FINAL

ENGINEERING EVALUATION/ COST ANALYSIS REPORT

Prepared for:

Small Arms Range / Hardfill 49 A
Former Griffiss Air Force Base
Rome, New York

through

the Air Force Center for Environmental Excellence
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TABLE OF CONTENTS

SECTION **PAGE**

LIST OF FIGURES

FIGURE **PAGE**

LIST OF TABLES

TABLE **PAGE**

APPENDICES

APPENDIX

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LIST OF ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DoD	Department of Defense
EBS	Environmental Baseline Survey
E&E	Ecology and Environment, Inc.
EE/CA	Engineering Evaluation/Cost Analysis
FPM	FPM Group, Ltd.
ft	feet
GLDC	Griffiss Local Development Corporation
IRA	Interim Remedial Action
IRP	Installation Restoration Program
LAW	LAW Engineering and Environmental Services, Inc.
MSL	mean sea level
NCP	National Contingency Plan
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
RL	Reporting Limit
SAR	Small Arms Range
SARA	Superfund Amendments and Reauthorization Act
S/S	Solidification/Stabilization

TAGM	Technical and Administrative Guidance Memorandum
USAF	U.S. Air Force
USC	United States Code
USEPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compounds
WP	Work Plan

1 INTRODUCTION

This Engineering Evaluation/Cost Analysis (EE/CA) report has been prepared in support of the proposed interim removal action (IRA) at the Small Arms Range (SAR), an Area of Concern (AOC). The SAR is also known as Installation Restoration Program (IRP) Site OT-61. The EE/CA has been prepared pursuant to Section 300.415(b)(4)(i) of the National Contingency Plan (NCP).

The objectives of this EE/CA report are to:

- Satisfy environmental review requirements.
- Satisfy administrative record requirements (documentation of removal action selection).
- Provide framework for evaluating and selecting alternative technologies.

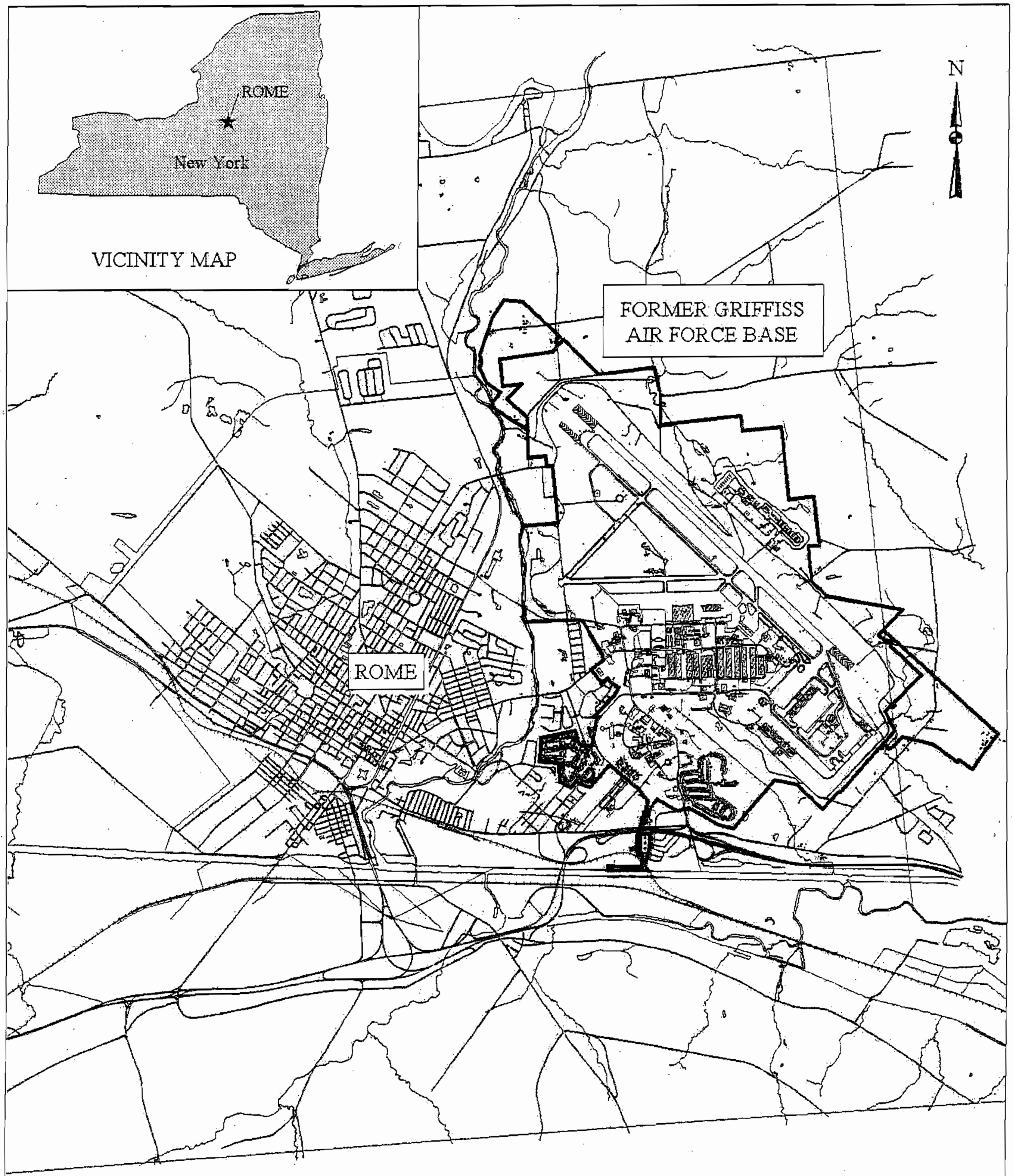
This EE/CA provides a comparative analysis of four alternatives for a site identified as suitable for implementation of a non-time-critical IRA for soil contamination at former Griffiss Air Force Base (AFB), Rome, New York (Figure 1-1). Lead is the contaminant of concern in the soil at the SAR. The IRA location is generally enclosed by the footprint of the former SAR berm. The former SAR berm was leveled within that area when the existing SAR berm was constructed (Figure 1-2). This area is also within the boundaries of Hardfill 49A, where hardfill materials were placed above the spread former berm material (Figure 1-3). The four alternatives considered in this EE/CA include Institutional/Engineering Controls; In-Situ Soil Solidification/Stabilization; Soil Excavation, Off-Site Treatment, and Disposal; and Soil Excavation, On-Site Screening with Off-Site Treatment and Disposal.

1.1 The United States Air Force Installation Restoration Program

This EE/CA report was prepared as part of the United States Air Force (USAF) IRP in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (i.e., Superfund). The purpose of the USAF IRP is to assess past hazardous waste disposal and spill sites at USAF installations and to develop remedial actions consistent with the NCP for sites that pose a threat to human health and welfare or the environment. This section presents information on the program origins, objectives, and organization.

In 1980, Congress enacted CERCLA which outlines the responsibility for identifying and remediating contaminated sites in the United States and its possessions. The CERCLA legislation identifies the U.S. Environmental Protection Agency (USEPA) as the primary policy and enforcement agency regarding contaminated sites.

In 1986 Superfund Amendments and Reauthorization Act (SARA) extended the requirements of CERCLA and modified CERCLA with respect to goals for remediation and the steps that lead to the selection of a remedial process. Under SARA, technologies that provide permanent removal or destruction of a contaminant are preferable to action that only contains or isolates the



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GRIFFISS AIR FORCE BASE
ROME, NEW YORK

FIGURE 1-1
BASE LOCATION MAP

Drawn by: G.L.D.	Checked by: J.B.	Date: 12/99

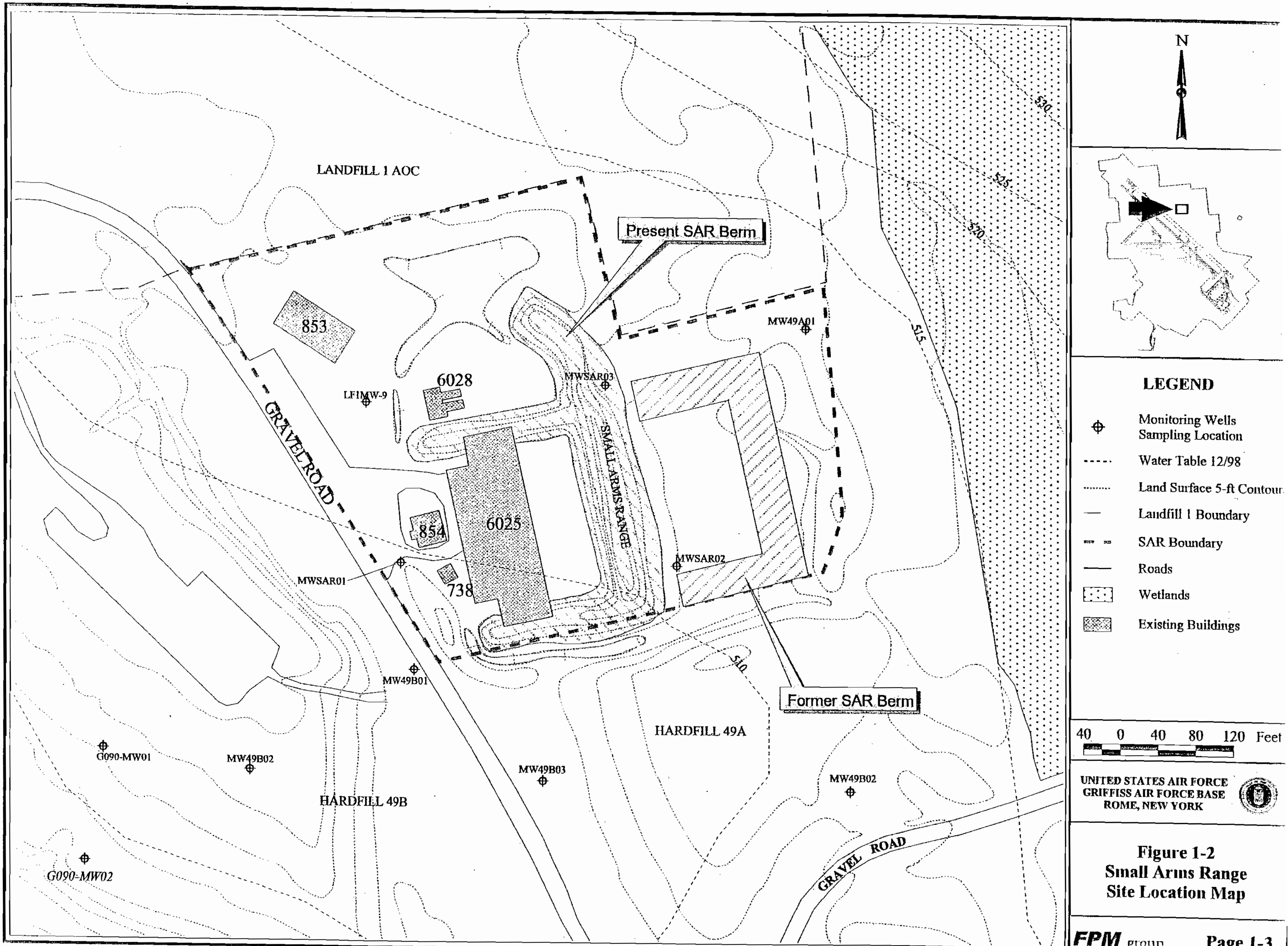

Figure 1-2
Small Arms Range
Site Location Map

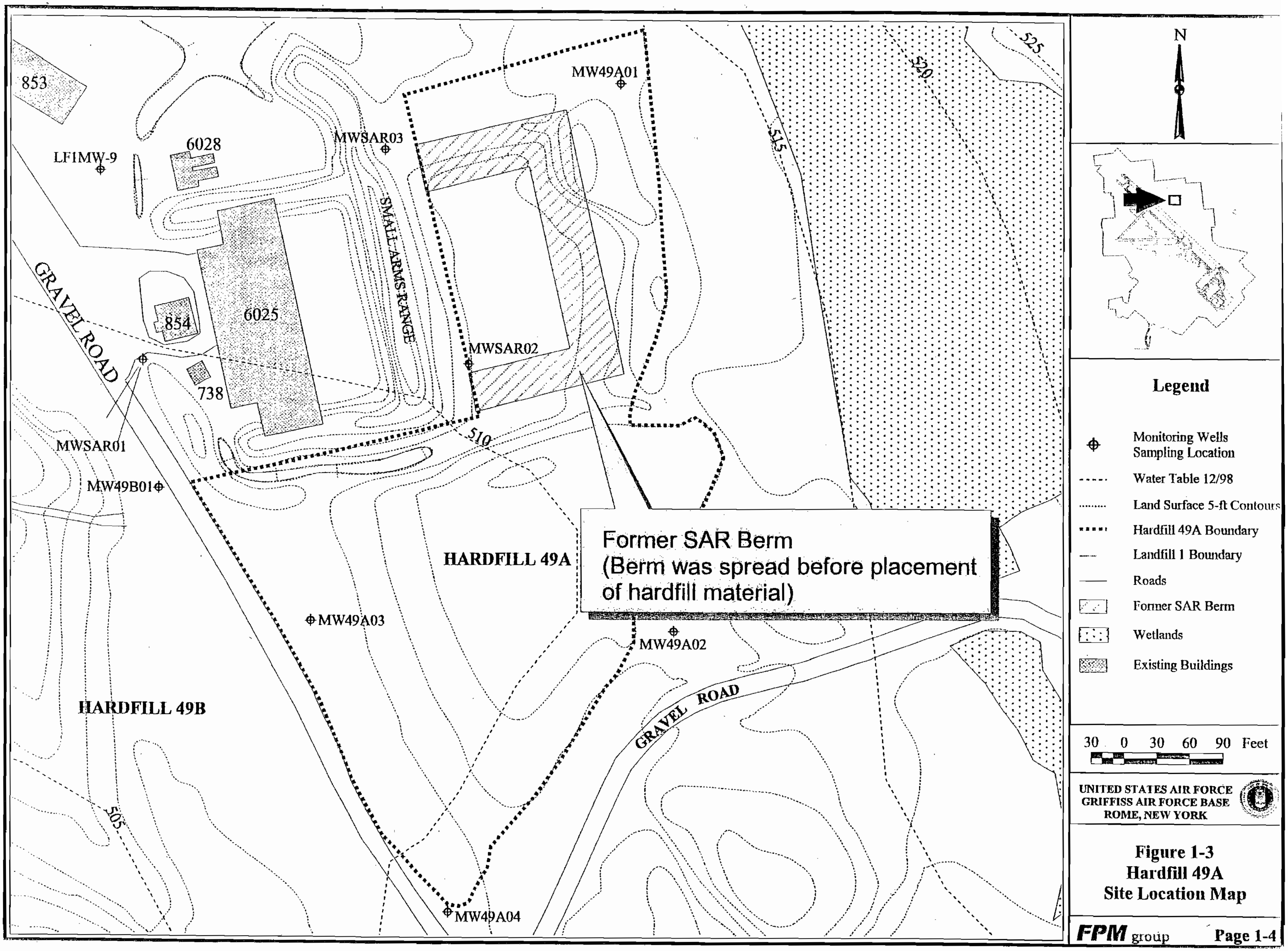

Figure 1-3
Hardfill 49A
Site Location Map

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contaminant. SARA also provides for greater interaction with public and state agencies and extends the USEPA's role in evaluating health risks associated with contamination. Under SARA, early determination of Applicable or Relevant and Appropriate Requirements (ARARs) is required, and the consideration of potential remediation alternatives is recommended at the initiation of a Remedial Investigation/Feasibility Study (RI/FS). SARA is the primary legislation governing remedial action at past hazardous waste disposal sites.

Executive Order 12580, adopted in 1987, gave various federal agencies, including the Department of Defense (DoD), the responsibility to act as lead agencies for conducting investigations and implementing remediation efforts when they are the sole or co-contributor to contamination on or off their properties.

To ensure compliance with CERCLA, its regulations, and Executive Order 12580, the DoD developed the IRP, under the Defense Environmental Restoration Program, to identify potentially contaminated sites, investigate these sites, and evaluate and select remedial actions for potentially contaminated facilities. The DoD issued the Defense Environmental Quality Program Policy Memorandum (DEQPPM) 80-6 regarding the IRP program in June 1980, and implemented the policies outlined in this memorandum in December 1980. The NCP was issued by USEPA in 1980 to provide guidance on a process by which (1) a contaminant release could be reported, (2) contamination could be identified and quantified, and (3) remedial actions could be selected. The NCP describes the responsibility of federal and state governments and those responsible for contaminant releases.

The DoD formally revised and expanded the existing IRP directives and amplified all previous directives and memoranda concerning the IRP through DEQPPM 81-5, dated 11 December 1981. The memorandum was implemented by a USAF message dated 21 January 1982.

The IRP is the DoD's primary mechanism for response actions on USAF installations affected by the provisions of SARA. In November 1986, in response to SARA and other USEPA interim guidance, the USAF modified the IRP to provide for an RI/FS program. The IRP was modified so that RI/FS studies could be conducted as parallel activities rather than serial activities. The program now includes SARA determinations, identification and screening of technologies, and development of alternatives. The IRP may include multiple field activities and pilot studies prior to a detailed final analysis of alternatives. Over the years, requirements of the IRP have been developed and modified to ensure that DoD compliance with federal laws, such as Resource Conservation and Recovery Act (RCRA), NCP, CERCLA, and SARA, can be met.

1.2 Report Organization

This EE/CA report is organized as follows:

- Chapter 1.0 Introduction: This chapter presents a brief introduction of the site, IRP program, and status.

- Chapter 2.0 Site Description and History: This chapter describes the Base location and history; detailed descriptions of the site and its history; discusses the regional and the site-specific geology, hydrogeology, meteorology; demographic profile, and current/future use of the site.

- Chapter 3.0 Site Characterization: This chapter discusses previous investigations and presents available information regarding the nature, extent, and estimated volume of contamination at the site.

- Chapter 4.0 Identification of Response Action Objectives: This chapter provides a description of the scope and objectives for the site, the schedule, and the ARARs for the site.

- Chapter 5.0 Identification and Evaluation of Response Action Alternatives: This chapter recommends an alternative based on the findings in the EE/CA.

- Chapter 6.0 Recommended Response Action Plan: This chapter provides implementation plan and schedule.

- Chapter 7.0 References. This chapter lists all documentation used to support and cited in this EE/CA.

- Appendix A – Cost Estimate Tables
- Appendix B – Test Pit Investigation Report
- Appendix C – Test Pit Logs
- Appendix D – Groundwater Investigation Report

2 SITE DESCRIPTION AND HISTORY

This chapter describes the Base location and history; provides detailed descriptions of the site and its history; discusses the regional and site-specific topography, geology, hydrogeology, hydrology; and meteorology and presents available information regarding the nature of contamination at the site.

2.1 Location and History

The SAR is located northeast of the base runways, bordered on the northeast by a wooded area, on the north by Landfill 1, on the south by Hardfill 49A, and on the southwest by a gravel road as shown by Figure 1-2. The SAR originally included a berm that included a 100-yard backstop. In the early 1980s, the former SAR berm was demolished and a new berm that reduced the shooting range distance from 100 yards to 50 yards was created. The footprint of the former berm (100-yard range), after being spread, was later used for disposal of hardfill in conjunction with the Hardfill 49A operation.

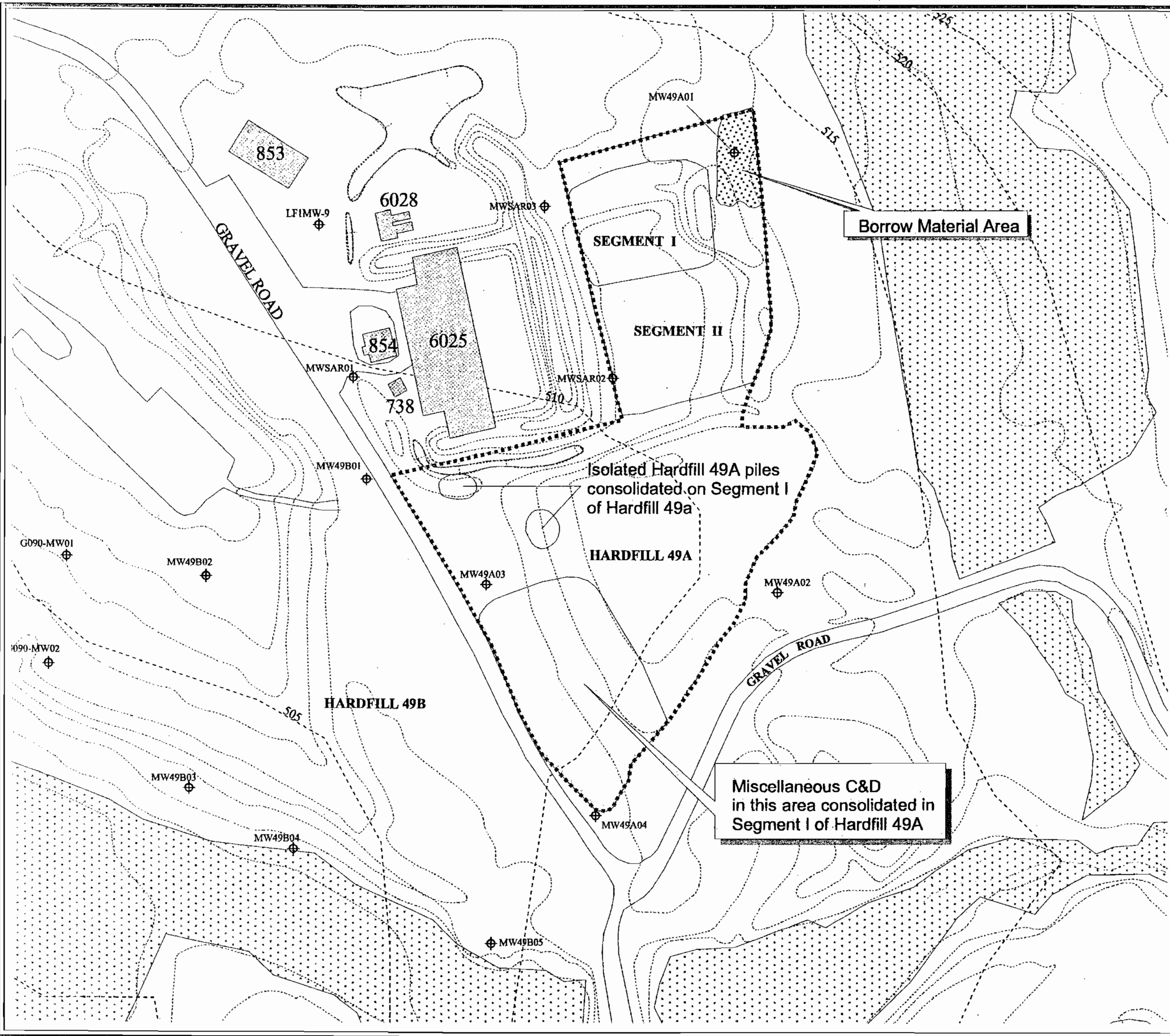
Hardfill 49A is adjacent to the SAR with a portion of the hardfill overlapping with the former SAR berm area, as shown by Figure 1-3. Hardfill 49A is approximately a 3-acres area that was an extension of the original SAR and later informally used for the placement of hardfill material and construction and demolition (C&D) after the SAR was reconfigured to its present orientation. Hardfill material included concrete, metallic debris, wood, and creosote treated poles. In 1998, CSI Scientific Application Group (CSI) consolidated all Hardfill 49A material into the northern portion of the SAR/Hardfill 49A area (see Figure 2-1), installed a geotextile (filter fabric) liner, and regraded Hardfill 49A including placing a soil cover (minimum six inches) and topsoil (four inches).

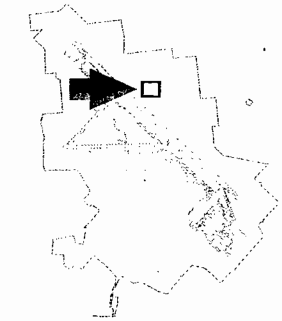
During 1998/1999, PEER Consultants, P.C. performed an IRA that targeted the 50-yard range (current berm configuration) when approximately 11,800 tons of lead-contaminated soil was removed, transported off-base, stabilized, and landfilled. During the IRA, test pits were performed east of the 50-yard backstop berm to confirm the extent of lead-contaminated soil. The test pits identified the presence of hardfill material above lead contaminated soil (associated with the former 100-yard berm). The 1998/1999 IRA restored the existing berm and identified the need for an additional IRA at the former SAR berm area that overlaps with Hardfill 49A. The area requiring an additional IRA is highlighted in Figure 2-2 and will be referred to hereon as the SAR/Hardfill 49A area.

2.2 Environmental Description

2.2.1 Topography and Surface Features

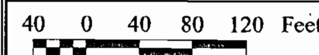
The former Griffiss AFB lies within the Mohawk Valley between the Appalachian plateau and the Adirondack Mountains. The topography across the former base is relatively flat with





LEGEND

- Monitoring Wells Sampling Location
- Land Surface 5-ft Contours
- Landfill 1 Boundary
- Roads
- Water Table 12/98
- Hardfill 49A
- Borrow Material Area
- Wetlands
- Existing Buildings



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ROME, NEW YORK

Figure 2-1
1998 Hardfill 49A
Removal Action

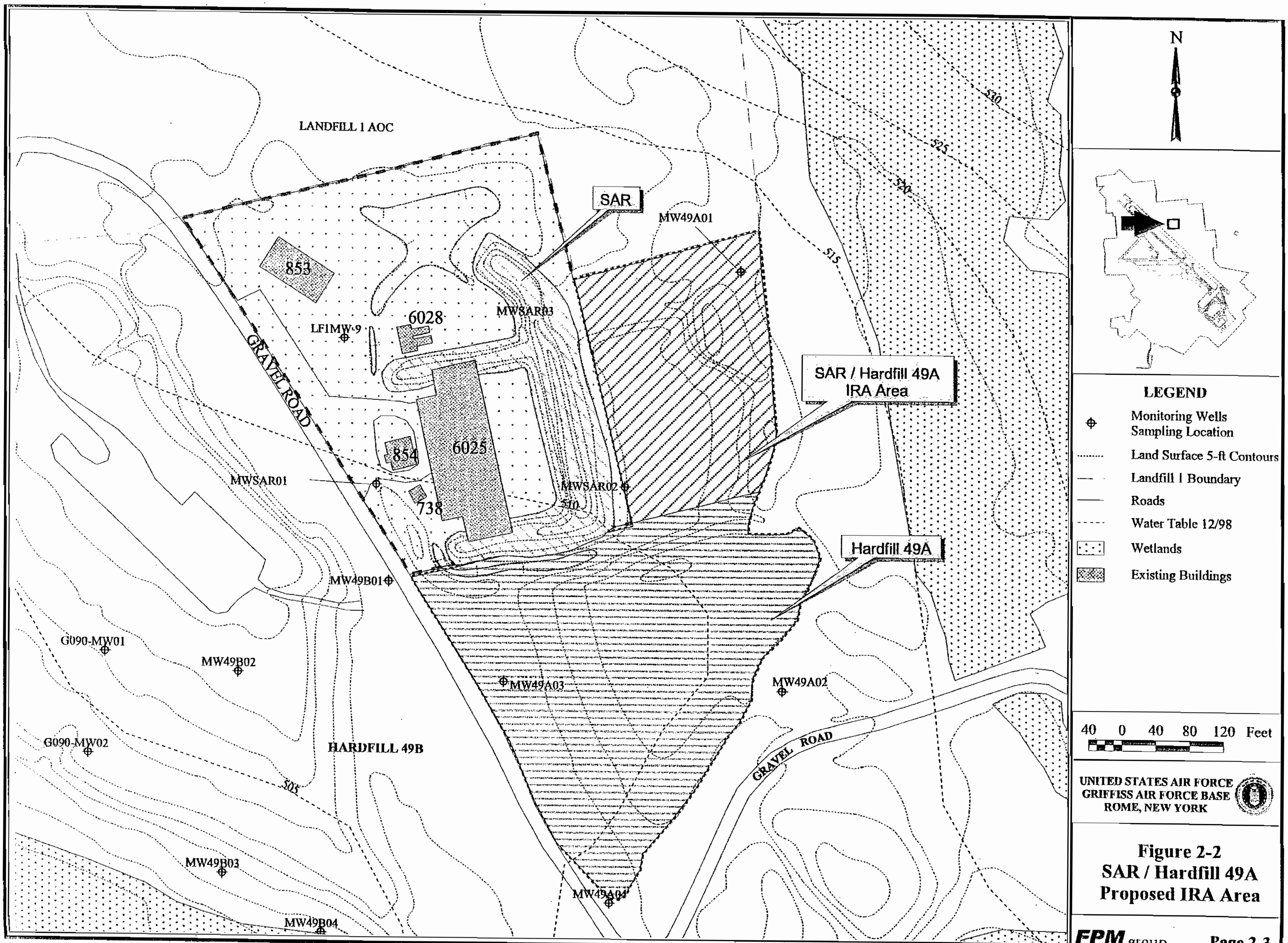

Figure 2-2
SAR / Hardfill 49A Proposed IRA Area

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elevations ranging from 435 to 595 feet above mean sea level (MSL). The highest elevations are to the northeast. A rolling plateau northeast of the former base reaches an elevation of 1300 feet.

The New York State Barge Canal and the Mohawk River valley lie south of the base at approximately 430 feet above MSL.

The SAR/Hardfill 49 A area can be described as an open and vegetated area that has little or no change in topography throughout the immediate area. Grass or permeable soils and gravel roughly cover 95 percent of the surface in the vicinity of the SAR/Hardfill 49A area. The only impervious areas are the adjacent SAR structures.

