section 3.3.2. The farthest downstream sampling station was sampled first, followed by the two consecutive upstream stations to negate any disturbances caused by stream wading. Table 3-6 presents the sample location, media sampled, analytes, and analytical methods for samples collected at Site SP-1. All samples collected from the three new sites were preserved and stored according to methods prescribed in Table 3-3.

All sampling equipment was decontaminated between samples by thoroughly washing with laboratory-grade detergent, and rinsing with distilled water and then with methanol.

3.3.6 Field QA/QC

During all environmental sampling activities conducted during the Stage 2 field program, numerous QA/QC procedures were observed to ensure the quality and integrity of the data. These procedures include:

- Maintenance of chain-of-custody records for all samples. Copies of these forms are contained in Appendix G.
- Collection of the following QA samples:
  - Trip Blanks; one for every 20 field water samples and analyzed for volatile organic compounds (VOCs). These samples consist of pouring American Society for Testing and Materials (ASTM) Type II demineralized water into vials in the laboratory. These samples traveled with the other sample containers until their return to the laboratory. Trip blanks check for bias added by sample handling, storage, and transport.

TABLE 3-6. NEW SITES SAMPLING ANALYSIS PLAN, INCLUDING SAMPLE LOCATIONS, MEDIA SAMPLED, ANALYTES, AND ANALYTICAL METHODS, FOR HANCOCK FIELD, NEW YORK

Sample Location	Organochlorine Pesticides Method E608 Water SW8080 Soil	Organophosphorus Pesticides Method SW8140	Chlorinated Phenoxy Acid Herbicides Method SW8150	Petroleum Hydrocarbons Method E418.1 SW[a]	Petroleum Hydrocarbons Method E418.1 SD[b]	PCBs Method SW8080	Purgeable Halocarbons Method E601 SW	Aromatic Volatile Organics Method SW8020	Volatile Organics Method SW8240	Lead Method E239.2 SW7420 SW	Lead Method E239.2 SW7420 SD
Entomology Underground Storage Tank (S-3)											
Water Sample	x	x	x								
ES-1	x	x	x								
ES-2	x	x	x								
ES-3	x	x	x								
Transformer Storage Area (SP-1)											
TS-1					x[c]	x[c]					
TS-2					x[c]	x[c]					
TS-3					x[c]	x[c]					
TS-4					x[c]	x[c]					
TS-5					x[c]	x[c]					
TS-6					x[c]	x[c]					
TS-7 (TS-6 Dup)					x[c]	x[c]					
Old Spill Area (S-1)											
SW,SD-30				x	x		x[a]	x[a]	x[b]	x	x[b]
SW,SD-31				x	x		x[a]	x[a]	x[b]	x	x[b]
SW,SD-32				x	x		x[a]	x[a]	x[b]	x	x[b]

---

[a] Surface Water, Resampled September 1987
[b] Sediment
[c] Soil

  - Field Blanks; one for every 20 field water samples and analyzed for the same parameters being sampled for that day. These samples consisted of pouring ASTM Type II water into the sample container in the field. Field blanks check for bias added by sampling conditions (atmosphere), packaging, handling, and transport.

  - Bailer/Sampler Washes; one for every 20 field water samples and analyzed for the same parameters being sampled for that day. These samples consisted of ASTM Type II water poured into the sampling device and then into the sample containers. Bailer/sampler washes check for bias added by sampling conditions and by incomplete sample decontamination.

  - One replicate was collected for every 10 water and soil samples collected. Replicate samples were collected just after and in the same manner as the regular environmental samples, as described in Sections 3.3.1, 3.3.2, and 3.3.4. No remark was made on the label that indicated the sample was a replicate.

- Cleaning of all equipment, including drilling tools and sampling instruments, between use (i.e., between monitoring wells or other sampling points) was conducted by washing the equipment with an Alconox solution (i.e., low residue, biodegradable detergent) and rinsing with clean distilled water and methanol. This method was used to ensure that contaminants were not transferred between monitoring points (EPA 1977).

A detailed discussion of both field and laboratory QA/QC is presented in Section 4.

3.4 AQUIFER TESTING

During the first round of field activities under the Stage 2 field program, in situ hydraulic conductivities were determined for each existing well except MW-4 and MW-5. Well MW-4 was broken and subsequently abandoned and therefore could not be tested. Well MW-5 is a flowing artesian well and testing using a slug method was impossible. The method used for all other wells employed addition or subtraction slug testing and is described by Hvorslev (1951, as cited in Freeze and Cherry 1979). This method makes a number of assumptions, including that the aquifer being tested is a homogeneous, isotropic, infinite medium in which both the soil and water are incompressible.

The slug test is accomplished by rapidly adding or removing a measured volume of water to the well to change the water level. The rate of recovery is monitored by measuring the return of the water to its pretest level. Plots then are made of the head level changes versus time. The hydraulic conductivity is calculated from these plots.

For the tests performed at Hancock Field, water was obtained from the base domestic water supply. One gallon of water was rapidly added to wells with the head response monitored using a transducer coupled to an electronic data logger. Well MW-10 had less than 2 feet of unsaturated casing, so an additional slug test was not feasible. This well was tested by removing a .325 gallon slug using a modified sampling bailer. Each well was tested twice by these techniques. All aquifer test were conducted after the September 1986 sampling round had been completed. Subsequent sampling events took into consideration the introduction of water into the well and additional purging to remove city water was accomplished. The results of these tests are presented and discussed in Section 4.2.2.3.

4. DISCUSSION OF RESULTS AND SIGNIFICANCE OF FINDINGS

Seven sites in two zones were investigated during this Phase II, Stage 2 effort at Hancock Field, New York. A soil gas survey was conducted at one site (FT-1) and geophysical surveys (magnetometry) were conducted at two sites (D-1 and D-3). Fifteen new groundwater monitoring wells were installed, nine in Zone 1 and six in Zone 2. Samples of wastes, groundwater, surface water, sediments, and soils were collected and submitted for laboratory analysis. This section summarizes the results of the sampling program and discusses the significance of these results with regard to the sites under investigation. This section is divided into four subsections: Quality Assurance/Quality Control Program, Geology, Interpretation of Analytical Results, and Site-Specific Results.

4.1 QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

The U.S. Air Force (USAF) Installation Restoration Program (IRP) Phase II, Stage 2 sampling effort at Hancock Field was conducted in two phases, an initial sampling program to confirm Phase II, Stage 1 results, and a comprehensive sampling program. The results of the quality assurance/quality control (QA/QC) procedures for the two sampling stages are discussed in the following sections.

A program of QA/QC procedures was instituted throughout the Phase II, Stage 2 sampling effort at Hancock Field and the subsequent analysis of samples. The intent of this QA/QC program is to ensure that collected samples are representative of the sites, and that analytical data accurately describe the characteristics and concentrations of constituents in the samples. The QA/QC program consisted of establishing routine QC procedures throughout the program, as well as preparing and analyzing both laboratory and field QA/QC samples. The QC procedures established and followed for field activities included preparation for sampling, sample collection, field measurements, and chain-of-custody. These procedures are discussed in Section 4.1.1. Laboratory QA/QC samples consisted of spiked samples, duplicate samples, and method blanks. These QA/QC samples were intended to verify the accuracy and precision of analytical procedures, and to assess the contamination potential of the laboratory. The results of the analyses of the laboratory QA/QC samples are discussed in Section 4.1.2. Field QA/QC samples consisted of field blanks, bailer washes, field replicates, and a trip blank. These QA/QC samples were intended to confirm the adequacy of the field procedures used in collecting samples. The results of the analyses of field QA/QC samples are discussed in Section 4.1.3.

4.1.1 Field Sampling Quality Assurance

The field activities at Hancock Field were planned and conducted to provide samples and data of consistent and known quality. During sampling (soil, groundwater, sediment, and surface water), the following procedures were adhered to to ensure the reliability of samples and data:

- Sample Containers: All sample bottles were cleaned by I-Chem, Hayward, California, using U.S. Environmental Protection Agency (EPA) protocols, before shipment to the field. All sample bottles were of a size and construction appropriate to the samples being collected, and had caps with Teflon® liners or Teflon®-faced septa.

- Sample Preservatives: Appropriate sample preservatives were added to the sample bottles in the field. Chemicals used were American Chemical Society (ACS) reagent grade or better (Nitric acid used for preservation of samples for metals analysis was reagent grade).

- Sample Integrity: To avoid cross-contamination of samples between sites, field personnel wore disposable gloves that were changed between sites and wore rubber boots that were decontaminated between sites.

- Decontamination Procedures: All sampling and monitoring equipment (split spoon samplers, Teflon® bailers, stainless steel buckets and funnel, and soil gas probes), were thoroughly decontaminated between use at each sampling site (see Section 3.3.6).

- Field Measurements (Groundwater and Surface Water): In conjunction with sampling activities, field measurements of pH, specific conductance, and temperature were made. The equipment used for these measurements was calibrated as follows:

  - Digital thermometers were calibrated daily (or more frequently) against a mercury thermometer

  - Conductivity meters were calibrated daily (or more frequently) against a standard solution of known conductivity

  - Digital pH meters were calibrated daily (or more frequently) with two standard pH buffers

  - Ionizable vapor meters (H-Nu meters) were calibrated daily (or more frequently) with a manufacturer-supplied calibration gas that is a nontoxic substitute for benzene.

- Field Observations: During field activities, daily logs were kept in a bound field notebook of water-resistant paper. Entries were made in indelible ink, and included:

  - Date, time, and place of sampling

  - Weather conditions at time of sampling

  - Data from field measurements (temperature, specific conductance, and pH of samples)

  - Data from physical tests (slug tests, etc.)

  - Observations about site and samples (odors, appearance, etc.)

  - Information about any activities, extraneous to sampling activities, that may affect the integrity of the samples (such as low-flying aircraft nearby, fossil-fueled motors being used nearby, painting operations being carried out upwind of sampling site).

- Field Replicates: Replicate aliquots were collected for 10 percent of all samples collected in the field, and submitted to the laboratory as blind samples. Evaluation of the analytical results from these replicate samples is used to evaluate the precision of the sampling and analysis effort. The results from these samples are discussed in Section 4.1.3.

- Field Blanks: Field blanks were prepared before the collection of environmental samples, using American Society for Testing and Materials (ASTM) Type II reagent water and I-Chem sample bottles. The results from the analyses of field blanks are used to indicate the presence of external contaminants that may have been introduced into samples during collection and shipment. The results from these samples are discussed in Section 4.1.3.

- Bailer Washes: Bailer wash samples were collected using ASTM Type II reagent water, a decontaminated bailer, and I-Chem sample bottles. The results from the analyses of bailer washes are used to evaluate the adequacy of bailer decontamination procedures in preventing cross-contamination of samples between wells. The results from these samples are discussed in Section 4.1.3.

- Trip Blanks: Trip blanks were prepared in the laboratory and shipped to the sampling site with the sample bottles. The trip blanks were stored with the sample bottles before use, transported to a sampling site, and shipped to the laboratory with the samples collected during that day's sampling event. The results from the analyses of trip blanks are used to assess the presence of contaminants that may have been introduced into sample bottles during shipment to the sampling site or during storage on the site, or introduced into samples during shipment from the site to the laboratory.

- Sample Storage and Shipping: After collection, samples were stored and shipped in insulated coolers with Blue Ice®. After receipt in the laboratory, samples were stored at 4°C.

- Chain-of-Custody: Chain-of-custody was maintained by field personnel until samples were released for shipment. Chain-of-custody forms were packed in each cooler for shipment, including:

  - Sample number (for each sample in shipment)
  - Date of collection (for each sample in shipment)
  - Number of containers of each sample
  - Sample description (environmental medium)
  - Analyses required for each sample
  - Shipment number
  - Time and date of shipment.

  Coolers were sealed securely before shipment.

4.1.2 Laboratory QC Results

The results of analyses of laboratory QC samples are presented in Appendix H and are summarized in Tables 4-1, 4-2, and 4-3. These samples, consisting of matrix spiked samples, duplicate analyses, and method blanks, serve as a check on the accuracy and precision of laboratory analyses and assess the contamination potential during routine analytical procedures. These QC samples are discussed in the following paragraphs, by chemical class, after general discussions of each QC sample type.

Matrix spiked samples are prepared by adding a known amount of one or more compounds to a second aliquot of a sample, followed by an analysis using the same procedures as performed on the first aliquot of the sample. The compounds used for the matrix spike analyses have a high probability of being present in the unadulterated sample and are among the analytes of interest. After analysis, the percent recovery is calculated for each constituent added by subtracting the amount found in the first aliquot from the results of the second aliquot and dividing this number by the known amount originally added to the second aliquot. This result is then expressed as a percentage. A summary of the matrix spike analysis is presented in Table 4-1, with complete details delineated in Appendix H.

Laboratory precision is determined by the analysis of duplicate aliquots of the same sample and comparing these results. This comparison often is

TABLE 4-1a. LABORATORY ACCURACY SUMMARY: SOIL

Chemical Class	No. Analyses	Recovery Ranges	Acceptable Range[a]	No. Accept. Analyses	No. Unaccept. Analyses
Metals					
Antimony (Sb)	1	0+	75-125%	0	1
Arsenic (As)	1	90%	75-125%	1	0
Beryllium(Be)	1	89%	75-125%	1	0
Cadmium (Cd)	1	90%	75-125%	1	0
Chromium (Cr)	1	90%	75-125%	1	0
Copper (Cu)	1	96%	75-125%	1	0
Lead (Pb)	3	78-90%	75-125%	3	0
Mercury (Hg)	2	99-100%	75-125%	2	0
Nickel	1	88%	75-125%	1	0
Selenium (Se)	1	107%	75-125%	1	0
Silver (Ag)	1	30+	75-125%	0	1
Thallium (Tl)	1	96%	75-125%	1	0
Zinc	1	85%	75-125%	1	0
Total	16			14	2
Base/Neutral and Acid Extractables					
1,2,4-Trichlorobenzene	3	53-60	39-98%	3	0
Acenaphthene	3	65-87%	46-118%	3	0
2,4-Dinitrotoluene	3	66-73%	24-96%	3	0
Pyrene	3	84-110%	26-127%	3	0
N-Nitrosodi-n-propylamine	3	60-76%	41-116%	3	0
1,4-Dichlorobenzene	3	35-53%	28-104%	3	0
Pentachlorophenol	3	14-34%	9-103%	3	0

TABLE 4-1a. LABORATORY ACCURACY SUMMARY: SOIL
(Continued)

Chemical Class	No. Analyses	Recovery Ranges	Acceptable Range[a]	No. Accept. Analyses	No. Unaccept. Analyses
Base/Neutral and Acid Extractables (Continued)					
Phenol	3	64-74%	27-123%	3	0
2-Chlorophenol	3	55-74%	27-123%	3	0
4-Chloro-3-methyl phenol	3	75-85%	23-97%	3	0
4-Nitrophenol	3	32-109%	10-80%	2	1
Total	33			32	1
Volatiles by GC/MS					
1,1-Dichloroethene	2	150-160%	59-172%	2	0
Trichloroethene	2	138-160%	62-137%	0	2
Chlorobenzene	2	82-108%	60-133%	2	0
Toluene	2	84-92%	59-139%	2	0
Benzene	2	100-106%	66-142%	2	0
Total	10			8	2

+Matrix interference.

[a] Control limits established by the EPA Contract Laboratory Program (CLP).

TABLE 4-1b. LABORATORY ACCURACY SUMMARY: WATER

Chemical Class	No. Analyses	Recovery Ranges	Acceptable Range[a]	No. Accept. Analyses	No. Unaccept. Analyses
Metals					
Antimony (Sb)	2	98-116%	75-125%	2	0
Arsenic (As)	2	82-92%	75-125%	2	0
Beryllium(Be)	2	92-112%	75-125%	2	0
Cadmium (Cd)	3	96-112%	75-125%	3	0
Chromium (Cr)	3	80-107%	75-125%	3	0
Copper (Cu)	2	110-112%	75-125%	2	0
Lead (Pb)	5	84-112%	75-125%	5	0
Mercury (Hg)	3	82-100%	75-125%	3	0
Nickel (Ni)	2	65-108%	75-125%	1	1
Selenium (Se)	2	87-98%	75-125%	2	0
Silver (Ag)	2	50-70%+	75-125%	0	2
Thallium (Tl)	2	102-136%+	75-125%	1	1
Zinc (Zn)	2	104-108%	75-125%	2	0
Aluminum (Al)	1	112%	75-125%	1	0
Barium (Ba)	1	120%	75-125%	1	0
Boron (B)	1	96%	75-125%	1	0
Calcium (Ca)	1	95%	75-125%	1	0
Cobalt (Co)	1	108%	75-125%	1	0
Iron (Fe)	1	112%	75-125%	1	0
Magnesium (Mg)	1	100%	75-125%	1	0
Manganese (Mn)	1	111%	75-125%	1	0
Molybdenum (Mo)	1	104%	75-125%	1	0
Potassium (K)	1	106%	75-125%	1	0
Sodium (Na)	1	90%	75-125%	1	0
Vanadium (V)	1	106%	75-125%	1	0
Total	44			40	4

TABLE 4-1b. LABORATORY ACCURACY SUMMARY: WATER (Continued)

Chemical Class	No. Analyses	Recovery Ranges	Acceptable Range[a]	No. Accept. Analyses	No. Unaccept. Analyses
<u>Base/Neutral and Acid Extractables</u>					
1,2,4-Trichlorobenzene	3	26-62%	39-98%	2	1
Acenaphthene	3	35-72%	46-118%	2	1
2,4-Dinitrotoluene	3	51-86%	24-96%	3	0
Pyrene	3	55-124%	26-127%	3	0
N-Nitroso-di-n-propylamine	3	46-75%	41-116%	3	0
1,4-Dichlorobenzene	3	28-53%	36-97%	2	1
Pentachlorophenol	3	15-57%	9-103%	3	0
Phenol	3	16-35%	12-89%	3	0
2-Chlorophenol	3	43-76%	27-123%	3	0
4-Chloro-3-methyl phenol	3	47-81%	23-97%	3	0
4-Nitrophenol	3	5-16%	10-80%	2	1
Total	33			29	4
<u>Volatiles by GC</u>					
1,1,1-Trichloroethane	4	70-110%	85-115%	3	1
1,1,2,2-Tetrachloroethane	4	38-112%	80-125%	3	1
1,1,2-Trichloroethane	4	68-102%	65-105%	4	0
1,1-Dichloroethane	4	80-100%	85-115%	4	0
1,1-Dichloroethene	4	70-100%	61-145%	4	0
1,2-Dichlorobenzene	8	60-105%	63-141%	7	1
1,2-Dichloroethane	4	50-105%	85-115%	3	1

TABLE 4-1b. LABORATORY ACCURACY SUMMARY: WATER (Continued)

Chemical Class	No. Analyses	Recovery Ranges	Acceptable Range[a]	No. Accept. Analyses	No. Unaccept. Analyses
<u>Volatiles (Continued)</u>					
1,2-Dichloropropane	4	60-95%	71-120%	3	1
1,4-Dichlorobenzene	8	65%-100%	76-142%	7	1
Bromodichloromethane	3	95-148%	85-115%	2	1
Bromoform	2	130-150%	60-140%	1	1
Carbon Tetrachloride	4	65-110%	85-115%	3	1
Chlorobenzene	4	61-95%	75-125%	2	2
Chlorodibromomethane	4	68-102%	65-105%	4	0
Chloroethane	4	23-129%	85-145%	2	2
Chloroform	4	0-161%	85-115%	2	2
cis-1,2-Dichloropropene	4	68-102%	65-105%	4	0
Methylene Chloride	4	38-129%	71-120%	3	1
Tetrachloroethene	4	38-112%	85-145%	3	1
trans-1,2-Dichloroethene	4	60-115%	85-115%	3	1
trans-1,3-Dichloropropene	4	55-95%	71-120%	2	2
Trichloroethene	4	90-103%	71-120%	4	0

TABLE 4-1b. LABORATORY ACCURACY SUMMARY: WATER
(Continued)

Chemical Class	No. Analyses	Recovery Ranges	Acceptable Range[a]	No. Accept. Analyses	No. Unaccept. Analyses
Volatiles (Continued)					
Trichlorofluoromethane	4	60-100%	61-145%	3	1
Vinyl Chloride	4	50-107%	60-110%	3	1
Benzene	3	58-98%	90-110%	2	1
Ethyl Benzene	4	54-105%	85-115%	3	1
Toluene	4	36-105%	85-115%	3	1
Total Xylenes	3	57-95%	60-140%	2	1
Dichlorodifluoromethane	1	107%*	60-110%	1	0
1,3-Dichlorobenzene	2	68-74%	73-135%	1	1
Total	118			91	27

+Matrix interference.

[a] Control limits (except VOA analyses) established by the EPA Contract Laboratory Program (CLP). VOA control limits based on laboratory historical data.

TABLE 4-2a. LABORATORY PRECISION SUMMARY: SOIL

Chemical Class	No. Analyses	RPD Range	Acceptable RPD[a]	No. Accept. Analyses	No. Unaccept. Analyses
Metals					
Arsenic (As)	1	2%	0-20%	1	0
Beryllium (Be)	1	26%	0-20%	1	0
Cadmium (Cd)	1	12%	0-20%	1	0
Chromium (Cr)	1	0	0-20%	1	0
Copper (Cu)	1	2%	0-20%	1	0
Lead (Pb)	2	4-7%	0-20%	2	0
Mercury (Hg)	2	6-18%	0-20%	2	0
Nickel (Ni)	1	18%	0-20%	1	0
Selenium (Se)	1	0	0-20%	1	0
Zinc (Zn)	1	9%	0-20%	1	0
Total	12			12	0
Base/Neutral and Acid Extractables					
Benzo(A)anthracene	2	12-54%	0-50%	1	1
Benzo(A)pyrene	2	1-2%	0-50%	2	0
Benzo(G,H,I)perylene	1	27%	0-50%	1	0
Benzo(K)fluoranthene	2	13-27%	0-50%	2	0
Fluoroanthene	2	16-30%	0-50%	2	0
Indeno (1,2,3-C,D) Pyrene	1	35%	0-50%	1	0
Pyrene	2	8-18%	0-50%	2	0
Phenanthrene	1	4%	0-50%	1	0
bis (2-Ethylhexyl) phthalate	1	67%	0-47%	0	1
Chrysene	1	1%	0-50%	1	0
Benzo(B)fluoranthene	1	4%	0-50%	1	0
Total	16			14	2

[a] RPD control limits are based on historical laboratory data or interim values where insufficient data have been generated.

TABLE 4-2b. LABORATORY PRECISION SUMMARY: WATER

Chemical Class	No. Analyses	RPD Range	Acceptable RPD[a]	No. Accept. Analyses	No. Unaccept. Analyses
<u>Metals</u>					
Chromium (Cr)	1	16%	0-20%	1	0
Lead (Pb)	2	0-17%	0-20%	2	0
Calcium (Ca)	1	4%	0-20%	1	0
Magnesium (Mg)	1	28%	0-20%	0	1
Manganese (Mn)	1	0	0-20%	1	0
Potassium (K)	1	0	0-20%	1	0
Sodium (Na)	1	7%	0-20%	1	0
Mercury (Hg)	1	0	0-20%	1	0
Total	9			8	1
<u>Base/Neutral and Acid Extractables</u>					
bis (2-Ethylhexyl) phthalate	2	4-30%	0-47%	2	0
(all other analytes less than detection)					
Total	2			2	0
<u>Volatiles by GC</u>					
1,1,1-Trichloroethane	1	0	0-28%	1	0
1,1,2,2-Tetrachloroethane	1	0	0-48%	1	0
1,1,2-Trichloroethane	2	0-16%	0-22%	2	0
1,1-Dichloroethane	1	0	0-18%	1	0
1,1-Dichloroethene	1	5%	0-14%	1	0
1,2-Dichlorobenzene	2	0	0-30%	2	0
1,2-Dichloroethane	1	0	0-26%	1	0
1,2-Dichloropropane	1	5%	0-26%	1	0
1,4-Dichlorobenzene	2	0	0-30%	2	0
Bromodichloromethane	3	5-35%	0-35%	3	0
Bromoform	2	4-7%	0-27%	2	0
Carbon Tetrachloride	2	5-12%	0-30%	2	0

TABLE 4-2b. LABORATORY PRECISION SUMMARY: WATER
(Continued)

Chemical Class	No. Analyses	RPD Range	Acceptable RPD[a]	No. Accept. Analyses	No. Unaccept. Analyses
Volatiles (Continued)					
Chlorobenzene	3	0-13%	0-13%	3	0
Chlorodibromomethane	2	0-16%	0-36%	2	0
Chloroethane	1	0	0-24%	1	0
Chloroform	3	0-24%	0-24%	3	0
cis-1,3-Dichloropropene	2	0-16%	0-37%	2	0
Methylene Chloride	4	0-31%	0-35%	4	0
Tetrachloroethene	2	3-27%	0-29%	2	0
trans-1,2-Dichloroethene	1	5%	0-33%	1	0
trans,1-3-Dichloropropene	1	5%	0-37%	1	0
Trichloroethene	2	1-5%	0-14%	2	0
Trichlorofluoromethane	2	0-66%	0-34%	1	1
Vinyl Chloride	1	53%	0-30%	0	1
Benzene	1	2%	0-11%	1	0
Ethyl Benzene	2	9-30%	0-35%	2	0
Toluene	2	5-47%	0-13%	1	1
Total Xylenes	2	0	0-35%	2	0
Total	50			47	3

[a] RPD control limits based on historical laboratory data or interim values where insufficient data have not been generated.

TABLE 4-3. SUMMARY OF DATA FROM FIELD AND LABORATORY BLANKS

Sample Shipment	Sample ID	Blank Type	Parameters Analyzed For	Analyte Identified	Conc. Found
2	FB-1	Trip	Volatiles	None	
	SW-24	Field	BNAs	None	
			Metals	None	
			Petroleum Hydrocarbons	None	
			Purgeables	Methylene Chloride	99 µg/L
	Blank 1	Lab (Soil)	BNAs	None	
	Blank 2	Lab (Soil)	BNAs	None	
	Blank 3	Lab (Soil)	BNAs	None	
4	FB-1	Trip	Petroleum Hydrocarbons	None	4.8 mg/L
	Blank	Lab (Water)	Purgeables	Methylene Chloride	0.59 µg/L
			Petroleum Hydrocarbons		2.6 mg/L
5	GW-19	Field	Petroleum Hydrocarbons	None	
			Purgeables	1,1,1-TCA	0.2 µg/L
				Methylene Chloride	6.2 µg/L
	GW-20	Bailer	Petroleum Hydrocarbons		4.9 mg/L
			Purgeables	Methylene Chloride	19 µg/L
	Blank	Lab	Purgeables	None	
6	Blank	Lab	BNAs	None	
			Purgeables	None	
			Alkalinity	None	
			Anions	None	
			Metals	None	
7	Blank	Lab	Purgeables	Methylene Chloride	0.25 µg/L
				Chloroform	0.06 µg/L

TABLE 4-3. SUMMARY OF DATA FROM FIELD AND LABORATORY BLANKS (Continued)

Sample Shipment	Sample ID	Blank Type	Parameters Analyzed For	Analyte Identified	Conc. Found
				1,1,1-Trichloroethane	0.03 µg/L
				Carbon Tetrachloride	0.32 ug/L
				Trichloroethene	0.59 µg/L
				Tetrachloroethene*	0.03 µg/L
			Volatiles	None	
			Metals	None	
			BNAs	None	
			Organochlorine Pesticides	None	
			Organophosphorus Pesticides	None	
			Chlorinated Herbicides	None	
			Mercury (cold vapor)	None	
			Lead	None	
8	Blank	Lab	Mercury (cold vapor)	None	
			Lead	None	
9	Blank	Lab	Purgeables	Dichlorodifluoromethane	2.2 µg/L
			Volatiles	None	
			BNAs	None	
			Miscellaneous Inorganics	None	
			Petroleum Hydrocarbons	None	
			Metals	Boron	0.019 mg/L
				Calcium	0.036 mg/L
10	Blank	Lab	Volatiles	Acetone	0.016 µg/L
				Methylene Chloride	0.039 µg/L
11	Blank	Lab	Thallium	None	

*1,1,2,2-tetrachloroethane and tetrachloroethene coelute; the peak is quantitated as all tetrachloroethene.

expressed as the relative percent difference (RPD), and is calculated by dividing the absolute difference in concentration between duplicate aliquots of the same sample by the mean concentration of the two results. This value is then expressed as a percentage by multiplying by 100. By definition, when the RPD is equal to 0 percent, the duplicate analyses are considered equivalent, hence a high degree of precision. The significance of an RPD value is dependent upon the magnitude of the analytical results being evaluated. Although a small RPD indicates good reproducibility, a large RPD does not necessarily indicate a lack of precision in the data being evaluated. For example, the RPD between 0.0001 and 0.0002 µg/L is the same as that between 1,000 and 2,000 µg/L (RPD = 67%). The high RPD associated with the first set of numbers may be acceptable due to the small values being evaluated, whereas the second set may have an unacceptable high RPD based on the magnitude of numbers being evaluated. In general, control limits are established for a range of values for each particular analyte and the results of the RPD calculation normally are evaluated with respect to these ranges. A summary of the duplicate analyses is presented in Table 4-2, and full details are provided in Appendix H.

Data quality objectives (DQOs) used for accuracy and precision in this sampling and analysis effort are the upper and lower control limits, delineating the range of acceptability for the percent recoveries and RPDs calculated from the analysis of QC samples. These control limits are defined by the 99 percent confidence interval (±3 standard deviations), and have been developed by either the laboratory from historical data or by EPA in their Contract Laboratory Program (CLP). For precision determinations, where insufficient historical laboratory data exist, interim control limits of 0 to 20 percent are used to evaluate the analytical results. Control limits for each analyte are presented in Tables 4-1 and 4-2.

Method blanks are generated in the laboratory by treating distilled deionized water as if it were a sample, and carrying it through all sample preparation steps of a method. Method blanks are generated for each method used. Method blanks are used to assess contamination potential in the laboratory environment. The results of the analyses of method blanks are presented in Table 4-3, as well as in Appendix H.

4.1.2.1 Volatile Organic Compounds (VOCs)
EPA Methods E601, E602, SW8020 (GC Analyses)
EPA Method SW8240 (GC/MS Analysis)

Seven matrix spike samples were analyzed and the percent recoveries calculated. The data from these analyses indicate generally acceptable analytical accuracy. Two of the seven spiked samples were analyzed by gas chromatography/mass spectrometry (GC/MS) and five were analyzed by GC methods. Both samples spiked for the GC/MS analysis had all analytes except one within the DQOs established for this method. Of the five samples spiked for the GC methods, one sample indicated an out of control situation. This sample triggered a halt of analyses until corrective action was completed. It was determined that the sample aliquot was improperly spiked, resulting in lower than acceptable spike recoveries. Since this did not affect other samples, no re-analyses were performed.

Three pairs of duplicate samples and one pair of matrix spike duplicates were analyzed by the GC method and two duplicate samples were analyzed by the GC/MS method. These data indicate a generally acceptable level of analytical precision for the GC method; however, insufficient data were produced for the GC/MS duplicate analysis to make a determination as to the precision of the method. All analytes for the GC/MS method were nondetectable. The DQOs for precision were met by all compounds in two of the duplicate pairs analyzed by GC. One additional pair had two compounds outside the control limits; however, these compounds were detected near or below the method detection limits, resulting in high RPDs. The fourth pair (matrix spike duplicates) of duplicate samples had one analyte outside the DQO.

Methylene chloride and toluene, both common laboratory contaminants, were detected in one method blank. These two compounds were detected at comparable concentrations in the water samples analyzed with this method blank. In another method blank, methylene chloride, chloroform, 1,1,1-trichloroethane, carbon tetrachloride, and trichloroethene were detected. The majority of the samples analyzed with this method blank were found to have similar concentrations to these compounds. Consequently, the presence of these compounds may be due to laboratory contamination, and therefore may not be environmentally significant.

4.1.2.2 Base/Neutral and Acid Extractables (BNAs)
EPA Methods E625 and SW8270

Three spiked water samples and three spiked soil samples were analyzed and the percent recoveries calculated. The data from these analyses indicate that the analytical accuracy of these analyses is acceptable. Five of the samples had one or less analyte outside the DQO ranges established, while the sixth had three analytes outside the DQO ranges considered by the laboratory to be anomalous.

Six pairs of duplicate samples were analyzed and the RPDs calculated. Two duplicate pairs had no detectable concentrations. In two duplicate pairs, the RPD of the detected analyte were within the laboratory-established DQO for precision. Two of the 11 analytes detected in the remaining duplicate pairs were outside of the DQO. Three soil method blanks and a water method blank analyzed for base/neutral and acid extractables (BNAs) showed no evidence of laboratory contamination.

4.1.2.3 Pesticides, Herbicides, and PCBs
EPA Methods E608, SW8140, SW8150, and SW8080

One sample was spiked with three organophosphorus pesticides and analyzed for percent recovery evaluation. No control limits have been established by the laboratory for these compounds; however, the percent recovery range obtained (99% recovery - 103% recovery) is indicative of an accurate analysis. The duplicate pair analyzed for organophosphorus pesticides had no detectable concentrations; therefore, no conclusions may be made concerning the precision of the analysis. No compounds were detected in a method blank analyzed by these methods.

4.1.2.4 Common Anions
EPA Method A429

At this time, no control limits have been established for common anion analysis because of insufficient historical laboratory data. An interim set of guidelines has been developed based on a limited set of data (<20 data points). For accuracy, the range has been set at ±30 percent, and for precision, the range has been set at 0 to 20 percent. Three samples were spiked, one sample for seven anions and two samples for orthophosphate only.

The recoveries for the multiple spike were all within the interim DQO limits with one exception, while the orthophosphate spikes had recoveries of 86 and 64 percent. Matrix interference is attributed to the low recoveries for the analytes outside the DQO established. In both instances, the analyte outside of the DQO range was orthophosphate. Examination of the chromatogram showed a negative peak eluting just before the orthophosphate peak, thus causing a reduction in value.

Three samples were analyzed in duplicate for the common anion method. Two of the samples had no detectable levels of anions, while the third had detectable levels for sulfate and chloride only. This third sample had RPDs within the interim DQOs established for this method. No common anions were detected in the method blanks.

4.1.2.5 Metals
EPA Methods E200.7, E206.2, E239.2, E245.1, E270.2, SW6010, SW7060, SW7420, SW7471, and SW7740

Soil, sediment, and water samples were spiked and analyzed for metals. One of the 102 recoveries calculated from these samples was outside of the DQO range. These data indicate that the analytical accuracy of these methods is very good. Soil, sediment, and water samples also were analyzed in duplicate pairs to evaluate the precision of the analyses. One of the 22 RPDs calculated exceeded the DQO, indicating very good precision for these analytical methods. None of these elements was detected in method blanks.

4.1.2.6 Alkalinity
EPA Method A403

No control limits have been established for this method because of a lack of sufficient historical laboratory data. An interim set of guidelines has been developed based on a limited data base (<20 data points), which was used to evaluate the data for this project. The range for accuracy was set at ±20 percent, while the range for precision was set at 0 to 20 percent. A single sample was spiked for alkalinity and analyzed in duplicate. Both the accuracy and precision from these analyses were within the interim DQOs for this method. The alkalinity determinations for the method blank were all nondetected at the detection limit of 0.5 mg/L.

4.1.2.7 Petroleum Hydrocarbons
EPA Method E418.1

Seven samples were analyzed in duplicate for petroleum hydrocarbons content. Five of the seven samples had no detectable levels of petroleum hydrocarbons; therefore, the results of their duplicate analyses cannot be evaluated for precision. The remaining two samples had RPD values of 9 and 11 percent. Since both of these values are within the interim guidelines of 0 to 20 percent, the results are indicative of precise analyses. Spiked samples were not analyzed and no petroleum hydrocarbons were detected in the method blanks.

4.1.2.8 Total Dissolved Solids
EPA Method E160.1

A single sample, GW-31, was analyzed in duplicate for total dissolved solids (TDS), with an RPD of 5 percent. This is within the interim guidelines set for this method at 0 to 20 percent. This method was not evaluated for accuracy by analyzing spiked samples, and no method blanks were analyzed for TDS.

4.1.2.9 Initial Sampling Laboratory QC Results

Samples from the initial sampling of Stage 1 wells were analyzed by TMA/ERG of Ann Arbor, Michigan. TMA/ERG did not provide control limits with their QC results; hence, our evaluation of accuracy and precision is based on control limits established by Science Applications International Corporation's (SAIC's) laboratory. Complete results of the duplicate analyses from the initial sampling effort are presented at the end of Appendix H. Duplicate analyses were performed for metals, other inorganic parameters, purgeable organic compounds, and BNA compounds. RPDs calculated from these analyses are generally good (22 out of 28 RPDs were less than 20 percent). The largest RPDs were calculated for total suspended solids (RPD of 40 percent), benzene (RPD of 59 percent, measurements made near the detection limit), and N-nitroso-Di-n-propylamine (RPD of 73 percent).

Complete results of the matrix spike analyses from the initial sampling effort are presented in Appendix H. The percent recoveries calculated from matrix spike analyses that were performed for metals, other inorganic parameters, and purgeable organic compounds are good, ranging from 92 to 127 percent. Matrix spike and surrogate spike analyses were performed for BNA compounds. Percent recoveries calculated from these analyses are acceptable, ranging from 20 to 120 percent for the matrix spike analyses and 20 to 157 percent for the surrogate spike analyses.

4.1.2.10 Follow-on Sampling Laboratory QC Results

Samples from the follow-on investigation of Site D-5 were analyzed by SAIC's laboratory in October and November 1987. The matrix spike samples for these analyses indicate good accuracy, with only the purgeables 1,2-dichlorobenzene and 1,4-dichlorobenzene and the ICAP metal calcium having percent recoveries outside established control limits. Precision of these analyses also was good, as indicated by the RPDs of laboratory duplicate analysis. For organics, only 1,1,1-trichloroethane and toluene had RPDs above the upper control limit of 20 percent. For metals, only copper showed a high RPD. The method blank data for this sampling event (Shipment 9) is shown in Table 4-3, and indicates minimal potential sample contamination by the refrigerant dichlorodifluoromethane and the metals boron and calcium. Overall, the quality of the data from this event is considered good. This assessment also holds for the resampling of Site D-5 wells for thallium in January 1989 (Shipment 11). All QC measures were within the established limits.

