Final

POL Hill Outparcel Closure Report

Hamilton Army Airfield

Prepared for

U.S. Army Corps of Engineers

February 2004

CH2MHILL
2485 Natomas Park Drive, Suite 600
Sacramento, California 95833-2937

DEPARTMENT OF THE ARMY
BASE REALIGNMENT AND CLOSURE
ATLANTA FIELD OFFICE
BRAC ENVIRONMENTAL COORDINATOR
HAMILTON ARMY AIRFIELD
1 BURMA ROAD
NOVATO, CALIFORNIA 94949

February 20, 2004

DAIM-BO-A-HA

Subject: Forwarding the *Closure Report POL Hill Outparcel* Hamilton Army Airfield; Novato, CA.

Ms. Naomi Feger
S.F. Bay Regional Water Quality Control Board
1515 Clay Street, Suite 1400
Oakland, CA 94612

Dear Ms. Feger,

The Army is pleased to provide the *Closure Report POL Hill Outparcel* Hamilton Army Airfield; Novato, CA for your review.

This document addresses all of the features of POL Hill not already addressed by the *POL Hill AST-2 Area Corrective Action Plan.*

If you have any questions, please contact me at (415) 883-6386.

Sincerely,

Edward Keller, P.E.
BRAC Environmental Coordinator
Hamilton Army Airfield

Enclosure

Copies Furnished

R. Seraydarian (EPA)
D. Diebert (DTSC)
L. McMahan (DTSC)
M. Neilan (City of Novato)
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Novato Library
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California Regional Water Quality Control Board
San Francisco Bay Region

Terry Tamminen
Secretary for Environmental Protection

1515 Clay Street, Suite 1400, Oakland, California 94612
(510) 622-2300 • Fax (510) 622-2460
http://www.swrcb.ca.gov/rwqcb2

Arnold Schwarzenegger
Governor

Date: FEB 10 2004
File No: 2159.5008 (NLF)

RECEIVED 2 11 04

Mr. Ed Keller
Department of the Army
Base Realignment and Closure Office
Atlanta Field Office
BRAC Environmental Coordinator
Hamilton Army Airfield
1 Burma Road
Novato, California 94949

Subject: Transmittal of Closure Letter and Site Summary for Department of Defense (DOD) Underground Storage Tanks at Hamilton Army Airfield, POL Hill, Novato, CA.

Dear Mr. Keller:

Army ID	RWQCB UST No.
D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, D13, D14, D15, D16, D17, D18, D19, D20, D21	21D9228

Dear Mr. Keller:

Attached please find the uniform underground storage tank (UST) closure letter and the site closure summary form for the above-references USTs. This letter documents that based on available information, no further action (NFA) related to the above-mentioned tanks is required.

The NFA status applies only to releases of petroleum from the fuel USTs listed for the above referenced site. For those sites where groundwater is polluted by non-petroleum related chemicals, this determination is only applicable to soil and groundwater impacts associated with the USTs. The Regional Water Quality Control Board shall be notified of any changes in future land use; staff understands this parcel is currently planned for use as open space.

If you have any questions, you may call Naomi Feger of my staff at 510-622-2328 or email nlf@rb2.swrcb.ca.gov.

Sincerely,

for Bruce H. Wolfe
Executive Officer

Enclosures: Case Closure Letter, Site Plan and Summary Format for DoD UST Nos. D1-D21.

cc: Lance McMahan, DTSC
Linda Dorn, SWRCB

California Regional Water Quality Control Board
San Francisco Bay Region

Terry Tamminen
Secretary for Environmental Protection

1515 Clay Street, Suite 1400, Oakland, California 94612
(510) 622-2300 • Fax (510) 622-2460
http://www.swrcb.ca.gov/rwqcb2

Arnold Schwarzenegger
Governor

Date: FEB 10 2004
File No: 2159.5008 (NLF)

Mr. Ed Keller
Department of the Army
Base Realignment and Closure Office
Atlanta Field Office
BRAC Environmental Coordinator
Hamilton Army Airfield
1 Burma Road
Novato, California 94949

Subject: Case Closure Letter for Department of Defense (DoD) Underground Storage Tanks at Hamilton Army Airfield, POL Hill, Novato, CA, including:

Army ID	RWQCB UST No.
D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, D13, D14, D15, D16, D17, D18, D19, D20, D21	21D9228

Dear Mr. Keller:

This letter confirms the completion of site investigations and remedial actions for the above listed underground storage tanks located at the above-described location (Figure 1-3). Thanks for your cooperation throughout this investigation. Your willingness and promptness in responding to our inquiries concerning these former tanks are greatly appreciated.

Based upon the information in the above-referenced file and with the provision that the information provided to this agency was accurate and representative of site conditions, no further action related to the above listed underground storage tanks release is required.

This notice is issued pursuant to a regulation contained in Section 2721 (e) of Title 23 of the California Code of Regulations.

Please contact our office if you have any questions regarding this matter.

Sincerely,

for Bruce H. Wolfe
Executive Officer

Site Summary Form

06-Feb-04

Facility Name: Hamilton Army Airfield **Staff Initials:** Naomi Feger **County Name:** Marin

Site: POL Hill **RB File No.:** 21D9228 **County Code :** 21

Address: Burma Road
Novato , CA 94949

Hydrology

Nearest Surface Water: drainage ditch

Distance to Surface Water (ft.): 75 feet

Water Wells Affected?: No **Distance to Wells (ft):** n/a **No. Wells:** 35

Groundwater Benef. Use: non-potable

Direction of GW Flow: northward

Highest GW Depth (ft): 0.46 MW112A

Lowest GW Depth(ft): -3.17

Geology

Site Geology: Four distinct geologic units; three unconsolidated units are underlain by bedrock. Pebbly sandy clay fill (0 to 7 feet thick) occur in gently sloping low lying areas and bay mud lies under the fill (0 to 4 feet thick). Bedrock is Franciscan Sandstone.

Pit Samples Submitted?: Yes **No. Borings:** 36 **Ground Elev. (ft.):** 5 to 50

Site Management

Potential Ecological Risk: site doesn't pose unacceptable level of risk

Future Land Use: open space

Human Health Risk: site doesn't pose unacceptable level of risk

Current Land Use: open space

Institutional Controls: residential deed restrictions

Management Requirements: N/A

Comments: This is a former tank farm consisting of 20 25,000 gallon USTs and one 750 gallon UST. In addition, there were three ASTs, one 25,000, one 2,500 and one 600 gallons.

In 1985, TPH was detected in samples collected from surface and subsurface soils. 11 monitoring wells were installed. 21 USTs, water control pit, water-separator house, concrete vaults and piping were removed in 1986. Soil removal totalled 13,000 cyds. Wells destroyed as
part of remediation.

In 1990 additional investigations were conducted. The three additional ASTs, the remaining fuel lines, concrete fuel islands, paving and additional soil (22,980.5 cyds) were removed. The cleanup goal was 100 ppm; soils were removed to the extent possible.

17 new wells were installed in 1991. 6 additional wells were installed in 1996. Wells in the former tank farm area were destroyed in 2002.

One 850,000 AST (AST-2) removed and is subject to a Corrective Action Plan. Nine wells remain open for monitoring the AST-2 portion of site.

Reports: 1993 Final Environmental Investigation Report, Hamilton Army Airfield, Volumes 1 and 2, Engineering Science, Inc.; 1991 Field Engineering Report - Miscellaneous Contaminated Sites, IT Corporation; 1194 Supplement to the Final Environmental Investigation Report, USACE, Sacramento District; 1996, Additional Environmental Investigation of BRAC Property, Woodward Clyde Federal Services; 1999, Petroleum, Oil and Lubricant Outparcel Closure Report BRAC Property, IT Corporation; 2003 Draft Closure Report POL Hill Outparcel, CH2MHill; Personal conversation with Hugh Ashley, November, 2003.

Staff Notes: Trenching and soil borings used to characterize site. Note that well MW-16 discussed below in groundwater results was removed during the excavation activities. MW112A is one of the replacement monitoring wells.

Remedial Activity

	Action Taken	Amount (gallons)
Free Product:		
Soil:	disposal	36,000 cyds
Ground Water:		n/a
Vapor:		

Groundwater Results, ppb

	Sample No	Source Matrix	Sampling Phase	Analyte Name	Qualifier	Value	Unit	MW Elevation	MW Latitude	MW Longitude
12/1/85	MW-16	Groundwater	Initial	TPH		730,000	ppb	-2 ft	38.06431	122.51929
2/1/97	MW112A(D)	Groundwater	Final	TPH		100	ppb	1.7		

Soil Results, ppm

DATE	Sample No	Source Matrix	Sampling Depth (ft)	Sampling Phase	Analyte name	Qualifier	Value	Unit	Comments
12/1/86	D12-04	Soil	0	Initial	TPH-purgeable		12000	ppm	

Sample collected from beneath tank at depth close to original grade of site prior to tank burial. Analyte reported as volatile fuel hydrocarbon. Tank with highest hit noted here.

12/1/91	LPOL-117	Soil	0	Final	TPH - JP-4		120	ppm	

Surface sample - TPH reported as JP-4. Exact location not clear - close to tank D14. Highest confirmation sample within former tank farm.

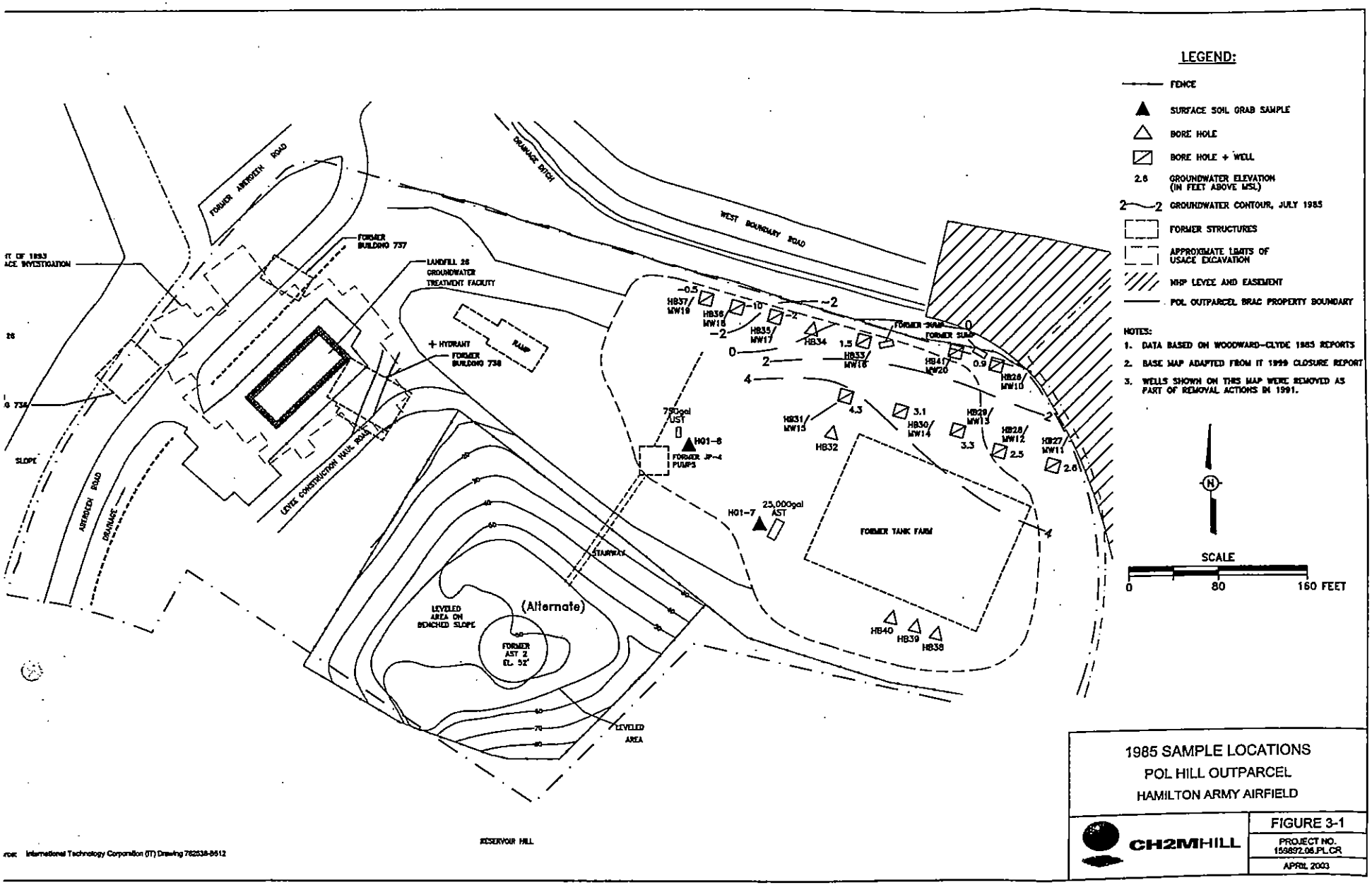
Tank Information

TANK NO.	TANK SIZE (gal)	TANK CONTENTS	TANK ACTION	DATE	LATITUDE (Decimal Degrees)	LONGITUDE (Decimal Degrees)
AST1	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51939
AST3A	2,500	diesel fuel	Removed	5/1/86	38.06394	122.51934
AST3B	600	unknown/gasoline	Removed	5/1/86	38.06394	122.51934
D01	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51939

D02	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51939
D03	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51939
D04	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51939
D05	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51939
D06	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51939
D07	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51939
D08	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51939
D09	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51939
D10	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51939

D11	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51939
D12	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51939
D13	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51939
D14	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51939
D15	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51939
D16	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51939
D17	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51939
D18	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51934
D19	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51934

D20	25,000	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51934
D21	750	Jet Fuel / Kerosene	Removed	5/1/86	38.06394	122.51934

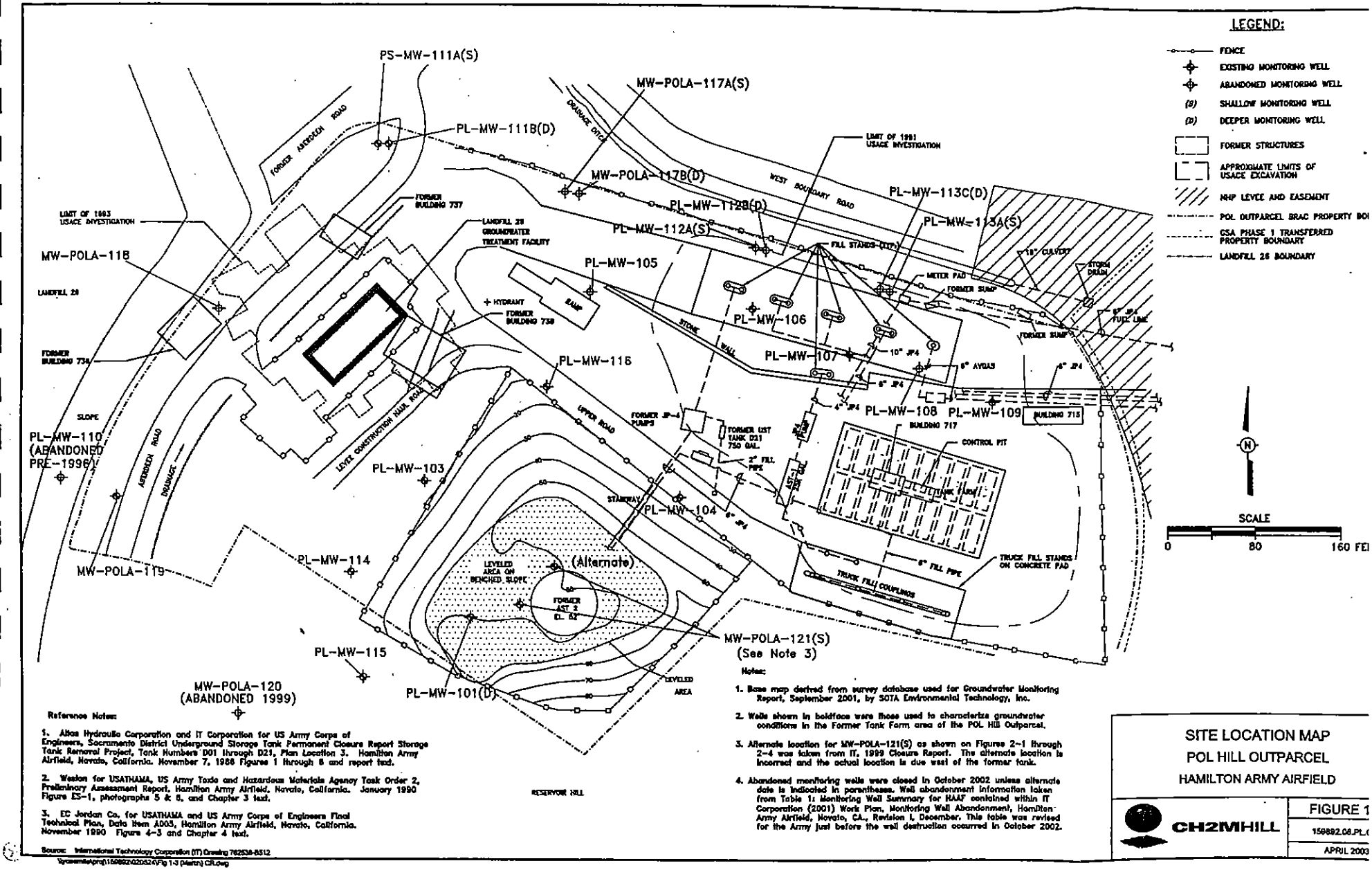


1985 SAMPLE LOCATIONS
POL HILL OUTPARCEL
HAMILTON ARMY AIRFIELD

CH2MHILL

FIGURE 3-1
PROJECT NO. 159892.06.PL.CR
APRIL 2003

rce: International Technology Corporation (IT) Drawing 782538-5512



Reference Notes:

1. Atlas Hydraulic Corporation and IT Corporation for US Army Corps of Engineers, Sacramento District Underground Storage Tank Permanent Closure Report Storage Tank Removal Project, Tank Numbers D01 through D21, Plan Location 3. Hamilton Army Airfield, Novato, California. November 7, 1988 Figures 1 through 8 and report text.

2. Weston for USATHAMA, US Army Toxic and Hazardous Materials Agency Task Order 2, Preliminary Assessment Report, Hamilton Army Airfield, Novato, California. January 1990 Figure ES-1, photographs 5 & 6, and Chapter 3 text.

3. EC Jordan Co. for USATHAMA and US Army Corps of Engineers Final Technical Plan, Data Item A005, Hamilton Army Airfield, Novato, California. November 1990 Figure 4-3 and Chapter 4 text.

Source: International Technology Corporation (IT) Drawing 762536-8512

Notes:

1. Base map derived from survey database used for Groundwater Monitoring Report, September 2001, by SOTA Environmental Technology, Inc.

2. Wells shown in boldface were those used to characterize groundwater conditions in the Former Tank Farm area of the POL Hill Outparcel.

3. Alternate location for MW-POLA-121(S) as shown on Figures 2-1 through 2-4 was taken from IT, 1999 Closure Report. The alternate location is incorrect and the actual location is due west of the former tank.

4. Abandoned monitoring wells were closed in October 2002 unless alternate date is indicated in parentheses. Well abandonment information taken from Table 1: Monitoring Well Summary for HAAF contained within IT Corporation (2001) Work Plan, Monitoring Well Abandonment, Hamilton Army Airfield, Novato, CA., Revision 1, December. This table was revised for the Army just before the well destruction occurred in October 2002.

SITE LOCATION MAP
POL HILL OUTPARCEL
HAMILTON ARMY AIRFIELD

CH2MHILL

FIGURE 1

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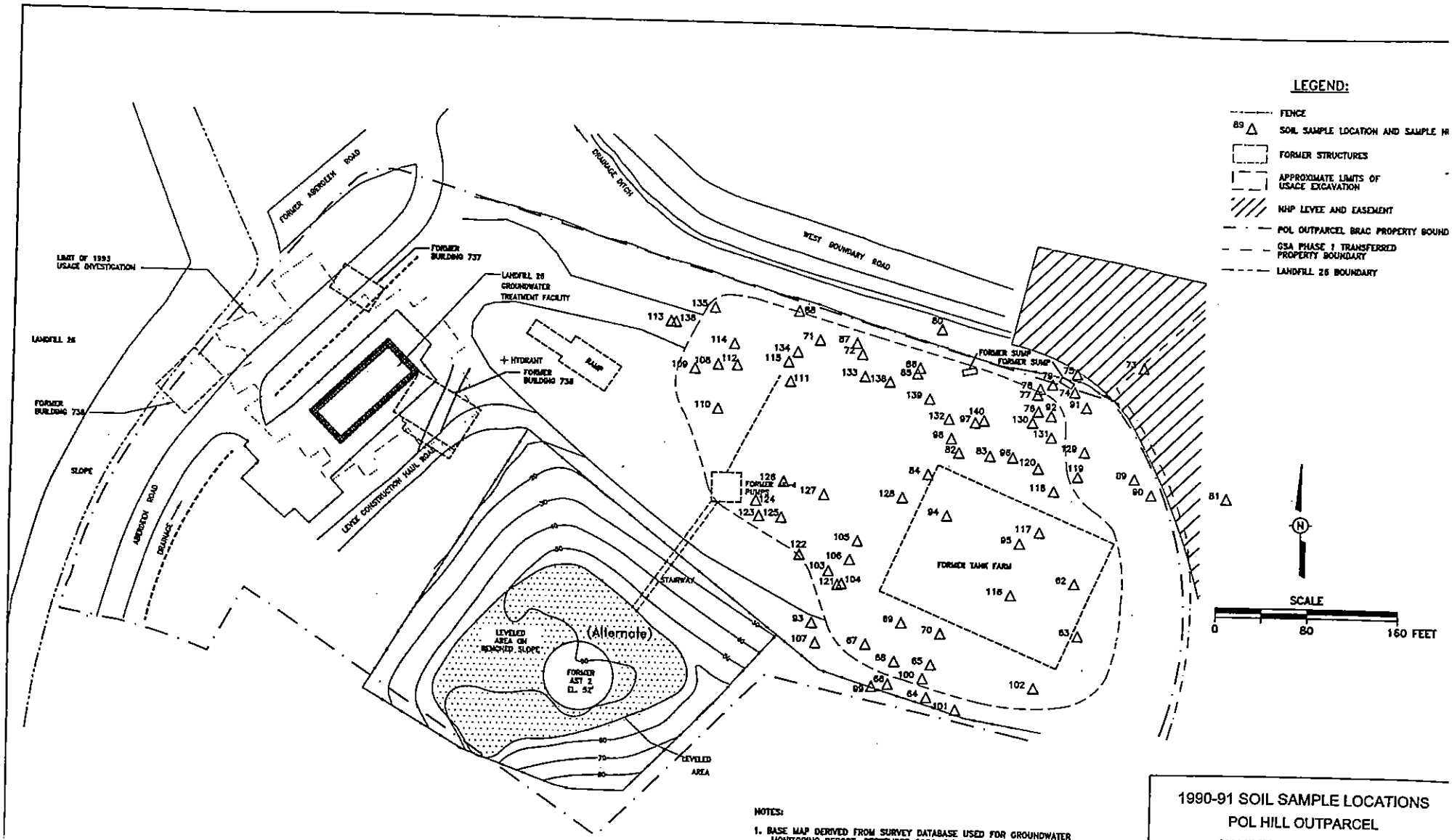
\\projects\Aprvj\156892\020524\Fig 1-3 (Martin) CR.dwg



NOTES:

1. BASE MAP DERIVED FROM SURVEY DATABASE USED FOR GROUNDWATER MONITORING REPORT, SEPTEMBER 2001, BY SOTA ENVIRONMENTAL TECHNOLOGY, INC.
2. SOURCE OF SAMPLE LOCATION DATA TAKEN FROM IT 1991, FIGURE 2.

Source: International Technology Corporation (IT) Drawing 782536-8512

1990-91 SOIL SAMPLE LOCATIONS
POL HILL OUTPARCEL
HAMILTON ARMY AIRFIELD

CH2MHILL

FIGURE 3-3

PROJECT NO. 159892.08.PL.CR

APRIL 2003

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Section Page

Appendices

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Figures

Acronyms and Abbreviations

Army	U.S. Department of the Army
AST	aboveground storage tank
ASTM	American Society of Testing and Materials
BRAC	Base Realignment and Closure
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CQC	Contractor Quality Control
DTSC	Department of Toxic Substances Control
GC	gas chromatography
GSA	General Services Administration
HAAF	Hamilton Army Airfield
IR	infrared spectroscopy
IT	International Technology Corporation
MSL	mean sea level
NHP	New Hamilton Project
PID	photoionization detector
POL	petroleum, oil, and lubricant
PQL	practical quantitation limits
RCG	Residential Cleanup Goal
RCRA	Resource Conservation and Recovery Act
RWQCB	Regional Water Quality Control Board
SAP	Sampling and Analysis Plan
SVOC	semivolatile organic compound
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
URC	unit risk concentrations
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USEPA	U.S. Environmental Protection Agency
UST	underground storage tanks
VOC	volatile organic compound
VFH	volatile fuel hydrocarbons

Executive Summary

This Closure Report was prepared for the U.S. Army Corps of Engineers (USACE), Sacramento District, to address all petroleum features located on the Petroleum, Oil, and Lubricant (POL) Hill Outparcel excluding the AST-2 area at Hamilton Army Airfield (HAAF) in Novato, California. The AST-2 area, also located within the POL Hill Outparcel, is addressed separately in the POL Hill Corrective Action Plan. POL Hill Outparcel was delineated during the Base Realignment and Closure process, and is scheduled for transfer to the City of Novato. This report presents the results of investigations for the POL Hill Outparcel to provide sufficient detail to demonstrate and recommend closure of POL Hill excluding the AST-2 area.

The POL Hill Outparcel was used by the Army and Air Force to store fuel from 1942 to 1986. Historically, 20 25,000-gallon underground storage tanks (USTs), one 750-gallon UST, and 3 aboveground storage tanks (ASTs) were located in the former tank farm area. Environmental investigations have determined that JP-4 jet fuel was the primary soil contaminant. There were also indications of minor releases of diesel fuel and waste oil. The data do not indicate that a release of leaded fuels occurred (International Technology Corporation [IT] 1999; IT 1997b). The only potential chemical of concern present at the site at levels above the residential cleanup goals (RCGs) was total petroleum hydrocarbons (TPH).

From 1985 through 1986, the Army investigated the soil and groundwater at the former tank farm. In 1985, TPH was detected in samples collected from surface and subsurface soils and from some of the groundwater wells (Woodward-Clyde 1985). In 1986 21 USTs, the water control pit, water-separator house (Building 717), and concrete vaults and piping were removed from the tank farm area. During the UST removal action, extensive soil staining was observed in some areas, thus the Army conducted additional investigations to evaluate the extent of soil contamination. Approximately 63 trenches were excavated during the investigation and soil and groundwater samples were collected and analyzed. TPH was detected in the soil and groundwater samples. In 1986, the Army conducted additional removal actions based on the sample results from the trenching investigation. Although large quantities of soil were removed, sample results indicated some TPH contaminated soil remained at the site.

From 1990 through 1996, the Army conducted several sampling events and removal actions in the tank farm area. In 1990, the Army began a trenching and sampling program to evaluate the extent of contamination for a second round of excavation. In the winter of 1990/1991, IT conducted further remediation at the tank farm area, based on the results of the trenching and sampling program. As part of the remedial activities, the Army removed the concrete fuel islands located on the west side of the POL Hill Outparcel; pavement from various portions of the property; several fuel lines that were left in place during the 1986 excavation; and three ASTs located west of the former location of the USTs (IT 1991).

In 1991, the Army installed nine of the new monitoring wells to characterize the former tank farm (ESI 1993). In addition, the Army completed 14 shallow soil borings near the former fuel distribution site (ESI 1993). The analytical results indicated that petroleum contamination was present at low concentrations in tank farm soil, and was not present in groundwater.

In 1993, Buildings 736, 737, and 738 were demolished because USACE began construction of a water treatment plant for Landfill 26 in the POL Hill Outparcel. During excavation activities, soil contaminated by petroleum hydrocarbons was excavated (USACE 1994). The excavated soils were then used as random fill in Landfill 26, which has a Resource Conservation and Recovery Act (RCRA) compliant cap. The cap is considered sufficient to protect potential human and ecological receptors from exposure to the impacted soils (IT 1997c).

In 1996 the Army drilled five additional soil borings around the perimeter of the treatment plant. The soil sample results for known TPH compounds were below the cleanup goal of 200 ppm.

In 1997, 1998, and 1999 following the completion of remediation activities in the former tank farm, the Army performed groundwater monitoring. The tank farm groundwater samples were all nondetect for TPH in 1998 and 1999 and below the closure criteria in 1997. These groundwater and soil data indicate that groundwater at the tank farm has not exceeded closure criteria since 1990 and that soil at the tank farm has not exceeded closure criteria since 1996.

Human health and environmental risks have been assessed (ESI 1993). The results of this study indicate that there are no substantial risks to humans or environmental receptors for toxic compounds under current or future land use scenarios.

The conclusion of this report is that remedial actions necessary for closure of all features associated with the tank farm (including below- and above-ground tanks, pumps, pipelines, and buildings) have been accomplished.

The general requirements necessary to demonstrate closure are:

- Fuel leaks were stopped and ongoing sources have been removed or remediated.
- The site was adequately characterized.
- Little or no groundwater impacts exist.
- No water wells, deeper drinking water aquifers, surface water, or other sensitive receptors are likely to be impacted.
- The site presents no significant risk to human health.

All general and specific closure criteria, listed above and in Section 1.4 of this report, have been met.

SECTION 1

Introduction

This Closure Report was prepared by CH2M HILL for the U.S. Army under contract to the U.S. Army Corps of Engineers (USACE), Sacramento District (contract number DACW05-99-0021). This Closure Report was prepared to address all the petroleum storage and handling facilities associated with the former tank farm area located on the Petroleum, Oil, and Lubricant (POL) Hill Outparcel at the former Hamilton Army Air Field (HAAF), Novato, California (Figures 1-1 and 1-2). The former tank farm area incorporates, for the purpose of this Closure Report, all facilities (except as noted below) at the POL Hill Outparcel including former below- and above ground tanks, vaults, pipes, pumps, and buildings. The former tank farm area does not include the former above-ground storage tank (AST-2) area located on Reservoir Hill, which is being addressed separately in a Corrective Action Plan (CAP) and is not further discussed this Closure Report. This report provides the results and interpretations to support and recommend the closure of the former tank farm at the POL Hill Outparcel (Figure 1-3).

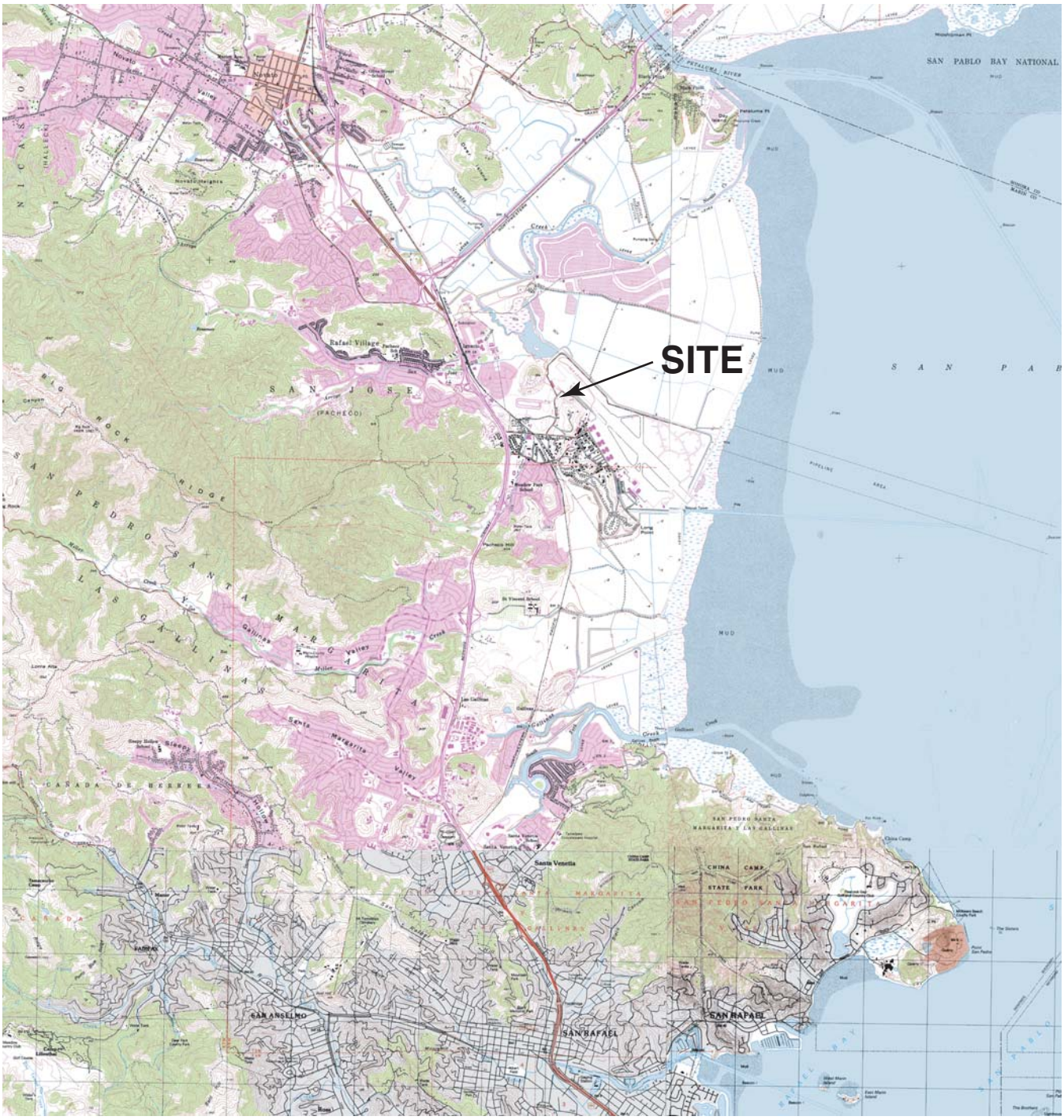
1.1 Purpose and Objectives

The purpose of this Closure Report is to document and summarize the results of historical investigations of the former tank farm located on the POL Hill Outparcel and to provide sufficient detail to demonstrate and recommend closure of these site features.