2.2.2 Geology

Unconsolidated sediments at the former Griffiss AFB consist primarily of glacial till with minor quantities of clay and sand and significant quantities of silt and gravel. The thickness of these sediments ranges from 0-12 feet in the northeast to 130 feet in the south. In general, the average thickness of the unconsolidated sediments is 25-50 feet in the central portion and 100-150 feet in the south and southwest portions of the former base. The bedrock beneath the base is composed of black Utica shale. The bedrock generally slopes from the north to the south and southwest. The depth to bedrock ranges from zero feet on the north side to as much as 150 feet on the south side.

The site-specific geology in the vicinity of SAR/Hardfill 49A area is characterized by hardfill and disturbed soils followed by native soils (outwash sands and gravels) based on information obtained during the 1998 remedial action conducted by the Air Force. The fill material consists of fine to medium sand, silt, gravel, concrete, wood debris, railroad ties, and metallic debris based on data obtained from test pitting activities. Native soils have been excavated to form berms around the hardfill. Hardfill materials have been incorporated into the upper two to three feet of the berm in places. Below the fill is up to eight feet of native fine to medium brown sands overlying glacial till. Borings conducted in previous investigations and remedial actions were terminated in the upper one to five feet of till.

2.2.3 Hydrogeology

The shallow water table aquifer lies within the unconsolidated sediments, where depth to groundwater ranges from ground surface to 57 feet below ground surface (bgs). Most groundwater at the base is encountered within 20 feet bgs. The shallow groundwater flow across the base generally moves from the topographic high in the Northeast towards the Mohawk River and New York Barge Canal in the South. There are several creeks that act as discharge areas for shallow groundwater. Drainage culverts and sewers installed throughout the base also act as a discharge conduit for subsurface water.

Groundwater flow in the vicinity of the SAR/Hardfill 49A area is to the southwest toward the Six Mile Creek tributary. The Six Mile Creek tributary is located 150 to 200 feet south and southwest of the SAR/Hardfill 49A area. Groundwater elevations are highest to the northeast in MW49A01 (522.50 feet AMSL) and lowest in MW49A03 (510.12 feet AMSL), located along the southwestern edge of the Hardfill 49A area. Landfill 1 is located upgradient (north) of Hardfill 49A and may represent a significant upgradient source of groundwater contaminants. Depths to groundwater ranged from 8.04 feet below ground surface in MWSAR02, located along the western edge of SAR/Hardfill 49A area and the existing SAR berm, to 18.86 feet below ground surface in MWSAR03, located between the northwest corner of SAR/Hardfill 49A area and the existing SAR berm. The average depth to the water table is 13.6 feet below ground surface in wells installed around Hardfill 49A. Gradients are 0.03 feet (ft)/ft across the site. (Parsons, 1997).

2.2.4 Surface Water Hydrology

The SAR/Hardfill 49A area is located approximately 1200 feet east of Six Mile Creek. Surface water run-off from the site drains into the Six Mile Creek drainage basin and then subsequently drains into the New York State Barge Canal.

2.2.5 Meteorology

Griffiss AFB experiences a continental climate characterized by warm, humid, moderately wet summers and cold winters with moderately heavy snowfalls. Because of its flat topography and high average precipitation, the former base is considered a groundwater recharge zone. The mean annual precipitation is 45.6 inches and the mean annual snowfall is 107 inches. The evapotranspiration rate is 23 inches. The average temperature during the winter season is 20 degrees Fahrenheit. Temperatures during the spring, summer, and fall vary from 31 to 81 degrees Fahrenheit. The prevailing winds are from the southwest, with an average wind speed of 5 knots.

2.3 Demographic Profile

The former Griffiss AFB has a daytime population of approximately 3500. This population includes Department of Defense employees (e.g. Air Force Research Laboratory [AFRL], etc.) and employees at the Griffiss Business and Technology Park businesses.

2.4 Current and Future Site Use

The SAR/Hardfill 49A area is located to the east and on the backside of the backstop of the existing SAR berm in the northeastern corner of the former Griffiss AFB. The SAR/Hardfill 49A area is currently not used. Under the Proposed Action for reuse of Griffiss AFB developed by the Griffiss Local Development Corporation (GLDC) (EIS, 1995), the SAR/Hardfill 49A area has been designated as vacant land (development reserve). Since 1996, Oneida Indian Nation

Police have been using the SAR for limited firearms training on an approximate once every six months schedule, firing less than 6,000 rounds per year. Since the existing SAR backstop berm borders the site in the direction or line of fire, future use of the SAR/Hardfill 49A area will likely be vacant property, tied to usage of the SAR as a limited use small arms firing range. It is the goal of the Air Force to minimize future liability associated with SAR/Hardfill 49A prior to property transfer.

3 SITE CHARACTERIZATION

During remedial activities conducted by PEER Consultants at the Griffiss AFB SAR in the fall of 1998 that consolidated hardfill materials into the northern portion of the SAR/Hardfill 49A area, a determination was made that lead contaminated soil was present beneath the hardfill material. Lead contaminated soil was found to extend from the existing SAR backstop berm to the eastern boundary of SAR/Hardfill 49A area. The contamination is believed to be assoiacted with the former SAR berm (100-yard range) when it was spread and the backstop berms were moved into their current configuration (50-yard range).

3.1 Previous Investigations

Following the hardfill consolidation remedial action performed by CSI in Fall 1998, in May and June 1999, a series of 21 test pits were excavated throughout SAR/Hardfill 49A area. Excavated materials were screened both visually and using direct reading x-ray fluorescence (XRF) equipment to assess the distribution of lead in the subsurface. A total of 47 soil samples and two duplicates were collected and submitted for analysis of total metals. A copy of the preliminary draft report (PEER, June 1999) is provided in Appendix B. Appendix C contains the test pit logs (PEER, June 1999). Figure 3-1 illustrates the test pit locations while Figures 3-2 and 3-3 respectively illustrate Cross-sections A-A' and B-B'. The test pit data is summarized in Table 3-1 and the analytical data for lead detections is summarized in Table 3-2. Based on the information developed from this test pit investigation, the following conclusions were made:

- Lead contamination appears to be widespread throughout the hardfill materials and is derived from several sources including bullets, lead paint and other lead containing materials (i.e. lead acid battery plates);
- Range-related lead contaminated soil (gravelly silt) underlies a significant portion of the hardfill;
- An area of sanitary refuse is located in the north-central portion of the site. This refuse also contains lead materials which are of a different origin than those in the hardfill/range-related deposits;
- Based on XRF screening, lead contamination of soil does not appear to continue into the underlying native sand and gravel;
- Lead contaminated materials extend into the groundwater at certain locations. At other locations, the groundwater is within 3-4 feet of the contaminated material and;
- Native materials at the site consist of sand and gravel without fines or organic matter. This material is anticipated to possess a high hydraulic conductivity and is unlikely to attenuate metals in leachate from the contaminated materials. This native material provides a pathway for dissolved lead to reach the groundwater.

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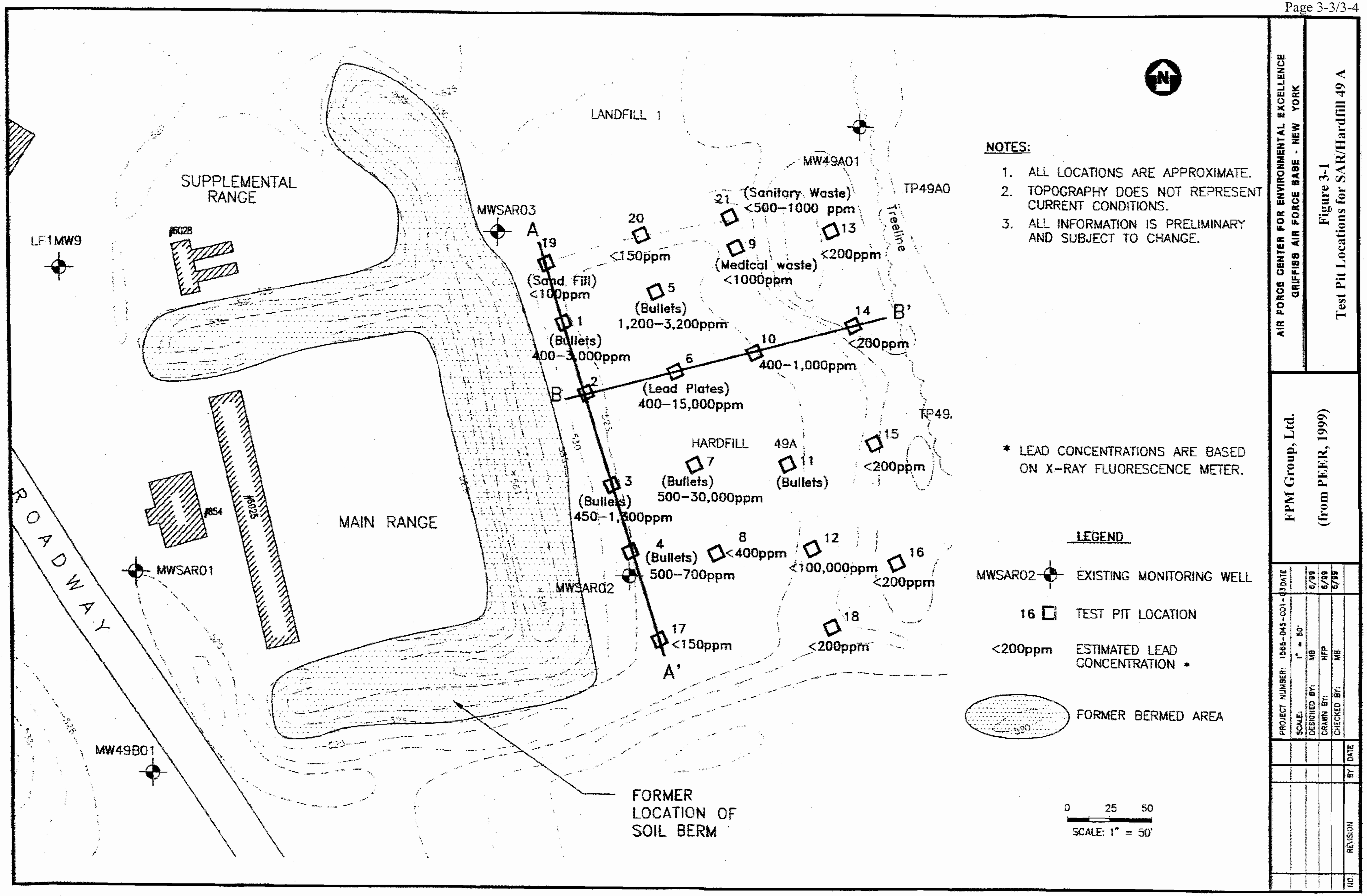
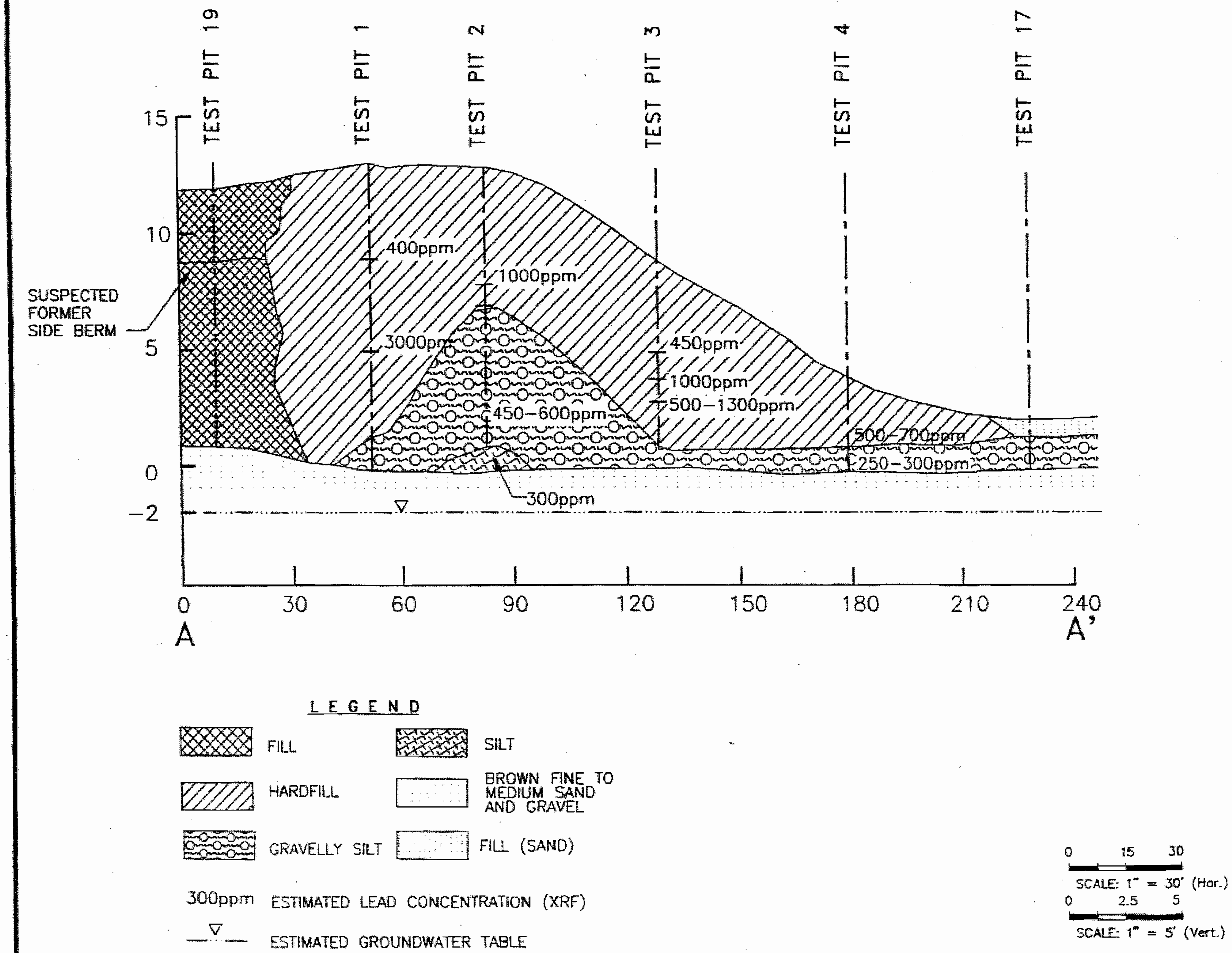


Figure 3-1
Test Pit Locations for SAR/Hardfill 49 A



BULLETS OBSERVED IN HARDFILL MATERIALS (SCATTERED) AND IN GRAVELLY SILT (DENSELY DISTRIBUTED)

HARDFILL– CONSIST OF TIMBERS, WOOD FRAGMENTS, PIPES, METAL FRAGMENTS, GLASS, FLOOR TILE, PAINTED WOOD, WIRE AND CABLE.

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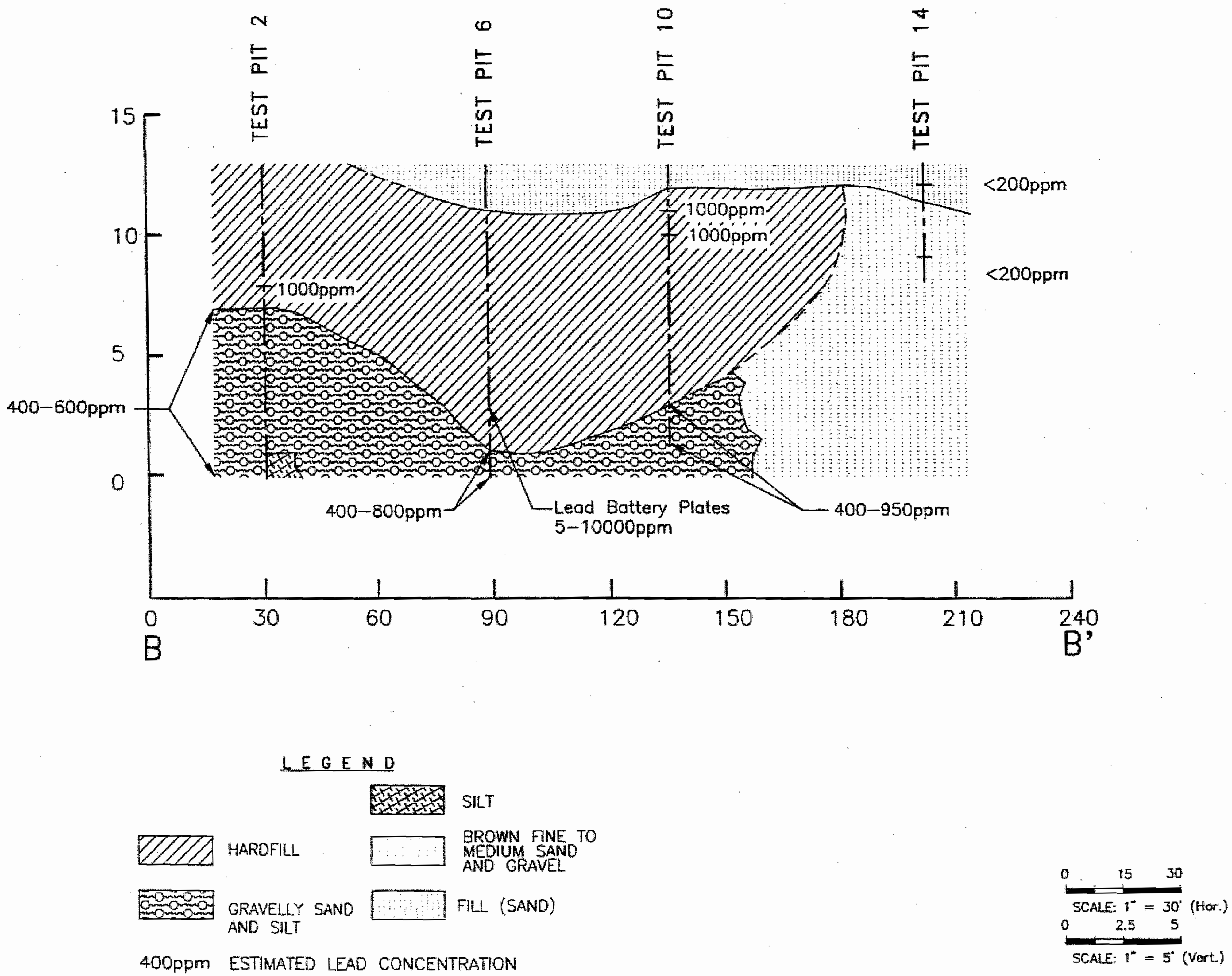
Figure 3-2
Cross Section A – A'

FPM Group, Ltd.
(from PEER, 1999)

PROJECT NUMBER:	1566-045-001-03	DATE
SCALE:	AS SHOWN	
DESIGNED BY:	MB	6/99
DRAWN BY:	HFP	6/99
CHECKED BY:	MB	6/99

NO	REVISION	BY	DATE

FILENAME: 15660IFIC



BULLETS OBSERVED IN HARDFILL MATERIALS
(SCATTERED) IN GRAVELLY SILT
(DENSELY DISTRIBUTED)

HARDFILL– CONSIST OF TIMBERS, WOOD FRAGMENTS, PIPES, METAL FRAGMENTS, GLASS, FLOOR TILE, PAINTED WOOD, WIRE AND CABLE.

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Figure 3-3
Cross Section B-B'

FPM Group, Ltd.
(from PEER, 1999)

PROJECT NUMBER: 1566-045-001-03		DATE
SCALE:	AS SHOWN	
DESIGNED BY:	MB	6/99
DRAWN BY:	HFP	6/99
CHECKED BY:	MB	6/99

NO.	REVISION	BY	DATE

FILENAME: 15680IF1d

Table 3-1 SAR/Hardfill 49A - Test Pit Information Summary

Test Pit Location	Environmental Description	Lead Presence	Samples (ft bgs)
1	Hardfill, gray soil, and C&DD with bullets to 12 feet. Gray silt with **bullets** 12 to 13 feet. Native soil at 13+ feet.	0 to 13 ft	4, 8, 13
2	Hardfill, gray soil, and C&DD with bullets to 6 feet. Gray silt with **bullets** 6 to 13 feet. Native soil at 13+ feet.	0 to 13 ft	5, 8, 12
3	Hardfill, gray soil, and C&DD with **bullets** to 8 feet. Dark gray silt, no visible bullets 8 to 9 feet. Native soil at 9+ feet.	0 to 8 ft	5, 6, 8
4	Hardfill and C&DD to 3 feet. Brown sand and gray silt with **bullets** 3 to 4 feet. Native soil at 4 feet.	3 to 4 ft	3, 4, 5
5	Brown sand to 3 feet. Hardfill, soil, and C&DD with **bullets** to 12 feet. Native soil at 12 feet.	3 to 12 ft	3-12, 14
6	Brown sand to 2 feet. Hardfill, soil, and C&DD with **bullets** and lead battery plates to 12 feet. Native soil at 12 feet.	2 to 12+ ft	10, 14
7	Brown sand to 1 foot. Hardfill, soil, and C&DD 1 to 8 feet. Dark gray silt with **bullets** 8 to 9 feet. Native soil at 12 feet.	8 to 9 ft 1 to 8 ft	2, 8, 9
8	Brown sand to 1 foot. Hardfill 1 to 5 feet. Gray silt 5 to 6 feet. Native soil at 6+ feet.		2, 5, 6
9	Fill to 1 foot. Sanitary/medical waste 1 to 3 feet with confetti like material having high XRF reading for **lead**. Native soil, 3 feet.	1 to 3 ft	3, 8
10	Brown silt to 1 foot. Hardfill, soil, and C&DD 1 to 10 feet. Dark gray silt with **bullets** 10 to 12 feet. Native soil at 12+ feet.	1 to 12 ft	3, 10, 11
11	Brown sand to 1 foot. Hardfill, soil with bullets, and C&DD 1 to 8 feet. Brown sand and **bullets** 8 to 10 feet. Native soil - 12 feet.	1 to 10 ft	2, 4, 8
12	Brown sand to 1 foot. Hardfill, soil, and C&DD 1 to 6 feet. Native soil at 12 feet. No bullets, some **possible lead** paint frags.	1 to 6 ft	5, 6
13	Brown sand to 2 feet (fill). Native soil at 2 feet.		4
14	Brown sand to 1.75 feet (fill). Native soil at 1.75 feet.		5
15	Native soil from land surface.		2
16	Native soil from land surface.		2
17	Brown sand to 1 foot. Hardfill (gray silt with occasional timbers) 1 to 2.5 feet. Native soil at 2.5+ feet.		2, 3
18	Brown sand to 1 foot. Hardfill, soil, and C&DD 1 to 4 feet. Gray silt with small area of lead patina 4 to 6 feet.. Native soil at 6 feet.	4 to 6 ft	5, 6
19	Brown silt and sand (fill) to 3 feet. Brown sand with one lead fragment 3 to 10 feet. Native soil at 11+ feet. No high XRF.		2, 3
20	Fill similar to landfill to the north to 2 feet. Native soil at 2 feet.		2, 3
21	Fill similar to landfill to the north to 1.5 feet. Sanitary refuse, soil, and **high level lead confetti like material** 1.5 to 9 feet. Native soil at 9 feet.	4 to 6 ft	2.5, 5, 10

Table 3-2 SAR/Hardfill 49A - Summary of Lead Detections

Sample Depth	A	B	C	D
Test Pit ID				
1	434	242	760	
2	482	112	208	
3	797	1400	1520	
4	189	119	3.2	
5	173	5.2		
6	214	1220		
7	146	489	4	
8	55.9	24.5	3.6	3.1
9	101	9.6		
10	106	8170	2180	
11	435	166	2230	
12	61	3.9		
13	7.8			
14	6			
15	7	6.4		
16	16.2			
17	23.8	2.2		
18	136	7.8		
19	80.3	4.4		
20	7.6	3		
21	423	33.3	3.6	

Notes:
Sample depths A, B, C, and D relate to progressively deeper samples at the location. Actual sample depths are provided in Table 3-1.
All results are reported in milligrams per kilogram.

FPM Group, Ltd. (FPM), under contract with Air Force Center for Environmental Excellence (AFCEE), conducted two groundwater sampling events at the Hardflll sites 49A, 49B, 49C, 49D, and the SAR. The sampling events were performed to confirm the conclusions in the Pre-design Investigation Report for Remedial Design at Hardfills 49A, 49B, 49C and 49D, Griffiss AFB (Parsons, February 1997) and the Final Investigation Report for the SAR, Griffiss AFB (Parsons, September 1997).

Analytical results for the 1999 and 2000 sampling events at the SAR/Hardfill 49A area show the following:

- 1999 results of volatile organic compounds (VOCs) were consistent with those measured in 1996; no VOCs were detected;
- 1999 results indicated wells MW49AO3 and MW49AO4 with phthalate compound detection at levels below reporting limits (RL) and well below New York State (NYS) Groundwater Standards;
- 1999 TPH-diesel range results were similarly low compared to those detected in 1996;
- Unlike the previous sampling events, the most recent round of sampling revealed no detections of lead in the groundwater as reported in the "total" and "dissolved" samples and;
- 2000 metals results indicate upgradient well MW49AO1 had sodium at levels exceeding the NYS Groundwater Standard in both the "total" and "dissolved" samples. Well MW49AO2 indicated exceedances for iron and manganese (in both "total" and "dissolved" samples), and MW49AO4 for iron only (in the "total" sample only). The "total" and "dissolved" iron and manganese results for 2000 were less than the previous sampling events, except for "total" iron in MW49AO2, which was slightly higher than the 1996 results, but approximately one order of magnitude less than the June 1999 results.

A draft copy of the summary report (FPM, August 2000) is provided in Appendix C.

3.2 Nature and Extent of Contamination

A soil cover placed on top of geotextile material was installed at the SAR/Hardfill 49A area where the consolidated hardfill materials were placed to mitigate or eliminate exposure risks associated with surface soil contamination at the site, and to provide an area consistent with future base reuse strategies. Subsequently, post closure activities including test pit investigation and further groundwater investigation, were conducted at the site. The results of the investigations indicated that lead contamination appears throughout the hardfill materials, and the lead is derived from several sources including bullets, lead paint and other lead containing materials. Additionally, lead contaminated materials extend into the groundwater at certain locations.

3.3 Contaminant Volume Estimation

Volume of contamination was calculated by review of information collected during test pitting. It was estimated that approximately 12,000 cubic yards of contaminated soil would require remediation. The quantity is estimated for planning purposes only. Actual quantities requiring remediation will depend on field observations during implementation of selected remedy.

4 IDENTIFICATION OF RESPONSE ACTION OBJECTIVES

The primary objective of the response action alternatives is to comply with the ARARs to the fullest extent possible, with consideration of costs and the feasibility of implementation.

4.1 Definition of Removal Scope

The scope of this response action encompasses the removal and/or treatment (depending on the selected alternative) of contaminated soil from the SAR/Hardfill 49A area to the extent that it no longer poses a threat to human health, groundwater, or the environment.

4.2 Specific Response Action Objectives

The following are specific objectives for this removal action:

- Remove and/or treat the contaminated soil until it meets the USEPA preliminary remediation goal (PRG) value of 400 mg/kg for lead
- If soil is excavated, the extent of any remaining contaminants shall be defined and characterized
- Dispose of miscellaneous construction and demolition debris
- Remove and/or treat and dispose of these wastes in a manner that minimizes emission of dust and contaminants into the atmosphere
- Complete the removal action in the shortest practical time period
- Restore the site, grade, and slopes to prevent ponding and support vegetation growth

4.3 Applicable or Relevant and Appropriate Requirements

Applicable requirements are defined as those promulgated federal, state, and local requirements that specifically address a hazardous substance, or contaminant found at the site. Relevant and appropriate requirements are those promulgated federal, state, and local requirements that, while not applicable, address problems sufficiently similar to those encountered at the site that their application is appropriate.

In addition to ARARs, there are non-promulgated advisories or guidance referred to as "to be considered" (TBCs). TBCs may be used to determine cleanup levels when ARARs don't exist or when use of ARARs alone would not be protective of human health or the environment. TBCs are not legally binding, however, if a TBC is chosen, it becomes a performance standard to which the selected response actions must comply.

- Chemical-specific ARARs establish numerical standards limiting the concentration of substances in the media of concern and/or the media affected by the response action.

- Location-specific ARARs are restrictions or considerations placed upon the conduct of activities in critical environments such as floodplains, wetlands, endangered species habitats, or historically significant areas.

- Action-specific ARARs are technology or activity based restrictions controlling the response action, and include performance and design standards.

A summary of the potential ARARs and TBCs for the Former Griffiss AFB is provided in Table 4-1. This table was used in the evaluation of alternatives described in Section 5.0 of this report.