For the reasons discussed in Section 3.3.4, the soil sampling points at Site FT-1 were resampled for volatile organics in August 1988 (Shipment 10). Groundwater at Site D-5 also was resampled for volatiles at this time. Analysis was conducted by Ecology and Environment, Inc. For one soil sample, matrix spike recoveries were low relative to the matrix spike duplicates for trichloroethane and benzene, but peak areas were acceptable. This, in turn, caused RPDs to be higher than acceptable. For subsequent soil samples, all QC limits were met. As shown in Table 4-3, the common laboratory contaminants acetone and methylene chloride were found in the method blank associated with the Site D-5 groundwater samples, both at less than 1 µg/L. In all, the quality of these data is acceptable.

4.1.3 Field QA/QC Results

The field sampling program at Hancock Field included procedures intended to ensure the validity of the resulting data. These field QA/QC procedures consisted of collecting and analyzing field blanks, bailer washes, field replicates, and a trip blank. Field blanks, bailer washes, and field replicates were submitted blind to the laboratory. These samples are intended as QA/QC checks on the integrity of sample collection, storage, and handling procedures, and bailer decontamination procedures. Collection procedures are discussed in the following paragraphs.

Trip blanks were prepared in the laboratory by pouring ASTM Type II reagent water into prepared sample bottles, randomly selected from the sample bottles prepared for the trip. Trip blanks were shipped to the project site with the lots of sample bottles. When a trip blank was used, it was transported to the sampling site, and then shipped for analysis with the samples collected during the day's sampling event. Trip blanks were not opened in the field.

Field blanks were prepared at the site of the collection of environmental samples, by pouring ASTM Type II reagent water into laboratory prepared sample bottles. These sample bottles were then handled in the same manner as environmental samples. Because field blanks accompany the environmental samples from the field to the laboratory, they are used to indicate the presence of external contaminants that may have been introduced into samples during collection and shipment.

Bailer wash samples were collected during the sampling day by pouring ASTM Type II reagent water into a cleaned bailer and then dispensing the water into sample bottles. Analyses of bailer washes are used to evaluate the adequacy of bailer decontamination procedures in preventing cross-contamination of samples between wells.

Field replicates were obtained by collecting two separate samples from the same monitoring station. Groundwater replicates were collected by filling one complete set of sample bottles, and then filling another set of sample

TABLE 4-10. BACKGROUND LEVELS OF PARAMETERS AT HANCOCK FIELD, NEW YORK

Parameter	Groundwater µg/L-organics mg/L-inorganics (MW-3)	Surface Water µg/L-organics mg/L-inorganics (SW-19)	Sediments mg/Kg (SD-19)	Soils mg/Kg (FS-I-1)
Priority Pollutant Metals				
Antimony	0.01u	0.2u	7.5u	0.21u
Arsenic	0.002	0.001u	15	5.6
Barium	0.11	NA	NA	NA
Beryllium	0.01u	0.005u	0.82	0.49
Boron	0.5u	NA	NA	NA
Cadmium	0.005*	0.005u	2.5	0.57
Calcium	110	NA	NA	NA
Chromium	0.05*	0.05u	28	10.2
Cobalt	0.1u	NA	NA	NA
Copper	0.05u	0.02u	52	22
Iron	0.9	NA	NA	NA
Lead	0.042u**	0.10u	7.8[c]	16
Manganese	3.3*	NA	NA	NA
Mercury	0.0002u	0.0002u	0.029u	0.062
Molybdenum	1.0u	NA	NA	NA
Nickel	0.05u	0.04u	27	10.7
Selenium	<0.001	0.002u	4.2	1.2
Silver	0.05u	0.01u	0.37u	0.21u
Sodium	30	NA	NA	NA
Thallium	0.5u	0.10u	1.8u	15u
Titanium	0.1u	NA	NA	NA
Vanadium	0.05u	NA	NA	NA
Zinc	0.4	0.005u	39[c]	37
Volatile Organic Compounds				
Benzene	0.2u	0.20u	0.0032u	0.0027u
Bromodichloromethane	0.10u	0.10u	0.0016u	0.0013u
Chloroform	0.05u	0.05u	0.0012u	0.0009u
1,2-Dichloroethane	0.03u	0.03u	0.0021u	0.0017u
Ethylbenzene	0.2u	0.20u	0.0054u	0.0044u
Methylene Chloride	0.25u	0.39[a]	0.0021u	0.0017u
1,1,2,2-Tetrachloroethane	0.03u	0.03u	0.0051u	0.0041u
1,1,1-Trichloroethane	0.03u	0.03u	0.0028u	0.0023u
Trichloroethylene	0.45	0.12u	0.0015u	0.0012u
Toluene	0.2u	0.20u	0.0045u	0.0037u
Xylene	NA	0.60u	NA	NA

(Continued)

TABLE 4-10. BACKGROUND LEVELS OF PARAMETERS AT HANCOCK FIELD, NEW YORK (Continued)

Parameter	Groundwater µg/L-organics mg/L-inorganics (MW-3)	Surface Water µg/L-organics mg/L-inorganics (SW-19)	Sediments mg/Kg (SD-19)	Soils mg/Kg (FS-I-1)
Other Compounds				
Petroleum Hydrocarbons (mg/L)	2.6[b]	2.6u[b]	52u	37u
bis (2-Ethylhexyl) Phthalate	10u	4.0u	0.22u	NA
Benzo(A)Pyrene	10u	2.0u	0.11u	NA
di-n-butyl Phthalate	10u	1.6u	0.11	NA
Pyrene	10u	2.0u	0.12	NA

NA = Not available.
u = Not detected at detection limit shown.
a = Methylene Chloride is a common laboratory contaminant, as recognized by the EPA CLP.
b = Values taken from trip blank.
c = Sampling station SD-16
* = Resampled December 1986.
** = Resampled September 1987.
NOTE: Background shown for shallow aquifer only because deep aquifer cannot be shown to be affected by the study sites (see Section 4.2.2). All soil and sediment data presented on a dry weight basis.

interest from interferences that may occur. In the analytical results for the sampling at Hancock Field, only compounds that also have been confirmed on the second column have been summarized. Impurities in the analytical system can account for contamination problems. This was avoided by running laboratory reagent blanks and method blanks. In addition, samples can be contaminated by diffusion of volatile organics into the sample during shipping and storage.

4.3.3.3 Extractable Priority Pollutants

The method used for the analysis of BNA priority pollutants is a GC/MS method and covers the determination of a number of organic compounds that are partitioned into an organic solvent and that are amenable to GC. Some interference is possible due to contamination in laboratory and analytical equipment, which can be avoided by running laboratory reagent and method blanks. The BNA parameters were analyzed for in the surface water samples at Hancock Field.

4.3.3.4 Heavy Metals

At Hancock Field, a variety of heavy metals in water were analyzed by atomic absorption spectrophotometry (AAS), while metals in soil and sediment were analyzed using inductively coupled argon plasma spectroscopy (ICP). For water, the method is applicable to both dissolved and suspended elements. For dissolved metals, the water samples were filtered before being acidified, to remove any suspended particles that could have resulted in erroneous results. For metals in soils and sediments, all samples were digested before being analyzed. Detection limits and sensitivity for soil and sediment analysis can vary with the matrices and the type of spectrometer being used. A variety of interferences, such as spectral, physical, and chemical interferences, are possible. During the analysis of the Hancock Field samples, this was avoided by proper use of analytical equipment and reagents and by preparation of field blanks, method blanks, and spike recovery techniques.

4.3.3.5 Volatile Organics

VOCs, including aromatic volatile organics and semivolatile organics, are associated with human activities and uses and typically are not found in areas unaffected by man. Because of their volatility, VOCs are often difficult to sample, especially when present at low levels. They are easily driven off during the sampling process or introduced as cross-contaminants during shipping and storage. The first step in the analysis of VOCs, irrespective of the particular matrix being considered, is the sample preparation and extraction step by a purge-and-trap method. GC/MS to analyze the compounds would be the next step. Aromatic volatile organics in water can be analyzed directly by the purge-and-trap procedure followed by GC. Method SW8240 also is used to determine VOCs and is particularly suited for soil samples, although it can be used for all types of solid waste samples. Interferences are possible impurities due to impurities in the analytical equipment or contamination of samples by diffusion of volatile organics into the sample.

4.3.3.6 Pesticides

Pesticide is a general term applied to insecticides, fungicides, herbicides, and rodenticides. The most persistent common pesticides are chlorinated compounds - the organochlorines, one group looked for in this study. Analyses also were performed for organophosphorus pesticides and chlorinated herbicides. Because these compounds do not occur naturally, any occurrence in the environment is as a result of human activities. All pesticides are analyzed using GC methods with detection limits in the parts per billion (ppb) range.

4.4 SITE-SPECIFIC RESULTS

The following sections present the site-specific field and laboratory results, and parallel the order specified in Appendix B, the Statement of Work. The analytical results summarized in these sections are presented in their entirety in Appendix H.

4.4.1 Zones 1 and 2, Existing Monitoring Wells MW-1 to MW-10

Nine of the 10 existing Stage 1 monitoring wells were purged and sampled in September 1986 as part of the initial field work for Stage 2. During purging, it was discovered that well MW-4 was damaged and no longer a valid monitoring well. The statement of work (SOW) subsequently was modified by the USAF Occupational and Environmental Health Laboratory (USAFOEHL) to abandon well MW-4 officially. Because of laboratory error, a portion of the September results were deemed invalid, and the nine wells were resampled in December 1986 and tested for cadmium, chromium, lead, manganese, and orthophosphate. Again, during the December sampling, holding times for mercury and orthophosphate were exceeded in some cases. Because of this, some of the wells were resampled in September 1987 for these two parameters.

The organic compounds detected in groundwater during this effort are shown in Table 4-11. Trichloroethylene (TCE) was the only organic chemical detected in both first and second column analyses. Five of the nine wells sampled were found to contain TCE, with the highest concentration (0.60 µg/L) found in well MW-9. No other organic compounds were detected in groundwater during this sampling round. However, the field blank prepared on the day well MW-9 was sampled contained a confirmed 0.25 ug/L of TCE. When considering this in the evaluation of the environmental sample, the actual levels of TCE in the groundwater would be substantially lower and of no environmental concern.

The inorganic compound analyses are shown in Table 4-12. Metals that were not detected in any of the wells sampled have not been reported in the table. A complete analytical summary is presented in Appendix H. Wells that were resampled for lead and orthophosphate in September 1987 showed no detectable quantities of the parameters, and hence are not shown in Table 4-12. All wells sampled were found to have iron concentrations exceeding the Federal Secondary drinking water standards. There is a direct correlation in these data between sample turbidity and some metals concentration. Because these samples were not filtered in the field, the nitric acid preservative was able to dissolve metals from the solids in the sample. Nonetheless, the sample from well MW-5, a flowing artesian well, was crystal clear and still exceeded the Federal Secondary drinking water standard for iron. This correlation does not hold for manganese, where highly turbid samples such as from wells MW-9 and MW-10 showed less manganese than the clear sample from MW-5. Certain other wells also were found to exceed the Primary and Secondary drinking water standards, as discussed below.

TABLE 4-11. SUMMARY OF ORGANIC COMPOUNDS DETECTED IN EXISTING WELLS, HANCOCK FIELD, NEW YORK
SEPTEMBER 1986

Parameter (µg/L)	Detection Limits (µg/L)	Published Standards or Criteria (µg/L)	MW-1	MW-2	MW-3	MW-5	MW-6	MW-7	MW-7 Duplicate	MW-8	MW-9	MW-10	Blank
Benzene	0.2	5.0[a]	ND	ND	ND	ND	ND	ND	1.8[e]	ND	ND	ND	1.7
1,1-Dichloroethane	0.07	5.0[a]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND[d]
Chloroform	0.05	100[b]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.6[d]
1,1,1-Trichloroethane	0.03	200[a]	ND	ND	ND	ND	ND	ND	0.14	ND	ND	ND	0.14[d]
Bromodichloromethane	0.10	100[b]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.31[d]
Trichloroethylene	0.12	5.0[a]	ND	ND	0.45	0.16	ND	ND	0.39	0.42	0.60	ND	0.25[d]
Tetrachloroethylene	0.03	0[c]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.038[d]

NOTES:

[a] Proposed MCL: Federal Register 50(219)46902

[b] The MCL for total trihalomethanes refers to the sum concentration of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.

[c] Proposed MCLG: Federal Register 50(210)46936

[d] Coeluting peaks determined on second column for two compounds, preventing positive confirmation when both those compounds are present, e.g., 1,1,1,TCA and TCE, bromodichloromethane and tetrachloroethylene, and chloroform and 1,1-dichloroethane.

[e] This result is unconfirmed because the second column analysis was not performed.

ND = Not Detected above detection limit shown.

The field measured parameters are provided in Table 4-12. The most notable value is relatively high specific conductance in well MW-8 (1,100 µmhos), which is discussed below.

Well MW-1--Well MW-1 is located cross-gradient (north) of Zone 2. Laboratory analysis of a groundwater sample from the well indicates that concentrations of iron, manganese, and TDS values exceeded Federal Secondary drinking water standards. The analysis also indicates the presence of cobalt, copper, and nickel, none of which were detected in other base monitoring wells. The nitrate nitrogen concentration was found to be nearly one order of magnitude higher than any other groundwater sample.

Well MW-2--Well MW-2 is located slightly upgradient (northwest) of Zone 2. Analysis of the groundwater from this well indicates that concentrations of arsenic, iron, manganese, and TDS exceed Federal Primary and Secondary drinking water standards.

Well MW-3--Well MW-3 is located upgradient (west) of Zone 2. Laboratory analysis showed TCE present, but at levels below both the EPA CAG 10^{-6} cancer risk estimates and the proposed MCL. The iron concentration exceeded Federal Secondary drinking water standards. The sulfate concentration within this well was noticeably higher in relation to most other wells on-base.

Well MW-5--Well MW-5 is located upgradient (southeast) of Zone 2. Laboratory analysis shows TCE values of just above the detection limit, but not exceeding proposed standards. The iron concentration in this well was found to be higher than Federal Secondary drinking water standards. The sulfate concentrations were also significantly above most other wells on-base.

Well MW-6--Well MW-6 is located downgradient (northeast) of Zone 2. Laboratory analysis of groundwater from this well showed the iron concentration to be in excess of Federal Secondary drinking water standards. The analysis also indicated the presence of molybdenum, an element that was not detected in any other well on-base. The oil and grease concentration in this well was somewhat higher than in other groundwater samples.

Well MW-7--Well MW-7 is located cross-gradient (southwest) of Zone 1. Laboratory analysis of groundwater from this well showed iron and manganese concentrations to be in excess of Federal Secondary drinking water standards. For QA/QC purposes, a duplicate groundwater sample was taken from well MW-7. The analysis showed that both samples were similar, except the duplicate showed quantifiable concentrations of TCE (0.39 µg/L) in excess of EPA CAG 10^{-6} cancer risk estimates.

Well MW-8--Well MW-8 is located downgradient (southeast) of Zone 1. Laboratory analysis indicates that TCE is present. EPA CAG 10^{-6} cancer risk estimates for TCE are not exceeded. Chloride, iron, and TDS values

TABLE 4-12. SUMMARY OF SAMPLING RESULTS, EXISTING WELLS, INORGANIC ANALYSIS, HANCOCK FIELD, NEW YORK, SEPTEMBER 1986

Parameter (mg/L)	Method	Detection Limit	Standards, Criteria, and Action Levels Federal and State	MW-1	MW-2	MW-3	MW-5	MW-6	MW-7	MW-7 Dup.	MW-8	MW-9	MW-10	Field Blank
Date sampled:				9/26	9/26	9/26	9/26	9/26			9/25	9/25	9/25	
pH				6.44	7.11	7.14	7.66	7.66	7.43	7.43	7.27	7.26	8.16	
Temperature (°C)				13	12	14	10	12.5	16	16	13	12	13	
Specific Conductance (μmhos)				718	795	665	490	455	438	438	1,100	420	260	
Bicarbonate-Alkalinity	A403	10	NA	180	510	360	200	200	262	290	290	330	145	4.6
Carbonate-Alkalinity	A403	1	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Alkalinity-Total	A403	10	NA	180	510	360	200	200	262	290	290	330	145	4.6
Aluminum	E200.7	0.1	NA	2.6	3.7	1.7	0.6	1.0	7.6	13	12	16	20	ND
Arsenic	E206.2	0.001	0.05	0.004	0.073	0.002	0.002	0.006	0.003	0.006	0.01	0.009	0.016	ND
Barium	E200.7	0.02	1.0[a]	0.04	0.4	0.11	0.04	0.08	0.10	0.15	0.35	0.24	0.51	ND
Cadmium	E200.7	0.005	0.01[a]	ND	ND	ND	ND	ND	ND	ND	ND	0.034	ND	ND
Calcium	E200.7	0.01	NA	110	120	110	64	57	110	110	120	120	120	1.4
Chloride	A429	1.0	250	26	180	54	52	54	13	12	400	9	8	ND
Copper	E200.7	0.05	1.0[a]	0.12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoride, Total	A429	0.1	1.4-2.4	0.58	0.65	0.25	0.12	0.16	0.39	0.48	0.30	0.72	0.37	ND
Iron	E200.7	0.007	0.3[a]	72	26	0.9	0.6	1.3	10	19	11	24	34	0.1
Lead	E239.2	0.042	0.05[a]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
Magnesium, Total	E200.7	0.03	NA	24	59	37	37	35	46	63	60	74	68	0.4
Manganese, Total*	E200.7	0.002	0.05[a]	1.5	0.47	0.003	0.014	0.026	0.054	0.051	0.033	0.077	0.031	ND
Molybdenum	E200.7	1.0	NA	ND	ND	ND	ND	1.0	ND	ND	ND	ND	ND	ND
Nickel, Total	E200.7	0.05	NA	0.06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ammonia Nitrogen	A429	0.01	NA	0.92	1.0	0.35	0.16	1.6	0.90	ND	0.50	ND	0.03	0.05
Nitrate Nitrogen	A429	0.01	10.0	3.4	ND	0.36	ND	ND	ND	ND	0.02	ND	ND	ND
Nitrite Nitrogen	A429	0.01	NA	0.03	0.04	ND	ND	ND	ND	0.04	0.02	ND	0.03	0.02
Oil & Grease (IR)	E413.2	1.0	NA	ND	ND	ND	ND	1.6	ND	ND	ND	ND	ND	ND
Ortho Phosphate**	A429	variable	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Potassium	E200.7	0.5	NA	3	5	1	ND	1	1	2	2	2	2	ND

(continued)

TABLE 4-12. SUMMARY OF SAMPLING RESULTS, EXISTING WELLS, INORGANIC ANALYSIS, HANCOCK FIELD, NEW YORK, SEPTEMBER 1986 (Continued)

Parameter (mg/L)	Method	Detection Limit	Standards, Criteria, and Action Levels Federal and State	MW-1	MW-2	MW-3	MW-5	MW-6	MW-7	MW-7 Dup.	MW-8	MW-9	MW-10	Field Blank
Selenium	E270.2	0.001-0.002	0.01[a]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.001
Sodium	E200.7	0.5	NA	21	45	30	13	13	6.1	5.6	150	4.5	5.4	ND
Total Dissolved Solids	E160.1	10	500	515	740	470	340	320	270	280	1100	360	200	12
Suspended Solids		1.0	NA	43	440	34	2.5	8.2	420	340	20	990	15	3.1
Sulfate	E200.7	0.5	250	57	13	130	110	100	38	35	84	24	90	ND
Titanium	E200.7	0.1	NA	ND	ND	ND	ND	0.1	0.2	0.9	0.6	0.7	1.3	0.1
Zinc	E200.7	0.1	5.0	0.6	0.8	0.4	0.2	0.3	0.5	0.8	0.5	0.6	0.6	ND

NOTES:
*Resampled and reanalyzed December 1986.
**Resampled and reanalyzed September 1987.
Only compounds that were detected have been reported in this table, except for Ortho Phosphate.
[a] Primary or Secondary Drinking Water Standard, Federal and State: MCL.
NA = Not Applicable.
ND = Not Detected at detection limit shown.

were in excess of Federal Secondary drinking water standards. The sodium concentration and specific conductance level in this well were elevated in comparison to the other wells on-base.

Well MW-9--Well MW-9 is located cross-gradient (northeast) of Zone 1. Laboratory analysis shows that TCE is present, but values do not exceed EPA CAG 10^{-6} cancer risk estimates. Also, iron, cadmium, and manganese concentrations exceeded Federal Primary and Secondary drinking water standards.

Well MW-10--Well MW-10 is located upgradient to cross-gradient (northwest) of Zone 1. Laboratory analysis indicates that iron concentration exceeded Federal Secondary drinking water standards.

TCE was the only organic contaminant found during the study. Of the five wells in which TCE was detected, all at less than 1 µg/L, only well MW-8 is in a downgradient position, and it is not in a direct flow path from any site. Therefore, the TCE appears to be unrelated to the sites under study, and may be indicative of a regional contamination problem. The concentrations detected average 0.4 µg/L, with the highest concentration being 0.6 µg/L. These levels are well below the EPA CAG 10^{-6} cancer risk estimates (2.8 µg/L) and the proposed MCL of 5.0 µg/L. Results of inorganic analyses appear to represent background conditions, except at well MW-8. Although all wells exceeded the Federal Secondary drinking water standard for iron and many exceeded the standard for manganese, these elements are almost certainly naturally occurring. The same is true for some other metals and TDS. As with organics, no inorganic contaminants can be tied to the sites under study.

The one notable exception to the above occurred at well MW-8. This well showed noticeably high concentrations of chloride, sodium, and TDS. This well is located just downhill from an old hard stand where the debris collected by road sweepers is dumped. Road salt (sodium chloride) may have leached from these sweepings and infiltrated the groundwater. Another possible explanation is that leakage is occurring from the highly mineralized bedrock aquifer to the shallow aquifer in this area, causing degradation in the quality of the shallow aquifer.

In summary, the general hydrogeologic setting described in the Stage 1 report has been confirmed, and additional data on hydraulic conductivities in Zone 2 have been obtained. The chemical analyses of groundwater conducted as part of the Stage 2 field activities, more detailed than in Stage 1, still fail to show any contamination that can be traced to the study sites. This may be due in part to the fact that few of the Stage 1 wells are located immediately downgradient of the sites.

4.4.2 Fire Training Area: Site FT-1

The Stage 2 investigation of Site FT-1 consisted of conducting a 30 point soil gas survey, collecting soil samples from 24 stations, and installing 3 monitoring well pairs surrounding the site. The new well pairs were sampled for rapid turnaround analysis to determine if additional wells were required; they were not.

The soil gas samples, which were collected by Target Environmental Services, were analyzed for benzene, toluene, xylenes, and total volatiles. The procedures used are discussed in Section 3.1.3 and the full soil gas report is contained in Appendix L. The soil gas sampling locations are shown in Figure 4-9 and the results are provided in Table 4-13.

Benzene, toluene, and total volatiles occurred in detectable concentrations in samples collected from 11 stations around Site FT-1. Xylene concentrations never exceeded the 2 ppb detection limit. Maps depicting concentrations of the detected parameters across the site and the detailed results and conclusions of the survey are presented in Appendix L.

A ring of high benzene concentrations was detected in the soils immediately adjacent to the concrete pad. Approximately 15 feet beyond the edge of the pad, benzene concentrations decrease considerably. The occurrence of contaminants appears to be entirely within the area enclosed by the earthen berm. A lobate extension of benzene at the 1 ppb concentration occurs immediately northwest of the pad. A minor amount of benzene contamination also was detected on the west side of Thompson Road at the approximate locations of well pair MW-12/12D.

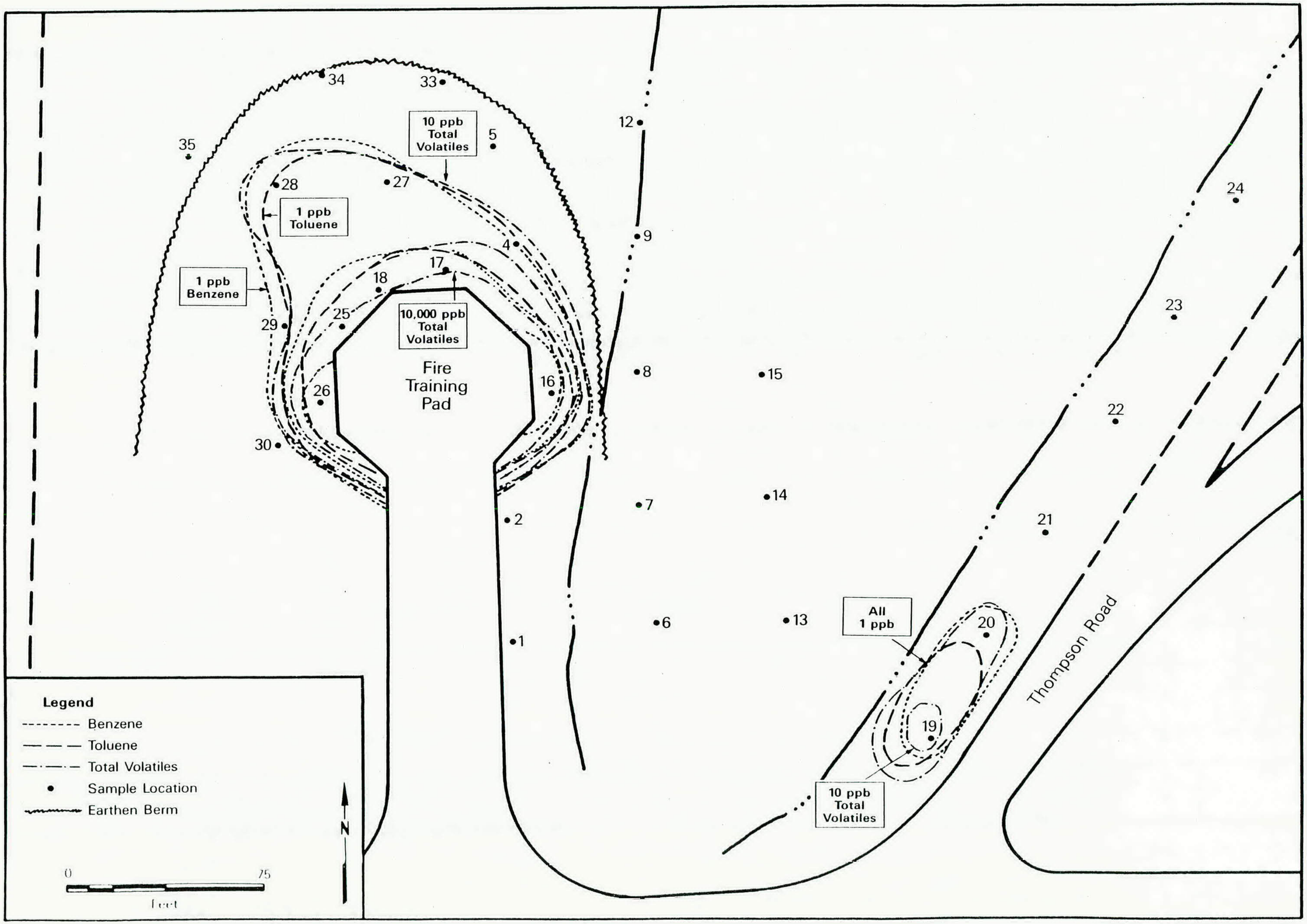

Figure 4-9. Soil Gas Results at FT-1

TABLE 4-13. LABORATORY RESULTS OF SOIL GAS SAMPLES,
HANCOCK FIELD, NEW YORK
(all ppb)

Sample	Benzene	Toluene	Xylenes	Total*
HF1	< 1	< 1	< 2	< 1
HF2	< 1	< 1	< 2	< 1
HF4	160	72	< 2	1,100
HF5	< 1	< 1	< 2	< 1
HF6	< 1	< 1	< 2	< 1
HF7	< 1	< 1	< 2	< 1
HF8	< 1	< 1	< 2	< 1
HF9	< 1	< 1	< 2	< 1
HF10	< 1	< 1	< 2	< 1
HF11	< 1	< 1	< 2	< 1
HF12	< 1	< 1	< 2	< 1
HF13	< 1	< 1	< 2	< 1
HF14	< 1	< 1	< 2	< 1
HF15	< 1	< 1	< 2	< 1
HF16	4,400	1,100	< 2	17,000
HF17	2,500	630	< 2	10,000
HF18	2,100	270	< 2	9,400
HF19	2	2	< 2	11
HF20	1	2	< 2	5
HF21	< 1	< 1	< 2	< 1
HF22	< 1	< 1	< 2	< 1
HF23	< 1	< 1	< 2	< 1
HF24	< 1	< 1	< 2	< 1
HF25	2,300	800	< 2	12,000
HF26	2,600	1,300	< 2	15,000
HF27	4	4	< 2	33
HF28	3	9	< 2	46
HF29	< 1	2	< 2	4
HF30	< 1	< 1	< 2	< 1
HF31	< 1	< 1	< 2	< 1
HF32	< 1	< 1	< 2	< 1
HF33	< 1	< 1	< 2	< 1
HF34	< 1	< 1	< 2	< 1
HF35	< 1	< 1	< 2	< 1

* Total represents an estimate based on the sum of all peaks and is calculated using the response factor of benzene.

The same general patterns of occurrence were obtained for toluene and total volatiles. For the most part, these substances were detected only in the soils enclosed by the earthen berm. The highest concentrations occur immediately east and west of the concrete pad.

Following the soil gas survey, a soil sampling grid was established, as shown in Figure 4-10. The SOW called for samples to be collected at 5-foot intervals to a depth of either 15 feet or to the water table, whichever occurred first. Because a perched water table was encountered at the depth of approximately 3 feet (see Section 4.2.2.1), only one sample was collected at each station. All samples were analyzed for:

- Petroleum hydrocarbons
- Lead
- Volatile organics.

These results are summarized in Tables 4-14 and 4-15. In addition, the 10 most contaminated samples, as judged from the soil gas results, also were analyzed for semivolatile organics (BNA) compounds. During the first round of sampling, holding times were exceeded for all 10 samples analyzed for semivolatile organics, which detect both polynuclear aromatic hydrocarbons (PNAs) and phthalate esters. Subsequently, all of the soils were resampled and analyzed; these results are included in Table 4-15.

The analytical results show that none of the volatile compounds detected in the soil gas survey were found in the soil samples. In fact, no volatiles were detected in soil during the initial sampling round in November 1986 nor during the resampling in August 1988. It is possible that volatiles were in the soils in 1986 and were not detected due to laboratory error. It is also possible that by 1988, the compounds detected in the soil gas had had sufficient time to volatilize. A more likely possibility is that small amounts of fuel seeped through the joints in the concrete hardstand during fire training activities and contributed volatiles to the soil vapor around the margins of the hardstand. In any case, soil gas was the only media where volatile organics were found, and they do not pose an unacceptable risk.

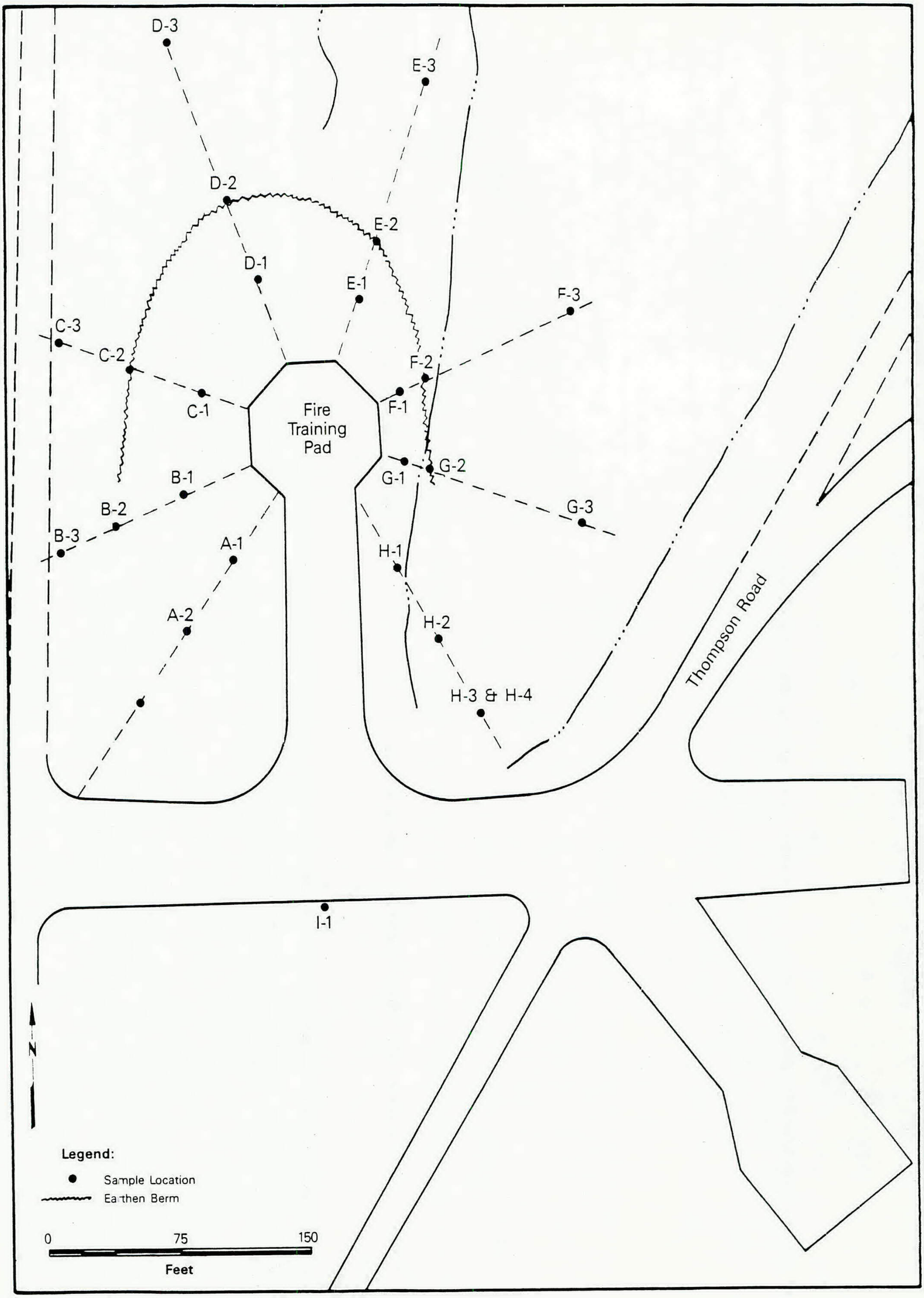

Figure 4-10. Soil Sampling Stations at FT-1

TABLE 4-14. SUMMARY OF RESULTS OF SOIL MONITORING FOR SITE FT-1, HANCOCK FIELD, NEW YORK

Parameter (units)	Method	Detection Limit	Standards, Criteria, and Action Levels Federal and State	FS-1-1 (Background)	FS-A-1	FS-A-2	FS-A-3	FS-A-4 (FS-A-3 DUP)	FS-B-2	FS-B-3	FS-C-3	FS-D-3	FS-E-3	FS-F-3	FS-G-2	FS-G-3	FS-H-1	FS-H-2	FS-H-3	FS-H-4 (FS-H-3 DUP)
Petroleum Hydrocarbons (mg/Kg)	SW3550/ E418.1	variable	NA	ND(30)^a	89	ND(29)	ND(29)	ND(30)	ND(30)	ND(33)	ND(30)	2300	48	ND(29)	*	110	ND(28)	99	ND(28)	ND(28)
Lead (mg/Kg)	SW3050/ SW7420	10	NA	13	8.8	9.1	11	12	8.6	7.7	6.9	120	15	7.1	37	11	6.7	14	9.4	6.5
Volatile Organics -GC/MS (mg/Kg)	SW5030/ SW8240	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

NOTE: All soil results reported on a dry weight basis.

ND = Not Detected at detection limit shown.
NA - Not Applicable.
* = Not analyzed for the above parameter.
a = Actual detection limit for the specific analyte.

TABLE 4-15. SUMMARY OF RESULTS OF SOIL MONITORING FOR SITE FT-1, HANCOCK FIELD, NEW YORK
DECEMBER 1986

Parameter (units)	Method	Detection Limit	Standards, Criteria, and Action Levels Federal	State	FS-B-1	FS-C-1	FS-C-2	FS-D-1	FS-D-2	FS-E-1	FS-E-2	FS-F-1	FS-F-2	FS-G-1
Petroleum Hydrocarbons (mg/Kg)	SW3550/ E418.1	variable	NA	NA	ND(31)	ND(27)	250	ND(26)	130	31	510	120	130	470
Lead (mg/Kg)	SW3050/ SW7420	10	NA	NA	9.6	11	14	11	15	12	19	11	12	11
Volatile Organics -GC/MS (mg/Kg)	SW5030/ SW8240	NA	NA	NA	ND	ND	ND	ND	ND	NA	NA	NA	NA	ND
Semivolatile Organics* -GC/MS (mg/Kg)	SW5030/ SW8270	As shown												
Anthracene		0.33	NA	NA	ND	1.1	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(A)Anthracene		0.33	NA	NA	0.66	1.3	0.88	1.8	ND	ND	ND	ND	ND	0.61
Benzo(A)Pyrene		0.33	NA	NA	ND	0.8	0.68	2.4	ND	ND	ND	ND	ND	0.5
Benzo(B)Fluoranthene		0.33	NA	NA	0.45	0.6	0.74	2.2	ND	ND	ND	ND	ND	0.46
Benzo(G, H, I)Perylene		0.33	NA	NA	ND	0.35	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(K)Fluoranthene		0.33	NA	NA	0.4	0.59	0.7	2.2	ND	ND	ND	ND	ND	0.4
bis (2-Ethylhexyl) Phthalate		0.33	NA	NA	ND	ND	2.3	0.56	ND	3.0	0.63	ND	ND	ND

TABLE 4-15. SUMMARY OF RESULTS OF SOIL MONITORING FOR SITE FT-1, HANCOCK FIELD, NEW YORK
DECEMBER 1986 (Continued)

Parameter (units)	Method	Detection Limit	Standards, Criteria, and Action Levels		FS-B-1	FS-C-1	FS-C-2	FS-D-1	FS-D-2	FS-E-1	FS-E-2	FS-F-1	FS-F-2	FS-G-1
			Federal	State										
Chrysene		0.33	NA	NA	0.64	1.2	0.84	1.6	ND	ND	ND	ND	ND	0.67
Fluoranthene		0.33	NA	NA	1.4	3.2	2.1	2.1	ND	ND	ND	ND	ND	1.4
Ideno (1,2,3-C,D) Pyrene		0.33	NA	NA	ND	0.45	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene		0.33	NA	NA	1.1	2.9	1.2	1.0	ND	ND	ND	ND	ND	0.79
Pyrene		0.33	NA	NA	1.7	2.9	2.4	4.5	ND	1.2	ND	ND	ND	1.3

NOTES:
All soil results reported on a dry weight basis, except for semivolatile organics which are reported on a wet weight basis.
NA = Not Applicable.
ND = Not Detected at detection limit shown.
* - resampled in September 1987 for semivolatile organics.