This report provides information on the site's environmental setting, previous land use, and the nature and extent of historic contaminant impacts. The results for soil and groundwater media are presented from previous site investigations and compared to applicable residential cleanup goals (RCGs). These comparisons are used to support the recommendation for closure of this area.

1.2 Problem Statement

The Army and the Air Force used the POL Hill Outparcel to store fuel from 1942 to 1986. Historically, 20 25,000-gallon underground storage tanks (USTs), 1 750-gallon UST, and 3 ASTs were located in the former tank farm area. Operation of the former tank farm resulted in documented impacts to soil and groundwater. Environmental investigations have determined that JP-4 jet fuel was the primary soil contaminant. There were also indications of minor releases of diesel fuel and waste oil. The data do not indicate that a release of leaded fuels occurred (International Technology Corporation [IT] 1999; IT 1997b). The only potential chemical of concern that was present at the site at levels above the Residential Cleanup Goals (RCGs) was total petroleum hydrocarbons. The soils containing TPH levels above 100 mg/kg were removed. The process of soil removal has also addressed shallow groundwater contamination previously observed in early investigations of the former tank farm.



0 1 2

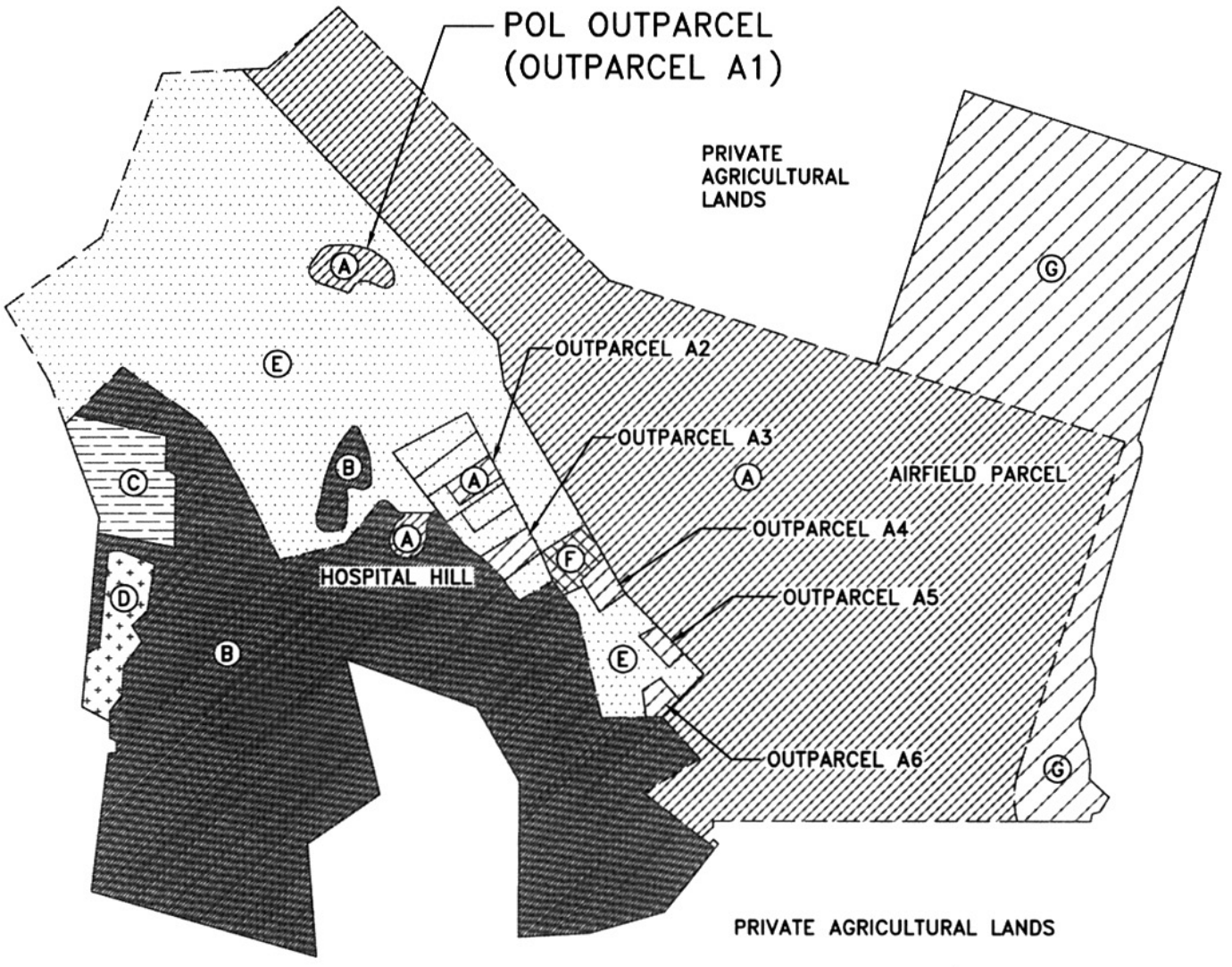
SCALE IN MILES

N

Source: USGS Novato, Petaluma Point, San Rafael, and San Quentin Quadrangles - July 1983

Figure 1-1
Site Location Map
POL Hill
Hamilton Army Airfield
Novato, California

CH2MHILL



LEGEND:

- ARMY–OWNED PROPERTY BOUNDARY
- (A) BRAC PROPERTY
- (B) NAVY HOUSING
- (C) LANHAM HOUSING
- (D) NOVATO SCHOOL DISTRICT
- (E) GSA SALE PARCEL
- (F) US COAST GUARD
- (G) STATE OF CALIFORNIA

N

APPROXIMATE SCALE

0 1000 2000 FEET

SOURCES:

Woodward–Clyde Federal Services Drawing SK9469

International Technology Corporation Drawing 762538–A315

BRAC PROPERTY LOCATION MAP
POL HILL
HAMILTON ARMY AIRFIELD
NOVATO, CALIFORNIA

CH2MHILL

FIGURE 1-2

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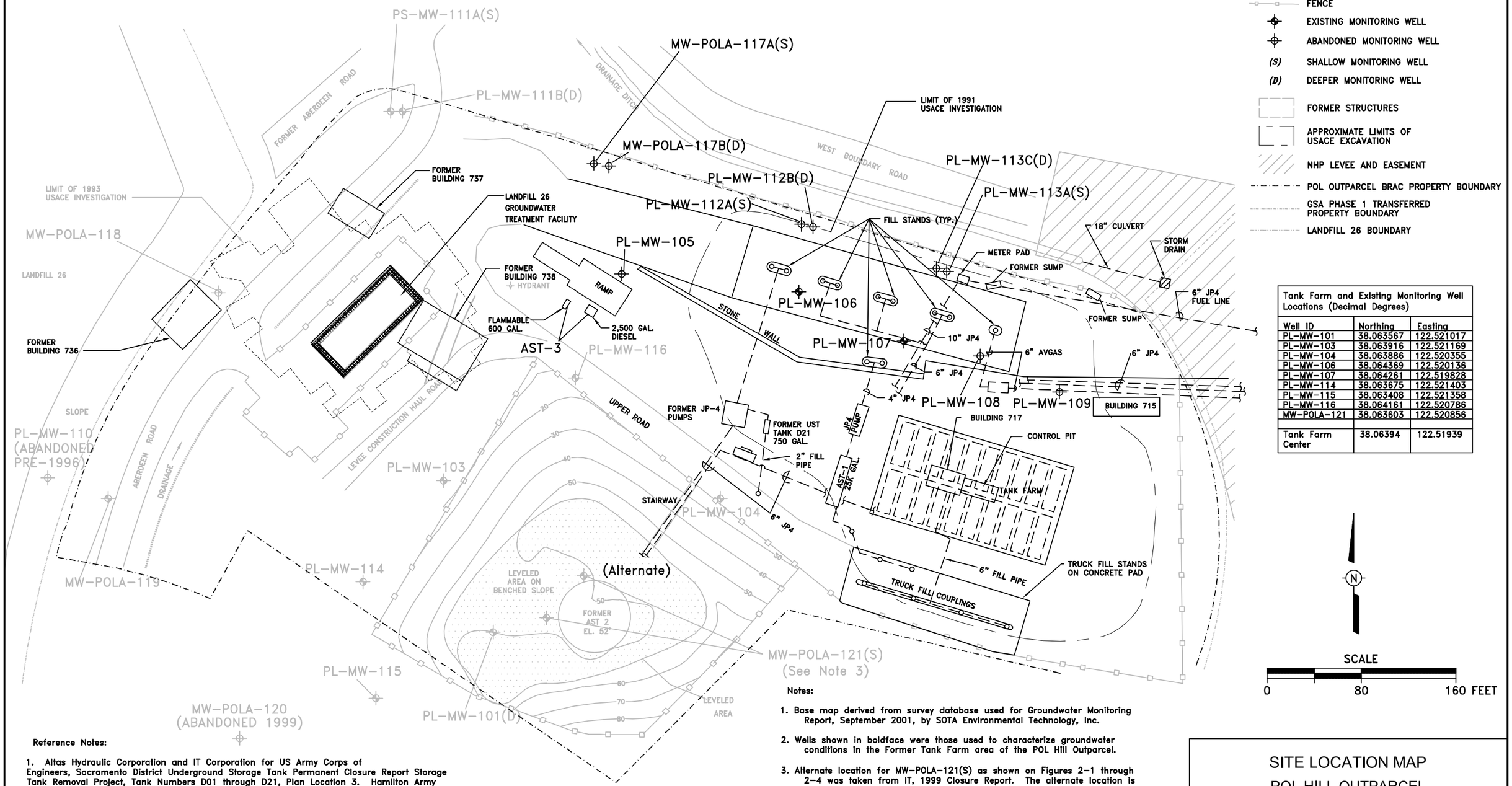
April 2003



LEGEND:

- FENCE
- EXISTING MONITORING WELL
- ABANDONED MONITORING WELL
- (S) SHALLOW MONITORING WELL
- (D) DEEPER MONITORING WELL
- FORMER STRUCTURES
- APPROXIMATE LIMITS OF USACE EXCAVATION
- NHP LEVEE AND EASEMENT
- POL OUTPARCEL BRAC PROPERTY BOUNDARY
- GSA PHASE 1 TRANSFERRED PROPERTY BOUNDARY
- LANDFILL 26 BOUNDARY

Tank Farm and Existing Monitoring Well Locations (Decimal Degrees)

Well ID	Northing	Easting
PL-MW-101	38.063567	122.521017
PL-MW-103	38.063916	122.521169
PL-MW-104	38.063886	122.520355
PL-MW-106	38.064369	122.520136
PL-MW-107	38.064261	122.519828
PL-MW-114	38.063675	122.521403
PL-MW-115	38.063408	122.521358
PL-MW-116	38.064161	122.520786
MW-POLA-121	38.063603	122.520856
Tank Farm Center	38.06394	122.51939

SCALE
0 80 160 FEET

Reference Notes:

1. Altas Hydraulic Corporation and IT Corporation for US Army Corps of Engineers, Sacramento District Underground Storage Tank Permanent Closure Report Storage Tank Removal Project, Tank Numbers D01 through D21, Plan Location 3. Hamilton Army Airfield, Navato, California. November 7, 1986 Figures 1 through 6 and report text.
2. Weston for USATHAMA, US Army Toxic and Hazardous Materials Agency Task Order 2, Preliminary Assessment Report, Hamilton Army Airfield, Navato, California. January 1990 Figure ES-1, photographs 5 & 6, and Chapter 3 text.
3. EC Jordan Co. for USATHAMA and US Army Corps of Engineers Final Technical Plan, Data Item A005, Hamilton Army Airfield, Navato, California. November 1990 Figure 4-3 and Chapter 4 text.

Notes:

1. Base map derived from survey database used for Groundwater Monitoring Report, September 2001, by SOTA Environmental Technology, Inc.
2. Wells shown in boldface were those used to characterize groundwater conditions in the Former Tank Farm area of the POL Hill Outparcel.
3. Alternate location for MW-POLA-121(S) as shown on Figures 2-1 through 2-4 was taken from IT, 1999 Closure Report. The alternate location is incorrect and the actual location is due west of the former tank.
4. Abandoned monitoring wells were closed in October 2002 unless alternate date is indicated in parentheses. Well abandonment information taken from Table 1: Monitoring Well Summary for HAAF contained within IT Corporation (2001) Work Plan, Monitoring Well Abandonment, Hamilton Army Airfield, Novato, CA., Revision 1, December. This table was revised for the Army just before the well destruction occurred in October 2002.

Source: International Technology Corporation (IT) Drawing 762538-B512

\\yosemite\proj\159892\020524\Fig 1-3 (March) CR.dwg

SITE LOCATION MAP
POL HILL OUTPARCEL
HAMILTON army AIRFIELD

CH2MHILL

FIGURE 1-3

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The entire POL Hill Outparcel is slated for transfer to the City of Novato, California. This Closure Report for the former tank farm along with the Corrective Action Plan for the former AST-2 area (under separate cover) are intended to support the property transfer of the POL Hill Outparcel to the City of Novato. The intended reuse of the entire POL Hill Outparcel by the City will be for recreational open space.

1.3 Regulatory Authority

The U.S. Army is the lead agency involved in the BRAC Closure process at HAAF (USACE 1991). The California Regional Water Quality Control Board (RWQCB) is the lead regulatory agency for the POL Hill Outparcel. This was formally documented in a letter from the California Department of Toxic Substances Control (DTSC) to the Army because petroleum hydrocarbons are not regulated as hazardous substances in the California Health and Safety Code (DTSC 1998). In addition, the U.S. Environmental Protection Agency (USEPA) is an oversight agency for closure of the POL Hill Outparcel.

Remediation activities described in this report were performed pursuant to the Comprehensive Remedial Investigation/Feasibility Study Work Plan (IT 1997a) and the Contractor Quality Control/Sampling and Analysis Plan (CQC/SAP) (IT 1997b), which were approved by the regulatory agencies. Additionally, the remedial investigation activities were consistent with the statutory requirements defined in the California Code of Regulations Title 23, Division 3, Chapter 16, Article 11 (Underground Storage Tanks) (1994).

Other guidance documents used in preparation of this Closure Report include the Tri-Regional Board Staff Recommendations for Preliminary Evaluation and Investigation of Underground Storage Tank Sites (TRWQCB 1990), the Supplemental Instructions to State Water Board, December 8, 1995, Interim Guidance on Required Cleanup at Low Risk Fuel Sites (RWQCB 1996), and the risk-based corrective action approach documented in the American Society of Testing and Materials (ASTM) Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites (1995) San Francisco Bay Basin (Region 2) Water Quality Control Plan (RWQCB 1995).

1.4 Closure Criteria

The general requirements necessary to demonstrate closure are:

- Fuel leaks were stopped and ongoing sources have been removed or remediated.
- The site was adequately characterized.
- Little or no groundwater impacts exist.
- No water wells, deeper drinking water aquifers, surface water, or other sensitive receptors are likely to be impacted.
- The site presents no significant risk to human health.

These issues are addressed in Sections 3 and 4 of this report and are summarized here.

The closure criteria for the POL Hill Outparcel were agreed upon by regulators and Army officials after a majority of the investigations performed at this site were completed. Cleanup criteria for the former tank farm are based on criteria developed for the POL Hill Outparcel.

The POL Hill Outparcel is located adjacent to the neighboring General Services Administration (GSA) Phase I Sale Area. The reuse of the GSA property is residential. The proposed future reuse of the POL Hill Outparcel is recreational. Since the proposed future use of the Outparcel is recreational open space, it presents a lower exposure to future human receptors than the residential land use exposure scenarios upon which the RCGs were originally based. For this reason, the cleanup criteria developed for the GSA Phase I Sale Area are more conservative when they are applied to the POL Hill Outparcel.

The RCG development process involved identifying a range of concentrations that could be used as cleanup goals. For soils, these cleanup goals included unit risk concentrations (URCs) representing a chemical concentration that will produce an excess cancer risk of one in a million (10^{-6}) and a hazard quotient equal to or greater than 1, background concentrations, and practical quantitation limits (PQLs). For groundwater, the list of potential goals included URCs, PQLs, and levels protective of aquatic receptors.

Once the range of concentrations was compiled for each medium, selection of cleanup goals for a residential receptor was based on the most stringent goal for each medium (soil and groundwater). Since the exposure for a recreational user is typically less than that for a residential receptor, using RCGs is conservative. The final cleanup goals established for this site are 200 ppm (TPH measured as diesel) for soil, 1,200 µg/L (TPH measured as JP-4[1]), and 600 µg/L (TPH measured as gasoline) for groundwater.

It should be noted that, before establishing the final cleanup goal of 200 ppm TPH in soil, several interim levels of TPH concentrations in soil were used between 1986 and 1996 to guide investigation and remediation activities at this site. A level of 1,000 ppm TPH in soil was used to guide initial activities between 1986 and 1987, and a level of 100 ppm of TPH in soil was used to guide excavation activities between 1990 and 1996.

1.5 Summary

The results of historical investigations and remedial actions at the former below-ground tank farm show:

- Sources of contamination (i.e., above- and below-ground fuel storage tanks, pumps, pipelines, and buildings) have been removed.
- Investigations conducted between 1985 and 1996 adequately characterize the site.
- To the extent physically possible, all soil with TPH concentrations above 100 ppm have been removed.
- Soil excavation activities in the former tank farm area have addressed groundwater contamination observed in initial investigations.
- Risk evaluations indicate there is no threat to human health or the environment.

[1] Because no numerical value existed for TPH measured as JP-4, the cleanup goal for TPH measured as diesel was used.

1.6 Data Comparability

Environmental investigations at the former tank farm have included both nonspecific TPH analyses that use infrared spectroscopy (IR), and partially specific TPH analysis methods that use gas chromatography (GC). IR methods are subject to interference from naturally occurring organic matter (i.e., Bay Muds). EPA Method 418.1 (EPA 1995) is an IR method that was used at HAAF during previous investigations to quantify total recoverable petroleum hydrocarbons (TRPH). Because of the problems with interferences, there is an uncertainty for using the TRPH data as an indicator of "true" hydrocarbon contamination. For this reason, TRPH data will not be used or referenced in this document.

GC methods (modified EPA Method 8015) can be used to distinguish between naturally occurring hydrocarbons and refined petroleum hydrocarbon products or contaminants. Two versions of modified EPA Method 8015, purgeable and extractable TPH fractions, have been used to analyze samples collected at HAAF. In this document, GC results are reported as specific TPH fractions (i.e., TPH measured as diesel, TPH measured as JP-4, TPH measured as motor oil, and TPH measured as gasoline). The Storage Tank Removal Report (Atlas, 1987) describes the project's need to measure volatile hydrocarbons, semi-volatile, and non-volatile hydrocarbons in order to characterize the complex fuel mixtures at the site, such as JP4. To accomplish this, two separate analytical methods were employed: a purge and trap/GC/FID and PID method was used to measure volatile hydrocarbons; and a liquid extraction with direct injection/capillary column GC/FID method was used for semi-volatile (kerosene and diesel) and non-volatile (lubricating oil) hydrocarbons. Based on this information, the Volatile Fuel Hydrocarbon (VFH) term is interpreted to mean purgeable TPH.

Although speciation of gasoline, diesel, and JP-4 is possible analytically, end users of the data must recognize that chemical interferences and degradation phenomena will influence quantities reported for each species. For example, higher levels of heavier petroleum products such as diesel, JP-4, or waste oils may contain some volatile components that produce a response when measuring TPH as gasoline. Similarly, the heavy ends of gasoline and JP-4 chains may also produce a response when measuring TPH as diesel. Furthermore, petroleum constituents may undergo varying degrees of weathering and degradation during the period between release and sample collection. Consequently, chromatogram signatures from investigative samples often do not match those associated with calibration standards. When the sample chromatogram does not match that of the fuel standard used for calibration, the contaminant is reported by the laboratory as "unknown hydrocarbon." When the unknown falls in the gasoline range (i.e., number of carbons in base chain) (C_7 to C_{12}), the result will be quantitated against the gasoline standard. When the unknown falls in the diesel (C_{10} to C_{24}), JP-4 (C_8 to C_{13}), or motor oil (C_{24} to C_{36}) range, the result will be quantitated against the diesel standard.

Given data limitations associated with historic methods (i.e., EPA Method 418. 1) and speciation uncertainties, this report presents the type and likely range of contaminant levels derived from correlating the investigative results with process knowledge. For example, soil and groundwater contamination attributed to releases from the former tank farm will be evaluated as JP-4 (see Section 2. 1) even though contaminant concentrations may have been reported as TRPH or gasoline/diesel.

SECTION 2

Site Description and History

The following sections provide the site-specific information on historical background and environmental conditions for the former tank farm within the POL Hill Outparcel. This information is intended to facilitate an understanding of the historical activities and physical characteristics of the site, and to provide a basis for evaluating the nature and extent of contamination as well as remedial activities described in Section 3.

2.1 Hamilton Army Airfield Facility Description

The HAAF was a 1,600-acre military installation located approximately 22 miles north of San Francisco on San Pablo Bay in Marin County, California (see Figure 1-1). The military installation was bounded on the north by the North Antenna Field (a formerly used defense site), private agricultural lands, and a private residential community (Bel Marin Keys); on the east by state-owned land and San Pablo Bay; on the south by private agricultural fields; and on the west by Nave Drive, which parallels State Highway 101.

The 7.84-acre POL Hill Outparcel has been addressed along with other BRAC sites; however, the outparcel is separate from the contiguous Main BRAC Property (see Figure 1-2). The POL Hill Outparcel is located on the north side of a ridge known as Reservoir Hill, and the adjacent lowlands southwest of West Boundary Road. The Outparcel is bounded by the GSA Phase II Sale Area. The former tank farm is located on the lowlands adjacent to Reservoir Hill (see Figure 1-3).

Hamilton Army Airfield (Base) was constructed on reclaimed tidal mud flats by the Army Air Corps in 1932. The site, previously known as Marin Meadows, had been used as ranch and farm land since the Mexican Land Grant (USACE, undated). Military operations began in December 1932, first as a base for bombers, and later as a base for transport and fighter aircraft. The Base played a major role during World War II as a training field and staging area for Pacific operations. During the war (i.e., early and mid-1940s), the Base hospital served as an acute care and rehabilitation facility for thousands of war casualties per month.

The Base was renamed Hamilton Air Force Base in 1947, when it was transferred to the newly created U.S. Air Force (USAF). The USAF used the Base primarily as a training and fighter installation until 1975. The USAF ended military operations at the Base in 1976, and the property was declared surplus by the Department of Defense (Hamilton Field Association, Inc. 1988). In 1976, the U.S. Department of the Army (Army) began aircraft operations at the airfield and supporting facilities with permission from the USAF. In 1984, the airfield property was officially transferred back to the Army and renamed Hamilton Army Airfield. The Base was declared surplus under the BRAC Act of 1988. The Army continued to use the airfield primarily for Army Reserve aircraft operations until March 1994. Currently, the BRAC Property is managed by the Department of the Army, I Corps, at Fort Lewis, Washington.

2.2 Description of Former Tank Farm Area

The former underground tank farm is located on the lowlands adjacent to Reservoir Hill (Figure 1-3). The former AST-2 on Reservoir Hill supplied JP-4 jet fuel to 20 25,000-gallon underground storage tanks within the tank farm. Three above ground storage tanks (ASTs) were also located in the former tank farm areas during operation. A series of pumps and pipes supported the fuel distribution system. A number of investigations and remedial actions were conducted at the former below-ground tank farm between 1985 and 1996. All of the USTs and ASTs associated with the tank farm have been removed. To the extent physically possible, soil with TPH concentrations greater than 100 ppm has been removed and replaced with fill.

There were 20 25,000-gallon USTs (UST-1 to UST-20) located in the main fuel storage area. The tanks were arranged in two rows of 10 (see Section 3.2 and Figure 3-2). Each tank was supported by four 3-foot-high concrete footings built on the original grade of the lowlands along Reservoir Hill. The tanks were buried beneath 20 feet of soil, which totally covered the tanks and created a hill that blended into the natural hillside of Reservoir Hill (Woodward-Clyde 1985). One 750-gallon UST (UST-21) was located approximately 150 feet north of the main tank farm area. All USTs in the former tank farm are known to have contained JP-4 except for the 750 gallon UST-21. Although the original contents of the 750-gallon UST are not documented, the contents observed during tank removal activities are reported to have resembled JP-4 (IT 1987).

Three ASTs were historically present in the former tank farm area. AST-1 was a 25,000 gallon tank that contained JP-4. Two ASTs (2,500 and 600 gallon capacities) were located in an area called the AST-3 area. These ASTs were not assigned individual numbers. The contents of the 2,500 and 600 gallon ASTs are not known (CH2MHILL, 2000). The 25,000 gallon JP-4 AST was operational until the early 1990s and was used to refuel occasional aircraft that were using the runway (Jordan 1990).

A series of pipelines, pumps, a sump, meters, and small structures supported and connected the features of the fuel supply and distribution system for aircraft operations. The structures located in the former tank farm were designated as Buildings 715, 717, 736, 737, and 738. Truck fill stands (pipes) were located along the western edge of the former tank farm area adjacent to Reservoir Hill. A groundwater treatment facility for the adjacent Landfill 26 was constructed in 1994 on land previously occupied by Buildings 736, 737, and 738.

2.3 Surface Water

HAAF is situated within the Novato Creek drainage basin, which is bounded by the Petaluma River basin to the north, San Pablo Bay to the east, the Coast Range hills to the west and southwest, and the Las Gallinas Creek drainage system to the south. The Coast Range hills act as the principal source of groundwater recharge and surface water drainage for the basin. Mean annual precipitation is 28 inches. The winter influx of rain results in an elevated groundwater table and some surface flooding. During summer months, rainfall averages less than 0.1 inch per month. This results in the evaporation of surface waters, a drop in the groundwater table, and extensive desiccation of shallow soil horizons (Woodward-Clyde 1996).

Reservoir Hill is located on outcroppings of a relatively steep, elevated bedrock knob. The low-lying portions of HAAF are drained by a system of concrete-lined ditches and storm drains that

tie into a perimeter drainage system. This perimeter drainage system directs flows to a pumping station where water is pumped to San Pablo Bay (Earth Tech 1994). The only perennial surface water feature in the vicinity of the POL Hill Outparcel is a drainage ditch that lies just outside the northwestern boundary of the area. This ditch collects runoff water that flows northward across the northern portion of the POL Hill Outparcel and groundwater seepage. The ditch originates from the area immediately to the east of the POL Hill Outparcel, then drains westward under Aberdeen Road and into the main HAAF perimeter drainage system (Woodward-Clyde 1995a).

2.4 Hydrogeology

2.4.1 Geology

HAAF lies within the northern coastal range geomorphic province of California, which consists of a series of generally fault-bounded, northwest-trending upland areas separated by intermontane valleys. Bedrock knobs present at the installation consist of yellow and buff clastic rocks that have been interpreted as serpentinite and sandstone bedrock from the Franciscan Complex of Jurassic to Cretaceous age.

The lowland areas of HAAF lie on former wetlands bordering San Pablo Bay. The bay occupies a valley between upland bedrock areas described above. The valley has been partially infilled with clastic sediments deposited in alluvial, fluvial, and shallow-marine environments. The principal surficial geology in this area is a dark, organic-rich, highly plastic, silty clay unit that was deposited in intertidal and shallow subtidal depositional environments. This unit, referred to as Bay Mud, may extend to depths as great as 90+ feet below ground surface in the eastern portion of the HAAF BRAC Property.

Soil types found at HAAF include Novato Clay, Reyes Clay, Saurin-Bonnydon complex, Saurin-Urban Land Bonnydon complex, Urban Land Xerothenths complex, Xerothenths Fill, and Xerotheths-Urban Land complex. A major component of shallow soils at HAAF is artificial fill that has been used for a variety of purposes, including levee construction, landfill cap materials, and road/taxiway base rock. This material is highly heterogeneous, consisting of variable proportions of clay, sand, gravel, and cobble-sized material (Earth Tech 1994).

Four distinct geologic units have been identified at POL Hill: three unconsolidated units underlain by bedrock. The pebbly sandy clay fill (0 to 7 feet thick) occurs in the gently sloping low-lying areas surrounding Reservoir Hill to a depth of 7 feet (IT 1999). Bay Mud lies under this fill (0 to 4 feet thick) in the lowlands of POL Hill Outparcel, where it is not disturbed by excavation. Sediments weathered from the sandstone bedrock underlie the Bay Mud in portions of the POL Hill Outparcel (Woodward-Clyde 1985). A weathered shaley sandstone bedrock lies beneath the unconsolidated materials in the lowlands and outcrops at Reservoir Hill (Woodward-Clyde 1995a). Unconsolidated sediments and soils are not thicker than 25 feet in any portion of POL Hill (IT 1999). The bedrock located beneath these units is the relatively impermeable, well indurated, fractured Franciscan Sandstone (IT 1999).

2.4.2 Groundwater

Groundwater at the POL Hill Outparcel occurs within the weathered bedrock along the flanks of Reservoir Hill. Recharge occurs as a result of rainfall on the top and slopes of the hill. Groundwater percolates into the weathered material and fractures in the bedrock.

Flow within the bedrock is assumed to be controlled by fractures. Production rates are generally less than 2 gallons per day (IT 1999). Groundwater in this site does not meet the criteria as a suitable source of drinking water because of the low yields and high salinity (SFRWQCB 2001). Groundwater in the vicinity of the former AST-2 occurs in the bedrock at a depth of approximately 20 to 35 feet below ground surface. In the vicinity of the former tank farm, groundwater occurs in the fill material below Reservoir Hill at increasingly shallower depths at lateral distances away from the toe of Reservoir Hill.

The water table surface appears to be unconfined beneath the hill and semi-confined in the gently sloping, low-lying areas that surround the hill. Groundwater data from wells near the drainage ditch along the northern boundary of POL Hill suggest that an upward hydraulic gradient exists between the shallower and deeper units of the area (IT 1997, 1999).

Hydraulic conductivity was evaluated at POL Hill Outparcel by the Army in 1997. Hydraulic conductivities were derived from slug tests at 12 wells, and recovery pump tests at 2 wells. The Bower and Rice (1976) slug test, and Jacob (1963) recovery methods were used to determine hydraulic conductivity in this area. The methods are most accurate in the determination of hydraulic conductivity in low-yield aquifers for small-scale (hundreds of feet) investigations (Batu 1998). The values of conductivity are low. They average 7.3×10^{-2} feet per day (2.6×10^{-8} meters per second), and range from 0.0028 to 5.3 feet per day (1.0×10^{-8} to 1.9×10^{-5} meters per second) (IT 1999).

The ground surface at the POL Hill Outparcel slopes downward to the north from the elevated AST-2 Area. Moving north, the ground surface elevation changes from 24.8 feet above mean sea level (MSL) at PL-MW-104 (the approximate northern boundary of the AST-2 Area) to 1.7 feet above MSL at MW-112A (S) (near the northern boundary of the POL Hill Outparcel). Moving west from the western fence line of the AST-2 Area, the ground surface elevations range from approximately 20 feet above MSL to approximately 18 feet above MSL near the southwest corner of the POL Hill Outparcel. The estimated 18-foot ground surface elevation at this point is interpolated from the ground surface at MW-POLA-119 (19.3 feet above MSL) and the ground surface at the abandoned PL-MW-110 (17.5 feet above MSL). Ground surface information was derived from previous IT Corporation reports (IT 1999).

The groundwater levels at the POL Hill Outparcel ranged 7.88 feet above MSL at PL-MW-104 to approximately 2 feet below MSL at PL-MW-112A(S) based on measurements shown on a site cross section by IT Corporation in March 1997. The highest water level elevations at PL-MW-104 were 10.75 feet above MSL in February 2002 and the lowest water level elevations were 5.77 feet above MSL in September 2001 (SOTA 2002). The lowest measured groundwater level at the POL Hill Outparcel was 3.17 feet below MSL at PL-MW-112A(S) in May 1997 (IT 1999).

Groundwater elevations indicate that flow is generally northward and flows to the lower elevation areas. In June of 1985, water elevations were shallow and close to sea level in the former tank farm area. Army data indicate that water levels dropped by 2 to 3 feet in this area from 1987 to 1990 (Woodward-Clyde 1985; IT 1999). Water elevation measurements in February 1991 show that water levels had risen 3 to 4 feet after excavation (ESI 1993). Water levels change very little (less than 1 foot) from one year to the next after 1994 (IT 1999).

SECTION 3

Summary of Investigation and Remedial Activities

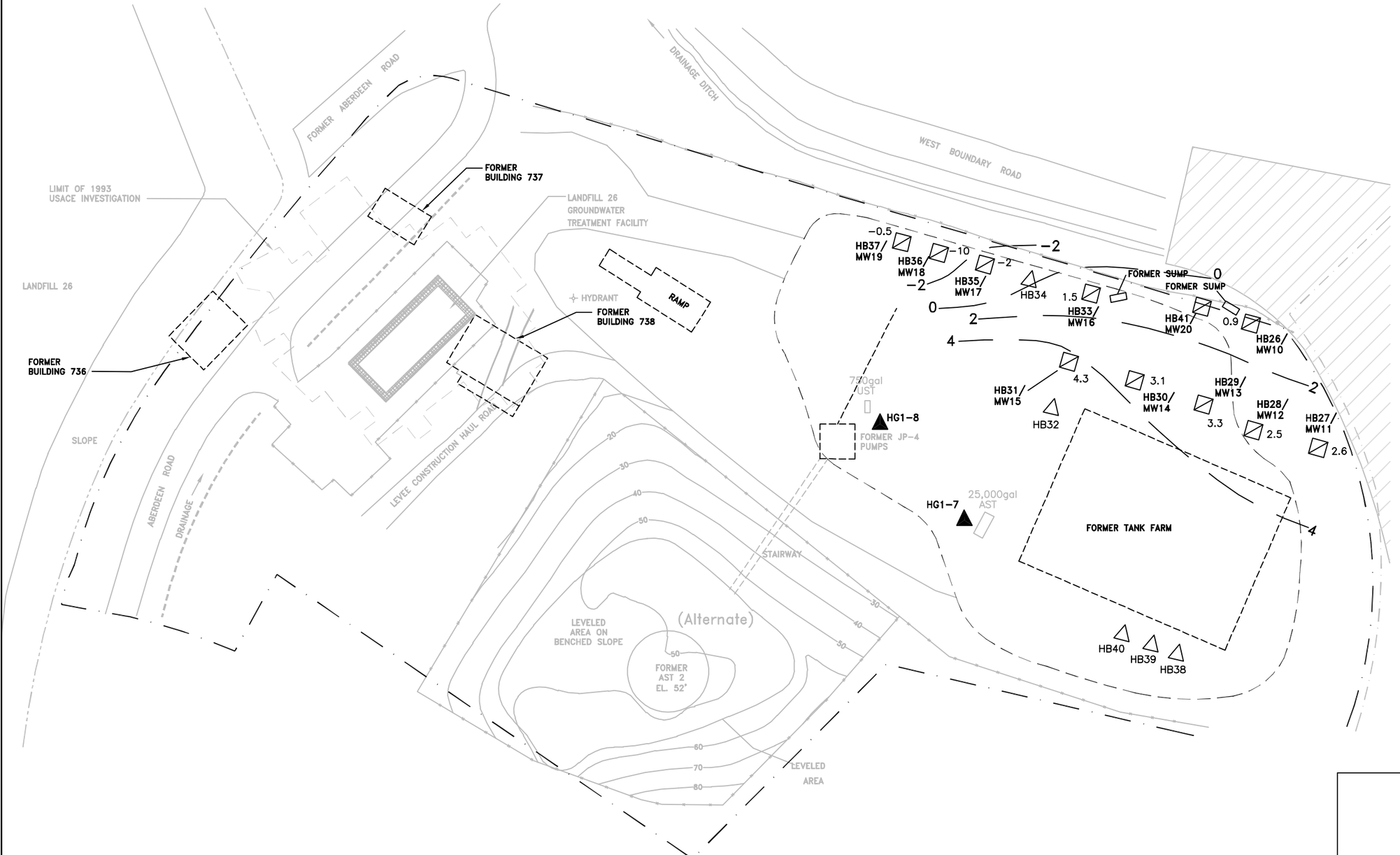
This section summarizes the results of petroleum hydrocarbon investigation and remedial activities conducted at the former tank farm. Data in this section is used to support recommendations for site closure presented in Section 4 of this report. Additional details regarding specific remedial investigation activities can be found in the Remedial Investigation Report for the POL Hill Outparcel (IT 1999), which can be found in Appendix A of this document. The summary provided below focuses on the activities conducted at the POL Hill Outparcel that were specific to the former tank farm.