Table 4-1 ARARs or TBCs[1]

Type	Citation
Chemical-Specific	
Identification and Listing of Hazardous Waste	40 CFR Part 261
State of New York, Recommended Soil Cleanup Objectives	NYS Department of Environmental Conservation (DEC) TAGM 4046 (revised 12/20/2002)
Hazardous Waste Identification Rule	40 CFR Parts 260, 261, 266, 268 Proposed Rule
Location-Specific	
The Archeological and Historic Preservation Act of 1974	16 United States Code (USC) 469
The Endangered Species Act of 1973	16 USC 1531 50 CFR Part 402
Action-Specific	
USEPA National Ambient Air Quality Standards	40 CFR Part 50
Resource Conservation and Recovery Act	
• Hazardous Waste Management System	40 CFR Part 260
• Standards For Transporters of Hazardous Waste	40 CFR Part 263
• Standards for Generation, Temporary Storage, and Shipment of Hazardous Waste.	40 CFR Part 262 Subparts A, B, C, and D
• Land Disposal Restrictions	40 CFR Part 268
Occupational and Health Safety Act (OSHA)	29 CFR Parts 1904, 1910, and 1926
Department of Transportation Rules for Hazardous Materials Transport	49 CFR Parts 107 and 171-173
USEPA's Revised Procedures for Planning and Implementing Off-Site Response Actions	OSWER Directive #9834.11

1. When Federal Citations are referenced, State and Local Citations also apply when more stringent.
2. Technical and Administrative Guidance Memorandum (TAGM)

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5 EVALUATION OF ALTERNATIVES

This section identifies the response action alternatives, describes the evaluation process utilized in selecting the best alternative, and evaluates the alternatives. The response action alternatives are presented in Section 5.1. The evaluation criteria used to assess the alternatives are presented in Section 5.2. An evaluation of alternatives is provided in Section 5.3. The recommended response action and steps required for implementation are discussed in Section 6.0.

5.1 Response Action Alternatives

Four alternatives were selected as viable response actions that should be further evaluated so that the best alternative can be utilized. These alternatives address the cleanup of contaminated soil at the SAR/Hardfill 49A area in order to be protective of the human health, groundwater, and the environment. The alternatives are:

- Alternative One - Institutional/Engineering Controls
- Alternative Two - In-Situ Soil Solidification/Stabilization
- Alternative Three - Soil Excavation, Off-Site Treatment and Disposal
- Alternative Four - Soil Excavation, On-Site Screening with Off-Site Treatment and Disposal

Based on review of the Preliminary Draft Report Test Pit Investigation (PEER, June 1999) and existing analytical data, the contaminated soil (primarily lead) at the SAR/Hardfill 49A area poses a risk to human health, groundwater, and the environment. Human health risk is posed by the potential for future development of the site, or maintenance that would expose subsurface soils. The soil contamination poses a threat to groundwater from leaching and other transport mechanisms. The presence of soil contamination poses a continual threat to subsurface and burrowing ecological receptors.

A groundwater-monitoring program may also be used to assess the effectiveness of the selected soil response action.

The alternative selected from the EE/CA process may not be the final remedy for the site. Changes in the future use of the site or additional discoveries may require additional work to be performed in order to prevent contact with the contaminated subsurface soils (e.g., excavation of a building foundation).

5.1.1 Institutional/Engineering Controls

This alternative involves limited involvement by placing land use controls (development of property as parking area or allowing no development) and engineering controls to prohibit access to the site (fencing, signage, etc.). The contaminated soil is not exposed and was generally reported to begin at two-feet bgs. There is no immediate potential for inhalation, ingestion, or dermal contact with the contaminated soil. Previous investigations indicate that the contaminated soil is a source of groundwater contamination. Future reuse of the site may expose subsurface soils thereby causing an environmental concern. Also, contamination in soil represents a threat to subsurface and burrowing ecological receptors.

5.1.2 In-Situ Soil Solidification/Stabilization

This alternative involves the in-situ solidification/stabilization (S/S), chemical reagents are mixed with waste to make use of complex chemical and physical reactions to improve physical properties and reduce contaminant solubility, toxicity, and/or mobility. S/S is a viable treatment for contaminated materials when the constituents cannot be treated, recovered, or destroyed by other methods because of technical or economical limitations. In solidification, a reagent is added to transform a sludge, sediment, or soil into a solid form. Solidification immobilizes the contaminants within the crystalline structure of the solidified material, thus reducing the contaminant leaching potential. In stabilization, a reagent is added to transform the material so that the hazardous constituents are in their least mobile or toxic form.

Ambient air in the work zone will be continuously monitored and the Site Safety Officer will select the appropriate level of personal protection equipment. Unless significant dust and particulates of contaminants are encountered, it is anticipated that PPE level D will be appropriate.

The site will be restored with clean fill placed in lifts to achieve the appropriate compaction. Clean topsoil and some trees, saved from the preliminary preparation of the site, shall be re-placed on top of the clean fill. The site will then be regraded for better drainage and to prevent ponding. A re-vegetation plan will be established by the remedial contractor to restore the areas affected by the in-situ treatment. A groundwater monitoring program will be established as indicated in Section 5.1.

5.1.3 Soil Excavation, Off-Site Treatment, and Disposal

This alternative involves the removal of contaminated soil until the project remediation goals are met. The soil cover placed over the hardfill material (approximately one foot) is assumed to be clean, will be stripped, temporarily placed on plastic liners for sampling and characterization. The remaining soil and hardfill material will then be excavated and characterized (assumed 50% non-hazardous waste) prior to being loaded and transported to an approved off-site treatment, storage, and disposal facility (TSDF) that is capable of long-term protection of human health and the environment.

Pumping is not anticipated to be required to dewater the excavation area. However, if required, liquid wastes will be sampled and disposed of according to federal, state, and local regulations.

Ambient air in the work zone will be continuously monitored and the Site Safety Officer will select the appropriate level of personal protection equipment. Unless significant dust and particulates of contaminants is encountered, it is anticipated that PPE level D will be appropriate.

The site will be backfilled with clean fill placed in lifts to achieve the appropriate compaction. Clean topsoil and some trees, saved from the preliminary excavation, shall be re-placed on top of the clean fill. The site will then be regraded for better drainage and to prevent ponding. A re-vegetation plan will be established by the remedial contractor to restore the areas affected by the removal and grading activities. A groundwater monitoring program and/or active remedy will be established as indicated in Section 5.1.

5.1.4 Soil Excavation, On-Site Screening with Off-Site Treatment and Disposal

This alternative involves the removal of contaminated soil until the project remediation goals are met. The soil cover placed over the hardfill material (approximately one foot) is assumed to be clean, will be stripped, temporarily placed on plastic liners for sampling and characterization. The remaining soil and hardfill material will then be excavated and the lead will be separated from the contaminated soil through on-site physical screening of the soil. The lead will be recycled, reducing the volume of soil characterized as hazardous waste. The soil will then be characterized (<u>assumed 80% non-hazardous waste</u>) prior to being loaded and transported to an approved off-site TSDF that is capable of long-term protection of human health and the environment.

The hardfill will be segregated and screened for contaminants prior to off-site disposal or recycling. If found in substantial quantities, the concrete may be beneficially recycled after adequate characterization.

Pumping is not anticipated to be required to dewater the excavation area. However, if required, liquid wastes will be sampled and disposed of according to federal, state, and local regulations.

Ambient air in the work zone will be continuously monitored and the Site Safety Officer will select the appropriate level of personal protection equipment. Unless significant dust and particulates of contaminants is encountered, it is anticipated that PPE level D will be appropriate.

The site will be backfilled with clean fill placed in lifts to achieve the appropriate compaction. Clean topsoil and some trees, saved from the preliminary excavation, shall be re-placed on top of the clean fill. The site will then be regraded for better drainage and to prevent ponding. A re-vegetation plan will be established by the remedial contractor to restore the areas affected by the removal and grading activities. A groundwater monitoring program and/or active remedy will be established as indicated in Section 5.1.

5.2 Evaluation Criteria

Alternatives are evaluated and ranked according to their effectiveness, implementability, and costs. The factors considered under each of these categories are shown below:

Effectiveness
- protection of human health and the environment
- compliance with ARARs
- short term effectiveness
- long-term effectiveness (permanence)

Implementability
- technical feasibility
- administrative feasibility
- availability of services and materials
- agency and community acceptance

Costs
- total investment for each alternative
- benefit for each alternative

5.2.1 Effectiveness

Effectiveness is a measure of an alternative's ability to protect human health, groundwater, and the environment and meet the criteria of the identified ARARs and TBCs. Each measure (protect human health/groundwater/environment and meet criteria of ARARs and TBCs) is considered for both the long-term and short-term. A concise interpretation of these criteria follows:

5.2.1.1 Protection of Human Health, Groundwater, and the Environment

This criterion is a measure of how well the alternative reduces the potential for human exposure to contaminants, contamination of groundwater, and exposure of ecological receptors, in the short-term and long-term. It considers the following:

- The net reduction in the toxicity, mobility, or volume of contaminated soil
- The potential exposure pathway between humans or biota (considering future land use) and contaminated soil
- The estimated quantity (volume) of residual contaminated soil
- The potential exposure pathway between humans or biota and releases or emissions from the active response alternatives

5.2.1.2 Compliance with ARARs

This criterion is a measure of how well the alternative meets the identified chemical, action, or location-specific ARARs and TBCs (federal, state and local) during the long-term and short-term.

5.2.1.3 Short-Term

This is a measure of how well the alternative meets the criteria of protecting human health/environment and meets the criteria of the ARARs and TBCs during implementation.

5.2.1.4 Long-Term

This is a measure of how well the alternative meets the criteria of protecting human health/environment and meets the criteria of the ARARs and TBCs after implementation.

5.2.2 Implementability

Implementability is a measure of whether an alternative can be physically and administratively implemented, such as the ability to construct or excavate. It is also a measure of the availability of the services and materials needed to implement the alternative. Other considerations regarding implementability include local agency and community acceptance of a given alternative. A concise interpretation of the criteria governing implementability is as follows:

5.2.2.1 Technical Feasibility

This criterion refers to:

- The reliability of the action with regard to implementation
- The actual ease of field implementation (e.g., excavation, construction action)
- The ease in undertaking future actions related to the initial undertaking
- The ability to monitor the effectiveness of the action

5.2.2.2 Administrative Feasibility

This criterion is a measure of the ease with which an alternative can be implemented in terms of permits and rights-of-entry, coordination of services to support the action (e.g., legal services), probability of continual enforcement, or the arrangement and delivery of security services.

5.2.2.3 Availability of Services and Materials

This criterion is a measure of the availability of goods and services needed to support implementation of the alternative. Examples of this criterion include the availability of specialized personnel (i.e., qualified contaminated soil removal technicians) and equipment, availability of the suitable storage facility for the contaminated soil, materials, and activity derived waste.

5.2.2.4 Agency Acceptance

This criterion deals with the acceptance of the alternative by applicable federal, state and local agencies, as expressed by representatives under the agencies' authority. Agency acceptance has been established based on information gathered during public meetings and with agency interaction to date.

5.2.2.5 Community Acceptance

This criterion relates to the degree of acceptance of the alternative by the Griffiss community, including owners of property adjacent to the base. Public sentiment expressed during town hall meetings, public workshops, city council or county supervisor meetings, or institutional analysis is a means of determining community acceptance. Rankings of alternatives under this criterion have been established based on information gathered during Restoration Advisory Board (RAB) meetings, requests from the GLDC, and interaction with base personnel.

5.2.3 Cost

Cost is a measure of the overall investment (dollars) to implement the alternative with consideration of the benefit of that investment to the public and site.

The cost of implementing each of the alternatives has been estimated using RACER (an accepted government estimating program). A detailed summary of these costs and assumptions is presented in Appendix A. For Alternatives 2, 3, and 4 the costs are either one-time costs or are expected to occur within one year. Alternative 1 (Institutional/Engineering Controls) and Long Term Monitoring is estimated to require 30 years to complete so the costs were converted to present worth for a fair comparison.

5.3 Evaluation of Response Action Alternatives

The following evaluation analyzes the effectiveness, implementability, and cost of each of the four response action alternatives identified for the SAR/Hardfill 49A area.

The alternative with the lowest-ranking score is considered the best in terms of these evaluation criteria. The ranking scores are based on assessing each criterion and assigning a number between 1 and 4 (1 = the best, i.e., most effective and 4 = the worst, i.e., the least effective). The equal weighing of criteria is in compliance with the National Contingency Plan ranking system.

5.3.1 Effectiveness

Table 5.1 provides the summary of the effectiveness criteria ranking for the four alternatives. Additional explanation follows the table.

Table 5-1 Effectiveness Criteria Evaluation

	Protection of Human Health and the Environment		Compliance with ARARs		Overall	
Alternative	**Long Term**	**Short Term**	**Long Term**	**Short Term**	**Score**	**Rank**
1. Institutional/Engineering Controls	4	1	4	4	13	4
2. In-Situ Solidification/ Stabilization	2	1	2	3	8	2
3. Soil Excavation/Off-Site Treatment/Disposal	2	3	1	1	7	1
4. Soil Excavation/On-Site Screening/Off-Site Treatment and Disposal	1	4	1	2	8	2

5.3.1.1 Protection of Human Health and Environment

Long Term Effectiveness

- Alternative One – Institutional/Engineering Controls would not reduce the potential for future groundwater contamination or potential exposure of the soils as a result of future projects. It is considered the least effective of the alternatives for the long term and was ranked 4.
- Alternative Two – The soil contamination would be stabilized in-situ to the maximum extent practicable. The lead would be bound to the local soils. This is considered the second most effective long-term solution so Alternative Two was given the rank of 2.
- Alternative Three – The soil contamination would be excavated to the maximum extent practicable. The soil would be characterized and disposed off-site. This is considered an effective long-term solution so Alternative Three was given the rank of 2.
- Alternative Four – This alternative is similar to Alternative Three except that the on-site soil screening would minimize the volume of hazardous waste and the lead would be removed and recycled. This is considered the most effective long-term solution so Alternative Four was given the rank of 1.

<u>Short Term Effectiveness</u>

- <u>Alternative One</u> – The soil contaminants have existed for many years and do not pose an immediate threat to the health and safety of the community because they are not exposed to the surface. The soil contaminants are at levels that could leach into the groundwater, but there are no groundwater receptors. Since the groundwater contamination will be monitored to ensure that unacceptable exposures are prevented, a ranking of 1 is justified.
- <u>Alternative Two</u> – In-Situ Soil Solidification/Stabilization has minimal short-term effects on the community. The soil contamination is stabilized and should not leach into the surrounding groundwater. Since the groundwater will be monitored to ensure that unacceptable exposures are prevented, a ranking of 1 is justified.
- <u>Alternative Three</u> – The short-term effects on the community from the excavation may result from dust emissions during excavation. Dust emissions may result from transportation and regrading activities. Dust suppression measures such as light water spraying and monitoring for lead would be performed to control any hazards. Due to the potential for community disruptions from traffic and the potential for dust emissions, this alternative was ranked 3.
- <u>Alternative Four</u> – The short-term effects on the community from the excavation, regrading, and transportation that may result are similar to Alternative Three. However, the on-site soil screening will result in a longer period associated with dust emissions. Dust suppression measures such as light water spraying and monitoring for lead would be performed to control any hazards. As a result, this alternative was ranked 4.

5.3.1.2 Compliance with ARARs and TBCs

<u>Long Term Effectiveness</u>

- <u>Alternative One</u> – Future development or subsurface projects may occur that would result in exposure to soil or groundwater contaminants as a result of No Action. Therefore this alternative is ranked 4 for being the least effective for compliance with ARARs and TBCs.
- <u>Alternative Two</u> – In-Situ Soil Solidification/Stabilization is the second most effective alternative for complying with the ARARs and TBCs and was ranked 2. The stabilized lead-contaminated soil will remain on-site and a small portion of the treated soil may leach at a future date.
- <u>Alternative Three</u> – Soil Excavation, Off-Site Treatment and Disposal is the most effective alternative for complying with the ARARs and TBCs and was ranked 1.
- <u>Alternative Four</u> – Soil Excavation, On-Site Screening with Off-Site Treatment and Disposal is equally effective as alternative 3 for complying with the ARARs and TBCs and was ranked 1.

Short Term Effectiveness

- Alternative One – The site is currently not compliant with the ARARs, therefore Institutional/Engineering Controls would be the least effective alternative and is ranked 4.
- Alternative Two – In-Situ Soil Solidification/Stabilization is a proven alternative for bringing the site into compliance with the ARARs. However, the presence of hardfill material and the depth of contamination will require repeated in-situ application (soil mixing using drilling and/or high-pressure injection) of chemical reagents. This alternative is therefore ranked 3.
- Alternative Three – Soil Excavation, Off-Site Treatment and Disposal is one of the fastest of the alternatives for bringing the site into compliance with the ARARs and is therefore ranked 1.
- Alternative Four –This alternative is similar to Alternative Three with the added duration of on-site soil screening. As a result, this alternative is ranked 2.

5.3.1.3 Overall Effectiveness Ranking

According to the effectiveness criteria evaluation (Table 5-1), Soil Excavation, Off-Site Treatment and Disposal (Alternative Three) is considered the most effective having the lowest overall score (7). Soil Excavation, On-Site Screening with Off-Site Treatment and Disposal (Alternative Four) and In-Situ Soil Solidification/Stabilization (Alternative Two) each received a slightly lower effectiveness score (8) mostly because due to the short-term impacts associated with on-site soil screening and the uncertainty associated with in-situ stabilization. Alternative One is the least effective since it is not protective of human health and the environment in the long term and does not comply with the ARARs and resulted in an effectiveness score of 13.

5.3.2 Implementability

Table 5.2 provides the summary of the implementability criteria ranking of the four alternatives. Additional explanation follows the table.

Table 5-2 Implementability Criteria Evaluation

Alternative	Technical Feasibility	Administrative Feasibility	Services And Materials	Agency Acceptance	Community Acceptance	Score	Rank
1. Institutional/Engineering Controls	1	4	1	4	4	14	4
2. In-Situ Solidification/ Stabilization	3	2	3	3	3	14	3
3. Soil Excavation, Off-Site Treatment and Disposal	1	1	2	2	2	8	2
4. Soil Excavation, On-Site Screening with Off-Site Treatment and Disposal	2	1	2	1	1	7	1

5.3.2.1 Technical Feasibility

- Alternative One – This alternative was ranked 1 because no technical implementation is required.
- Alternative Two – This alternative is a reliable and proven remedial technologies, but requires phasing of in-situ treatment activities and surpassing constraints associated with the presence of hardfill material. Additional technical programs for air monitoring, soil characterization, and dust emissions will have to be implemented. As a result, this alternative was ranked 3.
- Alternative Three – This alternative is one of the most reliable and proven remedial technologies, but requires phasing of excavation, stockpiling, transportation, and disposal activities. Additional technical programs for air monitoring, soil characterization, and dust emissions will have to be implemented. As a result, this alternative was ranked 1.
- Alternative Four – This alternative is similar to Alternative Three with the added requirment of on-site soil screening, therefore this alternative was ranked 2.

5.3.2.2 Administrative Feasibility

- Alternative One – This alternative was ranked 4 primarily due to the long-term administrative needs associated with Institutional/Engineering Controls. That is, the site would remain open requiring tracking, monitoring, inspections, land-use controls, etc.
- Alternative Two – This alternative was ranked 2 as the more demanding from an administrative perspective. The administrative needs include short-term needs and long-term needs. The treatment area will require monitoring and record keeping in accordance with USEPA, NYSDEC, and local agencies.
- Alternative Three – This alternative was ranked 1 as one of the least demanding from an administrative perspective. The administrative needs are all short-term needs. Excavation will require dig permits, coordination with utility companies, and possible

disruption of traffic patterns. Hauling, screening, treating, and disposal of waste will require keeping soil characterization records and transportation manifests in compliance with RCRA, USEPA, NYSDEC Department of Transportation, and local agencies.

- Alternative Four – This alternative was also ranked 1 as one of the least demanding from an administrative perspective. The administrative needs are all short-term needs. Excavation/Screening/Treatment will require dig permits, coordination with utility companies, and possible disruption of traffic patterns. Hauling and disposal of waste will require keeping soil characterization records and transportation manifests in compliance with RCRA, USEPA, Department of Transportation, NYSDEC, and local agencies.

5.3.2.3 Service and Materials

- Alternative One – Limited services and materials are required for Institutional/ Engineering Controls, therefore it was ranked 1.
- Alternative Two – In-Situ Soil Solidification/Stabilization requires specialty drilling and chemical supply. As a result, this alternative was ranked 3.
- Alternative Three – Soil Excavation, Off-Site Treatment and Disposal were described above. Several disposal facilities for lead-contaminated waste have been identified and are anticipated to be available for the foreseeable future. Qualified personnel for the supervision, monitoring and sampling are currently available on-Base. Since all these services are commonly used for Base projects, this alternative was ranked 2.
- Alternative Four – Soil Excavation, On-Site Screening with Off-Site Treatment and Disposal were described above. Several disposal facilities for lead waste have been identified and are anticipated to be available for the foreseeable future. Qualified personnel for the supervision, monitoring and sampling are currently available on-Base. Since all these services are commonly used for Base projects, this alternative was ranked 2.

5.3.2.4 Agency Acceptance

- Alternative One – This alternative was ranked 4 since the site is not in compliance with TAGM 4046 and regulatory agencies prefer active remediation.
- Alternative Two – This alternative was ranked 3 because the site will serve as the disposal area and require continued monitoring.
- Alternative Three – This alternative is similar to Alternative 4 except that it is associated with a larger volume of hazardous waste. Due to regulator preference for hazardous waste minimization, this alternative was ranked 2.
- Alternative Four – This alternative was ranked 1 because the site will be excavated, hazardous waste minimized, and the soil will be remediated and properly disposed of off-site.

5.3.2.5 Community Acceptance

- Alternative One – Since the potential exists for future exposure to site contaminants, this alternative was ranked 4.
- Alternative Two – This alternative was ranked 3. The in-situ treated soil will still be at the site. Also, the site will still require monitoring of the material to make sure that lead is not leached to the surrounding environment.
- Alternative Three – This alternative was ranked 2. Although site contaminants would be removed, hauling of waste is expected to require roughly 200 truckloads that may cause temporarily traffic congestion, dust emissions, and noise nuisances. 50% of the truckloads are anticipated to include Hazardous Waste under this alternative.
- Alternative Four – This alternative was ranked 1. Similar to Alternative 3, site contaminants would be removed, hauling of waste is expected to require roughly 200 truckloads that may cause temporarily traffic congestion, dust emissions, and noise nuisances. 20% of the truckloads are anticipated to include hazardous waste under this alternative.

5.3.2.6 Overall Implementability Ranking

Soil Excavation, On-Site Screening with Off-Site Treatment and Disposal (Alternative Four) is considered the best alternative in terms of overall implementability. The strengths of Alternative Four are based on administrative and regulatory agency acceptance. Soil Excavation, Off-Site Treatment and Disposal (Alternative Three) is ranked second, with the major difference resulting from the increased volume of Hazardous Waste generation. In-Situ Soil Solidification/ Stabilization (Alternative Two) is ranked third, and is also considered to have agency acceptance. However, it scored lower on the community acceptance because the treated soil remains on-site. Institutional/Engineering Controls (Alternative One) has the greatest ease of implementation for technical feasibility and availability but strongly lacks agency and community acceptance which resulted in fourth place.

5.3.3 Cost

Table 5.3 provides a summary of the cost criteria and ranking of the four alternatives. The cost estimates were prepared using RACER and are considered reasonable at the time this report was prepared. The cost estimate sheets appear in Appendix A. Further explanation of the cost evaluation follows the table.

Table 5-3 Cost Criteria Evaluation

Alternative	Cost	Investment	Benefit	Score	Rank
1. Institutional/Engineering Controls	$232,000	1	4	5	3
2. In-Situ Solidification/ Stabilization	$3,321,439	2	2	4	2
3. Soil Excavation, Off-Site Treatment and Disposal	$4,983,030	4	2	6	4
4. Soil Excavation, On-Site Screening with Off-Site Treatment and Disposal	$3,235,649	2	1	3	1

5.3.3.1 Investment

- Alternative One – Institutional/Engineering Controls is ranked 1 because limited investment is required. The cost identified represents investment necessary for 30 years of implementation of institutional control.
- Alternative Two – In-Situ Treatment was ranked 2 because it requires the second greatest investment (slightly higher, but similar to Alternative 4), the majority of which is for stabilization treatment costs.
- Alternative Three – This alternative was ranked 4 because it requires the greatest investment of action alternatives. This is primarily due to the hauling and disposal costs.
- Alternative Four – The excavation costs are the same as Alternative Three, however, the hauling and disposal costs are lower (less Hazardous Waste) so it was ranked 2.

5.3.3.2 Benefit

- Alternative One – Institutional/Engineering Controls is ranked 4 because it offers no benefit.
- Alternative Two – In-Situ Soil Solidification/Stabilization was ranked 2. It offers the second greatest benefit for protection of human health, groundwater, and the environment and is a quick solution. However the treated soil is still on-site with less associated risk.
- Alternative Three – Soil Excavation, Off-Site Treatment and Disposal was ranked 2. It offers a similar benefit to Alternative Two, except that the material will be off-site.
- Alternative Four – Soil Excavation, On-Site Screening with Off-Site Treatment and Disposal was ranked 1. It offers the greatest benefit for protection of human health, groundwater, and the environment primarily due to minimization of the hazardous waste volume.

5.3.3.3 Overall Cost Ranking

Soil Excavation, On-Site Screening with Off-Site Treatment and Disposal (Alternative Four) is considered the best option (ranked 1) in terms of investment made in the site and community and benefit to the environment. In-Situ Soil Solidification/Stabilization (Alternative Two), Soil Excavation, Off-Site Treatment and Disposal (Alternative Three), and Institutional/Engineering Controls (Alternative One) are respectively ranked 2, 3, and 4.

5.4 Overall Ranking of the Alternatives

The overall ranking of the alternatives in terms of their effectiveness, implementability, and cost is presented in Table 5.4. Soil Excavation, On-Site Screening with Off-Site Treatment and Disposal (Alternative Four) has the lowest score. There is a small margin between the remaining Alternatives with Institutional/Engineering Controls having the highest score. Additional factors or knowledge that may arise after the date of this document may change the recommendations of this EE/CA.

Table 5-4 Overall Ranking of Alternatives

Alternative	Total Effectiveness Score	Total Implementability Score	Total Cost Score	Total Overall Score	Total Overall Rank
1. Institutional/ Engineering Controls	13	14	5	32	4
2. In-Situ Solidification/ Stabilization	8	14	4	26	3
3. Soil Excavation, Off-Site Treatment and Disposal	7	8	6	21	2
4. Soil Excavation, On-Site Screening with Off-Site Treatment andDisposal	8	7	3	18	1

6 RECOMMENDED RESPONSE ACTION PLAN

Based on the evaluation performed in Section 5, Soil Excavation, On-Site Screening with Off-Site Treatment and Disposal is the best response action.

6.1 Implementation Plan

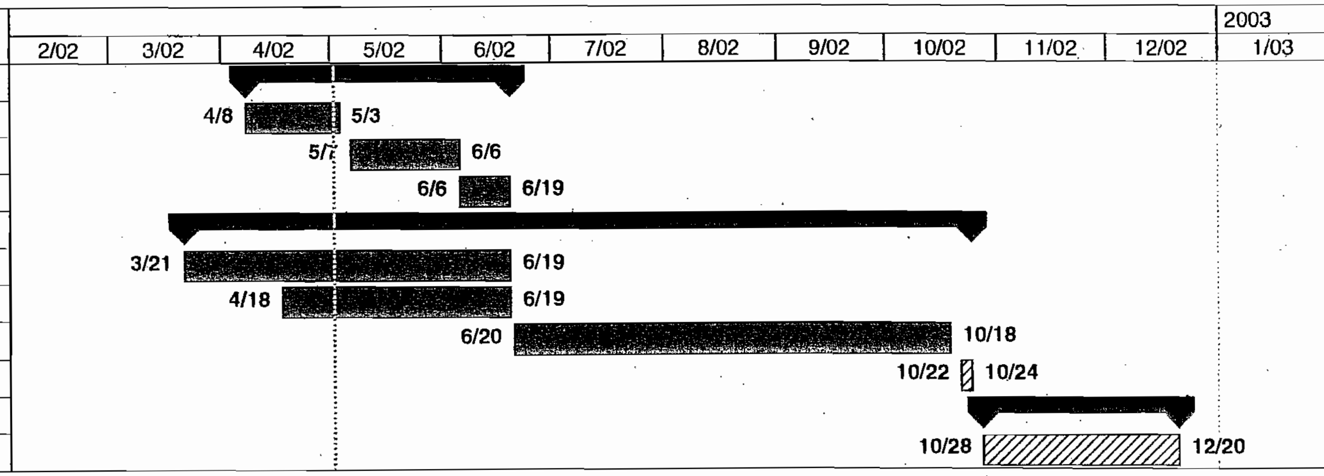
Following the review and acceptance of this EE/CA there are several activities required prior to implementation of the selected response action. Following regulatory and public review, a Remedial Action Work Plan, Sampling and Analysis Plan, and Site Specific Health and Safety Plan must be prepared. Detailed information such as the excavation plan, sampling and staging locations, haul routes, selection of screening/ treatment method, site layout plan, environmental monitoring, and organization charts will be described in these documents.

6.2 Implementation Schedule

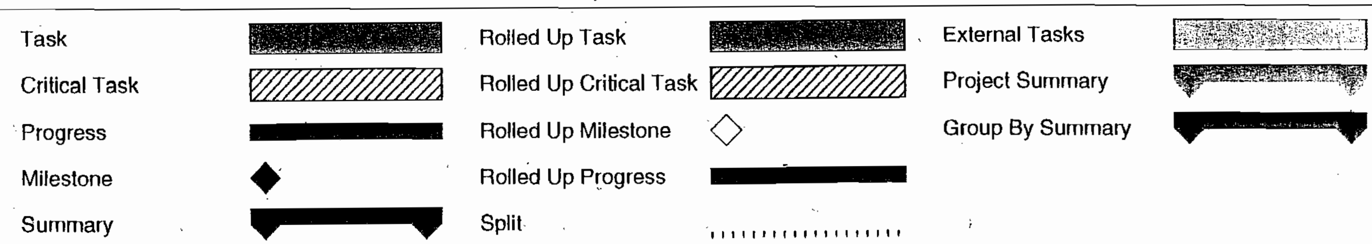
The schedule presented in Figure 6-1 presents the anticipated sequence of events necessary to complete the selected interim removal action – Soil Excavation, On-Site Screening with Off-Site Treatment and Disposal.