The analytical results further show that the contaminants of concern at this site are petroleum hydrocarbons, lead, phthalates, and various compounds classified as PNAs. Compounds detected from this group include:

- Anthracene
- Benzo(A)Anthracene
- Benzo(A)Pyrene
- Benzo(B)Fluoranthene
- Benzo(G,H,I)Perylene
- Benzo(K)Fluoranthene
- Chrysene
- Fluoroanthene
- Indeno(1,2,3-C,D)Pyrene
- Phenanthrene
- Pyrene.

These PNAs are not as well-studied as many environmental contaminants, but are known to be products of incomplete combustion of fuels, and are also components of asphalt and coal tar. They are known to range from noncarcinogenic (anthracene) to strongly carcinogenic (Benzo(A)Pyrene) (NAS 1972).

Bis (2-ethylhexyl) phthalate was the only phthalate detected at this site. The compound is used to soften plastics, and its presence at Site FT-1 is difficult to explain. It may be a relic from plastic materials that were set afire during fire training exercises, but is just as likely to have resulted from sample contamination by plastics.

The majority of the contamination found at Site FT-1 is contained within the earthen berm that surrounds the northern three quarters of the site. The exceptions are petroleum hydrocarbons at stations A-1, H-1, and D-3, and lead at station H-1.

Although no formally promulgated health criteria or standards exist for PNAs or phthalate esters in soil, it is possible to quantify the risks to human health due to exposure to contaminated soil. The exposure pathways of potential concern include direct ingestion of soil, inhalation of volatile compounds, inhalation of airborne contaminated soil particulates, and dermal contact with contaminated soil. In evaluating the significance of levels of PNAs and phthalates in soils at Site FT-1, the focus is on direct ingestion as the primary pathway of concern. There are several reasons for this: (1) the PNAs measured in soil and bis (2-ethylhexyl) phthalate (DEHP - the phthalate ester of greatest toxicological concern) are all low in vapor pressure and are bound tightly to the soil matrix; (2) the soils at Site FT-1 are wet and covered by vegetation; therefore, inhalation exposure to airborne particulates is not likely to be of significance; and (3) carcinogenic potency factors are available for evaluating the oral exposure route for DEHP and PNAs (USEPA 1986).

Quantity of soil ingested varies greatly as a function of age group. Young children below the age of 5 years may directly ingest from 1 to 10 grams of soil per day (Kimbrough et al. 1984). Intake for older individuals would be more indirect, associated with touching or wiping the face and mouth after coming in contact with soil. Daily intake levels are projected to be 0.1 grams for individuals 5 years and older.

To conduct an assessment of risk to human health associated with given levels of soil contamination, it is necessary to determine dose for the ingestion route of exposure. Ingested dose of a contaminant in soil may be defined as follows (USEPA 1984):

$$\text{Dose} = \frac{C_s \times \text{HIF}^{\text{ingestion}} \times \begin{array}{c}\text{Exposure}\\ \text{Duration}\end{array} \times \begin{array}{c}\text{Absorption}\\ \text{Factor}\end{array}}{\text{70-year Lifetime}} \qquad (1)$$

where: C_s = Concentration in soil (e.g., mg chemical/g soil)

$\text{HIF}^{\text{ingestion}}$ = Human intake factor for ingestion of soil (g soil/Kg body weight/day)

Exposure Duration = Total period of time of a 70-year lifetime during which human receptors come in contact with soil (days or years)

Absorption Factor = Fraction of ingested contaminant absorbed into blood stream (typically taken to be 100 percent in the absence of data).

The factor $\text{HIF}^{\text{ingestion}}$ must be calculated specifically for a given age group and period of exposure (e.g., short-term versus long-term/lifetime). In evaluating the circumstances at Site FT-1, it appears that only adults (assumed to be 18 to 70 years old) are at risk of exposure to contaminated soil. The factor $HIF^{ingestion}$ thus would be 0.0014 g soil/Kg/day (0.1 g soil day/70 Kg average body weight for 18- to 70-year old adults). Typically, the assessment of risk of exposure to carcinogenic compounds is based upon a lifetime (i.e., 70 years) exposure period (USEPA 1986). At Site FT-1, the exposure duration is taken to be only 52 years (i.e., ages 18 to 70). The absorption factor is assumed to be 100 percent (or 1.0) for all compounds under investigation. Substituting these data into equation (1), chronic daily dose estimates are determined for mean concentrations of all potential carcinogens in soils at Site FT-1.

For potentially carcinogenic compounds, risk to human health is expressed as the product of the chronic daily dose and the carcinogenic potency factor for a given compound (USEPA 1986):

$$R = \text{Dose} \times q_1^* \qquad (2)$$

where: Dose = Chronic daily intake for soil ingestion (mg/Kg/day)

q_1^* = Carcinogenic potency factor: the 95 percent upper bound estimate of the slope of the dose-response curve $(\text{mg/Kg/day})^{-1}$.

In this equation, R is an explicit estimate of excess lifetime cancer risk having a value between 0 and 1, and expresses the probability that the individual will get cancer over a lifetime of exposure at the specified dose level. In evaluating the risk of exposure to more than one carcinogenic compound, the risk values (R) for each chemical may be summed (in the absence of information on antagonistic or synergistic effects) to provide an overall estimate of total carcinogenic risk (USEPA 1986).

Of the compounds present in soil at Site FT-1, seven PNAs are potential or proven carcinogens. These PNAs are identified in Table 4-16. In addition, bis (2-ethylhexyl) phthalate is also a suspected carcinogen. The only PNA for which a carcinogenic potency factor is available is benzo(A)pyrene (11.5). In the absence of data, this q_1^* value will be assigned to the other PNAs under investigation. In doing this, the results are likely to be an overestimate of the true risks, given that benzo(A)pyrene is the most potent of the carcinogens detected at the site (Woo and Arcos 1981). Substituting calculated chronic daily doses and q_1^* values for the chemicals into equation (2), carcinogenic risk estimates are derived and presented in Table 4-16. The

TABLE 4-16. RISK CHARACTERIZATION FOR CARCINOGENS IN SOIL AT SITE FT-1, HANCOCK FIELD, NEW YORK: INGESTION EXPOSURE

Chemical	Mean Soil Concentration (µg/g)	Maximum Soil Concentration (µg/g)	Mean Chronic Ingestion Dose: Adults, 18 to 70 Years (mg/Kg/day)	Carcinogenic Potency Factor q,* $(\text{mg/Kg/day})^{-1}$	Individual Lifetime Carcinogeinc Risk 52-Year Exposure Period
Polynuclear Aromatic Hydrocarbons					
Benzo(A)Anthracene	0.525	1.8	5.25×10^{-7}	N/A[a](11.5)	6.0×10^{-6}
Benzo(A)Pyrene	0.438	2.4	4.38×10^{-7}	11.5	5.0×10^{-6}
Benzo(B)Fluoanthene	0.445	2.2	4.45×10^{-7}	N/A[a](11.5)	5.1×10^{-6}
Benzo(G,H,I)Perylene	0.035	0.35	3.5×10^{-8}	N/A[a](11.5)	4.0×10^{-7}
Benzo(K)Fluoranthene	0.429	2.2	4.29×10^{-7}	N/A[a](11.5)	4.9×10^{-6}
Chrysene	0.495	1.6	4.95×10^{-7}	N/A[a](11.5)	5.7×10^{-6}
Indeno(1,2,3-C,D)Pyrene	0.045	0.45	4.5×10^{-8}	N/A[a](11.5)	5.2×10^{-7}
Phthalates					
Bis (2-ethylhexyl) phthalate	0.649	3.0	6.49×10^{-7}	6.84×10^{-4}	4.4×10^{-10}
Combined Individual Lifetime Carcinogenic Risk Estimate					2.76×10^{-5}

N/A[a] = not available q,* value for benzo(A)pyrene has been used.

overall individual lifetime carcinogenic risk (summed across all chemicals) is calculated to be 6.12 x 10^{-5} (or an increased probability of 6.12 in 100,000 of getting cancer).

EPA guidance proposed for hazardous waste site evaluation is used in interpreting these results. In the remedial investigation/feasibility study (RI/FS) process under the Comprehensive Environmental Response, Compensation, and Liability Act/Superfund Amendments and Reauthorization Act (CERCLA/SARA), recent EPA guidance indicates that remedial alternatives should be refined as necessary to ensure that options considered span a carcinogenic risk range from 10^{-4} to 10^{-7} (USEPA 1986; Zamuda et al. 1986). The 10^{-6} risk level, however, often is chosen as the target risk within this range (Zamuda et al. 1986).

The risk characterization for Site FT-1 indicates a combined individual lifetime risk exceeding the 10^{-6} level for ingestion exposure to contaminated soil. However, the assessment was based on the worst-case assumptions that all PNAs present are as potent as benzo(A)pyrene, and that exposure is continuous over a 52-year period. Currently, there is no human exposure occurring at Site FT-1, and any future exposure is likely to be of limited duration and restricted to workers conducting cleanup or construction activities. Given these two facts, the actual risk to human health is likely to be on the order of 10^{-6} or less. It is concluded that projected lifetime risks of cancer are within the range of acceptability and do not constitute a significant threat to human health.

Lead was detected in the soil samples from Site FT-1 at levels ranging from 6.5 mg/Kg to 120 mg/Kg and averaging 16 mg/Kg. The level detected in the background soil sample (see Section 4.4.8) was 13 mg/Kg. Seven of the 26 samples had lead concentrations greater than background. The highest lead value, 120 mg/Kg, was found at sampling station D-3. This is also the station that had the highest petroleum hydrocarbon value (see below). Because these values were found at the sampling station farthest from the fire training area, with lower values in between, this occurrence may be from isolated waste dumping and not from fire training activities.

Petroleum hydrocarbons were detected at concentrations elevated over background at less than half of the sampling points (46 percent). With an average detection limit of 29 mg/Kg, levels detected ranged from 31 to 2,300 mg/Kg. No clear pattern of petroleum hydrocarbon occurrence in soils is revealed by these results. The highest value of 2,300 mg/Kg was found at the sampling station farthest from the actual training area (D-3). Other samples, such as C-1 and B-1, were high in both PNAs and phthalate esters, but no petroleum hydrocarbons were detected. Although the petroleum hydrocarbon test does not differentiate between compounds, and no standards or criteria exist for this parameter, it does serve as an indicator of contamination. The petroleum hydrocarbon results for Site FT-1 indicate that this parameter does not necessarily parallel other organic contamination patterns, and at least one value (D-3) does not appear to be site-related.

Following soil sample collection, three new well pairs were installed around Site FT-1, as shown in Figure 4-11. Each well pair consisted of a shallow well screened at the top of the water table aquifer, and a deep well screened at the top of the fractured bedrock aquifer. As discussed in Section 4.2, the deep wells show an upward hydraulic gradient from the deeper aquifer toward the water table aquifer. The deep wells further show that the flow directions in the two aquifer systems are nearly opposite one another. Thus, any contamination detected in the deep wells at Site FT-1 does not arise from the site, but from some other source to the southeast of Hancock Field. The contaminants found in the deep aquifer system, as listed in Table 4-17, were:

- 1,1,1-Trichloroethane (MW-11D)
- Toluene (MW-12D)
- Xylenes (MW-11D).

All of these compounds were detected at less than 5.5 µg/L, well below MCLs or MCLGs. Furthermore, 1,1,1-trichloroethane was detected at approximately the same concentration (0.2 µg/L) in the field blank as in well sample MW-11D (0.22 µg/L), and is thus not believed to represent environmental contamination.

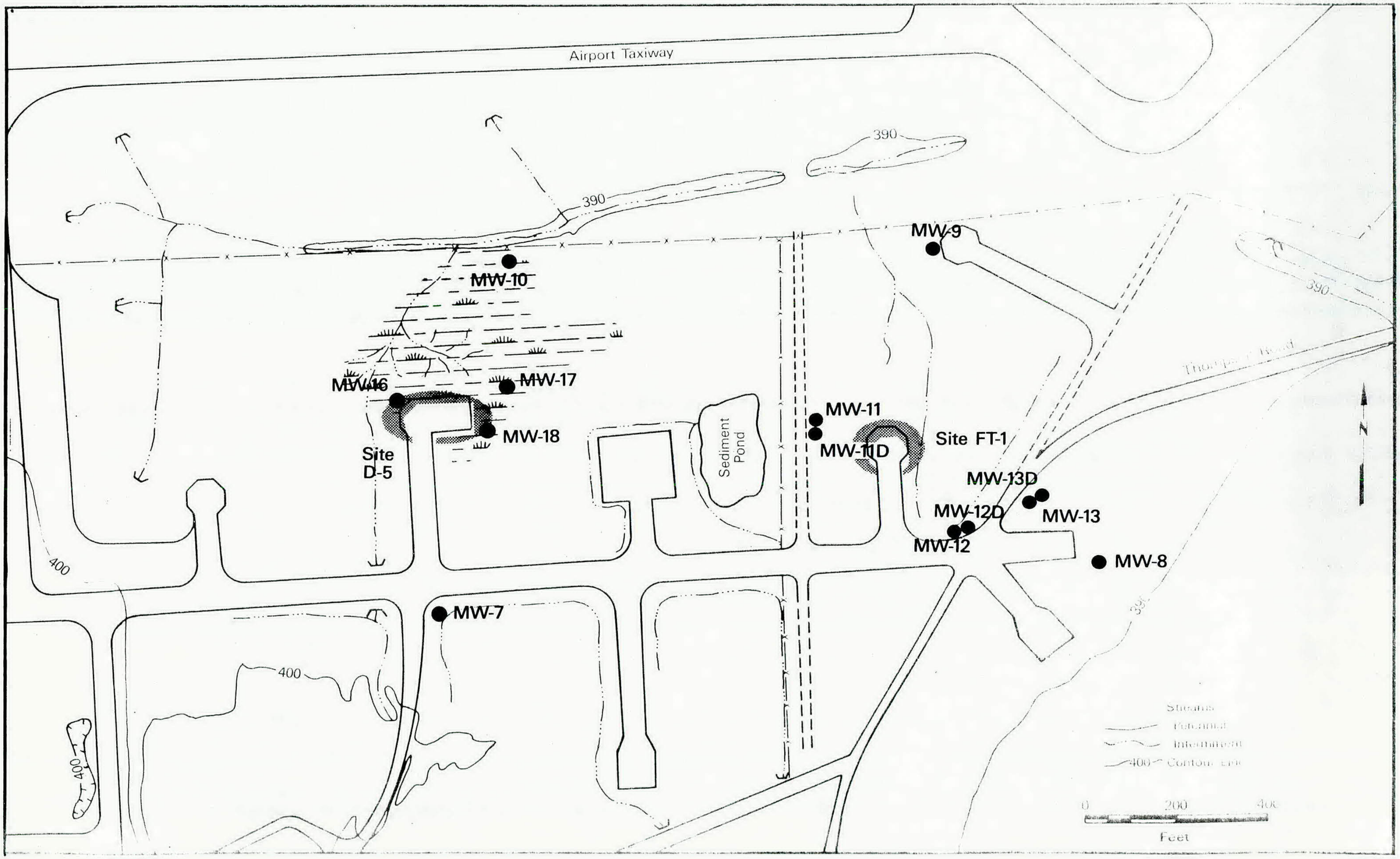

Figure 4-11. Zone 1 Monitoring Well Locations at Hancock Field

TABLE 4-17. SUMMARY OF RESULTS OF GROUNDWATER MONITORING FOR SITE FT-1, HANCOCK FIELD, NEW YORK

Parameter (mg/L)	Method	Detection Limit	Standards, Criteria, and Action Levels Federal and State	September 1986						January 1987								
Sample #				GW-11	GW-12	GW-13	GW-14	GW-15	GW-16	TB-1	GW-17	GW-18	GW-19	GW-20	GW-21	GW-22	GW-23	GW-24
Well #				MW-11	MW-11D	MW-12	MW-12D	MW-13	MW-13D	TRP BLK	MW-12	MW-12D	FLD BLK	BLR WSH	MW-11	MW-11D	MW-13	MW-13D
Field Parameters																		
Sp. Conductance (umhos/cm)	E120.1	NA	NA	820	3800	600	3600	810	5800	NR	590	3800	NR	NR	840	4000	830	5400
pH (standard units)	E150.1	NA	6.5 - 8.5[a]	6.7	7.5	6.8	6.8	6.9	6.6	NR	7.0	7.6	NR	NR	7.0	9.3	7.2	7.2
Temperature (C)	E160.1	NA	NA	10	9	10	10	11	11	NR	11	8	NR	NR	9	8	10	8
Petroleum Hydrocarbons (mg/L)	E418.1	0.5	NA	ND	0.80	2.0	1.9	6.8	3.3	2.6	5.3	4.8	4.8	4.9	10.0	5.2	11.0	4.9
Lead (mg/L)	E239.2	0.0019	0.05[a]	NR	NR	NR	NR	NR	NR	NR	0.010	0.0019	.0039	0.03	0.01	0.0022	0.0033	0.0025
Purgeable Halocarbons (ug/L)	E601																	
1,1,1-Trichloroethane		0.03	200[e]	ND	ND	ND	ND	ND	ND	NR	ND	ND	0.20	ND	0.06	0.22	0.22	ND
1,2-Dichloroethane		0.03	5[b]	ND	ND	ND	ND	ND	ND	NR	ND	ND	ND	ND	ND	ND	17	ND
Chloroform		0.05	100[c]	ND	0.06	ND	ND	ND	ND	NR	ND	ND	ND	0.05	0.10	ND	ND	ND
Methylene Chloride		0.24	0.19[d]	2.2	1.1	1.1	0.52	1.4	26	NR	1.1	ND	6.2	19	18	0.97*	0.80	0.53
Aromatic Volatile Organics (ug/L)	SW8020																	
Toluene[f]		0.20	200[e]	ND	0.70[g]	ND	0.40	ND	ND	NR	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes, total		0.60	440[e]	ND	5.30	ND	ND	ND	ND	NR	ND	ND	ND	ND	ND	1.0	ND	ND
Ethyl Benzene		0.2	680[e]	ND	1.4[g]	ND	ND	ND	ND	NR	ND	ND	ND	ND	ND	ND	ND	ND

NOTES:

* Confirmed at 0.97 ug/L in the second column analysis.

[a] Primary or Secondary Drinking Water Standard, Federal and State: Maximum Contaminant Level (MCL).

[b] Proposed MCL: Federal Register 50(219) 46902.

[c] The MCL for total trihalomethanes. Refers to the sum concentration of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.

[d] Ambient water quality criteria adjusted for toxicants in aquatic organisms and drinking water.

[e] Proposed Maximum Concentration Level Goal (MCLG): Federal Register 50(210) 46936.

[f] Lab Blank for samples GW-11 through GW-16 contained 0.5 ug/L of toluene.

[g] Cannot be confirmed because of coeluting peaks on second column.

NA = Not Applicable.

NR - Not Requested.

ND = Not Detected at detection limit shown.

Contamination detected in the shallow monitoring wells in January 1987 included:

- Petroleum hydrocarbons (wells MW-11 and MW-13)
- 1,1,1-Trichloroethane (wells MW-11 and MW-13)
- 1,2-Dichloroethane (well MW-13)
- Chloroform (well MW-11).

The petroleum hydrocarbons were nearly identical in upgradient well MW-11 (10 mg/L) as in downgradient well MW-13 (11 mg/L). This indicates that Site FT-1 is not contributing significant amounts of petroleum hydrocarbons to the shallow groundwater. No standards or criteria have been established for petroleum hydrocarbons by which to evaluate the significance of the concentrations detected here.

The 1,1,1-trichloroethane concentrations found in wells MW-11 and MW-13 (0.06 µg/L and 0.22 µg/L, respectively), and confirmed by second column analysis, are comparable to those concentrations found in the field blank collected during the second sampling round in January 1987 (0.20 µg/L). Also, concentrations for this contaminant were slightly higher upgradient of Site FT-1 than downgradient. For these reasons, 1,1,1-trichloroethane does not appear to be site-related. Furthermore, the concentrations found were well below the proposed MCL of 200 µg/L for 1,1,1-trichloroethane.

The 17 µg/L of 1,2-dichloroethane found and confirmed in well MW-13 is an enigma. It was not detected in any sample during the first round of sampling, and, though detected at the same concentration in well MW-11, was not confirmed by second column analysis. Therefore, although the presence of 1,2-dichloroethane is not readily explainable, it does not appear to represent environmental contamination.

Chloroform was detected in the sample from well MW-11 (0.1 µg/L), and in the bailer wash sample (0.05 µg/L) poured at the same time. The contaminant was confirmed by second column analysis in only the bailer wash and MW-11. Because well MW-11 is clearly upgradient and the values between the two confirmed results are similar, this is not believed to represent site-related environmental contamination. These concentrations are also well below the EPA CAG 10^{-6} cancer risk level of 5 µg/L.

In summary, the only quantifiable contamination at Site FT-1 is in shallow soils surrounding the site. As discussed above, the combined individual lifetime carcinogenic risk estimate for these soil contaminants is 6.12×10^{-5}. Based on the conservative nature of this estimate, and the fact that there is no public access to Site FT-1, the soil contamination found does not represent unacceptable risk. The VOCs detected in soil gas were not found in the soils themselves nor in surface water runoff or groundwater. Since human and nonhuman contact with these compounds is not possible, the risk associated with these compounds is negligible.

4.4.3 Surface Water and Sediments: Zones 1 and 2

Twenty-one surface water and sediment samples, and two duplicate samples, were collected along major drainage pathways during the Stage 2 field program to evaluate the effects of surface runoff draining the study sites. Figures 4-12 and 4-13 present the surface water and sediment sampling stations for Zones 1 and 2, respectively. Surface water samples were analyzed for:

- Specific conductance (field)
- pH (field)
- Temperature (field)
- Petroleum hydrocarbons
- Purgeable halocarbons
- Aromatic volatile organics
- Priority pollutant metals
- Extractable priority pollutants.

Sediment samples were analyzed for:

- Petroleum hydrocarbons
- Priority pollutant metals
- Volatile organics
- Semivolatile organics.

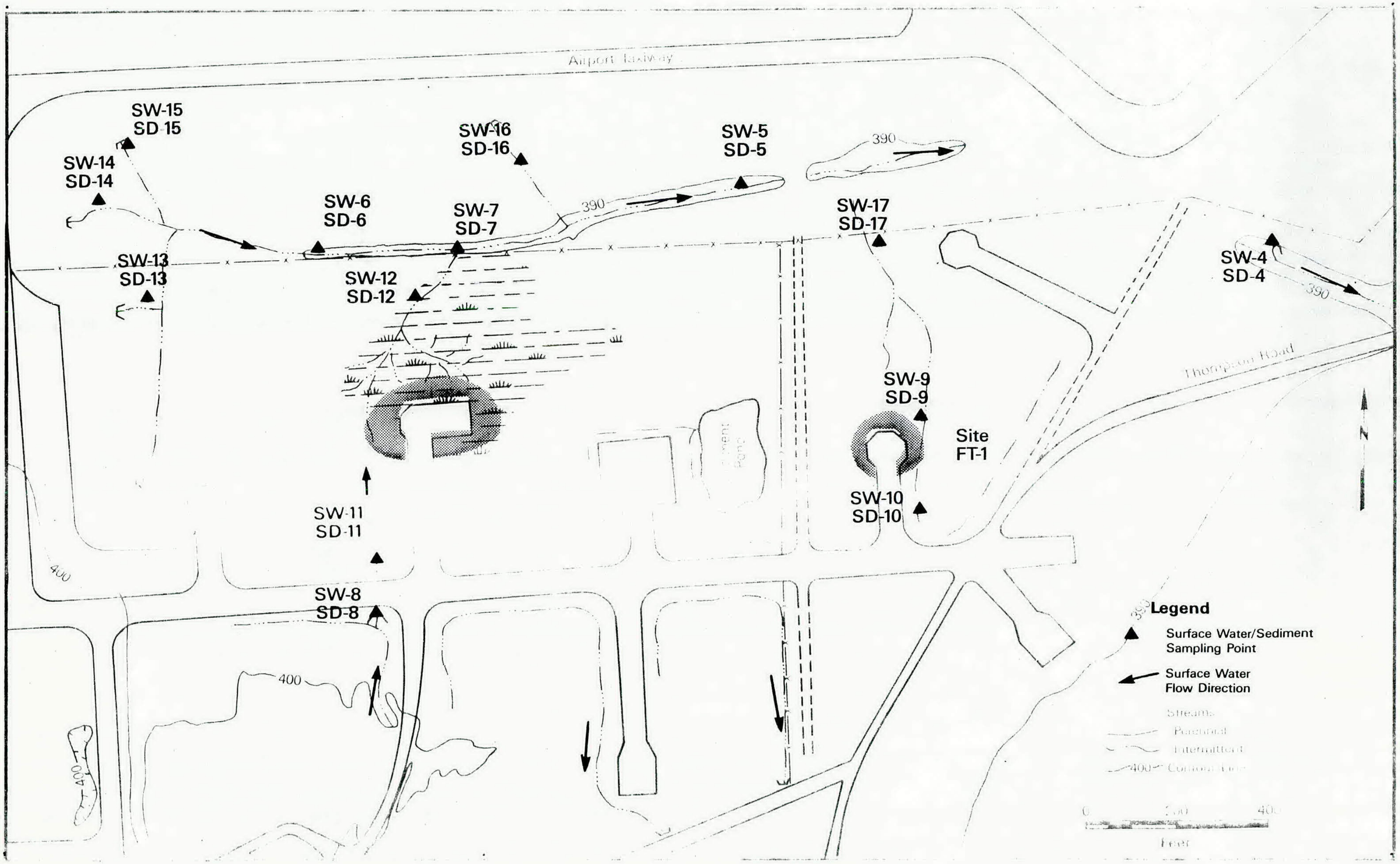

Figure 4-12. Surface Water/Sediment Sampling Points, Zone 1 at Hancock Field

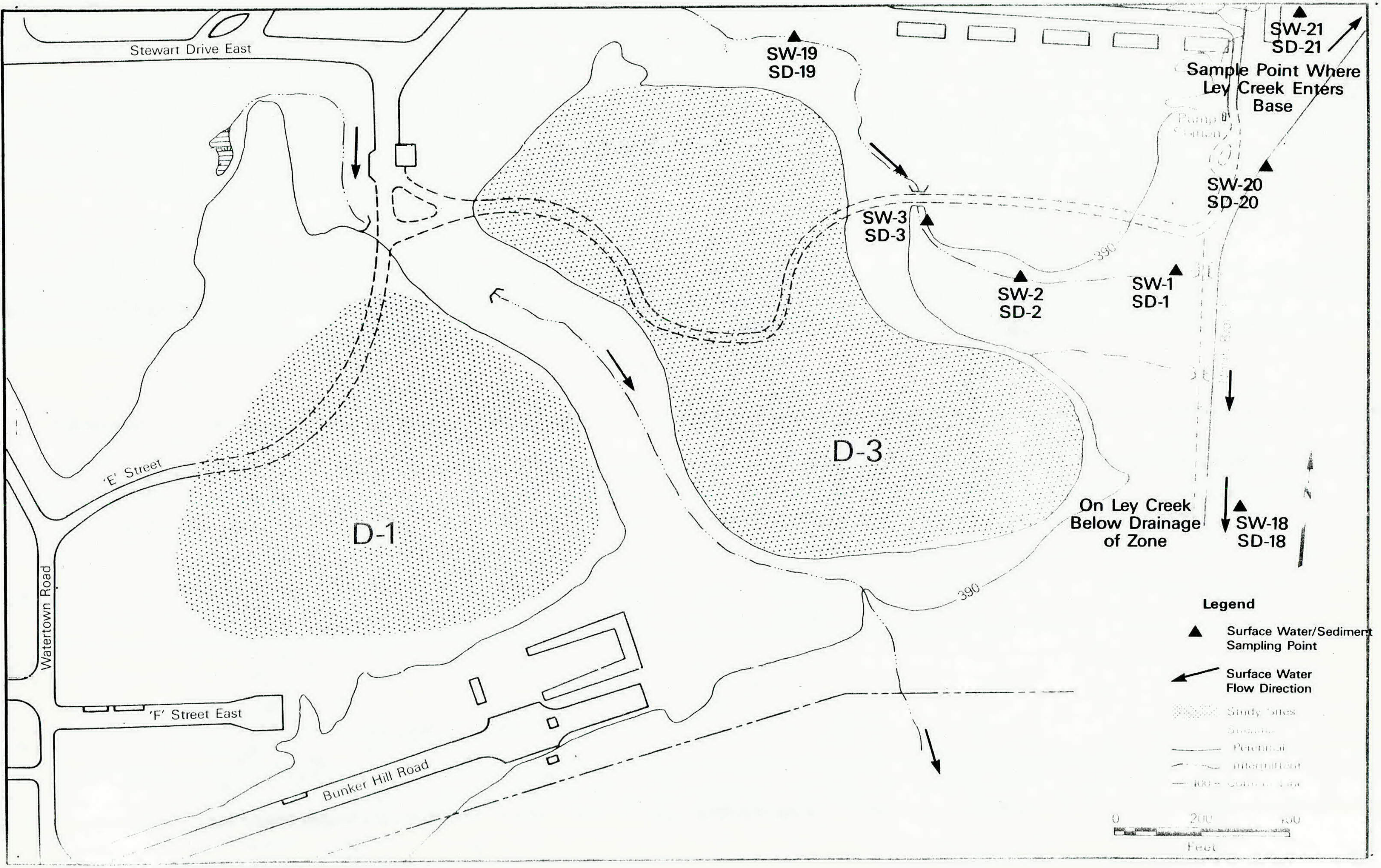

Figure 4-13. Zone 2 Surface Water/Sediment Sampling Point Locations at Hancock Field

The results of these analyses are summarized in Tables 4-18 through 4-21. Only those metals detected in surface waters are shown in Tables 4-18 and 4-20.

Surface Water: Zone 1

A variety of organic chemical compounds and metals were detected in surface waters collected from Zone 1, including:

- 1,1,1-Trichloroethane (SW-6, SW-7, SW-13)
- Polynuclear aromatics (SW-9, SW-10, SW-12)
- Bis (2-ethylhexyl) phthalate (SW-9, SW-10)
- Copper (SW-9, SW-10, SW-12)
- Zinc (SW-8, SW-9, SW-10, SW-11, SW-12, SW-13).

The 1,1,1-trichloroethane was detected in only three of the samples. This, in addition to the fact that similar levels of this compound were found in field blanks, suggests sampling train or laboratory contamination rather than true environmental contamination. During the Phase II, Stage 1 studies, halogenated organics were detected in all surface water samples. It was concluded that because of the high levels of halogenated organics detected in some samples, environmental contamination was indicated in surface water in Zone 1 (which contrasts with the conclusion presented here); however, the source of the halogenated organics was not apparent from the results of Stage 1 sampling and analysis. Methylene chloride was detected in almost all of the samples, but was also found at higher levels in the trip blank associated with the samples, and therefore can be considered to be a sampling artifact.

Zinc has been detected at rather low concentrations, ranging from 0.037 to 0.7 mg/L, in surface waters. Zinc naturally occurs in soil, and background levels have been observed at 26 mg/Kg in sediment and 330 mg/Kg in soil (see Table 4-10). It appears that zinc from the soil and sediment has entered the surface water, which could account for the low concentrations of zinc detected in the surface water.

TABLE 4-18. SUMMARY OF RESULTS OF SURFACE WATER MONITORING FOR ZONE 1, HANCOCK FIELD, NEW YORK

Parameter (units)	Method	Detection Limit	Standards, Criteria, and Action Levels Federal and State	SW-4	SW-4(D) SW-22	SW-5	SW-6	SW-7	SW-8	SW-9	SW-10	SW-11	SW-12	SW-13	SW-14	SW-24 (Trip Blk)	SW-15	SW-16	SW-17[e]
Field Parameters																			
Sp. Conductance (umhos/cm)	E120.1	--	NA	590	590	470	460	350	400	500	200	425	340	355	450		400	350	580
pH (standard units)	E150.1	--	6.5 - 8.5[a]	6.5	6.5	6.8	6.5	6.6	6.8	6.7	6.5	6.7	6.6	6.5	6.8		6.9	6.7	6.6
Temperature (C)	E170.1	--	NA	6	6	2	2	2	2	1	1	4	2	3	2		2	2	1
Petroleum Hydrocarbons (mg/L)	E418.1	0.5	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Purgeable Halocarbons (ug/L)	E601																		
1,1,1-Trichloroethane		0.03	200[b]	ND	ND	ND	0.31	0.7	ND	ND	ND	ND	ND	ND	2.1	ND	ND	ND	ND
Chloroform		0.05	5.0[c]	ND	ND	ND	ND	ND	0.05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride		0.25	0.19[e]	0.83	78	6.6	20	16	4.7	0.44	4.6	0.41	15	5	5.9	99	62	67	0.49
Aromatic Volatile Organics (ug/L)	SW5030/ SW8020			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Priority Pollutant Metals (mg/L)	E200.7																		
Copper		0.02	1.0[a]	ND	ND	ND	ND	ND	ND	0.41	.061	ND	.040	ND	ND	ND	ND	ND	NR
Zinc		0.005	5.0[a]	ND	ND	ND	ND	ND	0.037	0.11	0.15	.046	0.70	.015	ND	ND	ND	ND	NR
Extractable Priority Pollutants-GC/MS (ug/L)	E625																		
Benzo(A)Anthracene		4.0	0.0028[d]	ND	ND	ND	ND	ND	ND	ND	6.1	ND	ND	ND	ND	ND	ND	ND	NR
Benzo(A)Pyrene		2.0	0.0028[d]	ND	ND	ND	ND	ND	ND	ND	4.7	ND	ND	ND	ND	ND	ND	ND	NR
Benzo(B)Fluoranthene		2.0	0.0028[d]	ND	ND	ND	ND	ND	ND	ND	8.1	ND	ND	ND	ND	ND	ND	ND	NR
bis(2-Ethylhexyl)Phthalate		4.0	0.015[d]	ND	ND	ND	ND	ND	ND	17	7.8	ND	ND	ND	ND	ND	ND	ND	NR
Chrysene		2.0	0.0028[d]	ND	ND	ND	ND	ND	ND	ND	8.3	ND	3.2	ND	ND	ND	ND	ND	NR
Fluoroanthene		2.0	0.0028[d]	ND	ND	ND	ND	ND	ND	ND	10	ND	7.1	ND	ND	ND	ND	ND	NR
Phenanthrene		2.0	0.0028[d]	ND	ND	ND	ND	ND	ND	ND	6.2	ND	3.3	ND	ND	ND	ND	ND	NR
Pyrene		2.0	0.0028[d]	ND	ND	ND	ND	ND	ND	ND	18	ND	5.6	ND	ND	ND	ND	ND	NR
Di-N-Butyl Phthalate		1.6	34,000.[d]	ND	ND	ND	ND	ND	4.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	NR

NOTES:

NA = Not Applicable.

ND = Not Detected at detection limit shown.

NR - Not Requested.

[a] Primary or Secondary Drinking Water Standard, Federal and State: Maximum Contaminant Level (MCL).

[b] Safe Drinking Water Act, Maximum Concentration Level Goal (MCLG) .

[c] The MCL for total trihalomethanes. Refers to the sum concentration of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.

[d] Ambient water quality criteria adjusted for toxicants in aquatic organisms and drinking water.

[e] Analyses misidentified on chain-of-custody forms. Resampling impossible due to dry conditions.

TABLE 4-19. SUMMARY OF RESULTS OF SEDIMENT MONITORING FOR ZONE 1, HANCOCK FIELD, NEW YORK

Parameter (units)	Method	Detection Limit	Background Level	Health-based Guidelines*	SD-4**	SD-4(D) SD-22	SD-5**	SD-6**	SD-7**	SD-8
Petroleum Hydrocarbons (mg/Kg)	SW3550/ E418.1	variable	NA	NA	1500	ND(2000)	35	ND(37)	ND(31)	300
Priority Pollutant Metals (mg/Kg)	SW3050/ SW6010	variable								
Arsenic			10	0.063	4.4	7.1	11	3.3	2.7	6.5
Cadmium			1.7	273	1.7	2.3	0.84	0.59	0.33	4.0
Chromium			19	4,712	12	17	13	7.5	7.1	16
Copper			35	34,865	98	98	12	17	2.7	22
Lead			5.2	1,319	100	101	7.3	6.3	3.6	75
Mercury (CVAA)			0.051	1,885	0.11	ND	0.1	0.02	0.04	ND
Nickel			18	9,423	12	12	13	10	5.4	15
Selenium			2.8	2,827	1.1	ND	3.1	0.82	2.8	3.7
Thallium			ND	377	ND	ND	ND	ND	ND	ND
Zinc			26	197,885	89	89	61	28	46	97
Volatile Organics (GC/MS)	SW5030/ SW8240	variable		NA	ND	ND	ND	ND	ND	ND
Semivolatile Organics-GC/MS (mg/Kg)	SW3550/ SW8270									
Anthracene		as shown	NA	NA	3.5	NR	ND(0.11)	ND(0.12)	ND(0.10)	3.6
Benzo(A)Anthracene		as shown	NA	NA	20	NR	ND(0.22)	0.63	0.96	13.9
Benzo(A)Pyrene		as shown	NA	0.063	14.1	NR	ND(0.11)	0.68	0.76	11.1
Benzo(B)Fluoranthene		as shown	NA	NA	16	NR	ND(0.11)	ND(0.12)	0.77	11.3
Benzo(G,H,I)Perylene		as shown	NA	NA	8.8	NR	ND(0.22)	0.38	0.36	6.9
Benzo(K)Fluoranthene		as shown	NA	NA	6.8	NR	0.44	0.77	0.57	7.7
bis (2-Ethylhexyl) Phthalate		as shown	NA	1,378	4	NR	ND(0.22)	ND(0.23)	1.62	0.65
Chrysene		as shown	NA	NA	19	NR	0.48	ND(0.12)	0.97	14.8
di-N-Butyl Phthalate		as shown	NA	94,231	0.25	NR	ND(0.09)	ND(0.09)	ND(0.08)	0.129

NOTE: see notes on last page.