3.1 Field Investigations Conducted Prior to Tank Removal

In 1985, the Army conducted soil and groundwater investigations of the former tank farm prior to any tank removal or soil excavation activities (Woodward-Clyde 1985). During these investigations, 3 surface soil grab samples were collected and 42 samples were taken from 18 soil borings within the tank farm area (Woodward-Clyde 1985). Monitoring wells were installed in 11 of the soil borings located in the eastern lower bench (Woodward-Clyde 1985). Figure 3-1 and Table 3-1 show the sample locations and results of this sampling event. In summary, the results showed TPH contamination was present in surface and subsurface soil and in some groundwater monitoring wells. Three soil samples contained TPH concentrations above 1,000 ppm, with a maximum of 5,700 ppm TPH. Groundwater results indicated petroleum hydrocarbon concentrations ranged from nondetect (detection limit of 0.1 ppm) to 730 ppm in well MW-16. This well was located near the meter pad area in the northeastern portion of the tank farm. The 11 monitoring wells installed during this investigation were later destroyed during extensive soil excavation conducted during subsequent studies and remedial activities.

3.2 Tank Removal Activities and Sample Results

In 1986, the Army's contractor, Atlas Hydraulic (along with its subcontractor, IT Corporation) removed all 21 USTs at the former tank farm. Before removing the USTs, the contractors removed the water-control pit, water-separator house (Building 717), and concrete vaults and piping located over each of the USTs. Excavation began with the removal of the top 4 feet of soil to expose the tops of the tanks; no staining was observed at this stage. As excavation continued and piping and tanks were further exposed, staining was observed at multiple locations. Staining was extensive in some areas. No staining was observed during the removal of UST-21 (the 750-gallon UST).



LEGEND:

- FENCE
- SURFACE SOIL GRAB SAMPLE
- BORE HOLE
- BORE HOLE + WELL
- 2.6 GROUNDWATER ELEVATION (IN FEET ABOVE MSL)
- GROUNDWATER CONTOUR, JULY 1985
- FORMER STRUCTURES
- APPROXIMATE LIMITS OF USACE EXCAVATION
- NHP LEVEE AND EASEMENT
- POL OUTPARCEL BRAC PROPERTY BOUNDARY

NOTES:

1. DATA BASED ON WOODWARD-CLYDE 1985 REPORTS
2. BASE MAP ADAPTED FROM IT 1999 CLOSURE REPORT
3. WELLS SHOWN ON THIS MAP WERE REMOVED AS PART OF REMOVAL ACTIONS IN 1991.

Source: International Technology Corporation (IT) Drawing 762538-B512

1985 SAMPLE LOCATIONS
POL HILL OUTPARCEL
HAMILTON ARMY AIRFIELD

CH2MHILL

FIGURE 3-1

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TABLE 3-1
1985 Soil and Groundwater Sampling Results
Former Tank Farm, Hamilton Army Airfield

Sample Number	Matrix	Depth (ft)	TPH (ppm)	Detection Limit (ppm)
MW-10	water	wl	u	0.1
MW-11	water	wl	0.3	0.1
MW-12	water	wl	0.2	0.1
MW-13	water	wl	0.3	0.1
MW-14	water	wl	0.9	0.1
MW-15	water	wl	7.8	0.1
MW-16	water	wl	730.0	0.1
MW-17	water	wl	0.2	0.1
MW-18	water	wl	u	0.1
MW-19	water	wl	u	0.1
MW-20	water	wl	u	0.1
HG-1-7	soil	S	330	5
HG-1-8A	soil	S	190	5
HG-1-8B	soil	S	210	5
HB-26	soil	5.0	65	10
HB-26	soil	7.0	25	10
HB-26	soil	10.0	u	10
HB-27	soil	5	1,800	10
HB-27	soil	8	u	10
HB-27	soil	11	160	10
HB-28	soil	4.0	930	10
HB-28	soil	7.0	u	10
HB-28	soil	11.0	u	10
HB-29	soil	2.0	840	10
HB-29	soil	5.0	30	10
HB-29	soil	8.0	u	10
HB-30	soil	2.0	u	10
HB-30	soil	5.0	190	10
HB-30	soil	9.0	u	10
HB-31	soil	2.0	u	10
HB-31	soil	5.0	u	10
HB-31	soil	8.0	10	10
HB-32	soil	2.0	20	10

TABLE 3-1
1985 Soil and Groundwater Sampling Results
Former Tank Farm, Hamilton Army Airfield

Sample Number	Matrix	Depth (ft)	TPH (ppm)	Detection Limit (ppm)
HB-33	soil	3.0	1,100	10
HB-33	soil	6.0	u	10
HB-33	soil	9.0	u	10
HB-34	soil	2.0	130	10
HB-34	soil	5.0	u	10
HB-35	soil	2.0	540	10
HB-35	soil	5.0	10	10
HB-35	soil	8.0	u	10
HB-36	soil	2.0	u	10
HB-36	soil	5.0	u	10
HB-36	soil	8.0	u	10
HB-37	soil	2.0	5,700	10
HB-37	soil	5.0	u	10
HB-38	soil	2.0	u	10
HB-38	soil	5.0	u	10
HB-38	soil	8.0	500	10
HB-39	soil	2.0	u	10
HB-39	soil	5.0	670	10
HB-40	soil	2.0	20	10
HB-40	soil	5.0	u	10
HB-41	soil	2.0	u	10
HB-41	soil	5.0	u	10
HB-41	soil	8.0	u	10

Source: Woodward-Clyde 1985

ft: feet
ppm: parts per million
s: surface grab sample
TPH: total petroleum hydrocarbon
u: not detected
wl: water level

Upon removal, the 21 USTs were drained and cleaned with high-pressure water and surfactants. The tanks and pipes leading to them were dismantled and removed in accordance with the proper OSHA standards. Metal waste was removed to a recycling scrap yard. Field observations indicated that the tanks were in good condition, however the joints in the pipe may have leaked (IT 1987). After each tank was removed, two soil samples were collected at each tank location (one from beneath each end of the tank). The samples were analyzed for volatile fuel hydrocarbons (VFH). Sample results are shown in Table 3-2. Concentrations ranged from a low of 12 ppm at tank D09 to a high of 12,000 ppm at the east end of tank D12. All soil beneath the tanks was removed to the level of the original grade (IT 1987). All pipes running to the USTs were flushed, removed, and capped with the exception of a segment of 6-inch pipe running to an area near the west side of the former tank farm near the 25,000-gallon AST. This line was flushed and capped (IT 1987).

TABLE 3-2
Results of 1986 Soil and Groundwater Sampling During Tank Removal
Former Tank Farm, Hamilton Army Airfield

Tank Number	Sample Number	VFH (ppm)	Detection Limit (ppm)
D01	D01-03^{W}	1,600	10
D01	D01-04^{E}	350	10
D02	D02-03^{W}	1,300	10
D02	D02-04^{E}	5,600	10
D03	D03-03^{W}	130	10
D03	D03-04^{E}	310	10
D04	D04-03^{W}	2,600	10
D04	D04-04^{E}	700	10
D05	D05-03^{W}	2,800	10
D05	D05-04^{E}	590	10
D06	D06-03^{W}	2,100	10
D06	D06-04^{E}	1,400	10
D07	D07-03^{W}	740	10
D07	D07-04^{E}	930	10
D08	D08-03^{W}	19	10
D08	D08-04^{E}	660	10
D09	D09-03^{W}	12	10
D09	D09-04^{E}	150	10
D10	D10-03^{W}	810	10
D10	D10-04^{E}	3,300	10
D11	D11-03^{W}	1,600	10
D11	D11-04^{E}	1,600	10
D12	D12-03^{W}	60	10
D12	D12-04^{E}	12,000	10

TABLE 3-2
Results of 1986 Soil and Groundwater Sampling During Tank Removal
Former Tank Farm, Hamilton Army Airfield

Tank Number	Sample Number	VFH (ppm)	Detection Limit (ppm)
D13	D13-03^{W}	1,900	10
D13	D13-04^{E}	7,900	10
D14	D14-03^{W}	4,100	10
D14	D14-04^{E}	5,800	10
D15	D15-03^{W}	510	10
D15	D15-04^{E}	9,200	10
D16	D16-03^{W}	160	10
D16	D16-04^{E}	1,600	10
D17	D17-03^{W}	2,600	10
D17	D17-04^{E}	6,000	10
D18	D18-03^{W}	7,100	10
D18	D18-04^{E}	530	10
D19	D19-03^{W}	4,600	10
D19	D19-04^{E}	2,900	10
D20	D20-03^{W}	6,000	10
D20	D20-04^{E}	3,500	10
D21	D21-03^{W}	non-detect	10
D21	D21-04^{E}	non-detect	10

Note: The information provided (IT 1987) states that two samples came from beneath each tank on the eastern and western ends. For tanks D01 through D20, it was noted that the tanks were originally constructed on four 3-foot high concrete strip footings constructed on the original grade. The tanks were covered with approximately 20 feet of soil which totally buried the tanks and formed a hill that blended into a natural rock outcrop on both the southeast and southwest sides of the site. This would put the samples at approximately the original grade (the grade before the 20 tanks were installed).

For tank D21, six feet of overburden was excavated and the tank was removed. The two soil samples were collected from beneath the tank on the eastern and western ends. This would put the samples at approximately 9 to 10 feet below grade. This presumes the grade was similar to but somewhat below the grade of the 20 tanks as constructed.

VFH: volatile fuel hydrocarbon
^{E}: sampled at east end of tank
^{W}: sampled at west end of tank

IT collected water samples from the 11 monitoring wells installed previously by the Army contractor, Woodward-Clyde. Five wells (MW-11 through MW-15) were located at the base of the tank excavation, while six wells (MW-10, MW-16 through MW-19, and MW-20) were located along the northern boundary (Figure 3-1). The water samples were analyzed for volatile, semivolatile, and nonvolatile fuel hydrocarbons. The results showed only wells MW-13 and MW-16 contained contaminants at concentrations above 5 ppm (Table 3-3). Water from MW-13 contained VFH at 600 ppm and 1,100 ppm for semi- and non-VFH. MW-13 was located near the aviation gas water separator and a 6-inch pipeline that supplied JP-4 to the

TABLE 3-3
Well Water Sampled During Tank Removal

Well Number	Sample Number	VFH (ppm)	Detection Limit (ppm)	S&N-FH (ppm)	Detection Limit (ppm)
MW-10	D00-378	u	0.05	0.12	0.05
MW-11	D00-170	u	0.05	no data	0.05
MW-11	D00-377	0.98	0.05	0.91	0.05
MW-12	D00-376	0.07	0.05	0.083	0.05
MW-13	D00-375	600	0.05	1,100	0.05
MW-14	D00-374	0.26	0.05	0.07	0.05
MW-15	D00-173	0.84	0.05	no data	0.05
MW-15	D00-372	1.2	0.05	3.3	0.05
MW-16	D00-171	250	0.05	no data	0.05
MW-17	D00-382	u	0.05	u	0.05
MW-18	D00-380	u	0.05	0.18	0.05
MW-19	D00-172	u	0.05	no data	0.05
MW-19	D00-381	u	0.05	0.05	0.05
MW-20	D00-379	u	0.05	0.22	0.05

Source: IT 1987.

U: not detected
VFH: volatile fuel hydrocarbon
S&N-FH: semi- and nonvolatile fuel hydrocarbons

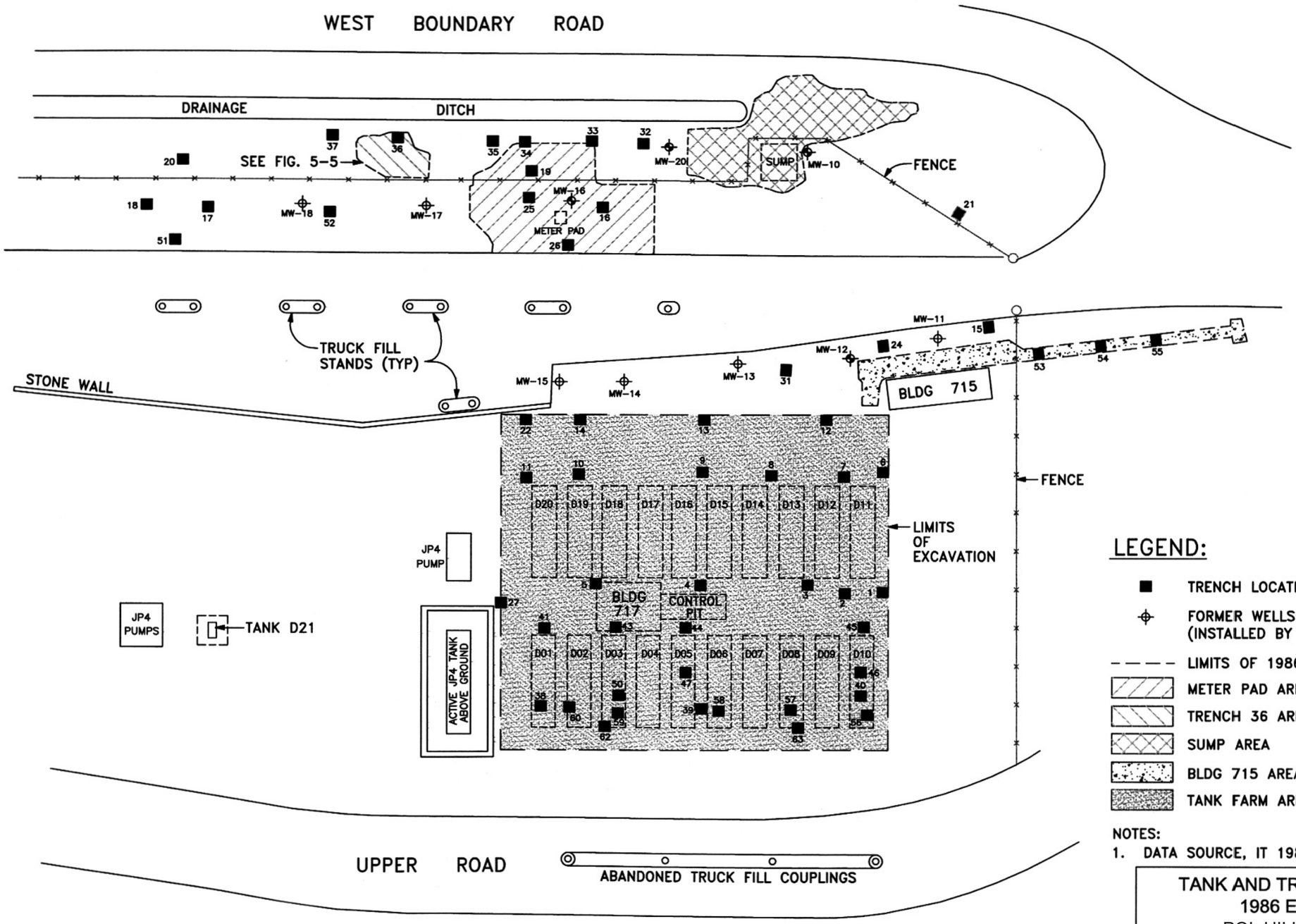
truck fuel stands. The separator and pipeline were removed during tank removal activities. Water from MW-16 contained VFH at 250 ppm and elevated levels of benzene, toluene, and xylene were also detected. MW-16 was located near the meter pad area.

3.3 Additional Trenching Investigation Following Tank Removal

In 1986, following the tank removal activities, the Army conducted additional investigations to evaluate the extent of soil contamination beneath the original grade. To accomplish this, IT implemented a trenching program and excavated 63 trenches to a depth of approximately 10 feet or until water or rock was encountered (See Figure 3-2 and Table 3-4).

Water samples were collected and analyzed for VFH, if water was encountered in the trench. Results for water samples collected from trenches ranged from non detect to 150 ppm VFH. Elevated benzene, toluene, ethylbenzene, and xylene (BTEX) levels were also detected in one water sample from Trench 16 (located near MW-16). Soil samples were collected and analyzed for both VFH, and semi- and non-VFH.

Visual observations during trenching and soil sample results indicated that hydrocarbons were present in some lenses of stained soil at concentrations greater than 1,000 ppm. Approximately one-half of the trench samples contained concentrations of TPH above



Data Source: International Technology Corporation (IT), 1987

TANK AND TRENCH LOCATIONS 1986 EXCAVATION

POL HILL OUTPARCEL

HAMILTON ARMY AIRFIELD

CH2MHILL

FIGURE 3-2

PROJECT NO. 159892.08.PL.CR

April 2003

TABLE 3-4
Results of 1986 Soil and Groundwater Sampling During Initial Excavation
Former Tank Farm, Hamilton Army Airfield

Trench Number	Depth (ft)	Sample Number	VFH (ppm)	Detection Limit (ppm)	S&N-FH (ppm)	Detection Limit (ppm)	Comments
1	1.0	D00-68	300	10	u	5	Rock at 1.0 ft
2	1.0	D00-69	66	10	110	5	
	3.0	D00-70	38	10	74	5	
3	1.0	D00-71	14	10	u	5	
	3.0	D00-72	430	10	>1,000	5	
	5.0	D00-73	30	10	47	5	
	7.0	D00-74	u	10	39	5	Water at 7.0 ft
4	1.0	D00-75	92	10	140	5	Water at 1.3 ft
5	1.0	No Sample	- -	10	- -	5	Water at 1.0 ft
6	1.0	D00-46	640	10	1,100	5	
	3.0	D00-47	180	10	- -	5	
7	1.0	D00-48	trace	10	- -	5	
	3.0	D00-49	750	10	1,200	5	
	5.0	D00-50	770	10	- -	5	
	7.0	D00-51	870	10	830	5	
8	1.0	D00-52	u	10	220	5	
	3.0	D00-53	u	10	20	5	
	5.0	D00-54	u	10	6	5	
	7.0	D00-55	36	10	36	5	
	10.0	D00-56	35	10	30	5	Water at 9.0 ft
9	1.0	D00-57	u	10	52	5	
	3.0	D00-58	44	10	670	5	
10	1.0	D00-59	11	10	14	5	
	3.0	D00-60	13	10	130	5	
	6.0	D00-61	u	10	10	5	
	7.0	D00-62	u	10	5	5	Water at 7.0 ft
	10.0	D00-63	trace	10	u	5	
11	1.0	D00-64	11	10	17	5	
	3.0	D00-65	75	10	110	5	
12	1.0	D00-79	u	10	u	5	
	3.0	D00-80	17	10	58	5	
13	1.0	D00-81	u	10	430	5	
	3.0	D00-82	380	10	1,400	5	
	5.0	D00-83	u	10	5	5	
	7.0	D00-84	18	10	130	5	
	8.0	D00-85	u	10	u	5	
14	1.0	D00-86	u	10	u	5	
	3.0	D00-87	u	10	u	5	
	5.0	D00-88	u	10	u	5	

TABLE 3-4
Results of 1986 Soil and Groundwater Sampling During Initial Excavation
Former Tank Farm, Hamilton Army Airfield

Trench Number	Depth (ft)	Sample Number	VFH (ppm)	Detection Limit (ppm)	S&N-FH (ppm)	Detection Limit (ppm)	Comments
	7.0	D00-89	55	10	28	5	
	7.0	D00-90	18	10	110	5	
15	1.0	D00-92	16	10	- -	5	
	3.0	D00-93	2,900	10	- -	5	
	5.0	D00-94	4,000	10	- -	5	
	7.0	D00-95	13	10	300	5	Water at 7.0 ft
	9.0	D00-96	21	10	10	5	
16	1.0	D00-97	1,600	10	- -	5	
	3.0	D00-98	440	10	- -	5	
	5.0	D00-99	9,000	10	- -	5	
	6.0	D00-100	2,300	10	- -	5	Water at 6.0 ft
17	2.0	D00-101	680	10	13,000	5	
17	3.5	D00-102	440	10	870	5	
18	2.0	D00-103	u	10	u	5	
	4.0	D00-104	u	10	u	5	
	5.0	D00-105	u	10	12	5	
	7.0	D00-107	u	10	u	5	
	10.0	D00-106	u	10	u	5	
19	1.5	D00-109	trace	10	- -	5	
	4.0	D00-110	2,800	10	- -	5	
	7.5	D00-111	u	10	u	5	
	9.0	D00-112	u	10	u	5	
20	1.5	D00-113	u	10	u	5	
	4.0	D00-114	u	10	u	5	
	6.0	D00-115	u	10	u	5	
	8.0	D00-116	u	10	u	5	
	10.0	D00-117	u	10	7	5	
21	1.5	D00-119	u	10	u	5	
	3.0	D00-120	u	10	220	5	
	5.0	D00-121	u	10	- -	5	
	8.0	D00-122	trace	10	- -	5	
	10.0	D00-123	u	10	- -	5	
22	1.5	D00-133	270	10	440	5	
	4.5	D00-134	62	10	310	5	
	5.0	D00-130	120	10	53	5	
	7.0	D00-135	41	10	120	5	
24	1.5	D00-140	94	10	- -	5	
	3.0	D00-141	1,200	10	- -	5	
	5.0	D00-142	420	10	940	5	

TABLE 3-4
Results of 1986 Soil and Groundwater Sampling During Initial Excavation
Former Tank Farm, Hamilton Army Airfield

Trench Number	Depth (ft)	Sample Number	VFH (ppm)	Detection Limit (ppm)	S&N-FH (ppm)	Detection Limit (ppm)	Comments
	7.0	D00-143	53	10	- -	5	Water at 7.0 ft
25	1.5	D00-144	11,000	10	- -	5	
	3.5	D00-145	220	10	- -	5	
	5.0	D00-146	1,500	10	- -	5	
	7.0	D00-148	140	10	>1,000	5	
	11.0	D00-149	trace	10	- -	5	Water at 9.0 ft
26	1.5	D00-150	6,800	10	- -	5	
	3.0	D00-151	47	10	- -	5	
	5.0	D00-152	50	10	78	5	
	7.0	D00-153	u	10	u	5	Water at 9.0 ft
27	2.0	D00-137	1,900	10	- -	5	Sample from under
	4.0	D00-155	3,200	10	- -	5	6 in capped pipe
31	1.0	D00-166	13	10	13	5	
	3.0	D00-167	6,700	10	- -	5	
	5.0	D00-168	940	10	- -	5	
	7.0	D00-169	720	10	>1,000	5	
32	1.0	D00-240	u	10	u	5	
	3.0	D00-241	u	10	u	5	
	5.0	D00-242	u	10	u	5	
	7.0	D00-243	68	10	u	5	
33	1.0	D00-244	u	10	u	5	
	3.0	D00-245	u	10	98	5	
	5.0	D00-246	u	10	u	5	
	7.0	D00-248	u	10	u	5	
34	1.0	D00-249	u	10	u	5	
	3.0	D00-251	u	10	110	5	
	5.0	D00-252	u	10	u	5	
	7.0	D00-253	u	10	u	5	
35	1.0	D00-254	u	10	u	5	
	3.0	D00-255	u	10	71	5	
	5.0	D00-256	u	10	100	5	
	7.0	D00-257	u	10	u	5	
36	1.0	D00-259	u	10	60	5	
	3.0	D00-260	430	10	950	5	
	5.0	D00-261	u	10	u	5	
	7.0	D00-262	u	10	u	5	
37	1.0	D00-263	u	10	u	5	
	3.0	D00-264	u	10	u	5	
	5.0	D00-265	u	10	u	5	

TABLE 3-4
Results of 1986 Soil and Groundwater Sampling During Initial Excavation
Former Tank Farm, Hamilton Army Airfield

Trench Number	Depth (ft)	Sample Number	VFH (ppm)	Detection Limit (ppm)	S&N-FH (ppm)	Detection Limit (ppm)	Comments
	7.0	D00-266	u	10	u	5	
38	1.0	D00-270	2,300	10	>1,000	5	
	2.0	D00-271	5,800	10	>1,000	5	
39	1.0	D00-272	240	10	>1,000	5	
40	1.0	D00-273	260	10	>1,000	5	
41	0.5	D00-274	3,900	10	>1,000	5	
43	1.5	D00-275	96	10	900	5	Water at 1.5 ft
44	1.0	D00-277	350	10	>1,000	5	
	2.0	D00-278	29	10	350	5	
45	2.0	D00-279	850	10	430	5	Rock at 3.0 ft
	3.0	D00-280	trace	10	56	5	
46	1.0	D00-282	1,100	10	>1,000	5	
47	1.0	D00-283	320	10	>1,000	5	
50	1.0	D00-284	37	10	360	5	Rock at 1.0 ft
51	1.0	D00-285	33	10	30	5	
	3.0	D00-286	340	10	330	5	
	5.0	D00-288	u	10	u	5	
	7.0	D00-289	u	10	u	5	
52	1.0	D00-290	u	10	60	5	
	3.0	D00-291	13	10	u	5	
	5.0	D00-292	u	10	10	5	
	7.0	D00-293	u	10	u	5	
53	3.5	D00-296	u	10	18	5	
54	3.0	D00-297	u	10	u	5	
55	2.5	D00-298	u	10	90	5	
56	0.5	D00-314	18	10	19	5	Rock at 0.5 ft
57	0.5	D00-315	290	10	>1,000	5	
58	0.5	D00-316	270	10	>1,000	5	
59	0.5	D00-317	340	10	>1,000	5	
60	0.5	D00-318	55	10	380	5	
62	1.0	D00-384	69	10	760	5	
63	1.0	D00-385	19	10	73	5	

Source: IT 1987.

ppm: parts per million
S&N-FH: semi- and nonvolatile fuel hydrocarbons
TPH: total petroleum hydrocarbon
u: not detected
VFH: volatile fuel hydrocarbon

100 ppm, and three of these contained concentrations above 1,000 ppm. The trenching activities identified the meter pad area, sump area, location of Trench 36, Building 715, and upper truck-fill area as areas where TPH concentrations were above 1,000 ppm. Releases in these areas appeared to be the result of pipe leaks or spills, and are not directly related to tank leakage.

3.4 Soil Excavation Activities Following Trenching Investigation

In 1986, following the trenching investigation, the Army conducted additional soil removal activities in the areas listed in the previous section. Soil at the meter pad area was excavated to an average depth of 8 feet (Figure 3-2). Following the removal of all stained soil in this area, soil samples were collected. All of the samples contained less than 1,000 ppm TPH except for two samples (one located beneath the concrete fill stand and one near the north end of the excavation; see Table 3-5). Additional removal of soil was postponed at this time and the excavation was backfilled with clean material.

TABLE 3-5
Results of 1986 Sampling After Soil Excavation in the Meter Pad Area
Former Tank Farm, Hamilton Army Airfield

Sample Number	Depth (ft)	VFH (ppm)	Detection Limit (ppm)	S&N-FH (ppm)	Detection Limit (ppm)	S&N-FH Comments
D00-181	4.0	12	10	5	5	Calculated as Kerosene
D00-195	6.0	33	10	520	5	Calculated as Kerosene
D00-196	3.0	89	10	40	5	Calculated as Kerosene
D00-197	4.0	u	10	10	5	Calculated as Kerosene
D00-198	3.0	u	10	u	5	Calculated as Diesel
D00-199	6.0	37	10	93	5	Calculated as Diesel
D00-216	4.0	u	10	u	5	Calculated as Kerosene
D00-217	5.0	12	10	180	5	Calculated as Kerosene
D00-218	3.0	u	10	u	5	Calculated as Kerosene
D00-219	4.0	u	10	31	5	Calculated as C-20
D00-220	5.0	53	10	u	5	Calculated as Kerosene
D00-222	8.0	u	10	u	5	Calculated as Kerosene
D00-223	8.0	u	10	u	5	Calculated as Kerosene
D00-224	8.0	u	10	u	5	Calculated as Kerosene
D00-225	8.0	u	10	9	5	Calculated as Kerosene
D00-226	8.0	u	10	u	5	Calculated as Kerosene
D00-227	8.0	u	10	u	5	Calculated as Kerosene
D00-228	8.0	u	10	u	5	Calculated as Kerosene
D00-229	8.0	u	10	17	5	Calculated as Diesel

TABLE 3-5
Results of 1986 Sampling After Soil Excavation in the Meter Pad Area
Former Tank Farm, Hamilton Army Airfield

Sample Number	Depth (ft)	VFH (ppm)	Detection Limit (ppm)	S&N-FH (ppm)	Detection Limit (ppm)	S&N-FH Comments
D00-230	8.0	u	10	u	5	Calculated as Kerosene
D00-232	8.0	u	10	u	5	Calculated as Kerosene
D00-295	4.0	770	10	1,000	5	Calculated as Kerosene
D00-299	3.0	u	10	u	7	Calculated as Kerosene
D00-300	3.5	u	10	u	7	Calculated as Kerosene
D00-301	3.5	64	10	>1,000	5	Calculated as Kerosene
D00-305	3.5	trace	10	u	6	Calculated as Kerosene
D00-306	6.0	u	10	u	5	Calculated as Kerosene
D00-307	3.5	u	10	10	5	Calculated as Kerosene
D00-309	6.0	u	10	u	5	Calculated as Kerosene
D00-310	3.5	u	10	u	10	Calculated as Kerosene
D00-311	3.5	260	10	85	5	Calculated as Kerosene
D00-312	6.5	u	10	u	5	Calculated as Kerosene
D00-319	6.0	u	10	u	5	Calculated as Kerosene
D00-320	3.5	66	10	200	5	Calculated as Kerosene
D00-321	3.5	91	10	73	5	Calculated as Kerosene

Source: IT 1987.

ppm: parts per million
S&N-FH: semi- and nonvolatile fuel hydrocarbons
u: not detected
VFH: volatile fuel hydrocarbon

Soil in the Trench 36 area was excavated to an average depth of 4 feet (Figure 3-2). Following soil removal in this area, soil samples were collected and all of the samples contained hydrocarbons at concentrations less than 50 ppm (Table 3-6). The excavation was backfilled with clean material.

The sump area was demolished and soil was excavated to an average depth of 7 feet (Figure 3-2). Strong hydrocarbon odors and visible staining were noted. Six soil samples collected from this area contained hydrocarbon concentrations greater than 1,000 ppm (Table 3-7). Additional removal of soil was postponed at this time and the excavation was backfilled with clean material.

Soil in the Building 715 area was excavated around pipelines identified in the area (Figure 3-2). Stained soil and soil samples confirmed that hydrocarbons in excess of 1,000 ppm were present in the area (Table 3-8). Building 715 was removed and further excavation activities were postponed at this time. The excavation near Building 715 was backfilled with clean material.