FIGURE 6-1
REMEDY IMPLEMENTATION SCHEDULE

ID	Task Name
1	**EE/CA**
2	Draft EE/CA
3	NYSDEC/EPA/Public Review
4	Final EE/CA / Action Memorandum
5	**Implementation of Selection Remedy**
6	Work Plans
7	Mobilization
8	Excavation/Screening/Off-Site Disposal
9	Site Restoration
10	**Reporting**
11	Construction Certification Report



Project: Hardfill 49A EECA
Date: 4/24//02



7 REFERENCES

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PEER, Test Pit Investigation at Hardfill 49 A at the Former Griffiss AFB, New York, Preliminary Report, June 1999

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U.S. Environmental Protection Agency, 1986. Superfund Amendments and Reauthorization Act (SARA).

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U.S. Environmental Protection Agency, 1990 (December). Superfund Removal Procedures Action Memorandum Guidance, EPA/540-P-90-004.

U.S. Environmental Protection Agency, 1992 (July). National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300 Section J.

U.S. Environmental Protection Agency, 1993 (August). Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA, EPA/540-R-93-057.

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APPENDIX A
COST TABLES

DD Form 1391 (Block 9) Detail Report
(With Markups)

Folder: Griffiss

Project

Name: Hardfill 49A EECA
ID: Hardfill 49A EECA
Location: GRIFFIS AFB, NEW YORK
Modifiers: **Material** 0.936
Labor 0.97
Equipment 1.096
Category: None
Report Option: Fiscal Year
Report Year: 2002

Site

Name: Hardfill 49A
ID: Hardfill 49A
Type: None

Phase Element

Name: Alernative 1
Type: Remedial Action
Labor Rate Group:
Analysis Rate Group:
Approach:
Media/Waste Type:
Secondary Media/Waste
Contaminant:
Secondary Contaminant:
Markup Template:
O&M Markup Template: N/A
Start Date:
Description: Institutional Controls

	U/M	Quantity	Unit Cost	Cost ($000)
RA - Alernative 1				
Site Inspection				**11.539**
Other Direct Costs	LS	1.00	81.66	0.082
Draftsman/CADD	HR	6.00	68.00	0.408

DD Form 1391 (Block 9) Detail Report (With Markups)

	U/M	Quantity	Unit Cost	Cost ($000)
Word Processing/Clerical	HR	16.00	51.86	0.830
QA/QC Officer	HR	5.00	124.61	0.623
Staff Scientist	HR	71.00	81.77	5.806
Project Manager	HR	10.00	164.25	1.643
Other Direct Costs	LS	1.00	18.68	0.019
Staff Scientist	HR	16.00	81.77	1.308
Project Manager	HR	5.00	164.25	0.821
RA - Supporting Facilities				
Fencing				**9.654**
Hazardous Waste Signing	EA	5.00	70.79	0.354
Boundary Fence, 5' Galvanized	LF	1,000.00	9.30	9.300

Current Working Estimate (CWE)	21.193
Supervision and Administration (S&A) (8%) (CWE * 0.08)	1.695
Supervision and Review (S&R) (3.5%) (CWE * 0.035)	0.742
Engineering Design During Construction (0.5%) (CWE * 0.005)	0.106
Escalation	1.0272
Programmed Amount	**24.381**

DD Form 1391 (Block 9) Detail Report
(With Markups)

Folder: Griffiss

Project

Name: Hardfill 49A EECA
ID: Hardfill 49A EECA
Location: GRIFFIS AFB, NEW YORK
Modifiers: **Material** 0.936
Labor 0.97
Equipment 1.096
Category: None
Report Option: Fiscal Year
Report Year: 2002

Site

Name: Hardfill 49A
ID: Hardfill 49A
Type: None

Phase Element

Name: Alternative 2
Type: Remedial Action
Labor Rate Group:
Analysis Rate Group:
Approach:
Media/Waste Type:
Secondary Media/Waste
Contaminant:
Secondary Contaminant:
Markup Template:
O&M Markup Template: N/A
Start Date:
Description: In-situ Treatment

	U/M	Quantity	Unit Cost	Cost ($000)
RA - Alternative 2				
In Situ Solidification				**1,511.880**
Operation of Pressure Washer, Including Water, Soap, Electricity, Labor	HR	101.00	61.58	6.220

DD Form 1391 (Block 9) Detail Report
(With Markups)

	U/M	Quantity	Unit Cost	Cost ($000)
Portland Cement Type I (Bulk)	TON	2,430.00	93.90	228.184
Electrical Charge	KWH	1,391.00	0.07	0.104
3,000 PSI Pressure Washer, 4.5 GPM	EA	1.00	7,855.15	7.855
Mobilize/DeMobilize of In Situ Solidification/Stabilization Equipment	EA	1.00	3,528.61	3.529
Operational Labor -In Situ Solidification/Stabilization	HR	824.00	504.09	415.368
Equipment Cost - In Situ Solidification/Stabilization	MO	5.00	52,584.99	262.925
Maintenance of Solidification/Stabilization Unit	YR	0.40	7,694.76	3.078
Bulk Chemical Transport (40,000 Lb Truckload)	EA	131.00	2,730.44	357.688
Urrichem Proprietary Additive (Bulk)	TON	162.00	1,290.33	209.033
Diesel Fuel	GAL	14,420.00	1.24	17.897
Decontamination Facilities				**33.991**
1,800 PSI Pressure Washer, 6 HP, 4.8 GPM	EA	1.00	1,969.69	1.970
Operation of Pressure Washer, Including Water, Soap, Electricity, Labor	HR	520.00	61.58	32.022
Professional Labor Management				**1,044.130**
Planning Documents Labor Cost	LS	1.00	219,009.88	219.010
Site Closure Activities Labor Cost	LS	1.00	0.00	0.000
Other Labor Cost	LS	1.00	0.00	0.000
Reimbursement Claims Preparation Labor Cost	LS	1.00	0.00	0.000
Responsible Party Labor Cost	LS	1.00	0.00	0.000
Permitting Labor Cost	LS	1.00	273,762.36	273.762
Public Notice Labor Cost	LS	1.00	3,832.67	3.833
As-Built Drawings Labor Cost	LS	1.00	27,376.23	27.376
Construction Oversight Labor Cost	LS	1.00	273,762.36	273.762
Project Management Labor Cost	LS	1.00	219,009.88	219.010

DD Form 1391 (Block 9) Detail Report
(With Markups)

	U/M	Quantity	Unit Cost	Cost ($000)
Reporting Labor Cost	LS	1.00	27,376.23	27.376
Monitoring (12 - months only)				**252.751**
TAL Metals (EPA 6010/7000s), Water, Water Analysis	EA	11.00	449.39	4.943
Well Development Equipment Rental (weekly)	WK	1.00	263.89	0.264
Disposable Materials per Sample	EA	11.00	9.31	0.102
Decontamination Materials per Sample	EA	11.00	8.31	0.091
Water Quality Parameter Testing Device	WK	1.00	263.89	0.264
Total Dissolved Solids (EPA 160.1), Water Analysis	EA	11.00	19.18	0.211
Project Manager	HR	44.00	152.73	6.720
Draftsman/CADD	HR	88.00	63.23	5.564
Word Processing/Clerical	HR	176.00	48.22	8.487
Field Technician	HR	142.00	61.17	8.686
Staff Scientist	HR	802.00	76.03	60.978
Total Suspended Solids (EPA 160.2), Water Analysis	EA	11.00	19.18	0.211
Project Engineer	HR	220.00	97.51	21.453
Car or Van Mileage Charge	MI	1,620.00	0.40	0.643
TAL Metals (EPA 6010/7000s), Soil Analysis	EA	110.00	449.39	49.433
Soil Moisture Content ASTM D2216	EA	110.00	33.90	3.729
Power Auger Rental	DAY	17.00	21.02	0.357
Disposable Bailer, Polyethylene, 1.5" Outside Diameter x 36"	EA	5.00	10.78	0.054
Furnish 55 Gallon Drum for Development/Purge Water	EA	5.00	87.44	0.437
Project Scientist	HR	864.00	92.73	80.121

DD Form 1391 (Block 9) Detail Report
(With Markups)

	U/M	Quantity	Unit Cost	Cost ($000)
RA - Supporting Facilities				
Access Roads				**20.128**
Medium Brush, Medium Trees, Clear, Grub, Haul	ACRE	0.57	7,876.99	4.490
18' Complete, 24" Corrugated Metal Pipe Culvert with Headwalls	EA	1.00	5,452.10	5.452
Compact Subgrade, 2 Lifts	CY	555.56	0.57	0.315
Ditch Excavation, Normal Soil, Haul Spoil 1 Mile	CY	1,203.70	3.78	4.555
Rough Grading, 14G, 1 Pass	SY	3,333.33	1.48	4.936
Fine Grading, 130G, 2 Passes	SY	1,333.33	0.28	0.379
Cleanup and Landscaping				**21.008**
Load & Haul Debris, 5 Miles, Dumptruck	CY	26.00	66.89	1.739
Area Preparation, 67% Level & 33% Slope	ACRE	0.65	89.65	0.058
Sodding, Average CONUS (Continental U.S.)	ACRE	0.65	28,877.31	18.770
Fertilizer, Hydro Spread	ACRE	0.65	192.34	0.125
Watering with 3,000-Gallon Tank Truck, per Pass	ACRE	5.20	56.06	0.291
Mowing	ACRE	0.65	36.88	0.024
Clear and Grub				**3.232**
Dozer 105 HP D5, Grubbing & Stacking	CY	121.00	8.01	0.970
Medium Brush without Grub, Clearing	ACRE	1.00	196.65	0.197
Clear Trees to 12" Diameter with D8 Cat	EA	100.00	12.91	1.291
> 6" and <= 12" Stump Removal, with D8	EA	100.00	7.75	0.775

Current Working Estimate (CWE)	2,887.120
Supervision and Administration (S&A) (8%) (CWE * 0.08)	230.970
Supervision and Review (S&R) (3.5%) (CWE * 0.035)	101.049
Engineering Design During Construction (0.5%) (CWE * 0.005)	14.436
Escalation	1.0272
Programmed Amount	**3,321.439**

Cost Database Date: 2001

Cost Type: User-Defined

Print Date: 4/14/02 4:52:47 AM

DD Form 1391 (Block 9) Detail Report
(With Markups)

Folder: Griffiss

Project

Name: Hardfill 49A EECA
ID: Hardfill 49A EECA
Location: GRIFFIS AFB, NEW YORK
Modifiers: **Material** 0.936
Labor 0.97
Equipment 1.096
Category: None
Report Option: Fiscal Year
Report Year: 2002

Site

Name: Hardfill 49A
ID: Hardfill 49A
Type: None

Phase Element

Name: Alternative 3
Type: Remedial Action
Labor Rate Group:
Analysis Rate Group:
Approach:
Media/Waste Type:
Secondary Media/Waste
Contaminant:
Secondary Contaminant:
Markup Template:
O&M Markup Template: N/A
Start Date:
Description: Off-site w/ No Screening

	U/M	Quantity	Unit Cost	Cost ($000)
RA - Alternative 3				
Excavation				**267.189**
Delivered & Dumped, Backfill with Stone	BCY	500.00	29.48	14.742

DD Form 1391 (Block 9) Detail Report
(With Markups)

	U/M	Quantity	Unit Cost	Cost ($000)
Unclassified Fill, 6" Lifts, Off-Site, Includes Delivery, Spreading, and Compaction	CY	15,010.00	10.48	157.357
Disposable Materials per Sample	EA	100.00	9.31	0.931
Soil Moisture Content ASTM D2216	EA	100.00	27.12	2.712
TAL Metals (EPA 6010/7000s), Soil Analysis	EA	100.00	359.51	35.951
Plastic Laminate Waste Pile Cover	SF	111,854.50	0.16	18.208
Decontaminate Heavy Equipment	EA	1.00	458.53	0.459
3 CY, Crawler-mounted, Hydraulic Excavator	CY	12,000.00	3.07	36.829
Off-site Transportation and Landfill Disposal				**512.475**
Dump Truck Transportation Hazardous Waste 400 - 499 Miles	MI	120,000.00	2.83	339.568
Dump Charges	CY	6,000.00	25.75	154.482
Bulk Solid Hazardous Waste Loading Into Truck	CY	6,000.00	3.07	18.425
Decontamination Facilities				**11.185**
1,800 PSI Pressure Washer Rental	MO	3.00	1,265.21	3.796
Operation of Pressure Washer, Including Water, Soap, Electricity, Labor	HR	120.00	61.58	7.390
Professional Labor Management				**1,083.830**
Other Labor Cost	LS	1.00	0.00	0.000
Project Management Labor Cost	LS	1.00	227,337.16	227.337
Planning Documents Labor Cost	LS	1.00	227,337.16	227.337
Construction Oversight Labor Cost	LS	1.00	284,171.47	284.171
Reporting Labor Cost	LS	1.00	28,417.15	28.417
As-Built Drawings Labor Cost	LS	1.00	28,417.15	28.417
Public Notice Labor Cost	LS	1.00	3,978.40	3.978
Site Closure Activities Labor Cost	LS	1.00	0.00	0.000
Permitting Labor Cost	LS	1.00	284,171.47	284.171
Responsible Party Labor Cost	LS	1.00	0.00	0.000

DD Form 1391 (Block 9) Detail Report
(With Markups)

	U/M	Quantity	Unit Cost	Cost ($000)
Reimbursement Claims Preparation Labor Cost	LS	1.00	0.00	0.000
Off-site Transportation and Landfill Disposal				**2,408.926**
Bulk Solid Hazardous Waste Loading Into Truck	CY	6,000.00	3.07	18.425
Dump Truck Transportation Hazardous Waste 400 - 499 Miles	MI	120,000.00	2.83	339.568
Truck Washout/Decontamination	EA	300.00	399.68	119.904
Landfill hazardous solid bulk waste, Requiring stabilization	CY	6,000.00	321.84	1,931.029
RA - Supporting Facilities				
Access Roads				**20.128**
Compact Subgrade, 2 Lifts	CY	555.56	0.57	0.315
18' Complete, 24" Corrugated Metal Pipe Culvert with Headwalls	EA	1.00	5,452.10	5.452
Ditch Excavation, Normal Soil, Haul Spoil 1 Mile	CY	1,203.70	3.78	4.555
Fine Grading, 130G, 2 Passes	SY	1,333.33	0.28	0.379
Rough Grading, 14G, 1 Pass	SY	3,333.33	1.48	4.936
Medium Brush, Medium Trees, Clear, Grub, Haul	ACRE	0.57	7,876.99	4.490
Cleanup and Landscaping				**21.008**
Area Preparation, 67% Level & 33% Slope	ACRE	0.65	89.65	0.058
Sodding, Average CONUS (Continental U.S.)	ACRE	0.65	28,877.31	18.770
Fertilizer, Hydro Spread	ACRE	0.65	192.34	0.125
Watering with 3,000-Gallon Tank Truck, per Pass	ACRE	5.20	56.06	0.291
Mowing	ACRE	0.65	36.88	0.024
Load & Haul Debris, 5 Miles, Dumptruck	CY	26.00	66.89	1.739
Clear and Grub				**6.698**
Dozer 200 HP D7, Grubbing & Stacking	CY	1,048.67	3.30	3.466
Medium Brush without Grub, Clearing	ACRE	1.00	196.65	0.197

DD Form 1391 (Block 9) Detail Report
(With Markups)

	U/M	Quantity	Unit Cost	Cost ($000)
Clear Trees to 12" Diameter with D8 Cat	EA	100.00	12.91	1.291
> 6" and <= 12" Stump Removal, with D8	EA	100.00	7.75	0.775
Dozer 105 HP D5, Grubbing & Stacking	CY	121.00	8.01	0.970

Current Working Estimate (CWE)	4,331.439
Supervision and Administration (S&A) (8%) (CWE * 0.08)	346.515
Supervision and Review (S&R) (3.5%) (CWE * 0.035)	151.600
Engineering Design During Construction (0.5%) (CWE * 0.005)	21.657
Escalation	1.0272
Programmed Amount	**4,983.030**

DD Form 1391 (Block 9) Detail Report
(With Markups)

Folder: Griffiss

Project

Name: Hardfill 49A EECA
ID: Hardfill 49A EECA
Location: GRIFFIS AFB, NEW YORK
Modifiers: **Material** 0.936
Labor 0.97
Equipment 1.096
Category: None
Report Option: Fiscal Year
Report Year: 2002

Site

Name: Hardfill 49A
ID: Hardfill 49A
Type: None

Phase Element

Name: Alternative 4
Type: Remedial Action
Labor Rate Group:
Analysis Rate Group:
Approach:
Media/Waste Type:
Secondary Media/Waste
Contaminant:
Secondary Contaminant:
Markup Template:
O&M Markup Template: N/A
Start Date:
Description: Off-site w/ on-site Screening

	U/M	Quantity	Unit Cost	Cost ($000)
RA - Alternative 4				
Excavation				**341.830**
Delivered & Dumped, Backfill with Stone	BCY	500.00	29.48	14.742

DD Form 1391 (Block 9) Detail Report
(With Markups)

	U/M	Quantity	Unit Cost	Cost ($000)
Unclassified Fill, 6" Lifts, Off-Site, Includes Delivery, Spreading, and Compaction	CY	15,010.00	10.48	157.357
Disposable Materials per Sample	EA	100.00	9.31	0.931
Soil Moisture Content ASTM D2216	EA	100.00	27.12	2.712
TAL Metals (EPA 6010/7000s), Soil Analysis	EA	100.00	359.51	35.951
Plastic Laminate Waste Pile Cover	SF	111,854.50	0.16	18.208
Decontaminate Heavy Equipment	EA	1.00	458.53	0.459
7' x 24' Triple-tray Vibrating Screening Unit, with Motor & Accessories	EA	1.00	37,812.10	37.812
3 CY, Crawler-mounted, Hydraulic Excavator	CY	24,000.00	3.07	73.658
Off-site Transportation and Landfill Disposal				**819.960**
Bulk Solid Hazardous Waste Loading Into Truck	CY	9,600.00	3.07	29.480
Dump Truck Transportation Hazardous Waste 400 - 499 Miles	MI	192,000.00	2.83	543.308
Dump Charges	CY	9,600.00	25.75	247.172
Decontamination Facilities				**11.185**
Operation of Pressure Washer, Including Water, Soap, Electricity, Labor	HR	120.00	61.58	7.390
1,800 PSI Pressure Washer Rental	MO	3.00	1,265.21	3.796
Professional Labor Management				**701.394**
Reimbursement Claims Preparation Labor Cost	LS	1.00	0.00	0.000
Responsible Party Labor Cost	LS	1.00	0.00	0.000
Project Management Labor Cost	LS	1.00	147,119.88	147.120
Planning Documents Labor Cost	LS	1.00	147,119.88	147.120
Construction Oversight Labor Cost	LS	1.00	183,899.85	183.900
Reporting Labor Cost	LS	1.00	18,389.98	18.390
As-Built Drawings Labor Cost	LS	1.00	18,389.98	18.390
Public Notice Labor Cost	LS	1.00	2,574.60	2.575

DD Form 1391 (Block 9) Detail Report
(With Markups)

	U/M	Quantity	Unit Cost	Cost ($000)
Site Closure Activities Labor Cost	LS	1.00	0.00	0.000
Other Labor Cost	LS	1.00	0.00	0.000
Permitting Labor Cost	LS	1.00	183,899.85	183.900
Off-site Transportation and Landfill Disposal				**890.346**
Bulk Solid Hazardous Waste Loading Into Truck	CY	2,400.00	3.07	7.370
Dump Truck Transportation Hazardous Waste 400 - 499 Miles	MI	48,000.00	2.83	135.827
Truck Washout/Decontamination	EA	120.00	399.68	47.962
Landfill hazardous solid bulk waste, Requiring stabilization	CY	2,400.00	291.33	699.187
RA - Supporting Facilities				
Access Roads				**20.128**
Compact Subgrade, 2 Lifts	CY	555.56	0.57	0.315
18' Complete, 24" Corrugated Metal Pipe Culvert with Headwalls	EA	1.00	5,452.10	5.452
Ditch Excavation, Normal Soil, Haul Spoil 1 Mile	CY	1,203.70	3.78	4.555
Fine Grading, 130G, 2 Passes	SY	1,333.33	0.28	0.379
Rough Grading, 14G, 1 Pass	SY	3,333.33	1.48	4.936
Medium Brush, Medium Trees, Clear, Grub, Haul	ACRE	0.57	7,876.99	4.490
Cleanup and Landscaping				**21.008**
Area Preparation, 67% Level & 33% Slope	ACRE	0.65	89.65	0.058
Sodding, Average CONUS (Continental U.S.)	ACRE	0.65	28,877.31	18.770
Fertilizer, Hydro Spread	ACRE	0.65	192.34	0.125
Watering with 3,000-Gallon Tank Truck, per Pass	ACRE	5.20	56.06	0.291
Mowing	ACRE	0.65	36.88	0.024
Load & Haul Debris, 5 Miles, Dumptruck	CY	26.00	66.89	1.739

DD Form 1391 (Block 9) Detail Report
(With Markups)

	U/M	Quantity	Unit Cost	Cost ($000)
Clear and Grub				**6.698**
Dozer 200 HP D7, Grubbing & Stacking	CY	1,048.67	3.30	3.466
Medium Brush without Grub, Clearing	ACRE	1.00	196.65	0.197
Clear Trees to 12" Diameter with D8 Cat	EA	100.00	12.91	1.291
> 6" and <= 12" Stump Removal, with D8	EA	100.00	7.75	0.775
Dozer 105 HP D5, Grubbing & Stacking	CY	121.00	8.01	0.970

Current Working Estimate (CWE)	2,812.549
Supervision and Administration (S&A) (8%) (CWE * 0.08)	225.004
Supervision and Review (S&R) (3.5%) (CWE * 0.035)	98.439
Engineering Design During Construction (0.5%) (CWE * 0.005)	14.063
Escalation	1.0272
Programmed Amount	**3,235.649**

APPENDIX B
TEST PIT INVESTIGATION REPORT

PRELIMINARY REPORT
TEST PIT INVESTIGATION AT
HARDFILL 49A AT
THE FORMER GRIFFISS AFB, NEW YORK

PRELIMINARY DRAFT
JUNE, 1999

PEER
Consultants, P.C. ENGINEERS • SCIENTISTS • MANAGEMENT CONSULTANTS

12300 Twinbrook Parkway • Suite 410 • Rockville, MD 20852 • (301) 816-0700 • FAX (301) 816-9291
Pollution, Environment, Energy and Resources

June 11, 1998

Mr. Wade Brower
AFCEE Resident Engineer
AFBCA/OL-X
153 Brooks Road
Griffiss AFB, NY 13441-4105

Reference: Contract DAHA90-94-D-0011, Delivery Order 045, Griffiss AFB
Hardfill 49A, Preliminary Report on the Test Pit Investigation

Dear Mr. Brower:

Please find enclosed a preliminary report on the test pit investigation conducted at Hardfill 49A. This results included in this report are based on visual observations and field screening utilizing direct reading x-ray fluorescence equipment. Confirmatory soil samples were collected from the test pits for analysis of total metals; however, the analytical results are not yet available. Without the confirmatory analytical results, this document is preliminary and should not be used for final decision making or be released for public information. It is our understanding that this preliminary report will be used by AFBCA as a tool to investigate several remediation options for the site and justify actions as necessary.

Sincerely,

PEER CONSULTANTS, P.C.

John W. Tucker, Jr., P.E.
Program Manager

Enclosures

cc: Mark Rabe - 4 copies

...\1701\GRIFFISS\RPT.LTR

PRELIMINARY REPORT
TEST PIT INVESTIGATION AT
HARDFILL 49A AT
THE FORMER GRIFFISS AFB, NEW YORK

PRELIMINARY DRAFT
JUNE, 1999

Preliminary Results of the Test Pit Investigation at Hardfill 49A

Introduction

Remedial activities were undertaken at the Small Arms Range (SAR) in late summer and fall of 1998. As a result of these activities, a determination was made that additional range-related lead contaminated soil may be present beneath the area known as Hardfill 49A. Consequently, a series of 16 test pits were proposed to investigate this possibility. The original intent was to excavate through the hardfill materials to the underlying native soils to determine whether range-related materials were present beneath the hardfill and, if so, to define the extent of such material.

Additional remedial activities at the SAR, currently in progress, required the removal of hardfill materials which were known to overlie a portion of the SAR berms. During these removal activities, visual indications of lead contamination of the hardfill materials were observed. Elevated lead levels were found in the hardfill material using direct reading x-ray fluorescence (XRF) equipment. As a result, the test pit activities were modified to also include screening of the hardfill materials.

Field Activities and Observations

Test-pit excavation was undertaken during the period from May 26, 1999 to June 7, 1999. Sixteen test pits, numbered as such, were installed at the locations shown on Figure 1. Screening of the excavated materials both visually and with handheld XRF equipment was performed throughout each excavation. XRF screening data is contained in the logs for each test pit. 400 ppm of lead has been the remedial goal for the SAR.

A maximum of three samples were obtained from each test pit for laboratory analysis using EPA SW-846 Methods 6010/7471 for total metals. Analytical results for the samples are pending. The logs for each test pit are provided in Attachment A.

To assist in interpreting the information obtained from the test pit activities, two cross-sections were prepared. The location of these cross-sections is shown on Figure 2. Figure 3 presents cross-section A-A' trending from north to south. Figure 4 presents cross-section B-B' trending from west to east. At this point no vertical or horizontal control has been established for the test pits. Certain assumptions were made in the construction of the cross-sections. For cross-section A-A', the elevation of the native materials in Test Pits 1-4 and 17 were assumed to be the same based on information developed during removal of the SAR berm. For cross-section B-B', the ground surface was assumed to be the same for each location. Given the lack of vertical and horizontal control, use of these cross-sections to estimate volumes should be avoided.

Hardfill materials were encountered in Test Pits 1 through 8 and 10 through 12 (See Figures 3 and 4). Hardfill materials consisted of treated timbers, wood fragments (painted and unpainted), various pieces of metal, crushed metal containers, pieces of pipe, concrete rubble, asphalt rubble, bricks, glass, and plastic. These materials were mixed with gray silt and gravel that commonly contained bullets and fragments. Of the locations where hardfill was encountered, only Test Pits 8 and 12 did not contain bullets and bullet fragments in the hardfill materials. In Test Pits 1 through 4, 6, 7, 10, and 11, gray gravelly silt with some sand was observed beneath the hardfill materials that contained bullets, bullet fragments, and lead patinas on the soil aggregate surfaces. Lead patinas (probably resulting from precipitation of dissolved lead) were visible as silvery coatings on both wood and soil in most of the test pits where lead containing materials were encountered.

Test Pit 9 was observed to contain fill materials that do not correlate with those found in the other pits. The material found in this pit was comprised of sanitary refuse containing primarily paper and general household refuse. Also found in the sanitary refuse was a small plastic bag containing approximately 50 hypodermic syringes and several empty blood vials. This medical waste was not labeled or identified in any fashion. Lead containing material (based on XRF readings) consisting of a confetti-like substance was observed in the sanitary refuse.

During the test pit excavation, it became apparent that additional lead bearing materials were present in the hardfill and sanitary refuse materials. Many of the wood fragments with paint were determined to contain lead. Lead acid battery plates were observed in the excavation for Test Pit 6. The confetti-like material found in Test Pit 9 was also determined to contain lead.

All four test pits on the eastern edge of the site (Test Pits 13 through 16) were found to contain neither hardfill nor range-related materials.

A second round of test pits (numbered 17 through 21) were installed to define the limits of lead contaminated material. The only test pit which was observed to contain lead associated with either the range or the hardfill materials was Test Pit 21 which was found to contain a small, discrete (approximately 1 cubic foot) clump of soil containing bullets. No continuity between this small deposit and those materials observed in the original 16 pits was observed. At this location large quantities of the confetti-like material observed in Test Pit 9 were also observed at this location.