(Continued)

TABLE 4-19. SUMMARY OF RESULTS OF SEDIMENT MONITORING FOR ZONE 1, HANCOCK FIELD, NEW YORK
(Continued)

Parameter (units)	Method	Detection Limit	Background Level	Health-based Guidelines*	SD-4**	SD-4(D) SD-22	SD-5**	SD-6**	SD-7**	SD-8
di-N-Octyl Phthalate		as shown	NA	NA	ND(0.11)	NR	0.18	ND(0.12)	ND(0.10)	ND(0.12)
Dibenzo(A,N)Anthracene		as shown	NA	NA	ND(0.11)	NR	ND(0.11)	ND(0.12)	ND(0.10)	1.6
Fluorene		as shown	NA	NA	2.3	NR	ND(0.11)	ND(0.12)	ND(0.10)	0.95
Fluoroanthene		as shown	NA	NA	26	NR	0.48	1.48	1.22	13.9
Indeno(1,2,3-C,D)Pyrene		as shown	NA	NA	8.4	NR	ND(0.11)	0.42	0.36	7.5
Naphthalene		as shown	NA	NA	ND(0.11)	NR	ND(0.11)	ND(0.12)	ND(0.10)	ND(0.12)
Phenanthrene		as shown	NA	NA	23	NR	0.18	0.78	0.85	14.8
Pyrene		as shown	NA	NA	25	NR	0.97	1.85	ND(0.10)	16

NOTE: see notes on last page.

(Continued)

TABLE 4-19. SUMMARY OF RESULTS OF SEDIMENT MONITORING FOR ZONE 1, HANCOCK FIELD, NEW YORK (Continued)

Parameter (units)	Method	Detection Limit	Background Level	Health-based Guidelines*	SD-9	SD-10	SD-11	SD-12	SD-13	SD-14**
Petroleum Hydrocarbons (mg/Kg)	SW3550/ E418.1	variable	NA	NA	ND(36)	ND(39)	720	ND(49)	ND(32)	ND(31)
Priority Pollutant Metals (mg/Kg)	SW3050/ SW6010	variable								
Arsenic			10	0.063	3.9	5.7	8.0	5.3	3.4	3.4
Cadmium			1.7	273	0.5	0.62	6.6	1.9	0.3	0.23
Chromium			19	4,712	9.9	11	25	11	3.1	5.1
Copper			35	34,865	10	13	34	15	3.7	8.2
Lead			5.2	1,319	27	33	150	32	5.8	3.4
Mercury (CVAA)			0.051	1,885	0.053	0.082	0.044	ND	ND	0.022
Nickel			18	9,423	6.7	10	21	8.6	2.3	6
Selenium			2.8	2,827	3.8	3.7	4.3	6.9	ND	ND
Thallium			ND	377	ND	ND	ND	ND	ND	ND
Zinc			26	197,885	36	48	330	190	28	18
Volatile Organics-GC/MS	SW5030/ SW8240			NA	ND	ND	ND	ND	ND	ND
Semivolatile Organics-GC/MS (mg/Kg)	SW3550/ SW8270									
Anthracene		as shown	NA	NA	ND(0.12)	0.51	17.11	0.17	ND(0.11)	ND(0.10)
Benzo(A)Anthracene		as shown	NA	NA	ND(0.234)	2.46	55	1.04	1.10	ND(0.19)
Benzo(A)Pyrene		as shown	NA	0.063	ND(0.12)	1.80	53	0.85	1.13	ND(0.10)
Benzo(B)Fluoranthene		as shown	NA	NA	ND(0.12)	2.79	58	1.87	0.30	0.15
Benzo(G,H,I)Perylene		as shown	NA	NA	ND(0.24)	0.64	34	ND(0.33)	ND(0.22)	ND(0.19)
Benzo(K)Fluoranthene		as shown	NA	NA	ND(0.12)	1.34	29	ND(0.16)	ND(0.11)	ND(0.10)
bis (2-Ethylhexyl) Phthalate		as shown	NA	1,378	ND(0.24)	ND(0.24)	ND(0.40)	1.00	ND(0.22)	ND(0.19)

NOTE: see notes on last page.

(Continued)

TABLE 4-19. SUMMARY OF RESULTS OF SEDIMENT MONITORING FOR ZONE 1, HANCOCK FIELD, NEW YORK
(Continued)

Parameter (units)	Method	Detection Limit	Background Level	Health-based Guidelines*	SD-9	SD-10	SD-11	SD-12	SD-13	SD-14**
Chrysene		as shown	NA	NA	ND(0.12)	2.13	ND(0.20)	1.67	0.26	0.18
di-N-Butyl Phthalate		as shown	NA	94,231	0.17	ND(0.09)	ND(0.16)	0.24	ND(0.09)	ND(0.08)
di-N-Octyl Phthalate		as shown	NA	NA	ND(0.12)	ND(0.12)	6.31	2.61	ND(0.11)	ND(0.10)
Dibenzo(A,H)Anthracene		as shown	NA	NA	ND(0.12)	ND(0.12)	ND(0.20)	ND(0.16)	ND(0.11)	ND(0.10)
Fluorene		as shown	NA	NA	ND(0.12)	ND(0.12)	6.31	ND(0.16)	ND(0.11)	ND(0.10)
Fluoroanthene		as shown	NA	NA	1.54	5.90	97	3.48	0.32	0.23
Indeno(1,2,3-C,D)Pyrene		as shown	NA	NA	ND(0.12)	0.70	32	ND(0.16)	ND(0.11)	ND(0.10)
Naphthalene		as shown	NA	NA	ND(0.12)	ND(0.12)	1.03	ND(0.16)	ND(0.11)	ND(0.10)
Phenanthrene		as shown	NA	NA	0.69	2.95	7.89	1.22	ND(0.11)	ND(0.10)
Pyrene		as shown	NA	NA	1.13	3.93	84	3.04	0.41	0.27

NOTE: see notes on last page.

(Continued)

TABLE 4-19. SUMMARY OF RESULTS OF SEDIMENT MONITORING FOR ZONE 1, HANCOCK FIELD, NEW YORK
(Continued)

Parameter (units)	Method	Detection Limit	Background Level	Health-based Guidelines*	SD-15	SD-16	SD-17[a]
Petroleum Hydrocarbons (mg/Kg)	SW3550/ E418.1	variable	NA	NA	ND(34)	ND(30)	ND(31)
Priority Pollutant metals (mg/Kg)	SW3050/ SW6010	variable					
Arsenic			10	0.063	5.2	5.5	NR
Cadmium			1.7	273	0.45	0.27	NR
Chromium			19	4,712	16	9.8	NR
Copper			35	34,865	19	13	NR
Lead			5.2	1,319	10	5.2	26
Mercury (CVAA)			0.051	1,885	ND	ND	NR
Nickel			18	9,423	17	11	NR
Selenium			2.8	2,827	2.4	2.8	NR
Thallium			ND	377	ND	ND	NR
Zinc			26	197,885	40	26	NR
Volatile Organics-GC/MS	SW5030/ SW8240		NA	NA	ND	ND	NR
Semivolatile Organics-GC/MS (mg/Kg)	SW3550/ SW8270						
Anthracene		as shown	NA	NA	ND(0.10)	ND(0.10)	NR
Benzo(A)Anthracene		as shown	NA	NA	ND(0.20)	ND(0.16)	NR
Benzo(A)Pyrene		as shown	NA	0.063	ND(0.10)	ND(0.10)	NR
Benzo(B)Fluoranthene		as shown	NA	NA	ND(0.10)	ND(0.10)	NR
Benzo(G,H,I)Perylene		as shown	NA	NA	ND(0.20)	ND(0.16)	NR
Benzo(K)Fluoranthene		as shown	NA	NA	ND(0.10)	ND(0.10)	NR
Bis (2-Ethylhexyl) Phthalate		as shown	NA	1,378	ND(0.20)	ND(0.16)	NR
Chrysene		as shown	NA	NA	ND(0.10)	ND(0.10)	NR
di-N-Butyl Phthalate		as shown	NA	94,231	0.14	ND(0.08)	NR
di-N-Octyl Phthalate		as shown	NA	NA	1.78	7.27	NR

NOTE: see notes on last page.

(Continued)

TABLE 4-19. SUMMARY OF RESULTS OF SEDIMENT MONITORING FOR ZONE 1, HANCOCK FIELD, NEW YORK
(Continued)

Parameter (units)	Method	Detection Limit	Background Level	Health based Guidelines*	SD-15	SD-16	SD-17[a]
Dibenzo(A,h)Anthracene		as shown	NA	NA	ND(0.10)	ND(0.10)	NR
Fluorene		as shown	NA	NA	ND(0.10)	ND(0.10)	NR
Fluoranthene		as shown	NA	NA	ND(0.10)	ND(0.10)	NR
Indeno(1,2,3-C,D)Pyrene		as shown	NA	NA	ND(0.10)	ND(0.10)	NR
Naphthalene		as shown	NA	NA	ND(0.10)	ND(0.10)	NR
Phenanthrene		as shown	NA	NA	ND(0.10)	ND(0.10)	NR
Pyrene		as shown	NA	NA	ND(0.10)	ND(0.10)	NR

NOTES:

All soil results reported on a dry weight basis.
(D) = Duplicate.
NA = Not Available.
ND = Not Detected at detection limit shown.
NR = Not Requested.
[a] - Analysis misidentified on chain-of-custody forms. Resampling impossible due to dry conditions.
* - Health-based guidelines based on ingestion exposure to chemicals in soil.
** - Resampled September 1987 and analyzed for mercury.

TABLE 4-20. SUMMARY OF RESULTS OF SURFACE WATER MONITORING FOR ZONE 2, HANCOCK FIELD, NEW YORK

Parameter (units)	Method	Detection Limit	Standards, Criteria, and Action Levels Federal and State	SW-1	SW-1 DUP SW-23*	SW-2	SW-3	SW-24 (Trip Blank)
Field Parameters								
Sp. Conductance (umhos/cm)	E120.1	—	NA	900	900	890	750	
pH (standard units)	E150.1	—	6.5 - 8.5[a]	6.7	6.7	6.7	6.8	
Temperature (°C)	E170.1	—	NA	5	5	5	5	
Petroleum Hydrocarbons (mg/L)	E418.1	0.50	NA	ND	ND	ND	ND	ND
Purgeable Halocarbons (ug/L)	E601							
1,1,1-Trichloroethane		0.03	200[b]	ND	ND	0.43	ND	ND
1,1-Dichloroethane		0.07	5.0[b]	ND	ND	ND	ND	ND
Tetrachloroethene		0.03	0.0[c]	ND	ND	ND	ND	ND
Methylene Chloride		0.25	0.19[d]	0.3	1.0	3.1	0.44	99
Trichlorofluoromethane		0.5	NA	ND	ND	ND	ND	ND
Chloroform		0.05	0.19[d]	ND	0.79	ND	ND	ND
Carbon Tetrachloride		0.12	0.4[d]	ND	1.3	ND	ND	ND
Bromodichloromethane		0.1	0.19[d]	ND	0.1	ND	ND	ND
Trichloroethene		0.12	2.7[d]	ND	3.1	ND	ND	ND
Chlorobenzene		0.25	488[d]	ND	ND	ND	ND	ND
Priority Pollutant Metals (mg/L)	E200.7							
Zinc		0.005	5.0[a]	ND	ND	ND	ND	ND
Extractable Priority (ug/L) Pollutants-GC/MS	E625	—		ND	ND	ND	ND	ND
Bis (2-Ethylhexyl) Phthalate		4.0	0.015[d]	ND	4.6	ND	ND	ND

NOTE: See notes on next page.

(Continued)

TABLE 4-20. SUMMARY OF RESULTS OF SURFACE WATER MONITORING FOR ZONE 2, HANCOCK FIELD, NEW YORK (Continued)

Parameter (units)	Method	Detection Limit	Standards, Criteria, and Action Levels Federal and State	SW-18*	SW-19	SW-20*	SW-21*
Field Parameters							
Sp. Conductance (umhos/cm)	E120.1	—	NA	390	710	575	590
pH (standard units)	E150.1	—	6.5 - 8.5^a	6.6	6.8	6.7	6.5
Temperature (°C)	E170.1	—	NA	2	2	2	6
Petroleum Hydrocarbons (mg/L)	E418.1	0.50	NA	ND	ND	ND	ND
Purgeable Halocarbons (ug/L)	E601						
1,1,1-Trichloroethane		0.03	200^b	ND	ND	ND	0.42
1,1-Dichloroethane		0.07	5.0^b	ND	ND	ND	ND
Tetrachloroethene		0.03	0.0^c	ND	ND	ND	ND
Methylene Chloride		0.25	0.19^d	ND	0.39	0.92	0.97
Trichlorofluoromethane		0.5	NA	ND	ND	ND	0.35
Carbon Tetrachloride		0.12	0.4^d	ND	ND	1.1	2.2
Bromodichloromethane		0.1	0.19^d	ND	ND	ND	ND
Trichloroethene		0.12	2.7^d	ND	ND	2.7	4.6
Chlorobenzene		0.25	488^d	ND	ND	0.32	0.83
Priority Pollutant Metals (mg/L)	E200.7						
Zinc		0.005	5.0^a	ND	ND	0.020	0.033
Extractable Priority (ug/L) Pollutants-GC/MS	E625	—					
Bis (2-Ethylhexyl) Phthalate		4.0	0.015^d	ND	ND	ND	10

NOTES:

* Resampled September 1987 for purgeable halocarbons, aromatic volatile organics, and mercury.

[a] Primary Drinking Water Standard, Federal and State: Maximum Contaminant Level (MCL).

[b] Proposed MCL: Federal Register 50(219)46902.

[c] Proposed Maximum Concentration Level Goal (MCLG): Federal Register 50(210)46936.

[d] Ambient water quality criteria adjusted for toxicants in aquatic organisms and drinking water.

NA = Not Applicable.

ND = Not Detected at detection limit shown.

[CI] = Compound found on both the primary and secondary column; however, potential interference from another compound on the secondary column prevents accurate quantification of the peak of interest.

TABLE 4-21. SUMMARY OF RESULTS OF SEDIMENT MONITORING FOR ZONE 2, HANCOCK FIELD, NEW YORK

Parameter (units)	Method	Detection Limit	Background Level (mg/Kg)	Health-based Guidelines* (mg/Kg)	SD-1	SD-1 DUP SD-23	SD-2	SD-3
Petroleum Hydrocarbons (mg/Kg)	SW3550/ E418.1	variable	NA	NA	ND(51)	120	140	ND(43)
Priority Pollutant Metals (mg/Kg)	SW3050/ SW6010	variable						
Arsenic			10	0.063	16	7	46	12
Cadmium			1.7	273	1.2	0.32	1.8	0.45
Chromium			19	4,712	9.3	2.9	9.3	4.3
Copper			35	34,865	ND	11	39	10
Lead			5.2	1,319	18	5	29	14
Mercury (CVAA)			0.051	1,885	0.033	0.043	0.013	0.067
Nickel			18	9,423	12	45	13	5.3
Selenium			2.8	2,827	2.6	ND	4.6	0.62
Thallium			ND	377	ND	ND	ND	ND
Zinc			26	197,885	100	28	170	38
Volatile Organics	SW5030/ SW8240	variable		NA	ND	ND	ND	ND
Semivolatile Organics-GC/MS (mg/Kg)	SW3550/ SW8270							
bis (2-Ethylhexyl) Phthalate		as shown	NA	1,378	0.31	NR	1.72	ND(0.27)
di-N-Butyl Phthalate		as shown	NA	94,231	ND(0.13)	NR	ND(0.17)	ND(0.11)
di-N-Octyl Phthalate		as shown	NA	NA	0.44	NR	ND(0.21)	ND(0.13)
Fluoroanthene		as shown	NA	NA	ND(0.16)	NR	ND(0.21)	ND(0.13)
Phenanthrene		as shown	NA	NA	ND(0.16)	NR	ND(0.21)	ND(0.13)
Pyrene		as shown	NA	NA	ND(0.16)	NR	ND(0.21)	ND(0.13)
Benzo(A)Pyrene		as shown	NA	NA	ND(0.16)	NR	ND(0.21)	ND(0.13)
Benzo(B)Fluoranthene		as shown	NA	NA	ND(0.16)	NR	ND(0.21)	ND(0.13)

NOTE: See notes on next page.

(Continued)

TABLE 4-21. SUMMARY OF RESULTS OF SEDIMENT MONITORING FOR ZONE 2, HANCOCK FIELD, NEW YORK (Continued)

Parameter (units)	Method	Detection Limit	Background Level (mg/Kg)	Health-based Guidelines* (mg/Kg)	SD-18**	SD-19	SD-20**	SD-21**
Petroleum Hydrocarbons (mg/Kg)	SW3550/ E418.1	variable		NA	ND(53)	ND(35)	2900	1500
Priority Pollutant Metals (mg/Kg)	SW3050/ SW6010	variable						
Arsenic			10	0.063	6.9	10	5.6	6.5
Cadmium			1.7	273	0.55	1.7	0.9	1.9
Chromium			19	4,712	4.6	19	9	14
Copper			35	34,865	14	35	27	100
Lead			NA	1,319	28	140	89	100
Mercury (CVAA)			0.051	1,885	0.03	ND	0.042	0.09
Nickel			18	9,423	6.5	18	11	11
Selenium			2.8	2,827	1.5	2.8	2.8	1.8
Thallium			ND	377	23	ND	ND	ND
Zinc			26	197,885	49	200	130	100
Volatile Organics	SW5030/ SW8240	variable		NA	ND	ND	ND	ND
Semivolatile Organics-GC/MS (mg/kg)	SW3550/ SW8270							
bis (2-Ethylhexyl) Phthalate		as shown		NA	0.83	0.22	5.71	2.39
di-N-Butyl Phthalate		as shown		NA	0.33	0.11	0.28	0.41
di-N-Octyl Phthalate		as shown		NA	0.52	ND(0.11)	0.59	ND(0.21)
Fluoroanthene		as shown		NA	0.59	ND(0.11)	1.31	ND(0.21)
Phenanthrene		as shown		NA	0.19	ND(0.11)	0.67	ND(0.21)
Pyrene		as shown		NA	0.43	0.12	2.07	ND(0.21)
Benzo(A)Pyrene		as shown		NA	ND(0.18)	ND(0.11)	0.69	ND(0.21)
Benzo(B)Fluoranthene		as shown		NA	0.33	ND(0.11)	1.40	ND(0.21)

NOTES:

* Health-based guidelines based on ingestion exposure to chemicals in soil.

** Resampled in September 1987 and analyzed for mercury.

All soil/sediment results reported on a dry weight basis.

NA = Not Applicable.

ND = Not Detected at detection limit shown.

NR = Mistakenly not requested on chain-of-custody form.

Copper and zinc were found at the greatest concentrations in samples that were highly turbid when collected. Since all surface water metals samples were filtered in the laboratory rather than in the field, and nonturbid samples did not show elevated concentrations, these elevated values do not appear to represent true surface water values, but include influence of particulate matter.

The PNAs also were found only in highly turbid samples and included:

- Benzo(A)Anthracene
- Benzo(A)Pyrene
- Benzo(B)Fluoranthene
- Chrysene
- Fluoroanthene
- Phenanthrene
- Pyrene.

These PNAs were found in samples both upgradient and downgradient of Sites FT-1 and D-5, which indicates that the sites are not contributing PNAs directly to surface water, and that the PNAs are likely airborne contaminants resulting from aircraft fuel combustion that have settled out in a widespread pattern. The sediment results, presented below, support this conclusion.

As with groundwater at Site FT-1, the presence of bis (2-ethylhexyl) phthalate in surface water samples SW-9 and SW-10 is difficult to explain. Although bis (2-ethylhexyl) phthalate is a common sampling and laboratory contaminant, present in most plastic ware and tubing, the laboratory and field QC data indicate that this is not the case with these samples. Sampling stations SW-9 and SW-10 are in sufficiently close proximity to the Fire Training Area to hypothesize that this phthalate occurrence resulted from plastic incineration. The possibility that the observed phthalate occurrence resulted from sample contamination during collection or containerization is not substantiated by the field blank (SW-24).

Sediments: Zone 1

The results of sediment sample analysis, shown in Table 4-19, indicate the presence of similar compounds as those found in surface water, as well as additional compounds. These chemicals include:

- Petroleum hydrocarbons
- Priority pollutant metals, including arsenic, cadmium, mercury, selenium, chromium, copper, lead, nickel, and zinc
- Polynuclear aromatics
- Phthalates.

Petroleum hydrocarbons were found in the highest concentration (1,500 mg/Kg) at SD-4, which is the lowest point of the Zone 1 drainage sampled and where an oil sheen was noted during sampling. This concentration is higher than the sum of all of the concentrations found upstream of this point. Although the concentrations found upstream of Site D-5 at stations SW-8 and SW-11 at 300 mg/Kg and 720 mg/Kg, respectively, indicated the presence of petroleum hydrocarbons, the surface water drainage in this area is not channelized and must flow through a broad swampy area and sampling station SW-12 before it discharges to well-defined drainage at station SW-7. Because no petroleum hydrocarbons were detected at either station SW-12 or SW-7, conclusions that stations SW-8 and SW-11 are contributing to the high values found at SW-4 are not possible. One explanation for the high petroleum hydrocarbons concentrations found at SW-4 is the large-scale construction activities in the area where a sewer line break on airport property was being repaired. In any event, neither Site FT-1 nor D-5 appear to be contributing to elevated levels of petroleum hydrocarbons downstream. This contrasts with the conclusion drawn during the Phase II, Stage 1 investigations, where Site FT-1 was identified as a source of contamination and contaminant migration was indicated. During Phase II, Stage 1 studies, oil and grease (included in the petroleum hydrocarbons group) were detected at elevated levels in all sediment samples collected. It was theorized that Site D-5 was not responsible for the high oil and grease levels detected, but that perhaps Site FT-1 was responsible based on the types of activities conducted in this area. However, as noted previously, high levels of petroleum hydrocarbons were detected at the lowest point of the Zone 1 drainage area and appear to be due to either runoff from the airport runway area or to the sewer line break on the airport property.

Arsenic concentrations in the sediments ranged from 3.3 to 11 mg/Kg, cadmium from 0.23 to 6.6 mg/Kg, selenium from not detected to a high of 6.9 mg/Kg, and copper from 2.7 to 98 mg/Kg. Other metals that were detected include mercury (not detected to 0.11 mg/Kg), chromium (3.1 to 25 mg/Kg), nickel (2.3 to 21 mg/Kg), lead (3.4 to 150 mg/Kg), and zinc (18 to 330 mg/Kg). In comparing the levels of the compounds detected in the sediments with background levels, arsenic concentration exceeded the background level in only one sample (SD-5), as did chromium (SD-11), nickel (SD-11), and copper (SD-4). Because only 1 of the 15 samples exceeded the background level for the above 4 compounds, and the highest concentration was above the background by only a small amount, it is concluded that although the concentrations of arsenic, chromium, nickel, and copper were somewhat elevated, the magnitude is not significant and poses no threat to human health or the environment.

Cadmium concentrations exceeded background levels in three samples (SD-8, SD-10, and SD-11), although the concentration in SD-12 (1.9 mg/Kg) was close to the background level (1.7 mg/Kg). Concentrations of lead, zinc, mercury, and selenium were higher than background levels in a majority of the samples. However, levels of mercury in the sediment are similar to the background levels detected in soil. At the time of sampling, background sediment sample (SD-19) was found to be dry and composed of very fine gravel material, indicating that its characteristics would be similar to that of the soil background sample. Thus, mercury levels in sediment are not of concern in Zone 1, since concentrations are roughly equal to background levels.

Although selenium concentrations did exceed background levels in at least six samples, only in one sample (SD-12) did the concentration (6.9 mg/Kg) exceed background levels by a large margin. In other samples, concentrations were near the background levels. Observed levels of selenium in the SD-12 sample are not of concern because selenium was not detected in either the groundwater or surface water in Zone 1, and downgradient sediment samples showed background levels. Selenium occurs naturally in soils and sediments, and the one high level recorded at Zone 1 can be attributed to this natural occurrence.

The high concentrations of lead at SD-8 and SD-11 appear to be nonpoint source related, possibly from flight line runoff. The concentrations above background at SD-4 again do not appear to reflect major contributions from the Zone 1 sites because intermediate points SD-7 and SD-5 do not show similar or higher concentrations.

The same PNAs and phthalates that were found in surface water were found in sediments, although at a greater number of points and in higher concentrations. The PNAs appear to be from nonpoint sources, such as aircraft exhaust fallout. This again contrasts with the Phase II, Stage 1 studies, where high levels of halogenated compounds detected in sediments were linked to Site FT-1, consistent with the conclusions drawn for the petroleum hydrocarbons level. The reasoning for the presence of phthalates in the sediment is the same as that for the presence in surface water (i.e., it appears that prior site activities, such as the incineration of plastics, is responsible for the presence of phthalates).

Surface Water: Zone 2

The results of surface water analyses for Zone 2 are summarized in Table 4-20. The only parameter found above the MCL was zinc, and this was found within Ley Creek at the two points (SW-20 and SW-21) above the drainage from Sites D-1 and D-3. Therefore, no site-related contamination of surface water is reflected in the Zone 2 surface water sampling. A variety of purgeable halocarbons were detected in the samples. Methylene chloride was detected in all samples except in SW-18. Moreover, methylene chloride also was detected in the trip blank for samples SW-1, SW-2, and SW-3 at a concentration higher than that in the samples. Therefore, it is considered a sampling analysis artifact. Since it was not detected in SW-18, it would appear that it is not site-related, since SW-19, SW-20, and SW-21 are all further upstream from SW-18 and unaffected by Sites D-1 and D-3. The same reasoning holds true for other halocarbons, such as trichlorofluoromethane, carbon tetrachloride, trichloroethene, and chlorobenzene, which were detected in SW-20 and SW-21 but not in SW-18. This contrasts with the results obtained from the Phase II, Stage 1 studies where environmental contamination due to halogenated organics was indicated; however, levels of the organics were low and would be of no concern. Chloroform, carbon tetrachloride, bromodichloromethene, and trichloroethene were detected in SW-23, which is a duplicate sample of SW-1. However, all four compounds were detected at low concentrations, very close to the EPA CAG 10^{-6} cancer risk level, and therefore are of no concern. The only extractable priority pollutant detected was bis (2-ethylhexyl) phthalate, which was detected at a low concentration in the SW-23 duplicate sample and in the upgradient sample SW-21.

However, if these purgeable halocarbons identified in SW-20 and SW-21 are related to environmental contamination, the source is further upstream than Site D-1 or D-3. Also, the furthest upstream sample along Ley Creek (SW-21) had the highest concentration of the purgeable halocarbons confirmed to be present in any of the surface water samples collected in Zone 2. The concentration of the purgeable halocarbons measured along Ley Creek decreases from the upstream sampling point SW-21 to the downstream point SW-18. The data indicate that the concentration of these compounds seems to be diluted below detection levels at sampling point SW-18. The only purgeable halocarbon that could be quantified from sampling surface water at SW-18 was 1,1,1-trichloroethane. The compound was present in the highest quantity at SW-21. Sampling point SW-21 is located along Ley Creek at the point where it crosses onto Hancock Field property; therefore, environmental contamination is a result of upstream off-base activities and not the result of past or present on-base activities. This rationale also is applicable to the extractable priority pollutants.

Sediments: Zone 2

The analytical results for Zone 2 sediment samples are summarized in Table 4-21. The parameters detected by this sampling effort include:

- Petroleum hydrocarbons (SD-1, SD-2, SD-20, SD-21)
- Arsenic (all samples)
- Copper (SD-21)

- Lead (SD-19, SD-20, SD-21)
- Zinc (SD-1, SD-2, SD-19, SD-20, SD-21)
- Polynuclear aromatics (SD-3, SD-18, SD-19, SD-20)
- Phthalates (SD-1, SD-2, SD-18, SD-19, SD-20, SD-21).

Petroleum hydrocarbons were detected in samples SD-2, SD-20, and SD-21, with the highest concentration found in SD-21 (2,900 mg/Kg). The presence of the petroleum hydrocarbons do not appear to be site-related and are probably due to the surface runoff from roadways upstream of Sites D-1 and D-3.

Copper was found at concentrations above background in sample SD-21 and close to background levels in SD-2. Sample SD-21 was collected at the point where Ley Creek enters the base and is not related to Sites D-1 and D-3. Lead was detected at concentrations much higher than background at sampling points SD-19, SD-20, and SD-21. None of these samples appears to represent contributions from the two landfills under study. Sample SD-19 was collected above the drainage from Site D-3, and samples SD-20 and SD-21 were collected from Ley Creek, also above the site drainage. Zinc concentrations in the drainage above the site under study (stations SD-19, SD-20, and SD-21) were found to be as high or higher than those found below the sites (stations SD-1 and SD-2). Therefore, Sites D-1 and D-3 do not appear to be contributing to zinc concentrations in Ley Creek sediments.

Arsenic was detected at concentrations above background in samples SD-1, SD-2, and SD-3, all of which would receive drainage from Site D-3, but below background levels in samples SD-18, SD-19, SD-20, and SD-21. The highest concentration of arsenic was found in sample SD-2 (46 mg/Kg), which is the mid-point of the drainage path. This appears to be an isolated area of high concentration that is not expected to spread, as discussed below. Arsenic in the sediments appears to be site-related and is the only compound of concern, especially since it is a carcinogen. An assessment of the risks due to the arsenic concentrations can be computed based on the methodology described in Section 4.4.2. Assuming ingestion exposure to soil of 0.1 grams of soil per day over a 52-year exposure period (ages 18 to 70), and assuming an average body weight of 70 Kg for an adult, the human intake factor is determined to be

1×10^{-6} gm soil/Kg/day. Based on an average concentration of 14.7 mg/Kg for arsenic in the soil, the ingestion dose is computed as:

$$\begin{aligned}\text{Dose} &= 14.7 \times 1 \times 10^{-6} \\ &= 1.47 \times 10^{-5} \text{ mg/Kg/day.}\end{aligned}$$

The cacinogenic potency factor for arsenic is 15 $(\text{mg/Kg/day})^{-1}$ (USEPA 1986). The risk to human health is then determined as:

$$\begin{aligned}\text{Risk} &= 1.47 \times 10^{-5} \times 15 \\ &= 2.2 \times 10^{-4}\end{aligned}$$

In the remedial investigation/feasibility study (RI/FS) process, recent EPA guidance suggests that remedial alternatives should be refined as necessary to ensure that options considered span a carcinogenic risk range from 10^{-4} to 10^{-7} (USEPA 1986; Zamuda et al. 1986). The 10^{-6} risk level, however, often is chosen as the target risk within this range (Zamuda et al. 1986). Based on this, the risks due to arsenic in Zone 2 would be judged unacceptably high. However, Zone 2 sites are isolated and located in a remote area. Only base personnel are likely to be in the vicinity of the site and the possibility of contact with the contaminated soil is minimal. Exposure to arsenic and the corresponding risk estimate, therefore, is likely to be a very small fraction of that projected. Given the results based upon the conservative exposure assumptions employed, the actual risks to human health are not anticipated to exceed the 10^{-6} level and would be considered acceptable. In addition, concentration of arsenic in sample SD-1, (closer to background levels), which is downgradient from SD-2, was much less than that in SD-2. Thus, it appears that the contamination has not migrated downstream, further reducing the risks associated with the arsenic levels.

PNA compounds, including fluoroanthene, phenanthrene, and pyrene, were detected in all Ley Creek sediment samples, as well as above and below Site D-3. This pattern of occurrence and the behavior of the contaminants supports the view that the PNAs result from aircraft and vehicular exhaust fallout or upstream sources and do not emanate from the two inactive landfills.

Phthalates, including bis (2-ethylhexyl) phthalate, di-n-butyl phthalate, and di-n-octyl phthalate, were detected in seven of the eight sediment samples collected in this zone. The highest concentrations were found in Ley Creek sediments and higher concentrations also were detected above and below Site D-3. Although the presence of these phthalates cannot be explained based on available data, the pattern of occurrence suggests that they do not arise in the sites under study. This is consistent with the conclusions drawn for the presence of organics in sediments in Zone 2.

4.4.4 Zone 2: Disposal Sites D-1 and D-3

In addition to the surface water and sediment investigation, which revealed no apparent site-related contamination, Zone 2 was investigated using a geophysical survey technique to search for buried metal and by installing and sampling six additional groundwater monitoring wells.

Magnetometry Survey

A magnetometry (geophysical) survey of Sites D-1 and D-3 in Zone 2 confirmed the presence of buried ferrous materials throughout both sites. Two types of subsurface conditions were identified by the survey: areas with continuous amounts of buried ferrous material, which represent major dumping areas; and areas with scattered amounts of ferrous material. The types of buried ferrous material can be confirmed only through visual assessments of surficial debris scattered over both sites. Metal objects seen included steel reinforcement bars, crushed and rusted 55-gallon drums, wire, paint cans, sectioned metal fences, beverage containers, metal signs, and unidentifiable pieces of metal. Other debris seen included concrete, plastic containers, bricks, wooden poles, and assorted domestic trash. The contents of the former landfills were more noticeable along the site margins. Areas exhibiting strong magnetic disturbances are mapped as anomalous zones. Numerous anomalous zones were found in both sites. Suggested test pit locations have been identified in case it becomes necessary to characterize further the areas of high ferrous metal content. The complete magnetometry survey report, including maps, is presented in Appendix M.

Groundwater Monitoring: Zone 2

In addition to the six existing shallow monitoring wells installed during Phase II, Stage 1 activities, six additional groundwater monitoring wells, two shallow and four deep, were installed during the Stage 2 investigation. With the abandonment of damaged well MW-4, Zone 2 is currently monitored by the 11 wells shown in Figure 4-14. The sampling of the Stage 1 wells is discussed in Section 4.4.1.

The six new Stage 2 wells were installed, developed, and sampled for:

- Carbonate, bicarbonate, and alkalinity
- Common anions
- Total dissolved solids
- Petroleum hydrocarbons
- Halogenated volatile organics
- Aromatic volatile organics
- 26 metals
- Extractable priority pollutants.

Specific conductance, pH, and temperature were measured in the field. The results of the groundwater sampling and analysis are summarized in Table 4-22.

As discussed in Section 4.2, the nature of the geohydrology at Hancock Field reduces the possibility of the contamination of the deeper bedrock aquifer by near surface sources. Because there is an upward hydraulic gradient from the confined bedrock aquifer toward the unconfined or partially confined surficial aquifer, contaminants cannot migrate downward. The least difference between water levels in paired wells occurs at Site 14, where the water level in MW-14D is only 0.1 feet higher than in MW-14. As discussed below, the water quality in MW-14 appears to represent greater leakage from the deeper aquifer to the shallow one than at other paired well locations. Therefore, only two of the six new wells (MW-14 and MW-15) are believed to represent potential contributions of constituents from Sites D-1 and D-3. The discussion of the two shallow wells is followed by a brief discussion of

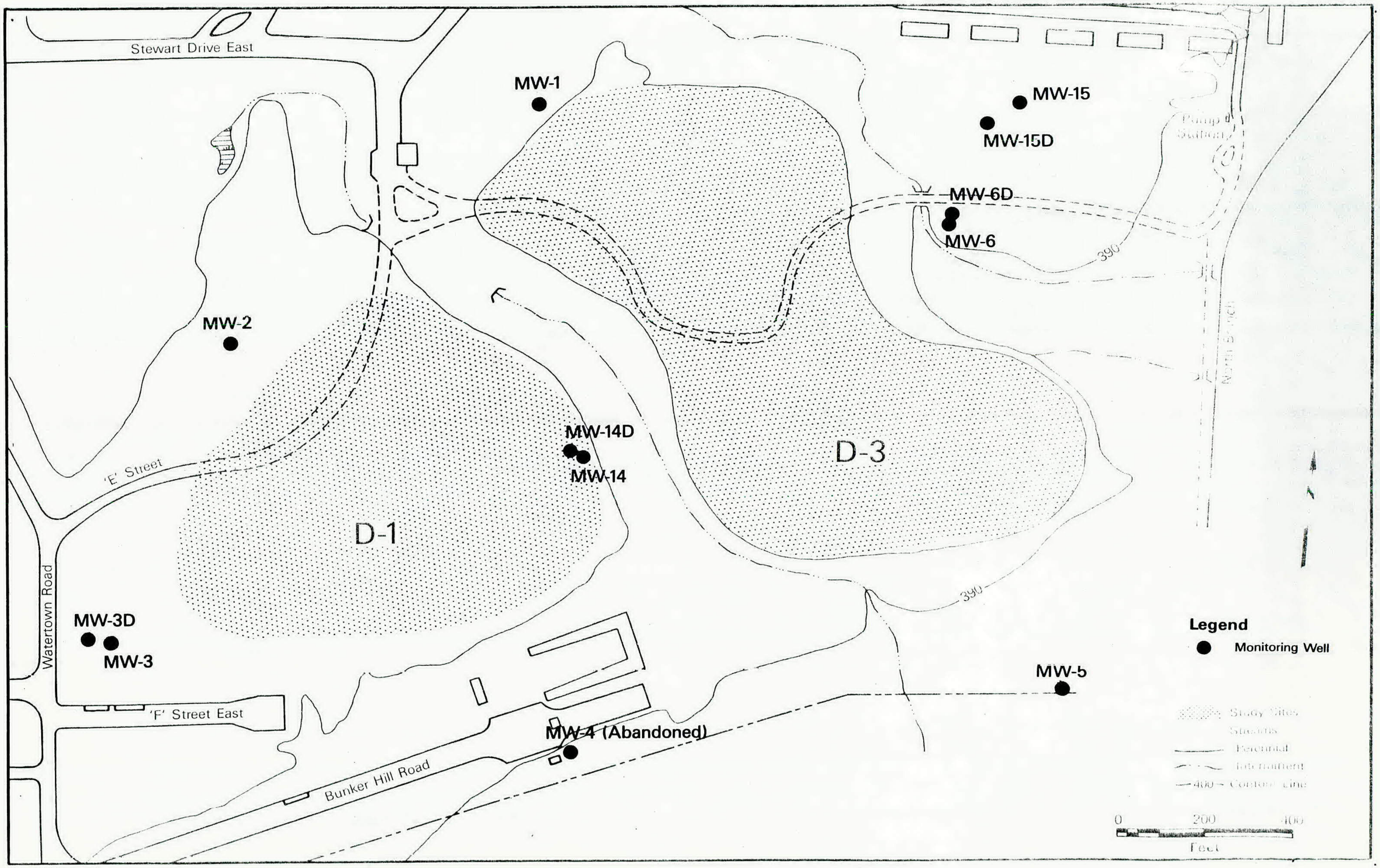

Figure 4-14. Zone 2 Monitoring Well Locations at Hancock Field

TABLE 4-22. SUMMARY OF RESULTS OF GROUNDWATER MONITORING FOR ZONE 2, HANCOCK FIELD, NEW YORK JANUARY 1987

Parameter (units)	Method	Detection Limit	Standards, Criteria, and Action Levels Federal and State	Sample # Well #						
				GW-25 MW-15D	GW-26 MW-15	GW-28 MW-3D	GW-29 MW-14	GW-30 MW-14D	GW-31 MW-6D	GW-32 MW-6D DUP
Field Parameters										
Sp. Conductance (umhos/cm)	E120.1	—	NA	14200	950	2500	2000	1800	1250	1250
pH (standard units)	E150.1	—	6.5 - 8.5[a]	9.4	9	9	9.2	9.2	8.1	8.1
Temperature (°C)	E170.1	—	NA	12	9	13	8	9	8	8
Alkalinity (mg/L CaCO3)	A403									
Carbonate		0.50	NA	26	ND	ND	ND	ND	110	120
Bicarbonate		0.50	NA	27	330	130	820	370	32	32
Total				53	330	130	820	370	140	150
Common Anions (mg/L)	A429									
Chloride		6.5	250[a]	3200	27	30	26	33	32	33
Ortho Phosphate*		variable	NA	ND	ND	ND	ND	ND	ND	ND
Sulfate		14	250[a]	1900	64	500	150	160	73	81
Total Dissolved Solids (mg/L)	E160.1	10	500	11,000	500	2,500	1,600	1,400	740	820
Purgeable Halocarbons (µg/L)	E601									
1,1,1-Trichloroethane		0.03	200[b]	0.26	ND	ND	ND	ND	ND	ND
Bromodichloromethane		0.10	100[c]	ND	ND	ND	ND	ND	4	ND
Bromoform		0.20	100[c]	ND	ND	ND	ND	ND	1.5	0.76
Chloroform		0.05	100[c]	0.27	0.15	ND	ND	0.12	18	18
Methylene Chloride		0.025	0.19[g]	0.68	0.61	0.38	0.3	0.4	0.43	ND
Aromatic Volatile Organics (ug/L)	SW5030/ SW8020									
Toluene		0.2	2000	ND	ND	ND	ND	0.45[f]	ND	ND

NOTE: See notes on next page.