TABLE 3-6
Results of 1986 Sampling After Soil Excavation in the Trench 36 Area
Former Tank Farm, Hamilton Army Airfield

Sample Number	Depth (ft)	VFH (ppm)	Detection Limit (ppm)	S&N-FH (ppm)	Detection Limit (ppm)	S&N-FH Comments
D00-261	5.0	u	10	u	5	
D00-390	3.0	11	10	10	5	
D00-391	3.0	u	5	u	5	
D00-393	3.0	13	10	5	5	
D00-394	3.0	22	10	18	5	

Source: IT 1987.

ppm: parts per million
S&N-FH: semi- and nonvolatile fuel hydrocarbons
u: not detected
VFH: volatile fuel hydrocarbon

TABLE 3-7
Soil Samples Collected During Excavation in the Sump Area

Sample Number	Depth (ft)	VFH (ppm)	Detection Limit	S&N-FH (ppm)	Detection Limit	S&N-FH Comments
D00-332	4.5	1,100	10	--	5	
D00-333	4.5	11,000	10	--	5	
D00-334	3.5	1,700	10	--	5	
D00-344	4.0	u	5	u	5	Calculated as Kerosene
D00-345	4.0	12	5	150	5	Calculated as Kerosene
D00-346	4.0	u	5	u	5	Calculated as Kerosene
D00-348	4.0	5	5	u	5	Calculated as Kerosene
D00-349	4.0	12	5	130	5	Calculated as Kerosene
D00-350	7.0	u	5	u	5	Calculated as Kerosene
D00-353	7.0	u	5	6	5	Calculated as Kerosene
D00-354	7.0	u	5	u	5	Calculated as Kerosene
D00-355	5.5	--	5	>1,000	5	Calculated as Kerosene
D00-356	4.5	6	5	5	5	Calculated as Kerosene
D00-357	4.5	33	5	230	5	Calculated as Kerosene
D00-359	4.5	26	5	110	5	Calculated as Kerosene
D00-360	7.0	u	5	14	5	Calculated as Kerosene
D00-361	7.0	u	5	u	5	Calculated as Kerosene
D00-362	4.5	--	5	>1,000	5	Calculated as Kerosene
D00-363	4.5	--	5	>1,000	5	Calculated as Kerosene
D00-364	4.5	25	5	690	5	Calculated as Kerosene
D00-365	4.5	u	5	u	5	Calculated as Kerosene
D00-366	4.5	u	5	u	5	Calculated as Kerosene
D00-367	7.0	5	5	u	5	Calculated as Kerosene
D00-368	7.0	u	5	u	5	Calculated as Kerosene

TABLE 3-7
Soil Samples Collected During Excavation in the Sump Area

Sample Number	Depth (ft)	VFH (ppm)	Detection Limit	S&N-FH (ppm)	Detection Limit	S&N-FH Comments
D00-370	4.5	35	5	700	5	Calculated as Kerosene
D00-386	6.0	320	10	630	5	Calculated as Kerosene
D00-395	6.5	u	5	u	5	Calculated as Kerosene
D00-396	7.5	5	5	7	5	Calculated as Kerosene

Source: IT 1987.

ppm: parts per million
S&N-FH: semi- and nonvolatile fuel hydrocarbons
u: not detected
VFH: volatile fuel hydrocarbon

TABLE 3-8
Soil Samples Collected During Excavation in the Building 715 Area

Sample Number	Depth (ft)	VFH (ppm)	Detection Limit (ppm)	S&N-FH (ppm)	Detection Limit (ppm)	S&N-FH Comments
D00-268	3	8,100	10	>1,000	5	Calculated as Kerosene
D00-269	3	3,400	10	>1,000	5	Calculated as Kerosene
D00-296	3.5	u	10	18	5	Calculated as C20
D00-297	3	u	10	u	5	Calculated as Kerosene
D00-298	2.5	u	10	90	5	Calculated as Oil
D00-302	3	trace	10	u	5	Calculated as Kerosene
D00-303	4	1,800	10	--	5	
D00-323	6	u	10	u	5	Calculated as Kerosene
D00-324	6	u	10	u	5	Calculated as Kerosene
D00-325	3	u	10	6	5	Calculated as Kerosene
D00-327	3	24	10	250	5	Calculated as Kerosene
D00-328	3	trace	10	66	5	Calculated as Kerosene
D00-387	4.5	--	10	>1,000	5	Calculated as Kerosene
D00-388	4.5	5	5	5	5	Calculated as Kerosene
D00-389	4.5	5	5	5	5	Calculated as Kerosene

Source: IT 1987.

ppm: parts per million
S&N-FH: semi- and nonvolatile fuel hydrocarbons
u: not detected
VFH: volatile fuel hydrocarbon

Stained soil was removed from around the capped 6-inch line at the upper road truck-fill area. Results from one soil sample collected against the rock interface below the capped pipe indicated VFH was present at concentrations above 1,000 ppm (Table 3-9). Additional removal of soil was postponed and the area was backfilled.

TABLE 3-9
Soil Sample Collected After Excavation in the Upper Road Truck-Fill Area
Former Tank Farm, Hamilton Army Airfield

Sample Number	Depth	VFH (ppm)	S&N-PH (ppm)	Detection Limit (ppm)
D00-239	at bedrock-soil interface	no data	>1,000	5

Source: IT 1987.

ppm: parts per million
S&N-FH: semi- and nonvolatile fuel hydrocarbons
u: not detected
VFH: volatile fuel hydrocarbon

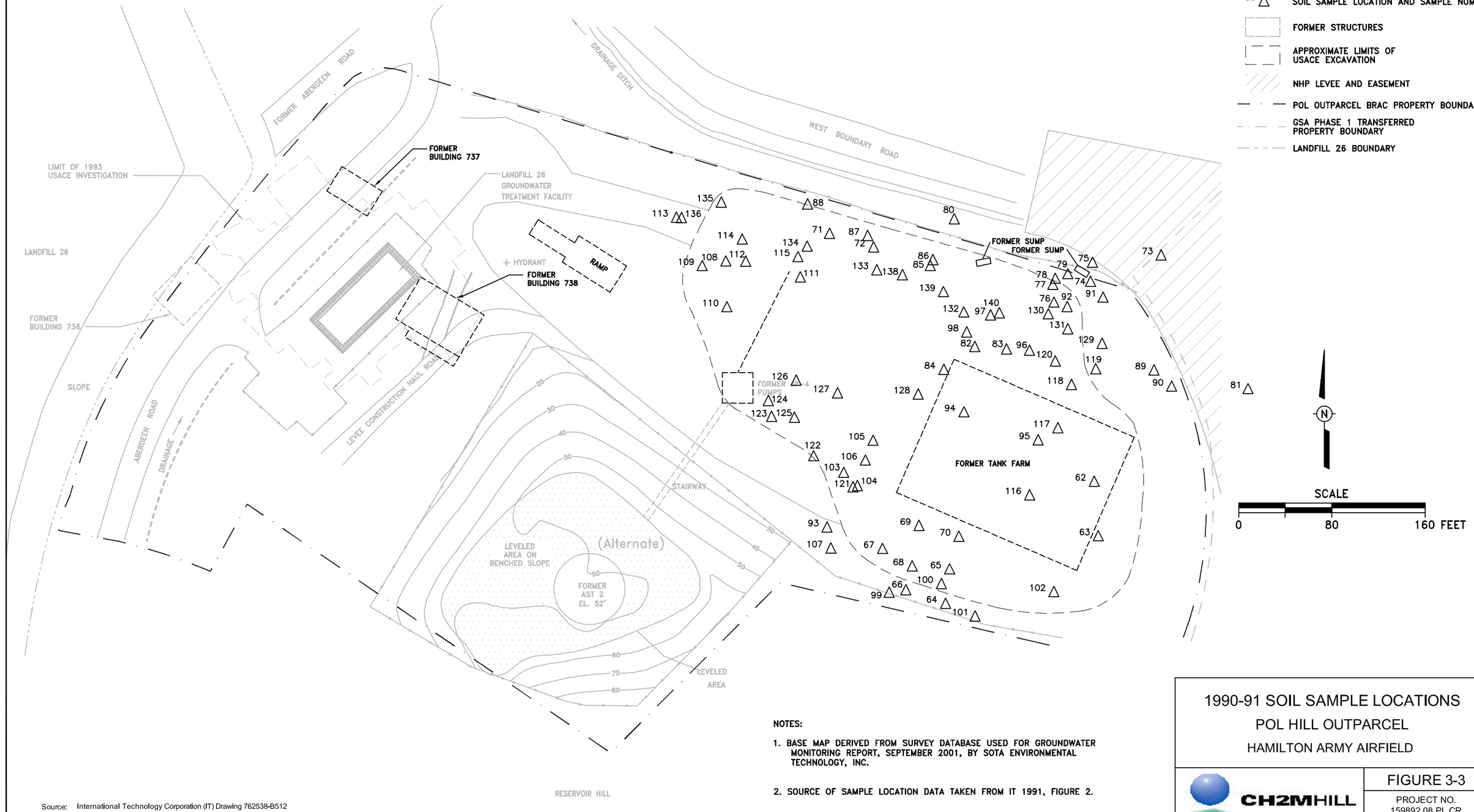
3.5 Remediation Activities

The Army began an extensive trenching and sampling program in 1990 to evaluate the vertical and horizontal extent of contamination. This program included all areas of suspected hydrocarbon release and areas where excavation was postponed in 1986 (USACE 1991). In the winter of 1990 and 1991, IT conducted further remediation during which soil was excavated in all areas where sample results showed TPH concentrations in excess of a newly established cleanup level of 100 ppm.

The trenching and sampling program included excavation of 61 trenches and the collection of a maximum of 3 samples per trench, and a collection of 32 additional surface samples. Trenches were completed to various depths from 1 to 12 feet below grade. Sample locations were chosen to address areas of contamination identified in previous studies that are shown on Figure 3-3. Table 3-10 presents the analytical results from these samples, which were analyzed by EPA Method 7421 for lead, Method 8015 for JP-4, and Method 8010/8020 for volatile organics (IT 1991). A total of 90 soil samples were analyzed for TPH (see Table 3-10). The results identified specific areas where TPH was present above the 100 ppm goal and indicated that levels of JP-4 above the cleanup level were present throughout the tank farm area. Detailed results of this investigation can be found in the IT investigation reports (IT 1991; IT 1999).

In 1991, following the field investigation described above, IT removed, to the extent physically possible, soils with concentrations above 100 ppm TPH (IT 1991; Woodward-Clyde 1995a; USACE 1991). The extent of the excavation is shown in Figure 3-4. The excavation was backfilled with clean fill (ESI 1993). A total of 78 confirmation samples were collected to verify that cleanup goals had been met. A total of 22,980.5 cubic yards of soil was removed from the former tank farm area (IT 1991).

In order to remove all contaminated soil, the Army removed the concrete fuel islands in the western part of the POL area, and pavement from various portions of the property. Several fuel lines that were left in place during 1986 excavation were also removed at this time. During excavation activities in 1991, IT also removed a 25,000-gallon JP-4 AST located west of the former location of the USTs (IT 1991). The AST was drained, pressure-washed, and transported offsite for disposal. Contaminated soil beneath the tank was excavated. The original monitoring wells installed by Woodward-Clyde were destroyed during the



NOTES:

1. BASE MAP DERIVED FROM SURVEY DATABASE USED FOR GROUNDWATER MONITORING REPORT, SEPTEMBER 2001, BY SOTA ENVIRONMENTAL TECHNOLOGY, INC.

2. SOURCE OF SAMPLE LOCATION DATA TAKEN FROM IT 1991, FIGURE 2.

Source: International Technology Corporation (IT) Drawing 762538-B512

1990-91 SOIL SAMPLE LOCATIONS

POL HILL OUTPARCEL

HAMILTON ARMY AIRFIELD

CH2MHILL

FIGURE 3-3

PROJECT NO. 159892.08.PL.CR

APRIL 2003

TABLE 3-10
Results of 1991 Sampling Before Secondary Soil Excavation
Former Tank Farm, Hamilton Army Airfield

Trench/Site Number	Depth (ft)	TPH as JP-4 (mg/kg)	Trench/Site Number	Sample Number	TPH as JP-4 (mg/kg)
LPOL-62	S	30	LPOL-101	S	u
LPOL-63	S	u	LPOL-102	7.0	u
LPOL-64	3.0	710	LPOL-103	1.0	u
LPOL-65	4.5	2,780	LPOL-103	1.0	56
LPOL-66	3.0	330	LPOL-104	3.0	83
LPOL-67	4.0	730	LPOL-105	3.0	12
LPOL-68	3.5	570	LPOL-106	2.0	140
LPOL-69	12.0	740	LPOL-107	8.0	1,190
LPOL-70	14.0	380	LPOL-107	5.0	u
LPOL-71	3.5	u	LPOL-108	5.0	2,490
LPOL-72	4.5	50	LPOL-109	3.0	u
LPOL-73	9.0	u	LPOL-110	S	u
LPOL-74	9.0	1,400	LPOL-111	S	u
LPOL-75	11.0	u	LPOL-112	S	u
LPOL-76	7.0	15	LPOL-113	S	u
LPOL-77	11.0	u	LPOL-114	S	220
LPOL-78	8.0	84	LPOL-115	S	1,170
LPOL-79	11.0	u	LPOL-116	S	27
LPOL-80	3.0	u	LPOL-117	S	120
LPOL-81	4.0	10	LPOL-117	S	u
LPOL-82	4.0	220	LPOL-118	S	u
LPOL-83	6.0	290	LPOL-119	S	2,050
LPOL-84	4.0	52	LPOL-120	S	8,340
LPOL-85	3.0	39	LPOL-121	S	u
LPOL-86	4.0	u	LPOL-122	S	u
LPOL-87	5.0	u	LPOL-123	S	u
LPOL-88	6.0	u	LPOL-124	S	1,230
LPOL-89	5.0	980	LPOL-125	S	u
LPOL-89	5.0	89	LPOL-126	S	10
LPOL-90	6.0	u	LPOL-127	S	460
LPOL-91	2.5	u	LPOL-127	S	u

TABLE 3-10
Results of 1991 Sampling Before Secondary Soil Excavation
Former Tank Farm, Hamilton Army Airfield

Trench/Site Number	Depth (ft)	TPH as JP-4 (mg/kg)	Trench/Site Number	Sample Number	TPH as JP-4 (mg/kg)
LPOL-92	5.0	1,210	LPOL-128	S	30
LPOL-93	9.0	u	LPOL-129	S	u
LPOL-94	5.0	u	LPOL-130	S	u
LPOL-95	7.0	70	LPOL-131	S	u
LPOL-96	6.0	21	LPOL-132	S	410
LPOL-97	2.0	u	LPOL-133	S	130
LPOL-98	4.0	910	LPOL-134	S	120
LPOL-99	6.0	1,420	LPOL-134	S	u
LPOL-99	S	u	LPOL-135	S	u
LPOL-99	S	230	LPOL-136	S	230
LPOL-100	3	350	LPOL-137	S	u
LPOL-100	S	22	LPOL-138	S	u
LPOL-100	S	100	LPOL-139	S	u
LPOL-101	4.0	360	LPOL-140	S	u

Source: IT 1991.

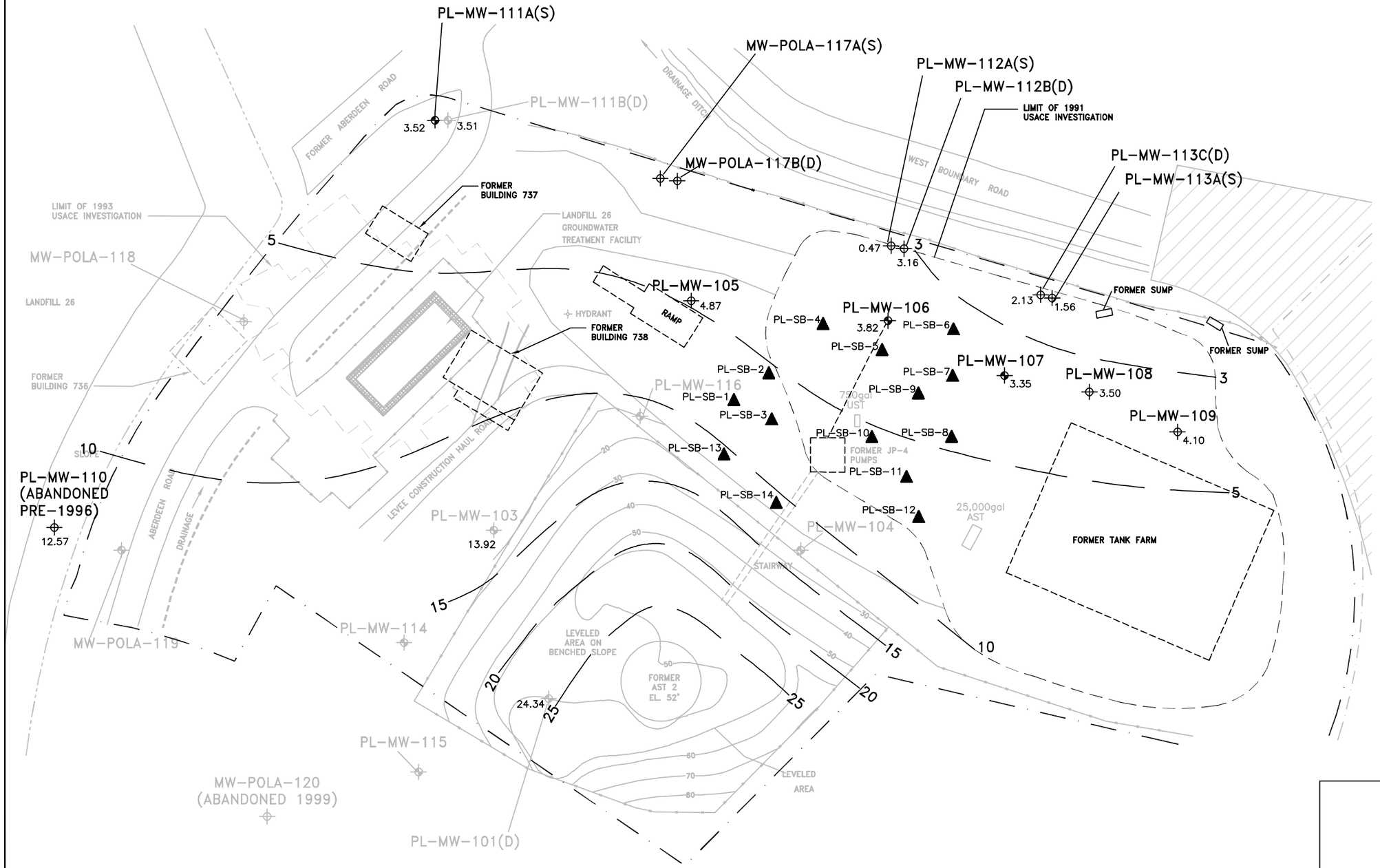
Detection Limit is10 mg/kg.
S: surface
TPH: total petroleum hydrocarbon
u: not detected

excavation activities conducted by IT in 1990-1991. The other two ASTs present in the AST-3 area were removed before or during the 1990 excavation.

3.6 Post-Remediation Sampling in the Former Tank Farm

In 1991, the Army installed 17 new monitoring wells throughout the POL Hill Outparcel. Nine of these wells were installed to characterize the former tank farm (wells PL MW-105 to -109, and 112A to 113C) (ESI 1993). The other wells were installed to evaluate AST-2. In addition to the monitoring wells, the Army installed 14 shallow soil borings near the former fuel distribution site (ESI 1993). Monitoring well and soil boring locations related to the former tank farm are shown on Figure 3-4. Analytical results for soil sampling and groundwater sampling are provided in Tables 3-11 and 3-12, respectively. The analytical results indicated that the remedial excavations performed by IT in 1990–1991 had successfully removed fuel contamination.

In July 1993, the U.S. Army Corps of Engineers (USACE) began construction of a water treatment plant for Landfill 26. The treatment plant is located north of the former tank farm within the POL Hill Outparcel. As part of the construction, Buildings 736, 737, and 738 were emptied and demolished. During excavation activities related to construction of the



LEGEND:

- FENCE
- EXISTING MONITORING WELL
- ABANDONED MONITORING WELL
- 1 ESI SOIL BORING
- 4.10 GROUNDWATER ELEVATION (IN FEET ABOVE MSL)
- 3—3 GROUNDWATER CONTOUR, FEBRUARY 1991
- FORMER STRUCTURES
- APPROXIMATE LIMITS OF 1991 USACE EXCAVATION
- NHP LEVEE AND EASEMENT
- POL OUTPARCEL BRAC PROPERTY BOUNDARY

NOTES:

1. DATA BASED ON ES 1993 REPORT
2. BASE MAP ADAPTED FROM IT 1999 CLOSURE REPORT
3. ABANDONED MONITORING WELLS WERE CLOSED IN OCTOBER 2002 UNLESS ALTERNATE DATE IS INDICATED IN PARENTHESES. WELL ABANDONMENT INFORMATION TAKEN FROM TABLE 1: MONITORING WELL SUMMARY FOR HAAF CONTAINED WITHIN IT CORPORATION (2001) WORK PLAN, MONITORING WELL ABANDONMENT, HAMILTON ARMY AIRFIELD, NOVATO, CA., REVISION I, DECEMBER. THIS TABLE WAS REVISED FOR THE ARMY JUST BEFORE THE WELL DESTRUCTION OCCURRED IN OCTOBER 2002.

N

SCALE

0 80 160 FEET

Source: International Technology Corporation (IT) Drawing 762538-B512

1991 SAMPLE LOCATIONS
POL HILL OUTPARCEL
HAMILTON ARMY AIRFIELD

CH2MHILL

FIGURE 3-4

PROJECT NO. 159892.08.PL.CR

APRIL 2003

TABLE 3-11
Results of 1991 Soil Sampling After Final Soil Excavation
Former Tank Farm, Hamilton Army Airfield

Sample Location	Depth (ft)	TPH (ppm)	Detection Limit (ppm)
PL-MW-106	16.0	u	10
PL-MW-107	17.0	u	10
PL-MW-108	13.0	u	10
PL-MW-109	11.0	u	10
PL-MW-110	10.0	16.1	10
PL-MW-111A	8.0	15.9	10
PL-MW-112A	8.0	25	10
PL-MW-113A	15.0	u	10
PL-MW-113C	13.0	15.1	10
PL-SB-1	5.5	u	10
PL-SB-1	7.5	u	10
PL-SB-2	5	u	10
PL-SB-2	10	u	10
PL-SB-3	10	u	10
PL-SB-4	5	u	10
PL-SB-4	7	51.4	10
PL-SB-5	5	30	10
PL-SB-5	7	u	10
PL-SB-6	5	u	10
PL-SB-6	7	u	10
PL-SB-7	5	u	10
PL-SB-7	7	u	10
PL-SB-8	5	u	10
PL-SB-8	7	20.5	10
PL-SB-9	5	u	10
PL-SB-9	7	u	10
PL-SB-10	9	10.4	10
PL-SB-10	10.5	u	10
PL-SB-11	7	20.6	10
PL-SB-12	7	20.2	10
PL-SB-13	5	u	10
PL-SB-13	10.5	u	10
PL-SB-14	5	51.4	10
PL-SB-14	5	64.2	10
PL-SB-14	10	72.3	10

Source: ESI 1993.

Some of the soil analytical data from the original table were removed because the borings are located outside of the POL Hill Outparcel and are within the POL Hill AST-2 Area. These include soil sample results for monitoring wells PL-MW-101, PL-MW-102, PL-MW-103, PL-MW-104, PL-MW-114, and PL-MW-115, and for soil borings PL-SB-15 and PL-SB-16. Excavations completed in the AST-2 Area during the winter of 1990/1991 removed contaminated soils down to bedrock as documented in the AST-2 Area Corrective Action Plan.

ft: feet
ppm: parts per million
TPH: total petroleum hydrocarbon
u: not detected in analysis

{value}: values suspect of contamination by air-rotary method

TABLE 3-12
Results of 1991 ES Groundwater Sampling After Final Soil Excavation
Former Tank Farm, Hamilton Army Airfield

Well Number	TPH (μg/L)	Detection Limit
Groundwater Samples Collected During Phase I Investigations		
MW-105	u	100 μg/L
MW-105	u	100 μg/L
MW-106	u	100 μg/L
MW-107	u	100 μg/L
MW-108	u	100 μg/L
MW-108	u	100 μg/L
MW-112A	u	100 μg/L
MW-112B	u	100 μg/L
MW-113A	u	100 μg/L
MW-113A	u	100 μg/L
MW-113C	u	100 μg/L
Groundwater Samples Collected During Phase II, Round 1 Investigations		
MW-105	u	100 μg/L
MW-106	u	100 μg/L
MW-107	u	100 μg/L
MW-108	u	100 μg/L
MW-109	u	100 μg/L
MW-112A	u	100 μg/L
MW-112B	u	100 μg/L
MW-113A	u	100 μg/L
MW-113C	u	100 μg/L
Groundwater Samples Collected During Phase II, Round 2 Investigations		
MW-105	u	100 μg/L
MW-106	u	100 μg/L
MW-107	u	100 μg/L
MW-108	u	100 μg/L
MW-109	u	100 μg/L
MW-112A	u	100 μg/L
MW-112B	u	100 μg/L
MW-113A	u	100 μg/L
MW-113C	u	100 μg/L

Source: ESI 1993.

TPH: total petroleum hydrocarbon
u: not detected in analysis
μg/L: micrograms per liter

treatment plant, visual observations, odor, and photoionization detector (PID) readings (for volatile organic compounds [VOCs]) indicated that the soil was impacted with petroleum hydrocarbons (USACE 1994a). The footprint included a buffer zone that extended 5 feet beyond the actual water treatment plant (USACE 1994a). The excavated soils were then used as random fill in Landfill 26, which has a Resource Conservation and Recovery Act (RCRA) compliant cap. The cap is considered sufficient to protect potential human and ecological receptors from exposure to the impacted soils (IT 1997c).

In 1996, following completion of the groundwater treatment plant, the Army drilled five additional soil borings around the perimeter of the treatment plant to confirm the presence or absence of petroleum hydrocarbons in the vicinity of the plant. These borings are identified as borings SB-POLA-101 through -104 and SB-POLA-118 on Figure 3-5. The borings were drilled to the water table or bedrock refusal. A total of 12 samples were collected. With one exception, all of the soil sample results for TPH compounds were below the cleanup goal of 200 ppm. One sample from a depth of 2 feet bgs in boring 101 contained an estimated unknown hydrocarbon at a concentration of 260 ppm. Although no cleanup level has been established for unknown hydrocarbons, the level detected is only slightly above the level established for diesel. In addition, the sample collected from a depth of 6.5 feet below ground surface (bgs) in boring 101 did not detect unknown hydrocarbons, indicating that the unknown hydrocarbon contamination did not extend downward significantly (IT 1999).

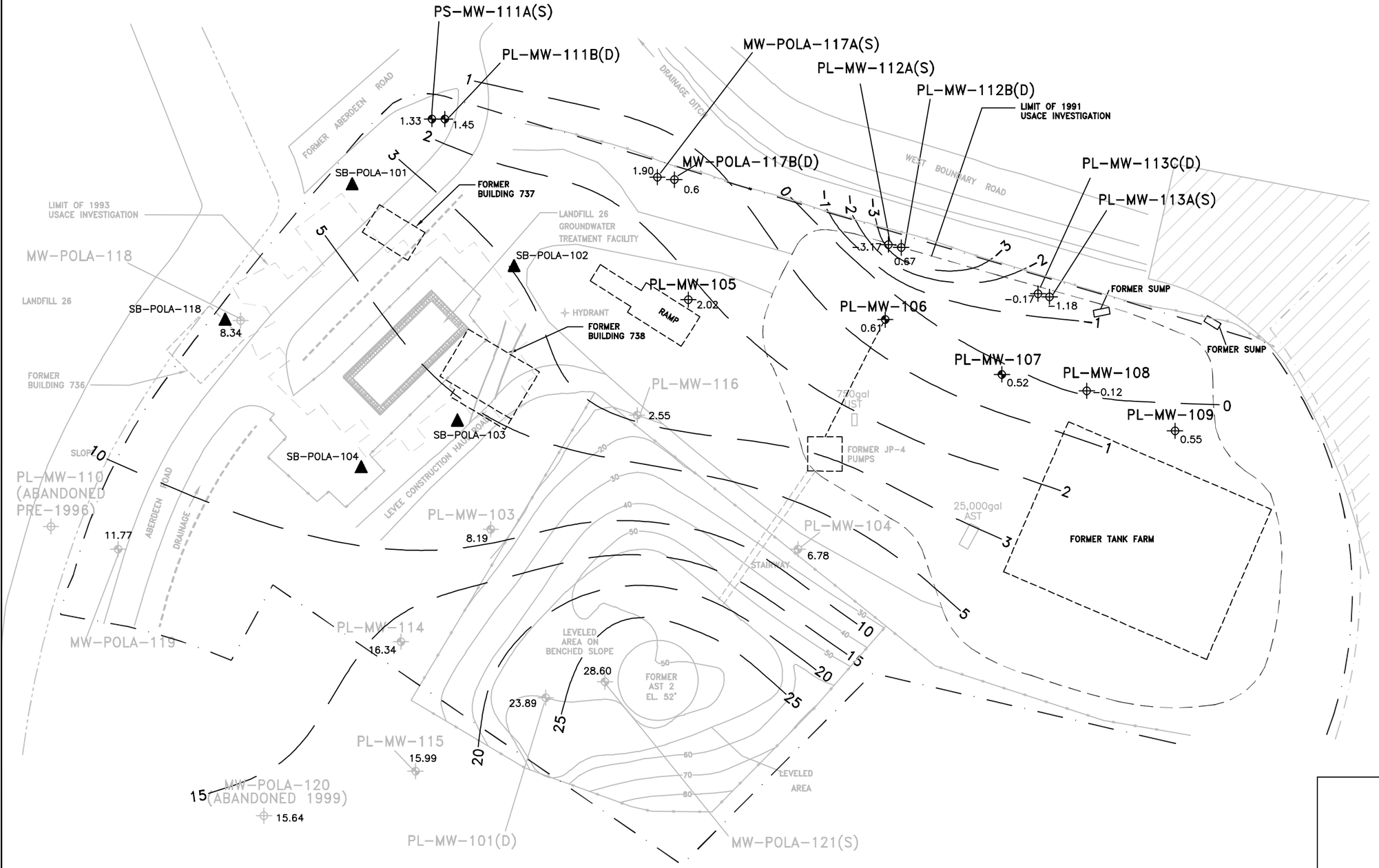
In 1997, 1998, 1999, 2001, and 2002, following the completion of remediation activities in the former tank farm, the Army conducted groundwater monitoring activities to evaluate a known release within the AST-2 area. Some of the wells evaluated in the AST-2 monitoring events were within the former tank farm area. Well locations are shown in Figure 3-6. The results from analytical testing of groundwater samples from the wells are summarized in Table 3-13. The tank farm groundwater samples were all nondetect for TPH in 1998 and 1999, and far below the closure criteria in 1997. These data indicate that tank farm groundwater has not exceeded closure criteria since 1990.

3.7 Risk Assessment

The ESI study (1993) also included an environmental risk assessment. Based on the available information, ESI found that POL Hill did not pose an unacceptable level of risk to either human or ecological receptors.

Human health risks were assessed for ingestion and dermal routes of exposure to lead, petroleum hydrocarbons, and bis(2-ethylhexyl)phthalate. Risks were assessed for future and current land uses. Carcinogenic risks were found to be $4x10^{-8}$ for base employees, $6 x10^{-8}$ for future residents, and $2 x10^{-9}$ for construction workers (ESI 1993). All risks were below the $1 x10^{-6}$ lower boundary for carcinogenic risk range (ESI 1993). Model blood lead levels were found to be below the 10 mg/dL target level.

No significant environmental risks were found to existing or future biological receptors in the POL Hill Area. Soil, sediments, and groundwater exposures were evaluated for current and future conditions. All mean concentrations of contaminants were lower than reported toxic levels of all receptors in the area.



LEGEND:

- FENCE
- EXISTING MONITORING WELL
- ABANDONED MONITORING WELL
- SOIL BORING
- 6.78 FEB GROUNDWATER ELEVATIONS (IN FEET ABOVE MSL)
- GROUNDWATER CONTOUR
- (S) SHALLOW MONITORING WELL
- (D) DEEPER MONITORING WELL
- FORMER STRUCTURES
- APPROXIMATE LIMITS OF USACE EXCAVATION
- NHP LEVEE AND EASEMENT
- POL OUTPARCEL BRAC PROPERTY BOUNDARY

NOTES:

1. DATA BASED ON USACE, 1994 AND IT, 1999
2. ABANDONED MONITORING WELLS WERE CLOSED IN OCTOBER 2002 UNLESS ALTERNATE DATE IS INDICATED IN PARENTHESES. WELL ABANDONMENT INFORMATION TAKEN FROM TABLE 1: MONITORING WELL SUMMARY FOR HAAF CONTAINED WITHIN IT CORPORATION (2001) WORK PLAN, MONITORING WELL ABANDONMENT, HAMILTON ARMY AIRFIELD, NOVATO, CA., REVISION I, DECEMBER. THIS TABLE WAS REVISED FOR THE ARMY JUST BEFORE THE WELL DESTRUCTION OCCURRED IN OCTOBER 2002.

N

SCALE
0 80 160 FEET

Source: International Technology Corporation (IT) Drawing 762538-B512

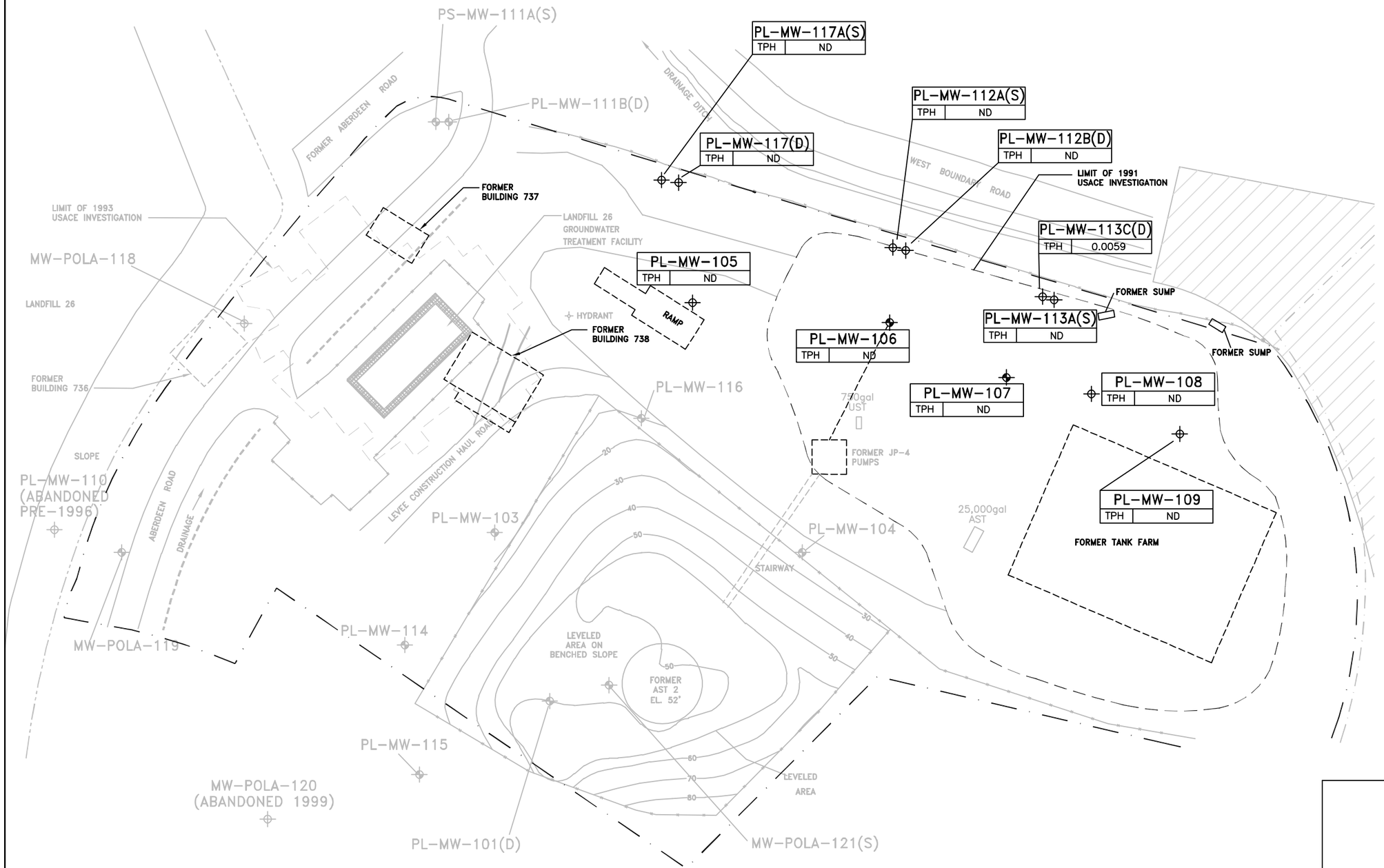
1996 & 1997 SAMPLE & WELL LOCATIONS
POL HILL OUTPARCEL
HAMILTON ARMY AIRFIELD

CH2MHILL

FIGURE 3-5

PROJECT NO. 159892.08.PL.CR

APRIL 2003



Source: International Technology Corporation (IT) Drawing 762538-B512

LEGEND:

- FENCE
- EXISTING MONITORING WELL
- ABANDONED MONITORING WELL
- *(S)* SHALLOW MONITORING WELL
- *(D)* DEEPER MONITORING WELL
- *TPH* COMBINED TPH-DIESEL, TPH-GASOLINE, AND TPH-JP4 DETECTIONS. CONCENTRATIONS ARE IN G/L
- *ND* NOT DETECTED (DETECTION LIMIT=1µG/L FOR TPH COMPOUNDS AND 1µG/L FOR BTEX)
- FORMER STRUCTURES
- APPROXIMATE LIMITS OF USACE EXCAVATION
- NHP LEVEE AND EASEMENT
- POL OUTPARCEL BRAC PROPERTY BOUNDARY

NOTES:

1. BASED ON PROCESS KNOWLEDGE, JP-4 WAS STORED IN THE TANKS, HOWEVER, BASED ON CHEMICAL INTERFERENCES AND DEGRADATION RESULTING IN THE QUANTIFICATION OF JP-4 AGAINST DIESEL AND GASOLINE STANDARDS, THE REPORTED VALUES FOR TPH-DIESEL AND TPH-GASOLINE WERE TOTALLED AT EACH LOCATION TO CONSERVATIVELY ESTIMATE THE EXTENT AND MAGNITUDE OF JP-4 GROUNDWATER CONTAMINATION.
2. SOURCE OF DATA FROM IT 1999.
3. ABANDONED MONITORING WELLS WERE CLOSED IN OCTOBER 2002 UNLESS ALTERNATE DATE IS INDICATED IN PARENTHESES. WELL ABANDONMENT INFORMATION TAKEN FROM TABLE 1: MONITORING WELL SUMMARY FOR HAAF CONTAINED WITHIN IT CORPORATION (2001) WORK PLAN, MONITORING WELL ABANDONMENT, HAMILTON ARMY AIRFIELD, NOVATO, CA., REVISION I, DECEMBER. THIS TABLE WAS REVISED FOR THE ARMY JUST BEFORE THE WELL DESTRUCTION OCCURRED IN OCTOBER 2002.