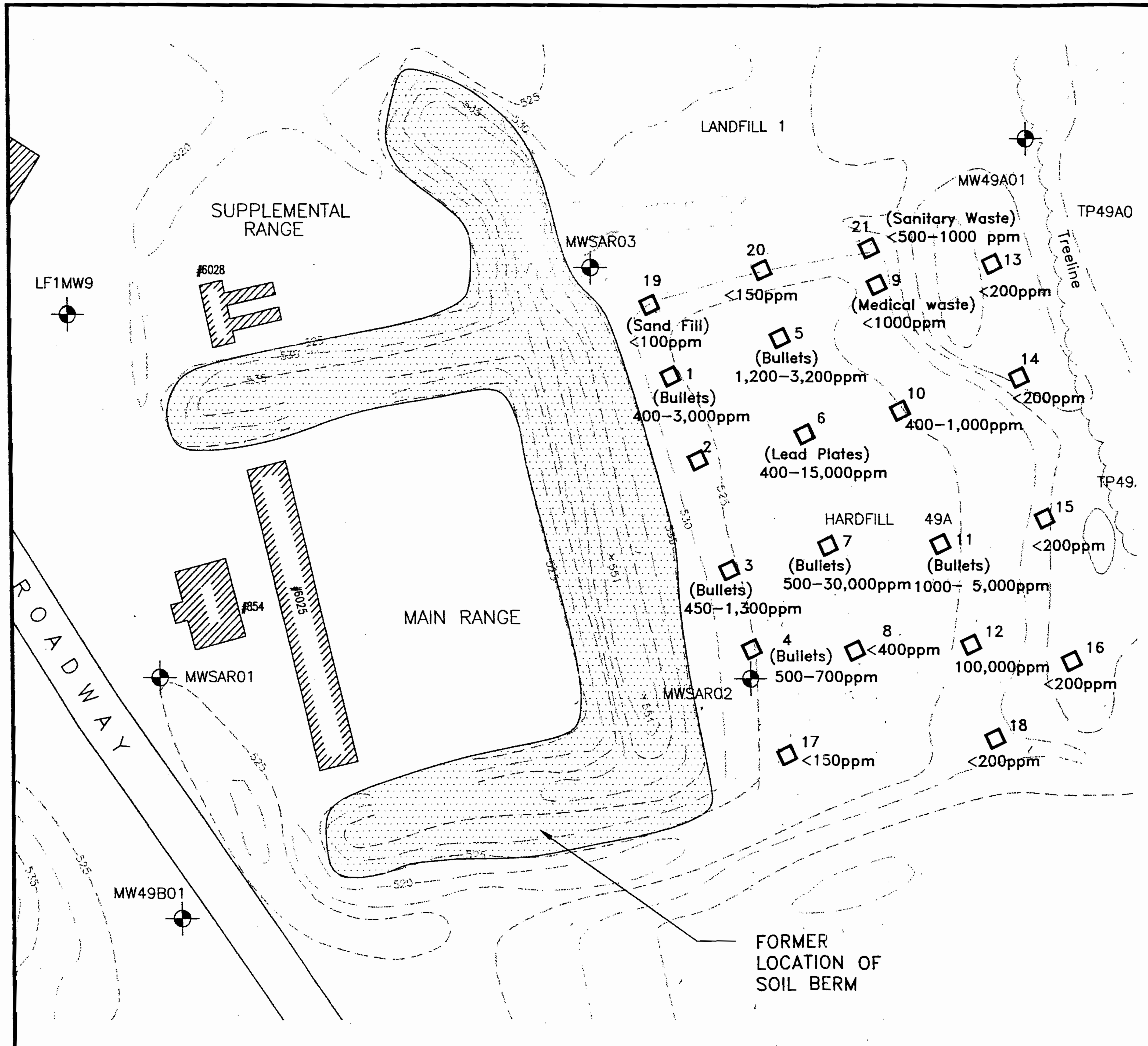
Beneath the fill materials, the native soil consists of sand and gravel with few to no fines or organic matter. This deposit was consistently found across the site. Groundwater was typically encountered 2-4 feet below the elevation of the native materials at Test Pits 1 through 4. At Test Pit 7, groundwater was observed to be in contact with the lead contaminated materials.

Summary and Conclusions

A total of 21 test pits were installed throughout the area known as Hardfill 49A. Excavated materials were screened both visually and using direct reading XRF equipment to assess the distribution of lead in the subsurface. A total of 47 samples plus two duplicates were collected and submitted to Severn Trent Laboratories in Amherst, New York for analysis for total metals.

Based on the information developed from this test pit investigation the following preliminary conclusions are made:

- Lead contamination appears to be widespread throughout the hardfill materials and is derived from several sources including bullets, lead paint and other lead containing materials (i.e. lead acid battery plates).
- Range-related lead contaminated soil (gravelly silt) underlies a significant portion of the hardfill.
- An area of sanitary refuse is located on the north central portion of the site. This refuse also contains lead materials which are of a different origin than those in the hardfill/range-related deposits.
- Lead contamination of soil does not appear to continue into the underlying native sand and gravel based on XRF screening.
- Lead contaminated materials extend into the groundwater at certain locations. At other locations, the groundwater is within 3-4 feet of the contaminated material.
- Native materials at the site consist of a sand and gravel without fines or organic matter. This material is anticipated to possess a high hydraulic conductivity, and is unlikely to attenuate metals in leachate from the contaminated materials. This native material provides a pathway for dissolved lead to reach the groundwater.



NOTES:

1. ALL LOCATIONS ARE APPROXIMATE.
2. TOPOGRAPHY DOES NOT REPRESENT CURRENT CONDITIONS.
3. ALL INFORMATION IS PRELIMINARY AND SUBJECT TO CHANGE.

* LEAD CONCENTRATIONS ARE BASED ON X-RAY FLUORESCENCE METER.

LEGEND

- MWSAR02 — EXISTING MONITORING WELL
- 16 □ — TEST PIT LOCATION
- <200ppm — ESTIMATED LEAD CONCENTRATION *
- FORMER BERMED AREA

0 25 50
SCALE: 1" = 50'

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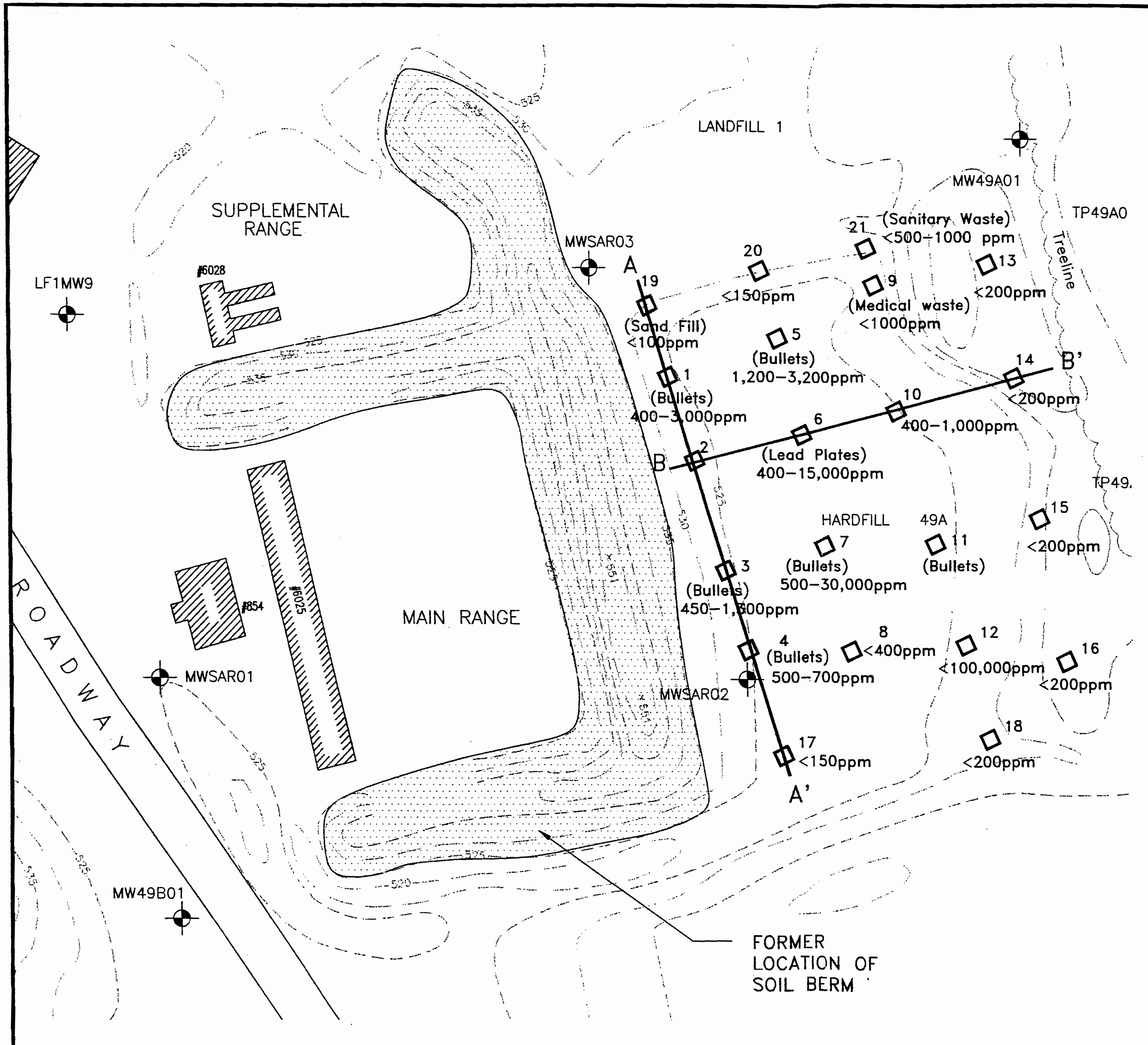
FIGURE 1
TEST PIT LOCATIONS

PEER CONSULTANTS, P.C.
12300 TWINBROOK PARKWAY
SUITE 410
ROCKVILLE, MARYLAND 20852
(301) 816-0700

PROJECT NUMBER: 1566-045-001-03		DATE
SCALE:	1" = 50'	
DESIGNED BY:	MB	6/99
DRAWN BY:	HFP	6/99
CHECKED BY:	MB	6/99

NO.	REVISION	BY	DATE

FILENAME: 15660F1A



NOTES:

1. ALL LOCATIONS ARE APPROXIMATE.
2. TOPOGRAPHY DOES NOT REPRESENT CURRENT CONDITIONS.
3. ALL INFORMATION IS PRELIMINARY AND SUBJECT TO CHANGE.

* LEAD CONCENTRATIONS ARE BASED ON X-RAY FLUORESCENCE METER.

LEGEND

MWSAR02 — EXISTING MONITORING WELL

16 □ — TEST PIT LOCATION

<200ppm — ESTIMATED LEAD CONCENTRATION *

FORMER BERMED AREA

0 25 50
SCALE: 1" = 50'

AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
GRIFFISS AIR FORCE BASE - NEW YORK

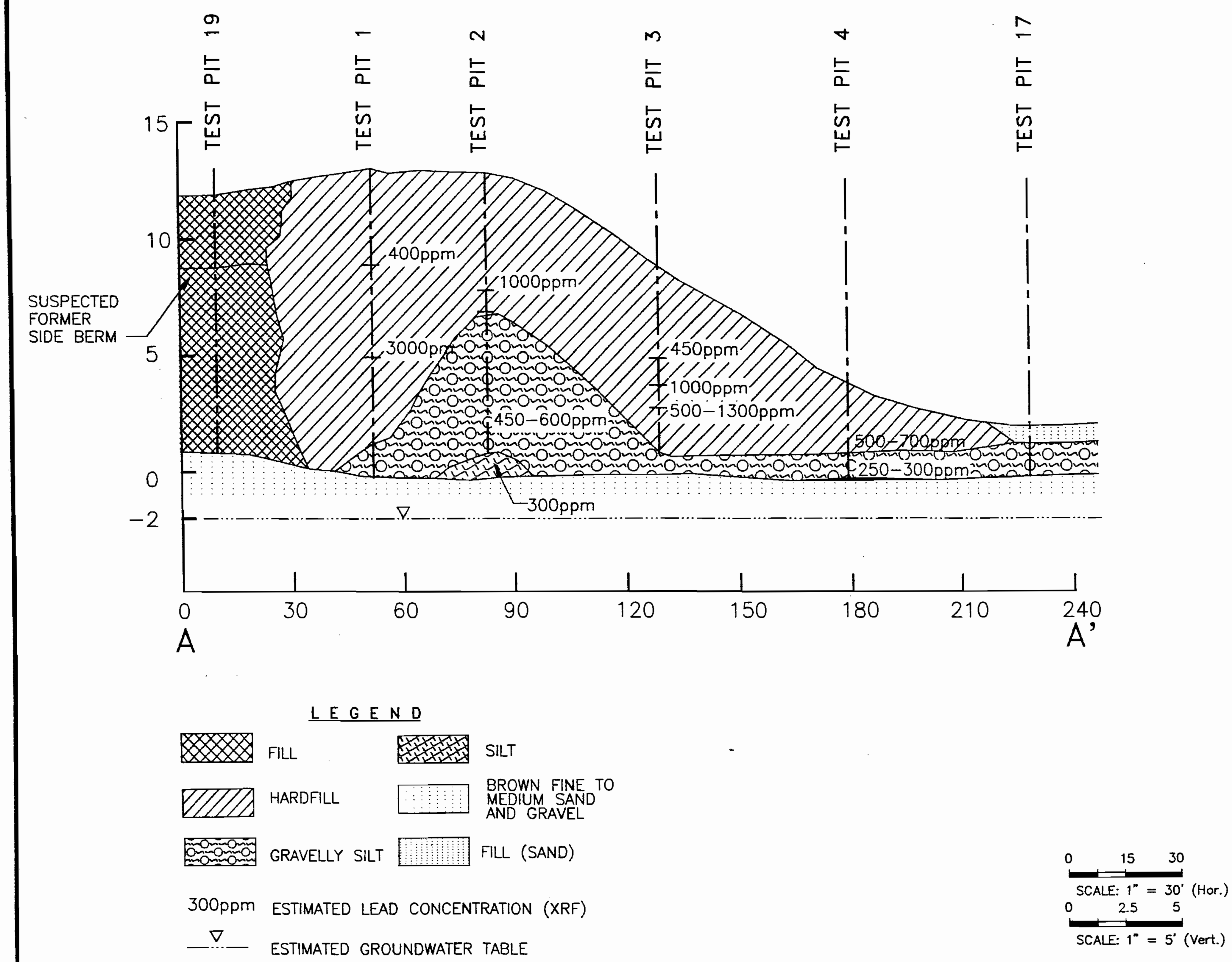
FIGURE 2
CROSS SECTION LOCATIONS

PEER CONSULTANTS, P.C.
12300 TWINBROOK PARKWAY
SUITE 410
ROCKVILLE, MARYLAND 20852
(301) 816-0700

PROJECT NUMBER: 1566-045-001-03		DATE
SCALE:	1" = 50'	
DESIGNED BY:	MB	6/99
DRAWN BY:	HFP	6/99
CHECKED BY:	MB	6/99

NO.	REVISION	BY	DATE

FILENAME: 15660F1B



BULLETS OBSERVED IN HARDFILL MATERIALS (SCATTERED) AND IN GRAVELLY SILT (DENSELY DISTRIBUTED)

HARDFILL– CONSIST OF TIMBERS, WOOD FRAGMENTS, PIPES, METAL FRAGMENTS, GLASS, FLOOR TILE, PAINTED WOOD, WIRE AND CABLE.

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GRIFFISS AIR FORCE BASE - NEW YORK

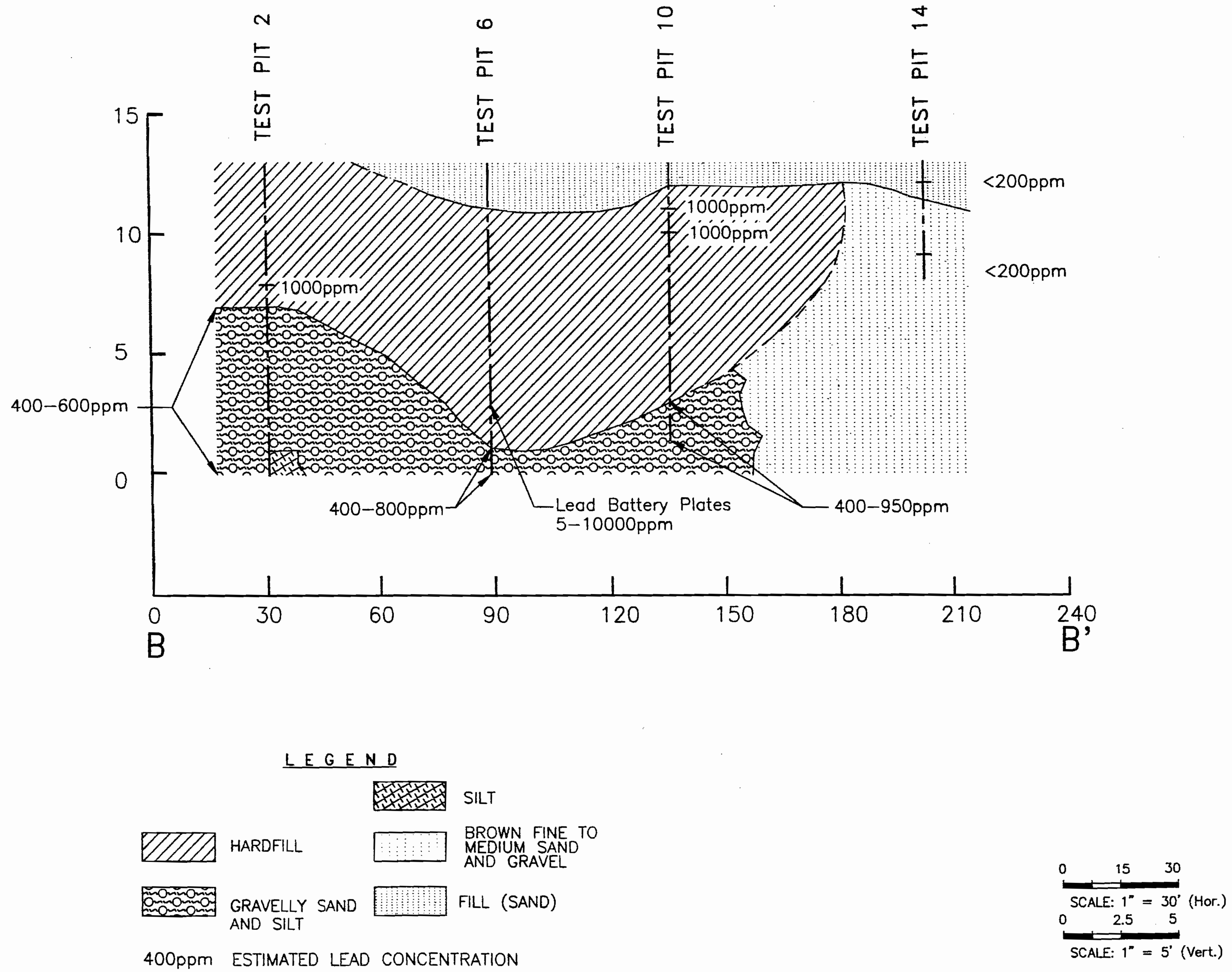
CROSS SECTION A-A'

PEER CONSULTANTS, P.C.
12300 TWINBROOK PARKWAY
SUITE 410
ROCKVILLE, MARYLAND 20852
(301) 816-0700
Est. 1978

PROJECT NUMBER: 1566-045-001-03		DATE
SCALE:	AS SHOWN	
DESIGNED BY:	MB	6/99
DRAWN BY:	HFP	6/99
CHECKED BY:	MB	6/99

NO.	REVISION	BY	DATE

FILENAME: 15660IF1C



BULLETS OBSERVED IN HARDFILL MATERIALS
(SCATTERED) IN GRAVELLY SILT
(DENSELY DISTRIBUTED)

HARDFILL– CONSIST OF TIMBERS, WOOD FRAGMENTS, PIPES, METAL FRAGMENTS, GLASS, FLOOR TILE, PAINTED WOOD, WIRE AND CABLE.

AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
GRIFFISS AIR FORCE BASE - NEW YORK

CROSS SECTION B-B'

PEER CONSULTANTS, P.C.
12300 TWINBROOK PARKWAY
SUITE 410
ROCKVILLE, MARYLAND 20852
(301) 816-0700
Est. 1978

PROJECT NUMBER:	1566-045-001-03	DATE
SCALE:	AS SHOWN	
DESIGNED BY:	MB	6/99
DRAWN BY:	HFP	6/99
CHECKED BY:	MB	6/99

NO.	REVISION	BY	DATE

FILENAME: 156601F1d

APPENDIX C
TEST PIT LOGS

Test Pit Logs, Hardfill 49A

Test Pit 1

0-12 feet	Timbers, wood fragments, metal fragments, pipes, cables, floor tiles, and bricks (Hardfill), mixed with soil consisting of gray silt and sand with whole bullets and fragments, lead patinas on wood and soil surfaces. XRF readings: 3 feet – 450 ppm, 4 feet – 1,000 ppm, 8 feet – 800 ppm
12-13 feet	Gray silt, little fine sand, whole bullets and fragments. XRF readings: 13 feet – 700 ppm
13+ feet	Brown fine to medium sand

Grab samples obtained from the 4, 8 and 13-foot depths.

Test Pit 2

0-6 feet	Timbers, utility poles, concrete rubble, steel straps, cable, and wire (Hardfill) mixed with soil consisting of gray silt and sand with bullets and fragments, lead patinas on soil surfaces. XRF readings: 5 feet – 1,000 ppm
6-12 feet	Gray sand and silt, bullets, bullet fragments and lead patinas. XRF readings in soil range from 450-650 ppm. Root mass produced a reading of 7,000 ppm.
12-13 feet	Gray silt containing bullets. XRF reading 300 ppm
13+ feet	Brown fine to medium sand

Grab samples were obtained from the 5, 8 and 12-foot depths.

Test Pit 3

0-8 feet	Steel, timbers, crushed metal containers (Hardfill) mixed with soil consisting of gray silt and sand with bullets and lead patinas. XRF readings 4 feet – 450 ppm, 5 feet – 1,000 ppm, 5.5-6 feet – 500 to 1,300 ppm
8-9 feet	Dark gray silt, no visible bullets or fragments. XRF reading <400 ppm
9+ feet	Brown fine sand

Grab samples were obtained from the 5, 6 and 8-foot depths.

Test Pit 4

0-3 feet	Treated timbers, utility poles (Hardfill)
3-3.5 feet	Brown sand and silt with bullets, bullet fragments and lead patinas. XRF readings from 500-700 ppm.
3.5-4 feet	Gray silt, some clay with shell casings. XRF readings from 250- 300 ppm
4+ feet	Brown fine sand, little silt, wet at 6 feet. XRF readings < 200 ppm

Grab samples obtained from the 3, 4 and 5-foot depths

Test Pit 5

0-1 feet	Brown sand (Topsoil).
1-3 feet	Brown sand and gravel with gray mottling (Fill). Steel strap at 3 feet.
3-12 feet	Wood fragments (painted and unpainted), pieces of metal, utility poles, railroad ties, cable, concrete rubble (Hardfill) mixed with soil consisting of gray sand and silt with bullets, buckshot. Lead patinas on the wood fragments yield XRF reading of 1,200 ppm. Painted wood piece reads 3,200 ppm. No correlating concentrations in the surrounding soil. Obtained composite sample from this unit.
12-14+ feet	Brown sand and gravel grading to brown fine to medium sand.

Composite sample obtained from the 3-12 foot interval.
Grab sample obtained from the 14-foot depth.

Test Pit 6

0-1 feet	Brown sand, some silt, little gravel (Topsoil)
1-2 feet	Brown sand and gravel (Fill)
2-12 feet	Timbers, utility poles, railroad ties, steel straps, cables, wood fragments (Hardfill) mixed with soil consisting of silt and sand with bullets and lead patinas. Lead acid battery plates were encountered at a depth of 10-12 feet. Associated soils produced readings from 5,000-10,000 ppm.
12-14+ feet	Light gray fine sand, little. XRF readings ranged from 400-800 ppm. Soils were wet at 14 feet.

Grab samples were obtained at the 10 and 14 foot depths.

Test Pit 7

0-1 feet	Brown fine sand and gravel (Topsoil)
1-8 feet	Metal, wood, rebar, pipe, concrete rubble, copper pipe, crushed metal container with roof tar (Hardfill) mixed with soil consisting of sand and silt. Wood fragment at 2- foot depth produced XRF reading of 30,000 ppm.
8-9 feet	Dark gray silt, some clay, dense, banded with brown medium sand and silt, lead patinas, bullets and bullet fragments. Very moist to wet. XRF readings range from 500-900 ppm.
9+ feet	Brown fine to medium sand, wet

Grab samples were obtained from the 2, 8 and 9-foot depths

Test Pit 8

0-1 feet	Brown sand and gravel, little silt (Topsoil)
1-5 feet	Steel, cables, crushed metal sheeting, wood fragments (Hardfill)
5-6 feet	Gray silt and sand, some fine gravel
6+ feet	Brown fine to medium sand, wet

Grab samples obtained from the 2, 5 and 6-foot depths
Duplicate sample obtained from the 6-foot depth

Test Pit 9

0-0.25 feet	Bluish gray fine sand (Fill)
0.25-1 feet	Brown fine sand and gravel (Fill)
1-3 feet	SAA with sanitary refuse, plastic bags, bottles, paper etc. Medical waste consisting of syringes and blood vials encountered at 2 feet. Confetti-like material produced XRF reading of 1,000 ppm
3-10+ feet	Brown fine to medium sand and gravel

Grab samples obtained from the 3 and 8-foot depths

Test Pit 10

0-1 feet	Brown silt and gravel with roots (Topsoil)
1-10 feet	Concrete rubble, bricks, metal fragments, wood fragments (Hardfill) mixed with soil consisting of gray silt and sand. XRF readings: 2 feet (from piece of wood with lead patinas) – 1,000 ppm, 3 feet – 1,000 ppm
10-12 feet	Dark gray silt with gravel, bullets, bullets fragments and lead patinas. XRF readings range from 400-950 ppm
12+ feet	Brown fine to medium sand and gravel

Grab samples obtained from the 3, 10 and 11-foot intervals

Test Pit 11

0-1 feet	Brown fine sand and gravel (Topsoil)
1-8 feet	Wood fragments, timbers, concrete rubble, asphalt rubble (Hardfill) mixed with soil consisting of silt and sand with bullets, bullet fragments and lead patinas. XRF readings 2 feet – 2,400 ppm, 4 feet – 1,000 ppm, 6 feet – 1,700 ppm
8-10 feet	Brown sand, dense, containing many bullets. XRF readings to 5,000 ppm.
10+ feet	Light brown medium sand, wet

Grab samples obtained from the 2, 4 and 8-foot depths

Test Pit 12

0-1 feet	Brown fine sand and gravel (Topsoil)
1-6 feet	Wood fragments, timbers (Hardfill), mixed with soil consisting of silt. XRF reading from painted piece of wood 100,000 ppm. No corresponding reading in soils. No bullets at this location.
6+ feet	Light brown, fine to medium sand. Water table reached at 10 feet.

Grab samples obtained from the 5 and 6-foot depths

Test Pit 13

0-2	Brown fine sand, little silt (Fill)
2-8+ feet	Brown fine sand and gravel

Grab sample obtained from the 4-foot depth

Test Pit 14

0-1.75 feet	Brown fine sand, little silt (Fill)
1.75-5+ feet	Brown sand and gravel

Grab sample obtained from the 5-foot depth

Test Pit 15

0-0.5 feet	Brown silt with roots (Topsoil)
0.5-8 feet	Brown medium sand, little gravel
8-10+ feet	Brown coarse sand and gravel, pockets of light brown fine sand

Grab sample and duplicate sample obtained from the 2-foot depth

Test Pit 16

0-1 feet	Brown fine sand and gravel with roots (Topsoil)
1-4 feet	Brown medium sand, some gravel
4-10+ feet	Brown coarse sand and gravel, small lenses of light brown fine sand

Grab sample obtained from the 2-foot depth

Test Pit 17

0-1 feet Brown sand, some silt and fine gravel (Topsoil)

1-2.5 feet Dark gray silt and fine gravel with occasional timbers (Hardfill)

2.5+ feet Brown fine to medium sand with manganese staining, wet

Grab samples obtained from the 2 and 3-foot depths

Test Pit 18

0-1 feet Brown fine sand, some silt, little fine gravel (Topsoil)

1-4 feet Bricks, wood fragments, asphalt, floor tile, concrete rubble, roof tile and plastic bags mixed with soil consisting of brown silt. No bullets, fragments, or lead patinas. Some wood fragments have lead paint but no corresponding soil contamination.

4-6 feet Gray silt and sand with pieces of wood, wet. At 5 feet encountered small area with lead patinas and XRF reading of 2,200 ppm. Remainder of interval <200 ppm.

6-8+ feet Brown sand and gravel, little silt, wet.

Grab samples obtained 5 and 6-foot depths

Test Pit 19

0-3 feet Brown silt and sand, some fine gravel becomes mottled with gray at 1-3 feet (Fill)

3-11 feet Brown sand and gravel, little silt. One lead fragment encountered but with no corresponding elevated XRF readings.

11+ feet Brown medium sand and gravel

Grab sample obtained from the 2 and 3-foot depths

Test Pit 20

0-2 feet Bluish gray fine sand, little silt consistent with the adjacent landfill to the north

2-12+ feet Brown fine to medium sand, little sand, moist

Grab samples obtained from the 2 and 3-foot depths

Test Pit 21

0-1.5 feet Bluish gray fine sand, little silt consistent with the adjacent landfill to the north

1.5-9 feet Sanitary refuse consisting of papers, plastic bags, miscellaneous household refuse. Small pocket of sand at 3 feet with bullets and XRF readings in soil of 1,000-1,100 ppm. At 5 feet encountered large quantities of confetti-like material encountered in Test Pit 9. XRF reading on material 20,000 ppm, on soil 500-800 ppm.

9-12+ feet Gray fine sand, little silt, wet at 11 feet.

Grab samples obtained from the 2.5, 5 and 10-foot depths

APPENDIX D
GROUNDWATER INVESTIGATION REPORT

DRAFT

INFORMAL TECHNICAL INFORMATION REPORT

HARDFILLS 49A, 49B, 49C AND 49D AND SMALL ARMS RANGE GROUNDWATER SAMPLING

Prepared for:

Areas of Interest
Long-Term Monitoring Program
Griffiss Air Force Base
Rome, New York

through

AFCEE
3207 North Road
Brooks AFB, TX 78235-5673

Prepared by:
FPM Group, Ltd.
153 Brooks Road
Rome, NY 13441

Contract No. F41624-95-D-8003
Delivery Order No. 11
Project No. JREZ 03-7040

Revision 1.1
December 2001

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EXECUTIVE SUMMARY

FPM Group, Ltd. (FPM) is under contract with the Air Force Center for Environmental Excellence (AFCEE) to conduct a long-term monitoring (LTM) program for the groundwater at several Areas of Interest (AOIs) at the former Griffiss Air Force Base (AFB), Rome, New York. Three groundwater sampling events were conducted under this contract at the Hardfill Site 49a and the Small Arms Range (SAR); Hardfills 49b, 49c, and 49d were sampled twice. The sampling events were performed to:

(a) confirm the conclusions in the Predesign Investigation Report for Remedial Design at Hardfill 49a, 49b, 49c, and 49d, Griffiss AFB (Parsons Engineering Science, Inc. (Parsons), February 1997a) and the Final Investigation Report for the Small Arms Range, Griffiss AFB (Parsons, September 1997b), based on analytical results which were later questioned; and

(b) monitor the groundwater quality in the vicinity of the SAR after the interim removal action performed in two phases during 1998 and 1999 by PEER Consultants, P.C.