(Continued)

TABLE 4-22. SUMMARY OF RESULTS OF GROUNDWATER MONITORING FOR ZONE 2, HANCOCK FIELD, NEW YORK (Continued)
JANUARY 1987

Parameter (units)	Method	Detection Limit	Standards, Criteria, and Action Levels Federal and State		Sample # Well # GW-25 MW-15D	GW-26 MW-15	GW-28 MW-3D	GW-29 MW-14	GW-30 MW-14D	GW-31 MW-6D	GW-32 MW-6D DUP
Metals Screen (mg/L)	E200.7										
Arsenic		0.002	0.05[a]	0.025[e]	0.044	ND	0.011	ND	ND	ND	ND
Selenium		0.004	0.10[a]	0.020[e]	0.035	ND	0.014	ND	ND	ND	ND
Potassium		0.0004	NA	NA	470	0.66	110	25.0	21.0	210	220
Boron		0.06	NA	NA	4.2	0.31	0.06	1.6	1.0	ND	ND
Calcium		0.32	NA	NA	1300	120	610	330	240	8.4	7.6
Chromium		0.044	0.05[a]	0.050[e]	ND	ND	ND	ND	ND	0.09	ND
Magnesium		0.05	NA	NA	240	47	56	120	100	2	1.3
Manganese		0.054	0.05[a]	0.030[e]	ND	ND	0.095	2.1	2	ND	ND
Sodium		0.24	NA	NA	1600	12	30	38	46	38	40
Silicon		0.18	NA	NA	4	8.6	5	11	7	3.8	2.2
Extractable Priority Pollutants-GC/MS (ug/L)	E625										
bis (2-Ethylhexyl) Phthalate		4.0	NA	4200[e]	ND	ND	ND	6.9	4.8	ND	10

NOTES:
Only those compounds that were detected have been included in this table.
[a] Primary Drinking Water Standard, Federal and State: Maximum Contaminant Level (MCL).
[b] Proposed MCL: Federal Register 50(219) 46902.
[c] The MCL for total trihalomethanes. Refers to the sum concentration of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.
[d] Proposed Maximum Concentration Level Goal (MCLG): Federal Register 40(210) 46936.
[e] New York State Class GA Potable Ground Water Standard.
[f] Could not be confirmed due to interference from coeluting peaks.
[g] Ambient water quality criteria adjusted for toxicants in aquatic organisms and drinking water.
NA = Not Applicable.
ND = Not Detected at detection limit shown.
[*] Resampled in September 1987.

groundwater quality in the bedrock aquifer, as represented by the four new bedrock wells.

Groundwater quality from MW-14 exceeded the Federal and state Secondary drinking water MCLs for pH (6.5-8.5) and manganese (0.03-0.05 mg/L). Compared with well MW-15 and other shallow Zone 2 wells, as listed in Table 4-10, MW-14 was found to be higher in specific conductance, TDS, manganese, potassium, and sulfate. All of these parameters are consistently higher in the deep wells than in the shallow wells. This fact, coupled with the fact that the water level difference between MW-14 and MW-14D is only 0.1 foot, leads to the conclusion that groundwater from the bedrock aquifer has leaked upward into the shallow aquifer and has contributed to degradation in water quality. The plasticizer bis (2-ethylhexyl) phthalate was detected at 6.9 µg/L in this well and cannot be explained except by possible sample or laboratory contamination. Although groundwater at MW-14 exceeds the two standards noted above, and is in a direct flow path from Site D-1, all of the parameters found to exceed standards appear to be naturally occurring.

Groundwater from well MW-15 exceeded the Federal and state MCL for pH, and is believed to be due to naturally occurring conditions. Chloroform was found at less than 1 µg/L. Although small amounts (10-20 gallons) of hydrant water, which could introduce chloroform, were introduced into wells during development, volumes greater than twice this amount were removed during development and purging. The presence of chloroform is not thought to be site-related because chloroform also was detected in all but one of the Zone 2 deep wells, which cannot be influenced by the sites.

Groundwater from the deep wells exceeded the Federal and state MCLs for:

- Chloride (MW-15D)
- Sulfate (MW-15D, MW-3D)
- Total dissolved solids (MW-15D)
- pH (MW-15D, MW-3D, MW-14D)
- Selenium (MW-15D, MW-3D)
- Arsenic (MW-15D).

Under the New York State classification of groundwater, the bedrock aquifer at MW-15D would be placed in Class GSB, the lowest class, by virtue of chloride concentrations in excess of 1,000 parts per million (ppm) and TDS in excess of 2,000 ppm. The best usage for Class GSB groundwater has been identified by the state as receiving water for waste disposal. Therefore, although groundwater from well MW-15D exceeded the New York Quality Standard for arsenic in Class GA groundwater (the highest classification), the aquifer does not fit the definition of that class.

Various organic compounds also were detected in Zone 2 deep wells, but concentrations were all below applicable standards or criteria. These include:

- 1,1,1-Trichloroethane (MW-15D)
- Bromodichloromethane (MW-6D)
- Bromoform (MW-6D and duplicate)
- Chloroform (MW-15D, MW-14D, MW-6D and duplicate)
- Toluene (MW-14D)
- Bis (2-ethylhexyl) phthalate (MW-14D)
- Methylene chloride (all samples).

Again, none of the contaminants found in the deep aquifer system is believed to be related to Sites D-1 and D-3 because of the upward hydraulic gradient from the bedrock aquifer to the surficial aquifer. The chloromethanes, bromodichloromethane, bromoform, and chloroform, are thought to be naturally occurring in this partially saline aquifer because all hydrant water introduced during well development was recovered several times over during development and purging. The methylene chloride is probably the result of laboratory contamination.

In summary, the only environmental contamination that can be traced to Sites D-1 and D-3 appear to be the higher-than-background arsenic concentration detected in some sediment samples. However, the risk associated with the presence of arsenic is considered to be minimal, taking into account the remote location of the site and the conservative estimate used in the risk assessment. In addition, the contamination does not appear to have migrated downstream and appears to be localized. Therefore, the contamination does not pose a threat to human health. Although the magnetometry survey indicates that both sites contain much buried ferrous metal, test pits would have to be opened in the sites to determine if significant amounts of hazardous wastes have been disposed of in these sites. Based on the results of groundwater, surface water, and sediment sampling, these two sites appear to be primarily rubble fills, and do not pose a threat from hazardous materials.

4.4.5 Entomology Underground Storage Tank (Site S-3)

One tank water sample and three soil samples were collected at an underground storage tank at the inactive entomology shop. All samples were analyzed for:

- Organochlorine pesticides
- Organophosphorus pesticides
- Chlorinated herbicides.

In addition, field measurements for pH, specific conductance, and temperature were taken for the tank water sample. Sampling results are summarized in Table 4-23 and the site is shown in Figure 4-15.

The only pesticide detected in the entomology underground storage tank (Sample EW-1) was the organophosphorus insecticide malathion. The presence of this compound was confirmed by second column analysis. For malathion, the most relevant criterion is the New York State Class GA groundwater standard of 7.0 µg/L. The level of 48 µg/L found in the tank is well above risk standard. Although the tank is not used as a drinking water supply, these values are provided for comparative purposes and to illustrate why the tank contents must be properly handled and disposed of.

Although the Hancock Field Phase I report indicates that the use of the entomology underground storage tank was discontinued in June 1979, the current Facilities Manager has indicated that the tank was likely in use until pesticide application by Hancock Field personnel ceased in May 1984. The tank also may have been used when Building 259 was closed in 1985, and a number of

TABLE 4-23. SUMMARY OF RESULTS OF SOIL AND TANK WATER MONITORING FOR SITE S-3, HANCOCK FIELD, NEW YORK
DECEMBER 1986

Parameter (units)	Method	Detection Limit	Drinking Water Standards, Criteria, and Action Levels		EW-1* Tank Water	ES-1 Soil	ES-2 Soil	ES-3 Soil
			Federal	State				
Field Parameters								
Sp. Conductance (umhos/cm)	E120.1				2500	NA	NA	NA
pH (standard units)	E150.1				7	NA	NA	NA
Temperature (°C)	E170.1				10	NA	NA	NA
Organochlorine Pesticides	E608/ SW8080	As shown			(ug/L)	(mg/Kg)	(mg/Kg)	(mg/Kg)
4,4-DDD					ND(0.32)	ND(0.0085)	ND(0.0090)	ND(0.0047)
4,4-DDE					ND(0.22)	0.170	0.042	0.0050
4,4-DDT			0.001	NA	ND(0.23)	0.220	0.100	0.0066
Dieldrin			0.001	NA	ND(0.22)	0.01	ND(0.0011)	ND(0.0011)
Heptachlor Epoxide			0.0	NA	ND(0.19)	0.0022	ND(0.0017)	ND(0.00090)
Organophosphorus Pesticides	SW8140	As shown			(ug/L)	(mg/Kg)	(mg/Kg)	(mg/Kg)
Malathion				7.0	48	ND(1.6)	ND(1.6)	ND(1.6)
Chlorinated Herbicides	SW8150	As shown			(ug/L)	(µg/Kg)	(µg/Kg)	(µg/Kg)
2,4,5-T				35	ND(6.5)	ND(0.29)	ND(0.28)	ND(0.29)
2,4,5-TP (Silvex)			None	0.26	ND(3.7)	ND(0.23)	ND(0.23)	ND(0.24)
2,4-D			100	4.4	ND(30)	ND(0.62)	ND(0.60)	ND(0.62)

Notes:

[*] Resampled September 1987 and analyzed for organochlorine pesticides/PCBs, organophosphorus pesticides, and chlorinated herbicides.

[a] Ambient water quality criteria adjusted for evaluation of toxicants in drinking water.

[b] New York State Class GA Potable Ground Water Standard.

[c] Proposed Maximum Concentration Level Goal (MCLG): Federal Register 50(210) 46936.

[d] Primary Drinking Water Standard, Federal and State: Maximum Contaminant Level (MCL).

NA = Not Applicable.

ND = Not Detected at detection limit shown.

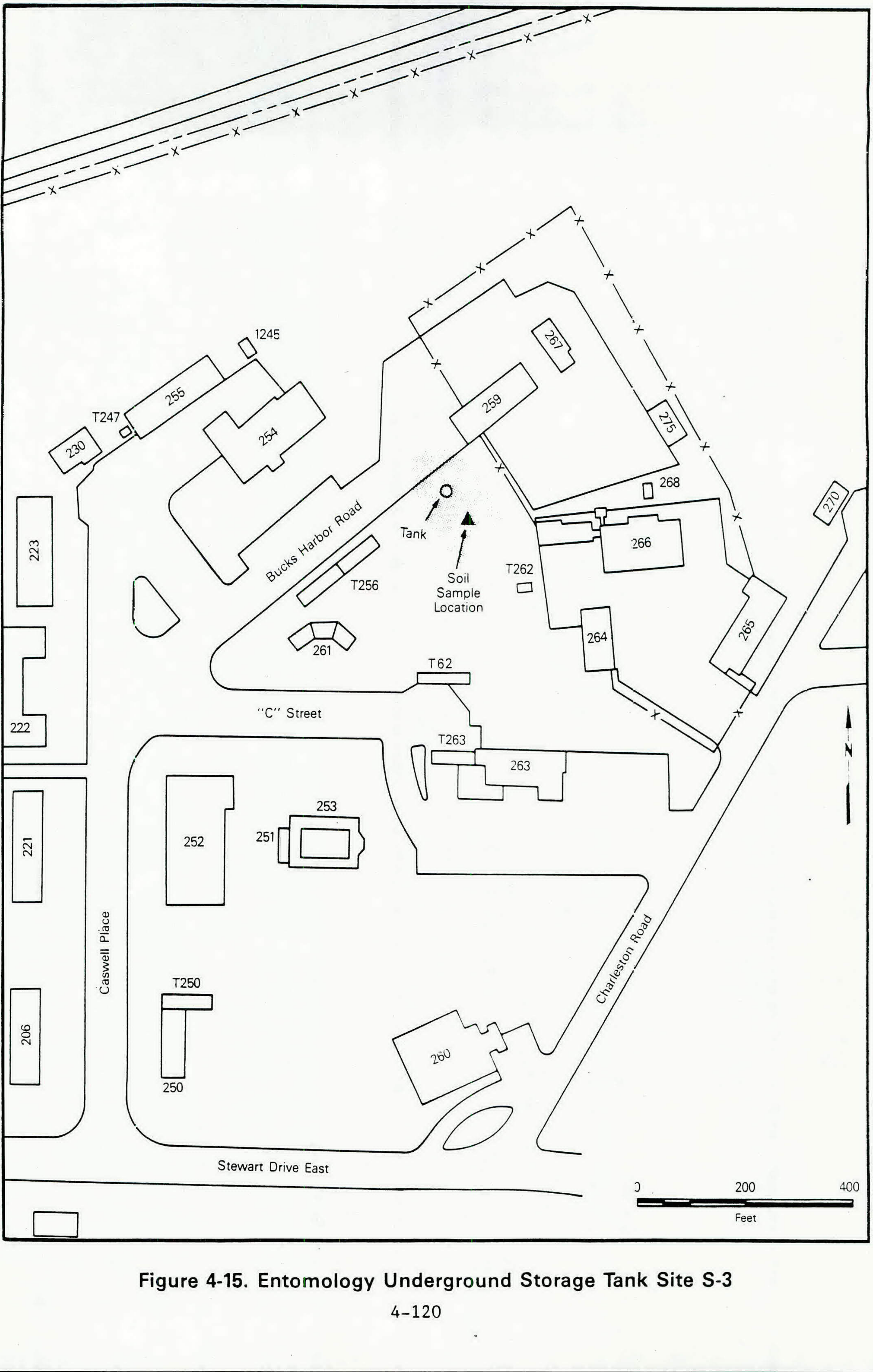

Figure 4-15. Entomology Underground Storage Tank Site S-3

pesticide containers were triple rinsed prior to disposal by the Defense Property Disposal Office (DPDO) (Zimmerman 1987). Given these dates, it is likely that the two insecticides detected in the tank are residuals from past entomology shop operations.

As Table 4-23 illustrates, DDE, DDT, dieldrin, and heptachlor epoxide were detected at less than 1 mg/Kg in soil approximately 20 feet downslope from the entomology underground storage tank. This area is a fenced yard; however, a potential for human exposure to these compounds exists. Although there are no formally promulgated health criteria or standards for these chemicals in soil, it is possible to quantify the risks to human health due to exposure to contaminated soil.

DDE, DDT, dieldrin, and heptachlor epoxide, all organochlorine pesticides, are potential carcinogens by the oral route of exposure. Carcinogenic potency factors are available for the latter three compounds by this route (USEPA 1986). Lifetime cancer risks for these chemicals therefore may be evaluated, assuming ingestion of contaminated soil as the exposure route of concern. Since carcinogenic potency factors are not available for the inhalation route of exposure, ingestion exposure is the only way to assess meaningfully the significance of observed levels of the potentially carcinogenic pesticides in soil. Carcinogenicity is the toxicological effect of greatest concern in evaluating the long-term risks to human health of exposure to toxicants at waste sites. Therefore, it has been selected as the basis for interpreting the observed concentrations of contaminants at Site S-3. No toxicological endpoints or reference doses have been proposed for evaluating acute exposure to these pesticides in soil (USEPA 1986).

In conducting a risk evaluation of soil contamination, it is necessary to determine the dose for the ingestion route of exposure. Ingested dose of contaminants in soil may be defined as follows:

$$\text{Dose} = C_s \times \text{HIF}_{\text{ingestion}} \qquad (1)$$

where: C_s = Concentration of the subject chemical in soil (µg/g)

$\text{HIF}_{\text{ingestion}}$ = Human intake factor: quantity of soil ingested per Kg body weight per day (g soil/Kg per day)

The factor $HIF_{ingestion}$ must be calculated separately for the short-term exposure scenario (i.e., for a particular age group) and for the lifetime exposure scenario (i.e., across all age groups).

At Site S-3, carcinogenic risks to humans are evaluated assuming lifetime exposure to observed levels of the pesticides in soils. Therefore, the human intake factor ($HIF_{ingestion}$) must reflect potential exposure over a 70-year period (i.e., lifetime). The quantity of soil ingested by humans varies considerably with age group. To estimate meaningfully the factor $HIF_{ingestion}$, it is necessary to characterize the distribution of soil ingestion as a function of age group and body weight. Data obtained from the Center for Environmental Health and Disease Control were used for this purpose (Kimbrough et al. 1984). Body weight distribution by age group data were obtained from USEPA (1985). Table 4-24 outlines the calculation of $HIF_{ingestion}$. As shown, this factor is defined as the weighted mean soil intake per Kg body weight per day, divided by the total exposure period (i.e., 70 years = 25,550 days). The value of $HIF_{ingestion}$, 0.025 g soil/Kg per day, is used in equation (1) to generate lifetime dose.

Using equation (1) and the soil concentrations provided in Table 4-24, lifetime ingestion doses are calculated. The additional lifetime cancer risk is determined by multiplying average lifetime dose times the carcinogenic potency factor for pesticides:

$$R = CDI \times q^* \qquad (2)$$

where: R = Additional individual lifetime cancer risk

CDI = Chronic daily intake or average lifetime ingestion dose (mg/Kg/day)

q * = Carcinogenic potency factor: 95 percent upper-bound estimate of the slope of the dose-response curve $(mg/Kg/day)^{-1}$.

The additional lifetime cancer risk due to exposure to more than one compound is determined by summing the individual risk estimates for each subject compound of concern (USEPA 1986).

TABLE 4-24. DETERMINATION OF THE HUMAN INTAKE FACTOR FOR INGESTION OF SOIL

Age	Soil Intake[a] (SIi) g/day	Time Interval (TIi) days	Mean Weight[b] (BWi) Kg	$\frac{(SIi)(TIi)}{BW}$
0-9 mo	0			
9-18 mo	1	270	10.5	25.7
1.5-3.5 yr	10.	730	13.6	536.7
3.5-5 yr	1	548	17.6	31.1
5-9 yr	0.1	1,460	23.8	6.1
9-12 yr	0.1	1,095	35.7	3.1
12-15 yr	0.1	1,095	50.5	2.2
15-18 yr	0.1	1,095	64.9	1.7
18-70 yr	0.1	18,980	70	27.1
				633.7g soil Kg body weight

$$HIF_L = \text{Weighted mean lifetime intake of soil} = \frac{\Sigma \, \frac{(SIi)(TIi)}{BWi}}{\Sigma TI_{total}}$$

= 633.7/25,550 days (70-year lifetime)

= 0.025g soil/Kg body weight/day

---

[a] Source: Kimbrough et al. 1984

[b] Source: USEPA 1985c. Body weights are for male children and adults.

The carcinogenic potency factors for DDT, dieldrin, and heptachlor epoxide are shown in Table 4-25. Substituting these values and the calculated lifetime doses into equation (2), individual lifetime cancer risk estimates are obtained. These estimates were developed based on both the mean and the maximum observed values of the pesticides in samples ES-1, ES-2, and ES-3. As shown in Table 4-25, the maximum additional lifetime cancer risk to the individual is on the order of 10^{-5} (i.e., an increased probability of 1 in 100,000). Based on mean concentrations of the pesticides in soil (not detected was treated as 0.0), the additional cancer risk is on the order of 10^{-6}.

EPA guidance proposed for hazardous waste site evaluation is used in interpreting these results. In the RI/FS process under CERCLA/SARA, recent EPA guidance indicates that remedial alternatives should be refined as necessary to ensure that options considered span a carcinogenic risk range from 10^{-4} to 10^{-7} (USEPA 1986, Zamuda et al. 1986). The 10^{-6} risk level, however, often is chosen as the target risk within this range (Zamuda et al. 1986).

It has been necessary to assume lifetime exposure (i.e., 70 years) of humans to pesticides at the observed concentrations in soils at Site S-3 to develop a measure of potential health risk. The true potential for human exposure to pesticides at Site S-3 is considered limited. The area surrounding the former entomology storage tank is fenced in and is not open to the general public. Furthermore, the soil in the area is completely covered by either pavement or thick lawn, preventing accidental exposure. Given these facts, and that the estimated individual lifetime carcinogenic risks are on the order of 10^{-6} (based on average soil levels), it is concluded that the risks of cancer are within the range of acceptability and do not constitute a significant threat to human health.

4.4.6 Transformer Storage Area (Site S-1)

This site consists of a small building (Building 530), located in a remote part of Hancock Field, where PCB-contaminated transformers were stored until their final removal in 1980 (Engineering-Science 1982). Six surface

TABLE 4-25. RISK CHARACTERIZATION FOR PESTICIDES IN SOIL AT SITE S-3, HANCOCK FIELD, NEW YORK

Chemical	Concentrations in Soil µg/g	Dose: Lifetime Soil Ingestion (mg/Kg/day)	q_1^* $(mg/Kg/day)^{-1}$	Maximum Additional Individual Lifetime Risk
DDT	0.22[a]	5.5×10^{-6}	0.34	1.87×10^{-6}
Dieldrin	0.01[a]	2.5×10^{-7}	30.	7.5×10^{-6}
Heptachlor Epoxide	0.0022[a]	5.5×10^{-8}	2.6	1.43×10^{-7}
				9.5×10^{-6}
DDT	0.11[b] (3)	2.75×10^{-6}	0.34	9.35×10^{-7}
Dieldrin	0.003[b] (3)	7.5×10^{-8}	30.	2.25×10^{-6}
Heptachlor Epoxide	0.0007[b] (3)	1.75×10^{-8}	2.6	4.55×10^{-8}
				3.23×10^{-6}

Notes:

[a] Maximum observed levels
[b] Mean levels, three samples
Not detected, assumed to be 0.0
(No.) = Number of samples

soil samples and one duplicate were collected surrounding and within Building 530, as shown in Figure 4-16. All of the samples were analyzed for petroleum hydrocarbons and PCBs. The results of these analyses are provided in Table 4-26.

Petroleum hydrocarbons were found in three of the samples at levels indicative of oil or grease spills. No standards exist for petroleum hydrocarbons in soil, and the levels encountered at this site, 250 to 2,200 mg/Kg, are believed to be typical of areas where vehicles or equipment have been parked.

The six soil samples and one duplicate were analyzed for seven specific arochlors (PCBs). Only one sample (TS-2) contained detectable amounts (0.098 mg/Kg) of one aroclor (1260). No Federal criteria or standards for the protection of human health have been developed for PCBs in soil. A level of 50 mg/Kg PCB has been established under the Toxic Substances Control Act (TSCA) in determining whether PCB-containing waste or soils should be treated as hazardous. The concentrations observed in the single contaminated sample (TS-2) at Site S-1 are approximately three orders of magnitude below the 50 mg/Kg TSCA guideline. The TSCA guideline, however, is not adequate for evaluating the potential health risks associated with exposure to PCB-contaminated soils. Toxicity measures are not available for use in evaluating the potential for noncarcinogenic or carcinogenic effects following inhalation exposure (i.e., carcinogenic potency factors or acceptable intake values have not been developed for inhalation exposure to PCBs) (USEPA 1986). Therefore, the risk characterization for this site is based on potential ingestion of PCB-contaminated soil following the methodology presented in Section 4.4.5. The results of this risk characterization are shown in Table 4-27.

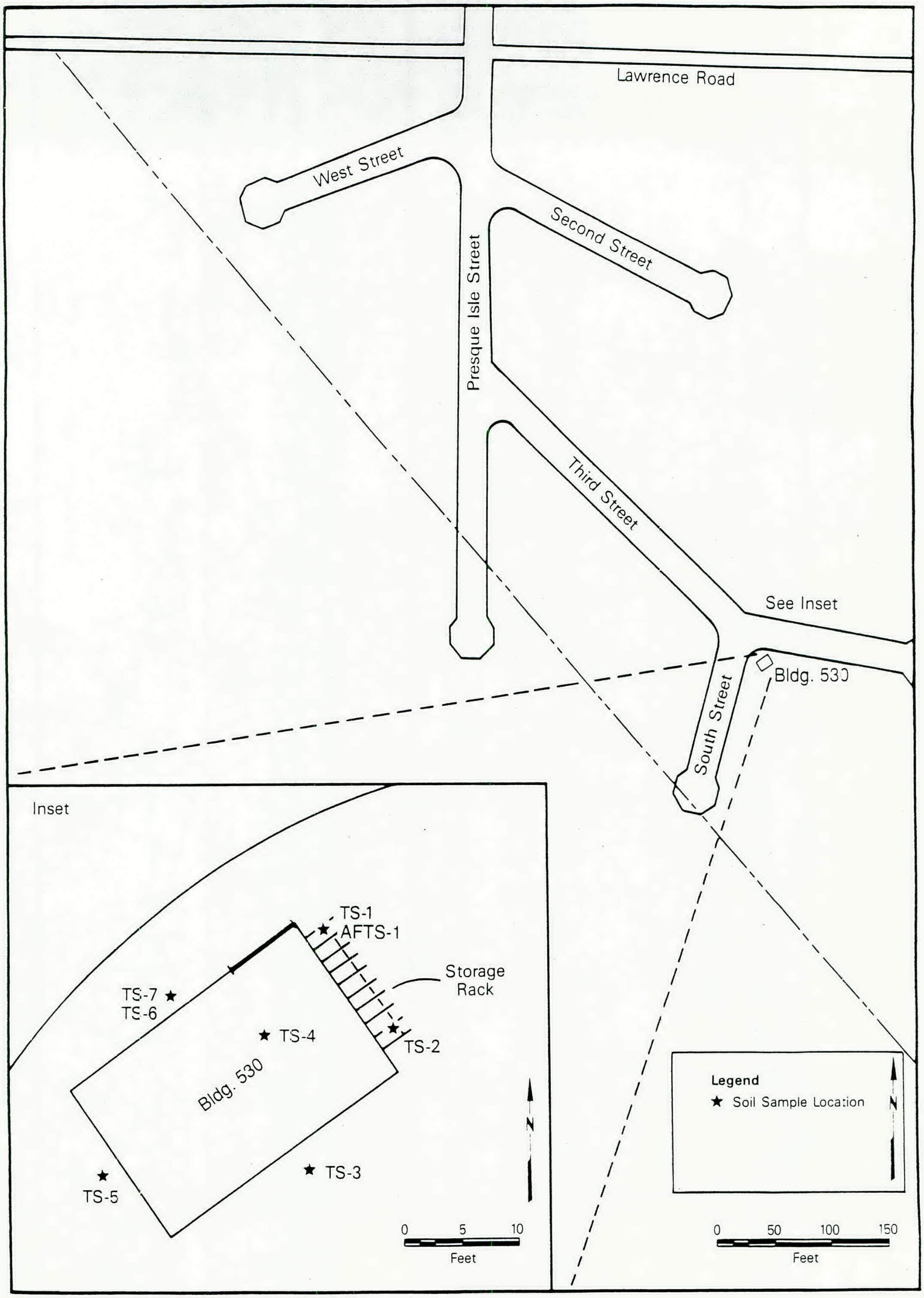

Figure 4-16. Transformer Storage Area, S-1

TABLE 4-26. SUMMARY OF RESULTS OF SOIL MONITORING FOR SITE S-1, HANCOCK FIELD, NEW YORK

Parameter (units)	Method	Detection Limit	Standards, Criteria, and Action Levels Federal and State	TS-1	TS-2	TS-3	TS-4	TS-5	TS-6	TS-7 (TS-6 DUP)
Petroleum Hydrocarbons (mg/Kg)	SW3550/ E418.1	variable		ND(39)	2200	ND(35)	250	ND(31)	400	330
PCBs (mg/Kg)	SW3550/ SW8080									
Arochlor 1260		variable	50 mg/Kg[a]	ND(0.59)	0.098	ND(0.053)	ND(0.067)	ND(0.054)	ND(0.41)	ND(0.50)

NOTES:

[a] Toxic Substances Control Act (TSCA) hazardous waste level.
ND = Not Detected at detection limit shown.

TABLE 4-27. RISK CHARACTERIZATION FOR PCBS IN SOIL AT SITE S-1, HANCOCK FIELD, NEW YORK

PCB Concentration in Soil	Dose: Lifetime Soil Ingestion (mg/Kg/day)	(Oral) q * $(mg/Kg/day)^{-1}$	Additional Individual Lifetime Risk
98 µg/Kg	2.45×10^{-6}	4.34	1.1×10^{-5}

Typically, an assessment of health risk exposure to contaminated soil is based on mean values for chemicals found in soil at a given site. At Site S-1, sampling was localized in the area of the transformer leak, as only one sample was found to contain detectable levels of PCBs. Using this single sample as the basis of analysis, the cancer risk to human health associated with lifetime ingestion of soil is projected to be on the order of 10^{-5}. This is likely an overestimate of the actual risks, since PCB contamination is restricted to the area directly under the transformer storage rack on the northeast side of Building 530. Based on the available information and the EPA guidelines for risk characterization and interpretation of hazardous waste sites, it is concluded that the projected lifetime risks of cancer from this site are within the range of acceptability and do not constitute a significant threat to human health.

4.4.7 Old Spill Area (Site SP-1)

Site SP-1 is a storm sewer outfall that drains surface water from the vicinity of the Semi-Automatic Ground Environment (SAGE) plant. This system is tied into a series of floor drains in Building 503, which is part of the SAGE plant complex, as shown in Figure 4-17. According to the base caretaker, discharges of fuel oil to the storm sewer occurred in the past when sump pumps in the Building 503 floor drains were set on automatic when an oil spill occurred in the building. Instead of the sumps being monitored and the fuel being pumped to an oil/water separator, the fuel automatically and mistakenly was pumped directly to the storm sewer. During the initial visit to this site

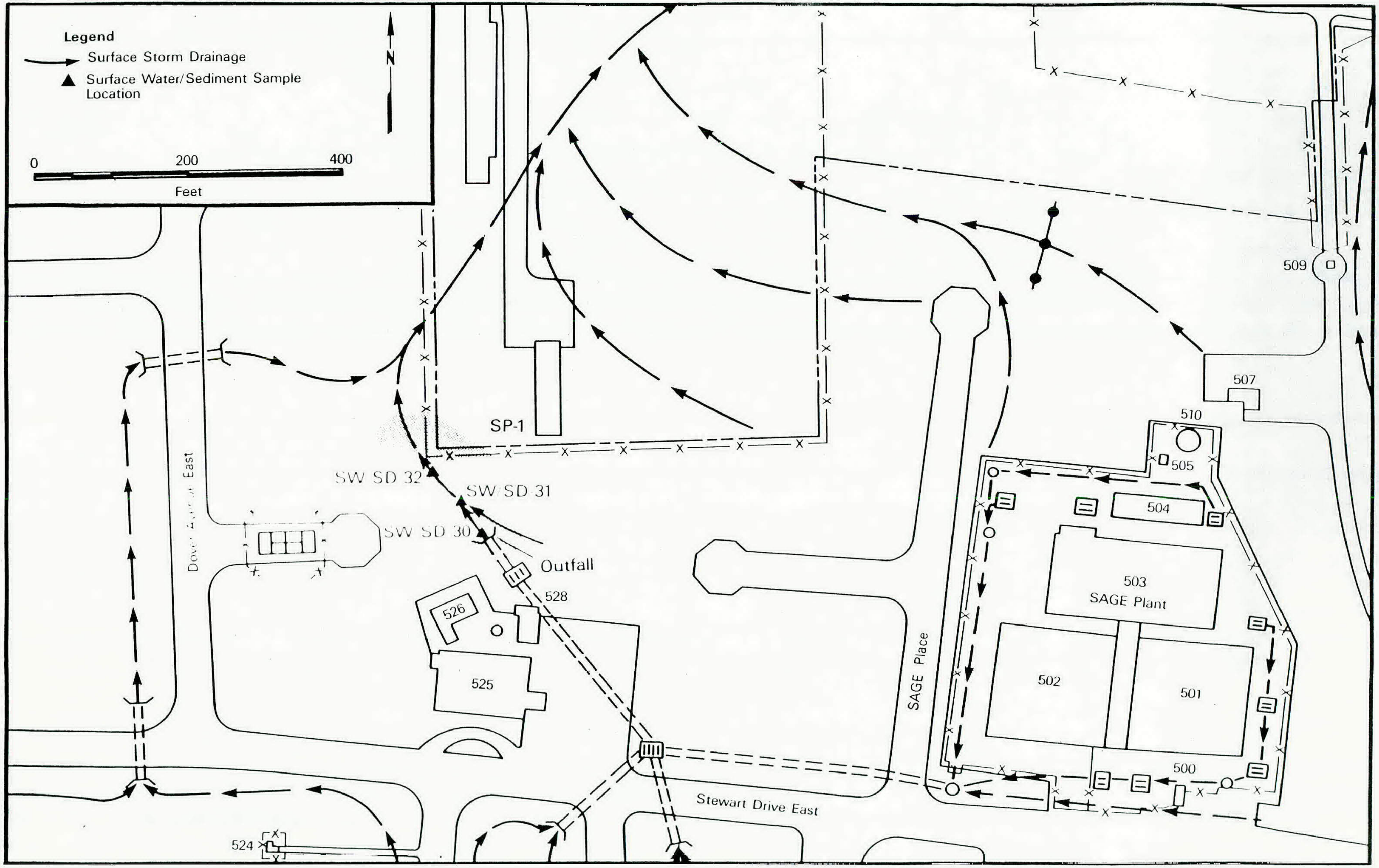

Figure 4-17. Old Spill Site, SP-1

in September 1986, no visible signs of contamination were evident. When the samples were collected in early December 1986, it was discovered that base facilities personnel had erected a new gravel silt trap and three hardware cloth and straw filters across the stream just below the outfall. As a result of this construction activity, the stream banks had been reworked and oil sheens were visible when bank sediments were disturbed.

Surface water and sediment samples were collected at the storm sewer outfall (SW/SD-30) and at points 50 and 100 feet downstream from the outfall (SW/SD-31 and 32). All surface water samples were field measured for pH, specific conductance, and temperature, and analyzed at the laboratory for:

- Petroleum hydrocarbons
- Purgeable hydrocarbons
- Aromatic volatile organics
- Lead.

The results of these analyses are provided in Table 4-28.

All sediment samples were analyzed for:

- Petroleum hydrocarbons
- Volatile organics
- Lead.

The sediment results are presented in Table 4-29.

In surface water, purgeable halocarbons were the only fraction in which contaminants were detected. The common solvent 1,1,1-trichloroethane (TCA) was found in all three surface water samples, with the highest concentration being 0.14 µg/L (SW-30). The Ambient Water Quality Criteria (AWQC) for evaluating the combined human exposure to this toxicant from drinking (surface) water and fish is 18,400 µg/L. The MCLG for levels of TCA in drinking water is 200 µg/L. Therefore, the low concentrations of this compound detected at Site SP-1 do not pose a threat to human health or the environment. Moreover, surface water in the vicinity is not used for drinking water.

TABLE 4-28. SUMMARY OF RESULTS OF SURFACE WATER MONITORING FOR SITE SP-1, HANCOCK FIELD, NEW YORK DECEMBER 1986

Parameter (units)	Method	Detection Limit	Standards, Criteria, and Action Levels Federal and State	SW-30	SW-31*	SW-32*
Field Parameters						
Sp. Conductance (umhos/cm)	E120.1	NA	NA	350	350	350
pH (standard units)	E150.1	NA	6.5 - 8.5[a]	7	7	7
Temperature (°C)	E160.1	NA	NA	8	8	8
Petroleum Hydrocarbons (mg/L)	E418.1	(0.50)		ND	ND	ND
Lead (mg/L)	E239.2	$0.92x10^{-3}$	0.05[a]	ND	ND	ND
Purgeable Halocarbons (ug/L)	E601					
1,1,1-Trichloroethane		0.03	200[b]	0.14	0.03[CI]	0.05[CI]
Carbon Tetrachloride		0.12	0.4[c]	ND	0.47	0.28
Chloroform		0.05	100[d]	ND	0.62	0.66
Tetrachloroethene		0.03	0.8[c]	ND	ND	0.16

NOTES:
* Resampled September 1987 and analyzed for purgeable halocarbons.
[a] Primary Drinking Water Standard, Federal, and State: Maximum Contaminant Level (MCL).
[b] Proposed MCL: Federal Register 50(219) 46092.
[c] AWQC adjusted for toxicants in aquatic organisms and drinking water.
[d] The MCL for total trihalomethanes. Refers to the sum concentration of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.
NA = Not Applicable.
ND = Not Detected at detection limit shown.
[CI] Compound found on both the primary and secondary column; however, there is potential interference from another compound on the secondary column, which prevents accurate quantitation of the peak of interest.