N

SCALE

0 80 160 FEET

MARCH/APRIL 1998 GROUNDWATER DATA

POL HILL OUTPARCEL

HAMILTON ARMY AIRFIELD

CH2MHILL

FIGURE 3-6

159892.08.PL.CR

APRIL 2003

TABLE 3-13
Analytical Results of Groundwater Sampling Performed After 1992
Former Tank Farm, Hamilton Army Airfield

Well Number	Analyte	Detection Limit (μg/L)	Result (μg/L)	Source	Date Sampled	GSA Cleanup Goal
MW-106	Aromatic VOC	0.5	u	USACE 1994	1994	835 mg/L
	TPH (EPA method 418.1)	50	u	USACE 1994	1994	1,200 μg/L
	TPH as gasoline (EPA 8015)	50	u	USACE 1994	1994	1,200 μg/L
	TPH as JP-4 (EPA 815)	50	u	USACE 1994	1994	1,200 μg/L
	TPH as diesel (EPA 8015)	50	u	USACE 1994	1994	1,200 μg/L
MW-105	Anthracene	40	u	IT 1999	1997	526,495 mg/L
	Benzo(a)anthracene	40	u	IT 1999	1997	200 mg/L
	Benzo(a)pyrene	40	u	IT 1999	1997	19.0 mg/l
	Benzo(b)flouranthene	40	u	IT 1999	1997	56 mg/L
	Chrysene	40	u	IT 1999	1997	2,128 mg/L
	Dibenz(a,h)anthracene	40	u	IT 1999	1997	29.0 mg/L
	Fluoranthene	40	u	IT 1999	1997	284,842 mg/L
	Fluorene	40	u	IT 1999	1997	38,988 mg/L
	Indeno(1,2,3-cd)pyrene	40	u	IT 1999	1997	301 mg/L
	Naphthalene	40	u	IT 1999	1997	1,710 mg/L
	Pyrene	40	u	IT 1999	1997	249,882 mg/L
	Benzene	1.0	u	IT 1999	1997	0.35 mg/L
	Ethylbenzene	1.0	u	IT 1999	1997	1,924 mg/L
	Toluene	1.0	u	IT 1999	1997	835 mg/L
	Xylenes	1.0	u	IT 1999	1997	20,299 mg/L
	Maximum TPH Reported**	50	u	IT 1999	1997	1,200 μg/L
MW-106	Maximum TPH Reported**	50	u	IT 1999	1997	1,200 μg/L
	all other GSA criteria	--	u	IT 1999	1997	--
MW-107	Maximum TPH Reported**	50	56	IT 1999	1997	1,200 μg/L
	all other GSA criteria	--	u	IT 1999	1997	--
MW-108	Maximum TPH Reported**	50	u	IT 1999	1997	1,200 μg/L
	all other GSA criteria	--	u	IT 1999	1997	--
MW-109	Maximum TPH Reported**	50	u	IT 1999	1997	1,200 μg/L
	all other GSA criteria	--	u	IT 1999	1997	--
MW-111A	Maximum TPH Reported**	50	u	IT 1999	1997	1,200 μg/L
	all other GSA criteria	--	u	IT 1999	1997	--
MW-111B	Maximum TPH Reported**	50	u	IT 1999	1997	1,200 μg/L
	all other GSA criteria	--	u	IT 1999	1997	--
MW-112A	Maximum TPH Reported**	50	100	IT 1999	1997	1,200 μg/L
	all other GSA criteria	--	u	IT 1999	1997	--
MW-112B	Maximum TPH Reported**	50	110	IT 1999	1997	1,200 μg/L
	all other GSA criteria	--	u	IT 1999	1997	--
MW-113A	Maximum TPH Reported**	50	59	IT 1999	1997	1,200 μg/L
	all other GSA criteria	--	u	IT 1999	1997	--

TABLE 3-13
Analytical Results of Groundwater Sampling Performed After 1992
Former Tank Farm, Hamilton Army Airfield

Well Number	Analyte	Detection Limit (µg/L)	Result (µg/L)	Source	Date Sampled	GSA Cleanup Goal
MW-113C	Maximum TPH Reported**	50	51	IT 1999	1997	1,200 µg/L
	all other GSA criteria	--	u	IT 1999	1997	--
MW-117A	Maximum TPH Reported**	50	50	IT 1999	1997	1,200 µg/L
	all other GSA criteria	--	u	IT 1999	1997	--
MW-117B	Maximum TPH Reported**	50	u	IT 1999	1997	1,200 µg/L
	all other GSA criteria	--	u	IT 1999	1997	--
MW-118	Maximum TPH Reported**	50	u	IT 1999	1997	1,200 µg/L
	all other GSA criteria	--	u	IT 1999	1997	--
MW-119	Maximum TPH Reported**	50	u	IT 1999	1997	1,200 µg/L
	all other GSA criteria	--	u	IT 1999	1997	--
MW-105	Maximum TPH Reported**	50	u	IT 1999	Mar. 1998	1,200 µg/L
MW-106	Maximum TPH Reported**	50	u	IT 1999	Mar. 1998	1,200 µg/L
MW-107	Maximum TPH Reported**	50	u	IT 1999	Mar. 1998	1,200 µg/L
MW-108	Maximum TPH Reported**	50	u	IT 1999	Mar. 1998	1,200 µg/L
MW-109	Maximum TPH Reported**	50	u	IT 1999	Mar. 1998	1,200 µg/L
MW-111A	Maximum TPH Reported**	50	u	IT 1999	Mar. 1998	1,200 µg/L
MW-111B	Maximum TPH Reported**	50	u	IT 1999	Mar. 1998	1,200 µg/L
MW-112A	Maximum TPH Reported**	50	u	IT 1999	Mar. 1998	1,200 µg/L
MW-112B	Maximum TPH Reported**	50	u	IT 1999	Mar. 1998	1,200 µg/L
MW-113A	Maximum TPH Reported**	50	u	IT 1999	Mar. 1998	1,200 µg/L
MW-113C	Maximum TPH Reported**	50	u	IT 1999	Mar. 1998	1,200 µg/L
MW-117A	Maximum TPH Reported**	50	u	IT 1999	Mar. 1998	1,200 µg/L
MW-117B	Maximum TPH Reported**	50	u	IT 1999	Mar. 1998	1,200 µg/L
MW-118	Maximum TPH Reported**	50	u	IT 1999	Mar. 1998	1,200 µg/L
MW-119	Maximum TPH Reported**	50	u	IT 1999	Mar. 1998	1,200 µg/L
MW-120	Maximum TPH Reported**	50	u	IT 1999	Jan. 1999	1,200 µg/L

**: maximum value reported when analyzed for TPH as gasoline, JP-4, diesel, and unknown extractable and purgeable
ft: feet
mg/L: milligrams per liter
TPH: total petroleum hydrocarbon
u: not detected in analysis
µg/L: micrograms per liter

SECTION 4

Conclusions and Recommendations

The previous section details the activities performed at the POL Hill Outparcel. The data show that petroleum contaminants have been removed from soil and groundwater to the extent possible at the former tank farm.

Soil excavation has removed soil containing TPH concentrations above the GSA Phase I Sale criteria of 200 ppm. Soil data from the investigations in 1991, 1993, and 1996 indicate that contaminants at concentrations above closure criteria have been removed from soil at the former tank farm (ESI 1993; USACE 1994; IT 1999). Analytical results of samples taken during excavation by IT in 1991 indicate that TPH concentrations detected in soil above 100 ppm were completely removed. Tables 3-5 through 3-10 show analytical data that indicate closure criteria have been met.

Investigations by Engineering-Science, Inc. (1993) and by IT (1999), as well as data from USACE (1994), show that all wells in the POL Hill tank farm area have met the closure criteria.

The general requirements for closure listed in Section 1.3 of this report have also been met. Review of analytical data, along with remediation procedures and other groundwater and soil data provided in this report indicates the following:

- The sources of contamination (i.e., USTs, ASTs, fuel lines, and supporting structures) have been removed.
- The site has been adequately characterized.
- Concentrations of TPH in groundwater meet acceptable standards in the former tank farm area.
- Drinking water is not affected. The environmental assessment performed by ESI indicates that health risks to humans and wildlife from exposure and use of soils and groundwater at this site are minimal (ESI 1993).

The information presented in this document indicates that the removal actions conducted at the site have successfully completed source removal, and that remedial activities and remedial action objectives necessary for closure of the former tank farm have been accomplished. All general and specific closure criteria for the former tank farm specified for closure have been met. Therefore, closure of this site is recommended.

SECTION 5

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APPENDIX A

Remedial Investigation Report for the Petroleum, Oil, and Lubricant Outparcel

Source: IT 1999 (Appendix A)

PETROLEUM, OIL, and LUBRICANT OUTPARCEL CLOSURE REPORT BRAC PROPERTY HAMILTON ARMY AIRFIELD NOVATO, CALIFORNIA

CONTRACT NO. DACW05-95-D-0001
DELIVERY ORDER NUMBER 0006

Submitted to:

U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, California 95814-2922

Submitted by:

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4005 Port Chicago Highway
Concord, California 94520

Revision C

December 23, 1999

Issued to:_____ Date:_____

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List of Acronyms

AST	aboveground storage tank(s)
ASTM	American Society for Testing and Materials
BRAC	Base Realignment and Closure
BTEX	benzene, toluene, ethylbenzene, and xylenes
CQC/SAP	Contractor Quality Control/Sampling and Analysis Plan
D.O.	dissolved oxygen
EPA	U.S. Environmental Protection Agency
ft	feet
gal	gallon
GSA	General Services Administration
HAAF	Hamilton Army Airfield
in.	inch(es)
IT	IT Corporation
JP	jet propellant
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per liter
MTBE	methyl-t-butyl ether
mV	millivolts
PCOC	potential chemical(s) of concern
PNA	polynuclear aromatic(s)
POL	Petroleum, Oil, and Lubricant
RAO	remedial action objective(s)
RCG	residential cleanup goal(s)
RWQCB	Regional Water Quality Control Board
TPH	total petroleum hydrocarbon(s)
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
UST	underground storage tank
°C	degrees Celsius
µg/kg	microgram(s) per kilogram
µg/L	microgram(s) per liter

NOTICE

This document was prepared by IT Corporation at the direction of the U.S. Department of the Army (Army) for the sole use of the Army and the regulatory agencies, the only intended beneficiaries of this work. No other party should rely on the information contained herein without the prior written consent of the Army. This report and the interpretations, conclusions, and recommendations contained within are based in part on information presented in other documents that are cited in the text and listed in the references. Therefore, this report is subject to the limitations and qualifications presented in the referenced documents.

Executive Summary

This Closure Report documents and summarizes the results of the remedial investigation activities performed at the Petroleum, Oil, and Lubricant (POL) Outparcel, which is located at Hamilton Army Airfield, Novato, California, and provides information to support the recommendation of closure. In addition, this report documents the conclusions to support closure of this outparcel. This report was prepared by IT Corporation for the U.S. Army Corps of Engineers, Sacramento District, under a Total Environmental Restoration Contract.

During prior activities, not associated with this remedial investigation twenty 25,000-gallon (gal) underground storage tanks (USTs), one 850,000-gal aboveground storage tank (AST) (AST-2), one 750-gal storage tank, and one 25,000-gal AST were removed from the outparcel. Contaminated soil was removed from the vicinity of the former tank farm, AST-2 and the footprint of the Landfill 26 Groundwater Treatment Facility to the extent practicable. Soil samples were collected and analyzed. All soil exceeding an agreed-upon petroleum-hydrocarbon (i.e., total petroleum hydrocarbons) cleanup criteria of 100 milligrams per kilogram was removed to concentrations below the cleanup criteria or to the limit of underlying bedrock where refusal occurred.

Remedial investigation activities at the POL Outparcel consist of

- Drilling five soil borings and collecting soil samples around the groundwater treatment facility to evaluate the extent of potential petroleum-hydrocarbon contamination
- Drilling and installing six groundwater monitoring wells to improve monitoring coverage
- Collecting groundwater samples from the newly installed and existing wells to evaluate the extent of potential contamination
- Collecting groundwater samples from the newly installed and existing wells to evaluate if natural attenuation is occurring
- Measuring water levels to evaluate groundwater flow patterns and rates
- Collecting samples of the surrounding rock outcrop to evaluate the absence or presence of petroleum-hydrocarbon contamination.

Based on results of the remedial investigation it was determined that the groundwater beneath the former tank farm was not impacted. Groundwater samples collected beneath the AST-2 area encountered petroleum-hydrocarbon contamination above the General Services Administration Residential Cleanup Goal of 1,200 micrograms per liter. However, analytical data indicate that:

- The source has been removed
- The plume is not migrating and is shrinking
- Natural attenuation has been shown to be occurring
- Impacted soil at the former tank area, area surrounding the groundwater treatment plant, and AST-2 area have been removed to the extent practicable
- Groundwater flow rates are low and flow directions are uniform
- The site does not pose a risk to human health.

Activities conducted in conjunction with the remedial investigation are sufficient to demonstrate conditions suitable for site closure. As a condition of closure, to evaluate plume stabilization and/or mass reduction of the petroleum-hydrocarbon plume, groundwater monitoring would continue on an annual basis in selected current monitoring wells.

A composite sample of the rock outcrop on Reservoir Hill indicated elevated petroleum-hydrocarbon concentrations. Remediation of the rock outcrop is not proposed since the asphaltic material, which covers the outcrop, is bound within the bedrock fractures, is not mobile, and is bound in such a manner that removal by hand is virtually impossible. The rock outcrop does not pose a human health or ecological risk.

This report documents the investigation, excavation, and sampling of the impacted soil and the related remediation activities. The data presented indicate that the remedial activities and remedial objectives necessary for transfer of the POL Outparcel have been accomplished.

In addition to the samples collected for chemical and biological testing for the monitoring program, one groundwater sample was collected from monitoring well PL-MW-107 on February 20, 1999, and analyzed for methyl-t-butyl ether (MTBE). The result was reported as

not detected with a detection limit of 2 micrograms per liter. The result indicates that there is no threat of MTBE at the POL Outparcel.

1.0 Introduction

IT Corporation (IT) prepared this Closure Report for the Petroleum, Oil, and Lubricant (POL) Outparcel, Base Realignment and Closure (BRAC) Property, at Hamilton Army Airfield (HAAF), Novato, California (Figure 1-1) for the U.S. Army through the U.S. Army Corps of Engineers (USACE), Sacramento District under Contract No. DACW05-95-D-0001, Delivery Order 0006, of the Total Environmental Restoration Contract. This closure report documents and summarizes the remedial investigation activities, which support closure of the site, and presents the details of the investigation activities in Appendix A.

The POL Outparcel lies within the upland portion of the HAAF northeast of the General Services Administration (GSA) Sale Area (Figure 1-2). The outparcel operated from 1942 until prior to May 1986, when the storage tanks were removed as the base fuel-storage center. The outparcel consists of a ridge known as Reservoir Hill and the immediate lowlands surrounding the hill (Figure 1-3). This outparcel has been previously referred to as the "POL Area" and "POL Hill." The POL Outparcel was comprised of three main features (Figure 1-3):

- A former tank farm containing one 750-gallon (gal) underground storage tank (UST), twenty 25,000-gal USTs, and one 25,000-gal aboveground storage tank (AST)
- A former 850,000 gal AST and associated piping (i.e., AST-2)
- The Landfill 26 groundwater treatment facility.

All tanks contained jet propellant (JP-4) fuel for aircraft operations; except possibly the 750-gal UST, which may have contained diesel fuel.

Each of these is discussed in greater detail in Section A.2.3 (Appendix A).

1.1 Purpose and Objectives

The purpose of this closure report is to document and summarize the results of the remedial investigation conducted at the POL Outparcel and to provide sufficient detail to demonstrate and support the recommendation of closure.

The remedial investigation activities conducted at the POL Outparcel consisted of

- Installing additional groundwater monitoring wells to improve monitoring well coverage
- Assessing the presence or absence of petroleum hydrocarbons in soil near the Landfill 26 groundwater treatment facility
- Performing groundwater monitoring, sampling, and slug or specific capacity testing to evaluate groundwater plume stability potential
- Collecting and analyzing
  - Groundwater samples to evaluate the extent of potential chemicals of concern (PCOCs)
  - Groundwater samples to evaluate if natural attenuation of the PCOCs in the groundwater is occurring
  - Samples of the rock outcrop surrounding Reservoir Hill to evaluate the absence or presence of petroleum-hydrocarbon contamination.

These activities were conducted to meet the scope of the remedial investigation, determine if natural attenuation of PCOCs was occurring, and aid in the closure of the site.

1.2 Problem Statement

Over the years, unknown amounts of JP-4 fuel may have leaked from the 850,000-gal AST (AST-2), the twenty 25,000-gal USTs, the 25,000-gal AST, the 750-gal UST and piping appurtenances and may have contaminated the surrounding soils and underlying groundwater. During removal of the AST and USTs, known and suspected impacted soils were excavated, if TPH concentrations exceeded 1,000 mg/kg, in an attempt to remediate each impacted location. Soil sampling was conducted along the periphery of each excavation to confirm contaminant removal (IT, 1987). Additional excavation activities were conducted if the impacted soils exceeded 100 mg/kg (IT, 1991). In addition, groundwater samples were collected beneath the former tank farm area and AST-2 area and analyzed to determine if the groundwater was impacted.

A rock outcrop, which surrounds the southern area immediately behind the former AST-2 location, has an area of visible staining. A composite sample of the rock outcrop was collected and analyzed to assess the staining. The environmental impacts of the staining are not

considered to be significant, and there are no associated assumed human health or ecological risks.

1.3 Closure Criteria

The basic requirements necessary to demonstrate closure are

- The leak was stopped and ongoing sources were removed or remediated
- The site was adequately characterized
- Little or no groundwater impacts exist
- No water wells, deeper drinking water aquifers, surface water, or other sensitive receptors are likely to be impacted
- The site presents no significant risk to human health.

The results of previous investigations and the remedial investigation will show that the sources (i.e., AST and USTs) were removed, impacted soil was removed to the extent practicable, and that there are no groundwater impacts, beneath the former tank farm area (that are above GSA Phase I Residential Cleanup Goals [RCGs]). There are minimal groundwater impacts in a total petroleum hydrocarbon (TPH) plume beneath Reservoir Hill (beneath the AST-2 area); however, the site does not pose a risk to human health (see Section 2.5).

1.4 Regulatory Authority

The U.S. Army is the lead agency involved in the BRAC Closure process at HAAF. The California Regional Water Quality Control Board (RWQCB) is the lead regulatory agency for the POL Outparcel. This was formally documented in a letter from the Department of Toxic Substances Control (DTSC) to the RWQCB since petroleum hydrocarbons are not regulated as hazardous substances in the California Health and Safety Code.

In addition, the U.S. Environmental Protection Agency (EPA) is an oversight agency for closure of the POL Hill Outparcel.

The work described in this report was performed pursuant to the Comprehensive Remedial Investigation/Feasibility Study Work Plan (IT, 1997a) and the Contractor Quality Control/Sampling and Analysis Plan (CQC/SAP) (IT, 1997b), which was approved by the

regulatory agencies. Additionally, the remedial investigation activities were conducted in accordance with the statutory requirements defined in the California Code of Regulations Title 23, Division 3, Chapter 16, Article 11 (Underground Storage Tanks) (1994).

Other guidance documents used in preparation of this closure report include the *Tri-Regional Board Staff Recommendations for Preliminary Evaluation and Investigation of Underground Storage Tank Sites* (TRWQCB, 1990), the *Supplemental Instructions to State Water Board, December 8, 1995, Interim Guidance on Required Cleanup at Low Risk Fuel Sites* (RWQCB, 1996), the risk-based corrective action approach documented in the American Society of Testing and Materials (ASTM) *Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites* (1995), and ASTM *Standard Guidance for Remediation of Groundwater by Natural Attenuation at Petroleum Release Sites* (1998).

1.5 Summary

During prior activities, contaminated soil was removed from the vicinity of the former tank farm and AST-2 to the extent practicable. All soil exceeding an agreed upon petroleum-hydrocarbon cleanup criteria of 100 milligrams per kilogram (mg/kg) was removed to concentrations below the cleanup criteria or to the limit of the underlying bedrock where refusal occurred. Groundwater samples collected beneath the tank farm (i.e., USTs) did not encounter contaminants above the GSA RCGs; however, groundwater samples collected beneath Reservoir Hill (i.e., AST-2) encountered petroleum-hydrocarbon contamination (i.e., TPH) above the GSA RCGs. It has been inferred from proximity of the groundwater plume to the former tank location, that the suspected source of the groundwater contamination is AST-2, which was removed. Additionally, the petroleum-hydrocarbon plume is not migrating and natural attenuation is occurring. The activities, including site remediation and confirmation sampling, conducted at the POL Outparcel as part of the remedial investigation are sufficient to demonstrate a condition suitable for site closure. As a condition of site closure, to evaluate stabilization and/or mass reduction of the petroleum-hydrocarbon plume, groundwater monitoring will continue in selected wells.

2.0 Description of Site History and Current Site Conditions

The following subsections present a description of the outparcel, the background and history of the outparcel, and results of previous investigations. The background information discussed in this section sets the stage for the remedial investigation activities described in Section 3.0, and is also necessary for demonstrating site closure.

2.1 Hamilton Army Airfield Property Description

Hamilton Army Airfield is a 1,600-acre former military installation located approximately 22 miles north of San Francisco on San Pablo Bay in Marin County, California (see Figure 1-1). The HAAF is bounded on the north by the North Antenna Field (a formerly used defense site), private agricultural lands, and a private residential community (Bel Marin Keys); on the east by state-owned land and San Pablo Bay; on the south by private agricultural fields; and on the west by Nave Drive which parallels State Highway 101.

The BRAC Property encompasses approximately 710 acres and is located primarily within the northeastern portion of the HAAF. To the southwest, the BRAC Property is bounded by the GSA Sale Area and U.S. Coast Guard-administered military housing, both of which are located within the current Base limits. The POL Outparcel is addressed with the BRAC sites; however, the outparcel is separate from the contiguous BRAC Property (see Figure 1-2). The POL Outparcel is located on the north side of a ridge known as Reservoir Hill, southwest of West Boundary Road, and is bounded by the GSA Phase II Sale Area (see Figure 1-3).

2.2 Facility Background and History

Hamilton Army Airfield was constructed on reclaimed tidal mud flats by the Army Air Corps in 1932. The site, previously known as Marin Meadows, had been used as ranch and farm land since the Mexican Land Grant (USACE, undated). Military operations began in December 1932, first as a Base for bombers, and later as a Base for transport and fighter aircraft. The Base played a major role during World War II as a training field and staging area for Pacific operations. During the war (i.e., early- and mid-1940s), the Base hospital served as an acute care and rehabilitation facility for thousands of war casualties per month.

The Base was renamed Hamilton Air Force Base in 1947 when it was transferred to the newly created U.S. Air Force (USAF). The USAF used the Base primarily as a training and fighter

installation until 1975. The USAF ended military operations at the Base in 1976, and the property was declared surplus by the Department of Defense (Hamilton Field Association, Inc., 1988). In 1976, the U.S. Department of the Army (Army) began aircraft operations at the airfield and supporting facilities with permission from the USAF. In 1984, the airfield property was officially transferred back to the Army and renamed Hamilton Army Airfield. The Base was declared surplus under the Base Realignment and Closure Act of 1988. The Army continued to use the airfield primarily for Army Reserve aircraft operations until March 1994. Currently, the BRAC Property is managed by the Department of the Army, I Corps, at Fort Lewis, Washington.

2.3 *Petroleum, Oil, and Lubricant Outparcel Description*

The POL Outparcel lies within the upland portion of HAAF, on the north side of a ridge known as Reservoir Hill and southwest of West Boundary Road (see Figure 1-3). The POL Outparcel is separated from the main portion of the BRAC Property by approximately 200 feet (ft) and is bounded by the GSA Phase II Sale Area. The POL Outparcel contained three main environmental features (see Figure 1-3):

- A former tank farm (twenty 25,000-gal USTs, one 25,000-gal AST, and one 750-gal UST)
- A former 850,000-gal AST and associated piping (i.e., AST-2)
- The Landfill 26 groundwater treatment facility.

Each of these are discussed further in Section A.2.3 (Appendix A),

The POL Outparcel operated as the Base fuel-storage center from 1942 until prior to May 1986, when the storage tanks were removed. Aboveground Storage Tank-2 stood on the hillside bench (i.e., Reservoir Hill) and supplied the former tank farm area by gravity feed through a pipeline. All tanks stored JP-4, except possibly the 750-gal storage tank, for aircraft operations. Discharges of jet fuel and other petroleum products may have impacted the soil and groundwater at the POL Outparcel.

Several small buildings (Building Nos. 736, 737, and 738) existed at the POL Outparcel and were last used for temporary storage of waste oil (see Figure 1-3). Prior to construction of the Landfill 26 groundwater treatment facility, these buildings were demolished. The groundwater

treatment facility was constructed northwest of Reservoir Hill in a low-relief area that is partially paved with asphalt. The facility was to provide service for Landfill 26, but has never been used.

2.4 Previous Investigations and Reports

Several field investigations and environmental studies were conducted for the POL Outparcel. Activities have included AST and UST decommissioning and removal, contaminated soil removal, contaminated soil aeration, and investigations of soil and groundwater to identify the nature and extent of contamination resulting from site activities. These investigations included the following:

- Hamilton Air Force Base-Storage Tank Removal Project (IT, 1987)
- Final Engineering Report, Miscellaneous Contaminated Sites (IT, 1991)
- Environmental Investigation Report (ESI, 1993)
- Supplement to the Final Environmental Investigation Report (USACE, 1994).

Results of the previous investigations confirmed or suggested the presence of petroleum hydrocarbons in the soil and groundwater at the POL Outparcel. This information was used to scope the remedial investigation activities summarized in Section 3.0 and detailed in Appendix A. Results of the previous POL Outparcel investigations are summarized in Table 2-1.

2.5 Geology and Hydrogeology

Reservoir Hill lies within the San Francisco-Marin structural block of the Northern Coast Range geomorphic province of California. The higher relief area to the west and south of HAAF are generally underlain by serpentinite and sandstone bedrock from the Franciscan Complex of Jurassic to Cretaceous age. The bedrock is locally overlain by Tertiary alluvium and colluvium deposits.

Groundwater occurs in the weathered bedrock along the flanks of Reservoir Hill. Recharge occurs from rainfall on the top and slopes of the hill with groundwater percolating into the weathered material and into fractures in the bedrock. Flow within the bedrock is controlled by fractures and also follows topography.

2.6 Groundwater Yield

Groundwater at the POL Outparcel and GSA Properties was determined to occur in a low-flow fractured bedrock layer and to have low aquifer production rates. The RWQCB is responsible

for enforcement of State Water Resource Control Board Policy 88-63 (RWQCB, 1992), which specifies several criteria for determining whether groundwater is suitable for municipal or domestic water supply (i.e., drinking water). One of the criteria for suitability is recovery rate. During the investigation, the groundwater within the POL Outparcel was recovered at an average of approximately 5 gallons per day, which is below the minimum recovery rate for beneficial-use designation of 200 gal per day.

Given the low groundwater yield based on our testing (see Appendix F), the primary use of the groundwater, i.e., recharge to San Francisco Bay, from the POL Outparcel is the same as the GSA properties, and suggests that GSA Phase I RCGs for groundwater also apply at the POL Outparcel.

2.7 *Evaluation of Existence of Potential Chemicals of Concern*

Because TPH was the only PCOC suspected to be present at elevated levels at the POL Outparcel, the following discussion focuses on the derivation of the RCG for TPH. Woodward-Clyde Federal Services reviewed the limits established for TPH constituents during 1995 to establish TPH cleanup levels for the GSA Property (WCFS, 1995a). This study established cleanup levels for TPH in the groundwater for the GSA Phase I Sale Area. The GSA Phase I RCGs for each medium (i.e., soil and groundwater) were developed based upon site conditions and suspected analytes to be encountered in the comprehensive remedial investigation. The POL Outparcel is uphill and upgradient of the GSA Phase II Sale Area and will have similar future land uses. The GSA Phase I Sale Area RCGs are directly applicable for use at the GSA Phase II Sale Area. Therefore, the GSA RCGs are applicable to the POL Outparcel (Table 2-2). Typically, cleanup levels are derived from an appropriate risk-based method (e.g., drinking water standards and excess cancer risk to receptor less than 10^{-6}). However, contaminant cleanup levels were already identified for unrestricted land use within the GSA Phase I Sale Area (WCFS, 1995b). Because these cleanup criteria (i.e., GSA RCGs) were previously developed and used for evaluation of other portions of the HAAF (i.e., Outparcel A-4 and Hospital Hill Outparcel) with similar site conditions, these levels served as the basis for all investigative and closure evaluations. Residential cleanup goals were adopted to avoid conditions being placed on the site transfer and to be conservative in evaluating potentially impacted soil and groundwater.

The GSA Phase I Sale Area RCGs were developed using a series of risk-based assessments and risk-management evaluations (WCFS, 1995b). The RCG selection process included the following steps:

- Quantitative human health risk assessments and ecological risk assessments were performed in which uncertainty in each step of the evaluation process (i.e., selection of PCOCs, exposure assumptions, toxicity assessment, and risk characterization) was addressed by assuming the most conservative "worst case" situation.

- Results of the human health risk assessments and ecological risk assessments were used to generate risk-based remedial action objectives (RAOs) for both the residential and commercial land-use scenarios. Assuming that the conservative assumptions made during the risk assessments were valid, the RAO was the concentration of a chemical that could be present at a site and not pose an unacceptable risk to receptors.

- Unless an RAO was greater than a chemical's background concentration, or significantly different from a benchmark, the background concentration was adopted as the RCG since it would be impractical to remediate a site to below background concentrations.

- Analyte background concentrations, analytical method practical quantification limits, and other benchmarks were compared to each RAO to assess the viability of the RAO. A benchmark is a promulgated regulatory standard, such as acceptable TPH concentrations based on Marin County UST regulations, or a toxicity-based screening value, such as EPA Region IX Preliminary Remediation Goals.

The remainder of this discussion focuses on the derivation of the RCG for TPH measured as diesel because TPH measured as diesel and gasoline were the only PCOCs suspected to be present at elevated levels at the former POL Outparcel AST and UST sites. In 1995, Woodward-Clyde Federal Services reviewed the established limits for diesel constituents to determine applicable TPH cleanup levels for the GSA Property. The results of this study are presented in *Groundwater TPH Cleanup Levels for GSA Sale Property* (WCFS, 1995c). This study established cleanup levels for TPH in the groundwater for the GSA Phase I Sale Property.

As part of this study, each of the diesel constituents was evaluated with respect to chemical risk and percent of diesel composition. Polynuclear aromatic hydrocarbons (PNAs) were determined to be the primary risk drivers for diesel fuel. Typical diesel fuel contains between 0.7- and 2-percent total PNAs. Using the conservative estimate of 2-percent total PNAs in diesel and an aquatic maximum contaminant level of 50 µg/L, a cleanup level for diesel of 2,500 µg/L was established for groundwater. However, during GSA RCG negotiations with the regulatory

agencies, an additional degree of conservatism was introduced by reducing the RCG from the calculated value of 2,500 µg/L to 1,200 µg/L. The GSA RCG of 1,200 µg/L will be used in evaluation of the groundwater results in this closure report to determine if remedial action needs to be implemented.

2.8 Summary

The results of the previous investigations indicate that residual hydrocarbon concentrations in soil in the former tank farm area are below 100 mg/kg and the groundwater beneath the former tank farm has not been impacted. A petroleum-hydrocarbon groundwater plume is present beneath the location of former AST-2, details are presented in Section 4.0. The extent of impact appears to be limited to the vicinity of former AST-2. The highest concentration in groundwater (TPH measured as JP-4 at 5,350 micrograms per liter [µg/L]) was reported in samples collected from monitoring well PL-MW-101, located immediately adjacent to the location of former AST-2. This well also exhibited the only consistent benzene concentrations in the former AST-2 area. The detections of JP-4 are consistent with the expected nature of the petroleum-hydrocarbon chemical constituents in this area since AST-2 was known to be a JP-4 storage tank.