This Informal Technical Information Report (ITIR) summarizes the results of the three groundwater sampling events.

The purpose of the June 1999 groundwater sampling event was to confirm previous conclusions that were based on questionable laboratory results, from samples collected from the Hardfills and SAR sites in September 1996, including samples submitted for volatile organic compound (VOC), semivolatile organic compound (SVOC), total petroleum hydrocarbons (TPH)-diesel, and total metals analysis. The 1999 sampling event results were similar to those obtained in September 1996, but total metals concentrations were, in many cases, higher than previously obtained levels and above regulatory standards (i.e., New York State [NYS] Class GA Groundwater Standards).

The purpose of the May 2000 groundwater sampling event was to assess whether the elevated metals concentrations from the June 1999 sampling event could be attributed to high turbidity levels in the samples, perhaps as a result of the agitation of groundwater resulting from the use of bailers to purge and sample the wells. Therefore, to minimize disturbances to the aquifer associated with purging and sampling with a disposable bailer, a low-flow sampling methodology was adopted for the May 2000 sampling event, and was performed according to the *United States Environmental Protection Agency (USEPA) Region II Ground Water Sampling Procedure, Low Stress (Low Flow) Purging and Sampling, March 1998*. In addition, groundwater samples were submitted for both total (unfiltered) and dissolved (filtered) metals analysis.

The results of the 2000 sampling event indicated that both total and dissolved metals results were generally lower than in both previous sampling events, likely as a result of the low-flow purging and sampling procedure used to collect the samples. Generally, releases to the groundwater that are attributable to a site were defined by samples with concentrations exceeding the "background" or upgradient concentration by greater than a factor of two, as specified by USEPA Region II in comments to the SAR Work Plan (Parsons, May 1996) dated July 12, 1996. The SAR Work Plan further specified that the releases attributable to a site are considered significant when groundwater concentrations also exceed the NYS Groundwater Standards. Metals reported at concentrations greater than NYS Groundwater Standards and two times the upgradient well concentrations were generally limited to iron and manganese, which have been found to be ubiquitous in the soils in and surrounding the former Griffiss AFB, and whose source cannot be attributed to the Hardfills or the SAR.

In April 2001, groundwater samples were collected from the vicinity of the SAR only (monitoring wells within the borders of the SAR and Hardfill 49a). Samples were collected using the low-flow purging and sampling method used in 2000. The results were nearly identical to those from the 2000 sampling event, i.e., the metals reported above the NYS Groundwater standards and more than two times above the upgradient well concentrations were limited to iron, manganese, and sodium. The recommendations included in previous documents (Parsons 1997a and b) were upheld by the analytical results obtained during these three sampling events, namely that groundwater remediation for these sites was not recommended, based on the present and potential use of groundwater for each site, contaminant properties and concentrations, and site hydrogeological conditions.

LIST OF ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AOI	Area of Interest
BTOC	below top of casing
CLP	Contract Laboratory Program
COC	contaminant of concern
DO	Delivery Order
DQO	data quality objective
DRO	diesel-range organics
FPM	FPM Group, Ltd.
FSP	Field Sampling Plan
GFAA	gas furnace atomic absorption
HSP	Health and Safety Plan
ICP	inductively coupled plasma
ITS	Intertek Testing Services
ITIR	Informal Technical Information Report
LCS	laboratory control sample
LTM	long-term monitoring
MS/MSD	matrix spike/matrix spike duplicate
NTU	nephelometric turbidity units
NYS	New York State
Parsons	Parsons Engineering Science, Inc.
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RL	reporting limits
SAR	Small Arms Range
SDG	Sample Delivery Group
STL	Severn Trent Laboratories

SVOC	semivolatile organic compound
TPH	total petroleum hydrocarbons
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
µg/L	micrograms per liter

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

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1.0 INTRODUCTION

This Informal Technical Information Report (ITIR) presents the results for groundwater sampling events conducted at the Hardfill sites 49a, 49b, 49c, 49d and the Small Arms Range (SAR) in June 1999 and May 2000, and at Hardfill site 49a and the SAR in April 2001, by FPM Group, Ltd. (FPM) at the former Griffiss Air Force Base (AFB), Rome, New York.

In 1996, Parsons Engineering Science, Inc. (Parsons) implemented the following Work Plans: Remedial Design at Hardfills 49a, 49b, 49c, and 49d, Griffiss AFB (July 1996a) and Environmental Site Assessment Small Arms Range, Griffiss AFB (May 1996b). The collected samples were submitted to Intertek Testing Services (ITS) for analysis and the data were incorporated in reports prepared by Parsons: Predesign Investigation Report For Remedial Design at Hardfills 49a, 49b, 49c, and 49d, Griffiss AFB (February 1997a) and Final Investigation Report For Small Arms Range, Griffiss AFB (September 1997b). The ITS analytical results were thence deemed suspect.

The June 1999 sampling event was the initial re-sampling of the Hardfills/SAR, which was performed to fill data gaps caused by disqualification of previous laboratory analytical results from samples collected in September 1996. Although the analytical results for VOCs and SVOCs correlated well between the September 1996 and June 1999 sampling events, the 1999 analytical results for several metals exceeded New York State Class GA Groundwater Standards. In a letter report submitted by FPM in November 1999, it was hypothesized that the elevated metals concentrations measured in the unfiltered samples were likely associated with high turbidity levels observed in the samples (turbidity levels were generally greater than 500 nephelometric turbidity units (NTU)). Additional sampling was recommended with analysis limited to only total (unfiltered) and dissolved (filtered) metals.

A second re-sampling event was conducted in May 2000. Samples were collected using a low-flow sampling technique recommended by the United States Environmental Protection Agency (USEPA) to minimize turbidity during the collection of samples (USEPA Region II, Ground Water Sampling Procedure, Low Stress (Low Flow) Purging and Sampling, March 1998), and samples were submitted for total and dissolved metals analysis. The results were used to evaluate the initial conclusions based on the September 1996 results presented by Parsons (1997a and b), pertaining to remedial actions necessary to close these sites.

In April 2001, the Hardfill 49a and SAR wells only were resampled to evaluate the effectiveness of the removal action conducted at the SAR, in which approximately 11,800 cubic yards of lead-contaminated soil (total lead concentrations above 400 mg/kg) were excavated, transported off-site, stabilized, and disposed of at a landfill facility. Groundwater samples were collected using the low-flow sampling method mentioned above and were submitted for total and dissolved metals analysis.

This report summarizes the results of each groundwater sampling event as compared to the 1996 ITS results, and separates the results according to each site: Hardfills 49a through 49d, and the

SAR. The sites and sampling locations are shown in Figures 1-1 through 1-4. Refer to the Parsons Work Plans (Parsons, 1996a and b) for a detailed description of each site and investigative history.

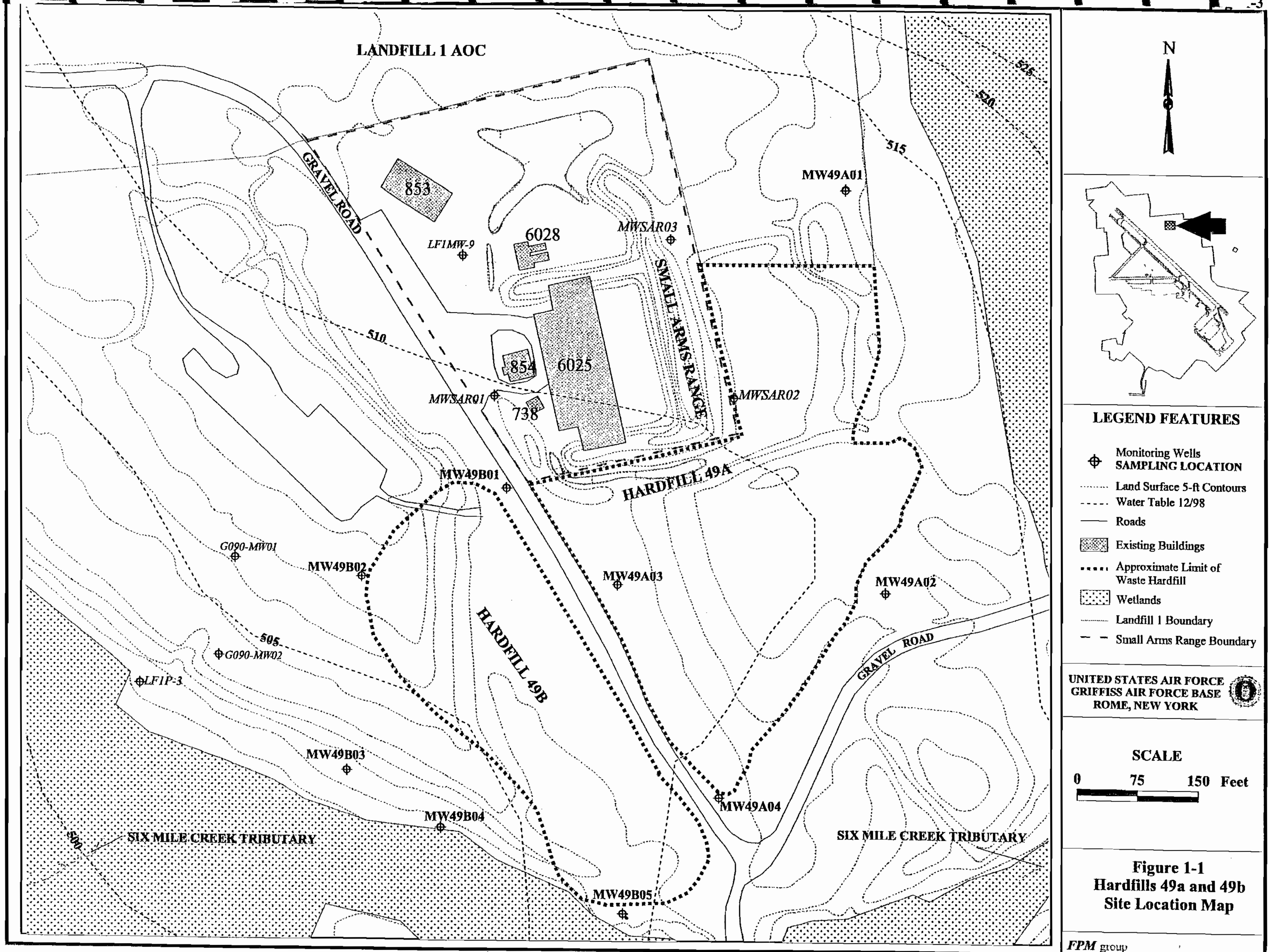

Figure 1-1
Hardfills 49a and 49b
Site Location Map

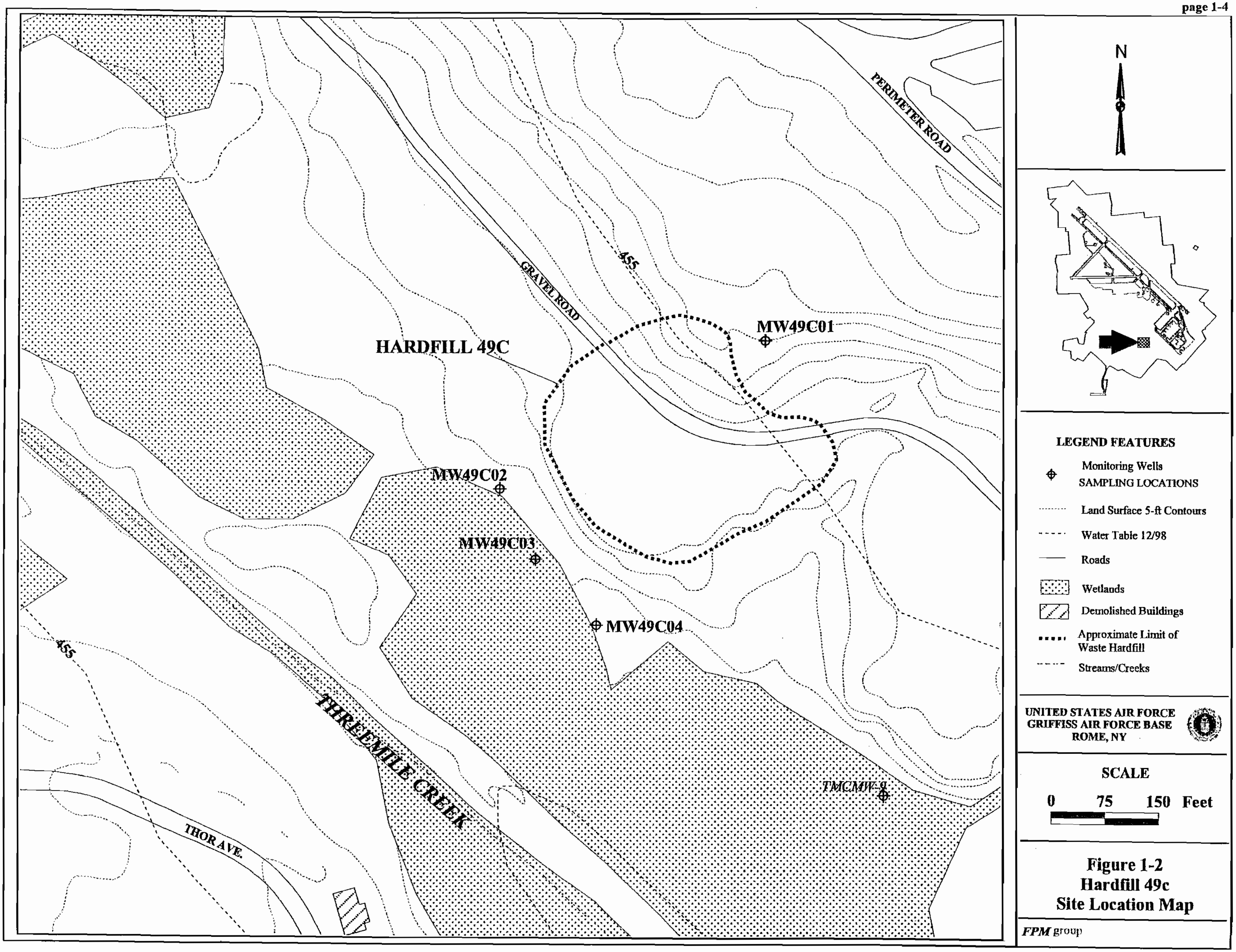

Figure 1-2
Hardfill 49c
Site Location Map

FPM group

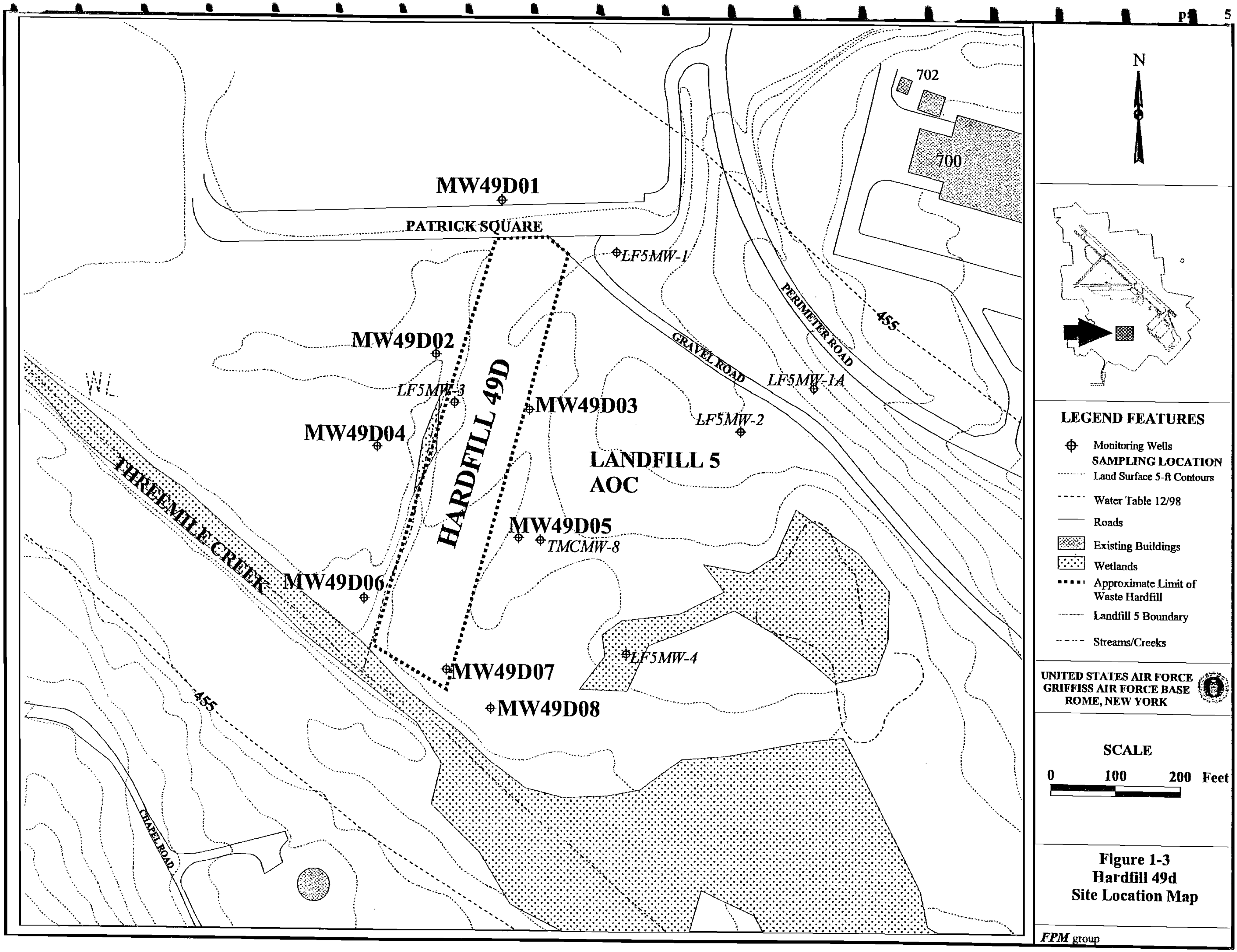

Figure 1-3
Hardfill 49d
Site Location Map

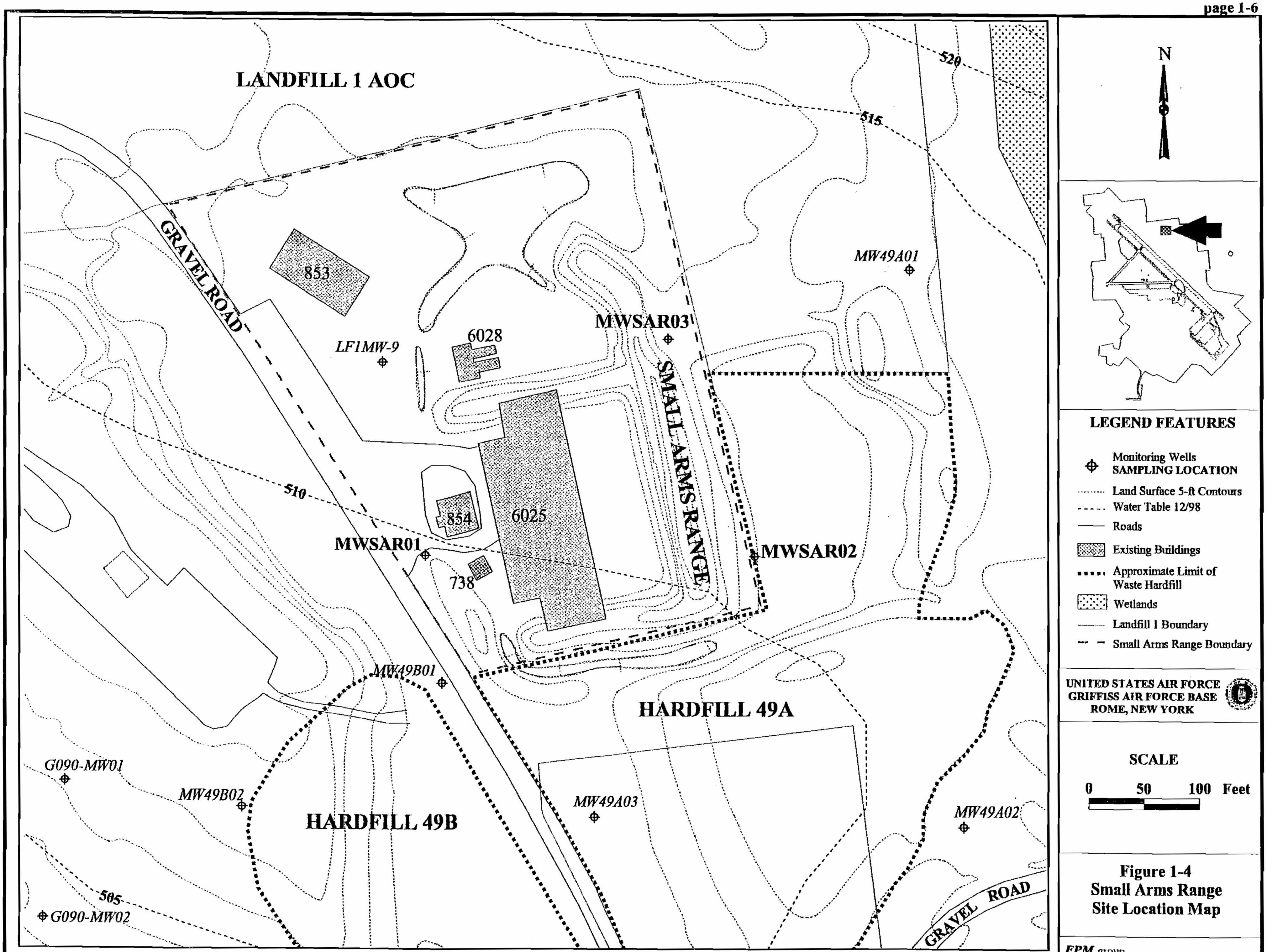

Figure 1-4
Small Arms Range Site Location Map

FPM group

2.0 FIELD SAMPLING AND ANALYTICAL ACTIVITIES

2.1 Field Sampling Activities

Groundwater sampling was conducted according to the protocols for site investigation established in the above referenced work plans (Parsons 1996a and 1996b), including the incorporated Field Sampling Plans (FSP) and Health and Safety Plans (HSP). Refer to these documents for details pertaining to the project description and organization, site history and environmental setting, field operations, analytical methods, and quality assurance program. However, the current AFCEE Quality Assurance Project Plan (QAPP), Version 3.0, was followed with AFCEE-approved project-specific variances under FPM's Delivery Order 11 (Appendix A).

Table 2-1 presents a summary of field activities conducted at each site. Refer to the Field Sampling Plans (Parsons, 1996a and b) for a detailed description of sampling methods employed during the September 1996 (Parsons) and June 1999 (FPM) sampling events.

To minimize disturbance of sediment in the bottom of the well and to prevent drawdown during purging which could mobilize otherwise immobile particulates, the USEPA low-flow purging and sampling method was used to collect groundwater samples during the 2000 and 2001 sampling events. In May 2000, however, the depth to groundwater was too deep to use a peristaltic pump (the limit is approximately 30 ft) in wells MW49B02 (depth to water 35.4 ft below top of casing (BTOC)) and MW49C01 (depth to water 41.8 ft BTOC); these were therefore purged and sampled with a disposable bailer, using special care to minimize drawdown and agitation within the screen during bailer removal.

Samples collected during the 2000 and 2001 sampling events were submitted for both "total" and "dissolved" metals analysis from all wells. Samples for "total" metals were submitted to the laboratory unfiltered and already preserved, having been acidified in the field using "prepreserved" 1:1 nitric acid provided by the laboratory; samples for "dissolved" metals analysis were submitted to the laboratory unpreserved and unfiltered. Upon receipt of the "dissolved" metals bottles, laboratory personnel filtered and then preserved the samples with 1:1 nitric acid.

Field Sampling Forms for each sampling event are included in Appendix B.

Table 2-1 Field Activities Summary

Site	Monitoring Wells Sampled			Sampling Method Employed		
Sampling Event	1999	2000	2001	1999	2000	2001
Hardfill 49a	MW49A01 MW49A02 MW49A03 MW49A04	MW49A01 MW49A02 MW49A03 MW49A04	MW49A01 MW49A02 MW49A03 MW49A04	Bailer (all)	Low-Flow (all)	Low-Flow (all)
Hardfill 49b	MW49B01 MW49B02 MW49B03 MW49B04 MW49B05	MW49B01 MW49B02 MW49B03 MW49B04 MW49B05	MW49B01[2]	Bailer (all)	Low-Flow Bailer Low-Flow Low-Flow Low-Flow	Low-Flow --- --- --- ---
Hardfill 49c	MW49C01 MW49C02 MW49C03 MW49C04	MW49C01 MW49C02 MW49C03 MW49C04		Bailer (all)	Bailer Low-Flow Low-Flow Low-Flow	---
Hardfill 49d	MW49D01 MW49D02 MW49D03 MW49D04 MW49D05 MW49D06 MW49D07 MW49D08	MW49D01 MW49D02 MW49D03 MW49D04 MW49D05 MW49D06 MW49D07 MW49D08		Bailer (all)	Low-Flow (all)	---
Small Arms Range	MWSAR01 MWSAR02 MWSAR03	MWSAR01 MWSAR02 MWSAR03	MWSAR01 MWSAR02 MWSAR03	Bailer (all)	Low-Flow (all)	Low-Flow (all)

[1]Not including QA/QC samples.
[2]MW49B01 was included in the May 2001 sampling event due to its immediate downgradient location from the SAR.

2.2 Analytical Testing Methods

The data quality was assessed in accordance with the quality assurance/quality control (QA/QC) requirements specified in the AFCEE QAPP Version 3.0 (including QAPP-specified analyte lists) and associated AFCEE-approved variances (Appendix A). The analytical testing was performed by Severn Trent Laboratories, Inc. (STL) located in Amherst, New York. For the June 1999 sampling event, the monitoring wells at the Hardfills and SAR sites were sampled for the following parameters: Volatile Organic Compounds (VOCs) by USEPA method SW8260B, Semivolatile Organic Compounds (SVOCs) by USEPA method SW8270C, Total Metals by inductively coupled plasma (ICP) (USEPA method SW6010), Lead by Graphite Furnace Atomic Absorption (GFAA) (USEPA method SW7421), Mercury by Cold Vapor (USEPA method SW7470A) and Total Petroleum Hydrocarbons (TPH)-Diesel range by USEPA method SW8015 (Modified) Diesel Range Organics (DRO). For the 2000 and 2001 sampling events, only the metals-related analyses were performed: Total and Dissolved/Soluble Metals by ICP (USEPA method SW6010), Lead by GFAA (USEPA method SW7421), and Mercury by Cold Vapor (USEPA method SW7470A).

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3.0 DATA QUALITY ASSURANCE AND QUALITY CONTROL EVALUATION

A complete (100%) data review was performed on the samples collected during the groundwater sampling investigation, including both groundwater and associated QC samples. The analytical test methods and QA/QC requirements used for the groundwater sample analysis were as specified in the AFCEE Quality Assurance Project Plan (QAPP), Version 3.0, and associated AFCEE-approved variances.

The data were validated according to the protocols and QC requirements associated with the respective analytical methods and those discussed in the QAPP. For data usability purposes, all values were further evaluated, including positive and non-detect results that were qualified "R" (Rejected) according to QAPP. The data usability analysis was based on the reviewer's professional judgment and on an assessment of how this data would fare with respect to the USEPA Contract Laboratory Program (CLP) National Functional Guidelines for Inorganic Data Review (February 1994 (EPA 540/R-94/013)).

The data validation review assessed the following QA/QC criteria:

- Reporting and method detection limits
- Holding times, sample preservation and storage
- GC/MS tuning criteria
- Initial calibration
- Second source calibration verification
- Continuing calibration
- Method, ambient, equipment, and trip blanks
- Surrogate spike results
- Field duplicate results
- Matrix spikes/matrix spike duplicates (MS/MSD)
- Internal standard areas and retention times
- Laboratory control samples (LCS)
- Qualitative and quantitative compound identification
- Chain-of-custody (COC)
- Case narrative, AFCEE forms, and deliverables compliance

The items listed above were evaluated in terms of compliance with AFCEE QAPP and USEPA criteria and protocols. Full data validation reports were generated and these reports along with the qualified analytical results (annotated laboratory data sheets, Form 2s) can be found in Appendix C.

3.1 Data Usability Results

Data review for usability is a process that evaluates the validated data in context with the original data quality objectives (DQOs). The formal process of usability determination involves a complex series of procedures including editing, screening, auditing, verifying, and reviewing the validated data.

Based on an evaluation of all the information in the analytical data groups, the data is highly usable with the data validation qualifiers as noted in the results. Using the data validation guidance (AFCEE QAPP, USEPA, and professional judgment), the results are 100% usable with no rejected values. Applying this to the QAPP's completeness criteria (number of valid results/total number of possible results), the results were 100% complete. Therefore, in summary, the incidental qualification of the groundwater results (typically estimated values J, UJ) has no significant impact on the overall project data quality.