TABLE 4-29. SUMMARY OF RESULTS OF SEDIMENT MONITORING FOR SITE SP-1, HANCOCK FIELD, NEW YORK

Parameter (units)	Method	Detection Limit	Background Level (mg/Kg)	Health-based guidelines* (mg/Kg)	SD-30	SD-31	SD-32
Petroleum Hydrocarbons (mg/Kg)	SW3550/ E418.1	variable	NA	NA	2100	30	ND(28)
Lead (mg/Kg)	SW7420	variable	5.2	1,319	21	22	19
Volatile Organics-GC/MS (mg/Kg)	SW8240	variable	--	--	ND	ND	ND

NOTES:

All soil/sediment results reported on a dry weight basis.
* Health-based guidelines based on ingestion exposure due to chemicals in soil.
NA = Not Applicable.
ND = Not Detected at detection limit shown.
-- = Indicates that values for specific chemicals are available and not as a group.

Chloroform and carbon tetrachloride were detected in samples SW-31 and SW-32, while tetrachloroethene was found in sample SW-32. The tetrachloroethene concentrations were well below the EPA CAG 10^{-6} cancer risk level (0.7 μg/L) and the adjusted AWQC (0.8 μg/L). Concentrations of carbon tetrachloride were below the EPA CAG 10^{-6} cancer risk level of (0.4 μg/L) and the proposed MCL of (5.0 μg/L). Moreover, carbon tetrachloride is believed to be a laboratory contaminant introduced during analysis because it was found in the method blank at a concentration of 0.32 μg/L, approximating that of the field samples. Chloroform concentrations were well below the MCL for total trihalomethanes and are not considered to pose a significant risk to human health.

The results of sediment analysis revealed no VOCs, and lead concentrations, which averaged 20.6 mg/Kg, were somewhat higher than background levels. However, these levels appear to be nonpoint source related, possibly from aircraft exhaust fallout. The only constituent found was an elevated concentration (2.1 mg/Kg) of petroleum hydrocarbons in sample SD-30. Although this is a positive indication of contamination, no health-based or other environmental criteria or standards exist for petroleum hydrocarbons.

This site was investigated because of fuel spills that occurred before 1973. The only analytes that point to residual fuel contamination were the lead and petroleum hydrocarbons found in sediments. The organic compounds detected in surface water do not appear to be fuel-related, and may result from some continuing operation upstream of Site SP-1.

4.4.8 Disposal Site D-5

Site D-5 is located at the end of an old aircraft hardstand that has been converted to a jet engine run-up area. This site is comparatively small (100 feet by 150 feet) and has been reported to contain construction rubble, empty annunition boxes, empty drums, and drums containing various amounts of paint thinners and solvents. Detailed records of specific quantities or types of waste disposed of at this site are not available, but wastes are most likely derived from the New York Air National Guard (NYANG) maintenance shops. The exact extent of this site is also difficult to determine because of earthmoving activities associated with modification of the aircraft hardstand. This site was active from 1958 to 1976.

Three new monitoring wells, as shown in Figure 4-11, were installed around Site D-5 in October 1987. These wells, along with existing well MW-10, were sampled for:

- Alkalinity
- Common anions
- Total dissolved solids
- Petroleum hydrocarbons
- Purgeable halocarbons
- Aromatic volatile organics
- Metals screen (26)
- Extractable priority pollutants.

The compounds detected in these wells are summarized in Table 4-30.

The results of the initial sampling at Site D-5 indicated that thallium was present in groundwater at levels above the AWQC for toxicants in drinking water. Because these values could not be explained, and analytical interferences with thallium are common, the Site D-5 wells were resampled for total and dissolved thallium in January 1989. No thallium was found above the AWQC, confirming the supposition of analytical interference.

Of the compounds detected, only the purgeable halocarbons appear out of the ordinary, and these are not believed to represent environmental contamination. The following purgeable halocarbons were detected:

- Chloroform (MW-17, MW-18)
- Dichlorodifluoromethane (all)
- Trichlorofluoromethane (MW-17, MW-18)
- Methylene chloride (MW-10, MW-16, MW-1[illegible])
- 1,1,1-Trichloroethane (MW-16).

Chloroform was detected at very low levels (< ug/L) in two well samples. These levels are believed to result from small amounts of city water introduced during drilling to counteract the effects of heaving formation

TABLE 4-30. SUMMARY OF RESULTS OF GROUNDWATER MONITORING FOR SITE D-5, HANCOCK FIELD, NEW YORK OCTOBER 1987

				Sample # Well #				
Parameter (units)	Method	Detection Limit	Standards, Criteria, and Action Levels Federal and State	GW-33 MW-10	GW-34 MW-16	GW-35 MW-16 DUP	GW-36 MW-17	GW-37 MW-18
Field Parameters								
Sp. Conductance (umhos/cm)	E120.1	—	NA	290	525	525	925	600
pH (standard units)	E150.1	—	6.5 - 8.5[b]	6.21	6.53	6.53	6.82	6.90
Temperature (°C)	E170.1	—	NA	18	17	17	17	17
Alkalinity (mg/L CaCO3)	A403							
Bicarbonate		2	NA	110	330	300	560	360
Total		2	NA	110	330	300	560	360
Common Anions (mg/L)	A429							
Chloride		variable	250[b]	5.1	6.4	6.4	10	7.3
Sulfate		variable	250[b]	51	ND	ND	ND	31
Total Dissolved Solids (mg/L)	E160.1	10	500	240	380	380	650	410
Purgeable Halocarbons (ug/L)	E601							
Chloroform		0.05	100[d]	ND	ND	ND	0.13[d]	0.93[d]
Dichlorodifluoromethane		1.81	NA	2.25[e]	2.72	2.77	2.41	2.16
Methylene Chloride		0.25	0.19[f]	0.51	0.54	0.53	0.41	ND
1,1,1-Trichloroethane		0.03	200[c]	ND	0.04	ND	ND	ND
Trichlorofluoromethane		0.25	NA	ND	ND	ND	0.22	0.22
Metals Screen (mg/L)	E200.7							
Aluminum		0.045	NA	0.88	0.58	0.66	0.61	0.74
Barium		0.002	1.0[a]	0.30	0.16	0.17	0.082	0.30
Boron		0.005	NA	ND	0.053	0.054	0.065	0.042

TABLE 4-30. SUMMARY OF RESULTS OF GROUNDWATER MONITORING FOR SITE D-5, HANCOCK FIELD, NEW YORK (Continued)
OCTOBER 1987

Parameter (units)	Method	Detection Limit	Standards, Criteria, and Action Levels Federal and State	Sample # Well # GW-33 MW-10	GW-34 MW-16	GW-35 MW-16 DUP	GW-36 MW-17	GW-37 MW-18
Calcium		0.010	NA	56	100	93	160	99
Copper		0.006	1.0[b]	0.013	ND	ND	ND	ND
Iron		0.007	0.3[b]	1.8	1.9	2.0	0.49	1.3
Magnesium		0.030	NA	9.9	26	24	39	22
Manganese		0.002	0.05[b]	0.12	0.62	0.65	2.3	0.56
Molybdenum		0.008	NA	0.018	ND	ND	0.014	0.024
Potassium		0.500	NA	1.1	1.8	1.7	ND	0.7
Silica		0.058	NA	4.0	9.2	9.3	9.7	7.3
Sodium		0.029	NA	2.4	3.1	3.3	5.2	2.5
Thallium (Total)		0.040	0.0178[f]	ND	ND	0.083	0.15	0.14
Thallium (Total 1/89)		0.040	0.0178[f]	ND	ND	ND	ND	0.0014
Thallium (Dissolved 1/89)		0.040	0.0178[f]	ND	ND	ND	ND	ND
Zinc		0.002	5.0	0.018	0.008	0.006	ND	0.009

NOTES:
Only those compounds that were detected have been included in this table.
All volatile, halogenated compounds included in the 8020 analysis were quantified using their response from the 601 analysis.

[a] Primary Drinking Water Standard, Federal and State: Maximum Contaminant Level (MCL).
[b] New York Secondary Drinking Water Standard.
[c] Proposed MCL: Federal Register 50(219) 46902.
[d] The MCL for total trihalomethanes. Refers to the sum concentration of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.
[e] Vinyl chloride and dichlorodifluoromethane coelute, the value is the total of both peaks, but is reported as the latter.
[f] Ambient water quality criteria adjusted for toxicants in drinking water.
NA = Not Applicable.
ND - Not Detected at detection limit shown.

materials. Furthermore, these levels are a small fraction of the Federal and State MCL for trihalomethanes (100 ug/L) and this aquifer is not used as a drinking water source. Consequently, even if these chloroform levels were believed to be site-related, and they are not, they would pose no threat to human health or the environment.

Dichlorodifluoromethane was detected in all samples, including the method blank, at levels ranging from 2.2 to 2.77 ug/L. Trichlorofluoromethane was detected in two well samples at 0.22 ug/L. Both of these compounds are common refrigerants known as chlorofluorocarbons (CFCs) and often are encountered as sample contaminants resulting from leaking refrigeration units. Both of these compounds are gases under ambient conditions and have relatively high vapor pressures (5 ATM and 1 ATM, respectively), and thus, would remain in the terrestrial environment for only short time spans. Because of these characteristics, and their low solubility, no standards, criteria, or action levels exist for these compounds in water. Thus, although these compounds were detected, they cannot be representative of site-related environmental contamination.

Methylene chloride, the most common laboratory sample contaminant, was detected at low levels (average <0.5 ug/L) in four samples and the method blank (second column analysis). Because this compound is a virtually ubiquitous laboratory contaminant, and was detected in an upgradient well (MW-16) and a cross-gradient well (MW-10), it is considered an analysis artifact and does not represent environmental contamination.

The only other purgeable halocarbon detected was 1,1,1-trichloroethane. This compound was found in the upgradient well (MW-16) at only 1 ug/L above the detection limit, a level of questionable validity. Furthermore, the level detected (0.4 ug/L) is an extremely small fraction of the proposed MCL of 200 ug/L for 1,1,1-trichloroethane, so even if this were convincingly environmental contamination, it would pose no threat to human health or the environment.

In summary, thallium and a number of halogenated VOCs were detected in samples from Site D-5. None of these compounds is believed to represent site-related contamination, especially from a site that ceased receiving wastes in 1976. The presence of these compounds in the samples can be explained by other mechanisms, and Site D-5 does not appear to be a source of environmental contamination.

4.4.9 Background Soil Sample

A single background soil sample was collected approximately 300 feet south of the Fire Training Area (Site FT-1), as shown in Figure 4-10. The SOW called for three samples to be collected in this effort at 5-foot intervals to a depth of 15 feet or to the water table, whichever occurred first. A seasonal perched water table (see Section 4.2.2.1) was encountered at approximately 3 feet BLS; therefore only one sample was collected. This sample was analyzed for 13 priority pollutant metals and petroleum hydrocarbons. The results of these analyses, shown in Table 4-31, reveal no petroleum hydrocarbons above the detection limit of 30 mg/Kg. Metals ranged from not detected for antimony, silver, and thallium, to 30 mg/Kg for zinc. As shown, all metals values are well within the ranges commonly encountered in mineral soils.

4.4.10 Summary

Seven sites in two zones at Hancock Field were investigated during this Phase II, Stage 2 study. These sites were investigated by:

- Soil gas survey
- Magnetometry survey
- Subsurface boring and well installation
- Hydrologic testing and measurements
- Environmental sampling.

The results of these investigations are summarized in Table 4-32.

TABLE 4-31. SUMMARY OF RESULTS OF BACKGROUND SOIL MONITORING, HANCOCK FIELD, NEW YORK

Parameter (units)	Method	Detection Limit	Normal Ranges in Soils (Fairbridge 1979)	FS-I-1
Petroleum Hydrocarbons (mg/Kg)	SW3550/ E418.1	30	NA	ND
Priority Pollutant Metals (mg/Kg)	SW3050/ SW6010			
Antimony	SW6010	0.17	2 - 10	ND
Arsenic	SW7060	0.53	0.01 - 40	4.6
Beryllium	SW6010	0.0003	0.1 - 40	0.40
Cadmium	SW6010	0.004	0.01 - 0.7	0.47
Chromium	SW6010	0.007	5 - 3,000	8.4
Copper	SW6010	0.006	2 - 100	18
Lead	SW7420	0.10	2 - 200	11
Mercury	SW7471	0.0002	0.01 - 0.8	0.051
Nickel	SW6010	0.15	5 - 5,000	8.8
Selenium	SW6010	0.75	0.01 - 38	1.0
Silver	SW6010	0.17	0.1 - 5	ND
Thallium	SW6010	0.12	0.1 - 12	ND
Zinc	SW6010	.002	10 - 300	30
Volatile Organics-GC/MS (mg/Kg)	SW8240			
1,1,1-Trichloroethane		1.9	NA	ND
1,1,2,2-Tetrachloroethane		3.4	NA	ND
1,1,2-Trichloroethane		2.5	NA	ND
1,1-Dichloroethane		2.4	NA	ND
1,1-Dichloroethene		1.4	NA	ND
1,2-Dichloroethane		1.4	NA	ND
1,2-Dichloropropane		3.0	NA	ND
2-Chloroethylvinyl ether		5.0	NA	ND
Benzene		2.2	NA	ND
Bromodichloromethane		1.1	NA	ND
Bromoform		2.4	NA	ND
Bromomethane		6.0	NA	ND
Carbon Tetrachloride		1.4	NA	ND
Chlorobenzene		3.0	NA	ND
Chlorodibromomethane		1.6	NA	ND
Chloroethane		2.6	NA	ND
Chloroform		0.8	NA	ND
Chloromethane		0.4	NA	ND
cis-1,3-Dichloropropene		1.0	NA	ND
Ethyl Benzene		3.6	NA	ND
Methylene Chloride		1.4	NA	ND
Tetrachloroethene		2.0	NA	ND
Toluene		3.0	NA	ND
trans-1,2-Dichloroethene		0.8	NA	ND
trans-1,3-Dichloropropene		2.5	NA	ND
Trichloroethene		1.0	NA	ND
Trichlorofuoromethane		2.5	NA	ND
Vinyl Chloride		0.9	NA	ND
Xylenes		3.0	NA	ND

Notes:
NA = Not Applicable.
ND = Not Detected at detection limit shown.

TABLE 4-32. SUMMARY OF INVESTIGATION RESULTS

Site(s)	Investigation	Results
Zones 1 and 2	9 Existing Wells Sampled For: • Alkalinity • Common Anions • Total Dissolved Solids • Petroleum Hydrocarbons • Purgeable Halocarbons • Aromatic Volatile Organics • 26 Metals • Extractable Priority Pollutants	No site-related contamination found
Fire Training Area: Site FT-1	30 point soil gas survey for: • Benzene • Toluene • Xylene • Total Volatiles	Measureable concentrations of benzene, toluene, and total volatiles found mostly within bermed area; not found in other media
	26 soil samples analyzed for: • Petroleum Hydrocarbons • Lead • Volatile Organics	Petroleum hydrocarbons found within bermed area
	10 soil samples also analyzed for: • Semivolatile Organics	Polynuclear aromatics and possibly phthalates found within bermed area; no significant health risk
	6 groundwater monitoring wells installed and analyzed for: • Petroleum hydrocarbons • Purgeable Halocarbons • Aromatic Volatile Organics	No site-related contamination found

TABLE 4-32. SUMMARY OF INVESTIGATION RESULTS (Continued)

Site(s)	Investigation	Results
Zones 1 and 2 Surface Water and Sediments	23 surface water samples analyzed for: ● Petroleum Hydrocarbons ● Purgeable Halocarbons ● Aromatic Volatile Organics ● 13 Metals ● Extractable Priority Pollutants	No site-related contamination found
	23 sediments samples analyzed for: ● Petroleum Hydrocarbons ● 13 Metals ● Volatile Organics ● Semivolatile Organics	No site-related contamination found
Zone 2: Disposal Sites D-1 and D-3	Magnetometry survey	Buried ferrous metal detected throughout both sites
	6 groundwater monitoring wells installed, sampled, and analyzed for: ● Alkalinity ● Common Anions ● Total Dissolved Solids ● Petroleum Hydrocarbons ● Purgeable Halocarbons ● Aromatic Volatile Organics ● 26 Metals ● Extractable Priority Pollutants	No site-related contamination found

TABLE 4-32. SUMMARY OF INVESTIGATION RESULTS (Continued)

Site(s)	Investigation	Results
Entomology Underground Storage Tank Site S-3	1 tank water sample	Malathion found in tank water
	3 soil samples analyzed for: • Organochlorine Pesticides • Organophosphorus Pesticides • Chlorinated Herbicides	Trace concentrations of DDE, DDT, dieldrin, and heptachlor epoxide found in soils; no significant health risk.
Transformer Storage Area Site S-1	7 soil samples analyzed for: • Petroleum Hydrocarbons • PCBs	Petroleum hydrocarbons found in 3 samples; detectable PCBs found in 1 sample; no significant health risk.
Old Spill Area Site SP-1	3 surface water samples analyzed for: • Petroleum Hydrocarbons • Purgeable Halocarbons • Aromatic Volatile Organics • Lead	Low concentrations (<2 µg/L) of 1,1,1-trichloroethane found in all 3 samples, trace concentration of 1,1,2,2-tetrachloroethane found in 1 sample; no significant health risk.
	3 sediments samples analyzed for: • Petroleum Hydrocarbons • Volatile Organics • Lead	Petroleum hydrocarbons (2100 mg/Kg) found in 1 sample; no risk evaluation possible.

TABLE 4-32. SUMMARY OF INVESTIGATION RESULTS (Continued)

Site(s)	Investigation	Results
Disposal Site D-5	3 shallow groundwater monitoring wells installed; new wells and existing well GW-10 sampled and analyzed for: • Alkalinity • Common Anions • Total Dissolved Solids • Petroleum Hydrocarbons • Purgeable Halocarbons • Aromatic Volatile Organics • Metals Screen (26) • Extractable Priority Pollutants	Low concentrations of halogenated volatile organics found in groundwater samples, but are analysis artifacts and not site-related.

Twenty-four monitoring wells were sampled, some more than once. The analytical results for these samples showed no groundwater contamination attributable to the sites under study. Site-related contamination was detected at:

- Fire Training Area (Site FT-1)
- Entomology Underground Storage Tank (Site S-3)
- Transformer Storage Area (Site S-1)
- Old Spill (Site SP-1)

In each case, risk assessments performed using the contaminant levels found and conservative exposure schemes show no significant human health or environmental risks posed by these four sites. Thorough investigation of Disposal Sites D-1 and D-3 in Zone 2 revealed no site-related contamination.

5. ALTERNATIVE MEASURES

This section presents the principal monitoring alternatives, by site, that are needed to meet the quantification goals of the U.S. Air Force (USAF) Installation Restoration Program (IRP) Phase II, Stage 2 at Hancock Field, New York. The sites addressed in this section are those where the Stage 1 or Stage 2 investigations have been adequate to confirm site-related contamination, but additional work may be necessary to define either the extent, pathways, or specific compounds involved. No significant health risks were found from Disposal Site D-5 in Zone 1, the surface water and sediments results in both Zones 1 and 2 (except Site SP-1), and Disposal Sites D-1 and D-3 in Zone 2. Contamination was found at the two sites addressed in this section, but, as we discuss below, at levels that do not require further action under the IRP.

5.1 FIRE TRAINING AREA (SITE FT-1)

Soils surrounding the Fire Training Area, principally those soils within the bermed portion of the site, are contaminated with lead, petroleum hydrocarbons, polynuclear aromatic compounds (PNAs), and phthalate esters. The presence of the phthalate esters is always suspect because they are common field and laboratory contaminants. The areal extent of these contaminants was fairly well-delineated by the Stage 2 sampling, and the risk assessment presented in Section 4.4.2 indicates that no significant human health risk is posed by the contaminants. The soil gas survey indicated that the volatile organics benzene and toluene were present in soil gas, at concentrations up to 4,400 and 1,300 ppb, respectively, while laboratory analysis of shallow soils from the same locality twice showed no volatile organics. Monitoring wells in the surficial aquifer showed no levels of benzene or toluene, and no site-related groundwater contamination was found. Also, no site-related surface water or sediment contamination was found. The volatile organics found in soil gas were not found in any other media. It is suspected that the soil vapor values measured resulted from small amounts of fuel that seeped through joints in the concrete hardstand and were being volatilized around the margins. This fuel would be prevented from entering groundwater by the thick silty clay layers near the surface, and would be restricted from entering surface water by the flat topography of the site. In any event, the volatile organics were not found in any medium through which human exposure or environmental release would occur. Therefore, it is concluded that this site poses no significant risk to human health or the environment, and no further action is warranted.

5.2 ENTOMOLOGY UNDERGROUND STORAGE TANK (SITE S-3)

As discussed in Section 4.4.5, one pesticide, the organophosphorus malathion, was detected at a level well above the standard in the one tank water sample collected. The three soil samples collected approximately 20 feet downslope of the tank access pipe contained trace concentrations (all less than 1 mg/Kg) of DDE, DDT, dieldrin, and heptachlor epoxide.

In an analysis of alternative measures for this site, the contents of the underground tank are treated as a waste material rather than as a contaminated environmental medium. Therefore, the preferred alternative for the tank contents is disposal through the Defense Property Disposal Office in accordance with the regulations of the Resource Conservation and Recovery Act (RCRA).

A risk assessment for exposure to the trace concentrations of pesticides in soils at this site shows individual lifetime cancer risks on the order of 10^{-5} to 10^{-6}, depending on whether maximum or mean concentrations are used in the assessment. This assessment assumes exposure to these soils over a 70-year lifetime. All soils at this site are covered with sod or concrete, however, and the true potential for human exposure to the pesticides is limited. Therefore, these soils do not pose an unacceptable threat to human health, and no additional monitoring or remedial action is recommended.

5.3 TRANSFORMER STORAGE AREA (SITE S-1)

Investigation of this site revealed minor petroleum hydrocarbon contamination at three of the six sampling points and one polychlorinated biphenyl (PCB) (Aroclor 1260 at 0.098 mg/Kg) at one sampling point. No standards exist for petroleum hydrocarbons, but the maximum concentration found (2.2 mg/Kg) is not believed to represent significant environmental degradation or to warrant further study. The single PCB concentration recorded is well below the Toxic Substances Control Act (TSCA) action level of 50 mg/Kg, and a risk assessment of this PCB value results in an individual lifetime cancer risk of 1.1 x 10^{-5}. This risk (which is based on very conservative assumptions) is within the target risk range of 10^{-4} to 10^{-7} cited in U.S. Environmental Protection Agency (EPA) guidance, so no further action is warranted at this site.

5.4 OLD SPILL AREA (SITE SP-1)

The surface water and sediments below the storm sewer outfall that constitute this site both exhibit low concentrations of fuel-related contamination. None of the organic compounds detected in surface water is at a concentration that represents significant health risk (all were detected at less than 1 µg/L). Sediments exhibit near background concentrations for lead, and only one of the three samples collected contained measurable amounts of petroleum hydrocarbons (2,100 mg/Kg). No standards or criteria exist for petroleum hydrocarbons, but this level is above background.

Although there are positive indications of contamination at this site, the concentrations of all constituents are low and no significant human health risk is posed. Therefore, a no action alternative is appropriate for this site as long as the site remains relatively undisturbed. If construction or other site-disturbing activities are considered for this area, precautions should be taken to prevent releases of fuel-related compounds from sediments to surface water.

6. RECOMMENDATIONS

This section presents recommendations based on investigations to date for each of the sites studied at Hancock Field, New York concerning the direction that should be taken within the U.S. Air Force (USAF) Installation Restoration Program (IRP). Each investigated site has been categorized as to the need for further IRP action. Three categories have been established to characterize these IRP needs. Category I sites are those sites that are believed to have been adequately investigated and characterized, and where no further monitoring or remedial action is deemed necessary at this time. All seven sites at Hancock Field have been placed in Category I. Category II sites are those sites that have been insufficiently characterized to make a confident assessment of the degree of environmental and human health threat that the sites pose. Sites that have been adequately characterized and require remedial action (IRP Phase IV) are assigned to Category III. None of the sites investigated at Hancock Field has been assigned to Category II or III.

6.1 CATEGORY I SITES

Samples that were collected from various environmental media during this Phase II, Stage 2 effort indicate that no further action is warranted at all seven sites (FT-1, D-1, D-3, D-5, S-1, S-3, and SP-1). The analytical data indicate that the sites, discussed below, pose no significant environmental or human health risks, as defined by U.S. Environmental Protection Agency (EPA) guidance.

6.1.1 Zone 2 (Sites D-1 and D-3)

A magnetometry survey was conducted over both Disposal Sites D-1 and D-3. Five existing and six new wells were sampled, and surface water and sediment samples were collected at seven sampling points. Although buried and partially buried ferrous metal was detected and mapped during the magnetometry survey, the only possible site-related contamination found was arsenic in three sediment samples. The concentrations and locations of this contamination do not pose a significant health risk.

6.1.2 Entomology Underground Storage Tank (Site S-3)

One sample of the contents of the underground storage tank was collected, and three soil samples were taken approximately 20 feet downslope from the tank access pipe. Malathion was found in the tank water. Trace levels of DDE, DDT, dieldrin, and heptachlor epoxide were found in soil samples. The contents of the tank qualify as hazardous waste and should be disposed of in accordance with USAF and EPA requirements. The trace pesticide concentrations found in soils pose no significant environmental or human health threat.

6.1.3 Old Spill Area (Site SP-1)

Three surface water samples and three sediment samples were collected at 50-foot intervals downstream from this storm sewer outfall. Low to trace concentrations of organic compounds were detected in surface water, and petroleum hydrocarbons were detected in one sediment sample. None of the concentrations that were detected pose a significant environmental or human health threat.

6.1.4 Transformer Storage Area (Site S-1)

Petroleum hydrocarbons were measured in three samples from this site, and less than 1 mg/Kg of polychlorinated biphenyls (PCBs) also were measured in one sample. The concentrations of constituents that were found do not pose a significant environmental or human health threat.

6.1.5 Zone 1 (Site D-5)

Low levels of purgeable halocarbons were detected in samples from all four wells. These purgeable halocarbons were determined to be analysis artifacts and not environmental contamination. This site poses no environmental or human health threat.

6.1.6 Fire Training Area (Site FT-1)

This site was investigated by conducting a 30-point soil gas survey, collecting 24 soil samples, and installing 6 new groundwater monitoring wells. The soil gas survey revealed the presence of volatile organic compounds (VOCs) that were not found in the shallow soils themselves. Soil samples revealed the presence of polynuclear aromatic (PNA) compounds, petroleum hydrocarbons, and phthalate esters. No site-related groundwater contamination was found, and the measured soil contamination poses no significant human health threat. The volatile organics found in soil gas were not found in other media and also do not pose a significant human health threat.

bottles. Soil replicate samples were collected by taking the samples from proximate areas in the soil column. Field replicates differ from laboratory duplicates, which are the same sample split in two. Analytical results of field replicates are used to evaluate the precision of field sampling procedures. Field replicates were collected for 10 percent of the samples collected.

The field QA data are presented in Table 4-4 and Appendix H. These data are discussed in the following paragraphs, by analyte.

4.1.3.1 Volatile Organic Compounds (VOCs)
EPA Methods E601, E602, SW8020, SW8240

VOCs were not detected in the trip blank, indicating that samples were not contaminated with volatile organic compounds (VOCs) during shipment, storage, or handling. VOCs were detected, however, in both of the field blank samples collected and in the bailer wash sample. The presence of these compounds may be attributed to:

- Laboratory contamination of the field QC samples. Methylene chloride is a common laboratory contaminant. Toluene, although not as common a laboratory contaminant, is known to be present when the tenax in the purge and trap apparatus is beginning to age, and this could be a potential source of the toluene.
- Improper equipment decontamination techniques.

The impact of these contaminants on the usefulness of the environmental data is discussed below:

The environmental significance of methylene chloride detected in surface water samples from shipment 2 cannot be evaluated because:

- The level of methylene chloride detected in Field Blank SW-24 is higher than, or roughly equivalent to, the level of methylene chloride detected in all of the surface water samples from shipment 2 (SW-1 through SW-16, SW-18 through SW-23, and SW-30 through SW-32).
- The available health criterion for methylene chloride is lower than the method detection limit for methylene chloride. Consequently, the methylene chloride concentrations of all shipment 2 samples, except for SW-30, exceed this criterion.

TABLE 4-4. SUMMARY OF FIELD REPLICATE DATA

Sample ID (type)	Sample Replicate ID (type)	Parameters Analyzed for (Positive Analysis Only)	Analytes Identified	Conc. Sample	Conc. Replicate	RPD**
FS A-3 (Soil)	FS A-4 (Soil)	Metals (mg/Kg)	Lead	11	12	9
		Petroleum Hydrocarbons (mg/Kg)		29	30	3
		Moisture (%)		17	18	6
FS H-3 (Soil)	FS H-4 (Soil)	Metals (mg/Kg)	Lead	9.4	6.5	36
		Petroleum Hydrocarbons (mg/Kg)		28	28	0
		Moisture (%)		15	17	12
TS-6 (Soil)	TS-7 (Soil)	Petroleum Hydrocarbons (mg/Kg)		400	330	19
		Moisture (%)				
SW-4 (Water)	SW-22 (Water)	BNAs (µg/L)	Bis (2-ethylhexyl) Phthalate	ND(4.0)	ND (4.0)	--
		Purgeables (µg/L)	Methylene Chloride	0.83	78	196
SW-1 (Water)	SW-23 (Water)	Purgeables (µg/L)	Methylene Chloride	0.3	0.79	90
GW-31 (Water)	GW-32 (Water)	BNAs (µg/L)	Bis (2-ethylhexyl) Phthalate	ND(4.0)	10	86
		Purgeables (µg/L)				
			Bromodichloromethane	4.0	3.4	16
			Bromoform	1.5	0.76	65
			Chloroform	18	18	0
			Methylene Chloride	0.43	ND(0.25)	53

TABLE 4-4. SUMMARY OF FIELD REPLICATE DATA (Continued)

Sample ID (type)	Sample Replicate ID (type)	Parameters Analyzed for (Positive Analysis Only)	Analytes Identified	Conc. Sample	Conc. Replicate	RPD**
		Alkalinity (mg/L)	Bicarbonate	32	32	0
			Carbonate	110	120	9
			Total	140	150	7
		Anions (mg/L)	Chloride	32	33	3
			Sulfate	73	81	10
		Metals (µg/L)	Calcium	8,400	7,600	10
			Chromium	92	ND(44)	71
			Magnesium	2,000	1,300	42
			Potassium	210,000	220,000	5
			Silica	3,800	2,200	53
			Sodium	38,000	40,000	5
		TDS (mg/L)		740	820	10
SD-1* (Sediment)	SD-23* (Sediment)	Metals (mg/Kg)	Arsenic	16	7.0	78
			Beryllium	0.4	ND (0.14)	96
			Cadmium	1.2	0.32	116
			Chromium	9.3	2.9	105
			Copper	ND (37)	11	108
			Lead	18	5.0	113
			Mercury	0.033	0.043	26
			Nickel	12	45	116
			Selenium	2.6	ND(0.2)	171
			Zinc	100	28	112

TABLE 4-4. SUMMARY OF FIELD REPLICATE DATA (Continued)

Sample ID (type)	Sample Replicate ID (type)	Parameters Analyzed for (Positive Analysis Only)	Analytes Identified	Conc. Sample	Conc. Replicate	RPD**
SD-1* (Sediment)	SD-23*	Petroleum Hydrocarbons (mg/Kg)		ND(51)	120	81
		Moisture (%)		55	49	12
SD-4* (Sediment)	SD-22*	Metals (mg/Kg)	Arsenic	4.4	7.1	47
			Beryllium	0.2	0.2	0
			Cadmium	1.7	2.3	30
			Chromium	12	17	34
			Copper	98	120	20
			Lead	100	97	3
			Nickel	12	12	0
			Selenium	1.1	ND (0.20)	138
			Zinc	89	110	21
		Petroleum Hydrocarbons (mg/Kg)		1,500	2,000	26
		Moisture (%)		31	63	68
GW-34 (Water)	GW-35 (Water)	Purgeables µg/L	Dichlorodifluoromethane	2.72	2.77	2
			Methylene Chloride	0.54	0.53	2
			1,1,1-Trichloroethane	0.04	0.03	29
		Misc. Inorganics mg/L	Alkalinity, Total	330	300	9
			Alkalinity, Bicarb	330	300	9
			Chloride	6.4	6.4	0
			Total Dissolved Solids	380	380	0

TABLE 4-4. SUMMARY OF FIELD REPLICATE DATA (Continued)

Sample ID (type)	Sample Replicate ID (type)	Parameters Analyzed for (Positive Analysis Only)	Analytes Identified	Conc. Sample	Conc. Replicate	RPD**
		Metals ICAP µg/L	Aluminum	580	660	13
			Barium	160	170	6
			Boron	53	54	2
			Calcium	100,000	93,000	7
			Iron	1,900	2,000	5
			Magnesium	26,000	24,000	8
			Potassium	1,800	1,700	6
			Silica	9,200	9,300	1
			Sodium	3,100	3,300	6
FSA-3 (Soil)	FSA-4 (Soil)	% Solids		77	77	0
FSH-3	FSH-4	% Solids		74	73	1
		Volatiles mg/Kg	Acetone	0.013	0.013	0

*Base/Neutral and Acid Extractables analysis was requested for the sample, but was not requested for the replicate.

**Where either of the results was ND, the detection limit was used to calculate the RPD.

ND = Not Detected, value in parentheses is detection limit.

The environmental significance of methylene chloride detected in groundwater samples from shipment 4 cannot be evaluated because:

- The level of methylene chloride detected in the method blank analyzed with this shipment exceeds, or is within one order of magnitude of, all of the samples from this shipment (GW-11 through GW-16), except for GW-16.
- The available health criterion for methylene chloride is lower than the method detection limit for methylene chloride. Consequently, the methylene chloride concentrations of all shipment 4 samples exceed this criterion.

The level of toluene detected in the method blank (0.50 µg/L) analyzed with samples from shipment 4 is roughly equivalent to the levels of toluene found in two of the samples, and may be attributed to laboratory contamination. This is not expected to impact the environmental assessment adversely because these levels are well below the recommended maximum contaminant level goal (MCLG) of 2,000 µg/L for toluene.

The environmental significance of methylene chloride detected in groundwater samples from shipment 5 (GW-17 through GW-24) cannot be evaluated because:

- The level of methylene chloride detected in Field Blank GW-19 and Bailer Wash GW-20 analyzed with this shipment exceeds the levels of methylene chloride detected in samples GW-17, GW-18, GW-21, GW-23, and GW-24.
- The available health criterion for methylene chloride is lower than the method detection limit for methylene chloride. Consequently, the methylene chloride concentrations of all shipment 5 samples, except for GW-18, exceeds this criterion.
- The concentration of methylene chloride detected in the first column analysis of GW-22 is suspect, based on the second column analysis.

The concentration of 1,1,1-trichloroethane in Field Blank GW-19 exceeds, or is roughly equivalent to, the concentrations of 1,1,1-trichloroethane found in samples GW-21, GW-22, and GW-23, and may be attributed to laboratory contamination. This is not expected to impact the environmental assessment adversely because these levels are well below the MCLG of 56 µg/L for 1,1,1-trichloroethane.

Although no field blanks or bailer washes were collected with the samples in shipments 3 or 6, the low levels of methylene chloride, 1,1,1-trichloroethane, and toluene detected in these samples may be the result of laboratory contamination.

Although no field blanks collected with the resampling effort (shipment 7) were analyzed for volatiles, the low levels of methylene chloride, chloroform, 1,1,1-trichloroethane, carbon tetrachloride, and trichloroethene detected in these samples may be the result of laboratory contamination.

RPDs in VOC analyses of replicate groundwater (GW-31 and GW-32) and surface water (SW-1, SW-23/SW4, and SW-22) samples ranged from 0 to 196 percent. Methylene chloride was found in all samples except the GW-32 sample. The significant disagreement in methylene chloride concentrations in these samples is further indication of probable laboratory contamination rather than field contamination. The presence of trihalomethanes in samples GW-31 and GW-32 may be attributed to the use of city water in well development, as discussed in Section 4.4.4. No VOCs were detected in replicate soil samples.

4.1.3.2 Base/Neutral and Acid Extractables (BNAs) EPA Methods E625 and SW8270

BNAs were not detected in the field blank, indicating that the BNAs detected in samples were site related. Because the field blank was handled and shipped with the environmental samples, these data also indicate that samples were not contaminated with BNAs during shipment, storage, or handling.

Analyses of replicate water samples for BNAs showed only bis-(2-ethylhexyl) phthalate as a contaminant. The reason for the difference in replicate groundwater sample GW-31 is unknown, but may be the result of laboratory or field contamination [bis (2-ethylhexyl) phthalate is a common plasticizer, and hence a common contaminant in BNA analyses]. The difference in the replicate surface water samples from monitoring station SW-4 is insignificant, since the positive analysis is close to the detection limit. No control limits have been determined for replicate analyses for BNAs. Due to the limited data, no conclusions may be made about the precision of the sampling.

4.1.3.3 Pesticides, Herbicides, and PCBs
EPA Methods E608, SW8140, SW8150, and SW8080

No trip blank, field blank, or bailer wash was analyzed for pesticides, herbicides, or polychlorinated biphenyls (PCBs); therefore, no conclusions may be made about field contamination of samples. No replicate samples were analyzed for pesticides, herbicides, and PCBs. Consequently, no conclusions may be made about the precision of the sampling.

4.1.3.4 Common Anions
EPA Method A429

No trip blank, field blank, or bailer wash was analyzed for common anions; therefore, no conclusions may be made about field contamination of samples. A pair of replicate samples was analyzed for common anions, with chloride and sulfate being found above the detection limit. The RPDs calculated from analyses of chloride and sulfate are 3 and 10 percent, respectively. With an interim control limit range of 0 to 20 percent, these data indicate sampling precision.

4.1.3.5 Metals
EPA Methods E200.7, E206.2, E239.2, E245.1, E270.2, SW6010, SW7060, SW7420, SW7471, and SW7740

Metal analytes were not detected in the field blank, indicating that samples were not contaminated with metals from sources other than sampling. Because the field blank was handled and shipped with the environmental samples, these data also indicate that samples were not contaminated with metals during shipment, storage, or handling.

Significant differences in the results of metals analyses were evident between replicate groundwater samples GW-31 and GW-32, and in replicate sediment samples SD-1 and SD-23, and SD-4 and SD-22. The reason for dissimilar concentrations of metals in the groundwater sample may be attributed to the amount of suspended particulates in the sample vials. Addition of preservative in the field may free previously bound metals associated with the suspended particulates. The differences in metals analyses in sediment samples are attributed to sample heterogeneity. Although sediments are composited before they are sampled, heterogeneities great enough to affect analytical results may remain.