Construction activities at the groundwater treatment facility indicated potential soil contamination. Therefore, soil samples were collected along a grid surrounding the footprint of the facility. All soils in excess of 100 mg/kg were removed to the extent practicable (either to below 100 mg/kg) or to bedrock.

3.0 Remedial Investigation Summary

The following subsections describe and summarize the results of the remedial investigation activities conducted at the POL Outparcel. This information will be used to document and demonstrate a condition suitable for site closure. For detailed results of these activities refer to the Remedial Investigation Report for the POL Outparcel, which is included as Appendix A of this document.

3.1 Remedial Investigation Activities

On behalf of the USACE, IT conducted remedial investigation activities at the POL Outparcel commencing in the winter of 1996. The activities were conducted per the Remedial Investigation/Feasibility Study Work Plan (IT, 1997a) and the CQC/SAP (IT, 1997b). The objectives of the investigative activities were to

- Improve groundwater monitoring coverage
- Evaluate the presence or absence of petroleum hydrocarbons in soil and groundwater near the Landfill 26 groundwater treatment facility
- Perform groundwater monitoring, sampling, and slug or specific capacity testing to evaluate groundwater plume stability and the potential for migration
- Perform groundwater sampling to evaluate evidence of natural attenuation
- Determine the extent of TPH impact at the rock outcrop located on Reservoir Hill.

In order to achieve the objectives, the following tasks were completed during the field activities:

- Drilling five soil borings and collecting soil samples around the groundwater treatment facility to evaluate the extent of petroleum-hydrocarbon contamination previously detected during construction
- Drilling six monitoring well borings and coring two monitoring well borings
- Installing new monitoring wells in the six borings (MW-POLA-117A, -117B, -118, -119, -120, and -121)
- Collecting groundwater samples from the newly installed and existing wells to evaluate the extent of PCOCs

- Collecting groundwater samples from the newly installed and existing wells to evaluate if natural attenuation is occurring

- Measuring water levels in the monitoring wells to evaluate groundwater flow patterns and rates

- Collecting samples of the rock outcrop surrounding Reservoir Hill to evaluate the absence or presence of petroleum-hydrocarbon contamination.

Details regarding the investigation activities are presented in Appendix A. Analytical results were used to identify the PCOCs, which were described in Sections 2.5, 4.0, and 5.0, and are presented in Appendix B.

3.2 *Remedial Investigation Results*

A summary of the results of the remedial investigation activities is presented below. Additional discussions and summaries of groundwater monitoring and natural attenuation sampling are presented in Sections 4.0 and 5.0, respectively. In addition, a complete description of the activities and results are presented in Appendices A through F of this closure report.

Five soil borings were drilled around the periphery of the 1994 USACE investigation/excavation of the Landfill 26 groundwater treatment facility from which 12 soil samples at depths ranging between 1.5 to 10.5 ft below ground surface were collected. Multiple detections included lead (12 detects ranging from 5.4 to 16.6 mg/kg), TPH measured as diesel (4 detects ranging from an estimated 12 to 260 mg/kg), and phenanthrene (2 detects at 55 and 71 micrograms per kilogram [µg/kg]). The following were detected once: 2-methylnaphthalene (43 µg/kg), benzo(a)anthracene (47 µg/kg), benzo(a)pyrene (51 µg/kg), benzo(b)fluoranthene (71 µg/kg), dibenz(a,h)anthracene (41 µg/kg), chrysene (70 µg/kg), fluoranthene (54 µg/kg), indeno(1,2,3-cd)pyrene (36 µg/kg), and pyrene (59 µg/kg).

A composite rock sample was collected, from the area of visible staining of the rock outcrop near the former location of AST-2. The sample was analyzed for TPH, PNAs, and polychlorinated biphenyls. Only chrysene (960 µg/kg) and TPH measured as diesel (1,800 mg/kg) were detected. Additionally, the rock outcrop was visually inspected to evaluate the extent of TPH-impacted rock, the extent of impact was mapped, and a rough volume of TPH-impacted rock was estimated at 65 cubic yards.

Six additional monitoring wells (MW-POLA- 117A, - 117B, - 118, - 119, - 120, and - 121) were installed, and five rounds of groundwater sampling were conducted (February 1997, March 1997, March/April 1998, September/October 1998, and January 1999). Wells PL-MW-101 and MW-POLA-121 (both located near AST-2) were the only wells with consistent contaminant detections during all rounds. Additionally, groundwater samples were collected in March/April 1998 and September/October 1998 and analyzed for hydrogeologic chemical indicators of biodegradation of petroleum hydrocarbons. A summary of the results of the groundwater chemical and natural attenuation monitoring program are presented in Sections 4.0 and 5.0, respectively.

Slug tests were performed in wells MW-POLA- 117A, -118, -119, -121 and PL-MW-101, -103, -104, -106, -108, -112B, -113A, and -113C to provide estimates of hydraulic conductivity and a better understanding of the hydrogeologic system for the POL Outparcel. Specific capacity and single-well pumping tests were performed in wells MW-POLA-117B and -120. Hydraulic conductivity at the site ranges from 2.8×10^{-2} ft/day in PL-MW-106 to 5.3 ft/day in PL-MW-108. Details are presented in Appendix F.

4.0 Groundwater Potential Contaminant of Concern Monitoring Summary

A groundwater monitoring and sampling program, including quarterly, semiannual, and annual sampling schedules, was developed for the POL Outparcel in 1997 (IT, 1999). Due to delays in the installation of new wells for the remedial investigation, the initial sampling round of all POL Outparcel wells (new and existing) was not completed until February 1997; and a second round was performed as scheduled in March 1997. Following a delay waiting for a decision on further activities at the POL Outparcel, the quarterly groundwater monitoring program was restarted in March 1998. The third, forth, and fifth rounds of samples were collected during March/April 1998, September/October 1998, and January 1999, respectively.

All groundwater samples were analyzed for TPH measured as purgeable; TPH measured as extractable; benzene, toluene, ethylbenzene, and xylenes (BTEX); lead; and PNAs. However, the only constituent consistently detected above the cleanup level (i.e., GSA Phase I RCGs) was TPH. The BTEX, lead, and PNA concentrations were either not detected or were below RCGs. Beginning with the January 1999 monitoring event the samples were analyzed only for TPH measured as purgeable and TPH measured as extractable. Analytical results from these sampling episodes are presented in Appendix E. In addition, Figures 4-1 through 4-4 show the TPH results over time and Table 4-1 presents the analytical results for the six wells which encompass the petroleum-hydrocarbon plume beneath the former location of AST-2.

An additional suite of samples was collected in March/April 1998 and September/October 1998 and analyzed for hydrogeochemical indicators of biodegradation of petroleum hydrocarbons. Analytical results for these biodegradation parameter samples are discussed in Section 5.0.

Water-level measurements were taken from new and previously existing groundwater monitoring wells during all sampling rounds. A discussion of groundwater gradients is presented in Appendix F (Aquifer Test Data). Additionally, monitoring was conducted for immiscible phases; however, none was observed in any well.

Although speciation of JP-4 is possible during laboratory analysis, natural biodegradation of JP-4 into related fuel constituents in the groundwater and chemical interferences during analysis typically result in the quantitation of JP-4 against diesel and gasoline standards (see Section 2.5).

For this reason, the reported values for TPH measured as gasoline and TPH measured as diesel were totaled at each location to conservatively approximate the concentrations of JP-4 in the groundwater.

Former AST-2

The TPH plume, which is located in the vicinity of the former AST-2, is depicted for the March 1994, February 1997, March/April 1998, and January 1999 sampling episodes on Figures 4-1 through 4-4, respectively. The plume shown on Figures 4-1 through 4-4 is defined by contours representing combined TPH concentrations of 100 µg/L, 500 µg/L, and 1,200 µg/L. The GSA Phase I RCG for TPH measured as diesel is 1,200 µg/L. The position of the plume boundary was drawn primarily based on detected TPH concentrations, but also taking into consideration the location of former AST-2, and the groundwater flow directions (Figures 4-1 through 4-4). The only wells with combined TPH detections exceeding the GSA Phase I RCG of 1,200 µg/L were PL-MW-101 (RCG exceeded in all sampling rounds) and MW-POLA-121 (RCG exceeded in March 1997 sample only). Each of these wells is located within approximately 80 ft of the former AST-2 location.

Former Tank Farm and Groundwater Treatment Plant

The area downgradient of the former AST-2 location consists of the former tank farm and groundwater treatment plant, groundwater samples collected from wells in these areas yielded lower TPH concentrations than those at the former AST-2 location. Samples collected from well PL-MW-104 during each of the three sampling episodes yielded TPH identified as "unknown (extractable)" at concentrations slightly above 200 µg/L and also yielded TPH identified as "unknown (purgeable)" at concentrations less than 200 µg/L. Total petroleum hydrocarbons identified as "unknown (extractable)" were detected sporadically at low levels (200 µg/L or below) in wells PL-MW-103, -107, -112B, -113A, -113C, and -115 and MW-POLA-117A. In six of these wells (all except well PL-MW-115), "unknown (extractable)" TPH was detected in only one of the three rounds of sampling. Well PL-MW-115 only had three detections out of seven rounds of sampling, and the last three rounds have been non-detect. These "unknown" hydrocarbon compounds are assumed to be degradation products of JP-4. Samples collected from the remaining wells have yielded no detectable TPH or BTEX compounds. It is concluded from sampling results that the groundwater beneath the former tank farm has not been impacted. Further discussions on the historical groundwater monitoring data and plume stability are presented in Section 5.2.

Miscellaneous Activities

One groundwater sample was collected from PL-MW-107 for methyl-t-butyl ether (MTBE) analysis on February 20, 1999. The result was reported as not detected with a detection limit of 2 µg/L. The results indicate that there is no threat of MTBE at the POL Outparcel.

Shea Homes and North Bay Construction are developing residential property adjacent to POL Hill. Two of the POL Hill monitoring wells, POLA-115 and POLA-120, are located on the adjacent property. Monitoring well 115 is located in a cul-de-sac of the planned development. It will be extended to accommodate future monitoring. The developer will coordinate the protection, raising of the well and covering with a traffic rated monitoring well street box as part of their backfill and paving operations at monitoring well 115. Monitoring well 120 has been abandoned.

To accomplish the well extension, an appropriate length of polyvinyl chloride pipe with a bell end will be installed on the existing 4 inch (in.) diameter well casing. The new length of 4-in. polyvinyl chloride well casing will be extended to within 3 to 4 in. of the finish asphalt grade. A comparable length of 8½-in.-diameter pipe will be attached to the existing "monument" pipe and will extend to within 6 in. of finish asphalt grade. The well casing will be capped and a slurry of neat cement grout will be placed in the annular space between the casing and outer well conductor casing (monument pipe). The grout will be placed to within 8 in. of finish grade.

The street box will be set and secured before asphalt is placed. The box will be placed approximately 1 in. above finish asphalt grade and the paving will be brought up to this level. This will create a slight mound to allow rain water to shed away from the box and prevent surface runoff contamination of the well. The well will be protected from hydrocarbon cross-contamination during paving.

Additionally, well POLA-120 was abandoned and destroyed on November 11, 1999, under local permit number WD94/00-10. Gregg Drilling and Testing of Martinez, California performed the well destruction. An earlier attempt to overdrill the well was unsuccessful due to the inability of the drill rig to penetrate bedrock. On November 9, 1999 Mr. Jock Smith of the Marin County Environmental Health Department gave approval to abandon the well in place by pressure grouting.

5.0 Natural Attenuation Summary

In conjunction with the March/April 1998 and September/October 1998 groundwater monitoring events, groundwater samples were collected and analyzed for hydrogeologic chemical indicators of biodegradation of petroleum hydrocarbons. This section provides the evidence that natural attenuation is occurring at the POL Outparcel, including

- A petroleum-hydrocarbon (i.e., TPH) plume is evident under the former location of AST-2. The plume orientation tends to conform with groundwater flow patterns. However, the plume is not migrating and is shrinking.
- Trend shows either a static or diminishing petroleum-hydrocarbon groundwater plume.
- Benzene, toluene, ethylbenzene, and xylene do not appear to be present in most of the wells, and where present, have diminished over time.
- Geochemical indicators of natural attenuation are present.

These lines of evidence are defined in ASTM *Standard Guide for Remediation of Groundwater by Natural Attenuation at Petroleum Release Sites* (1998) and are necessary for demonstrating the appropriateness of remediation by natural attenuation. The primary line of evidence is generally considered enough to demonstrate natural attenuation at the site is a viable remedial alternative, but secondary lines of evidence are required when the monitoring data are limited or are not conclusive.

This section is organized into four subsections. Section 5.1 describes the operative mechanisms of contaminant attenuation and geochemical indicators that demonstrate natural attenuation is occurring. Sections 5.2 and 5.3 discuss historical TPH concentrations and the results of two rounds of monitoring for geochemical indicators of natural attenuation at the site. Section 5.4 summarizes the primary and secondary lines of evidence that natural attenuation is occurring at the POL Outparcel.

5.1 Operative Mechanisms and Geochemical Indicators of Natural Attenuation

Natural attenuation is the reduction in concentration and mass of a contaminant plume due to processes occurring naturally in the environment. Natural attenuation occurs through a combination of physical, chemical, and biological processes, including volatilization, dispersion,

dilution, sorption, and biodegradation (also known as intrinsic bioremediation). All of these processes contribute to a measurable reduction of the concentrations of contaminants within the plume. Biodegradation, however, is the only process that can produce significant reduction of the total mass of the contaminant plume via conversion of the hydrocarbons into carbon dioxide and water (Buscheck et al., 1996).

Hydrocarbon biodegradation is a series of microbially mediated chemical reactions that produce changes in the ambient geochemistry of the groundwater in which the reactions occur (AFCEE, 1995). The occurrence of biodegradation is indicated by measured trends in several geochemical parameters. In general, any of the following trends observed across a dissolved TPH plume (with increasing contaminant concentration) would suggest the occurrence of natural biodegradation:

A relative *decrease* in:	A relative *increase* in:
dissolved oxygen	ferrous iron
oxidation-reduction potential (redox)	alkalinity
nitrate	methane
sulfate	sulfide

Dissolved oxygen (D.O.) is the most thermodynamically favored electron acceptor used in the biodegradation of petroleum hydrocarbons (AFCEE, 1995). Aerobic biodegradation decreases the available D.O. in the groundwater and provides one of the best indicators of fuel biodegradation. However, it is difficult to collect representative readings when monitoring wells do not recharge adequately during purging and sampling. Excessive drawdown (greater than 5 percent of the standing water in the well) during the purge cycle tends to aerate the well water and inflate the D.O. readings above ambient levels. The POL Outparcel wells are screened in relatively low permeability bedrock and aeration of the well water during purging is a problem with many of the wells.

Oxidation-reduction (redox) potential of groundwater is a measure of the electron activity and indicates the relative tendency of a solution to accept or transfer electrons (AFCEE, 1995). Redox reactions in petroleum-hydrocarbon-contaminated groundwater are usually biologically mediated; therefore, the redox potential of a groundwater system depends upon and influences rates of biodegradation. Redox potentials within the plume are lower than those outside the plume and are often correlative with dissolved oxygen concentrations. The areas where oxygen has been depleted by biodegradation tend to have the lowest redox potentials.

After the D.O. is depleted by biodegradation, nitrate, iron, and sulfate may be used as electron acceptors for anaerobic biodegradation. Utilization of nitrate during biodegradation can produce a marked decrease of nitrate in wells screened within the hydrocarbon plume. Utilization of ferric iron and sulfate for anaerobic degradation produces ferrous iron and sulfide, respectively. An increase in these parameters (above background concentrations) within the plume provides another indicator of biodegradation.

Methanogenesis is another biodegradation process that can occur under anaerobic conditions. This process generally occurs after oxygen, nitrate, iron, and sulfate have been depleted by biodegradation (AFCEE, 1995). During methanogenesis, carbon dioxide is used as an electron acceptor and methane is produced. The presence of methane in groundwater within the plume provides an indication of microbial degradation when concentrations exceed background.

Alkalinity variations across the hydrocarbon plume can also provide evidence of biodegradation. Alkalinity tends to be higher in wells located within the hydrocarbon plume than those positioned outside the plume.

Other parameters that provide useful information about biodegradation include pH and temperature. These parameters do not provide direct evidence that biodegradation is occurring, but indicate if the physical and chemical conditions of the groundwater system are conducive to biodegradation. For example, biodegradation operates best when the pH is between six and eight and at temperatures between 16 and 20 degrees Celsius (°C) (Buscheck and O'Reilly, 1995).

5.2 *Historical Total Petroleum Hydrocarbon/Benzene, Toluene, Ethylbenzene, and Xylene Concentrations*

Groundwater monitoring data have been collected at the POL Outparcel since 1992, but the monitoring frequency and analytical procedures have varied, creating some difficulties in evaluating temporal and spatial plume trends. Monitoring was sporadic from 1992 to 1996 as only three events were conducted. Since February 1997, most of the POL Outparcel wells have been sampled five or six times. During the initial two monitoring events conducted between July and September 1992, TPH was quantified using EPA Method 418.1 (EPA, 1995). This method is nonspecific and does not accurately quantify petroleum hydrocarbons in the volatile range. In subsequent monitoring events, TPH was quantified using the more accurate EPA Method 8015M. The TPH results from 1992; therefore, are not comparable to later TPH results and the EPA Method 418.1 results have been omitted from discussion of TPH trends below.

Total petroleum hydrocarbon concentrations have decreased since groundwater monitoring was implemented in 1992. Table 4-1 summarizes the TPH and BTEX concentrations for wells PL-MW-101, -103, -104, -114, and -115 and MW-POLA-121 located in or immediately downgradient of the source area (AST-2). Total petroleum hydrocarbon concentrations have decreased in all of these wells except PL-MW-101, where concentrations have fluctuated between 3,900 to 11,600 µg/L. Concentrations of TPH in wells PL-MW-103, -114, and -115 and MW-POLA-121 have actually decreased to just above or below 50 µg/L, the method detection limit for TPH.

Initial concentrations of BTEX detected in wells PL-MW-101 and MW-POLA-121 (Table 5-1) have declined significantly since 1992. Benzene and toluene were detected in PL-MW-101 in 1992, but have not been detected in subsequent events. Ethylbenzene and total xylenes in well PL-MW-101 have decreased from initial concentrations of 110 and 290 µg/L in July 1992 to 39 and 47 µg/L in October 1998, respectively. Benzene, ethylbenzene, and total xylenes were detected in well MW-POLA-121 during the February and March 1997 monitoring events, but these hydrocarbons were not detected during the subsequent monitoring events. Benzene, toluene, ethylbenzene, and xylenes have not been detected in wells PL-MW-103, -104, -114, and -115 during any monitoring events.

Total petroleum hydrocarbon isoconcentration contours for the March 1994, February 1997, March/April 1998, and January 1999 monitoring events show that the plume is shrinking (see Figure 4-1). The isoconcentration contours for 100 and 500 µg/L have clearly receded toward the source area since 1994, and the areal extent of the plume has been reduced by approximately 50 percent. The portion of the plume containing TPH concentrations in excess of the GSA Phase I Sale Area RCG of 1,200 µg/L also appears to be shrinking.

5.3 Geochemical Indicators

The geochemical parameters collected during the March/April 1998 and September/October 1998 monitoring events provide additional evidence for biodegradation of the TPH plume (Tables 5-1 and 5-2). Of the parameters, D.O., redox potential, ferrous iron, and methane data follow the expected trends described in Section 5.1 for evidence of biodegradation. Isoconcentration maps of these parameters are provided in Figures 5-1 through 5-8.

The data are contoured for wells PL-MW-101, -103, -104, -114, -115, and -116 and MW-POLA-120 and -121 only because these wells are located within and just outside the petroleum-hydrocarbon groundwater plume.

The geochemical parameters show the following conditions and lateral trends that are indicative of TPH biodegradation (Tables 5-1 and 5-2):

- Dissolved oxygen concentrations are lowest at wells PL-MW-101 and -104 and MW-POLA-121, these are the closest to the former AST-2. Dissolved oxygen concentrations in these wells ranged from 0.5 to 0.6 milligrams per liter (mg/L) and 0.8 to 1.94 mg/L during the March/April 1998 and September/October 1998 monitoring events, respectively. Also, these wells have the highest hydrocarbon concentrations, i.e., low D.O. coincides with high concentration portion of the hydrocarbon plume. The September/October 1998 D.O. concentrations were probably lower than actually measured, but some aeration occurred due to excessive drawdown during well purging. Dissolved oxygen concentrations generally increase with distance from these wells and the source area. This pattern provides a strong indication that aerobic biodegradation of the hydrocarbons has occurred.

- Redox potentials are lowest at PL-MW-101, MW-POLA-121, and PL-MW-104, ranging from -255.6 to 11.5 millivolts (mV). The lowest redox potentials (-255.6 and -228.8 mV) were measured in well PL-MW-101, which also had the highest concentrations of TPH and lowest D.O. concentrations. Except for well PL-MW-115, which had a redox potential of 11 mV during the September/October 1998 monitoring event, all other wells had higher redox potentials in March/April 1998. These data indicate that conditions have become reducing (through oxygen depletion) in the area of highest TPH concentrations, and support the conclusion drawn from the D.O. concentrations that aerobic biodegradation of the hydrocarbons has occurred.

- Ferrous iron concentrations were highest in wells nearest the former AST, which is consistent with the results for D.O. and redox. Ferrous iron concentrations were much higher during the September/October 1998 monitoring event, with a maximum concentration of 2.88 mg/L detected in well MW-POLA-121.

- Methane concentrations were consistently highest in wells PL-MW-101, -104, and -115 and MW-POLA-121, 0.04 to 2.8 mg/L and 0.05 to 3.2 mg/L, respectively. This indicates that methanogenesis has occurred in the center of the hydrocarbon plume.

- The pH of all samples ranged from roughly six to eight, the range most favorable for TPH biodegradation.

- The temperature of the groundwater samples ranged from 16 to 20°C during the March/April 1998 monitoring event and 20 to 27°C during the September/October 1998 monitoring event. These differences in temperature probably reflect normal seasonal variation. The lower temperature range measured in March/April 1998 is more favorable for biodegradation of fuels because oxygen is more soluble in cold water.

- Nitrate may not be a suitable electron acceptor at this site because it was not detected in wells near the former AST, and the maximum concentration in wells outside the plume was only 1.3 mg/L. It is possible that the available nitrate was consumed by biodegradation of the TPH plume, but the low concentrations detected in wells outside the plume suggest that it is not an important electron acceptor for the POL Outparcel.

- The total alkalinity (expressed as $CaCO_3$) data are not conclusive, as concentrations within the plume are comparable to those outside the plume. In general, areas contaminated by fuel hydrocarbons may exhibit a total alkalinity that is higher than that seen in background areas. However, a trend may never be evident since naturally occurring calcite in the Franciscan bedrock would affect the alkalinity of the pore water. This is because the microbially-mediated reactions causing biodegredation can yield an increase in the total alkalinity of the system. Changes in alkalinity are most pronounced during aerobic respiration, denitrification, iron reduction, and sulfate reduction, and less pronounced during methanogenesis.

- The sulfate and sulfide data are not conclusive. After dissolved oxygen, nitrate, and bioavailable iron have been depleted in the microbial treatment zone, sulfate may be used as an electron acceptor for anaerobic biodegredation. This process is termed sulfate reduction and results in the production of sulfide. Sulfate concentrations are used as an indicator of anaerobic degradation of fuel compounds. Therefore, the expected trend is decreasing sulfate and increasing sulfide toward the center of the plume. In general, sulfate concentrations are lower in wells nearest the former AST-2, but sulfide was not detected in any wells during the March/April 1998 monitoring event. However, if the dissolved oxygen, nitrate, and bioavailable iron have not been depleted, sulfate may not have yet been reduced, and therefore, sulfides may have not been produced. A maximum sulfide concentration of 0.36 mg/L was detected in the source area well, well PL-MW-101 during the September/October 1998 monitoring event, but sulfide was also detected in many wells outside the plume. However, sulfide detections in the wells outside the plume may be influenced by the chemical composition of the Bay Mud (where some of the wells are screened) compared to the result of microbial reactions.

The data collected on these parameters (especially D.O. and redox potential) strongly indicate that intrinsic bioremediation has occurred at the POL Outparcel. The data show the typical progression from aerobic to anaerobic biodegradation as oxygen is depleted in the area of highest TPH concentrations.

5.4 Summary

The groundwater monitoring data collected at the POL Outparcel indicate the TPH plume is shrinking and natural attenuation is occurring. The lines of evidence for natural attenuation include the following:

- With the exception of well PL-MW-101 that is located near the center of the source area, TPH concentrations have declined significantly since March 1994. The areal extent of the TPH plume was reduced by approximately 50 percent since March 1994.

- Concentrations of TPH in well PL-MW-101 does appear to be relatively stable, i.e., not increasing (see Table 4-1).

- Concentrations of BTEX constituents have declined in all wells since 1992, including well PL-MW-101. Except for well PL-MW-101, BTEX was not detected in any other wells since March 1997.

- Geochemical indicators (i.e., D.O., redox potential, ferrous iron, methane, and sulfate) follow the expected trends for a TPH plume undergoing biodegradation.

These data trends indicate natural attenuation, with groundwater monitoring as a viable remedial action for the POL Outparcel.

6.0 Summary and Conclusions

The purpose of this Closure Report is to document the remedial investigation activities performed and describe the process used to determine the appropriateness of closing the outparcel. The remedial investigation activities were conducted in accordance with a regulatory- and USACE-approved work plan (IT, 1997a) and the CQC/SAP (IT, 1997b). This section summarizes the need for corrective actions at the POL Outparcel. To document the remedial investigation for the POL Outparcel and subsequent closure of the outparcel, this Closure Report presented

- A summary of pertinent findings from previous investigations
- A description of the remedial investigation activities conducted
- The analytical results for these activities
- The condition of the outparcel following remedial investigation activities.

6.1 Need for Corrective Action

Analytes detected during the remedial investigation were evaluated to determine if PCOCs were present in the soil, rock, or groundwater at the POL Outparcel at concentrations above GSA Phase I RCGs. Results of this evaluation concluded that all impacted soil, exceeding an agreed upon petroleum-hydrocarbon cleanup criteria of 100 mg/kg (IT, 1991), was removed, to the extent practicable, during previous investigations, and replaced with clean fill material, or was removed to the limit of the underlying bedrock where refusal occurred.

The groundwater beneath the former tank farm was not impacted; however, petroleum hydrocarbons are present in the groundwater in the vicinity of the former location of AST-2. The extent of impact appears to be limited to the vicinity of the former AST-2. The highest concentrations in groundwater were reported in samples collected from well PL-MW-101, located immediately adjacent to the location of former AST-2. Additionally, evidence supports the fact that the petroleum-hydrocarbon plume at the POL Outparcel is static or is shrinking, and that natural attenuation is occurring.

Additionally, a composite sample of the rock outcrop on Reservoir Hill indicated that elevated concentrations of TPH measured as diesel were detected. However, remediation of the rock outcrop is not proposed since the asphaltic material that covers the outcrop is bound within the

bedrock fractures, is not mobile, and is bound in such a manner that removal by hand is virtually impossible.

6.2 Conclusions

All remedial investigation activities were completed as specified in the work plan (IT, 1997a). All analytical data were compared to applicable GSA Phase I RCGs, which indicate that:

- The source of contamination (i.e., USTs and AST) has been removed
- The impacted soil at the former tank farm area, the AST-2 area, and the area surrounding the groundwater treatment plant has been removed to the extent practicable
- The site has been adequately characterized, no groundwater impacts exist in the former tank farm area
- A petroleum-hydrocarbon groundwater plume exists in the vicinity of former AST-2
- The hydrocarbon plume is stable and shrinking
- Natural attenuation has been shown to be occurring at the site
- Groundwater flow rates are low and flow directions are uniform
- The site does not pose a risk to human health.

This closure report documents the investigation and related remediation activities. The information presented in this document indicates that the removal actions conducted at the site are believed to have completed source removal, and that remedial activities and remedial action objectives necessary to transfer the POL Outparcel have been accomplished and the outparcel is suitable for closure.

All requirements for closure of the POL Outparcel have been achieved. However, due to the presence of elevated petroleum-hydrocarbon concentrations (i.e., above GSA Phase I RCGs) in the groundwater plume in the vicinity of the former AST-2, groundwater monitoring (chemical parameters only) of selected existing monitoring wells would continue on an annual basis.

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Woodward Clyde Federal Services (WCFS), 1995a, *Groundwater TPH Cleanup Levels for GSA Sale Property*, Oakland, CA.

Woodward Clyde Federal Services (WCFS), 1995b, Letter to Matt Alix, USACE, Sacramento District, from Peggy Llewellyn and Michael Sartor, WCFS, February 24, 1995.

Woodward Clyde Federal Services (WCFS), 1995c, *Hamilton Army Airfield GSA Phase I Sale Area Cleanup Goals for Soil and Groundwater*, Oakland, CA.

Woodward Clyde Federal Services (WCFS), 1995d, *Corrective Action Work Plan, Hamilton Army Airfield, GSA Phase I Sale Area*, Revision 1, Oakland, CA.

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Tables

Table 2-1
Summary of Previous Investigations at the Petroleum, Oil, and Lubricant Outparcel
(Page 1 of 2)

Investigation	Remedial and/or Investigation Activities	References[a]
Hamilton Air Force Base Storage Tank Removal Project - IT Corporation	Removed twenty 25,000-gallon USTs[b], one 850,000-gallon AST[c] (AST-2), one 25,000-gal AST, one 750-gallon storage tank, and associated fuel lines and pumping system. Excavated soil with TPH[d] concentrations greater than 1,000 mg/kg[e] from the area around the removed tanks and piping systems. Approximately, 13,000 cubic yards of impacted soil was disposed off-site at a Class I landfill.	IT, 1987
Final Engineering Report, Miscellaneous Contaminated Sites - IT Corporation	Additional investigation of soil from the tank/piping system area resulted in the removal of contaminated soil exceeding TPH-concentrations of 100 mg/kg.	IT, 1991
Field Investigation Report - Engineering-Science, Inc.	Phase I: Thirteen composite soil samples were collected from the drill cuttings during construction of 13 of 15 monitoring wells. Concentrations of contaminants detected included bis(2-ethylhexyl)phthalate (7 detects ranging from 0.82 to 3.02 mg/kg), 2-methylnaphthalene (0.3 mg/kg), and lead (13 detects ranging from 5.94 to 15.2 mg/kg). One groundwater sample was collected from each monitoring well. Monitoring well PL-MW-101 was the only well with consistent detections of benzene (9.69 µg/L[f], ethylbenzene (210 µg/L), xylene (371 µg/L), 1,3-dimethylbenzene (479 µg/L), bis(2-ethylhexyl)phthalate (14.7 µg/L), and 2-methylnaphthalene (89 µg/L). Phase II: Two composite soil samples were collected from the drill cuttings during construction of 2 additional monitoring wells. Lead was the only constituent detected (8.7 and 16 mg/kg). Thirty soil samples were collected from 16 shallow auger borings; however, no contaminants were detected. Seventeen groundwater samples were collected during 2 sampling rounds from 17 wells. Monitoring well PL-MW-101 was the only well with consistent detections during both rounds of benzene (6.05 µg/L), toluene (10 µg/L), ethylbenzene (110 µg/L), xylene (290 µg/L), and 1,3-dimethylbenzene (280 µg/L).	ESI, 1993

Refer to references at end of table.

Table 2-1
Summary of Previous Investigations at the Petroleum, Oil, and Lubricant Outparcel

Investigation	Remedial and/or Investigation Activities	References[a]
Letter to J. Nusrala, Regional Water Quality Control Board, from the USACE[g]	Soil samples were collected along a system grid (approximately 14.5 to 14.5 ft[h]) surrounding the proposed groundwater treatment facility footprint after construction activities indicated that contamination existed. Samples were collected above the water table from 2 to 11 ft below ground surface. Analytical results indicated that the soils to the south/southeast of the treatment facility exhibited the highest concentrations (two samples in excess of 1,000 mg/kg of TPH measured as diesel, other detections greater than 100 mg/kg of TPH measured as diesel). According to the USACE personnel onsite during soil removal and sampling activities, all soils exceeding 100 mg/kg (TPH measured as diesel) beneath the treatment system footprint were excavated to the extent practicable (to bedrock).	USACE, 1993
Supplement to the Final Environmental Investigation Report - USACE	Two soil samples were collected during drilling and installation of monitoring well PL-MW-116 (see Figure A-1). No contaminants were detected. Collected groundwater samples from wells PL-MW-101, -103, -104, -106, -114, -115, and -116 (see Figure A-1). Detected TPH measured as diesel (5,350 µg/L[i]), ethylbenzene (129µg/L), and xylenes (405 µg/L). Additionally, TPH measured as diesel was detected in wells PL-MW-103, -104, -114, and -115 (417, 464, 355, and 803 µg/L, respectively).	USACE, 1994

[a] References

IT Corporation (IT), 1987, *Hamilton AFB Storage Tank Removal Project, Final Report*, Martinez, CA.
IT Corporation (IT), 1991, *Field Engineering Report - Miscellaneous Contaminated Sites, Hamilton Army Airfield*, Martinez, CA.
Engineering-Science, Inc. (ESI), 1993, *Final Environmental Investigation Report, Hamilton Army Airfield, Volumes I and II*, Novato, CA.
U.S. Army Corps of Engineers, Sacramento District (USACE), 1993, Letter to J. Nusrala, Regional Water Quality Control Board from the USACE, Oakland, CA.
U.S. Army Corps of Engineers, Sacramento District (USACE), 1994, *Supplement to the Final Environmental Investigation Report, Hamilton Army Airfield, California*, Sacramento, CA.