The data are valid and usable with qualifications as indicated in the data review. The data qualifiers are summarized as follows:

J The analyte was positively identified; the quantitation is an estimation.

U The analyte was analyzed for but not detected. The associated value is at or below the MDL.

UJ The analyte was analyzed for but not detected, however, the MDL is approximate and may or may not represent the actual limit of quantitation.

F The analyte was positively identified but the associated numerical value is below the RL.

R The data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

B The analyte was found in the associated blank as well as in the sample.

M A matrix effect was present.

S Applied to all field screening data.

T Tentatively-identified compound, using gas chromatography/mass spectroscopy (GC/MS).

Data flagging was performed according to the conventions described in the AFCEE QAPP (Version 3.0), USEPA National Functional Guidelines, and the reviewer's professional judgment. According to the QAPP, when multiple qualifiers are prescribed, the data review process assigned a final qualifier reflecting the most severe qualifier. The QAPP and applicable USEPA final data qualifiers for definitive data and the hierarchy of data qualifiers, listed in order of the most severe through the least severe, are R, M, F, J, B, UJ and U.

4.0 GROUNDWATER SAMPLING RESULTS

The results of the detected analytes for each sampling event (including the Parsons 1996 results) are summarized below. Similar to comparisons previously made by Parsons, detected analytes are compared to NYS Groundwater Standards and two times the upgradient well concentrations, as specified by USEPA Region II in comments to the original SAR Work Plan (Parsons, 1996b), dated July 12, 1996. (Although the criterion used in the Predesign Investigation Report For Remedial Design At Hardfills 49a, 49b, 49c, and 49d (Parsons, 1997a) was *three* times the upgradient well concentration, two times is applied for the latest rounds of sampling at the Hardfills as a conservative measure.)

4.1 Hardfill 49a

The Hardfill 49a results summary of the groundwater sampling events conducted in September 1996, June 1999, May 2000, and April 2001 is presented in Table 4-1. The well locations are shown in Figure 1-1. Results of interest include the following:

1999 Sampling Results

- VOC results were consistent with those measured in 1996; no VOCs were detected.
- SVOC results indicated wells MW49A03 and MW49A04 with phthalate compound detections at levels below reporting limits (RL) and well below NYS Groundwater Standards.
- TPH-diesel range results were similarly low compared to those detected in 1996.

2000 Sampling Results

- Unlike the previous sampling events, no detections of lead were reported in either the "total" or "dissolved" samples.
- Results from metals analyses indicated upgradient well MW49A01 with similar metals detected as previously, except chromium, cobalt, copper, lead, and nickel were not detected in either the "total" or "dissolved" samples. Sodium was detected in MW49A01 at levels exceeding the NYS Groundwater Standard in both the "total" and "dissolved" samples. In accordance with previous evaluations, applying the two times upgradient well rule for wells which indicated metals at concentrations above NYS Groundwater Standards, well MW49A02 indicated exceedances for iron and manganese (in both "total" and "dissolved" samples), and MW49A04 for iron only (in the "total" sample only). The "total" and "dissolved" iron and manganese results for 2000 were less than the previous sampling events, except for "total" iron in MW49A02, which was slightly higher than the 1996 result, but approximately one order of magnitude less than the June 1999 results.

2001 Sampling Results

- Metals analysis results were similar to those reported in 2000, except that antimony was detected at MW49A01 in the "total" sample, and in the "total" samples at wells MW49A02 and MW49A03 (but at levels below two times the upgradient well [MW49A01]). Additionally, applying the two times upgradient well rule for wells which indicated metals at

Table 4-1
1996-2001 Groundwater Analytical Results
Hardfill 49a

WELL ID	--	MW49A01						MW49A02						
SAMPLE ID	NYSDEC GW STANDARDS	MW49A01	MW49A01A	MW49A0113BA		MW49A0113CA		MW49A02	MW49A02A	MW49A02D	MW49A0214BA		MW49A0214CA	
		upgradient	upgradient	total	soluble	total	soluble			field dup.	total	soluble	total	soluble
DATE OF COLLECTION		9/3/1996	6/24/1999	5/1/2000	5/1/2000	4/17/2001	4/17/2001	9/4/1996	6/24/1999	6/24/1999	5/1/2000	5/1/2000	4/17/2001	4/17/2001
Depth to Groundwater (ft BTOC)	--	14.34	14.28	13.01	13.01	12.65	12.65	16.75	16.55	16.55	14.48	14.48	13.89	13.89
VOCs (µg/L)														
NONE DETECTED	--	U	U	NA	NA	NA	NA	U	U	U	NA	NA	NA	NA
SVOCs (µg/L)														
bis(2-ethylhexyl) phthalate	5	U	U	NA	NA	NA	NA	U	U	U	NA	NA	NA	NA
di-n-butyl phthalate	50	U	U	NA	NA	NA	NA	U	U	U	NA	NA	NA	NA
TPH (mg/L)														
diesel components	--	0.18F	0.78J	NA	NA	NA	NA	0.27F	1.0J	1.2J	NA	NA	NA	NA
Metals (µg/L)														
aluminum	--	28080	34100	430	102F	115F	26.4F	2852	13000J	27000J	170F	U	162F	U
antimony	3	10.2F	U	U	U	14.1F	U	21.0F	U	U	U	U	10.1F	U
arsenic	25	6.90	14.7F	U	U	U	U	U	21.8J	33.2J	U	U	3.5F	U
barium	1000	142	160	7.9	4.9F	7.0	6.7	60.4	118J	192J	18.1	15.4	18.6	16.4
beryllium	--	1.35F	3	1.9F	U	0.9F	U	U	U	1.8F	2.1B	U	U	U
cadmium	5	U	U	U	U	U	U	U	U	U	U	U	0.7F	U
calcium	--	22798	41700	2550	2290	2470	2370	22317	10600J	13200J	7930	7910	9770	9560
chromium	50	60.1F	51.8	U	U	U	U	17.8F	21.7J	45.1J	U	U	U	U
cobalt	--	61.2F	31.9	U	U	U	U	8.0F	6J	13.4J	U	U	U	U
copper	200	87.90	130	U	U	U	U	34.8F	41.4J	97.9J	U	U	U	U
iron	300	58557	68400	624	U	112	21.8F	6613	61000J	97200J	8820	2160	8810M	1600
lead	25	27.2	40.5	U	U	U	U	69.7	11.3J	26.9J	U	U	2.0M	U
magnesium	--	15943	24900	377	265	348	304	3001	4170J	7980J	1280	1250	1350	1280
manganese	300	980	2370	43	26.8	33.6	31.1	3289	2600	2700	1440	1330	1760M	1630
mercury	1	0.07F	U	U	U	U	U	U	U	U	U	U	U	U
molybdenum	--	U	U	U	U	U	U	U	U	U	U	U	U	U
nickel	100	51.3F	65.5	U	U	U	2.1F	7.11F	15.5J	35.3J	U	U	U	4.4F
potassium	--	11095	9060	2500J	2380	2290	2620	2203F	3440J	5810J	973J	540	600	668
selenium	10	U	U	U	U	U	U	U	U	U	U	U	U	U
silver	50	U	U	U	U	U	U	U	U	U	U	U	U	U
sodium	20000	142725	41700	134000	121000	132000	134000	2381	2360	2560	2500	1930	2380	1870
thallium	--	U	13.2F	U	U	U	U	U	10.7F	15.3F	U	U	U	U
vanadium	--	58.5F	64.2	U	U	U	U	6.55F	30.5J	61.8J	U	U	U	U
zinc	--	139.40	253.00	U	4.0F	6.9F	14.6F	34.50	87.2J	175J	U	10.4F	U	17.7F

Notes:

[shaded] - Indicates concentration exceeds the NYS Class GA Groundwater Standard (upgradient only) and two times the upgradient concentration.

-- - Indicates no NYS Class GA Groundwater Standard.

B - The analyte was found in an associated blank, as well as in the sample.

F - The analyte was positively identified but the associated numerical value is below the Reporting Limit (RL).

J - The analyte was positively identified, the quantitation is an estimation.

NA - Not Available.

R - The data is unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

U - The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.

For VOCs and SVOCs, only detected compounds are displayed.

Table 4-1
1996-2001 Groundwater Analytical Results
Hardfill 49a

WELL ID	--	MW49A03						MW49A04					
SAMPLE ID	NYSDEC GW STANDARDS	MW49A03	MW49A03A	MW49A0313BA		MW49A0311CA		MW49A04	MW49A04A	MW49A0414BA		MW49A0413CA	
				total	soluble	total	soluble			total	soluble	total	soluble
DATE OF COLLECTION		9/3/1996	6/24/1999	5/1/2000	5/1/2000	4/17/2001	4/17/2001	9/4/1996	6/24/1999	5/1/2000	5/1/2000	4/17/2001	4/17/2001
Depth to Groundwater (ft BTOC)	--	14.93	15.65	12.67	12.67	11.48	11.48	16.41	16.52	14.41	14.41	12.94	12.94
VOCs (µg/L)													
NONE DETECTED	--	U	U	NA	NA	NA	NA	U	U	NA	NA	NA	NA
SVOCs (µg/L)													
bis(2-ethylhexyl) phthalate	5	U	4F	NA	NA	NA	NA	U	U	NA	NA	NA	NA
di-n-butyl phthalate	50	U	U	NA	NA	NA	NA	U	3F	NA	NA	NA	NA
TPH (mg/L)													
diesel components	--	U	0.14F	NA	NA	NA	NA	0.27F	0.36J	NA	NA	NA	NA
Metals (µg/L)													
aluminum	--	22538	79200M	138F	52.5F	103F	U	684	26700	124F	U	29.9F	U
antimony	3	33.7F	U	U	U	13.5F	U	29.4F	U	U	U	U	U
arsenic	25	33.4	95.6M	U	U	U	U	1.1F	40.1	U	U	U	4.3F
barium	1000	159	347M	14.2	15.1	19.0	18.3	22.6	208	14.7	11.9	12.8	13.4
beryllium	--	U	6.2M	U	U	U	U	U	1.5F	U	U	U	U
cadmium	5	U	U	U	U	U	U	U	U	U	U	U	U
calcium	--	73809	55200	113000	115000M	161000	152000	74701	75600	75200	71800	91900	86900
chromium	50	54.0F	106M	U	U	U	U	15.5F	38.9	U	U	U	U
cobalt	--	88.1	111M	U	U	U	U	U	38.7	U	U	U	U
copper	200	154	391M	3.3F	U	U	U	16.0F	96.1	U	U	U	2.8F
iron	300	70918	198000M	112M	225	49.4F	U	1899	63300	887	U	33.9F	U
lead	25	45.7	209M	U	U	U	U	11.5	19.8	U	U	U	U
magnesium	--	14964	32300M	5240	5140	7860	7420	4602	10800	3030	2870	4130	3800
manganese	300	9054	23800M	13	2.6F	5	1.4F	486	6770	231	6.8	25.9	3.8
mercury	1	0.15F	U	U	U	U	U	U	U	U	U	U	U
molybdenum	--	U	U	U	U	U	U	U	U	U	U	U	U
nickel	100	62.9F	176M	U	U	U	1.8F	3.16F	39.5	U	U	U	16.80
potassium	--	6955	10100M	1200M	1260	1190	1420	1634F	5940	2390J	2120	1960	2280
selenium	10	U	U	U	U	U	U	U	U	U	U	U	U
silver	50	U	U	U	5.8M	U	U	U	U	U	U	1.8F	U
sodium	20000	4857	3700M	3740M	2760	1500	1360	1565	2070	1050	U	1120	401F
thallium	--	U	63.8M	U	U	U	U	U	17.3F	U	U	U	5.3F
vanadium	--	52.0F	148M	U	U	U	U	U	48.5	U	U	U	U
zinc	--	244	618M	U	7.1F	U	9.9F	18.6F	163	U	9.4F	U	70.10

Notes:
[shaded] - Indicates concentration exceeds the NYS Class GA Groundwater Standard (upgradient only) and two times the upgradient concentration.
-- - Indicates no NYS Class GA Groundwater Standard.
B - The analyte was found in an associated blank, as well as in the sample.
F - The analyte was positively identified but the associated numerical value is below the Reporting Limit (RL).
M - A matrix effect was present.
NA - Not Available.
R - The data is unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.
U - The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.
For VOCs and SVOCs, only detected compounds are displayed.

concentrations above NYS Groundwater Standards, only well MW49A02 indicated exceedances for iron and manganese (in both "total" and "dissolved" samples).

- Lead was detected only in MW49A02, but was reported below the NYS Groundwater Standard (2.0M µg/L "total" lead, with the "M" indicating a potential matrix effect).

4.2 Hardfill 49b

The Hardfill 49b results summary of the groundwater sampling events conducted in September 1996, June 1999, May 2000, and April 2001 is presented in Table 4-2. The well locations are shown in Figure 1-1. Results of interest include the following:

1999 Sampling Results

- VOC results were consistent with those measured in 1996; no VOCs were detected.
- SVOC results indicated well MW49B04 with a phthalate compound detection at levels below the RL and well below the NYS Groundwater Standards.
- TPH-diesel range results were similarly low as those detected in 1996.

2000 Sampling Results

- In the 2000 samples, dissolved selenium was reported in all five wells at concentrations above the NYS Groundwater Standard of 10 µg/L, including upgradient well MW49B01, while it was not reported above the detection limit in "total" samples.
- Results from metals analyses indicated upgradient well MW49B01 with similar metals detected as previously, except chromium, cobalt, copper, lead, and nickel were not detected above the reporting limit in either the "total" or "dissolved" samples. In accordance with previous evaluations, applying the two times upgradient well rule for wells which indicated metals at concentrations above NYS Groundwater Standards, MW49B02 (sampled with a bailer) indicated exceedances for iron and manganese (in both "total" and "dissolved" samples), and MW49B05 for "total" iron only. However, all of the results for "total" iron at Hardfill 49b were qualified with "B," indicating that iron was also present in a QC blank; "dissolved" manganese results above the reporting limit were similarly qualified with "B" for all Hardfill 49b samples.
- Lead was detected only in MW49B02, but was reported below the NYS Groundwater Standard (8.3 µg/L "total" lead).

2001 Sampling Results

- Due to its location immediately downgradient of the SAR, monitoring well MW49B01 was sampled during the 2001 sampling event. 2001 metals results for MW49B01 were similar to those reported in 2000, except that selenium was not detected in either the "total" or "dissolved" sample.

4.3 Hardfill 49c

The Hardfill 49c results summary of the groundwater sampling events conducted in September 1996, June 1999 and May 2000 is presented in Table 4-3. The well locations are shown in Figure 1-2. Results of interest include the following:

Table 4-2
1996-2001 Groundwater Analytical Results
Hardfill 49b

WELL ID	--	MW49B01						MW49B02			
SAMPLE ID	NYSDEC GW STANDARDS	MW49B01	MW49B01A	MW49B0115BA		MW49B0114CA		MW49B02	MW49B02A	MW49B0235BA	
		upgradient	upgradient	total	soluble	total	soluble			total	soluble
DATE OF COLLECTION		9/3/1996	6/22/1999	5/2/2000	5/2/2000	4/17/2001	4/17/2001	9/4/1996	6/22/1999	5/2/2000	5/2/2000
Depth to Groundwater (ft BTOC)	--	16.74	17.56	15.39	15.39	14.21	14.21	36.36	37.15	35.43	35.43
VOCs (µg/L)											
NONE DETECTED	--	U	U	NA	NA	NA	NA	U	U	NA	NA
SVOCs (µg/L)											
di-n-butyl phthalate	50	U	U	NA	NA	NA	NA	U	U	NA	NA
TPH (mg/L)											
diesel components	--	0.10F	0.29F	NA	NA	NA	NA	0.12F	0.75F	NA	NA
Metals (µg/L)											
aluminum	--	2525	14600	263	42.5F	87.8F	U	336F	51200	11400	262
antimony	3	33.6F	U	U	U	U	U	35.8F	U	U	U
arsenic	25	1.7F	U	U	U	U	3.6F	U	54	U	U
barium	1000	28	202	8.0	6.9	7.9	8.1	24.0	335	58.9	19.8
beryllium	--	U	3.7	2.9B	U	0.9F	U	U	5.4	4.9B	U
cadmium	5	1.78F	U	U	U	U	U	U	1	U	U
calcium	--	97164	84700	60700B	57500B	62100	58300	114030	76500	77300B	102000B
chromium	50	18.3F	8	U	U	U	U	15.4F	50.7	8.8	U
cobalt	--	3.97F	16.8	U	U	U	U	U	76.7	9.9	8.3
copper	200	24.1F	58.5	U	U	U	2.6F	15.9F	264	43.4	U
iron	300	14641	24000	218B	U	U	U	917	124000	20600B	186
lead	25	U	11.5	U	U	U	U	18.80	85.60	8.3	U
magnesium	--	6724	10300	5660	5370	6000	5630	5138	17700	5950	5270
manganese	300	133	2280	17.5	13.2B	2.2F	4.6	399	10900	1940	673B
mercury	1	U	U	U	U	U	U	U	U	U	U
molybdenum	--	U	U	U	U	U	U	U	U	U	U
nickel	100	6.38F	18.5	U	9.6F	U	3.9F	2.7F	106	12.8	13.4B
potassium	--	1783F	1740	611J	561	778	877	2193F	11000	6020J	2070
selenium	10.0	U	U	U	34.5	U	U	U	U	U	52.3
silver	50	U	U	U	U	U	U	U	U	U	U
sodium	20000	6570	1980	4310	3240	4920	4340	14661	4040	8090	6320
thallium	--	U	U	U	U	U	U	U	32.1	U	U
vanadium	--	4.72F	6.6	U	U	U	U	U	89.4	18.8	U
zinc	--	33	121	U	7.9F	U	15.6F	U	350	60.7B	6.7F

Notes:

(shaded) - Indicates concentration exceeds the NYS Class GA Groundwater Standard (upgradient only) and two times the upgradient concentration.

-- - Indicates no NYS Class GA Groundwater Standard.

B - The analyte was found in an associated blank, as well as in the sample.

F - The analyte was positively identified but the associated numerical value is below the Reporting Limit (RL).

J - The analyte was positively identified, the quantitation is an estimation.

NA - Not Available.

R - The data is unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

U - The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.

For VOCs and SVOCs, only detected compounds are displayed.

Table 4-2
1996-2001 Groundwater Analytical Results
Hardfill 49b

WELL ID	--	MW49B03						MW49B04				MW49B05			
SAMPLE ID	NYSDEC	MW49B03	MW49B03A	MW49B0308BA		MW49B0308BC (dup)		MW49B04	MW49B04A	MW49B0405BA		MW49B05	MW49B05A	MW49B0512BA	
	GW			total	soluble	total	soluble			total	soluble			total	soluble
DATE OF COLLECTION	STANDARDS	9/4/1996	6/22/1999	5/2/2000	5/2/2000	5/2/2000	5/2/2000	9/4/1996	6/22/1999	5/2/2000	5/2/2000	9/4/1996	6/22/1999	5/2/2000	5/2/2000
Depth to Groundwater (ft BTOC	--	9.21	9.83	8.36	8.36	8.36	8.36	5.19		4.57	4.57	13.06	13.36	11.74	11.74
VOCs (µg/L)															
NONE DETECTED	--	U	U	NA	NA	NA	NA	U	U	NA	NA	U	U	NA	NA
SVOCs (µg/L)															
di-n-butyl phthalate	50	U	U	NA	NA	NA	NA	U	1F	NA	NA	U	U	NA	NA
TPH (mg/L)															
diesel components	--	0.50F	0.38J	NA	NA	NA	NA	0.35F	0.43J	NA	NA	0.45F	1.2J	NA	NA
Metals (µg/L)															
aluminum	--	10146	44300	181F	U	195F	U	1850	25800	85.6F	U	1584	88300	406	47.2F
antimony	3	36.3F	U	U	U	U	U	56F	U	U	U	42.8F	U	U	U
arsenic	25	6.4	27.5	U	U	U	U	2.2F	18.3F	U	U	2.6F	62.4	U	U
barium	1000	117	273	26.3	23.3	25.2	23.3	33.7	174	7.2	5.8	73.3	355	50.6	45.4
beryllium	--	U	3.2	3.0B	U	2.8B	U	U	2.2	3.2B	U	U	5.40	U	U
cadmium	5	U	U	U	U	U	U	4.74F	3.4	U	U	U	U	U	U
calcium	--	131860	157000	130000B	125000B	128000B	126000B	129190	74100	56100B	57000B	156480	190000	184000B	179000B
chromium	50	29.2F	56.5	U	U	U	U	16.9F	34.5	10.8	U	17.5F	130	7.5	U
cobalt	--	31.6F	29.6	U	3.0F	U	4.5F	3.7F	24	U	3.2F	6.96F	57.80	U	U
copper	200	47.4F	151	U	U	U	U	20.7F	106	U	U	20.8F	402	4.3F	U
iron	300	30720	116000	227B	U	190B	U	4149	53400	180B	U	3577	176000	741B	U
lead	25	9.14	34	U	U	U	U	1.86F	33.40	U	U	8.03	174	U	U
magnesium	--	11179	24600	7750	7250	7580	7220	11835	13500	4510	4320	9579	34600	8770	8190
manganese	300	2013	4450	8.7J	1.8F	7.0J	1.2F	1230	11000	187	U	7298	3310	140	64.7B
mercury	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U
molybdenum	--	U	U	U	U	U	U	U	U	U	U	U	U	U	U
nickel	100	19.2F	70.6	U	10.3B	U	9.4F	5.71F	64.8	U	9.0F	10.5F	137	U	9.3F
potassium	--	3763F	8490	2950J	3280	3050J	3030	1979F	6760	378F	U	8350	11600	5400J	5270
selenium	10	U	U	U	68.2	U	68.7	3.9F	U	U	30.7	U	U	U	99.6
silver	50	U	U	U	U	U	U	U	U	U	U	U	U	U	U
sodium	20000	22170	8850	7480	6180	7380	6290	13531	5020	5380	4460	8731	5800	7270	6430
thallium	--	U	23.1	U	U	U	U	U	22.6	U	U	U	27.5	U	U
vanadium	--	22.9F	82.9	U	U	U	U	3.46F	47.6	U	U	2.72F	150	U	U
zinc	--	74	261	14.2F	4.2F	18.4F	7.0F	38.1	140	U	6.1F	40.3	709	15.7F	4.8F

Notes:

[shaded box] - Indicates concentration exceeds the NYS Class GA Groundwater Standard (upgradient only) and two times the upgradient concentration.

-- - Indicates no NYS Class GA Groundwater Standard.

B - The analyte was found in an associated blank, as well as in the sample.

F - The analyte was positively identified but the associated numerical value is below the Reporting Limit (RL).

J - The analyte was positively identified, the quantitation is an estimation.

NA - Not Available.

R - The data is unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

U - The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.

For VOCs and SVOCs, only detected compounds are displayed.

Table 4-3
1996, 1999, and 2000 Groundwater Analytical Results
Hardfill 49c

WELL ID	--	MW49C01				MW49C02			
SAMPLE ID	NYSDEC GW STANDARDS	MW49C01	MW49C01A	MW49C0142BA		MW49C02	MW49C02A	MW49C0205BA	
		upgradient	upgradient	total	soluble			total	soluble
DATE OF COLLECTION		9/6/1996	6/22/1999	5/2/2000	5/2/2000	9/6/1996	6/22/1999	5/2/2000	5/2/2000
Depth to Groundwater (ft BTOC)	--	40.98	42.43	41.78	41.78	4.84	5.93	4.85	4.85
VOCs (µg/L)									
1,1,1-trichloroethane	5	U	U	NA	NA	U	U	NA	NA
1,1-dichloroethane	5	U	U	NA	NA	U	U	NA	NA
chloroform	7	3.8F	U	NA	NA	U	U	NA	NA
SVOCs (µg/L)									
NONE DETECTED	--	U	U	NA	NA	U	U	NA	NA
TPH (mg/L)									
diesel components	--	0.11F	0.27F	NA	NA	0.12F	0.34J	NA	NA
Metals (µg/L)									
aluminum	--	4.67F	2980	226	U	2279	5970	336	U
antimony	3	57.7F	U	U	U	117F	UJ	U	U
arsenic	25	U	U	U	U	U	U	U	U
barium	1000	23	34.6	18.9	16.0	75.5	86.5	50.9	46.9
beryllium	--	U	U	3.3B	U	U	U	4.0B	U
cadmium	5	3.45F	U	U	U	5.12F	U	U	U
calcium	--	91290	108000	95700B	91100B	207320	208000B	210000B	198000B
chromium	50	15.9F	5.4	U	U	20.1F	9.1	U	U
cobalt	--	U	U	U	3.1F	3.47F	2.4F	U	2.9F
copper	200	42.7F	64.6	12.1	U	33.3F	36.2	U	U
iron	300	371	4570	209B	U	3499	8000	268B	U
lead	25	6.3	10.0	U	U	1.9F	4.0F	U	U
magnesium	--	7919	10800	8450	7990	20834	23200	21500	20900
manganese	300	45.1	314.0	30.3	1.7F	486	683B	214	153B
mercury	1	U	U	U	U	U	U	U	U
molybdenum	--	U	U	U	U	U	U	U	U
nickel	100	2.01F	U	U	11.0B	6.24F	8.2F	U	10.3B
potassium	--	1025F	1610	1220J	1150	1419F	2610J	723J	631
selenium	10	U	U	U	37.1	U	U	U	88.1
silver	50	U	U	U	U	U	U	U	U
sodium	20000	2487	1510	2130	U	1798	1960	1820	U
thallium	--	U	U	U	U	U	U	U	U
vanadium	--	U	5.5	U	U	2.77F	11	U	U
zinc	--	133	28.7	17.5F	9.5F	46.2	37.5	16.9F	6.3F

Notes:
(shaded) - Indicates concentration exceeds the NYS Class GA Groundwater Standard (upgradient only) and two times the upgradient concentration.
-- - Indicates no NYS Class GA Groundwater Standard.
B - The analyte was found in an associated blank, as well as in the sample.
F - The analyte was positively identified but the associated numerical value is below the Reporting Limit (RL).
J - The analyte was positively identified, the quantitation is an estimation.
NA - Not Available.
R - The data is unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.
U - The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.
For VOCs and SVOCs, only detected compounds are displayed.

Table 4-3
1996, 1999, and 2000 Groundwater Analytical Results
Hardfill 49c

WELL ID	--	MW49C03					MW49C04			
SAMPLE ID	NYSDEC GW STANDARDS	MW49C03	MW49C03A	MW49C03D	MW49C0305BA		MW49C04	MW49C04A	MW49C0405BA	
				field dup	total	soluble			total	soluble
DATE OF COLLECTION		9/6/1996	6/22/1999	6/22/1999	5/2/2000	5/2/2000	9/6/1996	6/22/1999	5/2/2000	5/2/2000
Depth to Groundwater (ft BTOC)	--	4.96	5.95	5.95	4.97	4.97	4.94	5.83	4.87	4.87
VOCs (µg/L)										
1,1,1-trichloroethane	5	14	4.3	4.0	NA	NA	U	U	NA	NA
1,1-dichloroethane	5	U	0.65F	0.61F	NA	NA	U	U	NA	NA
chloroform	7	U	U	U	NA	NA	U	U	NA	NA
SVOCs (µg/L)										
NONE DETECTED	--	U	U	U	NA	NA	U	U	NA	NA
TPH (mg/L)										
diesel components	--	0.14F	0.86J	0.96J	NA	NA	0.03F	0.19F	NA	NA
Metals (µg/L)										
aluminum	--	579	4860	4100	194F	U	912	3550	U	U
antimony	3	75.4F	UJ	UJ	U	U	67.8F	U	U	U
arsenic	25	U	U	U	U	7.4F	U	U	U	U
barium	1000	70.6	77.6	78.6	61.8	26.0	79.9	84.5	48.3	42.7
beryllium	--	U	1.6F	U	4.0B	U	U	U	4.9B	U
cadmium	5	3.38F	1.4J	UJ	U	U	3.49F	U	U	U
calcium	--	206670	156000B	156000B	145000B	133000B	166410	144000M	97900B	93400B
chromium	50	15.0F	4.1F	U	U	U	16.7F	U	U	U
cobalt	--	2.59F	11.3	13	16.8	4.5F	U	1.3F	U	3.7F
copper	200	22.8F	27.6J	38J	7.1	U	36.7F	39.9	U	U
iron	300	815	7810	6710	188B	U	1837	4940M	U	U
lead	25	23.7	5.2	5.3	U	U	20.90	U	U	U
magnesium	--	30837	24300	24600	12800	11800	20418	18700	13200	12400
manganese	300	7001	8350B	9400B	10200	4930B	199	505	230	214B
mercury	1	U	U	U	U	U	0.08F	U	U	U
molybdenum	--	U	U	U	U	U	U	U	U	U
nickel	100	7.05F	11.8	9.7F	U	11.6B	3.17F	U	U	10.2B
potassium	--	2908F	3330J	3120J	2550J	2300	3409F	2180	3490J	3470
selenium	10	U	U	U	U	76.60	U	U	U	57.0
silver	50	U	U	U	U	U	U	U	U	U
sodium	20000	14570	12600	12600	8340	7220	24252	13100	3470	2400
thallium	--	U	16.5F	14.2F	U	U	U	U	U	U
vanadium	--	U	9J	7.2J	U	U	U	6	U	U
zinc	--	97.2	72.4	63	13.1F	12.4F	46.4	50.2	14.0F	U

Notes:

(shaded) - Indicates concentration exceeds the NYS Class GA Groundwater Standard (upgradient only) and two times the upgradient concentration.