4.1.3.6 Alkalinity
EPA Method A403

No trip blank, field blank, or bailer wash was analyzed for alkalinity; therefore, no conclusions may be made about field contamination of samples. A pair of replicate samples was analyzed for bicarbonate, carbonate, and total alkalinity, resulting in RPDs of 0, 9, and 7 percent, respectively. Using the interim control limit range of 0 to 20 percent, these data indicate good sampling precision.

4.1.3.7 Petroleum Hydrocarbons
EPA Method E418.1

Petroleum hydrocarbons were detected in a field blank, a bailer wash sample, and a trip blank. The presence of these compounds is attributed to two factors, neither of which is expected to impact environmental assessment of the site adversely.

- The concentrations of petroleum hydrocarbons detected in Field Blank GW-19 and Bailer Wash GW-20 are attributed to exhaust from jets taking off from the nearby airport. Similar concentrations of petroleum hydrocarbons were detected in the water samples collected in the same area as these field check samples.
- The petroleum hydrocarbons detected in Trip Blank FB-1 are attributed to storage of the sample, before shipment, in an area separated by an open doorway from an area where gasoline-powered generators were used. These generators are considered to be the source of petroleum hydrocarbons detected in Trip Blank FB-1. Petroleum hydrocarbons were detected in samples GW-11 through GW-24 only, indicating that empty sample bottles in the storage area were not contaminated with petroleum hydrocarbons.

Significant differences are evident in petroleum hydrocarbon analyses for the replicate sediment samples collected at SD-1 and SD-23 and at SD-4 and SD-22. The difference between replicate samples SD-1 and SD-23 is attributed to sample heterogeneity, as discussed earlier. The difference between the replicate samples SD-4 and SD-22 is due to matrix interferences, which resulted in the high detection limit achieved in the replicate and is further indication of the heterogeneity associated with soils. While no control limits have been established for analysis of petroleum hydrocarbons, the RPDs from other replicate soil samples are all relatively low.

Analysis for TDS in replicate groundwater samples from well MW-6D are in good agreement, as are moisture analyses in replicate soil and sediment samples.

4.1.3.8 Initial Sampling Field QA/QC Results

One pair of field replicate samples was collected (well GW-7) during the initial sampling effort. These data are presented in Appendix H. Analyses of these samples show differences in concentrations of aluminum, iron, magnesium, and benzene. The reason for these differences is unknown.

Overall, the results of field replicate analyses were acceptable, and indicate good QA/QC procedures associated with field sampling techniques.

4.2 GEOLOGY AND HYDROGEOLOGY

As discussed in Section 3.2.1, 15 new wells were installed during Stage 2 in the 2 zones at Hancock Field. Information from these 15 new wells, in conjunction with information from the 9 existing (Stage 1) wells in these 2 zones, has enabled a more comprehensive characterization of hydrogeologic, geologic, and geochemical conditions in the vicinity of the zones under investigation. This section discusses these conditions for each of the 2 zones based upon all 24 wells now in existence. Descriptions of the existing Stage 1 wells located in Zones 1 and 2 are contained in the IRP Phase II, Stage 1 report. Well logs and well construction summaries that provide detailed backup to the information presented here are included in Appendix D.

4.2.1 Geology

Three new well pairs (MW-11/11D, -12/12D, and -13/13D), and 3 shallow wells (MW-16, -17, and -18), were installed in Zone 1 around Sites FT-1 and D-5, respectively, to complement existing wells MW-7, MW-8, MW-9, and MW-10 installed during Stage 1 activities. The relative positions of the Stage 1 wells and the new Stage 2 wells installed in Zone 1 are shown in Figure 4-1. Well pair MW-11/11D is 115 feet due west of the westernmost edge of Site FT-1. Well pair MW-12/12D is located 200 feet southeast of FT-1, and well pair MW-13/13D is located 255 feet east-southeast of FT-1. Wells MW-16, MW-17, and

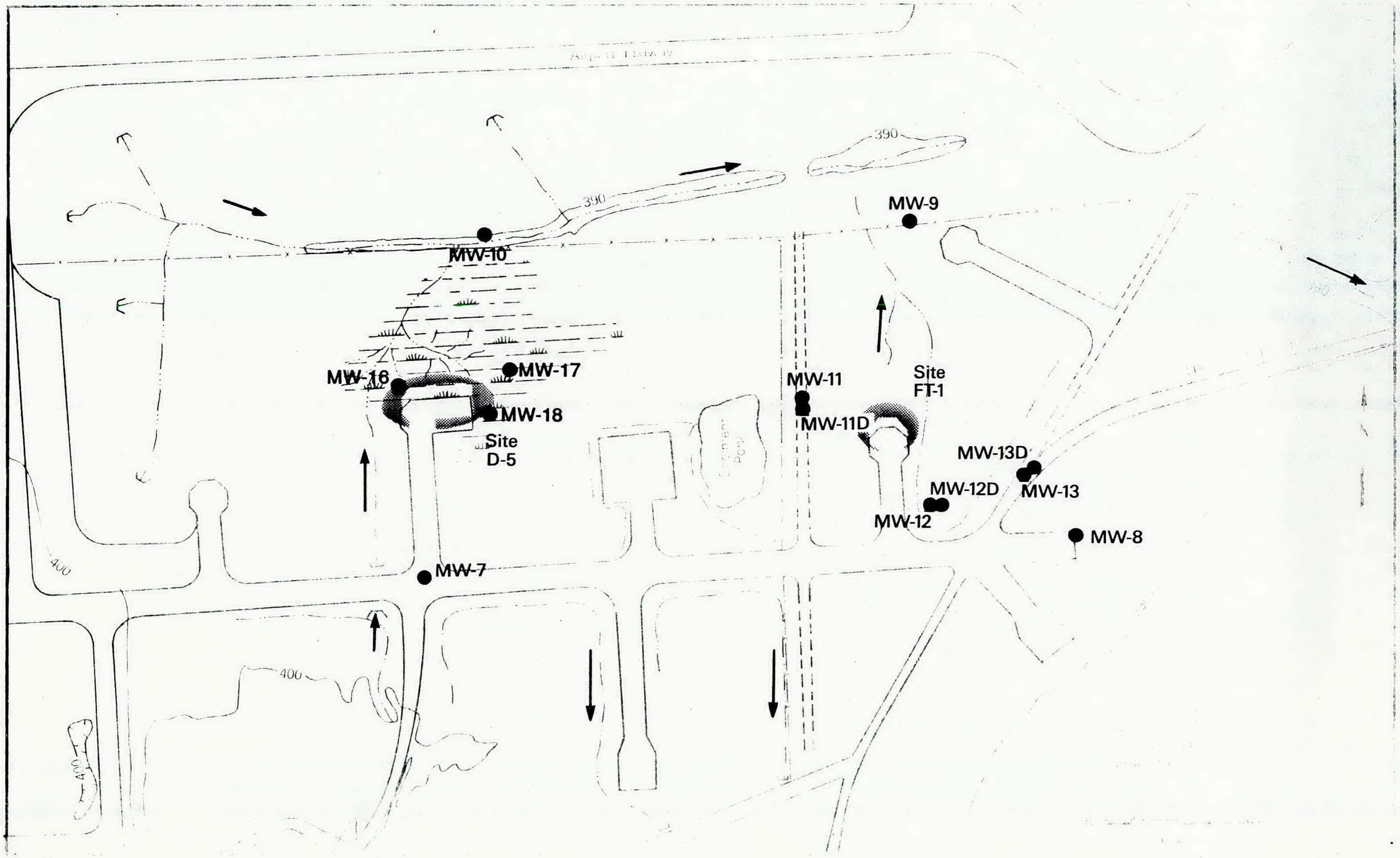

Figure 4-1. Zone 1 Monitoring Well Locations at Hancock Field

MW-18 surround Disposal Site D-5. All shallow wells were installed 30 feet below land surface (BLS), and the deep wells range in depth from 122.4 feet BLS for MW-13D to 130.6 feet BLS for MW-11D.

The lithologies encountered and the stratigraphic relationships identified between wells at Hancock Field are products of depositional environments of glacial and periglacial origin, and are associated with Wisconsin Glaciation. Three basic lithologic types were encountered during drilling activities in Zone 1: stiff clay and gravel, sand, and silt and clay. Major units can be correlated across the zone, although unit thicknesses vary. A cross-section, developed from well log data obtained from the three deep wells installed around Site FT-1, is shown in Figure 4-2.

The local bedrock in Zone 1 is a competent dark gray to green shale facies of the Vernon Formation. The shale contains fractures and partings along bedding planes, which occasionally are mineralized with gypsum and/or dolomite. Bedrock was encountered at elevation 290.6 feet mean sea level (MSL) (106 feet BLS) at MW-11D, elevation 296.6 feet MSL (100 feet BLS) at MW-12D, and elevation 302.3 feet MSL (94 feet BLS) at MW-13D. Bedrock thus appears to be gently dipping in a westward direction beneath Zone 1.

Based on the subsurface data obtained from the three deep wells installed in Zone 1, a thick, laterally continuous horizon of compact till appears to overlie the gray shale. The till consists almost entirely of stiff clay and silt along with lesser amounts of gravel and coarse sand derived from the bedload of the glacier. The till unit is approximately 65 feet thick in the FT-1 area and tends to occur at shallower depths east and southeast of Site FT-1. The unit becomes increasingly compact with depth.

A unit consisting mostly of fine to medium sand with traces of silt overlies the till layer. The sands generally are well-sorted and are likely to have been deposited by meltwater streams that flowed beneath and away from the retreating ice front. On a local scale, the unit exhibits a tendency to thin slightly from MW-11D to MW-13D.

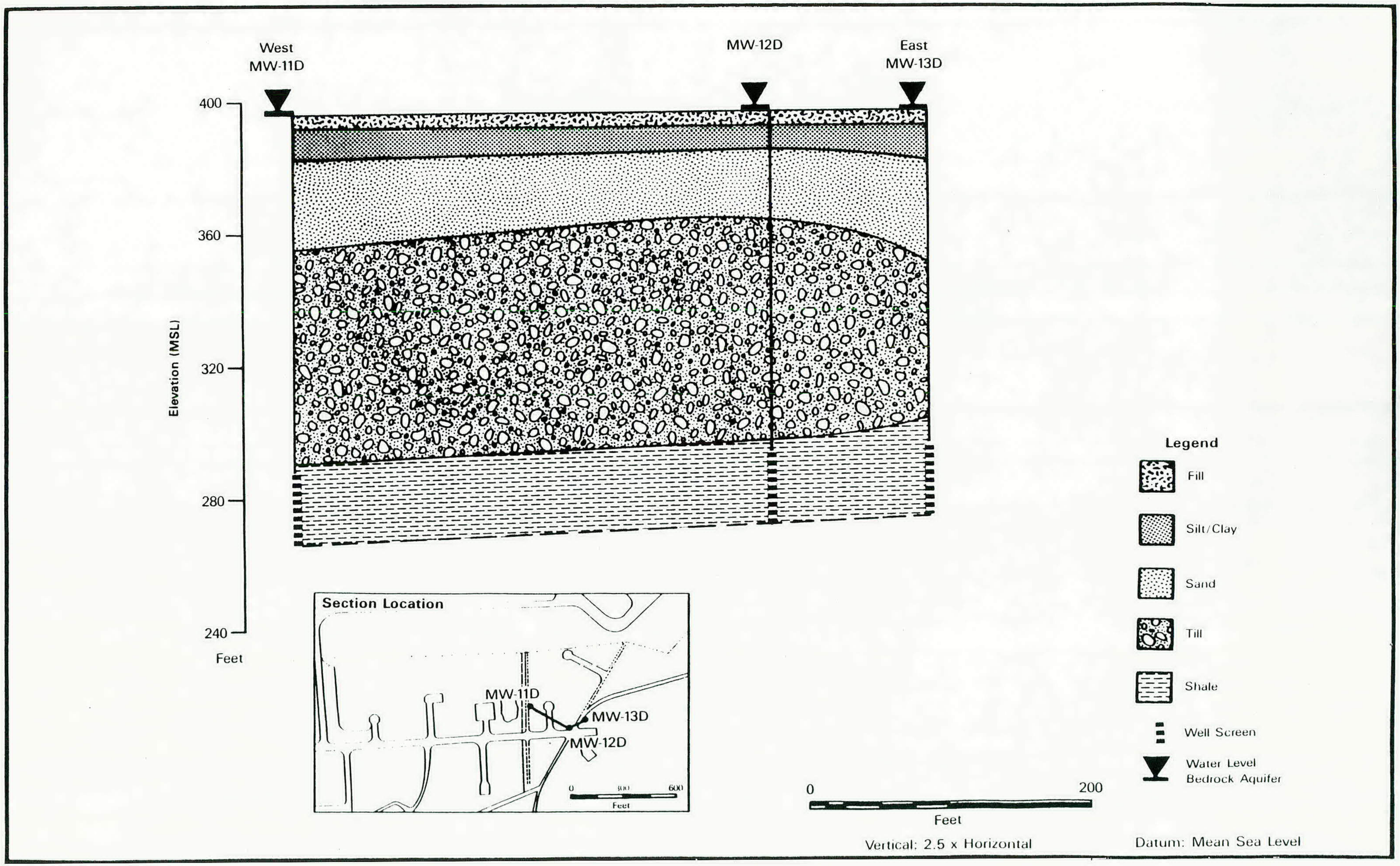

Figure 4-2. Geologic Cross-Section Through Zone 1

The uppermost layer of the unit is composed primarily of clay and silt, implying a quiescent, perhaps lacustrine, depositional environment. The clay and silt unit has been observed throughout the zone, and on the average is 13 feet thick. In Zone 1, this layer of silty clay material restricts surface recharge of groundwater and thereby protects groundwater from contaminants released on or near the surface.

Six new wells, deep wells MW-3D and MW-6D and well pairs MW-14/14D and 15/15D, were installed in Zone 2 during Stage 2 activities. The relative positions of all of the wells in this zone are presented in Figure 4-3. Shallow wells did not exceed 30 feet in depth, and deep wells ranged from 96 to 144 feet BLS.

The local stratigraphy of Zone 2 is more complex than that noted for Zone 1. Much of the area has been disturbed by construction activities (i.e., fill placed in natural low lying areas), which masks any geomorphic features that could aid in the geologic interpretations. A stratigraphic interpretation, illustrated in the cross-section shown in Figure 4-4, was constructed from well log data collected during Stages 1 and 2. Some of the units encountered during drilling, particularly the finer-grained glacio-fluvial deposits, are heterogeneous, sporadic, and thin, and could not be individually correlated across the zone. To facilitate correlation, these deposits have been broadly categorized as a sand unit. In addition, some lithologies were not encountered consistently across the zone. This is particularly true of two units: a gravel deposit that occurs near the surface in the western area, but is absent in the south-central and eastern areas; and a surficial deposit of silt and clay, which is common in the southeastern part of the zone and is responsible for artesian conditions at MW-5.

Four deep wells in Zone 2 provided detailed lithologic information from surface to bedrock. The local bedrock is generally an incompetent, fractured red shale belonging to the Vernon Formation. The fractures typically are filled with clay and mineralized with gypsum and dolomite. Bedrock was encountered at 338.9 feet MSL (66 feet BLS) at MW-3D, 327.7 feet MSL (75 feet BLS) at MW-14D, 286.2 feet MSL (109 feet BLS) at MW-6D, and 297.7 feet MSL (100 feet BLS) at MW-15D. Analysis of these elevations indicates that the surface of the bedrock shale is dipping to the east or northeast.

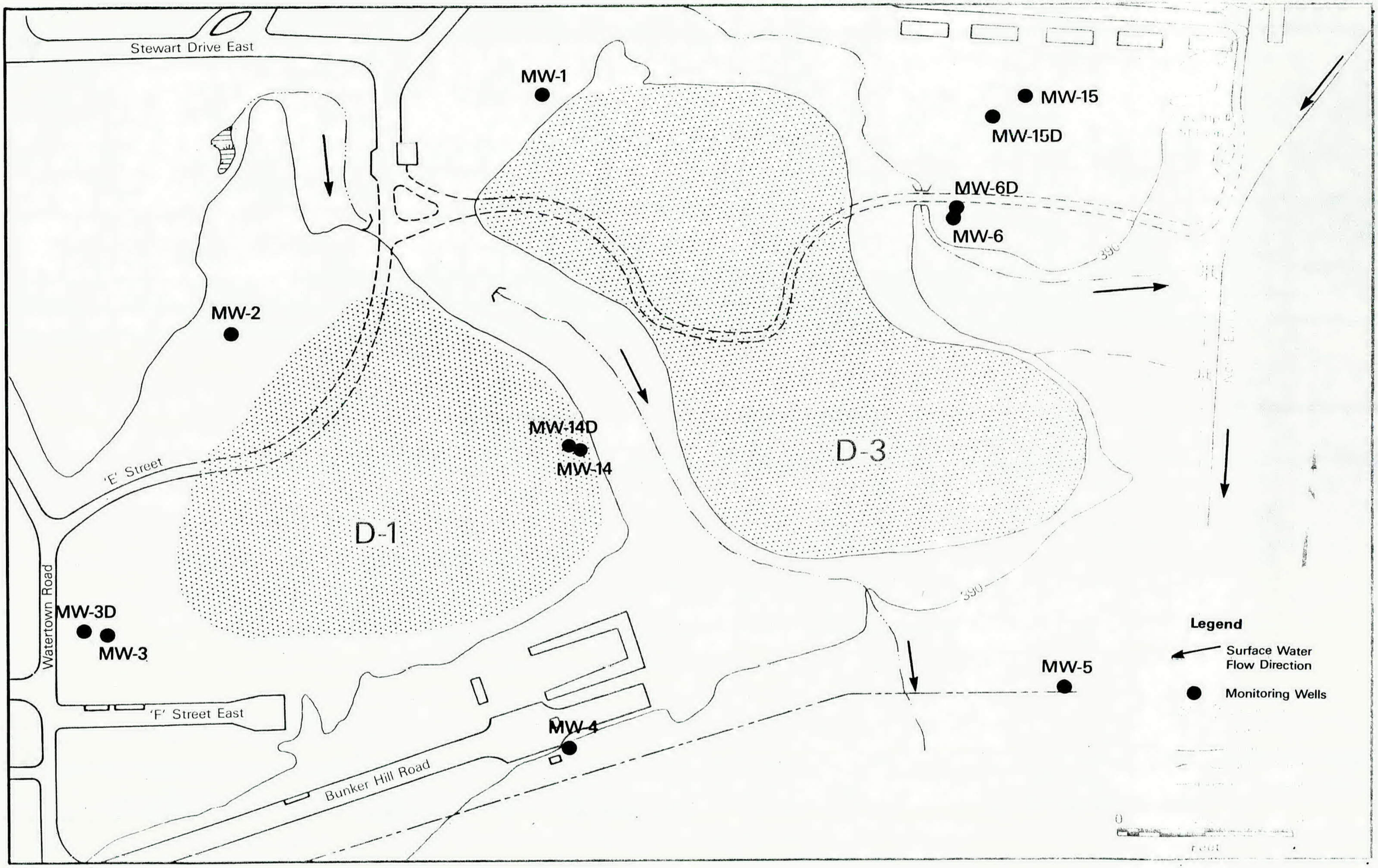

Figure 4-3. Zone 2 Monitoring Well Locations at Hancock Field

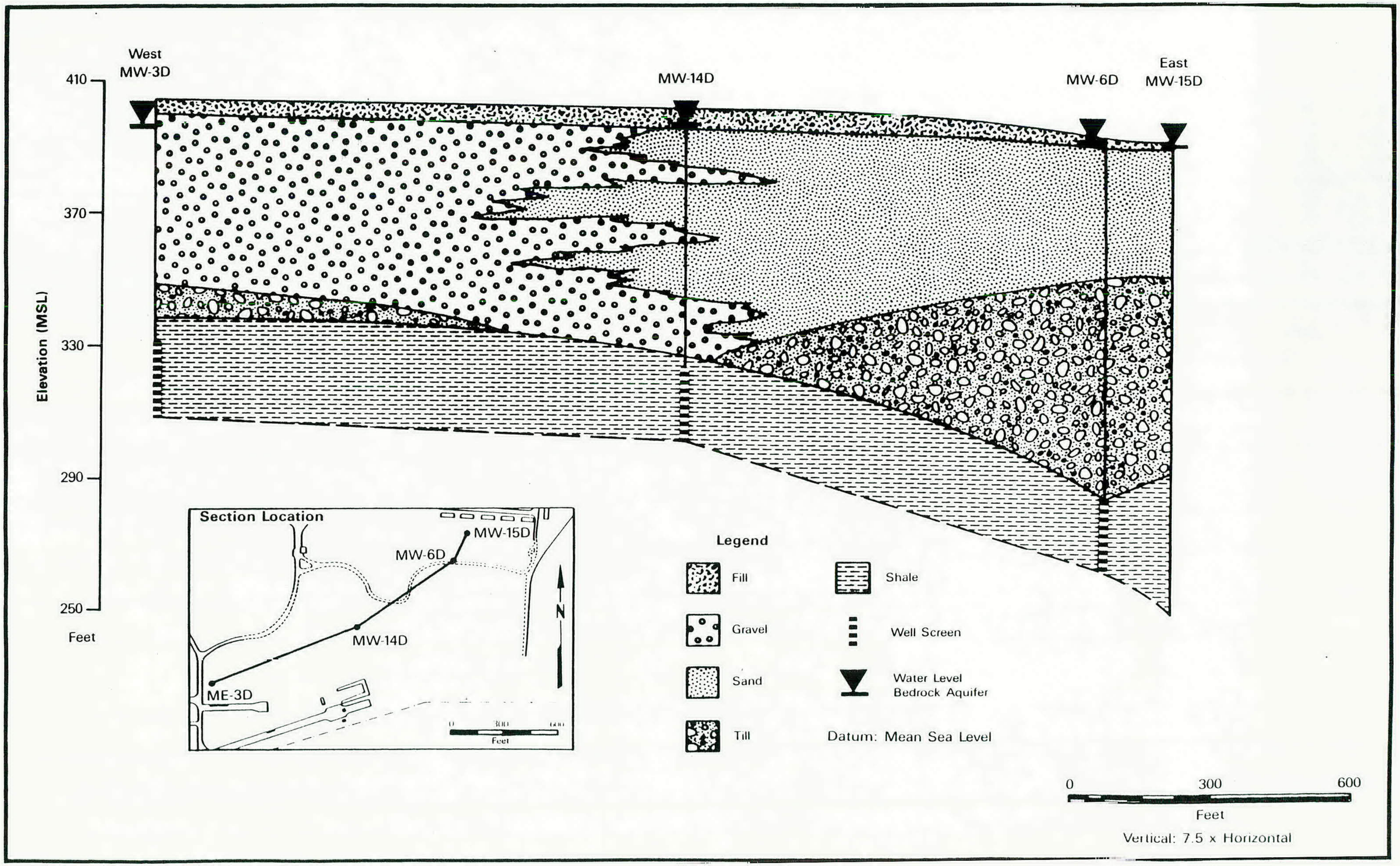

Figure 4-4. Geologic Cross-Section Through Zone 2

A compact layer of till overlies the red shale in most areas of the zone. This horizon of stiff, brown to red clay containing varying amounts of gravel is thicker in eastern sections of the zone, where it is 30 to 38 feet thick. At the western edge of the zone, at well MW-3D, the layer of till is only about 10 feet thick. At MW-14D, the unit appears to be absent, perhaps scoured away by localized paleofluvial activity. Stratographic logging during the drilling of MW-14D was complicated by the inability of the air compressor to clear the borehole between 50 and 100 feet BLS. This may have been caused by clay from the till clogging the casing or by the compressors lack of air volume to lift the large cobbles.

A distinct deposit of gravel overlies the till deposit in some western sections, separated only by a thin horizon of fine to medium sand at MW-3D. The gravel is generally well-sorted, which suggests that it was deposited in the higher velocity flow zones of meandering stream channels. At MW-3D, the gravel unit is 50 feet thick, and it may be even thicker in the vicinity of MW-2. In this localized area, the gravel unit extends nearly to the surface, and is overlain only by fill material. In fact, the gravel extends to the land surface in the vicinity of well MW-2. As Figure 4-4 shows, the gravel unit pinches out a short distance to the east, northeast, and southeast, with only thin remnant fingers occurring in sandy horizons observed at MW-14D. Past records and maps indicate that several gravel pits existed in the area of MW-2 and MW-3; thus, it is possible that the gravel may have been locally extracted or thinned by man.

A heterogeneous unit consisting mostly of fine sand with occasional influxes of medium sand and silt along with trace increments of clay and/or gravel overlies the till deposit in all other areas of Zone 2. Thickness of this unit is as great as 75 feet at MW-14D, where it is the only unit observed, with the exception of some thin fingers of gravel. Aside from a thin layer of surficial fill, this unit occurs as the uppermost deposit in eastern portions of the Zone 2.

In southeastern portions of Zone 2, the surficial deposits consist of a mixture of clay and silt with trace amounts of fine sand. The sand unit discussed previously lies stratigraphically beneath this unit. The clay and silt unit was deposited in a low-energy environment, such as in an ice margin lake or in the overbank regions of a stream. The unit also may have been deposited in western portions of the study area, but since has been removed by erosion. A maximum observed thickness of 25 feet occurs in the vicinity of MW-5 and MW-4.

4.2.2 Groundwater Hydrology

As noted in Section 2.2.2, the principal aquifers at Hancock Field include the well-sorted, fairly homogeneous sand and gravel deposits and the highly fractured and jointed Vernon Formation shales. These two units comprise the surficial and bedrock aquifers, respectively, at the base, and the confining layer separating the two is the glacial till which, by nature, has low effective porosity, low hydraulic conductivity, and low specific yields. In the two zones being investigated at Hancock Field, the surficial aquifer is found in the well-sorted sands overlying the glacial till. Specific yields and hydraulic conductivities can be very high in these sands and gravels, and where there are overlying confining units, artesian conditions can be present.

The bedrock aquifer at Hancock Field, the fractured and jointed Vernon Formation shale, is not particularly transmissive; groundwater movement and storage occurs in the localized fractures and bedding planes, and can be enhanced by solution-widening of these channels. At Hancock Field, much of the groundwater stored in the fractured shale Vernon Formation is under confined conditions because of the generally continuous overlying basal till.

Site-specific hydrogeologic conditions encountered in Zones 1 and 2 at Hancock Field are consistent with this general two aquifer scenario. Findings regarding depths to groundwater and groundwater flow directions are discussed below for each aquifer in each of the two zones investigated. Table 4-5 presents the data obtained on groundwater elevations during each Stage 2 sampling effort.

TABLE 4-5. GROUNDWATER LEVELS AT HANCOCK FIELD

			September 1986		March 1987		October 1987	
Zone	Well	Surface Elevation MSL	Depth to Water (ft)	Water Table Elevation MSL	Depth to Water (ft)	Water Table Elevation MSL	Depth to Water (ft)	Water Table Elevation MSL
1	MW-7	397.4	5.44 BLS	391.96	3.20 BLS	394.20	6.44 BLS	390.96
	MW-8	393.0	5.93 BLS	387.07	4.09 BLS	388.91	7.01 BLS	385.99
	MW-9	395.7	6.28 BLS	389.42	4.01 BLS	391.69	7.25 BLS	388.45
	MW-10	392.3	0.04 ALS	392.34	2.06 ALS	394.36	0.17 BLS	392.47
	MW-11	396.7			3.70 BLS	393.00	8.00 BLS	388.70
	MW-11D	396.6			1.11 ALS	397.71	---	---
	MW-12	396.4			5.94 BLS	390.46	10.37 BLS	386.03
	MW-12D	396.6			1.23 ALS	397.83	---	---
	MW-13	396.3			6.56 BLS	389.74	9.79 BLS	386.51
	MW-13D	396.3			1.48 ALS	397.78	---	---
	MW-16	395.7					2.81 BLS	392.89
	MW-17	395.6					3.40 BLS	392.20
	MW-18	395.9					4.03 BLS	391.87
2	MW-1	399.5	6.84 BLS	392.66	3.28 BLS	396.22		
	MW-2	413.4	20.39 BLS	393.01	17.9 BLS	395.50		
	MW-3	402.8	9.68 BLS	393.12	6.66 BLS	396.14		
	MW-3D	404.9			8.17 BLS	396.73		
	MW-4*	390.1	2.21 ALS	392.31				
	MW-5	387.0	4.98 ALS	391.98	4.98 ALS	391.98		
	MW-6	394.8	5.21 BLS	389.59	4.21 BLS	390.59		
	MW-6D	395.2			1.05 BLS	394.15		
	MW-14	402.6			6.94 BLS	395.66		
	MW-14D	402.7			7.11 BLS	395.59		
	MW-15	398.0			6.07 BLS	391.93		
	MW-15D	397.7			4.18 BLS	393.52		

* Abandoned Well
MSL = Mean Sea Level
BLS = Below Land Surface
ALS = Above Land Surface

4.2.2.1 Zone 1 Hydrogeology

The surficial aquifer in Zone 1 consists of groundwater primarily under water table conditions, but artesian conditions in the fine silt/clay and fine sand deposits that overlie the glacial till do exist locally. Shallow aquifer groundwater elevations in Zone 1 ranged from 394.36 feet MSL (artesian) in MW-10 to 389.74 feet MSL in MW-13. The potentiometric surface of the shallow aquifer, as of March 1987, is depicted in Figure 4-5. Based on this water level information, the maximum head differential across the zone is 5.45 feet between MW-10 and MW-8. In the Stage 1 field program conducted in 1983, a head differential of 6.51 feet was observed between the same two wells. The present head differential produces a hydraulic gradient of approximately 0.004 feet per foot. Based on this gradient and hydrologic data (Secton 4.2.2.3), groundwater velocities for the surficial aquifer in Zone 1 range from 4.02 to 7.26 feet per year.

The groundwater flow direction in the surficial aquifer underlying Zone 1 is east-southeast, as shown by the potentiometric surface plots in Figure 4-5 and Figure 4-5a. This direction is consistent with interpretations presented in the Phase II, Stage 1 effort and consistent with those made during the first round of Stage 2 field activities in September 1986. The direction of groundwater flow is toward the major off-base receiving stream and the groundwater flow direction may be influenced by the proximity of Ley Creek. Because the surficial aquifer is also locally artesian, groundwater may be discharging to Ley Creek from the surficial glacial deposits in the area. Since MW-10 is hydrogeologically upgradient from the Fire Training Area (Site FT-1), this potential surface discharge would not be expected to contain any contaminants identified in Zone 1.

The potentiometric surface of the surficial aquifer in the vicinity of the Fire Training Area (Site FT-1) was approximately 5 feet BLS in March 1987. During the collection of soil samples from borings around Site FT-1 (in November 1986), water was encountered in the hand augered boreholes from the surface to depths up to 3 feet BLS. During resampling in September 1987, no water collected in the shallow boreholes. This evidence suggests that a seasonal perched water table exists in the vicinity of Site FT-1 and a

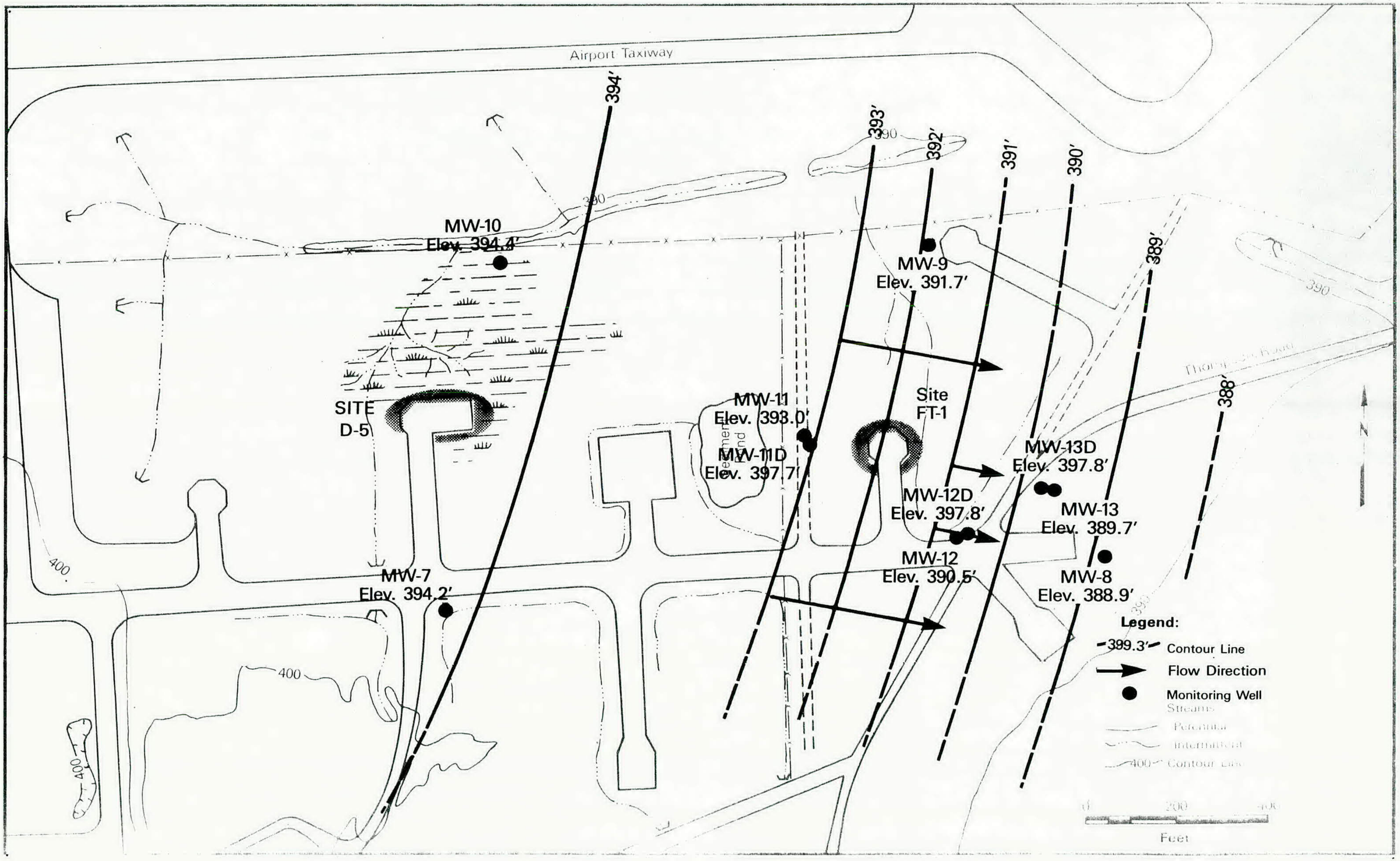

Figure 4-5. Potentiometric Surface of Glaciofluvial Aquifer of Zone 1 at Hancock Field, March 1987

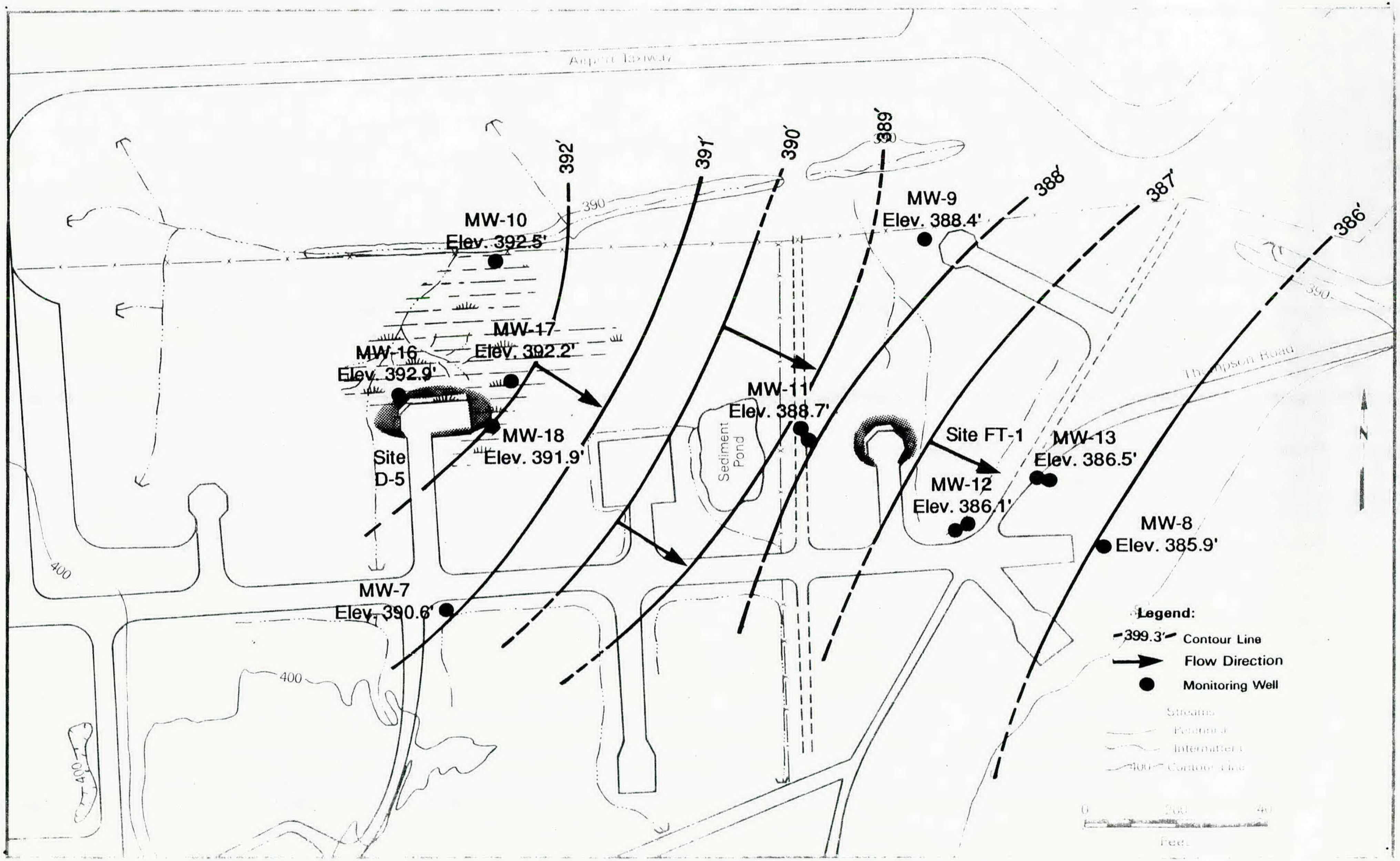

Figure 4-5a. Potentiometric Surface of Glaciofluvial Aquifer of Zone 1 at Hancock Field, October 1987

measurable seasonal variation can be expected. The boring logs for wells MW-11, MW-12, and MW-13 (Appendix D) indicate relatively low permeability materials, clays, and silty clays exist from near the surface to depths of 10 to 12 feet BLS in this area. These materials restrict infiltration in this area, which also has flat topography and ill-defined surface drainage. These conditions cause a perched water table to be formed during wetter months by precipitation that can neither infiltrate nor run off.