[b] underground storage tank(s)
[c] above ground storage tank(s)
[d] total petroleum hydrocarbon(s)
[e] milligram(s) per kilogram
[f] microgram(s) per kilogram
[g] U.S. Army Corps of Engineers
[h] feet
[i] micrograms per liter

Checked By: Mat 12-23-99
Approved By: AWS 12-23-99

Table 4-1. Petroleum, Oil, and Lubricant Outparcel Wells
Total Petroleum Hydrocarbon and Benzene, Toluene, Ethylbenzene, and Total Xylenes Concentrations
(July 1992 to January 1999)

	PL-MW-101								
Analyte	Jul-92	Aug-92	Mar-94	Feb-97	Mar-97	Apr-98	Jul-98	Oct-98	Jan-99
Benzene	6	6	<5	<10	<1	<1	<1	<1	NA (a)
Toluene	10	4.3	<5	<10	<1	<1	<1	<1	NA
Ethylbenzene	110	94	129	78	77	46	42	39	NA
Xylenes	290	260	405	140	120	52	34	47	NA
Total TPH (b)	(c)	(c)	5350	11400	8500	4800	3900	7600	9700
TPH-P (d)	(c)	(c)	(e)	4800	4600	2700	2300	2900	4400
TPH-E (f)	(c)	(c)	5350	6600	3900	2100	1600	4700	5300

	PL-MW-103								
Analyte	Jul-92	Aug-92	Mar-94	Feb-97	Mar-97	Apr-98	Jul-98	Oct-98	Jan-99
Benzene	<1	<1	<0.5	<1	<1	<1	<1	<1	NA
Toluene	<1.5	<1.5	<0.5	<1	<1	<1	<1	<1	NA
Ethylbenzene	<1.4	<1.4	<0.5	<1	<1	<1	<1	<1	NA
Xylenes	<1.4	<1.4	<0.5	<1	<1	<1	<1	<1	NA
Total TPH (b)	(c)	(c)	417	110	<50	200	76	<50	<50
TPH-P (d)	(c)	(c)	(e)	<50	<50	(e)	76	<50	<50
TPH-E (f)	(c)	(c)	417	110	<50	200	<50	<50	<50

	PL-MW-104								
Analyte	Jul-92	Aug-92	Mar-94	Feb-97	Mar-97	Apr-98	Jul-98	Oct-98	Jan-99
Benzene	<1.1	<1.1	<0.5	<1	<1	<1	<1	<1	NA
Toluene	<1.5	<1.5	<0.5	<1	<1	<1	<1	<1	NA
Ethylbenzene	<1.4	<1.4	<0.5	<1	<1	<1	<1	<1	NA
Xylenes	<1.4	<1.4	<0.5	<1	<1	<1	<1	<1	NA
Total TPH (b)	(c)	(c)	464	400	410	287	<50	263	370
TPH-P	(c)	(c)	(e)	130	180	67	<50	83	200
TPH-E	(c)	(c)	464	270	230	220	<50	180	170

	PL-MW-114								
Analyte	Jul-92	Aug-92	Mar-94	Feb-97	Mar-97	Apr-98	Jul-98	Oct-98	Jan-99
Benzene	<1.1	<1.1	<0.5	<1	<1	<1	<1	<1	NA
Toluene	<1.5	<1.5	<0.5	<1	<1	<1	<1	<1	NA
Ethylbenzene	<1.4	<1.4	<0.5	<1	<1	<1	<1	<1	NA
Xylenes	<1.4	<1.4	<0.5	<1	<1	<1	<1	<1	NA
Total TPH (b)	(c)	(c)	355	<50	<50	<50	<50	<50	<50
TPH-P	(c)	(c)	(e)	<50	<50	<50	<50	<50	<50
TPH-E	(c)	(c)	355	<50	<50	<50	<50	<50	<50

	PL-MW-115								
Analyte	Jul-92	Aug-92	Mar-94	Feb-97	Mar-97	Apr-98	Jul-98	Oct-98	Jan-99
Benzene	<1.1	<1.1	<0.5	<1	<1	<1	<1	<1	NA
Toluene	<1.5	<1.5	<0.5	<1	<1	<1	<1	<1	NA
Ethylbenzene	<1.4	<1.4	<0.5	<1	<1	<1	<1	<1	NA
Xylenes	<1.4	<1.4	<0.5	<1	<1	<1	<1	<1	NA
Total TPH (b)	(c)	(c)	803	140	<50	100	<50	<50	<50
TPH-P	(c)	(c)	(e)	<50	<50	<50	<50	<50	<50
TPH-E	(c)	(c)	803	140	<50	100	<50	<50	<50

	MW-POLA-121								
Analyte	Jul-92	Aug-92	Mar-94	Feb-97	Mar-97	Apr-98	Jul-98	Oct-98	Jan-99
Benzene	NS (g)	NS	NS	2.7	4.6	<1	<1	<1	NA
Toluene	NS	NS	NS	<1	<1	<1	<1	<1	NA
Ethylbenzene	NS	NS	NS	7.3	10	<1	<1	<1	NA
Xylenes	NS	NS	NS	7.7	13	<1	<1	<1	NA
Total TPH (b)	NS	NS	NS	1060	1360	100	<50	<50	54
TPH-P	NS	NS	NS	480	630	<50	<50	<50	54
TPH-E	NS	NS	NS	580	730	100	<50	<50	<50

All detected analytes are shown in bold.
Units are in milligrams per liter.

(a) not analyzed
(b) Total petroleum hydrocarbons (extractable and purgeable). The extractable and purgeable hydrocarbon results were added together to provide a conservative estimate of the residual hydrocarbon contamination.
(c) Total petroleum hydrocarbons were quantified using EPA Method 418.1. These results are not considered equivalent to the EPA Method 8015M results obtained from the March 1994 and later monitoring events.
(d) Total petroleum hydrocarbons measured as purgeable
(e) no associated result
(f) Total petroleum hydrocarbons measured as extractable
(g) not sampled, well was not installed until January 1997

Checked by MM 12-23-99
Approved by AWS 12-23-99

Table 2-2
General Services Administration Residential Cleanup Goals

Chemical	Soil (mg/kg[a])[b]	Groundwater (mg/L[c])[d]
Polychlorinated Biphenyls	0.16	8.2
Benzene	0.84	0.35
cis-1,2-dichloroethylene	25	8.4
1,1-dichloroethane	11	7.5
1,1-dichloroethylene	0.034	0.0083
trans-1,2-dichloroethylene	338	149
Trichloroethylene	7.7	2.3
Vinyl Chloride	0.0047	0.00085
Benzo(a)anthracene	0.11	200
Benzo(a)pyrene	0.186	19
Benzo(b)fluoranthene	0.11	56
Benzo(k)fluoranthene	0.11	19
Dibenz(a,h)anthracene	0.037	29
Indeno(1,2,3-cd)pyrene	0.11	301
Lead (total)	190	2.3
Oil and grease	500	NA[e]
TPH[f] measured as gasoline (purgeable)	100	0.6
TPH measured as diesel (extractable)	200	1.2

[a] milligram(s) per kilogram
[b] Woodward-Clyde Federal Services, 1995c, *Hamilton Army Airfield GSA Phase I Sale Area Cleanup Goals for Soil and Groundwater*, Oakland, CA.
[c] milligram(s) per liter
[d] Woodward-Clyde Federal Services, 1995d, *Corrective Action Work Plan, Hamilton Army Airfield, GSA Phase I Sale Area*, Revision 1, Oakland, CA.
[e] not applicable
[f] total petroleum hydrocarbon(s)

Checked by: MMS 12-23-99

Approved by: AWS 12-23-99

Table 5-1. Geochemical Indicators
March/April 1998 Monitoring Event

Well	Dissolved Oxygen (mg/L)[a]	Redox (millivolts)	Ferrous Iron (mg/L)	Methane (mg/L)	Sulfate (mg/L)	Total Sulfide (mg/L)	Nitrate (mg/L)	Total Alkalinity as $CaCO_3$ (mg/L)	pH	Temperature (°C)[b]
PL-MW-101	0.50	-225.6	0.07	2.8	53	ND (<0.05)[c]	ND (<0.05)	516	6.96	19.4
PL-MW-103	0.70	121.1	ND (<0.05)	0.0039	69	ND (<0.05)	0.24	205	6.87	16.8
PL-MW-104	0.60	24.6	0.01	0.04	10	ND (<0.05)	ND	509	6.78	18.7
PL-MW-105	6.40	217.1	0.01	ND (<0.002)	56	ND (<0.05)	0.45	239	7.47	19.2
PL-MW-106	5.20	217.7	ND (<0.05)	0.0028	105	ND (<0.05)	0.09	493	7.30	16.6
PL-MW-107	6.50	174.0	0.01	ND (<0.002)	261	ND (<0.05)	0.10	749	8.05	19.7
PL-MW-108	3.30	221.1	NS[d]	ND (<0.002)	31	ND (<0.05)	ND (<0.05)	248	7.43	18.9
PL-MW-109	5.50	214.0	NS	0.0056	48	ND (<0.05)	ND (<0.05)	413	7.03	19.0
PL-MW-111A[e]	5.70	197.3	ND (<0.05)	ND (<0.002)/ND (<0.002)[f]	249/252	ND (<0.05)	ND (<0.05)/ND (<0.05)	369/368	7.12	12.6
PL-MW-111B	5.00	224.7	ND (<0.05)	ND (<0.002)	234	ND (<0.05)	ND (<0.05)	388	7.32	20.0
PL-MW-112A[e]	2.80	217.3	ND (<0.05)	ND (<0.002)	357	ND (<0.05)	0.10	445	7.55	16.3
PL-MW-112B	4.20	146.5	ND (<0.05)	ND (<0.002)	175	ND (<0.05)	0.19	403	7.99	20.2
PL-MW-113A[e]	2.60	114.0	0.01	0.0022	6360	ND (<0.05)	ND (<0.05)	654	6.90	16.5
PL-MW-113C	2.90	187.4	ND (<0.05)	0.0096	277	ND (<0.05)	ND (<0.05)	596	7.65	17.7
PL-MW-114	1.40	179.0	0.01	ND (<0.002)	49	ND (<0.05)	0.06	176	7.40	17.7
PL-MW-115	1.00	144.5	0.02	0.058/0.062	132/130	ND (<0.05)	ND (<0.05)/ND (<0.05)	300/301	7.35	17.0
PL-MW-116	6.70	197.4	ND (<0.05)	ND (<0.002)	26	ND (<0.05)	1.3	165	6.94	17.3
PL-MW-117A[e]	2.60	190.7	0.01	ND (<0.002)	137	ND (<0.05)	0.27	320	7.50	16.1
PL-MW-117B	3.60	137.4	ND (<0.05)	ND (<0.002)/ND (<0.002)	125/122	ND (<0.05)	0.50/0.49	275/277	8.12	19.9
MW-POLA-118	3.20	184.1	ND (<0.05)	ND (<0.002)	173	ND (<0.05)	0.90	273	7.30	17.1
MW-POLA-119	1.90	146.9	0.01	ND (<0.002)	191	ND (<0.05)	0.22	337	7.12	20.6
MW-POLA-120	2.60	203.7	0.02	ND (<0.002)	119	ND (<0.05)	0.62	242	7.11	19.9
MW-POLA-121	0.60	11.5	ND (<0.05)	0.12	15	ND (<0.05)	ND (<0.05)	128	6.42	17.9

[a] Milligrams per liter
[b] Degrees Celsius
[c] Not detected above practical quantitation limit (practical quantitation limit is in parenthesis)
[d] Not sampled
[e] These are nested well pairs which are completed with a shallow zone (A) and deep zone (B)
[f] Original sample result/field duplicate result

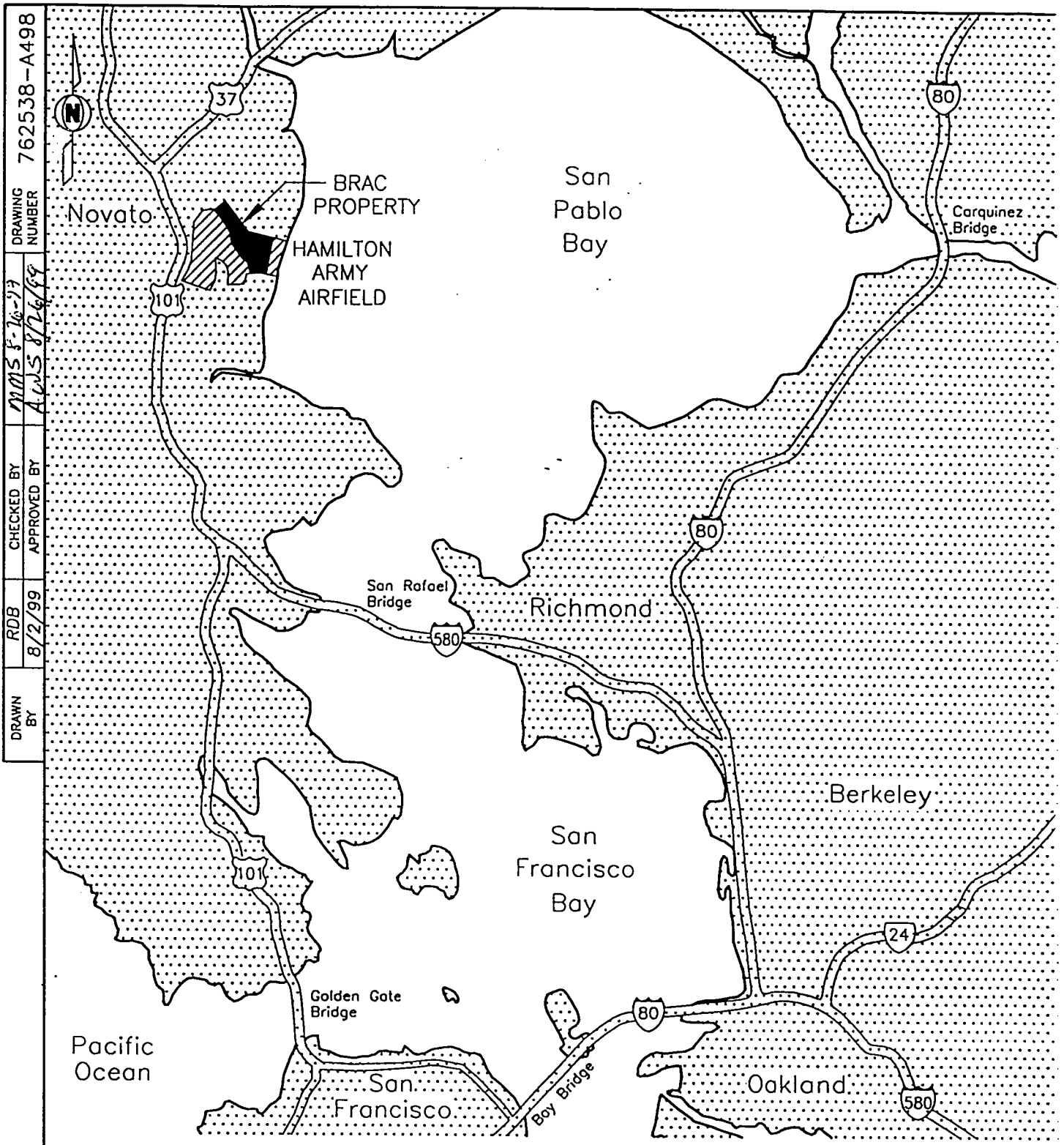
Checked by MMS 12-23-99
Approved by AWS 12-23-99

Table 5-2. Geochemical Indicators
September/October 1998 Monitoring Event

Well	Dissolved Oxygen (mg/L)[a]	Redox (millivolts)	Ferrous Iron (mg/L)	Methane (mg/L)	Sulfate (mg/L)	Total Sulfide (mg/L)	Nitrate (mg/L)	Total Alkalinity as $CaCO_3$ (mg/L)	pH	Temperature (^{o}C)[b]
PL-MW-101	0.82	-228.8	0.22	3.2	53	0.36	ND (<0.05)[c]	544	6.94	21.23
PL-MW-103	2.85	79.9	0.29	0.010	109	0.01	ND (<0.05)	240	6.94	22.24
PL-MW-104	1.94	-50.2	0.01	0.15	8	ND (<0.05)	ND (<0.05)	556	6.77	25.38
PI-MW-105	5.59	350.2	ND (<0.05)	ND (<0.002)	58	0.01	ND (<0.05)	242	7.25	23.15
PL-MW-106	2.12	131.3	ND (<0.05)	0.0046	107	0.03	0.088	514	7.24	25.49
PL-MW-107	7.99	285.2	ND (<0.05)	ND (<0.002)	210	0.12	0.06	756	8.12	22.49
PL-MW-108	4.31	254.7	0.05	ND (<0.002)	64	0.04	0.065	462	7.18	24.07
PL-MW-109	5.45	215.8	0.03	ND (<0.002)	51	0.02	ND (<0.05)	429	7.04	25.42
PL-MW-111A[d]	1.00	145.1	0.02	ND (<0.002)/ND (<0.002)[e]	270/261	0.05	ND (<0.05)/ND (<0.05	389/391	6.91	25.91
PL-MW-111B	1.05	172.4	0.01	ND (<0.002)	250	ND (<0.05)	ND (<0.05)	397	6.93	25.76
PL-MW-112A[d]	2.90	205.4	0.01	ND (<0.002)	571	0.13	0.13	562	7.14	22.46
PL-MW-112B	1.35	190.8	ND (<0.05)	ND (<0.002)	202	0.01	0.18	416	7.50	21.02
PL-MW-113A[d]	3.60	204.5	0.01	ND (<0.002)	7360	0.01	ND (<0.05)	688	6.80	25.92
PL-MW-113C	2.13	184.0	ND (<0.05)	0.0059	282	0.01	ND (<0.05)	614	7.55	23.29
PL-MW-114	1.52	225.6	ND (<0.05)	0.13	78	ND (<0.05)	0.055	227	7.06	20.73
PL-MW-115	2.10	10.6	ND (<0.05)	0.052/0.051	137/148	0.01	ND (<0.05)/ND (<0.05	281/283	7.09	21.16
PL-MW-116	6.11	285.5	0.01	ND (<0.002)	29	0.04	0.98	166	6.96	22.24
PL-MW-117A[d]	3.61	231.2	ND (<0.05)	ND (<0.002)	143	0.05	0.42	322	7.57	25.71
PL-MW-117B	2.00	242.3	ND (<0.05)	ND (<0.002)/ND (<0.002)	125/125	0.01	0.54/0.55	264/264	7.89	25.47
MW-POLA-118	1.50	186.2	0.81	ND (<0.002)	219	0.26	1	303	7.04	27.80
MW-POLA-119	2.11	144.1	0.08	ND (<0.002)	196	0.02	0.35	315	7.18	25.60
MW-POLA-120	2.82	183.3	ND (<0.05)	ND (<0.002)	114	ND (<0.05)	0.9	231	7.05	20.74
MW-POLA-121	1.91	-61.5	2.88	0.6	13	0.06	ND (<0.05)	404	6.81	22.77

[a] Milligrams per liter
[b] Degrees Celcius
[c] Not detected above practical quantitation limit (practical quantitation limit is in parenthesis)
[d] These are nested well pairs which are completed within a shallow zone (A) and deep zone (B)
[e] Original sample/duplicate sample

Checked by MMS 12-23-99
Approved by AWS 12-23-99



DRAWING NUMBER 762538-A498

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RDB 8/2/99	APPROVED BY	MMS 8-16-99 AWS 8/26/99

FIGURE 1-1

SITE LOCATION MAP
HAMILTON ARMY AIRFIELD

PREPARED FOR

USACE SACRAMENTO DISTRICT
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

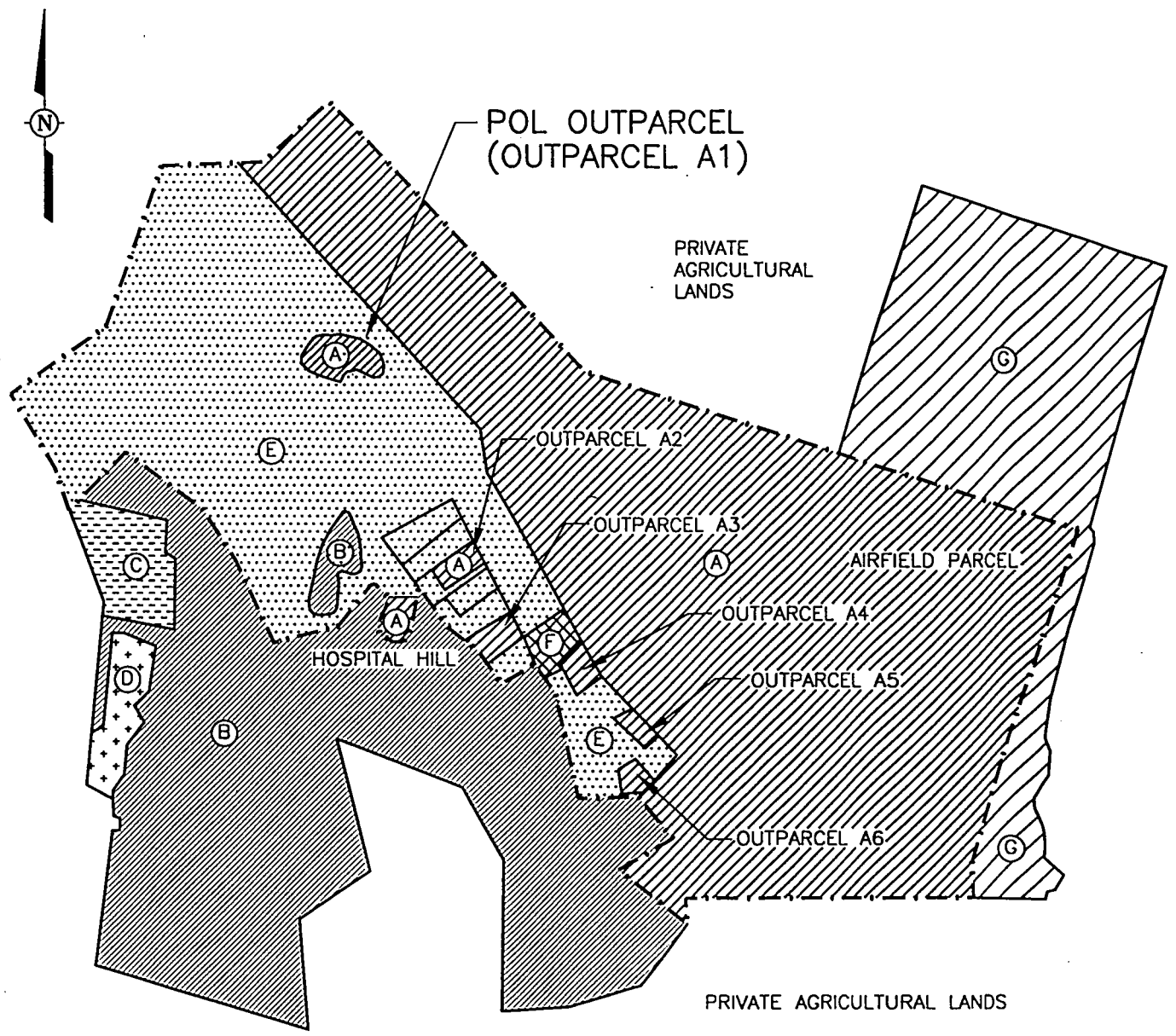
INTERNATIONAL TECHNOLOGY CORPORATION

REFERENCE: WOODWARD-CLYDE DRAWING SK-1 FIGURE 1-1

BRAC POL

slmbphaa

DRAWN BY	RDB	CHECKED BY	DRAWING NUMBER
	8/24/99	APPROVED BY	762538-A315



LEGEND:

- ARMY-OWNED PROPERTY BOUNDARY
- (A) BRAC PROPERTY
- (B) NAVY HOUSING
- (C) LANHAM HOUSING
- (D) NOVATO SCHOOL DISTRICT
- (E) GSA SALE PARCEL
- (F) US COAST GUARD
- (G) STATE OF CALIFORNIA

APPROXIMATE SCALE

0 1000 2000 FEET

FIGURE 1-2

BRAC PROPERTY LOCATION MAP
HAMILTON ARMY AIRFIELD

PREPARED FOR

USACE SACRAMENTO DISTRICT
TOTAL ENVIRONMENTAL
RESTORATION CONTRACT

INTERNATIONAL TECHNOLOGY CORPORATION

REFERENCE:
WOODWARD-CLYDE FEDERAL SERVICES DRAWING SK9469.

BRAC POL

bplm

DRAWN BY	RDB	CHECKED BY	AWS	DRAWING NUMBER	762538-B525
	10/13/99	APPROVED BY	11/16/99		

LIMIT OF 1993 USACE INVESTIGATION

FORMER ABERDEEN ROAD

FORMER BUILDING 737

LANDFILL 26 GROUNDWATER TREATMENT FACILITY

DRAINAGE DITCH

WEST BOUNDARY ROAD

LIMIT OF 1991 USACE INVESTIGATION

LANDFILL 26

RAMP

HYDRANT

FORMER BUILDING 738

FORMER BUILDING 736

SLOPE

ABERDEEN ROAD

DRAINAGE

LEVEE CONSTRUCTION HAUL ROAD

FORMER JP-4 PUMPS

STAIRWAY

FORMER TANK FARM

LEVELED AREA ON BENCHED SLOPE

FORMER AST 2 EL. 52'

RESERVOIR HILL

LEGEND:

- FENCE
- FORMER STRUCTURES
- APPROXIMATE LIMITS OF USACE EXCAVATION
- NHP LEVEE AND EASEMENT
- POL OUTPARCEL BRAC PROPERTY BOUNDARY
- GSA PHASE I TRANSFERRED PROPERTY BOUNDARY
- LANDFILL 26 BOUNDARY

APPROXIMATE SCALE

70 0 70 FEET

FIGURE 1-3

POL OUTPARCEL SITE MAP

BRAC PROPERTY

HAMILTON ARMY AIRFIELD

PREPARED FOR

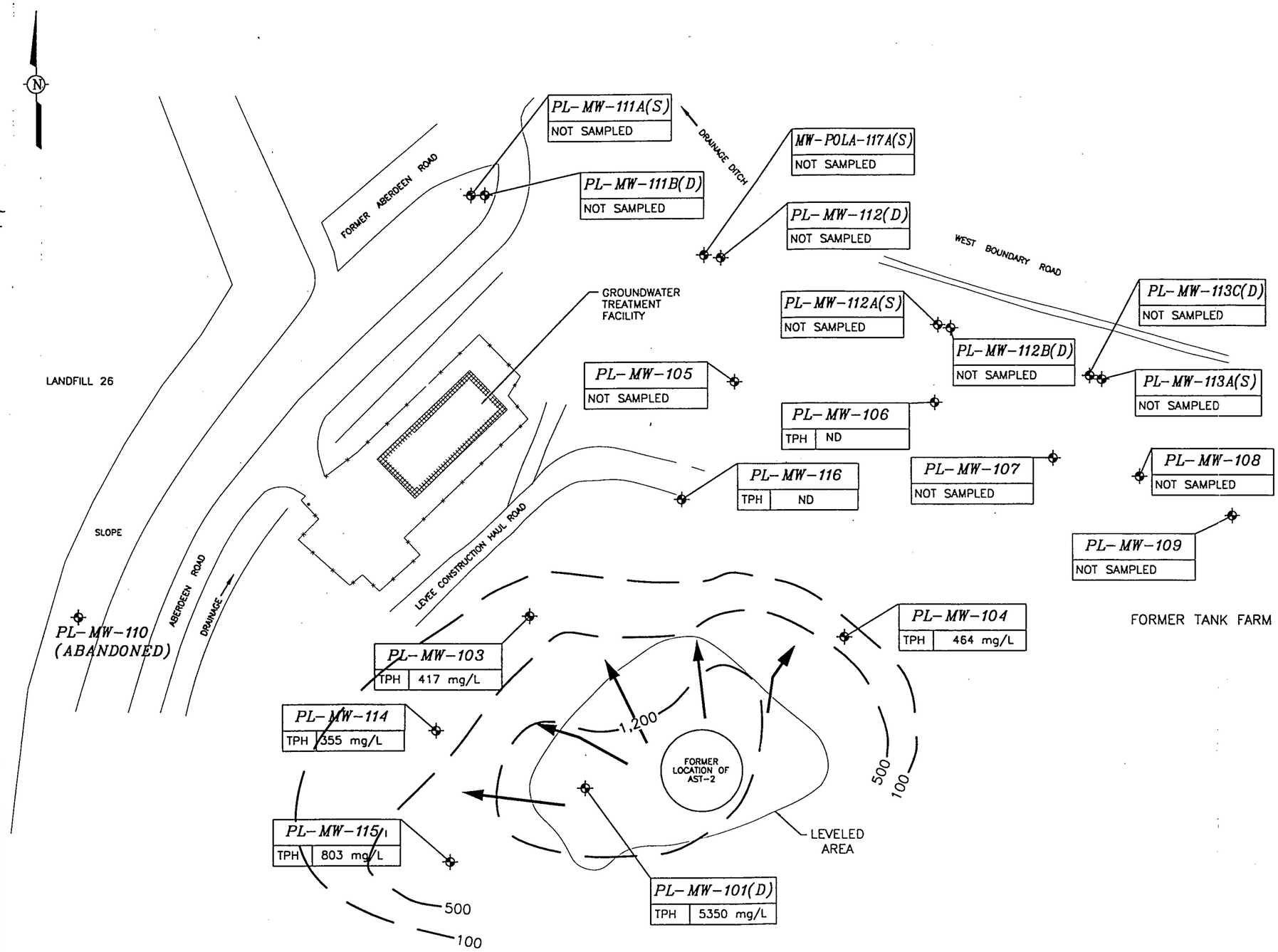
USACE SACRAMENTO DISTRICT TOTAL ENVIRONMENTAL RESTORATION CONTRACT

INTERNATIONAL TECHNOLOGY CORPORATION

BRAC POL

POLOSM XREF: HBASE12S

DRAWN BY	RDB	CHECKED BY	CMS	12-4-99	DRAWING NUMBER	762538-B512
	10/13/99	APPROVED BY	Aw/s	12/16/99		



LEGEND:

- FENCE
- EXISTING MONITORING WELL
- INFERRED GROUNDWATER FLOW DIRECTION
- 100 — CONTOURS REPRESENT COMBINED TPH-DIESEL, TPH-GASOLINE, AND TPH-JP4 DETECTIONS. CONCENTRATIONS ARE IN µG/L.
- ND — NOT DETECTED (DETECTION LIMIT=50µG/L FOR TPH COMPOUNDS AND 1µG/L FOR BTEX)
- (S) SHALLOW MONITORING WELL
- (D) DEEPER MONITORING WELL

NOTE:

- BASED ON PROCESS KNOWLEDGE, JP-4 WAS STORED IN THE TANKS. HOWEVER, BASED ON CHEMICAL INTERFERENCES AND DEGRADATION RESULTING IN THE QUANTIFICATION OF JP-4 AGAINST DIESEL AND GASOLINE STANDARDS, THE REPORTED VALUES FOR TPH-DIESEL AND TPH-GASOLINE WERE TOTALLED AT EACH LOCATION TO CONSERVATIVELY ESTIMATE THE EXTENT AND MAGNITUDE OF JP-4 GROUNDWATER CONTAMINATION.