-- - Indicates no NYS Class GA Groundwater Standard.

B - The analyte was found in an associated blank, as well as in the sample.

F - The analyte was positively identified but the associated numerical value is below the Reporting Limit (RL).

J - The analyte was positively identified, the quantitation is an estimation.

NA - Not Available.

R - The data is unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

U - The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.

UJ - The analyte was analyzed for but not detected, however, the MDL is approximate and may or may not represent the actual limit of the quantitation.

For VOCs and SVOCs, only detected compounds are displayed.

1999 Sampling Results

- VOC results were consistent with those measured in 1996. 1,1,1-trichloroethane was detected in well MW49C03, but at a concentration three times lower than the 1996 result and below the NYS Groundwater Standard; a very low level of 1,1-dichloroethane was also detected in this well, which is indicative of potential degradation of 1,1,1-trichloroethane.
- SVOC results indicated no SVOC compounds detected above their respective reporting limits.
- TPH-diesel range results were similarly low as those detected in 1996.

2000 Sampling Results

- Dissolved selenium was reported in all four wells at concentrations above the NYS Groundwater Standard of 10 μg/L, including upgradient well MW49C01, while it was not reported above the detection limit in "total" samples.
- Results from metals analyses indicated upgradient well MW49C01 with similar metals detected as previously, except chromium, copper, lead, and nickel were not detected above the reporting limit in either the "total" or "dissolved" samples. In accordance with previous evaluations, applying the two times upgradient well rule for wells which indicated metals at concentrations above NYS Groundwater Standards, only MW49C03 indicated an exceedance, for manganese only (in both "total" and "dissolved" samples).

4.4 Hardfill 49d

The Hardfill 49d results summary of the groundwater sampling events conducted in September 1996, June 1999 and May 2000 is presented in Table 4-4. The well locations are shown in Figure 1-3. Results of interest include the following:

1999 Sampling Results

- VOC results indicated no detections, which was an improvement from the 1996 results when chloroform was present at low levels in several wells.
- SVOC results indicated no SVOC compounds detected above their respective reporting limits.
- TPH-diesel range results were similarly low as those detected in 1996.

2000 Sampling Results

- 2000 metals results indicate upgradient well MW49D01 with similar metals detected as previously, except chromium, lead, and nickel were not detected above the reporting limit in either the "total" or "dissolved" samples. Sodium was detected in MW49D01 above the NYS Groundwater Standard in the "dissolved" sample. In accordance with previous evaluations, applying the two times upgradient well rule for wells which indicated metals at concentrations above NYS Groundwater Standards, each downgradient well except for MW49D08 indicated iron exceedances (in both "total" and "dissolved" samples for MW49D02, MW49D03, and MW49D06, otherwise in the "total" sample only).

Table 4-4
1996, 1999, and 2000 Groundwater Analytical Results
Hardfill 49d

WELL ID	--	MW49D01				MW49D02				MW49D03			
SAMPLE ID	NYSDEC	MW49D01	MW49D01A	MW49D0111BA		MW49D02	MW49D02A	MW49D0205BA		MW49D03	MW49D03A	MW49D0307BA	
	GW	upgradient	upgradient	total	soluble			total	soluble			total	soluble
DATE OF COLLECTION	STANDARDS	9/5/1996	6/21/1999	5/3/2000	5/3/2000	9/5/1996	6/21/1999	5/3/2000	5/3/2000	9/5/1996	6/21/1999	5/3/2000	5/3/2000
Depth to Groundwater (ft BTOC)	--	10.80	12.15	10.97	10.97	4.65	6.30	5.17	5.17	6.74	8.29	6.53	6.53
VOCs (µg/L)													
chloroform	7	7.3	U	NA	NA	U	U	NA	NA	3.1F	U	NA	NA
SVOCs (µg/L)													
NONE DETECTED	U	U	U	NA	NA	U	U	NA	NA	U	U	NA	NA
TPH (mg/L)													
diesel components	--	0.21F	0.31J	NA	NA	0.07F	0.88J	NA	NA	0.19F	0.73J	NA	NA
Metals (µg/L)													
aluminum	--	359F	614	153F	U	1717	3230	229	U	1127	2680	240	U
antimony	3	62.5F	U	U	U	64.2F	U	U	U	81.3F	U	U	U
arsenic	25	3.5F	U	U	U	U	10.5F	U	U	1.5F	U	U	U
barium	1000	165	111	94.9	84.5	217	236	92.8	78.9	231	248	122	104
beryllium	--	U	U	U	U	U	U	U	U	U	U	U	U
cadmium	5	3.24F	U	U	U	3.0F	U	U	1.1B	3.71F	U	U	1.2B
calcium	--	109660	144000	183000B	180000B	94487	146000	92100B	87700B	183250	215000	304000B	292000B
chromium	50	15.7F	U	U	U	17.5F	U	U	U	17.4F	U	U	U
cobalt	--	U	1.8F	U	U	2.58F	U	U	U	5.49F	1.4F	U	U
copper	200	24.2F	12.9B	5.5	U	21.2F	49.1B	9.0	5.5	48.9F	36.8B	4.9F	U
iron	300	22605	5330	165	U	3711	12800	1640	633	6964	21800	3100	457
lead	25	3.72F	U	U	U	2.98F	4.0F	U	U	2.82F	8.00	U	U
magnesium	--	10252	13700	8300	8340	18160	20700	7500	6850	21152	26400	36200	34200
manganese	300	1636	3600	469	342B	366	913	3471	323B	5357	7030	905	906B
mercury	1	U	U	U	U	U	U	U	U	U	U	U	U
molybdenum	--	U	U	4.5F	U	U	U	6.2F	U	U	U	5.3F	U
nickel	100	4.17F	U	U	U	2.77F	U	U	6.5F	7.67	U	U	U
potassium	--	13505	10600	13400	15400J	3087F	10100	4190	5390J	10419	9780	5580	6910J
selenium	10	U	U	U	U	U	U	U	U	U	U	U	U
silver	50	U	U	U	U	U	U	U	U	U	U	U	U
sodium	20000	89783	53900	19400	21300	47116	65300	23100	23200	13747	21800	21300	22400
thallium	--	1.04	U	8.4F	U	U	U	U	U	U	10.6F	U	U
vanadium	--	U	2.1F	U	U	U	11.90	4.8F	U	U	7.7	U	U
zinc	--	35.8	U	U	U	26.7	76	U	4.6F	76.2	89.4	28.5B	19.5F

Notes:

[shaded] - Indicates concentration exceeds the NYS Class GA Groundwater Standard (upgradient only) and two times the upgradient concentration.

-- - Indicates no NYS Class GA Groundwater Standard.

B - The analyte was found in an associated blank, as well as in the sample.

F - The analyte was positively identified but the associated numerical value is below the Reporting Limit (RL).

NA - Not Available.

R - The data is unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

U - The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.

For VOCs and SVOCs, only detected compounds are displayed.

Table 4-4
1996, 1999, and 2000 Groundwater Analytical Results
Hardfill 49d

WELL ID	--	MW49D04				MW49D05				MW49D06					
SAMPLE ID	NYSDEC GW STANDARDS	MW49D04	MW49D04A	MW49D0409BA		MW49D05	MW49D05A	MW49D0507BA		MW49D06	MW49D06A	MW49D0607BA		MW49D0607BC (dup)	
				total	soluble			total	soluble			total	soluble	total	soluble
DATE OF COLLECTION		9/5/1996	6/21/1999	5/3/2000	5/3/2000	9/5/1996	6/21/1999	5/3/2000	5/3/2000	9/5/1996	6/22/1999	5/3/2000	5/3/2000	5/3/2000	5/3/2000
Depth to Groundwater (ft BTOC)	--	8.50	10.15	9.16	9.16	6.80	8.47	7.36	7.36	4.83	10.24	6.63	6.63	6.63	6.63
VOCs (µg/L)															
chloroform	7	3.2F	U	NA	NA	U	U	NA	NA	U	U	NA	NA	NA	NA
SVOC' (µg/L)															
NONE DETECTED	U	U	U	NA	NA	U	U	NA	NA	U	U	NA	NA	NA	NA
TPH (mg/L)															
diesel components	--	0.22F	0.58F	NA	NA	0.14F	0.37J	NA	NA	0.25F	1.10	NA	NA	NA	NA
Metals (µg/L)															
aluminum	--	1083	5970	138F	U	2616	3000	593	U	783	674	218	U	189F	U
antimony	3	67.1F	U	U	U	86.5F	U	U	U	70.8F	U	U	U	U	U
arsenic	25	1.5F	U	U	U	2.3F	U	U	U	1.6F	U	U	U	U	U
barium	1000	154	181	144	119	142	154	91.6	70.4	138	184	173	129	172	132
beryllium	--	U	U	U	U	U	U	U	U	U	U	U	U	U	U
cadmium	5	3.34F	U	U	U	4.24F	U	U	U	3.19F	U	1.0	0.9F	U	1.5B
calcium	--	96645	95800	96600B	92400B	128300	116000	92700B	86000B	149040	220000	205000B	194000B	205000B	199000B
chromium	50	16.5F	5.5	U	U	19.6F	U	U	U	16.7F	U	U	U	U	U
cobalt	--	U	3.2F	U	U	8.17F	1.6F	U	U	6.74F	U	U	U	U	U
copper	200	35.2F	61.1	U	U	35.1F	16.4	19.0	15.5	22.1F	U	U	U	U	U
iron	300	2535	13000	2930	104	6921	5900	526	89.2F	7195	17200	12800	2070	13000	2360
lead	25	2.06F	3.8F	U	U	3.83F	U	U	U	U	U	U	U	U	U
magnesium	--	16276	18500	20600	19700	17001	16000	12200	11000	23946	38800	34800	33100	34800	33800
manganese	300	2312	1550	1010	861B	1697	1690	1330	657B	1348	1290	1150	1070B	1150	1090B
mercury	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U
molybdenum	--	U	U	U	U	U	U	U	U	U	U	4.7F	U	U	U
nickel	100	4.81F	U	U	U	6.92F	U	U	5.5F	3.26F	U	U	U	U	U
potassium	--	3450F	2960	1210	1420J	4457F	3140	1630	2030J	2620F	2590	2000	2730J	2230	2420J
selenium	10	U	U	U	U	U	U	U	U	U	U	U	U	U	U
silver	50	U	U	U	U	U	U	U	U	U	U	U	U	U	U
sodium	20000	26963	2630	2040	1790	3251	2940	3140	2810	13624	8070	13300	13900	13300	14000
thallium	--	U	U	U	U	U	U	U	U	U	U	8.4F	U	U	U
vanadium	--	U	10.5	U	U	3.45F	5.6	U	U	U	1.7F	U	U	U	U
zinc	--	33.0	44.3	U	U	41.7	13.9F	U	14.5F	29.7	U	U	U	U	U

Notes:
(shaded) - Indicates concentration exceeds the NYS Class GA Groundwater Standard (upgradient only) and two times the upgradient concentration.
-- - Indicates no NYS Class GA Groundwater Standard.
B - The analyte was found in an associated blank, as well as in the sample.
F - The analyte was positively identified but the associated numerical value is below the Reporting Limit (RL).
NA - Not Available.
R - The data is unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.
U - The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.
For VOCs and SVOCs, only detected compounds are displayed.

Table 4-4
1996, 1999, and 2000 Groundwater Analytical Results
Hardfill 49d

WELL ID	--	MW49D07				MW49D08			
SAMPLE ID	NYSDEC GW STANDARDS	MW49D07	MW49D07A	MW49D0705BA		MW49D08	MW49D08A	MW49D0804BA	
				total	soluble			total	soluble
DATE OF COLLECTION		9/5/1996	6/22/1999	5/3/2000	5/3/2000	9/5/1996	6/22/1999	5/3/2000	5/3/2000
Depth to Groundwater (ft BTOC)	--	3.47	5.40	4.73	4.73	3.02	4.92	4.00	4.00
VOCs (µg/L)									
chloroform	7	U	U	NA	NA	U	U	NA	NA
SVOCs (µg/L)									
NONE DETECTED	U	U	U	NA	NA	U	U	NA	NA
TPH (mg/L)									
diesel components	--	0.04F	U	NA	NA	0.14F	0.48F	NA	NA
Metals (µg/L)									
aluminum	--	331F	4010	155F	U	319F	1230	94.6F	U
antimony	3	75.8F	U	U	U	65.0F	U	U	U
arsenic	25	U	U	U	U	U	U	U	U
barium	1000	142	129	130	98.5	145	180	186	157
beryllium	--	U	U	U	U	U	U	U	U
cadmium	5	7.01F	U	U	U	3.06F	U	U	U
calcium	--	114490	79500	78600B	73700B	71979	91800	90500B	85000M
chromium	50	15.9F	5	U	U	15.5F	U	U	U
cobalt	--	U	1.5F	U	U	U	U	U	U
copper	200	23.9F	11.20	U	U	21.2F	3.3F	U	U
iron	300	768	5460	5090	U	646	2590	287	U
lead	25	1.75	U	U	U	U	U	U	U
magnesium	--	27575	23000	23800	22200	29772	36000	36800	32900
manganese	300	388	425	312	258B	145	236	168	155B
mercury	1	U	U	U	U	U	U	U	U
molybdenum	--	U	U	U	U	U	U	U	U
nickel	100	U	U	U	U	U	U	U	U
potassium	--	2131F	2510	1020	1260J	1760F	2100	2040	2250M
selenium	10	U	U	U	U	U	U	U	6.2M
silver	50	U	U	U	U	U	U	U	5.8M
sodium	20000	2470	2520	1680	U	50339	53400	54900M	53100M
thallium	--	U	U	U	U	U	U	U	U
vanadium	--	U	7.70	U	U	U	2.1F	U	U
zinc	--	31.7	34.6	U	U	24.9	U	U	4.6F

Notes:

[shaded] - Indicates concentration exceeds the NYS Class GA Groundwater Standard (upgradient only) and two times the upgradient concentration.

-- - Indicates no NYS Class GA Groundwater Standard.

B - The analyte was found in an associated blank, as well as in the sample.

F - The analyte was positively identified but the associated numerical value is below the Reporting Limit (RL).

M - A matrix effect was present.

NA - Not Available.

R - The data is unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

U - The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.

For VOCs and SVOCs, only detected compounds are displayed.

- Exceedances for "total" manganese in MW49D06 were also reported. Although "dissolved" manganese levels in MW49D03 and MW49D06 also exceeded the two times upgradient well rule, these results were qualified with a "B," indicating that manganese was also present in a QC blank. Finally, both "total" and "dissolved" sodium exceedances were found in MW49D08, but these concentrations were qualified with an "M" signifying a matrix effect associated with their analysis.

4.5 Small Arms Range (SAR)

The SAR results summary of the groundwater sampling events conducted in September 1996, June 1999, May 2000, and April 2001 is presented in Table 4-5. The well locations are shown in Figure 1-4. Results of interest include the following:

1999 Sampling Results

- VOC results indicated several compounds detected slightly above the NYS Groundwater Standards in upgradient well MWSAR03, which included 1,4-dichlorobenzene and vinyl chloride. MWSAR03 is downgradient of Landfill 1, which may be contributing to these contaminants. Additionally, trace levels of benzene and dichlorodifluoromethane were also detected in this well. These low contaminant levels do not pose any human health risk and may be attributable to an upgradient source.
- SVOC results indicated only 1,4-dichlorobenzene detected, at levels similar to those detected in the VOC analysis.
- TPH-diesel range results were similarly low as those detected in 1996.

2000 Sampling Results

- Results from metals analyses indicated upgradient well MWSAR03 with similar metals detected as previously, except aluminum, arsenic, chromium, cobalt, copper, lead, and nickel were not detected above the reporting limit in either the "total" or "dissolved" samples. Total antimony was reported in MWSAR03 at 10.8F µg/L, above the NYS Groundwater Standard. In accordance with previous evaluations, applying the two times upgradient well rule for wells which indicated metals at concentrations above NYS Groundwater Standards, wells MWSAR01 and MWSAR02 each indicated one exceedance, for iron ("total" sample only) and manganese ("total" and "dissolved" samples), respectively.

2001 Sampling Results

- Metals analysis results were similar to those reported in 2000, except that antimony was detected not only in the "total" sample at MWSAR03, but also in the "total" samples at wells MWSAR01 and MWSAR02 (levels were below two times the upgradient well (MWSAR03)). Additionally, applying the two times upgradient well rule for wells which indicated metals at concentrations above NYS Groundwater Standards, only well MW49A02 indicated exceedances for iron ("dissolved" sample only) and manganese (in both the "total" and "dissolved" samples).
- Lead was detected in samples collected at MWSAR01 and MWSAR02, but at levels below the NYS Groundwater Standard (3.3F and 5.8 µg/L "total" lead, respectively).

Table 4-5
1996-2001 Groundwater Analytical Results
Small Arms Range (SAR)

WELL ID	--	MWSAR01							MWSAR02									
SAMPLE ID	NYSDEC GW STANDARDS	MWSAR01	MWSAR01A	MWSAR01D	MWSAR0114BA		MWSAR0113CA		MWSAR02	MWSAR02A	MWSAR0209BA		MWSAR0209BC (dup)		MWSAR0208CA		MWSAR0208CC (dup)	
					total	soluble	total	soluble			total	soluble	total	soluble	total	soluble	total	soluble
DATE OF COLLECTION		9/3/1996	6/23/1999	6/23/1999	5/4/2000	5/4/2000	4/17/2001	4/17/2001	9/3/1996	6/23/1999	5/1/2000	5/1/2000	5/1/2000	5/1/2000	4/17/2001	4/17/2001	4/17/2001	4/17/2001
Depth to Groundwater (ft BTOC)	--	15.31	16.00	16.00	13.80	13.80	12.59	12.59	10.70	10.86	9.00	9.00	9.00	9.00	8.26	8.26	8.26	8.26
VOCs (µg/L)																		
1,4-dichlorobenzene	3	U	U	U	NA	NA	NA	NA	U	U	NA	NA	NA	NA	NA	NA	NA	NA
benzene	1	U	U	U	NA	NA	NA	NA	U	U	NA	NA	NA	NA	NA	NA	NA	NA
dichlorodifluoromethane	5	U	U	U	NA	NA	NA	NA	U	U	NA	NA	NA	NA	NA	NA	NA	NA
vinyl chloride	2	U	U	U	NA	NA	NA	NA	U	U	NA	NA	NA	NA	NA	NA	NA	NA
SVOCs (µg/L)																		
1,4-dichlorobenzene	3	U	U	U	NA	NA	NA	NA	U	U	NA	NA	NA	NA	NA	NA	NA	NA
TPH (mg/L)																		
diesel components	--	0.08F	0.27J	0.38J	NA	NA	NA	NA	0.23F	2.3J	NA	NA	NA	NA	NA	NA	NA	NA
Metals (µg/L)																		
aluminum	--	967	104000J	130000J	745	43.5F	104F	U	145F	15600	U	62.9F	U	50.0F	116F	U	44.6F	U
antimony	3	45.3F	U	U	U	U	11.7F	U	28.1F	U	U	U	U	U	16.6B	U	9.5F	U
arsenic	25	U	42.8J	59.6J	U	U	U	U	U	11.3F	U	U	U	U	U	U	U	U
barium	1000	30.2	372	427	15.1	11.2	8.9	8.2	15.4F	66.6	19.9	16.5	18.0	15.7	29.0	29.0	28.9	29.1
beryllium	--	U	8.7	10.4	1.6F	U	0.7F	U	U	U	U	U	1.9F	U	0.8F	U	0.8F	U
cadmium	5	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
calcium	--	159620	82400	77200	90900	85000	72100	66100	48192	50300	81500	74700	77900	72200	102000	99900	109000	98100
chromium	50	15.4F	152J	194J	U	U	U	U	14.0F	21.7	U	U	U	U	U	U	U	U
cobalt	--	U	106J	134J	U	U	U	U	U	8.3	U	U	U	U	U	U	U	U
copper	200	16.4F	447J	412J	U	U	U	U	13.9F	55.1	3.3F	U	U	U	U	U	U	U
iron	300	1636	182000J	238000J	558	U	U	U	319	28500	221	125J	175	97.0F	1200	616	280	675
lead	25	30.8	251J	366J	U	U	3.3F	U	21.6	14.6	U	U	U	U	U	U	5.80	U
magnesium	--	8852	38700J	49000J	4340	3910	2880	2570	6339	9900	7070	6500	6640	6330	9460	9170	10000	8970
manganese	300	45.7	7670	9320	18.0	3.8	2.0F	2.3F	838	4920	3750	3240	3510	2900	9300	9190	9990	9010
mercury	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
molybdenum	--	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
nickel	100	3.15F	180J	234J	U	U	U	1.7F	13.5F	26.3	5.2F	8.3F	U	8.3F	10.00	11.30	7.2F	9.4F
potassium	--	2325F	8820	9010	1930J	1320	1180	1140	1591F	5600	2180J	2010	2160J	1870	2240	2520	2300	2490
selenium	10	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
silver	50	U	U	U	U	U	U	U	U	U	U	U	U	U	1.7F	U	U	U
sodium	20000	3697	1830	1700	4270	3630	3640	2630	5220	6340	6650	5770	6330	5580	4810	3920	4150	3670
thallium	--	U	35.8J	45.6J	U	U	U	U	U	6.6F	U	U	U	U	U	U	U	U
vanadium	--	U	196J	248J	U	U	U	U	U	28.4	U	U	U	U	U	U	U	U
zinc	--	21.50	788J	990J	15.6F	6.0F	14.8F	14.2F	U	88.2	14.5F	7.1F	U	18.1F	5.5F	13.0F	U	18.9F

Notes:
[shaded] - Indicates concentration exceeds the NYS Class GA Groundwater Standard (upgradient only) and two times the upgradient concentration.
-- - Indicates no NYS Class GA Groundwater Standard.
B - The analyte was found in an associated blank, as well as in the sample.
F - The analyte was positively identified but the associated numerical value is below the Reporting Limit (RL).
J - The analyte was positively identified, the quantitation is an estimation.
M - A matrix effect was present
NA - Not Available.
U - The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.
For VOCs and SVOCs, only detected compounds are displayed.

Table 4-5
1996-2001 Groundwater Analytical Results
Small Arms Range (SAR)

WELL ID	--	MWSAR03					
SAMPLE ID	NYSDEC GW STANDARDS	MWSAR03	MWSAR03A	MWSAR0318BA		MWSAR0317CA	
		upgradient	upgradient	total	soluble	total	soluble
DATE OF COLLECTION		9/3/1996	6/23/1999	5/1/2000	5/1/2000	4/17/2001	4/17/2001
Depth to Groundwater (ft BTOC)	--	20.67	20.62	18.01	18.01	16.66	16.66
VOCs (µg/L)							
1,4-dichlorobenzene	3	U	3.50	NA	NA	NA	NA
benzene	1	U	0.77F	NA	NA	NA	NA
dichlorodifluoromethane	5	U	0.74F	NA	NA	NA	NA
vinyl chloride	2	U	2.2J	NA	NA	NA	NA
SVOCs (µg/L)							
1,4-dichlorobenzene	3	U	4.00	NA	NA	NA	NA
TPH (mg/L)							
diesel components	--	0.17F	0.31J	NA	NA	NA	NA
Metals (ug/L)							
aluminum	--	346F	15700	U	46.2F	92.4F	U
antimony	3	19.4F	U	10.8F	U	20.1B	U
arsenic	25	7.5	49.2	U	U	U	U
barium	1000	58.8	152	23.0	19.9	33.3	30.7
beryllium	--	U	U	1.6F	U	0.8F	U
cadmium	5	U	U	U	U	U	1.1
calcium	--	21909	41900	117000	112000	93800	86200
chromium	50	14.8F	18.4	U	U	U	U
cobalt	--	41.0F	16.0	U	U	U	U
copper	200	15.5F	72.2	3.1F	U	U	U
iron	300	49621	128000	105	U	2400	U
lead	25	U	15.9	U	U	U	U
magnesium	--	1920	11700	6050	5900	5800	5290
manganese	300	6343	9700	12.9	15.7	7.4	3.2
mercury	1	U	U	U	U	U	U
molybdenum	--	U	U	U	U	U	U
nickel	100	2.84F	30.4	U	U	U	U
potassium	--	2276F	5730	4880J	4520	3020	3230
selenium	10	U	U	U	U	U	U
silver	50	U	U	U	U	U	U
sodium	20000	3529	6570	6600	5650	3980	2990
thallium	--	U	27	U	U	U	U
vanadium	--	U	27.90	U	U	U	U
zinc	--	23.4	114	U	4.0F	7.5F	22.5F

Notes:
[shaded] - Indicates concentration exceeds the NYS Class GA Groundwater Standard (upgradient only) and two times the upgradient concent
-- - Indicates no NYS Class GA Groundwater Standard.
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F - The analyte was positively identified but the associated numerical value is below the Reporting Limit (RL).
J - The analyte was positively identified, the quantitation is an estimation.
M - A matrix effect was present
NA - Not Available.
U - The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.
For VOCs and SVOCs, only detected compounds are displayed.

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5.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are based on the data collected during the three groundwater sampling events performed by FPM from 1999 to 2001:

- The overall correlation between the 1996 and 1999 sampling round was good for VOCs, SVOCs and TPH-diesel range. The results of the two sampling events generally indicated no detects to incidental trace level detections of VOCs and SVOCs. Also apparent in the two rounds were diesel-range hydrocarbons at only trace levels.

- With respect to metals, on a qualitative basis the analytical results from the sampling events using the low-flow purging and sampling technique (2000 and 2001) were significantly different from previous results, as several metals detected in the earlier sampling events were reported undetected in 2000/2001. Both "total" and "dissolved" metals concentrations reported in samples collected during the 2000/2001 sampling events were lower, up to two orders of magnitude lower in some cases. These differences are likely due to the less turbid groundwater samples collected using the low-flow purging and sampling technique. Turbidity levels were significantly lower for all samples collected during the 2000 sampling event, as noted on the field sampling forms (Appendix A). Results exceeding NYS Groundwater Standards from previous sampling events were likely attributable to entrained suspended particulates dislodged from the bottom of the well or through the well screen by purging and sampling with a bailer (Puls and Barcelona, 1989, Ground Water Sampling for Metals Analysis, EPA/540/4-89/001); these particles, unlike those sampled using the low-flow methodology, are not representative of the mobile constituents in the Hardfills/SAR formations.

- The correlation between the VOC, SVOC, and TPH-diesel data resulting from the analysis of samples collected during the 1996 sampling event (Parsons) and those collected during the 1999 sampling event (FPM) resolved the uncertainty associated with the suspect ITS data. The initial re-sampling event performed in 1999 yielded dissimilar results from the 1996 results for some metals, (e.g., some metals were detected during one event but not in the other), probably in direct correlation to the turbidity or solids content of the samples collected using a disposable bailer. The metals data were validated by the re-sampling events performed in May 2000 and April 2001 using the low-flow purging and sampling technique, as discussed above.

- In general, the 2000/2001 sampling events results for "total" and "dissolved" metals were similar, with the exception of aluminum, antimony, iron, lead, and manganese, indicating that for most metals, the total fraction of metals is in the dissolved phase. Contrastingly, the presence of aluminum, antimony, iron, lead, and manganese may be largely associated with hydrous metal oxides (i.e., polymeric species) or inorganic/organic colloids (i.e., adsorbed species), both of which would likely be filtered out of the "dissolved" samples. Alternatively, the dissolved species of these metals may precipitate out upon oxidation and/or colloid formation during filtration.

Alternatively, the dissolved species of these metals may precipitate out upon oxidation and/or colloid formation during filtration.

- During the 2000 sampling event, the main metals reported at levels exceeding NYS Groundwater Standards and more than two times the upgradient well concentrations were iron and manganese, and are likely associated with mobile, suspended particulates such as inorganic/organic colloids and/or hydrous metal complexes. Several studies suggest that these metal oxides are nearly ubiquitous in soils (Lee, G.F., 'Session IV Transport Mechanisms: Role of Hydrous Metal Oxides in the Transport of Heavy Metals in the Environment,' Proc. of Symposium of Transport of Heavy Metals in the Environment, IN: Progress in Water Technology 17: 137-147 (1975)). The presence of iron and manganese is widespread throughout the Base and is not specific to the Hardfills and the SAR (Parsons, 1997a and b). Iron and manganese were measured above NYS Groundwater Standards in off-base wells up to 1,340 μg/L and 495 μg/L, respectively (Law, 1996).

- Since the "total" metals results were reported non-detect for selenium in all wells sampled during the 2000 sampling event, the presence of selenium in the Hardfill 49b and 49c "dissolved" samples is likely an artifact of the filtering process or the sample handling in the laboratory. This is further supported by the fact that this anomaly occurred in *all* of the samples collected at Hardfills 49b and 49c, which were handled in the same analytical batch, but did not occur for any of the samples collected at the other Hardfills or the SAR (handled in separate analytical batches). Furthermore, according to the New York State Department of Environmental Conservation (NYSDEC) Technical and Administrative Guidance Manual #4015 (Policy Regarding Alteration of Groundwater Samples Collected for Metals Analysis), if unfiltered samples meet applicable standards or requirements, there is no need to analyze a filtered sample. Given that the unfiltered sample results for selenium were "non-detect" across each of the Hardfills and the SAR, and that selenium was not detected above the detection limit during previous sampling events, selenium is not deemed a constituent of concern at these sites.

The 2000/2001 groundwater sampling results from the Hardfills and SAR sites indicate that the metals concentrations in groundwater at the SAR and at the Hardfills do not pose a current or potential threat to public health or the environment, and generally corroborate with previous 1996 results and the conclusions drawn by the Parsons remedial design/final investigation reports (Parsons, 1997a and 1997b).

6.0 REFERENCES

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