The fractured bedrock aquifer beneath the glacial till at Zone 1 exhibits artesian conditions at all three wells installed. Groundwater elevations in Zone 1 deep wells installed during the Stage 2 field program ranged from 397.78 feet MSL in MW-13D to 397.71 feet MSL in MW-11D. Figure 4-6 presents the groundwater elevations measured in the deep fractured shale aquifer beneath Zone 1. The maximum head differential obtained from the three deep wells is 0.12 feet between wells MW-12D and MW-11D. This value produces a hydraulic gradient of 0.0003 feet per foot toward the northwest. The water level elevations measured in March 1987 further identifies the artesian conditions that exist within Zone 1. All water level elevations in the shale aquifer were higher than those measured in the surficial aquifer. This indicates that the lower aquifer is confined and any leakage would be upward, and eliminates any downward movement of contaminants.

The groundwater flow direction in the fractured shale aquifer beneath Zone 1 may be to the northwest based on water level data obtained in March 1987. However, since the gradient between the wells is only 0.07 feet, this flow direction cannot be defined with any degree of confidence, nor were any contours projected in Figure 4-6. It should be noted that the dip of the bedrock surface in the vicinity of Site FT-1 has a westerly component, and this could influence the groundwater flow direction. The northwesterly trend may be a result of the existing artesian conditions. An accurate evaluation of the groundwater flow direction would require wells spaced much further apart and seasonal measurements.

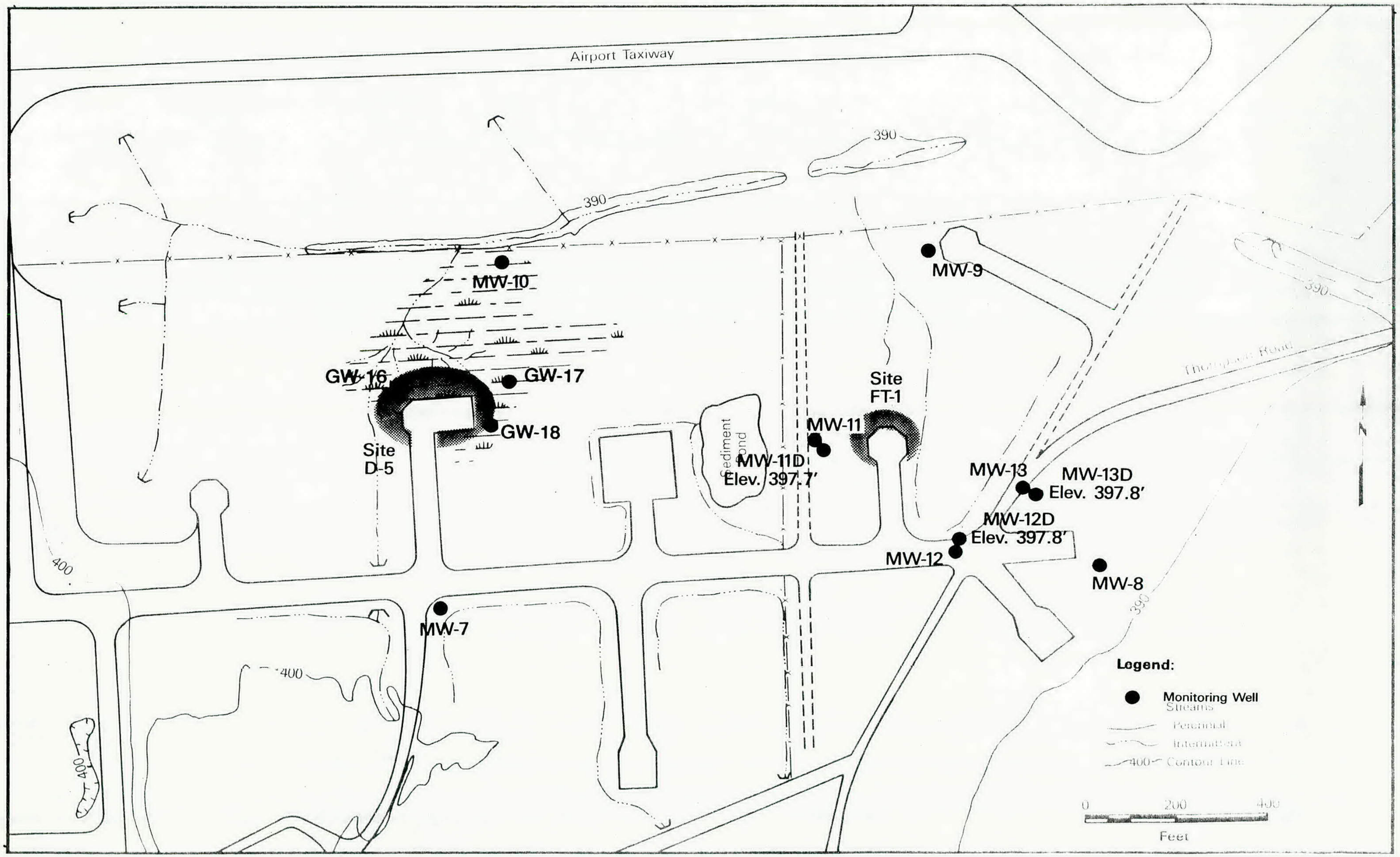

Figure 4-6. Groundwater Elevations of Fractured Shale Aquifer of Zone 1 at Hancock Field, March 1987

4.2.2.2 Zone 2 Hydrogeology

In Zone 2, groundwater again occurs in both the fine sand and gravel surficial deposits and in the underlying fractured shale bedrock. Groundwater in the surficial glaciofluvial sand and gravel aquifer is present under water table conditions at MW-1, MW-2, MW-3, MW-6, MW-14, and MW-15 and under artesian conditions at MW-5. Artesian conditions also were identified to be present in MW-4 before it was abandoned. The artesian conditions in the south-central and southeast portions of Zone 2 are caused by an overlying confining layer of silty clay.

Within Zone 2, shallow aquifer groundwater elevations ranged from 392.0 feet MSL in MW-5 to 393.2 feet MSL in MW-2. The potentiometric surface of the shallow aquifer, as of March 1987, is presented in Figure 4-7. The groundwater flow direction in the glaciofluvial aquifer in Zone 2 is to the southeast. Note that a groundwater ridge or "saddle" extends to the north-northeast from wells MW-3/3D through well MW-1. West of this ridge, groundwater in the surficial aquifer appears to move to the northwest. In September 1986, flow directions were to the east in western portions of the zone, to the northeast in central portions of the zone, and to the northwest in southeastern portions of the zone. During Stage 1 efforts, the flow direction was generally east-northeast across the zone. The data suggest that the direction of groundwater flow in the surficial aquifer in Zone 2 is influenced by the interplay between seasonal (precipitation, evapotranspiration) and site-specific (recharge and runoff rates, character of surface deposits and slope of land surface, density of vegetation, and amount of land development) influences. Because of these variations in groundwater flow directions, a well may be hydrogeologically downgradient, upgradient, or across-gradient from a given point in Zone 1, depending upon the season and precipitation events.

Based on data obtained in March 1987, the maximum head differential across Zone 2 is 5.69 feet between MW-1 and MW-6. This value is 2.94 feet greater than the 2.69-foot head differential measured during Stage 1 efforts in 1983. The hydraulic gradient in March 1987 was approximately 0.0065 feet per foot. As discussed in Section 4.2.2.3, the results in the groundwater

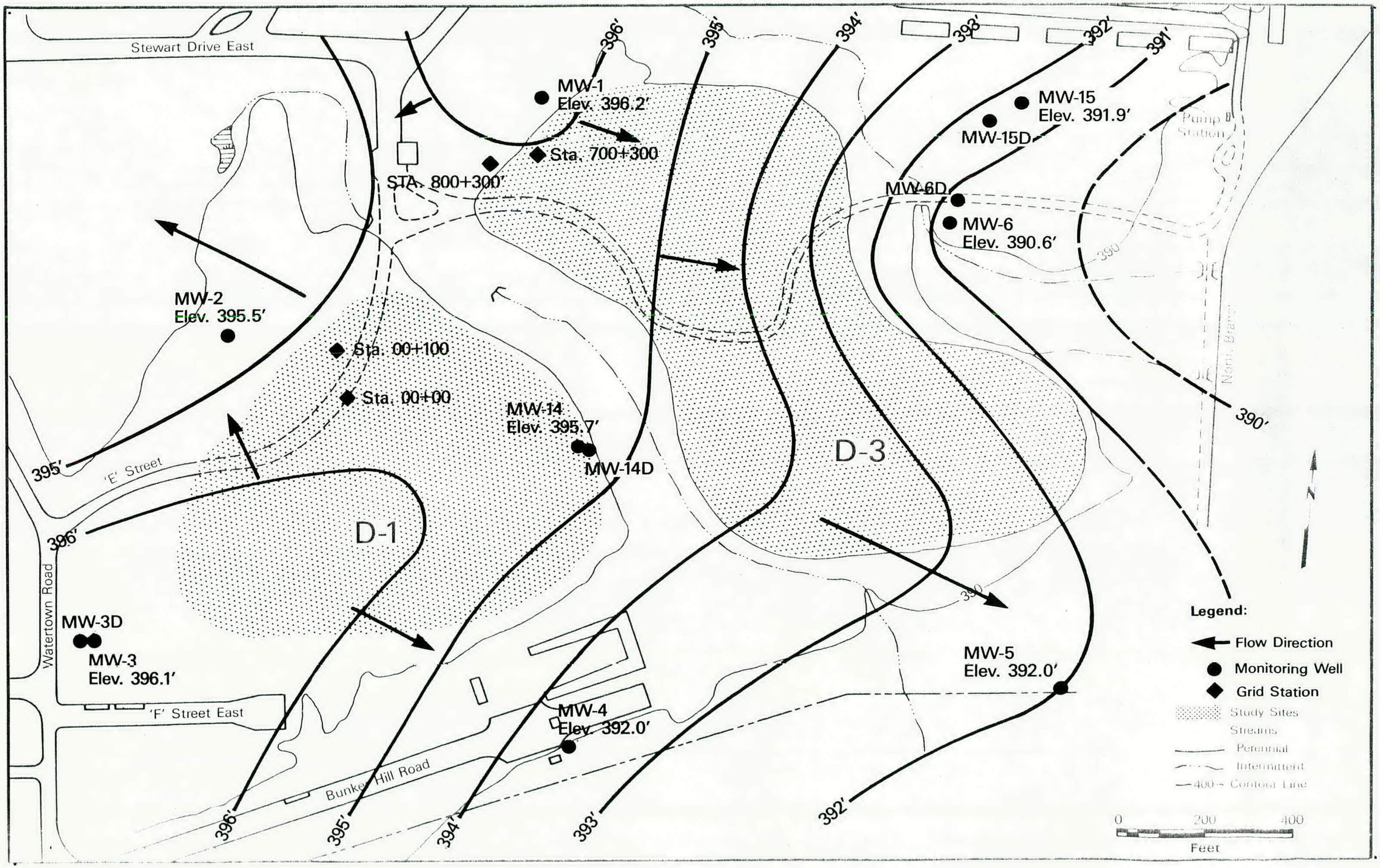

Figure 4-7. Potentiometric Surface of Glaciofluvial Aquifer of Zone 2, Hancock Field, March 1987

velocity ranges for the surficial aquifer in Zone 2 range from 287 feet per year in the gravel deposits to 109 feet per year in the sand deposits.

Groundwater in the fractured shale bedrock aquifer is present under artesian conditions throughout Zone 2. The confining bed of tight clay till that overlies the majority of the bedrock may be responsible for this condition. Groundwater elevations in bedrock aquifer wells installed in Zone 2 ranged from 393.52 feet MSL in MW-15D to 396.73 feet MSL in MW-3D. The potentiometric surface of the deep fractured shale aquifer is depicted in Figure 4-8. The maximum head differential obtained from bedrock wells across the zone is 3.21 feet, and occurs between wells MW-3D and MW-15D. The hydraulic gradient for the bedrock aquifer is 0.0015 feet per foot.

Based on water level measurements obtained in March 1987, the groundwater flow direction in the fractured shale aquifer of Zone 2 is to the northeast. Figure 4-4 shows that groundwater is generally following the dip of the shale bedrock unit.

One hydrogeologic feature that should be addressed in Zone 2 is the potential "window" mentioned earlier between the surficial and bedrock aquifers in the vicinity of well MW-14D. As the cross-section in Figure 4-4 shows, the glacial till that is generally considered to be a confining layer/aquitard at Hancock Field appears to be absent in the vicinity of well MW-14D. Although this occurs immediately beneath one of the landfill or "rubble" fill areas in Zone 2, it is not considered to be significant at Hancock Field regarding expanded contaminant migration. As observed earlier, the bedrock aquifer at Hancock Field beneath both Zones 1 and 2 is under confined and locally artesian conditions. Thus, any breaches in the confining till layer will result in an upward movement of groundwater from the bedrock aquifer into the surficial aquifer. Comparison of water level elevations from all paired wells within Zone 2, with the exception of well pair MW-14/14D, show an upward gradient from the shale to the surficial aquifer. At well pair MW-14/14D, the gradient is in the downward direction, supporting the conclusion that the confining layer of till is absent. The data also indicate

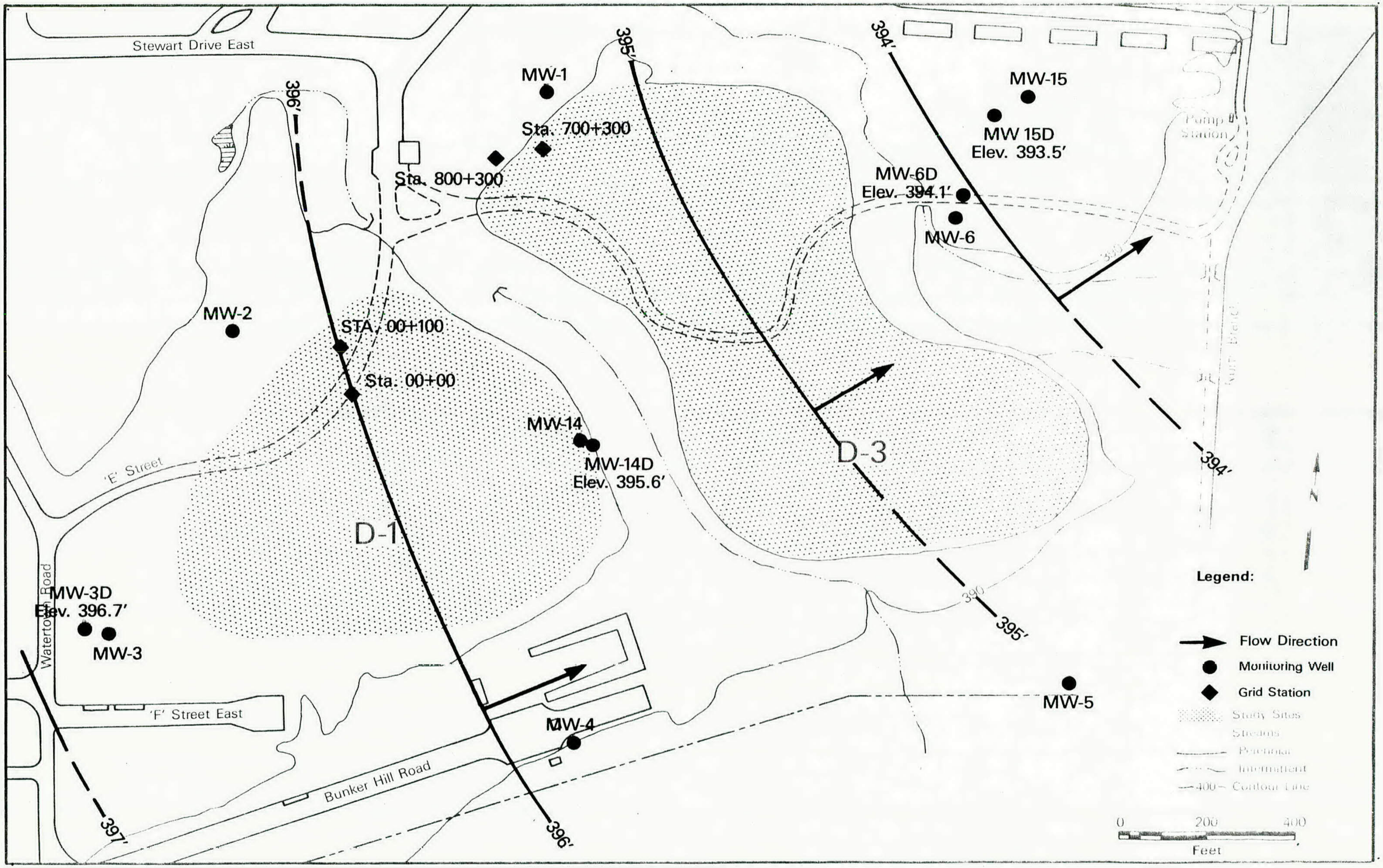

Figure 4-8. Potentiometric Surface of Fractured Shale Aquifer of Zone 2, Hancock Field, March 1987

the potential of downward movement of water from the surficial to the shale aquifer. However, this may be misleading because of the drastic differences in groundwater velocities between the two units. Water moving up from the lower aquifer may be dissipated laterally very quickly and the positive head is masked within the surficial aquifer.

4.2.2.3 Aquifer Testing

Aquifer tests were performed on all but two of the existing wells in Zones 1 and 2 during the first round of field activities in September 1986, using the slug test method developed by Hvorslev (1951). Wells MW-4 and MW-5 were the only existing wells not tested. Well MW-4 was damaged and no longer suitable as a monitoring well. Because of flowing artesian conditions at well MW-5 and its inaccessibility, no method of testing could be devised. A subtraction slug test was performed on well MW-10, since the well had less than 2 feet of unsaturated casing.

Table 4-6 presents the results of the slug tests. Groundwater velocities have been calculated using the hydraulic conductivities and hydraulic gradients derived from both zones. The following equation has been used to determine groundwater velocities:

$$V= KI/n$$

where:

V = Groundwater Velocity (ft/sec)
K = Hydraulic Conductivity (ft/sec)
I = (Dimensionless) Hydraulic Gradient
n = (Dimensionless) Effective Porosity.

Effective porosity values were obtained from the literature:

$^{n}\text{sand}$ = 35 percent
$^{n}\text{gravel}$ = 30 percent.

Table 4-6. SLUG TEST RESULTS

Zone	Well	Hydraulic Conductivity (K) cm/sec September 1983	Hydraulic Conductivity (K) cm/sec September 1986	Material Opposite Well Screen
1	MW-7	2.8×10^{-4}	3.35×10^{-4}	Fine sand and silt
	MW-8	3.7×10^{-4}	1.46×10^{-3}	Fine sand and silt
	MW-9	1.0×10^{-4}	1.52×10^{-4}	Fine sand and silt
	MW-10	1.5×10^{-4}	3.40×10^{-4}	Very fine sand
2	MW-1	1×10^{-2}[a]	5.68×10^{-3}	Fine sand and silt
	MW-2	1×10^{-2}[a]	1.28×10^{-2}	Gravel
	MW-3	1×10^{-2}[a]	$>1.28 \times 10^{-2}$[b]	Fine sand to gravel
	MW-4	1×10^{-5}	Damaged	Silty sand
	MW-5	[c]	[d]	Very fine sand
	MW-6	1×10^{-4}	1.00×10^{-3}	Fine sand to gravel

[a] Head declines too rapidly for measurement. Values based on published literature (Freeze and Cherry 1979).

[b] Same as a, value based on most rapid K measured, well MW-2.

[c] Groundwater under artesian conditions; test not applicable.

[d] Same as c, well inaccessible to available pump.

Using the above equation, the horizontal velocities of groundwater in the fine glacial sands of Zone 1 range from 4.02 to 7.26 feet per year. Horizontal velocities in Zone 2 range from 287 feet per year in gravel deposits to 109 feet per year in sand deposits.

4.2.3 Surface Water

As noted in the Stage 1 report, surface water flow at Hancock Field has been altered drastically by construction activities. Surface water within Zone 1 is controlled by drainage ditches that direct flow north to a small drainage channel. The drainage channel empties into Ley Creek, located east of Zone 1. Some runoff from the airport also is collected by this drainage channel.

Within Zone 2, water flows in all directions from Disposal Sites D-1 and D-3. Runoff leaving these sites to the north and west is collected in drainage ditches. Collected water is rerouted for discharge in the swampy area east and south of the site. Eventually, this water flows to Ley Creek via a channelized tributary. Surface runoff leaving the disposal area to the east and south flows directly into the swampy area.

Twenty-one surface water and sediment sampling points were established along major drainage pathways during the scope of the Stage 2 field program to evaluate the effects of surface runoff draining the study sites in both zones. The locations of the surface water and sediment sampling stations are provided in Section 4.4.3.

4.2.4 Background Water Quality

The quality of water is generally poor across the middle of the Central New York Region. This natural condition results from the presence of salt and gypsum within the shale units. Water flowing through and along the upper surfaces of these units has dissolved the salt and gypsum deposits in the fractures and joints, resulting in the high sulfate, chloride, and TDS content of the water. The shale unit that comprises the bedrock aquifer at Hancock Field possesses the poorest quality groundwater in the region. This shale unit is composed of Vernon Shale (discussed in Section 2.1) and Camillus

Shale. TDS range from 1,560 to more than 34,000 mg/L; hardness ranges from 490 to 5,050 mg/L; sulfate ranges from 439 to 3,510 mg/L; and chloride ranges from 3.6 to 21,200 mg/L. The high mineral content is not all natural; contributions also have been made by industrial waste discharges (Weist and Giese 1969).

Surface water quality depends greatly on the source area, which ultimately is controlled by the season. Surface water in streams is a composite of overland runoff and groundwater discharge. During periods of heavy precipitation, most of the flow in streams is composed of overland runoff that has had little time to dissolve mineral matter. During periods of light precipitation, most, if not all, of the stream base flow is derived from groundwater. Water quality tends to suffer during times of little precipitation due to higher amounts of dissolved mineral matter. The water quality of streams flowing over the Vernon and Camillus Shales shows significant signs of deterioration, since aquifers in these bedrock unis are degraded. Reportedly, fluctuations of 500 to 1,000 mg/L of dissolved solids can be expected (Weist and Giese 1969).

4.3 INTERPRETATION OF ANALYTICAL RESULTS

This section describes the approach used in interpreting and discussing the analytical results obtained for groundwater, surface water, sediment, and soil samples collected at Hancock Field. The evaluation of results was accomplished by a series of assessments, which included:

- Comparison with appropriate Federal and state standards or criteria
- Comparison with local or regional background levels (where available)
- Examination of laboratory and field QA/QC data.

4.3.1 Federal and State Standards or Criteria for Groundwater and Surface Water

Federal and state agencies have established health standards and criteria that mandate or suggest maximum contaminant concentrations allowable in drinking and/or surface water. Table 4-7 summarizes these criteria. The concentrations of constituents reported in samples from Hancock Field were evaluated with respect to the established health standards or criteria to identify the concentrations of substances in groundwater or surface water that might pose a possible health or environmental hazard. The health standards and criteria applied to each of the parameters detected during Phase II, Stage 2 are presented in Table 4-7 and are derived from the following:

- Maximum Contaminant Levels (MCLs) and New York Drinking Water Standards (NYDWS). MCLs are federally enforceable drinking water standards established by the Safe Drinking Water Act (SDWA). MCLs have been established for the parameters As, Ba, Cd, Cr, Pb, Hg, Se, Ag, chloroform, and bromodichloromethane. The State of New York has adopted the MCLs for the eight metals as state drinking water standards. In addition, New York has adopted standards for pH and concentrations of copper, iron, and zinc allowable in drinking water. The standards for copper, iron, and zinc are not based on adverse effects to human health, but on organoleptic effects. This means that exceeding these concentrations of copper or zinc can impart an unpleasant taste or smell to drinking water. Because MCLs and NYDWS are enforceable, they were used, when available, to determine whether the concentrations of substances detected at Hancock Field posed possible health or environmental hazards.

- New York State Class GA Groundwater Standards. New York State has adopted a three-category system of groundwater classification. Class GA is the highest classification and must meet quality standards that in many cases are more stringent than the primary and secondary water quality standards. Class GA groundwaters may be used as sources of drinking water. These standards are referenced where they apply to interpretation of groundwater contaminant levels.

- Maximum Contaminant Level Goals (MCLGs). MCLGs are nonenforceable goals for concentrations of contaminants in drinking water. MCLGs are established under the SDWA and are set at levels resulting in no known or anticipated adverse human health effects within an adequate margin of safety. MCLGs for substances considered to be probable carcinogens are set at zero, MCLGs for other substances are based on chronic toxicity data or other health effects data. MCLGs are used in the development of MCLs. Before promulgation, both MCLs and MCLGs are proposed in the Federal Register for public comment.

- Clean Water Act, Water Quality Criteria for Human Health. The Federal Water Quality Criteria propose estimates of pollutant concentrations in aquatic organisms and surface water that will not result in adverse health effects to humans. Although EPA recommends that the concentration of possible or proven carcinogens be zero, they have derived contaminant concentrations that correspond to particular carcinogenic risk levels. The Federal Water Quality Criteria have been used to evaluate data in cases where NYDWS, MCLs, or Carcinogen Assessment Groups (CAGs) were unavailable. Concentrations corresponding to the 1×10^{-6} risk level are generally accepted as maximum acceptable contaminant levels.

TABLE 4-7. STANDARDS AND CRITERIA

Parameters	Drinking Water Standards and Criteria	New York Class GA Groundwater Standards[c]
Metals (mg/L)		
Arsenic	0.05[a]	0.025
Barium	1.0[a]	1.0
Cadmium	0.01[a]	0.01
Chromium (Total)	0.05[a]	0.05
Copper	1.0[b]	1.0
Iron	0.3[b]	0.3
Lead	0.05[a]	0.025
Mercury	0.002[a]	0.002
Nickel	0.0154[d]	NA
Selenium	0.01[a]	0.02
Silver	0.05[a]	0.05
Zinc	5.0[b]	5.0
Volatile Organic Compounds (µg/L)		
Benzene	5[e]	ND
Bromodichloromethane	100[a]	NA
Chloroform	100[a]	NA
1,2-Dichloroethane	5[e]	NA
Ethylbenzene	680[f]	NA
Methylene Chloride	0.19[d]	NA
1,1,2,2-Tetrachloroethane	0.17[d]	NA
1,1,1-Trichloroethane	200[e]	NA
Trichloroethylene	5[e]	10
Toluene	2,000[f]	NA
Xylene	440[f]	NA
Other Organic Compounds (µg/L)		
bis (2-Ethylhexyl) Phthalate	21,000[d]	4,200
Benzo(A)Pyrene	3.1[d]	ND
Polychlorinated Biphenyls	0[f]	0.1

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[a] SDWA MCLs, and New York Primary Drinking Water Standards. The sum concentration of chloroform, bromodichloromethane, bromoform, and dibromochloromethane must be less than 100 µg/L. EPA 540/1-86/060.

[b] New York Secondary Drinking Water Standards.

[c] New York Quality Standards Applicable to Class GA Water.

[d] Ambient Water Quality Criteria (WQC) for Protection of Human Health Adjusted for Drinking Water Only. Values for copper and zinc are based on taste and odor (organoleptic) effects, not human health effects. EPA 540/1-86/060.

[e] Proposed MCLs. EPA 540/1-86/060.

[f] Proposed MCLGs. EPA 540/1-86/060.

NA = not available.

ND = not detectable.

- Health-based Guidelines for Contaminants in Soil. Currently, no formally promulgated health criteria or standards exist for chemicals in soil; however, there is a need to evaluate the significance of the observed levels of contamination and quantifying the risks to human health due to exposure to the contaminated soil. Based on guidance provided in the Superfund Public Health Assessment Manual (USEPA 1986), SAIC has evaluated risks of exposure to carcinogens and noncarcinogens in soil, assuming ingestion of a small amount of soil per day. Table 4-8 presents toxicity data for potential carcinogenic and noncarcinogenic effects. For noncarcinogens, chronic acceptable intakes (AIC) were used as a measure of risks associated due to ingestion. For carcinogens, EPA has developed cancer risk estimates for concentrations of trichloroethylene, tetrachloroethylene, carbon tetrachloride, 1,2-dichloroethane, 1,1-dichloroethylene, benzene, 1,1,1-trichloroethane, and 1,1,2,2-tetrachloroethane in soils. Although any exposure to a carcinogen carries some risk, concentrations corresponding to the 1 x 10^{-6} risk level were chosen by the USAF as maximum acceptable levels. The 1 x 10^{-6} risk level expresses the probability that an individual will develop cancer when exposed daily over a 70-year lifetime to the specified concentration of a contaminant. An equivalent way of expressing the 1 x 10^{-6} risk level is a one in a million risk of developing a cancer. Since carcinogenic risks, and presumably the effects of noncarcinogens, are additive, several compounds detected at low levels may indicate a greater health problem. Table 4-9 presents health-based guidelines for levels of chemicals in soil. It must be stressed that acceptable concentrations of chemicals in soil shown in the table are not based on threshold effects assumptions. The values in the table are upper levels for soil concentrations beyond which there would be cause for concern.

4.3.2 Background Levels

Background contaminant levels are concentrations observed in environmental media in the absence of identified sources of contamination. Samples from upgradient monitoring stations frequently are shown to be free of contaminants of site-specific origin, and are used to obtain background levels that can be compared to samples from other monitoring stations. This approach is used because appropriate background values could not be found in the literature for all parameters and media. Because not all parameters were analyzed at each groundwater sampling station, the background values for contaminants of concern, shown in Table 4-10, are a combination of values reported for well MW-3 (clearly upgradient) and MW-15 (cross-gradient and uncontaminated). For surface water and sediments, sampling station SW/SD-19 was selected as most representative, because of its location in the drainage above Site D-3.

TABLE 4-8. TOXICITY DATA FOR POTENTIAL CARCINOGENIC AND NONCARCINOGENIC EFFECTS FOR RISK CHARACTERIZATION

Chemical	AIC (Oral Route) (mg/Kg/day)	Carcinogenic Potency Factors (Oral Route) $(\text{mg/Kg/day})^{-1}$	
Antimony	4×10^{-4}	--	
Arsenic	--	15	[A]
Beryllium	5×10^{-4}	--	
Cadmium	2.9×10^{-4}	--	
Chromium (VI)	5×10^{-3}	--	
Copper	3.7×10^{-3}	--	
Lead	1.4×10^{-3}	--	
Mercury	2×10^{-3}	--	
Nickel	1×10^{-2}	--	
Selenium	3×10^{-3}	--	
Silver	3×10^{-3}	--	
Thallium	4×10^{-4}	--	
Zinc	2.1×10^{-1}	--	
Benzene	--	5.2×10^{-2}	[A]
Benzo(A)Pyrene	--	15	[A]
Bis (2-Ethylhexyl) Phthalate	2×10^{-2}	6.84×10^{-4}	[A]
Bromodichloromethane			
Chloroform	1×10^{-2}	8.1×10^{-2}	[B2]
1,2-Dichloroethane	--	9.1×10^{-2}	[B2]
Dichloromethane	6×10^{-2}	7.5×10^{-3}	[B2]
Di-n-butyl Phthalate	1×10^{-1}	--	
Ethylbenzene	1×10^{-1}	--	
Pyrene	--	--	
1,1,2,2-Tetrachloroethane	--	2×10^{-1}	[C]
Toluene	3×10^{-1}	--	
1,1,1-Trichloroethane	5.4×10^{-1}	--	
Trichloroethylene	--	1.1×10^{-2}	[B2]
Xylene	1×10^{-2}	--	

Notes:

Weight-of-Evidence Categories for Potential Carcinogens

[Group A] - Human carcinogen; sufficient evidence from epidemiologic studies to support a casual association between exposure and cancer.

[Group B2] - Probable human carcinogen; sufficient evidence of carcinogenicity in animals, inadequate evidence of carcinogenicity in humans.

[Group C] - Possible human carcinogen; limited evidence of carcinogenicity in animals.

Source: USEPA 1986.

The data from this sampling point appear to represent background conditions except for lead and zinc in the sediments. The lead and zinc values used as background comparisons are from sampling station SD-16. Background levels for soils are taken from the one background soil sample (FS-I-1) collected south of Site FT-1 and discussed in Section 4.4.8.

4.3.3 Overview of Analytical Methods Used

As an aid to understanding the interpretation of site-specific results, each of the major analyses performed at Hancock Field is discussed in general terms below.

4.3.3.1 Petroleum Hydrocarbons

The method used for the analysis of petroleum hydrocarbons in water is for the measurement of fluorocarbon-113 extractable petroleum hydrocarbons and is a measure of only the mineral oils. The method is applicable to the measurement of light fuels and can include certain organic dyes, sulfur compounds, and mineral hydrocarbons, including petroleum distillates as well as other organic compounds. The measurement may be subject to interferences, but the method is sensitive to levels of 1 mg/L and less and can be extended to ambient monitoring. Relatively rapid volatilization of the more volatile components of gasoline can result in less reliable quantification of this product, where present. In addition, interferences from nonpetroleum substances generally are expected to be of greater concern in soils because of the broad range of organic compounds present in that matrix. Despite the analytical interferences and limitations, the method is useful as a general indicator of oil and grease and fuel contaminations. At Hancock Field, the major source of petroleum hydrocarbons was expected to be associated with disposal or spills of fuels and lubricating oils and exhaust from aircraft fuel combustion.

4.3.3.2 Purgeable Halocarbons

The method used for the analysis of purgeable halocarbons is a purge and trap gas chromatographic method applicable to the determination of a total of 29 purgeable halocarbons. The method describes analytical conditions for a second gas chromatographic column that can be used to confirm measurements made with the primary column. This is helpful in resolving the compounds of

TABLE 4-9. HEALTH-BASED GUIDELINES FOR LEVELS OF CHEMICALS IN SOIL

Chemical	Background Level[a]		Health-based Guidelines: Ingestion Exposure to Chemicals in Soil[b]	
	Sediment (mg/Kg)	Soil (mg/Kg)	Protection Against Adverse Noncarcinogenic Effects[c]	Carcinogenic Effects: Concentration Corresponding to 10^{-6} Risk Level[d]
Antimony	ND	ND	376.92 mg/Kg	—
Arsenic	10	4.6	—	0.063 mg/Kg
Beryllium	0.55	0.4	471.15 mg/Kg	—
Cadmium	1.7	0.47	273.27 mg/Kg	—
Chromium (VI)	19	8.4	4,711.54 mg/Kg	—
Copper	35	18	34,865.38 mg/Kg	—
Lead	5.2	13	1,319.23 mg/Kg	—
Mercury	ND	0.051	1,884.61 mg/Kg	—
Nickel	18	8.8	9,423.07 mg/Kg	—
Selenium	2.8	1.0	2,826.92 mg/Kg	—
Silver	ND	ND	2,826.92 mg/Kg	—
Thallium	ND	ND	376.92 mg/Kg	—
Zinc	26	30	197,884.61 mg/Kg	—
Benzene	ND	ND	—	18.12 mg/Kg
Benzo(A)Pyrene	ND	Not Available	—	0.063 mg/Kg
Bis (2-Ethylhexyl) Phthalate	ND	Not Available	18,846.15 mg/Kg	1,377.64 mg/Kg
Bromodichloromethane	ND	ND	N/A	—
Chloroform	ND	ND	9,423.07 mg/Kg	11.63 mg/Kg
1,2-Dichloroethane	ND	ND	—	10.35 mg/Kg
Dichloromethane	ND	ND	56,538.46 mg/Kg	125.64 mg/Kg
Di-n-Butyl Phthalate	74	ND	—	—
Ethylbenzene	ND	ND	94,230.77 mg/Kg	—
Pyrene	83	ND	—	—
1,1,2,2-Tetrachloroethane			—	4.71 mg/Kg
Toluene	ND	ND	282,692.31 mg/Kg	—
1,1,1-Trichloroethane			508,846.15 mg/Kg	—
Trichloroethylene	ND	ND	—	85.66 mg/Kg
Xylene	Not Available		9,423.07 mg/Kg	—

(Continued)

TABLE 4-9. HEALTH-BASED GUIDELINES FOR LEVELS OF CHEMICALS IN SOIL (Continued)

NOTES:

ND = Not detected at detection limit.

[a] For sediment, sampling station SD-19 was selected as most representative of background levels, while FS-I-1 was selected as the background sample for soil.

[b] Assumes ingestion exposure to soil of 0.1 grams soil/day, 52-year exposure period (ages 18 to 70), 70 Kg body weight

Human intake factor ($HIF_{ingestion}$) =

$$\frac{0.1\text{ g soil}}{\text{day}} \times \frac{52\text{ years exposure}}{70\text{-year lifetime}} \times \frac{1}{70\text{ Kg body weight}} = \frac{0.001\text{ g soil}}{\text{Kg/day}}$$

Target Soil Concentration = Reference Dose/$HIF_{ingestion}$

[c] Protection against chronic ingestion exposure assuming threshold effects. Toxicity measure used: acceptable intake value for chronic oral exposure (AIC). Source - Superfund Public Health Evaluation Manual (USEPA 1986)

[d] Given the exposure assumptions in "b" above, these levels in soil would be associated with an additional individual lifetime risk of cancer of 1 in 1,000,000 (i.e., 10^{-6}). These soil concentrations are not based on threshold effects assumption. All levels of exposure to a carcinogen are considered to carry a degree of risk of cancer. **IMPORTANT:** The evaluation of exposure to more than one carcinogen in soil must consider the combined effects of all compounds. In the absence of information or synergism or antagonism, additivity is assumed. The target soil concentration shown here (corresponding to the 10^{-6} risk level) assumes exposure to only one potential carcinogen at a time. These target soil concentrations would be lower assuming simultaneous exposure to more than one potential carcinogen. Carcinogenic potency factors obtained from the Superfund Public Health Evaluation Manual (USEPA 1986).