SCALE
0 80 160 FEET

FIGURE 4-1

TOTAL PETROLEUM HYDROCARBON CONCENTRATIONS IN GROUNDWATER
POL OUTPARCEL
MARCH 1994
BRAC PROPERTY
HAMILTON ARMY AIRFIELD

PREPARED FOR

USACE SACRAMENTO DISTRICT
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

INTERNATIONAL TECHNOLOGY CORPORATION

BRAC POL

tph0394

DRAWING NUMBER	762538-B513
CHECKED BY	MMS 12-16-99
APPROVED BY	[illegible] 12/16/99
RDB	10/15/99
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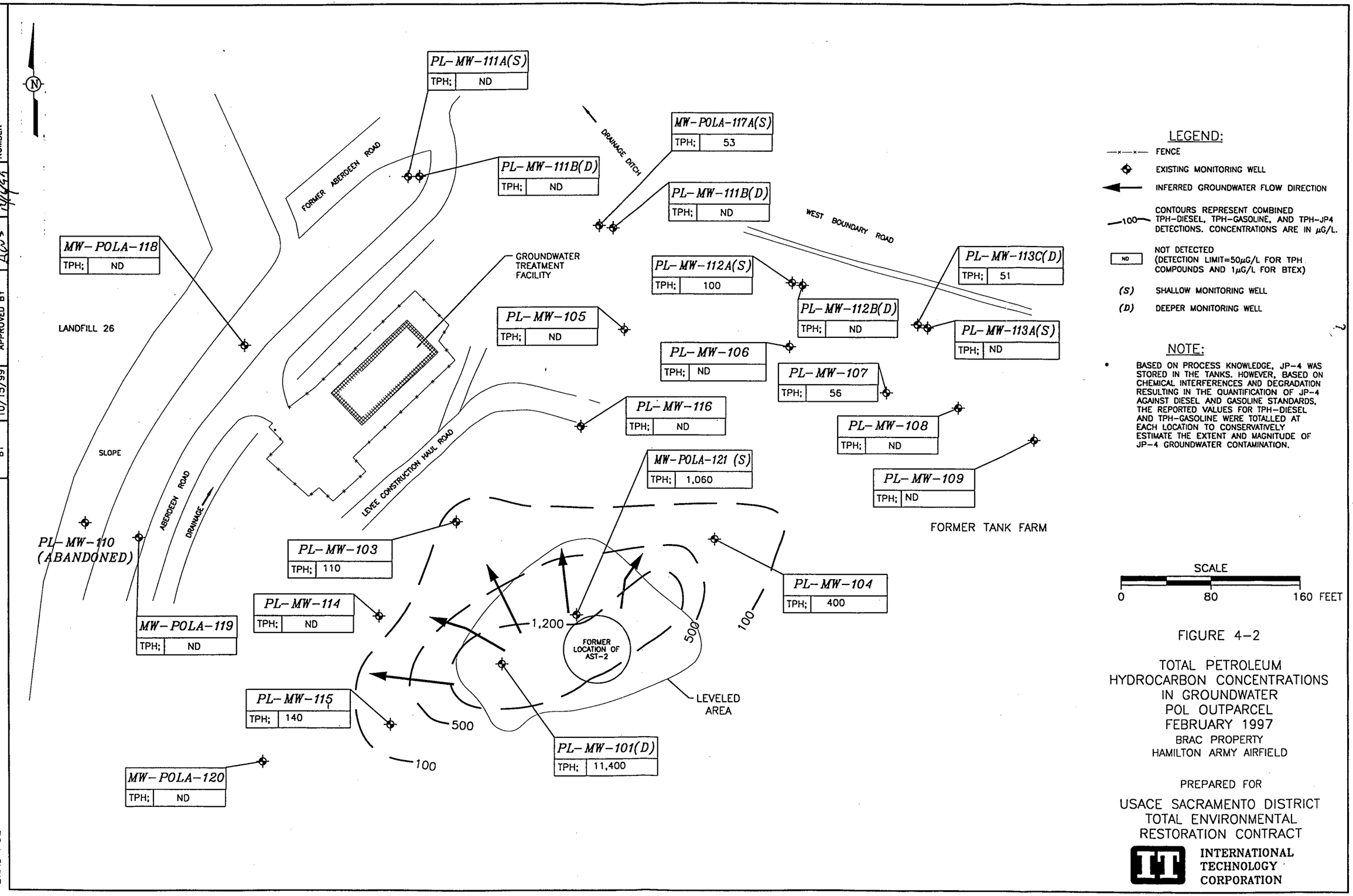


FIGURE 4-2

TOTAL PETROLEUM HYDROCARBON CONCENTRATIONS IN GROUNDWATER
POL OUTPARCEL
FEBRUARY 1997
BRAC PROPERTY
HAMILTON ARMY AIRFIELD

PREPARED FOR

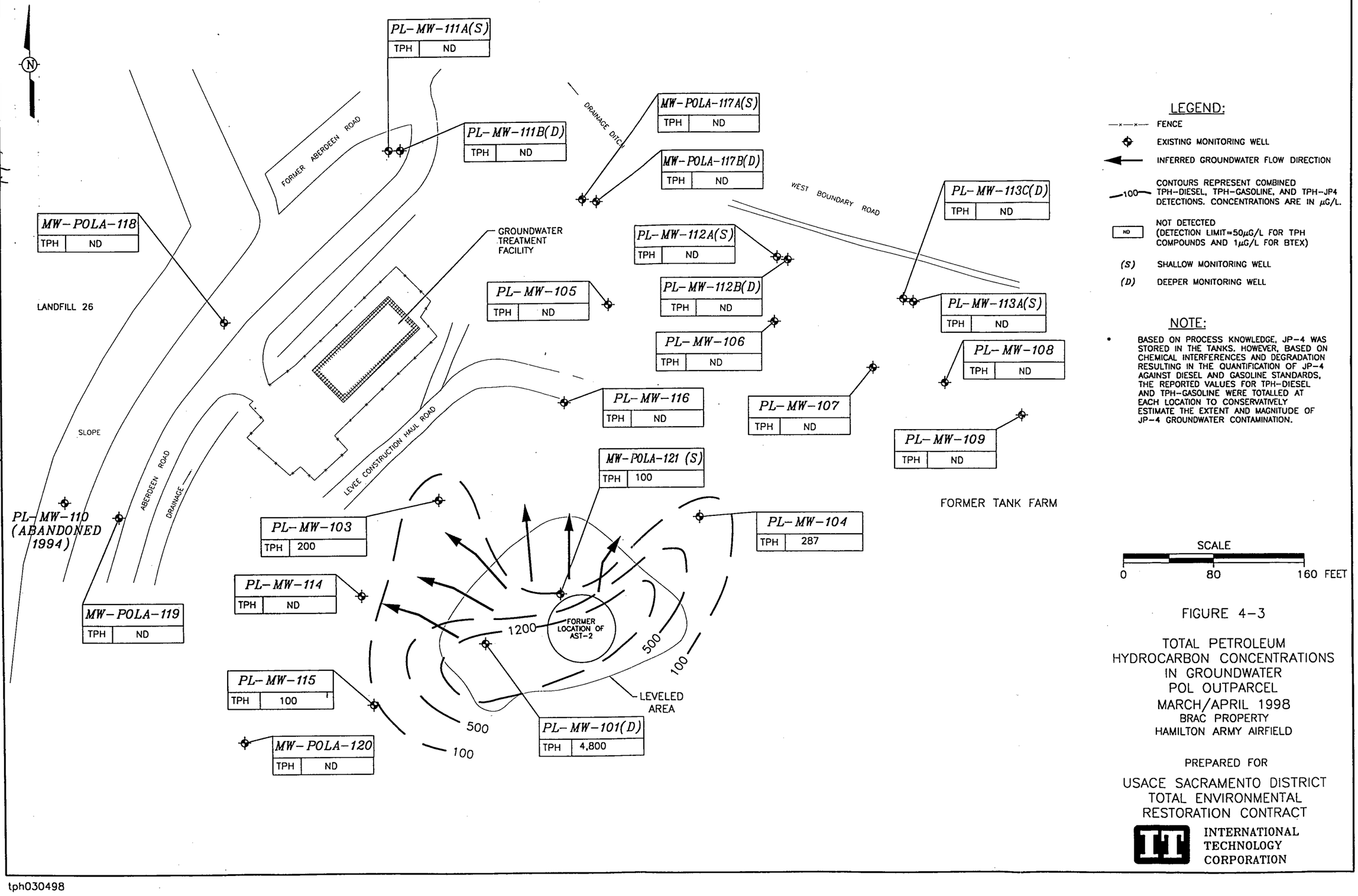
USACE SACRAMENTO DISTRICT
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

INTERNATIONAL TECHNOLOGY CORPORATION

BRAC POL

tph0297

DRAWN BY	CHECKED BY	DRAWING NUMBER
RDB 12/15/99	APPROVED BY	762538-B514



LEGEND:

- FENCE
- EXISTING MONITORING WELL
- INFERRED GROUNDWATER FLOW DIRECTION
- 100 — CONTOURS REPRESENT COMBINED TPH-DIESEL, TPH-GASOLINE, AND TPH-JP4 DETECTIONS. CONCENTRATIONS ARE IN µG/L.
- ND — NOT DETECTED (DETECTION LIMIT=50µG/L FOR TPH COMPOUNDS AND 1µG/L FOR BTEX)
- (S) SHALLOW MONITORING WELL
- (D) DEEPER MONITORING WELL

NOTE:

* BASED ON PROCESS KNOWLEDGE, JP-4 WAS STORED IN THE TANKS. HOWEVER, BASED ON CHEMICAL INTERFERENCES AND DEGRADATION RESULTING IN THE QUANTIFICATION OF JP-4 AGAINST DIESEL AND GASOLINE STANDARDS, THE REPORTED VALUES FOR TPH-DIESEL AND TPH-GASOLINE WERE TOTALLED AT EACH LOCATION TO CONSERVATIVELY ESTIMATE THE EXTENT AND MAGNITUDE OF JP-4 GROUNDWATER CONTAMINATION.

SCALE
0 80 160 FEET

FIGURE 4-3

TOTAL PETROLEUM HYDROCARBON CONCENTRATIONS IN GROUNDWATER
POL OUTPARCEL
MARCH/APRIL 1998
BRAC PROPERTY
HAMILTON ARMY AIRFIELD

PREPARED FOR

USACE SACRAMENTO DISTRICT
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

INTERNATIONAL TECHNOLOGY CORPORATION

BRAC POL

tph030498

DRAWN BY	RDB	CHECKED BY	AMS	DRAWING NUMBER	762538-B515
	10/15/99	APPROVED BY	AMS 12-16-99		

N

PL-MW-111A(S)
NOT SAMPLED

PL-MW-111B(D)
NOT SAMPLED

FORMER ABERDEEN ROAD

DRAINAGE DITCH

MW-POLA-117A(S)
NOT SAMPLED

MW-POLA-117B(D)
NOT SAMPLED

WEST BOUNDARY ROAD

PL-MW-113C(D)
NOT SAMPLED

MW-POLA-118
NOT SAMPLED

GROUNDWATER TREATMENT FACILITY

PL-MW-112A(S)
NOT SAMPLED

PL-MW-112B(D)
NOT SAMPLED

PL-MW-113A(S)
NOT SAMPLED

LANDFILL 26

PL-MW-105
NOT SAMPLED

PL-MW-106
NOT SAMPLED

PL-MW-107
NOT SAMPLED

PL-MW-108
NOT SAMPLED

PL-MW-116
TPH ND

SLOPE

ABERDEEN ROAD

DRAINAGE

LEVEE CONSTRUCTION HAUL ROAD

PL-MW-109
NOT SAMPLED

MW-POLA-121 (S)
TPH 54

PL-MW-104
TPH 370

FORMER TANK FARM

PL-MW-110
(ABANDONED)

PL-MW-103
TPH ND

PL-MW-114
TPH ND

MW-POLA-119
NOT SAMPLED

1,200

500

100

FORMER LOCATION OF AST-2

500

100

LEVELED AREA

PL-MW-115
TPH ND

MW-POLA-120
TPH ND

PL-MW-101(D)
TPH 9,700

LEGEND:

- FENCE
- EXISTING MONITORING WELL
- INFERRED GROUNDWATER FLOW DIRECTION
- 100 — CONTOURS REPRESENT COMBINED TPH-DIESEL, TPH-GASOLINE, AND TPH-JP4 DETECTIONS. CONCENTRATIONS ARE IN µG/L.
- ND — NOT DETECTED (DETECTION LIMIT=50µG/L FOR TPH COMPOUNDS AND 1µG/L FOR BTEX)
- (S) SHALLOW MONITORING WELL
- (D) DEEPER MONITORING WELL

NOTE:

- BASED ON PROCESS KNOWLEDGE, JP-4 WAS STORED IN THE TANKS. HOWEVER, BASED ON CHEMICAL INTERFERENCES AND DEGRADATION RESULTING IN THE QUANTIFICATION OF JP-4 AGAINST DIESEL AND GASOLINE STANDARDS, THE REPORTED VALUES FOR TPH-DIESEL AND TPH-GASOLINE WERE TOTALLED AT EACH LOCATION TO CONSERVATIVELY ESTIMATE THE EXTENT AND MAGNITUDE OF JP-4 GROUNDWATER CONTAMINATION.

SCALE
0 80 160 FEET

FIGURE 4-4

TOTAL PETROLEUM HYDROCARBON CONCENTRATIONS IN GROUNDWATER
POL OUTPARCEL
JANUARY 1999
BRAC PROPERTY
HAMILTON ARMY AIRFIELD

PREPARED FOR

USACE SACRAMENTO DISTRICT
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

INTERNATIONAL TECHNOLOGY CORPORATION

BRAC POL

tph0199

DRAWN BY	CHECKED BY	DRAWING NUMBER
BRAC POL	RDB 10/15/99	762538-B516

N

FORMER ABERDEEN ROAD

DRAINAGE DITCH

WEST BOUNDARY ROAD

GROUNDWATER TREATMENT FACILITY

LANDFILL 26

SLOPE

ABERDEEN ROAD

DRAINAGE

LEVEE CONSTRUCTION HAUL ROAD

PL-MW-111A(S)	
CH_4	ND

PL-MW-111B(D)	
CH_4	ND

MW-POLA-117A(S)	
CH_4	ND

MW-POLA-117B(D)	
CH_4	ND

PL-MW-112B(D)	
CH_4	ND

PL-MW-112A(S)	
CH_4	ND

PL-MW-113C(D)	
CH_4	0.0096 mg/L

PL-MW-113A(S)	
CH_4	0.0022 mg/L

MW-POLA-118	
CH_4	ND

PL-MW-105	
CH_4	ND

PL-MW-106	
CH_4	0.0028 mg/L

PL-MW-116	
CH_4	ND

PL-MW-107	
CH_4	ND

PL-MW-108	
CH_4	ND

PL-MW-109	
CH_4	0.0056 mg/L

PL-MW-103	
CH_4	0.0039 mg/L

MW-POLA-119	
CH_4	ND

PL-MW-110 (ABANDONED)

PL-MW-114	
CH_4	ND

PL-MW-115	
CH_4	0.058 mg/L

MW-POLA-120	
CH_4	ND

PL-MW-101(D)	
CH_4	2.8 mg/L

MW-POLA-121 (S)	
CH_4	0.12 mg/L

PL-MW-104	
CH_4	0.04 mg/L

0.1

1.0

0.01

0.01

FORMER LOCATION OF AST-2

FORMER TANK FARM

LEVELED AREA

LEGEND:

- FENCE
- PAVEMENT BOUNDARY
- EXISTING MONITORING WELL
- 0.1 — METHANE CONCENTRATION CONTOUR (mg/L)
- ND NOT DETECTED
- (S) SHALLOW MONITORING WELL
- (D) DEEPER MONITORING WELL

SCALE

0 80 160 FEET

FIGURE 5-1

METHANE (CH_4) CONCENTRATIONS
MARCH/APRIL 1998
POL OUTPARCEL
BRAC PROPERTY
HAMILTON ARMY AIRFIELD

PREPARED FOR

USACE SACRAMENTO DISTRICT
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

INTERNATIONAL TECHNOLOGY CORPORATION

meth030498

DRAWN BY	CHECKED BY	DRAWING NUMBER
BRAC POL	RDB 10/15/99	762538-B517

N

PL-MW-111A(S)
Fe2+ ND

PL-MW-111B(D)
Fe2+ ND

DRAINAGE DITCH

MW-POLA-117A(S)
Fe2+ 0.01 mg/L

MW-POLA-117B(D)
Fe2+ ND

PL-MW-112A(S)
Fe2+ ND

PL-MW-112B(D)
Fe2+ ND

PL-MW-113C(D)
Fe2+ ND

PL-MW-113A(S)
Fe2+ 0.01 mg/L

WEST BOUNDARY ROAD

FORMER ABERDEEN ROAD

MW-POLA-118
Fe2+ ND

LANDFILL 26

GROUNDWATER TREATMENT FACILITY

PL-MW-105
Fe2+ 0.01 mg/L

PL-MW-106
Fe2+ ND

PL-MW-107
Fe2+ 0.01 mg/L

PL-MW-108
Fe2+ NS

PL-MW-109
Fe2+ NS

PL-MW-116
Fe2+ ND

SLOPE

ABERDEEN ROAD

DRAINAGE

LEVEE CONSTRUCTION HAUL ROAD

PL-MW-103
Fe2+ ND

MW-POLA-119
Fe2+ 0.01 mg/L

PL-MW-110
(ABANDONED)

PL-MW-104
Fe2+ 0.01 mg/L

PL-MW-114
Fe2+ 0.01 mg/L

0.02 0.04 0.06

FORMER LOCATION OF AST-2

MW-POLA-121 (S)
Fe2+ ND

FORMER TANK FARM

LEVELED AREA

MW-POLA-120
Fe2+ 0.02 mg/L

PL-MW-101(D)
Fe2+ 0.07 mg/L

PL-MW-115
Fe2+ 0.02 mg/L

LEGEND:

- FENCE
- PAVEMENT BOUNDARY
- EXISTING MONITORING WELL
- 0.02 FERROUS IRON CONCENTRATION CONTOUR (mg/L)
- ND NOT DETECTED
- (S) SHALLOW MONITORING WELL
- (D) DEEPER MONITORING WELL

SCALE
0 80 160 FEET

FIGURE 5-2

FERROUS IRON (FE^{2+}) CONCENTRATIONS
MARCH/APRIL 1998
POL OUTPARCEL
BRAC PROPERTY
HAMILTON ARMY AIRFIELD

PREPARED FOR

USACE SACRAMENTO DISTRICT
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

INTERNATIONAL TECHNOLOGY CORPORATION

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DRAWN BY	CHECKED BY	DRAWING NUMBER
RDB 10/15/99	MJS 12-16-99	762538-B518
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	Links 12/16/99	

N

PL-MW-111A(S)
Eh 197.3 mV

PL-MW-111B(D)
Eh 224.7 mV

MW-POLA-117A(S)
Eh 190.7 mV

MW-POLA-117B(D)
Eh 143.7 mV

PL-MW-112A(S)
Eh 217.3 mV

PL-MW-112B(D)
Eh 146.5 mV

PL-MW-106
Eh 217.7 mV

PL-MW-113C(D)
Eh 187.4 mV

PL-MW-113A(S)
Eh 114.0 mV

MW-POLA-118
Eh 184.1 mV

PL-MW-105
Eh 217.1 mV

PL-MW-116
Eh 197.4 mV

PL-MW-107
Eh 174.0 mV

PL-MW-108
Eh 221.1 mV

PL-MW-109
Eh 214 mV

MW-POLA-119
Eh 146.9 mV

PL-MW-103
Eh 121.1 mV

PL-MW-104
Eh 24.6 mV

PL-MW-110
(ABANDONED)

PL-MW-114
Eh 179.0 mV

PL-MW-115
Eh 144.5 mV

MW-POLA-121 (S)
Eh 11.5 mV

PL-MW-101(D)
Eh -255.6 mV

MW-POLA-120
Eh 203.7 mV

FORMER ABERDEEN ROAD
DRAINAGE DITCH
WEST BOUNDARY ROAD
GROUNDWATER TREATMENT FACILITY
LANDFILL 26
SLOPE
ABERDEEN ROAD
DRAINAGE
CONSTRUCTION HAUL ROAD
FORMER LOCATION OF AST-2
LEVELED AREA
FORMER TANK FARM

150
100
50
0
-50
-100
-200

LEGEND:
- FENCE
- PAVEMENT BOUNDARY
- EXISTING MONITORING WELL
- 50 — OXIDATION/REDUCTION POTENTIAL (millivolts)
- ND NOT DETECTED
- (S) SHALLOW MONITORING WELL
- (D) DEEPER MONITORING WELL

SCALE
0 80 160 FEET

FIGURE 5-3

OXIDATION/REDUCTION POTENTIAL (Eh)
MARCH/APRIL 1998
POL OUTPARCEL
BRAC PROPERTY
HAMILTON ARMY AIRFIELD

PREPARED FOR

USACE SACRAMENTO DISTRICT
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

INTERNATIONAL TECHNOLOGY CORPORATION

BRAC POL

oxid030498

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	10/15/99	APPROVED BY	ALS	12/16/99		

N

PL-MW-111A(S)
D.O. 5.7 mg/L

PL-MW-111B(D)
D.O. 5.0 mg/L

FORMER ABERDEEN ROAD

DRAINAGE DITCH

MW-POLA-117A(S)
D.O. 2.6 mg/L

MW-POLA-117B(D)
D.O. 3.6 mg/L

PL-MW-112A(S)
D.O. 2.8 mg/L

PL-MW-112B(D)
D.O. 2.9 mg/L

WEST BOUNDARY ROAD

PL-MW-113C(D)
D.O. 4.2 mg/L

PL-MW-113A(S)
D.O. 2.6 mg/L

MW-POLA-118
D.O. 3.2 mg/L

LANDFILL 26

GROUNDWATER TREATMENT FACILITY

PL-MW-105
D.O. 6.4 mg/L

PL-MW-106
D.O. 5.2 mg/L

PL-MW-107
D.O. 6.5 mg/L

PL-MW-108
D.O. 3.3 mg/L

PL-MW-116
D.O. 6.7 mg/L

SLOPE

ABERDEEN ROAD

DRAINAGE

LEVEE CONSTRUCTION HAUL ROAD

2.0

1.0

PL-MW-109
D.O. 5.5 mg/L

PL-MW-103
D.O. 0.7 mg/L

MW-POLA-119
D.O. 1.9 mg/L

PL-MW-110
(ABANDONED)

PL-MW-114
D.O. 1.4 mg/L

1.0

2.0

0.5

PL-MW-104
D.O. 0.6 mg/L

FORMER TANK FARM

FORMER LOCATION OF AST-2

0.5

LEVELED AREA

PL-MW-101(D)
D.O. 0.5 mg/L

MW-POLA-121 (S)
D.O. 0.6 mg/L

MW-POLA-120
D.O. 2.6 mg/L

PL-MW-115
D.O. 1.0 mg/L

2.0

LEGEND

- FENCE
- PAVEMENT BOUNDARY
- EXISTING MONITORING WELL
- 0.5 DISSOLVED OXYGEN CONCENTRATION CONTOUR (mg/L)
- ND NOT DETECTED
- (S) SHALLOW MONITORING WELL
- (D) DEEPER MONITORING WELL

SCALE
0 80 160 FEET

FIGURE 5-4

DISSOLVED OXYGEN (DO) CONCENTRATIONS
MARCH/APRIL 1998
POL OUTPARCEL
BRAC PROPERTY
HAMILTON ARMY AIRFIELD

PREPARED FOR

USACE SACRAMENTO DISTRICT
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

IT INTERNATIONAL TECHNOLOGY CORPORATION

BRAC POL

doc030498

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BRAC POL	RDB 10/15/99	MMS 12/16/99	762538-B520

N

PL-MW-111A(S)
CH4 ND

PL-MW-111B(D)
CH4 ND

FORMER ABERDEEN ROAD

DRAINAGE DITCH

MW-POLA-117A(S)
CH4 ND

MW-POLA-117B(D)
CH4 ND

WEST BOUNDARY ROAD

MW-POLA-118
CH4 ND

GROUNDWATER TREATMENT FACILITY

PL-MW-112A(S)
CH4 ND

PL-MW-113C(D)
CH4 0.0059 mg/L

LANDFILL 26

PL-MW-105
CH4 ND

PL-MW-112B(D)
CH4 ND

PL-MW-113A(S)
CH4 ND

PL-MW-106
CH4 0.0046 mg/L

PL-MW-108
CH4 ND

PL-MW-107
CH4 ND

SLOPE

ABERDEEN ROAD

DRAINAGE

LEVEE CONSTRUCTION HAUL ROAD

PL-MW-116
CH4 ND

PL-MW-109
CH4 ND

FORMER TANK FARM

PL-MW-103
CH4 0.01 mg/L

MW-POLA-119
CH4 ND

PL-MW-104
CH4 0.15 mg/L

PL-MW-110
(ABANDONED)

PL-MW-114
CH4 0.13

0.1

0.01

1.0

FORMER LOCATION OF AST-2

MW-POLA-121 (S)
CH4 0.6 mg/L

PL-MW-115
CH4 0.052 mg/L

LEVELED AREA

PL-MW-101(D)
CH4 3.2 mg/L

MW-POLA-120
CH4 ND

LEGEND:

- FENCE
- PAVEMENT BOUNDARY
- EXISTING MONITORING WELL
- 0.1 — METHANE CONCENTRATION CONTOUR (mg/L)
- ND NOT DETECTED
- (S) SHALLOW MONITORING WELL
- (D) DEEPER MONITORING WELL

SCALE

0 80 160 FEET

FIGURE 5-5

METHANE (CH4) CONCENTRATIONS
SEPTEMBER/OCTOBER 1998
POL OUTPARCEL
BRAC PROPERTY
HAMILTON ARMY AIRFIELD

PREPARED FOR

USACE SACRAMENTO DISTRICT
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

INTERNATIONAL TECHNOLOGY CORPORATION

meth091098

DRAWN BY	RDB	CHECKED BY		DRAWING NUMBER
	10/15/99	APPROVED BY		762538-B521

N

PL-MW-111A(S)
Fe2+ 0.02

PL-MW-111B(D)
Fe2+ 0.01

FORMER ABERDEEN ROAD

DRAINAGE DITCH

MW-POLA-117A(S)
Fe2+ ND

MW-POLA-117B(D)
Fe2+ ND

WEST BOUNDARY ROAD

PL-MW-113C(D)
Fe2+ ND

MW-POLA-118
Fe2+ 0.81

GROUNDWATER TREATMENT FACILITY

PL-MW-112A(S)
Fe2+ 0.01

PL-MW-112B(D)
Fe2+ ND

LANDFILL 26

PL-MW-105
Fe2+ ND

PL-MW-113A(S)
Fe2+ 0.01

PL-MW-106
Fe2+ ND

PL-MW-108
Fe2+ 0.05

SLOPE

PL-MW-116
Fe2+ 0.01

PL-MW-107
Fe2+ ND

ABERDEEN ROAD

DRAINAGE

LEVEE CONSTRUCTION HAUL ROAD

PL-MW-109
Fe2+ 0.03

MW-POLA-121 (S)
Fe2+ 2.88

PL-MW-103
Fe2+ 0.29 mg/L

0.1

1.0

MW-POLA-119
Fe2+ 0.08

PL-MW-104
Fe2+ 0.01

PL-MW-110
(ABANDONED)

PL-MW-114
Fe2+ ND

FORMER LOCATION OF AST-2

PL-MW-115
Fe2+ ND

LEVELED AREA

PL-MW-101(D)
Fe2+ 0.22

MW-POLA-120
Fe2+ ND

FORMER TANK FARM

LEGEND:

- FENCE
- PAVEMENT BOUNDARY
- EXISTING MONITORING WELL
- 0.02 FERROUS IRON CONCENTRATION CONTOUR (mg/L)
- ND NOT DETECTED
- (S) SHALLOW MONITORING WELL
- (D) DEEPER MONITORING WELL

SCALE
0 80 160 FEET

FIGURE 5-6
FERROUS Fe^{2+})
CONCENTRATIONS
SEPTEMBER/OCTOBER 1998
POL OUTPARCEL

BRAC PROPERTY
HAMILTON ARMY AIRFIELD

PREPARED FOR

USACE SACRAMENTO DISTRICT
TOTAL ENVIRONMENTAL
RESTORATION CONTRACT

INTERNATIONAL TECHNOLOGY CORPORATION

BRAC POL

ferr091098

DRAWN BY	CHECKED BY	DRAWING NUMBER
RDB 10/15/99	APPROVED BY	762538-B522

N

PL-MW-111A(S) Eh 145

PL-MW-111B(D) Eh 172

FORMER ABERDEEN ROAD

DRAINAGE DITCH

MW-POLA-117A(S) Eh 231

MW-POLA-117B(D) Eh 242

WEST BOUNDARY ROAD

PL-MW-113C(D) Eh 184

MW-POLA-118 Eh 186

GROUNDWATER TREATMENT FACILITY

PL-MW-112A(S) Eh 205

PL-MW-112B(D) Eh 191

PL-MW-105 Eh 350

PL-MW-113A(S) Eh 205

LANDFILL 26

PL-MW-106 Eh 131

PL-MW-108 Eh 255

PL-MW-116 Eh 286

PL-MW-107 Eh 285

PL-MW-109 Eh 216

SLOPE

ABERDEEN ROAD

DRAINAGE

LEVEE CONSTRUCTION HAUL ROAD

FORMER TANK FARM

MW-POLA-119 Eh 144

PL-MW-103 Eh 80

PL-MW-104 Eh -50

PL-MW-110 (ABANDONED)

PL-MW-114 Eh 226

-50 0 100

FORMER LOCATION OF AST-2

MW-POLA-121 (S) Eh -62

-100

PL-MW-115 Eh 11

-50 0 100

LEVELED AREA

PL-MW-101(D) Eh -229

MW-POLA-120 Eh 183

LEGEND

- FENCE
- PAVEMENT BOUNDARY
- EXISTING MONITORING WELL
- 50 OXIDATION/REDUCTION POTENTIAL (millivolts)
- ND NOT DETECTED
- (S) SHALLOW MONITORING WELL
- (D) DEEPER MONITORING WELL

SCALE

0 80 160 FEET

FIGURE 5-7

OXIDATION/REDUCTION POTENTIAL (Eh)
SEPTEMBER/OCTOBER 1998
POL OUTPARCEL
BRAC PROPERTY
HAMILTON ARMY AIRFIELD

PREPARED FOR

USACE SACRAMENTO DISTRICT
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

IT INTERNATIONAL TECHNOLOGY CORPORATION

BRAC POL

oxid091098

DRAWN BY	CHECKED BY	DRAWING NUMBER
RDB	MMS 12-16-98	762538-B523
10/15/99	APPROVED BY Ans 12/16/98	

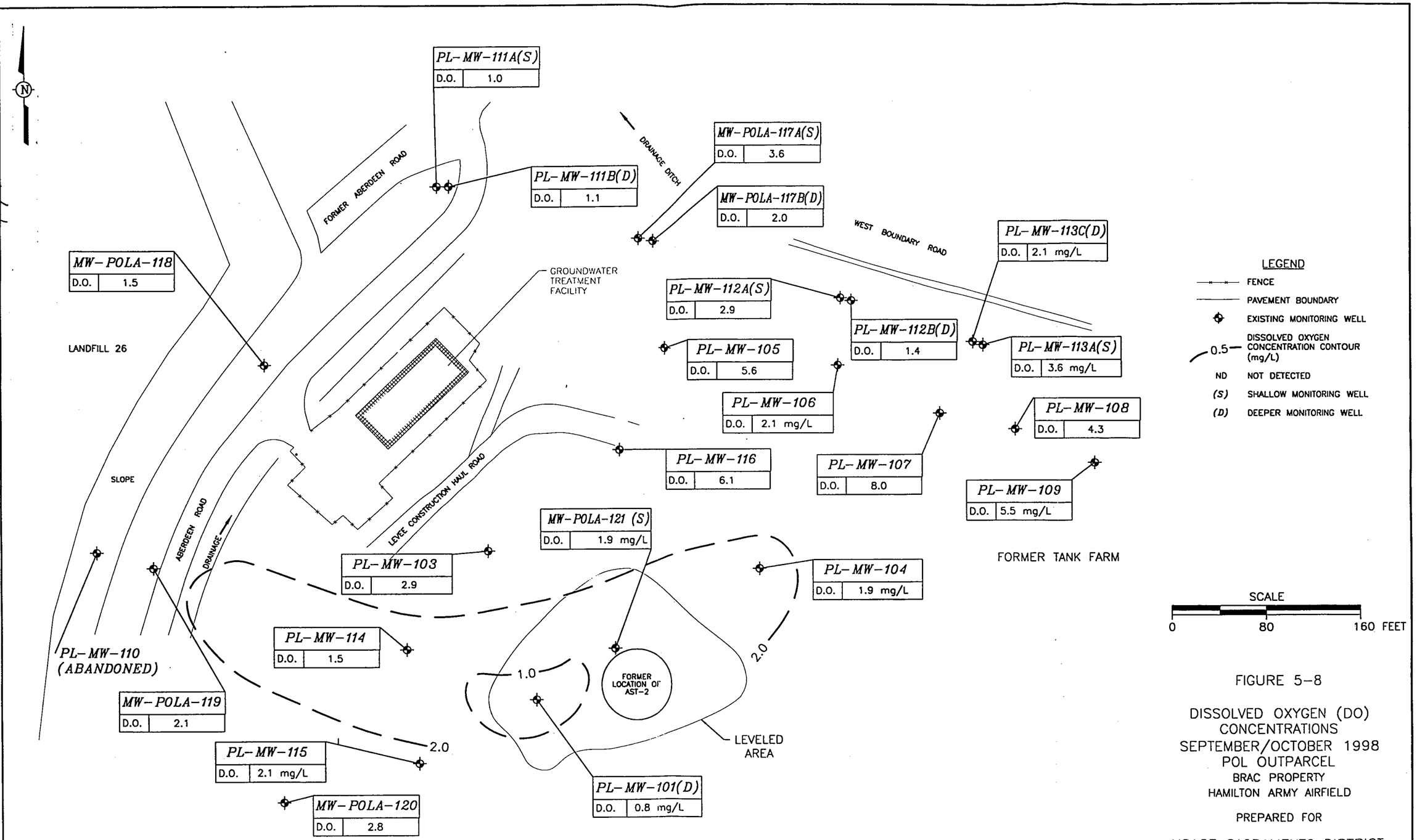

FIGURE 5-8

DISSOLVED OXYGEN (DO) CONCENTRATIONS
SEPTEMBER/OCTOBER 1998
POL OUTPARCEL
BRAC PROPERTY
HAMILTON ARMY AIRFIELD

PREPARED FOR

USACE SACRAMENTO DISTRICT
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

INTERNATIONAL TECHNOLOGY CORPORATION

BRAC POL

doc091098

TABLE A-1
Monitoring Well Construction Details
POL Outparcel, Hamilton Army Airfield

Well Number	Date Completed	Drilled Depth (ft)	Well Depth (ft)	Borehole Diameter (in)	Screen Interval (ft)	PVC Stickup	Ground Elevation (ft above MSL)	Depth to Water (ft bgs)	Steel Monument Stickup (ft)
MW-101	1/31/1991	53.0	49.6	10	29.8-49.3	0	47.1	28.0	0.5
MW-103	1/30/1991	27.0	26.8	10	11.5-26.5	0	14.8	1.0	0.5
MW-104	1/31/1991	42.8	42.6	10	27.8-42.3	0	24.8	18.8	0.5
MW-105	12/27/1990	19.8	19.5	10	4.8-19.2	0	9.1	8.8	0.5
MW-106	1/23/1991	18.0	17.6	10	7.8-17.3	0	4.4	5.7	0.5
MW-107	1/23/1991	17.3	17.0	10	7.2-16.7	0	4.6	7.2	0.5
MW-108	1/24/1991	17.2	16.9	10	7.1-16.6	0	4.5	7.1	0.5
MW-109	1/25/1991	18.2	18.0	10	8.1-17.7	0	5.2	6.9	0.5
MW-110*	1/17/1991	17.1	16.8	10	6.9-16.5	0	17.5	7.3	0.5
MW-111A	1/18/1991	17.4	17.1	10	7.3-16.8	0	5.2	3.1	0.5
MW-111B	1/28/1991	29.5	29.3	10	24.0-29.0	0	5.2	3.9	0.5
MW-112A	1/22/1991	17.1	17.1	10	7.4-16.9	0	1.7	13.7	0.5
MW-112B	1/18/1991	29.8	29.5	10	24.7-29.2	0	1.8	1.5	0.5
MW-113A	1/22/1991	17.0	16.5	10	6.7-16.2	0	2.6	5.9	0.5
MW-113C	1/29/1991	30.0	29.8	10	24.0-29.5	0	2.8	3.5	0.5
MW-114	8/18/1992	27.8	27.3	10	12.0-27.0	0	20.6	6.7	0.5
MW-115	8/21/1992	28.0	27.8	10	17.5-27.5	0	22.5	7.6	0.5
MW-116	3/1/1994	35.0	21.6	8.5	11.3-21.3	2.15	15.8	6.2	2.5
MW-117A	10/18/1996	17.6	15.0	10.0	5.0-15.0	3.2	5.26	no data	3.1
MW-117B	10/19/1996	28.0	26.0	10.0	16.0-26.0	2.1	5.15	no data	2.4
MW-118	10/24/1996	16.4	15.0	10.0	5.0-15.0	2.1	12.39	no data	2.6
MW-119	10/11/1996	17.0	14.4	12.0	4.4-14.4	2.2	19.3	no data	3.0
MW-120**	1/30/1997	40	30.66	8.63	15.0-30.0	2.9	25.5	no data	3.6
MW-121	1/31/1997	40	32.67	8.63	7.0-32.0	2.4	46	no data	3.4

Sources: ES, 1993;USACE, 1994; IT,1999
All wells have 4" Schedule 40 PVC pipe, with 0.010 inch slot screens
All wells installed according to USATHAMA geotechnical specifications, with a minimum of 2.0 ft of grout/cement seal and 2.0 ft of bentonite seal
* Abandoned in place sometime after 1992
** Abandoned and destroyed in 1999 to permit development of the area
Abbreviations: ft = feet, in = inches, MSL = mean sea level, bgs = below ground surface